2015 Global Health Summer Opportunities
The Massachusetts General Hospital-Mbarara University of Science and Technology (MUST) collaboration joins bio-medical research, academic medicine, and community health initiatives to improve the delivery of rural health care in resource-limited settings. The Uganda program has two components. After a brief orientation, students join peers from MUST in developing and implementing four-week community health improvement projects from the Bugoye Health Center, a rural public clinic along the Uganda-DRC border. The second half of the summer is spent in Mbarara, with students taking the lead on one or two service projects to support ongoing collaboration priorities and gain experience in strengthening health systems at the Mbarara Regional Referral Hospital. Basic administrative tasks are common and an ability to work independently with minimal supervision is essential.
This internship will be set at the Partners In Health / Socios En Salud Sucursal Peru (PIH-Peru) site in Lima, Peru. Harvard faculty members have collaborated with PIH-Peru for more than 15 years to improve the detection and treatment of drug-resistant TB, working closely with the Ministry of Health and engaging community treatment supporters. Ongoing collaborative projects at the PIH-Peru site include major research and training initiatives focused on: shortening the duration of TB therapy, understanding the ability of drug-resistant TB strains to cause new cases, developing a rapid urine-based diagnostic test for active TB, decreasing default during treatment for drug-resistant TB, improving the detection and treatment of children with drug-resistant TB, and providing intensive and ongoing technical assistance for the management of drug-resistant TB. Interns will be introduced to the activities of all of these project teams.
Interns with The Research Program on Children and Global Adversity (RPCGA) at the FXB Center for Health and Human Rights will contribute to supporting data collection, management, and analysis of two ongoing intervention projects related to resilience and mental health for children, youth, and families affected by adversity. In Sierra Leone, the proposed research will significantly advance knowledge of the intergenerational effects of war in sub-Saharan Africa using ecological developmental theory to study mechanisms of trauma and resilience operating at the individual, family, and community levels. In Rwanda, the project will develop and pilot a family-based intervention that can be initiated as families come into contact with health systems via routine HIV testing and care, with the goal of preventing mental health problems in children affected by HIV/AIDS. Preference will be given to students with course training in psychology, global health, child health, education, or economics.
The Dursaisingh Laboratory studies the biology and pathogenesis of human malaria using molecular, genetic and cell biological approaches. Specifically, we are interested in the mechanism by which the malaria parasite invades red blood cells, the regulation of parasite virulence genes by epigenetic mechanisms, and the effect of red blood cell mutations on malaria infection. Preference will be given to students with experience or coursework in molecular biology, genetics, biology, or infectious diseases.
The Essex Laboratory conducts research on the virology, immunobiology, and molecular epidemiology of HIV-1 viruses. The research is oriented to the evolution of new viruses, both circulating recombinant forms and variants that emerge by accumulation of mutations. The studies are usually linked to questions of vaccine design, disease pathogenesis, drug efficacy, and transmission efficiency. These topics are addressed with particular emphasis on the HIV-1C epidemic in southern Africa, and tied to our clinical studies in Botswana. Preference will be given to students with coursework or experience in molecular biology or genetics. Students should have taken Life Sciences 1a or equivalent.
The Botswana–Harvard AIDS Institute Partnership (BHP) is a collaborative research and training initiative between the Government of the Republic of Botswana and the Harvard School of Public Health AIDS Initiative. At the heart of BHP’s mission is a collaborative approach to conducting clinical and laboratory-based research, with an emphasis on training and building local capacity. Students may have an opportunity to work on either wet lab projects or the ongoing Clinical Information Technology Project. Applicants for the lab project should have previous wet lab research experience, and preference will be given to rising juniors and seniors who have taken courses that include wet lab experience or have a previous research experience in a wet lab. Applicants for the Clinical Informational Technology Project must have significant prior programming experience and are expected to be able to program independently in Python during the summer.

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Under the leadership of Professor Wafaie W. Fawzi, the Harvard-Tanzania Partnership seeks to address critical gaps in nutrition and global health research training, with training opportunities in the areas of nutrition and infectious disease, perinatal/child health, and chronic disease. Harvard faculty and international collaborators provide mentorship and research opportunities for students to engage in nutrition-related global health research in resource-poor settings. The Harvard-Tanzania Partnership conducts several large epidemiologic studies and randomized clinical trials. While nutrition is the central focus of ongoing research activities, it is considered within a broader public health agenda including global health. Student projects may center on the basic sciences, clinical data-collection, and/or potential policy outcomes based on the study findings. In the past, students have assisted with data entry and analysis and other administrative tasks essential to the research agenda. Preference will be given to students who have taken SLS 19.

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The Goldberg Laboratory focuses on host-pathogen interactions and development of novel antibiotics. One focus of the lab research is the molecular mechanisms of interactions of bacterial pathogens with mammalian host cells. Much of our work focuses on the intestinal pathogen Shigella, which is responsible for an estimated 550 million cases of diarrhea and dysentery and 1.1 million deaths annually worldwide. A second focus in the lab is the development of a novel class of antibiotics that will be active against those bacteria which are resistant to currently available antibiotics, and will minimize the development of resistance. Preference will be given to students with coursework or experience in molecular biology, biology, chemistry, and biochemistry.
The Hartl Laboratory uses genome sequencing to study the historical evolution of the malaria parasite and the emergence of genetic resistance to artemisinin-based combination drug therapies to malaria. Based on parasite sequences from Senegal, we have identified candidate genes involved in artemisinin resistance; other features revealed by analysis include selection against GC-to-AT substitutions that offsets the large mutational bias toward AT, and the rapid decay of linkage disequilibrium across short distances. We also trace the evolution of parasite drug resistance, focusing on an essential enzyme that is a critical target of antifolate drugs used in malaria treatment. We pioneered an approach that puts the concept of an adaptive landscape in the experimental context of protein evolution. We’ve found that the adaptive landscape of resistance in DHFR is unexpectedly smooth with limited instances of sign epistasis and virtually no reciprocal sign epistasis. Experiments are ongoing to determine whether this smoothness is a general property of protein evolution in sequence space.

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Through this Institute of Politics co-sponsored Director’s Internship, students will apply for positions with the Office of Global Affairs of the Department of Health and Human Services. OGA sets priorities for international engagements and develops and strengthens relationships with government agencies, foreign ministries of health, multilateral partners, and with civil society and the private sector. OGA provides policy recommendations and staff support to senior HHS leadership in the areas of global health and social issues, and coordinates international health and social matters across HHS. OGA’s government partners include the National Security Staff, the Department of State, the Department of Defense, the U.S. Agency for International Development, and others. Multilateral partners include the World Health Organization, the Pan American Health Organization, the Global Fund to Fight AIDS, Tuberculosis and Malaria, the U.N. Joint Program on HIV/AIDS (UNAIDS), the Organization for Economic Cooperation and Development, and the GAVI Alliance.

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This internship offers students the opportunity to interact with and experience health care policy, public health administration, and Congress from a non-partisan, Executive Branch perspective. HRSA is the primary federal agency that is committed to improving access to health care services for people who are uninsured, isolated, or medically vulnerable. HRSA/OL activities range from the legislative development processes to ongoing congressional interaction, engagement, and relationship building, as well as research and strategic communication. Student interns will have the opportunity to assist with projects that have impact on the delivery and availability of health care in the United States. Read the program description for more details or visit the HRSA website.

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Young Leaders for Global Health

Harvard University Center for AIDS Research

Harvard students involved in this Project will assist with the implementation of this community engagement and enrichment program to educate local urban youth located in the Boston area on the impact of HIV among young people, especially in the U.S. Students will be responsible for facilitating educational sessions, which will include conducting community presentations at local youth summer programs, and recruiting project participants as well as local guest speakers and experts. Students will actively work to support all of the project’s efforts in HIV education and health promotion.

While working on this Project, students will:
• Develop leadership and facilitation skills
• Model positive behaviors and impact social norms, and
• Effectively communicate culturally appropriate HIV educational awareness message strategies.

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Washington, D.C.
Photo Courtesy of Myra Khan
The Hung Laboratory combines chemical and genomic approaches to define host-pathogen interactions and to reveal essential in vivo gene functions of pathogens that may be potential therapeutic targets for antimicrobial development. In addition, by deploying small organic molecules on a genome-wide scale to both perturb and understand bacterial infection, Dr. Hung seeks to identify new therapeutic prospects for a variety of devastating pathogens, including *Vibrio cholerae*, *Pseudomonas aeruginosa*, and *Mycobacterium tuberculosis*. The Hung lab uses chemical, biological, and genomic approaches to understand host-pathogen interactions and to develop new paradigms on how to intervene on infection. Preference will be given to students with previous coursework in biology and chemistry with a lab component, or to those with previous lab experience.
Young Leaders for Global Health

Children’s Hospital Boston: Division of Infectious Diseases

Tuberculosis

Robert Husson

The Husson Laboratory studies adaptive mechanisms of *Mycobacterium tuberculosis* that are important for the pathogenesis of TB disease. The main areas of research focus on signal transduction and transcription regulation in the bacterium. A range of microbiologic, biochemical, molecular, and proteomic approaches are used in our research. Preference will be given to students with coursework in biology, molecular biology, biochemistry, and/or microbiology.

From the Interns

I completed wet lab work, conducting research on CRISPR/CAS9 systems of RNA interference in *Mycobacterium*. The goal of the project was to develop a system with which to study various membrane pathways in *M. tuberculosis*. The best thing about the program was getting to talk to doctors in the Infectious Diseases department at Children’s Hospital about their work.

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Advice for Future Interns

My advice to future students is to not be afraid of asking questions - there are many opportunities to learn about both research and the clinical applications of basic research.
The Harvard Global Health Institute Program Development interns will have the opportunity to be actively involved in the Institute’s educational initiatives, helping to create curricular materials on integrative, cross-disciplinary issues in global health. They will gain exposure to the work of the Institute and to the realm of topics, disciplines, and careers that are integral to the field of global health. The Program Development Internship may appeal to students looking to explore global health career options related to education or evidence-based policymaking. As a part of the global health summer research cohort, Program Development interns will have the opportunity to take part in the various workshops, seminars and presentations organized by the Institute, building a network of peers who are interested in a range of global health challenges and opportunities.
Treatment Action Group (TAG) is an independent AIDS research and policy think tank fighting for better treatment, a vaccine, and a cure for AIDS. TAG’s TB/HIV project works to catalyze global leadership and strengthen global and U.S.-focused advocacy, with the goal of increased funding and improved research, programs, treatments, and policies that secure universal access to quality services for people with TB and HIV. TAG and Partners In Health recently launched a campaign called “Zero TB Deaths, New Infections and Suffering,” which calls for urgent global action against TB. This campaign sets ambitious targets in order to catalyze the global response to TB, which kills 2 million people annually despite being both preventable and curable. Students will work on various aspects of the campaign, support other TAG TB/HIV projects, and perform administrative tasks where needed.

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The Kuritzkes Laboratory researches HIV-1 drug resistance, viral fitness, and HIV-1 persistence. For many HIV-infected patients, antiretroviral therapy’s benefits are limited by drug-resistant virus. Additionally, the reduced replicative capacity of drug-resistant variants of HIV-1 may contribute to the persistent immunological benefits in patients who are “failing” antiretroviral therapy. The laboratory is exploring the mechanisms behind resistance and using a novel recombinant marker virus assay to determine the fitness of drug-resistant HIV-1 and to study the effect of viral fitness in the evolution of antiretroviral drug resistance. Additional research, inspired by the apparent “functional” cure in an HIV-1-infected patient through allogeneic stem-cell transplantation, is focused on a cure for HIV infection. Ongoing studies seek to identify, characterize, and quantify the reservoir of cells harboring latent HIV-1, and to determine the impact of ablative and non-ablative chemotherapy, autologous and allogeneic stem cell transplantation on the viral reservoir. Students must have Life Sciences 1a/1b or equivalent with laboratory; upper-level courses in molecular biology preferred.

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The Kwon Laboratory is focused on applying new technologies to the study of immune responses against HIV at mucosal surfaces. Mucosal surfaces represent both the primary site of HIV transmission and the largest reservoir of viral replication. We are employing new technologies, such as next-generation sequencing, and those developed in conjunction with our collaborators at the Massachusetts Institute of Technology, to simultaneously capture multiple measures of viral, metagenomic, and adaptive immune factors important for HIV immunity and pathogenesis. In the past, students have conducted wet lab experiments, analyzed data, and shadowed clinicians.
Hepatitis C virus (HCV) infection affects more than 170 million people worldwide, putting them at risk of liver failure and liver cancer. Therapies are of limited efficacy and no vaccines are available. We try to understand the role of T-cell responses targeting HCV during acute and chronic infection in order to define the correlates of immune protection and T-cell failure and facilitate development of better therapies or vaccines, and also to use HCV as a general model for human immunology. In addition we are interested in how co-infection with HIV modulates the immune response against HCV. Research opportunities involve direct interaction with clinical staff and patient samples/data. Students with an interest in viral immunity, translational research, and medical sciences are welcome. Previous experience in a biological/biomedical lab and training in basic lab techniques are required. Experience in cell culture and/or flow cytometry is preferred.
The Le Gall Laboratory focuses on understanding how HIV is degraded inside infected cells into peptides presented to immune cells. We aim to decipher what factors lead to efficient peptide presentation to immune cells, how the virus tries to prevent its presentation to immune cells, and how to use this knowledge to design vaccine immunogens. Our research topics make use of multiple techniques and assays, ranging from protein biochemistry, cell biology, immunology and virology. In the past students, have worked with experiments (cell culture, cell fractionation, peptidase activities, Western blot, immunoprecipitation, protein degradation, HPLC, mass spec analysis, killing assays), data analysis, data presentation at group meetings, journal club, and report preparation. Knowledge in immunology (antigen processing and presentation, MHC, T cells), cell biology, or HIV would be helpful for applicants.
The Lesser Laboratory is interested in understanding the many ways that bacterial pathogens like Shigella, Salmonella and enteropathogenic E. coli manipulate host cells to cause disease. In particular, the lab focuses on identifying and characterizing the roles in pathogenesis of proteins that the bacteria directly inject into host cells. The Lesser lab uses a variety of techniques to address these issues, including hypothesis-driven and systems biology approaches. Diarrheal diseases, many of which are caused by the bacteria our laboratory studies, are the second-leading cause of death in children under five years old, particularly in developing countries. By deciphering the ways that these bacteria cause disease we hope to identify new ways to treat and prevent these potentially lethal infections. Preference will be given to students with coursework or experience in microbiology, molecular biology, systems biology, or cell biology.
The Lieberman Laboratory studies cytotoxic T lymphocytes (CTLs) and their role in antiviral immunity, which has applications for the treatment of herpes simplex virus 2, HIV, cancer, hepatitis, and other diseases. It focuses on the molecular pathways used by CTLs to induce cell death, especially the CTL proteasegranzyme A, which induces a novel form of programmed cell death. The lab is exploring the molecular basis for DNA destruction and mitochondrial damage in this caspase-independent apoptotic pathway, and has shown that granzyme A targets the SET complex, a chromatin modifying and DNA repair complex mobilized in response to oxidative stress. Recent work has focused on the biochemistry and cell biology behind the action of perforin, the CTL protein responsible for delivering the death-inducing granzymes into targeted cells. Preference will be given to students concentrating in the biological sciences; previous laboratory experience is desired by not required.
The Luster Laboratory developed a markedly improved humanized mouse model of HIV by transplanting human CD34+ stem cells and autologous human thymic grafts into immunodeficient mice. We have achieved robust repopulation of mouse lymphoid and peripheral tissues with human immune cells, and have generated anti-HIV cellular and humoral immune responses in these mice. The model allows us to study the biology of HIV-1 and the host immune response to HIV, as well as HIV vaccines and immune correlates of a protective vaccine. Further, the model enables us to interrogate the role of key molecules and pathways implicated in the human immune response to HIV. We are exploring whether the PD-1 pathway will reinvigorate “exhausted” CD8+ T-cells in vivo and lead to better control of HIV replication. Preference will be given to biology/immunology students, and to applicants with small-animal lab experience. Facility training will be required and can be completed prior to start date.
Tuberculosis is a difficult disease to treat, in part because it can adapt to survive antibiotic treatment even when the DNA sequence would suggest that they are susceptible. In collaboration with the Rubin lab at Harvard, this site provides students an opportunity to work with Professor Babak Javid at Tsinghua University in Beijing, one of China’s leading medical schools. Dr. Javid’s lab has found that this resistance could be due, in part, to changes in how accurately bacteria translate the genome sequence into proteins. Moreover, bacteria are able to modulate translational fidelity in response to their growth conditions.

In the past, undergraduates have studied the mechanisms underlying translational fidelity. Students live on the Tsinghua campus and join Tsinghua and Cambridge University undergraduates (along with graduate students and postdocs) in the lab. Only English is spoken in lab; preference will be given to students with previous laboratory experience.

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Tuberculosis (TB), caused by *Mycobacterium tuberculosis*, remains one of the world’s largest killers. The Rubin Laboratory studies the bacteria that cause TB and their interaction with the host with an eye toward developing new antibiotics. Because these bacteria are hazardous and working with them requires extensive training, most undergraduates work with related bacteria but still with the goal of understanding the pathogen. In the past, undergraduates have worked on a range of topics from very basic (such as understanding the molecular mechanisms underlying cell division) to applied (testing potential antibiotics for their activity against pathogenic relatives of *M. tuberculosis*). Students should have a biology background and basic science interests. Previous lab experience is useful but not essential.
Today’s global society has been revolutionized by technological advances, including the unprecedented transfer of information via new and emerging media modalities, that greatly influence health policy decisions, the direction of philanthropic aid, and individual health behaviors. While social media can pose challenges to health, it also represents an incredible opportunity to supplement traditional methods of public and global health messaging when grounded in evidence and the scientific process. The Harvard Global Health Institute has created a new fellowship opportunity for students with an interest in social media and an appreciation for social justice, global health, and the practical impact of scientific discovery. Students will work at existing HGHI summer program sites abroad (options are: Rwanda, Uganda, and South Africa). They will explore how social media can constructively portray global health research and programs.
The Harvard International Negotiation Program (INP) takes a unique approach to conflict management and post-conflict mental health. Rather than focusing on mental health treatment of individuals affected by conflict, INI focuses on the psychological dynamics that perpetuate conflict. If societies only treat war-affected individuals through psychotherapy, group polarizations are still likely to exist and become the potential seeds of renewed violence. Thus, INP draws on the wisdom of mental health to develop ideas to prevent collective violence and its recurrence, thus avoiding the high costs of war on mental health and human life. Students will research identity and conflict resolution, assist Dr. Shapiro with preparations for his latest book, and participate in related activities. Preference will be given to students with coursework or experience in psychology, political science, government, or negotiation.
The Wirth Laboratory studies the biology of the malaria parasite and how it can evade drug or immune pressure. We use population genomic and functional approaches to identify and validate genetic variants associated with important clinical phenotypes, including drug resistance and immune evasion. Once validated, we convert these variants into genotyping assays to assess their frequency and distribution in natural parasite populations. To understand the mechanisms of drug resistance, we culture-adapt parasites and test their response to existing and novel drugs. We also work with collaborators in Senegal to assess changing parasite responses to artemisinin-based compounds and partner drugs. Finally, we create tools to identify and track parasites in order to better understand how vaccine and drug interventions reduce transmission. Preference will be given to students with coursework or experience in molecular biology, genetics, population genomics, public health, epidemiology, computational biology, or bioinformatics.

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Malaria is one of the greatest health challenges in the world, and the majority of disease transmission occurs in developing countries where it becomes an important obstacle to economic development. Drug resistance of *Plasmodium falciparum*, the most deadly human malaria parasite, makes malaria control very difficult. The World Health Organization has identified three assessment approaches for antimalarial drug susceptibility of *P. falciparum*: in vivo drug study, *in vitro* drug assay, and drug resistance molecular marker. These approaches require researchers to have access to infected red blood cells directly from infected patients, which are only available in endemic areas. The Wirth lab applies population genetic approaches to questions of malaria transmission and disease. With collaborators at the University Cheikh Anta Diop in Senegal we interrogate patterns of parasite drug resistance and population structure to infer biological changes and assess effectiveness of intervention strategies against malaria. Wet lab research experience required.

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Don McKenzie Hospital is situated in Botha’s Hill, 45 km from Durban, South Africa, in the beautiful Valley of a Thousand Hills. Students participate in the daily running of the clinic, assisting with data capture and clerical duties (filing, writing blood forms, pill counting to assess patient adherence). Previous groups have performed file audits, assessing patient adherence, assisting with identification of patients lost to follow up, and assessing Hepatitis prevalence. Students may also shadow doctors on ward rounds and typically spend one or two days per week accompanying field workers in the Umndeni Care Programme (UCP) in the rural KwaXimba area as they perform home visits. UCP is involved in community-based door-to-door HIV counseling and testing, TB screening, social support, adherence monitoring, and HIV prevention education.

From the Interns
“Over the summer we split our time between Don McKenzie Tuberculosis & HIV Hospital, and Umndeni Care Program (UCP)... With both we did data entry and also accompanied UCP on their home visits. Some of the beautiful things about this program were seeing the incredible work being done by UCP and Don McKenzie despite many structural barriers to healthcare, as well as the resilience, warmth and hope of the community of KwaXimba.

Advice for Future Interns
“Definitely journal, or spend time chatting with other people in your program, because being there will make you think about a lot every single day.”