

BIOGRAPHICAL SKETCH

NAME: Bowman, Natalie McCarter

eRA COMMONS USER NAME: nbowman

POSITION TITLE: Assistant Professor of Medicine

EDUCATION/TRAINING

INSTITUTION AND LOCATION	DEGREE	Completion Date MM/YYYY	FIELD OF STUDY
Harvard College, Cambridge, MA	AB	06/1999	Chemistry
Cambridge University, Cambridge, UK	MPhil	11/2001	Biochemistry
Columbia University College of Physicians and Surgeons, New York, NY	MD	05/2007	Medicine
The Johns Hopkins Hospital, Baltimore, MD	Residency	06/2010	Internal Medicine
University of North Carolina, Chapel Hill, NC	Fellowship	06/2013	Infectious Diseases
UNC Gillings School of Global Public Health, Chapel Hill, NC	MPH	08/2013	Epidemiology

A. Personal Statement

My research focuses on HIV and parasitic coinfections in Latin America, with a particular focus on opportunistic infections that affect the central nervous system such as toxoplasmosis and Chagas disease. I am broadly interested in the epidemiology and pathogenesis of parasites and neglected tropical diseases, especially those that are prevalent in the Americas. In addition to my studies in South America, I have also begun work studying diarrheal diseases in Nicaragua with Dr. Sylvia Becker-Dreps (UNC Family Medicine) and Filemon Bucardo (UNAN-León), and I hope to expand this collaboration in the future to examine the epidemiology of Chagas disease in this county. I have also expanded my work in vector-borne infections to study the emerging Zika virus epidemic in Nicaragua and Brazil.

B. Positions and Honors**Positions and Employment**

1999-2000: Research assistant, Cardiology, Brigham and Women's Hospital, Boston, MA
2004-2006: Research fellow, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD, and AB PRISMA, Lima, Peru
2007-2010: Internal medicine resident, Johns Hopkins Hospital, Baltimore, MD
2010-2011: Freelance writer, Johns Hopkins POC-IT Guide, Baltimore, MD
2010-2013: Infectious diseases fellowship, University of North Carolina at Chapel Hill, Chapel Hill, NC
2011-2013: Locum tenens, Moses Cone Healthcare, Greensboro, NC
2013: Locum tenens, Wake County Health Department HIV clinic, Raleigh, NC
2013-2014: Fogarty Global Health Fellow, University of North Carolina at Chapel Hill, Chapel Hill, NC
2013-2014: Clinical Instructor, University of North Carolina at Chapel Hill, Chapel Hill, NC
2013-present: Burroughs Wellcome Fund/ American Society of Tropical Medicine and Hygiene Postdoctoral Fellow, University of North Carolina at Chapel Hill, Chapel Hill, NC
2014-present: Assistant Professor, University of North Carolina, Chapel Hill, Chapel Hill, NC

Licensing and Certifications

2010-present: North Carolina Medical License #2010-01099

2010-present: American Board of Internal Medicine certification in Internal Medicine

2012-present: American Board of Internal Medicine certification in Infectious Diseases

Professional Memberships

2011-present: Member, Infectious Diseases Society of America

2011-present: Member, HIV Medicine Association

2012-present: Member, American Society of Tropical Medicine and Hygiene

2013-present: Member, International Society of Infectious Diseases

2015-present: Member, American Medical Association

Honors and Awards

1995-1999: Harvard College Scholarship

2000-2001: Cambridge Overseas Trust Bursary

2004-2005: Fogarty Ellison Overseas Fellowship in Global Health and Clinical Research

2005-2006: NIH T35 Training Grant

2006: Honorable mention, Alpha Omega Alpha Pharos Medical Student Essay Contest

2006: CDC Foundation OC Hubert Fellowship

2011-2013: Ruth Kirchstein NRSA T32 Training Grant

2012: ID Week Fellows' Day Workshop Travel Grant

2012: American Society of Tropical Medicine and Hygiene 2012 Annual Meeting Travel Award

2012-present: NIH Loan Repayment Program

2012-present: Burroughs Wellcome Fund/ American Society of Tropical Medicine and Hygiene Postdoctoral Fellowship in Tropical Infectious Diseases

2013: Delta Omega Honorary Society in Public Health

2013-2014: Fogarty Global Health Fellowship

2014-2015: UNC-Nicaragua Pilot Grant

2014-present: UNC CFAR Project Development Grant

2014-present: NIH/NIAID K23 Career Development Award

2016: UNC Junior Faculty Development Award

2016-2017: UNC Explorations in Global Health Grant

C. Contribution to Science

1. The epidemiology of urban Chagas disease

This body of work describes the epidemiology of Chagas disease in periurban communities of Arequipa, Peru, where Chagas disease emerged in the last few decades in the context of rapid rural-to-urban migration and settlement in shantytowns on the edge of the city. In some neighborhoods, triatomines infested the majority of houses, but the presence of *Trypanosoma cruzi* was more focalized. Our work showed that the parasite became established in a series of "micro-epidemics" that occurred after widespread triatomine infestation in these neighborhoods. Since Chagas disease has historically been a problem mainly in rural areas, these findings have important implications for control efforts, especially vector control and human screening programs. I was involved in study design, data collection and analysis, and manuscript preparation for these papers.

Levy MZ, Small DS, Vilhena DA, **Bowman NM**, Kawai V, Cornejo del Carpio JG, Cordova-Benzaquen EG, Gilman RH, Bern C, Plotkin J. Retracing micro-epidemics of Chagas disease using epicenter regression. *PLoS Computational Biology* (2011) 7:e1002146. PMID 21935346.

Bowman, NM, Kawai V, Levy MZ, Cornejo del Carpio JG, Cabrera L, Delgado F, Malaga F, Cordova Benzaquen E, Pinedo VV, Steurer F, Seitz AE, Gilman RH, Bern C. Chagas disease transmission in periurban communities of Arequipa, Peru. *Clinical Infectious Diseases* (2008) 46:1822-8. PMID 18462104.

Bowman NM. Chagas disease. An ancient malady meets the twenty-first century. *Pharos Alpha Omega Alpha Honor Medical Society* (2007) 70:24-29. PMID 17583151.

Levy MZ, **Bowman NM**, Kawai V, Waller L, Cornejo del Carpio JG, Cordova Benzaquen E, Gilman RH, Bern C. Peri-urban infestation by *Triatoma infestans* carrying *Trypanosoma cruzi* in Arequipa, Peru. *Emerging Infectious Diseases* (2006) 12:1345-1352. PMID 17073082.

2. Clinical Chagas disease

In addition to characterizing the epidemiology of Chagas disease in urban Arequipa, I have contributed to our understanding of the development of chronic Chagas disease in children. I designed, carried out, analyzed,

and wrote up the study on autonomic function in children, in which we found that otherwise healthy children who were seropositive for Chagas disease had impaired responses on a variety of simple tests of autonomic function compared to matched seronegative controls. This suggests that the damage inflicted by the parasite begins very early in the disease process and reinforces the importance of early diagnosis and treatment of Chagas disease. Later studies examined autonomic function in adults and found that pupillometry, while sensitive to detect autonomic dysfunction in diabetic adults, did not detect dysfunction in adults with chronic Chagas disease.

Halperin A, Tornheim J, Vu N, Galdos-Cardenas G, Ferrufino L, Camacho M, Justiniano J, Colanzi R, **Bowman N**, Morris T, MacDougal H, Bern C, Moore S, Gilman RH. Pupillary light reflexes are associated with autonomic dysfunction in Bolivian diabetics but not Chagas disease patients. *American Journal of Tropical Medicine and Hygiene* (2016) 94:1290-1298.

Bowman NM, Kawai V, Gilman RH, Bocangel C, Cabrera L, Levy MZ, Cornejo del Carpio JG, Delgado F, Galdos G, Rosenthal L, Pinedo Cancino VV, Steurer F, Seitz A, Bern C. Autonomic dysfunction and risk factors associated with *Trypanosoma cruzi* infection among children in Arequipa, Peru. *American Journal of Tropical Medicine and Hygiene* (2011) 84:85-90. PMID 21212207.

3. Chagas disease diagnostics

Other work that arose from this project described the geographic variability in the performance of commercially available serological tests for Chagas disease; the local strains and prevalence of *Trypanosoma cruzi* may affect test performance and should prompt careful evaluation when new diagnostics are employed in a given location.

Castro Y, Gilman RH, Mejia C, Clark DE, Choi J, Reimer-McAtee MJ, Castro R, Flores F, Valencia-Ayala E, Torrico F, Le Blanc J, **Bowman N**, Castillo-Neyra R, Liotta L, Luchini A. Use of a Chagas urine nanoparticle test (Chunap) to correlate with parasitemia levels in *T. cruzi*/HIV co-infected patients. *PLoS Neglected Tropical Diseases* (2016) 10:e0004407. doi: 10.1371/journal.pntd.

Levy MZ, **Bowman NM**, Kawai V, Plotkin JB, Waller LA, Cabrera L, Steurer F, Seitz AE, Pinedo-Cancino VV, Cornejo del Carpio JG, Cordova-Benzaquen E, McKenzie FE, Maguire JH, Gilman RH, Bern C. Spatial patterns in discordant diagnostic results for Chagas disease: links to transmission hotspots. *Clinical Infectious Diseases* (2009) 26:134-145. PMID 19278335.

Verani J, Seitz A, Gilman RH, LaFuente C, Galdos-Cardenas G, Kawai V, de LaFuente E, Ferrufino L, **Bowman NM**, Pinedo-Cancino V, Levy MZ, Todd C, Kirchoff L, Verastegui M, Bern C. Geographic variability in the sensitivity of recombinant antigen-based rapid tests for chronic *Trypanosoma cruzi* infection. *American Journal of Tropical Medicine and Hygiene* (2009) 80:410-415. PMID 19270291.

Levy MZ, Kawai V, **Bowman NM**, Waller LA, Cabrera L, Pinedo-Cancino VV, Seitz AE, Steurer FJ, Cornejo Del Carpio JG, Cordova-Benzaquen E, Maguire JH, Gilman RH, Bern C. Targeted Screening Strategies to Detect *Trypanosoma cruzi* Infection in Children. *PLoS Neglected Tropical Diseases* (2007) 1:e103. PMID 18160979.

4. Epidemiology and population genetics of malaria

I have worked on a variety of projects investigating the epidemiology of *Plasmodium falciparum* malaria in Africa. In the first study, we evaluated the duration of Kenyan children's humoral and cellular immune responses to different genotypes of *P. falciparum* malaria in areas of different malaria transmission, finding that humoral responses were long-lasting but cellular responses, while protective against parasitemia, waned rapidly after infection. In the second study, we examined blood samples from Lilongwe, Malawi for infection by multiple strains of malaria using next generation sequencing techniques and compared strains in different areas of the city. We found that diversity was higher in children than in adults, perhaps due to poorly developed immunity, and that there were local differences in parasite populations on the local level. This level of diversity is important to recognize in the ongoing development of malaria vaccines. In the second, we analyzed a cohort of pregnant women followed until birth and discovered that HIV infection only increased risk of parasitemia in multigravid women, while all primigravidae had an increased risk of parasitemia regardless of HIV status. These findings may have implications for malaria control programs, as HIV multigravidae may be at higher risk for placental malaria than previously thought.

Bowman NM, Juliano JJ, Snider CJ, Kharabora O, Meshnick SR, Vulule J, John CC, Moormann AM.

Longevity of genotype-specific immune responses to *Plasmodium falciparum* merozoite surface protein 1 in Kenyan children from regions of different malaria transmission intensity. *American Journal of Tropical Medicine and Hygiene* (2016) Accepted for publication.

Bowman NM, Congdon S, Mvalo T, Patel JC, Escamilla V, Emch M, Martinson F, Hoffman I, Meshnick SR, Juliano JJ. Comparative population structure of *Plasmodium falciparum* circumsporozoite protein NANP repeat lengths in Lilongwe, Malawi. *Scientific Reports* (2013) 3:1990. doi:10.1038/srep01990. PMCID 23771124.

Nhkoma ET, **Bowman NM**, Kalilani-Phiri L, Mwpassa V, Rogerson SJ, Meshnick SR. The effect of HIV infection on the risk, frequency, and intensity of *Plasmodium falciparum* parasitemia in primigravid and multigravida women in Malawi. *American Journal of Tropical Medicine and Hygiene* (2012) 87:1022-1027. PMCID 23045249.

5. Ethnic neutropenia

I worked with Dr. Victor Grann, an oncologist, studying the differences in neutrophil count and prevalence of neutropenia in healthy women of different racial and ethnic backgrounds. We found that African heritage placed women at higher risk for neutropenia as these women had lower mean absolute neutrophil counts. This baseline data is important because it may help inform safe administration of chemotherapy to women of African descent, who are more likely to miss doses due to neutropenia. I was involved in data analysis for both papers and wrote the second manuscript.

Grann VR, Ziv E, Joseph CK, Neugut AI, Wei Y, Jacobson JS, Horwitz MS, **Bowman N**, Beckmann K, Hershman DL. Duffy (Fy), DARC, and neutropenia among women from the United States, Europe and the Caribbean. *British Journal of Haematology* (2008) 143:288-293. PMCID 18710383.

Grann VR, **Bowman N**, Joseph C, Wei Y, Horwitz MS, Jacobson JS, Santella RP, Hershmann DL. Neutropenia in 6 ethnic groups from the Caribbean and the U.S. *Cancer* (2008) 113:854-60. PMCID 18543314.

6. Other

Bowman, NM, Goswami N, Lippincott CK, Vinikoor MJ, Miller WC. Clinical scoring for risk of resistant organisms in pneumonia: Right idea, wrong interpretation. *Clinical Infectious Diseases* (2012) 55:749-750. PMCID 22670045.

Pandian V, Gilstrap DL, Mirski MA, Haut ER, Haider AH, Efron DT, **Bowman NM**, Yarmus LB, Bhatti NI, Stevens KA, Vaswani R, Feller-Kopman D. Predictors of short-term mortality in patients undergoing percutaneous dilatational tracheostomy. *Journal of Critical Care* (2011) 420.e9-420.e15. PMCID 22176805.

Bowman NM, Falade O, Gupta A. An unexpected source. *American Journal of Medicine* (2010) 123:993-995. PMCID 21035589.

Online list of published work in MyBibliography:

<http://www.ncbi.nlm.nih.gov/sites/myncbi/natalie.bowman.1/bibliography/41421647/public/?sort=date&direction=ascending>

D. **Research Support**

Ongoing Research Support

UNC School of Medicine Emerging Challenges in Biomedical Research 06/07/2016-06/06/2017
Is Zika virus a sexually transmitted infection?

The goal of this project is to determine duration of Zika viral shedding in different body fluids and to examine compartmentalization of the virus in these fluids to elucidate the potential role of sexual transmission in the spread of Zika virus.

Role: Coinvestigator

UNC Explorations in Global Health 04/04/2016-04/03/2017
Diagnostics to define epidemiology and clinical aspects of Zika virus infection

The goal of this project is to clarify the epidemiology of Zika virus as it emerges in a naïve population in León, Nicaragua and to clarify the immune response to the virus and its cross-reactivity with prior dengue infections, as dengue is endemic in the region.

Role: Principal Investigator

UNC Junior Faculty Development Award 01/01/2016-12/31/2016

Characterizing the microbiome of *Triatoma infestans*, the vector of Chagas disease

The goal of this project is to elucidate the role of the triatomine microbiome in transmission of Chagas disease using laboratory-raised and wild-caught *T. infestans* insects from Chagas-endemic areas.

Role: Principal Investigator

K23 Career Development Award (K23 AI113197-02)

09/01/2014-08/31/2019

The pathogenesis of *T. cruzi* in HIV-infected persons in Bolivia

The goal of this project is to examine the clinical findings associated with reactivation Chagas disease in HIV-infected persons and to investigate the role of host immune response and parasite genetic diversity on the pathogenesis of reactivation Chagas disease.

Role: Principal Investigator

UNC CFAR Developmental Award (P30 AI50410)

08/01/2014-present

Clinical and genetic characteristics of HIV-associated CNS parasitic infections in South America

The goal of this project is to evaluate clinical and epidemiological features that distinguish central nervous system Chagas disease and cerebral toxoplasmosis in HIV-infected patients and to explore the role of genetic diversity of these organisms in their pathogenesis in this population.

Role: Principal Investigator

Burroughs Wellcome/ASTMH Postdoctoral Fellowship in Tropical Infectious Diseases 09/01/2013-present

Exploration of the genetic diversity of *Trypanosoma cruzi* infections in Bolivia and Peru

The goal of this project is to describe the degree of genetic diversity present both within infected individuals and on a population scale using next generation sequencing technology.

Role: Investigator

Completed Research Support

UNC-Nicaragua Pilot Grant

08/01/2014-09/31/2015

Risk factors for norovirus infection in Nicaraguan children

The goal of this project is to determine the effect of household contact on young children's risk of severe norovirus infection in León, Nicaragua.

Role: Principal Investigator

Fogarty Global Health Fellowship (5R25TW009340)

Vanderhorst (PI)

08/01/2013-07/31/2014

Exploration of the genetic diversity of *Trypanosoma cruzi* infections in Bolivia and Peru

The goal of this project was to compare genetic diversity of *T. cruzi* in areas of South America with different transmission intensity and to describe the degree of genetic diversity in HIV-infected individuals using next generation sequencing technology.

Role: Investigator

Ruth Kirschstein NRSA (T32AI715134-13)

Margolis (PI)

09/01/2011-08/31/2013

Genetic diversity of *Plasmodium falciparum* infections in Malawian patients

The goal of this project was to describe the extent of genetic diversity of *P. falciparum* malaria infections in Malawian patients both within individual hosts and across geographic space.

Role: Investigator/Trainee