PI: **Ross, Jennifer M**	Title: Modeling approaches to prioritize TB prevention among people with HIV in Uganda	
Received: 05/04/2018	Opportunity: PA-18-369 Clinical Trial:Not Allowed	Council: 10/2018
Competition ID: FORMS-E	FOA Title: Mentored Research Scientist Development Award (Parent K01 - Independent Clinical Trial Not Allowed)	
1K01AI138620-01A1	Dual:	Accession Number: 4166880
IPF: 9087701	Organization: UNIVERSITY OF WASHINGTON	
Former Number:	Department:	
IRG/SRG: AIDS	AIDS: Y	Expedited: Y
Subtotal Direct Costs (excludes consortium F&A) Year 1: [redacted] Year 2: [redacted] Year 3: [redacted] Year 4: [redacted]	Animals: N Humans: Y Clinical Trial: N Current HS Code: 30 HESC: N	New Investigator: Early Stage Investigator:

Senior/Key Personnel:	*Organization:*	*Role Category:*
Jennifer Ross	UNIVERSITY OF WASHINGTON	PD/PI
David Dowdy	Johns Hopkins University	Other (Specify)-Co-Mentor
JUDITH WASSERHEIT	UNIVERSITY OF WASHINGTON	Other (Specify)-Co-Mentor
Simon Hay	University of Washington	Other (Specify)-Co-Mentor
Ruanne Barnabas	UNIVERSITY OF WASHINGTON	Other (Specify)-Mentor

OMB Number: 4040-0001
Expiration Date: 10/31/2019

APPLICATION FOR FEDERAL ASSISTANCE
SF 424 (R&R)

3. DATE RECEIVED BY STATE	**State Application Identifier**

1. TYPE OF SUBMISSION*

❍ Pre-application ● Application ❍ Changed/Corrected Application

4.a. Federal Identifier
AI138620

b. Agency Routing Number

2. DATE SUBMITTED

Application Identifier
A134482

c. Previous Grants.gov Tracking Number

5. APPLICANT INFORMATION **Organizational DUNS*:** [redacted]

Legal Name*: UNIVERSITY OF WASHINGTON
Department: Office of Sponsored Programs
Division: Office of Research
Street1*: [redacted]
Street2:
City*: SEATTLE
County:
State*: WA: Washington
Province:
Country*: USA: UNITED STATES
ZIP / Postal Code*: [redacted]

Person to be contacted on matters involving this application
Prefix: First Name*: Carol Middle Name: Last Name*: Rhodes Suffix:
Position/Title: Director, Office of Sponsored Programs
Street1*: [redacted]
Street2:
City*: Seattle
County: King
State*: WA: Washington
Province:
Country*: USA: UNITED STATES
ZIP / Postal Code*: [redacted]
Phone Number*: [redacted] Fax Number: [redacted] Email: [redacted]

6. EMPLOYER IDENTIFICATION NUMBER *(EIN) or (TIN)** [redacted]

7. TYPE OF APPLICANT* H: Public/State Controlled Institution of Higher Education

Other (Specify):
Small Business Organization Type ❍ Women Owned ❍ Socially and Economically Disadvantaged

8. TYPE OF APPLICATION*

❍ New ● Resubmission
❍ Renewal ❍ Continuation ❍ Revision

If Revision, mark appropriate box(es).
❍ A. Increase Award ❍ B. Decrease Award ❍ C. Increase Duration
❍ D. Decrease Duration ❍ E. Other *(specify)* :

Is this application being submitted to other agencies?* ❍Yes ●No What other Agencies?

9. NAME OF FEDERAL AGENCY*
National Institutes of Health

10. CATALOG OF FEDERAL DOMESTIC ASSISTANCE NUMBER
TITLE:

11. DESCRIPTIVE TITLE OF APPLICANT'S PROJECT*
Modeling approaches to prioritize TB prevention among people with HIV in Uganda

12. PROPOSED PROJECT
Start Date* Ending Date*
09/01/2018 08/31/2022

13. CONGRESSIONAL DISTRICTS OF APPLICANT
WA-007

SF 424 (R&R) APPLICATION FOR FEDERAL ASSISTANCE

14. PROJECT DIRECTOR/PRINCIPAL INVESTIGATOR CONTACT INFORMATION

Prefix: First Name*: Jennifer Middle Name: M Last Name*: Ross Suffix:
Position/Title: Acting Instructor/Senior Fellow
Organization Name*: UNIVERSITY OF WASHINGTON
Department:
Division:
Street1*: UNIVERSITY OF WASHINGTON
Street2: Office of Sponsored Programs
City*: SEATTLE
County:
State*: WA: Washington
Province:
Country*: USA: UNITED STATES
ZIP / Postal Code*: [redacted]
Phone Number*: [redacted] Fax Number: Email*: [redacted]

15. ESTIMATED PROJECT FUNDING

a. Total Federal Funds Requested* $[redacted]
b. Total Non-Federal Funds* $[redacted]
c. Total Federal & Non-Federal Funds* $[redacted]
d. Estimated Program Income* $[redacted]

16.IS APPLICATION SUBJECT TO REVIEW BY STATE EXECUTIVE ORDER 12372 PROCESS?*

a. YES ○ THIS PREAPPLICATION/APPLICATION WAS MADE AVAILABLE TO THE STATE EXECUTIVE ORDER 12372 PROCESS FOR REVIEW ON:
DATE:
b. NO ● PROGRAM IS NOT COVERED BY E.O. 12372; OR
○ PROGRAM HAS NOT BEEN SELECTED BY STATE FOR REVIEW

17. By signing this application, I certify (1) to the statements contained in the list of certifications* and (2) that the statements herein are true, complete and accurate to the best of my knowledge. I also provide the required assurances * and agree to comply with any resulting terms if I accept an award. I am aware that any false, fictitious, or fraudulent statements or claims may subject me to criminal, civil, or administrative penalties. (U.S. Code, Title 18, Section 1001)

● I agree*

** The list of certifications and assurances, or an Internet site where you may obtain this list, is contained in the announcement or agency specific instructions.*

18. SFLLL or OTHER EXPLANATORY DOCUMENTATION File Name:

19. AUTHORIZED REPRESENTATIVE

Prefix: First Name*: Carol Middle Name: Last Name*: Rhodes Suffix:
Position/Title*: Director of Sponsored Programs
Organization Name*: University of Washington
Department: Office of Sponsored Programs
Division: Office of Research
Street1*: [redacted]
Street2:
City*: Seattle
County: King
State*: WA: Washington
Province:
Country*: USA: UNITED STATES
ZIP / Postal Code*: [redacted]
Phone Number*: [redacted] Fax Number: [redacted] Email*: [redacted]

Signature of Authorized Representative*
[redacted]

Date Signed*
05/04/2018

20. PRE-APPLICATION File Name:

21. COVER LETTER ATTACHMENT File Name:FINAL_CovLtr_ModelingTB3_20180423.pdf

424 R&R and PHS-398 Specific
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OMB Number: 4040-0010
Expiration Date: 10/31/2019

Project/Performance Site Location(s)

Project/Performance Site Primary Location

❍ I am submitting an application as an individual, and not on behalf of a company, state, local or tribal government, academia, or other type of organization.

Organization Name: UNIVERSITY OF WASHINGTON
Duns Number: [redacted]
Street1*: Office of Sponsored Programs
Street2: [redacted]
City*: SEATTLE
County:
State*: WA: Washington
Province:
Country*: USA: UNITED STATES
Zip / Postal Code*: [redacted]
Project/Performance Site Congressional District*: WA-007

Project/Performance Site Location 1

❍ I am submitting an application as an individual, and not on behalf of a company, state, local or tribal government, academia, or other type of organization.

Organization Name: University of Washington, Allergy & Infectious Dis.
DUNS Number: [redacted]
Street1*: [redacted]
Street2: [redacted]
City*: SEATTLE
County: King
State*: WA: Washington
Province:
Country*: USA: UNITED STATES
Zip / Postal Code*: [redacted]
Project/Performance Site Congressional District*: WA-007

Funding Opportunity Number: PA-18-369. Received Date: 2018-05-04T16:42:25.000-04:00

Project/Performance Site Location 2

❍ I am submitting an application as an individual, and not on behalf of a company, state, local or tribal government, academia, or other type of organization.

Organization Name: Makerere University
DUNS Number: [redacted]
Street1*: [redacted]
Street2:
City*: Kampala
County:
State*:
Province:
Country*: UGA: UGANDA
Zip / Postal Code*:
Project/Performance Site Congressional District*: 00-000

Additional Location(s) File Name:

OMB Number: 4040-0001
Expiration Date: 10/31/2019

RESEARCH & RELATED Other Project Information

1. Are Human Subjects Involved?* ● **Yes** ❍ **No**

1.a. If YES to Human Subjects

Is the Project Exempt from Federal regulations? ❍ Yes ● No

If YES, check appropriate exemption number: _ 1 _ 2 _ 3 _ 4 _ 5 _ 6 _ 7 _ 8

If NO, is the IRB review Pending? ● **Yes** ❍ **No**

IRB Approval Date:

Human Subject Assurance Number 00006878

2. Are Vertebrate Animals Used?* ❍ **Yes** ● **No**

2.a. If YES to Vertebrate Animals

Is the IACUC review Pending? ❍ Yes ❍ No

IACUC Approval Date:

Animal Welfare Assurance Number

3. Is proprietary/privileged information included in the application?* ❍ **Yes** ● **No**

4.a. Does this project have an actual or potential impact - positive or negative - on the environment?* ❍ **Yes** ● **No**

4.b. If yes, please explain:

4.c. If this project has an actual or potential impact on the environment, has an exemption been authorized or an environmental assessment (EA) or environmental impact statement (EIS) been performed? ❍ Yes ❍ No

4.d. If yes, please explain:

5. Is the research performance site designated, or eligible to be designated, as a historic place?* ❍ **Yes** ● **No**

5.a. If yes, please explain:

6. Does this project involve activities outside the United States or partnership with international collaborators?* ● **Yes** ❍ **No**

6.a. If yes, identify countries: Uganda

6.b. Optional Explanation: Research in Uganda

	Filename
7. Project Summary/Abstract*	FINAL_Abstract_ModelingTB3_20180501.pdf
8. Project Narrative*	FINAL_ProjectNarrative_ModelingTB3_20180423.pdf
9. Bibliography & References Cited	FINAL_References_ModelingTB3_20180501.pdf
10.Facilities & Other Resources	FINAL_Resources_ModelingTB3_20180419.pdf
11.Equipment	FINAL_Equipment_ModelingTB3_20180419.pdf
12. Other Attachments	FINAL_ForeignJustification_ModelingTB3_20180423.pdf

Funding Opportunity Number: PA-18-369. Received Date: 2018-05-04T16:42:25.000-04:00

PROJECT SUMMARY/ABSTRACT

The goal of this proposed K01 mentored career development award is to support Dr. Jennifer Ross's research training in the advanced epidemiologic methods of geospatial and mathematical modeling of HIV and tuberculosis (TB) to further her goal of developing targeting strategies for prevention of TB among people living with HIV (PLHIV). Dr. Ross is currently an Acting Instructor/Senior Fellow in infectious diseases at the University of Washington. This award will support her development in modeling methods and implementation science to facilitate her transition to becoming an independent investigator. She will receive mentorship from Dr. Ruanne Barnabas, Professor Simon Hay, Dr. David Dowdy, and Dr. Judith Wasserheit for this award.

The research goal of the award is to maximize the public health impact of preventive therapy (PT), either with isoniazid alone or with rifapentine, for TB prevention in HIV-infected individuals using cutting-edge geospatial models that integrate existing epidemiologic information. TB is the leading cause of death among PLHIV in sub-Saharan Africa, including those recently started on antiretroviral (ART) therapy in Uganda. PT prevents tuberculosis and TB-associated mortality among PLHIV, but fewer than 5% of eligible Ugandans receive it due to limited resources to successfully implement PT programs. This award will marry the expanding sources of TB and HIV surveillance data in Uganda with the expertise at UW and the Institute for Health Metrics and Evaluation in spatiotemporal and mathematical modeling to produce novel tools that guide PT implementation.

This K01 proposal will inform the prioritization of PT through three research aims. In the first aim, Dr. Ross will examine the relationship between ART coverage and geographic predictors of TB with TB prevalence, incidence, and mortality among PLHIV using geospatial and mathematical models. In the second aim, Dr. Ross will estimate the impact of PT implementation on HIV-TB mortality using mathematical models of a regionally-targeted implementation strategy versus uniform roll-out. Finally, in the third aim, Dr. Ross will engage stakeholders to inform model development, evaluate the effect of engagement with the model on stakeholder support of modeling, and facilitate implementation of targeted TB prevention.

This award will support Dr. Ross to dedicate more than 75% of her effort to research as she furthers her learning in the methods and application of state-of-the-art geospatial and mathematical modeling techniques. Acquiring these advanced skills will facilitate her future R01 proposals. With her clinical training in infectious disease, her outstanding mentorship, and the support of this award to further develop her expertise, Dr. Ross will be well-positioned to contribute to the control of TB and HIV epidemics in sub-Saharan Africa.

PROJECT NARRATIVE

This study will develop mapping and modeling tools to guide use of the antibiotic isoniazid for preventing tuberculosis (TB) among people with HIV infection. This study takes place in Uganda, where TB is the leading cause of death among people with HIV, and is important for global health because TB is among the leading causes of death for the more than 35 million people living with HIV worldwide. The tools developed may help to stretch limited health resources by identifying the places where prioritizing isoniazid use could have the greatest health impact.

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FACILITIES AND OTHER RESOURCES

University of Washington
Department of Global Health – International Clinical Research Center

Facilities

The **University of Washington (UW),** one of the largest institutions of higher education in the West, and its affiliate institutions provide an excellent environment for training and research characterized by recent growth, diversity and excellence in all types of health-related research and education. Many of the approximately 3,900 teaching and research faculty are known nationally and internationally for their accomplishments. The University has been the top public university in federal research funding every year since 1974 and among the top five universities, public and private, in federal funding since 1969. Of this, the largest share comes from the National Institutes of Health (NIH) and the Department of Health and Human Services (DHHS), indicating the depth and breadth of the University's health research program.

The University of Washington provides the only Schools of Medicine and Public Health for five states of the Pacific Northwest, with interdisciplinary collaborations facilitated by sharing of a contiguous campus with Schools of Pharmacy, Nursing, Social Work, and Dentistry, adjacent to Schools of Arts and Sciences, Business, Law, and Public Affairs. The UW and its affiliated institutions have developed interdisciplinary HIV/AIDS research, education, and service programs in most regions of the developing world. The Schools of Medicine and Public Health have jointly established a Department of Global Health providing the focal point for UW international health programs.

The UW research infrastructure offers a wide array of services to support researchers—including technology transfer, human subjects review, and grant and contract services. Faculty and staff have access to the UW library system, which is home to more than seven million volumes and 62,000 current serials. Each UW investigator and staff member has Ethernet access, and the UW mainframe computer is available to investigators and staff, which provides access to online reference services, websites, and databases.

The **International Clinical Research Center (ICRC, Dr. C. Celum, Director; Dr. J. Baeten, Co-Director)** is a center within the Department of Global Health, University of Washington, dedicated to conducting high quality, high impact biomedical and implementation research and utilizing well-designed systems for research and clinical trial operations. The ICRC offices are located on the 12th floor of the Ninth & Jefferson building (NJB) located on the Harborview Medical Center campus. Approximately 6,000 sq. ft. is dedicated to ICRC office space for investigators and administrative staff in the NJB. The space provides for 30 faculty, visiting scientists, staff, and students. All offices and conference rooms are wired with T-100 Ethernet cabling and dual voice/data communication capabilities. Secure Wi-Fi access is available.

Ten conference rooms on the 12th and 13th floors of NJB are available for use. All include data, phone, and projector connections; select rooms include wall-mounted LCD monitors and Polycom videoconferencing capabilities; and one is a fully-equipped classroom for distance learning, including data connections, ceiling-hung projector and screen, lectern with data connections and in-room audio, a ceiling-mounted camera, press-to-talk boundary microphones, Polycom videoconferencing, and two-way audio from lectern to a control room with live webcasting, webinar, and lecture capture capability. One videoconferencing suite includes a dedicated Polycom videoconferencing system with 80-port hub, wall-mounted camera configured for enhanced telepresence, and two wall-mounted LCD monitors. This system enables video connections from up to 80 H.323-compliant videoconferencing clients as well as voice-only participants.

Dr. Ruanne Barnabas and other faculty are provided with private, enclosed office spaces in close proximity to colleagues with similar research interests. Other staff are grouped together by function in a combination of enclosed offices and cubicles. Each team supervisor has a private enclosed office near other team members. These teams are divided into operational focus including data, research, administration, and lab. There are two centrally-located administrative offices housing the main administrative staff including the administrative systems manager and grants operation manager as well as other key support staff.

The University of Washington is committed to the development of early stage investigators. The International Clinical Research Center conducts weekly work in progress meetings for early stage investigators to receive feedback on their research and has outstanding support for administration of study projects. The Department of Global Health, the University of Washington and Fred Hutchinson Cancer Research Center CFAR (Center for AIDS Research), and the University of Washington, conduct career enrichment workshops and seminars, facilitate formal peer groups and provide support and instruction for conducting research. These resources contribute to the support of early stage investigators.

The **University of Washington ICRC Central Specimen Repository** houses samples from multiple HIV prevention research studies. The ICRC Laboratory is located on the 3rd floor of the Ninth & Jefferson Building on the Harborview Medical Center campus. The 850 sq. ft. laboratory contains both bench and desk space with computer work stations. The Lab manager has an individual office adjacent to the laboratory space. The lab space is sectioned into BSL1 for contained specimen handling and BSL2 where a 4-ft. biological safety cabinet is available for appropriate containment for clinical (HSV and HIV-positive) sample manipulations. In a third section of the Laboratory there is space for six -80°C freezers. There is sufficient space for receiving specimens, preparing aliquots and shipping material to other testing laboratories. The Central Repository also has access to the University of Washington Retrovirology Laboratory (Dr. Robert Coombs, Director) for any laboratory activities that require BSL3 containment, such as plasma viral loads. The ICRC Repository includes space for (48) -80°C and -20°C freezers in the Freezer Farm, located on the second parking level. This storage facility can store 2.6 million specimens.

Each freezer is equipped with an alarm to track temperature variations. Data Capture software is used to manage temperature and immediately alert staff to adverse conditions. This system operates nonstop and has a built-in power backup.

Relevant Schools and Departments at the University of Washington

School of Public Health
The UW School of Public Health is ranked among the top ten public health schools in the U.S., and has had over 10,000 graduates in the past 40 years. The School houses the Departments of Epidemiology, Global Health, Biostatistics, Environmental and Occupational Health Sciences, and Health Services, and offers interdisciplinary programs in Health Administration, Maternal and Child Health, Nutritional Sciences, Pathobiology, and Public Health Genetics. More than 30 centers and institutes bring together faculty from throughout the School to collaborate and do research across disciplines. The School partners with a number of health organizations including the Bill & Melinda Gates Foundation, Fred Hutchinson Cancer Research Center, Group Health Research Institute, Seattle Children's Hospital, U.S. Department of Veterans Affairs, PATH, and local and regional health departments across a five-state region.

Division of Allergy and Infectious Diseases, Department of Medicine
The Division of Allergy and Infectious Diseases has over 75 full-time faculty members, 50 clinical faculty members, and 15 adjunct or affiliate faculty members. Faculty have been nationally and internationally recognized for their work in a variety of subspecialties, including phagocyte biology and function, HIV/AIDS and other sexually transmitted diseases and infections, viral diseases, immuno-compromised hosts, bacterial pathogenesis, geographic medicine, urinary tract infections, and the molecular biology of infectious diseases.

The Division offers two fellowship training programs which are closely integrated with a number of local hospitals, clinics, and research institutions to provide a wide variety of clinical and research experience. Research training is offered in 9 areas of special emphasis: Clinical Epidemiology of Infectious Diseases, Clinical Trials, Human Immunodeficiency Virus Infection, Immunocompromised Host, Infectious Disease Immunology, Leukocyte Biology and Function, Pathogenesis of Bacterial, Fungal, and Parasitic Diseases, Pathogenesis of Viral Diseases, and Sexually Transmitted Diseases. Affiliations include Fred Hutchinson Cancer Research Center, Harborview Medical Center, Seattle Cancer Care Alliance, Seattle Children's Hospital, University of Washington Medical Center, and VA Puget Sound Health Care System.

Department of Medicine

The University of Washington's Department of Medicine is one of the best-funded departments of medicine in the nation, ranking in the top 10 of most funded departments of medicine in the United States since 2006. The Department has more than 1,000 full-time faculty members who are active in all levels of training—medical school, four residency pathways, and subspecialty fellowship programs. The Department's residencies and fellowships are considered among the best programs in the country. Department of Medicine faculty members are leaders of major multidisciplinary and translational research centers at the University of Washington, including Center for AIDS and STD, Center for Lung Biology, Center for Research in Reproduction and Contraception, Diabetes and Obesity Center of Excellence, Fred Hutchinson Cancer Research Center (FHCRC), Institute for Stem Cell and Regenerative Medicine, Institute of Translational Health Sciences, Kidney Research Institute, and affiliated with a number of research centers and projects including the AIDS Clinical Trials Unit, AIDS Vaccine Evaluation Unit, Center of Excellence in Women's Health, HIV Prevention Trials Unit, and Virology Research Clinic. Research partners include the Fred Hutchinson Cancer Research Center, Puget Sound Blood Center, Group Health Center for Health Studies, and other centers of advanced study, and research takes place in multidisciplinary centers affiliated with the Department, as well as laboratories at UW Medical Center, Harborview Medical Center, VA Puget Sound Health Care System, and Fred Hutchinson Cancer Research Center.

Department of Epidemiology
The Department of Epidemiology is consistently rated as one of the top epidemiology departments in the United States. The department offers MPH, MS, and PhD degrees in epidemiology, with approximately 165 graduate students at any one time. There is a wide range of faculty expertise, with 70 faculty and an additional ~100 health professionals and scientists holding adjunct and affiliate appointments in the department. Faculty research is highly interdisciplinary and encompasses a broad range of topics, including cancer, HIV/AIDS, sexually transmitted diseases, cardiovascular disease, maternal and child health, injury, trauma and violence, women's health, diseases of aging, and Alzheimer's disease. In addition to infectious agents, faculty research focuses on behavioral, nutritional, genetic, metabolic, environmental and medical factors associated with institutions and programs in the area, including Public Health Seattle-King County, the Fred Hutchinson Cancer Research Center, Group Health Research Institute, Harborview Injury Prevention and Research Center, the Veteran's Administration, and the University of Washington School of Medicine.

Department of Global Health
The Department of Global Health (DGH) was established in 2007 through a generous gift and endowment from the Bill & Melinda Gates Foundation, and complementary Washington State resources. UW DGH bridges the schools of Medicine and Public Health, with a mandate to harness the expertise and interdisciplinary power of all 16 UW schools and colleges. Currently, the department has more than 330 faculty representing 15 of 16 UW schools and colleges and 41 departments. It is the second largest department at the University in terms of funding for research and training programs, and includes more than 30 centers, programs, initiatives, and the Institute for Health Metrics and Evaluation (IHME). The Department offers a wide selection of programs, including MPH and PhD degrees, Health Metrics & Evaluation Fellowships, and Graduate Certificate Programs in Global Health, Global Health of Women, Adolescents, and Children (Global WACh), Global Injury and Violence Prevention, and HIV and STIs. A Global Health Minor is also open to students from across campus. Current and emerging focus areas include: health metrics and evaluation, infectious diseases, workforce development, health system strengthening and implementation science, climate change, global trauma and violence, global medicines safety, women, children and adolescent health, and a strong crosscutting focus on social justice and equity.

In addition to the ICRC, the Department's major research centers and service and capacity-building programs include:

- **Institute for Health Metrics and Evaluation (IHME)** is dedicated to improving health for everyone worldwide by improving health evidence. IHME provides rigorous and comparable measurement of the world's most important health problems and evaluates the strategies used to address them.

- **Center for AIDS Research (CFAR)** is an NIH-funded infrastructure program that advances the prevention, detection, and treatment of HIV infection and AIDS by fostering collaborative and interdisciplinary research, supporting career development in early-stage investigators, and providing cutting-edge core support to researchers and scientists at our affiliated institutions. CFAR members

include more than 550 UW and affiliated faculty, research scientists, and predoctoral and postdoctoral students.

- **Kenya Research and Training Center** provides an academic forum to support both trainees and investigators in the planning, implementation, analysis, and presentation of research conducted in Kenya.

- **International Training and Education Center for Health (I-TECH)** works with local ministries of health, universities, non-governmental organizations (NGOs), medical facilities, and other partners to support the development of a skilled health work force and well-organized national health delivery systems.

- **Global Center for Integrated Health of Women, Adolescents and Children (Global WACh)** is a joint effort among the UW departments of Global Health, Pediatrics, and Obstetrics & Gynecology. The center makes scientific discoveries, cultivates leaders, and bridges disciplines to advance the tightly connected health and well-being of women, adolescents, and children.

- **Program for Education and Research in Latin America (PERLA)** encourages interdisciplinary research, training, and implementation activities, and provides a forum to bring faculty, students, and community members together to improve the health and well-being of people in Latin America and the Caribbean.

- **Global Medicines Program** works to improve the access, use, safety, quality, cost-effectiveness, and affordability of medicines in low and middle-income income countries.

- **Center for Health and the Global Environment**, facilitates interdisciplinary collaborations across UW's schools and colleges to promote systems-based approaches to help communities prepare for, cope with, and adapt to a changing climate.

- **Health Alliance International (HAI)** is a UW-affiliated, non-governmental organization that partners with ministries of health to strengthen government primary health care and foster social, economic, and healthequity for all. HAI consists of over 150 field staff in Mozambique, Timor-Leste, and Côte d'Ivoire, and 22 staff at headquarters in Seattle, including seven UW DGH faculty.

The **University of Washington Libraries** will support the proposed project by making the latest scientific articles and other resources on dissemination science, social marketing, health promotion, and workplaces available to the investigator team.

The University of Washington library system is one of the premier research libraries in North America. It was the recipient of the 2004 Excellence in Academic Libraries Award that recognizes the top university research library in North America, the highest honor an academic library can receive. The award, presented by the Association of College and Research Libraries (ACRL, an organization of 12,000 members in North America) recognizes the library staff for programs that deliver exemplary services and resources to further the educational mission of the institution. The library system includes a collection of nearly six million cataloged volumes, an equal number in microfilm, more than 50,000 serial titles, and several million items in other formats are accessible through the Internet and in the 27 branch libraries on campus.

The **Health Sciences Libraries**, a subset of the UW Library system, are the University of Washington's primary resource for information in the biomedical sciences, including the fields of biomedicine, dentistry, nursing, pharmacy, public health, social work, and allied disciplines. The collections include more than 350,000 bound volumes and about 2,400 current journal subscriptions. The Health Sciences Libraries serve as headquarters for the National Network of Libraries of Medicine, Pacific Northwest Region, which provides consultation and training to health professionals in Alaska, Idaho, Montana, Oregon, and Washington, and services to health sciences libraries throughout the region. Librarians at the Health Sciences Libraries have expertise in searching for documents and providing information assistance. Desktop access (including remote/off-campus desktop access) to thousands of electronic journals is available to UW investigators at no cost. Document delivery via e-mail for

items not available in the electronic journal collection is available 24 hours a day with normal (within 24 hours of request) or rush (within 4 hours of request) turn-around.

All of the **support services** at the University of Washington are available for the use of staff, trainees and faculty. These include a machine shop, electronics shop, computer graphics services, photographic services, and financial management services. There is daily courier service between the University of Washington, Fred Hutchinson Cancer Research Center, Harborview Medical Center, and several clinics and research sites to transport specimens and materials between clinics and laboratories.

Computing

The University of Washington leads the region in providing state-of-the-art access to networked information and innovative, cost-effective computing tools for a wide variety of applications. University-supported resources include Ethernet access and various databases including the Current Index to Statistics, Medline, the UW library catalog, and the Library of Congress. The University also negotiates group-discounted site licenses for software that are widely used by the University community. UW Information Technology also offers Nebula Managed Desktop Services, which includes delivery and installation of the Nebula software suite, phone support, private and shared file server space, security (patching, anti-virus, hot fixes), power management, drive mappings, printer installs, file restores, and basic set-up and troubleshooting for Outlook email and calendaring. The UW Information Technology service has partnered with Google to provide “UW Google Apps”, a service that provides access to many web-based applications that are integrated with UW email accounts, including Google Apps Email with over 7 GB of storage, Google Calendar, Google Talk, Google Docs, and other applications. UW Learning and Scholarly Technologies (LST) offers free workshops on software such as Adobe Creative Suite and Adobe Photoshop, and online curriculum in computing fundamentals, design and graphics, digital audio and video, document creation, spreadsheets and databases, and web publishing. UW LST also offers its own free online suite of web-based communication and collaboration applications for use in teaching, learning, research, and everyday work, including an online survey tool, file sharing, and shared work space.

All members of the ICRC team are supplied with robust computing technology, including laptops, desktops, printers, other peripherals and software; in many cases, these are available at discounted academic prices. Four faculty members use Apple laptops utilizing Bootcamp and Fusion to ensure compatibility with Windows-based programs. The remaining computers are equipped with Windows and Office. All computers are required to have Sophos anti-virus software. Other specialized software provided to personnel with demonstrated need include SAS, SPSS, Stata, Epi Info, R, S Plus, Endnote, Adobe Acrobat Professional, Adobe Photoshop and Illustrator, Microsoft Project and Visio.

The ICRC utilizes secure file servers managed and supported by University of Washington IT services. The servers have remote and local access capabilities, and are backed up daily with redundant backup storage off site. The file folders on the server are restricted to ICRC-specific user groups, the membership of which are regularly reviewed internally and maintained on an ongoing basis. In addition, the files within these directories are password-protected when deemed necessary. A restricted section of the server is reserved for the data team who have exclusive password-protected access. Changes to server access are carefully monitored and must be approved before implementation.

Primary IT support is provided in house. Services include on-demand software support, hardware troubleshooting, general technical support, computing services research, smartphone and A/V support. Travelling employees have access to this support and have redundant systems in place including remote backup, secure external hard drives and travel readiness sessions. Additional post-travel computer check-ups are performed to ensure continued stability of the equipment and programs. In conjunction with UW IT services, IT support is available 24 hours a day.

The ICRC Central Specimen Repository has 3 computers and 2 barcode scanners available for scanning incoming and outgoing specimens. The computers are linked to a dedicated in house server hosting the Repository Freezerworks database which is backed up nightly. Service is provided both in house and by the UW Health Sciences server group.

A Ricoh WorkCentre copier is available, with multifunction capability including copy, print, color and B&W

scanning, and fax. Also available are an HP color laserjet printer and an HP B&W business size printer.

Data Management

DF/Net Research, Inc.
The ICRC contracts with DF/Net Research, Inc. to perform data management tasks (e.g. clinical database programming and maintenance). DF/Net uses DataFax, an off-the-shelf study and data management software package, that uses fax machines, bar codes, and intelligent character recognition (ICR) technologies to collect and monitor clinical study data. The DataFax system provides DF/Net data management staff with tools for data entry, data quality control, and overall study management. DataFax is considered a closed system with centralized data management at DF/Net. The images of case report forms are received, processed by ICR software, and stored in a proprietary database on the DataFax server. All CRF images remain in an electronic form within DataFax throughout the data management process.

Security is included at the system, DataFax, and procedural level to limit data access to authorized individuals. All transactions are fully recorded in a secure audit trail.

In house data staff are provided with view-only access to a study's DataFax database via iDataFax. iDataFax is designed for users who need specific access to view subject case report forms (CRF), data, and data queries in a strictly defined role that does not allow for changing data. In addition, in house data staff are provided access to view and download study reports and/or CRFs for printing via the DF/Net web portal. Changes to access of this portal must be approved before implementation.

REDCap
The ICRC has access to REDCap electronic data capture tools hosted at the Institute of Translational Health Sciences, University of Washington. REDCap (Research Electronic Data Capture) is a free, secure, web-based application designed to support data capture for research studies, providing 1) an intuitive interface for validated data entry; 2) audit trails for tracking data manipulation and export procedures; 3) automated export procedures for seamless data downloads to common statistical packages; and 4) procedures for importing data from external sources.

Teleconferencing Capabilities
The ICRC regularly hosts logistically complex international conference calls utilizing either standard international long distance or a third-party teleconferencing service. Both options require a secure pin to use. Calls to African countries are often actively monitored in house to ensure call stability. The monitor is able to respond immediately to poor connections and dropped callers via an electronic activity panel provided by the teleconferencing service. The monitor and teleconferencing operator work in conjunction to ensure all parties have joined and remain on the call. A log of all calls is maintained and regularly reviewed.

Videoconferences are also periodically scheduled, most often utilizing Skype, Polycom or Adobe Connect. One conference rooms is equipped with advanced videoconferencing equipment including high definition video cameras and projectors; all four rooms are equipped with webcams and LCD screens for use with Skype and other videoconferencing methods. A keypad-secured dedicated control room houses the Adobe Connect server. This server is also operable via an advanced remote control pad. All of these systems are supported in house.

Clinical
N/A

Laboratory
N/A

EQUIPMENT

Existing equipment is enumerated in the Facilities and Other Resources pages.

FOREIGN JUSTIFICATION

The goal of this proposed K01 is to maximize the public health impact of preventive therapy (PT) for tuberculosis (TB) prevention in HIV-infected individuals using cutting-edge geospatial models that integrate existing epidemiologic information. TB is the leading cause of death from an infectious disease globally. Persons with HIV infection have a much higher risk of developing TB and dying from it than do HIV-negative persons. Despite the recent, rapid scale-up of access to antiretroviral therapy (ART), nearly 17% of people living with HIV in sub-Saharan Africa die within the first year of starting ART, with TB as the leading cause of death. PT prevents mortality due to TB when used alone or in combination with ART. However, fewer than five percent of eligible Ugandans receive PT, due to drug shortages and the challenge of implementing PT screening programs. This proposal develops geospatial and mathematical transmission models to help identify in which regions of Uganda PT would provide the most benefit, so that resources could be prioritized to those regions. The models developed in this proposal would have utility in many other countries that have high burdens of HIV and TB infection. Research conducted in this grant is highly relevant to populations around the world, but would be difficult to conduct in US populations and health systems because the US has a much lower prevalence of HIV/TB co-infection, and much greater resources available to provide care than the countries with high burdens of HIV/TB co-infection.

OMB Number: 4040-0001
Expiration Date: 10/31/2019

RESEARCH & RELATED Senior/Key Person Profile (Expanded)

PROFILE - Project Director/Principal Investigator

Prefix: First Name*: Jennifer Middle Name M Last Name*: Ross Suffix:

Position/Title*: Acting Instructor/Senior Fellow
Organization Name*: UNIVERSITY OF WASHINGTON
Department:
Division:
Street1*: UNIVERSITY OF WASHINGTON
Street2: Office of Sponsored Programs
City*: SEATTLE
County:
State*: WA: Washington
Province:
Country*: USA: UNITED STATES
Zip / Postal Code*: [redacted]

Phone Number*: [redacted] Fax Number:

E-Mail*: [redacted]

Credential, e.g., agency login: [redacted]

Project Role*: PD/PI Other Project Role Category:

Degree Type: MD,MPH,AB Degree Year:

Attach Biographical Sketch*: File Name: FINAL_Biosketch_Ross_20180427.pdf

Attach Current & Pending Support: File Name:

Funding Opportunity Number: PA-18-369 . Received Date: 2018-05-04T16:42:25.000-04:00

PROFILE - Senior/Key Person

Prefix: First Name*: Ruanne Middle Name Vanessa Last Name*: Barnabas Suffix:

Position/Title*: Associate Professor
Organization Name*: UNIVERSITY OF WASHINGTON
Department: Global Health
Division:
Street1*: [redacted]
Street2:
City*: SEATTLE
County:
State*: WA: Washington
Province:
Country*: USA: UNITED STATES
Zip / Postal Code*: [redacted]

Phone Number*: [redacted] Fax Number:

E-Mail*: [redacted]

Credential, e.g., agency login: [redacted]

Project Role*: Other (Specify) Other Project Role Category: Mentor

Degree Type: MD,PHD,MS Degree Year:

Attach Biographical Sketch*: File Name: FINAL_Biosketch_BARNABAS_20180427.pdf

Attach Current & Pending Support: File Name: FINAL_OS_Barnabas_ModelingTB3_20180501.pdf

PROFILE - Senior/Key Person

Prefix: First Name*: David Middle Name Wesley Last Name*: Dowdy Suffix:

Position/Title*: Associate Professor
Organization Name*: Johns Hopkins University
Department:
Division:
Street1*: [redacted]
Street2: [redacted]
City*: Baltimore
County:
State*: MD: Maryland
Province:
Country*: USA: UNITED STATES
Zip / Postal Code*: [redacted]

Phone Number*: [redacted] Fax Number:

E-Mail*: [redacted]

Credential, e.g., agency login: [redacted]

Project Role*: Other (Specify) Other Project Role Category: Co-Mentor

Degree Type: MD,PHD,MS,BS Degree Year:

Attach Biographical Sketch*: File Name: FINAL_Biosketch_Dowdy_20180423.pdf

Attach Current & Pending Support: File Name: FINAL_OS_Dowdy_ModelingTB3_20180320.pdf

PROFILE - Senior/Key Person

Prefix: First Name*: Simon Middle Name Last Name*: Hay Suffix:

Position/Title*: Professor
Organization Name*: University of Washington
Department: Global Health
Division:
Street1*: [redacted]
Street2:
City*: Seattle
County:
State*: WA: Washington
Province:
Country*: USA: UNITED STATES
Zip / Postal Code*: [redacted]

Phone Number*: [redacted] Fax Number:

E-Mail*: [redacted]

Credential, e.g., agency login: [redacted]

Project Role*: Other (Specify) Other Project Role Category: Co-Mentor

Degree Type: Degree Year:

Attach Biographical Sketch*: File Name: FINAL_Biosketch_Hay_20180423.pdf

Attach Current & Pending Support: File Name: FINAL_OS_Hay_ModelingTB3_20180320.pdf

PROFILE - Senior/Key Person

Prefix: First Name*: JUDITH Middle Name N. Last Name*: WASSERHEIT Suffix:

Position/Title*: Chair
Organization Name*: UNIVERSITY OF WASHINGTON
Department: Global Health
Division:
Street1*: Harris Hydraulics Building
Street2: University of Washington
City*: Seattle
County:
State*: WA: Washington
Province:
Country*: USA: UNITED STATES
Zip / Postal Code*: [redacted]

Phone Number*: [redacted] Fax Number:

E-Mail*: [redacted]

Credential, e.g., agency login: [redacted]

Project Role*: Other (Specify) Other Project Role Category: Co-Mentor

Degree Type: MD,MPH,BA Degree Year:

Attach Biographical Sketch*: File Name: FINAL_Biosketch_Wasserheit_20180423.pdf

Attach Current & Pending Support: File Name: FINAL_OS_Wasserheit_ModelingTB3_20180320.pdf

OMB No. 0925-0001 and 0925-0002 (Rev. 09/17 Approved Through 03/31/2020)

BIOGRAPHICAL SKETCH

Provide the following information for the Senior/key personnel and other significant contributors.
Follow this format for each person. **DO NOT EXCEED FIVE PAGES.**

NAME: **Ross, Jennifer M.**

eRA COMMONS USER NAME (credential, e.g., agency login): [redacted]

POSITION TITLE: Acting Instructor/Senior Fellow – Division of Infectious Disease – University of Washington

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable. Add/delete rows as necessary.)*

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	Completion Date MM/YYYY	FIELD OF STUDY
Dartmouth College – Hanover, NH	AB	06/2003	Cell Biology
Oregon Health and Science University – Portland, OR	MD	06/2009	Medicine
Oregon Health and Science University – Portland, OR	MPH	06/2009	Epidemiology/Biostats
University of California, San Francisco, CA	Residency	06/2012	Internal Medicine
University of Washington – Seattle, WA	Fellowship	06/2016	Infectious Disease

A. Personal Statement

I am an Acting Instructor/Senior Fellow within the University of Washington Division of Allergy and Infectious Disease. In pursuing the K01 Career Development Award, I am building my research niche in the application of geostatistical and mathematical models to understand dynamics of HIV co-infections in East Africa. These models will help to guide targeted co-infection prevention efforts to achieve health gains for people living with HIV. While I enjoy studying the relationship between HIV and several other co-infecting pathogens, I have elected to focus on the prevention of tuberculosis (TB) because it is the leading cause of death among Ugandans living with HIV, and because of my network of mentors and colleagues researching TB in East Africa.

I have developed a strong foundation in research methods while also completing my clinical training in Internal Medicine and Infectious Disease. I completed a Master of Public Health (MPH) in epidemiology and biostatistics, coursework in mathematical modeling, and learned to use geographic information systems (GIS). I spent 11 months working in Uganda as a Fogarty Global Health Research Fellow and developing collaborations with investigators at the Uganda National TB and Leprosy Program, US CDC, and universities. This K01 award would support me to pursue advanced coursework in these fields while also receiving hands-on research mentorship from my mentorship team, which is led by Dr. Ruanne Barnabas, a physician-scientist with specialty expertise in infectious diseases, an expert in mathematical modeling of HIV co-infections, and PI of clinical trials of models of HIV care in Uganda and South Africa.

I began dedicating the majority of my effort to geospatial modeling and burden estimation for TB and HIV in January 2017, with mentorship from my proposed K01 co-mentor, Professor Simon Hay, and his team at the Institute for Health Metrics and Evaluation (IHME). A K01 award would support me to further develop these models to specifically address HIV/TB co-infection, develop parameters for the effectiveness of IPT and ART for TB prevention, and apply these models to guide TB prevention therapy with IPT within Uganda.

B. Positions and Honors

Positions and Employment

July 2009 - June 2012	Intern and Resident in Internal Medicine, University of California San Francisco
July 2012 - June 2013	Clinical Assistant Professor of Medicine, San Francisco General Hospital
July 2013 - July 2016	Research Fellow in Infectious Disease, University of Washington, Seattle, WA
Aug 2016 - present	Acting Instructor/Senior Fellow, Infectious Disease, University of Washington
January 2017 – present	Clinical Fellow, Geospatial Modeling, Institute for Health Metrics and Evaluation (IHME), University of Washington

Other Experience

June 2003 – July 2004	Emerging Infectious Disease Laboratory Training Fellow, CDC, Atlanta, GA
April 2004	Visiting Researcher, Universidad Peruano Cayetano Heredia, Lima, Peru
July 2014	Scholarship recipient, Summer Institute for Statistics and Modeling of Infectious Diseases, University of Washington
Aug 2015– June 2016	Fogarty Global Health Fellow, Entebbe, Uganda
June 2016	Sponsored participant, Clinic on Meaningful Modeling of Infectious Disease, South African Centre for Epidemiologic Modelling and Analysis (SACEMA)

Honors

2006	Portland Foundation for Medical Excellence Scholar
2007	Infectious Disease Society of America Student Scholar
2008	Alpha Kappa Kappa, OHSU School of Medicine
2009	Alpha Omega Alpha medical honor society inductee
2012	UCSF Internal Medicine Residency Professionalism Award
2012	UCSF Clinical and Translational Research Institute Travel Award
2016	Travel Award, International AIDS Conference, Durban, South Africa
2018	UW TB Research and Training Center Junior Investigator Award

C. Contributions to Science

C.1 Geospatial and dynamic transmission modeling of TB, HIV, and other infections

I began learning geospatial analysis during my Internal Medicine residency at the University of California, San Francisco. In 2011, I traveled to Uganda to interview patients about their TB symptoms, how and where they sought care in the community, and which modes of transportation they used to access the clinic. Then, I learned to use geographic information systems (GIS) to develop a geospatial model of access to TB care in our program's TB surveillance network in Uganda. Subsequently, I identified that mathematical modeling would be a complementary tool to geospatial modeling, and sought mentorship from Dr. Ruanne Barnabas at the University of Washington to begin learning this skill. In collaboration with another trainee, we modeled the potential impact of valacyclovir suppressive therapy for people living with HIV on HIV transmission in South Africa, drawing parameters from the clinical trials of valacyclovir suppressive therapy conducted by colleagues at the University of Washington. When I returned to Uganda in 2015-2016 as a Fogarty Global Health Fellow, I developed a study of the impact of cotrimoxazole prophylaxis for people living with HIV on population malaria burden. I presented the geospatial modeling component of this project at the annual meeting of American Society for Tropical Medicine and Hygiene. Following my year in Uganda, I returned to the University of Washington to join the Institute for Health Metrics and Evaluation (IHME), where I develop geospatial models for TB.

Peer reviewed publications

*These authors contributed equally

a. **Ross JM**, Cattamanchi A, Miller CR, Tatem AJ, Katamba A, Haguma P, Handley MA, Davis JL. Investigating Barriers to Tuberculosis Evaluation in Uganda Using Geographic Information Systems. *American Journal of Tropical Medicine and Hygiene*. 2015 Jul 27. pii: 14-0754. PMCID: PMC4596591.

b. **Ross JM***, Ying R*, Celum CL, Baeten JL, Lingappa JL, Thomas KK, Murnane P, Krows M, van Rooyen H, Hughes JP, Barnabas RV. Modeling HIV disease progression and transmission at population-level: The potential impact of modifying disease progression in HIV treatment programs. *Epidemics*. Published online 05 December 2017. DOI 10.1016/j.epidem.2017.12.001. PMID: 29223580.

Manuscripts under review

a. **Ross JM**, Henry NJ, Dwyer-Lindgren LA, Paula de Lobo A, Marinho de Souza F, Biehl MH, Ray SE, Reiner RC, Stubbs RW, Wiens KE, Earl L, Kutz MJ, Bhattacharjee NV, Kyu HH, Naghavi M, Hay SI. Progress toward eliminating TB and HIV deaths in Brazil, 2001–2015: a spatial assessment. Manuscript submitted for publication.

b. Reiner RC, Graetz N, Troeger C, Casey DC, Garcia GM, Mosser JF, Desphande A, Ray SE, Blacker BF, Rao PC, Osgood-Zimmerman A, Burstein R, Davis I, Letourneau I, Earl L, **Ross JM**, Khalil I, Farag T, Weiss DJ, Gething PW, Kassebaum N, Mokdad AH, Murray CJL, Hay SI. Local variation in childhood diarrheal morbidity and mortality in Africa, 2000-2015. In revision at *The New England Journal of Medicine*.

C.2 TB and Latent TB Disease Burden Estimation

As part of the TB team for the Global Burden of Disease Study at IHME, I contribute to modeling and producing manuscripts about global, regional, and national-level burden of TB and latent TB infection (LTBI) by HIV infection status and drug susceptibility classes. I developed a method for improving the estimation of TB disease progression risk among persons with LTBI and advanced HIV infection (CD4 cell count <200 cells per mm^3) that was incorporated into the GBD modeling strategy in 2017. I also provided clinical insight to an effort led by my colleague, Dr. Kirsten Wiens, to use the geography of TB strain patterns to improve burden of disease estimation for TB.

Peer reviewed publication

a. GBD Tuberculosis Collaborators (including **Ross JM** and Hay SI) The global burden of tuberculosis: results from the Global Burden of Disease Study 2015. *Lancet Infectious Diseases*. 2018; 18(3):261-284. DOI: 10.1016/S1473-3099(17)30703-X. PMCID: PMC5831985.

Manuscripts under review

a. [redacted]

b. [redacted]

C.3 HIV co-infection epidemiology and program evaluation

I enjoy studying the relationship between HIV and other co-infection pathogens, including the role of HIV in impacting transmission of other infectious diseases. In my first project as an infectious diseases fellow, I developed skills in systematic review and meta-analysis, which are essential for generating parameters for mathematical models, by completing a systematic review of the effect of hepatitis C infection on HIV viral load with mentorship from K01 mentors Dr. Ruanne Barnabas and Dr. Judy Wasserheit. I also worked with colleagues of Dr. Barnabas in Uganda and at the University of Washington to evaluate scale-up of a program of community-based HIV care in Uganda.

Early in my career, I served as an Emerging Infectious Disease Laboratory Training Fellow at the Centers for Disease Control and Prevention for the year between my college graduation and matriculation in medical school (2003-2004). I worked with mentors Dr. Vitaliano Cama and Dr. Lihua Xiao in the Division of Parasitic Disease to learn molecular epidemiology and describe genotype and clinical phenotype correlations for cryptosporidiosis in Peruvians with HIV. I completed the majority of the DNA extraction, nucleic acid amplification, and sequencing that led to the publication listed below. I also worked internationally teaching laboratory techniques to trainees at Universidad Peruana Cayetano Heredia in Lima, Peru.

Peer reviewed publications

*These authors contributed equally

a. Cama VA. **Ross JM**. Crawford S. Kawai V. Chavez-Valdez R. Vargas D. Vivar A. Ticona E. Navincopa M. Williamson J. Ortega Y. Gilman RH. Bern C. Xiao L. Differences in clinical manifestations among

Cryptosporidium species and subtypes in HIV-infected persons. *Journal of Infectious Diseases.* 196(5):684-91, 2007 Sep 1. PMID: 17674309.

b. Petersdorf N*, Ross JM*, Weiss HA, **Barnabas RV**, Wasserheit JN; HCV and HIV Transmission Working Group. Systematic review and meta-analysis of hepatitis C virus infection and HIV viral load: new insights into epidemiologic synergy. J Intl AIDS Soc. 2016;19:20944. doi: 10.7448/IAS.19.1.20944. PMCID: 5030209.

c. Asiimwe S*, Ross JM*, Arinaitwe A, Tumusiime O, Turyamureeba B, Roberts DA, O'Malley G, **Barnabas RV**. Expanding HIV testing and linkage to care in southwestern Uganda with community health extension workers. J Int AIDS Soc. 2017;21:80-7. doi: 10.7448/IAS.20.5.21633. PMCID: 5577731.

Complete List of Published Work in My Bibliography:
http://www.ncbi.nlm.nih.gov/sites/myncbi/1ngewagtk595p/bibliography/40404577/public/?sort=date&direction=ascending

D. Research Support

Ongoing Research Support

[redacted] **Hay/Murray (co-PIs)** **10/01/15-09/30/20**
[redacted]
Role: Clinical Fellow

Completed Research Support

NIH T32 AI007140 **S. Lukehart (PI)** **07/01/14-08/31/15**
University of Washington STD/AIDS Training Grant
This research fellowship supported my training in research methods (epidemiologic analysis, introductory mathematical modelling, systematic review and meta-analysis) in assessing the impact of HIV and HIV care on co-infections.
Role: Trainee

NIH R25 TW009345 **J. Zunt (PI)** **09/01/15-06/30/16**
Fogarty International Center (Global Health Fellowship Award to Jennifer Ross: Estimating the impact of cotrimoxazole prophylaxis on malaria burden in Kenya and Uganda)
The Global Health Fellowship Program is an 11-month clinical research training program for post-doctorate trainees and doctoral students in the health professions, sponsored by the National Institutes of Health's Fogarty International Center (FIC) in partnership with several NIH Institutes and Offices.
The goal of my fellowship project is to assess the degree of geographic overlap between HIV and malaria in Uganda and Kenya and estimate how cotrimoxazole preventive therapy for people living with HIV impacts malaria burden, using the tools of geospatial modeling and mathematical modelling.
Role: Fogarty Global Health Fellow

NIH/NIAID P30 AI027757 **K. Holmes (PI)** **01/01/14-07/31/16**
Center for AIDS Research (New Investigator Award to Ruanne Barnabas: Co-infection interventions to delay HIV progression: Effectiveness estimates)
The Aims of the Developmental Core are to recruit young scientists into research careers on HIV/AIDS, support collaborative, interdisciplinary AIDS-related research, and provide support to trainees. For Dr. Barnabas' project, the goals of her work are to estimate the effectiveness of HIV co-infection treatment to delay HIV progression.
Role: Trainee

OMB No. 0925-0001 and 0925-0002 (Rev. 09/17 Approved Through 03/31/2020)

BIOGRAPHICAL SKETCH
DO NOT EXCEED FIVE PAGES.

NAME: **Barnabas, Ruanne Vanessa**

eRA COMMONS USER NAME (credential, e.g., agency login): [redacted]

POSITION TITLE: Associate Professor

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable. Add/delete rows as necessary.)*

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	Completion Date MM/YYYY	FIELD OF STUDY
University of Cape Town, Cape Town, South Africa; *cum laude*	MD	12/1997	Bachelor of Medicine and Bachelor of Surgery
Groote Schuur Hospital Complex and Addington Hospital, South Africa	Residency	08/1999 and 12/2000	Internal Medicine
University of Oxford, Oxford, UK; *with distinction*	MSc (Epi)	09/2000	Epidemiology, Evolution and Control of Infectious Disease
University of Oxford, Oxford, UK	DPhil (Clinical Med)	06/2005	Mathematical modeling of HPV infection and cervical carcinoma
Fred Hutchinson Cancer Research Center, Seattle, WA	Postdoctoral Fellowship	06/2009	HIV Vaccines Trial Network (HVTN)
University of Washington, Seattle, WA	Fellowship	08/2010	Infectious Diseases

A. Personal Statement

As primary mentor for Dr. Jennifer Ross's K01 award, I will utilize my experience and training in modeling of HIV co-infections, HIV epidemiology, HIV clinical care, and health economics to guide her in completion of her research and training aims. My research focuses on interventions for HIV treatment and prevention, specifically on community-based strategies to increase access to antiretroviral therapy (ART) for HIV. I am the protocol chair of the Delivery Optimization for ART Study, which will evaluate the effectiveness and cost-effectiveness of decentralized, community-based ART initiation and follow-up compared to clinic-based care in Uganda and South Africa (OPP1134599). I lead a growing group of three faculty, and 14 trainees (2 fellows, 1 postdcos and 11 predocs) that use empiric data, costs, and mathematical models to estimate the potential impact and cost-effectiveness of HIV interventions and inform public health policy. My work is supported by 2 R21 grants from NIH and an R01-equivalent grant from the BMGF (4.5 million direct cost). For this award I will provide guidance to Dr. Ross as she completes her analyses, and I will provide critical feedback on her manuscripts and grant proposals. I will work closely with Professor Hay, Dr. Dowdy, Dr. Wasserheit, to help Dr. Ross achieve her goal of becoming an independent investigator.

1. Ross JM, Ying R, Celum CL, Baeten JM, Thomas KK, Murnane PM, van Rooyen H, Hughes JP, **Barnabas R**. Modeling HIV disease progression and transmission at population-level: The potential impact of modifying disease progression in HIV treatment programs. Epidemics. Published online 05 Dec 2017 [original work]. doi.org/10.1016/j.epidem.2017.12.001. NIHMS: 927302.
2. Asiimwe S, Ross JM, Arinaitwe A, Tumusiime O, Turyamureeba B, Roberts DA, O'Malley G, **Barnabas RV**. Expanding HIV testing and linkage to care in southwestern Uganda with community health extension workers. J Int AIDS Soc. 2017;21:80-7 [original work]. doi: 10.7448/IAS.20.5.21633. PMCID: 5577731.
3. Petersdorf N, Ross JM, Weiss HA, **Barnabas RV**, Wasserheit JN; HCV and HIV Transmission Working Group. Systematic review and meta-analysis of hepatitis C virus infection and HIV viral load: new insights into epidemiologic synergy. J Intl AIDS Soc. 2016;19:20944 [review]. doi: 10.7448/IAS.19.1.20944. PMCID: 5030209.

B. Positions and Honors

Positions and Employment

Jan-Dec 1998	Medical Intern at Groote Schuur Hospital Complex, Cape Town, South Africa
Jan-Sept 1999	Medical Officer, Addington Hospital, Durban, South Africa
Oct-Dec 2000	Medical Officer, Addington Hospital, Durban, South Africa
Oct 1999 – Jan 2003	Rhodes Scholar, University of Oxford, Oxford, UK
Feb 2003 – Jan 2006	Oxford Nuffield Medical Fellow, University of Oxford, Oxford, UK
Feb-Jun 2006	Research Fellow, Cancer Epidemiology Unit, University of Oxford, Oxford, UK
July 2006 – Jun 2009	Post-doctoral Research Fellow, Vaccine and Infectious Diseases Institute, Fred Hutchinson Cancer Research Center, Seattle, US
July 2009 – Aug 2010	Clinical Fellow in Allergy and Infectious Diseases
Sept 2010 – Dec 2012	Acting Clinical Instructor, Dept. of Global Health, Division of Allergy and Infectious Diseases, School of Medicine, University of Washington
Jan 2013 – Jun 2017	Assistant Professor, Dept. of Global Health, Division of Allergy and Infectious Diseases, Schools of Medicine and Public Health, University of Washington
Jul 2017 – current	Associate Professor, Dept. of Global Health, Division of Allergy and Infectious Diseases, Schools of Medicine and Public Health, University of Washington

Other Experience and Professional Memberships

2009 Member, Infectious Diseases Society of America
2013 Scientific Advisory Committee of the 2014 International HIV Treatment as Prevention Workshop

Honors

1999	United World College Scholarship
2000	Rhodes Scholar, University of Oxford, Oxford, UK
2002-2005	Prize Scholar, Merton College, Oxford, UK
2003-2006	Oxford Nuffield Medical Fellow, University of Oxford, Oxford, UK
2004-2006	Janet Vaughan Junior Research Fellow, Somerville College, Oxford, UK
2010-2014	University of Washington ITHS KL2 Scholar
2017-current	King K. Holmes Endowed Professorship in STD and AIDS

C. Contribution to Science

1. **Community-based HIV testing and linkage to care**: My recent work focuses on delivering community-based HIV testing and linkage to HIV treatment and prevention in Africa. The number of HIV-positive persons on life-saving antiretroviral therapy (ART) will need to double over the next few years to prevent HIV-associated morbidity and mortality, and onward HIV transmission. However, there is a critical need to develop and test efficient and scalable implementation strategies to achieve universal knowledge of HIV serostatus and linkage to care. Our implementation science work demonstrated that community-based HIV testing strategies achieve high uptake of testing and linkage to care and are a cost-effective approach to scaling up ART delivery. Our work has had an impact of the delivery of HIV testing: we participated in reviewing and contributing to the World Health Organization (WHO) guidelines for HIV testing, which were released at the International AIDS Society meeting in Vancouver, Canada, in July 2015.
   a. **Barnabas RV**, van Rooyen H, Tumwesigye E, et al. Uptake of antiretroviral therapy and male circumcision after community-based HIV testing and strategies for linkage to care versus standard clinic referral: a multisite, open-label, randomised controlled trial in South Africa and Uganda. Lancet HIV. 2016;3:e212-20. doi: 10.1016/S2352-3018(16)00020-5. PMCID: 4852382.
   b. **Barnabas RV**, van Rooyen H, Tumwesigye E, et al. Initiation of antiretroviral therapy and viral suppression after home HIV testing and counselling in KwaZulu-Natal, South Africa, and Mbarara district, Uganda: a prospective, observational intervention study. Lancet HIV. 2014;1:e68-e76. doi: 10.1016/S2352-3018(14)70024-4. PMCID: 4292844.
   c. Ying R, Sharma M, Celum C, Baeten JM, van Rooyen H, Hughes JP, Garnett G, **Barnabas RV**. Home HIV testing and counselling to reduce HIV incidence in a generalised epidemic setting: a mathematical modeling analysis. Lancet HIV. 2016;3:e275-82 [original work]. doi: 10.1016/S2352-3018(16)30009-1. PMCID: 4927306.
   d. *van Rooyen H, **Barnabas RV**, Baeten JM, et al. High HIV testing uptake and linkage to care in a novel

*The first two authors contributed equally to this paper.

program of home-based HIV counseling and testing with facilitated referral in KwaZulu-Natal, South Africa. J Acquir Immune Defic Syndr. 2013;64:e1-e8. doi: 10.1097/QAI.0b013e31829b567d. PMCID: 3744613.

2. **Combination HIV prevention**: In parallel to implementation and evaluation of HIV testing and linkage strategies, we have estimated the impact, cost and cost-effectiveness of combination HIV prevention interventions using costing methods and mathematical models of HIV transmission. Specially, we estimated the effectiveness, cost and cost-effectiveness of pre-exposure prophylaxis (PrEP) combined with ART for serodiscordant couples in Africa, and explored the impact of adherence. These studies, exploring synergies between interventions and costs, are important for policy makers choosing between interventions for combination HIV prevention.
   a. Ying R, Sharma M, Heffron R, Celum C, Baeten JM, Katabira E, Bulya N, **Barnabas RV**. Cost-effectiveness of pre-exposure prophylaxis targeted to high-risk serodiscordant couples as a bridge to sustained ART use in Kampala, Uganda. J Int AIDS Soc. 2015;18:20013. doi: 10.7448/IAS.18.4.20013. PCMID: 4509901.
   b. Celum C, Baeten JM, Hughes JP, **Barnabas R**, et al. Integrated strategies for combination HIV prevention: principles and examples for men who have sex with men in the Americas and heterosexual African populations. J Acquir Immune Defic Syndr. 2013;63:S213-20 [review]. PMCID: 3708491.
   c. Hallett TB, Baeten JM, Heffron R, **Barnabas R**, et al. Optimal uses of antiretrovirals for prevention in hiv-1 serodiscordant heterosexual couples in South Africa: a modelling study. PLoS Med. 2011; 8:e1001123. doi: 10.1371/journal.pmed.1001123. PMCID: 3217021.
   d. **Barnabas RV**, Revill P, Tan N, Phillips A. Cost-effectiveness of routine viral load monitoring in low- and middle-income countries: A systematic review. J Int AIDS Soc. 2017;20:50-61 [original work]. doi: 10.1002/jia2.25006.

3. **HIV co-infections**: My focus on ART delivery optimization strategies started with a focus on factors that influence HIV viral load, and, consequently HIV transmission. I reviewed the impact of HIV co-infections and co-infection treatment on HIV viral load. We found that in countries where the burden of HIV co-infections is high, co-infections explain 15%-20% of HIV transmission. This was an important finding as it explained in part the geographic disparity in HIV prevalence and supported integration of co-infection treatment and prevention programs as part of HIV control.
   a. **Barnabas RV**, Baeten JM, Lingappa JR, et al. Acyclovir prophylaxis reduces the incidence of herpes zoster among HIV-infected individuals: results of a randomized clinical trial. J Infect Dis. 2016;213:551-5. doi: 10.1093/infdis/jiv318. PMCID: 4721901.
   b. *Abu-Raddad LJ, **Barnabas RV**, Janes H, et al. Have the explosive HIV epidemics in sub-Saharan Africa been driven by higher community viral load?. AIDS. 2013;27:981-9 [comment]. doi: 10.1097/01.aids.0000432463.23508.a2. PMCID: 3725236.
   c. **Barnabas RV**, Wasserheit JN, Huang Y, et al. Impact of herpes simplex virus type 2 on HIV-1 acquisition and progression in an HIV vaccine trial (the Step Study). J Acquir Immune Defic Syndr. 2011;57:238-44. doi: 10.1097/QAI.0b013e31821acb5. PMCID: 3446850.
   d. ***Barnabas RV**, Webb EL, Weiss HA, Wasserheit JN. The role of co-infections in HIV epidemic trajectory and positive prevention: a systematic review and meta-analysis. AIDS, 2011;25:1559-73. doi: 10.1097/QAD.0b013e3283491e3e. PMCID: 3151007.

4. **Estimating the impact of HPV vaccination on cervical cancer incidence**: My early work used dynamic mathematical models of HPV infection to estimate the impact and cost-effectiveness of HPV vaccination on cervical cancer incidence in Finland, Australia and the United Kingdom. This project was one of the first transmission models of HPV, and described the impact of vaccinating girls and boys compared to girls only and the optimum age at vaccination. We participated in the Advisory Committee on Immunization (ACIP) HPV vaccine guideline meetings and the World Health Organization (WHO) consultation and these results influenced HPV vaccine guidelines.
   a. Canfell K, **Barnabas R**, Patnick J, Beral V. The predicted effect of changes in cervical screening practice in the UK: results from a modelling study. Br J Cancer. 2004; 91:530-6. PMCID: 2409838.
   b. **Barnabas RV**, Laukkanen P, Koskela P, et al. Epidemiology of HPV 16 and cervical cancer in Finland and the potential impact of vaccination: mathematical modelling analyses. PLoS Med. 2006;3:e138. PMCID: 1434486.
   c. French KM, **Barnabas RV**, Lehtinen M, et al. Strategies for the introduction of human papillomavirus vaccination: modeling the optimum age- and sex-specific pattern of vaccination in Finland. Br J Cancer.

2007;96:514-8. PMCID: 2360033.

d. Smith MA, Canfell K, Brotherton JML, Lew JB, **Barnabas RV**. The predicted impact of vaccination on human papillomavirus infections in Australia. Int J Cancer. 2008;23:1854-63. PMID: 18636563.

5. **Epidemiologic and health economic analyses for treatment and prevention of sexually transmitted infections**: As part of the implementation science focus of our work, we have estimated the epidemiologic and economic impact of prevention and treatment of sexually transmitted infections (STIs), including herpes simplex virus type 2 (HSV-2) and human papillomavirus (HPV). We found that there is epidemiologic synergy between STIs, and, ongoing prevention and treatment interventions are effective at reducing STI-associated morbidity and mortality.
   a. **Barnabas RV**, Celum C. Infectious co-factors in HIV-1 transmission herpes simplex virus type-2 and HIV-1: new insights and interventions. Curr HIV Res. 2012;10:228-37. PMCID: 3563330.
   b. Bochner AF, Baeten JM, Rustagi AS, Nakku-Joloba E, Lingappa JR, Mugo NR, Bukusi EA, Kapiga S, Delany-Moretlwe S, Celum C, **Barnabas RV**; Partners in Prevention HSV/HIV Transmission Study and Partners PrEP Study Teams. A cross-sectional analysis of Trichomonas vaginalis infection among heterosexual HIV-1 serodiscordant African couples. Sex Trans Infect. 2017;93:520-9 [original work]. doi: 10.1136/sextrans-2016-053034.
   c. Kulasingam SL, Benard S, **Barnabas RV**, et al. Adding a quadrivalent human papillomavirus vaccine to the UK cervical cancer screening programme: a cost-effectiveness analysis. Cost Eff Resour Alloc. 2008;6:4. PMCID: 2290741.
   d. **Barnabas RV**, Carabin H, Garnett G. The potential role of suppressive therapy for sex partners in the prevention of neonatal herpes: a health economic analysis. Sex Transm Infect. 2002; 78:425-9. PMCID: 1758356.

Complete List of Published Work in MyBibliography:
http://www.ncbi.nlm.nih.gov/sites/myncbi/ruanne.barnabas.1/bibliograpahy/44999353/public

D. Research Support

Ongoing Research Support

NIH/NIAID R21 AI122867 **Barnabas (PI)** **09/01/16-08/01/18**
Association between schistosomiasis infection and HIV-1 acquisition, transmission and disease progression in Africa
This proposal uses existing data and specimens from four longitudinal studies of HIV acquisition conducted in schistosomiasis-endemic areas of Kenya and Uganda to estimate the impact of schistosome infection on HIV-1 acquisition, transmission or disease progression and the proportion of HIV cases attributable to schistosome infection.
Role: Principal Investigator

[redacted] **Barnabas (PI)** **08/17/15-08/31/20**
[redacted]
Role: Principal Investigator

NIH/NIMH MH110026 **Barnabas, R, van Rooyen (PIs)** **08/01/16-07/31/18**
Do lottery incentive strategies increase engagement in HIV care and uptake of antiretroviral therapy among South African men?
The major goal of this project is to adapt and strengthen innovative and high-yield conditional incentive lottery strategies to engage this hard to reach population, HIVpositive South African men, in HIV care and ART.
Role: Co-Principal Investigator

NIH/NIAID P30 AI027757 **Holmes (PI)** **03/01/97-05/31/18**
International Core University of Washington Center for AIDS Research
Dr. John-Stewart is the Director of the International Core. The UW CFAR International Core supports, facilitates and coordinates research on HIV/AIDS by University of Washington faculty in developing countries by providing research mentorship, logistical, operational and infrastructure support as well as small pilot grants.
Role: Lead for the Health Economic and Impact Study Team (HEIST)

CDC 3H25PS004364 **Golden (PI)** **01/01/15-12/31/18**
STD AAPPS Supplemental Funding for Enhanced Program Evaluation
We will describe the implementation of integrating HIV-related activities into STI PS and evaluate the effect of PS both as an STI treatment strategy and their effect on our expanded HIV-related outcomes. Analyses will also assess the overall cost-effectiveness of STI PS as well as the incremental cost-effectiveness of integrating HIV-related activities into STI PS.
Role: Co-Investigator

USAID AID-OAA-A-15-00034 **Celum (PI)** **07/20/15-07/17/20**
Scaleable, effective delivery of microbicides and PrEP for young women in Kenya and South Africa
We propose to develop and evaluate effective, scalable strategies that are context-specific and gender responsive for closing critical gaps in microbicide and PrEP delivery for African women in high HIV incidence settings.
Role: Co-Investigator

NCI U01 CA199334 **Kim (PI)** **09/09/15-08/31/20**
Comparative modeling to inform cervical cancer control policies
The major goal of this subaward is to oversee the transmission modeling for high-risk groups being performed at the University of Washington, specifically focusing on the potential impact of cervical cancer screening and prevention intervention on cervical cancer incidence among high-risk women and evaluating novel interventions.
Role: Co-Investigator

NIH/NIAID R01 AI125498 **Baeten, John-Stewart (co-PIs)** **04/01/16-03/31/21**
Delivering PrEP in Pregnancy
In this study we aim to compare two models of PrEP delivery in pregnant women – universal PrEP (offered to all women, women self-select) or targeted PrEP (partner HIV saliva self-test to provide partner HIV status data that is combined with risk score for PrEP offer decision).
Role: Co-Investigator

NIH/NIMH R01 MH095507 **Baeten (PI)** **04/01/16-03/31/21**
Delivery of integrated PrEP and ART for HIV prevention for couples in Kenya
The main goal of this project is to extend the prior work by conducting a stepped-wedge trial evaluate roll-out of this strategy in public health clinics in Kenya, where policy support for implementing HIV-1 prevention for couples is high.
Role: Co-Investigator

US Dept of State S-LMAQM-16-CA-1103 **John-Stewart (PI)** **10/01/16-09/30/18**
DREAMS Innovation Challenge Project
We will implement and compare models of PrEP delivery in public health systems (MCH/FP) well-attended by young women at risk for HIV. Cost-effectiveness, PrEP uptake, adherence, and feasibility in FP and MCH clinics will be determined and compared. Innovations include PrEP in MCH/FP, partner self-testing, adherence support, drug monitoring and cost modeling.

NIH/NICHD R01 MH110296 **Heffron (PI)** **08/23/17-07/31/22**
Integrated PrEP and ART Delivered in Ugandan Public Health Clinics to Improve HIV and ART Outcomes for HIV Serodiscordant Couples
Using a stepped wedge design, we will rollout PrEP integrated with ART provision among Ugandan HIV serodiscordant couples in public health clinics around Kampala, Uganda, with concurrent attention to behavioral counseling and costing components. Results will provide compelling data to inform the widespread delivery of this intervention as a component of Ugandan national HIV prevention policy.
Role: Co-Investigator

OMB No. 0925-0001 and 0925-0002 (Rev. 10/15 Approved Through 10/31/2018)

BIOGRAPHICAL SKETCH

Provide the following information for the Senior/key personnel and other significant contributors.
Follow this format for each person. **DO NOT EXCEED FIVE PAGES**.

NAME: **Dowdy, David Wesley**

eRA COMMONS USER NAME (credential, e.g., agency login): [redacted]

POSITION TITLE: Associate Professor of Epidemiology

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable. Add/delete rows as necessary.)*

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	Completion Date MM/YYYY	FIELD OF STUDY
Duke University	B.S	05/1999	Chemistry, Biology
Johns Hopkins University	Sc.M.	05/2002	Epidemiology
Johns Hopkins University	M.D.	05/2008	Medicine
Johns Hopkins University	Ph.D.	05/2008	Epidemiology
University of California, San Francisco	Residency	06/2011	Internal Medicine

A. Personal Statement

I am a practicing general internist and infectious disease epidemiologist with interdisciplinary expertise in epidemiology, health economics, implementation science, and mathematical modeling. I have a strong interest in mentorship: I have served as the primary or co-primary mentor for over 35 trainees (postdoctoral fellows, PhD students, and Master's students) and have contributed to mentoring (e.g., as a project advisor) over 75. I am the primary mentor on a K08 award (Emily Kendall) and a co-mentor on a K23 award (Christina Yoon). My content area of greatest familiarity is mathematical and simulation modeling of interventions to control tuberculosis (TB) and HIV. In the field, I have collected empirical data to inform such models in over 10 countries across 4 continents. I have used such models to evaluate the medium-term epidemiological and economic impact of improved TB and HIV diagnostic and therapeutic strategies: both locally and globally, in hypothetical and real populations. I serve on the steering committee of the Gates Foundation-funded TB Modeling and Analysis Consortium, with primary responsibility for the consortium's Modeling Research Group. I am also an active member of the Center for TB Research and Center for AIDS Research at Johns Hopkins, as well as the Uganda Tuberculosis Implementation Research Consortium (U-TIRC). I have known Dr. Ross for over 7 years and am delighted to have the opportunity to contribute to her K01 application as a member of her mentorship team.

1. Arinaminpathy, N., **Dowdy, D.** (2015) Understanding the incremental value of novel diagnostic tests for tuberculosis. Nature, 528(7580):S60-7.
2. Pai M, Behr, MA, **Dowdy D**, Dheda K, Divangahi M, Boehme CC, Ginsberg A, Swaminathan S, Spigelman M, Getahun H, Menzies D, Raviglione M. (2016) Tuberculosis. Nat Rev Dis Primers, 2:16076. PMID: 27784885.
3. Kendall, E.A., Fojo, A.T., **Dowdy, D.W.** (2017) Expected effects of adopting a 9 month regimen for multidrug-resistant tuberculosis: a population modelling analysis. Lancet Respir Med, 5(3):191-199. PMC5332590.
4. Kendall EA, Shrestha S, Cohen T, Nuermberger E, Dooley KE, Gonzalez-Angulo L, Churchyard GJ, Nahid P, Rich ML, Bansbach C, Forissier T, Lienhardt C, **Dowdy DW**. (2017) Priority-Setting for Novel Drug Regimens to Treat Tuberculosis: An Epidemiologic Model. PLOS Med, 14(1):e1002202. doi: 10.1371/journal.pmed.1002202. PMC5207633.

B. Positions and Honors

Positions and Employment

2008 Consultant, Center for Global Development and Population Services International
2008-2011 Resident, Internal Medicine Residency Program, University of California, San Francisco
2010-2014 Consultant, World Health Organization
2011-2012 Assistant Professor, Dept. of Epidemiology, Johns Hopkins Bloomberg School of Public Health
2011- Joint Appointment, Division of General Internal Medicine, Johns Hopkins University
2011- Physician, Johns Hopkins Community Physicians at East Baltimore Medical Center
2012- Steering Committee Member, TB Modeling and Analysis Consortium [Gates Foundation]
2012-2015 B. Frank and Kathleen Polk Assistant Professor of Epidemiology, Johns Hopkins University
2015- Associate Professor of Epidemiology, Johns Hopkins University
2016- Joint Appointment, Dept. of International Health, Johns Hopkins Bloomberg Sch of Public Health
2017- Director, Translational Epidemiology Initiative, Dept. of Epidemiology, JHBSPH

Other Experience and Professional Memberships

2010- Member, International Union Against Tuebrculosis and Lung Disease
2011- Diplomate, American Board of Internal Medicine
2011-2014 Academic Editor, PLOS ONE
2012-2014 Member, International AIDS Society
2013 NIH AIDS Clinical Epidemiology Study Section & IRIDA Special Emphasis Panel, reviewer
2014 NIH International Research on Infectious Diseases, including AIDS Study Section, reviewer
2014- Section Editor, PLOS ONE
2014 Medical Research Council of South Africa, ad hoc reviewer
2015 NIH Infectious, Reproductive, Asthma, and Pulmonary Conditions Study Section, reviewer
2016 NIH Microbiology and Infectious Diseases B Study Section, reviewer
2016 NIH Special Study Sections on Clinical Trials (2), reviewer
2017- NIH Microbiology and Infectious Diseases B Study Section, standing member

Honors

2004 Robert Dyar Award, Department of Epidemiology, JHU, Baltimore, MD
2005 Charlotte Silverman Award, Department of Epidemiology, JHU, Baltimore, MD
2008 Arthur M. Dannenberg, Jr. Award for Tuberculosis Research, Johns Hopkins Center for TB Research, Baltimore, MD
2008 Alpha Omega Alpha Honor Society, JHU, Baltimore, MD
2008 David E. Rogers Award for Professionalism, Ethics, and Community, JHU, Baltimore, MD
2008 Warfield T. Longcope Prize in Clinical Medicine, JHU, Baltimore, MD
2009 Julius Krevans Award for Outstanding Housestaff Service, Department of Medicine, University of California, San Francisco (UCSF)
2010 Teaching Excellence Award for Cherished Housestaff (TEACH), UCSF School of Medicine
2010 Floyd Rector Clinical Science Research Award, Internal Medicine Residency Program, UCSF
2010 Diane Becker Award in Clinical Epidemiology and Prevention, Johns Hopkins General Internal Medicine Housestaff Research Award, Baltimore, MD
2011 Tom Evans Teaching Award, UCSF Internal Medicine Residency Program
2012 Union Young Investigator Prize, International Union Against Tuberculosis and Lung Disease
2013 Advising, Mentoring, and Teaching Recognition Award, JHBSPH, Baltimore, MD
2014 Golden Apple Teaching Award for best large class, JHBSPH, Baltimore, MD
2016 Excellence in Mentorship Award, JHUSOM, Baltimore, MD

C. Contribution to Science

1. **Transmission Modeling of TB and HIV:** A critical question with many TB/HIV public health interventions is their potential impact on transmission. Population-level models can also be used to gain insight as to the mechanisms by which epidemics of TB and HIV develop. I have constructed a number of transmission models of TB and HIV to answer many relevant questions in this field. Specific areas of emerging interest include modeling the interactions of TB interventions (especially diagnostics) with the public health system, emergence and control of drug-resistant TB, transmission of TB within geographic “hotspots,” and preventive

interventions. Results from my modeling efforts have helped to transform both scientific understanding of these issues, as well as local policy (e.g., TB culture in South Africa).

a. **Dowdy, D.W.,** Golub, J.E., Chaisson, R.E., Saraceni, V. (2012) Heterogeneity in tuberculosis transmission and the role of geographic hotspots in propagating epidemics. Proc Natl Acad Sci USA, 109(24): 9557-62. PMC3386125.
b. Shah, M., Perry, A., Risher, K., Kapoor, S., Grey, J., Sharma, A., Rosenberg, E.S., Del Rio, C., Sullivan, P., **Dowdy, D.W.** (2016) Effect of the US National HIV/AIDS Strategy targets for improved HIV care engagement: a modelling study. Lancet HIV 3(3):e140-6. PMC4787987.
c. Kendall, E.A., Fojo, A.T., **Dowdy, D.W.** (2017) Expected effects of adopting a 9 month regimen for multidrug-resistant tuberculosis: a population modelling analysis. Lancet Respir Med, 5(3):191-199. PMC5332590.
d. Kendall EA, Shrestha S, Cohen T, Nuermberger E, Dooley KE, Gonzalez-Angulo L, Churchyard GJ, Nahid P, Rich ML, Bansbach C, Forissier T, Lienhardt C, **Dowdy DW**. (2017) Priority-Setting for Novel Drug Regimens to Treat Tuberculosis: An Epidemiologic Model. PLOS Med, 14(1):e1002202. doi: 10.1371/journal.pmed.1002202. PMC5207633.

2. **Economic Evaluation of TB and TB/HIV Interventions:** I have led a number of economic evaluations of key interventions in TB and TB/HIV control that have helped to advance our understanding of those interventions' economic implications. The area of my greatest contribution in this field has been to that of diagnostic testing and preventive therapy for TB, particularly in HIV-positive populations. I developed one of the earliest models of the cost-effectiveness of TB diagnostics, and my work on the negative economic consequences of serological testing for TB in India helped lead to a nationwide ban on this practice. Importantly, I have expertise in empirical costing methods and have applied these to costing of TB interventions. I have also contributed to the theory of economic evaluation in TB, helping to advance the way we think about the economics of TB diagnostic testing and preventive therapy.

a. **Dowdy, D.W.**, Steingart, K.R., & Pai, M. (2011) Cost-effectiveness of serological testing for active tuberculosis in India. PLOS Med, 8(8), e1001074. PMC3153451
b. Zwerling, A.A., Sahu, M.,…,**Dowdy, D.W.** (2015) Screening for tuberculosis among adults newly diagnosed with HIV in sub-Saharan Africa: a cost-effectiveness analysis. J Acquir Immune Defic Syndr 70(1):83-90. PMC4556591.
c. Hsiang, E., Little, K.M., Haguma, P., Hanrahan, C.F., Katamba, A., Cattamanchi, A., Davis, J.L., Vassall, A., **Dowdy, D.** (2016) Higher cost of implementing Xpert MTB/RIF in Ugandan peripheral settings: implications for cost-effectiveness. Int J Tuberc Lung Dis 20(9):1212-8. PMC5018405.
d. Debes, A.K., Gilman, R.H., Onyango-Makumbi, C., Ruff, A., Oberhelman, R., **Dowdy, D.W.** (2017) Cost-effectiveness of Diagnostic Algorithms for Tuberculosis in Children Less Than 5 Years of Age. Pediatr Infect Dis J. 36(1):36-43. PMC5214221.

3. **Implementation of TB Public Health Interventions:** I have more recently become closely engaged in evaluating the implementation of interventions to control TB, from the perspectives of collecting empirical data to understand how interventions (especially diagnostic and preventive interventions) are implemented in the "real world" and linking those data to models that can help us better understand how to better scale up those interventions across a variety of settings. I have served as the PI on an R21-funded project to develop "user-friendly" models to aid in the implementation of TB diagnostics, an R21-funded project to evaluate the scale-up of TB diagnosis in Uganda, and most recently have initiated an R01-funded trial of the comparative implementation of TB case-finding in rural South Africa. In these projects, I have worked closely with experts on the ground to ensure that results are scalable and meaningful to public health.

a. Schito, M., Peter, T.F., Cavanaugh, S., **Dowdy, D.W.** (2012) Opportunities and challenges for cost-efficient implementation of new point-of-care diagnostics for HIV and tuberculosis. J Infect Dis, 205 Suppl 2, S169-S180. PMC3334507
b. **Dowdy, D.W.**, Andrews, J.R., Dodd, P.J., Gilman, R.H. (2014) A user-friendly, open-source tool to project impact and cost of diagnostic tests for tuberculosis. ELife 3. PMC4082287.
c. Sun, A.Y., Denkinger, C.M., **Dowdy, D.W.** (2014) The impact of novel tests for tuberculosis depends on the diagnostic cascade. Eur Respir J 44(5): 1366-9.

d. Theron, G., Jenkins, H.E., Cobelens, F., Abubakar, I., Khan, A.J., Cohen, T., **Dowdy, D.W.** (2015) Data for action: collection and use of local data to end tuberculosis. Lancet, 386(10010):2324-33. PMC4708262.

4. **Epidemiology and Clinical Trials of TB/HIV Diagnosis and Case Finding:** I have participated in a number of clinical trials that have sought to evaluate the effectiveness and impact of TB/HIV diagnosis and case-finding, including an evaluation of molecular diagnosis for TB in four countries of southern Africa, preventive therapy for TB in Brazil, and TB case-finding among individuals receiving diagnoses of active TB in Malawi. In addition, I have directed observational studies of pathways to TB diagnosis in India and Vietnam, as well as the impact of body mass index on TB treatment monitoring in Indonesia. These studies have helped to advance understanding of where TB preventive therapy is likely to have greatest impact, and also the role of empiric treatment in determining the effectiveness of novel TB diagnostic testing.

   a. **Dowdy, D.W.,** Geng, E., Christopoulos, K.A., et al. (2011) Mortality among antiretroviral-eligible patients in an urban public clinic. J Acquir Immune Defic Syndr, 57(4), 297-300. PMC3159809.
   b. Theron, G. Zijenah, L, Chanda, D., Clowes P, Rachow A, Lesosky M, Bara W, Mungofa S, Pai M, Hoelscher M, **Dowdy D**, Pym A, Mwaba P, Mason P, Peter J, Dheda K; TB-NEAT team (2014) Feasibility, accuracy, and clinical effect of point-of-care Xpert MTB/RIF testing for tuberculosis in primary-care settings in Africa: a multicenter, randomized, controlled trial. Lancet, 383(9915), 424-435.
   c. Theron, G., Peter, J., **Dowdy, D.**, Langley, I., Squire, S.B., Dheda, K. (2014) Do high rates of empirical treatment undermine the potential effect of new diagnostic tests for tuberculosis in high-burden settings? Lancet Infect Dis, 9(13), 70360-70368.
   d. Putri, F.A., Burhan, E., Nawas, A., **Dowdy, D.W.** (2014) Body mass index predictive of sputum culture conversion among MDR-TB patients in Indonesia. Int J Tuberc Lung Dis, 18(5), 564-570.

Complete List of Published Work in MyBibliography:
http://www.ncbi.nlm.nih.gov/myncbi/browse/collection/42950951/?sort=date&direction=ascending

D. Research Support

Ongoing Research Support

NIH/NHLBI R01 HL138729 **(Dowdy)** **08/15/17-07/31/21**
A Comprehensive Snapshot of Tuberculosis Transmission in an Urban Ugandan Community
This study aims to find all cases of TB within an urban Ugandan slum and characterize both the transmission patterns and potential impact of alternative strategies to prevent TB transmission.
Role: PI

NIH/NINR R01 NR016650 **(Baral)** **01/01/17-12/31/21**
An Adaptive Randomized Evaluation of Nurse-Led HIV Treatment Retention Interventions for Women Living with HIV
We are conducting an adaptive randomized trial of interventions to retain female sex workers in HIV care in eastern South Africa characterize metrics of stigma for key populations and implement stigma-reduction
Role: Co-Investigator (health economist and mathematical modeler)

NIH/NIAID R01 AI116787 **(Dowdy)** **01/15/15-12/31/19**
Comparative Effectiveness/Implementation of TB Case Finding in Rural South Africa
This trial compares the effectiveness and implementation of three strategies for active TB case finding in rural South Africa: household contact tracing, incentive-based contact tracing, and facility-based screening.
Role: PI

[redacted] **(Dowdy)** **04/01/13-04/30/18**
[redacted]
Role: PI

NIH/NIAID R01 HL130192 **(Cattamanchi)** **01/01/16-12/31/20**
Single-Sample Tuberculosis Evaluation to Facilitate Linkage to Care: The SIMPLE TB Trial
We are conducting a randomized implementation trial of peripheral versus centralized TB diagnosis across multiple clinics in Uganda to evaluate whether rapid linkage to care improves patient outcomes.
Role: Co-Investigator

NIH/NIAID 1R01AI095041-01A1 **(Golub)** **07/01/11-05/31/18**
Quantiferon Gold Test for Detecting TB Infection in HIV/AIDS Patients in South Africa
This is a cluster randomized trial comparing the time to known latent TB status among HIV infected patients receiving QGIT or TST for detection of latent TB.
Role: Co-investigator, health economist, mathematical modeler

NIH/NIAID 1R01AI104824 - 01A1 **(Davis)** **04/01/13-03/30/18**
Mobile Health for Implementation of Home-Based TB Contact Investigation in Uganda
This research will investigate the implementation, effectiveness, cost-effectiveness, and epidemiological impact of a mobile health-based intervention for home-based contact investigation in Uganda.
Role: Subcontract PI, health economist

[redacted] **(White)** **04/01/13-04/30/18**
[redacted]
Role: Subcontract PI

[redacted] **(Gupta)** **06/23/13-09/27/18**
[redacted]
Role: Co-Investigator

NIH/NIDA R01 DA037440 **(Go)** **07/01/13-06/30/18**
An RCT to integrate MMT and HIV services for IDU in Vietnam
This is a cluster-randomized trial of integrated HIV care with methadone maintenance therapy (MMT) in Vietnam.
Role: Co-investigator, health economist

CDC T288330 **(Sullivan)** **10/01/14-09/30/19**
Enhancing Models of HIV, Viral Hepatitis, STIs, and Tuberculosis to Inform and Improve Public Health Impact
This is a five-year cooperative agreement with the CDC to improve their modeling capacity and enable more data-driven and transparent approaches to infectious disease control in the United States.
Role: Subcontract PI

NIH/NIAID R01 AI114458 **(Merritt)** **07/01/15-06/30/19**
Assessing Social Value in Economic Evaluation to Scale Up Novel TB Drug Regimens
This project is designed to develop an innovative methodology to incorporate norms of social value in traditional economic evaluation for the scale-up of new public health interventions including MDR-TB.
Role: Co-investigator

Completed Research Support

[redacted]
(Khan) **10/01/16-12/31/17**
[redacted]
Role: Subcontract PI

OMB No. 0925-0001 and 0925-0002 (Rev. 09/17 Approved Through 03/31/2020)

BIOGRAPHICAL SKETCH

Provide the following information for the Senior/key personnel and other significant contributors.
Follow this format for each person. **DO NOT EXCEED FIVE PAGES.**

NAME: Hay, Simon Iain

eRA COMMONS USER NAME (credential, e.g., agency login): [redacted]

POSITION TITLE: Professor of Global Health and Director of Geospatial Science, University of Washington

EDUCATION/TRAINING

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	Completion Date MM/YYYY	FIELD OF STUDY
University of Bristol, England	B.Sc.	06/1992	Zoology
University of Oxford, England	D.Phil	10/1996	Zoology
University of Oxford, England	M.A	06/2000	Zoology
University of Oxford, England	D.Sc.	07/2014	Epidemiology

A. PERSONAL STATEMENT

In April 2015, I joined the University of Washington as a Professor of Global Health and Director of Geospatial Science at the Institute for Health Metrics and Evaluation (IHME). Prior to joining IHME, I was a Professor of Epidemiology and Head of SEEG at the University of Oxford's Department of Zoology. In my current work, I investigate spatial and temporal aspects of infectious disease epidemiology to provide an improved evidence-base for rational disease control from local to global scales. I completed much of the development of my geospatial work under the umbrella of the Malaria Atlas Project (MAP), of which I am a co-founder. My recent research has focused on advancing this malaria work and extending its methods to HIV/AIDS, tuberculosis, and the infectious disease contributors to pneumonia and diarrhoea. Collectively, these diseases account for the majority of the avertable infectious disease morbidity and mortality worldwide.

I directly supervise Dr. Jennifer Ross in her modelling of TB and HIV at IHME and mentor her in career development. I will continue to serve as a mentor for her proposed K01 career development award. Currently, I supervise and mentor investigators at multiple stages of career progression, including four junior faculty members and five postdoctoral and clinical fellows.

B. Positions and Honors

Positions and Employment

1993-1996 Postgraduate Research Assistant, Department of Zoology, University of Oxford
1996-1999 Postdoctoral Research Officer, Department of Zoology, University of Oxford
1999-2008 Senior Research Fellow, Department of Zoology, University of Oxford
2008-2012 Reader of Infectious Disease Epidemiology, Department of Zoology, University of Oxford
2012-2015 Professor of Epidemiology, Department of Zoology, University of Oxford
2012-2015 Head of Spatial Ecology and Epidemiology Group, Department of Zoology, University of Oxford
2015- Professor of Global Health, University of Washington, Institute for Health Metrics and Evaluation
2015- Director, Geospatial Sciences, University of Washington, Inst. for Health Metrics and Evaluation

Other Experience and Professional Memberships (Selected)

2004- Member of the expert technical committees on malaria monitoring and evaluation, Roll Back Malaria partnership of the WHO
2008- Founding member of the Malaria Elimination Group (MEG) convened by the Global Health Group of University of California - San Francisco (UCSF) Global Health Sciences
2010- Information Technologies Task Force for the Roll Back Malaria Monitoring and Evaluation Reference Group

2012-	Member of the Dengue Antigenic Cartography Consortium
2013-	Research committee and finance committee of the Department of Zoology, University of Oxford
2013-2015	Elected as the 52nd President of the Royal Society of Tropical Medicine and Hygiene (2013-2015, elected to Board of Trustees in 2012)
2013-	Expert member of the WHO Writing Committee for the Global Strategic Plan on *Plasmodium vivax* malaria control and elimination
2013-	Chair of the executive board of the International Research Consortium on Dengue Risk Assessment, Management and Surveillance
2013-	The World Health Organization designated the Spatial Ecology and Epidemiology Group (SEEG) a WHO Collaborating Centre in Geospatial Disease Modelling (UNK-255)
2014	President and scientific committee chair for the Royal Society of Tropical Medicine and Hygiene biennial conference “Measuring Progress” attended by HRH the Princess Royal
2014-	Chair of the World Health Organization advisory group on dengue burden estimation and member, WHO Technical Working group (TWG) on Dengue
2014-	Chair and Secretariat Lead of the Malaria Modelling Consortium, Bill & Melinda Gates Fdn
2014-	Member of the Ebola Modelling Group (Department of Health, U.K.) convened to advise SAGE on epidemiological modeling
2014	Member of Scientific Advisory Group on Emergencies (SAGE), for Ebola (Department of Health, U.K.), convened to respond to commissions from COBR

Honors

1991-1993	Rose Bracher Memorial Prize, University of Bristol
1993-1996	Texas Instruments Computer Scholarship
1998-	Fellow by membership of the Royal Society of Tropical Medicine and Hygiene
2003	American Society for Photogrammetry and Remote Sensing Leica Geosystems Award
2006	Research Publication of the Year, Malaria Foundation International
2007-	Fellow by membership of the Royal Geographical Society
2008	Scientific Medal, Zoological Society of London
2012	The Back Award, Royal Geographical Society
2013	The Bailey K. Ashford Medal, American Society of Tropical Medicine and Hygiene
2013	Mathematical, Physical and Life Sciences (MPLS) Division, Impact Award, University of Oxford
2014-	Fellow by election of the Royal College of Physicians of Edinburgh
2014-	Fellow by election of the American Society of Tropical Medicine and Hygiene

C. CONTRIBUTION TO SCIENCE

I have over 300 publications including twelve in *Nature* and *Science*, eleven in *The Lancet* and fourteen in *PLoS Med*. These publications have been cited more than 6000 times per year, leading to an h-index of >89 and >30,500 lifetime citations on Google Scholar. A full list of publications is available at: https://www.ncbi.nlm.nih.gov/sites/myncbi/simon.hay.1/bibliography/53660887/public/?sort=date&direction=ascending

1. **Mapping the distribution, prevalence and disease burden of malaria**: Risk of malaria infection affects nearly half the world's population, and the World Health Organization (WHO) estimates that in 2010, the disease caused about 660,000 deaths. To provide accurate and detailed information about which regions of the world are the most affected by malaria, a significant portion of my research has centered on generating new and innovative methods to map the global distribution of malaria. Notably, in my role managing the Malaria Atlas Project (MAP), an international collaboration of researchers aiming to improve the cartography of malaria, I led the effort to develop a groundbreaking mapping approach combining epidemiological, geographical and demographic data and making use of advanced statistical techniques to help predict malaria distribution and overcome the limitations of partial reporting. In 2006, I received a **Research Publication of the Year** award from the Malaria Foundation International 2006 for Snow *et al.* (2005). *Nature*, 434: 214-217. This is the most cited paper in the last five years in the ISI subject category of parasitology. Other priority malaria-related projects are mapping the distribution of the main *Anopheles* mosquitoes that transmit the parasite and genetic disorders that attenuate human susceptibility or impact risk of side effects from treatments.

a. **Hay SI**, Okiro EA, Gething PW, Patil AP, Tatem AJ, Guerra CA, Snow RW. (2010) Estimating the global clinical burden of Plasmodium. *PLoS Med,* 7(6):e1000290. doi:10.1371/journal.pmed.1000290. PMCID: PMC2885984.

b. Gething, PW, Patil, AP, Smith, DL, Guerra, CA, Elyazar IRF, Johnston GL, Tatem AJ, **Hay SI**. (2011) A new world malaria map: *Plasmodium falciparum* endemicity in 2010. *Malaria Journal*, 10:378. PMCID: PMC3274487.

c. Howes RE, Piel FB, Patil AP, Nyangiri OA, Gething PW, Dewi M, Hogg MM, Battle KE, Padilla CD, Baird JK, **Hay SI**. (2012) G6PD deficiency prevalence and estimates of affected populations in malaria endemic countries: a geostatistical model-based map. *PLoS Med.,* 9(11):e1001339. PMCID: PMC3496665.

d. Gething PW, Elyazar IR, Moyes CL, Smith DL, Battle KE, Guerra CA…**Hay SI**. (2012) A long neglected world malaria map: *Plasmodium vivax* endemicity in 2010. *PLoS Negl Trop Dis*, 6(9):e1814. PMCID: PMC3435256.

2. **Mapping the distribution, prevalence and disease burden of dengue and chikungunya**: Along with my work to improve the cartography of malaria, my research has focused on modeling the risk and mapping the burden of dengue, and more recently, chikungunya. Dengue and chikungunya are increasing global public health concerns due to their rapid geographical spread and increasing disease burden. Knowledge of the contemporary distribution of their shared vectors, Aedes aegypti and Aedes albopictus remains incomplete and is complicated by an ongoing range expansion fuelled by increased global trade and travel. Mapping the global distribution of these vectors and the geographical determinants of their ranges is essential for public health planning. As the head of the Geospatial Group, I lead ongoing research intended to guide vaccine, drug, and vector control efforts. This includes assessing the potential levels of exposure in particular regions by examining distribution maps and its seasonal variation.

   a. Brady OJ, Gething PW, Bhatt S., Messina JP, Brownstein JS, Hoen AG, Moyes CL, Farlow AW, Scott TW, **Hay SI.** (2012) Refining the global spatial limits of dengue virus transmission by evidence-based consensus. *Public Library of Science Neglected Tropical Diseases*, 6(8): e1760. PMCID: PMC3413714.

   b. Bhatt S, Gething PW, Brady OJ, Messina JP, Farlow AW, Moyes CL, Drake JM, Brownstein JS, Hoen AG, Sankoh O, Myers MF, George DB, Jaenisch T, Wint GRW, Simmons CP, Scott TW, Farrar JJ, **Hay SI.** (2013) The global distribution and burden of dengue. *Nature*, 496(7446): 504-507. PMCID: PMC3651993.

   c. Brady OJ, Johansson MA, Guerra CA, Bhatt S, Golding N, Pigott DM, Delatte H, Grech MG, Leisnham PT, Maciel-de-Freitas R, Styer LM, Smith DL, Scott TW, Gething PW, **Hay SI**. (2014) Modelling adult Aedes aegypti and Aedes albopictus survival at different temperatures in laboratory and field settings. *Parasit Vectors,* 6:351. PMCID: PMC3867219.

   d. Kraemer MUG, Sinka ME, Duda KA, **Hay SI**. (2015) The global distribution of the arbovirus vectors Aedes aegypti and Ae. albopictus. *eLife,* 4:e08347. PMCID: PMC4493616

3. **Global climate and environmental change** is expected to significantly affect the growth of parasites that cause malaria, dengue and other vector-driven diseases. I have used similar techniques applied in my disease mapping and burden estimation research to explore the range of climate and environmental factors that are likely to impact disease burden, such as population growth, urbanization, temperature, precipitation, and deforestation. This work has enabled the ever-changing baseline of these diseases to be estimated and effective intervention strategies to be designed and evaluated.

   a. Guerra CA, Snow RW, **Hay SI**. (2006) A global assessment of closed forests, deforestation and malaria risk. *Annals of Tropical Medicine and Parasitology*, 100(3):189-204. PMCID: PMC3204444.
   b. Gething PW, Smith DL, Patil AP, Tatem AJ, Snow RW, **Hay SI**. (2010) Climate change and the global malaria recession. *Nature*, 465(7296):342-345. PMCID: PMC2885436.
   c. Tatem AJ, Gething PW, Smith DL, **Hay SI**. (2013) Urbanization and the global malaria recession. *Malar J.* 2013 Apr 17;12:133. doi: 10.1186/1475-2875-12-133. PMCID: PMC3639825.
   d. Messina, JP, Kraemer, MUG, Brady, OJ, **Hay, SI** (2016). Mapping global environmental suitability for Zika virus. *eLife,* 5: e15272. doi: 10.7554/eLife.15272. PMCID: PMC4889326.

4. **Big data sciences:** In my work toward disease burden and risk mapping, I exploit novel big data sources, approaches, and technologies to improve the evidence base for more rational implementation of disease control. Much of my work has entailed the collation of large, heterogeneous datasets covering the entire time

and geographical range of a disease or disease vector, and the processing and analysis of such datasets. I am currently working toward leveraging the opportunities of and addressing the challenges of big data sources to map and update in real-time disease risk and occurrence. Methods that are utilized in these studies include application of time-series analysis, spatial analysis, remote sensing and satellite sensors, and leveraging geographical information systems to generate consistent, reliable, and timely information. The volume, velocity, and variety of occurrence information from these sources will increase rapidly and transform our ability to create geographical baselines for a range of diseases. Importantly, I have also been developing tools and software that makes the modelled data outputs available in a range of formats, including image files and GIS surface files, for use in advocacy, education, and further research and to help parameterize or validate other mathematical models.

a. Patil AP, Gething PW, Piel FB, **Hay SI**. (2011) Bayesian geostatistics in health cartography: the perspective of malaria. *Trends Parasitol,* 27(6):246-53. doi: 10.1016/j.pt.2011.01.003. PMCID: PMC3109552.
b. Weiss DJ, Atkinson PM, Bhatt S, Mappin B, **Hay SI**. (2014) An effective approach for gap-filling continental scale remotely sensed time-series. *ISPRS Journal of Photogrammetry and Remote Sens*, 98:106-118. PMCID: PMC4308023.
c. **Hay SI**, George DB, Moyes CL, Brownstein JS. (2013) Big data opportunities for global infectious disease surveillance. *Public Library of Science Medicine*, 10(4): e1001413. PMCID: PMC3614505.
d. Moyes CL, Temperley WH, Henry AJ, Burgert CR, **Hay SI.** (2013) Providing open access data online to advance malaria research and control. *Malar J*, 12:161. doi: 10.1186/1475-2875-12-161. PMCID: PMC3662599.

D. RESEARCH SUPPORT

Ongoing Research Support (Selected)

[redacted] **Hay/Murray (co-PIs)** **10/1/2015 – 09/30/2020**

Role: Co-Principal Investigator

[redacted] **Hay (PI)** **10/1/2013 – 06/30/2018**

Role: Principal Investigator

[redacted] **Smith (PI)** **09/1/2014 – 11/30/2019**

Role: Collaborator

[redacted] **Gething (PI)** **2014 – 2018**

Role: Co-Investigator

[redacted] **Hay (PI)** **10/01/2017 – 12/31/2021**

Role: Principal Investigator

Completed Research Support (Selected)

[redacted] **Murray (PI)** **2007 – 2017**

Role: Co-Investigator

[redacted] **Hay (PI)** **2014 – 2017**

Role: Principal Investigator

[redacted] **Hay (PI)** **2014 – 2016**

Role: Principal Investigator

[redacted] **Hay (PI) 2011 – 2016**

Role: Principal Investigator

[redacted] **2011 – 2016**

Role: Chair of the consortium Executive Board, Lead of Work Package Four

[redacted] **Hay (PI)** **2012 – 2016**

Role: Principal Investigator

[redacted] **Hay (PI)** **2013 – 2014**

Role: Principal Investigator

[redacted] **Hay (PI)** **2010 – 2014**

Role: Principal Investigator

OMB No. 0925-0001 and 0925-0002 (Rev. 10/15 Approved Through 10/31/2018)

BIOGRAPHICAL SKETCH

Provide the following information for the Senior/key personnel and other significant contributors.
Follow this format for each person. **DO NOT EXCEED FIVE PAGES.**

NAME: **Wasserheit, Judith N.**

eRA COMMONS USER NAME (credential, e.g., agency login): [redacted]

POSITION TITLE: William H. Foege Chair, Dept of Global Health, Professor of Global Health, Medicine; Adjunct Professor of Epidemiology, University of Washington, Affiliate Investigator, Program in Infectious Diseases, Fred Hutchinson Cancer Research Center

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable. Add/delete rows as necessary.)*

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	Completion Date MM/YYYY	FIELD OF STUDY
Princeton University, Princeton, NJ	B.A.	1974	Biochemistry/Slavic languages
Harvard Medical School, Boston, MA	M.D.	1978	Medicine
Johns Hopkins University, Baltimore, MD	M.P.H.	1989	Public Health

A. Personal Statement

I am pleased to serve as a mentor focusing on implementation science for Dr. Jennifer Ross's K01 career development award. As Professor and Chair of Global Health and Professor of Medicine at the University of Washington, I have played a central role in building innovative, interdisciplinary curricular programs and infrastructure across the Schools of Medicine and Public Health as well as with our international partners. My experience in HIV/STI research, training, and program/policy development in the context of the reproductive health of women and girls provide a strong foundation for my contributions to this research program. As Director of CDC's Division of STD/HIV Prevention (subsequently STD Prevention), I led the development and implementation of large scale STI/HIV prevention programs and national STI/HIV policy including research on and enhanced programs for partner services. As co-director of UW's first graduate course in Implementation Science, and a member of the team that developed UW's PhD program in Global Health Metrics and Implementation Science – the first and, to date, only such doctoral program in the world, I have been directly involved with relevant training programs. I have served as a research mentor to numerous trainees, and am pleased to continue my mentoring relationship with Dr. Ross in this role.

B. Positions and Honors

Positions and Employment

1978-80 Columbia Presbyterian Medical Center; New York, NY Medical Intern & Surgical Intern
1980-82 Emory University Hospitals; Atlanta, Georgia, Medical Junior & Senior Resident
1982-84 University of Washington; Seattle, Washington, Research Fellow, Infectious Diseases
1982-84 Co-developer & co-director Southeast Asian Refugee Clinic, Harborview Medical Center, Univ. of Washington
1984-86 Infectious Disease Research Physician, International Centre for Diarrhoeal Disease Research, Bangladesh (ICDDR,B)
1986-89 Assistant Professor, Dept. of Medicine, Division of Infectious Diseases, Johns Hopkins University
1986-89 Faculty, STD Training Center, Baltimore, Maryland
1986-89 Assistant Chief, STD Clinical Services, Baltimore City Health Department (BCHD); Medical Director, Druid STD Clinic, BCHD
1989-92 Chief, Sexually Transmitted Diseases Branch (newly established) Allergy & Infectious, NIAID, NIH
1992-95 Director, Division of STD/HIV Prevention, National Center for Prevention Services, CDC
1995-01 Director, Division of STD Prevention, National Center for HIV, STD & TB Prevention, CDC

2001-pres. Member, Clinical Research Division, Program in Infectious Diseases, Fred Hutchinson Cancer Research Center, Seattle, WA
2001-pres. Professor of Medicine, Division of Allergy & Infectious Diseases, University of Washington
2001-2006 Director, HIV Vaccine Trials Network, Fred Hutchinson Cancer Research Center, Seattle, WA
2007-pres. Professor of Global Health & Medicine; University of Washington
2007-2014 Vice Chair, Dept. of Global Health, University of Washington
2014-pres. William H. Foege Chair, Department of Global Health, University of Washington

Other Experience and Professional Memberships

1991 WHO Working Group on Sexually Transmitted Diseases, Research Priorities (Vice-Chairman)
1991-1994 International Center for Research on Women, Women & AIDS Programme, Technical Advisory Group
1991-1994 American Venereal Diseases Association, Executive Board
1991-1997 International Society for STD Research, Board
1992-1996 STD Diagnostics Initiative, Steering Committee
Feb. 1993 WHO, Informal Technical Working Group on STD Activities in the Global Programme on AIDS (Chairperson)
1994-1997 National Academy of Sciences' Panel on Reproductive Health (Co-Chair)
1997-1999 American Public Health Association, Program Development Board
1997-pres. Editorial Board, Sexually Transmitted Diseases
1996-1998 UNAIDS Steering Committee on STD Diagnostics Development & Research
1998-2000 Horizons Project (global operational HIV/AIDS research), Technical Advisory Group
Oct 1998 UNAIDS/WHO Consultation on STD Interventions for Preventing HIV: What is the Evidence? (Co-chair)
2000–2008 National Institute of Mental Health (NIMH) DSMB for Collaborative HIV/STD Prevention Trial
2003-2006 NIAID Partnership in AIDS Vaccine Evaluation - Chair, Site Development Working Group
Global HIV Vaccine Enterprise
2003 Chair, Clinical Trials Capacity Working Group
2002-pres. Center for AIDS Research, Socio-behavioral & Prevention Research Core Steering Committee
2002-pres. Consultant for Mathematical Modeling for HIV/STD Research Program
2003-pres. NIAID Partnership in AIDS Vaccine Evaluation; Chair, Site Development Working Group
2003-pres. Global HIV Vaccine Enterprise; Chair, Clinical Trials Capacity Working Group
2003-2006 HIV Vaccine Trials Network Safety Monitoring Board
2004-pres. Columbia University Center for AIDS Research (CU-CFAR) External Advisory Committee Member
2005-2009 Seattle Vaccine Research Fund Board Member
2008 Washington Global Health Alliance Executive Committee Member
2008-pres. Consortium of Universities for Global Health,
Founding Member, Board of Directors, 2008
Board of Directors, Secretary/Treasurer, 2009-2012
Chair, Board of Directors, 2012-2014; Member 2008-present
2013 Member, American Epidemiological Society

Honors

1974 B.A., Cum Laude Princeton University
1974 Phi Beta Kappa Princeton University
1974 Sigma Xi Princeton University
1978 Louise B. Carr Prize, Harvard Medical School
1990 Special Achievement Award, Public Health Service
1991 Special Recognition Award Public Health Service
1991 Young Professional Award, Maternal-Child Health, American Public Health Ass'n
1993 Public Health Leadership Institute Scholar, Centers for Disease Control & Prevention, Univ. of California
1996 Presidential Meritorious Rank Award Department of Health and Human Services
1997 Edward E. Kass Award Lecture in Infectious Disease History, Infectious Diseases Society of America
1997 ASTDA Achievement Award, American STD Association

2002 ASHA Presidential Award for Outstanding Work in STD Research, American Social Health Association
2006 Member, Institute of Medicine, National Academy of Sciences
2007 Paul G. Rogers Society Global Health Research Ambassador
2009 Heath Clark Endowed Lectureship, London School of Hygiene & Tropical Medicine
2013 Profile, Global Health Leadership, Lancet 2014; Vol 384, Sep, 13, 2014:947
2015 Johns Hopkins University Society of Scholars
2015 Top 300 Women Leaders in Global Health, Global Health Programme, Graduate Institute of International and Development Studies, Twitter campaign

C. Contributions to Science

1. **Epidemiological synergy between HIV and other infections** –Sexually transmitted HIV epidemics exhibit strikingly different patterns around the globe. Understanding the contribution of modifiable risk factors such as coinfections is critical to development of effective HIV prevention programs and policies. My research in this area began with an examination of the interactions between HIV and other STIs. These analyses identified potentially explosive, mutually reinforcing effects for several STIs and led to the concept of epidemiological synergy between HIV and other STIs, which informed HIV and STI program design in a number of countries. Subsequently, my colleagues and I extended this work to explore the interactions between HIV and other infections, including malaria, TB and, most recently, HCV infection. I served as primary or co-investigator on each of these analyses.
   a. **Wasserheit JN:** Epidemiological synergy: Interrelationships between HIV infection and other STDs. In: Chen L, Sepulveda J, Segal S, eds. *AIDS and Women's Health: Science for Policy and Action*. New York, Plenum Press, 1991, pp 47-72. (Reprinted in Sex Transm Dis, 19:61-77, 1992.)
   b. Barnabas RV, Webb EL, Weiss HA, **Wasserheit JN.** The role of coinfections in HIV epidemic trajectory and positive prevention: a systematic review and meta-analysis. AIDS 2011 Aug 24;25(13):1559-73. PMCID: 3151007.
   c. Abu-Raddad LJ, Barnabas RV, Janes H, Kublin J, Longini IG, Weiss H, **Wasserheit JN** and the HIV Viral Load Working Group. Have the explosive HIV epidemics in sub-Saharan Africa been driven by higher community viral load? AIDS 2013, 27:981-989. PMCID: 3725236.
   d. Petersdorf N*, Ross JM*, Weiss HA, Barnabas RV, **Wasserheit JN**. Systematic review and meta-analysis of HCV infection and HIV viral load: new insights into epidemiologic synergy. *Journal of the International AIDS Society*. 19**:**20944, 2016 19 Sep. PMCID: 5030209.
      *Joint first authors

2. **Prevention and control of sexually transmitted infections (STIs), including HIV, and their impact on the reproductive health of women, particularly in low and middle income countries (LMICs)** – Until recently, in many LMICs there has been limited appreciation of the burden of disease and reproductive morbidity associated with STIs and other reproductive tract infections (RTIs) in women. I spent two years in Bangladesh leading the first population-based study of the epidemiology of STIs, HIV infection and other RTIs in the Indian Subcontinent, and examining the impact of these infections on contraceptive practices. This work was subsequently extended to Egypt and Indonesia, and then to sub-Saharan Africa. The studies revealed that there is a high prevalence of non-HIV STIs and other RTIs in many groups of women living in LIMCs. These women often have very limited access to STI/RTI services, resulting in serious reproductive sequelae. Furthermore, they may attribute their genital tract symptoms to contraceptives, prompting method discontinuation. These studies helped policy makers and program managers understand the urgent need for STI/RTI risk reduction counseling, screening and treatment services, and, together with systematic reviews of STI/HIV interventions, helped redefine national program priorities. I served as primary or co-investigator on each of these studies.
   a. **Wasserheit JN**, Harris JR, Chakraborty J, Kay B, Mason KJ: Reproductive tract infections in a family planning population in rural Bangladesh. Studies in Family Planning 1989. Mar-Apr;20(2):69-80.
   b. **Wasserheit JN**: The significance and scope of reproductive tract infections among Third World women. Internatl J Obstet Gynec 1989; 3:145-68.
   c. Padian NS, McCoy SL, Balkus JE**, Wasserheit, JN.** Weighing the Gold in the Gold Standard: Challenges in HIV Prevention Research. AIDS 2010 Mar 13;24(5):621-35. PMCID: 3695696.
   d. Wetmore CM, Manhart LE**, Wasserheit JN.** Randomized Controlled Trials of Interventions to Prevent

Sexually Transmitted Infections: Learning from the Past to Plan for the Future. Epidemiologic Reviews 2010 Apr;32(1):121-36. PMCID: 2912604.

3. **Epidemiology and microbial etiologies of pelvic inflammatory disease (PID)** – My initial research focus was on PID because of its critical role in infertility and potentially fatal ectopic pregnancy. These studies included one of the first laparoscopic evaluations of the microbiology and histopathology of endometritis and salpingitis conducted in the United States. They demonstrated that poly-microbial flora was frequently present, and that minimally symptomatic chlamydial infection was commonly associated with upper tract inflammation. Subsequent studies helped define socio-behavioral correlates of PID risk and health system correlates of risk of sequelae such as infertility. This research contributed to the development of CDC's PID treatment guidelines and the launch of this nation's national Chlamydia and Infertility Prevention Program. I served as primary or co-investigator on each of these studies.
   a. **Wasserheit JN,** Bell TA, Kiviat NB, Wolner-Hanssen P, Zabriskie V, Kirby BD, Prince E, Holmes KK, Stamm WE, Eschenbach DA**:** Microbial causes of proven pelvic inflammatory disease and efficacy of clindamycin and tobramycin. Ann Intern Med 104:187-93, 1986.
   b. Washington AE, Cates W, Jr, **Wasserheit JN**: Preventing pelvic inflammatory disease. JAMA. 1991 Nov 13;266(18):2574-80.
   c. Hillis SD, Joesoef R, Marchbanks PA, **Wasserheit JN**, Cates W, Westrom L: Delayed care of pelvic inflammatory disease as a risk factor for impaired fertility. Am J Obstet Gynecol, 1993 May;168(5):1503-9.
   d. Aral SO, **Wasserheit JN**: Social and behavioral correlates of pelvic inflammatory disease (PID). Sex Transm Dis. 1998; 25:378-85.

4. **Implementation and scale-up of phase-specific strategies for STI and HIV epidemics** -- The design, implementation and scale-up of effective evidence-based interventions for STI prevention and control has traditionally been guided by episodic analyses of local STI epidemiology. This work suggested that the subpopulation distribution of STI epidemics changes in predictable ways over time, shaped by both biological and behavioral factors, and that the subpopulation distribution offers a useful way to define STI epidemic phase which, in turn, is a key consideration in the design of effective STI prevention and control programs. The analyses were both stimulated by and informed CDC's development of the United States' Chlamydia and Infertility Prevention Program and Syphilis Elimination Program. I served as primary or co-investigator on each of these analyses.
   a. **Wasserheit JN,** Aral SO**:** The dynamic topology of STD epidemics: Implications for STD prevention strategies. J Infect Dis 1996 Oct; 174 Suppl 2:S201-13.
   b. Gunn RA, Rolfs RT, Greenspan JR, Seidman RL, **Wasserheit JN**: The changing paradigm of sexually transmitted disease prevention and control: Expanding from a clinic-based to a community-wide, population-oriented approach. JAMA 1998 Mar 4;279(9):680-4
   c. St. Louis ME, **Wasserheit JN**: Elimination of syphilis in the United States. Science 1998 Jul 17;281(5375):353-4.
   d. Aral SO, Blanchard J, Brunham R, Moses S, **Wasserheit JN, eds.** Phase Specific Strategies for the Prevention, Control, and Elimination of Sexually Transmitted Diseases. Sexually Transmitted Infections, 2002;78 (Suppl 1).

Complete List of Published Work in MyBibliography:
http://www.ncbi.nlm.nih.gov/sites/myncbi/12iatNpko-b5L/bibliography/48266577/public/?sort=date&direction=ascending

D. Research Support

Ongoing Research Support

NIH P30 AI027757-26 (PI: King Holmes; Project PI: Kenneth Sherr) 06/01/13 - 05/31/18
University of Washington Center for AIDS Research
Project: Implementation Science Scientific Working Group
Project Goals: The aim of the Implementation Science Scientific Working Group is to improve the speed, efficiency and quality of translation of scientific evidence on HIV & STI prevention and care into effective, large scale health programs. It will leverage local and international multidisciplinary expertise to develop innovative

models for implementing and scaling-up efficacious HIV and STI interventions, and apply rigorous methods to study develop a base of evidence to guide scale-up.
Role: Co-investigator

[redacted] **08/01/15 – 07/31/20**
NIH/Fogarty (Subaward PI: Carey Farquhar)
[redacted]
Role: Co-investigator

[redacted]
(PI: Judd Walson) 10/13/16-9/30/21
[redacted]
Role: Course co-director

Completed Research Support

NIH 1R24TW008907-01 (PI: James N Kiarie, MD) 09/27/10 - 2/29/16
Programmatic-Strengthening Medical Education for Improved Health Outcomes in Kenya
Sub-contract: MEPI-Programmatic (Consortium PI: Carey Farquhar, MD, MPH)

NIH 1R24TW008889-01 (PI: James N Kiarie, MD) 09/27/10 - 2/29/16
Linked-Strengthening Maternal, Newborn & Child Health Research Training in Kenya
Sub-contract: MEPI-Linked (UW Consortium PI: Grace John-Stewart, MD, MPH, PhD)

NIH/NIAID 5T32AI007044 (Wesley C. Van Voorhis, PI) 07/01/11 - 06/30/17
Host Defense Training in Allergy and Infectious Diseases
Program Goals: Develop leaders (post-doctoral fellows) in infectious disease research, either laboratory-based research or epidemiological research.
Role: Mentor

HRSA: U91HA06801B (PI, King Holmes; sub-award PI, Farquhar, Carey) 07/01/12 - 06/30/17
International AIDS Education and Training Center (ITECH): Afya-Bora Consortium Fellowship in Global Health Leadership
Project Goals: The Afya Bora Consortium Fellowship provides training for African and U.S. Health professionals to lead and manage major health programs in their own countries. The program will develop a sustainable training program owned by the South-South Consortium which will improve delivery of health-related services and may counter emigration of African health professionals.
Role: Co-investigator

[redacted] **(PI: Judith Wasserheit) 07/01/15 - 6/30/17**
[redacted]
Role: Principal Investigator

OTHER SUPPORT
Barnabas, RV

ACTIVE

[redacted] 08/17/15-08/31/20
$[redacted]

P30 AI027757 (Holmes) 03/01/97-05/31/18
NIH/ NIAID $[redacted]
***International Core University of Washington Center for AIDS Research**
Dr. John-Stewart is the Director of the International Core. The UW CFAR International Core supports, facilitates and coordinates research on HIV/AIDS by University of Washington faculty in developing countries by providing research mentorship, logistical, operational and infrastructure support as well as small pilot grants.

[redacted] 01/01/15-12/31/18
$[redacted]

[redacted] 07/20/15-07/17/20
$[redacted]

U01 CA199334 (Kim, JJ) 09/09/15-08/31/20
NCI $[redacted] (UW subcontract)
Comparative modeling to inform cervical cancer control policies
The major goal of this subaward is to oversee the transmission modeling for high-risk groups being performed at the University of Washington, specifically focusing on the potential impact of cervical cancer screening and prevention intervention on cervical cancer incidence among high-risk women and evaluating novel interventions.

R01 AI125498 (Multi-PI, Baeten, John-Stewart) 04/01/16-03/31/21
NIH/NIAID $[redacted]
Delivering PrEP in Pregnancy
In this study we aim to compare two models of PrEP delivery in pregnant women – universal PrEP (offered to all women, women self-select) or targeted PrEP (partner HIV saliva self-test to provide partner HIV status data that is combined with risk score for PrEP offer decision).

R21MH110026 (Barnabas, R., van Rooyen, H.) 08/01/16 - 07/31/18
NIH/NIMH $[redacted]
Do lottery incentive strategies increase engagement in HIV care and uptake of antiretroviral therapy among South African men?
The major goal of this project is to adapt and strengthen innovative and high-yield conditional incentive lottery strategies to engage this hard to reach population, HIV positive South African men, in HIV care and ART.

R01 MH095507 (Baeten) 08/14/16-04/30/21
NIH/NIMH $[redacted]

Delivery of integrated PrEP and ART for HIV prevention for couples in Kenya
The main goal of this project is to extend the prior work by conducting a stepped-wedge trial evaluate roll-out of this strategy in public health clinics in Kenya, where policy support for implementing HIV-1 prevention for couples is high.

R21AI122867-01A1 (Barnabas, R.) 07/01/16-06/30/18
NIH/NIAID $[redacted]
Association between schistosomiasis and HIV-1 acquisition, transmission and disease progression in Africa
The major goal of this project is to find a strong association between schistosomiasis and HIV transmission, acquisition, or diseases progression, an additional benefit of mass treatment of schistosomiasis would be safe and cost-effective prevention of HIV.

S-LMAQM-16-CA-1103 (John-Stewart) 10/01/16-9/30/18
[redacted]

R01 MH109309 (Multi-PI, Haberer, Baeten) 12/01/15-11/30/19
NIH/NIMH $[redacted] (Subcontract)
Next generation real-time monitoring for PrEP adherence in young Kenyan women
We propose to use the next-generation Wisepill to explore the combination of real-time adherence monitoring with real-time adherence feedback, triangulated with real-time assessment of HIV-related behaviors.

1R01MH113435-01 (Sherr) 04/01/17-03/31/22
NIH $[redacted]
Scaling up the systems analysis and improvement approach for prevention of mother-to-child HIV transmission in Mozambique (SAIA-SCALE)
This proposal scales-up a health systems intervention (the systems analysis and improvement approach - SAIA) that packages systems engineering methods (including cascade analysis, flow mapping, and continuous quality improvement) and was previously shown to be effective in improving the prevention of mother-to-child HIV transmission cascade.

U19 MH113191 (MPIs: Petersen, Rao, Bhana) 07/01/17-06/30/22
NIMH $[redacted] (subaward)
Southern Africa Research Collaboration for Mental Health Integration
This project aims to conduct and train in implementation science research on the scale up of an integrated care intervention in the context of HIV in South Africa.

1R01AI134130-01 (PI, Carey Farquhar) 07/01/17-06/30/22
NIH/NIAID $[redacted]
Implementing Assisted Partner Services to HIV Test and Treat Men in Western Kenya
It is estimated that >50% of HIV-infected Kenyans are unaware of their status and men are significantly less likely to test and link to care than women. This proposal addresses low uptake of HIV testing and poor linkage to care and treatment services among men in sub-Saharan Africa. The overarching goal is to demonstrate using implementation science methods that assisted partner services (aPS) is a safe and effective strategy to increase the proportion of men living with HIV who know their serostatus and that aPS will improve male engagement in HIV treatment programs.

OPP1152764 (El Sadr) 07/20/17-06/30/18

[redacted] $[redacted] (subaward)

[redacted]

1R34 DA045620 (Stekler) 07/01/17-06/30/20
NIH $[redacted]
Interventions to Improve the HIV PrEP Cascade among Methamphetamine Users
This project proposes to develop two interventions, text messaging and peer navigation, with potential to improve PrEP adherence and persistence among methamphetamine-using MSM and trans.

R01 MH110296 (Heffron) 09/01/16-06/30/21
NIH/NICHD $[redacted]
Integrated PrEP and ART Delivered in Ugandan Public Health Clinics to Improve HIV and ART Outcomes for HIV Serodiscordant Couples
Using a stepped wedge design, we will rollout PrEP integrated with ART provision among Ugandan HIV serodiscordant couples in public health clinics around Kampala, Uganda, with concurrent attention to behavioral counseling and costing components. Results will provide compelling data to inform the widespread delivery of this intervention as a component of Ugandan national HIV prevention policy.

R01 MH114629 (co-PIs: J Baeten, K Ngure) 07/01/17-06/30/20
NIH/NIMH $[redacted]
HIV-1 self-testing to improve the efficiency of PrEP delivery
We propose to use HIV-1 self-testing to reduce the frequency of clinic visits for persons taking PrEP, and we will evaluate the effectiveness and safety of our approach using a randomized, non-inferiority trial among HIV-1 serodiscordant couples initiating PrEP in Kenya

1R01MH114648 – 01 (Medina-Marino) 07/01/17-06/30/22
NIH $[redacted] (subaward)
The Community PrEP Study
The proposed study leverages existing community-based HIV counseling and testing platforms in South Africa and evaluates, using a mixed methods approach, a community-based prevention-effective PrEP adherence program in AGYW whilst optimizing the PrEP cascade.

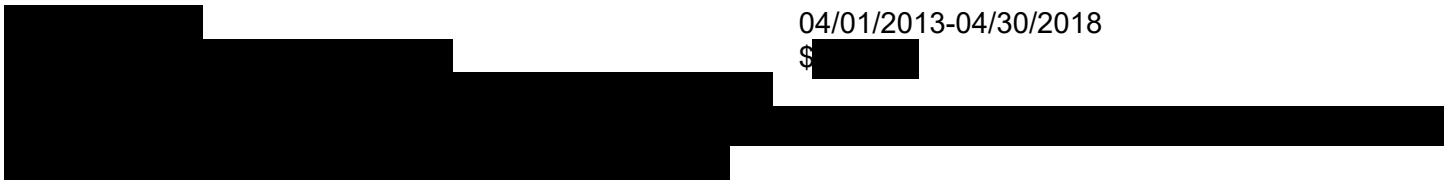
[redacted] 07/19/17-08/31/18
$[redacted]

PENDING
1 R21 MH115770-01A1 (Barnabas, Heerden) 07/01/18-06/30/20
NIH/NIMH $[redacted]
Leveraging routing science to optimize ART delivery for efficient scale-up, high ART coverage, and viral suppression in South Africa
Working closely with Amazon, we propose to develop and test a software application (Deliver Health) that uses spatial GPS data on where HIV-positive clients live, distance from mobile van potential locations, street maps, and client needs and preferences to inform an objective delivery algorithm.

P30 AI027757 (Baeten) 09/30/88 – 05/31/23
NIH/NIAID [redacted]
University of Washington / Fred Hutch Center for AIDS Research
The UW/FH Center for AIDS Research fosters collaborative and interdisciplinary research, supports HIV research career development of young investigators, and serves HIV investigators at our affiliated institutions.

OTHER SUPPORT
Dowdy, David

ACTIVE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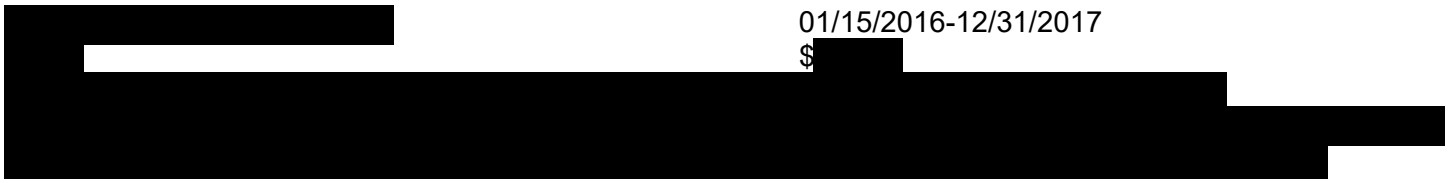
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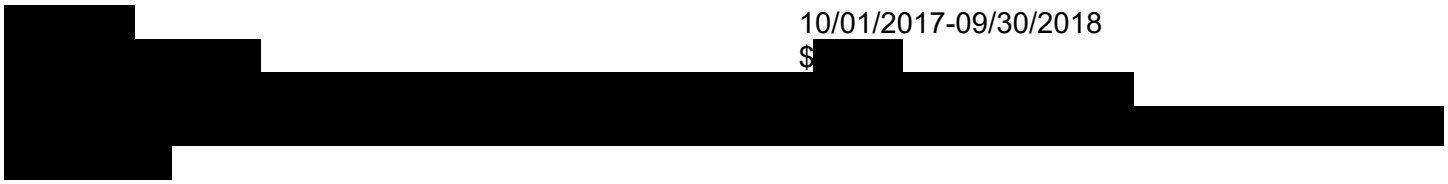
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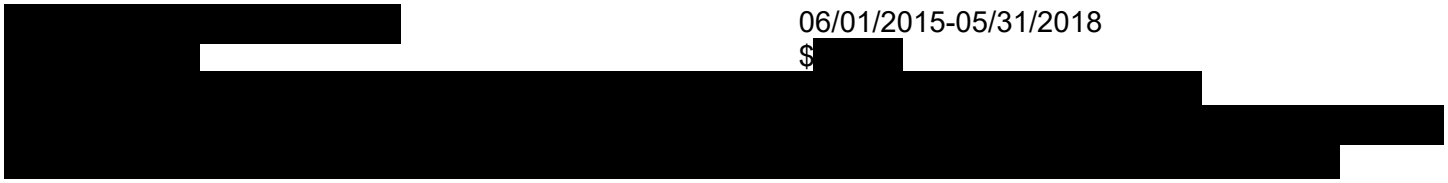
06/01/2015-05/31/2018
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10/01/2014-05/02/2018
$

R01HL138728 08/15/2017-07/31/2021
NIH/NHLBI $
A Comprehensive Snapshot of Tuberculosis Transmission in an Urban Ugandan Community
This study aims to find all cases of TB within an urban Ugandan slum and characterize both the transmission patterns and potential impact of alternative strategies to prevent TB transmission.

R01NR016650 (Baral) 09/26/2016-06/30/2021
NIH/NINR $
An Adaptive Randomized Evaluation of Nurse-Led HIV Treatment Retention
This trial will use adaptive implementation strategies tested through a sequential multiple assignment randomized trial (SMART) to assess interventions aimed at increasing sustained viral suppression among female sex workers living with HIV in Durban, South Africa. We will leverage an adaptive implementation strategy to characterize who needs the most intensive interventions to achieve sustained viral suppression amongst a population of women with the highest HIV burden, the most at risk of HIV transmission, and the most marginalized in social and health systems.

[redacted] 01/01/2014-05/31/2018
$[redacted]

[redacted] 03/23/2015-03/31/2018
$[redacted]

R01AI095041 (Golub) 06/25/2013-05/31/2018
NIH/NIAID $[redacted]
Quantiferon Gold Test for Detecting TB Infection in HIV/AIDS Patients in Brazil
Despite the fact that preventive therapy is effective in preventing tuberculosis in HIV-infected patients, TB is the most common cause of death among HIV-infected patients worldwide. The purpose of this project is to study whether a new blood assay for detecting latent TB infection can be linked with routine CD4 blood draw in an operational setting and shown to be more effective at diagnosing latent TB infection and initiating preventive therapy more quickly in these high risk patients.

R01AI114458 (Merritt) 07/01/2015-06/30/2019
NIH/NIAID $[redacted]
Assessing Social justice in Economic Evaluation to Scale up Novel MDR-TB Regimen
To provide a valuable new tool to support ethical responsibility in deciding whether and how to offer new drug treatments to populations of patients living with Multi-Drug-Resistant Tuberculosis (MDR-TB) in specific countries or areas.

R01AI116787(Dowdy) 01/15/2015-12/31/2019
NIH/NIAID $[redacted]
Comparative Effectiveness/Implementation of TB Case Finding in Rural South Africa
This trial compares the effectiveness and implementation of three strategies for active tuberculosis case finding in a rural African setting: household contact tracing, incentive-based contact tracing, and facility-based screening. We aim to demonstrate which of these strategies finds the most cases and does so in the most cost-effective fashion.

[redacted] 06/23/2013-09/27/2018
$[redacted]

PENDING

[redacted] 07/01/2017-06/30/2022
$[redacted]

[redacted] 11/01/2017-10/30/2022

This is a trial of decentralized TB testing versus bundled training of mid-level healthcare staff to evaluate the optimal way to improve TB case finding in clinics across Uganda.

OTHER SUPPORT
Hay, Simon

ACTIVE

[redacted] 10/01/15 – 09/30/20
$[redacted]

[redacted] 10/01/13 – 06/30/18
$[redacted]

[redacted] 09/01/17 – 12/31/20
$[redacted]

[redacted] (Lim) 11/012017 – 12/2021
$[redacted]

PENDING

None.

OTHER SUPPORT
Wasserheit, Judith N.

ACTIVE

D43 TW010141-01 (PI: Dalton Wamalwa) 8/1/2015-7/31/2020
Source: NIH/Fogarty $[redacted] (Sub-award)
Project Title: Partnership for Health Research Training in Kenya
Project Goals: This training program will train junior faculty from the University of Nairobi, Kenyatta University and Maseno University in research skills, mentored research and mentored grant writing to build a pool of scientists able to address Kenya's health challenges in HIV/AIDS, Maternal Newborn and Child Health and Mental Health.

2P30AI027757-27 (PI: Jared Baeten) 06/01/2013-5/31/2018
Source: NIH Total Direct Costs: $[redacted]
Project Title: University of Washington Center for AIDS Research
Implementation Science Scientific Working Group
Project Goals: The aim of the Implementation Science Scientific Working Group is to improve the speed, efficiency and quality of translation of scientific evidence on HIV & STI prevention and care into effective, large scale health programs. It will leverage local and international multidisciplinary expertise to develop innovative models for implementing and scaling-up efficacious HIV and STI interventions, and apply rigorous methods to study develop a base of evidence to guide scale-up.

PENDING

None.

OMB Number: 4040-0001
Expiration Date: 10/31/2019

RESEARCH & RELATED BUDGET - SECTION A & B, Budget Period 1

ORGANIZATIONAL DUNS*: [redacted]

Budget Type*: ● Project ❍ Subaward/Consortium

Enter name of Organization: UNIVERSITY OF WASHINGTON

Start Date*: 09-01-2018 **End Date*:** 08-31-2019 **Budget Period: 1**

A. Senior/Key Person

	Prefix	First Name*	Middle Name	Last Name*	Suffix	Project Role*	Base Salary ($)	Calendar Months	Academic Months	Summer Months	Requested Salary ($)*	Fringe Benefits ($)*	Funds Requested ($)*
1 .		Jennifer		Ross		PD/PI	[redacted]	9.0			[redacted]	[redacted]	[redacted]

Total Funds Requested for all Senior Key Persons in the attached file

Additional Senior Key Persons: File Name:

Total Senior/Key Person [redacted]

B. Other Personnel

Number of Personnel*	Project Role*	Calendar Months	Academic Months	Summer Months	Requested Salary ($)*	Fringe Benefits*	Funds Requested ($)*
	Post Doctoral Associates						
	Graduate Students						
	Undergraduate Students						
	Secretarial/Clerical						
1	Programmer	1.92			[redacted]	[redacted]	[redacted]
1	**Total Number Other Personnel**					**Total Other Personnel**	[redacted]
						Total Salary, Wages and Fringe Benefits (A+B)	[redacted]

RESEARCH & RELATED Budget {A-B} (Funds Requested)

Funding Opportunity Number: PA-18-369 . Received Date: 2018-05-04T16:42:25.000-04:00

RESEARCH & RELATED BUDGET - SECTION C, D, & E, Budget Period 1

ORGANIZATIONAL DUNS*: [redacted]

Budget Type*: ● Project ❍ Subaward/Consortium

Organization: UNIVERSITY OF WASHINGTON

Start Date*: 09-01-2018 **End Date*:** 08-31-2019 **Budget Period: 1**

C. Equipment Description

List items and dollar amount for each item exceeding $[redacted]

Equipment Item	**Funds Requested ($)***
Total funds requested for all equipment listed in the attached file	
Total Equipment	**0.00**

Additional Equipment: File Name:

D. Travel	**Funds Requested ($)***
1. Domestic Travel Costs (Incl. Canada, Mexico, and U.S. Possessions)	
2. Foreign Travel Costs	[redacted]
Total Travel Cost	[redacted]

E. Participant/Trainee Support Costs		**Funds Requested ($)***
1. Tuition/Fees/Health Insurance		
2. Stipends		
3. Travel		
4. Subsistence		
5. Other:		
Number of Participants/Trainees	**Total Participant Trainee Support Costs**	**0.00**

RESEARCH & RELATED Budget {C-E} (Funds Requested)

Tracking Number: GRANT12621699 Funding Opportunity Number: PA-18-369 . Received Date: 2018-05-04T16:42:25.000-04:00

RESEARCH & RELATED BUDGET - SECTIONS F-K, Budget Period 1

ORGANIZATIONAL DUNS*: [redacted]

Budget Type*: ● Project ❍ Subaward/Consortium

Organization: UNIVERSITY OF WASHINGTON

Start Date*: 09-01-2018 **End Date*:** 08-31-2019 **Budget Period: 1**

F. Other Direct Costs	Funds Requested ($)*
1. Materials and Supplies	[redacted]
2. Publication Costs	
3. Consultant Services	
4. ADP/Computer Services	
5. Subawards/Consortium/Contractual Costs	
6. Equipment or Facility Rental/User Fees	
7. Alterations and Renovations	
8 . Conference Calls, Airtime and Internet Data	[redacted]
9 . Participant Costs & Uganda Subject Review	[redacted]
10 . Course Fees, Books	[redacted]
Total Other Direct Costs	[redacted]

G. Direct Costs	Funds Requested ($)*
Total Direct Costs (A thru F)	[redacted]

H. Indirect Costs

Indirect Cost Type	Indirect Cost Rate (%)	Indirect Cost Base ($)	Funds Requested ($)*
1 . MTDC	8.0	[redacted]	[redacted]
		Total Indirect Costs	[redacted]

Cognizant Federal Agency DHHS, Janet Turner (415) 437-7820
(Agency Name, POC Name, and POC Phone Number)

I. Total Direct and Indirect Costs	Funds Requested ($)*
Total Direct and Indirect Institutional Costs (G + H)	[redacted]

J. Fee	Funds Requested ($)*

K. Total Costs and Fee	Funds Requested ($)*
	[redacted]

L. Budget Justification*	File Name: FINAL_BudgJust_ModelingTB3_20180501.pdf (Only attach one file.)

RESEARCH & RELATED Budget {F-K} (Funds Requested)

Tracking Number: GRANT12621699 Funding Opportunity Number: PA-18-369 . Received Date: 2018-05-04T16:42:25.000-04:00

OMB Number: 4040-0001
Expiration Date: 10/31/2019

RESEARCH & RELATED BUDGET - SECTION A & B, Budget Period 2

ORGANIZATIONAL DUNS*: [redacted]

Budget Type*: ● Project ❍ Subaward/Consortium

Enter name of Organization: UNIVERSITY OF WASHINGTON

Start Date*: 09-01-2019 **End Date*:** 08-31-2020 **Budget Period: 2**

A. Senior/Key Person

	Prefix	First Name*	Middle Name	Last Name*	Suffix	Project Role*	Base Salary ($)	Calendar Months	Academic Months	Summer Months	Requested Salary ($)*	Fringe Benefits ($)*	Funds Requested ($)*
1 .		Jennifer		Ross		PD/PI	[redacted]	9.0			[redacted]	[redacted]	[redacted]

Total Funds Requested for all Senior Key Persons in the attached file

Additional Senior Key Persons: File Name:

Total Senior/Key Person [redacted]

B. Other Personnel

Number of Personnel*	Project Role*	Calendar Months	Academic Months	Summer Months	Requested Salary ($)*	Fringe Benefits*	Funds Requested ($)*
	Post Doctoral Associates						
	Graduate Students						
	Undergraduate Students						
	Secretarial/Clerical						
1	Programmer	1.92			[redacted]	[redacted]	[redacted]
1	**Total Number Other Personnel**					**Total Other Personnel**	[redacted]
						Total Salary, Wages and Fringe Benefits (A+B)	[redacted]

RESEARCH & RELATED Budget {A-B} (Funds Requested)

Funding Opportunity Number: PA-18-369 . Received Date: 2018-05-04T16:42:25.000-04:00

RESEARCH & RELATED BUDGET - SECTION C, D, & E, Budget Period 2

ORGANIZATIONAL DUNS*: [redacted]

Budget Type*: ● Project ❍ Subaward/Consortium

Organization: UNIVERSITY OF WASHINGTON

Start Date*: 09-01-2019 **End Date*:** 08-31-2020 **Budget Period: 2**

C. Equipment Description

List items and dollar amount for each item exceeding $[redacted]

Equipment Item	**Funds Requested ($)***
Total funds requested for all equipment listed in the attached file	
Total Equipment	**0.00**

Additional Equipment: File Name:

D. Travel	**Funds Requested ($)***
1. Domestic Travel Costs (Incl. Canada, Mexico, and U.S. Possessions)	
2. Foreign Travel Costs	[redacted]
Total Travel Cost	[redacted]

E. Participant/Trainee Support Costs		**Funds Requested ($)***
1. Tuition/Fees/Health Insurance		
2. Stipends		
3. Travel		
4. Subsistence		
5. Other:		
Number of Participants/Trainees	**Total Participant Trainee Support Costs**	**0.00**

RESEARCH & RELATED Budget {C-E} (Funds Requested)

Tracking Number: GRANT12621699 Funding Opportunity Number: PA-18-369 . Received Date: 2018-05-04T16:42:25.000-04:00

RESEARCH & RELATED BUDGET - SECTIONS F-K, Budget Period 2

ORGANIZATIONAL DUNS*: [redacted]

Budget Type*: ● Project ❍ Subaward/Consortium

Organization: UNIVERSITY OF WASHINGTON

Start Date*: 09-01-2019 **End Date*:** 08-31-2020 **Budget Period: 2**

F. Other Direct Costs	Funds Requested ($)*
1. Materials and Supplies	[redacted]
2. Publication Costs	[redacted]
3. Consultant Services	
4. ADP/Computer Services	
5. Subawards/Consortium/Contractual Costs	
6. Equipment or Facility Rental/User Fees	
7. Alterations and Renovations	
8 . Conference Calls, Airtime and Internet Data	[redacted]
9 . Ugandan Human Subjects Review and Participant Costs	[redacted]
10 . Course Fees and Registration	[redacted]
Total Other Direct Costs	[redacted]

G. Direct Costs	Funds Requested ($)*
Total Direct Costs (A thru F)	[redacted]

H. Indirect Costs

Indirect Cost Type	Indirect Cost Rate (%)	Indirect Cost Base ($)	Funds Requested ($)*
1 . MTDC	8.0	[redacted]	[redacted]
		Total Indirect Costs	[redacted]

Cognizant Federal Agency (Agency Name, POC Name, and POC Phone Number): DHHS, PSC, DCA, Janet Turner (415) 437-7820

I. Total Direct and Indirect Costs	Funds Requested ($)*
Total Direct and Indirect Institutional Costs (G + H)	[redacted]

J. Fee	Funds Requested ($)*

K. Total Costs and Fee	Funds Requested ($)*
	[redacted]

L. Budget Justification*	File Name: FINAL_BudgJust_ModelingTB3_20180501.pdf (Only attach one file.)

RESEARCH & RELATED Budget {F-K} (Funds Requested)

OMB Number: 4040-0001
Expiration Date: 10/31/2019

RESEARCH & RELATED BUDGET - SECTION A & B, Budget Period 3

ORGANIZATIONAL DUNS*: [redacted]

Budget Type*: ● Project ❍ Subaward/Consortium

Enter name of Organization: UNIVERSITY OF WASHINGTON

Start Date*: 09-01-2020 **End Date*:** 08-31-2021 **Budget Period: 3**

A. Senior/Key Person

	Prefix	First Name*	Middle Name	Last Name*	Suffix	Project Role*	Base Salary ($)	Calendar Months	Academic Months	Summer Months	Requested Salary ($)*	Fringe Benefits ($)*	Funds Requested ($)*
1 .		Jennifer		Ross		PD/PI	[redacted]	9.0			[redacted]	[redacted]	[redacted]

Total Funds Requested for all Senior Key Persons in the attached file

Additional Senior Key Persons: File Name:

Total Senior/Key Person [redacted]

B. Other Personnel

Number of Personnel*	Project Role*	Calendar Months	Academic Months	Summer Months	Requested Salary ($)*	Fringe Benefits*	Funds Requested ($)*
	Post Doctoral Associates						
	Graduate Students						
	Undergraduate Students						
	Secretarial/Clerical						
1	Programmer	2.28			[redacted]	[redacted]	[redacted]
1	**Total Number Other Personnel**					**Total Other Personnel**	[redacted]
						Total Salary, Wages and Fringe Benefits (A+B)	[redacted]

RESEARCH & RELATED Budget {A-B} (Funds Requested)

Funding Opportunity Number: PA-18-369 . Received Date: 2018-05-04T16:42:25.000-04:00

RESEARCH & RELATED BUDGET - SECTION C, D, & E, Budget Period 3

ORGANIZATIONAL DUNS*: [redacted]

Budget Type*: ● Project ❍ Subaward/Consortium

Organization: UNIVERSITY OF WASHINGTON

Start Date*: 09-01-2020 **End Date*:** 08-31-2021 **Budget Period: 3**

C. Equipment Description

List items and dollar amount for each item exceeding $[redacted]

Equipment Item	**Funds Requested ($)***
Total funds requested for all equipment listed in the attached file	
Total Equipment	**0.00**

Additional Equipment: File Name:

D. Travel	**Funds Requested ($)***
1. Domestic Travel Costs (Incl. Canada, Mexico, and U.S. Possessions)	
2. Foreign Travel Costs	[redacted]
Total Travel Cost	[redacted]

E. Participant/Trainee Support Costs		**Funds Requested ($)***
1. Tuition/Fees/Health Insurance		
2. Stipends		
3. Travel		
4. Subsistence		
5. Other:		
Number of Participants/Trainees	**Total Participant Trainee Support Costs**	**0.00**

RESEARCH & RELATED Budget {C-E} (Funds Requested)

Tracking Number: GRANT12621699 Funding Opportunity Number: PA-18-369 . Received Date: 2018-05-04T16:42:25.000-04:00

RESEARCH & RELATED BUDGET - SECTIONS F-K, Budget Period 3

ORGANIZATIONAL DUNS*: [redacted]

Budget Type*: ● Project ❍ Subaward/Consortium

Organization: UNIVERSITY OF WASHINGTON

Start Date*: 09-01-2020 **End Date*:** 08-31-2021 **Budget Period: 3**

F. Other Direct Costs	Funds Requested ($)*
1. Materials and Supplies	[redacted]
2. Publication Costs	[redacted]
3. Consultant Services	
4. ADP/Computer Services	
5. Subawards/Consortium/Contractual Costs	
6. Equipment or Facility Rental/User Fees	
7. Alterations and Renovations	
8 . Conference Calls, Airtime and Internet Data	[redacted]
9 . Ugandan Human Subjects Review and Participant Costs	0.00
10 . Course Fees and Registration	0.00
Total Other Direct Costs	[redacted]

G. Direct Costs	Funds Requested ($)*
Total Direct Costs (A thru F)	[redacted]

H. Indirect Costs

Indirect Cost Type	Indirect Cost Rate (%)	Indirect Cost Base ($)	Funds Requested ($)*
1 . MTDC	8.0	[redacted]	[redacted]
		Total Indirect Costs	[redacted]

Cognizant Federal Agency (Agency Name, POC Name, and POC Phone Number): DHHS, PSC, DCA, Janet Turner (415) 437-7820

I. Total Direct and Indirect Costs	Funds Requested ($)*
Total Direct and Indirect Institutional Costs (G + H)	[redacted]

J. Fee	Funds Requested ($)*

K. Total Costs and Fee	Funds Requested ($)*
	[redacted]

L. Budget Justification*	File Name: FINAL_BudgJust_ModelingTB3_20180501.pdf (Only attach one file.)

RESEARCH & RELATED Budget {F-K} (Funds Requested)

Tracking Number: GRANT12621699 Funding Opportunity Number: PA-18-369 . Received Date: 2018-05-04T16:42:25.000-04:00

OMB Number: 4040-0001
Expiration Date: 10/31/2019

RESEARCH & RELATED BUDGET - SECTION A & B, Budget Period 4

ORGANIZATIONAL DUNS*: [redacted]

Budget Type*: ● Project ❍ Subaward/Consortium

Enter name of Organization: UNIVERSITY OF WASHINGTON

Start Date*: 09-01-2021 **End Date*:** 08-31-2022 **Budget Period: 4**

A. Senior/Key Person

	Prefix	First Name*	Middle Name	Last Name*	Suffix	Project Role*	Base Salary ($)	Calendar Months	Academic Months	Summer Months	Requested Salary ($)*	Fringe Benefits ($)*	Funds Requested ($)*
1 .		Jennifer		Ross		PD/PI	[redacted]	9.0			[redacted]	[redacted]	[redacted]

Total Funds Requested for all Senior Key Persons in the attached file

Additional Senior Key Persons: File Name:

Total Senior/Key Person [redacted]

B. Other Personnel

Number of Personnel*	Project Role*	Calendar Months	Academic Months	Summer Months	Requested Salary ($)*	Fringe Benefits*	Funds Requested ($)*
	Post Doctoral Associates						
	Graduate Students						
	Undergraduate Students						
	Secretarial/Clerical						
1	Programmer	1.68			[redacted]	[redacted]	[redacted]
1	**Total Number Other Personnel**					**Total Other Personnel**	[redacted]
						Total Salary, Wages and Fringe Benefits (A+B)	[redacted]

RESEARCH & RELATED Budget {A-B} (Funds Requested)

Funding Opportunity Number: PA-18-369 . Received Date: 2018-05-04T16:42:25.000-04:00

RESEARCH & RELATED BUDGET - SECTION C, D, & E, Budget Period 4

ORGANIZATIONAL DUNS*: [redacted]

Budget Type*: ● Project ❍ Subaward/Consortium

Organization: UNIVERSITY OF WASHINGTON

Start Date*: 09-01-2021 **End Date*:** 08-31-2022 **Budget Period: 4**

C. Equipment Description

List items and dollar amount for each item exceeding $[redacted]

Equipment Item	**Funds Requested ($)***
Total funds requested for all equipment listed in the attached file	
Total Equipment	**0.00**

Additional Equipment: File Name:

D. Travel	**Funds Requested ($)***
1. Domestic Travel Costs (Incl. Canada, Mexico, and U.S. Possessions)	
2. Foreign Travel Costs	[redacted]
Total Travel Cost	[redacted]

E. Participant/Trainee Support Costs		**Funds Requested ($)***
1. Tuition/Fees/Health Insurance		
2. Stipends		
3. Travel		
4. Subsistence		
5. Other:		
Number of Participants/Trainees	**Total Participant Trainee Support Costs**	**0.00**

RESEARCH & RELATED Budget {C-E} (Funds Requested)

Tracking Number: GRANT12621699 Funding Opportunity Number: PA-18-369 . Received Date: 2018-05-04T16:42:25.000-04:00

RESEARCH & RELATED BUDGET - SECTIONS F-K, Budget Period 4

ORGANIZATIONAL DUNS*: [redacted]

Budget Type*: ● Project ❍ Subaward/Consortium

Organization: UNIVERSITY OF WASHINGTON

Start Date*: 09-01-2021 **End Date*:** 08-31-2022 **Budget Period: 4**

F. Other Direct Costs	Funds Requested ($)*
1. Materials and Supplies	
2. Publication Costs	[redacted]
3. Consultant Services	
4. ADP/Computer Services	
5. Subawards/Consortium/Contractual Costs	
6. Equipment or Facility Rental/User Fees	
7. Alterations and Renovations	
8 . Conference Calls, Airtime and Internet Data	[redacted]
9 . Ugandan Human Subjects Review and Participant Costs	[redacted]
Total Other Direct Costs	[redacted]

G. Direct Costs	Funds Requested ($)*
Total Direct Costs (A thru F)	[redacted]

H. Indirect Costs

Indirect Cost Type	Indirect Cost Rate (%)	Indirect Cost Base ($)	Funds Requested ($)*
1 . MTDC	8.0	[redacted]	[redacted]
		Total Indirect Costs	[redacted]

Cognizant Federal Agency (Agency Name, POC Name, and POC Phone Number): DHHS, PSC, DCA, Janet Turner (415) 437-7820

I. Total Direct and Indirect Costs	Funds Requested ($)*
Total Direct and Indirect Institutional Costs (G + H)	[redacted]

J. Fee	Funds Requested ($)*

K. Total Costs and Fee	Funds Requested ($)*
	[redacted]

L. Budget Justification* File Name: FINAL_BudgJust_ModelingTB3_20180501.pdf (Only attach one file.)

RESEARCH & RELATED Budget {F-K} (Funds Requested)

Tracking Number: GRANT12621699 Funding Opportunity Number: PA-18-369 . Received Date: 2018-05-04T16:42:25.000-04:00

BUDGET JUSTIFICATION
University of Washington

The proposed studies in this K01 award will occur primarily in Seattle, Washington. No subcontract is needed.

PERSONNEL

Jennifer Ross, MD, MPH, Principal Investigator (9.0 cal mos in Y1-4)
Dr. Ross is Acting Instructor/Senior Fellow in the Department of Medicine, Division of Allergy and Infectious Diseases at the University of Washington. Dr. Ross will carry out the research project and training described in this proposal. Dr. Ross will be responsible for initiating the study, procurement and analysis of data, and publication of results.

Ruanne Barnabas, MBChB, DPhil, Primary Mentor (No salary support requested)
Dr. Barnabas is Associate Professor in the Departments of Medicine and Global Health at the University of Washington. Dr. Barnabas will help guide Dr. Ross's career and research development, focusing on her development as a successful junior investigator at UW. Dr. Barnabas will advise Dr. Ross in the development and validation of mathematical models for TB-HIV. She will provide critical feedback to Dr. Ross on her manuscripts and grants and assist in the development of an R01 proposal.

Simon Hay, DPhil, DSc, Co-Mentor (No salary support requested)
Dr. Hay is Professor in the Department of Global Health at the University of Washington and Director of Geospatial Science at the Institute for Health Metrics and Evaluation (IHME) at the University of Washington. Dr. Hay will mentor Dr. Ross in the development of spatiotemporal models for TB-HIV co-infection (Aim 1) and the engagement of stakeholders in data visualization (Aim 3).

David Dowdy, MD, PhD, Co-Mentor (No salary support requested)
Dr. Dowdy is an Associate Professor of Epidemiology at Johns Hopkins University and an expert in the mathematical modeling of TB. Dr. Dowdy will advise Dr. Ross on development of her mathematical and statistical models for Aims 1 and 2.

Judith Wasserheit, MD, MPH, Co-Mentor (No salary support requested)
Dr. Wasserheit is Professor and Chair of the Department of Global Health at the University of Washington and an accomplished researcher and educator in Implementation Science. She will advise Dr. Ross on the engagement of stakeholders in Aim 3.

Yukari Manabe, MD, Scientific Advisor (No salary support requested)
Dr. Manabe is Professor in the Departments of Medicine and International Health at Johns Hopkins University. Dr. Manabe has a long history of multidisciplinary investigation into the prevention and treatment of TB and HIV-TB co-infection in Uganda, including assessment of clinical prevention interventions. She will mentor Dr. Ross in the application of TB prevention interventions (Aim 2) and the practicalities of conducting investigations in Uganda.

Stella Zawedde-Muyanja, MD, MPH, Scientific Advisor (No salary support requested)
Dr. Zawedde is a physician with advanced training in implementation science at the Infectious Diseases Institute at Makerere University in Kampala, Uganda. Dr. Zawedde will advise Dr. Ross with accessing and interpreting program data for TB to input into the models (Aims 1&2) and also facilitate introduction to key TB stakeholders (Aim 3).

Frank Mugabe, MBChB, MHSM, Scientific Advisor (No salary support requested)
Dr. Mugabe is a medical doctor with specialized training in TB epidemiology who is Program Manager of the Uganda TB and Leprosy Program and served as Principal Investigator of the Uganda National TB Prevalence Survey. Dr. Mugabe will advise Dr. Ross and the research team regarding assembly of TB surveillance and prevalence survey data (Aim 1), engagement of stakeholders (Aim 3), and dissemination of results (All aims).

TBN, Programmer (1.92 cal mos in Y1-Y2; 2.28 cal mos in Y3; 1.68 cal mos in Y4)
A programmer will aid with programming the transmission model, the creation of figures and maps, and development of the user interface for TB/HIV modeling.

Fringe Benefits
Funds for fringe benefits are included in the personnel budget request. These benefits include health insurance, social security & Medicare taxes, workers compensation, medical aid & industrial insurance, UWRP, state retirement, unemployment compensation, and separation leave payments for classified & professional staff and are calculated at the University of Washington's current rates.

Research faculty: 26.2%
Professional Staff: 33.3%

TRAVEL

We request $[redacted] over the course of Y1-4 for travel. The international travel costs include one trip to Uganda per year for the first year and year 3, and two trips per year for years 2 and 4. The anticipated trip costs include airfare, lodging, and internal travel at a total cost of $[redacted] per trip. Each trip will last approximately four weeks.

As presentation of findings at international conferences forms an important part of Dr. Ross's career development plan, conference expenses are included at $[redacted] per year for registration, travel, visa fees, and lodging at one international conference per year.

SUPPLIES- $[redacted]

We request $[redacted] for materials required to carry out the project. These materials include a tablet computer at $[redacted] in Y1 and two additional tablet computers in Y3 to carry out the data visualization aim ($[redacted] Funds for a computer and external monitor for Dr. Ross and a computer for the programmer are requested for $[redacted] in Y1. Licenses for software for the tablet computers are requested for $[redacted] ($[redacted] in year one and $[redacted] in year two). R programs for mathematical modeling are open-source and free. ArcGIS mapping software and REDCap questionnaire software are available through the UW site license without charge to investigators.

PUBLICATIONS - $[redacted]

Support for publication fees is requested at $[redacted] in year two, $[redacted] in year three, and $[redacted] in year four of the award. The budget requested for publication fees increases in subsequent years of the award because more publications are anticipated in these later years.

OTHER

Conference Calls, International Airtime and Printing
Funds to support international telephone calls in the amount of $[redacted] per year are requested. Funds to support the purchase of airtime and internet data bundles for Dr. Ross's use while in Uganda are requested at $[redacted] over the course of Y1-4. Printing for the materials to use in presenting the data for Aim 3 is requested at $[redacted]

Uganda Human Subjects Review
Review of the study protocol for these aims will require payment of $[redacted] to the Research Ethics Committee at the Uganda Virus Research Institute and a registration fee of $[redacted] paid to the Uganda National Council for Science and Technology. Payment of foreign institutional review board fees is not supported by the University of Washington indirect fees.

Participant Incentives
We request $[redacted] for participant incentives of $[redacted] per interview (x2) per participant (x30).

Class and Course Materials
We request $[redacted] over the course of Y1 and 2. The University of Washington tuition exemption program supports UW faculty to take up to six credits of coursework per quarter with a full waiver of tuition. An application fee of $[redacted] per year and course fee of $[redacted] per course are charged (x2 courses in Y1 and x3 courses in Y2). A scholarship will be requested for the UW Summer Institute in Statistics and Modeling in Infectious Disease (SISMID). Costs for books and course materials are included. This program will support the course outline proposed by Dr. Ross in her career development plan.

INDIRECT COSTS

Per RFA-18-369, Indirect Costs are calculated at a rate of 8% of modified total direct costs.

RESEARCH & RELATED BUDGET - Cumulative Budget

	Totals ($)	
Section A, Senior/Key Person		[redacted]
Section B, Other Personnel		[redacted]
Total Number Other Personnel	4	
Total Salary, Wages and Fringe Benefits (A+B)		[redacted]
Section C, Equipment		0.00
Section D, Travel		[redacted]
1. Domestic	0.00	
2. Foreign	[redacted]	
Section E, Participant/Trainee Support Costs		0.00
1. Tuition/Fees/Health Insurance	0.00	
2. Stipends	0.00	
3. Travel	0.00	
4. Subsistence	0.00	
5. Other	0.00	
6. Number of Participants/Trainees	0	
Section F, Other Direct Costs		[redacted]
1. Materials and Supplies	[redacted]	
2. Publication Costs	[redacted]	
3. Consultant Services	0.00	
4. ADP/Computer Services	0.00	
5. Subawards/Consortium/Contractual Costs	0.00	
6. Equipment or Facility Rental/User Fees	0.00	
7. Alterations and Renovations	0.00	
8. Other 1	[redacted]	
9. Other 2	[redacted]	
10. Other 3	870.00	
Section G, Direct Costs (A thru F)		[redacted]
Section H, Indirect Costs		[redacted]
Section I, Total Direct and Indirect Costs (G + H)		[redacted]
Section J, Fee		0.00
Section K, Total Costs and Fee (I + J)		[redacted]

PHS 398 Cover Page Supplement

OMB Number: 0925-0001

Expiration Date: 03/31/2020

1. Vertebrate Animals Section

Are vertebrate animals euthanized? ○ Yes ● No

If "Yes" to euthanasia

Is the method consistent with American Veterinary Medical Association (AVMA) guidelines?

○ Yes ○ No

If "No" to AVMA guidelines, describe method and provide scientific justification

2. *Program Income Section

*Is program income anticipated during the periods for which the grant support is requested?

○ Yes ● No

If you checked "yes" above (indicating that program income is anticipated), then use the format below to reflect the amount and source(s). Otherwise, leave this section blank.

*Budget Period	*Anticipated Amount ($)	*Source(s)

Tracking Number: GRANT12621699

Funding Opportunity Number: PA-18-369 . Received Date: 2018-05-04T16:42:25.000-04:00

PHS 398 Cover Page Supplement

3. Human Embryonic Stem Cells Section

*Does the proposed project involve human embryonic stem cells? ○ Yes ● No

If the proposed project involves human embryonic stem cells, list below the registration number of the specific cell line(s) from the following list: http://grants.nih.gov/stem_cells/registry/current.htm. Or, if a specific stem cell line cannot be referenced at this time, check the box indicating that one from the registry will be used:

❑ Specific stem cell line cannot be referenced at this time. One from the registry will be used.

Cell Line(s) (Example: 0004):

4. Inventions and Patents Section (Renewal applications)

*Inventions and Patents: ○ Yes ● No

If the answer is "Yes" then please answer the following:

*Previously Reported: ○ Yes ○ No

5. Change of Investigator/Change of Institution Section

❑ Change of Project Director/Principal Investigator

Name of former Project Director/Principal Investigator

Prefix:

*First Name:

Middle Name:

*Last Name:

Suffix:

❑ Change of Grantee Institution

*Name of former institution:

Tracking Number: GRANT12621699 Funding Opportunity Number: PA-18-369 . Received Date: 2018-05-04T16:42:25.000-04:00

PHS 398 Career Development Award Supplemental Form

OMB Number: 0925-0001
Expiration Date: 03/31/2020

Introduction	
1. Introduction to Application (for Resubmission and Revision applications)	FINAL_Introduction_ModelingTB3_20180502.pdf
Candidate Section	
2. Candidate Information and Goals for Career Development	FINAL_CandidateInfo_ModelingTB3_20180501.pdf
Research Plan Section	
3. Specific Aims	FINAL_SpecificAims_ModelingTB3_20180501.pdf
4. Research Strategy*	FINAL_ResearchPlan_ModelingTB3_20180502.pdf
5. Progress Report Publication List (for Renewal applications)	
6. Training in the Responsible Conduct of Research	FINAL_TrainingResponsibleConduct_ModelingTB3_20180417.pdf
Other Candidate Information Section	
7. Candidate's Plan to Provide Mentoring	
Mentor, Co-Mentor, Consultant, Collaborators Section	
8. Plans and Statements of Mentor and Co-Mentor(s)	FINAL_MentorStatements_ModelingTB3_COMBINED_20180420.pdf
9. Letters of Support from Collaborators, Contributors, and Consultants	FINAL_LOS_ModelingTB3_20180501.pdf
Environment and Institutional Commitment to Candidate Section	
10. Description of Institutional Environment	FINAL_InstitutionalEnviro_ModelingTB3_20180417.pdf
11. Institutional Commitment to Candidate's Research Career Development	FINAL_InstitutionalCommitment_ModelingTB3_20180409.pdf
Other Research Plan Section	
12. Vertebrate Animals	FINAL_Vertebrates_ModelingTB3_20180417.pdf
13. Select Agent Research	FINAL_SelectAgent_ModelingTB3_20180417.pdf
14. Consortium/Contractual Arrangements	FINAL_Consortia_ModelingTB3_20180417.pdf
15. Resource Sharing	FINAL_ResourceSharingPlan_ModelingTB3_20180417.pdf
16. Authentication of Key Biological and/or Chemical Resources	FINAL_AuthenticationBio_ModelingTB3_20180417.pdf
Appendix	
17. Appendix	

Tracking Number: GRANT12621699
Funding Opportunity Number: PA-18-369. Received Date: 2018-05-04T16:42:25.000-04:00

PHS 398 Career Development Award Supplemental Form

Citizenship*:

18. U.S. Citizen or Non-Citizen National?* ● Yes ○ No

If no, select most appropriate Non-U.S. Citizen option

- ❑ With a Permanent U.S. Resident Visa
- ❑ With a Temporary U.S. Visa
- ❑ Not Residing in the U.S.

If you are a non-U.S. citizen with a temporary visa applying for an award that requires permanent residency status, and expect to be granted a permanent resident visa by the start date of the award, check here: ❑

Tracking Number: GRANT12621699 Funding Opportunity Number: PA-18-369. Received Date: 2018-05-04T16:42:25.000-04:00

INTRODUCTION TO RESUBMISSION OF K01 APPLICATION – MAY 7, 2018

I sincerely thank members of the Committee for their careful review of my K01 proposal. My K01 was favorably reviewed overall, with a priority score of [redacted] I am happy to present this revision incorporating the Committee's recommendations. This revision preserves the strengths noted in the initial review, indicating that it is a "high-impact topic than can have a major effect on public health", placing it "on the cutting edge of infectious disease modeling" with "an outstanding team of mentors".

Candidate and Career Development

Reviewers noted that, "The candidate's training and research experience are outstanding and well supportive of this award application". In response to the reviewer question about whether I plan to pursue a career in modeling or implementation, I suggest that, following in the path of my mentors, who are also NIH-funded modelers, implementers, and physicians (Dr. Barnabas and Dr. Dowdy), I plan to build my work at the intersection of these fields, with a particular focus on how modeling can improve intervention implementation and implementation research can improve models. As recognized, I continue to be academically productive, with a **first-author HIV modeling paper** with Dr. Barnabas published in *Epidemics*, co-authorship on the Institute for Health Metrics and Evaluation model of the global burden of TB published in *Lancet Infectious Diseases*, and **four additional papers under review** with Prof. Hay. My first-author study with Prof. Hay modeling HIV and TB mortality in Brazil using geospatial methods was recently recognized with the University of Washington TB Junior Investigator Award. I also completed the TB modeling post-graduate course at the Union World Conference on TB and Lung Disease in October, 2017 and removed it from my training plan.

I shortened the overall proposal length to four years, as the programming and data management skills that I built in the past year will accelerate the pace of the study. I removed these two courses from the training plan and condensed portions of the research plan to fit within four years, as below.

Mentorship

This proposal preserves the team of mentors noted to be "outstanding" from the initial review. Dr. Barnabas, who now holds the King K. Holmes Endowed Professorship in STD and AIDS, highlighted in her primary mentor letter the two prior K awardees whom she has mentored, as did Dr. Dowdy. Professor Hay has not mentored a K awardee, as his career was previously based in the United Kingdom at the University of Oxford. However, he has supervised 10 doctoral theses leading to three Wellcome Trust Fellowships, three Assistant Professorships, and the remainder of mentees currently working as research scientists, post-doctoral fellows, and for the WHO.

Dr. Frank Mugabe, Program Manager of the Uganda National TB and Leprosy Program (NTLP), who was an early supporter of the project, has joined the advisory team. He states that **this study is specifically requested by the NTLP** in order to extend the reach of limited resources and advocate for additional preventive therapy scale-up. His support facilitates the study and minimizes any political barriers to implementation of its findings.

Revision of the Research Plan

There are several notable modifications to the research plan. First, as requested by the reviewers, **specific deliverables** are included for each aim. Additional manuscripts beyond these deliverables are likely to be generated as the analyses yield other novel findings. Aim 1 now includes geospatial HIV prevalence estimates from IHME that incorporate Population-Based Impact Assessment (PHIA) data and consideration of the impact of patient travel on geographic case notification patterns. We present more detail about the approach to model validation. Additionally, we suggest that the model validation process will yield important insights into the **key mechanistic drivers of the differences between HIV-TB dynamics in different regions**, which is an innovative finding with its own value, in addition to the actual estimates.

The second aim now includes modeling for isoniazid plus rifapentine as an alternative to isoniazid alone, and additional data for costing the intervention strategies, as requested by the Reviewer 1. Rather than being an obvious hypothesis, we suggest that quantifying the impacts of a targeted intervention approach is vitally important in order to promote the paradigm shift required by stakeholders to move away from the current uniform approach. I increased the frequency of meetings with Dr. Dowdy to reflect a faster pace of HIV-TB transmission modeling in the four-year award period.

Aim 3, which includes engagement with HIV and TB stakeholders in Uganda was noted to be "an important aspect of global health that most investigators completely ignore." Changes include a revised implementation outcomes evaluation framework focusing on perceived acceptability and feasibility of modeled strategies. I condensed the timeline of the stakeholder engagement to fit within the four-year study.

Thank you for your helpful comments. I remain fully committed to this proposal and to an academic career using innovative modeling strategies to optimize prevention of HIV related conditions and avert deaths from HIV.

CANDIDATE BACKGROUND

I am submitting this K01 application to further my goal of becoming an academic investigator focused on developing geospatial and transmission modeling methods to support targeted interventions to address the epidemics of HIV and its co-infections, including tuberculosis (TB), in sub-Saharan Africa.

My HIV co-infection research interest started years ago with my first job as an Emerging Infectious Disease Laboratory Training Fellow at the Centers for Disease Control and Prevention (CDC). Using molecular epidemiology, I published genotype and clinical phenotype correlations for cryptosporidiosis in Peruvians with HIV.[1] I also taught laboratory techniques to trainees at Universidad Peruana Cayetano Heredia in Lima, Peru.

Because I wanted patient care to be part of my career and to inform my research, following my work at CDC, I returned to my home state of Oregon to attend medical school at Oregon Health and Science University (OHSU) and concurrently completed a Master of Public Health (MPH) in epidemiology and biostatistics. I also led the Global Health Alliance multidisciplinary student group, which catalyzed the development of the OHSU Global Health Center. Subsequently, I pursued internal medicine residency training at the University of California, San Francisco (UCSF), one of the world's leading universities for HIV research. I worked with Dr. Luke Davis in Uganda to investigate the barriers to accessing care for TB. Study clinicians suggested that lengthy travel was a barrier to care, and so I learned to use geographic information systems (GIS) mapping software to model the travel time required for our patients to reach health centers. I was the first author of our analysis of geographic barriers to TB care in Uganda.[2]

I chose the University of Washington (UW) for my infectious disease fellowship to develop my modeling skills and be mentored by investigators conducting the front-line HIV research in East Africa. I completed the course in infectious disease dynamic transmission (mathematical) modeling taught by my primary mentor, Dr. Ruanne Barnabas, and collaborated with her on several projects investigating HIV co-infection with hepatitis C virus[3], modeling HIV disease progression[4], and program evaluation for HIV care in Uganda.[5] I was awarded a Fogarty Global Health Fellowship to support a research year in Uganda, where I used GIS mapping and statistical modeling to estimate how the scale-up of cotrimoxazole prophylactic therapy may be affecting malaria burden, based on the overlapping geographies of malaria and HIV.[6] This work introduced me to the vast amount of data reported to the national electronic surveillance database (DHIS-2) or collected by the Presidents Emergency Plan for AIDS Relief (PEPFAR), and the potential for these data to better direct efforts for infectious disease prevention and control.

Following my return to UW from Uganda, I sought mentorship from world renowned infectious disease cartographer, Professor Simon Hay, who had recently arrived at the UW-affiliated Institute for Health Metrics and Evaluation (IHME) to extend the geostatistical modeling approaches that he developed for malaria[7] to HIV, TB, diarrhea, and pneumonia. He has supported my work with his geospatial modeling team and the Global Burden of Disease Study (GBD) TB team since January, 2017, as a prelude to a career development award. In this role, I adapted the code for a geospatial small area estimation model to map TB and HIV deaths for the more than 5400 municipalities in Brazil over a 15 year period, and am first author of the manuscript that is currently under review (Fig. 1). We began modeling in Brazil because it is a high-TB-burden country with invested collaborators and excellent mortality data that will allow us to develop techniques for areas with limited data. At IHME, I also co-author TB, HIV-TB[8], and latent TB (manuscript under review) burden estimation for GBD. I continue collaboration in HIV co-infection modeling with Dr. Barnabas, including an individual patient data meta-analysis of the impact of isoniazid preventive therapy plus ART for the WHO. Her studies of community-based HIV care will form a venue for eventual implementation of these modeled strategies.

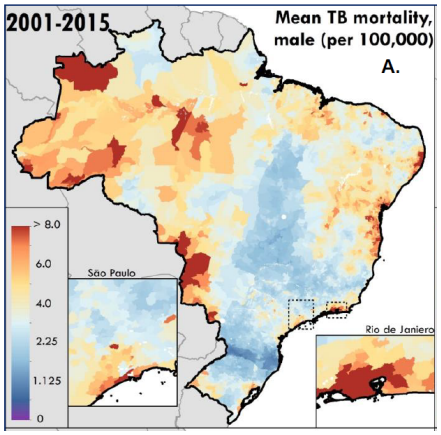


Fig. 1. Mean male TB mortality rate per 100,000 population in Brazilian municipalities, 2001 - 2015.

I developed this K01 proposal to continue to develop my research niche with guidance from my expert mentors. This K01 award will support me to devote at least 75% of my effort to research as I develop techniques for combining state-of-the-art geospatial and mathematical models and engaging stakeholders in adoption of modeled strategies. Acquiring these advanced skills will inform my future R01 proposals, which may include modeling and evaluating implementation of geographically-specific strategies for HIV and TB prevention interventions in high-burden countries. With my clinical training in infectious disease, my outstanding mentorship, and the support of this award, I will be well-positioned to contribute to the improved control of HIV and TB epidemics in sub-Saharan Africa.

CAREER GOALS AND OBJECTIVES

My long-term career goal is to be an academic investigator focused on applying geospatial and modeling methods to support targeted interventions to address the epidemics of HIV and its co-infections, including tuberculosis (TB), in sub-Saharan Africa. **I aim to work at the intersection of modeling and implementation science.** I have developed a strong foundation in geospatial analysis and mathematical modeling alongside my clinical training, and I seek further mentorship and instruction in order to accomplish the state-of-the art analyses and implementation research that will best inform public health programs. I have developed the following goals for this K01 award period, which will position me well to apply the rapidly-expanding body of geographic information about infectious disease burden to inform clinical intervention programs that improve health.

Long-term career goals

1. To accelerate control of the global HIV-TB epidemic by informing targeted application of TB prevention interventions among people living with HIV (PLHIV).
2. To develop methodology for assessing the geographic, demographic, and health services predictors of infectious disease morbidity that will be applicable across sub-Saharan Africa through my work as an academic principal investigator.

Short-term goals for K01 award period

1. To learn techniques for geospatial modeling for HIV and tuberculosis through direct mentorship, coursework, and peer learning at the Institute for Health Metrics and Evaluation (IHME), and apply these techniques to understand spatial heterogeneity in HIV-TB co-infection within Uganda.
2. To design, construct, and validate mathematical models of HIV-TB co-infection, and learn how to estimate the efficacy of TB prevention interventions observed in clinical sites to other settings.
3. To learn data visualization and implementation science techniques for communicating with decision-makers about models and facilitating adoption of evidence-informed policy.
4. To refine my scientific writing and presentation skills through the preparation of first-author manuscripts and presentations at research conferences.
5. To successfully compete for R01 funding for the development, monitoring, and evaluation of a model-based strategy to prevent TB infection in Uganda.

The University of Washington (UW) Department of Global Health is an ideal environment to support me in reaching these goals. I will benefit from the mentorship of my team, the resources of the UW-affiliated IHME, and the support of other investigators in the Department with decades of experience conducting infectious disease interventions in developing countries.

CANDIDATE'S PLAN FOR CAREER DEVELOPMENT/TRAINING ACTIVITIES

A. Career Development and Training Aims: My career development and training aims are aligned with my research aims, which will build my skills in epidemiological modeling and will allow me to inform the design of targeted clinical interventions for infectious disease control. By completing **Aim 1**, I will learn to use infectious disease surveillance datasets together with maps of demographic indicators to build geospatial and mathematical models of HIV/TB co-infection. In **Aim 2**, I will calibrate a mathematical model to the HIV and TB transmission dynamics within Uganda and learn to develop model parameters for clinical interventions and techniques for cost-effectiveness analysis. In **Aim 3**, I will gain experience with translational research by applying an implementation framework to the engagement of key stakeholders in the feasibility and acceptability of using modeling to inform policy.

B. Mentored Modeling Research: My **primary mentor, Dr. Ruanne Barnabas MBChB, DPhil.,** is Associate Professor of Medicine and Global Health at the University of Washington and holds the King. K. Holmes Endowed Professorship in STD and AIDS. She is the author of more than 59 peer reviewed publications. Dr. Barnabas has served as my research mentor for the past three years. She completed her DPhil at the University of Oxford in the mathematical modeling of infectious diseases, and now she applies mathematical models of HIV to design and assess high-impact HIV-prevention interventions in Uganda, Kenya, and South Africa. She is the PI of two R21 grants funded by NIAID (AI122867) and NIMH (MH110026), as well as the R01-equivalent Delivery Optimization for Antiretroviral Therapy in Uganda and South Africa Study funded by the [redacted]. She is the health economics lead for multiple NIH-funded HIV-prevention studies in Uganda and South Africa. Dr. Barnabas has previously mentored seventeen clinical and public health trainees and junior investigators. We meet weekly when we are both in Seattle, and share calls when we are traveling.

Table 1: Team Members, Roles, Expertise, and Frequency of Meetings			
Team Member	**Role**	**Expertise Relevant to Aims**	**Meeting**
Dr. Ruanne Barnabas	Primary Mentor	**All Aims** Mathematical modeling of the impact of HIV co-infections and care interventions. Cost-effectiveness analysis. Implementation of HIV care in Uganda.	Weekly in person
Prof. Simon Hay	Co-mentor	**Aims 1 and 3** Geospatial modeling of infectious disease burden Data visualization and communication of modeling analyses	Weekly in person
Dr. David Dowdy	Co-mentor	**Aims 1 and 2** Mathematical modeling of HIV-TB co-infection	Bi-weekly via skype
Dr. Judith Wasserheit	Co-mentor	**Aim 3** Evaluation of stakeholder engagement	Monthly in-person
Dr. Yukari Manabe	Advisor	**Aims 2 and 3** Assessment of TB prevention interventions in Uganda Engagement with TB stakeholders in Uganda	Monthly via skype
Dr. Stella Zawedde-Muyanja	Advisor	**Aims 1 and 3** Interpretation of TB surveillance data Engagement with TB stakeholders in Uganda	Monthly via skype
Dr. Frank Mugabe	Advisor	**Aims 1 and 3** Interpretation of TB surveillance data Engagement with TB stakeholders in Uganda	Monthly via skype

Co-Mentors - I will have three co-mentors during this award, in addition to my primary mentor. This large mentoring team is necessary to complete the multidisciplinary aims of my proposal.

Professor Simon Hay, DPhil, DSc is an internationally renowned infectious disease cartographer and Director of Geospatial Science at the Institute for Health Metrics and Evaluation (IHME) at the University of Washington (UW). I am currently supported by an award to Professor Hay from the Bill and Melinda Gates Foundation to similarly map disease burden for HIV and TB at the global, national, and local scales. He will mentor me in geospatial methods and data visualization. We meet weekly in-person.

Dr. David Dowdy, MD, PhD is a physician-epidemiologist at Johns Hopkins University with extensive experience modeling tuberculosis transmission and the impact of diagnostic interventions, including modeling HIV-TB co-infection in Uganda. Dr. Dowdy is a founding member of the TB Modeling Analysis Consortium. Dr. Dowdy will assist me with development of the HIV-TB transmission models for Aims 1 and 2. We will meet bi-weekly by Skype, with more frequent calls as necessary during phases of intensive model building.

Dr. Judith Wasserheit, MD, MPH is Chair of the Department of Global Health at the University of Washington, and an accomplished investigator in the fields of HIV co-infection research and implementation science. Dr. Wasserheit will advise me on the evaluation of the interaction with TB and HIV stakeholders for Aim 3. She and I will meet monthly during the period where I am developing and evaluating the stakeholder intervention. Additionally, as my department chair, she and I will meet every six months to assess my progress as a junior faculty member.

Scientific advisors – Multidisciplinary collaboration with the following key personnel will facilitate the successful completion of this project.

Dr. Yukari Manabe, MD is an infectious disease physician-scientist at Johns Hopkins University who was formerly the Director of Research at the Infectious Disease Institute at Makerere University in Kampala, Uganda. Dr. Manabe has a long history of multidisciplinary investigation into the prevention and treatment of TB and HIV-TB co-infection in Uganda, including assessment of clinical prevention interventions. She will advise me in implementation science, the application of TB prevention interventions, and the practicalities of conducting investigations in Uganda.

Dr. Stella Zawedde-Muyanja, MD, MPH is a physician-epidemiologist with advanced training in implementation science who previously served as a project manager at the International Union Against Tuberculosis and Lung Disease in Kampala, Uganda and is now a PhD candidate in Epidemiology at Makarere University. She will assist me with analysis of TB surveillance data (Aim 1) and also facilitate introduction to key TB stakeholders (Aim 3). Dr. Zawedde-Muyanja and I will have monthly skype calls, with more frequent calls as needed.

Dr. Frank Mugabe, MBChB, MHSM is medical doctor and Program Manager of the Uganda National TB and Leprosy Program (NTLP). He was Principal Investigator of the Uganda National TB Prevalence Survey. He will advise on inclusion of TB surveillance data into the modeling, stakeholder engagement, and interpretation and

dissemination of study findings.

C. Training Activities: I will achieve my training aims through didactic coursework, mentored field work, tutorials (hands-on mentoring), and attendance at conferences (Table 2).

Components of Career Development Plan	Pre-award	Year 1	Year 2	Year 3	Year 4
Aim 1: Build Geostatistical and Mathematical Models of HIV Co-infections with TB					
UW Didactic Coursework					
- BIOST 555: Statistical Methods for Spatial Epidemiology		✓			
- EPI 554: Introduction to Epidemic Modeling for Infectious Diseases	✓				
Field time in Uganda to acquire and review data		✓	✓	✓	✓
Tutorials with Prof. Hay, Dr. Dowdy and Dr. Barnabas	✓	✓	✓	✓	✓
Aim 2: Use a Mathematical Model of HIV-TB Co-infection to Predict the Impact and Cost of Interventions					
TB Modelling Analysis Consortium Workshop	✓				
UW Didactic Coursework					
- UW Summer Institute in Statistics and Modeling (SISMID)	✓	✓	✓		
- GH 590: Cost Effectiveness of Medical Interventions (short course)			✓		
Modeling and cost-effectiveness tutorials with Dr. Barnabas and Dr. Dowdy		✓	✓	✓	✓
Aim 3: Develop Best Practices for Communicating and Implementing Modeling Studies					
UW Didactic Coursework					
- GH 590c: Interactive Data Visualizations			✓		
- GH 541: Implementation Science in Global Health			✓		
- Manuscript preparation short-course with Dr. Anna Wald		✓			
Field work in Uganda to acquire and review data			✓	✓	✓
Tutorials with Prof. Hay, Dr. Barnabas, and IHME colleagues		✓	✓	✓	✓
R01 Grant Proposal					
UW Didactic Coursework					
- EPI 588: Writing Research Proposals				✓	
R01 preparation, submission, and re-submission					✓

Didactic Coursework - I will take for-credit coursework, as shown in Table 2. This coursework is directly applicable to the data generated by my aims. Fieldwork will be conducted in off terms.

Scheduled Conferences and Seminars – The University of Washington Department of Global Health is home to a vibrant academic community. I will attend the weekly Infectious Disease Clinical Conference, the weekly IHME Seminar, and conferences sponsored by the Center for AIDS Research (CFAR). I will also participate in weekly research group meetings with Dr. Barnabas' group and TB modeling team meetings at IHME.

National and International Conferences – I plan to attend annually and present research findings at relevant meetings, such as the Conference on Retroviruses and Opportunistic Infections (CROI) and the International Union Against TB and Lung Disease.

D. Non-Research Activities: The Department of Global Health has **committed to protecting at least 75% of my time for research activities.** In my non-research time, I will maintain my clinical practice by attending on the infectious disease consultation service up to 4 weeks per year (≤6%). Teaching responsibilities will total <6%.

E. Pathway to Independence: I will engage in the following activities to ensure that I am on track to submit an R01 application in year 4. I will also attend the UW Institute for Translational Health Sciences (ITHS) Faculty Career Development Series, which is designed to help young investigators transition to faculty roles.

Publications – I aim to produce at least 2 first-author manuscripts per year, as detailed in the anticipated outcomes of the research plan. I will take a manuscript course (Table 2) and receive support from my mentors during the drafting and revision process.

Grant Writing – With the ultimate goal to produce a successful R01 application, I will receive instruction in grant writing by taking Epi 588: Writing Research Proposals during the second year of this award. I plan to submit additional smaller proposals during the award period, including a New Investigator Award application to the UW Center for AIDS Research.

SPECIFIC AIMS: Despite recent increases in access to antiretroviral therapy (ART), nearly 17% of people living with HIV (PLHIV) in sub-Saharan Africa die within the first year of starting ART, with TB as the leading cause of death.[9-13] Preventive therapy (PT) with daily isoniazid (IPT) or weekly high-dose isoniazid with rifapentine (3HP) prevents mortality due to TB in PLHIV when used alone or in combination with early ART.[12,14-16] However, **fewer than five percent of eligible Ugandans receive PT**, despite national HIV treatment guidelines that endorse the World Health Organization's recommendation for it in TB high-burden countries.[17-20]

Implementing successful PT programs depends on adequate drug supply and the clinical and diagnostic capacity to effectively screen for active TB. Additionally, some persons experience treatment limiting adverse effects. However, prioritizing PT implementation to most at-risk persons could maximize the health benefit of PT programs and minimize the programmatic and health costs from adverse effects. Within Uganda, estimated adult HIV prevalence varies from 1.3% to 17.8% by district[21], and TB prevalence at cluster sites varied by 15-fold in the national TB prevalence survey.[22] **Geospatial modeling can integrate these and other data** to identify areas of greatest disease burden, allowing resources to **focus on areas of greatest need**. Dynamic transmission and cost-effectiveness modeling can predict the impact of intervention scale-up on disease burden, and at what programmatic cost.

Preventive therapy reduces the risk of active TB and TB associated mortality, but the duration of protection varies between clinical studies conducted in different sites and with different regimens[12,15,23,24]. Understanding the reasons for this variation is critical to predicting how PT implementation will affect TB outcomes in the settings of high, medium, or low TB and HIV prevalence found within Uganda. Program costs constrain scale-up, and so we will estimate the cost of providing PT in health facilities or in communities, anticipating that community-based ART programs may be leveraged to deliver PT too. With a fully parameterized and validated district-level model of PT, we can optimize a strategy for geographically prioritizing scale-up of PT that accounts for heterogeneity of HIV-TB disease burden. PT is currently underutilized in Uganda, and there exists a critical need for tools to advocate for and guide implementation and maximize health gains. Finally, incorporating health stakeholders into this research is essential for guiding the development of practical disease models and advancing understanding of how to increase acceptability and feasibility of modeled strategies.
The specific aims are:

Aim 1: Examine the relationship between district-level ART coverage and district-level geographic predictors of TB with TB prevalence, incidence, and mortality among PLHIV.

Approach: Build geospatial models of TB prevalence, incidence, and mortality among PLHIV using the district as the level of analysis. Include ART coverage, population prevalence of TB[25], geographic accessibility, population density[26], undernutrition, and poverty[27] as predictors. Fit a dynamic transmission model of HIV-TB infection to district-level prevalence and mortality estimates.

Hypothesis: A spatiotemporal model that incorporates HIV and TB epidemiology, demography, and health service coverage can predict TB prevalence and mortality among PLHIV. Strength of association between predictor variables and outcome may vary by district.

Aim 2: 2a) Estimate the impact of PT on incident TB, TB mortality and adverse effects among PLHIV. 2b) Quantify the differences in TB outcomes and cost for regionalized PT implementation.

Approach: Systematically review the impact of PT on incident TB, TB mortality, and adverse effects among PLHIV. Apply PT efficacy estimates to mathematical model developed in Aim 1 to evaluate efficacy and cost-effectiveness of PT scale-up scenarios.

Hypothesis: A strategy that prioritizes PT in districts with the highest anticipated TB transmission will show greater gains in health (incident TB cases, deaths and DALYs averted) than a uniform roll-out of PT.

Aim 3: Engage stakeholders to inform model development and evaluate strategies to improve the acceptability and feasibility of modeled strategies for TB prevention.

Approach: Utilize structured interviews with HIV and TB stakeholders to inform model development and identify barriers to incorporation of modeling into policy. Assess how interaction with the model affects stakeholder perceptions of acceptability and feasibility of a regionally-based PT strategy.

Hypothesis: Stakeholders who engage with the model in an interactive format will report greater acceptability and feasibility of using models to inform policy.

The models developed in this analysis will contribute to fundamental knowledge of the drivers of TB infection, and will inform TB prevention efforts beyond PT as other interventions are brought to scale. Learning these techniques will position me to contribute to the targeted control of TB and other co-morbidities among PLHIV throughout sub-Saharan Africa.

RESEARCH STRATEGY

A. Significance

Tuberculosis (TB) is the leading cause of death among people living with HIV (PLHIV) in sub-Saharan Africa, including those recently started on antiretroviral (ART) therapy in Uganda.(10) HIV infection is the leading risk factor for TB infection in Uganda, and nearly 50% of TB cases in Uganda occur in HIV-positive individuals.(28) Preventive therapy (PT) with isoniazid (IPT) or isoniazid and rifapentine (3HP) prevents tuberculosis and TB-associated mortality among PLHIV(12), and is recommended by the World Health Organization (WHO) for all PLHIV following screening for active TB who live in settings of moderate to high TB prevalence.(29) Promising results for one month therapy (1HP) are also becoming available.(30) Implementing any regimen in successful PT programs is non-trivial because it depends on adequate drug supply and the clinical and diagnostic capacity to effectively screen for active TB. An attempt to broadly roll-out IPT in Uganda in 2014 was halted after just 4 months when isoniazid stock-outs led to restriction of the drug to certain centers (Personal communication, S. Zawedde and F. Mugabe, October 2017). As a result, fewer than 5% of eligible Ugandans receive PT.(31)

Dynamic transmission (mathematical) modeling allows investigators to simulate epidemics and assess how variations in the application of a disease prevention intervention impact the simulated epidemic. A study using this method in Kenya found that prioritizing HIV-prevention interventions (including early ART, medical male circumcision, and sexual behavior change counseling) at the district level based on the epidemiology of HIV would be expected to prevent an additional 100,000 (14%) HIV infections as compared to a strategy of uniform deployment of interventions with the same total cost.(32) Strategies that are tailored to the local epidemiology have also been recommended for accelerating progress to reduce TB incidence.(33)

Understanding the local drivers of HIV-TB co-infection is critically important for design of TB prevention programs in resource-limited countries like Uganda, which have high burdens of TB (incidence 161/100,000)(34) and HIV (7.3% population prevalence)(35), but geographic variation in prevalence of both infections within the country. Uganda has 112 administrative districts (Fig. 2). The estimated adult HIV prevalence ranges from a low of 1.3% in some districts to a high of 17.8% in another.(21) Crude TB prevalence ranged by more than 15-fold between clusters in the 2015 national prevalence survey (Fig. 2).(22) Prevalence of active TB in a cohort of more than 22,000 Ugandans initiating ART ranged between 3.6% and 22.4% across clinical sites in eight districts.(36) Similarly, prevalence of latent tuberculosis infection (LTBI) varies from 16% to 49% in cross-sectional studies among adolescents and adults in rural versus urban Uganda(37, 38), but has not been comprehensively reported nationwide. These heterogeneities are important because trials of the standard 6-month course of IPT have been more successful in settings of moderate TB transmission intensity, such as in communities in Brazil(15) and Cote d'Ivoire(12), than in high-transmission communities in southern Africa, where participants have experienced rapid re-infection after stopping isoniazid.(14, 24, 39) Courses of IPT lasting at least 36 months have been recommended for these high-transmission settings.(40) Understanding which parts of Uganda have an HIV-TB co-infection epidemic more like Cote d'Ivoire than South Africa could inform the optimal use of TB prevention interventions by region.

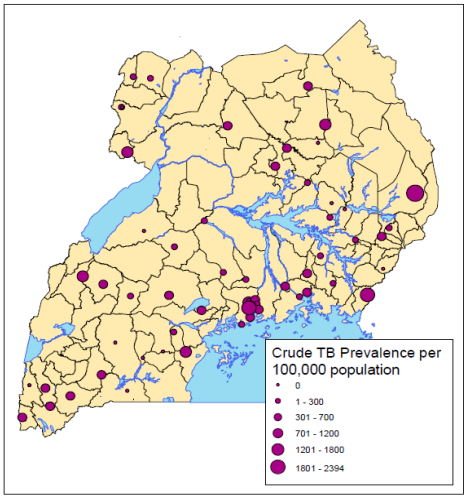


Figure 2: Crude TB prevalence at cluster locations from 2015 Uganda National TB Prevalence Survey shown with boundaries of the 112 districts from 2010 census.

This proposed K01 award will characterize the TB-HIV co-infection epidemics at a district level in Uganda, allowing for targeted application of the prevention interventions that are best suited to different regions. At the same time, it will develop a method for incorporating routinely collected public health surveillance data with publicly available demographic data and the results of a systematic, population-based TB prevalence survey, which will make the method generalizable to other African countries with similar sources of data. Looking specifically at TB cases occurring with PLHIV ensures that the TB map can be rapidly translated into TB prevention efforts among this disproportionately-affected group. Aim 3 will develop tools in collaboration with the Ministry of Health and other Ugandan TB and HIV stakeholders for the successful incorporation of modeling analyses into implementation of health programs. This is important because many decision-makers in national health programs come from a background of clinical medicine or public health that does not include instruction in geospatial or transmission (mathematical) modeling. Engagement of these stakeholders will improve the model and facilitate adoption of targeted TB prevention into the national strategy for prevention of TB.

B. Innovation

This K01 proposal includes two primary innovations: (1) the development of cutting-edge, linked geospatial and mathematical models to **guide implementation at a sub-national scale** for preventive therapy (PT), and (2) the engagement of stakeholders in model development and evaluation of strategies to improve the acceptability and feasibility of modeled strategies. This work is responsive to calls from the President's Emergency Plan for AIDS Relief (PEPFAR) to do the "right intervention at the right place at the right time(41) for HIV. Additionally, this novel technique is scale-able to other countries in sub-Saharan Africa because it utilizes data that are routinely collected as part of population health surveillance or through PEPFAR. Professor Hay, a mentor for this project, and his colleagues broke new ground when they developed a global malaria map(42) using a geostatistical model incorporating malaria surveillance studies together with climate data and demographic surveys; this investigation will adapt similar geospatial modeling methods to fit the epidemiology of HIV and TB. While geospatial and transmission modeling methods have been applied to understand HIV-TB or TB dynamics within a community(43-45), developing models for a whole country that include sub-national variation will be a novel contribution. This work will be performed in collaboration with the HIV and TB modeling teams at the Institute for Health Metrics and Evaluation (IHME) at the University of Washington (UW). Our multidisciplinary team of clinicians, epidemiologists, modelers, and public health leaders will facilitate the rapid translation of the TB and HIV models into public health strategies designed to prevent TB disease and death.

This proposal's **Aim 3** includes an innovative effort to engage key stakeholders in Uganda's HIV and TB programs in order improve model utility and inform strategies to overcome barriers to implementation. This important step is responsive to NIH's PA-15-010(46) for R-series grants to "promote research in identifying, quantifying, reducing, and communicating spatial uncertainty in health research to improve disease control and prevention." It is also in line with a framework jointly proposed by infectious disease modelers and policy makers to enhance the incorporation of models into policy.(47) **To our knowledge, this is the first such effort to evaluate the acceptability and feasibility of incorporating model-based strategies for tuberculosis into policy using an implementation science framework.**

C. Approach

C.1. Overall strategy (Fig. 3): Use the tools of geospatial and mathematical modeling to predict TB prevalence and mortality among PLHIV by district in Uganda, estimate the effectiveness of TB prevention interventions, and engage stakeholders to assess the acceptability and feasibility of a locally-tailored strategy for prevention of TB deaths among PLHIV.

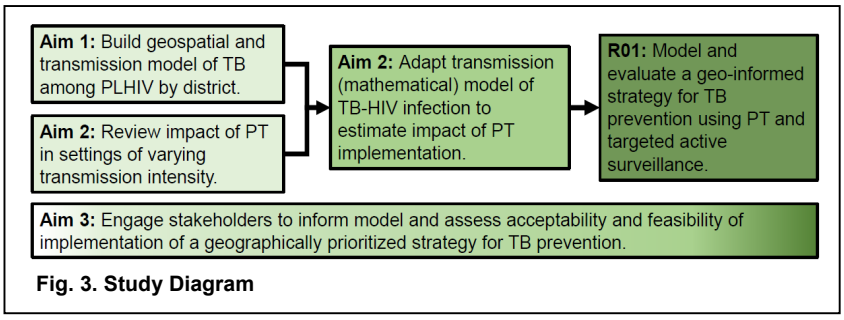


Fig. 3. Study Diagram

C.2 Preliminary studies: The preliminary investigations focus on geospatial modeling techniques (a+b), TB burden modeling (c), and developing model parameters (d).

C.2.a. Accessibility of TB diagnosis in Uganda – In prior studies(2), we estimated travel time for patients presenting for TB care in clinics in six regions of Uganda. I learned to use geographic information systems (GIS) by completing this geospatial analysis and learned the landscape of TB treatment services in Uganda.

C.2.b. Geospatial modeling of TB and HIV in Brazil (Fig. 1) – I adapted a geospatial small area estimation model to estimate TB mortality and incidence and HIV mortality in Brazil (manuscript under review). Professor Hay mentored me in this effort. This is similar to the method we will use for HIV-TB in Uganda, but requires adaptation to use different data sources, such as program surveillance data instead of vital registration.

C.2.c. Estimating the global burden of TB by country – With the TB team at IHME, I helped to model TB incidence, prevalence and mortality for the Global Burden of Disease Study.(8) Our latest work models the global burden of latent TB infection at the country-level (manuscript under review).

C.2.d. Mapping ART scale-up in Uganda – My work as a Fogarty fellow included mapping the scale-up of ART by district from 2010 to 2015 using data from PEPFAR and national surveillance. ART use increased from approximately 207,000 persons to at least 760,000 in 2015. The map of ART scale-up that I developed will be incorporated into the model for this proposal. As ART reduces the risk of developing tuberculosis by 30-60%(12), we anticipate ART use to be an important predictor of TB incidence among PLHIV.

C.3. Aim 1: Examine the relationship between district-level ART coverage and district-level geographic predictors of TB with active TB prevalence, incidence, and mortality among PLHIV.

C.3.a. Overview- This aim combines national surveillance data for HIV and TB with maps of population density, TB health services, poverty, smoking, alcohol abuse, and undernutrition to examine the relationship between HIV-TB risk factors and outcomes of active HIV-TB prevalence and TB mortality among PLHIV. It develops in two steps. First, we assess the relationship between HIV-TB predictors and HIV-TB prevalence, incidence and HIV-TB mortality using a geospatial model, incorporating the notion that **adjacent districts may be more similar than geographically disparate ones**. Then, we build a dynamic transmission model to simulate the HIV-TB epidemic occurring within a district. While we will use the same model structure for each district, we use different values for model parameters depending on the regional differences from the geospatial model. These analyses will be completed with data that are already collected, but which have not been analyzed in this way.

C.3.b. Data sources: Outcomes – The data source for the outcome of **HIV-TB mortality** will be TB mortality among PLHIV reported in the Ministry of Health electronic surveillance system, DHIS-2, by district, between 2012 and 2017. We begin in 2012 because this is the first year that TB mortality was included in DHIS-2. The primary data source for the outcome of **HIV-TB prevalence** will be the 2014-2015 national TB prevalence survey(22), which included 70 sites spread across the geographic regions (N=10) of the Uganda AIDS Indicator Surveys. Whereas surveillance data under-ascertain TB cases, this survey better ascertained TB cases by offering WHO TB symptom screening and chest x-ray for all participants, with sputum culture and HIV testing performed for persons with TB symptoms or a positive chest x-ray.(28) **HIV-TB incidence** will be estimated from TB case notifications, which will be adjusted for underreporting using maps of treatment seeking behavior and TB diagnostic capacity. Incidence, which is the most challenging outcome to estimate, will also be triangulated from district-level prevalence and mortality using the transmission model.

C.3.c. Data sources: Predictors – One value will be calculated for each predictor variable (Table 1) for each district (n=112). In the case of data that varies across the district, such as the population density, undernutrition and poverty rate, the population-weighted mean value for the district will represent the entire district. A model of district-level accessibility to health facilities with the clinical and laboratory capacity to diagnose TB will be developed using maps of health facilities, road networks, and poverty. Trends in HIV prevalence and ART coverage will be evaluated between 2006 and 2016 because of the time-lag associated with HIV disease progression and greatest risk for progression from latent to active TB infection. All data for predictor variables have already been collected. The source data for several predictors are made available for freely public use, while permission to use others will be provided to us from colleagues at the Ugandan National TB and Leprosy Program (NTLP), as indicated in our letters of support. The ongoing relationships between our research group and key personnel in these programs will facilitate access to these data sources.

Table 1: Candidate predictor variables for TB prevalence and mortality among PLHIV.

Predictor		Description	Data Type	Data Source
1.	TB Prevalence*	Age-adjusted TB prevalence taken from a national population-based survey.	Population-based household cluster survey	2014-2015 National TB Prevalence Survey(22)
2.	District HIV Prevalence	Age-adjusted HIV prevalence at 5x5 km geographic resolution 2000-2015 forthcoming from Prof. Hay's IHME geospatial team, aggregated to district – level.	Bayesian hierarchical geostatistical model. See representative publications.(48-50)	AIDS Indicator Surveys, Population Health Impact Assessment (PHIA)
3.	District ART Coverage	Proportion of the HIV+ individuals receiving ART as reported in national surveillance system, DHIS-2.	Aggregated patient data	PEPFAR 2006-2011. DHIS-2 for 2012 – 2016.
4.	Distance to Health Facility#	Population-weighted calculation performed using GIS and maps of public and private health facilities	Expansion of prior modeling analysis conducted by J. Ross.	Uganda Ministry of Health maps of health facilities
5.	Health facility TB diagnostic capacity	Presence of smear microscopy and/or Xpert MTB/RIF equipment in the health facility.	Publicly available (DHS), published (IHME-ABCE), and supplemented from NTLP	DHS Service Provision Assessment, Access, Bottlenecks, Care, and Equity Project(51)
6.	Population Density	Mapped from national census surveys at 1km x1km resolution, age-stratified	Publicly-available map made from census data.	WorldPop 2015(26)
7.	Poverty	Mapped from national census surveys at 1km x1km resolution	Publicly-available map made from census data.	WorldPop 2015(27)
8.	Undernutrition	Proportion of adults with BMI<18.5, proportion of children with underweight	Modeled from household cluster survey	Demographic and Health Surveys 2006- 2016
9.	Smoking and alcohol use	Prevalence of tobacco and alcohol use among adults	Modeled from household cluster survey	Demographic and Health Surveys 2006- 2016
10.	Treatment seeking behavior	Proportion of persons seeking care for febrile illness.	Modeled from household cluster surveys	Demographic and Health Surveys 2006- 2016, TB Prevalence Survey(22)

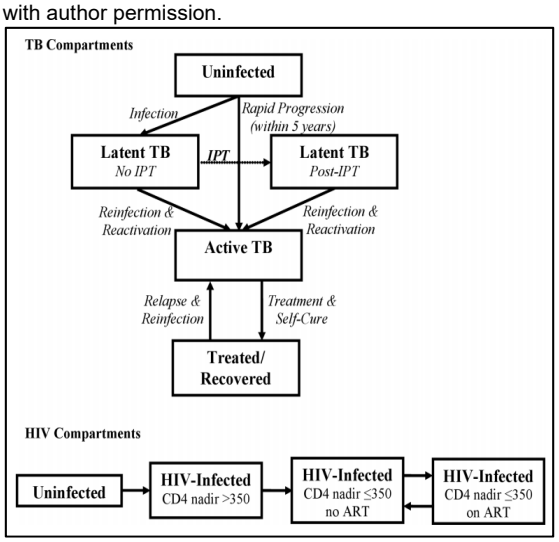
*While HIV-TB prevalence will be an outcome variable, whole population TB prevalence will be evaluated as a potential predictor variable.
#The proposed analysis will develop an aggregate measure of district-level accessibility to a health facility with TB diagnostic capability.

C.3.d Geospatial model - Geospatial models using a small area estimation approach appropriate for rare disease outcomes in geographic districts (polygons) will be developed for HIV-TB prevalence, incidence and mortality using a Bayesian statistical approach with template model builder (TMB) in R.(52-54) This modeling approach draws strength from neighboring regions in time and space to stabilize estimates for rare outcomes. We will **report uncertainty bounds for estimates** by generating 1000 candidate maps from the posterior distributions of the model parameters and reporting the 2.5th and 97.5th percentiles. The model includes data collected a different levels of geographic resolution, such as the regional-level results of the TB prevalence survey and the district-level notifications data to generate estimates at the level of the district (n=112). Predictors with a significant bivariate relationships with each outcome will be included multivariate models.

C.3.e Incorporating travel for care seeking – We expect that some patients will seek care outside of their home district, resulting in case notifications and deaths that may reflect a disproportionate burden in urban centers. Surveillance data from Kampala capitol city district include the home districts of patients. We will assess these data and anticipate modeling Kampala with districts in the surrounding region. Additionally, we will compare estimates from the household-based prevalence survey with case notifications to examine spatial patterns in care seeking and case underreporting.

C.3.e. Sample size calculation – The sample size of 112 districts yields >90% power to detect a modest correlation (>0.3) between the predictor and outcome variables assuming a slope of 0.10 in a linear regression model (Sampsi_reg, Stata version 14).

Figure 4. Candidate transmission model of TB-HIV co-infection developed by Dowdy and colleagues. Included with author permission.



C.3.f. Adaptation and validation of a district-level mathematical model of TB-HIV co-infection – We will adapt a dynamic transmission model of HIV-TB co-infection to include predictors from the statistical model described in section 3.c. to simulate the TB-HIV co-epidemics in each district. We will adapt the model developed by Dr. David Dowdy, mentor for this proposal, to estimate the impact of IPT on the HIV-TB co-infection epidemic in Rio de Janeiro, Brazil (Fig. 3).(55) This deterministic compartmental model includes people who are TB-uninfected, have latent TB infection (with or without PT), active TB, and are recovered from TB infection. **Each TB compartment is subdivided by HIV and ART status.** The district HIV-TB prevalence will inform the population of each compartment at initiation. Over time, individuals develop latent and then active TB infection, followed by recovery with treatment or death. Simultaneously, individuals are in a compartment that corresponds to their HIV and treatment status. Rates of flow through the compartments are determined by a series of differential equations solved numerically in R. The parameters described below govern rates of movement between compartments.

Table 2: Sources of Transmission Model Parameters

Derived from Epidemiologic Data		Estimated from Literature	
Model Parameter	**Source**	**Model Parameter**	**Source**
TB transmissions per infectious person-year	Model incidence from NTLP* case notifications	**Relative infectiousness of TB in PLHIV**	Williams[56]
Rate of TB diagnosis and treatment	TB prevalence, National TB Prevalence Survey[22]	**Partial immunity to TB re-infection if latently infected**	Cohen[57], Sutherland[58]
TB mortality rate	Model from NTLP* treatment outcomes	**Proportion of LTBI that progress rapidly to TB**	Vynnycky[59]
TB infections resulting in rapid progression (HIV+)	HIV positive TB cases, NTLP*	**TB progression from remote TB infection (HIV-)**	Dye[60]
Rate of ART initiation	Estimate from ART coverage CDC/PEPFAR	**Protective efficacy of PT against reactivation TB**	Aim 2 Danel[12], Rangaka[61]
HIV incidence	UNAIDS[21], IHME district-level estimates[64]	**TB progression rate after remote infection (HIV+)**	Gilks[62] Horsbough[63]
HIV mortality rate	IHME HIV district-level estimates[64]	*National TB and Leprosy Programme Surveillance Data	
TB relapse rate	Retreatment proportions, NTLP*		
Non-HIV, non-TB mortality	IHME district-level estimates		

C.3.g Model parameterization and validation – We will fit district-specific parameters for disease progression using a maximum likelihood approach by inputting into the model prevalence and mortality estimates generated from epidemiologic data in Aim 1, and from the literature (Table 2).(12, 21, 56-64) We will use data from a randomly chosen set of half of the districts (N=56) for model calibration, and reserve data from the remaining 56 districts for model validation. We will compare parameter values generated between calibration and validation model runs and models in the literature.(65, 66) Additionally, we will validate the HIV-TB model

predictions using data obtained for an additional year of surveillance (2018) not used for calibration. We will use these validation comparisons to generate insights into the key mechanistic drivers of differences in HIV-TB outcomes, as well as to validate the district-level estimates. **HIV and TB interact in the model** because persons who are **HIV-positive have a greater risk of progressing to active TB infection** (higher parameter value) **than do HIV negative individuals.** ART reduces the risk of progression from LTBI to active TB by 65%.(67)

C.3.h. Aim deliverables – We anticipate publishing manuscripts related to each of the following analyses:

-Mapping and modeling subnational variation in HIV/TB co-infection dynamics in high-burden settings.
-Mapping treatment seeking behavior for TB and accessibility of diagnostic services in Uganda.
-Spatial comparison of prevalence survey data and case notifications to localize missing patients.
-Assessing the relationship between ART scale-up and TB case notifications (led by Dr. Zawedde)

C.3.i. Limitations and alternative approaches - One challenge of documenting TB in settings with limited health infrastructure is that not all cases of TB are detected. We are emphasizing modeling of active HIV-TB prevalence and mortality because of the limitations of using TB case notifications to represent TB incidence, where current methods rely on expert opinion of case detection rates to adjust upward notification rates.(68) While we will explore modeling HIV-TB incidence directly using TB case notifications (with adjustment by treatment seeking behavior, and TB diagnostic capacity), we will also triangulate HIV-TB incidence by inputting the prevalence and mortality estimates into the transmission model. Developing methodological advances for using routine notifications data is a valuable goal, as notifications are frequently the most abundant source of TB data in countries without vital registration. We do not expect access to health surveillance data to be a limitation due to our strong working relationships with leaders in Ugandan ministries (see letters). The IHME geospatial model of HIV prevalence is currently under production, with anticipated publication in early 2019. If there are delays in production of this model, then we will utilize an alternative source for district-level HIV prevalence estimates.(21)

C.4. Aim 2a: Estimate the impact of PT (IPT and 3HP) on incident TB, TB mortality and adverse effects among PLHIV. Aim 2b: Quantify differences in TB outcomes for regionalized PT implementation.

C.4.a. Overview and rationale – Systematically review of the impact of PT on TB incidence, mortality, and adverse events across different populations groups and settings of HIV and TB burden. We will incorporate PT into the mathematical model of HIV-TB infection developed in Aim 1 and simulate how regional PT strategies would impact the HIV-TB co-infection epidemic, and at what cost.

C.4.b. Adapt the model to include the impact of PT on incident TB, TB mortality and adverse effects for PLHIV – We will add compartments to the model for persons who develop severe treatment limiting adverse effects while taking PT. PT will reduce the risk of progression from LTBI to active TB. The magnitude of this reduction will be determined by a systematic review of observational cohorts or clinical trials assessing the relative risk of four outcomes for PLHIV: (1) active TB, (2) TB mortality, (3) drug-resistant TB, and (4) severe adverse events. We will follow Cochrane Collaboration guidelines in completing our review and PRISMA guidelines in reporting the results. We will develop our search strategy in cooperation with a research librarian to include PubMed, Embase, and conference abstracts, as per Cochrane guidelines.(69) **We will stratify the studies by PT regimen** (6-9 months daily isoniazid versus 1-3 months of weekly rifapentine with isoniazid) and ART use, and assess as covariates the proportion of participants with a positive tuberculin skin test or interferon gamma release assay, participant CD4 count, TB diagnostic method, and length of PT. When available, we will assess the local HIV prevalence and TB incidence reported in the surrounding community. Study heterogeneity may preclude a meta-analysis; however, careful assessment of the studies and covariates will inform the bounds for the parameters that we use in the model to represent the effect of PT on an individual's risk of developing TB.

C.4.c. Including multidrug resistant TB in model – Drug resistance could reduce the efficacy of PT. While the prevalence of multidrug resistance in Uganda is low at 1.6%(28) and a prior meta-analysis suggests no significantly increased risk of drug resistance following IPT(70), we will vary the parameters for PT efficacy due to drug resistance similarly to other modeling analyses.(71)

C.4.d. Model outcomes, scenarios, and anticipated results – The outcomes from the modeling in this aim are incident TB cases among PLHIV, TB associated mortality, and disability adjusted life years (DALYs) averted by PT. DALYs averted will be calculated with a 0% discount rate and without age-weighting to conform with current Global Burden of Disease Study methods.(72) **The model scenarios include 1) uniform distribution** of PT across all health facilities providing ART versus **2) prioritization of PT** to health facilities and community-based ART programs in regions with greatest TB prevalence. We anticipate that prioritization of PT use in the highest transmission areas will have a greater health impact than a uniform strategy, and this study seeks to quantify that benefit. We may identify a region of very low TB burden where the risk of adverse events from PT poses a greater harm than the potential benefit.

C.4.e. Costing approach – We will estimate the incremental costs of delivering PT and the treatment costs incurred or averted in each of the modeled scenarios. We will use micro-costing data collected as part of the **Delivery Optimization for ART study (PI Barnabas)** to estimate the cost of **community-based PT** and micro-costing data for clinic-based TB screening and diagnosis collected by Dr. Dowdy as part of a pending trial in Uganda. Budget expense report data for isoniazid costs will be provided by the National TB and Leprosy Programme. We will estimate the cost efficiencies gained by using a uniform national versus regional strategy and conduct sensitivity analyses for this parameter.

C.4.f. Cost-effectiveness analysis (Table 3) – We will estimate the incremental cost effectiveness ratio (ICER) per incident HIV-TB case, death, and DALY averted by each of the PT scenarios described above. Interventions will be considered cost-effective if the ICER is <3 times local gross domestic product and very cost-effective if the ICER is <1 times GDP per DALY averted, per WHO guidelines.(73) This will assist decision makers to compare with other health priorities. We will follow guidelines by the Panel of Cost-Effectiveness in Health and Medicine(74) and report on 1, 5, 10, and 15 year time frames.

Table 3: Cost-effectiveness analysis

Perspective	Programmatic (e.g., NTLP)
Cost estimates	Isoniazid, costs of care
Data collection	Cost data from NTLP budget, DO-ART trial (PI Barnabas) for community care
Health Outcomes	Incident HIV-TB cases, deaths, and DALYS averted
Discount rate	3% per year, varies 0-5% in sensitivity analysis
Analytic time frame	Report on 1, 5, 10, and 15 year time frames

C.4.g. Aim deliverables - We anticipate publishing manuscripts related to each of the following analyses:

- Systematic review and meta-analysis of impact of PT on incident TB, TB mortality and adverse effects
- Forecasting TB outcomes, adverse events, and costs of uniform versus geographically prioritized PT in high-burden settings.
- Modeling potential TB outcomes and cost for community-based versus clinic-based PT implementation.

C.4.i. Limitations and alternative approaches – Differences in HIV and TB transmission dynamics and care may mean that PT performs differently in Uganda than in other settings. We will conduct our analysis with a range of efficacy parameters for PT to assess the sensitivity of our predictions to assumptions about PT effectiveness. Comprehensive data on LTBI prevalence are not available for fitting the model and will be derived using the model and assessed relative to published estimates.(37, 38)

C.5 Aim 3: Engage stakeholders to inform model development and evaluate strategies to improve the acceptability and feasibility of modeled strategies for TB prevention.

C.5.a Rationale – This aim is rooted in the field of **implementation science** by studying how to promote the integration of research model findings into policy. As many decision-makers in health programs come from a background of clinical medicine or public health that does not include instruction in geostatistical or transmission modeling, poor communication about modeling processes and results can form a bottleneck to implementation of findings.(47) We see an opportunity to assess how stakeholder participation in the results and data visualization process affects perceptions of acceptability and feasibility in a way that generalizes to other modeling efforts.

C.5.b Overview of randomized evaluation of model engagement – In a two-part process, we will first recruit stakeholders in the Uganda HIV and TB programs, brief them on the proposed model, and solicit their advice about key model inputs. Then, after completing the initial model, we will randomize the stakeholders to receive the model results in an interactive versus passive format, and quantify differences in implementation outcomes.

C.5.c. Definition of outcomes for implementation research – The concept of "implementation outcomes" as defined by Proctor and colleagues(75) to be distinct from clinical or service outcomes, provides a framework for assessment of eight areas which impact future intervention success (Fig. 5). This framework will guide the development of a questionnaire for evaluation of the impact of the method of presentation of model results on implementation outcomes. The outcomes of acceptability and feasibility (Fig. 5) will be explored in-depth in the questionnaire, as these are suitable for evaluation prior to intervention, and are hypothesized to vary by format of model presentation.

Fig 5. Implementation Outcomes (Proctor, *et al*)

Acceptability[1]	Appropriateness	Fidelity	Penetration
Adoption	Feasibility[2]	Cost	Sustainability

[1]*The perception among implementation stakeholders that a given treatment, service, practice or innovation is agreeable, palatable, or satisfactory.*
[2]*The extent to which a new treatment, or an innovation, can be successfully carried out within a given agency or setting.*

C.5.d. Development of user interface for model – IHME has pioneered the use of innovative methods of data visualization for stakeholder engagement (http://www.healthdata.org/results/data-visualizations). Grant funds will support the work of a dedicated programmer to develop an interface for stakeholders to alter the model inputs and receive the model predictions in multiple data visualization formats. Data visualizations will be available as

maps or charts. The user will be able to focus on their region of the country or the whole country model.

C.5.e. Participant recruitment and eligibility – For the initial questionnaires, we will recruit 30 senior program leaders from the National Tuberculosis and Leprosy Programme (NTLP), International Union Against TB and Lung Disease (TB Union), Centers for Disease Control (CDC) Uganda office, and the Ugandan AIDS Commission (UAC). Personnel targeted for recruitment will have titles such as Program Manager, Project Team Lead, or District Health Officer. We will utilize introductions from within our research group and affiliated public health officials (see letters of support).

C.5.f. Structured questionnaires with TB and HIV stakeholders – Meetings will be conducted in private locations and in English by Dr. Ross. The meeting will involve administration of a structured questionnaire focusing on suggested key inputs to models and perceived barriers to implementation of modeled strategies.

C.5.g. Data analysis – The responses to the stakeholder questionnaires will be reported by theme based on the implementation outcomes (Fig.5). Descriptive statistics will be calculated using R.(76) Comments from the questionnaire will be used to inform modeling and provide context without a formal qualitative analysis.

C.5.h. Follow-up meetings with model results – After completion of Aim 2, we will re-engage with stakeholders and present them with the model results predicting active TB incidence, HIV-TB deaths and DALYs averted in a targeted versus uniform strategy for PT implementation. Participants will be randomized to one of two arms using an algorithm in R. Participants in the intervention arm will receive a brief presentation of model results, followed by an opportunity to engage with the model and visualizations of the results on a tablet computer. Participants in the control arm will be invited to attend a presentation of the model results with an opportunity to ask questions of the presenter. After each session, an approximately 15-minute questionnaire via tablet computer. Questionnaires will focus on the participants' (1) familiarity with the techniques of geostatistical or mathematical modeling, (2) prior experience using modeling to inform programmatic decisions, (3) perceptions of the acceptability of modeling analyses to inform programmatic decisions, and (4) perceived barriers to implementation of targeted TB prevention. Questionnaire responses will be primarily numerical in nature, using tools such as Likert scales to assess responses.

C.5.i. Aim deliverables - We anticipate publishing manuscripts related to each of the following topics:

- Data and model visualization for stakeholder engagement
- Effect of model engagement strategy on stakeholder perceptions of intervention acceptability and feasibility

C.5.j. Limitations and alternative approaches – We anticipate that stakeholders will be willing to participate because our project already enjoys the support of leadership in the Ministry of Health (see letters of support). We could hear from participants that they are unlikely to change policy based on the results of a model, even after an opportunity to engage with the model. One reason could be that programs that prioritize resources to particular regions could be perceived as inequitable. To overcome this critique, we would emphasize the creation of a TB-prevention strategy for each district, even if particular districts have higher priority for PT implementation.

D. Conclusions and Future Directions: These studies will make important contributions to the understanding of the drivers of HIV-TB co-infection in a high-burden sub-Saharan African country and inform strategies for PT use in regions of varying HIV and TB prevalence. Developing a quantitative approach to using disease maps to inform health strategies (Aims 1+2) will be broadly applicable to the vast amount of geospatial health data currently published or under production.(64) The findings of Aim 3 will yield insight into the best practices for communicating about modeling studies and results. Through collaborations that I am building via IHME with many national TB programs in African nations, I would be eager to extend these methods to other African settings. Additionally, I will propose a further study to develop and evaluate implementation of multiple regionally-specific interventions for TB and HIV, such as mobile testing units and rapid TB diagnostic platforms including Xpert MTB/RIF) prioritized in different regions in Uganda.

Aim	Task	Yr 1		Yr 2		Yr 3		Yr 4	
	IRB submission	✓							
1	Assemble predictor and outcome data for geospatial model	✓	✓						
	Develop maps of predictor variables		✓	✓					
	Build geospatial model of HIV-TB co-infection			✓	✓				
	Conduct systematic review of progression from LTBI to active			✓	✓				
	Build transmission (mathematical) model of TB-HIV			✓	✓	✓			
2	Conduct systematic review of PT impact	✓	✓						
	Generate scenarios for targeted versus uniform PT use					✓	✓		
	Conduct cost-effectiveness analysis for model scenarios					✓	✓		
3	Identify TB and HIV stakeholders for interview		✓						
	Conduct initial stakeholder interviews			✓					
	Present model scenarios and categorize perception of results							✓	
All	Dissemination of results			✓	✓	✓	✓	✓	✓
R01 Prep	Parameterize HIV-TB transmission model for other interventions								✓
	Preparation and submission of R01 grant								✓

6.0 TRAINING IN THE RESPONSIBLE CONDUCT OF RESEARCH

My research will utilize data from people living with HIV infection in a developing country (Uganda), placing ethical standards at the forefront of our preparation for the project. The University of Washington's Department of Global Health is an international leader in training researchers in the responsible conduct of research. In the first year of my award period, I will attend the three-credit course Epidemiology 586: Responsible Conduct of Research – Global and Local, taught by Department of Global Health Professor Carey Farquhar. Among the objectives of the course are to teach students to (1) discuss the importance of scientific integrity in research, (2) describe submission of materials to domestic and foreign IRBs, and (3) discuss ethical dilemmas faced by international and domestic researchers.

I have also completed prior training in the responsible conduct of research. I enrolled in the UW Biomedical Research Integrity (BRI) Series for 2014 and 2015, completing 8 hours of lecture attendance and small group sessions focused on conflict of interest, data acquisition and ownership, responsible authorship, collaborative science, mentoring, and research misconduct. I also completed the Collaborative Institutional Review Board Training Initiative (CITI) course on the protection of human research participants in April of 2015. Both UW BRI and CITI courses fulfill the NIH requirement for Research Integrity Training. My Fogarty Global Health Fellowship included a 3.5 hours of discussion of research bioethics, responsible authorship, creating consent documents and submitting for institutional review, and ethics in international health research. I will renew my BRI enrollment in 2019 as either a participant or small group facilitator.

Date	Title	Hours	Format	Topics
Prior Training				
2015	Protection of Human Research Participants	2	Web-based	Belmont Report, Helsinki Conventions, IRB approvals, beneficence, autonomy and justice, special populations in research
2014-2015	UW Biomedical Research Integrity Series	8	Lecture and discussion groups	Conflict of interest, responsible authorship, research misconduct
2015	Fogarty Global Health Fellowship Orientation	1.5	Large group discussion	Ethics of clinical trials in global health
2015-2016	Fogarty Global Health Fellow Curriculum	3	Group discussion and written assignments	Responsible authorship, development of consent documents and submission for IRB review
Future training				
2019	Responsible Conduct of Research (Global and Local)	20	Daily seminar and small group discussion	Development of ethical research protocols, submission for IRB review, vulnerable populations
2019	UW Biomedical Research Integrity Series (renewal)	8	Lecture and discussion groups	TBA

PHS Human Subjects and Clinical Trials Information

OMB Number: 0925-0001 and 0925-0002

Expiration Date: 03/31/2020

Are Human Subjects Involved	● Yes ○ No
Is the Project Exempt from Federal regulations?	○ Yes ● No
Exemption Number	❑ 1 ❑ 2 ❑ 3 ❑ 4 ❑ 5 ❑ 6 ❑ 7 ❑ 8
Other Requested Information	

Human Subject Studies

Study#	Study Title	Clinical Trial?
1	Engagement of stakeholders to inform model development and facilitate implementation of preventive therapy for TB prevention	No

Section 1 - Basic Information (Study 1)

OMB Number: 0925-0001 and 0925-0002

Expiration Date: 03/31/2020

1.1. Study Title *

Engagement of stakeholders to inform model development and facilitate implementation of preventive therapy for TB prevention

1.2. Is this study exempt from Federal Regulations * ❍ Yes ● No

1.3. Exemption Number ❑ 1 ❑ 2 ❑ 3 ❑ 4 ❑ 5 ❑ 6 ❑ 7 ❑ 8

1.4. Clinical Trial Questionnaire *

1.4.a. Does the study involve human participants?	● Yes	❍ No
1.4.b. Are the participants prospectively assigned to an intervention?	● Yes	❍ No
1.4.c. Is the study designed to evaluate the effect of the intervention on the participants?	● Yes	❍ No
1.4.d. Is the effect that will be evaluated a health-related biomedical or behavioral outcome?	❍ Yes	● No

1.5. Provide the ClinicalTrials.gov Identifier (e.g. NCT87654321) for this trial, if applicable

Section 2 - Study Population Characteristics (Study 1)

2.1. Conditions or Focus of Study

- Acceptability of study results to stakeholders in Uganda TB and HIV programs

2.2. Eligibility Criteria

Stakeholders will be recruited from the leadership of organizations such as the Ministry of Health, National TB and Leprosy Program (NTLP), Centers for Disease Control (CDC), and International Union Against TB and Lung Disease. They will be adults aged 18 or older, as children do not hold these positions. English fluency will be required, as presentations and interviews will be conducted in English.

2.3. Age Limits	Min Age: 18 Years	Max Age: N/A (No limit)
2.4. Inclusion of Women, Minorities, and Children	FINAL_WomenMinoritiesChildren_ModelingTB3_20180423.pdf	
2.5. Recruitment and Retention Plan	FINAL_RecruitmentRetentionPlan_ModelingTB3_20180423.pdf	
2.6. Recruitment Status	Not yet recruiting	
2.7. Study Timeline	FINAL_Timeline_ModelingTB3_20180423.pdf	
2.8. Enrollment of First Subject	01/15/2020	Anticipated

INCLUSION OF WOMEN, MINORITIES, AND CHILDREN

This description applies to Aim 3 of the proposal. Aims 1 and 2 do not involve human subjects research, as they involve secondary analyses of de-identified data collected for another purpose, which the research team will not be able to link to identifiable information.

1. Inclusion of Women and Minorities

The participants recruited for the stakeholder study in Aim 3 are expected to be a roughly equal proportion of men and women. The majority of these participants will likely be black/African race, as these are the individuals who hold the majority of public health positions in Uganda. Individuals who are not of black/African race will also be eligible for participation if they hold leadership positions within HIV-TB organizations. No sex/gender, racial, or ethnic group will be excluded from participation. No separate analysis of responses by gender or race is planned due to the sample size of only 30 participants. Participants will be recruited through the research networks of my mentors and key collaborators.

2. Inclusion of Children

No children will be included in the human subjects portion of the study, which is the stakeholder engagement study in Aim 3, as they do not hold decision-making positions within TB or HIV organizations in Uganda. De-identified data from children will be included in the models developed in Aims 1 and 2 of the study. Data from children will include the TB case notifications among HIV-positive children, child HIV prevalence, prevalence of poverty, and prevalence of child undernutrition in each district. Additionally, data will be included from adolescents ages 15 years and above, who meet the NIH definition of children, as the national population based TB prevalence survey included persons ages 15 years and older.

RECRUITMENT AND RETENTION

I plan to recruit 30 TB and HIV stakeholders to participate in Aim 3 of the proposal. These stakeholders will be drawn from the leadership of organizations such as the Ministry of Health, National TB and Leprosy Programme (NTLP), Centers for Disease Control (CDC), and International Union Against TB and Lung Disease (TB Union). Likely candidates will have titles such as Program Manager, Project Specialist, and District Health Officer. They will all be adults aged 18 or older, as children do not hold these positions. Their health status will not be relevant to their participation.

The 30 stakeholders will be recruited using convenience sampling through the professional networks of my mentors and scientific advisors. At least one participant from each of 10 health regions in the country will be recruited through these networks. Fluency in English language will be required to participate in the study. A small monetary participant incentive will be provided to improve retention in the study for the second interview, though it is not essential for the success of the aim that the participants all be the same in the first and second portions of the study. No subpopulation will be excluded.

STUDY TIMELINE

This timeline applies to the human subjects portion of the proposal, which involves engagement with stakeholders in Ugandan HIV and TB programs regarding the acceptability and feasibility of modeling strategies. The timeline for the other aims of the proposal are detailed in the research plan.

I will initially engage with stakeholders early in the second year of the proposal in structured interviews (Table). I will re-engage with stakeholders early in the fourth year of the proposal to present the modeled scenarios and evaluate how presentation of the results in an interactive versus passive format affects perceptions of acceptability and feasibility of the results.

Table: Timeline for engagement with stakeholders in Aim 3 of the research proposal

Aim	Task	Yr 1		Yr 2		Yr 3		Yr 4	
3	Identify TB and HIV stakeholders for interview		✓						
	Conduct initial stakeholder interviews			✓					
	Present model scenarios and categorize perception of results							✓	
	Dissemination regarding the effect of engagement method on perceptions of acceptability and feasibility								✓

Inclusion Enrollment Reports

IER ID#	Enrollment Location Type	Enrollment Location
Study 1, IER 1	Foreign	Potential stakeholders from the 10 health regions of Uganda will be recruited.

Inclusion Enrollment Report 1

Using an Existing Dataset or Resource* : ❍ Yes ● No

Enrollment Location Type* : ❍ Domestic ● Foreign

Enrollment Country(ies): UGA: UGANDA

Enrollment Location(s): Potential stakeholders from the 10 health regions of Uganda will be recruited.

Comments: This form corresponds to aim 3 of the proposal. For this implementation science aim, we will recruit stakeholders in the Uganda HIV and TB programs, brief them on the proposed modeling effort, and randomize them to receive the model results in one of two formats. Participants in the intervention arm will attend a forum where they can interact with a user interface for the model. Participants in the control arm will be invited to a presentation of the model results.

Planned

Racial Categories	Ethnic Categories				Total
	Not Hispanic or Latino		Hispanic or Latino		
	Female	Male	Female	Male	
American Indian/ Alaska Native	0	0	0	0	0
Asian	0	0	0	0	0
Native Hawaiian or Other Pacific Islander	0	0	0	0	0
Black or African American	15	15	0	0	30
White	0	0	0	0	0
More than One Race	0	0	0	0	0
Total	15	15	0	0	30

Cumulative (Actual)

Racial Categories	Ethnic Categories									Total
	Not Hispanic or Latino			Hispanic or Latino			Unknown/Not Reported Ethnicity			
	Female	Male	Unknown/ Not Reported	Female	Male	Unknown/ Not Reported	Female	Male	Unknown/ Not Reported	
American Indian/ Alaska Native	0	0	0	0	0	0	0	0	0	0
Asian	0	0	0	0	0	0	0	0	0	0
Native Hawaiian or Other Pacific Islander	0	0	0	0	0	0	0	0	0	0
Black or African American	0	0	0	0	0	0	0	0	0	0
White	0	0	0	0	0	0	0	0	0	0
More than One Race	0	0	0	0	0	0	0	0	0	0
Unknown or Not Reported	0	0	0	0	0	0	0	0	0	0

Total	0	0	0	0	0	0	0	0	0	0

Section 3 - Protection and Monitoring Plans (Study 1)

3.1. Protection of Human Subjects	FINAL_HumanSubj_ModelingTB3_20180423.pdf
3.2. Is this a multi-site study that will use the same protocol to conduct non-exempt human subjects research at more than one domestic site?	❍ Yes ● No ❍ N/A
If yes, describe the single IRB plan	
3.3. Data and Safety Monitoring Plan	FINAL_DataSafetyMonitoring_ModelingTB3_20180423.pdf
3.4. Will a Data and Safety Monitoring Board be appointed for this study?	❍ Yes ● No
3.5. Overall structure of the study team	FINAL_StudyTeam_ModelingTB3_20180423.pdf

PROTECTION OF HUMAN SUBJECTS

Overview: Aim 3 is non-exempt human subjects research, and a full description of human subjects protection is provided for this aim. This study engages stakeholders in Ugandan TB and HIV programs at two points in the overall proposal. First, stakeholders input is solicited for the design of the models, and then the human subjects portion of the research assesses the effect of presentation of model results on perceived acceptability and feasibility of the proposed solutions. This is not a clinical trial, as the assessments proposed do not involve biomedical or health-related behavioral outcomes.

Aims 1 and 2 do not involve human subjects research, as they use only secondary analysis of de-identified data collected for another purpose, and for which the investigators have no method of linking to the individual's identity.

Aim 3: Engage stakeholders to inform model development and facilitate implementation of PT for TB prevention.

1. Risks to Human Subjects
1.a Human Subjects Involvement, Characteristics, and Design

Study Design
This is an implementation science study designed to engage stakeholders in Ugandan HIV and TB programs to assess the feasibility and acceptability of incorporating models into program planning. Engagement with stakeholders comes at two points in the research. First, in year 1 of the project, stakeholder input is solicited for the design of the models, and then, in year 4, the human subjects portion of the research assesses the effect of presentation of model results on perceived acceptability and feasibility of the proposed solutions. This is not a clinical trial, as the assessments proposed do not involve biomedical or health-related behavioral outcomes.

Characteristics of the Subject Population
I plan to recruit 30 TB and HIV stakeholders to participate in Aim 3 of the proposal. These stakeholders will be drawn from the leadership of organizations such as the Ministry of Health, National TB and Leprosy Programme (NTLP), Centers for Disease Control (CDC), and International Union Against TB and Lung Disease (TB Union). Likely candidates will have titles such as Program Manager, Project Specialist, and District Health Officer. They will all be adults aged 18 or older, as children do not hold these positions. Their health status will not be relevant to their participation.

Sampling Plan
The 30 stakeholders will be recruited using convenience sampling through the professional networks of my mentors and scientific advisors. Fluency in English language will be required to participate in the study. A small monetary participant incentive will be provided to improve retention in the study for the second interview, though it is not essential for the success of the aim that the participants all be the same in the first and second portions of the study. No subpopulation will be excluded.

Rationale for Involvement of Special Vulnerable Populations
No vulnerable populations, as defined by HHS regulations, will be included in the research.

Assignment to Study Group
There will be no assigned study groups for the first round of interviews. For the second part of the study, participants will be randomly assigned to one of two intervention groups. Participants randomized to the intervention arm will attend a forum where they can interact with a user interface for the model, manipulate its inputs, and visualize the results in different formats (e.g., maps versus charts, prevalence versus mortality). Participants in the control arm will be invited to a presentation of the model results with an opportunity to ask questions of the presenter.

Collaborating Sites
All interviews will be conducted in Uganda in the offices of the research participants. The proposed research will involve collaboration with investigators at Johns Hopkins University (Manabe, Dowdy), Makarere University

(Zawedde-Muyanja, in addition to the University of Washington (Ross, Barnabas, Hay). We will seek human subjects review from the University of Washington and Makarere University prior to initiating our research.

1.b. Study Procedures, Materials, and Potential Risks

Study Procedures and Research Materials

For Aim 3 of this proposal, we will recruit 30 Ugandan TB and HIV stakeholders for an approximately 30 minute visit to administer a structured questionnaire. Subsequently, we will randomize the stakeholders to receive the model results in one of two formats. Participants randomized to the intervention arm will attend a forum where they can interact with a user interface for the model, manipulate its inputs, and visualize the results in different formats (e.g., maps versus charts, prevalence versus mortality). Participants in the control arm will be invited to a presentation of the model results with an opportunity to ask questions of the presenter. Involvement of human subjects is necessary to complete this aim, which involves evaluating their perceptions of the feasibility and acceptability of modeled scenarios based on alternate visualizations of the results. Engagement with stakeholders will also improve the applicability of the models generated by this proposal.

The research material collected from the participant will include their responses to questionnaires administered on a tablet computer. Example questions for the first survey are whether participants have ever received instruction in modeling, the barriers to incorporating modeling results into their decision-making, and what they perceive as important factors for the model to include. Example questions for the second survey, which will follow a visual display of the model results, will include the acceptability of implementing a public health strategy that differs by geographic region, and also what additional resources they would need to implement such a strategy.

Access to Identifiable Private Information and Data Management

The participant's name will be collected on a consent form and linked with a study code. No private information will be collected by the questionnaire on the tablet computer. The study PI and research assistant will be the only people who have access to the names of participants on the consent forms. Consent forms will be kept in a locked cabinet. Coded questionnaire responses will be uploaded from the tablet to a password-protected file on the UW One Drive. The identities of study participants will not be shared. The employment affiliation of study participants will not be linked to their comments in publications.

Potential Risks

The questionnaires involved in this research will expose the participants to minimal risk. There is a possibility that subjects could feel embarrassed by disclosing a lack of knowledge or expertise to the investigator. We will seek to minimize this risk by having participants complete the questionnaire in tablet form rather than by responding to the investigator.

2. Adequacy of Protection Against Risks

2.a Informed Consent and Assent

The 30 stakeholders will be recruited using convenience sampling through the professional networks of my mentors and scientific advisors. I will document informed consent for participation using a written consent form.

2.b Protections Against Risk

Procedures for Minimizing Potential Risks

The consent forms that include the participants' names will be kept in a locked file on the UW campus. There is potential risk for loss of forms prior to their receipt on the UW campus, but this would be expected to cause minimal harm as these forms would only indicate study participation and not responses to any questions. The file linking study identifiers to participant names will be kept in a password protected file on the secure UW One Drive online. Only the research assistant and I (as project PI) will have access to this file. The research assistant will be required to take online training in the Responsible Conduct of Research prior to their participation.

Necessary Medical or Professional Intervention

No need for medical or professional intervention is anticipated in this investigation.

2.c Research Involving Vulnerable Populations

No vulnerable populations, as defined by HHS regulations, will be included in the research.

3. Potential Benefits of the Proposed Research to Human Subjects and Others

The subjects themselves are not expected to benefit from this research. However, incorporation of modeling into decision-making could facilitate more efficient use of resources by health programs, which could allow more people to benefit from efficient spending by health programs.

4. Importance of the Knowledge to be Gained

The knowledge gained from this proposed research is expected to inform future efforts to communicate with decision-makers about the design and results of models. This could improve the quality and applicability of models and also increase the likelihood that decision-makers incorporate model results into their policy decisions.

DATA AND SAFETY MONITORING PLAN

The proposed research does not require a data and safety monitoring plan as it does not include a clinical trial and poses minimal risks to participants.

OVERALL STRUCTURE OF STUDY TEAM

Not applicable. This proposal does not include a clinical trial.

Section 4 - Protocol Synopsis (Study 1)

4.1. Brief Summary

4.2. Study Design

4.2.a. Narrative Study Description

4.2.b. Primary Purpose

4.2.c. Interventions

Type	Name	Description

4.2.d. Study Phase

Is this an NIH-defined Phase III Clinical Trial? ❍ Yes ❍ No

4.2.e. Intervention Model

4.2.f. Masking ❍ Yes ❍ No

❑ Participant ❑ Care Provider ❑ Investigator ❑ Outcomes Assessor

4.2.g. Allocation

4.3. Outcome Measures

Type	Name	Time Frame	Brief Description

4.4. Statistical Design and Power

4.5. Subject Participation Duration

4.6. Will the study use an FDA-regulated intervention? ❍ Yes ❍ No

4.6.a. If yes, describe the availability of Investigational Product (IP) and Investigational New Drug (IND)/ Investigational Device Exemption (IDE) status

4.7. Dissemination Plan

Delayed Onset Studies

Delayed Onset Study#	Study Title	Anticipated Clinical Trial?	Justification
The form does not have any delayed onset studies			

12.0 VERTEBRATE ANIMALS

Not applicable

13.0 SELECT AGENT RESEARCH

Not applicable

14.0 CONSORTIUM/CONTRACTUAL AGREEMENTS

Not applicable

15.0 RESOURCE SHARING PLAN

Not applicable

16.0 Authentication of Key Biological and/or Chemical Resources

Not applicable