

BIOGRAPHICAL SKETCH

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NAME: Annick Bórquez

eRA COMMONS USER NAME (credential, e.g., agency login): ABORQUEZ

POSITION TITLE: Associate Professor at the Division for Infectious Diseases and Global Public Health, University of California San Diego

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
Lycée Franco-Mexicain, Mexico	Baccalaureate	06/2002	Science
University of Edinburgh, UK	BSc.Hons	06/2006	Microbiology
Imperial College London	MSc	09/2007	Epidemiology
Imperial College London	PhD	03/2013	HIV Epidemiology
Imperial College London	Postdoc	09/2015	HIV Epidemiology
University of California San Diego	Postdoc	06/2019	HIV and Drug Use Epidemiology

A. Personal Statement

My expertise in social, HIV and substance use epidemiology and my advanced technical skills in dynamic modeling of infectious diseases put me in good position to offer mentorship to both pre-doctoral and post-doctoral researchers invested in a career addressing substance use and HIV among marginalized populations.

I received my Masters and PhD training in epidemiology at the Department of Infectious Disease Epidemiology at Imperial College London (ICL), renowned for developing high quality methods in mathematical modeling. I subsequently worked as a postdoctoral researcher as part of the HIV Modeling Consortium at ICL, and developed a new modeling tool used by UNAIDS to estimate HIV incidence in the generalized epidemics of sub-Saharan Africa. In 2015, I joined the Division of Infectious Diseases and Global Public Health (ID&GPH) at UCSD as a postdoctoral scholar through a NIDA fellowship to investigate the potential impact of the Mexican drug law reform on HIV incidence among people who inject drugs on the Mexico-U.S. border.

Currently, I am an Associate Professor at the division of ID&GPH at UCSD and the principal investigator of a NIDA DP2 Avenir grant aiming to predict emerging drug use epidemics and associated health harms (including overdose) in the US using statistical and dynamic modeling [1,2]. My research at UCSD has also focused on evaluating the contribution of structural factors to substance use and related HIV/HCV epidemics as well as interventions to address them, including drug law reform [3], medication for opioid use disorders (MOUD) and more recently drug checking services [4]. My research under the DP2 aims to advance our predictive analytic infrastructure to enable preemptive planning for prevention of drug use related outbreaks. We developed and validated the first model predicting next year overdose death rates at county level across the US and published our 2022 predictions to support policy making. I am also a co-investigator on a NIDA R01 grant investigating the impact of changes in drug tourism and drug markets on health among PWID in San Diego and Tijuana (PI Strathdee), on a NIDA R01 investigating network related factors in the context of naloxone distribution and overdose response (PI Wagner), and on an NIAID R01 implementing a digital cohort of transgender women across the U.S. (MPI Wirtz and Reisner).

I am committed to pre-doctoral and post-doctoral training, and as part of my teaching I co-developed and co-teach the Infectious Diseases Epidemic and Economic Modeling for Public Policy for MPH and doctoral students in the departments of Medicine and Family Medicine and Public Health at UCSD. I am also a faculty member of the Interdisciplinary Research on Substance Use joint SDSU-UCSD doctoral program and a mentor on both the T32 training program on HIV and substance use and the T32 training program on HIV and other infections of pandemic potential (HOPE). I currently mentor for the NIDA T32 postdoctoral training program in

HIV and substance use and provide training in dynamic modeling methods of substance use and associated health harms including HIV, HCV and overdose, as well as in mixed-methods research and grantsmanship to support trainees in their transition to independence.

Citations:

1. Marks C, Abramovitz D, Donnelly C, Carrasco G, Carrasco-Hernández R, Ciccarone D, González-Izquierdo A, Martin NK, Strathdee S, Smith D, **Bórquez A**. Identifying Counties at Risk of High Overdose Mortality Burden Throughout the Emerging Fentanyl Epidemic in the United States: A Predictive Statistical Modeling Study. *The Lancet Public Health*, 2021 Oct;6(10):e720-e728.
2. Marks C, Carrasco-Escobar G, Carrasco-Hernandez R, Johnson D, Ciccarone D, Strathdee SA, Smith D, **Bórquez A**. Methodological approaches for the prediction of opioid use-related epidemics in the United States: a narrative review and cross-disciplinary call to action. *Transl Res*. 2021 Mar 30:S1931-5244(21)00081-5. doi: 10.1016/j.trsl.2021.03.018. Epub ahead of print. PMID: 33798764.
3. **Bórquez A**, Beletsky L, Nosyk B, Strathdee S, Madrazo A, Abramovitz D, Rafful C, Morales M, Cepeda J, Krebs E, Panagiotoglou D, Vickerman P, Boily MC, Thomson N, Martin N, 2018. The effect of public health-oriented drug law reform on HIV incidence in people who inject drugs in Tijuana, Mexico: an epidemic modelling study. *The Lancet Public Health*, Sep;3(9):e429-e437
4. Bailey, K., Abramovitz, D., Artamonova, I., Davidson, P., Stamos-Buesig, T., Vera, C. F., Patterson, T. L., Arredondo, J., Kattan, J., Bergmann, L., Thihalolipavan, S., Strathdee, S. A., **Borquez, A.** (2023). Drug checking in the fentanyl era: Utilization and interest among people who inject drugs in San Diego, California. *The International journal on drug policy*, 118, 104086.

Ongoing research projects:

DP2DA049295

Annick Borquez (PI)

07/01/2019-05/31/2024

Real time prediction of emerging drug use epidemics in the United States

Role: PI

New Frontiers in Research Fund (NFRFR)

Daniel Werb (PI)

02/01/2023-04/30/2026

Preventing morbidity and mortality among people who inject drugs in the post-pandemic era: Modelling the impact of service restrictions during COVID-19 across three North American countries

Role: Co-Investigator

R01DA49644

Strathdee Steffanie A (PI)

04/01/2020-01/31/2025

Ethno-epidemiology of HCV, HIV and Overdose associated with Drug Markets and Drug Tourism

Role: Co-Investigator

R01AI172092

Andrea Wirtz and Sari Reisner (PI)

07/2022-06/2027

Enhanced Cohort methods for HIV Research and Epidemiology (ENCORE) among transgender women in the United States

Role: Co-Investigator and site PI

R01DA057682

Karla Wagner (PI)

09/2022-08/2025

A network-based, mixed methods study to identify and support multiple overdose responders and inform overdose prevention interventions

Role: Co-Investigator

B. Positions, Scientific Appointments, and Honors

Positions and Scientific Appointments

2023-current: Associate Professor, Division of Infectious Diseases and Global Public Health, Department of Medicine, University of California San Diego

2019-2023: Assistant Professor, Division of Infectious Diseases and Global Public Health, Department of Medicine, University of California San Diego

Honors

2019-2024: NIDA HIV/AIDS research Avenir award

2015-2016: UC-MEXUS-CONACYT postdoctoral fellowship

2015: NIDA U.S.-Mexico drug abuse prevention research fellowship

2008-2012: Recipient of Medical Research Council Scholarship (UK) to pursue a PhD at ICL

C. Contributions to Science

1. My research under the NIDA Avenir (DP2) grant has impelled **the development of a prediction infrastructure in the drug use field to enable preemptive public health planning** as opposed to emergency responses [1]. We reviewed the literature [2] to identify key studies that have proposed methods to enable the early detection, risk assessment, or prediction of opioid use related epidemics of overdose, HIV, HCV or tuberculosis, finding few studies had applied predictive methodologies in the field of drug use and fewer had implemented rigorous model validation. We are currently updating this review as momentum is growing in the field. We developed a statistical model to predict overdose death rates at county level across the contiguous US in the next year and validated it on overdose mortality data over the fentanyl epidemic [3]. We modified this model and produced predictions for 2022 which we released as a pre-print the first week of January 2022. To inform overdose outbreak early detection and prediction models, we are investigating the value of alternative data sources such as Google searches or Reddit to monitor drug use patterns at population level [4]. We are currently pursuing research to implement state level models to maximize locally available data and extending our predictive modeling tool set based on stakeholders' needs.

1. **Borquez, A.**, & Martin, N. K. (2022). Fatal overdose: Predicting to prevent. *The International journal on drug policy*, 104, 103677. doi: 10.1016/j.drugpo.2022.103677
2. Marks C, Carrasco-Escobar G, Carrasco-Hernandez R, Johnson D, Ciccarone D, Strathdee SA, Smith D, **Bórquez A.** Methodological approaches for the prediction of opioid use-related epidemics in the United States: a narrative review and cross-disciplinary call to action. *Transl Res.* 2021 Mar 30:S1931-5244(21)00081-5. doi: 10.1016/j.trsl.2021.03.018. Epub ahead of print.
3. Marks C, Abramovitz D, Donnelly C, Carrasco G, Carrasco-Hernández R, Ciccarone D, González-Izquierdo A, Martin NK, Strathdee S, Smith D, **Bórquez A.** Identifying Counties at Risk of High Overdose Mortality Burden Throughout the Emerging Fentanyl Epidemic in the United States: A Predictive Statistical Modeling Study. *The Lancet Public Health*, 2021 Oct;6(10):e720-e728.
4. Patton, T., Abramovitz, D., Johnson, D., Leas, E., Nobles, A., Caputi, T., Ayers, J., Strathdee, S., & **Bórquez, A.** (2022). Characterizing Help-Seeking Searches for Substance Use Treatment From Google Trends and Assessing Their Use for Inveillance: Longitudinal Descriptive and Validation Statistical Analysis. *Journal of medical Internet research*, 24(12), e41527. doi: 10.2196/41527

2. A growing recognition for the need to rigorously investigate the **role of structural factors in shaping HIV, HCV and overdose risk among marginalized populations** has prompted the implementation of epidemiological studies specifically designed to gather relevant data on these processes. These emerging data opened the possibility to use epidemic modeling to characterize these risks and estimate the potential impact of interventions addressing structural factors in order to inform policy decision making. Few modeling studies have so far investigated this question and my current research at UCSD is contributing to this effort. I developed a model of HIV transmission among PWID in Tijuana, Mexico, to investigate the potential impact of

the Mexican drug law reform in reducing HIV incidence in this population. The reform is expected to decrease incarceration rates and police harassment which are associated with greater HIV risk. The model incorporates incarceration patterns and exposure to police harassment mediated through syringe confiscation to reproduce the mechanisms through which the reform could reduce HIV incidence among PWID. This work was published in the *Lancet Public Health* [1]. I also carried out qualitative interviews among PWID in Tijuana to assess the acceptability and feasibility of implementing police-led referrals for harm reduction and substance use treatment services in the context of these drug law reforms [2]. I am expanding the model to investigate the impact of other socio-structural factors including drug border tourism and changing drug markets on HIV, HCV and overdose epidemics among PWID on both sides of the U.S.-Mexico border [3-4].

1. **Bórquez A**, Beletsky L, Nosyk B, Strathdee S, Madrazo A, Abramovitz D, Rafful C, Morales M, Cepeda J, Krebs E, Panagiotoglou D, Vickerman P, Boily MC, Thomson N, Martin N, 2018. The effect of public health-oriented drug law reform on HIV incidence in people who inject drugs in Tijuana, Mexico: an epidemic modelling study. *The Lancet Public Health*, Sep;3(9):e429-e437
2. Olgin GK, **Bórquez A**, Baker P, Clairgue E, Morales M, Bañuelos A, Arredondo J, Harvey-Vera A, Strathdee S, Beletsky L, Cepeda JA. Preferences and acceptability of law enforcement initiated referrals for people who inject drugs: a mixed methods analysis. *Subst Abuse Treat Prev Policy*. 2020 Oct 2;15(1):75. doi: 10.1186/s13011-020-00319-w. PubMed PMID: 33008431
3. **Bórquez A**, Garfein R, Abramovitz D, Liu L, Beletsky L, Werb D, Mehta S, Rangel G, Magis-Rodriguez C, González-Zúñiga P, Strathdee SA. Prevalence and Correlates of Injecting with Visitors from the United States among People Who Inject Drugs in Tijuana, Mexico. *Journal of Immigrant and Minority Health*, Journal of Immigrant and Minority Health, doi: 10.1007/s10903-019-00868-8.
4. **Bórquez A**, Abramovitz D, Cepeda J, Rangel G, González-Zúñiga P, Martin NK, Magis-Rodríguez C, Strathdee SA. Syringe sharing among people who inject drugs in Tijuana: before and after the Global Fund. *Salud Mental*, Volume 42, Issue 4, July-August 2019

3. Our epidemic modeling study [1] **investigating the potential impact and cost-effectiveness of an HIV pre-exposure prophylaxis (PrEP) intervention** among men who have sex with men (MSM) and transgender women (TW) in Lima, Peru, was the first to explore the role of this novel intervention in a middle-income country and contributed to driving this discussion within the Latin American region. I developed the model based on a thorough investigation of sexual behaviors among MSM and TW according to sexual identity, sexual positioning and risk factors such as sex work which were relevant programmatically allowing the identification of populations to be prioritized for prevention. The cost-effectiveness analysis in particular, highlighted the importance of focusing PrEP prevention efforts on populations with a higher incidence burden as opposed to ensuring a broad coverage of the intervention. This has since been confirmed in other studies in a range of settings. Our review [2] comparing the cost-effectiveness estimates of PrEP obtained from epidemic modeling studies looking at different populations and settings was a timely study that allowed identifying key factors determining the potential of PrEP but also a significant contribution to the field of modeling as it provided a platform to systematically compare modeling assumptions, explain differences and harmonize findings. As part of the *Lancet* series on sex work, I also developed a model of HIV transmission that specifically represents TW sex workers, their clients and their stable partners, to determine the combination of prevention interventions (including PrEP) that would be required to reduce the number of new infections among TW sex workers by 50% in 10 years [3]. I further developed this study to incorporate information obtained from a stakeholder analysis and health system capacity evaluation carried out in Peru within the context of an NIH R21 grant to take into account acceptability and feasibility of implementing PrEP and early treatment and produce cost-effectiveness estimates of the different combinations of interventions [4]. The latter has directly influenced the development of a new HIV programmatic plan focusing on TW. This is the first time that the specific HIV prevention/care needs of TW are formally delineated by the Peruvian Ministry of Health.

1. **Bórquez A**, Gomez GB, Caceres C, Segura E, Grant R, Garnett GP, Hallett TB. (2012). The Potential Impact of Pre-Exposure Prophylaxis for HIV Prevention among Men Who Have Sex with Men and Transwomen in Lima, Peru: A Mathematical Modelling Study. *PLoS Med*. Vol:9, ISSN:1549-1676
2. Gomez GB, **Bórquez A**, Case KK, Wheelock A, Vassall A, Hankins C, 2013, The Cost and Impact of Scaling Up Pre-exposure Prophylaxis for HIV Prevention: A Systematic Review of Cost-Effectiveness Modelling Studies, *PLoS Med*, Vol:10, ISSN:1549-1676

3. Poteat T, Wirtz A, Radix A, **Bórquez A**, Silva-Santisteban A, Deutsch MB, Islam Khan S, Winter S, Operario D, 2014, HIV risk and preventive interventions in transgender women sex workers, *The Lancet*, Early Online Publication, 22 July 2014
4. **Bórquez A**, Guanira J, Revill P, Silva-Santisteban A, Kelly S, Salazar X, Bracamonte P, Minaya P, Hallett T, Cáceres C. (2018). The impact and cost-effectiveness of combined HIV prevention scenarios among transgender women sex-workers in Lima, Peru: a mathematical modelling study. *Lancet Public Health*.

4. During my postdoctoral stay at ICL, I developed and validated a model **to estimate HIV incidence in the generalized epidemics of Sub-Saharan Africa according to identifiable determinants of risk** [1]. Programmatic planning in HIV requires estimates of the distribution of new HIV infections acquired and transmitted according to identifiable characteristics of individuals to maximize the use of resources and curb epidemic spread. The UNAIDS Modes of Transmission model was used over the past decade to produce estimates of the distribution of new infections in a range of countries; however, it suffered from several limitations and an alternative approach was needed [2,3]. In sub-Saharan Africa, robust data sources collected routinely and historical epidemiological observations are available to inform and validate such estimates. I developed a predictive model representing the population according to factors demonstrated to be powerfully associated with HIV acquisition risk: gender, marital status, geographic location, key risk behaviors (sex work, injecting drug use, male to male sex), sero-discordancy within couples, circumcision, and ART status. The model estimates the distribution of new infections acquired by group within a Bayesian framework accounting for regional prior information on demographic and epidemiological characteristics. The potential contribution of each group to transmission is then inferred making further assumptions about sexual mixing patterns and transmission rates. I validated and trained the model against direct observations of HIV incidence by subgroup in cohort data from Zimbabwe, Uganda, Malawi and Tanzania. The model performed well in all sites and is being used by UNAIDS as part of its epidemic tool-set to contribute to programmatic guidance.

1. **Bórquez A**, Cori A, Pufall EL, Kasule J, Slaymaker E, Price A, Elmes J, Zaba B, Crampin M, Kagaayi J, Lutalo T, Gregson S, Hallett TB, (2016). The Incidence Patterns Model to Estimate the Distribution of New HIV Infections in Sub-Saharan Africa: Development and Validation of a Mathematical Model, *PLoS Med.*13;13(9):e1002121. doi: 10.1371/journal.pmed.1002121.
2. Gouws E, Cuchi P, on behalf of the **International Collaboration on Estimating HIV Incidence by Modes of Transmission** (2012). Focusing the HIV response through estimating the major modes of HIV transmission: a multi-country analysis. *Sex Transm Infect*; 88(Suppl_2): i76–i85
3. Case KK, Ghys P, Gouws E, Eaton JW, **Bórquez A**, Stover J, Cuchi P, Abu-Raddad L, Garnett GP, Hallett TB, on behalf of the HIV Modelling Consortium (2012). Understanding the modes of transmission model of new HIV infection and its use in prevention planning. *Bull World Health Organ*, 90:831-838

Complete List of Published Work in MyBibliography (51 publications):

<https://www.ncbi.nlm.nih.gov/myncbi/1PYYYn0hI6CAb/bibliography/public/>