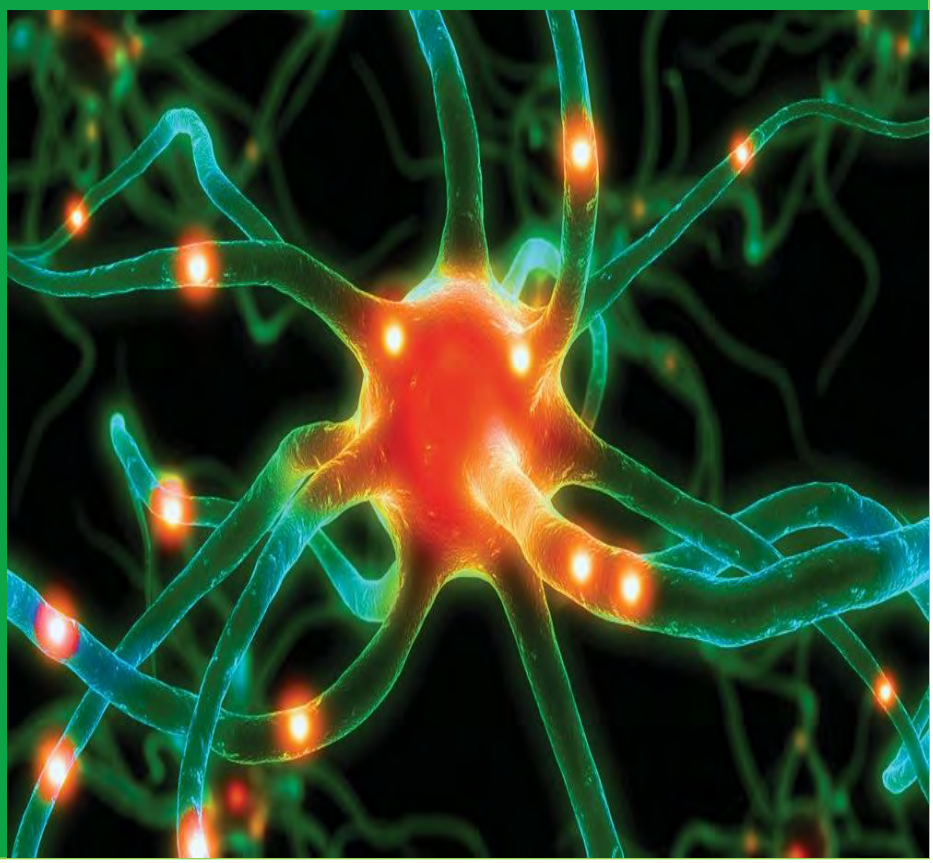
Brain Disorders in the Developing World: Research Across the Lifespan Program

Program Evaluation 2003-2013



Fogarty International Center

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Executive Summary

Given the wide range of conditions that emerge at various life stages, brain disorders affect people all across the globe. Yet, the prevalence and burden of brain disorders was largely underestimated in the 20th century according to a 2001 National Academy of Sciences' Institute of Medicine report[1]. To address this global challenge, the Fogarty International Center and its partners established the *Brain Disorders in the Developing World: Research Across the Lifespan Program* in 2003. Over its first ten years, the program has experienced tremendous success and has resulted in significant scientific advances that have enhanced knowledge of brain disorders in low and middle-income countries (LMICs) and increased brain disorders research capacity across the globe.

Brain Program Objectives

- Support the conduct of basic, epidemiological, clinical, prevention, intervention or health services research in the area of nervous system development, function and impairment throughout life, of relevance to low and middle-income countries (LMICs)
- Build sustainable research capacity related to brain disorders in LMICs

The Brain Program is a truly trans-NIH initiative and has successfully catalyzed engagement by many NIH Institutes and Centers with total funding for the program at approximately $84M.

Number of Awards by Administering Institutes or Centers (FY2003-FY2013)

	R01	R21
NIAAA	1	2
NIA	5	8
NIDA	2	8
NIMH	7	20
NIEHS	2	12
NINDS	10	18
NICHD	8	8
OD	N/A	N/A
FIC	2	43
TOTAL	37	119

Enhanced Empirical Evidence

Publications allow grantees to share relevant and important research evidence with the brain disorders community and the Brain Program has generated evidence in areas from mental health and substance abuse to peripheral nervous system trauma to gene environmental interactions. To date, **435 peer-reviewed publications** from **249 unique journals**, in addition to **14 books or book chapters** were published with the support of the Brain Program. For a complete list of publications, please see Appendix H.

[1] Copies of *Neurological, Psychiatric, and Developmental Disorders: Meeting the Challenge in the Developing World* are available for sale from the National Academy Press; call (800) 624-6242 or (202) 334-3313 or visit the NAP home page at www.nap.edu.

Other Research Outcomes

The Brain Program has had tremendous success catalyzing research and capacity building related to brain disorders. Importantly many grantees of the program describe how they successfully extended the reach of their Brain Program-funded activities by accessing additional funding. Specifically, 65% of awardees report having submitted applications to other funders for **"spin-offs"** or **new research projects** that were catalyzed or otherwise enabled by the Brain Program. In addition to providing the opportunity to generate more evidence, the numerous examples of spin-off projects illustrate important capacity that has been built by the program as evidenced by the success grantees have had in applying for and securing funding outside of the Brain Program to continue research related to brain disorders.

Example of NIH Funded Spin-Offs

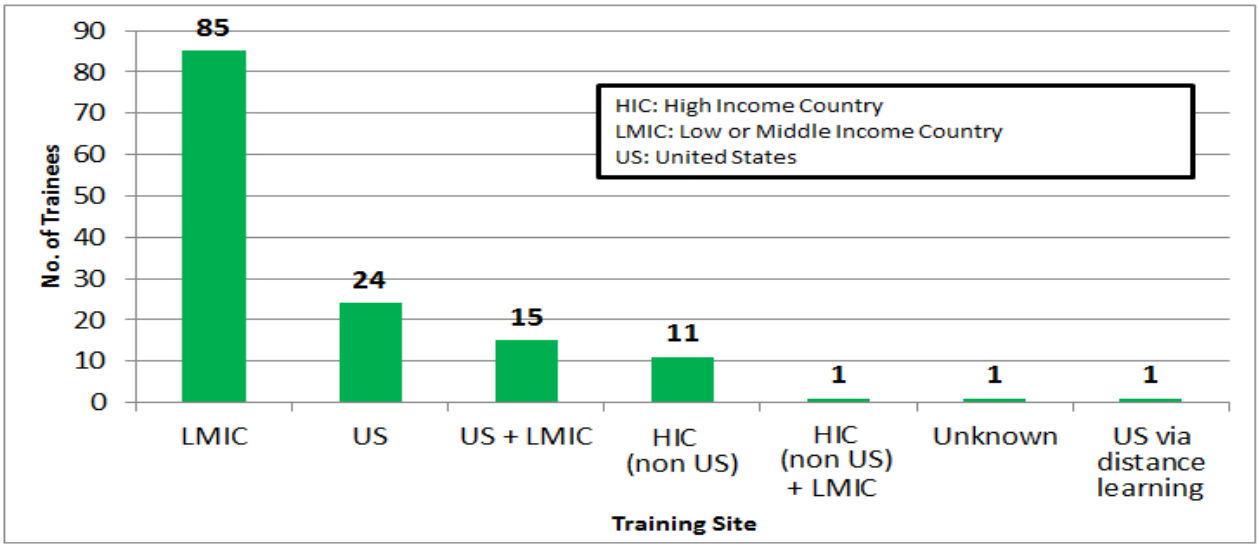
- **Tri-National Training Program in Psychiatric Genetics (D43TW008302):** A research training program in India and Egypt that trains doctoral students while also providing infrastructure development and gene mapping efforts in schizophrenia and bipolar I disorder.
- **Partnerships for Mental Health Development in Sub-Saharan Africa (U19MH098718):** A regional hub for six Sub-Saharan African countries that will train, support and build innovative research capacity as it relates to mental health service development in the region.
- **Role of Calcium Channels in Aging Skeletal Muscle (R03TW08091):** A US and Argentinian research collaboration that explores the cellular and molecular mechanisms responsible for the decline in skeletal muscle performance with aging.

Important research outputs other than publications were developed with support of the Brain Program. These outputs included **new tools for clinical assessment** in the LMIC context, development and/or evaluation of **new interventions**, and **new lab tools or methods**. These outputs are described in more detail in section 4.2.2 *Other Research Outputs*.

Capacity Building

Training and mentoring a robust cadre of brain disorders researchers and strengthening the long-term capacity of LMIC institutions is an integral feature of the Brain Program. The information gathered through this evaluation suggests that trainees ranged from long-term undergraduate students to senior researchers with the majority receiving training and mentoring in a LMIC setting.

Beyond trainees, the LMIC collaborators involved in the Brain Program have been impacted, thus, cultivating a **robust pipeline** for research in brain disorders in the LMIC institutions. Many LMIC collaborators who responded to the Brian Program survey noted that the projects built strong connections between the US and LMIC institutions which inevitability afforded opportunities to build regional and/or international connections, gain new skill, increase the visibility of their research or LMIC institution and aid in a career promotion.



Given the significant burden of brain disorders in LMICs, building local and national capacity to address research and evidence needs is an essential step in combating these diseases. The Brain Program has demonstrated important successes in building this capacity by successfully creating a **global network of researchers** with grantees in more than **45 countries**.

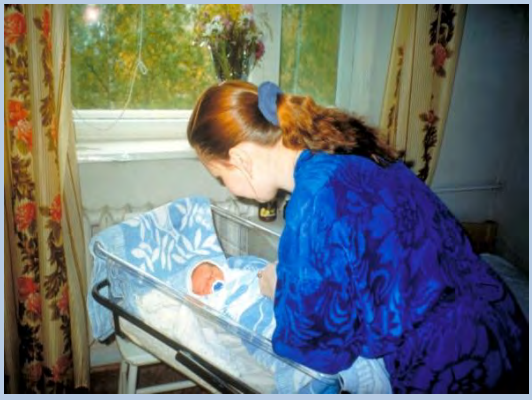
Research on Alzheimer's in Colombia: One project in Colombia provided a powerful platform for collaboration between foreign and local scientists, and created opportunities for synergy between basic and clinical research. The Brain Program supported extensive training for senior Colombian collaborators in US laboratories, the establishment of a transgenic mouse colony and infrastructure for laboratory research in Colombia. These capacity-building efforts laid the foundation for a groundbreaking, $100M clinical trial for Alzheimer's prevention, a critical issue in the country. Major research accomplishments from the project include studies with transgenic mouse models of Alzheimer's that resulted in identification or further refinement of possible targets for gene therapy.

Policy and Public Health

Brain Program activities have informed policies and programs at a national or international level. Examples include:

- Researchers in Peru established the first surveillance system for retroviral and viral meningoencephalitis.
- A Zambian project identified that a WHO Pharmaceutical Regulatory Authority policy negatively impacted worldwide access to an anti-epileptic drug.
- Research on fetal alcohol syndrome (FAS) spurred the dissemination of information and brought fetal alcohol syndrome to the attention of Russian leadership and key health officials.

Research on Fetal Alcohol Syndrome in Russia: One team used findings from their R21 award to develop extensive Russian-language education materials about fetal alcohol syndrome (FAS), including websites for the public and for providers that were the first of their kind. The project helped spur the dissemination of information and bring FAS to the attention of Russian leaders, key health professionals, and offices from the Russian Ministry of Health. A Coordinating Council for Prevention of Harm from Alcohol and FAS was recently established with the aim to promote research and develop services in Russia.



1.0 Introduction and Background

1.1 Program Review

The John E. Fogarty International Center (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,[2] 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.

The *Brain Disorders in the Developing World: Research Across the Lifespan* ("Brain Program") was reviewed over the course of several months in mid- 2013. This report describes the results of the Brain Program review and is laid out in six sections. It begins with a description of the methods used to collect and analyze data on the Brain Program processes and outcomes (Section 1). The next two sections describe program history, context and implementation (Sections 2 and 3). Section 4 describes evidence of the Brain Program outputs, outcomes, and impacts in four categories: 1) leveraged funding impact (Sub-Section 4.1); 2) enhanced empirical outputs (Sub-Section 4.2); 3) policy or implementation outcomes; (Sub-Section 4.3) and 4) capacity building impacts (Sub-Section 4.4). Finally, Section 5 describes evaluation conclusions and recommendations.

This report is part of a larger brain disorders-related initiative. From February 11-12, 2014, FIC and its partners held a tenth anniversary symposium "Frontiers in Neuroscience for Global Health: Tenth Anniversary of the Brain Disorders in the Developing World: Research Across Lifespan Program" reflecting on the past ten years in neuroscience and the Brain Program contribution to the field. Following the symposium, FIC's Center for Global Health Studies (CGHS)[3] held a workshop from February 13-14, 2014 that brought together experts in brain disorders to engage in a writing project resulting in nine separate manuscripts to be published in a special supplement in Nature aimed at highlighting gaps, opportunities, and emerging new priorities in brain disorders-related research and training as they relate to low- and middle-income countries (LMICs). The hope is that this series of papers will provide a scientific roadmap and will help to catalyze research aimed at further reducing the global burden of morbidity and mortality caused by brain disorders in LMICs.

1.2 Methodology

The approach to this review of the Brain Program was broadly guided by the FIC Framework for Evaluation[4] as well as a program logic model, which was developed to illustrate how the Brain Program is intended to work to achieve its goals (for the final version of the Brain Program Logic Model, see Appendix A). Portions of the data collection and analysis were conducted by the

[2] Available online at http://www.fic.nih.gov/about/plan/eval_framework.htm, accessed May 6, 2008.

[3] The CGHS is a new body at the FIC and has been designed to serve as a hub for short-term, project-based scholarship in global health science and policy, short-term training, as well as a forum for international scientific dialogue and collaboration in global health research. A multidisciplinary, multi-sectoral approach is encouraged in all projects, utilizing project-based teams of researchers and individuals who bring diverse expertise from a range of disciplines and sectors. CGHS strives to serve as a catalytic force that brings NIH together with leading low- and middle-income country (LMIC) scientists and policymakers to discuss common research priorities, opportunities and synergies.

[4] See footnote 2.

Science and Technology Policy Institute. Representatives from co-funding NIH Institutes with equities in the Brain Program reviewed and approved the report.

Guided by the logic model, the FIC Framework for Evaluation, and in consultation with FIC staff, a set of evaluation study questions were developed (See Appendix B). These questions were used to gather and review all data which were collected from several sources. Data for the evaluation came from four major sources: 1) Administrative sources including NIH databases (e.g. NIH RePORT, MEDLINE, SPIRES+, IMPACII, and QVR); 2) Interviews with NIH staff; 3) Interviews with Program Principal Investigators (PIs) which form the basis for the Project Outcome Case Studies; and 4) Census Survey of Principal Investigators and Major Foreign Collaborators. Further explanation of these methods is provided below.

1.2.1 Data Collection

Data for the Brain Program evaluation derived from four major data collection efforts. Note, data spans various time periods per collection: for award characteristics and funding, data represents the ten year span of the program, FY2003-FY2013; projects selected for case studies must have had their first project funded on or before FY2010; interviews were conducted with the current Brain Program Officer representative at each partnering NIH Institute as of 2013; and the online survey data only includes the opinions of grantees funded from FY2003-FY2012.

1.2.2 Administrative Sources

Relevant data on award characteristics, mechanism, funding, awardees, Requests for Applications (RFAs), and publications was extracted from relevant NIH databases. In addition, applications and progress reports were reviewed manually in order to extract supplemental information about proposed objectives, methods, outputs, and outcomes.

1.2.3 Interviews with NIH Staff

Informational interviews were conducted via telephone with individuals from NIH program partners at NIH and included the following:

- FIC Program Officer responsible for the Brain Program and
- Representatives from eight Institutes and Centers that have funded Brain Program projects.

For details on questions that were asked in these interviews, see Appendix C.

1.2.4 Interviews with Program PIs/Project Outcome Case Studies

This evaluation takes a novel approach in order to provide more robust qualitative evidence illustrating program outcomes and impacts using detailed case studies focusing on the outcomes of individual projects were developed for 10 of the 29 projects first funded on or before 2010 that have competed successfully for Brain R01 funding to date. Case study candidates were selected purposefully with input from the FIC Program Officer. The goal in selecting projects was to include those for which there was strongest evidence for successful research and capacity building while also representing diverse geographic regions, disease foci, and/or supported activities. At least one project was included from the portfolio of each of the seven ICs that have funded Brain Program R01s based on recommendations made in interviews with IC representatives. Sources of information for the case studies included telephone interviews with the Principal Investigator of each case study project, applications, progress reports, and survey responses from associated individuals. Other individuals and sources such as news reports were consulted for additional information as relevant. The results of each case study have been written up as a brief narrative report (approximately 2-5 pages). All written case studies were

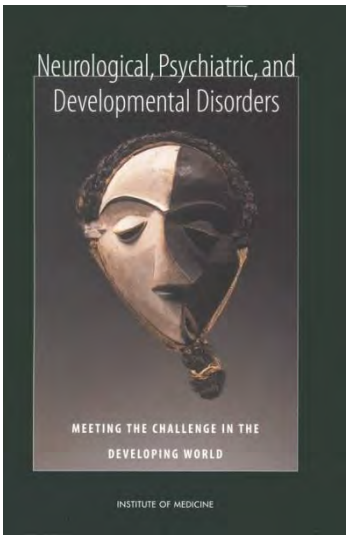
then reviewed and approved by the Principal Investigators for accuracy and are included in Appendix D.

1.2.5 Census Survey of Principal Investigators and Major Foreign Collaborators

Finally, a web-based census survey of Principal Investigators (PIs) and primary foreign collaborators was conducted, with OMB approval. The primary 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 E.

The contact PI and primary foreign collaborator (or US/high income country (HIC) collaborator if the PI was from an LMIC) for each of the 114 Brain Program projects initiated by FY2012 were invited to participate in the web-based survey implemented via SurveyMonkey. In cases where the PI or primary collaborator changed over time (4 projects and 15 projects, respectively), additional individuals were invited to participate. Email addresses were extracted primarily from a list maintained by the program staff and supplemented by web searches and inquiries to PIs as necessary. The survey was open for approximately 1.5 months (from October 9, 2013 to November 20, 2013). Following the initial invitation, reminders were sent periodically to non-respondents from the evaluation contractor and the program officers.

A total of 247 individuals were initially targeted for participation, but 5 could not be contacted (one is deceased, and a current email address could not be located for the other four). Of the 242 individuals successfully contacted, 162 (66.9%) responded substantively (defined as either officially submitting results at the end of the survey or answering at least one question from each third of the questionnaire). An additional 9 individuals logged into the survey website but only answered 1-3 questions each; since an answer to the first question was required in order to reach additional questions, these were not counted as deliberate responses, and they were not included in the analysis of survey results. The response rate was higher for US/HIC respondents (84.6%) than for LMIC-based respondents (50.4%). At least one substantive survey response was received for a large majority of the funded projects (103 of 114 or 90.3%). For questions pertaining to personal opinions or experiences, responses were tallied separately for US/HIC collaborators and LMIC collaborators. For all other questions, multiple responses pertaining to a single project were combined to include all answers, and any discrepancies were handled as noted in the description of individual analyses.



Source: The National Academies Press

2.0 Program Background and Description

The proportion of the global burden of disease attributable to mental, neurological and substance use disorders together is expected to rise worldwide in the future because of the projected increase in the number of individuals entering the age of risk for the onset of many such disorders. However, the rise will be steeper in LMICs, because of the continuing and long lasting effects of early life trauma, infectious disease and malnutrition which contribute to neurological and neurodevelopmental disorders and mental retardation. Despite their enormous contribution to the burden of disease and disability, nervous system disorders have been largely absent from the global health research agenda. Given these trends, reducing disease and

disability associated with brain and other nervous system disorders should be a critical priority in global research.

2.1 Program Origin and History

The Brain Program originated at a time when chronic diseases had not yet gained traction as an important priority in the global health arena. However, in 2001, the U.S. Institute of Medicine published a report entitled "Neurological, Psychiatric, and Developmental Disorders: Meeting the Challenges in the Developing World" that would define the increasing burden and identify areas for intervention, research, and capacity building in brain disorders. Study sponsors included the National Institutes of Health (FIC, the National Institute of Child Health and Human Development, the National Institute of Neurological Disorders and Stroke, and the National Institute of Mental Health), the U.S. Centers for Disease Control and Prevention, and the Global Forum for Health Research. This report not only brought together a growing body of evidence indicating that the impact of brain disorders had been largely underestimated, particularly in the developing world, but it also provided the seed for the Brain Program.

A “consultation” of experts was convened by FIC in 2002 in order to solicit input on key priorities in brain disorders and how to most effectively frame a program to address these priorities. The first Brain Program Request for Applications (RFA-TW-03-007) was issued in November 2002. Applications were solicited for the Exploratory/Developmental Research Grant Award (R21) mechanism only. In May 2005, Request for Applications (RFA-TW-05-100) sought applicants for both the R21 and R01 mechanism. Only those awarded an R21 in 2003 were eligible to apply for the R01 research grant; all other applicants were to apply for a R21 requesting two years of funding.

Partners listed on solicitations over time include nine Institutes and Centers at the NIH (National Eye Institute (NEI), National Institute on Aging (NIA), National Institute on Alcohol Abuse and Alcoholism (NIAAA), The Eunice Kennedy Shriver National Institute of Child Health and Human Development (NICHD), National Institute on Drug Abuse (NIDA), National Institute of Environmental Health Sciences (NIEHS), National Institute of Mental Health (NIMH), National Institute of Neurological Disorders and Stroke (NINDS), and Office of Dietary Supplements (ODS), the Institute of Neuroscience, Mental Health and Addiction at the Canadian Institutes of Health Research (CIHR) and the National Council of Science and Technology in Mexico. Over the years partners such as Autism Speaks and National Alliance for Autism Research have also contributed to the Brain Program.

2.2 Program Objectives, Structure, and Logic

The Brain Program model allows investigators in the US and other HICs to gain experience working in low- and middle-income settings while at the same time strengthening the research base of the US and foreign institutions in LMICs. The program is designed to promote collaborative research focused on brain disorders in LMICs and to build capacity in LMICs where brain disorders are a relevant public health challenge. Like many FIC programs, the model emphasizes training and capacity building in addition to scientific research opportunities. However, this award is unique in that it is an R21/R01 award with emphasis on capacity building, rather than a more typical FIC D43 or R25 training or education grant that requires a research base to be in place for a training award. This is significant in that the Brain Program funds

empirical research and capacity building simultaneously.

Specifically, the purpose of the program is to "support the development and conduct of innovative, collaborative research and research training projects, between developed and developing country scientists, on brain disorders throughout life, relevant to low- and middle-income nations."[5]

Brain Program objectives include:

1. To encourage multidisciplinary collaborative approaches to identify and address brain disorders of particular importance to low- and middle-income countries;
2. To address brain disorders of significance to developing nations by promoting international cooperation between scientists and institutions in these countries and investigators in the U.S. and other developed nations who are pursuing relevant research programs;
3. To build and enhance the research capacity of developing nations to identify and address relevant brain/neurodevelopmental disorders across the lifespan.

It is worth noting that the program has always included an emphasis on "research across the lifespan." The phrase has been defined to include research topics that cross cut the lifespan, such as nutrition or early exposure (e.g. to diseases or environmental toxins) with sequelae or impact throughout life, as well as topics relevant only to specific portion of the lifespan, such as pediatric or aging-related disorders. More information on the lifespan approach to the program can be found in the textbox below.

Focus on the Lifespan

The trajectory of brain and nervous system development and function starts with the genetic blueprint. From conception on, this multidimensional code interacts with both the internal and external environment mediated by chemical tags and associated proteins to express different phenotypes related to health and disease in an intricate epigenetic dance. Thus, the Funding Opportunity Announcements (FOAs) under this program have encouraged research across the lifespan.

Research topics for the latest FOA were "related to nervous system function and/or impairment from birth to advanced age … Research on co-morbidities and conditions that affect nervous system function at different life stages as well as across the lifespan... Applicants may propose a research and capacity building program on some aspect of nervous system function and/or impairment at any stage of life from conception to death and on to the next generations."

Studies over the past decade have included those on conditions that first manifest at any stage of life and focus on diagnosis, etiology, co-morbidities, treatment, rehabilitation, and the role of health systems in care and treatment. A few examples include pediatric epilepsy in Africa and neurodevelopmental disorders in India (eg. autism), genetics and treatment of mental illness in the Middle East, substance abuse in Africa, neurodegenerative diseases (e.g. Parkinson's) and stroke in India and China.

Experience, environment, etc. at any stage of life can influence brain and nervous system conditions and behavior at any later stage. The neurological consequences of early conditions such as nutrition, cerebral malaria or heavy metal exposure when young, or traumatic psychological or physical brain injury throughout life, are all examples of research areas addressed through the Brain Program.

Finally some research closes the circle with a focus on epigenetic mechanisms which provide the route for influences throughout the life-cycle onto the next generation.

[5] http://grants.nih.gov/grants/guide/pa-files/PAR-05-100.html

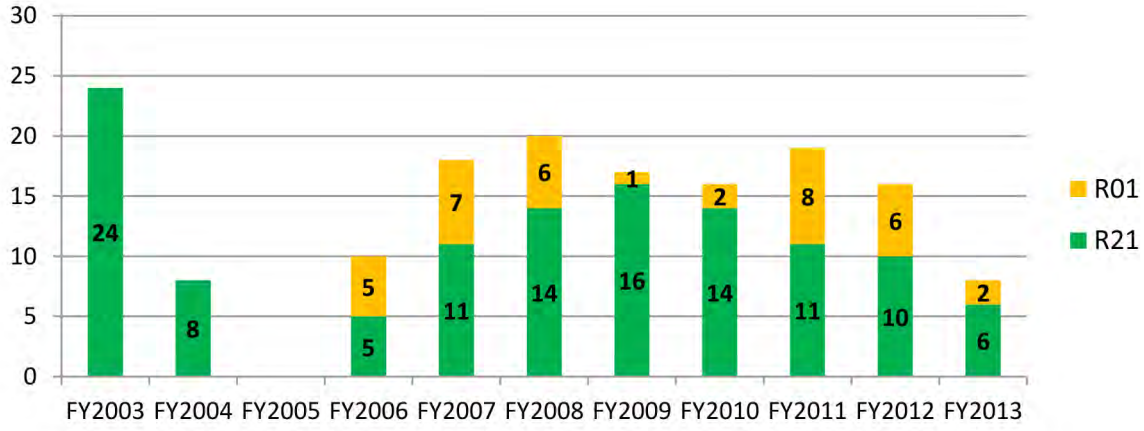
As depicted in the Brain Program logic model (Appendix A), the program is structured to support the R21 exploratory/developmental research grant award, the R01 full research project award as well as an annual network meeting. During the R21 award period, applicants have two years to initiate preliminary studies and training, and to organize, plan, prepare, and assemble the information and data for an application for a more comprehensive R01 application involving collaboration between the developed and developing country investigators. The R01 involves collaboration between developed and developing country investigators and incorporates both research and capacity building and is intended to build on the research and research capacity building needs and activities identified and piloted in the awarded R21. Many of the R01s are funded by partnering NIH Institute and co-funded by FIC for a period of up to five years.

Each of these activities is intended to lead to specific outputs as indicated. Network meetings create a platform for communication and collaboration among grantees and support the sharing of new knowledge, lessons learned, and key challenges.

2.3 Portfolio of Funded Awards

The total value of the Brain Program awards made between FY2003 and FY2013 was $84.3M. Over $55M (65%) went towards funding the 37 R01 projects, with the average R01 receiving $1.48M for a 5 year period. Approximately $29.3M went towards funding R21 projects, to which FIC contributed over $10.2M or 35%. The average size of a R21 was $245,990 for a two year period.

Figure 1: Number of Funded Awards by Fiscal Year



2.3.1 Applications and Success Rates

During its first 10 years, the Brain Program received a total of 649 applications for Type 1 and Type 2 awards. These applications were submitted by 410 applicants[6]: 545 were R21 applications and 104 were R01 applications. 156 applications were funded.

- For the R01 applications only: Thirty-seven applications were funded with 23 (62%)

[6] Applicants determined by Contact Name on Application

being awarded on their first try, 11 (30%) submitted twice and three (8%) submitted three times before receiving funding. Thirty-nine applications were never funded. Of these 39, nine (23%) were submitted twice and one (3%) submitted three times without ever successfully getting awarded

- For the R21 applications: A total of 119 applications were funded, 93 (78%) were awarded on their first try while 22 (19%) were submitted twice and four (3%) were submitted three times before receiving funding. Of the 344 applications that never received funding, 47 (14%) were submitted twice and four (2%) submitted three times without ever successfully getting awarded.

Also noteworthy was that 49 Type 3 (supplemental) applications were received between 2004 and 2012: 25 were supplements to R01s and 24 were to R21s. These supplements had a 100% success rate.

Table 1: Number of Applications Received and Success Rates by Funding Announcement

Request for Applications	Not Funded	Funded	Total	Average Success Rate
TW03-007 (R21)	100	32	132	24%
PAR05-100 (R21)	85	14	99	14%
PAR06-420 (R21)	44	20	64	31%
PAR08-113 (R21)	116	36	152	24%
PAR11-031 (R21)	81	17	98	17%
R21 SUB-TOTAL	426	119	545	22%
PAR05-100 (R01)	23	12	35	34%
PAR07-268 (R01)	5	6	11	55%
PAR08-112 (R01)	20	10	30	33%
PAR11-030 (R01)	19	9	28	32%
R01 SUB-TOTAL	67	37	104	39%

The average success rate for each funding cycle and mechanism can be found in Table 1. Success rates for R01 and R21 applications were substantially different, although the discrepancy over time has diminished. The average success rate for R01 applications (Type 1 and Type 2 grants only) over the past 10 years is 39% and the average success rate for the R21 is 22%.

The 2008 program announcement for the Brain Program saw the highest number of R21 awards funded (36). Over the entire decade, the number of R21 awards funded per Funding Opportunity Announcement (FOA) fluctuated between 14 and 36 grants per announcement. Similarly, the program announcement for the R01 received the highest number of applications and funded the most awards (12) in its first round in 2005. Application numbers for both mechanisms have been consistent throughout the program's lifespan.

2.3.2 Funding by IC Program Partners

Given the trans-NIH nature of brain disorders research and capacity-building, the Brain Program plays a unique role at NIH and has successfully catalyzed engagement by many Institutes and Centers across the NIH. In its first year, for example 24 R21s were awarded. FIC administered 10 (43%) of these awards and partner ICs (NIMH, NIEHS, NIDA, NINDS) administered the remaining

14 (57%). Seven partnering NIH Institutes have administered their own Brain Program awards as shown in Table 2.

Table 2: Number of Awards by Administering Institutes or Centers (FY2003-FY2013)

	R01	R21
NIAAA	1	2
NIA	5	8
NIDA	2	8
NIMH	7	20
NIEHS	2	12
NINDS	10	18
NICHD	8	8
OD	N/A	N/A
FIC	2	43
TOTAL	37	119

Similarly, the program leveraged a substantial amount of funding from across the NIH. NINDS was the most significant contributor investing over $21.9M to the program with 79% of the funds going to R01 awards. Of the remaining partners, NICHD and NIMH contributed expenditures of $15.3M and $12.0M respectively followed by NIA, NIDA, NIEHS, NIAAA and offices in the Office of the Director (OD) (see Figure 2b).

Figure 2a: Funding Sources by NIH Partners by Fiscal Year (2003-2013)

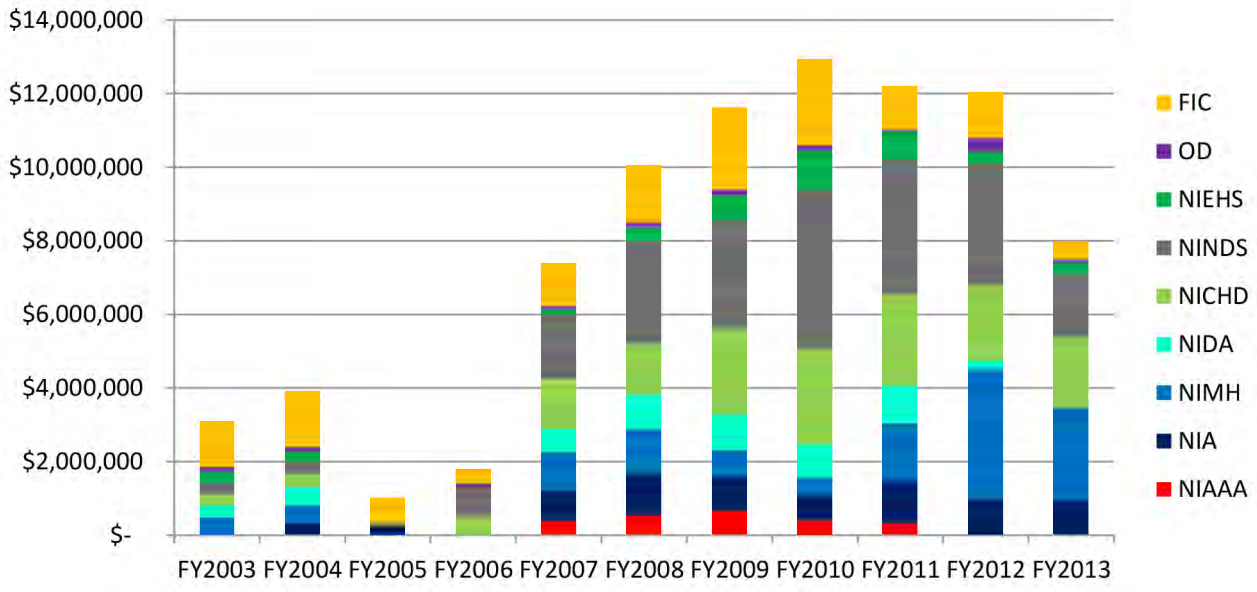
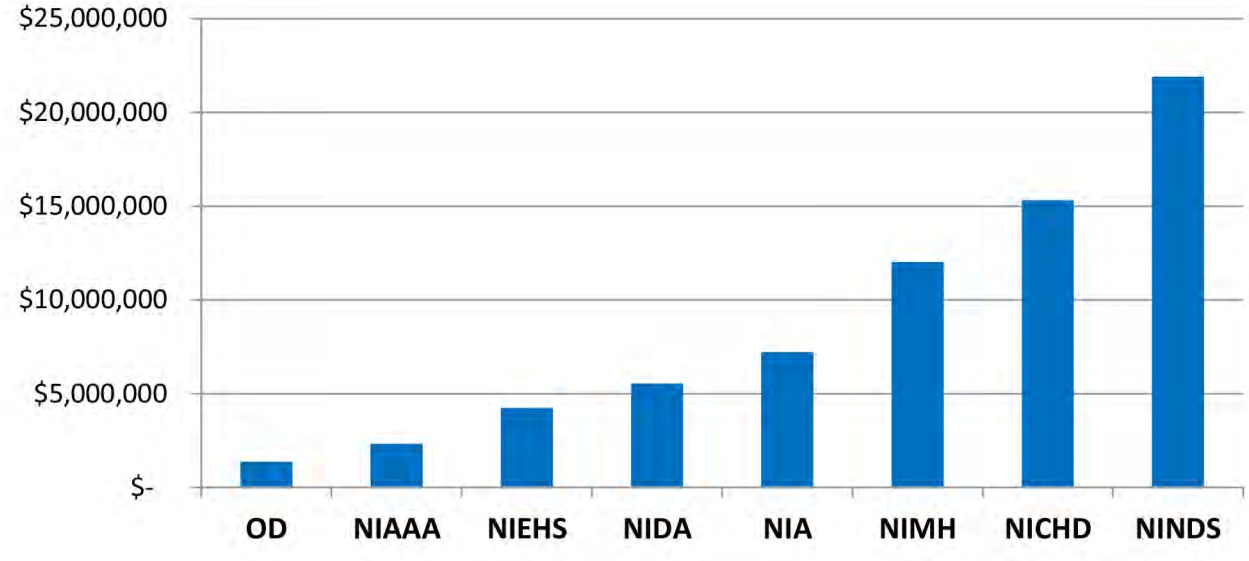


Figure 2b: Total Funding by NIH Partners (2003-2013)



2.3.3 Program Snapshot by Region

The Brain Program has focused research projects in 45 countries in six regions (Figure 3). In the following analysis, countries were classified using the World Bank's regional categories. The majority of awards, both R21 and R01, have supported projects in Sub-Saharan Africa and Latin America and the Caribbean. Thirty-six percent of the R21 awards and 41% of the R01 awards focus their research in Sub-Saharan Africa. As indicated in Figure 4b, there have been 19 R21 awards for grants focused in Thailand, China, Vietnam and Republic of Palau, all within the East Asia and Pacific region. Five of the R21s conducting research in East Asia and Pacific applied for R01s, but none were successful in getting funded.

Figure 3: Country Focus Research of Brain Awards

Figure 4a: Total Number of Awards by Region for R21 Mechanism (FY2003-FY2013)

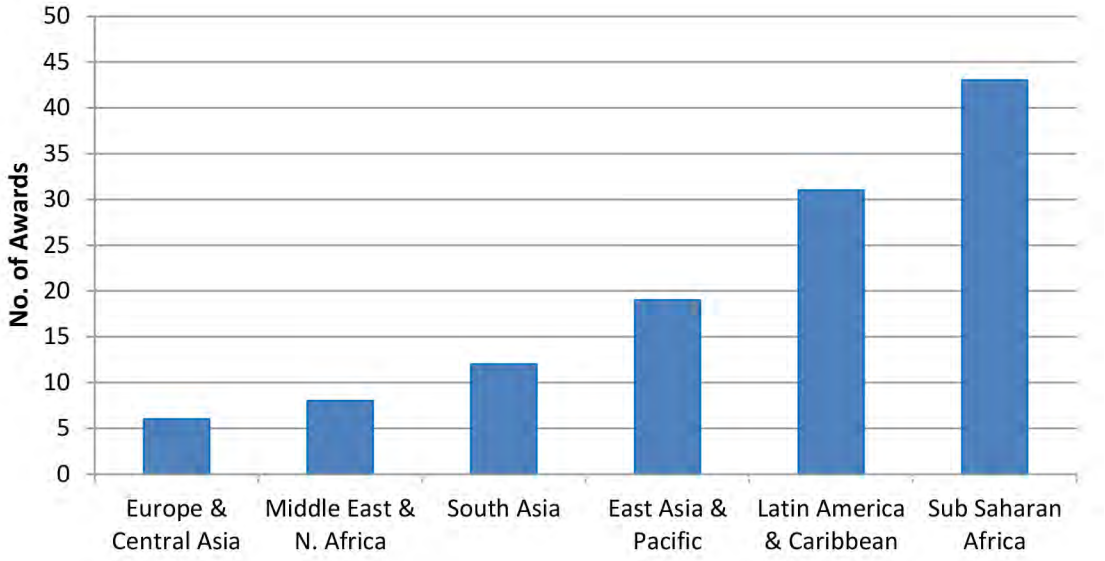
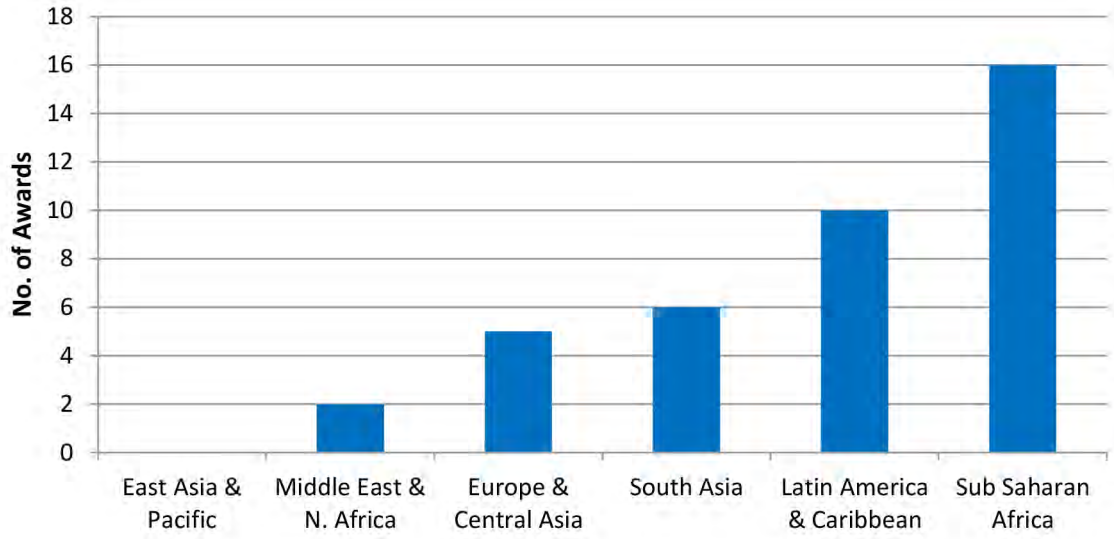


Figure 4b: Total Number of Awards by Region for R01 Mechanism (FY2006-FY2013)



2.3.4 Program Snapshot by Disease Category and Methodology

According to the Brain Program FOA, the Brain Program collaborative research projects are intended to "conduct research on nervous system development, function and impairment at any stage of life and on topics particularly relevant to LMICs." These goals are reflected in the focus areas of the Brain Program awards, as described below, though categories have been made more specific for the purposes of the evaluation.

Awards were coded for disease area (Figure 5) and methodology type (Figure 6) based on review of applications and progress reports. Awards were coded for disease area based on review of applications and progress reports.

Figure 5 is a breakdown of award by disease category. The largest proportion of awards (21 or

18%) has focused on HIV in relation to brain disorders. Awards dealing with issues of dementia, aging or Alzheimer's disease were the next most common disease category with 15 projects (13%), followed closely by perinatal conditions and exposures with 13 projects (11%). Other categories include projects focusing on issues of access to health care; nutrition and cognitive development; and food derived toxin exposure.

With respect to methodology used by projects, the vast majority of awards use epidemiological research methods, as illustrated in Figure 6.

Impact in Sub-Saharan Africa (SSA)

Since the beginning of the program, the SSA region has received substantial interest from grantees and collaborating institutions in the US. The R21 program has funded over 36% of its research and research capacity building efforts in Sub-Saharan countries; for the R01 it is slightly higher with 41%. Part of the strong interest is due to the unmet needs of the region. African and non-African collaborators jumped on the opportunity to work together on brain disorders research as there were very little other research funding opportunities available at the time.

Some of the program's most ground-breaking work has come from the HIV/AIDS research being conducted by Brain Program grantees. Given that infectious disease and HIV/AIDS remain endemic to the SSA region, much of the research conducted there has focused on the entire spectrum of HIV research from basic science to community interventions. For example, grantees are addressing how carrying a HIV subtype that is not conventionally seen in Western settings (e.g. subtype D) can have a varied impact on the risk of dementia in patients and are investigating the effectiveness of highly active antiretroviral therapy in persons carrying a HIV subtype. These studies focus on different population groups at different life stages, including pediatric HIV+ patients and their neurodevelopmental trajectories to adult patients and their HIV-related neurological complications and neurocognitive deficits.

Figure 5: Brain Program Projects by Disease Focus

Note: Multiple R01s associated with the same R21 were coded separately, increasing the total project count to 117. Disease codes were designed to be non-overlapping, and only one disease code was applied to each project.

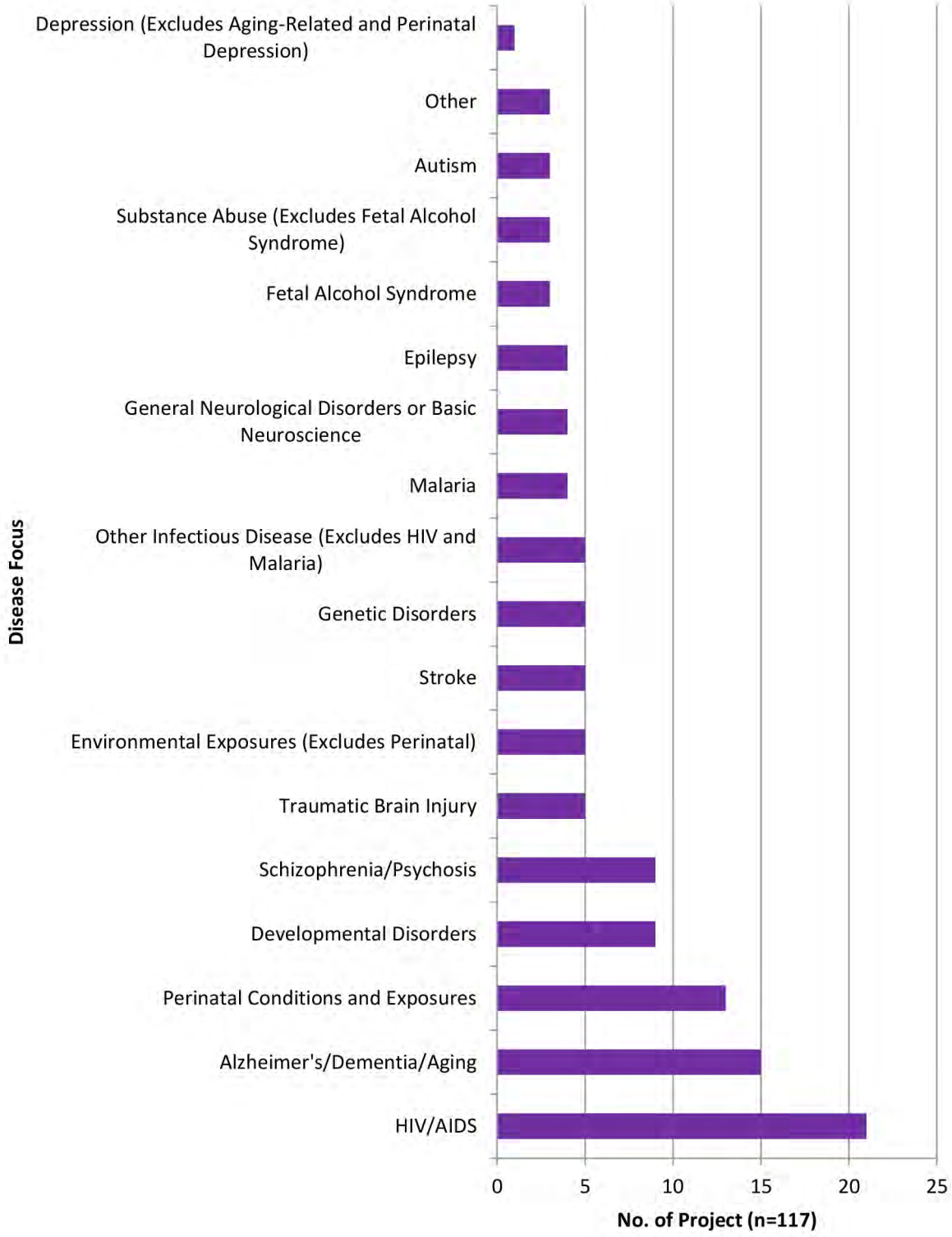
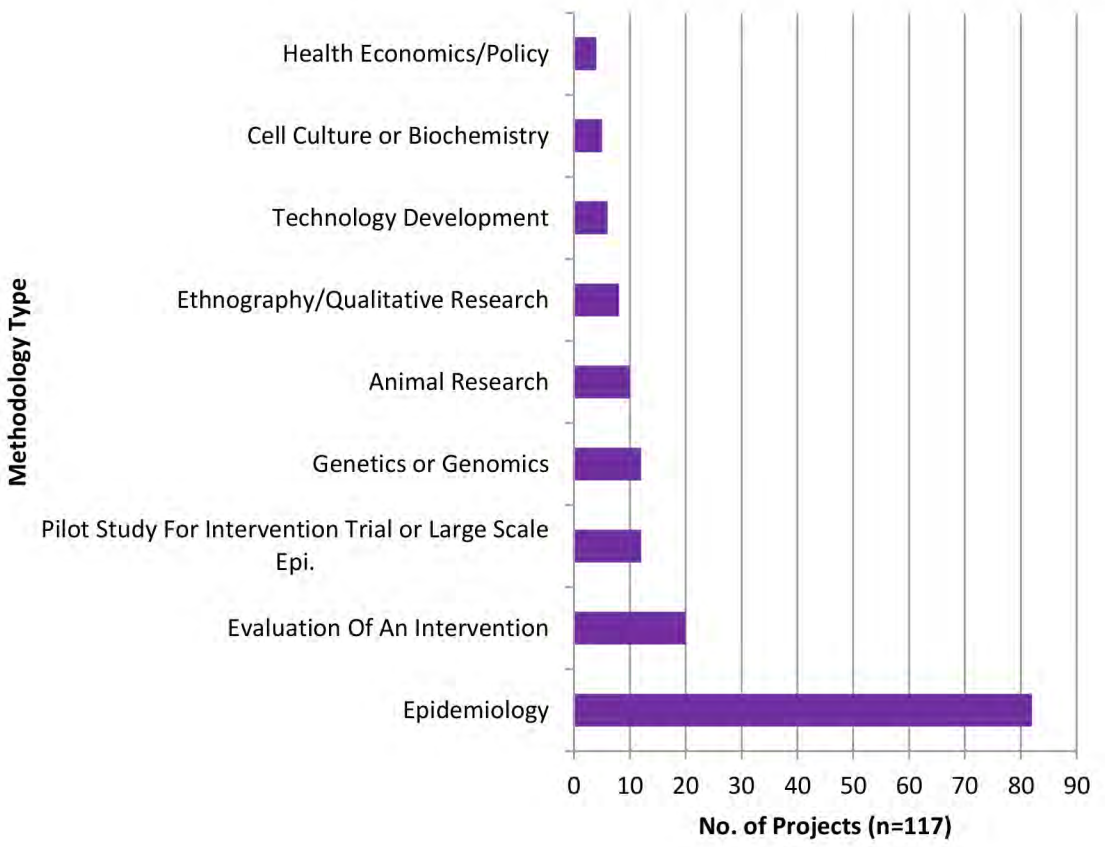


Figure 6: Brain Program Projects by Methodology Type
Note: Multiple R01s associated with the same R21 were coded separately, increasing the total project count to 117. Multiple methodology codes were applied to projects with more than one substantive component.



3.0 Process-Related Results

3.1 Review Process

Brain Program applications have been reviewed by Special Emphasis Panels assembled by the Center for Scientific Review (CSR). In interviews and survey responses, program stakeholders expressed some concerns about the review process. First, it was noted that reviewers do not always have a clear understanding of the R21 mechanism's unique role in this program; in fact, some comments from reviewers suggest that they have similar expectations for an R21 as they would for an R01. This misalignment with how the R21 is intended to work within the Brain Program has the potential to impact scoring of applications. Second, it was also noted that reviewers do not always have consistent views about the role of capacity building in this program. For example, one grantee suggested that "perhaps [FIC should] enlighten the reviewers that the Brain R01 differs from the usual R01 in that it encourages training and capacity building." Finally, and importantly, another awardee stated that "it seemed like the review committee for the R01 did not have a good understanding of some of the mitigating factors involved in international research."

3.2 Transfer of Funds

Since transfer of funds to LMIC institutions is sometimes known to cause difficulties for many NIH programs, this issue was the focus of several survey questions.

Twenty eight of 38 respondents to the awardee survey (74%) reported that funds or resources were transferred between the collaborating institutions as part of their specific Brain Program awards. Of those 28 respondents, 27 provided information on the types of mechanisms employed to transfer these resources; multiple mechanisms were employed per award. The majority (89%) were transferred between institutions via subcontracts. Many (56%) also reported that goods/services were purchased by the lead institution and subsequently transferred to collaborating institutions. A few awardees highlighted that the process of transferring funds tends to be a slow, lengthy and time-consuming procedure. One awardee described a lengthy process of transferring goods when a US company would not accept an order or responsibility for shipping an order of ultra-low freezers to Africa. Thus, the grantee had to purchase items through the Asian market but it took time in order to ensure that the countries he was purchasing from were authorized to do business with the U.S. Another awardee stated that it "remains a very difficult process - subcontracts are very slow to process."

Other noteworthy comments included a respondent who stated that given how slow the process is they end up paying their colleagues directly as consultants. One awardee discussed the regulatory requirements of the NIH as being quite reasonable "but different Universities interpret regulations in more stringent ways making it challenging at times to get money to our foreign sites." Another indicated simply that: "foreign country guidelines had to be followed."

3.3 Networking Opportunities

Network Meetings are held annually to provide grantees with an opportunity to interact with each other and with NIH staff. Current awardees are required to budget to attend one network meeting per year, and the Program Officer reported that active awarded grants are often represented by at least one participant (PI, collaborator, trainee) at each meeting. Although past grantees are welcome and encouraged to attend, there is not funding available from NIH for this purpose.

Outside of the annual Network Meetings, the FIC Program Officer maintains a central Brain Program web page on the FIC website as well as a list-serve and a "LinkedIn" group that awardees can choose to join. Most (89%) of the survey respondents reported that overall the Brain Program provided sufficient opportunities to interact with other awardees and their collaborators.

3.4 Other Sources of Support for Funded Projects

Awardee survey respondents were asked about supplemental contributions to their Brain Program grant. Twenty two (54%) of 41 survey respondents reported that they had non-NIH funding or institutional support that supplemented their Brain Program project support. Of those 22, 18 (82%) awardees collectively provided 30 sources for these funds including:

- Low- and middle- income country Institutions or Universities
    - Salary support and space from Federal University of Minas Gerais (Brazil)

    - Salary support from Sree Chitra Tirunal Institute for Medical Sciences & Technology (India)
    - Additional funding and logistical support from Vietnam National University
    - Salary, administrative and logistical support from Universidad Peruana Cayetano Heredia (Peru)
    - Student and staff salary from Consejo de Investigaciones Cientificas y Tecnicas (Argentina)
- U.S. Institutions or Foundations
    - Monetary Support from Michigan State University
    - Funding for research team and research supplies from University of Minnesota
    - Discretionary funding for the PI used toward research expenses from Harvard University
    - Research support from Howard Hughes Medical Institute
    - Research support from Simons Foundation
    - Statistical support from Oregon Clinical and Translational Research Institute

For a complete list of non-NIH supplemental support, see Appendix F.

3.5 Other Issues Raised by Awardees

It should be noted that many survey respondents and interviewees volunteered positive comments about the program, ranging from "thank you very much" to "continue and expand it" to "it is a fantastic program". Many discussed the impact the program had on their career or on the larger community such as the university. One survey respondent, a foreign collaborator, states that "without the program, I would have probably given up a research career in Brazil. The obstacles to continue performing research and training have been great, but the support I have received from the program allowed me to attain my goals and to multiply knowledge by training other researchers." Another awardee noted that the Brain Program has helped upgrade his universities' rankings due to the increased research capacity.

However, when survey respondents and interviewees were given the chance to provide suggestions for future improvements to the program, a variety of issues were raised. Those issues that were mentioned by more than one interviewee and/or were judged to be most significant include the following:

- *Further engagement in LMIC culture or government*. One survey respondent stated that there should be a greater emphasis on the cultural or international variations in health factors. Another discussed the need for better dialogue between the NIH and governments; with approvals for protocol and funds substantially different in LMICs, improved communications would be valuable in avoiding delays in funding.
- *Insufficient skill sets at foreign institutions.* A survey respondent who collaborated closely with foreign partners described barriers due to lack of sufficient skills. The awardee stated that training for research methodology and advanced statistical analysis are necessary skills that some LMIC researchers lack and if NIH were to train LMIC researchers in these areas it would help develop human capacity and research capacity in LMICs.
- *Encourage multi-country approach*: Specific instances would be encouraging multi-site projects in different LMIC or allowing lead investigators and funds to move institutions easier so they can set up more research centers and sites in various countries.

3.6 Other Significant Issues Raised by Partner ICs

Other noteworthy issues raised by the partner IC representatives in interviews include the following:

- *Inclusion in the planning process.* In general, representatives from the partner ICs stated that they felt they had been included appropriately in planning processes. However, one representative commented that the partner ICs were not given enough time to review and approve of the most recent renewal FOA.
- *Importance of a dedicated solicitation.* Interviewees agreed that a dedicated Brain Program solicitation stimulates interest from LMICs in collaborative research and allows ICs to fund awards that would not ordinarily survive the review process, giving foreign investigators a chance.
- *Larger financial Investment from FIC.* Several of the partner IC representatives commented that a larger investment by FIC would make it easier for them to argue to their leaders for additional funding. However, one partner IC representative explained that her IC would prefer that FIC did not fund its own R21 awards.
- *Duration of the award.* Several interviewees suggested that the duration of the R21 award (two years) was not sufficient to accomplish what they had hoped to achieve. One interviewee says that two years was not enough time to develop a solid R01 research project. Another thought that a new mechanism, such as an administrative 1- year award, could help bridge the gap for selective awardees between their R21 and application for a R01.

4.0 Program Results

4.1 Leveraged Funding

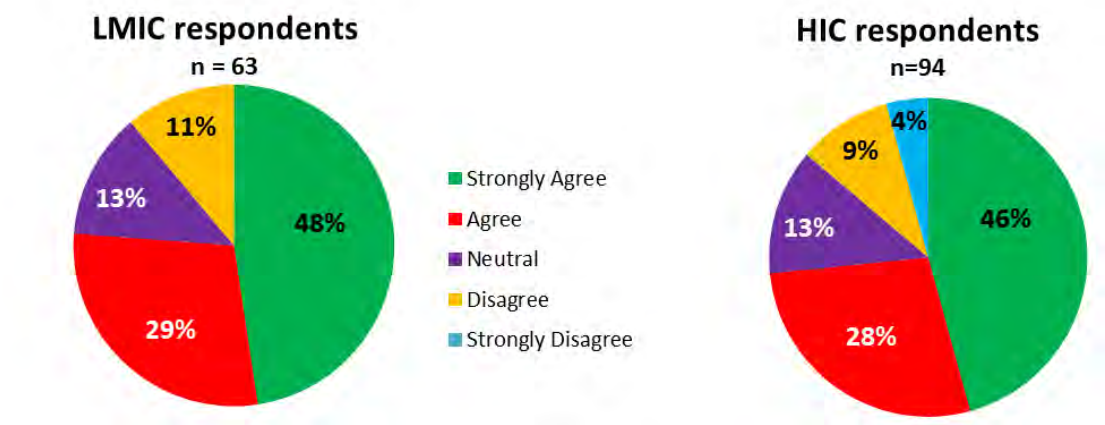
The Brain Program was successful at catalyzing research and capacity building related to brain disorders and accordingly many grantees of the program describe how they extended the reach of their Brain-funded activities by accessing additional funding. This section describes how grantees obtained additional funding to continue projects initiated with Brain Program R21 awards, and how the program may have catalyzed spin-off projects. The numerous examples of spin-off projects catalyzed by this program speak to the program's ability to generate interest in the research topics across the global. The Brain Program has created a cadre of researchers successful in applying and securing funding in a competitive research market to continue in research related to brain disorders.

4.1.1 Funding to Continue Projects Initiated with Brain R21 awards

Of the 113 R21 projects funded through FY2012, the teams associated with 62 (54%) had applied for Brain Program R01 funding and 31 (28%) had competed successfully for at least one R01 award by 2013. One of those R21 awards generated two separate Brain Program R01s, and another was associated with three separate R01s.

When asked to rate the degree to which they agreed with the statement "After the period of R21 support, we were prepared to compete successfully for an NIH R01 award or comparable funding from another source," approximately half of all survey respondents said they strongly agreed, and another 28-29% agreed (Figure 7).

Figure 7: Survey Responses Regarding Preparedness to Compete for an R01



To more fully understand what happened to 72% of funded projects that have not progressed to the R01 stage the survey included the question "Have you and/or your collaborators applied for additional funding to continue the research project(s) initiated with your Brain Program R21 award?" Responses to this question were somewhat difficult to interpret. First, there was considerable disagreement among responses for the same project, with investigators from 22 of the 103 projects for which there was at least one response (21%) giving conflicting responses (Table 3).

Table 3: Survey Responses Regarding Applications for Follow-up Funding and Actual Number of Applications for Brain Program R01 Funding

	Number of Projects	Percent of projects (N=114)	Actual Brain Program R01 applications in this group
Applied to BP + other funders	32	28%	26
Applied to BP only	35	31%	31
Applied to other funders only	11	10%	2
Did not apply for additional funding	25	22%	1
No survey response	11	10%	2

Second, when comparing answers to the survey question against actual application records, major discrepancies were apparent within each category (Table 3, last column). This would seem to imply that either some respondents didn't understand the question or that some team members were not aware of applications submitted by others.

Survey respondents who reported that they applied to other funders only were asked to explain why they chose not to apply for a Brain Program R01 award. Of the 11 projects for which there was an answer in this category, 5 of the teams reported that their R21 projects are still in progress. Two additional teams stated that the PI is no longer a US-based investigator; one of these teams has already received funding from CIHR and the other thought the likelihood of competing successfully as a non-US investigator was very low. Responses from the four other

teams suggest a variety of issues, including difficulties in getting the proposal together, doubts about the team's ability to compete successfully, and doubts about the project being a good fit for the Brain Program:

> "I wanted to apply for the R01, but I did not believe that I had adequate data from my R21 to do so, as things did not go completely as planned. In retrospect, and after talking with other grantees, I realize that I should have submitted the R01 based on my preliminary findings."/"The funding became strongly competitive and the budget has been reduced dramatically. Our team decided to seek for other funding resources where our application would be more competitive for successful funding."
>
> "Because of timing issue - the R21 had not finished before the R01 application deadline"/"Deadlines and difficulties to get proposal together. Inability to get US collaborators."
>
> "We applied to NIMH (and did not receive the award). At the time the Brain Disorders mechanism did not seem like the best fit for our application."
>
> "The environment in which to conduct a research study was extremely difficult and the preliminary data was not ready for the application. In addition, capacity building was very challenging to implement, which means that an R01 would have required sending someone from the US or a developed country to conduct it, which goes against the whole spirit of the Brain program. The additional funds we sought were actually to increase the sample size of the R21, and would not have taken the question much further."

Survey respondents who reported that they have not applied for additional funding were asked to choose from a menu of possible explanations, with multiple selections allowed. Of the 37 projects for which there was at least one answer in this category, 24 (65%) reported that the R21 project was still in progress and/or they hadn't yet had time to apply (Table 4). Of these, 20 (83%) indicated that they intended to apply for additional funding in the future, and the other 4 were undecided or didn't answer the question.

Table 4: Survey Responses Regarding Reason for Not Applying for Additional Funding After the R21

Reason selected	Number of projects	Percent of projects for which there was a response (N=37)
The R21 project is still in progress and/or we haven't yet had time to apply	24	65%
The project has reached its logical conclusion or exhausted its potential	6	16%
We're not confident that we could compete successfully for additional funding	6	16%
The project is no longer a priority and/or we don't have time to pursue it at this time	1	3%
I prefer not to answer	2	5%

Another 6 respondents (16%) reported that the project had reached its logical conclusion or exhausted its potential, and the same number reported that they were not confident that they could compete successfully for additional funding. One investigator indicated that the project is no longer a priority.

Respondents who indicated that they had applied to funders other than the Brain Program were asked to report the type of funder to which they applied. Of the 43 projects for which at least one investigator answered this question, 23 (53%) reported applying to an NIH Institute or Center, and 19 (44%) reported applying to an NGO or charitable foundation (Table 5).

Table 5: Survey Responses Regarding Type of Other Funder to Which Respondents Applied for Funds to Continue the Brain Program Project

	Number of Projects	Percent of projects for which there was a response (N=43)
An NIH Institute or Center	23	53%
Another US government agency	8	19%
Government source in another high income country or region	7	16%
Government source in a low or middle income country	8	19%
Non-governmental organization or charitable foundation	19	44%
Institutional bridge funding or other institutional funding source	2	5%

Twenty-four (56%) of the project teams that reported applying for other funding from sources other than the Brain Program reported that they had actually received funds from these sources, and 20 specified actual sources and amounts of funding (Table 6).

Table 6: Outside Funding Source to Continue Brain Program Project Reported by Survey Respondents

Type of source	Specific source	Combined total
HIC government; NGO	Canadian Institutes of Health Research (Canada); Heart & Stroke Foundation (Canada)	More than $100,000
HIC government; HIC institution	University of Minnesota (USA); Canadian Global Health Stars (Canada)	More than $100,000
HIC government; LMIC government	European Union (through Argentine Agency); Argentine Research Council (Argentina); Argentine Agency for Promotion of Science & Technology (Argentina)	$50,000-$100,000
LMIC government	Beijing Municipal Commission of Science and Technology (China)	More than $100,000
LMIC government	Sao Paulo State Research Support Foundation (Brazil); National Council for Scientific Development (Brazil)	More than $100,000
LMIC university	University of Ruhuna (Sri Lanka)	Less than $10,000
NGO	International Brain Research Organization; National Academy of Sciences; International Diabetes Federation	More than $100,000
NGO	Michael J Fox Foundation	More than $100,000
NGO	Simons Foundation	More than $100,000
NIH	NIA/NIH (USA)	More than $100,000
NIH	NIEHS/NIH (USA)	More than $100,000
NIH	NIAID/NIH (USA)	More than $100,000
NIH	NCRR; NHGRI/FIC/R90; NHGRI/FIC/T90	More than $100,000
NIH; HIC institution	Children's Hospital of Alabama (USA); NICHD	More than $100,000
NIH; LMIC government	NIMH; Chinese Natural Science Foundation (China)	More than $100,000
NIH; NGO	Harry Crossley Foundation (South Africa); International AIDS Society CIPHER grant; NIH	More than $100,000
NIH; NGO	NINDS; Neurologic AIDS Research Consortium; Waterloo Foundation (UK)	More than $100,000
Other US government; NGO	CDC NCBDDD (through a cooperative agreement with Association of University Centers on Disabilities); USAID; the Russian Foundation for Basic Research (Russia); Médecins du Monde (France)	More than $100,000
Private sources; Industry	Private sources; Industry	$50,000-$100,000

When asked whether there was anything that the Brain Program could have done to improve their ability to secure additional funding, the largest number of suggestions focused on three topics: additional guidance/assistance with the application process (8 comments); improving the review process (8 comments); and increasing opportunities to apply (6 comments). Specifically, multiple respondents commented on each of the following points:

- Provide clearer guidance about the application process, especially regarding program requirements and the appropriate contacts at NIH to resolve specific issues.
- Consider providing funding and advisory support for specific logistical issues common to multiple projects such as clinical trial requirements, IRB issues, database management and sharing, institutional coordination, sample repositories, etc.
- Offer more frequent and more predictably-timed FOAs.
- Reviewers should be experts in the subject matter of the application, have a better understanding of the challenges associated with conducting research in LMIC settings, and be more consistent in considering both research and capacity-building goals of the Brain Program.

Other suggestions can be found in Appendix G including some suggestions regarding grant mechanism changes, funding assistance and networking support systems.

4.1.2 "Spin-off" Projects and leveraged funding

Having demonstrated how grantees successfully extended the reach of their Brain Program awards, this section describes spin-off projects. For the purpose of the evaluation, "spin-offs" were defined as new research projects that are not direct continuations of the project(s) initiated with a Brain Program award but were catalyzed or otherwise enabled by the Brain Program project. Of the 101 projects for which there was at least one survey response regarding a proposal or application for a spin-off project, 65 (64%) reported that there had been at least one spin-off project to date, and 43 (43%) reported that at least one spin-off project had been funded.

Of the large variety of spin-off projects described by respondents, 12 have so far been funded by NIH (Table 7). Among those funded by FIC are a GRIP award, 2 FIRCA collaborations, an NCoD D43 training program, and several projects involving Fogarty Fellows. Projects funded by other NIH Institutes include two large-scale clinical trials (focused on Alzheimer's prevention and childhood nutrition) and a $2.5 million NIMH cooperative agreement that aims to develop mental health research capacity in Sub-Saharan Africa.

Table 7: Reported Spin-Off Projects Funded by NIH

Brain Program Project	Spin-Off Project Title	Funding NIH IC	Award Number	Approximate dollar value
R21ES018730; SATHIAKUMAR	Particulate Matter and Black Carbon:Respiratory Health in Sri Lankan Children	FIC (GRIP)	R01TW009401	800,000
R21TW006665/ R01AG029798; GOYA	Role of Calcium Channels in Aging Skeletal Muscle	FIC (FIRCA BB)	R03TW008091	150,000
R21TW007800; PRADO	Decreased Cholinergic Tone and Mitochondrial Dysfunction in Heart	FIC (FIRCA BB)	R03TW008425	150,000
R21TW007997/ R01MH093246 NIMGAONKAR	Tri National Training Program in Psychiatric Genetics	FIC (NCoD)	D43TW008302	500,000
R21MH093296; SUSSER	The Town Hill Assessment of Needs (TANK) Study	FIC (Fellows and Scholars program)	unknown	15,000 plus Fellow stipend

R21NS065713; BOULWARE	Transverse Myelitis project investigating pathogenesis and etiologies	FIC (Fellows and Scholars program)	unknown	40,000
R21TW006804; STILES	Fogarty Global Health Fellows Coordinating Center	FIC (Fellows and Scholars Coordinating Center)	R25TW009340	1,223,480
R21MH093304; COHEN	Partnerships for Mental Health Development in Sub-Saharan Africa	NIMH	U19MH098718	2,500,000
R21TW006703/ R01HD053055; CARLO	First BITES:Complementary Feeding, a Global Network Cluster Randomized Controlled Trial	NICHD (Global Network for Women's and Children's Health)	NCT01084109	2,000,000
R21TW006794/ R01NS055349/ R01HD064416; JOHN	Neurologic AIDS Research Consortium	NINDS (Neurologic AIDS Research Consortium)	U01NS032228	200,000
R21TW009151; MASELKO	Thinking Healthy Programme, THP	NIMH	U19MH095687	281,635
R21AG024063/ R01AG029802; KOSIK	Alzheimer's Prevention Initiative	NIA	RF1AG041705	15,252,950

One additional reported spin-off project had been funded by USAID:

- A project using the skeleton of our ZAT--Zambian Achievement Test [funded by the Brain Program] to develop the GAT--Gambian Achievement Test (Brain Program award: R21TW006764/R01TW008274; PI GRIGORENKO; dollar value: $300k)

Three reported spin-off projects have been funded by the Canadian Government through the Grand Challenges in Global Health initiative:

- A project to implement mental health services at the primary level at Zanmi Lasante in Haiti (Brain Program award: R21MH093298; BECKER; dollar value: $500k)
- A project to develop and evaluate a low cost community service for mental disorders in youth in Kashmir (Brain Program award: R21TW8049/R01MH093303; PI MALLA; dollar value: $270k)
- A project exploring the link between maternal depression and child development (Brain Program award: R21TW009151; PI MASELKO; dollar value: $1M)

Fifteen spin-off projects had been funded by LMIC governments, including the governments of Argentina, Brazil, China, Colombia, India, Russia, and Thailand (Table 8), and an additional four projects had been supported by universities in Bulgaria, Nepal, and Thailand (Table 8).

Finally, 19 spin-off projects had been funded by other organizations, including charitable foundations, professional organizations, advocacy groups, and US universities (Table 9). Notable among them are two projects funded by the Bill and Melinda Gates Foundation, one of which has reportedly received $2 million in support.

Table 8: LMIC-Funded Spin-Off Projects

Brain Program Project	Reported objectives of spin-off project	LMIC funder	Approximate dollar value
R21AG029799/ R01AG039330; VERGHESE	Neuroimaging study in frontal dementias, testing our cognitive screening instrument in new site.	Department of Science & Technology (India)	53,777
R21ES015464; MCILVANE	Development of a battery of nonverbal tests for behavioral development that could possibly assess cross cultural behavior development in children and specially those affected by the metal mercury present in their daily diet	Conselho Nacional de Desenvolvimento Cientifico e Tecnologico (Brazil)	25,000
R21ES015464; MCILVANE	Not specified	Consortium of Brazilian funding agencies (Brazil)	1,500,000
R21MH093294; LI	Develop new tools, socially and culturally sensitive, to measure social cognition in patients with psychotic symptoms.	Shanghai Mental Health Center (China)	3,500
R21MH093294; LI	Develop new tools, socially and culturally sensitive, to measure social cognition in patients with psychotic symptoms.	Shanghai Nature Science Foundation (China)	17,000
R21MH093294; LI	Develop new tools, socially and culturally sensitive, to measure social cognition in patients with psychotic symptoms.	Chinese Nature Science Foundation (China)	38,000
R21TW006665/ R01AG029798; GOYA	Collaboration on gene therapy for aging skeletal muscle	Argentine Agency for Scientific and Technological Development (Argentina)	4,000
R21TW006706/ R01NS076348; CONFORTO	To develop home-based protocols of neurostimulation and rehabilitation for low- and middle-income countries.	Foundation for Research Support of the State of São Paulo (Brazil)	50,000
R21TW006706/ R01NS076348; CONFORTO	To compare eligibility characteristics of patients with stroke for rehabilitation protocols in a middle-income country, and high-income countries	Conselho Nacional de Desenvolvimento Científico e Tecnológico (Brazil)	275,000
R21TW007882; DE ERAUSQUIN	Creation of an early detection and early intervention program for psychotic disorders in the Province of Jujuy, Argentina	Ministerio de Salud de la Nación (Argentina)	20,000
R21TW007997/ R01MH093246;	A collaboration in India with the same research goals as our R21 grant	Department of Biotechnology (India)	unknown

NIMGAONKAR			
R21TW009263; CHEN	Home care delivered by multi-disciplinary team to home-bound elders.	Ministry of Public Health (Thailand)	unknown
R21TW009263; CHEN	Developing a training curriculum on eldercare case management for elders with dementia.	National Community Health Fund (Thailand)	unknown
R21TW009332; PUYANA	Development of the National Guidelines for Severe TBI Adult Management in Colombia in order to minimize variability and heterogeneity of the medical practice in specialized hospitals.	Colombian National Institute of Science and Technology (Colombia)	150,000
R21TW006745/ R01AA016234; BALACHOVA	Preventing FAS/ARND in Russian Children/Expansion to Interdisciplinary HIV Prevention in Women	Russian Foundation for Basic Research (Russia)	unknown

Table 9: Other Funded Spin-Off Projects

Brain Program Project	Reported objectives of spin-off project	Funder	Approximate dollar value
R21NS073509; BIRBECK	Study of HIV stigma (as it intersects with epilepsy stigma)	American Medical Association	7,000
R21NS073509; BIRBECK	Vitamin intervention study for HIV neuropathy	American Academy of Neurology	100,000
R01NS061693; BIRBECK	Neurodevelopment and maternal nutrition	American Brain Foundation	Unknown
R21DA018093/ R01DA023697; DAVIDSON	Explore the assessment of autism in children in South Africa which included children in the Asenze cohort and others under treatment for HIV in KwaZulu-Natal	Autism Speaks	Unknown
R21TW006713/ R01HD053131; GUERRANT	Cognitive impact of early childhood enteric infections	Bill and Melinda Gates Foundation	Unknown
R21TW006703/ R01HD053055; CARLO	The preconception nutritional trial being developed by the Global Network	Bill and Melinda Gates Foundation	2,000,000

R01NS061693; BIRBECK	Brain MRIs in pediatric HIV and cerebral malaria	Dana Foundation	200,000
R21NS069228; BIRBECK	Neuroimaging Grant-using NeuroInterp	Dana Foundation	300,000
R21TW006794/ R01NS055349/ R01HD064416; JOHN/BOIVIN	Treatment of sickle cell anemia in a malaria endemic area	Doris Duke Charitable Foundation	450,000
R21NS069275; O'NEAL	Evaluating the screening strategy developed in the R21 as a completely community-based intervention	Foundation support (not able to disclose)	160,000
R21TW008049/ R01MH093303; MALLA	Developing and evaluating a low cost community service for mental disorders in youth in Kashmir.	Graham Boekch Foundation	40,000
R21MH096559/ R01HD071664; VAN DER KOUWE	Gaitanalysis and neuroimaging on children with Spastic dysplasia due to HIV encephalopathy Hearing and language assessment of children with HIV in South Africa	Harry Crossley Foundation	1,800
R21MH096559/ R01HD071664; VAN DER KOUWE	Gaitanalysis and neuroimaging on children with Spastic diplegia due to HIV encephalopathy Hearing and language assessment of children with HIV in South Africa	International AIDS Society CIPHER Grant	unknown
R21ES013108/ R01AG036469; MAESTRE	Prevent diabetes as way of preventing dementia	International Diabetes Federation	400,000
R21NS048839; JACOBY	Work has continued in China in the context of the International League Against Epilepsy Global Campaign programme	International League Against Epilepsy	unknown
R21ES018723; TRASANDE	Studies of prenatal phthalate exposures and childhood obesity in Mexico	NYU Global Public Health Research Fund	15,000
R21NS065713; BOULWARE	Transverse Myelitis project investigating pathogenesis and etiologies	University of Minnesota	20,000
R21TW007997/ R01MH093246; NIMGAONKAR	A collaboration in UK with the same research goals as our R21 grant	Unnamed UK charity	Unknown

R21TW006794/ R01NS055349/ R01HD064416; JOHN/BOIVIN	Examine whether exposure to cerebral malaria is associated with an increased risk of subsequent behaviour and psychiatric difficulties, and if so, whether any such difficulties also follow other complications of falciparum malaria.	Waterloo Foundation	90,000

4.2 Enhanced Empirical Evidence

Brain Program projects have contributed to progress in key scientific areas related to brain disorders by generating evidence related to neurodevelopmental disorders, nervous system disorders, mental health, infection, environmental exposures, and trauma, and other areas. The information in the section below is drawn from NIH databases, analysis of progress reports, award-linked publications, and from survey responses.

4.2.1 Publications

In this section, we will discuss the specific quantitative scientific contributions of Brain Program awards by examining numbers of publications and citations. The first 10 years of the program have produced many contributions to scientific knowledge by way of published literature. Using progress reports, survey responses, and the NIH SPIRES database, a total of 435 peer-reviewed publications and 14 books or book chapters were identified as outputs of Brain Program projects so far. A complete list is included as Appendix H.

At least one publication was identified for 80 of the 114 Brain Program projects (70%) and for 30 of the 32 projects that included an R01 award (94%). The average number of publications per project overall was 3.8; counting only projects for which at least one publication was identified, the average was 5.4 publications per project; and counting only projects that included at least one R01 award the average was 7.8 publications per project. Brain Program publications appeared in 249 unique journals. The top 10 cited of these articles can be found in Table 10. Seven articles were cited over 100 times according to Thomson Reuters counts and 21 articles were cited over 50 times. The average 2012 journal impact factor was 4.58. Both citation counts and impact factors were collected only if the information was available from the Thomson Reuters database. Journals with very high impact factors (over 10) in which Brain Program publications have appeared include:

- New England Journal of Medicine (51.658), 3 publications
- Nature Genetics (35.532), 4 publications
- Journal of the American Medical Association (23.332), 1 publication
- Molecular Psychiatry (14.897), 1 publication
- Neuron (14.027), 1 publication
- Trends in Neurosciences (13.494), 1 publication
- PLoS Medicine (13.05), 2 publications
- Lancet Neurology (12.167), 2 publications
- Journal of Allergy and Clinical Immunology (12.047), 1 publication
- American Journal of Human Genetics (11.68), 2 publications
- Brain Research Reviews (10.342), 1 publication

Table 10: Most Cited Publications

Publication	Brain Program Project(s)	Citation Count
Heaton RK, Clifford DB, Franklin DR Jr, Woods SP, Ake C, Vaida F, Ellis RJ, Letendre SL, Marcotte TD, Atkinson JH, Rivera-Mindt M, Vigil OR, Taylor MJ, Collier AC, Marra CM, Gelman BB, McArthur JC, Morgello S, Simpson DM, McCutchan JA, Abramson I, Gamst A, Fennema-	R21MH077487/ R01MH094159; ACHIM	268

Notestine C, Jernigan TL, Wong J, Grant I; CHARTER Group. *HIV-associated neurocognitive disorders persist in the era of potent antiretroviral therapy: CHARTER Study*. Neurology. 2010 Dec 7;75(23):2087-96. PMID: 21135382.		
Clifford DB, De Luca A, Simpson DM, Arendt G, Giovannoni G, Nath A. *Natalizumab-associated progressive multifocal leukoencephalopathy in patients with multiple sclerosis: lessons from 28 cases*. Lancet Neurol. 2010 Apr;9(4):438-46. Review. Erratum in: Lancet Neurol. 2010 May;9(5):463. PMID: 20298967.	R21MH071213/ R01NS055628; NATH	242
Izquierdo I, Bevilaqua LR, Rossato JI, Bonini JS, Medina JH, Cammarota M. *Different molecular cascades in different sites of the brain control memory consolidation.* Trends Neurosci. 2006 Sep;29(9):496-505. Epub 2006 Jul 26. Review. PMID: 16872686.	R21TW007800; PRADO	177
Limoli CL, Giedzinski E, Bonner WM, Cleaver JE. *UV-induced replication arrest in the xeroderma pigmentosum variant leads to DNA double-strand breaks, gamma -H2AX formation, and Mre11 relocalization.* Proc Natl Acad Sci U S A. 2002 Jan 8;99(1):233-8. Epub 2001 Dec 26. PMID: 11756691.	R21TW006805/ R01MH080601; HOLDING	134
Morris AP, Voight BF, Teslovich TM, Ferreira T, et al. *Large-scale association analysis provides insights into the genetic architecture and pathophysiology of type 2 diabetes.* Nat Genet. 2012 Sep;44(9):981-90. PMID: 22885922.	R21NS064908; DANESH	129
Jacoby A, Snape D, Baker GA. *Epilepsy and social identity: the stigma of a chronic neurological disorder.* Lancet Neurol. 2005 Mar;4(3):171-8. Review. PMID: 15721827.	R21NS048839; JACOBY	127
Karmiloff-Smith A, Thomas M, Annaz D, Humphreys K, Ewing S, Brace N, Duuren M,Pike G, Grice S, Campbell R. *Exploring the Williams syndrome face processing debate: the importance of building developmental trajectories*. J Child Psychol Psychiatry. 2004 Oct;45(7):1258-74. PMID: 15335346.	R21TW006761; KARMILOFF-SMITH	125
Langford TD, Letendre SL, Marcotte TD, Ellis RJ, McCutchan JA, Grant I, Mallory ME, Hansen LA, Archibald S, Jernigan T, Masliah E; HNRC Group. *Severe, demyelinating leukoencephalopathy in AIDS patients on antiretroviral therapy.* AIDS. 2002 May 3;16(7):1019-29. PMID: 11953468.	R21NS055639; LANGFORD	91
Guerrant RL, Oriá RB, Moore SR, Oriá MO, Lima AA. *Malnutrition as an enteric infectious disease with long-term effects on child development.* Nutr Rev. 2008 Sep;66(9):487-505. Review. PubMed PMID: 18752473.	R21TW006713/R01 HD053131; GUERRANT	82
Tobin JL, Di Franco M, Eichers E, May-Simera H, Garcia M, Yan J, Quinlan R, Justice MJ, Hennekam RC, Briscoe J, Tada M, Mayor R, Burns AJ, Lupski JR, Hammond P, Beales PL. *Inhibition of neural crest migration underlies craniofacial dysmorphology and Hirschsprung's disease in Bardet-Biedl syndrome*. Proc Natl Acad Sci U S A. 2008 May 6;105(18):6714-9. Epub 2008 Apr 28. PMID: 18443298.	R21TW006761; KARMILOFF-SMITH	76

Although this was not a separate survey question, it should also be noted that a number of PIs

reported in other sections that publications are in progress or that they expect to publish in the future, so numbers in this report are likely an underestimate.

4.2.2 Other Research Outputs

This section describes additional research outputs other than publications. Survey respondents were presented with a list of possible research outputs other than publications that was generated from review of progress reports and asked to indicate whether their Brain Program award(s) contributed to their development. Results are summarized in Table V-A-2-1.

Tools, instruments, or protocols for clinical assessment in LMIC settings. Seventy-seven projects (75%) reported developing a new tool for clinical assessment in the LMIC context, and progress reports confirm that adaptation and validation of such tools was a major focus of many R21 projects. Specific examples include:

- Developed norms for the Bayley Scale of Infant Development for use in Sub-Saharan Africa
- Developed the Kilifi Development Inventory which is being used in projects in Uganda and Tanzania
- Conducted the first nationally representative child mental health epidemiological survey
- Developed new culture fair cognitive screening tool for use in low education population
- Provided two validated brief screening tools for clinical practice to improve screening accuracy among Arabic speaking older people with low education. Award also provided an excellent one-phase diagnostic assessment for dementia in epidemiological research.
- Enhanced clinical assessment by an objective non-invasive recording device applicable for field work
- Accepted the IsiZulu translation of the Strengths and Difficulties Questionnaire as official and placed on the SDQ website for use by clinicians and researchers working with IsiZulu population
- Developed methods to track and correct motion during imaging so that high quality images and MR spectra of children can be acquired without sedation
- Developed a community based screening tool for neurodevelopmental disorders (NDST) and consensus criteria for Autism Spectrum Disorders, Attention Deficit Hyperactive Disorder and Neuromotor Impairments in 2-9 year old children that is being used by the Rashtriya Bal Swasthya Karyakram, the Indian national program for disabilities. Grantees received requests from public health researchers in India and Africa for using the NDST in their respective scientific studies.

New intervention for prevention, screening, diagnosis, or therapy. Forty two projects (41%) reported development and/or evaluation of a new intervention. In several cases, the intervention was developed based on R21 findings and then implemented and evaluated as the focus of the R01 project. Specific examples include:

- A motion picture comedy on cysticercosis, sanitation and pig management shown to villagers in Burkina Faso, followed by facilitated community planning
- A number of interventions targeting key actors

Burkina Faso village

intended to reduce epilepsy-associated stigma in Zambia
- A physician-delivered brief intervention to reduce risky drinking in women who could become pregnant in Russia
- An early intervention for infants at risk for developmental delays who show signs of aggression, self-injury, and stereotyped behavior

Laboratory tool, instrument, protocol, model, or method. New lab tools or methods were reported by 41 projects (40%). For example, several projects focused specifically on developing animal models of disease.

Patient registry or cohort. Patient registries or cohorts were reported by 39 projects (38%). For example, one survey respondent wrote: "Our ongoing Project already has developed a collection data tool that seems to be the first neurotrauma registry in the country. The tool is going to have an important impact into the capacity building process of the trauma care improvement in Colombia. We are including government hospitals and the ministry of health is really motivated and has several expectations regarding this research process. Also the information will be vital in order to understand neurotrauma care quality improvement and this information will be really important in the construction of public policies in a near future in the country."

Database, information system, or software tool. Information-related outputs were reported by 37 projects (36%). For example, creating a central repository for data was an important component of many projects. The Brain projects also helped to introduce the NeuroInterp radiologic data management system to several countries in Sub-Saharan Africa.

Biospecimen repositories. Biospecimen repositories were reported by 30 projects (29%). Repositories generally included blood, urine, or tissue samples from humans, and, in at least one case, animals.

Table 11: Survey Responses Regarding Research Outputs Other Than Publications

	Number of projects	Percent of projects with a survey response (N=103)
Tool, instrument, or protocol for clinical assessment in low and middle income country settings	77	75%
New intervention for prevention, screening, diagnosis, or therapy	42	41%
Laboratory tool, instrument, protocol, model, or method	41	40%
Patient registry or cohort	39	38%
Database, information system, or software tool	37	36%
Biospecimen repository	30	29%
None of the above	6	6%
Other*	4	4%

*Note: a few respondents checked "other" in order to provide additional information about a previous response; these responses were excluded from the count.

4.3 Research Evidence and Capacity Informing Policy or Practice

Although there is an ever-growing body of evidence on brain disorders, much has been written about how advances in research do not always lead to adaptation of evidence-based practices in real-world settings. Implementation science seeks to examine research translation to optimize adoption of scientific advances in the real world and at scale and ensures that the evidence generated has the greatest population impact in a relatively small amount of time.[7]

In addition to contributing research to a growing scientific field and overall capacity in LMICs, there are several examples of where data generated by Brain-funded researchers has provided critical evidence used to inform international and national practice and policy. As the program continues to mature and research capacity grows in countries where grants are awarded, more examples of evidence-based policy outcomes should follow.

Before describing what is known about policy and practice outcomes, it must be acknowledged that available evidence regarding impacts was limited. In some cases, the available evidence was not sufficient to establish the degree to which the research and capacity resulting from Brain Program awards contributed to policy or programmatic outcomes. For all outcomes described, Brain-related research and data are reported by PIs to have contributed to the passage or implementation of a policy or program.

Survey respondents and interviewees were asked to identify concrete impacts that their Brain Program projects may have had in informing healthcare practice, or health policy. Examples of Brain Program activities informing policies and programs at a national or international level are described below (additional information is available in the case studies, Appendix D).

Identification of a key barrier to anti-epileptic drug access worldwide. A wholly unexpected but significant finding of Dr. Gretchen Birbeck and Prof. Elwyn Chomba's project in Zambia was that access to anti-epileptic drugs in Zambia was being negatively impacted by actions of the WHO Pharmaceutical Regulatory Authority. Specifically, phenobarbitone, the cheapest and first line anti-epileptic drug, had long been listed as a scheduled agent because it has a chemical structure similar to abused drugs, but these regulations were rarely enforced before the WHO Pharmaceutical Regulatory Authority began urging these

Sign outside of the Chikankata Epilepsy Clinic

[7] Glasgow and Chambers. Developing Robust, Sustainable, Implementation Systems Using Rigorous, Rapid and Relevant Science. Clinical and Translational Science. Volume 5, Issue 1, pages 48–55, February 2012.

governments to make enforcement a priority. Using a combination of quantitative and qualitative methods, this project established that phenobarbitone was becoming less available in Zambia as a direct result. After announcing the finding at an international epilepsy congress, it became apparent that similar things were happening in many other LMIC regions, but the international community had not yet realized it. The International League Against Epilepsy has now developed a task force on access to anti-epileptic drugs to engage WHO in finding solutions and to support LMIC governments in changing the blanket regulations or developing mechanisms for legal distribution.

Increased awareness of Fetal Alcohol Spectrum disorder at a national level in Russia. Drs. Barbara Bonner and Tatiana Balachova and their collaborators in Russia used their R21 findings and supplemental funding from CDC to develop extensive Russian-language education materials about Fetal Alcohol Syndrome, including websites for the public and for providers that were the first of their kind. They also collaborated with the Moscow Central Public Health Research Institute (the main public health organization in Russia with strong ties to the Ministry of Health) to disseminate information and bring FASD to the attention of the Institute leaders, key health professionals, and offices from the Russian Ministry of Health. The Institute recently collaborated with NIAAA to conduct two US-Russia meetings focused on alcohol consumption and FASD at which Dr. Balachova was invited to present findings. The Institute has recently established a Coordinating Council for Prevention of Harm from Alcohol and FAS that aims to promote research and develop services in Russia; the Council is chaired by the Director of the Institute (who is also a former Minister of Health).

Surveillance for retroviral and viral meningoencephalitis in Peru. Drs. Joseph Zunt and Silvia Montano established the first surveillance system for retroviral and viral meningoencephalitis in Peru. Among the many interesting findings was Herpes Simplex Virus (HSV) was the most common detectable cause of encephalitis, with 22.4% prevalence in the cohort of patients examined. Consistent with study protocols, each patient presenting with HSV encephalitis received intravenous (IV) Acyclovir as a benefit of this study. With the proven benefit of acyclovir treatment for reducing morbidity and mortality of HSV infections, this finding represents a significant public health development for at least one-fifth of encephalitis patients in Peru. As a result of their studies, the Ministry of Health is making IV Acyclovir more readily available in Emergency Rooms of the major hospitals within Lima and other major cities.

Further examples include:

- A project spanning multiple countries in Latin America established the first prospectively validated management protocol for traumatic brain injury patients treated without intracranial pressure monitoring. Guideline efforts based on this work have been initiated in Europe and the US and will result in formal revision of current guidelines within the next 12 months. (Chesnut)
- Adenoviral vectors developed by a project in Argentina are being used to treat myocardial infarct and lung inflammatory diseases in preclinical models. (Goya)
- A collaborating institution in Argentina has become a national reference center for Neuronal Ceroid Lipofuscinoses, and rare diseases have been the focus of recent national legislation. (Noher de Halac)
- A Portuguese language monograph for new mothers and pregnant women who are HIV-infected and their healthcare providers developed by a Brain Program project has been published on a state-level public health authority website in Brazil. (Bass)

- New diagnostic tools for early-stage psychosis developed by a Brain project are being used by healthcare workers in China. (Li)
- A study in multiple countries demonstrated that survivors of birth asphyxia following resuscitation with bag and mask had positive neurological outcomes, leading WHO and other agencies to strongly recommend resuscitation of these infants with their new program Essential Newborn Care. The American Academy of Pediatrics has also developed and introduced a program for resuscitation at birth for developing countries. (Carlo)
- In Lebanon, a project attracted the attention of the Ministry of Labor that ultimately resulted in a ministerial decree which controls work of children under age 18. (Nuwayhid)
- In Pakistan, a project brought the issue of lead exposures for pregnant women and children to the attention of the Ministry of Environment, contributing to new initiatives to control and reduce lead exposure in vulnerable populations. (Sathiakumar)
- In South Africa, a project contributed to a 2012 initiative for school-based screening for developmental disabilities. (Davidson)
- In Tunisia, a Brain project led to recognition of the leucine-rich repeat kinase 2 (LRRK2) gene mutation (p.G2019S) as a leading risk factor for Parkinson's disease in Arab-Berber communities of North Africa. (Farrer)
- In Turkey, focused training efforts led to government recognition of Developmental-Behavioral Pediatrics as a sub-specialty. With this recognition, additional federal funds will be available to support the training of pediatricians in this field. (Leventhal)
- In Uganda, a project resulted in recommendations to the Ministry of Health on how governmental and non-governmental agencies can better address the needs of children with neurodevelopmental disorders and their families and communities. (Kakooza)

More quotations from survey respondents that describe additional national or international impacts by country can be found in Appendix I.

4.4 Enhanced Research Capacity

Given the challenge brain disorders in LMICs presents, building local and national capacity to address research and evidence needs is an essential step in combating the epidemic. Training the next generation of researchers on the science of brain disorders is an integral part of the Brain Program. In fact, the FOA[8] asserts that "In addition to pilot research studies the proposed program should contain explicit strategies or plans to assess the research and research capacity needs and to strengthen this capacity through research training, career development, mentoring and/or other models. The assessment may include, but is not limited to, needed skills and expertise in laboratory, clinical, epidemiological and social science research. Research training for the LMIC collaborators and their staff, in the context of the proposed R21 and subsequent R01 research, may take place at any of the collaborating sites and may vary, depending on the strengths of the particular investigators and institutions that apply and specific training and other capacity building needs to support research and future interventions in the LMIC. The major portion of the proposed research must be conducted at the LMIC site(s) and the majority of the funds must be used for research and research-related costs at the LMIC site (including collaborator training). Any research at the HIC site must also involve training for participating

[8] http://grants.nih.gov/grants/guide/pa-files/PAR-11-031.html

LMIC country collaborators."

To determine the capacity building outcomes for Brain Program grantees, we examined the number and nature of trainees reported from 2002-2011 awards. We also examined annual progress reports and conducted qualitative interviews with select grantees to learn more about institutional capacity and partnership and collaboration efforts that resulted from the program. Specific training and capacity-building activities supported by individual projects are described in more detail in the sections that follow, along with related outputs, outcomes, and impacts.

4.4.1 Capacity-Building Strategies

The models that Brain Program projects use to build capacity are as unique as the data they generate from their projects. As this R21-R01 structure allows for a high amount of interpretation of the capacity building requirements, different projects approach the goal in many different ways. The section below highlights some models of capacity building that have proved particularly effective in creating research capacity. Of the ten case study projects, a different capacity-building "strategy" was apparent for each; these are summarized briefly in Table 12 and in more detail in Appendix D.

Table 12: Brief Summary of Capacity-Building Strategies for Case Study Projects

Primary Collaborators: Institution	Disease Focus	Brief Summary of Capacity-Building Strategies
Balachova: University of Oklahoma Health Sciences Center, US **Tsvetkova and Volkova:** St. Petersburg State University and Nizhny Novgorod State Pedagogical University, Russia	Fetal Alcohol Syndrome	• Build core of Russian researchers via training for graduate students and involving senior researchers in FASD research for the first time • Establish the first and only Russian IRB for behavioral research at St. Petersburg State University • Build key collaborations with government and NGOs for dissemination and scale-up of interventions • Demonstrate feasibility of US-Russian collaboration on behavioral research
Birbeck: Michigan State University, US **Chomba:** University Teaching Hospital, Zambia	Epilepsy-associated stigma	• Establish a network of four field sites in Zambia plus a coordinating center, each staffed with trained data collectors • Provide tuition, stipend, and mentoring support for one student to complete a PhD in Community Health at the University of KwaZulu-Natal and another to complete a Master's degree in Sociology at the University of Zambia • Provide training opportunities for Zambian grant managers, including a visit from their US counterparts • Provide training to Zambian EEG/MRI technicians, including travel to Malawi to be trained by colleagues trained on another NIH award
Carabin: University of Oklahoma Health Sciences Center, US **Millogo:** University de Ouagadougou, Burkina Faso	Cystecercosis and epilepsy	• Develop methods for data and sample collection suitable for field use in Burkina and train a field team to apply those methods • Collaborate with the University of Antwerp to equip and train a lab in Burkina Faso to perform ELISA tests in-country • Provide formal academic training in public health and immunology to young researchers from Burkina Faso at US and European universities (note: this was largely unsuccessful) • Involve a PhD student from Mali in the research and encourage her to use the data for her dissertation
Guerrant: University of	Cognitive impairment	• Provide extensive project-specific training opportunities and mentoring (primarily

Virginia, US **Lima and Oriá:** Federal University of Ceará, Brazil	due to malnutrition and diarrheal burden in children	in the US) for junior investigators from an already well-established group at the Federal University of Ceara
John and Boivin: University of Minnesota and Michigan State University, US **Idro, Opoka, Bangirana and Nakasujja:** Mulago Hospital at Makerere University, Uganda	Cognitive impairment due to severe malaria	• Development of a Severe Malaria Research Center, including space, computing facilities, and clinical and laboratory equipment • Training workshops for project staff members on infectious diseases, malaria, neuropsychology testing and other aspects of the project. Additional workshops have focused on topics such as clinical study design and scientific writing. • Individual mentored training for selected project staff members in emergency triage, identification of severe malaria, seizure management, and other clinical and technical skills. • Contribution to research training for 2 diploma level students, 5 Masters students, 5 PhD students, and 1 post-doctoral fellow. • Contribution to development of a Pediatric ICU at Mulago Hospital via training and equipment upgrades.
Kosik: University of California Santa Barbara, US **Cardona-Gomez:** Universidad de Antioquia, Colombia	Alzheimer's disease	• Provide extensive training and mentoring (in the US and Colombia) for Colombian investigators in order to help establish a research program in basic neuroscience to complement and support the existing clinical research program and to meet the unique needs of a region plagued by neurogenetic problems • Establish a transgenic mouse colony, viral vector core, and related laboratory facilities at the University of Antioquia
Nimgaonkar: University of Pittsburgh **Mansour:** Mansoura University Hospital, Egypt	Schizophrenia	• Use the research project to facilitate mentored training for Egyptian psychiatrists in clinical evaluation, molecular genetic techniques, statistical analysis, and ethical conduct in research • Purchase equipment for molecular genetic research, bioinformatics, computation, and genome sequencing to equip the laboratory facilities for psychiatric genetics that the project helped to leverage from Mansoura University
Tshala-Katumbay: Oregon Health Sciences University, US	Cassava cyanogen exposure and motor neuron degeneration	• Demonstrate the feasibility of careers in biomedical research to young people, academics and clinicians after decades of conflict • Involve PhD candidates in the project

Muyembe: Kinshasa University and National Institute of Biomedical Research, DRC		• With support from the International Brain Research Organization (IBRO), develop training workshops and symposia with an emphasis on ethics, research design and methodology, and neurotoxicity • Establish collaborative ties between the University of Kinshasa and the national institute for biomedical research (INRB) • Establish an IRB National Institute for Biomedical Research (INRB)
Vassileva: University of Illinois at Chicago, US **Georgiev and Vasilev:** St. Naum University Hospital, Sofia and Bulgarian Addictions Institute, Bulgaria	Opiate and stimulant abuse	• Demonstrate feasibility of sustainable research in Bulgaria • Establish IRBs at two Bulgarian institutions • Conduct training seminars and annual workshops in basic neuropsychological theory and practice open to all Bulgarian psychiatrists, psychologists, and neurologists • Adapt and validate commonly-used clinical assessment instruments for Bulgaria and make them freely available to interested researchers • Establish communication between government agencies and various substance abuse specialists and clinics in Bulgaria, specifically with the goal of creating treatment options for heroin users with criminal histories and advocating for additional research
Zunt: University of Washington, US **Montano:** U.S. Naval Medical Research Center Detachment-Lima, Peru	Retroviral infection of the central nervous system	• Conduct training workshops (open to project personnel and other Latin American researchers and technicians) focused on responsible conduct of research and other topics identified as priorities in a formal survey of Peruvian neuroscientists. • Provide other short, medium and long-term training opportunities for junior researchers, often in collaboration with other FIC awards supporting collaboration between the University of Washington and Peru (e.g. Fellows and Scholars, AITRP, etc.)

4.4.2 Training Activities

The evaluation also sought to look systematically at what types of specific training activities grantees engaged in. Applications and progress reports were used to generate a list of specific types of training, and survey respondents were then asked to select which types of training had been supported with their awards. Table 13 summarizes survey results by project, and the training types are described in more detail below.

Project-related training at the LMIC site(s). Survey results suggest that almost all (96%) of projects included training or mentoring at the LMIC site in skills, methods, or procedures essential to the research project. An analysis of proposals suggests that this was usually accomplished through either intensive group training sessions and individual teaching or mentoring or a combination of the two. Group training sessions were often convened at the start of the project or data collection phase, and they usually involved senior collaborators from both partner countries. Projects that included data collection at multiple sites sometimes developed more sophisticated training programs for data collectors, with LMIC-based coordinators first receiving training themselves and then traveling to other sites to train others. Training of this type typically focused on clinical or field data collection protocols and/or lab techniques and protocols.

Broader-scope training at the LMIC site(s). Survey results suggest that this type of training was also very common, with 84% of projects reporting that it was a component. Like project-specific training, it was typically delivered using intensive group training sessions or individual mentoring or both. Examples of this type of training include providing deeper knowledge of the scientific or clinical context for the Brain Program project, training in general research skills, or training in scientific writing and/or grant-writing.

Non-degree training for LMIC personnel at a high-income country site. 70% of projects reported training at a HIC site. Progress reports suggest that this type of training was usually relatively brief (a few weeks to a few months) and was sometimes combined with a trip to the US for another purpose, such as to attend a Networking Meeting. There were examples of longer-term non-degree training, such as support for an LMIC postdoctoral fellow to spend several years at the high-income partner site in one of the case studies, but this seems to have been relatively rare.

Workshops, seminars, or symposia. Around 70% of projects also reported holding workshops, seminars, or symposia that were open to LMIC personnel not directly involved in the Brain project. These focused on a wide variety of topics, including dissemination of information about the project itself, topics in brain disorders research, and specific clinical or research skills. Anecdotally, this is one of the components that PIs reported was frequently cut from proposals to accommodate budget cuts.

Training in research ethics. Around 69% reported training in research ethics as a component, but progress reports suggest that this was often a relatively minor component in terms of resource use, with many projects encouraging personnel to participate in online training courses. More extensive training sometimes took place in connection with the development of a new Institutional Review Board. For example, in one of the case study projects, the head of the IRB at the US partner institution made several trips to Russia to train and advise her

counterparts as they established the first Russian IRB for behavioral research. One of the case study projects also organized a regional conference on responsible conduct of research for Latin America that was attended by 670 investigators and healthcare workers.

Training at a third-party LMIC site. A somewhat surprising result of the survey was that almost half of projects (48%) reported training for LMIC personnel at an LMIC site that was not one of the primary collaborators on the Brain project. We know of at least two examples of this type of training from the case studies. In one case, MRI technicians from Zambia were sent to Malawi to be trained by a group of technicians who had already received training through the PI's other projects. In another case, a Zambian staff member was supported to complete a PhD at a South African institution. The PI reported that this decision was beneficial to both the project and the trainee because it allowed him to remain in Zambia for the majority of his training.

Use of project data in a Masters or Doctoral thesis. Around half (48%) of projects reported that project data had been used as part of a Masters or PhD thesis by students at an LMIC institution, and 26% reported that project data had been used by Masters or PhD students at a HIC institution.

Tuition support. A much smaller percentage of projects reported providing direct support to students for tuition, fees, and stipend; 17% of projects supported at least one student at an LMIC institution, and 10% supported at least one student to be trained at a HIC institution. Examples from the case studies suggest that the goal of degree-based training was to help build a core of brain researchers at the LMIC site. In at least one instance, training at HIC institutions was the preferred strategy because there were no opportunities whatsoever for relevant training in the partner country (Burkina Faso). Unfortunately, the strategy was not successful in that case, as the students from Burkina Faso failed to thrive in PhD programs.

Training for LMIC research administrators. 37% of projects reported a component of training for LMIC grant administrators. This was reported as a priority for the case study project in Zambia, where administrators from the US institution traveled to spend time with their counterparts. Benefits of this mutual exchange described by the PI included building personal relationships to facilitate cooperation, giving the US administrators a greater appreciation for the challenges their African counterparts face, and encouraging cooperative problem-solving on issues such as finding more effective software solutions. Zambian grant administrators who could obtain the appropriate visas were also supported to attend an annual conference of the US-based National Council of University Research Administrators; others attended a grants administration course offered by a South African NGO.

Curriculum development. Development of academic courses or course modules for LMIC institutions was reported as a component of 26% of projects. Progress reports suggest that one common mechanism has been for faculty from HIC institutions to share or adapt existing courses and modules with LMIC institutions, sometimes online or with the HIC partners doing some or all of the teaching. In addition, progress reports describe at least one example of a new bilateral training program (between Columbia University and the University of KwaZulu-Natal) focused on epidemiology and public health aspects of child disability in developing countries. In addition, one of the case study projects developed a wholly new training program focused on "Toxins, diet, and neurodegeneration" in the Democratic Republic of Congo using supplemental funds provided by the International Brain Research Organization.

Table 13: Survey Responses Regarding Training Activities Supported by Brain Program Awards

	Number of projects	Percent of projects for which we have a response (N=103)
Training or mentoring at the low or middle income country site(s) in skills, methods, or procedures essential to the research project(s)	99	96%
Training or mentoring at the low or middle income country site(s) that was broader in scope, including deeper knowledge of scientific or clinical context, general research skills, grant-writing, publications, etc.	87	84%
Formal or informal training for personnel from the low or middle income country site(s) at a high income country institution that did not result in a degree	72	70%
Workshops, seminars, or symposia held at low or middle income country site(s) that were open to individuals not directly involved in the funded research project(s)	72	70%
Training in research ethics	71	69%
Formal or informal training for personnel from the low or middle income country site(s) at an institution in a low or middle income country that was not one of the primary collaborators on the Brain project	49	48%
Use of project data as part of a Doctoral or Master's thesis at a low or middle income country institution	48	47%
Training for administrators or other non-research staff at a low or middle income country institution	38	37%
Use of project data as part of a Doctoral or Master's thesis at a high income country institution	27	26%
Development of curriculum for academic courses or course modules to be offered at a low or middle income country institution	27	26%
Use of award funds to pay tuition or fees for one or more trainee(s) enrolled in a degree program at a low or middle income country institution	18	17%
Use of award funds to pay tuition or fees for one or more trainee(s) enrolled in a degree program at a high income country institution	10	10%
None of the above	2	2%
Other	6	6%

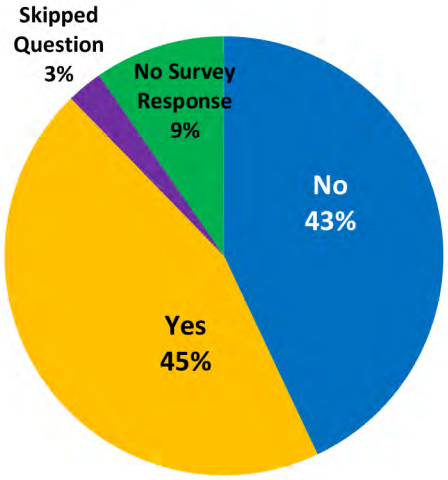
4.4.3 Trainees

Since the Brain Program is a research program, FIC does not currently require awardees to report systematically on trainees, and trainees from this program are not included in FIC's trainee

tracking system. An attempt was made to extract quantitative information about trainees from annual and final progress reports, but results were inconclusive. Documents from only 38 projects named any trainees at all. 108 individuals were named in connection with at least one training activity from those projects, but the information provided about the nature of their training experiences (in terms of duration, objectives, methods, etc.) was so inconsistent that further analysis was not feasible.

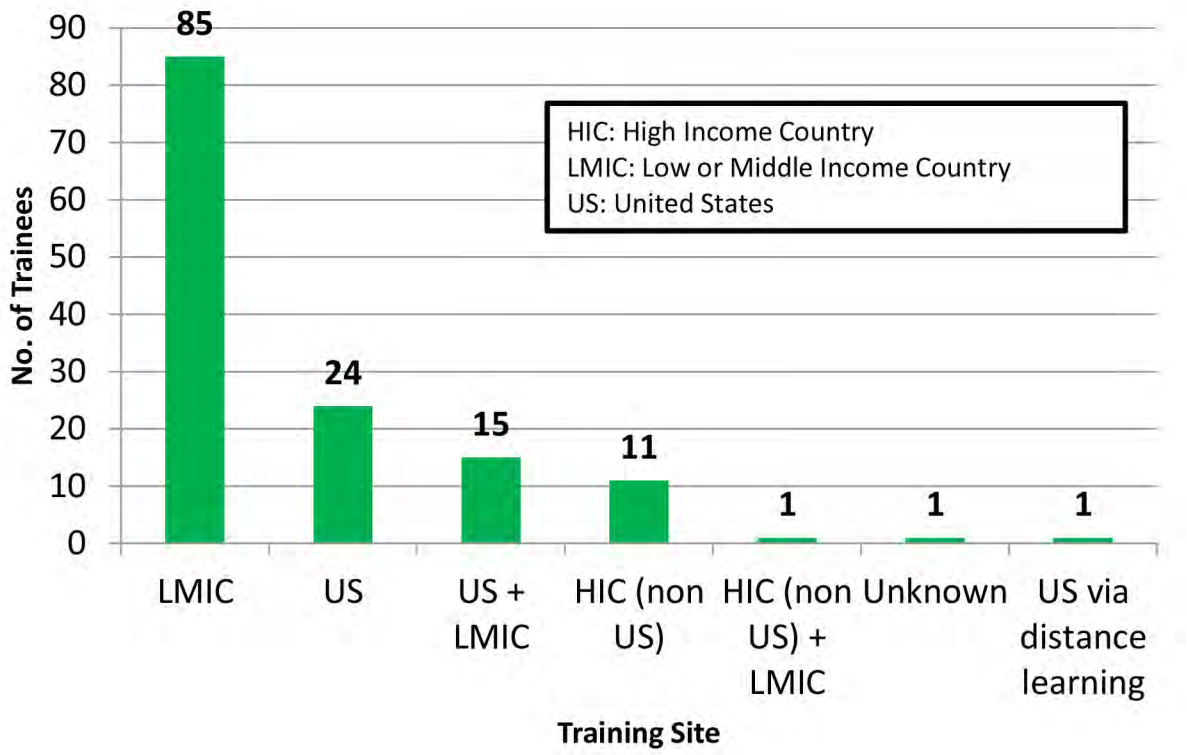
Survey respondents were asked “Have any individuals from low or middle income countries received long-term training (6 months or more) as part of your Brain Program R21 or R01 award?” When responses were combined by project with any “yes” response taking precedence over any “no” response, 51 (50%) of projects said that there had been long-term trainees (Figure 8).

Figure 8: Projects Reporting at Least One Long-Term Trainee



Respondents from 42 projects (37%) listed 138 long-term trainees. Of these, the majority (62%) received their training at an LMIC site only and another 11% were trained at a combination of US and LMIC sites (Figure 9). Duration of training ranged from 6 months (the minimum reporting threshold) to a maximum of seven years, with an average of 23 months.

Figure 9: Reported Long-Term Trainees by Site of Training



Survey respondents were also asked to report title and affiliation of trainees before and after training. The information provided suggests that trainees ranged from undergraduate students to senior researchers, but the quality and consistency of the information provided was not sufficient to determine what percentage showed a clear progression in terms of career advancement.

4.4.4 Impacts on Careers of Collaborators

Cultivating a robust pipeline for research in brain disorders is an integral objective of the Brain Program and understanding how this has impacted researchers who have engaged in Brain-funded activities is critical to documenting the program's impact. This section describes several examples of how the Brain Program impacted LMIC collaborators' careers. Respondents were asked to briefly describe any significant impacts the Brain Program award had on their own careers (Note: Since trainees and collaborators are not formally tracked, it was not possible to systematically assess the impact of the program on their careers). Themes in responses from LMIC collaborators included the following:

- The project helped to build strong collaborative ties between institutions and to build regional and international networks of contacts (16 responses). For example:
    - "Receiving an NIH-funded Brain Disorders Award has facilitated networking between different researchers in Lebanon and opened opportunities for potential collaborations between departments."
    - "It has given me the opportunity to help build a professional research network to address issues on brain disorders. The network functions at both a national and international level through the involvement of collaborative research institutions."
- Collaborators gained new skills and/or knowledge (14 responses). Examples include:

    - "I have had opportunity to learn about the tools used in neurocognitive assessment especially in HIV-infected individuals."
    - "This grant had a very clear impact in my career. Not only due because it opened a collaboration with a well-established lab in the US who enabled a postdoctoral fellow in my lab to get training in the generation of genetically modified mice (then transferred to my home institution) but also because through this collaboration I learned other skills (i.e. grant writing, etc.)"
    - "This award has given me the opportunity to work with a variety of neurological illnesses and/or systemic illnesses with related neurological conditions and thus increasing my clinical and epidemiological knowledge on this area."
    - "Extend my research network to the Middle East and my field of research to cross-cultural studies about dementia/"
- The NIH award increased the visibility and prestige of individuals and their research groups (6 responses). Examples include:
    - "The impact of the program for my research group and Institution was enormous (a watershed). Being awarded these highly competitive funds widened my scientific visibility in my country. We became a prestigious research group in the field of gene therapy for the aging brain. The scope of our collaboration also increased after receiving the Brain Disorders awards."
    - "Obtaining an R21 has also raised my personal standing in my institution and placed me in a position to hopefully get an R01, which would enhance my personal standing, not just locally but also in international terms."
- The project (especially resulting publications) contributed to specific promotions (7 responses). Examples include:
    - "I was contracted renewing my position as researcher of the Consejo Nacional de Investigaciones Científicas y Técnicas. I was nominated as Professor Consult of the Universidad Nacional de Cordoba."
    - "The success of my research contributed towards my promotion to full professor."
    - "It was key to get my faculty position as associate professor at my home University and to set my own laboratory devoted to research lines complementary to the Brain disorders grants."
    - "Allowed me to develop a very strong research program with high impact publications that led to my recruitment to Canada."

Other noteworthy responses from LMIC collaborators can be found in Appendix J:

4.4.5 Enhanced Institutional Research Capacity

FIC promotes strong institutional research capacity through investments in research support infrastructure and training in areas such as research ethics and management. A strong research environment helps to ensure that scientists can stay and conduct research in their home institutions, and enables institutions to serve as centers of excellence that can attract international scientific collaboration. As described above for training activities, applications and progress reports were used to generate a preliminary list of institutional research capacity-building activities and outcomes for survey respondents to review and select those that were supported by their award(s). Results are summarized in Table 14.

Increasing visibility or prestige of brain-related research. At least 85 projects (83%) reported that one impact of the Brain award was to increase the visibility or prestige of brain-related

research at the LMIC site.

Supporting conference participation by LMIC personnel. A large majority of projects reported supporting participation by LMIC personnel in both international (80%) and national/regional (77%) conferences. Several interviewees commented on the importance of conference participation as a capacity-building strategy, with one commenting that trainees of the Brain Program had more opportunities in this respect than many students at HIC institutions.

New working groups or networking opportunities. Sixty-four projects (63%) reported that the award contributed to establishing a new working group or other networking opportunities at the LMIC site. This finding was somewhat surprising given that relatively few applications and progress reports mention specific activities in this area. Those that did discussed developing working groups, deliberately forming relationships with government officials and NGOs, and linking LMIC research labs to clinics. In one case, survey respondents mentioned working with an international consulting firm to establish a multi-site Latin American Brain Injury Consortium. Another project reported establishing "a collaborative network for mental health work in the native communities in the three countries [Argentina, Bolivia, Peru]."

Obtaining durable equipment. Fifty-six projects (55%) reported that the LMIC site obtained durable equipment valued at $1000 or more. Types of equipment mentioned frequently in applications included lab equipment (with more expensive items often being used or donated), specialized clinical equipment, computers, and vehicles (for field studies involving extensive travel). In addition, at least two of the case study projects included establishing and equipping a new laboratory or facility (a psychiatric genetics lab in Egypt and a transgenic mouse facility and gene therapy lab in Colombia).

Establishing LMIC IRBs. At least 30 projects (29%) reported establishing and registering an Institutional Review Board at the LMIC site, including three of the case study projects (in Bulgaria, Democratic Republic of Congo, and Russia).

Establishing research centers, clinical units, academic programs, and faculty positions. Between 14% and 29% of projects reported that the award contributed to establishing a new research center, clinical unit, academic program, or faculty position; a total of 50 projects (49%) reported a contribution to at least one of these. The survey didn't ask for details regarding the specific nature of the contribution, but evidence from applications and progress reports suggest that the following mechanisms are possible:

- Leveraging resources and cooperation from host institutions and governments by increasing the prestige of brain research and/or demonstrating success
- Direct support for coordinators and/or administrative support at the LMIC site
- Direct support for critical equipment, computers, furniture, and renovations at the LMIC site
- Assistance provided by collaborating experts from HIC institutions
- Enhanced networking and collaboration within the existing community of brain researchers and/or training to add new members
- Development of shared resources (e.g. databases, equipment, assessment tools)

Table 14: Survey Responses Regarding Institutional Research Capacity Building Activities Supported by Brain Program Awards

	Number of projects	Percent of projects for which there was a response (N=102)
Increasing the visibility or prestige of brain-related research	85	83%
Participation in international conferences by low or middle income country personnel	82	80%
Participation in national/regional conferences by low or middle income country personnel	79	77%
Establishing a new working group or other mechanism to encourage networking and collaboration among researchers	64	63%
Purchasing or obtaining durable equipment (clinical, laboratory, or other) worth more than $1000	56	55%
Establishing and registering an Institutional Review Board (IRB)	30	29%
Establishing a new research center	30	29%
Establishing a new clinical unit or subdivision	24	24%
Establishing a new faculty position	20	20%
Establishing a new academic program	14	14%
Other*	4	6%
None of the above	3	3%

*Note: a few respondents checked "other" in order to provide additional information about a previous response; these responses were excluded from the count.

Respondents who selected "other" listed the following explanations:

- "Inter-institutional collaboration in research (relatively rare)"
- "Establish a new laboratory"
- "Establishing a regular neurology clinic that runs every week"
- "Set a research laboratory and help to initiate a research network in Neuroscience in the Brazilian Northeast"

4.4.6 Other Capacity Building Outcomes and Impacts

Other research capacity building outcomes and impacts include the following:

Disseminating information about preventable diseases and/or treatment options to the general public. Most of the Brain projects did not include significant dissemination and public education components, and interviews suggested that the primary reason was budget constraints. However, there were reports of this type of work being done based on project findings with supplemental funds. For example, one of the case study projects obtained funds from CDC after the R21 to develop a Russian-language website and training materials on Fetal Alcohol Spectrum Disorders (FASD).

Training of students from HIC institutions at the LMIC site. Several survey respondents and interviewees reported that one benefit of the Brain Program collaboration was to establish a base for LMIC-based training and research projects for students from the HIC institution. The three reported spin-off projects funded by the FIC Fellows and Scholars program may represent additional examples of this phenomenon.

Setting institutional precedents and/or changing attitudes towards research. When asked about other impacts of the project, one survey respondent wrote: "I think an important impact has been the change in the way of thinking about surgical clinical research in low and middle income countries. This includes med students, faculties and administrators of the hospitals. Now they understand the importance of research and how this is not an impossible task." Similarly, one of the case study PIs reported that her project had set an institutional precedent for prevention research and clinical trials at two Russian universities, and it is well known throughout Russia as a successful example of international research collaboration.

5.0 Summary Findings

Ten years ago, there was a dearth of knowledge on the burden of brain and nervous system disorders in LMICs. The first Funding Opportunity Announcement for the "Brain Disorders in the Developing World: Research Across the Lifespan" program came out when the research community was just starting to acknowledge the need for further evidence based research on issues particularly relevant to LMICs in the exploration of the human brain and nervous system.

A decade later, the interest, both nationally and internationally, has exponentially grown. In April 2013, the Obama administration announced the federally funded Brain Research through Advancing Innovative Neurotechnologies (BRAIN) Initiative[9], with an initial investment of $100 million. The initiative will bring together federal agencies, including NIH, who together will focus on the understanding of the human brain through new technologies. According to an Interim Report by the NIH Brain Working group the goal at the NIH is "on the development and use of tools for acquiring fundamental insight about how the nervous system functions in health and disease." In essence, the Brain Program has been supporting this type of research, in countries and settings previously under-represented and therefore an untapped rich source for possible new discoveries, since its inception.[10]

5.1 Highlights

Around the world, scientific interest in neuroscience and neurological health across the lifespan issues has boomed over the past decade. The Brain Program has contributed greatly to research and capacity building efforts in over 45 countries. US and foreign collaborators have jumped on the opportunity to work together on research that addresses issues ranging from neurodevelopmental (e.g. autism, fetal alcohol syndrome and learning disabilities) to neurodegenerative (e.g. Alzheimer's, Parkinson's diseases) to neuropsychiatric (e.g. depression and schizophrenia, posttraumatic stress) disorders. Some of the greatest advances regionally

[9] http://www.whitehouse.gov/blog/2013/04/02/brain-initiative-challenges-researchers-unlock-mysteries-human-mind

[10] Advisory Committee to the NIH Director. "Interim Report: BRAIN Working Group." September 16, 2013. Pdf available at http://www.nih.gov/science/brain/

have come out of the Sub-Saharan African countries with the HIV/AIDS research being conducted by Brain Program grantees having especially high impact. For example, one grantee has documented the effect HIV/AIDS had on the neurodevelopment of children to show that exposure to maternal HIV in utero can lead to developmental delays across the first two years of life.

In addition to the research and capacity building, some grantees were successful in adapting tools for clinical assessment or developing new interventions for prevention or diagnosis. Other grantees have provided evidence that has since led to changes in international and national policies. It is expected that as the program progresses and more R01s mature, the number of research outputs, including evidence-based policies, will continue to grow.

In terms of conceptual framework, the program offered a new and successful approach to funding research at FIC, emphasizing collaboration with other NIH ICs. There are eight partnering ICs that have loyally participated in the program since the onset. Even during times when budgets were constrained and the "doubling" period at NIH subsided, these partners continued to contribute and participate; a sign of true dedication to the mission and purpose of the program. Beyond the normal co-funding of Fogarty awards, these ICs have administered their own grants under the FIC Brain Program's FOAs. This has created a network of program officers who, devoted to the success of their Brain grantees, help leverage the resources of their respective Institutes and strengthen the overall Brain Program. The unique infrastructure of the program has allowed the Brain Program to be more successful than any single program that Fogarty or elsewhere at NIH could have done on its own.

5.2 Recommendations

Overall, the Brain Program has experienced success in generating new scientific evidence related to brain disorders and in building research capacity in LMICs. Notable opportunities for the future of the Brain Program include:

- Maintaining flexibility in how capacity building is defined;
- Continuing to allow for research on a range of disorders occurring or originating at different points in the lifespan;
- Enabling stronger networking among awardees and awardee institutions;
- Focusing on emergent implementation science agenda related to brain disorders;
- Expanding leveraged investment beyond NIH ICs to include other global partnerships (e.g. Global Alliance for Chronic Disease, Dementia Summit, US-EU Stroke Consortia); and
- Encouraging grantees to dovetail their research efforts with other international, large-scale, longitudinal or cohort neuroscience studies

More specific recommendations include:

Solicitation Guidelines. The Brain Program focus on "research capacity building" has allowed PIs the ability to address a broad range of training needs at the collaborating foreign institutions. Without defining a narrow set of criteria within the FOA, the grantees and their projects are afforded the opportunity for more flexible and creative approaches to capacity building. Similarly, the Brain Program solicitation's general approach to neurological disorders and periods in the lifespan has allowed PIs the flexibility to address a broad range of topics relevant

to the interests and needs of the collaborating scientists, institutions and countries. As evident in Figure 5, Brain Program grantees have focused on an array of disease topics over the decade. Evidence from the evaluation suggests that this flexibility with regards to age, disorders and training has been critical to the productivity and success of the Brain Program and should continue to be encouraged and incorporated into future program announcements.

Trainee Tracking. Given Brain Program unique dual emphasis on research and research training, understanding impacts on capacity is critical to understanding the success of the program. Given that the program supports R01s, FIC and NIH do not require formal reporting on trainees. Moving forward, it is critical that a more systematic approach be developed to collecting and analyzing capacity building efforts related to the Brain Program.

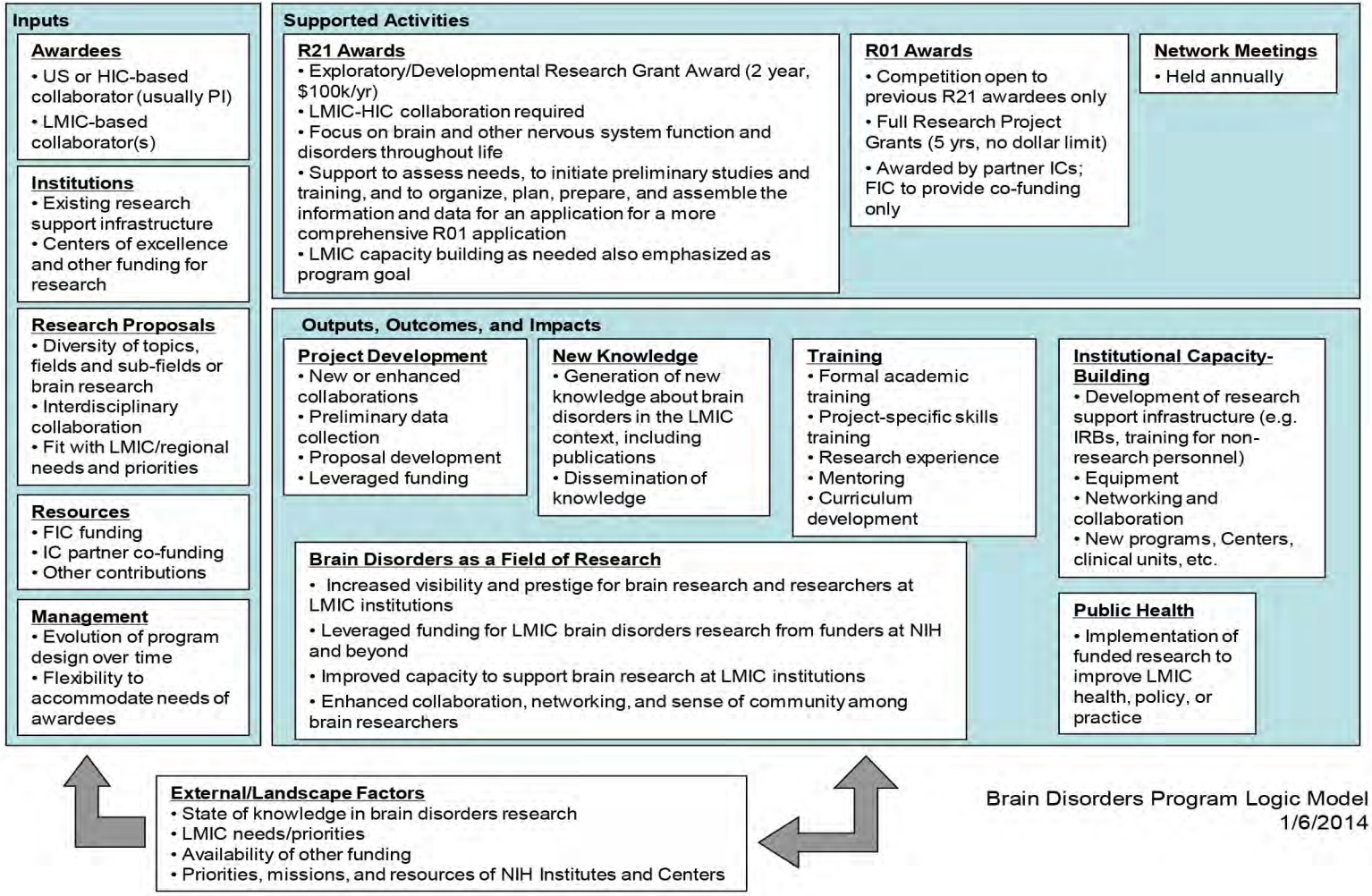
Network Cohesiveness. Given the breadth of projects across different ages, disorders and geographic areas (and funded by various ICs), it is imperative to create a community of practice to share successes, challenges, scientific advances and approaches. The success of the program will only benefit from enhanced collaboration and networking. This collaboration will help the mission of Fogarty to promote and strengthen the human and infrastructure needs that will sustain the research programs in these LMIC institutions. To encourage these networking and collaborative activities, encouragement and incentives to do so should be formally written into the program announcements.

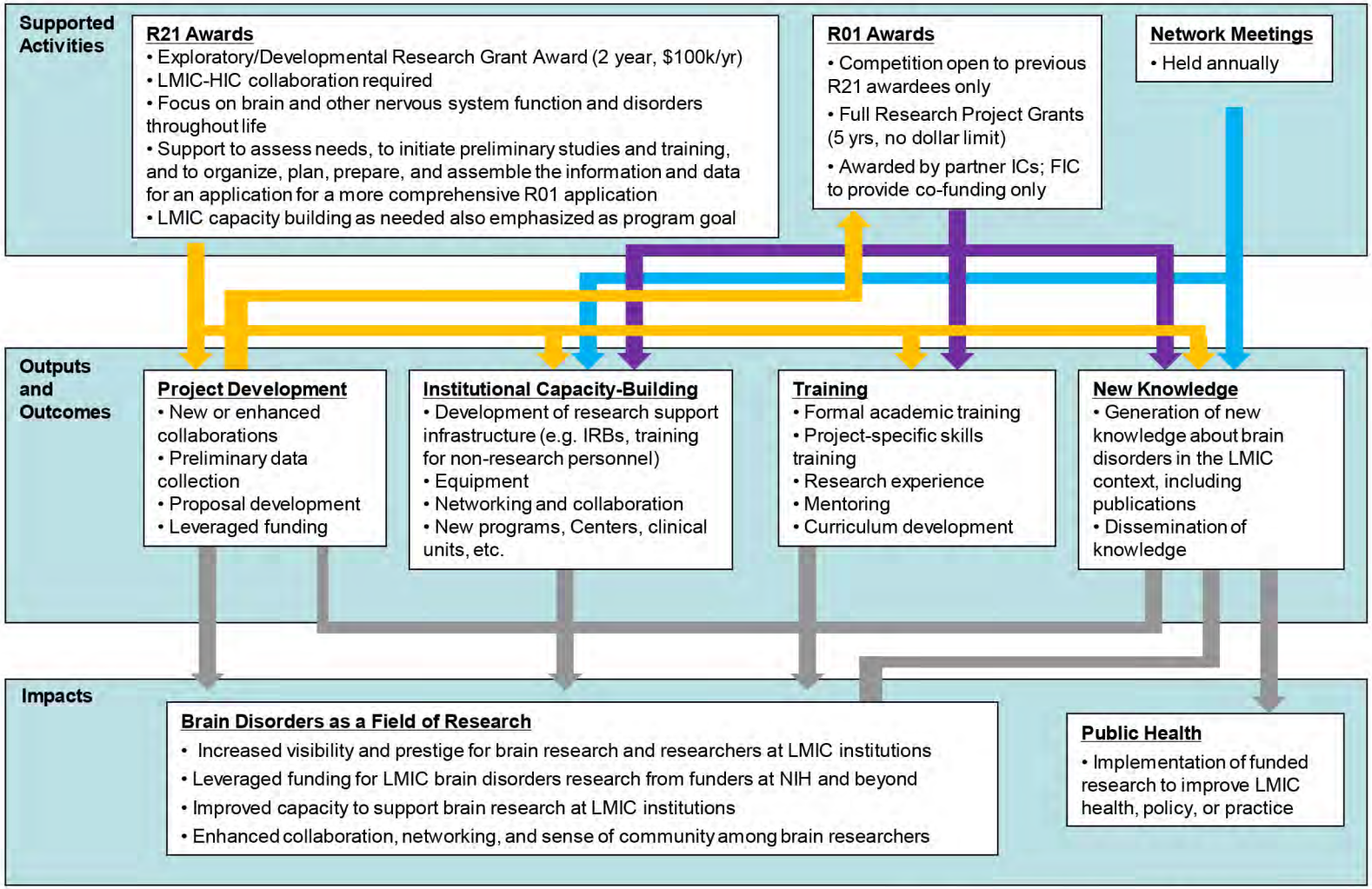
Implementation Research. As a result of the research supported by the Brain Program, new interventions for screening, diagnosis and therapy have been developed and promise improved outcomes for individuals and communities. However, the gap between the promise of scientifically proven health innovations and their successful implementation in the real world persists in a wide variety of contexts including interventions related to brain disorders. Implementation science is critical to the design and effective implementation of evidence-based, scalable strategies that address current barriers to successful brain disorders interventions. Moreover, effective use of scientific evidence from implementation research can be enhanced through more robust collaborations between researchers, program implementers, and policy-makers. Supporting implementation science and multi-disciplinary collaboration and communication between researchers, policy-makers and program implementers is a critical new direction for the Brain Program to explore in an effort to simultaneously help ensure that research is country-driven and responsive to the local context and to enhance effective use of scientific evidence in programs and policies.

Acronyms

CDC	Centers for Disease Control and Prevention
CIHR	Canadian Institutes of Health Research
FASD	Fetal Alcohol Spectrum Disorder
FIC	Fogarty International Center
FIRCA (BB)	Fogarty International Research Collaboration Award (Basic Biomedical)
FOA	Funding Opportunity Announcement
GRIP	Global Research Initiative Program for New Foreign Investigators
HIC	High Income Country
LMIC	Low and Middle Income Country
NCBDDD	National Center on Birth Defects and Developmental Disabilities
NCoD	Non-communicable Chronic Diseases Research Training
NCRR	National Center for Research Resources
NEI	National Eye Institute
NGO	Non-governmental organization
NHGRI	National Human Genome Research Institute
NIA	National Institute on Aging
NIAAA	National Institute on Alcohol Abuse and Alcoholism
NIAID	National Institute of Allergy and Infectious Diseases
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
NINDS	National Institute on Neurological Disorders and Stroke
ODS	Office of Dietary Supplements
PI	Principal Investigator
RFA	Request for Application
USAID	U.S. Agency for International Development
WHO	World Health Organization

Appendix A: Program Logic Models





Brain Disorders Theory of Action Logic Model
1/6/2014

Appendix B: Evaluation Study Questions

A. Program Design and Implementation
A1. 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 (including LMIC communities/potential end-users of research)?
A2. 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?
A3. Mechanism and Transfer of Funds: Do level of funding, duration of funding, and other mechanism details appear to be optimal? What might be the impact of hypothetical changes? (including impact on other IC partners) How are funds transferred between institutions, and are there barriers to transfer?
A4. Evolution: Has the program design changed over time? If yes, how and why? Has the program adjusted appropriately to any unanticipated events or new opportunities?
A5. Partners: Which ICs have participated as partners, and which have not? What roles have partners played in the program? Are the needs of the partners being met? Are there any barriers to participation?
A6. Review Process: Is the current review process adequate? Were multiple program goals (especially LMIC capacity building) given sufficient attention? Did feedback from reviewers significantly impact funded projects?
A7. Network Meetings and Communication: Have the Network Meetings been an effective tool to encourage communication and networking among awardees? Are there adequate mechanisms for sharing data and/or best-practices among Brain Program awardees/trainees?
A8. Applicants and Success Rates: How has the program advertised itself to potential applicants? Have sufficient efforts been made to attract diverse talent and interdisciplinary teams? What have been the application and success rates?
B. Portfolio of Supported Activities
B1. Portfolio of Funded Awards: How many and what types of awards have been funded to date (including mechanism, institution, country/region, research topic, PIs, etc.)?
B2. Models for Training and Capacity-Building: Within the portfolio of Brain Program awards, is it possible to identify distinct approaches or models for LMIC training and capacity building?
B3. Awarded Institutions: Is there evidence that awarded institutions (LMIC and HIC) have supported the funded projects (via contribution of resources or in other ways)? Has lack of infrastructure or support at the LMIC institutions been a barrier to progress?
B4. LMIC needs/priorities: Do applicants/awardees conduct local needs assessments as part of the planning process? Is there evidence that funded projects reflect local needs?
C. Outcomes
C1. Knowledge: What have been the direct research outputs and outcomes of the Brain Program?
C2. Leveraged Funding (Project): How successful has the Brain Program been in catalyzing further interest in related topics? Specifically, have R21 projects been successfully converted to R01s within the Brain Program? If not, are there specific barriers, and did awardees find other sources of support for these projects? Have R01 projects found sustainable sources of support beyond the Brain Program?

C3. Leveraged Funding (Funders): How has the program affected the plans and portfolios of partner ICs? Is there evidence that 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? Is there evidence that the program catalyzed additional interest in or support for LMIC brain research anywhere else?
C4. Awareness Among LMIC Researchers: Is there any evidence that the program has increased awareness or raised profile of brain-related research topics within LMIC institutions and research communities? Is there evidence for dissemination of knowledge to LMIC researchers beyond direct trainees?
C5. Collaboration and Networking: Is there evidence that supported activities facilitated new or enhanced relationships among investigators? Is there evidence that participation expanded the network of contacts for LMIC investigators?
C6. Training: How many and what types of people have been trained by the Brain Program? Have former trainees established productive research careers? How did trainees benefit from the experience?
C7. Research Infrastructure: Is there evidence that supported activities established or enhanced sustainable research infrastructure at LMIC institutions, including registrations, IRBs, large equipment/facilities, new Centers or programs, etc.
C8. Other Research Capacity Building: Is there evidence for other RCB outcomes, such as increased prestige for the MFC and/or LMIC institution?
C9. Policy and/or public health impacts: Is there evidence of any direct impact of funded activities on policy or public health? Have there been interactions between awardees/projects and policy-makers and/or the general public in developing countries?
C10. Synergies with Other NIH Programs: Do the funded institutions overlap with LMIC "Centers of Excellence" {as defined as having multiple (7+) ongoing NIH collaborations}, especially the NIMH Centers of Excellence? Do funded institutions or personnel participate in large-scale research networks or other NIH-funded awards/efforts in brain/neuro science? Is there evidence for synergy?
D. Broader Context
D1. Alignment with strategic priorities: Do the program goals align appropriately with the FIC strategic plan and/or with other FIC initiatives? Strategic plans and initiatives elsewhere at NIH?
D2. Existing LMIC capacity and needs: Where is there underlying research capacity in "brain disorders" (ex: neurodevelopmental or neurodegenerative diseases, addictive disorders, seizure disorders, PTSD) in developing countries? Is there a need for additional capacity-building in specific countries/fields?
D3. Funding landscape: Are other funders supporting similar research and capacity-building? Is FIC filling a strategic gap by supporting developing-country researchers to do brain disorder research?

Appendix C: Interview Questions for Partner ICs

1. When/how did you/your IC become involved in the Brain Program?
    - What made the program attractive and/or motivated your IC to participate?
    - Were there any barriers to participation?
    - Did you feel that you were included appropriately in the planning process?
2. How does the amount of time and effort you devote to the Brain Program awards compare with other awards in your portfolio?
    - Do you put an unusual amount of effort into working with the LMIC institutions/investigators?
    - Have there been issues with transfer of funds? Lack of infrastructure? Other LMIC-specific issues? How did you handle them?
    - Have you attended Network Meetings or participated in other events?
3. Is the current program implementation optimal to meet your IC's needs? Is there anything specific about it you would like to see changed?
    - Are you happy with the quality and diversity of applications? Is there any group you would like to see targeted?
    - If awards were larger or smaller or longer or shorter, would that change your willingness to participate?
    - Do you like the collaborative R21->R01 mechanism?
    - Requirement that 50% of funding go to foreign site?
    - How do you feel about the dual research/capacity-building goals of the program?
    - Other issues?
4. What have been the most important benefits or outcomes of the program, from your IC's perspective?
    - Without this program, do you believe you would be receiving applications of similar quality involving LMIC investigators?
    - Have you been happy with the quality of the science?
    - Has your IC developed long-term relationships with any of the funded investigators, or do you expect that you will?
    - Have capacity-building efforts had an impact on what you've been able to fund outside of the Brain Program?
    - Other benefits?
5. Has participation in the program had any indirect or "ripple" effects at your IC?
    - Increased awareness of/interest in LMIC research or capacity building?
    - Any impact on strategic planning or thinking?
    - Stronger ties to FIC or other ICs?
    - Other?
6. Do you anticipate that your IC will continue to participate in the Brain Program?
7. Is there anything else about the program that you would like to discuss or that you think should be included in the evaluation?

Appendix D: Case Studies

Brain Program Project Outcomes Case Study Summary

Award Numbers: R21TW006745/ R01AA016234

PI: Tatiana Balachova, PhD (R01)
Associate Professor, Center on Child Abuse and Neglect, Department of Pediatrics, University of Oklahoma Health Sciences Center

Barbara Bonner, PhD (R21)
CMRI/Jean Gumerson Endowed Professor, Associate Director of the Child Study Center, Director of the Center on Child Abuse and Neglect, Department of Pediatrics, University of Oklahoma Health Sciences Center

MFCs: Larissa Tsvetkova, PhD
Vice Rector, St. Petersburg State University, Russia

Elena Volkova, PhD
Vice Rector, Professor, Director of Institute of Applied Psychology, Nizhny Novgorod State Pedagogical University, Director of Nizhny Novgorod Resource Center Childhood without Violence and Cruelty

Alla Shaboltas, PhD
Dean, College (Faculty) of Psychology, Associate Professor of Psychology; St Petersburg State University, Russia

R01 Project Title: Preventing FAS/ARND in Russian Children

Start Date(s): 2003 (R21), 2007 (R01)

Co-funding IC(s): NIAAA

Data Sources: Phone interview with Drs. Balachova and Bonner; Survey responses from Drs. Balachova and Tsvetkova; Publications; Applications and progress reports

Highlights/Overview

The over-arching goal of this project was to develop and evaluate strategies to prevent Fetal Alcohol Spectrum Disorders (FASD) in Russia. The exploratory R21 study was followed by the development of a specific intervention to be delivered to women of childbearing age by OB-Gyn physicians, a Russian-language informational website on FASD (the first of its kind), and other training materials with funding from the Centers for Disease Control and Prevention. The R01 project was a randomized controlled clinical trial to evaluate the intervention. Data indicate significant reductions in the risk for alcohol-exposed pregnancies in both the intervention and control groups. A full analysis is not yet complete, but it appears that there are higher improvements in the intervention condition. Major capacity-building accomplishments include training and providing research experience to Russian graduate students, involving Russian faculty at the two primary collaborating institutions and several other institutions in FASD and prevention research, establishing the first Russian IRB for behavioral research, establishing key collaborations for dissemination of information and scale-up of the intervention, and providing a critical increase in FASD awareness among the general public and health professionals in Russia.

Background and Objectives

Child abuse and neglect is a primary research interest for Drs. Bonner and Balachova. They decided to focus their Brain Program proposal on Fetal Alcohol Spectrum Disorder (FASD) as it was an area in which there was sufficient existing knowledge and ethical/legal clarity for a research project to have an impact on policy and practice. They sought Russian collaborators because of Dr. Balachova's roots and because it is a region with a high prevalence of FASD and relatively little stigma attached to maternal alcohol use. They identified collaborators at two sites that would be representative of Russia as a whole: urban St. Petersburg and the more rural region surrounding Nizhniy Novgorod. Dr. Balachova had existing contacts from her training at St. Petersburg State University and Bekhterev Research Psychoneurological Institute in St. Petersburg, and Drs. Bonner and Balachova both knew Dr. Elena Volkova of Nizhny Novogorod Pedagogical University through work in Eastern Europe with the Open Society Foundation.

The R21 research project was designed to explore the knowledge and attitudes of childbearing-age women and their partners, pediatricians, and obstetrician-gynecologists regarding FASD at both sites via focus groups and large-

scale survey administration. One of the major findings was that there was little information available on FASD in Russia for physicians and the general public. Based on these results and the urging of a consultant from the Centers for Disease Control and Prevention, the US-Russian research team applied for and received funding from the CDC to develop Russian-language educational and training materials and make them available through a website. The main objective of the R01 project, for which Dr. Balachova assumed the role of Principal Investigator, was to design and evaluate the impact of a brief training intervention delivered by obstetrician-gynecologists via a controlled trial.

Research Outcomes

There have been a total of 46 peer-reviewed publications associated with this project to date including 14 peer-reviewed articles published in US, Russian, and international professional journals. English language journals include *Substance Use and Misuse, Addiction, Addiction Science and Clinical Practice,* and the *International Journal of Alcohol and Drug Research;* Russian journals include *Bekhterev Review of Psychiatry and Medical Psychology, Yakut Medical Journal*, and other scientific journals. In addition, there have been 107 presentations at professional conferences in the US, Russia, and other countries.

Findings from the R21 study. As expected, the R21 study found that the majority of women of childbearing age drink at risky levels in Russia. Binge drinking is a cultural norm and the study indicated that the majority of women who try to get pregnant or are at risk for an unplanned pregnancy because of a lack of contraception, drink at risky levels and are at risk for fetal alcohol exposure prior to pregnancy awareness. There was a significant reduction in alcohol use after pregnancy awareness with the majority of women abstaining or significantly reducing alcohol use when recognizing they were pregnant. These data identified an urgent need in targeting non-pregnant women prior to conception in FASD prevention efforts. Another key finding from the R21 study was that Russian women find actual research data more compelling than simple warnings that a behavior is risky. While Russian women rely on their doctors for advice, they also consider it important to have their own knowledge that allows them to decide what constitutes a health risk. Furthermore, they find actual research data that demonstrate a risk more compelling than simple warnings. The team interpreted this finding as underscoring the importance of building capacity for local research on this topic.

Development of FASD training materials and a Russian language website. Following the R21 project, the team obtained two awards from CDC to: 1) develop FASD education materials and 2) design a website to provide a broader dissemination of the education. The Russian language website (http://www.netfas.net) includes a site for the general public and a site for health professionals. When the website was launched in 2005, intensive searches by the research team suggested that it was the only web-based source of Russian-language information on FASD. There are now numerous Russian websites that include information about FASD, and many cite or reference the data from the Brain Program project or materials developed by the US-Russian research team in consecutive studies. Dr. Balachova continues to volunteer her time in order to maintain the website for the general public and a website for health professionals. Other training materials developed include: 1) training for Russian health professionals in FASD diagnosis; 2) informational brochures for women focused on FASD and contraception; and 3) a brief intervention to reduce the risk for alcohol-exposed pregnancies and alcohol use among pregnant women (the subject of the R01 prevention trial).

Preliminary findings from the RO1 study. Building on the results from the R21, a new R01 study application was developed to evaluate a prevention intervention that was designed to be deliverable by OB/GYN physicians. The evaluation of the intervention funded by the R01 is ongoing, and preliminary results suggest that there is a significant reduction in women's at-risk drinking behavior for both the intervention and control groups, with a higher reduction in women's risk for an alcohol-exposed pregnancy and improvements in knowledge, attitudes, and drinking behaviors in the intervention condition.

Capacity Building Outcomes and Impacts

One capacity-building goal of the project was to build a core of Russian researchers interested in FASD. Strategies included training and providing research experiences for Russian graduate students and involving more senior researchers in FASD and applied behavioral research. Faculty from psychology, pediatrics, OB/GYN, substance abuse, and public health have participated in supported studies and then continued FASD research, training, and

advocacy with support from other sources or integrating FASD work into their university appointments and job responsibilities. Establishing the first and only Russian IRB for behavioral research at St. Petersburg State University was a core capacity-building strategy. Additional capacity-building outcomes and impacts have included setting an institutional precedent for international collaboration on prevention research, building a collaborative relationship with the Moscow Central Public Health Research Institute to facilitate dissemination of information, collaborations with US AID and Médecins du Monde to scale up the intervention to other parts of Russia and Eastern Europe, and catalyzing several spin-off projects. These outcomes and impacts are described in more detail below.

Training for Russian Graduate Students. A total of 29 graduate students from St. Petersburg State University (SPSU), Nizhny Novgorod State Pedagogical University (NNSPU), and University of Oklahoma Health Sciences Center (OUHSC) have been trained and participated in the project as data collectors and research coordinators. Data Collectors received initial training in a three-day seminar that covered the study protocols as well as FASD, research methodology, ethics, and other research topics. Participation in a research project that involves faculty from multiple disciplines (psychology, medicine, and public health) provided a unique training experience for students. In addition, under the supervision of the project faculty from SPSU, NNSPU, and OUHSC, seven Master's dissertations, six PhD dissertations, and three of the highest Doctor of Science Degree dissertations focused on various aspects of our FASD research have been completed. Eleven Master and PhD dissertations have been successfully defended and others are being completed currently. Several students received travel awards and support from the grant and had the opportunity to present at international meeting in the US and Europe, such as the American Public Health Association (APHA) conventions, International Society for Biomedical Research on Alcoholism (ISBRA) , and the Research Society on Alcoholism (RSA) meetings.

Career development for senior collaborators. In addition to training new researchers, the project has attracted senior Russian researchers to FASD research. To date, senior collaborators have published 16 papers on FASD that were not directly supported by the project, including several in English, which is relatively rare for Russian behavioral research. Senior collaborators have received exposure at the international level and presented at international conferences and meetings as well as the annual Brain Program Networking Meeting.

Establishing a Russian IRB for behavioral research. An Institutional Review Board (IRB) for behavioral research was established and registered at Saint Petersburg State University. It remains the only IRB that reviews behavioral research at the university. The IRB Chair from the University of Oklahoma Health Sciences Center played a critical role, making several visits to Russia to provide training, advice, and materials to our Russian colleagues.

Setting an institutional precedent for prevention research and clinical trials. Saint Petersburg State University has a strong history and culture of psychological research, while Nizhny Novgorod State Pedagogical University has historically been more focused on applied psychology than research. Prior to the RO1 project, neither institution had ever been involved in a study focused on FASD, a large-scale evaluation of a behavioral intervention, or a clinical trial of any type. The project is now well known in Russia, having received attention from local newspapers, universities and professional newsletters, and a write-up in the *Bulletin of the World Health Organization*. The current Dean of Psychology at SPSU and Vice President for research at NNSPU have publicly described the project as an example of how successful international research can be conducted in Russia and how much it contributes to Russian university education and research.

Collaboration with the Moscow Central Public Health Research Institute for Dissemination of Information. A public health faculty member from the Moscow Central Public Health Research Institute (the main public health organization in Russia with strong ties to the Ministry of Health) has been a member of the RO1 project's Advisory Board since 2007. Her participation on the board has provided useful advice on how best to disseminate information. She has played a key role in bringing FASD to the attention of the Institute leaders, key health professionals, and offices from the Russian Ministry of Health. The Institute recently collaborated with NIAAA to conduct two US-Russia meetings focused on alcohol consumption and FASD at which Dr. Balachova was invited to present findings. The Institute has recently established a Coordinating Council for Prevention of Harm from Alcohol and FAS that aims to promote research and develop services in Russia; the Council is chaired by the Director of the Institute (who is also a former Minister of Health).

Collaborations for Scaling Up the Intervention. The US-Russian research team began working with USAID in 2012 to scale up the intervention in Russia, but the project stalled as USAID discontinued support for all Russian projects. The possibility of moving the project to Ukraine is still being explored. More recently, the project team was approached by Médecins du Monde (a French NGO similar to Doctors Without Borders) to request training and assistance in applying the intervention and tools developed by the study to improve services for disadvantaged women throughout Russia. Several training seminars and working meetings were held during 2011 and 2012, including a two-day "FAS School" event intended to train health professionals who could then train others. The project team intends to continue collaboration with Médecins du Monde to educate physicians, train trainers, and implement FASD prevention in services to women who are heavy or at-risk drinkers.

Spin-off Project at St. Petersburg Pediatric Academy. A neurodevelopmental pediatrician from the St. Petersburg Pediatric Academy who was recruited to serve as a faculty on the R21 study in 2003 was trained by the US experts in FAS diagnosis and participated as a trainer and faculty in consecutive projects. He has since established himself as a national expert in FAS diagnosis and research, and his students have so far completed two PhD dissertations focused on FAS in children. The results have been published in Russian journals and presented at international meetings.

Spin-off Project at Irkutsk Medical University in Siberia. The US-Russian research team has been approached by a pediatrician at Irkutsk Medical University in Siberia who is developing her own small-scale research and training program for medical students focused on FAS. She and the team submitted a joint proposal for a new Brain Program R21 award in 2013, but it did not receive funding. The pediatrician and her colleagues at IMU will conduct a conference in May 2014, and members of the US team will personally fund their travel to participate in a training event for Russian physicians and to establish a research collaboration team at IMU. The PFAS team remains committed to collaborating on a revised study proposal and providing as much assistance as possible to build capacity in FASD and prevention research in Siberia.

Next Steps

As discussed above, the team may continue to support research and scale-up projects in Siberia and other parts of Russia and Ukraine. In addition, Dr. Balachova recently began work on a new study in collaboration with the St. Petersburg State University that will focus on prevention of HIV risk among Russian women of childbearing age. The new project is a natural extension of the previous work, as the Brain Program's R01 project involved asking similar questions to the same population and revealed a high prevalence of risky sexual behaviors combined with at-risk drinking that increase women's risk for STI and HIV.

In addition to prevention projects, Dr. Balachova plans to turn her attention to improving the identification of FAS and Neurodevelopmental Disorders associated with Prenatal Alcohol Exposure in Russia and developing interventions to help children impacted by FASD. The need for services and interventions is well-documented, and interviewees were aware of only one Russian research group currently focused on this problem.

Brain Program Project Outcomes Case Study Summary
Award Number(s): R01NS061693 (R21 was via the Stigma program)
PI: Gretchen Birbeck, MD, MPH, DTMH, FAAN
Professor, Neurology and Epidemiology, Michigan State University
Director, International Neurological and Psychiatric Epidemiology Program (INPEP) , Michigan State University (at time of award)
Professor, Neurology and Public Health, University of Rochester (currently)
Director - Epilepsy Care Team, Chikankata Hospital, Mazabuka, Zambia
Honarary Lecturer - Department of Internal Medicine, University of Zambia, Lusaka, Zambia
Adjunct Faculty - School of Health Sciences, University of KwaZulu Natal, Durban, South Africa

MFC: Elwyn Chomba, MBChB, DCH, MRCP
Senior Lecturer/ Consultant Paediatrician – University Teaching Hospital (UTH) (at time of award)
Minister of Child Health, Zambia (current position)
R01 Project Title: Epilepsy-associated stigma in Zambia: Evidence-based interventions and outcomes (R01)
Start Year(s): 2008
Co-funding IC(s): NINDS
Data Sources: Phone interview with Dr. Birbeck; Survey responses from Dr. Birbeck and Prof. Chomba; Publications; Applications and progress reports

Highlights/Abstract
Dr. Gretchen Birbeck, Professor Elwyn Chomba, and their team set out to explore epilepsy-associated stigma in Zambia and to develop and evaluate low cost, evidence-based interventions to decrease the social and medical morbidity associated with epilepsy. To date they have implemented and evaluated interventions that focus on availability of medication, specific interventions aimed at decreasing stigmatizing attitudes among “power” groups such as teachers, clerics, and police officers; CME programs for health care workers; collaboration with traditional healers to increase care-seeking; and peer support groups as an intervention to decrease stigma and improve care-seeking. The team is currently working on a proposal to package the successful interventions for national scale up and implementation by the Zambian Ministry of Health. In addition, a wholly unexpected result of these studies was the finding that certain policies of the WHO Pharmaceutical Regulatory Authority were resulting in limited access to anti-epileptic drugs, not only in Zambia but throughout lower income countries worldwide. A task force has since been established by the International League Against Epilepsy to address this problem by working with the WHO and LMIC governments. Capacity-building strategies have included establishing six field sites, project-specific training for the research staff, tuition support and mentoring for two postgraduate students, and training for Zambian grant administrators. Finally, the project has helped to expand EEG and MRI capacity in Zambia by training technicians and developing guidelines for treatment of patients with epilepsy.

Background and Objectives
Prior to this project, Dr. Birbeck had been working in Zambia as part of a loosely affiliated group of researchers interested in epilepsy care delivery, epidemiology, and health services. It was clear to this group that stigma associated with epilepsy in Zambia was a major barrier to all research and service delivery. When FIC’s **Stigma and Global Health Research Program** was announced in 2003, they viewed it as an opportunity to assess that barrier in a meaningful way. Drs. Birbeck and Chomba applied for an R21 and were awarded in the first cohort. The objectives of the R21 project were to gain a broader understanding of epilepsy-associated stigma, the impact of such stigma, the social context of the disorder, self-perceptions of people with epilepsy, and the socioeconomic and medical

sequelae of epilepsy in Zambia.
When the R21 was complete, the team decided in consultation with the NIH Program Officer that the next phase of the project, focused on implementation research, was a good fit for the Brain Program. The goals of the R01 project included implementing and assessing a series of multi-faceted, evidence-based, community and clinic-oriented interventions to decrease feelings of stigma among people with epilepsy. An administrative supplement was added to the parent award in 2011 (project year 3) to expand EEG and MRI capacity in Zambia and to evaluate the impact of these newly-available technologies on quality of care and outcomes. The R01 project is currently in a no-cost extension.

Research Outcomes

The project has contributed to 25 publications to date, of which approximately 10 are attributable to the R01, and many of the findings from the R01 work have not yet been published. Journals where project publications have appeared include the *Lancet Neurology, American Journal of Tropical Medicine and Hygiene*, *Epilepsy and Behavior*, *Epilepsia*, *Neurology International, Seizure: The European Journal of Epilepsy*, and the *Medical Journal of Zambia*. The primary research outcome of the project has been the development, implementation, and evaluation of several low-cost, scalable interventions to reduce epilepsy-associated stigma. A next step will be to work with the Zambian Ministry of Health to create a package of interventions with proven effectiveness for implementation on a larger scale. Additionally, the project has helped to advance understanding of stigma as a phenomenon, which may lead to better assessment tools that can be used worldwide. Resources from this project were also used to develop a set of EEG guidelines for treating patients with epilepsy in Zambia. Finally, an unexpected finding from this study regarding a barrier to anti-epileptic drug access in Zambia will likely inform policy changes at WHO and throughout the developing world. These outcomes are described in more detail in the sections below.

Low-Cost, Scalable Interventions for Reduction of Epilepsy-Associated Stigma. The project has resulted in the development, implementation, and evaluation for effectiveness of a variety of interventions designed to reduce epilepsy-associated stigma in Zambia. These interventions were developed collaboratively based on findings of the exploratory R21 project, with an emphasis on solutions that would be inexpensive and easily replicable. Interventions include:

(1) Development of an advocacy team to educate District Health Management Team (DHMTs) and administrators in charge of purchasing medications for provincial health systems in Zambia;
(2) Educational programs customized for specific “power” groups including teachers, clerics and police officers and designed to improve knowledge regarding epilepsy and tolerance for people with epilepsy;
(3) A continuing medical education (CME) programs for health care workers (HCWs) to improve their capacity to diagnose and treat epilepsy and decrease their contribution to epilepsy-associated stigma;
(4) In selected provinces, the EASZ team will work with the Traditional Healers' National Association of Zambia representatives as well as with traditional healers recommended by community leaders to develop programs and relationships that will facilitate referral of people with refractory epilepsy and seizures to healthcare centers;
(5) Develop peer mentor support groups for women, men, and youth with epilepsy.

Interventions with demonstrated effectiveness so far include peer support groups for youth and workshops where teachers are unknowingly introduced to a person with epilepsy (identified as a key determinant of stigmatizing behavior in this group). The team has also collaborated with economists at the Zambian Ministry of Health to do some costing studies for specific interventions. As a next step, the Zambian Ministry of Health has asked the team to develop a proposal for a “package” of interventions with demonstrated effectiveness to be implemented as part of Maternal and Child Health and Community Health Programs, likely with funding from UNICEF.

Improved Tools for Assessing Stigma, in Zambia and Beyond. Although this work is not yet complete, the PI believes that this project will be important in disentangling the neurocognitive processes involved in stigma into components so that assessment tools can be improved. Currently understanding of these processes is limited, as are available assessment tools. Zambia is an excellent place to study epilepsy-associated stigma because the

phenomenon is so extreme, but the theoretical and practical findings will likely be generalizable elsewhere.

EEG Guidelines for Treatment of Patients with Epilepsy in Zambia. Working with the Neurologic & Psychiatric Society of Zambia, the project developed a set of EEG guidelines for people with epilepsy that have been published in the *Medical Journal of Zambia*. This effort was undertaken because EEG technology had recently been made available at the University Teaching Hospital, but it wasn't clear that healthcare workers would know how to use the technology to treat people with epilepsy. In particular, the concern was that patients who could benefit would not be sent for EEGs or that treatment would be unnecessarily delayed in order to wait for an EEG unless there was a set of guidelines endorsed by an authoritative body. The need for guidelines was also underscored by a study finding that, among healthcare workers, lack of knowledge about how to treat people with epilepsy was a major driving factor for stigmatizing behavior. When given a little bit of knowledge and direction, healthcare workers provided better care and felt better about doing it.

Identification of A Key Barrier to Anti-Epileptic Drug Access. A wholly unexpected but significant finding of this study was that access to anti-epileptic drugs in Zambia was being negatively impacted by actions of the WHO Pharmaceutical Regulatory Authority. Specifically, phenobarbitone, the cheapest and first line anti-epileptic drug, had long been listed as a scheduled agent because it has a chemical structure similar to abused drugs, but these regulations were rarely enforced before the WHO Pharmaceutical Regulatory Authority began urging these governments to make enforcement a priority. Using a combination of quantitative and qualitative methods, this project established that phenobarbitone was becoming less available in Zambia as a direct result. After announcing the finding at an international epilepsy congress, it became apparent that similar things were happening in many other LMIC regions, but international community had not yet realized it. The International League Against Epilepsy has now developed a task force on access to anti-epileptic drugs to engage WHO in finding solutions and to support LMIC governments in changing the blanket regulations or developing mechanisms for legal distribution.

Capacity Building Outcomes and Impacts

A major capacity-building component of this project was to establish a total of four field sites in Zambia, including extensive project-specific training for the many research assistants who collected the data and a coordinating office at the University of Zambia in Lusaka. In addition to the training provided to all team members in order to complete the research, one individual received tuition, stipend, and mentoring support that allowed him to complete a PhD in Community Health at the University of KwaZulu-Natal, and another was supported while completing a Master's degree in Sociology at the University of Zambia. Another set of capacity-building activities focused on providing training opportunities for Zambian grant managers at the research sites.

The supplement added developing EEG and MRI capacity as an additional capacity-building focus. The original strategy was to focus on training for physicians, but it quickly became apparent that lack of technical expertise was an even more important barrier to use of these technologies in Zambia. Capacity-building efforts have therefore focused primarily on training for Zambian technicians, who had previously received only two weeks of training (their US-based counterparts are trained for two years). Some additional effort has been devoted to mentoring Zambian physicians in interpretation of these technologies, but this remains an area of need. Overall, the expanded capacity for EEG and MRI in Zambia has helped to attract additional research projects.

Finally, both Dr. Birbeck and Prof. Chomba emphasized the importance of the publications associated with this award in advancing Prof. Chomba's career; she successfully moved from a clinical track to an academic position and has recently been appointed Minister of Child Health. Additional information about these outcomes and impacts is provided below.

Establishing Field Sites. The R21 phase established four study sites: two located in Lusaka (University Teaching Hospital , Chainama Hills College Hospital) and two in rural areas of the Southern Provinces (Chikankata Health Services in Mazabuka and Monze Mission Hospital in Monze). A headquarters for the study, equipped with computers, a high-speed internet connection, and teleconferencing capacity, was also established at the University Teaching Hospital. A primary capacity-building aim was to expand and enhance established field-based, research capacity for survey delivery, data collection, data entry, and survey development for local study teams at each site. Research support teams from each site attended an initial training in Lusaka and were supervised and mentored on

an ongoing basis by members of the Headquarters team. Additional professional development opportunities were also made available to team members, including support for a clinical officer to attend a meeting in Goa, India addressing "Leadership in Mental Health" and support for a senior collaborator to travel to the US in order to attend the Brain Program network meetings, present at the Society for Neuroscience, and visit Michigan State University.

Support for a Zambian PhD Student. A former Zambian clinical officer who was a key collaborator for the duration of the project is about to complete a PhD in Community Health at the University of Kwazulu-Natal in South Africa with academic, mentoring and financial support from the Brain Program. The trainee elected to complete his degree at a South African institution because there was no capacity for this type of training in Zambia, but remaining relatively close to home allowed him to stay engaged with the project during most of his training. His thesis focused on improving detection and diagnosis of depression and/or anxiety as comorbidities of epilepsy in primary healthcare settings in Zambia and has already resulted in three peer-reviewed publications. He has recently been hired as faculty at the University of Zambia and made Director for Research at the nation's primary psychiatric facility, which would not have been possible without a PhD. In that role, he will help to implement WHO's Lifting the Burden campaigns for headache care in Zambia, and he is also the lead researcher on the first ever population-based headache care study in Sub-Saharan Africa.

Support for a Zambian Master's Student. A Zambian teacher was selected through a competitive process to receive mentoring, tuition and stipend support to complete a Masters in sociology at University of Zambia with support from the project. Her research focused on analysis of the effects of epilepsy stigma on mother-child relationships and caregiving, an area that was not well-understood after the R21 exploratory phase. She has since moved to a larger district and is playing a role in developing support programs for parents of children with epilepsy.

Training for Zambian grant administrators. Training for LMIC grant administrators in order to give them the skills necessary to effectively manage international awards was a capacity-building priority for this project. Several grant administrators from Michigan State traveled to Zambia to spend time with their counterparts at the collaborating institutions and any other institution that was willing to cover the modest travel costs for staff members to attend the training sessions. Benefits of this mutual exchange included building personal relationships to facilitate cooperation, giving the US administrators a greater appreciation for the challenges their African counterparts face, and encouraging cooperative problem-solving on issues such as finding more effective software solutions. Zambian grant administrators who could obtain the appropriate visas were also supported to attend an annual conference of the US-based National Council of University Research Administrators; others attended a grants administration course offered by a South African NGO.

EEG and MRI Capacity-Building. Training for the Zambian EEG and MRI technicians involved two components. First, project funds were used to bring several US-based technicians to Zambia in order to work with their Zambian peers. Second, a Zambian technician was sent to Blantyre, Malawi on the Pediatric Research Ward for training in EEG acquisition. The Malawi-based technicians who provided the training had been trained previously through other NIH-funded projects. Preliminary findings suggest that improvements in MRI technician training have substantially improved image quality. A manuscript detailing the impact of EEG and MRI in this environment is under development. Dr. Birbeck has also provided in-service training and mentoring to Zambian physicians in the interpretation of EEGs for critically ill patients, but there is a strong need for additional training in order to develop these skills. Although it isn't all attributable to the Brain Program project, the expanded capacity for EEG and MRI in Zambia has attracted several new projects, including a study of nutrition and neuropathy supported by FIC and the American Brain Foundation and a study of brain MRIs in pediatric HIV and cerebral malaria supported by the Dana Foundation.

Career Impacts for Professor Chomba. These projects also added substantially to the research experience of the primary collaborators. Professor Elwyn Chomba successfully moved from a clinical track to tenure track, a move that is very rare in Zambia. Although she did have other research projects and international collaborations, including collaborations with Dr. Birbeck and others on rural populations and HIV, this Brain Program project and the associated publications were a critical academic credential. Dr. Chomba was initially appointed Assistant

Professor and has since become Minister of Child Health. Although this position makes it difficult for her to continue being involved in research, she has played a key role in bringing the project's interventions to the attention of the Ministry of Health.

Next Steps

As the R01 project nears completion, one concrete next step will be to work with the Zambian Ministry of Health to create a package of interventions with proven effectiveness for implementation on a larger scale. In addition, Dr. Birbeck expressed confidence that she will continue to collaborate with members of this research team on projects in Zambia, ideally with the Zambian researchers leading the way. She also expressed confidence that the individual who completed a PhD as part of this project will play a key role in the Zambian research community for many years to come.

Brain Program Project Outcomes Case Study Summary
Award Numbers: R21NS055353/R01NS064901
PI: Hélène Carabin, DVM, PhD
Professor of Epidemiology, University of Oklahoma Health Sciences Center
MFC: Athanase Millogo, MD
Associate Professor of Neurology, University de Ouagadougou, Burkina Faso
R01 Project Title: EFECAB: Improving pig management to prevent epilepsy in Burkina Faso
Start Date(s): 2006 (R21), 2010 (R01)
Co-funding IC(s): NINDS
Data Sources: Phone interview with Dr. Carabin; Survey responses from Dr. Carabin; Publications; Applications and progress reports

Highlights/Overview

The over-arching goal of this project is to reduce cysticercosis and its neurologic effects in Burkina Faso. A major accomplishment to date has been the development of an intervention to improve sanitation through screening of a comedic film about cysticercosis followed by the use of the Participatory Hygiene And Sanitation Transformation (PHAST) approach to improve sanitation. The effectiveness of the intervention is currently being evaluated in a randomized controlled trial in 60 villages in three provinces of Burkina. The trial will include the development of a large repository of serum samples from humans and pigs that will be available as a research resource for future studies. Capacity-building strategies have included intensive training and protocol development for field workers, development of capacity to conduct ELISA tests at a laboratory in Burkina, and degree-based training for individuals from Burkina and Mali in order to create future research leaders.

Background and Objectives

Cysticercosis is a zoonotic infection caused by the eggs of *Taenia solium*, a tapeworm carried by humans and transmitted between humans and pigs. Neurocysticercosis (NCC), or cysticercosis involving cysts in the brain, is a common cause of acquired epilepsy and headaches in LMIC regions where pigs are raised. Dr. Hélène Carabin first became involved with NCC research while serving on an expert panel on zoonoses at the UN Food and Agriculture Organization. She was initially consulted by a Tanzanian student who planned to study cysticercosis prevalence in pigs in several villages in one district in Tanzania, and she later worked with the same student to design a community-based randomized trial looking at infection of pigs as an outcome. After Dr. Carabin moved to Oklahoma, she met a number of students from Benin through a USAID program (ATLAS) designed to bring Francophone students to the campus to complete post-graduate degrees. She first applied for a Brain Program award to study NCC prevalence in Benin with a neurologist she met through a student, but that application was not successful and the collaboration didn't come together. Later, another student from Benin accepted a job in Burkina Faso. He introduced Dr. Carabin to Dr. Athanase Millogo, a neurologist who suspected NCC as a common cause of epilepsy among his patients, but didn't have the ability to confirm it. Dr. Carabin also re-connected with veterinary epidemiologist Dr. Rasmané Ganaba, who she had met previously through her graduate studies in Canada. Together, they adapted the Benin proposal for Burkina Faso. Dr. Carabin reported that it was the strength and reliability of her collaborators in Burkina Faso that made her confident that something could be accomplished there, despite the lack of previous research on NCC and research infrastructure.

The objective of the R21 project was to estimate prevalence of epilepsy and NCC in humans and porcine cysticercosis in pigs in three villages in Burkina Faso. The R01 project focused on development of an intervention to reduce NCC and epilepsy using a PRECEDE PROCEED (community participatory) approach and evaluation of that intervention in a community-based randomized controlled trial over four years. The R01 project is still in progress; the baseline follow-up has just been completed but the data have not yet been fully cleaned and analyzed. Dr.

Carabin described several obstacles that have caused delays in publishing from the R01 baseline data, including supply issues at the laboratory, a few problems with the use of PDAs which necessitates the re-entry of data, the necessity of visiting some of the villages during the cropping season (which limits data collection time to early mornings and evenings), a new wave of mining activity in Burkina Faso that has caused many households to leave their villages, and errors made by a physician who was a member of the original field team.

It should also be noted that transfer of resources was a particular challenge for this project. Dr. Millogo's institution, the University of Ouagadougou, was originally supposed to be a sub-contractor on the R21, but transfer of funds proved to be unworkable because of overhead requests from the university that were above the allowable limits. Instead, R21 funds were transferred directly to the foreign collaborator's account and managed from there, which worked but was only a temporary solution. For the R01 project, administration in Burkina shifted to the NGO AFRICSante, which has turned out to be very effective at managing the subcontract.

Research Outcomes

There have been four publications associated with this project to date, all from the R21 data. Journals include *PLoS Neglected Tropical Diseases*, *Epilepsia*, and *Acta Neurologica Scandinavica*. Additional publications are anticipated as the R01 data become available. Perhaps the most important research accomplishment to date has been the development and implementation of the intervention via a community participatory approach. The nature of the final intervention, screening of a comedic film followed by the use of the Participatory Hygiene And Sanitation Transformation (PHAST) approach to improve sanitation, was very different from what the team had originally anticipated. A second major research output is the repository of biospecimens created by the R01 study; these will be available as a resource for future research. Other research outputs and outcomes to date include preliminary findings about NCC prevalence from the R21 study and the R01 baseline, a repository of serum samples from humans and pigs, qualitative findings about perceptions of NCC and epilepsy, and preliminary spatial mapping of porcine infection.

Development of an intervention to improve sanitation via a community participatory approach. Dr. Carabin reported that she had initially expected the intervention to resemble an approach piloted in Tanzania, where researchers worked with villagers to build pigpens using local materials. However, in initial discussions with three pilot communities, it quickly became apparent that Burkina Faso is too poor for that approach to be feasible. Food is so scarce during certain seasons that feeding penned pigs would be impossible. Instead, discussions suggested that the villagers were already concerned about disposal of human waste and would be open to interventions focused on improved sanitation. The team first gravitated towards an approach called Community-Lead Total Sanitation, through which communities are facilitated to develop their own approaches for eliminating open defecation. However, the NGO responsible for implementation of CLTS in Burkina demanded unreasonable compensation to work with the project. An agreement was eventually reached with another group to assist in implementing Participatory Hygiene And Sanitation Transformation (PHAST), a cheaper, shorter, and more sustainable facilitation process along the same lines as CLTS. In addition, some of the collaborators from Burkina Faso approached an international award-winning film and television producer (Noraogo Sawadogo) from a region of Burkina where NCC is prevalent. He agreed to develop a 52 minute comedy about epilepsy, sanitation, and pig management at a steep discount from his normal rate. So the full intervention at the center of the randomized trial is to screen the film in each village, discuss the

film with villagers, and then remain for another two days to work with the community in developing approaches to improve sanitation through PHAST.

Development of a repository of biospecimens. The R01 project is expected to result in collection of blood samples from approximately 3600 humans and 2400 pigs from 60 villages in three provinces. The samples are currently stored in duplicate at the laboratory in Burkina Faso that performs the serologic analyses in a freezer purchased by the project. Dr. Carabin has already begun discussions with potential collaborators about how these samples might be used in future projects. A new Brain Program R21 application was submitted in the latest round to study blood microbiomes, but it was not funded. Dr. Carabin plans to revise and re-submit it.

Preliminary findings about prevalence of NCC in Burkina Faso. The R21 study, which was limited to three villages, estimated the lifetime prevalence of epilepsy at 4.5% (95% CI 3.2, 6.1), which is consistent with other regions of the developing world where NCC is known to be endemic. Seropositivity of circulating antigens to the larval stage of T. solium in pigs was comparable to that found in other African countries, but humans in one of the villages had a much higher seroprevelance than has been reported for other endemic areas. Preliminary findings from the R01 baseline study suggest that NCC is clustered in Burkina and that overall prevalence may be lower than the R21 results suggested. The team is currently investigating the possibility that a recent initiative by the Gates Foundation to treat helminth infections in Burkina may also be reducing *T. solium* infections in humans. Consistent with this hypothesis, project data reveal that prevalence remains higher in pigs (average of 45% across 60 villages).

Findings about perceptions of NCC and epilepsy in Burkina. Finally, in connection with the R21 project, the team conducted interviews with 10 individuals in the pilot villages about their knowledge of NCC and perceptions of epilepsy. The majority of interviewees reported that epilepsy had mystical causes, and they appeared to be unaware of any relationship between epilepsy and pig cysticercosis; in fact, only four individuals identified parasites of any kind as a potential cause of epilepsy. It also appears to be the case that epilepsy is highly stigmatized in Burkina Faso. Interviews suggested that people with epilepsy are viewed as having brought shame to their families and are forbidden to marry, share meals with others, and go to public places.

Capacity Building Outcomes and Impacts

The capacity-building strategy for this project was essentially two-pronged. One focal area was to develop methods for data and sample collection suitable for field use in Burkina and to train personnel to collect data and analyze samples. With the help of collaborators at the Institute of Tropical Medicine in Antwerp, the team has also trained staff at the IRSS (Institute for Health Sciences Research) in Burkina Faso to perform the necessary ELISA tests in-country.

The second strategy was to provide formal academic training in public health and immunology to young researchers from Burkina Faso in the hope of creating future leaders. As there are no institutions in Burkina Faso capable of providing this type of training, candidates were funded to pursue degrees at the University of Oklahoma Health Sciences Center and at the Institute of Tropical Medicine in Antwerp in Belgium. A total of two candidates entered training programs, but only one completed a first degree (an MPH) leaving the PhD program. As a backup strategy, a graduate student from Mali has since become involved with the project and will likely use it as part of her PhD training. These outcomes are described in more detail below.

Data collection protocols and field team. The project included development and piloting of a screening and diagnostic process for NCC suitable for field use in Burkina. All interviews are conducted using PDAs, which avoid error at the time of transcription of the answers. The process begins with an interview of the household chief which includes a listing of all household members and questions on property owned in order to develop a wealth index. The list is used to sample a participant at random who is asked to answer a screening questionnaire (developed in French and Mooré and translated in the field as appropriate) that includes questions about possible symptoms of NCC as well as socio-demographic data and risk factors. The mothers of each household are also interviewed regarding cooking habits and sanitation. Administration of the questionnaire is followed by collection of a blood sample from the participants at baseline and the two follow-ups. Subjects who screen positive for possible symptoms (seizures, progressively worsening severe headaches) are assessed by a physician, and those who are confirmed with relevant symptoms are offered CT-scans and treatment for the duration of the study. Pig farmers

are also interviewed about their practices, and blood samples are taken from pigs and sows. The field team responsible for collecting the data consists of a physician, a veterinarian, and six field workers. All team members have received extensive training in protection of human subjects in research, the data collection using PDAs and intervention protocols and are supervised by the senior collaborators in Burkina. The project schedule requires that the field team visits all 60 villages across Burkina Faso every 18 months.

Laboratory capacity for serologic analyses. As part of the R21 project, the team sought to identify a laboratory in Burkina that would be capable of conducting the serologic analyses necessary for diagnosis of cysticercosis in humans and pigs. No commercial kit is available for this ELISA so the conduct of the test requires considerable amount of training. A ministry-of-health affiliated research center in Bobo Dioulasso (IRSS – Institute of Health Sciences Research) was identified as the only candidate with sufficient space, equipment, and knowledge. The establishment of a serological diagnostic centre for the project at that laboratory has been overseen by collaborators at the Institute of Tropical Medicine in Antwerp. Materials necessary to perform two different tests and reference samples have been transferred from Belgium to Burkina. Training for the laboratory workers in Burkina has included several 1-2 week sessions focused on theoretical aspects of serological diagnosis and hands-on training with ELISA. Initial visits focused on helping the lab to develop each step of the tests, and more recent visits by the Belgian collaborators have been primarily supervisory. Positive and negative reference samples are run on each test plate, and all raw data are assessed by ITMA staff. Dr. Carabin reported that the lab is now capable of functioning mostly on its own, although the workers continue to rely on the Belgian collaborators to troubleshoot problems.

Degree-based training at HIC institutions for candidates from Burkina. A capacity-building priority for this project was to provide training and academic credentials in public health and immunology to new researchers from Burkina in the hope of creating future faculty members and research leaders. As there are no opportunities to acquire these types of training in Burkina, the only option was to send qualified candidates abroad. The initial trainee received tuition, stipend, and travel support to complete an MPH degree at the University of Oklahoma Health Sciences Center with funds from the R21. The same candidate began a PhD with R01 funding and made it through his general exams, but he left the program shortly after returning to Burkina to conduct field work. He later went on to complete an MS in mental health and has elected to remain in Oklahoma. A second candidate from Burkina was supported to enter a PhD program in immunology at the Institute of Tropical Medicine in Antwerp, where she had already completed an MS. Her dissertation was supposed to focus on evaluating the performance of the AgELISA test for the diagnosis of neurocysticercosis and test the variation of levels of antigens through time. However, like the first candidate she left the program without completing her dissertation research.

Training for US-based graduate students from Mali, Nepal, and Cameroon. Once it was apparent that the trainees from Burkina were not going to work out, it was necessary to change tactics. The public health trainee has been replaced on the project by a graduate student in the early stages of PhD training at the University of Oklahoma Health Sciences Center. She is originally from Mali, which borders Burkina to the north. If all goes as planned, she will continue to support the project and use the data as the basis for her dissertation. Two additional graduate students have been involved with data analysis; a student from Nepal is conducting GIS analysis of infection in pigs and humans, and a student from Cameroon is working with data from the focus groups and cost data.

Networking and career development for the senior collaborators. In part due to this project, Dr. Millogo has become involved in raising awareness about NCC in West Africa. In 2009, he was appointed the first leader of the newly established Cysticercosis Working Group for Western and Central Africa (CWGWCA). Dr. Carabin reported that participation has also motivated the senior collaborators to work on manuscripts in English and to apply for new grants.

Next Steps

As the R01 study is still very much in progress, it's early to be thinking about next steps. However, one possible avenue to explore is what else can be done with the repository of biospecimens collected as part of this project. Dr. Carabin and a collaborator applied for a new Brain Program R21 in the last round to look at blood microbiomes in the samples that have been collected as part of this project, which is of particular interest because NCC can impact

both the brain and the gut. The proposal was not funded, but they are planning to revise and re-submit it. Dr. Carabin believes it might also be possible to use the blood samples to search for evidence of other parasites other than *T. solium* that might help to explain the high prevalence of epilepsy and headaches in Burkina.

Dr. Carabin also emphasized the need to study mental health in connection with NCC and epilepsy. Possible physiological links between these conditions and diseases such as depression have not been fully explored, and neither have the mental health implications of the extreme stigma and social isolation that this population endures. However, studying mental health in LMICs is challenging under the best of circumstances, and the challenges are particularly daunting in a country like Burkina, where many of the languages aren't written.

Brain Program Project Outcomes Case Study Summary
Award Numbers: R21TW006713; R01HD053131
PI: Richard Guerrant, MD
Professor, International Medicine, School of Medicine, University of Virginia
MFCs: Aldo Lima, MD, PhD
Professor and Director, Institute of Biomedicine/Clinical Research Unit/Center for Global Health, Federal University of Ceará, Brazil
Reinaldo Oriá, DVM, PhD
Adjunct Professor of Histology and Embryology, Institute of Biomedicine/Clinical Research Unit/Center for Global Health, Federal University of Ceará, Brazil
R21 Title and Start Date: APOE Genotype in Brazilian Children with Early Diarrhea
R01 Title and Start Date: APOE and the Effects of Malnutrition on Cognitive and Intestinal Development
Start Year(s): R21, 2003; R01, 2006
Co-funding IC(s): NICHD
Data Sources: Phone interview with Drs. Guerrant and Oriá; Survey responses from Drs. Guerrant and Oriá; Publications; Applications and progress reports

Highlights/Abstract

Dr. Richard Guerrant, Dr. Aldo Lima, Dr. Reinaldo Oriá and their team set out to explore the genetic determinants of physical and cognitive impairment which results from malnutrition and diarrheal burden in children born in poor urban areas of Northeast Brazil. A major, but unexpected, research finding was the protective effect of the "Alzheimer's gene", APOE4, for children suffering from malnutrition and diarrheal disease. Through long-term studies with impoverished children they found a striking association of APOE4, with protection from the cognitive developmental impairments. This finding was extended as they demonstrated this protective effect in murine models, using APOE knockout and APOE4 "knock-in" mice. The project's capacity-building strategies have leveraged the trust built from a long-established research collaboration and the support from several NIH training awards to develop the skills and careers of junior investigators in Brazil and the United States who value the benefits of international collaboration.

Background and Objectives

Dr. Richard Guerrant and Dr. Aldo Lima have been research collaborators since the 1980s, investigating children's health and development issues. Due to their International Collaborations in Infectious Disease Research program (ICIDR- U01 AI026512-16), now in its 25th year, they have a well-developed collaborative relationship. Their research efforts have focused on relieving the effects of severe diarrhea and its accompanying malnutrition that kill 1- 3 million children worldwide each year and developmentally impair many millions more children who survive repeated bouts of diarrhea. During the course of their careers, they have defined new etiologies, novel mechanisms and short-term and long-term impacts of persistent and recurring diarrheal illnesses on cognitive development. The goal of their R21-supported research collaboration with Dr. Oria was to establish the importance of genetic markers, such as APOE4, in the causal relationship between diarrhea, malnutrition and cognitive impairment, through active prospective surveillance in poor urban areas in Northeast Brazil. With the preliminary data collected from the R21 project, they applied for R01 support to test the hypothesis that early childhood diarrhea and malnutrition have long-term cognitive impairments consequences for children with the APOE4 "Alzheimer's gene" which might be ameliorated by specific interventions.

Research Outcomes

The project has contributed to 18 publications and 46 meeting abstracts and presentations. The primary research outcome of the project has been the discovery of highly significant correlations of the Alzheimer's-associated APOE4 allele in children with protection against diarrhea and malnutrition. Although, Drs. Guerrant, Lima and their colleagues, Drs. Reinaldo Oria and Peter Patrick found that shantytown children in Northeast Brazil suffering from diarrhea and malnutrition endured lasting cognitive deficits similar to those seen in patients with Alzheimer's disease, they were surprised to learn that some children are protected from developmental problems if they have the APOE4 gene. Additional investigations used APOE knock-out mice, exposed to severe malnutrition when put under premature weaning conditions to approximate the conditions of children living in poor settings of the developing world. With the introduction of human APOE4 genes into these mice, they saw protection against intestinal infection and malnutrition, thus extending the previous findings in APOE4-positive children.

Protection against Diarrhea and Malnutrition. The impact of malnutrition, heavy diarrheal burden, and multiple enteric infections in the early childhood years extends beyond immediate risks of morbidity and mortality. Maternal and childhood malnutrition is the underlying cause of nearly 3.5 million deaths and 35% of the disease burden in children younger than 5 years. Dr. Guerrant and Dr. Lima focused their research on shantytown children from Northeast Brazil who survive repeated bouts of diarrhea and malnutrition, but still suffer from impaired cognitive development, physical fitness, and growth. Because these children exhibited an "Alzheimer's-like" deficit in higher executive function and semantic fluency, they hypothesized the greatest negative impact on cognitive function would occur in children carrying the APOE4 allele which is associated with late-onset Alzheimer's disease. However, when they examined the children who experienced the heavier diarrhea burdens, those with APOE4 did significantly better in the cognition testing when compared with APOE4-negative children with similar diarrhea burdens. Positive correlations between APOE4 occurrence and semantic fluency persisted, even after adjusting for family income, maternal education, and breast-feeding.

"Balanced polymorphism" is the term used to describe how certain genetic alleles can be both selectively advantageous and potentially deleterious at the same or sequential times. The unexpected outcome of this project reveals that the same gene that poses increased risks for Alzheimer's disease, APOE4, appears to confer the survival advantage of protection against the cognitive impairment seen under the stress of heavy diarrhea and parasitic infections in early childhood. Whether this effect is an "antagonistic pleiotropy" denoting one gene controlling more than one trait, one beneficial and another deleterious remains unclear (depending upon whether the APOE4 effects are different traits or just different manifestations of the same trait at different life stages, either arguably making *senescence* "adaptive" in evolution, as long as heavy child diarrhea burdens persist!).

APOE Transgenic Mouse Studies. Based upon these findings, the R01 project went further to explore the roles of malnutrition and the APOE gene expression on intestinal maturation and brain development in transgenic mice challenged with early post-natal malnutrition. This challenge model involves early experimental weaning (maternal separation), much like the early weaning with consequent heavy diarrhea burdens and malnutrition that occurs in Brazilian shantytown children. Using APOE knock-out and human APOE4 "knock-in" mice, the team was able to demonstrate the growth protective effects of APOE4 under the stress of malnutrition and intestinal infection.

<u>Capacity Building Outcomes</u>

At the outset of the R01 project, the physical laboratory infrastructure at Federal University of Ceará was well-resourced by the Brazilian government, including 9,500 square feet of research support facilities. Therefore, a major capacity-building component of this project was to provide extensive project-specific training for the many junior Brazilian team members in order to complete the research. For many years, the University of Virginia and Federal University of Ceará have utilized capacity building activities leveraged from NIH FIC training awards to provide advanced research experiences to outstanding young investigators working from Brazil. This project builds upon the sustained and productive collaborations between the two institutions by training young investigators in novel genetic and molecular techniques and providing career enhancement opportunities when they present their research at national and international conferences.

<u>Next Steps</u>

Drs. Guerrant, Lima, and Oriá and colleagues are now applying for a NIH transformative grant to extend their

research to address biomarkers of the “impoverished gut” and the role that key nutritional interventions might play in ameliorating the developmental deficits seen in malnourished children from the developing world. Recently, their research has shown a role for nutrients, such as glutamine, in repairing intestinal function, ameliorating malnutrition, and improving child development. They are establishing collaborations with colleagues (Dr. Michael Vitek) at Duke University and (Dr. Sean Moore) Cincinnati’s Children’s Hospital’s researchers to study gut absorption and anti-inflammatory APOE mimetic peptides.

Brain Program Project Outcomes Case Study Summary
Award Numbers: R21TW006794/R01NS055349/R01HD064416
PI(s): Chandy John, MS, MD (R21, first R01, third R01 [renewal])
Professor of Pediatrics and Medicine, Director, Division of Global Pediatrics, University of Minnesota

Michael J. Boivin, PhD, MPH (second R01)
Professor in Psychiatry and in Neurology/Ophthalmology, Michigan State University;
Adjunct Research Investigator in Psychiatry, University of Michigan, Ann Arbor

MFC(s): Richard Idro, MBChB, MMed, PhD (R21, first R01, third R01)
Pediatrician, Department of Paediatrics and Child Health, Mulago Hospital, Kampala, Uganda; Honorary Lecturer, Department of Paediatrics and Child Health, Makerere University, Kampala, Uganda

Robert Opoka, MBChB, MMed, MS (R21, first R01, third R01), Pediatrician, Department of Pediatrics, Mulago Hospital, Kampala, Uganda; Senior Lecturer, Department of Paediatrics and Child Health, Makerere University, Kampala, Uganda

Paul Bangirana, PhD, MS (first, second and third R01s), Lecturer, Department of Psychiatry, Makerere University, Kampala, Uganda

Noeline Nakasujja, MBchB, MMed (Multiple PI on second R01)
Clinical Faculty in Psychiatry, Makaerere University College of Medicine, Mulago Hospital, Kampala, Uganda

R01 Project Title: Pathogenesis of Cognitive/Neurologic Deficits in Central Nervous System Malaria; Computerized Cognitive Rehabilitation in Children after Severe Malaria
Start Date(s): 2003 (R21), 2008 (John R01), 2011 (Boivin R01), 2014 (John R01 renewal)
Co-funding IC(s): NINDS, NICHD
Data Sources: Phone interview with Dr. John; Survey responses from Drs. John, Boivin, and Nakasuja; Publications; Applications and progress reports

Highlights/Overview

The over-arching goal of this project was to characterize the impact of severe malaria in childhood on cognitive function. The R21 study focused on assessing cognitive impairment in children age 5-12 years with cerebral malaria. The first R01 study followed up with assessment of cognitive impairment in children 18 months to 12 years with cerebral malaria or severe malarial anemia, evaluating pathways that might lead to impairment; a recently-funded renewal will assess pathways that lead to cognitive impairment in the 5 most common forms of severe malaria. The second R01 study is evaluating the effectiveness of an intervention called Computerized Cognitive Rehabilitation Therapy (CCRT) in improving neuropsychological performance in Ugandan children who survive severe malaria. Major study findings include documentation of a large burden of cognitive impairment from not only from cerebral malaria but also from severe malarial anemia, a more common condition that has not previously been linked with cognitive impairment. Major capacity-building accomplishments include in-depth training for project and general medical staff in clinical and technical skills, establishment of a Center for Severe Malaria Research in Uganda, development of a pediatric intensive care unit, and contributions to training for students supported by other sources (including a D43 training award) in the areas of neuropsychology, immunology, epidemiology, clinical research and administration.

Background and Objectives

Malaria is a leading cause of death in children under 5 years of age in Uganda, but its impacts on survivors have not been well characterized. The objective of this set of projects has been to characterize the impact of malaria on cognitive function. Dr. Chandy John and Dr. Richard Idro had collaborated previously on malaria studies in the highlands of Uganda. Dr. Michael Boivin brought experience with neuropsychological assessment in young African children, including children with malaria, to the collaboration. The project was conducted at Mulago Hospital and Makerere University in Kampala, Uganda.

The R21 study, led by Drs. John, Idro, and Opoka, focused on assessing cognitive impairment in children age 5-12 years with cerebral malaria. The first R01 study, with the same leadership team, followed up with assessment of

cognitive impairment in a cohort of children 18 months to 12 years with cerebral malaria or severe malarial anemia, evaluating pathways that might lead to impairment. A recently-funded renewal will assess pathways that lead to cognitive impairment in the 5 most common forms of severe malaria in the era of artesunate treatment. The second R01 study, led by Drs. Boivin and Nakasujja, is evaluating the effectiveness of an intervention called Computerized Cognitive Rehabilitation Therapy (CCRT) in improving neuropsychological performance in a subset of Ugandan children from the cohort who survive severe malaria. A third R01-level study, funded by a U01 grant from NICHD separate from the Brain Program, was also nested within the first R01 study and assessed the effect of acute vs. delayed iron treatment in severe malaria.

Research Outcomes

This group of awards has generated 26 publications to date, including publications in *Pediatrics*, the *Journal of Infectious Diseases*, the *American Journal of Tropical Medicine and Hygiene*, and the *Malaria Journal*. Major research accomplishments include adaptation and validation of neuropsychological tests for young children and documentation of a higher than expected burden of cognitive impairment following both cerebral malaria and severe malaria anemia.

Adaptation and validation of neuropsychological tests for young children in Uganda. The initial R21 study included adaptation and validation of neuropsychological tests for children developed at the University of Minnesota, all of which were new to Sub-Saharan Africa, and the R01 study helped to validate these tests in a larger population over time. Researchers at the University of Washington are now using these tests for studies in Kenya, and numerous other research groups have inquired about the tests and plan to assess and adapt them for use in other countries.

Findings on cognitive impairment in severe malaria. The R21 study showed that approximately 25% of children with cerebral malaria had cognitive impairment two years after the episodes. The R01 cohort study included younger children and additional genetic and immunologic data in an attempt to assess what factors may lead to cognitive impairment. Preliminary data from the R01 study suggest that children with severe malaria anemia also have significant cognitive impairment. This is a particularly important finding because this condition is far more common than cerebral malaria, so the cognitive impairment burden from severe malarial anemia may be very high. The team is still investigating the pathways that may lead to cognitive impairment.

Capacity Building Outcomes and Impacts

Drs. Opoka, Idro and Bangirana led the assessment of needs for capacity-building at Mulago Hospital and Makerere University. The overall strategy was to leverage existing strengths in clinical research to create complementary strengths in neuropsychology, epidemiology and immunology research. Establishing a Severe Malaria Research Center was a major capacity-building strategy. Project staff received “core” training in project protocols as well as broader training in clinical research and infectious diseases, and this support helped to enable improved care of patients throughout the hospital as project staff moved on to new positions at Mulago Hospital. The project also contributed to training of students and post-doctoral fellows in the areas of neuropsychology, immunology, epidemiology, clinical research and administration. Finally, the project provided key support in training and equipment that enabled development of a pediatric intensive care unit.

Severe Malaria Research Center. The project contributed to the establishment of a Severe Malaria Research Center at Makerere University. In addition to training faculty and staff, the project helped to secure space and establish a data center that also assists the department of Pediatrics. Internet and server infrastructure were developed through additional funding from MIMCOM. Funds from the project, the University of Minnesota, and other grants were combined to equip the Center with a basic science laboratory, clinical instrumentation, indirect ophthalmoscopes, an EEG machine, and equipment for neuropsychological testing. These resources have helped the Center to develop and support multiple subsequent research studies, including studies on iron deficiency, sickle cell disease, and severe anemia.

“Core” training for project staff. At the start of each study, several multi-day workshops have been held in order to provide all of the project staff members with background on infectious diseases, malaria, neuropsychology testing and other aspects of the project. Attendees included medical officers, nurses, data managers, EEG technicians, and lab staff. The workshops have also been attended by nurses and medical staff not directly involved in the study.

Additional workshops have focused on topics such as clinical study design and scientific writing. Individual project staff members received mentored training in emergency triage, identification of severe malaria, seizure management, and other clinical and technical skills. Medical officers received more extensive mentored training in the neuropsychological testing and home environment testing required to collect study data. Senior ophthalmologists from the Malawi-Wellcome Trust research group came to Kampala to provide training of medical staff in indirect ophthalmoscopy for identification of malaria retinopathy (a clinical marker that correlates with sequestration, which is felt to underlie the pathogenesis of cerebral malaria). Dr. Gretchen Birbeck, the Principal Investigator on three other Brain Program projects in Sub-Saharan Africa, provided training to the study pediatrician and neurologist in EEG testing and reading as a consultant.

Research training. The project, in combination with funds from the University of Minnesota and a NINDS/FIC D43 training grant, has supported training of Ugandan students in the areas of neuropsychology, immunology, epidemiology, clinical research and administration. Trainees have included 2 diploma level students, 5 Masters students, 5 PhD students, and 1 post-doctoral fellow.

Contribution to development of a Pediatric ICU. Project funds were combined with contributions from the University of Minnesota to purchase upgraded equipment for acute care of critically ill children, including an oxygen concentrator and flow meter, pulse oximeters, glucometers, and blood pressure cuffs. In addition to the training workshops, medical officers, residents and nurses also received specialized training in emergency care and triage and in care of very sick children. Combined, these equipment upgrades and training enabled development of a 24-hour Pediatric Intensive Care Unit at Mulago Hospital.

Next Steps

The team recently received funding for a renewal study from the first R01 study, with the goal of exploring whether cognitive impairment occur after other common forms of severe malaria. In particular, the investigators hope to learn which pathways lead to cognitive impairment after severe malaria and whether these pathways are different for different forms of severe malaria. When those studies are complete, the team hopes it will be possible to develop and test specific interventions to prevent cognitive impairment after severe malaria. The study team also hopes to continue to advance research infrastructure and capacity at Mulago Hospital and Makerere University, as many areas, such as the Pediatric ICU, still require additional support and development.

Brain Program Project Outcomes Case Study Summary
Award Numbers: R21AG024063/R01AG029802
PI: Kenneth Kosik, MD, MPH, DTMH, FAAN
Co-Director, Neuroscience Research Institute, University of California, Santa Barbara
MFC: Gloria Patricia Cardona-Gomez, PhD
Professor of Neuroscience and Cellular and Molecular Neurobiology and Researcher, Universidad de Antioquia, Medillin, Colombia
R01 Project Title: Development of RNAi as Treatment for Neurodegeneration
Start Date(s): 2004 (R21), 2007 (R01)
Co-funding IC(s): NIA
Data Sources: Phone interview with Dr. Kosik; Survey responses from Drs. Kosik and Cardona-Gomez; Publications; Applications and progress reports; Media reports about the API trial

Highlights/Overview

The over-arching goal of this project was to build capacity for basic neuroscience research at the University of Antioquia, which is located in the heart of a region of Colombia plagued by neurogenetic conditions including a form of early-onset Alzheimer's disease. Major research accomplishments include studies with transgenic mouse models of Alzheimer's that resulted in identification or further refinement of possible targets for gene therapy. Capacity-building accomplishments include extensive training for senior Colombian collaborators in US laboratories and the establishment of a transgenic mouse colony and infrastructure for laboratory research in Colombia. In addition, the PI argues that these capacity-building efforts in basic neuroscience served as an entry point for collaboration that eventually resulted in a groundbreaking, $100M clinical trial for Alzheimer's prevention that is based primarily in the Antioquia region.

Background and Objectives

The origins of this collaboration go back many years, when Dr. Kosik was invited by a colleague to visit Colombia and subsequently became interested in developing capacity for neuroscience in Latin America. In the early 1990s, he was approached at a lecture by Dr. Francisco Lopera, Chief of Neurosciences Program at the University of Antioquia, who was studying a group of related families (around 5000 individuals) in the rural areas around Medallin with a very high prevalence of Alzheimer's-like dementia. A long-term collaboration was established between Dr. Lopera and Dr. Kosik focused on genetic and epidemiologic investigation of what turned out to be a form of early-onset Alzheimer's disease caused by a single mutation, nicknamed Paisa after the word for "countrymen" that the locals of this Basque-influenced region use to refer to themselves. The purpose of the Brain Program project was to expand the existing collaboration between Dr. Kosik and Dr. Lopera's group to include basic neuroscience research. Dr. Patricia Cardona-Gomez, a Colombian neuroscientist who had just completed training at the Cajal Institute in Spain, returned to Colombia to lead the effort.

The research objectives of the R21 project were to assess RNAi gene suppression for Alzheimer's Disease and Huntington's Disease in a culture system and to prepare viral vectors for gene suppression in transgenic animal models of these diseases. The R01 project focused on using transgenic animal models to answer questions about the cause and possible treatment of neurofibrillary pathology in Alzheimer's. Specifically, the objectives were: 1) to test whether suppression of Cdk5 via RNAi delivered in a viral vector can modify neurofibrillary pathology in an animal model; and 2) to test whether whether BACE1 inhibition by RNAi delivery can retard or prevent the

development of neurofibrillary pathology in an animal with both plaques and tangles.

Research Outcomes

There have been 3 publications associated with this project to date. Journals include *Reviews in the Neurosciences, Journal of Neuroscience*, and *Human Mutation*. The R21 research focused on suppression of BACE1, for which reagents had already been developed by the Kosik lab. The R01 project expanded the scope of inquiry to include Cdk5 as an additional target. Significant research accomplishments include use of RNAi in novel ways and evidence to support both Cdk5 and BACE1 as targets for further study.

Novel research techniques using RNAi. The team implemented a collaboration with the lab of Beverly Davis at the University of Iowa and an international expert on viral delivery. The techniques adapted by the Colombian laboratories involved using a microRNA backbone inserted in a viral vector such as AAV to suppress genes in a host animal.

Identification of targets for Alzheimer's therapeutics. Findings suggest that both CDK5miR and BACE1/Hsc70 have potential as agents for Alzheimer's gene therapy. CDK5 miR produces neuroprotection, spine morphogenesis and synaptic proteins association in neuronal primary cultures. BACE1/Hsc70 has an inverse relationship in lipid rafts of AD brains, preventing the association of HSC70/LAMP2 to induce PHF-1 clearance by autophagy-lysosomal system.

Capacity Building Outcomes and Impacts

In general, the capacity-building goal for this project was to establish a research program in basic neuroscience at the University of Antioquia to complement and support the existing clinical research program and to meet the unique needs of a region plagued by neurogenetic problems. Major capacity-building accomplishments include extensive training in the US for the senior Colombian investigators and the establishment of a transgenic mouse colony, viral vector core, and related laboratory facilities at the University of Antioquia. In addition, Drs. Kosik, Lopera, and Cardona argues that the capacity building efforts of the Brain Program project actually helped to enable the trial itself by creating a new entry point for collaboration with outside investigators, helping to build trust and goodwill, and creating opportunities for synergy between basic and clinical research. Dr. Kosik also expressed hope that the collaborative approach this project helped to establish can serve as a model for future clinical research in Antioquia and other LMIC regions.

US-based training for Colombian investigators. During the R21 period, Dr. Cardona and a senior collaborator made an extended visit to the US to receive training at the Kosik lab, the lab at UC Irvine that provided the triple transgenic mice, and the lab of a collaborator at the University of Iowa that specializes in design and construction of viral vectors. They returned to the US for eight months during the R01 period for additional training, accompanied by a Colombian PhD student whose dissertation was based on the Brain Program project. Two Colombian technicians were also supported to make shorter visits to Dr. Kosik's lab. Upon their return, Dr. Cardona and the other collaborators disseminated their new knowledge to students and colleagues at the University of Antioquia. Two of these students subsequently completed PhD training with Dr. Kosik at UCSB.

Impact on Dr. Cardona's Career. This project enabled Dr. Cardona to return to Colombia and establish herself as an independent researcher. She received extensive bilateral training as described above. She was also promoted to full professor, largely on the strength of the Brain Program project and its outputs.

Establishing a Transgenic Mouse Colony, Gene Therapy/Viral Vector Core, and Laboratory Infrastructure. During the R21 period, research space, a vivarium, stereotactic injection procedures, and microscopy were established at the University of Antioquia. The R01 enabled the establishment of a breeding colony of the 3xTg AD mice transferred from the LaFerla lab at UC Irvine. A core facility for gene therapy and viral vectors was also equipped with R01 funds and will be available to generate viral vectors for future research projects.

Contribution to API prevention trial in Colombia. A high profile, $100M clinical trial for Alzheimer's prevention was launched in 2012 by a group that includes Banner Alzheimer's Institute, the University of Antioquia and Genentech. NIA contributed roughly $15M to help launch the initiative. The trial will study an experimental anti-amyloid antibody treatment called crenezumab in approximately 300 members of the Antioquian family with the Paisa mutation, plus a smaller number of subjects in the US. The Antioquian region is a unique resource for this type of trial because the Paisa mutation is highly prevalent and results in a very predictable pattern of disease at a

relatively young age. There is no question that the collaborative efforts of Drs. Kosik and Lopera laid the groundwork for the trial, and Dr. Lopera will serve as one of the lead investigators. However, Dr. Kosik argues convincingly that the research capacity-building efforts in basic neuroscience supported by the Brain Program program also played a key role. Specifically, he argues that collaborative research in basic neuroscience served as an entry point for serious collaboration between Colombian researchers and the international community on Alzheimer's research. Having built close, collaborative relationships and intellectual energy is what allowed for trust to develop between the researchers, and that eased the transition into the community for the clinical study. The first reaction of communities like this one to outside researchers is usually suspicion, but an integrated, collaborative, long-term investment in the region helped to break down those barriers in this case.

Model for Responsible Study of Genetic Conditions in LMIC Populations. Because of its unique genetic heritage and mountainous terrain, the Antioquia region appears to be a living genetic laboratory; the Paisa-mutation is just one of several rare genetic conditions that are concentrated in this population. Dr. Kosik expressed hope that the long-term collaboration between his group and Dr. Lopera's, which has included full partnership for the Colombians and intensive capacity-building for both basic and applied research, can be a model for future studies in Colombia and throughout the developing world. The model has not yet been documented as such, but the clinical trial has generated interest from the international research community as well as the media. In 2010, a story about the plight of the Antioquian families and the upcoming trial appeared on the front page of the New York Times. The team was also recently approached by the producers of Nova about a possible television documentary.

Next Steps

Dr. Kosik and Cardona-Gomez are committed to finding new sources of funding to continue their collaboration. They believe it is still necessary to sustain a basic research training program in Colombia to complement the ongoing clinical trial. For example, there may be an opportunity to use biopsies from affected family members to clone their neurons using iPS techniques. However without the research and training capacity in place, it will be challenging to conduct this research in-country. .

Brain Program Project Outcomes Case Study Summary
Award Numbers: R21TW007997;
PI: Vishwajit L. Nimgaonkar, MD, PhD
Professor of Psychiatry, School of Medicine, University of Pittsburgh
MFC: Hader A. Mansour, MD, PhD
Instructor, Department of Psychiatry, University of Pittsburgh & Lecturer, Mansoura University Hospital, Egypt
R21 Title: Building Sustainable Research Capacity at Mansoura Egypt
R01 Title: Multi-pronged genetic studies of schizophrenia in an inbred population
Start Year(s): R21: 2007; R01: 2012
Co-funding IC(s): N/A
Data Sources: Phone interview with Dr. Nimgaonkar; Survey responses from Dr. Nimgaonkar; Publications; Applications and progress reports

Highlights and Objectives

Drs. Vishwajit Nimgaonkar and Hader Mansour, and their team planned to use a focused research project-based approach to accomplish two objectives: 1) investigate the hypothesis that there is increased consanguinity (inbreeding) among parents of patients with schizophrenia (SZ) in the Nile delta region; and 2) enable research capacity development in Egypt. The team has demonstrated that the consanguinity rates are significantly elevated among Egyptian SZ patients and gene mapping studies are currently being conducted to identify genetic variables associated with SZ risk. Built upon lessons learned from previous collaborations between the U.S. and India, this project has facilitated training of several Egyptian junior psychiatrists in clinical evaluation, molecular genetic techniques, statistical analysis, and ethical conduct in research. The PI and co-PI used the project to leverage matching funds and establish the brand new "Psychiatric Genetics Unit" at Mansoura University. They hope the resources and expertise garnered through this work can address the neglected state of schizophrenia research in the Middle East.

Background and Objectives

Prior to this project, Dr. Mansour trained in medicine and completed residencies at Mansoura University in Egypt. The collaboration between Drs. Nimgaonkar and Mansour began in 2000 when Dr. Mansour, then a junior faculty member at Mansour University, came to University of Pittsburgh for graduate training on an Egyptian government scholarship. He trained under Dr. Nimgaonkar for five years, mastering laboratory techniques related to psychiatric genetics. As Dr. Mansour returned to a faculty position at Mansoura University, they viewed this program as a way to maintain their collaboration, develop research capacity in Egypt, and investigate schizophrenia genetics in the region. The objectives of the R21 project were to gain a better understanding of how consanguinity (inbreeding) among parents of patients with schizophrenia (SZ) or schizoaffective (SA) disorder contributes to the prevalence of these disorders. In the longer term, they expect to use this research project to collect data for future R01 grants and assemble a sustainable core of research personnel and infrastructure at Mansoura University. Despite recent political disturbances, U.S. and Egyptian collaborators have steadfastly continued their research. Drs. Nimgaonkar and Mansour maintain that the current political situation has not impacted research at Mansoura University, where the atmosphere is less politically charged than in Cairo. Ultimately, Dr. Nimgaonkar intends to transition the direction of the study to Dr. Mansour and his Egyptian colleagues.

Research Outcomes

The project has contributed to several publications in *Psychiatry Research, Schizophrenia Research, and American Journal of Medical Genetics*, describing new knowledge that there is an increased consanguinity among patients with SZ in the Nile delta region of Egypt. Drs. Nimgaonkar and Mansour and their team found that consanguinity rates are significantly elevated among Egyptian SZ patients in the Nile delta region. Consanguineous marriages occur among diverse ethnic groups across the world, and in Middle Eastern populations, approximately 20 – 70% of marriages are between consanguineous individuals. This research might help address the growing concern in the Middle East about the public health impact of consanguinity.

Dr. Nimgaonkar and his colleagues have developed several neurocognitive assessment tools that could be used to

facilitate future research in Egypt in this area. His team has translated and back-translated, from English to Arabic, the Penn computerized neurocognitive battery (CNB), the Sleep Timing Questionnaire, and the Composite Scale for use in the project. They have also developed a biospecimen repository to enable investigators at Mansoura University to conduct DNA analysis for current and future studies.

The team is also using homozygosity by descent (HBD) analysis to conduct SZ gene mapping studies, a novel study for participants of Middle Eastern ancestry. Their preliminary studies suggest there may be genetic variables associated with SZ risk. These conclusions were developed based on findings of the exploratory R21 project, and are similar to those observed with earlier bipolar disorder studies from Dr. Nimgaonkar's laboratory. In recognition of the public health relevance of consanguinity in the Middle East, developing expertise in genomics research is a major focus for the R01 period of the project.

Capacity Building Outcomes

The R21 project itself was designed to be the basis for capacity building activities at Mansoura University and in the Egyptian research community. Dr. Nimgaonkar's strategy -- using a focused research project to enable infrastructure and research capacity development -- was modeled after lessons learned from a similar collaboration with Nohar Lohia Hospital in New Delhi, India. The project facilitated training for Egyptian psychiatrists in clinical evaluation, molecular genetic techniques, statistical analysis, and ethical conduct in research based upon training modules Dr. Nimgaonkar previously designed. In addition to training individual researchers, new equipment was purchased for molecular genetic research, bioinformatics, computation, and genome sequencing. Moreover, Drs. Nimgaonkar and Mansour used the project itself to leverage additional financial support from Mansoura University to establish dedicated laboratory facilities for psychiatric genetics.

Training for Egyptian Psychiatrists. During the R21 project period, six junior faculty psychiatrists were selected from Mansour University to be trained in clinical evaluation techniques using didactic and experiential approaches at the University of Pittsburgh and Mansour University. The selected trainees all hold junior faculty positions as lecturers in Mansoura University's Department of Psychiatry. Assisted by U.S. investigators and research staff, Dr. Mansour led research training modules in clinical evaluation, molecular genetic techniques, statistical analysis, and ethical conduct in research at Mansoura University, with supplemental workshops at the University of Pittsburgh. Bi-weekly phone calls to University of Pittsburgh, video links and an electronic bulletin board ensured continued training and communication. Through this training these junior psychiatrists are now empowered to pursue individual research projects in areas of their choosing, such as psychopathology associated with mood disorders, reproduction and fertility in patients with bipolar disorder, and comorbidity associated with pervasive developmental disorders.

Three additional Egyptian junior psychiatrists are earning their doctorate degrees in psychiatric genetics, and each trainee will have a local mentor and a U.S. mentor. Their training is linked to the ongoing Brain Program R01 research project, and supported through a FIC/NIMH D43 training grant. For example, one Mansour University student translated the Penn computerized neurocognitive battery (CNB) from English to Arabic as part of her research on cognitive functions of schizophrenia patients. Another PhD candidate is studying schizophrenia and cognitive impairment due infectious neurotropic organisms. She visited the University of Pittsburgh from May - September 2011, and attended courses in Biostatistics, Genetics and Psychology at the School of Public Health. All of the trainees attended annual grant writing workshops and were provided additional training in assessment and diagnostic procedures as needed. In addition, they received training in high throughput genotyping, bioinformatics, and data management for the genome sequencing analysis components of their projects.

Equipment and Infrastructure. Using the R21 grant and matching funds from Mansour University, Drs. Nimgaonkar and Mansour secured 200 square feet of laboratory space at the university dedicated to psychiatric genetics. With the R01 grant, the dedicated space grew to 600 square feet and was officially named the "Psychiatric Genetics Unit". The R21 and R01 awards have also been used to equip the laboratory with a qPCR machine, desktop computers, annual software licenses and external hard drives to handle genome wide association study files. Establishing and equipping this research unit enabled the investigators at Mansoura University to form a collaboration with the National Research Center (NRC), an Egyptian government funded research institution.

Next Steps

Since the start of the R01 in December 2012, Dr. Nimgaonkar and his colleagues have obtained approval from the IRBs at Mansoura University and the University of Pittsburgh to collect blood samples and use HBD analysis to identify novel genetic polymorphisms associated with schizophrenia risk. They will continue recruiting participants and collecting samples to reach target numbers for the study cohorts. They will also continue capacity building activities, including intensive training in bioinformatics and data management for Egyptian investigators.

Brain Program Project Outcomes Case Study Summary
Award Numbers: R21NS048838; R01NS055627
PI: Desiré Tshala-Katumbay, MD, PhD
Associate Professor, Neurology, School of Medicine, Oregon Health & Science University
Co-Investigator: Michael Boivin PhD, MPH
Associate Professor, Neurology & Psychiatry, Michigan State University (MSU), Michigan
MFC:
Tamfum Muyembe, MD PhD
Professor, Faculty of Medicine, Kinshasa University & Director National Institute of Biomedical Research (INRB), Democratic Republic of Congo

Kazadi Kayembe, MD, PhD
Professor, Faculty of Medicine, Kinshasa University, DRC

R21 Title: Food (cassava) cyanogen exposure and motor neuron degeneration
R01 Title: Toxicodietary and genetic determinants of susceptibility to neurodegeneration
Start Year(s): R21, 2009; R01, 2010
Co-Funding IC(s): NIEHS

Highlights/Abstract

With support from the Brain Program, Drs. Desiré Tshala-Katumbay, Tamfum Muyembe, and Kazadi Kayembe and their team conducted studies to characterize and understand biomarkers and mechanisms of the motor and cognitive deficits associated with cassava (food) toxicity. They were among the first to characterize cognitive deficits associated with cassava cyanogenic toxicity, thereby revealing the dramatic underestimation of the disease burden in populations in Sub-saharan Africa. The team has also identified novel disease biomarkers that can be used to predict motor and cognitive deficits in konzo patients. The project has also led to cooperation with the DRC Ministry of Health, World Health Organization (WHO), Food Agriculture Organization (FAO), and other non-governmental organizations such as the International Brain Research Organization (IBRO) and the International Society for Neurochemistry (ISN), Third World Medical Research Foundation (TWMRF), for training activities, information sharing and other events. Finally, the project has helped to build the limited research capacity in the war-torn Democratic Republic of Congo and neighboring countries.

Background and Objectives

Cassava is a staple crop for more than 400 million people dwelling under the tropics, but it also contains toxic compounds that are implicated in the paralysis of legs and other diseases of the nervous system. Prior to this project, Dr. Tshala-Katumbay conducted his doctoral research on these phenomena, known locally as konzo, in his native country of Democratic Republic of Congo (DRC). Epidemiological studies showed an association between outbreaks of konzo, low dietary intake of proteins, and chronic dietary reliance on linamarin-containing cassava as staple food. However, the mechanism by which cassava contributes to neurodegenerative disease is unclear. This research project brings together collaborators from the Oregon Health & Science University, Michigan State University, University of Kinshasa, DRC Ministry of Health, and INRB (Congo-based national biomedical research institution) to elucidate the toxicodietary and genetic determinants of susceptibility to konzo. The objective of the R21 grant was to develop a laboratory model to understand why cassava consumption causes paralysis and build research capacity through training of young DRC researchers. The goals of the R01 grant are to characterize the clinical pattern of neurodegenerative effects associated with cassava toxicity, determine whether genetic polymorphisms increase the risk of disease, and continue the capacity building activities initiated during the R21 period.

Research Outcomes

The project has contributed to 8 publications in journals such as *Neurology, Journal of Molecular Neuroscience, Food and Chemical Toxicology, and Pediatrics*. The major research outcome of the project is the identification and characterization of the cognitive deficits associated with konzo, the cassava- related toxic disease. As in other cassava-dependent Sub-Saharan countries (e.g., Cameroun, Central African Republic, Mozambique, Tanzania) konzo heavily affects children, often causing paralysis. While the neuroepidemiology of konzo and paralysis phenotype are well characterized, Dr. Tshala-Katumbay and his colleagues were the first to show that children who rely on the same diet, but not paralyzed, perform worse on neuropsychological tests than children from areas not affected by konzo. Those results indicate that the burden of cassava poisoning and toxicity is even higher than that previously known. In addition, the project has also identified novel disease biomarkers that can be used to predict cognitive deficits in konzo patients. The research team found that low levels of albumin and high levels of isoprostanes (markers of oxidative damage) in patient serum are risk factors for konzo. The project has also led to cooperation with the DRC Ministry of Health, WHO, FAO and other non-governmental organizations for training activities and other events. The project's findings have been instrumental in improving scientific understanding of this disease, which affects populations throughout Sub-saharan Africa, while addressing additional issues of global health and security concerns.

Cognitive Deficits Associated with Konzo. This project supported the first epidemiological studies of konzo in Congo with a focus on the neurocognitive impairment within cassava-reliant populations. Clinical patterns of motor and cognitive deficits were ascertained by neuropsychological testing of school-age children in a cross-sectional study. In addition to elucidating paralysis risk factors, the research team also found that children who rely on insufficiently processed cassava display dramatic cognitive impairments. This new finding indicates the overall burden associated with cassava-related diseases has been underestimated and public health intervention measures should be expanded.

Identification of Biomarkers and Genetic markers. The goals of the R01 included investigating whether these cognitive impairments are related to nutritional deficiencies, genetic polymorphisms, or other biomarkers. Biomarker studies showed a distinct pattern of oxidative damage suggesting that oxidative stress may play a pathogenic role in cassava-associated motor and cognitive deficits. They also determined that low levels of albumin and high levels of isoprostanes in patient serum may be good markers for such deficits. Genetic studies are exploring whether polymorphisms in the chief cyanide-detoxifying enzyme, thiosulfate sulfur transferase (TST), may impact TST activity in populations relying on cassava as a staple food. While the results of the genetic studies are still being analyzed, the identification of biomarkers may prove to be a useful tool in predicting cognitive deficits. Moreover, this work has contributed to a repository of biospecimens of plasma, serum, urine and DNA from 300 subjects which can be used for future research in this area.

<u>Capacity Building Outcomes and Impacts</u>

Because of the recent wars in the DRC, Dr. Tshala-Katumbay's approach to capacity building priorities began at a very basic level. He cited the major challenge he found was attracting the interest of young people, academics and clinicians around conducting biomedical research. He found that a majority of the DRC medical community was in private practice just to survive and there was very little infrastructure or equipment for research purposes. In addition, he found it difficult to assess if the young people trained in a war climate were technically and ethically responsible enough to conduct the necessary research. Drs. Tshala-Katumbay, Kazadi Kayembe, and Tamfum Muyembe met with local investigators, faculty, and staff at the Ministry of Health, to assess needs and strategy for

research capacity building at University of Kinshasa Neuroscience Center. With help from the International Brain Research Organization (IBRO), they developed training workshops and symposiums with an emphasis on ethics, research design and methodology, and neurotoxicity. Longer term capacity building activities includes training Ph.D. candidates, hosting a series of cooperative workshops at the National Institute for Biomedical Research (INRB), building collaborative ties between the University of Kinshasa and the national institute for biomedical research (INRB), and establishing an IRB at the INRB. Dr. Tshala-Katumbay has also leveraged the project's scientific success to build strong connections with international health advocacy organizations and DRC government officials.

Training activities. During the R21 grant period, several training activities were initiated to trigger interest in neuroscience and neurotoxicology research. These included a ten-day neuroscience/neurotoxicity training course for 17 junior researchers, a workshop on "Research Design and Methodology in The Developing World", and research training for 2 promising graduate students and one postdoctoral scientist. The training activities started under the R21 leveraged $29,000 in additional support from International Brain Research Organization (IBRO) and Third World Medical Research Foundation (TWMRF) to organize and advanced neuroscience workshop on "Diet, Toxins, and Neurodegeneration". The workshop attendees included faculty from US, Europe, Africa, and Students from African countries such as Congo, Rwanda, Cameroun, and Ethiopia.

To sustain this capacity building on limited funds, Dr. Tshala-Katumbay created a partnership with DRC INRB, a worldwide leader on hemorrhagic fever research, which is headed by Dr. Tamfum Muyembe. The partnership gave the young trainees exposure to a well-equipped institution and was instrumental in building connections between the university system and the government. A junior faculty, Dr. Mumba Ngoyi MD PhD, was able to grab the fundamentals of grant writing and NIH submission and submitted a R21 application to FIC. The grant that, if funded, will focus on the interaction between nutritional toxicity and infection on the occurrence of epilepsy. Finally, though another small training grant from IBRO, training in neuropsychological testing has been extended to Rwanda, a DRC neighboring country that is desperately in need of research capacity building in this area.

Government and NGO cooperation. At an early stage of the project, Dr. Tshala-Katumbay met with the Minister of Higher Education who expressed government's gratitude and provided a letter of support, copies of which were sent to FIC. Following the meeting, the government put additional efforts into remodeling the laboratory infrastructure at the University Neuroscience center (CNPP). Dr. Tshala-Katumbay developed cooperative connections with the Congolese government to the extent that the Head of Nutrition at the DRC Ministry of Health, Dr. Banea Mayambu, MD PhD, became one of the co-investigators on the R01 grant.

Furthermore, the PI and co-PIs met with high-profile officials in the DRC and academicians to increase awareness on the issue of cassava neurotoxicity and secure multidisciplinary support from the Congolese government. These meetings led to the organization of (1) One workshop on "Research Design and Methodology" organized by the PI at the Neurology Center of the University of Kinshasa to prepare young investigators for epidemiological work on the field; (2) One workshop on "Neuropsychological Testing" at the National Institute for Biomedical Research (INRB); and (3) One "awareness" conference in which study preliminary findings were presented to biomedical scientists and representatives of the Congo Government, World Health Organization, and Food and Agriculture Organization. The company "Solar World," a world leader in sustainable energy, has extended their support to the Congo project through the OHSU Global Health Center led by Dr. Peter Spencer and TWMRF led by Valerie Palmer, by donating 12 modules of solar panels to help solve energy problems in the villages affected by konzo.

<u>Next Steps</u>

At this stage of the project, Dr. Tshala-Katumbay and his team have characterized consistent findings that cassava-related toxicity is responsible for motor and cognitive deficits using both small animal experiments and human clinical studies. The next step involves conducting "field work" to determine effective public health interventions that will reduce the population's dietary cyanide load and reduce the disease burden. During the R01 stage to the project, the PI and co-investigator Dr. Banea Mayambu developed collaborations with Dr. Howard Bradbury and team, funded by the Australian Agency for International Development. AusAID scientists developed a method to process cassava that would reduce the cyanide load associated with consumption of this staple crop. Drs. Tshala-Katumbay and Banea Mayambu's team at the DRC Ministry of Health, and AusAID-funded scientists worked

together to investigate whether this might constitute an effective intervention. They determined that there were no new cases of konzo in villages that have adopted the cassava processing method. The team will reapply for R01 funding within 12-18 months in order to expand these studies by conducting controlled trials in DRC villages, examining cyanide loads, biomarkers, and clinical outcomes. Dr. Tshala-Katumbay also plans to submit a D43 training grant application to FIC to provide a more robust training support for the project's graduate researchers.

Brain Program Project Outcomes Case Study Summary
Award Numbers: R21DA018086; R01DA021421
PI: Jasmin Vassileva, MD
Assistant Professor, Department of Psychiatry, School of Medicine, University of Illinois at Chicago
MFCs: Stefan Georgiev, MD, MPH
University Hospital, Department of Neurology & Psychology, Sofia, Bulgaria
Georgi Vasilev, MD, MPH
Bulgarian Addictions Institute
R21 Title and Start Date: Neuro-Cognitive Aspects of Opiate Abuse & Antisocial Behavior
R01 Title and Start Date: Varieties of Impulsivity in Opiate and Stimulant Users
Start Year(s): R21, 2003; R01, 2008
Co-funding IC(s): NIDA
Data Sources: Phone interview with Dr. Vassileva and foreign collaborator, Dr. Georgi Vasilev ; Survey responses from Drs. Vassileva and Vasilev; Publications; Applications and progress reports

Highlights/Abstract
With support from the Brain Program, Dr. Vassileva and colleagues conducted studies to understand and characterize the effect of monosubstance drug use on neurocognitive function. The primary research outcome of the project has been the novel characterization of decision-making deficits and their specificity to a particular type of drug use. The project has propagated additional studies on dimensions of impulsivity that are closely related to high-risk sexual and injection risk behaviors and additional public health implications, such as HIV infection. Given the lack of resources and infrastructure for neurocognitive research, establishing this project in of itself provided a significant step to developing research capacity by instilling confidence amongst Bulgarians that they can conduct quality, comprehensive, interdisciplinary research.

Background and Objectives
While trained as a clinical psychologist in the United States, Dr. Vassileva was born in Bulgaria and sought to establish professional partnerships with Bulgarian researchers when she learned about the Brain Program. On a return trip to her homeland, she learned that Bulgaria had a significantly high prevalence of heroin addiction. Bulgaria's geographical position made it a key country on the 'Balkan Drug Route', through which approximately 80% of the heroin currently used in Western Europe passes. Consequently, heroin is easily available in the country, and in fact heroin addiction has become one of the most significant health and legal problems. Patterns of heroin addiction in Bulgaria are unique in that polysubstance dependence is uncommon. Consequently, study of Bulgarian drug addicts provides a unique opportunity to evaluate neurocognitive and psychiatric consequences of relatively "pure" heroin use.
Research on addiction and its neuro-cognitive consequences is minimal in Bulgaria, despite a significant need to address these concerns. Dr. Vassileva met and formed partnerships with physicians and mental health professionals in Sofia, Bulgaria to study the effect of drug abuse on the brain and the development of addiction. Historically, it is difficult to isolate drug effects on cognition from dysfunction associated with comorbid conditions, such as Antisocial Personality Disorder (ADP) and psychopathy. The Bulgarian legal system facilitates the opportunity to study heroin-dependent subjects with and without ADP because all detainees arrested for drug-related charges undergo mandated medical and psychological evaluations. Dr. Vassileva's Bulgarian collaborators have access to a large population of pre-trial detainees, a large majority of whom have been detained for drug-related crimes.
At the start of the project, there was a complete absence of neurocognitive research and only nascent research of drug addiction in Bulgaria. So creation of the collaboration itself was a significant step toward building research capacity. Still, the team exceeded their initial goals for the R21 grant by testing three times the number of subjects than anticipated in an exploratory study on cognitive function of "pure" heroin addicts. The knowledge gained from the R21 studies directly led to the objectives of the R01 grant to better understand the role of impulsivity in drug addiction and to continue capacity building efforts for clinical research, in general, in Bulgaria.

Research Outcomes and Challenges

The project has contributed to 3 publications in *PLOS One, Journal of Clinical and Experimental Neuropsychology,* and the Bulgarian journal entitled *Clinical and Consulting Psychology.* The project has led to two keynote presentations and nine additional manuscripts that are under view or in preparation. The primary research outcome of the project has been the novel characterization of decision-making deficits and their specificity to a particular type of drug being used even after protracted discontinuation of drug use. Furthermore, the project has propagated additional studies on dimensions of impulsivity that are closely related to high-risk sexual and injection risk behaviors and additional public health implications, such as HIV infection.

The project encountered unanticipated challenges with the administration of St. Naum Hospital (the Bulgarian subcontractor) which caused significant delays and led to the study being transferred to a new facility, the Bulgarian Addictions Institute. The administration of the hospital did not honor their agreements or provide the resources they promised for conducting the study at their site, and attempts to remedy problems with the administration at St. Naum's were unsuccessful. The hospital did not provide them with office space or conditions adequate for conducting research with human subjects, and they closed the St. Naum Hospital substance abuse clinic which was to serve as a major referral site for study participants. Furthermore, the hospital administration was not supportive of the recruitment and testing of substance dependent individuals and informed the researcher team that they did not want study participants to be visible on the main hospital grounds. Ultimately, all of these conditions seriously threatened the validity of the data that would be collected.

After obtaining prior approval from NIDA to transfer the study to the Bulgarian Addictions Institute, the research team began intensive subject recruitment and testing. Currently, the project has already surpassed its Year 4 recruitment and testing goal of 252 study participants.

<u>Capacity Building Outcomes and Impacts</u>

Despite a significant need to address the public health impacts of drug addiction in Bulgaria, there was a lack of research training in neuropsychology and very little capacity for drug addiction research prior to 2003. This project was the first multi-disciplinary study of its kind in Bulgaria and generated a new confidence among the Bulgarian research community that they were capable of conducting world-class research. Because there was very little research infrastructure present in Bulgaria, the project's capacity building achievements may appear modest, but were critical to creating the foundation for sustainable research capacity. Specifically, institutional review boards (IRBs) were established at two Bulgarian institutions, clinical assessment instruments were developed and translated in Bulgarian, and training seminars in basic neuropsychological theory and practice were conducted. Dr. Vassileva and her team expanded their research capacity building efforts by establishing new inter-agency collaborations among various substance abuse specialists and clinics in Bulgaria. They also advocated, at the national government level, for greater research support with the goal of employing research findings to arrive at evidence-based policy decisions in the field of mental health and addictions.

Given the minimal research activities in Bulgaria, establishing this project in of itself is a significant step to developing research capacity. Dr. Peter Vassilev, a co-investigator on the R01, cites economic constraints and lack of funding for researchers as the reason for Bulgaria's diminished research capacity. In addition to the project's interdisciplinary approach, which is unique in Bulgaria, he estimates that the length and size of the R01 award itself makes it the most sustainable research project in Bulgaria. Moreover, Dr. Vassilev went on to explain that Bulgarians sometimes think things are impossible. However, he believes this project demonstrates that organized and sustainable projects are possible in Bulgaria, "…this proves those people wrong by showing they [Bulgarians] can conduct quality, comprehensive research."

Soon after the project began, Dr. Vassileva assisted her Bulgarian colleagues to establish an Institutional Review Board (IRB) at St-Naum State University Hospital, and obtained a federal-wide assurance for the newly created IRB. She and her colleagues then translated and back-translated a number of commonly used clinical assessment instruments into Bulgarian. Such contemporary cognitive neuroscience paradigms were lacking in Bulgaria, so these made our measures freely available to all interested researchers in the country, serving as a basic foundation for enhancing research capacity. Additional capacity building efforts included training seminars in basic neuropsychological theory and practice for psychiatrists, psychologists, and neurologists; seminars and annual

workshops in various topics in neuropsychology and addictions neuroscience open to mental health professionals from across the country; and purchasing computers, printers, software, or services such as access to the internet and long-distance telephone lines, for the use at the Bulgarian research site.

As part of the research capacity building activities Dr. Vassileva and her established collaborators are presenting their work throughout Bulgaria. They created an inter-agency cooperation between the Clinic of Forensic Psychiatry and Psychology, where most criminally-involved drug addicts in Sofia are being sent for psychological and psychiatric evaluation and the available drug treatment centers in Sofia, in order to provide treatment options for heroin users with criminal histories. Additionally, by establishing a collaboration with the Molecular Medicine Center at the Medical University in Sofia, they were able they were able to collect, bank, and test DNA samples from their study participants. As a result of Dr. Vassileva's efforts to meet the President of the Bulgarian Psychological Association (BPA), she was invited to give the keynote address and present her research at the BPA national meeting.

One of the R01 research capacity building goals was to advocate, at governmental level, for greater research support in Bulgaria. Ultimately, this advocacy would lead utilization of research findings for evidence-based policy making in the field of mental health and addictions. In September 2009, the PI met with Dr. Tonka Varleva, Head of the Department of Prevention and Control of HIV/AIDS at the Bulgarian Ministry of Health. The discussion focused on the current HIV situation in Bulgaria, the role of drug addiction in the HIV epidemic, and possible implications of our current and future research for HIV prevention and intervention efforts in the country. Dr. Vassileva and her colleagues wish they could have more of an impact on public health policy outcomes, but recognize that it is in the early stages, and conducting solid research is the first step.

Next Steps

While most of their efforts will be put towards completing and submitting the 6 manuscripts currently in preparation, Dr. Vassileva and her colleagues will continue to recruit subjects and collect DNA samples to complete the R01 studies on addiction to different classes of drugs and its association with manifestations of impulsivity. They plan to continue their data dissemination efforts by presenting at national and international conferences. In addition, Dr. Vassileva is a co-investigator on two R01 applications examining the neurocognitive impact of drug use on individuals with HIV.

Although this study is unrelated to the current R01, Dr. Vassileva will submit another R01 application that builds upon collaborations formed as a result of the R01-supported project. On one of her visits to Bulgaria, she was invited to the "Roma" Foundation to discuss increasing rates of heroin addiction and HIV infection in this unique population. The Roma (a.k.a. Gypsies) are the largest ethnic minority in Bulgaria and Europe, and also have a relatively uniform genetic background, shared environment, and large intact families, presenting unique advantages for genetic research. The study will focus on the role of neurocognitive impulsivity and drug addiction within this population, which appears to have a specific vulnerability to heroin addiction and HIV prevalence rate at 12 times the non-Roma Bulgarian population.

Brain Program Project Outcomes Case Study Summary
Award Numbers: R21NS048838; R01NS055627
PI: Joseph Zunt, MD, MPH
Assistant Professor, Neurology, University of Washington
MFC: Silvia Montano, MD, MPH
Research Physician, HIV Program, U.S. Naval Medical Research Center Detachment-Lima (NMRCD)
R21 Title and Start Date: Central Nervous System Infections in Peru
R01 Title and Start Date: Retroviral Infections of the Nervous System in Peru
Start Year(s): R21, 2003; R01, 2006
Co-Funding IC(s): NINDS

Highlights/Abstract
With support from the Brain Program, Drs. Joseph Zunt and Silvia Montano and their team conducted studies to understand and characterize the origin and manifestations of retroviral infection of the Central Nervous System in Peru. They were among the first to define prevalence of Human T Cell Lymphotropic Virus (HTLV) infection of the central nervous system (CNS) in indigenous populations living in the Peruvian Amazon. The team has provided new knowledge about the burden of retroviral infection and CNS coinfections across different populations with varying risk factors. They have also identified Herpes Simplex Virus (HSV) infection as a major cause of encephalitis in the Peruvian population, which lends itself to accessible public health treatment options. Finally, the project has helped to build the research capacity in Peru and Latin America through targeted and sustained training activities that are responsive to the self-reported needs of Peruvian neuroscientists.

Background and Objectives
Prior to this project, Dr. Joseph Zunt studied HTLV-I infections in Peru with FIRCA support in the late 1990's and co-authored the first of multiple publications with Dr. Montano on the subject in 1999. From his research experiences in Peru and speaking with Peruvian neurologists, Dr. Zunt realized there was a lack of understanding around brain infection etiology and a limited ability to diagnose infections affecting the central nervous system. Drs. Zunt and Montano applied for a R21 and were awarded in the first cohort. The goal of their R21-supported research collaboration included gaining a better understanding of central nervous system infections affecting Peruvians and building capacity around diagnosis and treatments at multiple Peruvian institutions. When the R21 project was completed, they applied for R01 support in order to build on the collaborations and investigations initiated during the R21 grant. The goals of the R01 included studying the clinical manifestations of retroviral, opportunistic infections of the central nervous system.

Research Outcomes
The project has contributed to 7 publications in journals such as *Journal of Neurovirology, American Journal of Tropical Medicine and Hygiene, Clinical Infectious Diseases, PLOS One*, and *Journal of Acquired Immune Deficiency Syndrome*. The primary research outcome of the project has been the novel characterization of HTLV prevalence rates among indigenous individuals living in the Peruvian Amazon. In addition, the project has helped to illuminate and define the risk determinates and clinical manifestations of HTLV-I, HTLV-II, and HIV infection and coinfections of these retroviruses in the four largest cities in Peru. Notably, resources from this project were also used to initiate a study to determine HSV infection as a major cause of encephalitis. These results will likely inform public health treatment policy measures on a larger scale.

Epidemiology of HTLV infection. At the time of the R21 grant submission in 2003 there was only one tertiary referral center for neurologic disease in Peru, the Instituto de Ciencias Neurologicas in Lima. Moreover, there were no referral centers in Peru for patients with neurologic disease related to either HIV infection or HTLV infection of the CNS. The majority of HTLV-I-infected persons never develop clinically significant disease, however a small number of HTLV-I seropositive people also have neurologic disease manifestations. The first effort under the R21 grant called for establishing a surveillance system for retroviral and viral meningoencephalitis in order to define the needs and opportunities for viral CNS infection research in Peru. From the initial surveillance system, Drs. Zunt and Montano discovered that HTLV was unexpectedly prevalent in selected populations in Lima and two of the largest

cities in the Amazon Jungle. They detected HTLV-2 infection in 1.1% and HTLV-1 infection in 2.5% of indigenous individuals living in 19 communities near the Amazon River city of Pucallpa.

Therefore, the objectives within the R01 focused on the infectious etiology of retroviral encephalitis in Peru and describe risk factors and clinical presentation for retroviral encephalitis. Dr. Zunt and his colleagues developed a network of neurologists, hospitals, and universities in four geographic regions of Peru to define the most common causes of meningitis and encephalitis. The Collaborative Network for Tropical Neurologic Infectious Diseases established with researchers in nongovernmental and Ministry of Health institutions in Peru, with the U.S. Naval Medical Research Center Detachment (NMRCD) in Peru, and with Universities in Peru and the United States, now supports research on the clinical epidemiology of retroviral infections and their interactions with emerging tropical infections in Peru.

Over the course of the R01 grant period, they conducted cross-sectional studies of high and low-risk populations and collaborated with colleagues conducting nationwide surveys of female sex workers (FSW) and men who have sex with men (MSM) to better define the seroprevalence of HTLV infection in Peru. Compared to other high and low-risk Peruvian populations, they observed an unanticipated decline in HTLV-1 seroprevalence from 14.5% in 1993 to 3.1% in 2010 that persisted even after adjustment for age. Their studies also helped define some of the more common manifestations and infections occurring during retroviral infection including hearing impairment and ear disease in HIV-infected children, cognitive impairment, and peripheral neuropathy.

Coinfection of the CNS in indigenous populations. As a result of the R01 studies, Drs. Zunt and Montano were able to provide new knowledge about the burden of retroviral infection and CNS coinfections across different populations with varying risk factors. Among these novel findings were HTLV prevalence rates among indigenous individuals living in the Peruvian Amazon. They identified cryptococcal meningitis and tuberculosis as the most common CNS infections in HIV infected people living in Arequipa and Iquitos. These complications occurred in HIV-infected people not receiving HAART therapy. They were also able to create a cohort of HTLV-1 and -2 infected people to provide opportunities for better defining the long-term neurologic complications of HTLV infections and coinfections.

Encephalitis and HSV infection. Finally, a noteworthy result arose while examining the effects of retroviral infection on natural history of opportunistic infections. They determined that Herpes Simplex Virus (HSV) was the most common detectable cause of encephalitis – with 22.4% prevalence in the cohort of patients examined. Consistent with study protocols, each patient presenting with HSV encephalitis received intravenous acyclovir as a benefit of this study. With the proven benefit of acyclovir treatment for reducing morbidity and mortality of HSV infections, this finding represents a significant public health development for at least one-fifth of encephalitis patients in Peru. They have shared this data with the Peruvian government and hope to make additional advancements to impact public health policy.

<u>Capacity Building Outcomes and Impacts</u>

The foundation of the capacity-building portion of this project was the successful implementation of a needs assessment survey. Based upon that survey, responsible conduct of research workshops and other training workshops were conducted for project personnel and hundreds of researchers and technicians from around Peru and Latin America. Another set of capacity building activities leveraged other training programs from FIC and other organizations for medium and long term training of junior researchers.

Needs Assessment Survey. The needs assessment survey consisted of asking Peruvian neuroscientists to determine their research and training needs in Peru. The self-assessment survey included open-ended questions about medical school training, research methodological training, and the most pressing areas where research is lacking in neuroscience in Peru.

Responsible Conduct of Research Training. R21 funds supported three workshops on research methodology, collaborative research and authorship, and responsible conduct of research workshops. Responsible Conduct of Research conferences for 670 investigators and healthcare workers in Peru were conducted using didactic lectures, audience participation, and case study analysis in the training curriculum. At the completion of these workshops, Peruvian researchers built their own network of institutional review boards (IRBs). Moreover, they invited IRB

committee members from twelve Latin American countries to Peru for follow-up responsible research conduct training, resulting in the "Conference in Ethics in Collaborative International Research: Practical Issues and Constructive Tools for Latin American Research Teams."

Additional Short and Medium Term Training. Over the life of the project, additional capacity building activities were provided, including

- Mentor training for 67 faculty mentors, trainees and investigators;
- Research methodology for 16 clinical researchers in Tumbes;
- Laboratory training in quantitative HTLV PCR for three Peruvian virology technicians at the NIH and University of Washington (UW); and
- NIH-sponsored research administration training for two Peruvian administrators
- Comprehensive epidemiologic training for 7 neurologists in Seattle;
- One-week research methodology training workshop for 27 neurologists and epidemiologists; and
- Distance learning certificates in biostatistics for 16 Peruvian researchers

Long-term training. Their R01 grant expanded training for developing researchers with the long-term objective of developing a cadre of investigators capable of designing and conducting a broad-based research program encompassing descriptive epidemiology, pathogenesis, diagnosis and management of CNS infections for the region. To accomplish this goal, they offered short, medium and long-term activities to increase research capacity. The short-term activities included short courses on responsible conduct of research and research methodology for Peruvian neurologists and distance learning modules for a biostatistics certificate program.

In order to maximize the medium and long-term activities, they developed synergies with other FIC training programs. Drs. Zunt and Montano co-directed the University of Washington-Peru collaboration for the FIC International Clinical Research Scholars Program where they have mentored 32 developing clinical researchers since 2004. The have collaborated with FIC other training programs to support training of 8 Peruvian neurologists and 6 investigators in epidemiology, neuropathology and virology at the University of Washington, NIH and Peru. Through these collaborations, they helped build capacity by working with research institutions and universities in both countries educate and train students and researchers across Peru.

<u>Next Steps</u>

Dr. Zunt has already submitted a R01 renewal application. If successful, they plan to use their current library of CNS samples to look for etiology of other encephalitis conditions through the utilization of newer techniques such as mass-tag PCR.

Appendix E: Survey Questions

OMB #: 0925-0681; Expiration Date: 9/30/2016
Public reporting burden for this collection of information is estimated to average 35 minutes per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. An agency may not conduct or sponsor, and a person is not required to respond to, a collection of information unless it displays a currently valid OMB control number. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to: NIH, Project Clearance Branch, 6705 Rockledge Drive, MSC 7974, Bethesda, MD 20892-7974, ATTN:
PRA (0925-0681).

Welcome to the Brain Disorders in the Developing World Survey!

The purpose of this survey is to collect information relevant to an evaluation of the Brain Disorders in the Developing World: Research Across the Lifespan program (referred to as "Brain Disorders program") administered by the John E. Fogarty International Center at the National Institutes of Health (NIH). You have been invited to participate in the survey because you participated in one or more research projects funded by this program. Please note that the evaluation will be focused on the program 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 the outcomes of your award(s) and your experiences with the program via a web-based questionnaire. You may refuse to answer any particular question and you may stop answering questions at any time. Survey results will be reported in the aggregate, and you will not be identified as a source for specific information in any report or publication resulting from the evaluation study. There will be no immediate benefit to you from participation, nor are there any known risks.

Your participation in this survey is completely voluntary. If you wish to withdraw your consent after completing the survey form, or if you have any questions about the evaluation study, please contact the lead evaluation contractor, Christina Viola Srivastava, at christina.violasrivastava@nih.gov or (+1) 617-721-9055. If you have questions you would prefer to direct to NIH, please contact Dr. Rachel Sturke at rachel.sturke@nih.gov or (+1) 301-480-6025.

1. Have you and/or your collaborators applied for additional funding to continue the research project(s) initiated with your Brain Disorders R21 award?
    - Yes, we applied to the Brain Disorders program for an R01 award and/or renewal only
    - Yes, we applied to the Brain Disorders program for an R01 award and to other funders
    - Yes, we applied to funders other than the Brain Disorders program only
    - No, we have not applied for additional funding
    - I prefer not to answer
2. Please explain the reason(s) you decided not to apply for a Brain Disorders R01 award. [Free text]
3. Why haven't you applied for funding to continue the research project(s) initiated with your Brain Disorders R21 award? (Select all that apply)
    - The R21 project is still in progress and/or we haven't yet had time to apply

- The project has reached its logical conclusion or exhausted its potential
- The project is no longer a priority and/or we don't have time to pursue it at this time
- We're not confident that we could compete successfully for additional funding
- I prefer not to answer
- Other (please specify)

4. Do you intend to apply for funding to continue your Brain Disorders project(s) in the future?
   - Yes, we intend to apply for a Brain Disorders R01 award only
   - Yes, we intend to apply for a Brain Disorders R01 award and to other funders
   - Yes, we intend to apply to other funders only
   - No, we do not intend to apply for additional funding
   - We haven't decided yet
   - I prefer not to answer
5. To which organization(s) other than the Brain Disorders program did you apply for additional funding to continue the project(s) initiated with your Brain Disorders R21 award? (Select all that apply)
   - An NIH Institute or Center
   - Another US government agency
   - Government source in another high income country or region
   - Government source in a low or middle income country
   - Non-governmental organization or charitable foundation
   - Other (please specify)
6. Have you been awarded additional funding from any of these sources?
   - Yes
   - No
   - I prefer not to answer
7. Please list the name of any funder(s) other than the Brain Disorders program that have provided support for continuing the project(s) initiated with your Brain Disorders R21 award. [Free text]
8. What is the approximate total dollar value of all awards from sources other than the Brain Disorders program that have supported continuing the project(s) initiated with your Brain Disorders R21 award?
   - Less than $10,000
   - $10,000-$25,000
   - $25,000-$50,000
   - $50,000-$100,000
   - More than $100,000
   - I prefer not to answer
9. Is there anything that the Brain Disorders program could have done differently to improve your ability to secure additional funding for your project(s)? [Free text]
10. Did any institution or funding source other than NIH contribute supplemental resources (such as additional research funding, salary support, facilities, equipment, etc.) to your Brain Disorders project during the period of R21/R01support?
    - Yes
    - No
11. Please specify the name of any institutions or funders other than NIH that provided supplemental resources and the type of resources provided. [Free text]
12. Have funds or resources been transferred between the collaborating institutions as part of your Brain

Disorders award(s)?

- Yes
- No

13. Which of the following mechanisms were employed to transfer resources between collaborating institutions? (Select all that apply)
    - Funders were transferred between institutions via subcontracts
    - Goods/services were purchased by the lead institution and subsequently transferred to collaborating institution(s)
    - Goods/services were purchased directly by collaborating institution(s) and the lead institution later provided reimbursement
    - The lead institution set up purchase orders with the collaborating institution(s) listed as a recipient
    - The lead institution issued a university credit card to the collaborating institution(s)
    - Goods/services (used or new) were donated by the lead institution to the collaborating institution(s)
    - Other (please specify)
14. Do you have additional comments about transfer of resources between collaborating institutions? [Free text]
15. Please rate the degree to which you agree or disagree with the statements below regarding your Brain Disorders award. (see picture)

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
A significant amount of effort was devoted to overcoming barriers due to lack of infrastructure at the low or middle income country institution(s)	◯	◯	◯	◯	◯
My home institution was very supportive of the Brain Disorders project(s)	◯	◯	◯	◯	◯
My collaborators' institution(s) were very supportive of the Brain Disorders project(s)	◯	◯	◯	◯	◯
Potential end-users of the research results (e.g. healthcare providers, public health officials, non-governmental institutions, policy-makers) were consulted as part of the Brain Disorders project	◯	◯	◯	◯	◯
After the period of R21 support, we were prepared to compete successfully for an NIH R01 award or comparable funding from another source	◯	◯	◯	◯	◯
The Brain Disorders program provided sufficient opportunities to interact with other awardees and their collaborators	◯	◯	◯	◯	◯
Participation in the Brain Disorders program expanded my network of contacts in the brain disorders research community	◯	◯	◯	◯	◯

16. Have your Brain Disorders award(s) contributed to any publications in peer-reviewed journals?
    - Yes
    - No

[The evaluation team has compiled a preliminary list of publications associated with Brain Disorders awards based on available sources. Could you please review the preliminary list by following the link below and make any additions or corrections necessary to the publications list for your award (s)? Please note that the link will open a Google Document in a new browser window; you will need to return to this page and click "next" to complete the survey.]

17. Have your Brain Disorders award(s) contributed to the development of any tools or other research outputs that could be used to facilitate future research? (Select all that apply)
    - Tool, instrument, or protocol for clinical assessment in low and middle income country settings
    - New intervention for prevention, screening, diagnosis, or therapy
    - Patient registry or cohort
    - Biospecimen repository
    - Laboratory tool, instrument, protocol, model, or method
    - Database, information system, or software tool
    - None of the above
    - Other (please specify)
18. Please describe any impacts that your Brain Disorders project(s) have had so far on public health, healthcare practice, or health policy. [Free text]
19. Have your Brain Disorders award(s) included any of the following types of training activities? (Select all that apply)
    - Training or mentoring at the low or middle income country site(s) in skills, methods, or procedures essential to the research project(s)
    - Training or mentoring at the low or middle income country site(s) that was broader in scope, including deeper knowledge of scientific or clinical context, general research skills, grant-writing, publications, etc.
    - Training in research ethics
    - Formal or informal training for personnel from the low or middle income country site(s) at a high income country institution that did not result in a degree
    - Formal or informal training for personnel from the low or middle income country site(s) at an institution in a low or middle income country that was not one of the primary collaborators on the Brain Disorders project
    - Use of award funds to pay tuition or fees for one or more trainee(s) enrolled in a degree program at a low or middle income country institution
    - Use of award funds to pay tuition or fees for one or more trainee(s) enrolled in a degree program at a high income country institution
    - Use of project data as part of a Doctoral or Master's thesis at a low or middle income country institution
    - Use of project data as part of a Doctoral or Master's thesis at a high income country institution
    - Development of curriculum for academic courses or course modules to be offered at a low or middle income country institution
    - Workshops, seminars, or symposia held at low or middle income country site(s) that were open to individuals not directly involved in the funded research project(s)
    - Training for administrators or other non-research staff at a low or middle income country institution
    - None of the above
    - Other (please specify)
20. Have any individuals from low or middle income countries received long-term training (6 months or more) as part of your Brain Disorders R21 or R01 award?
    - Yes
    - No
21. Please list the name, duration of training, site(s) of training, title/affiliation during training, and

current title/affiliation (if known) of any long-term trainees (trained for 6 months or more) associated with your Brain Disorders award(s). [Free text]

22. Do you have additional long-term trainees to enter?
    - Yes
    - No
23. Please list the name, duration of training, site(s) of training, title/affiliation during training, and current title/affiliation (if known) of any additional long-term trainees (trained for 6 months or more) associated with your Brain Disorders award(s). [Free text]
24. Please briefly describe any significant impact(s) that your Brain Disorders award(s) have had on your own career. [Free text]
25. Are you aware of any additional low and middle income country research project(s) that could be considered "spin-offs" from your Brain Disorders project(s)? We define "spin-offs" as new research projects that are not direct continuations of the project(s) initiated with your Brain Disorders award(s) but were catalyzed or enabled by the Brain Disorders award(s).
    - Yes
    - No
26. Please briefly describe the primary research objectives of any "spin-off" projects. [Free text]
27. If new funding has been secured for any of the "spin-off" projects described above, please list the name of each funder and the approximate dollar amount of the award(s). [Free text]
28. Have your Brain Disorders award(s) contributed significantly to any of the following types of institutional research capacity-building at one or more low or middle income country institutions? (Select all that apply)
    - Establishing a new research center
    - Establishing a new clinical unit or subdivision
    - Establishing a new academic program
    - Establishing a new faculty program
    - Participation in national/regional conferences by low and middle income country personnel
    - Participation in international conferences by low and middle income country personnel
    - Purchasing or obtaining durable equipment (clinical, laboratory, or other) worth more than $1000
    - Establishing a new working group or other mechanism to encourage networking and collaboration among researchers
    - Establishing and registering an Institutional Review Board (IRB)
    - Increasing the visibility or prestige of brain-related research
    - None of the above
    - Other (please specify)
29. If there have there been any other significant outcomes or impacts of your Brain Disorders award(s) not covered in the previous questions, please describe. [Free text]
30. Do you have any suggestions for NIH on how the Brain Disorders program could be improved? [Free text]
31. Are there any other comments you would like to make about your experience with the Brain Disorders Program? [Free text]

Appendix F: Non-NIH Funders that Provided Supplemental Resources

High Income Institutions or Universities

North America

- Financial support from Yale University
- Drug donations from Valeant Pharmaceuticals
- Salary support from Research Foundation for Mental Hygiene at NY State Psychiatric Institute (US)
- Financial support from Harvard Medical School
- Financial support from Chicago Biomedical Consortium
- Infrastructure support from Lurie's Children's Memorial Research Center
- Infrastructure support from Department of Neonatal and Developmental Medicine Laboratory, Division of Neonatology Department of Pediatrics Stanford University
- Infrastructure support from Natus Medical (US)
- Salary and research supplies provided by University of Minnesota
- Research support from Howard Hughes Medical Institute
- Research support from the Simons Foundation
- Travel support from Abbot Laboratories
- Training and research support from International Brain Research Organization
- Technology support from Solar World
- Training support from International Society for Neurochemistry
- Financial support from University of Minnesota
- Salary support from Columbia University
- Financial support from Boston Children's Hospital
- Financial support from Michigan State University IRGP award
- Salary support from Michigan State University
- Financial support from American Medical Association
- Unidentified support from University of Texas HSC at San Antonio
- Unidentified support from the US Department of Agriculture
- Unidentified support from Beth Israel Deaconess Medical Center
- Unidentified support from Florida A & M University
- Salary support from the Department of Defense (US)
- Financial and administrative support from Duke University
- Unidentified support from CURE (Uganda)
- Personnel and training support from Yale Medical School
- Research support from University of Pennsylvania
- Salary and travel support from Georgia State University
- Salary and infrastructure support from Michael J Fox Foundation
- Financial support from Autism Speaks
- Unidentified support from Gates Foundation
- Financial and research support from Burroughs Wellcome (US)
- Technology and financial support from Integra Neurosciences (US)
- Research support from Integra Foundation (US)
- Financial support from University of Washington Neurosurgery Aldrete Fund
- Salary and infrastructure from University of Virginia
- Statistical support from the Oregon Clinical and Translational Research Institute

- Salary support from Stanley Medical Research Institute (US)
- University of Alabama at Birmingham
- Unidentified support from Dixon Foundation (US)
- Unidentified support from Children's Hospital of Alabama
- Salary support from University of Massachusetts Medical School
- Unidentified support from Canadian Institutes of Health Research (Canada)

Western Europe

- Personnel and financial support from Wellcome Trust (UK)
- Research support from Wellcome Trust Sanger Institute (UK)
- Salary and infrastructure support from University of Liverpool (UK)
- Personnel support from Université de Limoges (France)
- Environmental support from the EHESP School of Public Health (France)
- Financial support from Parnassia Institute in The Hague (Netherlands)
- Research support from European Union
- Salary support from London School of Hygiene and Tropical Medicine (UK)
- Salary support from Kings College (UK)
- Salary and travel support from Danish Dementia Research Center (Denmark)

Low- and Middle- Income Country Institutions or Universities

Latin America

- Financial support from Consejo Nacional de Investigaciones Científicas y Técnicas (Argentina)
- Salary and research support from Argentine Research Council (Argentina)
- Research and infrastructure support from Argentine Agency for Scientific and Technological Development (Argentina)
- Research and travel support from Argentine Ministry of Science (Argentina)
- Financial support from Universidad Nacional de Córdoba-Argentina- Secretaría de Ciencias y Técnica (Argentina)
- Salary support from Fundacion Huesped (Argentina)
- Travel support from Agencia Nacional de Promoción Cientifica y Tecnologica (Argentina)
- Salary support from Consejo de Investigaciones Cientificas y Tecnicas (Argentina)
- Financial support from Ministerio de Ciencia y Tecnología- Gobierno de la Provincia de Córdoba (Argentina)
- Fundacion de Lucha contra los Trastornos Neurologicos y Psiquiatricos en Minorias (Argentina)
- Salary, administrative and infrastructure support from Universidad de Santa Cruz de la Sierra (Bolivia)
- Salary and infrastructure support from Federal University of Minas Gerais (Brazil)
- Salary and infrastructure support from Universidade Federal do Para (Brazil)
- Salary and infrastructure support from Conselho Nacional de Desenvolvimento Cientifico e Tecnologico (Brazil)
- Unidentified support from Brazilian National Council for Research (Brazil)
- Ceara State Research-for-AIDS Foundation (Brazil)
- Infrastructure support from Hospital das Clinicas at Sao Paulo University (Brazil)
- Salary and infrastructure support from Colciencias (Colombia)
- Unidentified support from University of Costa Rica (Costa Rica)
- Infrastructure and administrative support from University of the West Indies (Jamaica)
- Personnel and travel support from Consejo Nacional de Ciencia y Tecnología (Mexico)

- Supplies provided by Centro de Investigación y de Estudios Avanzados (Mexico)
- Supplies provided by the Instituto Mexicano del Seguro Social (Mexico)
- Supplies provided by Instituto Nacional de Psiquiatría (Mexico)
- Salary, administrative and infrastructure support from Universidad Peruana Cayetano Heredia (Peru)
- Infrastructure support from University of Zulia (Venezeula)
- Infrastructure support from Fundaconciencia (Venezeula)

Europe & Asia

- Financial support from Medical University (Bulgaria)
- Unidentified support from National Nature Science Foundation (China)
- Unidentified support from the Chinese Science and Technology Commission (China)
- Unidentified support from a local government foundation (China)
- Salary and travel support from Guangxi Medical University (China)
- Salary support from Guangzhou Medical University (China)
- Unidentified support from Shanghai Mental Health Center (China)
- Travel support from Manipal University (India)
- Financial support from National Trust, Government of India
- Unidentified support from Indian Council of Medical Research (India)
- Salary support from Sree Chitra Tirunal Institute for Medical Sciences & Technology (India)
- Personnel support from Institute of Psychiatry, Rawalpindi (Pakistan)
- Personnel and infrastructure support from the Center for Non-Communicable Diseases (Pakistan)
- Infrastructure support from University of Kelaniya (Sri Lanka)
- Personnel support from University of Ruhuna (Sri Lanka)
- Infrastructure support from University of Ankara Medical School (Turkey)
- Research and logistical support from Vietnam National University (Vietnam)
- Personnel and logistical support from Danang Psychiatric Hospital (Vietnam)

Middle East & North Africa

- Unidentified support from the Egyptian Ministry of Scientific Research (Egypt)
- Research support from American University of Beirut (Lebanon)
- Salary and infrastructure support from Tunisian Ministry of high education (Tunisia)

Sub-Saharan Africa

- Infrastructure support from Institut de Recherche en Sciences de la Santé (Burkina Faso)
- Travel support from MLW (Congo)
- Infrastructure support from Federal Neuropsychiatric Hospital Yaba, Lagos (Nigeria)
- Salary support from University of Ibadan (Nigeria)
- Salary support from Stellenbosch University (South Africa)
- Technology and salary support from CIPRA-SA Network (South Africa)
- Salary and infrastructure support University of Cape Town (South Africa)
- Research and infrastructure support from Medical Research Council (South Africa)
- Financial support from Walter Sisulu University (South Africa)
- Salary support from University of Steelenbosch (South Africa)
- Salary and financial support from University of Kwazulu Natal (South Africa)
- Infrastructure support from Makerere University College of Health Sciences (Uganda)
- Infrastructure support from Mulago National Referral Hospital (Uganda)

Appendix G: Improving Ability to Secure Funding (Grantee Responses)

Funding Suggestions or Concerns

- Provide some form of bridge funding to help projects transition to other funding sources. (3 comments)
- Structure funding such that more goes to the LMIC collaborator(s), and carefully screen proposals that claim to build capacity at LMIC sites but fail to do so. (1 comment)
- Make it easier for foreign PIs to apply for NIH funding (1 comment)
- Encourage applicants to secure matching funds from NGOs, and provide them with additional resources to do so, including summary information about the program and individual projects (2 comments)

Mechanism Suggestions

- Consider adding other mechanisms in this domain in addition to the R01. Examples might include linked awards made directly to foreign collaborators for additional projects, linked awards for specific capacity-building activities, training awards, consortium awards, etc. (4 comments)
- Make R21 awards larger and/or longer to facilitate additional capacity-building (3 comments)

Suggestions for Supporting Networking within NIH or with other Funders

- Provide assistance in identifying and networking with other potential funders for Brain Program projects. (3 comments)
- Provide additional information on other NIH funding opportunities and topics of greatest interest to the other ICs. (2 comments)
- Add more partner ICs, specifically NIAID, and expand priorities to include HIV. (2 comments)
- Provide information to awardees about other NIH-funded groups working in the same region to facilitate collaboration. (1 comment)

Other Suggestions

- Request reports and communicate directly with the foreign collaborator to enable them to build independent relationships with NIH. (1 comment)
- Require “co-PI” status for foreign collaborator. (1 comment)
- Generate project progress review reports for each funded R21 project, and make them a part of the review process for R01 funding such that those who have made excellent progress receive priority. (1 comment)

Appendix H: Publications

Project	Pub Year	Author(s)	Title	Journal Title	Vol, Page	2012 Impact Factor
R01NS061693	2011	GL Birbeck, E Chomba, M Atadzhanov, A Haworth, E Mbewe, EM Mpabalwani for the Neurologic & Psychiatric Society of Zambia (NPSZ)	Evidence-Based Guidelines for EEG Utilization at the University Teaching Hospital (UTH)	Medical Journal of Zambia	38(3):9-15	unavailable
R01NS061693	2012	GL Birbeck, E Chomba, E Mbewe, M Atadzhanov, A Haworth, H Kansembe	The cost of implementing a nationwide program to decrease the epilepsy treatment gap in a high gap country	Neurology International	4(e14):60-64	unavailable
R01NS061693	2013	EK Mbewe, LT Uys, GL Birbeck	The Impact of a Short Depression and Anxiety Screening Tool in Epilepsy Care in Primary Health Care Settings in Zambia	Am J Trop Med Hyg	[Epub ahead of print]	2.45
R01NS061693	2013	EK Mbewe, LR Uys, GL Birbeck	Detection and Management of Depression and Anxiety as Comorbidities of Epilepsy in Primary Health Care Settings in Zambia	Epilepsy Behav	27(2):296-300	2.335
R01NS061693	2013	MA Elafros, J Mulenga, E Mbewe, A Haworth, E Chomba, M Atadzhanov, GL Birbeck	Peer Support Groups as an Intervention to Decrease Epilepsy-Associated Stigma	Epilepsy Behav	27:188-19	2.335
R01NS061693	2013	EK Mbewe, LR Uys, GL Birbeck	Detection and Management of Depression and/or Anxiety for People with Epilepsy in Primary Health Care Settings in Zambia	Seizure: The European Journal of Epilepsy	22(5):401-402	2.004
R01NS061693	2008	Birbeck, Gretchen L; Chomba, Elwyn; Atadzhanov, Masharip; Mbewe, Edward; Haworth, Alan	Women's experiences living with epilepsy in Zambia.	Am J Trop Med Hyg	V:79 P:168-72	2.45
R01NS061693	2008 Nov	Chomba, Elwyn; Haworth, Alan; Atadzhanov, Masharip; Mbewe, Edward; Birbeck, Gretchen L	The socioeconomic status of children with epilepsy in Zambia: implications for long-term health and well-being.	Epilepsy Behav	V:13 P:620-3	2.335
R01NS061693	2010 Nov	Atadzhanov, Masharip; Haworth, Alan; Chomba, Elwyn N; Mbewe, Edward K; Birbeck, Gretchen Lano	Epilepsy-Associated Stigma in Zambia: What factors predict greater felt stigma in a highly stigmatized population?	Epilepsy Behav	V:19 P:414-8	2.335
R01NS061693	2010 Sep	Chomba, Elwyn Nachanya; Haworth, Alan; Mbewe, Edward; Atadzhanov, Masharip; Ndubani, Philimon; Kansembe, Henry; Birbeck, Gretchen Lano	The current availability of antiepileptic drugs in Zambia: implications for the ILAE/WHO "out of the shadows" campaign.	Am J Trop Med Hyg	V:83 P:571-4	2.45
R01NS061693	2012 Dec	Meyer, Ana-Claire L; Dua, Tarun; Boscardin, W John; Escarce, Jose J; Saxena, Shekhar; Birbeck, Gretchen L	Critical determinants of the epilepsy treatment gap: A cross-national analysis in resource-limited settings	Epilepsia	V:53 P:2178-85	3.961
R21AA017410	2012	Saleh, Muhammad G; Sharp, Sarah-Kate; Alhamud, Alkathafi; Spottiswoode, Bruce S; van der Kouwe, Andre J W; Davies, Neil H; Franz, Thomas; Meintjes, Ernesta M	Long-term left ventricular remodelling in rat model of nonreperfused myocardial infarction: sequential MR imaging using a 3T clinical scanner.	J Biomed Biotechnol	V:2012 P:504037	2.436
R21AA017410	2009 Sep	Mainero, Caterina; Benner, T; Radding, A; van der Kouwe, A; Jensen, R; Rosen, B R; Kinkel, R	In vivo imaging of cortical pathology in multiple sclerosis using ultra-high field MRI.	Neurology	V:73 P:941-8	8.312

R21AA017410	2011 Aug	Hess, Aaron T; Tisdall, M Dylan; Andronesi, Ovidiu C; Meintjes, Ernesta M; van der Kouwe, Andre J W	Real-time motion and B0 corrected single voxel spectroscopy using volumetric navigators.	Magn Reson Med	V:66 P:314-23	2.964
R21AA017410	2012 Feb	Hess, Aaron T; Andronesi, Ovidiu C; Dylan Tisdall, M; Gregory Sorensen, A; van der Kouwe, Andre J W; Meintjes, Ernesta M	Real-time motion and B(0) correction for localized adiabatic selective refocusing (LASER) MRSI using echo planar imaging volumetric navigators.	NMR Biomed	V:25 P:347-58	3.214
R21AA017410	2012 Oct	Alhamud, A; Tisdall, M Dylan; Hess, Aaron T; Hasan, Khader M; Meintjes, Ernesta M; van der Kouwe, Andre J W	Volumetric navigators for real-time motion correction in diffusion tensor imaging	Magn Reson Med	V:68 P:1097-108	2.964
R21AG024063/ R01AG029802	2011	Lopez-Tobon, Alejandro; Castro-Alvarez, John Fredy; Piedrahita, Diego; Boudreau, Ryan L; Gallego-Gomez, Juan Carlos; Cardona-Gomez, Gloria Patricia	Silencing of CDK5 as potential therapy for Alzheimer's disease.	Rev Neurosci	V:22 P:143-52	2.413
R21AG024063/ R01AG029802	2010 Oct 20	Piedrahita, Diego; Hernandez, Israel; Lopez-Tobon, Alejandro; Fedorov, Dmitry; Obara, Boguslaw; Manjunath, B S; Boudreau, Ryan L; Davidson, Beverly; Laferla, Frank; Gallego-Gomez, Juan Carlos; Kosik, Kenneth S; Cardona-Gomez, Gloria Patricia	Silencing of CDK5 reduces neurofibrillary tangles in transgenic alzheimer's mice.	J Neurosci	V:30 P:13966-76	7.271
R21AG024063/ R01AG029802	2012 Dec	Lalli, Matthew A; Garcia, Gloria; Madrigal, Lucia; Arcos-Burgos, Mauricio; Arcila, Mary Luz; Kosik, Kenneth S; Lopera, Francisco	Exploratory data from complete genomes of familial alzheimer disease age-at-onset outliers	Hum Mutat	V:33 P:1630-4	5.686
R21AG024065/ R01AG028188	2011 Jan	Purohit, Dushyant P; Batheja, Nirmala O; Sano, Mary; Jashnani, Kusum D; Kalaria, Rajesh N; Karunamurthy, Arivarasan; Kaur, Shalinder; Shenoy, Asha S; Van Dyk, Kathleen; Schmeidler, James; Perl, Daniel P	Profiles of Alzheimer's disease-related pathology in an aging urban population sample in India.	J Alzheimers Dis	V:24 P:187-96	3.832
R21AG024065/ R01AG028188	2012 June	Nair G, Van Dyk, U. Shah, D. P. Purohit, C. Pinto, A. B.Shah, H. Grossman, D. Perl, V. Ganwir, S. Shanker, and M. Sano	Characterizing Cognitive Deficits and Dementia in an Aging Urban Population in India.	Int J Alzheimer's Dis.	Volume 2012 (2012): 673849.	unavailable
R21AG028180	2010	Wang H, Gao T, Wimo A, Yu X	Caregiver time and cost of home care for Alzheimer's disease: a clinic-based observational study in Beijing, China	Aging International	35(2):153-165	unavailable
R21AG028180	2010	Zhang N, Wang H*, Yu X	Neurocognitive features of first-episode late-onset depression	Chinese Journal of Geriatric Heart Brain and Vessel Disease	12(6):484-487	unavailable
R21AG028180	2010	Ma W, Wang H*, Cummings JL, Yu X	Reliability and validity of Chinese version of Neuropsychiatric Inventory-Questionnaire in patients with Alzheimer's disease	Chinese Mental Health Journal	24(5):338-343	unavailable
R21AG028180	2011	Wang X, Zhang N, Li H, He Y, Yu X, Wang H	Association between baseline memory performance and neurocognitive outcome at 6-month follow-up among elderly with first-episode late-onset depression	Chinese Journal of Geriatric Heart Brain and Vessel Diseases	13(7): 579-582	unavailable

R21AG028180	2011	Li H, Zhang N, Zhang M, Yuan H, Su MY, Yu X, Wang H	Comparison of brain atrophy patterns between first-episode late-onset depression and mild cognitive impairment	Chinese Journal of Geriatric Heart Brain and Vessel Diseases	13(7): 587-590	unavailable
R21AG028180	2011	Zhang MY, Wang H*, Li T, Yu X	Characteristics of neuropsychiatric symptoms among individuals with Alzheimer's disease in a memory clinic setting	Chinese Mental Health Journal	25(4):259-264	unavailable
R21AG028180	2012	Li T, Wang H*, Yang YH2, Galvin JE3, Morris JC4, Yu X1	Reliability and validity of Chinese version of AD8	Chinese Journal of Internal Medicine	55(10):777-780	unavailable
R21AG028180	2012	He Y, Wang H*, Su MY, Yuan H, Li T, Zhang M, Yu, X	Relationship between brain gray matter volume and memory performance in mild cognitive impairment and Alzheimer's disease: a voxel-based morphometric study	Chinese Journal of Nervous and Mental Diseases	38(7):411-416	unavailable
R21AG028180	2012	Li T, Wang H*, Zhang M, et al.	Discrimination value of diffusion tensor imaging and memory performance in the detection of mild cognitive impairment and early Alzheimer's disease	Chinese Mental Health Journal	26(12):920-926	unavailable
R21AG028180	2012	Zhang M, Wang H*, Li T, Yu X	Prevalence of Neuropsychiatric Symptoms across the Memory Declining Continuum: an Observational Study in a Memory Clinic Setting	Dement Geriatr Cogn Disord Extra	2:200-208	2.787
R21AG028180	2013	Dai B, Mao Z, Mei J, Levkoff S, Wang H, Pacheco M, Wu B	Caregivers in China: Knowledge of Mild Cognitive Impairment	PLoS ONE	8(1): e53928	4.092
R21AG028180	2013	Mei YJ, Levkoff S, Wang Q, Wang H, Cui D, Mao Z, Wu B	Views on Lifestyle Change From Caregivers of People With Cognitive Impairment in China	SAGE Open	DOI: 10.1177/ 2158244013499160	unavailable
R21AG028182	2010 May	Borenstein, Amy R; Mortimer, James A; Ding Ding; Schellenberg, Gerard D; DeCarli, Charles; Qianhua Zhao; Copenhaver, Cathleen; Qihao Guo; Shugang Chu; Galasko, Douglas; Salmon, David P; Qi Dai; Yougui Wu; Petersen, Ronald; Zhen Hong	Effects of Apolipoprotein E-ε4 and -ε2 in Amnestic Mild Cognitive Impairment and Dementia in Shanghai: SCOBHI-P	Am J Alzheimers Dis Other Demen	V:25 P:233-8	1.518
R21AG028182	2010 Nov	Mortimer, James A; Borenstein, Amy R; Ding, Ding; Decarli, Charles; Zhao, Qianhua; Copenhaver, Cathleen; Guo, Qihao; Chu, Shugang; Galasko, Douglas; Salmon, David P; Dai, Qi; Wu, Yougui; Petersen, Ronald; Hong, Zhen	High normal fasting blood glucose is associated with dementia in Chinese elderly.	Alzheimers Dement	V:6 P:440-7	5.902
R21AG028182	2010 Oct	He, Jing; Iosif, Ana-Maria; Lee, Dong Young; Martinez, Oliver; Chu, Shuguang; Carmichael, Owen; Mortimer, James A; Zhao, Qianhua; Ding, Ding; Guo, Qihao; Galasko, Douglas; Salmon, David P; Dai, Qi; Wu, Yougui; Petersen, Ronald C; Hong, Zhen; Borenstein, Amy R; DeCarli, Charles	Brain Structure and Cerebrovascular Risk	Arch Neurol	V:67 P:1231-7	7.685
R21AG028187	2009	Boutajangout, Allal; Goni, Fernando; Knudsen, Elin; Schreiber, Fernanda; Asuni, Ayodeji; Quartermain, David; Frangione, Blas; Chabalgoity, Alejandro; Wisniewski, Thomas; Sigurdsson, Einar M	Diminished amyloid-beta burden in Tg2576 mice following a prophylactic oral immunization with a salmonella-based amyloid-beta derivative vaccine.	J Alzheimers Dis	V:18 P:961-72	3.832

R21AG028187	2008 May	Goni, F; Prelli, F; Schreiber, F; Scholtzova, H; Chung, E; Kascsak, R; Brown, D R; Sigurdsson, E M; Chabalgoity, J A; Wisniewski, T	High titers of mucosal and systemic anti-PrP antibodies abrogate oral prion infection in mucosal-vaccinated mice.	Neuroscience	V:153 P:679-86	3.556
R21AG029799/ R01AG039330	2009 Jan	Pillai, Jagan A; Verghese, Joe	Social networks and their role in preventing dementia.	Indian J Psychiatry	V:51 Suppl 1 P:S22-8	unavailable
R21AG029799/ R01AG039330	2009 Jan	Pillai, Jagan A; Verghese, Joe	Social networks and their role in preventing dementia.	Indian J Psychiatry	V:51 P:22-28	unavailable
R21AG029799/ R01AG039330	2010 Dec	Ambrose, Anne F; Noone, Mohan L; Pradeep, V G; Johnson, Beena; Salam, K A; Verghese, Joe	Gait and cognition in older adults: Insights from the Bronx and Kerala.	Ann Indian Acad Neurol	V:13 P:S99-S103	0.572
R21AG029799/ R01AG039330	2010 Jun	Verghese, Joe; Holtzer, Roee	Walking the walk while talking: cognitive therapy for mobility in dementia?	Neurology	V:74 P:1938-9	8.312
R21AG029799/ R01AG039330	2010 Mar	Mathuranath, P S; Cherian, P Joseph; Mathew, Robert; Kumar, Suresh; George, Annamma; Alexander, Aley; Ranjith, Neelima; Sarma, P S	Dementia in Kerala, South India: prevalence and influence of age, education and gender.	Int J Geriatr Psychiatry	V:25 P:290-7	2.977
R21AG029799/ R01AG039330	2012 Jul	Tsai, Richard; Noone, Mohan; Johnson, Beena; Pradeep, Vayyattu G; Verghese, Joe	Potentially inappropriate medication use in individuals with mild cognitive impairment: results from the Kerala Einstein Study	J Am Geriatr Soc	V:60 P:1369-70	3.737
R21AG029799/ R01AG039330	2012 Nov	Verghese, Joe; Noone, Mohan L; Johnson, Beena; Ambrose, Anne F; Wang, Cuiling; Buschke, Herman; Pradeep, Vayyattu G; Abdul Salam, Kizhakkaniyakath; Shaji, Kunnukatil S; Mathuranath, Pavagada S	Picture-based memory impairment screen for dementia.	J Am Geriatr Soc	V:60 P:2116-20	3.737
R21AG029799/ R01AG039330	2012 Nov-Dec	Mathuranath, P S; George, Annamma; Ranjith, Neelima; Justus, Sunita; Kumar, M Suresh; Menon, Ramsekhar; Sarma, P Shankara; Verghese, Joe	Incidence of Alzheimer's disease in India: a 10 years follow-up study	Neurol India	V:60 P:625-30	0.956
R21AG029799/ R01AG039330	2012 Oct	Buss, S; Noone, M L; Tsai, R; Johnson, B; Pradeep, V G; Salam, K A; Mathuranath, P S; Verghese, J	Objective cardiac markers in dementia: Results from the Kerala–Einstein study	Int J Cardiol	Vol. 167, Issue 2, Pages 595-596	7.078
R21AG029799/ R01AG039330	2013 Jan	Verghese, Joe	Slaying dementia dragons with blood, lungs, and guts.	J Am Geriatr Soc	V:61 P:155-7	3.737
R21DA018086/ R01DA021421	2011	Bozgunov, K., Naslednikova, R., Vassileva, J	The construct of psychopathy and its assessment	Clinical and Consulting Psychology,	4, (6), 1-9	unavailable
R21DA018086/ R01DA021421	2012	Vassileva, J., Bozgunov, K., Vasilev, G	The role of impulsivity in addictive disorders	Bulgarian Journal of Psychology	40 (3-4), 89-108	unavailable
R21DA018086/ R01DA021421	2012	Paxton, Jessica L; Vassileva, Jasmin; Gonzalez, Raul; Maki, Pauline M; Martin, Eileen M	Neurocognitive performance in drug-dependent males and females with posttraumatic stress disorder symptoms.	J Clin Exp Neuropsychol	V:34 P:521-30	1.862
R21DA018086/ R01DA021421	2007 Dec	Vassileva, Jasmin; Gonzalez, Raul; Bechara, Antoine; Martin, Eileen M	Are all drug addicts impulsive? Effects of antisociality and extent of multidrug use on cognitive and motor impulsivity.	Addict Behav	V:32 P:3071-6	1.752
R21DA018086/ R01DA021421	2011 Apr	Vassileva, Jasmin; Georgiev, Stefan; Martin, Eileen; Gonzalez, Raul; Segala, Laura	Psychopathic heroin addicts are not uniformly impaired across neurocognitive domains of impulsivity.	Drug Alcohol Depend	V:114 P:194-200	3.141

R21DA018087/ R01TW008040	2007	Pienaar, I S; Schallert, T; Russell, V A; Kellaway, L A; Carr, J A; Daniels, W M U	Early pubertal female rats are more resistant than males to 6-hydroxydopamine neurotoxicity and behavioural deficits: a possible role for trophic factors.	Restor Neurol Neurosci	V:25 P:513-26	1.415
R21DA018087/ R01TW008040	2011	Sterley, Toni-Lee; Howells, Fleur M; Russell, Vivienne A	Effects of early life trauma are dependent on genetic predisposition: a rat study.	Behav Brain Funct	V:7 P:11	2.127
R21DA018087/ R01TW008040	2011	Womersley, Jacqueline S; Hsieh, Jennifer H; Kellaway, Lauriston A; Gerhardt, Greg A; Russell, Vivienne A	Maternal separation affects dopamine transporter function in the spontaneously hypertensive rat: an in vivo electrochemical study.	Behav Brain Funct	V:7 P:49	2.127
R21DA018087/ R01TW008040	2005 Dec	Howells, Fleur M; Russell, Vivienne A; Mabandla, Musa V; Kellaway, Lauriston A	Stress reduces the neuroprotective effect of exercise in a rat model for Parkinson's disease.	Behav Brain Res	V:165 P:210-20	3.417
R21DA018087/ R01TW008040	2006 Sep	Faure, Jacqueline; Uys, Joachim D K; Marais, Lelanie; Stein, Dan J; Daniels, Willie M U	Early maternal separation followed by later stressors leads to dysregulation of the HPA-axis and increases in hippocampal NGF and NT-3 levels in a rat model.	Metab Brain Dis	V:21 P:181-88	1.825
R21DA018087/ R01TW008040	2008 Mar	Mabandla, Musa V; Dobson, Bryony; Johnson, Shula; Kellaway, Laurie A; Daniels, Willie M U; Russell, Vivienne A	Development of a mild prenatal stress rat model to study long term effects on neural function and survival.	Metab Brain Dis	V:23 P:31-42	1.825
R21DA018087/ R01TW008040	2008 Nov	Pienaar, I S; Kellaway, L A; Russell, V A; Smith, A D; Stein, D J; Zigmond, M J; Daniels, W M U	Maternal separation exaggerates the toxic effects of 6-hydroxydopamine in rats: implications for neurodegenerative disorders.	Stress	V:11 P:448-56	2.952
R21DA018087/ R01TW008040	2008 Oct	Pienaar, Ilse S; Daniels, William M U; Gotz, Jurgen	Neuroproteomics as a promising tool in Parkinson's disease research.	J Neural Transm	V:115 P:1413-30	2.514
R21DA018087/ R01TW008040	2009 Dec	Mabandla, Musa V; Kellaway, Lauriston A; Daniels, William M U; Russell, Vivienne A	Effect of exercise on dopamine neuron survival in prenatally stressed rats.	Metab Brain Dis	V:24 P:525-39	1.825
R21DA018087/ R01TW008040	2009 Dec	Grace, Laurian; Hescham, Sarah; Kellaway, Lauriston A; Bugarith, Kishor; Russell, Vivienne A	Effect of exercise on learning and memory in a rat model of developmental stress.	Metab Brain Dis	V:24 P:643-57	1.825
R21DA018087/ R01TW008040	2009 Dec	Hescham, Sarah; Grace, Laurian; Kellaway, Lauriston A; Bugarith, Kishor; Russell, Vivienne	Effect of exercise on synaptophysin and calcium/calmodulin-dependent protein kinase levels in prefrontal cortex and hippocampus of a rat model of developmental stress.	Metab Brain Dis	V:24 P:701-9	1.825
R21DA018087/ R01TW008040	2009 Dec	Marais, Lelanie; Stein, Dan J; Daniels, Willie M	Exercise increases BDNF levels in the striatum and decreases depressive-like behavior in chronically stressed rats.	Metab Brain Dis	V:24 P:587-97	1.825
R21DA018087/ R01TW008040	2009 Dec	Daniels, W M U; Fairbairn, L R; van Tilburg, G; McEvoy, C R E; Zigmond, M J; Russell, V A; Stein, D J	Maternal separation alters nerve growth factor and corticosterone levels but not the DNA methylation status of the exon 1(7) glucocorticoid receptor promoter region.	Metab Brain Dis	V:24 P:615-27	1.825
R21DA018087/ R01TW008040	2009 Dec	Zigmond, Michael J; Cameron, Judy L; Leak, Rehana K; Mirnics, Karoly; Russell, Vivienne A; Smeyne, Richard J; Smith, Amanda D	Triggering endogenous neuroprotective processes through exercise in models of dopamine deficiency.	Parkinsonism Relat Disord	V:15 Suppl 3 P:S42-5	3.274

R21DA018087/ R01TW008040	2010 Aug 30	Leak, Rehana K; Castro, Sandra L; Jaumotte, Juliann D; Smith, Amanda D; Zigmond, Michael	Assaying multiple biochemical variables from the same tissue sample.	J Neurosci Methods	V:191 P:234-8	2.114
R21DA018087/ R01TW008040	2010 Jul	Mabandla, Musa Vuyisile; Russell, Vivienne Ann	Voluntary exercise reduces the neurotoxic effects of 6-hydroxydopamine in maternally separated rats.	Behav Brain Res	V:211 P:16-22	3.417
R21DA018087/ R01TW008040	2011 Jan	Cohen, Ann D; Zigmond, Michael J; Smith, Amanda D	Effects of intrastriatal GDNF on the response of dopamine neurons to 6-hydroxydopamine: time course of protection and neurorestoration.	Brain Res	V:1370 P:80-8	2.728
R21DA018087/ R01TW008040	2012 Feb	Daniels, Willie M U; Marais, Lelanie; Stein, Dan J; Russell, Vivienne A	Exercise normalizes altered expression of proteins in the ventral hippocampus of rats subjected to maternal separation.	Exp Physiol	V:97 P:239-47	3.211
R21DA018087/ R01TW008040	2012 Jan	Zigmond, Michael J; Cameron, Judy L; Hoffer, Barry J; Smeyne, Richard J	Neurorestoration by physical exercise: moving forward.	Parkinsonism Relat Disord	V:18 Suppl 1 P:S147-50	3.274
R21DA018087/ R01TW008040	2012 May	Dimatelis, Jacqueline Jeanette; Hendricks, Sharief; Hsieh, Jennifer H-W; Vlok, Mare N; Bugarith, Kishor; Daniels, William Mu; Russell, Vivienne A	Exercise partially reverses the effect of maternal separation on hippocampal proteins in 6-hydroxydopamine lesioned rat brain	Exp Physiol	V: P:	3.211
R21DA018087/ R01TW008040	2012 Sep	Hendricks, Sharief; Ojuka, Edward; Kellaway, Lauriston A; Mabandla, Musa V; Russell, Vivienne A	Effect of maternal separation on mitochondrial function and role of exercise in a rat model of Parkinson's disease	Metab Brain Dis	V:27 P:387-92	1.825
R21DA018087/ R01TW008040	2012 Sep	Makena, Nokuthula; Bugarith, Kishor; Russell, Vivienne A	Maternal separation enhances object location memory and prevents exercise-induced MAPK/ERK signalling in adult Sprague-Dawley rats	Metab Brain Dis	V:27 P:377-85	1.825
R21DA018087/ R01TW008040	2013 Feb	Sterley, Toni-Lee; Howells, Fleur M; Russell, Vivienne A	Maternal separation increases GABA(A) receptor-mediated modulation of norepinephrine release in the hippocampus of a rat model of ADHD, the spontaneously hypertensive rat.	Brain Res	V:1497 P:23-31	2.728
R21DA018093/ R01DA023697	3/7/2013	Chhagan, Meera K; Mellins, Claude A; Kauchali, Shuaib; Craib, Murray H; Taylor, Myra; Kvalsvig, Jane D; Davidson, Leslie L	Mental Health Disorders Among Caregivers of Preschool Children in the Asenze Study in KwaZulu-Natal, South Africa.	Matern Child Health J	V: P:	unavailable
R21DA018093/ R01DA023697	2006 Jun	Kauchali, Shuaib; Davidson, Leslie L	Commentary: the epidemiology of neurodevelopmental disorders in Sub-Saharan Africa--moving forward to understand the health and psychosocial needs of children, families, and communities.	Int J Epidemiol	V:35 P:689-90	4.517
R21DA018093/ R01DA023697	2011 Dec	Chhagan, Meera K; Kauchali, Shuaib; Arpadi, Stephen M; Craib, Murray H; Bah, Fatimatou; Stein, Zena; Davidson, Leslie L	Failure to test children of HIV-infected mothers in South Africa: implications for HIV testing strategies for preschool children.	Trop Med Int Health	V:16 P:1490-4	2.795
R21DA018093/ R01DA023697	2012 Dec	Scherzer, Alfred L; Chhagan, Meera; Kauchali, Shuaib; Susser, Ezra	Global perspective on early diagnosis and intervention for children with developmental delays and disabilities.	Dev Med Child Neurol	V:54 P:1079-84	2.918
R21DA018095	2005 May	Miller, Laurie C	International adoption, behavior, and mental health.	JAMA	V:293 P:2533-5	23.332

R21DA018095	2005 Oct	Miller, Laurie C	Immediate behavioral and developmental considerations for internationally adopted children transitioning to families.	Pediatr Clin North Am	V:52 P:1311-30, vi-vii	1.14
R21DA018095	2006 Mar	Miller, Laurie C; Chan, Wilma; Litvinova, Aina; Rubin, Arkady; Comfort, Kathleen; Tirella, Linda; Cermak, Sharon; Morse, Barbara; Kovalev, Igor; Boston-Murmansk Orphanage Research Team	Fetal alcohol spectrum disorders in children residing in Russian orphanages: a phenotypic survey.	Alcohol Clin Exp Res	V:30 P:531-8	2.933
R21DA018095	2007 Dec	Miller, Laurie C; Chan, Wilma; Litvinova, Aina; Rubin, Arkady; Tirella, Linda; Cermak, Sharon	Medical diagnoses and growth of children residing in Russian orphanages.	Acta Paediatr	V:96 P:1765-9	1.411
R21DA018095	2008 Jan	Tirella, L G; Chan, W; Cermak, S A; Litvinova, A; Salas, K C; Miller, L C	Time use in Russian Baby Homes.	Child Care Health Dev	V:34 P:77-86	1.396
R21DA021422	2012	Churchwell, John C; Carey, Paul D; Ferrett, Helen L; Stein, Dan J; Yurgelun-Todd, Deborah A	Abnormal Striatal Circuitry and Intensified Novelty Seeking Among Adolescents that Abuse Methamphetamine and Cannabis	Dev Neurosci	V:34 P:310-7	3.413
R21DA021422	2007 Sep	Gruber, Staci A; Silveri, Marisa M; Yurgelun-Todd, Deborah A	Neuropsychological consequences of opiate use.	Neuropsychol Rev	V:17 P:299-315	2.435
R21DA021422	2013 Jun	Sung, Young-Hoon; Carey, Paul D; Stein, Dan J; Ferrett, Helen L; Spottiswoode, Bruce S; Renshaw, Perry F; Yurgelun-Todd, Deborah A	Decreased frontal N-acetylaspartate levels in adolescents concurrently using both methamphetamine and marijuana	Behav Brain Res	V:246 P:154-61	3.417
R21DA024626	2011	Bongard, Stephan; al'Absi, Mustafa; Khalil, Najat Sayem; Al Habori, Molham	Khat use and trait anger: effects on affect regulation during an acute stressful challenge.	Eur Addict Res	V:17 P:285-91	2.525
R21DA024626	2013	Hoffman, Richard; Al'absi, Mustafa	Working memory and speed of information processing in chronic khat users: preliminary findings.	Eur Addict Res	V:19 P:1-6	2.525
R21DA024626	2010 Dec	Hoffman, Richard; Al'Absi, Mustafa	Khat use and neurobehavioral functions: suggestions for future studies.	J Ethnopharmacol	V:132 P:554-63	3.014
R21DA024626	2011 Jun	Kroll, Jerome; Yusuf, Ahmed Ismail; Fujiwara, Koji	Psychoses, PTSD, and depression in Somali refugees in Minnesota.	Soc Psychiatry Psychiatr Epidemiol	V:46 P:481-93	2.861
R21DA024626	2012 Feb	al'Absi, Mustafa; Grabowski, John	Concurrent use of tobacco and khat: added burden on chronic disease epidemic.	Addiction	V:107 P:451-2	4.313
R21DA024626	2012 Nov-Dec	Nakajima, Motohiro; al'Absi, Mustafa; Dokam, Anisa; Alsoofi, Mohammed; Khalil, Najat Sayem	An examination of the Fagerström Test for Nicotine Dependence among concurrent tobacco and khat users.	J Psychoactive Drugs	V:44 P:437-41	unavailable
R21DA024626	2013 Apr	Kassim, Saba; Croucher, Ray; al'Absi, Mustafa	Khat dependence syndrome: a cross sectional preliminary evaluation amongst UK-resident Yemeni khat chewers.	J Ethnopharmacol	V:146 P:835-41	3.014
R21DA024626	2013 Mar-Apr	al'Absi, Mustafa; Khalil, Najat Sayem; Al Habori, Molham; Hoffman, Richard; Fujiwara, Koji; Wittmers, Lorentz	Effects of chronic khat use on cardiovascular, adrenocortical, and psychological responses to stress in men and women.	Am J Addict	V:22 P:99-107	unavailable
R21ES013108/ R01AG036469	2012	Mena, Luis J; Orozco, Eber E; Felix, Vanessa G; Ostos, Rodolfo; Melgarejo, Jesus; Maestre, Gladys E	Machine learning approach to extract diagnostic and prognostic thresholds: application in prognosis of cardiovascular mortality.	Comput Math Methods Med	V:2012 P:750151	0.791

R21ES013108/ R01AG036469	2012 Oct	Maestre, Gladys E	Assessing dementia in resource-poor regions.	Curr Neurol Neurosci Rep	V:12 P:511-9	3.783
R21ES015464	2011 May	Brino, ALF, Barros, RS, Galvão, O. F, Garotti, MF, Cruz, IRN, Santos, JR, Dube, WV, McIlvane	Sample stimulus control shaping and restricted stimulus control in capuchin monkeys: A methodological note	J Exp Anal Behav	V:95 P:387-98	1.385
R21ES015464	2011 Nov	Campos, Heloisa Cursi; Debert, Paula; da Silva Barros, Romariz; McIlvane, William J	Relational discrimination by pigeons in a go/ no-go procedure with compound stimuli: a methodological note.	J Exp Anal Behav	V:96 P:417-26	1.385
R21ES015464	2012 Jun	Brino, ALF, Galvão, OF, Barros, RS, Goulart, PRK, McIlvane, WJ	Restricted stimulus control in stimulus control shaping with a capuchin monkey	Psychol & Neuroscience	V:5 P:83-9	unavailable
R21ES015465	2012 Sep	Lorenz, Alyson N; Prapamontol, Tippawan; Narksen, Warangkana; Srinual, Niphan; Barr, Dana B; Riederer, Anne M	Pilot study of pesticide knowledge, attitudes, and practices among pregnant women in northern Thailand.	Int J Environ Res Public Health	V:9 P:3365-83	1.818
R21ES015472	2012 Aug	Meyer-Baron, Monika; Kim, Eun A; Nuwayhid, Iman; Ichihara, Gaku; Kang, Seong-Kyu	Occupational exposure to neurotoxic substances in Asian countries - challenges and approaches.	Neurotoxicology	V:33 P:853-61	3.096
R21ES015472	2012 Aug	Rohlman, Diane S; Nuwayhid, Iman; Ismail, Ahmed; Saddik, Basema	Using epidemiology and neurotoxicology to reduce risks to young workers.	Neurotoxicology	V:33 P:817-22	3.096
R21ES016523	2010 Sep	Kordas, Katarzyna; Queirolo, Elena I; Ettinger, Adrienne S; Wright, Robert O; Stoltzfus, Rebecca J	Prevalence and predictors of exposure to multiple metals in preschool children from Montevideo, Uruguay.	Sci Total Environ	V:408 P:4488-94	3.286
R21ES017223	2011 Mar	Rohlman, Diane S; Anger, W Kent; Lein, Pamela	Correlating neurobehavioral performance with biomarkers of organophosphorous pesticide exposure.	Neurotoxicology	V:32 P:268-76	3.096
R21ES017223	2012 Aug	London, Leslie; Beseler, Cheryl; Bouchard, Maryse F; Bellinger, David C; Colosio, Claudio; Grandjean, Philippe; Harari, Raul; Kootbodien, Tahira; Kromhout, Hans; Little, Francesca; Meijster, Tim; Moretto, Angelo; Rohlman, Diane S; Stallones, Lorann	Neurobehavioral and neurodevelopmental effects of pesticide exposures.	Neurotoxicology	V:33 P:887-96	3.096
R21ES017223	2012 Aug	Rohlman, Diane S; Nuwayhid, Iman; Ismail, Ahmed; Saddik, Basema	Using epidemiology and neurotoxicology to reduce risks to young workers	Neurotoxicology	V:33 P:817-22	3.096
R21ES017223	2012 Jul	Ismail, A A; Bodner, T E; Rohlman, D S	Neurobehavioral performance among agricultural workers and pesticide applicators: a meta-analytic study.	Occup Environ Med	V:69 P:457-64	3.02
R21ES017225/ R01ES019841	2012	Kassa R, Monterroso V, Wentzell J, Ramos AL, Couchi E, Lecomte MC, Iordanov M, Kretzschmar D, Nicolas G, Tshala-Katumbay D	Proximal giant neurofilamentous axonopathy in mice genetically engineered to resist calpain and caspase cleavage of α-II spectrin	J Mol Neurosci	47(3):631-8	2.891
R21ES017225/ R01ES019841	2013	Jean Pierre Banea, J. Howard Bradbury, Chretienne Mandombi, Damien Nahimana, Ian C.Denton, N'landa Kuwa, D Tshala Katumbay	Effectiveness of wetting method for control of konzo and reduction of cyanide poisoning by removal of cyanogens from cassava flour	Food and Nutrition Bulletin	in press	2.106
R21ES017225/ R01ES019841	2013	Banea JP, Bradbury JH, Mandombi C, Nahimana D, Denton IC, Kuwa N, Tshala Katumbay D	Control of konzo by detoxification of cassava flour in three villages in the Democratic Republic of Congo	Food Chem Toxicol	60C:506-513	2.999

R21ES017225/ R01ES019841	2013	Kassa R, Monterroso V, David LL, Tshala-Katumbay D	Diagnostic and Therapeutic Potential of Tetanus Toxin-Derivatives in Neurological Diseases	J Mol Neurosci	Epub ahead of print	2.891
R21ES017225/ R01ES019841	2013	Luabeya MK, Mwanza JC, Mukendi KM, Tshala-Katumbay D	APRONES: neurology research and education in the Democratic Republic of the Congo	Neurology	80(19):1806-7	8.312
R21ES017225/ R01ES019841	2011 Mar	Kassa, Roman M; Kasensa, Nyamabo L; Monterroso, Victor H; Kayton, Robert J; Klimek, John E; David, Larry L; Lunganza, Kalala R; Kayembe, Kazadi T; Bentivoglio, Marina; Juliano, Sharon L; Tshala-Katumbay, Desire D	On the biomarkers and mechanisms of konzo, a distinct upper motor neuron disease associated with food (cassava) cyanogenic exposure.	Food Chem Toxicol	V:49 P:571-8	2.999
R21ES017225/ R01ES019841	2013 Apr	Boivin, Michael J; Okitundu, Daniel; Makila-Mabe Bumoko, Guy; Sombo, Marie-Therese; Mumba, Dieudonne; Tylleskar, Thorkild; Page, Connie F; Tamfum Muyembe, Jean-Jacques; Tshala-Katumbay, Desire	Neuropsychological effects of konzo: a neuromotor disease associated with poorly processed cassava.	Pediatrics	V:131 P:e1231-9	4.789
R21ES017225/ R01ES019841	2013 Mar	Tshala-Katumbay, D; Mumba, N; Okitundu, L; Kazadi, K; Banea, M; Tylleskar, T; Boivin, M; Muyembe-Tamfum, J J	Cassava food toxins, konzo disease, and neurodegeneration in sub-Sahara Africans.	Neurology	V:80 P:949-51	8.312
R21ES017226	2011 May	Manasyan, Albert; Chomba, Elwyn; McClure, Elizabeth M; Wright, Linda L; Krzywanski, Sara; Carlo, Waldemar A; Eunice Kennedy Shriver National Institute of Child Health and Human Development Global Network for Women's and Children's Health Research	Cost-effectiveness of essential newborn care training in urban first-level facilities.	Pediatrics	V:127 P:e1176-81	4.789
R21ES017226	2013 Apr	Carlo, Waldemar A; Goudar, Shivaprasad S; Pasha, Omrana; Chomba, Elwyn; Wallander, Jan L; Biasini, Fred J; McClure, Elizabeth M; Thorsten, Vanessa; Chakraborty, Hrishikesh; Wallace, Dennis; Shearer, Darlene L; Wright, Linda L; Brain Research to Ameliorate Impaired Neurodevelopment-Home-Based Intervention Trial Committee and the National Institute ofýýChild Health and Human Development Global Network for Women's and Children's Health Research Investigators	Randomized Trial of Early Developmental Intervention on Outcomes in Children after Birth Asphyxia in Developing Countries	J Pediatr	V:162 P:705-712.e3	4.035
R21ES018723	2011 Aug	Cifuentes, Enrique; Kasten, Felipe Lozano; Trasande, Leonardo; Goldman, Rose H	Resetting our priorities in environmental health: an example from the South-North partnership in Lake Chapala, Mexico.	Environ Res	V:111 P:877-80	3.398
R21ES018730	2011 Apr	Winans, Bethany; Humble, Michael C; Lawrence, B Paige	Environmental toxicants and the developing immune system: a missing link in the global battle against infectious disease?	Reprod Toxicol	V:31 P:327-36	3.226
R21HD053057	2013	unknown	INCLEN Diagnostic Tool for Attention Deficit Hyperactive Disorder (INDT- ADHD): Use of Appropriateness Criteria Developed for Indian Context.	Indian Pediatrics	[accepted]	1.036

R21HD053057	2013	unknown	INCLEN Diagnostic Tool for Autism Spectrum Disorder (INDT- ASD): Use of Appropriateness Criteria Developed for Indian Context	Indian Pediatrics	[accepted]	1.036
R21HD053057	2013	unknown	INCLEN Diagnostic Tool for Epilepsy (INDT-EPI) for Primary Care Physicians	Indian Pediatrics	[accepted]	1.036
R21HD053057	2013	unknown	INCLEN Diagnostic Tool for Neuro-motor Impairment (INDT-NMI) for Primary Care Physician	Indian Pediatrics	[accepted]	1.036
R21HD057808	2012 Sep	Rahbar, Mohammad H; Samms-Vaughan, Maureen; Loveland, Katherine A; Pearson, Deborah A; Bressler, Jan; Chen, Zhongxue; Ardjomand-Hessabi, Manouchehr; Shakespeare-Pellington, Sydonnie; Grove, Megan L; Beecher, Compton; Bloom, Kari; Boerwinkle, Eric	Maternal and paternal age are jointly associated with childhood autism in Jamaica.	J Autism Dev Disord	V:42 P:1928-38	unavailable
R21HD057808	2012 Sep	Rahbar, Mohammad H; Samms-Vaughan, Maureen; Ardjomand-Hessabi, Manouchehr; Loveland, Katherine A; Dickerson, Aisha S; Chen, Zhongxue; Bressler, Jan; Shakespeare-Pellington, Sydonnie; Grove, Megan L; Bloom, Kari; Wirth, Julie; Pearson, Deborah A; Boerwinkle, Eric	The role of drinking water sources, consumption of vegetables and seafood in relation to blood arsenic concentrations of Jamaican children with and without Autism Spectrum Disorders	Sci Total Environ	V:433 P:362-70	3.286
R21HD057808	2013 Jan	Rahbar, Mohammad H; Samms-Vaughan, Maureen; Loveland, Katherine A; Ardjomand-Hessabi, Manouchehr; Chen, Zhongxue; Bressler, Jan; Shakespeare-Pellington, Sydonnie; Grove, Megan L; Bloom, Kari; Pearson, Deborah A; Lalor, Gerald C; Boerwinkle, Eric	Seafood consumption and blood mercury concentrations in Jamaican children with and without autism spectrum disorders.	Neurotox Res	V:23 P:22-38	3.514
R21HD060500	2012 Jan	Mayo-Ortega, Liliana; Oyama-Ganiko, Rosa; Leblanc, Judith; Schroeder, Stephen R; Brady, Nancy; Butler, Merlin G; Reese, R Matthew; Richman, David M; Peacock, Georgina; Foster, Jessica; Marquis, Janet	Mass Screening for Severe Problem Behavior among Infants and Toddlers In Peru	J Ment Health Res Intellect Disabil	V:5 P:246-259	unavailable
R21HD060500	2012 Jan	Schroeder, Stephen R; Courtemanche, Andrea	Early Prevention of Severe Neurodevelopmental Behavior Disorders: An Integration.	J Ment Health Res Intellect Disabil	V:5 P:203-214	unavailable
R21HD060500	2013 May	Rojahn, Johannes; Schroeder, Stephen R; Mayo-Ortega, Liliana; Oyama-Ganiko, Rosao; LeBlanc, Judith; Marquis, Janet; Berke, Elizabeth	Validity and reliability of the Behavior Problems Inventory, the Aberrant Behavior Checklist, and the Repetitive Behavior Scale-Revised among infants and toddlers at risk for intellectual or developmental disabilities: a multi-method assessment approach.	Res Dev Disabil	V:34 P:1804-14	unavailable
R21HD060520	7/26/2013	Kongtip, Pornpimol; Nankongnab, Noppanun; Woskie, Susan; Phamonphon, Akkarat; Tharnpoophasiam, Prapin; Wilaiwan, Kitsiluck; Srasom, Punnee	Organophosphate urinary metabolite levels during pregnancy, delivery and postpartum in women living in agricultural areas in Thailand	J Occup Health	V: 55, P: 367-75	1.634

R21HD060524	2011 Sep	Bodeau-Livinec, Florence; Briand, Valerie; Berger, Jacques; Xiong, Xu; Massougbodji, Achille; Day, Karen P; Cot, Michel	Maternal anemia in Benin: prevalence, risk factors, and association with low birth weight.	Am J Trop Med Hyg	V:85 P:414-20	2.45
R21MH071213/ R01NS055628	2008	Rumbaugh, Jeffrey A; Steiner, Joseph; Sacktor, Ned; Nath, Avindra	Developing neuroprotective strategies for treatment of HIV-associated neurocognitive dysfunction.	Futur HIV Ther	V:2 P:271-280	unavailable
R21MH071213/ R01NS055628	2006 Feb	Riedel, D; Ghate, M; Nene, M; Paranjape, Rs; Mehendale, Sm; Bollinger, Rc; Sacktor, N; McArthur, Jc; Nath, A	Screening for human immunodeficiency virus (HIV) dementia in an HIV clade C-infected population in India.	J Neurovirol	V:12 P:34-8	2.31
R21MH071213/ R01NS055628	2006 Oct	Mahadevan, Anita; Satishchandra, Parthasarathy; Prachet, Krishnamurthy Kulkarni; Sidappa, Nagadenahalli Byrareddy; Ranga, Udaykumar; Santosh, Vani; Yasha, Thagadur Chickabasavaiah; Desai, Anita; Ravi, Vasanthapuram; Shankar, Susarla Krishna	Optic nerve axonal pathology is related to abnormal visual evoked responses in AIDS.	Acta Neuropathol	V:112 P:461-9	2.694
R21MH071213/ R01NS055628	2007 Sep	Mahadevan, Anita; Shankar, Susarla K; Satishchandra, Parthasarathy; Ranga, Udaykumar; Chickabasaviah, Yasha Thagadur; Santosh, Vani; Vasanthapuram, Ravi; Pardo, Carlos A; Nath, Avindra; Zink, Mary C	Characterization of human immunodeficiency virus (HIV)-infected cells in infiltrates associated with CNS opportunistic infections in patients with HIV clade C infection.	J Neuropathol Exp Neurol	V:66 P:799-808	4.718
R21MH071213/ R01NS055628	2008 Jan-Feb	Mahadevan, A; Tagore, R; Siddappa, N B; Santosh, V; Yasha, T C; Ranga, U; Chandramouli, B A; Shankar, S K	Giant serpentine aneurysm of vertebrobasilar artery mimicking dolichoectasia--an unusual complication of pediatric AIDS. Report of a case with review of the literature.	Clin Neuropathol	V:27 P:37-52	1.2
R21MH071213/ R01NS055628	2010 Apr	Clifford, David B; De Luca, Andrea; DeLuca, Andrea; Simpson, David M; Arendt, Gabriele; Giovannoni, Gavin; Nath, Avindra	Natalizumab-associated progressive multifocal leukoencephalopathy in patients with multiple sclerosis: lessons from 28 cases.	Lancet Neurol	V:9 P:438-46	12.167
R21MH071213/ R01NS055628	2010 Apr	Wang, Tongguang; Lee, Myoung-Hwa; Johnson, Tory; Allie, Rameeza; Hu, Lina; Calabresi, Peter A; Nath, Avindra	Activated T-cells inhibit neurogenesis by releasing granzyme B: rescue by Kv1.3 blockers.	J Neurosci	V:30 P:5020-7	7.271
R21MH071213/ R01NS055628	2010 Jun	Kumar, G G Sharath; Mahadevan, A; Guruprasad, A S; Kovoor, Jerry M E; Satishchandra, P; Nath, Avindra; Ranga, Udaykumar; Shankar, S K	Eccentric target sign in cerebral toxoplasmosis: neuropathological correlate to the imaging feature.	J Magn Reson Imaging	V:31 P:1469-72	2.749
R21MH071213/ R01NS055628	2011 Jun	Johnson, Tory; Nath, Avindra	Immune reconstitution inflammatory syndrome and the central nervous system.	Curr Opin Neurol	V:24 P:284-90	4.936
R21MH071213/ R01NS055628	2011 Mar	Nath, Avindra; Clements, Janice E	Eradication of HIV from the brain: reasons for pause.	AIDS	V:25 P:577-80	6.245

R21MH071213/ R01NS055628	2013 Feb	Joseph, Jeymohan; Achim, Cristian L; Boivin, Michael J; Brew, Bruce J; Clifford, David B; Colosi, Deborah A; Ellis, Ronald J; Heaton, Robert K; Gallo-Diop, Amadou; Grant, Igor; Kanmogne, Georgette D; Kumar, Mahendra; Letendre, Scott; Marcotte, Thomas D; Nath, Avindra; Pardo, Carlos A; Paul, Robert H; Pulliam, Lynn; Robertson, Kevin; Royal 3rd, Walter; Sacktor, Ned; Sithinamsuwan, Pasiri; Smith, Davey M; Valcour, Victor; Wigdahl, Brian; Wood, Charles	Global NeuroAIDS roundtable.	J Neurovirol	V:19 P:1-9	2.31
R21MH071214/ R01HD053216	2012	Donahue, Marie Collins; Dube, Queen; Dow, Anna; Umar, Eric; Van Rie, Annelies	"They Have Already Thrown Away Their Chicken": barriers affecting participation by HIV-infected women in care and treatment programs for their infants in Blantyre, Malawi	AIDS Care	V:24 P:1233-9	unavailable
R21MH071214/ R01HD053216	2008 Jul	Van Rie, Annelies; Mupuala, Aimee; Dow, Anna	Impact of the HIV/AIDS epidemic on the neurodevelopment of preschool-aged children in Kinshasa, Democratic Republic of the Congo.	Pediatrics	V:122 P:e123-8	4.789
R21MH071214/ R01HD053216	2009 Dec	Van Rie, Annelies; Dow, Anna; Mupuala, Aimee; Stewart, Paul	Neurodevelopmental trajectory of HIV-infected children accessing care in Kinshasa, Democratic Republic of Congo.	J Acquir Immune Defic Syndr	V:52 P:636-42	4.653
R21MH071214/ R01HD053216	2009 Jun	Ferguson, Gillian; Jelsma, Jennifer	The prevalence of motor delay among HIV infected children living in Cape Town, South Africa.	Int J Rehabil Res	V:32 P:108-14	1.055
R21MH071214/ R01HD053216	2012 Dec	Sturdevant, Christa Buckheit; Dow, Anna; Jabara, Cassandra B; Joseph, Sarah B; Schnell, Gretja; Takamune, Nobutoki; Mallewa, Macpherson; Heyderman, Robert S; Van Rie, Annelies; Swanstrom, Ronald	Central nervous system compartmentalization of HIV-1 subtype C variants early and late in infection in young children.	PLoS Pathog	V:8 P:e1003094	9.127
R21MH071214/ R01HD053216	2012 May	Hanrahan, Colleen F; Westreich, Daniel; Van Rie, Annelies	Verification bias in a diagnostic accuracy study of symptom screening for tuberculosis in HIV-infected pregnant women.	Clin Infect Dis	V:54 P:1377-8; author reply 1378-9	8.195
R21MH071214/ R01HD053216	2012 Sep	Dube, Queen; Dow, Anna; Chirambo, Chawanangwa; Lebov, Jill; Tenthani, Lyson; Moore, Michael; Heyderman, Robert S; Van Rie, Annelies; CHIDEV study team	Implementing early infant diagnosis of HIV infection at the primary care level: experiences and challenges in Malawi.	Bull World Health Organ	V:90 P:699-704	5.25
R21MH077487/ R01MH094159	2010 Dec	Heaton, R K; Clifford, D B; Franklin Jr, D R; Woods, S P; Ake, C; Vaida, F; Ellis, R J; Letendre, S L; Marcotte, T D; Atkinson, J H; Rivera-Mindt, M; Vigil, O R; Taylor, M J; Collier, A C; Marra, C M; Gelman, B B; McArthur, J C; Morgello, S; Simpson, D M; McCutchan, J A; Abramson, I; Gamst, A; Fennema-Notestine, C; Jernigan, T L; Wong, J; Grant, I; CHARTER Group	HIV-associated neurocognitive disorders persist in the era of potent antiretroviral therapy: CHARTER Study.	Neurology	V:75 P:2087-96	8.312

R21MH077487/ R01MH094159	2013 Feb	Joseph, Jeymohan; Achim, Cristian L; Boivin, Michael J; Brew, Bruce J; Clifford, David B; Colosi, Deborah A; Ellis, Ronald J; Heaton, Robert K; Gallo-Diop, Amadou; Grant, Igor; Kanmogne, Georgette D; Kumar, Mahendra; Letendre, Scott; Marcotte, Thomas D; Nath, Avindra; Pardo, Carlos A; Paul, Robert H; Pulliam, Lynn; Robertson, Kevin; Royal 3rd, Walter; Sacktor, Ned; Sithinamsuwan, Pasiri; Smith, Davey M; Valcour, Victor; Wigdahl, Brian; Wood, Charles	Global NeuroAIDS roundtable.	J Neurovirol	V:19 P:1-9	2.31
R21MH080611/ R01MH094160	2010	Kanmogne, Georgette D; Kuate, Callixte T; Cysique, Lucette A; Fonsah, Julius Y; Eta, Sabine; Doh, Roland; Njamnshi, Dora M; Nchindap, Emilienne; Franklin Jr, Donald R; Ellis, Ronald J; McCutchan, John A; Binam, Fidele; Mbanya, Dora; Heaton, Robert K; Njamnshi, Alfred K	HIV-associated neurocognitive disorders in sub-Saharan Africa: a pilot study in Cameroon.	BMC Neurol	V:10 P:60	2.167
R21MH080611/ R01MH094160	2009 Oct	Njamnshi, A K; Bissek, A C Zoung-Kanyi; Ongolo-Zogo, P; Tabah, E N; Lekoubou, A Z; Yepnjio, F N; Fonsah, J Y; Kuate, C T; Angwafor, S A; Dema, F; Njamnshi, D M; Kouanfack, C; Djientcheu, V de P; Muna, W F T; Kanmogne, G D	Risk factors for HIV-associated neurocognitive disorders (HAND) in sub-Saharan Africa: the case of Yaounde-Cameroon.	J Neurol Sci	V:285 P:149-53	2.353
R21MH080611/ R01MH094160	2013 Feb	Joseph, Jeymohan; Achim, Cristian L; Boivin, Michael J; Brew, Bruce J; Clifford, David B; Colosi, Deborah A; Ellis, Ronald J; Heaton, Robert K; Gallo-Diop, Amadou; Grant, Igor; Kanmogne, Georgette D; Kumar, Mahendra; Letendre, Scott; Marcotte, Thomas D; Nath, Avindra; Pardo, Carlos A; Paul, Robert H; Pulliam, Lynn; Robertson, Kevin; Royal 3rd, Walter; Sacktor, Ned; Sithinamsuwan, Pasiri; Smith, Davey M; Valcour, Victor; Wigdahl, Brian; Wood, Charles	Global NeuroAIDS roundtable.	J Neurovirol	V:19 P:1-9	2.31
R21MH080612/ R01NS074903	2011 Nov	Holguin, Adelina; Banda, Mwanza; Willen, Elizabeth J; Malama, Costantine; Chiyenu, Kaseya O; Mudenda, Victor C; Wood, Charles	HIV-1 effects on neuropsychological performance in a resource-limited country, Zambia.	AIDS Behav	V:15 P:1895-901	unavailable
R21MH080612/ R01NS074903	2013 Feb	Joseph, Jeymohan; Achim, Cristian L; Boivin, Michael J; Brew, Bruce J; Clifford, David B; Colosi, Deborah A; Ellis, Ronald J; Heaton, Robert K; Gallo-Diop, Amadou; Grant, Igor; Kanmogne, Georgette D; Kumar, Mahendra; Letendre, Scott; Marcotte, Thomas D; Nath, Avindra; Pardo, Carlos A; Paul, Robert H; Pulliam, Lynn; Robertson, Kevin; Royal 3rd, Walter; Sacktor, Ned; Sithinamsuwan, Pasiri; Smith, Davey M; Valcour, Victor; Wigdahl, Brian; Wood, Charles	Global NeuroAIDS roundtable.	J Neurovirol	V:19 P:1-9	2.31
R21MH083465	2013 Feb	Sacktor, Ned; Nakasujja, Noeline; Okonkwo, Ozioma; Skolasky, Richard L; Robertson, Kevin; Musisi, Seggane; Katabira, Elly	Longitudinal neuropsychological test performance among HIV seropositive individuals in Uganda	J Neurovirol	V:19 P:48-56	2.31

R21MH083465	2013 Feb	Joseph, Jeymohan; Achim, Cristian L; Boivin, Michael J; Brew, Bruce J; Clifford, David B; Colosi, Deborah A; Ellis, Ronald J; Heaton, Robert K; Gallo-Diop, Amadou; Grant, Igor; Kanmogne, Georgette D; Kumar, Mahendra; Letendre, Scott; Marcotte, Thomas D; Nath, Avindra; Pardo, Carlos A; Paul, Robert H; Pulliam, Lynn; Robertson, Kevin; Royal 3rd, Walter; Sacktor, Ned; Sithinamsuwan, Pasiri; Smith, Davey M; Valcour, Victor; Wigdahl, Brian; Wood, Charles	Global NeuroAIDS roundtable.	J Neurovirol	V:19 P:1-9	2.31
R21MH093294	2012 Nov	Yung, Alison R; Woods, Scott W; Ruhrmann, Stephan; Addington, Jean; Schultze-Lutter, Frauke; Cornblatt, Barbara A; Amminger, G Paul; Bechdolf, Andreas; Birchwood, Max; Borgwardt, Stefan; Cannon, Tyrone D; de Haan, Lieuwe; French, Paul; Fusar-Poli, Paolo; Keshavan, Matcheri; Klosterkotter, Joachim; Kwon, Jun Soo; McGorry, Patrick D; McGuire, Philip; Mizuno, Masafumi; Morrison, Anthony P; Riecher-Rossler, Anita; Salokangas, Raimo K R; Seidman, Larry J; Suzuki, Michio; Valmaggia, Lucia; van der Gaag, Mark; Wood, Stephen J; McGlashan, Thomas H	Whither the attenuated psychosis syndrome?	Schizophr Bull	V:38 P:1130-4	8.486
R21MH093294	2012 Sep	Li, Huijun	Mental health literacy, stigma, and early intervention.	Asian J Psychiatr	V:5 P:209-10	unavailable
R21MH093294	2013 Mar	Walder, Deborah J; Holtzman, Carrie W; Addington, Jean; Cadenhead, Kristin; Tsuang, Ming; Cornblatt, Barbara; Cannon, Tyrone D; McGlashan, Thomas H; Woods, Scott W; Perkins, Diana O; Seidman, Larry J; Heinssen, Robert; Walker, Elaine F	Sexual dimorphisms and prediction of conversion in the NAPLS psychosis prodrome.	Schizophr Res	V:144 P:43-50	4.374
R21MH093296	2013 Mar	Baumgartner, J N; Susser, E	Social integration in global mental health: what is it and how can it be measured?	Epidemiol Psychiatr Sci	V:22 P:29-37	2.938
R21MH096559/ R01HD071664	2012	Tisdall MD, Hess AT, Reuter M, Meintjes EM, Fischl B, van der Kouwe AJW	Volumetric Navigators (vNavs) for Prospective Motion Correction and Selective Reacquisition in Neuroanatomical MRI	Magnetic Resonance in Medicine	68(2):389-99	3.267
R21MH096559/ R01HD071664	2013	Hess AT, Laughton B, Mbugua K, van der Kouwe AJW, Meintjes EM	Quality of 186 Child Brain Spectra Using Motion and B0 Shim Navigated SVS	Journal of Magnetic Resonance Imaging	In press	2.566
R21MH096559/ R01HD071664	2011 Mar	Silver, Amanda L; Nimkin, Katherine; Ashland, Jean E; Ghosh, Satrajit S; van der Kouwe, Andre J W; Brigger, Matthew T; Hartnick, Christopher	in Cognitively Impaired Patients	Arch Otolaryngol Head Neck Surg	V:137 P:258-63	1.779
R21MH096559/ R01HD071664	2012 Oct	Alhamud, A; Tisdall, M Dylan; Hess, Aaron T; Hasan, Khader M; Meintjes, Ernesta M; van der Kouwe, Andre J W	Volumetric navigators for real-time motion correction in diffusion tensor imaging	Magn Reson Med	V:68 P:1097-108	2.964

R21NS048838/ R01NS055627	2008	Lescano, A Roxana; Blazes, David L; Montano, Silvia M; Moran, Zoe; Naquira, Cesar; Ramirez, Edwin; Lie, Reidar; Martin, Gregory J; Lescano, Andres G; Zunt, Joseph R	Research ethics training in Peru: a case study.	PLoS One	V:3 P:e3274	4.092
R21NS048838/ R01NS055627	2011	Shah, Sural K; Nodell, Bobbi; Montano, Silvia M; Behrens, Chris; Zunt, Joseph R	Clinical research and global health: mentoring the next generation of health care students.	Glob Public Health	V:6 P:234-46	unavailable
R21NS048838/ R01NS055627	2012	Blas, Magaly M; Alva, Isaac E; Garcia, Patricia J; Carcamo, Cesar; Montano, Silvia M; Munante, Ricardo; Zunt, Joseph R	Association between human papillomavirus and human T-lymphotropic virus in indigenous women from the Peruvian Amazon.	PLoS One	V:7 P:e44240	4.092
R21NS048838/ R01NS055627	2005 Apr	Walker, Melanie; Zunt, Joseph R	Parasitic central nervous system infections in immunocompromised hosts.	Clin Infect Dis	V:40 P:1005-15	8.195
R21NS048838/ R01NS055627	2006 Dec	Zunt, J R; Montano, S M; Beck, I; Alarcon, J Ov; Frenkel, L M; Bautista, C T; Price, R; Longstreth, W T	Human T-lymphotropic virus type 1-associated myelopathy/tropical spastic paraparesis: viral load and muscle tone are correlated.	J Neurovirol	V:12 P:466-71	2.31
R21NS048838/ R01NS055627	2006 Jan	Walker, Melanie; Kublin, James G; Zunt, Joseph R	Parasitic central nervous system infections in immunocompromised hosts: malaria, microsporidiosis, leishmaniasis, and African trypanosomiasis.	Clin Infect Dis	V:42 P:115-25	8.195
R21NS048838/ R01NS055627	2006 May	Zunt, Joseph R; La Rosa, Alberto M; Peinado, Jesus; Lama, Javier R; Suarez, Luis; Pun, Monica; Cabezas, Cesar; Sanchez, Jorge	Risk factors for HTLV-II infection in Peruvian men who have sex with men.	Am J Trop Med Hyg	V:74 P:922-5	2.45
R21NS048838/ R01NS055627	2009 Dec	Esteban, Peggy Martinez; Thahn, Ton G; Bravo, Julio Flores; Roca, Lenka Kolevic; Quispe, Nicanor Mori; Montano, Silvia M; Zunt, Joseph	Malnutrition associated with increased risk of peripheral neuropathy in Peruvian children with HIV infection.	J Acquir Immune Defic Syndr	V:52 P:656-8	4.653
R21NS048838/ R01NS055627	2009 Jan	Harrington, Amanda T; Creutzfeldt, Claire J; Sengupta, Dhruba J; Hoogestraat, Daniel R; Zunt, Joseph R; Cookson, Brad T	Diagnosis of neurocysticercosis by detection of Taenia solium DNA using a global DNA screening platform.	Clin Infect Dis	V:48 P:86-90	8.195
R21NS048838/ R01NS055627	2009 Jul	La Rosa, Alberto M; Zunt, Joseph R; Peinado, Jesus; Lama, Javier R; Ton, Thanh G N; Suarez, Luis; Pun, Monica; Cabezas, Cesar; Sanchez, Jorge; Peruvian HIV Sentinel Surveillance Working Group	Retroviral infection in Peruvian men who have sex with men.	Clin Infect Dis	V:49 P:112-7	8.195
R21NS048838/ R01NS055627	2011 Feb	Montano, Silvia M; Hsieh, Evelyn J; Calderon, Martha; Ton, Thanh G N; Quijano, Eberth; Solari, Vicky; Zunt, Joseph R	Human papillomavirus infection in female sex workers in Lima, Peru.	Sex Transm Infect	V:87 P:81-2	2.854
R21NS048838/ R01NS055627	2011 Nov	Nelson, Christina A; Zunt, Joseph R	Tuberculosis of the central nervous system in immunocompromised patients: HIV infection and solid organ transplant recipients.	Clin Infect Dis	V:53 P:915-26	8.195
R21NS048838/ R01NS055627	2012 Dec	Quinn, Roswell; Salvatierra, Javier; Solari, Vicky; Calderon, Martha; Ton, Thanh G N; Zunt, Joseph R	Human papillomavirus infection in men who have sex with men in Lima, Peru.	AIDS Res Hum Retroviruses	V:28 P:1734-8	2.705

R21NS048838/ R01NS055627	2012 Nov	Alva, Isaac E; Orellana, E Roberto; Blas, Magaly M; Bernabe-Ortiz, Antonio; Cotrina, Armando; Chiappe, Marina; Kochel, Tadeusz J; Carcamo, Cesar P; Garcia, Patricia J; Zunt, Joseph R; Buffardi, Anne L; Montano, Silvia M	HTLV-1 and -2 Infections among 10 Indigenous Groups in the Peruvian Amazon	Am J Trop Med Hyg	V:87 P:954-6	2.45
R21NS048838/ R01NS055627	2013 Feb	Mori, Nicanor; Guevara, Jose M; Tilley, Drake H; Briceno, Jesus A; Zunt, Joseph R; Montano, Silvia M	Streptococcus equi subsp. zooepidemicus meningitis in Peru.	J Med Microbiol	V:62 P:335-7	2.502
R21NS048838/ R01NS055627	2013 Jan	Abanto, Carlos; Ton, Thanh G N; Tirschwell, David L; Montano, Silvia; Quispe, Yrma; Gonzales, Isidro; Valencia, Ana; Calle, Pilar; Garate, Arturo; Zunt, Joseph	Predictors of functional outcome among stroke patients in Lima, Peru	J Stroke Cerebrovasc Dis	22(7):1156-62	1.984
R21NS048839	2005 Mar	Jacoby, Ann; Snape, Dee; Baker, Gus A	Epilepsy and social identity: the stigma of a chronic neurological disorder.	Lancet Neurol	V:4 P:171-8	12.167
R21NS048839	2009 Jan	Snape, D; Wang, W; Wu, J; Jacoby, A; Baker, G	Knowledge gaps and uncertainties about epilepsy: findings from an ethnographic study in China.	Epilepsy Behav	V:14 P:172-8	2.335
R21NS048839	2009 Nov	Aydemir, Nuran; Trung, Dang Vu; Snape, Dee; Baker, Gus A; Jacoby, Ann; CREST Study Team	Multiple impacts of epilepsy and contributing factors: findings from an ethnographic study in Vietnam.	Epilepsy Behav	V:16 P:512-20	2.335
R21NS048839	2011 Jul	Yang, Rong-Rong; Wang, Wen-Zhi; Snape, Dee; Chen, Gong; Zhang, Lei; Wu, Jian-Zhong; Baker, Gus A; Zheng, Xiao-Ying; Jacoby, Ann	Stigma of people with epilepsy in China: views of health professionals, teachers, employers, and community leaders.	Epilepsy Behav	V:21 P:261-6	2.335
R21NS048839	2012 Oct	Guo, Wencui; Wu, Jianzhong; Wang, Wenzhi; Guan, Biyan; Snape, Dee; Baker, Gus A; Jacoby, Ann	The stigma of people with epilepsy is demonstrated at the internalized, interpersonal and institutional levels in a specific sociocultural context: findings from an ethnographic study in rural China.	Epilepsy Behav	V:25 P:282-8	2.335
R21NS048840/ R01NS064905	2013 Feb	Kimberly, W Taylor; Lima, Fabricio O; O'Connor, Sydney; Furie, Karen L	Sex differences and hemoglobin levels in relation to stroke outcomes.	Neurology	V:80 P:719-24	8.312
R21NS055348	2009 Oct	Looareesuwan, Sornchai; Laothamatas, Jiraporn; Brown, Truman R; Brittenham, Gary M	Cerebral malaria: a new way forward with magnetic resonance imaging (MRI).	Am J Trop Med Hyg	V:81 P:545-7	2.45
R21NS055353/ R01NS064901	2009	Carabin, Helene; Millogo, Athanase; Praet, Nicolas; Hounton, Sennen; Tarnagda, Zekiba; Ganaba, Rasmane; Dorny, Pierre; Nitiema, Pascal; Cowan, Linda D; Evaluation du Fardeau Economique de la Cysticercose Au Burkina Faso (EFECAB)	Seroprevalence to the antigens of Taenia solium cysticercosis among residents of three villages in Burkina Faso: a cross-sectional study.	PLoS Negl Trop Dis	V:3 P:e555	4.569
R21NS055353/ R01NS064901	2011	Ganaba, Rasmane; Praet, Nicolas; Carabin, Helene; Millogo, Athanase; Tarnagda, Zekiba; Dorny, Pierre; Hounton, Sennen; Sow, Adama; Nitiema, Pascal; Cowan, Linda D	Factors associated with the prevalence of circulating antigens to porcine cysticercosis in three villages of burkina faso.	PLoS Negl Trop Dis	V:5 P:e927	4.569

R21NS055353/ R01NS064901	2012 Dec	Millogo, Athanase; Nitiema, Pascal; Carabin, Helene; Boncoeur-Martel, Marie Paule; Rajshekhar, Vedantam; Tarnagda, Zekiba; Praet, Nicolas; Dorny, Pierre; Cowan, Linda; Ganaba, Rasmane; Hounton, Sennen; Preux, Pierre-Marie; Cisse, Rabiou	Prevalence of neurocysticercosis among people with epilepsy in rural areas of Burkina Faso.	Epilepsia	V:53 P:2194-202	3.961
R21NS055353/ R01NS064901	2012 Oct	Nitiema, P; Carabin, H; Hounton, S; Praet, N; Cowan, L D; Ganaba, R; Kompaore, C; Tarnagda, Z; Dorny, P; Millogo, A; Efecab	Prevalence case-control study of epilepsy in three Burkina Faso villages.	Acta Neurol Scand	V:126 P:270-8	2.469
R21NS055639	2008	Grigorian, Aline; Hurford, Rosemary; Chao, Ying; Patrick, Christina; Langford, T Dianne	Alterations in the Notch4 pathway in cerebral endothelial cells by the HIV aspartyl protease inhibitor, nelfinavir.	BMC Neurosci	V:9 P:27	2.85
R21NS055639	2009	Gemechu, Tufa; Tinsae, Mihrete; Ashenafi, Senait; Rodriguez, Victor Manuel; Lori, Alfredo; Collins, Michelle; Hurford, Rosemary; Haimanot, Rahel; Sandoval, Melissa; Mehari, Enawgaw; Langford, T Dianne	Most common causes of natural and injury-related deaths in Addis Ababa, Ethiopia.	Pathol Res Pract	V:205 P:608-14	1.219
R21NS055639	2002 May	Langford, T Dianne; Letendre, Scott L; Marcotte, Thomas D; Ellis, Ronald J; McCutchan, J Allen; Grant, Igor; Mallory, Margaret E; Hansen, Lawrence A; Archibald, Sarah; Jernigan, Terry; Masliah, Eliezer; HNRC Group	Severe, demyelinating leukoencephalopathy in AIDS patients on antiretroviral therapy.	AIDS	V:16 P:1019-29	6.245
R21NS055639	2008 Aug	Rearden, Ann; Hurford, Rosemary; Luu, Nhan; Kieu, Emily; Sandoval, Melissa; Perez-Liz, Georgina; Del Valle, Luis; Powell, Henry; Langford, T Dianne	Novel expression of PINCH in the central nervous system and its potential as a biomarker for human immunodeficiency virus-associated neurodegeneration.	J Neurosci Res	V:86 P:2535-42	3.086
R21NS055639	2010 May	Robertson, Kevin; Liner, Jeff; Hakim, James; Sankale, Jean-Louis; Grant, Igor; Letendre, Scott; Clifford, David; Diop, Amadou Gallo; Jaye, Assan; Kanmogne, Georgette; Njamnshi, Alfred; Langford, T Dianne; Weyessa, Tufa Gemechu; Wood, Charles; Banda, Mwanza; Hosseinipour, Mina; Sacktor, Ned; Nakasuja, Noeline; Bangirana, Paul; Paul, Robert; Joska, John; Wong, Joseph; Boivin, Michael; Holding, Penny; Kammerer, Betsy; Van Rie, Annelies; Ive, Prudence; Nath, Avindra; Lawler, Kathy; Adebamowo, Clement; Royal 3rd, Walter; Joseph, Jeymohan; NeuroAIDS in Africa Conference Participants	NeuroAIDS in Africa.	J Neurovirol	V:16 P:189-202	2.31
R21NS058293	2009 Sep	Mainero, Caterina; Benner, T; Radding, A; van der Kouwe, A; Jensen, R; Rosen, B R; Kinkel, R P	In vivo imaging of cortical pathology in multiple sclerosis using ultra-high field MRI.	Neurology	V:73 P:941-8	8.312
R21NS058294	2009 Nov	Bogdanovic, Jelena; Halsey, Neal A; Wood, Robert A; Hamilton, Robert G	Bovine and porcine gelatin sensitivity in children sensitized to milk and meat.	J Allergy Clin Immunol	V:124 P:1108-10	12.047

R21NS064885	2010 Dec	Nishioka, Kenya; Vilarino-Guell, Carles; Cobb, Stephanie A; Kachergus, Jennifer M; Ross, Owen A; Hentati, Emna; Hentati, Faycal; Farrer, Matthew J	Genetic variation of the mitochondrial complex I subunit NDUFV2 and Parkinson's disease.	Parkinsonism Relat Disord	V:16 P:686-7	3.274
R21NS064885	2010 Jun	Nishioka, Kenya; Vilarino-Guell, Carles; Cobb, Stephanie A; Kachergus, Jennifer M; Ross, Owen A; Wider, Christian; Gibson, Rachel A; Hentati, Faycal; Farrer, Matthew J	Glucocerebrosidase mutations are not a common risk factor for Parkinson disease in North Africa.	Neurosci Lett	V:477 P:57-60	2.055
R21NS064885	2010 Mar	Dachsel, Justus C; Nishioka, Kenya; Vilarino-Guell, Carles; Lincoln, Sarah J; Soto-Ortolaza, Alexandra I; Kachergus, Jennifer; Hinkle, Kelly M; Heckman, Michael G; Jasinska-Myga, Barbara; Taylor, Julie P; Dickson, Dennis W; Gibson, Rachel A; Hentati, Faycal; Ross, Owen A; Farrer, Matthew J	Heterodimerization of Lrrk1-Lrrk2: Implications for LRRK2-associated Parkinson disease.	Mech Ageing Dev	V:131 P:210-4	4.857
R21NS064885	2010 Oct	Jasinska-Myga, Barbara; Kachergus, Jennifer; Vilarino-Guell, Carles; Wider, Christian; Soto-Ortolaza, Alexandra I; Kefi, Mounir; Middleton, Lefkos T; Ishihara-Paul, Lianna; Gibson, Rachel A; Amouri, Rim; Yahmed, Samia Ben; Sassi, Samia Ben; Zouari, Mourad; El Euch, Ghada; Ross, Owen A; Hentati, Faycal; Farrer, Matthew J	Comprehensive sequencing of the LRRK2 gene in patients with familial Parkinson's disease from North Africa.	Mov Disord	V:25 P:2052-8	4.558
R21NS064888	2012	Njamnshi, Alfred K; Seke Etet, Paul F; Perrig, Stephen; Acho, Alphonse; Funsah, Julius Y; Mumba, Dieudonne; Muyembe, Jean-Jacques; Kristensson, Krister; Bentivoglio, Marina	Actigraphy in human African trypanosomiasis as a tool for objective clinical evaluation and monitoring: a pilot study.	PLoS Negl Trop Dis	V:6 P:e1525	4.569
R21NS064888	2013	Lejon V, Bentivoglio M, Franco JR	Human African trypanosomiasis, supported by our project - but unfortunatly with no acknowledgements	Handbook of Clinical Neurology	Vol 114, pp.169-181	unavailable
R21NS064888	2013	Kristensson K, Masocha W, bentivoglio M	Mechanisms of CNS invasion and damage by parasites	Handbook of Clinical Neurology	Vol 114, pp.11-22	unavailable
R21NS064888	2011 Jan	Bentivoglio, Marina; Mariotti, Raffaella; Bertini, Giuseppe	Neuroinflammation and brain infections: historical context and current perspectives.	Brain Res Rev	V:66 P:152-73	10.342
R21NS064888	2012 Jan	Amin, Daniel Ndem; Vodnala, Suman K; Masocha, Willias; Sun, Bo; Kristensson, Krister; Rottenberg, Martin E	Distinct Toll-like receptor signals regulate cerebral parasite load and interferon ýý/ýý and tumor necrosis factor ýý-dependent T-cell infiltration in the brains of Trypanosoma brucei-infected mice.	J Infect Dis	V:205 P:320-32	6.41
R21NS064888	2012 Mar-Apr	Masocha, Willias; Kristensson, Krister	Passage of parasites across the blood-brain barrier.	Virulence	V:3 P:202-12	2.264
R21NS064888	2012 May	Seke Etet, Paul F; Palomba, Maria; Colavito, Valeria; Grassi-Zucconi, Gigliola; Bentivoglio, Marina; Bertini, Giuseppe	Sleep and rhythm changes at the time of Trypanosoma brucei invasion of the brain parenchyma in the rat.	Chronobiol Int	V:29 P:469-81	4.028
R21NS064908	2010 Apr	International Stroke Genetics Consortium; Wellcome Trust Case-Control Consortium 2	Failure to validate association between 12p13 variants and ischemic stroke.	N Engl J Med	V:362 P:1547-50	51.658

R21NS064908	2012 Apr	Cheng, Yu-Ching; Anderson, Christopher D; Bione, Silvia; Keene, Keith; Maguire, Jane M; Nalls, Michael; Rasheed, Asif; Zeginigg, Marion; Attia, John; Baker, Ross; Barlera, Simona; Biffi, Alessandro; Bookman, Ebony; Brott, Thomas G; Brown Jr, Robert D; Chen, Fang; Chen, Wei-Min; Ciusani, Emilio; Cole, John W; Cortellini, Lynelle; Danesh, John; Doheny, Kimberly; Ferrucci, Luigi; Grazia Franzosi, Maria; Frossard, Philippe; Furie, Karen L; Golledge, Jonathan; Hankey, Graeme J; Hernandez, Dena; Holliday, Elizabeth G; Hsu, Fang-Chi; Jannes, Jim; Kamal, Ayeesha; Khan, Muhammad Saleem; Kittner, Steven J; Koblar, Simon A; Lewis, Martin; Lincz, Lisa; Lisa, Antonella; Matarin, Mar; Moscato, Pablo; Mychaleckyj, Josyf C; Parati, Eugenio A; Parolo, Silvia; Pugh, Elizabeth; Rost, Natalia S; Schallert, Michael; Schmidt, Helena; Scott, Rodney J; Sturm, Jonathan W; Yadav, Sunaina; Zaidi, Moazzam; Boncoraglio, Giorgio B; Levi, Christopher Royce; Meschia, James F; Rosand, Jonathan; Sale, Michele; Saleheen, Danish; Schmidt, Reinhold; Sharma, Pankaj; Worrall, Bradford; Mitchell, Braxton D; GARNET Collaborative Research Group; GENEVA Consortium; International Stroke Genetics Consortium	Are myocardial infarction--associated single-nucleotide polymorphisms associated with ischemic stroke?	Stroke	V:43 P:980-6	5.729
R21NS064908	2012 Sep	Morris, Andrew P; Voight, Benjamin F; Teslovich, Tanya M; et al.	Large-scale association analysis provides insights into the genetic architecture and pathophysiology of type 2 diabetes.	Nat Genet	V:44 P:981-90	35.532
R21NS065713	2012	Rajasingham, Radha; Rolfes, Melissa A; Birkenkamp, Kate E; Meya, David B; Boulware, David R	Cryptococcal meningitis treatment strategies in resource-limited settings: a cost-effectiveness analysis.	PLoS Med	V:9 P:e1001316	13.05
R21NS065713	2012	Butler, Elissa K; Boulware, David R; Bohjanen, Paul R; Meya, David B	Long term 5-year survival of persons with cryptococcal meningitis or asymptomatic subclinical antigenemia in Uganda.	PLoS One	V:7 P:e51291	4.092
R21NS065713	2012 Dec	Rajasingham, Radha; Boulware, David R	Reconsidering cryptococcal antigen screening in the U.S. among persons with CD4	Clin Infect Dis	V:55 P:1742-4	8.195
R21NS065713	2013 Mar	Durski, Kara N; Kuntz, Karen M; Yasukawa, Kosuke; Virnig, Beth A; Meya, David B; Boulware, David R	Cost-effective Diagnostic Checklists for Meningitis in Resource Limited Settings.	J Acquir Immune Defic Syndr	V: P:	4.653
R21NS069228	2010	MJ Potchen, GL Birbeck, JK Demarco, SD Kampondeni, ME Molyneux, N. Beare, M Sapuwa, C Antonio, EP Mwandira, TE Taylor	Neuroimaging Findings in Children with Ophthalmologically Confirmed Cerebral Malaria	Eur J Radiol.	74: 262-268	2.512
R21NS069228	2013	SD Kampondeni, MJ Potchen, NAV Beare, KB Seydel, SJ Glover, TE Taylor, GL Birbeck	MRI Findings in a Cohort of Brain Injured Survivors of Pediatric Cerebral Malaria	Am J Trop Med Hyg	88(3):542-546	2.45

R21NS069228	2013	MJ Potchen, SD Kampondeni, K Ibrahim, J Bonner, KB Seydel, TE Taylor, GL Birbeck	NeuroInterp: A Method for Facilitating Neuroimaging Research on Cerebral Malaria	Neurology	81(6):585-8	8.312
R21NS069228	2012 Oct	Potchen, M J; Kampondeni, S D; Seydel, K B; Birbeck, G L; Hammond, C A; Bradley, W G; DeMarco, J K; Glover, S J; Ugorji, J O; Latourette, M T; Siebert, J E; Molyneux, M E; Taylor, T E	Acute brain MRI findings in 120 Malawian children with cerebral malaria: new insights into an ancient disease.	AJNR Am J Neuroradiol	V:33 P:1740-6	3.167
R21NS069228	2013 Apr	Potchen, M J; Kampondeni, S D; Mallewa, M; Taylor, T E; Birbeck, G L	Brain Imaging in Normal Kids (BRINK): A Community-Based MRI Study in Malawian Children	Trop Med Int Health	V:18 P:398-402	2.795
R21NS073509	2013 Feb	Siddiqi, Omar K; Koralnik, Igor J; Atadzhanov, Masharip; Birbeck, Gretchen L	Emerging subspecialties in neurology: global health.	Neurology	V:80 P:e78-80	8.312
R21TW006665/ R01AG029798	2006	Herenu, C B; Morel, G R; Bellini, M J; Reggiani, P C; Sosa, Y E; Brown, O A; Goya, R G	Gene therapy in the neuroendocrine system.	Front Horm Res	V:35 P:135-42	1.632
R21TW006665/ R01AG029798	2009	Console GM, Hereñú CB, Camihort GA, Luna GC, Ferese C, Goya RG	Effect of insulin-like growth factor-I gene therapy on the somatotropic axis in experimental prolactinomas	Cells Tissues Organs	190: 20-26	3.322
R21TW006665/ R01AG029798	2009	Lozza FA, Chinchilla LA, Barbeito CG, Goya RG, Gimeno EJ, Portiansky EL.	Changes in carbohydrate expression in the cervical spinal cord of rats during aging	Neuropathology	29, 258–262	1.909
R21TW006665/ R01AG029798	2010	Camihort GA, Herenu CB, Luna GC, Rodriguez SS, Bracamonte MI, Goya RG, Console GM	Morphological Changes Induced by Insulin-Like Growth Factor-I Gene Therapy in Pituitary Cell Populations in Experimental Prolactinomas	Cells Tissues Organs	191: 316-25	3.322
R21TW006665/ R01AG029798	2011	Bellini, Maria J; Herenu, Claudia B; Goya, Rodolfo G; Garcia-Segura, Luis M	Insulin-like growth factor-I gene delivery to astrocytes reduces their inflammatory response to lipopolysaccharide.	J Neuroinflammation	V:8 P:21	3.827
R21TW006665/ R01AG029798	2011	Reggiani PC, Poch B, Cónsole MG, Rimoldi OJ, Schwerdt JI, Tüngler V, Garcia-Bravo MM, Dardenne M, Goya RG	Thymulin-based gene therapy and pituitary function in animal models of aging	Neuroimmunomodulation	18: 350-356	1.835
R21TW006665/ R01AG029798	2011	Reggiani, Paula C; Poch, Brenda; Console, Gloria M; Rimoldi, Omar J; Schwerdt, Jose I; Tungler, Victoria; Garcia-Bravo, Margarita M; Dardenne, Mireille; Goya, Rodolfo G	Thymulin-based gene therapy and pituitary function in animal models of aging.	Neuroimmunomodulation	V:18 P:350-6	1.835
R21TW006665/ R01AG029798	2012	Reggiani PC, Cónsole GM, Dardenne M, Goya	Therapeutic potential of the thymic peptide thymulin	Current Pharmaceutical Design	in press	3.311
R21TW006665/ R01AG029798	2013	Rodriguez SS, Schwerdt JI, Barbeito CG, Flamini AM, Han Y, Bohn MC, Goya RG	Hypothalamic insulin-like growth factor-I gene therapy prolongs estral cyclicity and protects ovarian structure in middle-aged female rats	Endocrinology	154: 2166-2173	4.459
R21TW006665/ R01AG029798	2013	Martines EV, Reggiani PC, Camihort G, Luna G, Zappa MF, Brown OA, Goya RG, Cónsole GM.;	The thymulin-lactotropic axis in rodents: thymectomy, immuno-neutralization and gene transfer studies; ,	Neuroimmunomodulation	in press	1.835
R21TW006665/ R01AG029798	2005 Feb	Carri, Nestor G; Sosa, Yolanda E; Brown, Oscar A; Albarino, Cesar; Romanowski, Victor; Goya, Rodolfo G	Studies on in vivo gene transfer in pituitary tumors using herpes-derived and adenoviral vectors.	Brain Res Bull	V:65 P:17-22	2.184

R21TW006665/ R01AG029798	2006 Aug	Reggiani, P C; Herenu, C B; Rimoldi, O J; Brown, O A; Pleau, J-M; Dardenne, M; Goya, R G	Gene therapy for long-term restoration of circulating thymulin in thymectomized mice and rats.	Gene Ther	V:13 P:1214-21	4.782
R21TW006665/ R01AG029798	2006 Aug	Garcia de Bravo, Margarita M; Polo, Monica P; Reggiani, Paula C; Rimoldi, Omar J; Dardenne, Mireille; Goya, Rodolfo G	Partial prevention of hepatic lipid alterations in nude mice by neonatal thymulin gene therapy.	Lipids	V:41 P:753-7	1.935
R21TW006665/ R01AG029798	2006 Dec	Portiansky, Enrique Leo; Barbeito, Claudio Gustavo; Gimeno, Eduardo Juan; Zuccolilli, Gustavo Oscar; Goya, Rodolfo Gustavo	Loss of NeuN immunoreactivity in rat spinal cord neurons during aging.	Exp Neurol	V:202 P:519-21	4.156
R21TW006665/ R01AG029798	2006 Feb	Herenu, Claudia B; Brown, Oscar A; Sosa, Yolanda E; Morel, Gustavo R; Reggiani, Paula C; Bellini, Maria J; Goya, Rodolfo G	The neuroendocrine system as a model to evaluate experimental gene therapy.	Curr Gene Ther	V:6 P:125-9	3.386
R21TW006665/ R01AG029798	2006 May	Morel, Gustavo R; Brown, Oscar A; Reggiani, Paula C; Herenu, Claudia B; Portiansky, Enrique L; Zuccolilli, Gustavo O; Pleau, Jean M; Dardenne, Mireille; Goya, Rodolfo G	Peripheral and mesencephalic transfer of a synthetic gene for the thymic peptide thymulin.	Brain Res Bull	V:69 P:647-51	2.184
R21TW006665/ R01AG029798	2007 Apr	Bellini, Maria J; Carino, Monica H; Tacconi-Gomez Dumm, Nelva; Goya, Rodolfo G	Fatty acid profiles in hepatic membranes of rats with different levels of circulating estrogen and prolactin.	Comp Biochem Physiol A Mol Integr Physiol	V:146 P:470-4	1.863
R21TW006665/ R01AG029798	2007 Feb	Herenu, C B; Cristina, C; Rimoldi, O J; Becu-Villalobos, D; Cambiaggi, V; Portiansky, E L; Goya, R G	Restorative effect of insulin-like growth factor-I gene therapy in the hypothalamus of senile rats with dopaminergic dysfunction.	Gene Ther	V:14 P:237-45	4.782
R21TW006665/ R01AG029798	2007 Jul	Goya, Rodolfo G; Reggiani, Paula C; Vesenbeckh, Silvan M; Pleau, Jean M; Sosa, Yolanda E; Console, Gloria M; Schade, Rudiger; Henklein, Peter; Dardenne, Mireille	Thymulin gene therapy prevents the reduction in circulating gonadotropins induced by thymulin deficiency in mice.	Am J Physiol Endocrinol Metab	V:293 P:E182-7	4.138
R21TW006665/ R01AG029798	2008 Feb	Morel, Gustavo R; Reggiani, Paula C; Console, Gloria M; Rimoldi, Omar J; Vesenbeckh, Silvan M; Garcia-Bravo, Margarita M; Rodriguez, Silvia S; Brown, Oscar A; Goya, Rodolfo G	Potential of gene therapy for restoration of endocrine thymic function in thymus-deficient animal models.	Curr Gene Ther	V:8 P:49-53	3.386
R21TW006665/ R01AG029798	2008 Jul	Sanchez, H L; Silva, L B; Portiansky, E L; Herenu, C B; Goya, R G; Zuccolilli, G O	Dopaminergic mesencephalic systems and behavioral performance in very old rats.	Neuroscience	V:154 P:1598-606	3.556
R21TW006665/ R01AG029798	2009 Dec	Morel, Gustavo R; Caron, Ruben W; Console, Gloria M; Soaje, Marta; Sosa, Yolanda E; Rodriguez, Silvia S; Jahn, Graciela A; Goya, Rodolfo G	Estrogen inhibits tuberoinfundibular dopaminergic neurons but does not cause irreversible damage	Brain Res Bull	V:80 P:347-52	2.184
R21TW006665/ R01AG029798	2009 Feb	Reggiani, Paula C; Morel, Gustavo R; Console, Gloria M; Barbeito, Claudio G; Rodriguez, Silvia S; Brown, Oscar A; Bellini, Maria Jose; Pleau, Jean-Marie; Dardenne, Mireille; Goya, Rodolfo G	The thymus-neuroendocrine axis: physiology, molecular biology, and therapeutic potential of the thymic peptide thymulin.	Ann N Y Acad Sci	V:1153 P:98-106	4.364
R21TW006665/ R01AG029798	2009 Jul 1	Rodriguez, Silvia S; Castro, Maria G; Brown, Oscar A; Goya, Rodolfo G; Console, Gloria M	Gene Therapy for the Treatment of Pituitary Tumors.	Expert Rev Endocrinol Metab	V:4 P:359-370	unavailable
R21TW006665/ R01AG029798	2009 Jun	Reggiani, P; Martines, E; Ferese, C; Goya, R; Console, G	Morphological restoration of gonadotrope population by thymulin gene therapy in nude mice.	Histol Histopathol	V:24 P:729-35	2.404

R21TW006665/ R01AG029798	2009 Mar	Fontana, Paula Andrea; Barbeito, Claudio Gustavo; Goya, Rodolfo Gustavo; Gimeno, Eduardo Juan; Portiansky, Enrique Leo	Impact of very old age on the expression of cervical spinal cord cell markers in rats.	J Chem Neuroanat	V:37 P:98-104	1.753
R21TW006665/ R01AG029798	2009 Nov	Camihort, Gisela A; Herenu, Claudia B; Luna, Georgina C; Rodriguez, Silvia S; Bracamonte, Maria I; Goya, Rodolfo G; Console, Gloria M	Morphological Changes Induced by Insulin-Like Growth Factor-I Gene Therapy in Pituitary Cell Populations in Experimental Prolactinomas.	Cells Tissues Organs	V: P:	3.322
R21TW006665/ R01AG029798	2009 Sep	Herenu, C B; Sonntag, W E; Morel, G R; Portiansky, E L; Goya, R G	The ependymal route for insulin-like growth factor-1 gene therapy in the brain.	Neuroscience	V:163 P:442-7	3.556
R21TW006665/ R01AG029798	2010 Jun	Rodrigues de Amorim, Miguel Augusto; Garcia-Segura, Luis Miguel; Goya, Rodolfo Gustavo; Portiansky, Enrique Leo	Decrease in PTEN and increase in Akt expression and neuron size in aged rat spinal cord.	Exp Gerontol	V:45 P:457-63	3.804
R21TW006665/ R01AG029798	2010 May	Morel, G R; Sosa, Y E; Bellini, M J; Carri, N G; Rodriguez, S S; Bohn, M C; Goya, R G	Glial cell line-derived neurotrophic factor gene therapy ameliorates chronic hyperprolactinemia in senile rats.	Neuroscience	V:167 P:946-53	3.556
R21TW006665/ R01AG029798	2011 Apr	Martines, Eliana; Reggiani, Paula C; Schwerdt, Jose I; Goya, Rodolfo G; Console, Gloria	Neonatal thymulin gene therapy in nude mice: Effects on the morphology of the pituitary corticotrope population.	Histol Histopathol	V:26 P:471-9	2.404
R21TW006665/ R01AG029798	2011 Jul	Portiansky EL; Nishida F; Barbeito CG; Gimeno EJ, Goya RG	Increased number of neurons in the cervical spinal cord of aged female rats	PloS One	6: e22537	4.092
R21TW006665/ R01AG029798	2011 Mar	Nishida, F; Morel, G R; Herenu, C B; Schwerdt, J I; Goya, R G; Portiansky, E L	Restorative effect of intracerebroventricular insulin-like growth factor-I gene therapy on motor performance in aging rats.	Neuroscience	V:177 P:195-206	3.556
R21TW006665/ R01AG029798	2012 Apr	Schwerdt, Jose I; Goya, Gerardo F; Calatayud, M Pilar; Herenu, Claudia B; Reggiani, Paula C; Goya, Rodolfo G	Magnetic field-assisted gene delivery: achievements and therapeutic potential.	Curr Gene Ther	V:12 P:116-26	3.386
R21TW006665/ R01AG029798	2012 Aug	Reggiani, Paula C; Barbeito, Claudio G; Zuccolilli, Gustavo O; Console, Gloria M; Flamini, Alicia M; Dardenne, Mireille; Goya, Rodolfo G	Neonatal thymulin gene therapy prevents ovarian dysgenesis and attenuates reproductive derangements in nude female mice.	Endocrinology	V:153 P:3922-8	4.459
R21TW006665/ R01AG029798	2012 Sep	Reggiani, Paula C; Martines, Eliana V; Camihort, Gisela A; Poch, Brenda; Goya, Rodolfo G; Console, Gloria M	Role of thymulin on the somatotropic axis in vivo.	Life Sci	V:91 P:166-71	2.527
R21TW006678/ R01HD057834	2007 Nov	Ertem, I O; Atay, G; Dogan, D G; Bayhan, A; Bingoler, B E; Gok, C G; Ozbas, S; Haznedaroglu, D; Isikli, S	Mothers' knowledge of young child development in a developing country.	Child Care Health Dev	V:33 P:728-37	1.396
R21TW006678/ R01HD057834	2008 Mar	Ertem, Ilgi O; Dogan, Derya G; Gok, Canan G; Kizilates, Sevim U; Caliskan, Ayliz; Atay, Gulsum; Vatandas, Nilgun; Karaaslan, Tugba; Baskan, Sevgi G; Cicchetti, Domenic V	A guide for monitoring child development in low- and middle-income countries.	Pediatrics	V:121 P:e581-9	4.789
R21TW006678/ R01HD057834	2009 Aug	Ertem, Ilgi Ozturk; Pekcici, Emine Bahar Bingoler; Gok, Canan Gul; Ozbas, Sema; Ozcebe, Hilal; Beyazova, Ufuk	Addressing early childhood development in primary health care: experience from a middle-income country.	J Dev Behav Pediatr	V:30 P:319-26	2.265

R21TW006703/ R01HD053055	2010	Wallander, Jan L; McClure, Elizabeth; Biasini, Fred; Goudar, Shivaprasad S; Pasha, Omrana; Chomba, Elwyn; Shearer, Darlene; Wright, Linda; Thorsten, Vanessa; Chakraborty, Hrishikesh; Dhaded, Sangappa M; Mahantshetti, Niranjana S; Bellad, Roopa M; Abbasi, Zahid; Carlo, Waldemar; BRAIN-HIT Investigators	Brain research to ameliorate impaired neurodevelopment--home-based intervention trial (BRAIN-HIT).	BMC Pediatr	V:10 P:27	1.904
R21TW006703/ R01HD053055	2009 Mar	Halloran, D R; McClure, E; Chakraborty, H; Chomba, E; Wright, L L; Carlo, W A	Birth asphyxia survivors in a developing country.	J Perinatol	V:29 P:243-9	1.593
R21TW006703/ R01HD053055	2012 May	Carlo, Waldemar A; Goudar, Shivaprasad S; Pasha, Omrana; Chomba, Elwyn; McClure, Elizabeth M; Biasini, Fred J; Wallander, Jan L; Thorsten, Vanessa; Chakraborty, Hrishikesh; Wright, Linda L; Brain Research to Ameliorate Impaired Neurodevelopment-Home-based Intervention Trial Committee; National Institute of Child Health and Human Development Global Network for Womenýýýs and Childrenýýýs Health Research	Neurodevelopmental outcomes in infants requiring resuscitation in developing countries.	J Pediatr	V:160 P:781-5.e1	4.035
R21TW006703/ R01HD053055	2013 Apr	Carlo, Waldemar A; Goudar, Shivaprasad S; Pasha, Omrana; Chomba, Elwyn; Wallander, Jan L; Biasini, Fred J; McClure, Elizabeth M; Thorsten, Vanessa; Chakraborty, Hrishikesh; Wallace, Dennis; Shearer, Darlene L; Wright, Linda L; Brain Research to Ameliorate Impaired Neurodevelopment-Home-Based Intervention Trial Committee and the National Institute ofýýChild Health and Human Development Global Network for Women's and Children's Health Research Investigators	Randomized Trial of Early Developmental Intervention on Outcomes in Children after Birth Asphyxia in Developing Countries	J Pediatr	V:162 P:705-712.e3	4.035
R21TW006706/ R01NS076348	2010 Mar	Conforto, Adriana Bastos; Ferreiro, Karina Nocelo; Tomasi, Camilla; dos Santos, Renata Laurenti; Moreira, Viviane Loureiro; Marie, Suely Kazue Nagahashi; Baltieri, Silvia Cristina; Scaff, Milberto; Cohen, Leonardo G	Effects of somatosensory stimulation on motor function after subacute stroke.	Neurorehabil Neural Repair	V:24 P:263-72	4.278
R21TW006706/ R01NS076348	2010 Sep-Oct	Ferreiro, Karina N; Santos, Renata L Dos; Conforto, Adriana B	Psychometric properties of the portuguese version of the Jebsen-Taylor test for adults with mild hemiparesis.	Rev Bras Fisioter	V:14 P:377-82	0.368
R21TW006713/ R01HD053131	2007	Oria, Reinaldo B; Patrick, Peter D; Blackman, James A; Lima, Aldo A M; Guerrant, Richard L	Role of apolipoprotein E4 in protecting children against early childhood diarrhea outcomes and implications for later development.	Med Hypotheses	V:68 P:1099-107	1.276

R21TW006713/ R01HD053131	2012	Azevedo, Orleancio Gomes R; Oliveira, Renato Andre C; Oliveira, Bruna Castro; Zaja-Milatovic, Snjezana; Araujo, Celina Viana; Wong, Deysi Viviana T; Costa, Tie Bezerra; Lucena, Herene Barros Miranda; Lima Jr, Roberto Cesar P; Ribeiro, Ronaldo A; Warren, Cirle A; Lima, Aldo Angelo M; Vitek, Michael P; Guerrant, Richard L; Oria, Reinaldo B	Apolipoprotein E COG 133 mimetic peptide improves 5-fluorouracil-induced intestinal mucositis.	BMC Gastroenterol	V:12 P:35	2.422
R21TW006713/ R01HD053131	2012	Mitter, Sumeet S; Oria, Reinaldo B; Kvalsund, Michelle P; Pamplona, Paula; Joventino, Emanuella Silva; Mota, Rosa M S; Goncalves, Davi C; Patrick, Peter D; Guerrant, Richard L; Lima, Aldo A M	Apolipoprotein E4 influences growth and cognitive responses to micronutrient supplementation in shantytown children from northeast Brazil.	Clinics (Sao Paulo)	V:67 P:11-8	unavailable
R21TW006713/ R01HD053131	2007 Dec	Maciel, Andressa A F L; Oria, Reinaldo B; Braga-Neto, Manuel B; Braga, Andrea B; Carvalho, Eunice B; Lucena, Herene B M; Brito, Gerly A C; Guerrant, Richard L; Lima, Aldo A M	Role of retinol in protecting epithelial cell damage induced by Clostridium difficile toxin A.	Toxicon	V:50 P:1027-40	2.246
R21TW006713/ R01HD053131	2008 Dec	Coutinho, Bruna P; Oria, Reinaldo B; Vieira, Carlos M G; Sevilleja, Jesus Emmanuel A D; Warren, Cirle A; Maciel, Jamilly G; Thompson, Meghan R; Pinkerton, Relana C; Lima, Aldo A M; Guerrant, Richard L	Cryptosporidium infection causes undernutrition and, conversely, weanling undernutrition intensifies infection.	J Parasitol	V:94 P:1225-32	1.165
R21TW006713/ R01HD053131	2008 Feb	Lorntz, Breyette; Boissevain, Jane R; Dillingham, Rebecca; Kelly, Jane; Ballard, April; Scheld, W Michael; Guerrant, Richard L	A trans-university center for global health.	Acad Med	V:83 P:165-72	1.867
R21TW006713/ R01HD053131	2008 Sep	Guerrant, Richard L; Oria, Reinaldo B; Moore, Sean R; Oria, Monica O B; Lima, Aldo A M	Malnutrition as an enteric infectious disease with long-term effects on child development.	Nutr Rev	V:66 P:487-505	3.503
R21TW006713/ R01HD053131	2009 Nov	Oria, Reinaldo B; Costa, Carlos Mauricio C; Lima, Aldo A M; Patrick, Peter D; Guerrant, Richard L	Semantic fluency: a sensitive marker for cognitive impairment in children with heavy diarrhea burdens?	Med Hypotheses	V:73 P:682-6	1.276
R21TW006713/ R01HD053131	2010 Aug	Roche, James K; Cabel, Ace; Sevilleja, Jesus; Nataro, James; Guerrant, Richard L	Enteroaggregative Escherichia coli (EAEC) impairs growth while malnutrition worsens EAEC infection: a novel murine model of the infection malnutrition cycle.	J Infect Dis	V:202 P:506-14	6.41
R21TW006713/ R01HD053131	2010 Jun	Ladd, Fernando V L; Ladd, Aliny A B L; Ribeiro, Antonio Augusto C M; Costa, Samuel B C; Coutinho, Bruna P; Feitosa, George Andre S; de Andrade, Geanne M; de Castro-Costa, Carlos Mauricio; Magalhaes, Carlos Emanuel C; Castro, Ibraim C; Oliveira, Bruna B; Guerrant, Richard L; Lima, Aldo Angelo M; Oria, Reinaldo B	Zinc and glutamine improve brain development in suckling mice subjected to early postnatal malnutrition.	Nutrition	V:26 P:662-70	3.025
R21TW006713/ R01HD053131	2010 Mar	Oria, R B; Patrick, P D; Oria, M O B; Lorntz, B; Thompson, M R; Azevedo, O G R; Lobo, R N B; Pinkerton, R F; Guerrant, R L; Lima, A A M	ApoE polymorphisms and diarrheal outcomes in Brazilian shanty town children.	Braz J Med Biol Res	V:43 P:249-56	1.15

R21TW006713/ R01HD053131	2011 Oct	Ueno, Priscilla M; Oria, Reinaldo B; Maier, Elizabeth A; Guedes, Marjorie; de Azevedo, Orleancio G; Wu, David; Willson, Tara; Hogan, Simon P; Lima, Aldo A M; Guerrant, Richard L; Polk, D Brent; Denson, Lee A; Moore, Sean R	Alanyl-glutamine promotes intestinal epithelial cell homeostasis in vitro and in a murine model of weanling undernutrition.	Am J Physiol Gastrointest Liver Physiol	V:301 P:G612-22	3.649 3.622
R21TW006713/ R01HD053131	2012 Jun	Castro, Ibraim C; Oliveira, Bruna B; Slowikowski, Jacek J; Coutinho, Bruna P; Siqueira, Francisco Julio W S; Costa, Lourrany B; Sevilleja, Jesus Emmanuel; Almeida, Camila A; Lima, Aldo A M; Warren, Cirle A; Oria, Reinaldo B; Guerrant, Richard L	Arginine decreases Cryptosporidium parvum infection in undernourished suckling mice involving nitric oxide synthase and arginase.	Nutrition	V:28 P:678-85	3.025
R21TW006724/ R01NS058302/ R01NS080648/ R01HD060570	2012	Chesnut RM, Temkin N, Carney N, et al.	A Trial of Intracranial-Pressure Monitoring in Traumatic Brain Injury	N Engl J Med	367:2471-81	51.658
R21TW006724/ R01NS058302/ R01NS080648/ R01HD060570	2013	Chesnut RM	Intracranial pressure monitoring: headstone or a new head start The BEST TRIP trial in perspective	Intensive Care Med	39:771-4	5.258
R21TW006724/ R01NS058302/ R01NS080648/ R01HD060570	2013	Chesnut RM	Editorial: Intracranial pressure monitoring for brain injury	J Neurosurg	119:1226-7	3.148
R21TW006724/ R01NS058302/ R01NS080648/ R01HD060570	2013	Chesnut RM, Petroni G, Rondina C	Intracranial-Pressure Monitoring in Traumatic Brain Injury	N Engl J Med	368:1751-2	51.658
R21TW006724/ R01NS058302/ R01NS080648/ R01HD060570	2010 Mar	Petroni, Gustavo; Quaglino, Marta; Lujan, Silvia; Kovalevski, Leandro; Rondina, Carlos; Videtta, Walter; Carney, Nancy; Temkin, Nancy; Chesnut, Randall	Early prognosis of severe traumatic brain injury in an urban argentinian trauma center.	J Trauma	V:68 P:564-70	3.129
R21TW006724/ R01NS058302/ R01NS080648/ R01HD060570	2012 Dec	Chesnut, Randall M; Temkin, Nancy; Carney, Nancy; Dikmen, Sureyya; Pridgeon, Jim; Barber, Jason; Celix, Juanita M; Chaddock, Kelley; Cherner, Marianna; Hendrix, Terence; Lujan, Silvia; Machamer, Joan; Petroni, Gustavo; Rondina, Carlos; Videtta, Walter	Traumatic Brain Injury in Latin America: Lifespan Analysis Randomized Control Trial Protocol	Neurosurgery	V:71 P:1055-63	2.785
R21TW006724/ R01NS058302/ R01NS080648/ R01HD060570	2012 Jul	Carney, Nancy; Lujan, Silvia; Dikmen, Sureyya; Temkin, Nancy; Petroni, Gustavo; Pridgeon, Jim; Barber, Jason; Machamer, Joan; Cherner, Mariana; Chaddock, Kelley; Hendrix, Terence; Rondina, Carlos; Videtta, Walter; Celix, Juanita M; Chesnut, Randall	Intracranial pressure monitoring in severe traumatic brain injury in latin america: process and methods for a multi-center randomized controlled trial.	J Neurotrauma	V:29 P:2022-9	4.295

R21TW006724/ R01NS058302/ R01NS080648/ R01HD060570	2013 Mar	Weintraub, Sandra; Dikmen, Sureyya S; Heaton, Robert K; Tulsky, David S; Zelazo, Philip D; Bauer, Patricia J; Carlozzi, Noelle E; Slotkin, Jerry; Blitz, David; Wallner-Allen, Kathleen; Fox, Nathan A; Beaumont, Jennifer L; Mungas, Dan; Nowinski, Cindy J; Richler, Jennifer; Deocampo, Joanne A; Anderson, Jacob E; Manly, Jennifer J; Borosh, Beth; Havlik, Richard; Conway, Kevin; Edwards, Emmeline; Freund, Lisa; King, Jonathan W; Moy, Claudia; Witt, Ellen; Gershon, Richard C	Cognition assessment using the NIH Toolbox.	Neurology	V:80 P:S54-64	8.312
R21TW006729/ R01HD053053	2006 Nov	Hambidge, K Michael; Abebe, Yewelsew; Gibson, Rosalind S; Westcott, Jamie E; Miller, Leland V; Lei, Sian; Stoecker, Barbara J; Arbide, Isabel; Teshome, Akilu; Bailey, Karl B; Krebs, Nancy F	Zinc absorption during late pregnancy in rural southern Ethiopia.	Am J Clin Nutr	V:84 P:1102-6	6.562
R21TW006729/ R01HD053053	2008 Apr	Abebe, Yewelsew; Bogale, Alemtsehay; Hambidge, K Michael; Stoecker, Barbara J; Arbide, Isabel; Teshome, Akilu; Krebs, Nancy F; Westcott, Jamie E; Bailey, Karl B; Gibson, Rosalind S	Inadequate intakes of dietary zinc among pregnant women from subsistence households in Sidama, Southern Ethiopia.	Public Health Nutr	V:11 P:379-86	2.123
R21TW006729/ R01HD053053	2008 Mar	Gibson, Rosalind S; Abebe, Yewelsew; Stabler, Sally; Allen, Robert H; Westcott, Jamie E; Stoecker, Barbara J; Krebs, Nancy F; Hambidge, K Michael	Zinc, gravida, infection, and iron, but not vitamin B-12 or folate status, predict hemoglobin during pregnancy in Southern Ethiopia.	J Nutr	V:138 P:581-6	3.647
R21TW006729/ R01HD053053	2008 Mar	Kennedy, Tay; Thomas, David G; Woltamo, Tesfaye; Abebe, Yewelsew; Hubbs-Tait, Laura; Sykova, Vladimira; Stoecker, Barbara J; Hambidge, K Michael	Growth and Visual Information Processing in Infants in Southern Ethiopia.	J Appl Dev Psychol	V:29 P:129-140	1.733
R21TW006729/ R01HD053053	2009 Dec	Bogale, Alemtsehay; Abebe, Yewelsew; Stoecker, Barbara J; Abuye, Cherinet; Ketema, Kassu; Hambidge, K Michael	Iodine status and cognitive function of women and their five year-old children in rural Sidama, southern Ethiopia.	East Afr J Public Health	V:6 P:296-9	unavailable
R21TW006729/ R01HD053053	2009 Jul	Stoecker, B J; Abebe, Y; Hubbs-Tait, L; Kennedy, T S; Gibson, R S; Arbide, I; Teshome, A; Westcott, J; Krebs, N F; Hambidge, K M	Zinc status and cognitive function of pregnant women in Southern Ethiopia.	Eur J Clin Nutr	V:63 P:916-8	3.072
R21TW006729/ R01HD053053	2009 Jul	Gibson, Rosalind S; Abebe, Yewelsew; Hambidge, K Michael; Arbide, Isabel; Teshome, Aklilu; Stoecker, Barbara J	Inadequate feeding practices and impaired growth among children from subsistence farming households in Sidama, Southern Ethiopia.	Matern Child Nutr	V:5 P:260-75	1.741
R21TW006729/ R01HD053053	2011 Jul-Aug	Aubuchon-Endsley, Nicki L; Grant, Stephanie L; Berhanu, Getenesh; Thomas, David G; Schrader, Sarah E; Eldridge, Devon; Kennedy, Tay; Hambidge, Michael	Hemoglobin, growth, and attention of infants in southern Ethiopia.	Child Dev	V:82 P:1238-51	4.915
R21TW006745/ R01AA016234	2007	Balachova, T., & Sobell, L.	Using motivational interviewing with patients with alcohol problems	Bekhterev Review of Psychiatry and Medical Psychology	V:1 P:4-7	unavailable
R21TW006745/ R01AA016234	2007	Balachova, Tatiana N; Bonner, Barbara L; Isurina, Galina L; Tsvetkova, Larissa A	Use of focus groups in developing FAS/FASD prevention in Russia.	Subst Use Misuse	V:42 P:881-94	1.229

R21TW006745/ R01AA016234	2010	Balachova, T.N., Isurina G.L., Grandilevskaya, I.V., Regentova, A.U., Pechenezhskaya, M.S., Burina, E.A.,& FAS Research Group	FAS prevention in Russian children: Technology of development of a preventive intervention	Publishing of SPSPMA	119-121	unavailable
R21TW006745/ R01AA016234	2012	Skitnevskaya L.	Personality characteristics of women of childbearing age who drink at-risk	Bulletin of Samara Scientific Centre of Russian Academy of Sciences (RAS)	V. 14 January/ February, p.172-175	unavailable
R21TW006745/ R01AA016234	2012	Balachova T., Volkova E., Kosyh E., Skitnevskaya L.V.	Alcohol usage peculiarities of women of child-bearing age in Nizhniy Novgorod region	Tambov University Bulletin	issue 1 (105), 2012, Section (the Humanities), 118-123	unavailable
R21TW006745/ R01AA016234	2012	T.N., Isurina G.L., Tsvetkova L.A., Volkova E.N., Bonner B.L.	Methodology of design of FASD preventive programme	Vestnik St. Petersburg University	Series 16. 2012. Issue 4., 61-70	unavailable
R21TW006745/ R01AA016234	2012	Bonner B.L., Isurina G.L., Regentova A. U., Tsvetkova L.A.	Studies on the effect of informational materials on women's attitudes to alcohol consumption during pregnancy	Vestnik St. Petersburg University	Ser. 12. 2012. Issue 4., 91-98	unavailable
R21TW006745/ R01AA016234	2012	Balachova T.N., Bonner B.L., Isurina G.L., Pechenezhskaya M.S., Regentova A.U., Tsvetkova L.A	The experience of focus groups usage in the process of developing Fetal Alcohol Syndrome prevention programme	Vestnik St. Petersburg University	Ser. 12.2012. Issue 3., 26-36	unavailable
R21TW006745/ R01AA016234	2013	Balachova T., Bonner B., Chaffin M., Isurina G., Shapkaitz V., Tsvetkova L., Volkova E., Grandilevskaya I., Skitnevskaya L., & Knowlton	Brief FASD prevention intervention: physicians' skills demonstrated in a clinical trial in Russia	Addiction Science & Clinical Practice	8:01:00	unavailable
R21TW006745/ R01AA016234	2013	Balachova T., Bonner B., Bard D., Chaffin M., Isurina G., Owora A., Tsvetkova L., Volkova E.	Women's receptivity to Fetal Alcohol Spectrum Disorders prevention approaches: A case study of two regions in Russia	International Journal of Alcohol and Drug Research	Accepted	unavailable
R21TW006745/ R01AA016234	2012 Jan	Balachova, Tatiana; Bonner, Barbara; Chaffin, Mark; Bard, David; Isurina, Galina; Tsvetkova, Larissa; Volkova, Elena	Women's alcohol consumption and risk for alcohol-exposed pregnancies in Russia.	Addiction	V:107 P:109-17	4.313
R21TW006761	2006	Gray, Victoria; Karmiloff-Smith, Annette; Funnell, Elaine; Tassabehji, May	In-depth analysis of spatial cognition in Williams syndrome: A critical assessment of the role of the LIMK1 gene.	Neuropsychologia	V:44 P:679-85	3.924
R21TW006761	2004 Oct	Karmiloff-Smith, Annette; Thomas, Michael; Annaz, Dagmara; Humphreys, Kate; Ewing, Sandra; Brace, Nicola; Duuren, Mike; Pike, Graham; Grice, Sarah; Campbell, Ruth	Exploring the Williams syndrome face-processing debate: the importance of building developmental trajectories.	J Child Psychol Psychiatry	V:45 P:1258-74	5.422
R21TW006761	2005 Dec	Hammond, Peter; Hutton, Tim J; Allanson, Judith E; Buxton, Bernard; Campbell, Linda E; Clayton-Smith, Jill; Donnai, Dian; Karmiloff-Smith, Annette; Metcalfe, Kay; Murphy, Kieran C; Patton, Michael; Pober, Barbara; Prescott, Katrina; Scambler, Pete; Shaw, Adam; Smith, Ann C M; Stevens, Angela F; Temple, I Karen; Hennekam, Raoul; Tassabehji, May	Discriminating power of localized three-dimensional facial morphology.	Am J Hum Genet	V:77 P:999-1010	11.68
R21TW006761	2005 Mar	Scerif, Gaia; Karmiloff-Smith, Annette	The dawn of cognitive genetics? Crucial developmental caveats.	Trends Cogn Sci	V:9 P:126-35	9.155

R21TW006761	2006 Feb	Paterson, Sarah J; Girelli, Luisa; Butterworth, Brian; Karmiloff-Smith, Annette	Are numerical impairments syndrome specific? Evidence from Williams syndrome and Down's syndrome.	J Child Psychol Psychiatry	V:47 P:190-204	5.422
R21TW006761	2006 Mar	Karmiloff-Smith, Annette	The tortuous route from genes to behavior: A neuroconstructivist approach.	Cogn Affect Behav Neurosci	V:6 P:9-17	3.866
R21TW006761	2007 Aug	Cornish, Kim; Scerif, Gaia; Karmiloff-Smith, Annette	Tracing syndrome-specific trajectories of attention across the lifespan.	Cortex	V:43 P:672-85	3.123
R21TW006761	2007 Aug	Ansari, Daniel; Donlan, Chris; Karmiloff-Smith, Annette	Typical and atypical development of visual estimation abilities.	Cortex	V:43 P:758-68	3.123
R21TW006761	2007 Dec		The use of 3D face shape modelling in dysmorphology.	Arch Dis Child	V:92 P:1120-6	2.786
R21TW006761	2007 May	Cox-Brinkman, Josanne; Vedder, Anouk; Hollak, Carla; Richfield, Linda; Mehta, Atul; Orteu, Kate; Wijburg, Frits; Hammond, Peter	Three-dimensional face shape in Fabry disease.	Eur J Hum Genet	V:15 P:535-42	4.003
R21TW006761	2007 Nov	Wilding, John; Cornish, Kim	Independence of speed and accuracy in visual search: evidence for separate mechanisms.	Child Neuropsychol	V:13 P:510-21	1.797
R21TW006761	2008 Jun	Cornish, K; Turk, J; Hagerman, R	The fragile X continuum: new advances and perspectives.	J Intellect Disabil Res	V:52 P:469-82	unavailable
R21TW006761	2008 Jun	Hammond, P; Forster-Gibson, C; Chudley, A E; Allanson, J E; Hutton, T J; Farrell, S A; McKenzie, J; Holden, J J A; Lewis, M E S	Face-brain asymmetry in autism spectrum disorders.	Mol Psychiatry	V:13 P:614-23	14.897
R21TW006761	2008 May	Tobin, Jonathan L; Di Franco, Matt; Eichers, Erica; May-Simera, Helen; Garcia, Monica; Yan, Jiong; Quinlan, Robyn; Justice, Monica J; Hennekam, Raoul C; Briscoe, James; Tada, Masazumi; Mayor, Roberto; Burns, Alan J; Lupski, James R; Hammond, Peter; Beales, Philip L	Inhibition of neural crest migration underlies craniofacial dysmorphology and Hirschsprung's disease in Bardet-Biedl syndrome.	Proc Natl Acad Sci U S A	V:105 P:6714-9	9.737
R21TW006761	2008 Sep	Van Herwegen, Jo; Ansari, Daniel; Xu, Fei; Karmiloff-Smith, Annette	Small and large number processing in infants and toddlers with Williams syndrome.	Dev Sci	V:11 P:637-43	unavailable
R21TW006761	2011 Jan	Zhan, Jian-Ying; Wilding, John; Cornish, Kim; Shao, Jie; Xie, Chun-Hong; Wang, Yan-Xia; Lee, Kang; Karmiloff-Smith, Annette; Zhao, Zheng-Yan	Charting the developmental trajectories of attention and executive function in Chinese school-aged children.	Child Neuropsychol	V:17 P:82-95	1.797
R21TW006764/ R01TW008274	2007	Grigorenko, Elena L; Jarvin, Linda; Kaani, Bestern; Kapungulya, Paula Pule; Kwiatkowski, Jonna; Sternberg, Robert J	Risk factors and resilience in the developing world: one of many lessons to learn.	Dev Psychopathol	V:19 P:747-65	unavailable
R21TW006764/ R01TW008274	2013	Reich, J., Tan, M., Hart, L., Thuma, P. E., Grigorenko, E. L.	Reading comprehension and its component skills in a resource-limited and linguistically complex setting: Learning to read in Rural Zambia	*Insights on Learning Disabilities*	*10,* 67-88	unavailable
R21TW006764/ R01TW008274	2013	Campbell, D., Bick, J., Yrigollen, C. M., Lee, M., Joseph, A., Chang, J. T., Grigorenko, E. L.	Schooling and variation in the COMT gene: the devil is in the details	*Journal of Child Psychology and Psychiatry*	*54*, 1056-1065	5.422

R21TW006764/ R01TW008274	2013	Reich, J., Hein, S. Krivulskaya, S., Hart, L., Gumkowski, N., Learning Disabilities Project Zambia, & Grigorenko, E. L.	Associations between household responsibilities and academic competencies in the context of education accessibility in Zambia	*Learning and Individual Differences*	in press	1.507
R21TW006764/ R01TW008274	2007 Dec	Grigorenko, Elena L	Rethinking disorders of spoken and written language: generating workable hypotheses.	J Dev Behav Pediatr	V:28 P:478-86	2.265
R21TW006764/ R01TW008274	2009 Jan	Grigorenko, Elena L	Speaking genes or genes for speaking? Deciphering the genetics of speech and language.	J Child Psychol Psychiatry	V:50 P:116-25	5.422
R21TW006764/ R01TW008274	2009 Jan	Hirunsatit, Rungnapa; George, Elizabeth D; Lipska, Barbara K; Elwafi, Hani M; Sander, Lisa; Yrigollen, Carolyn M; Gelernter, Joel; Grigorenko, Elena L; Lappalainen, Jaakko; Mane, Shrikant; Nairn, Angus C; Kleinman, Joel E; Simen, Arthur A	Twenty-one-base-pair insertion polymorphism creates an enhancer element and potentiates SLC6A1 GABA transporter promoter activity.	Pharmacogenet Genomics	V:19 P:53-65	3.991
R21TW006764/ R01TW008274	2011 Jan	Palejev, Dean; Hwang, Wookyeon; Landi, Nicole; Eastman, Maria; Frost, Stephen J; Fulbright, Robert K; Kidd, Judith R; Kidd, Kenneth K; Mason, Graeme F; Mencl, W Einar; Yrigollen, Carolyn; Pugh, Kenneth R; Grigorenko, Elena L	An application of the elastic net for an endophenotype analysis.	Behav Genet	V:41 P:120-4	2.52
R21TW006764/ R01TW008274	2011 Jan	Skiba, Thomas; Landi, Nicole; Wagner, Richard; Grigorenko, Elena L	In search of the perfect phenotype: an analysis of linkage and association studies of reading and reading-related processes.	Behav Genet	V:41 P:6-30	2.52
R21TW006764/ R01TW008274	2012 Mar	Tan Mei, Reich Jodi, Hart L, Thuma Philip E, Grigorenko Elena L.	Examining the Specific Effects of Context on Adaptive Behavior and Achievement in a Rural African Community: Six Case Studies from Rural Areas of Southern Province, Zambia.	J Autism Dev Disord	[Epub ahead of print]	unavailable
R21TW006786	2010 Jun	Fajardo-Dolci, German; Gutierrez-Vega, Rafael; Arboleya-Casanova, Heberto; Villalobos, Aremis; Wilson, Kate S; Garcia, Sandra G; Sotelo, Julio; Cordova Villalobos, Jose A; Diaz-Olavarrieta, Claudia	Clinical characteristics of fatalities due to influenza A (H1N1) virus in Mexico.	Thorax	V:65 P:505-9	6.525
R21TW006794/ R01NS055349/ R01HD064416	2009	Lovegrove, Fiona E; Tangpukdee, Noppadon; Opoka, Robert O; Lafferty, Erin I; Rajwans, Nimerta; Hawkes, Michael; Krudsood, Srivicha; Looareesuwan, Sornchai; John, Chandy C; Liles, W Conrad; Kain, Kevin C	Serum angiopoietin-1 and -2 levels discriminate cerebral malaria from uncomplicated malaria and predict clinical outcome in African children.	PLoS One	V:4 P:e4912	4.092
R21TW006794/ R01NS055349/ R01HD064416	2009	Bangirana, Paul; John, Chandy C; Idro, Richard; Opoka, Robert O; Byarugaba, Justus; Jurek, Anne M; Boivin, Michael J	Socioeconomic predictors of cognition in Ugandan children: implications for community interventions.	PLoS One	V:4 P:e7898	4.092
R21TW006794/ R01NS055349/ R01HD064416	2009	Boivin, Michael J; Giordani, Bruno	Neuropsychological assessment of African children: evidence for a universal brain/ behavior omnibus within a coconstructivist paradigm.	Prog Brain Res	V:178 P:113-35	4.191

R21TW006794/ R01NS055349/ R01HD064416	2010	Boivin, Michael J; Bangirana, Paul; Shaffer, Rebecca C; Smith, Rebecca C	The relationship between visual-spatial and auditory-verbal working memory span in Senegalese and Ugandan children.	PLoS One	V:5 P:e8914	4.092
R21TW006794/ R01NS055349/ R01HD064416	2011	Bangirana, Paul; Allebeck, Peter; Boivin, Michael J; John, Chandy C; Page, Connie; Ehnvall, Anna; Musisi, Seggane	Cognition, behaviour and academic skills after cognitive rehabilitation in Ugandan children surviving severe malaria: a randomised trial.	BMC Neurol	V:11 P:96	2.167
R21TW006794/ R01NS055349/ R01HD064416	2011	Bangirana, Paul; Musisi, Seggane; Boivin, Michael J; Ehnvall, Anna; John, Chandy C; Bergemann, Tracy L; Allebeck, Peter	Malaria with neurological involvement in Ugandan children: effect on cognitive ability, academic achievement and behaviour.	Malar J	V:10 P:334	2.913
R21TW006794/ R01NS055349/ R01HD064416	2013	Bangirana, Paul; Menk, Jeremiah; John, Chandy C; Boivin, Michael J; Hodges, James S	The association between cognition and academic performance in ugandan children surviving malaria with neurological involvement.	PLoS One	V:8 P:e55653	4.092
R21TW006794/ R01NS055349/ R01HD064416	2006 Sep	John, Chandy C; Opika-Opoka, Robert; Byarugaba, Justus; Idro, Richard; Boivin, Michael J	Low levels of RANTES are associated with mortality in children with cerebral malaria.	J Infect Dis	V:194 P:837-45	6.41
R21TW006794/ R01NS055349/ R01HD064416	2007 Feb	Boivin, Michael J; Bangirana, Paul; Byarugaba, Justus; Opoka, Robert O; Idro, Richard; Jurek, Anne M; John, Chandy C	Cognitive impairment after cerebral malaria in children: a prospective study.	Pediatrics	V:119 P:e360-6	4.789
R21TW006794/ R01NS055349/ R01HD064416	2008 Apr	Opoka, Robert O; Xia, Zongqi; Bangirana, Paul; John, Chandy C	Inpatient mortality in children with clinically diagnosed malaria as compared with microscopically confirmed malaria.	Pediatr Infect Dis J	V:27 P:319-24	3.176
R21TW006794/ R01NS055349/ R01HD064416	2008 Feb	John, Chandy C; Panoskaltsis-Mortari, Angela; Opoka, Robert O; Park, Gregory S; Orchard, Paul J; Jurek, Anne M; Idro, Richard; Byarugaba, Justus; Boivin, Michael J	Cerebrospinal fluid cytokine levels and cognitive impairment in cerebral malaria.	Am J Trop Med Hyg	V:78 P:198-205	2.45
R21TW006794/ R01NS055349/ R01HD064416	2008 Jul	John, Chandy C; Bangirana, Paul; Byarugaba, Justus; Opoka, Robert O; Idro, Richard; Jurek, Anne M; Wu, Baolin; Boivin, Michael J	Cerebral malaria in children is associated with long-term cognitive impairment.	Pediatrics	V:122 P:e92-9	4.789
R21TW006794/ R01NS055349/ R01HD064416	2008 Mar	John, Chandy C; Park, Gregory S; Sam-Agudu, Nadia; Opoka, Robert O; Boivin, Michael J	Elevated serum levels of IL-1ra in children with Plasmodium falciparum malaria are associated with increased severity of disease.	Cytokine	V:41 P:204-8	2.214
R21TW006794/ R01NS055349/ R01HD064416	2009 Aug	Bangirana, Paul; Giordani, Bruno; John, Chandy C; Page, Connie; Opoka, Robert O; Boivin, Michael J	Immediate neuropsychological and behavioral benefits of computerized cognitive rehabilitation in Ugandan pediatric cerebral malaria survivors.	J Dev Behav Pediatr	V:30 P:310-8	2.265
R21TW006794/ R01NS055349/ R01HD064416	2009 Jun	Opoka, Robert O; Bangirana, Paul; Boivin, Michael J; John, Chandy C; Byarugaba, Justus	Seizure activity and neurological sequelae in Ugandan children who have survived an episode of cerebral malaria.	Afr Health Sci	V:9 P:75-81	0.5
R21TW006794/ R01NS055349/ R01HD064416	2009 Sep	Bangirana, P; Seggane-Musisi; Allebeck, P; Giordani, B; John, C C; Opoka, O R; Byarugaba, J; Ehnvall, A; Boivin, M J	A preliminary examination of the construct validity of the KABC-II in Ugandan children with a history of cerebral malaria.	Afr Health Sci	V:9 P:186-92	0.5

R21TW006794/ R01NS055349/ R01HD064416	2010 Apr	Sam-Agudu, Nadia A; Greene, Jennifer A; Opoka, Robert O; Kazura, James W; Boivin, Michael J; Zimmerman, Peter A; Riedesel, Melissa A; Bergemann, Tracy L; Schimmenti, Lisa A; John, Chandy C	TLR9 polymorphisms are associated with altered IFN-gamma levels in children with cerebral malaria.	Am J Trop Med Hyg	V:82 P:548-55	2.45
R21TW006794/ R01NS055349/ R01HD064416	2010 Sep	John, Chandy C; Kutamba, Elizabeth; Mugarura, Keith; Opoka, Robert O	Adjunctive therapy for cerebral malaria and other severe forms of Plasmodium falciparum malaria.	Expert Rev Anti Infect Ther	V:8 P:997-1008	3.218
R21TW006794/ R01NS055349/ R01HD064416	2012 Nov	Frosch, Anne E P; John, Chandy C	Immunomodulation in Plasmodium falciparum malaria: experiments in nature and their conflicting implications for potential therapeutic agents	Expert Rev Anti Infect Ther	V:10 P:1343-56	3.218
R21TW006804	2005	Sarfo, Bismark Y; Armah, Henry B; Irune, Ikovwaiza; Adjei, Andrew A; Olver, Christine S; Singh, Shailesh; Lillard Jr, James W; Stiles, Jonathan K	Plasmodium yoelii 17XL infection up-regulates RANTES, CCR1, CCR3 and CCR5 expression, and induces ultrastructural changes in the cerebellum.	Malar J	V:4 P:63	2.913
R21TW006804	2007	Armah, Henry B; Wilson, Nana O; Sarfo, Bismark Y; Powell, Michael D; Bond, Vincent C; Anderson, Winston; Adjei, Andrew A; Gyasi, Richard K; Tettey, Yao; Wiredu, Edwin K; Tongren, Jon Eric; Udhayakumar, Venkatachalam; Stiles, Jonathan K	Cerebrospinal fluid and serum biomarkers of cerebral malaria mortality in Ghanaian children.	Malar J	V:6 P:147	2.913
R21TW006804	2008	Lucchi, Naomi W; Tongren, Jon Eric; Jain, Vidhan; Nagpal, Avinash C; Kauth, Christian W; Woehlbier, Ute; Bujard, Hermann; Dash, Aditya P; Singh, Neeru; Stiles, Jonathan K; Udhayakumar, Venkatachalam	Antibody responses to the merozoite surface protein-1 complex in cerebral malaria patients in India.	Malar J	V:7 P:121	2.913
R21TW006804	2008	Jain, Vidhan; Armah, Henry B; Tongren, Jon E; Ned, Renee M; Wilson, Nana O; Crawford, Sara; Joel, Pradeep K; Singh, Mrigendra P; Nagpal, Avinash C; Dash, A P; Udhayakumar, Venkatachalam; Singh, Neeru; Stiles, Jonathan K	Plasma IP-10, apoptotic and angiogenic factors associated with fatal cerebral malaria in India.	Malar J	V:7 P:83	2.913
R21TW006804	2010	Wilson, Nana O; Bythwood, Tameka; Solomon, Wesley; Jolly, Pauline; Yatich, Nelly; Jiang, Yi; Shuaib, Faisal; Adjei, Andrew A; Anderson, Winston; Stiles, Jonathan K	Elevated levels of IL-10 and G-CSF associated with asymptomatic malaria in pregnant women.	Infect Dis Obstet Gynecol	V:2010 P:	unavailable
R21TW006804	2011	Wilson, Nana O; Jain, Vidhan; Roberts, Christina E; Lucchi, Naomi; Joel, Pradeep K; Singh, Mrigendra P; Nagpal, Avinash C; Dash, Aditya P; Udhayakumar, Venkatachalam; Singh, Neeru; Stiles, Jonathan K	CXCL4 and CXCL10 predict risk of fatal cerebral malaria.	Dis Markers	V:30 P:39-49	1.642
R21TW006804	2011	Lucchi, Naomi W; Jain, Vidhan; Wilson, Nana O; Singh, Neeru; Udhayakumar, Venkatachalam; Stiles, Jonathan K	Potential serological biomarkers of cerebral malaria.	Dis Markers	V:31 P:327-35	1.642

R21TW006804	2011	Jain, Vidhan; Lucchi, Naomi W; Wilson, Nana O; Blackstock, Anna J; Nagpal, Avinash C; Joel, Pradeep K; Singh, Mrigendra P; Udhayakumar, Venkatachalam; Stiles, Jonathan K; Singh, Neeru	Plasma levels of angiopoietin-1 and -2 predict cerebral malaria outcome in Central India.	Malar J	V:10 P:383	2.913
R21TW006804	2011	Sarfo, Bismark Y; Wilson, Nana O; Bond, Vincent C; Stiles, Jonathan K	Plasmodium berghei ANKA infection increases Foxp3, IL-10 and IL-2 in CXCL-10 deficient C57BL/6 mice.	Malar J	V:10 P:69	2.913
R21TW006804	2012	Liu, Mingli; Amodu, Audu S; Pitts, Sidney; Patrickson, John; Hibbert, Jacqueline M; Battle, Monica; Ofori-Acquah, Solomon F; Stiles, Jonathan K	Heme mediated STAT3 activation in severe malaria.	PLoS One	V:7 P:e34280	4.092
R21TW006804	2008 Dec	Wilson, Nana O; Huang, Ming-Bo; Anderson, Winston; Bond, Vincent; Powell, Michael; Thompson, Winston E; Armah, Henry B; Adjei, Andrew A; Gyasi, Richard; Tettey, Yao; Stiles, Jonathan K	Soluble factors from Plasmodium falciparum-infected erythrocytes induce apoptosis in human brain vascular endothelial and neuroglia cells.	Mol Biochem Parasitol	V:162 P:172-6	2.951
R21TW006804	2008 May	Wilson, Nana O; Adjei, Andrew A; Anderson, Winston; Baidoo, Stella; Stiles, Jonathan K	Detection of Plasmodium falciparum histidine-rich protein II in saliva of malaria patients.	Am J Trop Med Hyg	V:78 P:733-5	2.45
R21TW006804	2008 May	Gregory-Bass, Rosalind C; Olatinwo, Moshood; Xu, Wei; Matthews, Roland; Stiles, Jonathan K; Thomas, Kelwyn; Liu, Dong; Tsang, Benjamin; Thompson, Winston E	Prohibitin silencing reverses stabilization of mitochondrial integrity and chemoresistance in ovarian cancer cells by increasing their sensitivity to apoptosis.	Int J Cancer	V:122 P:1923-30	4.734
R21TW006804	2008 Oct	Jain, Vidhan; Nagpal, Avinash C; Joel, Pradeep K; Shukla, Manmohan; Singh, Mrigendra P; Gupta, Rasik B; Dash, Aditya P; Mishra, Saroj K; Udhayakumar, Venkatachalam; Stiles, Jonathan K; Singh, Neeru	Burden of cerebral malaria in central India (2004-2007).	Am J Trop Med Hyg	V:79 P:636-42	2.45
R21TW006804	2009 Feb	Meade, John C; de Mestral, Jacqueline; Stiles, Jonathan K; Secor, W Evan; Finley, Richard W; Cleary, John D; Lushbaugh, William B	Genetic diversity of Trichomonas vaginalis clinical isolates determined by EcoRI restriction fragment length polymorphism of heat-shock protein 70 genes.	Am J Trop Med Hyg	V:80 P:245-51	2.45
R21TW006804	2009 Jun	Yatich, Nelly J; Yi, Jiang; Agbenyega, Tsiri; Turpin, Archer; Rayner, Julian C; Stiles, Jonathan K; Ellis, William O; Funkhouser, Ellen; Ehiri, John E; Williams, Jonathan H; Jolly, Pauline E	Malaria and intestinal helminth co-infection among pregnant women in Ghana: prevalence and risk factors.	Am J Trop Med Hyg	V:80 P:896-901	2.45
R21TW006804	2010 Mar	Mixson-Hayden, Tonya; Jain, Vidhan; McCollum, Andrea M; Poe, Amanda; Nagpal, Avinash C; Dash, Aditya P; Stiles, Jonathan K; Udhayakumar, Venkatachalam; Singh, Neeru	Evidence of selective sweeps in genes conferring resistance to chloroquine and pyrimethamine in Plasmodium falciparum isolates in India.	Antimicrob Agents Chemother	V:54 P:997-1006	4.565
R21TW006804	2011 Jul	Wilson, Nana O; Ceesay, Fatou K; Obed, Samuel A; Adjei, Andrew A; Gyasi, Richard K; Rodney, Patricia; Ndjakani, Yassa; Anderson, Winston A; Lucchi, Naomi W; Stiles, Jonathan K	Intermittent preventive treatment with sulfadoxine-pyrimethamine against malaria and anemia in pregnant women.	Am J Trop Med Hyg	V:85 P:12-21	2.45

R21TW006804	2011 Jun	Liu, Mingli; Guo, Shanchun; Hibbert, Jacqueline M; Jain, Vidhan; Singh, Neeru; Wilson, Nana O; Stiles, Jonathan K	CXCL10/IP-10 in infectious diseases pathogenesis and potential therapeutic implications.	Cytokine Growth Factor Rev	V:22 P:121-30	8.831
R21TW006804	2012 Jun	Wilson, Nana O; Ceesay, Fatou K; Hibbert, Jacqueline M; Driss, Adel; Obed, Samuel A; Adjei, Andrew A; Gyasi, Richard K; Anderson, Winston A; Stiles, Jonathan K	Pregnancy outcomes among patients with sickle cell disease at Korle-Bu Teaching Hospital, Accra, Ghana: retrospective cohort study.	Am J Trop Med Hyg	V:86 P:936-42	2.45
R21TW006805/ R01MH080601	2008	A. Abubakar, P. Holding, A. Van Baar, C. R. J. C. Newton,F. J. R. Van De Vijver	Monitoring psychomotor development in a resource limited setting: an evaluation of the Kilifi Developmental Inventory	Annals of Tropical Paediatrics	28 (3), 217–226 (5)	0.92
R21TW006805/ R01MH080601	2008	Abubakar, A., van de Vijver, A.J.R., van Baar, A., Mbonani, L., Kalu, R., Newton, C.J.R. & Holding, P	Socioeconomic Status, Anthropometric Status, and Psychomotor Development of Kenyan Children from a Resource-Limited Setting: A Path-Analytic Study	Early Human Development	84 (9) 613-621	2.02
R21TW006805/ R01MH080601	2008	Robertson K, Kopnisky K, Hakim J, Merry C, Nakasujja N, Hall C, Traore M, Sacktor N, Clifford D, Newton C, Van Rie A, Holding P, Clements J, Zink C, Mielke J, Hosseinipour M, Lalloo U, Amod F, Marra C, Evans S, Liner J, Participants OB	Second assessment of NeuroAIDS in Africa	Journal of Neurovirology	14 (2) 89-101	2.85
R21TW006805/ R01MH080601	2008	Abubakar A., Van Baar, A, Van de Vijver F.J.R., Holding P Newton C.R. J. C.	Paediatric HIV and neurodevelopment in sub-Saharan Africa: a systematic review	Trop Med Int Health	13 (7) 880-887	2.795
R21TW006805/ R01MH080601	2009	A. Abubakar, P. Holding, A. Van Baar, C. R. J. C. Newton & F. J. R. Van De Vijver	The Role of Weight-For-Age and Disease Stage in Poor Psychomotor Outcome of HIV Infected Children in Kilifi, Kenya	Developmental Medicine & Child Neurology	51,968-973	2.776
R21TW006805/ R01MH080601	2010	Abubakar, A., Van de Vijver, F., Van Baar, A., Bomu, G., and Holding, P	Developmental monitoring using parental reports in resource-poor settings: The case of Kilifi Kenya	Acta Paediatr	99 (2) 291-297	1.411
R21TW006805/ R01MH080601	2010	Robertson K, Liner J, Hakim J, Sankalé JL, Grant I, Letendre S, Clifford D, Diop AG, Jaye A, Kanmogne G, Njamnshi A, Langford TD, Weyessa TG, Wood C, Banda M, Hosseinipour M, Sacktor N, Nakasuja N, Bangirana P, Paul R, Joska J, Wong J, Boivin M, Holding P, Kammerer B, Van Rie A, Ive P, Nath A, Lawler K, Adebamowo C, Royal W 3rd, Joseph J; NeuroAIDS in Africa Conference Participants	NeuroAIDS in Africa	Journal of Neurovirology	Jun;16(3):189-202	2.85
R21TW006805/ R01MH080601	2011	A. Abubakar, P. Holding, M. Mwangome, K. Maitland	Maternal perceptions of factors contributing to severe under-nutrition among children in a rural African setting	Rural and Remote Health	11 (online), no. 1423	0.82
R21TW006805/ R01MH080601	2012	Mwangome F.K., Holding, P, Songola K.M., Bomu G.	Barriers To Hospital Deliveries In A Rural Setting In Coast Province, Kenya – Community Attitudes And Behaviours	Rural and Remote Health	42:52:00	0.82
R21TW006805/ R01MH080601	2013	Amina Abubakar *, Penny Holding , Anneloes Van Baar , Charles. Newton , Fons Van de Vijver , Kimberly Andrews	The Performance of Children Prenatally Exposed to HIV on the A-Not-B Task in Kilifi, Kenya: A Preliminary Study	Espy Int. J. Environ. Res. Public Health	10(9), 4132-4142	unavailable

R21TW006805/ R01MH080601	2002 Jan	Limoli, Charles L; Giedzinski, Erich; Bonner, William M; Cleaver, James E	UV-induced replication arrest in the xeroderma pigmentosum variant leads to DNA double-strand breaks, gamma -H2AX formation, and Mre11 relocalization.	Proc Natl Acad Sci U S A	V:99 P:233-8	9.737
R21TW006805/ R01MH080601	2009 Jul	Malhotra, Indu; Dent, Arlene; Mungai, Peter; Wamachi, Alex; Ouma, John H; Narum, David L; Muchiri, Eric; Tisch, Daniel J; King, Christopher L	Can prenatal malaria exposure produce an immune tolerant phenotype? A prospective birth cohort study in Kenya.	PLoS Med	V:6 P:e1000116	13.05
R21TW006805/ R01MH080601	2010 Jun	Abubakar, Amina; Holding, Penny; Van de Vijver, Fons J R; Newton, Charles; Van Baar, Anneloes	Children at risk for developmental delay can be recognised by stunting, being underweight, ill health, little maternal schooling or high gravidity.	J Child Psychol Psychiatry	V:51 P:652-9	5.422
R21TW006805/ R01MH080601	2012 Mar	Steiner, Kevin L; Malhotra, Indu; Mungai, Peter L; Muchiri, Eric M; Dent, Arlene E; King, Christopher L	In utero activation of fetal memory T cells alters host regulatory gene expression and affects HIV susceptibility.	Virology	V:425 P:23-30	3.351
R21TW007554	2008	Ilyas Mirza, Tariq Mehmood, Amina Tareen, Leslie Davidson, Atif Rahman	FEASIBILITY STUDY ON THE USE OF THE TEN QUESTIONS SCREEN BY LADY HEALTH WORKERS TO DETECT DEVELOPMENTAL DISABILITIES IN PAKISTAN	JPPS	5(2): 97-100	unavailable
R21TW007554	2008	AMINA TAREEN, MANSOOR AHMED, IKHLAQUE AHMED, Siham Sikander, Khadija Tahir, Assad Hafeez, Ilyas Mirza, Atif Rahman	Feasibility Study of a Community-Based Intervention for Mental Retardation in Rural Pakistan	Pak Paed J	32(4): 200-07	unavailable
R21TW007554	2009	I. Mirza,1 A. Tareen,2 L. L. Davidson3 & A. Rahman	Community management of intellectual disabilities in Pakistan: a mixed methods study	Journal of Intellectual Disability Research	volume 53 part 6 pp 559–570	unavailable
R21TW007554	2009	AMI NA TAREEN, I LYAS MI R ZA, AYE SHA MI NHAS , FAREED MINHAS AND AT I F RAHMAN	Developing a child and adolescent mental health service in a low-income country: a global partnership model	Psychiatric Bulletin	33, 181^183	unavailable
R21TW007800	2006 Sep	Izquierdo, Ivan; Bevilaqua, Lia R M; Rossato, Janine I; Bonini, Juliana S; Medina, Jorge H; Cammarota, Martin	Different molecular cascades in different sites of the brain control memory consolidation.	Trends Neurosci	V:29 P:496-505	13.494
R21TW007800	2007 Dec	Ribeiro, Fabiola M; Pinthong, Metta; Black, Stefanie A G; Gordon, Alexis C; Prado, Vania F; Prado, Marco A M; Rylett, R Jane; Ferguson, Stephen S G	Regulated recycling and plasma membrane recruitment of the high-affinity choline transporter.	Eur J Neurosci	V:26 P:3437-48	3.673
R21TW007800	2007 Jan	Ribeiro, Fabiola M; Ferreira, Lucimar T; Marion, Sebastian; Fontes, Stefany; Gomez, Marcus; Ferguson, Stephen S G; Prado, Marco A M; Prado, Vania F	SEC14-like protein 1 interacts with cholinergic transporters.	Neurochem Int	V:50 P:356-64	2.857
R21TW007800	2008 Jun	Caetano, Fabiana A; Lopes, Marilene H; Hajj, Glaucia N M; Machado, Cleiton F; Pinto Arantes, Camila; Magalhaes, Ana C; Vieira, Monica De Paoli B; Americo, Tatiana A; Massensini, Andre R; Priola, Suzette A; Vorberg, Ina; Gomez, Marcus V; Linden, Rafael; Prado, Vania F; Martins, Vilma R; Prado, Marco A M	Endocytosis of prion protein is required for ERK1/2 signaling induced by stress-inducible protein 1.	J Neurosci	V:28 P:6691-702	7.271

R21TW007800	2008 May	Guidine, Patricia A M; Rezende, Gustavo H S; Queiroz, Claudio M T; Mello, Luiz Eugenio; Prado, Vania F; Prado, Marco A M; Pereira, Grace S; Moraes, Marcio F D	Vesicular acetylcholine transporter knock-down mice are more susceptible to pilocarpine induced status epilepticus.	Neurosci Lett	V:436 P:201-4	2.055
R21TW007800	2009 Feb	de Castro, B M; Pereira, G S; Magalhaes, V; Rossato, J I; De Jaeger, X; Martins-Silva, C; Leles, B; Lima, P; Gomez, M V; Gainetdinov, R R; Caron, M G; Izquierdo, I; Cammarota, M; Prado, V F; Prado, M A M	Reduced expression of the vesicular acetylcholine transporter causes learning deficits in mice.	Genes Brain Behav	V:8 P:23-35	3.795
R21TW007800	2009 Oct	de Castro, Braulio M; De Jaeger, Xavier; Martins-Silva, Cristina; Lima, Ricardo D F; Amaral, Ernani; Menezes, Cristiane; Lima, Patricia; Neves, Cintia M L; Pires, Rita G; Gould, Thomas W; Welch, Ian; Kushmerick, Christopher; Guatimosim, Cristina; Izquierdo, Ivan; Cammarota, Martin; Rylett, R Jane; Gomez, Marcus V; Caron, Marc G; Oppenheim, Ronald W; Prado, Marco A M; Prado, Vania F	The vesicular acetylcholine transporter is required for neuromuscular development and function.	Mol Cell Biol	V:29 P:5238-50	6.188
R21TW007800	2010 Apr	Lara, Aline; Damasceno, Denis D; Pires, Rita; Gros, Robert; Gomes, Eneas R; Gavioli, Mariana; Lima, Ricardo F; Guimaraes, Diogo; Lima, Patricia; Bueno Jr, Carlos Roberto; Vasconcelos, Anilton; Roman-Campos, Danilo; Menezes, Cristiane A S; Sirvente, Raquel A; Salemi, Vera M; Mady, Charles; Caron, Marc G; Ferreira, Anderson J; Brum, Patricia C; Resende, Rodrigo R; Cruz, Jader S; Gomez, Marcus Vinicius; Prado, Vania F; de Almeida, Alvair P; Prado, Marco A M; Guatimosim, Silvia	Dysautonomia due to reduced cholinergic neurotransmission causes cardiac remodeling and heart failure.	Mol Cell Biol	V:30 P:1746-56	6.188
R21TW007800	2010 May	Lima, Ricardo de Freitas; Prado, Vania F; Prado, Marco A M; Kushmerick, Christopher	Quantal release of acetylcholine in mice with reduced levels of the vesicular acetylcholine transporter.	J Neurochem	V:113 P:943-51	3.999
R21TW007803	2010 Dec	Ierago, Laura; Malsol, Cynthia; Singeo, Techong; Kishigawa, Yuri; Blailes, Francisca; Ord, Lisa; Florsheim, Paul; Phillips, Lisa; Kuartei, Stevenson; Tiobech, Josepha; Watson, Berrymoon; Ngiralmau, Hilda	Adoption, family relations and psychotic symptoms among Palauan adolescents who are genetically at risk for developing schizophrenia.	Soc Psychiatry Psychiatr Epidemiol	V:45 P:1105-14	2.861
R21TW007803	2010 May	Madraisau, Sheri; Tomoichi, Ulai; Ord, Lisa M; Florsheim, Paul; Phillips, Lisa J; Blailes, Francisca; Basilius, Merlyn; Kuartei, Stevenson; Tiobech, Josepha; Myles-Worsley, Marina; Ngiralmau, Hilda	Early signs and symptoms of psychosis among Palauan adolescents.	Early Interv Psychiatry	V:4 P:153-61	1.653
R21TW007882	2009 May	Anastasia, Agustin; Torre, Luciana; de Erausquin, Gabriel A; Masco, Daniel H	Enriched environment protects the nigrostriatal dopaminergic system and induces astroglial reaction in the 6-OHDA rat model of Parkinson's disease.	J Neurochem	V:109 P:755-65	3.999

R21TW007997/ R01MH093246	2011	Hader Mansour, Kareem Kandil, Joel Wood, Warda Fathi, Mai Elassy, Ibtihal Ali, Hala Salah, Amal Yassin, Hanan Elsayed, Salwa Tobar, Hala El-Boraie, Ahmed Eissa, Mohamed Elhadidy, Nahed E. Ibrahim, Farha El-Chennawi, Wafaa El-Bahaei, Vishwajit L. Nimgaonkar	Reduced Fertility and Fecundity among Patients with Bipolar I Disorder and Schizophrenia in Egypt	Psychiatry Investig	Sep;8(3):214-20	1.055
R21TW007997/ R01MH093246	2009 Sep	Mansour, Hader; Klei, Lambertus; Wood, Joel; Talkowski, Michael; Chowdari, Kodavali; Fathi, Warda; Eissa, Ahmed; Yassin, Amal; Salah, Hala; Tobar, Salwa; El-Boraie, Hala; Gaafar, Hanan; Elassy, Mai; Ibrahim, Nahed E; El-Bahaei, Wafaa; Elsayed, Mohamed; Shahda, Mohamed; El Sheshtawy, Eman; El-Boraie, Osama; El-Chennawi, Farha; Devlin, Bernie; Nimgaonkar, Vishwajit L	Consanguinity associated with increased risk for bipolar I disorder in Egypt.	Am J Med Genet B Neuropsychiatr Genet	V:150B P:879-85	3.231
R21TW007997/ R01MH093246	2010 Jul	Mansour, Hader; Fathi, Warda; Klei, Lambertus; Wood, Joel; Chowdari, Kodavali; Watson, Annie; Eissa, Ahmed; Elassy, Mai; Ali, Ibtihal; Salah, Hala; Yassin, Amal; Tobar, Salwa; El-Boraie, Hala; Gaafar, Hanan; Ibrahim, Nahed E; Kandil, Kareem; El-Bahaei, Wafaa; El-Boraie, Osama; Alatrouny, Mohamed; El-Chennawi, Farha; Devlin, Bernie; Nimgaonkar, Vishwajit L	Consanguinity and increased risk for schizophrenia in Egypt.	Schizophr Res	V:120 P:108-12	4.374
R21TW007997/ R01MH093246	2011 Jun	Mansour, Hader; Chowdari, Kodavali; Fathi, Warda; Elassy, Mai; Ibrahim, Ibtihal; Wood, Joel; Bamne, Mikhil; Tobar, Salwa; Yassin, Amal; Salah, Hala; Elsayed, Hanan; Eissa, Ahmed; El-Boraie, Hala; Ibrahim, Nahed E; Elsayed, Mohamed; El-Bahaei, Wafaa; Gomaa, Zeinab; El-Chennawi, Farha; Nimgaonkar, Vishwajit L	Does telomere length mediate associations between inbreeding and increased risk for bipolar I disorder and schizophrenia?	Psychiatry Res	V:188 P:129-32	2.524
R21TW008049/ R01MH093303	2010	Iyer, S.N., Mangala, R., Thara, R., Malla, A.K.	Preliminary findings from a study of first-episode psychosis in Montreal, Canada and Chennai, India: comparison of outcomes	Schizophr Res	121(1-3): 227-33	4.374
R21TW008049/ R01MH093303	2011	Iyer, S. N., Mangala, R., Anitha, J., Thara, R., Malla, A.K.	An examination of patient-identified goals for treatment in a first-episode programme in Chennai, India	Early Interv Psychiatry	5(4): 360-5	1.653
R21TW008049/ R01MH093303	2011	Iyer, S.N., Loohuis, H., Pawliuk, N., Joober, R., Malla, A.K.	Concerns reported by family members of individuals with first-episode psychosis	Early Interv Psychiatry	5(2):163-7	1.653
R21TW008222	2013 Mar	Kakooza-Mwesige, K; Ssebyala, K; Karamagi, C; Kiguli, S; Smith, K; Anderson, M; Croen, L; Trevathan, E; Hansen, R; Smith, D; Grether, JK	Adaptation of the 'ten questions' to screen for autism and other neuro-developmental disorders in Uganda	Autism	[Epub ahead of print]	unavailable
R21TW008223	2010 Dec	Mochida, Ganeshwaran H; Ganesh, Vijay S; Felie, Jillian M; Gleason, Danielle; Hill, R Sean; Clapham, Katie Rose; Rakiec, Daniel; Tan, Wen-Hann; Akawi, Nadia; Al-Saffar, Muna; Partlow, Jennifer N; Tinschert, Sigrid; Barkovich, A James; Ali, Bassam; Al-Gazali, Lihadh; Walsh, Christopher A	A homozygous mutation in the tight-junction protein JAM3 causes hemorrhagic destruction of the brain, subependymal calcification, and congenital cataracts.	Am J Hum Genet	V:87 P:882-9	11.68

R21TW008223	2010 Mar	Shen, Jun; Gilmore, Edward C; Marshall, Christine A; Haddadin, Mary; Reynolds, John J; Eyaid, Wafaa; Bodell, Adria; Barry, Brenda; Gleason, Danielle; Allen, Kathryn; Ganesh, Vijay S; Chang, Bernard S; Grix, Arthur; Hill, R Sean; Topcu, Meral; Caldecott, Keith W; Barkovich, A James; Walsh, Christopher A	Mutations in PNKP cause microcephaly, seizures and defects in DNA repair.	Nat Genet	V:42 P:245-9	35.532
R21TW008223	2010 Nov	Yu, Timothy W; Mochida, Ganeshwaran H; Tischfield, David J; Sgaier, Sema K; Flores-Sarnat, Laura; Sergi, Consolato M; Topcu, Meral; McDonald, Marie T; Barry, Brenda J; Felie, Jillian M; Sunu, Christine; Dobyns, William B; Folkerth, Rebecca D; Barkovich, A James; Walsh, Christopher A	Mutations in WDR62, encoding a centrosome-associated protein, cause microcephaly with simplified gyri and abnormal cortical architecture.	Nat Genet	V:42 P:1015-20	35.532
R21TW008223	2010 Oct	Walsh, Christopher A; Engle, Elizabeth C	Allelic diversity in human developmental neurogenetics: insights into biology and disease.	Neuron	V:68 P:245-53	14.027
R21TW008223	2012 Nov	Mochida, Ganeshwaran H; Ganesh, Vijay S; de Michelena, Maria I; Dias, Hugo; Atabay, Kutay D; Kathrein, Katie L; Huang, Hsuan-Ting; Hill, R Sean; Felie, Jillian M; Rakiec, Daniel; Gleason, Danielle; Hill, Anthony D; Malik, Athar N; Barry, Brenda J; Partlow, Jennifer N; Tan, Wen-Hann; Glader, Laurie J; Barkovich, A James; Dobyns, William B; Zon, Leonard I; Walsh, Christopher A	CHMP1A encodes an essential regulator of BMI1-INK4A in cerebellar development.	Nat Genet	V:44 P:1260-4	35.532
R21TW008412	2012 Sep	Bower, James H; Mwendo, Emanuel; Walker, Richard; Maro, Venance; Enquosellasie, Fikre; Ali, Seid	Validity of a screening instrument for neurologic disability in resource-poor African communities.	J Neurol Sci	V:320 P:52-5	2.353
R21TW008430	2010	Franco DL, Rezával C, Cáceres A, Schinder AF and Ceriani MF	ENA/VASP downregulation triggers cell death by impairing axonal maintenance in hippocampal neurons	Molecular and Cellular Neuroscience	44(2):154-64	3.837
R21TW008431	2012	Tirschwell, David L; Ton, Thanh G N; Ly, Kiet A; Van Ngo, Quang; Vo, Tung T; Pham, Chien Hung; Longstreth Jr, William T; Fitzpatrick, Annette L	A prospective cohort study of stroke characteristics, care, and mortality in a hospital stroke registry in Vietnam.	BMC Neurol	V:12 P:150	2.167
R21TW008431	2012 Sep	Fitzpatrick, Annette L; Van Ngo, Quang; Ly, Kiet A; Ton, Thanh G N; Longstreth Jr, W T; Vo, Tung T; Heitzinger, Kristen; Pham, Chien H; Tirschwell, David L	Symptoms and risk factors for stroke in a community-based observational sample in Viet Nam.	J Epidemiol Glob Health	V:2 P:155-163	unavailable
R21TW008433	2009	Kohan R, Cismondi IA, Dodelson de Kremer R, Muller V, Guelbert N, Tapia Anzolini V, Fietz M, Oller-Ramírez AM, Noher de Halac I	An integrated strategy for the diagnosis of Neuronal Ceroid Lipofuscinoses types 1 (CLN1) and 2 (CLN2) in eleven Latin American patients	Clinical Genetics	76:372-82	4.247
R21TW008433	2011	Kohan R, Cismondi IA, Oller-Ramírez AM, Guelbert N, Tapia Anzolini V, Alonso G, Mole SE, Dodelson de Kremer R, Noher de Halac I	Therapeutic Approaches to the Challenge of Neuronal Ceroid Lipofuscinoses	Current Pharmaceutical Biotechnology	12(6):867-83	2.69

R21TW008433	2013	Kohan R, Carabelos MN, Xin W, Sims K, Guelbert N, Cismondi IA, Pons P, Alonso G, Troncoso M, Witting S, Pearce DA, Dodelson de Kremer R, Oller-Ramírez AM, Noher de Halac I	Neuronal ceroid lipofuscinosis type CLN2: a new rationale for the construction of phenotypic subgroups based on a survey of 25 cases in South America	Gene	516:114-121	2.341
R21TW008433	2011 Feb-Mar	Kovacs, Attila D; Saje, Angelika; Wong, Andrew; Szenasi, Gabor; Kiricsi, Peter; Szabo, Eva; Cooper, Jonathan D; Pearce, David A	Temporary inhibition of AMPA receptors induces a prolonged improvement of motor performance in a mouse model of juvenile Batten disease.	Neuropharmacology	V:60 P:405-9	4.814
R21TW008433	2011 May	Finn, Rozzy; Kovacs, Attila D; Pearce, David A	Altered sensitivity of cerebellar granule cells to glutamate receptor overactivation in the Cln3(ýýex7/8)-knock-in mouse model of juvenile neuronal ceroid lipofuscinosis.	Neurochem Int	V:58 P:648-55	2.857
R21TW008433	2013 Mar	Kohan, Romina; Carabelos, Maria Noelia; Xin, Winnie; Sims, Katherine; Guelbert, Norberto; Cismondi, Ines Adriana; Pons, Patricia; Alonso, Graciela Irene; Troncoso, Monica; Witting, Scarlet; Pearce, David A; Dodelson de Kremer, Raquel; Oller-Ramirez, Ana Maria; Noher de Halac, Ines	Neuronal ceroid lipofuscinosis type CLN2: a new rationale for the construction of phenotypic subgroups based on a survey of 25 cases in South America.	Gene	V:516 P:114-21	2.341
R21TW009332	2013	Rubiano AM, Puyana JC, Mock CN, Bullock MR, Adelson PD.	Strengthening neurotrauma care systems in low and middle income countries	Brain Injury	27(3):262-72	1.513
R21TW009332	2013	Rubiano AM, Puyana JC.	Intracranial-pressure monitoring in traumatic brain injury [comment]	N Engl J Med	368(18):1748	51.658
R21TW009384	2013	Besio W., Cuellar-Herrera M., Luna-Munguia H., Orozco-Suárez S., Rocha L	Effects of transcranial focal electrical stimulation alone and associated with a sub-effective dose of diazepam on pilocarpine-induced status epilepticus and subsequent neuronal damage in rats	Epilepsy Behav	28, pp. 432-436	2.335
R21TW009384	2013 Apr	Rogel-Salazar, G; Luna-Munguia, H; Stevens, K E; Besio, W G	Transcranial focal electrical stimulation via tripolar concentric ring electrodes does not modify the short- and long-term memory formation in rats evaluated in the novel object recognition test	Epilepsy Behav	V:27 P:154-8	2.335

Appendix I: National Impacts by Region and Country (Grantee Responses)

Latin America

- **Argentina.** "Two of our adenoviral vectors are being used or going to be used by Argentine and Brazilian colleagues to treat myocardial infarct and lung inflammatory diseases in preclinical models." (Goya)
- **Argentina.** "The Project led to the adoption of routine clinical screening for the brain disorder under study [HIV- 1 associated cognitive motor Disorders] in the collaborating partner's clinics and to the use of a structured algorithm provided by the Project for making diagnoses related to the brain disorder under study." (Goodkin)
- **Argentina.** "Our Center at the Children´s Hospital in the Province of Cordoba in Argentina has become the reference diagnostic unit for Neuronal Ceroid Lipofuscinoses with an international standard. We perform clinical, biochemical, morphological and molecular assessment of 8 out of 14 types of the diseases. The laboratory works in an international network with colleagues around the world. The diagnostic procedures are complex and must be developed in specialized units providing multidisciplinary services. The medical community of pediatricians, neuro pediatricians and genetic counselors in Argentina increased education and were prepared for the recognition of the diseases deriving the patients and samples to our Unit. The families initiated an organization, still not validated by the government. The country has new laws regarding rare diseases, which were approved by the parliament with the participation of families of the cohort we studied. We adhered to the international consensus for registry and approved treatment trials." (Noher de Halac)
- **Brazil.** "We held a 1-day meeting in Brazil and presented the results as well as a Portuguese language monograph to be used by new mothers and pregnant women who are HIV-infected - and their service providers - to improve service usage and reduce stigma. The state-level public health authority has posted this monograph on their website." (Bass)
- **Peru. "**The screening strategy [for neurocysticercosis, a parasitic infection of the central nervous system caused by *Taenia solium* larval cysts] developed in this project is being considered as a potential surveillance mechanism in post-elimination areas of Peru." (O'Neal)
- **Multiple Countries in Latin America.** "Large impact within the global TBI medical community as to clinical use and research needs toward re-establishing the role of intracranial pressure monitoring in managing TBI. We have also established the first, prospectively validated management protocol for TBI patients treated without ICP monitoring. Guideline efforts based on our Randomised Controlled Trial publication have been initiated in Europe and the US and will result in formal revision of current guidelines within the next 12 months." (Chesnut)
- **Venezuela.** "[Changed] standard practices across Zulia´s health system regarding diagnosis and treatment of dementia." (Maestre)

Europe & Asia

- **China.** "The new diagnostic tools [for early-stage psychosis] are used to help to identify patients at early stage and help to reduce duration of untreated illness. This stage of illness is new to most professionals in the medical and psychiatric field; our research brings awareness of this illness to the medical field and general public and is in many ways impacting public health and clinical practice." (Li)
- **Pakistan.** "The results of the R21… informed key stake holders in Pakistan including the Ministry of health and Ministry of Environment about high levels of environmental lead exposures that impact pregnant women and young children. Initiatives are now underway to control and reduce

lead exposure in vulnerable populations." (Sathiakumar)

- **Pakistan.** "We have developed a resource center to train community workers in management of intellectual disability in rural Pakistan." (Meyer)
- **Thailand.** "Regarding impact on public health, it has an impact in three hospitals participated in three provinces in Thailand. The pediatricians and well-baby nurses had been trained to monitor neurodevelopment of infants." (Woskie)
- **Turkey.** "The main impact was the training of developmental-behavioral pediatricians in Ankara, Turkey. This training resulted in new specialists to evaluate and treat children, and the Co-PI from Turkey was able to persuade the government to recognize the sub-specialty of Developmental-Behavioral Pediatrics. With this recognition, federal funds are available to support the training of pediatricians in this field." (Leventhal/Ertem)

Middle East & North Africa

- **Lebanon.** "The project had an indirect effect on policy. It attracted the attention of the Ministry of Labor in Lebanon and the Regional Office for the International Labour Organization who jointly asked the PI to prepare the list of worst forms of child labor for Lebanon. Later, this list was adopted as the basis for a ministerial decree (Decree 8987, September 2012) which controls work of children under age 18." (Nuwayhid)
- **Tunisia.** The leucine-rich repeat kinase 2 (LRRK2) gene mutation (p.G2019S) "is now recognized as the leading risk factor for Parkinson's disease in Arab-Berber communities of North Africa. Resources and infrastructure, developed in part because of the project aims and Michael J Fox funding, are now in place. Major international research investment in academia and industry is working on therapeutic initiatives e.g. LRRK2 kinase competitive inhibition." (Farrer)

Sub-Saharan Africa

- **Burkina Faso.** "The pilot study (R21) did have a very important impact on one of the 3 pilot villages. Before the project, not a single epilepsy patient was receiving modern treatment at the dispensary. When we left about 3 months later, more than 20 people were receiving treatment. We believe that we were successful at reducing stigma." (Carabin)
- **Kenya.** "Increased interest in regional hospitals in including developmental monitoring as part of road to growth programme." (Holding)
- **South Africa.** "Strengthened referral systems for children with developmental disabilities. Improved health care worker capacity to better diagnose and manage mental health and substance use disorders. Influenced department of basic education to adopt low cost early diagnosis of sensory deficits vision hearing screening among school learners. A national initiative was launched in 2012 as part of integrated school health programme where screening was adopted." (Mcilvane)
- **Uganda.** "Cryptococcal antigen lateral flow assay (field trial for FDA approval in July 2011); team members have been involved with WHO cryptococcal meningitis treatment guidelines; diagnostic algorithm for meningitis - under consideration by WHO; cryptococcal antigen screening among persons entering HIV care - WHO and PEPFAR recommendation." (Boulware)
- **Uganda.** "The initiation of antiretroviral therapy among patients with HIV induced cognitive impairment would be delayed in resource limited settings because an individual's CD4 would not have dropped low enough to initiate therapy but now consideration of starting therapy on those cognitively impaired is part of guidelines for management in patient care." (John/Boivin)
- **Uganda.** "We have made comprehensive recommendations to the Ugandan Ministry of Health and other stakeholders on how governmental and non-governmental agencies can better

address the needs of children with neurodevelopmental disorders and their families and communities. Accompanying the recommendations to the MOH is a detailed training plan for incorporation of basic screening for NDDs in Uganda. Recommendations and a full report on the project were presented to governmental and non-governmental stakeholders during a well-attended meeting on July 19, 2013 In Kampala, Uganda." (Kakooza)

Multiple Countries

- **Africa and South Asia.** "We demonstrated that survivors of birth asphyxia following resuscitation with bag and mask had neurological outcomes at 3 years comparable to infants who were healthy at birth. This is important as resuscitation was frequently not used as there were concerns of permanent brain injury. Now, WHO and other agencies strongly recommend resuscitation of these infants with their new program Essential Newborn Care. The American Academy of Pediatrics has also developed and introduced a program for resuscitation at birth for developing countries. Both programs draw on the neurological outcomes of our study as evidence these infants should get resuscitated as ours was the first trial with healthy controls." (Carlo)

Appendix J: Impacts on Careers of Collaborators (Grantee Responses)

Foreign Collaborators Perspective

- "Helped me to set up a leading research center in the country."
- "I am currently registering for a PHD on the neurodevelopmental work, but this would probably not have been possible if I did not have the infrastructure and support provided by the award."
- "Improved my understanding about how to work with NIH-funded research"
- "My collaboration allowed invaluable access to scientific publications not available at my home Institution"
- "The awards helped me to get back to my research interests as an essential part of my professional identification"
- "The Brain Disorders Award has given me a frame work within which to conduct my research. I was pottering along doing neurodevelopmental assessments and my Co-PIs approached me to add cutting edge neuroimaging. They are far more experienced at research and writing up results and this has boosted my ability to write and publish."
- "The Brain Disorders awards have been crucial for me to continue performing research and training other researchers in Brazil. Without the infrastructure built by the program, all the knowledge I acquired in fellowships at Intramural NIH and in Switzerland would not have been multiplied, and my lines of research would probably not have been continued."
- "Also, my research on dementia caregiving has advanced me to be deeply involved in policy advocacy for dementia care, and have been invited to WHO international advisory board to drafting the WHO report on dementia (released in 2012)."
- "I have improved my writing skills as part of writing the manuscript from the R21 and putting together the RO1 application."
- "Improved my public speaking skills and presentation by providing platform to share our study results."
- "Furthermore the tool we adapted/developed has been requested by other researchers for their use in other activities. I am constantly being approached for consultation on neurological disabilities in children."

HIC collaborators touched on themes including the following:

- The collaboration formed or strengthened by the Brain Program award has been particularly rewarding and/or productive (17 responses)
- Participation broadened individuals' research interest or helped them expand to new areas (11 responses)
- The project provided opportunities for networking, especially in the LMIC region (11 responses)
- The individual gained new knowledge, skills, or experience, particularly related to research in an LMIC environment (10 responses)
- The project and associated outputs contributed to a specific promotion (e.g. to tenure track, full professorship, etc.) (9 responses)
- The project generated or provided access to cohorts, data sets, interesting clinical cases, etc. that will be useful as resources for future research (7 responses)
- The project established or helped to solidify the individual's position or reputation as a leader in a particular area of research (5 responses)
- Participation strengthened the individual's commitment to continue working in LMIC regions (5 responses)
- This was the individual's first time as a PI or first R01 (4 responses)
- This was an opportunity to pursue research in the individual's birth country (2 responses)