

CASE STUDY: PROFESSOR LYDIA BOUROUIBA

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INTRODUCTION

Most academics do not have the incentives, training, or resources needed to engage effectively with policymakers, and few policymakers read peer-reviewed scientific journals. This disconnect between the information that policymakers seek and the output of academic institutions means that public policies are often developed without the best available evidence.

MIT's Policy Lab at the Center for International Studies (PL@CIS) works with faculty and researchers at MIT to identify policy-relevant research, help researchers articulate the policy implications of their work, and develop the necessary relationships with the policymakers and stakeholders to engage them in a targeted and efficient way. Specifically, PL@CIS provides (a) mentorship and advice from faculty and staff with experience in the policy world, (b) logistical support, (c) communication training, and (d) modest grants to cover the cost of travel for outreach to the policy community.

The objective is to foster ongoing connections between scholars and members of the policy community on issues of mutual interest and expertise. Two-way dialogue also encourages policy-relevant research by allowing faculty members to anticipate the impact of potential scholarly projects and prioritize among them accordingly. This new model of policy engagement allows for significant impact with relatively small investments of faculty time and money (given that the underlying research is already funded).

This report will present a case study of one PL@CIS supported faculty member who has successfully built relationships with the public policy community which have led to two-way dialogues that are both informing public policy and the direction of her research.

THE PL@CIS AND PROFESSOR LYDIA BOUROUBA

Professor Lydia Bourouiba is an Associate Professor in Fluid Dynamics in the Departments of Civil and Environmental Engineering, the Institute for Medical Engineering and Sciences, and Mechanical Engineering. Her research focuses on the fluid dynamics and epidemiology of disease transmission, aiming to understand the physical mechanisms by which pathogens in human, animal, and agricultural populations are spread. Professor Bourouiba's research uses combined theoretical and experimental approaches to model and understand the dynamics of the drops, bubbles, and biological fluids that shape disease transmission, and to develop novel associated control strategies or risk assessment tools.

Specifically, Professor Bourouiba's work on human health includes discovering the important role of turbulence in shaping the transport range and dispersal of contaminated droplets during sneezes or other forms of expiration (like coughing or violent exhalations), how complex fluids are fragmented (or broken down) as they are ejected in the form of droplets interacting with the turbulent cloud, and multiscale mathematical models of disease propagation within populations. These insights are critical to re-design indoor spaces, but also for protocol and guidelines for infection control issued by organizations such as the CDC and WHO in addition to other world organizations.

In the case of agriculture, her research examines the transmission of foodborne and crop pathogens with the ultimate goal of improving food safety and economic prosperity. This work is relevant to best practices of irrigation and spacing of crops, deciding what area should be discarded from harvest in a field upon discovery of an infected plant, innovation and recommendations on the selection of fluid system, including spray systems, and associated fluids that are optimized to use in fresh food washing and irrigation.

Professor Bourouiba's work revealed that historical understandings of disease transmission—and the public health guidelines based on those understandings—often run counter to reality. For example, her work showed that

the fluids expired during sneezes form sheets of fluid that separate into ligaments before finally dispersing as droplets, embedded into a turbulent multiphase cloud that can spread infectious droplets up to 200 times farther than originally believed, when ignoring the cloud. Three infectious diseases that spread via this mechanism were among the top ten causes of death in 2016, according to Baylor College of Medicine. By aiding the development of better public health protocols and guidelines to limit disease transmission, Professor Bourouiba's research has the potential to save lives.

Before partnering with the PL@CIS, Professor Bourouiba did not have a background in policy engagement. However, she was interested in sharing the results of her research in the form of novel risk assessment tools developed by her lab to be used for development of more effective and relevant guidelines and control strategies developed with policymakers and stakeholders. Specifically, Professor Bourouiba was interested in analyzing the extent of the relevance, accuracy, and effectiveness of the current guidelines on indoor respiratory disease transmission to develop policy recommendations in healthcare and agricultural communities. As she began to work in this area, she became interested in engaging with a wider spectrum of stakeholders to inform them about the potential impact of her research for public health and safety decision-making.

Professor Bourouiba discovered the PL@CIS during the first Call for Proposals in 2015, and has since focused on three engagement projects that have developed over the past several years:

1. **Infectious Disease + Public Health Policy for Mitigation of Transmission:** This project aimed to establish connections with the health policy, monitoring, and risk assessment communities, including at the Centers for Disease Control and Prevention (CDC), the Food and Drug Administration (FDA), the Public Health Agency of Canada, and the French Society for Hospital Hygiene, to aid in informing the science used for the development of new guidelines for infection control and outbreak response in North America and Europe. Once established, Professor Bourouiba sought to strengthen and formalize these connections through collaborative agreements. She also aimed to develop oral presentations, briefings, and written communication of her research for broad policy audiences to be available for use by policy stakeholders and infection control specialists.

2. **Food Safety and Agricultural Disease Management - Risk Assessment for Policy:** This project aimed to establish connections between Professor Bourouiba’s agricultural and food safety research and policy communities, including the US Division of Agriculture (USDA) and the US Food and Drug Administration (FDA). The goal being to communicate the latest research results on food safety and agricultural disease management to inform surveillance, prevention, and control guidelines of outbreaks and disease spread in the field or from “field to fork.” Over the course of this project, Professor Bourouiba formed academic, industry, and international connections and collaborations. Her work has contributed in the development of briefings and research collaborations focused on food safety and agricultural policy.
3. **Policy at the Fluids and Health 2019 Conference:** The goal of this project is to combine the work of previous two projects to bring public policy stakeholders and academics together at a workshop. The program will occur during the summer of 2019 at the Institut d’Etudes Scientifiques de Cargese, France, with approximately 80 participants receiving training on the study of fluid flows as they pertain to applications of human health and food safety. There will be a particular emphasis on the how such questions fit into infection control and prevention strategies for public health and how research on fluids and physical processes be tackled and used to help progress guidelines, early detection, and control and prevention of infectious diseases. The intended outcome of the workshop is to create a new interdisciplinary community of researchers focused on developing the fundamental insights necessary to address policy challenges in the areas of public health and food safety practices. By introducing researchers to policymakers, and policymakers to researchers, Professor Bourouiba aims to develop and grow a community aiming to solve policy relevant questions with rigorous and state-of-the-art research in biophysics and fluid dynamics. She will work with the PL@CIS to prepare summaries of course reading material for policymakers who will be in attendance and a document that captures the discussions that occur at the workshop itself.

POLICY ECOSYSTEM

With the support of the PL@CIS, Professor Bourouiba has identified a variety of policymakers and policy stakeholders, which include industrial, clinical, and government agency partners in public health and agricultural

policy. Looking at her work in public health policy, Professor Bourouiba has identified the following organizations, organized by category:

FEDERAL

- Centers for Disease Control and Prevention (CDC): The CDC works under the U.S. Department of Health and Human Services to respond to emerging health threats, generally focusing on public health and safety. One of the ways they seek to accomplish this mission is by facilitating research on the mechanisms of disease transmission and tracking the spread of disease using epidemiology.

PRIVATE SECTOR

- Massachusetts General Hospital (MGH): MGH is the largest teaching hospital of Harvard Medical School, with a strong biomedical research facility that includes work on public health and disease transmission.
- Pfizer: Pfizer is an American pharmaceutical company that develops a range of medicines and vaccines and is the largest pharmaceutical company in the US by 2018 sales. While they do not seem to conduct overlapping research, Pfizer has launched a disease prevention campaign that is relevant to Professor Bourouiba's work.
- Novartis: Novartis is a Swiss pharmaceutical company with a multinational presence and is one of the largest pharmaceutical companies in the world by sales. Similar to Pfizer, Novartis' research branch (Novartis Institute for Biomedical Research) has a division focused on prevention of transmission of tropical diseases.

ACADEMIA

- Center for Applied Mathematics in Bioscience and Medicine (CAMBAM) (McGill University, Canada): The CAMBAM, based at McGill University in Montreal, is a department focused on leveraging applied math for medical research. Professor Bourouiba's work in mathematical modeling of fluid flows in disease transmission extends their work in applied mathematics to multiscale models of disease transmission.

PROFESSIONAL SOCIETIES

- American Physical Society (APS): The APS is an academic society for physicists that aims to further and spread their knowledge of physics.
- American Society for Microbiology (ASM): The ASM is an academic society for microbiologists, and supports research focusing on the mechanisms of disease transmission.
- International Society for Aerosol in Medicine (ISAM): The ISAM is an international academic society focused on research into uses and complications of aerosols in medicine. The interaction of Professor Bourouiba with the group opened discussions on how such focus can have overlapping dimensions with research on how diseases might be transmitted via aerosols.

INTERNATIONAL ORGANIZATIONS AND FOREIGN GOVERNMENTS

- French Society of Hospital Hygiene (SF2H): This professional organization develops health and safety guidelines for anyone who works in the field of hygiene promotion. In addition, recommendations made by SF2H are used or referred to by other international organizations, e.g., the World Health Organization. Collaborations with Professor Bourouiba were established and continue to develop with the aim to improve hospital guidelines and protocols relating to disease transmission.
- Center for Disease Control China (CDC China): Under the Ministry of Health, the CDC China is an agency that focuses on maintaining Chinese public health.
- World Health Organization (WHO): The WHO is an agency of the United Nations that issues guidelines and recommendations for international public health. They often base their recommendations on national organizations, such as the French Society for Hospital Hygiene
- Centre National de la Recherche Scientifique (CNRS): The CNRS is a French national research center. The results of their research often influence French public health policy.
- Jefferson Foundation: This foundation promotes collaboration between French and American researchers by funding collaborative grants in STEM.

In the area of agricultural policy, Professor Bourouiba has identified the following organizations:

FEDERAL

- Agricultural Research Service (ARS), United States Department of Agriculture (USDA): Based in the USDA, the ARS supports agricultural research that can inform agricultural and food safety policies at various levels from farm to fork. Collaborations with Professor Bourouiba were established and continue to develop.
- Division of Risk and Decision Analysis and Foodborne Disease Group, Food and Drug Administration (FDA): Based in the FDA, these groups use risk analysis to evaluate and inform regulations concerning food safety and foodborne illnesses. Collaborations with Professor Bourouiba were established and continue to develop.

PRIVATE SECTOR

- Taylor Farms: Taylor Farms is an American company focusing on consumer agriculture, specifically fresh-cut fruits and vegetables. They would be interested in Professor Bourouiba's work on minimizing food contamination.
- McEntire Produce: This American fresh produce company is based in the Southeast. They would be similarly interested in Professor Bourouiba's work on minimizing fresh food contamination.
- Riverview LLP: They would be interested in Professor Bourouiba's work on optimizing production in the field by reducing disease transmission and maximizing delivery of controls on parasitic plants.

INTERNATIONAL ORGANIZATIONS AND FOREIGN GOVERNMENTS

- Public Health Agency of Canada: This Canadian agency develops infection control and food safety guidelines for the Government of Canada.
- CEBAS-CISC Murica, Spain: CEBAS-CSIC is a Spanish agricultural research organization that focuses on sustainability and safe agricultural development.
- French National Institute for Agricultural Research (IRNA): The IRNA is one of the leading agricultural research institutes in Europe, and often partners with the French government in developing agricultural safety guidelines.

She has also presented her work at discipline-specific conferences, such as the Society for Healthcare Epidemiology of America Annual Meeting and the International Conference on Emerging Infectious Diseases and organized a special session on Plant Health and Global Economy at the 2018 International Congress of Plant Pathology.

IDENTIFYING AND PRIORITIZING STAKEHOLDERS

Professor Bourouiba's efforts in public health policy began when she was invited to be the keynote speaker at the 2015 French Society for Hospital Hygiene (Sf2H) annual conference and CDC's International Conference on Emerging Infectious Diseases. There, she met a number of infectious disease and infection control researchers, clinicians and policy specialists, who were interested in incorporating her work into training and hospital guidelines and public health recommendations. Through these interactions, she was able to develop an understanding of the public health policy ecosystem at a range of levels, from front-line practitioner to hospital infection control specialists, to regional or national policy makers.

For academics who want to engage with policymakers, balancing time between research and outreach is an important consideration. Therefore, some amount of prioritization is always required. For this project, Professor Bourouiba prioritized engaging with the French Society for Hospital Hygiene and the CDC because of the range of training, guidelines or recommendations they are involved in at a range of levels. For example, the guidelines issued by the French Society for Hospital Hygiene are often adopted by the World Health Organization.

In her work on agricultural disease transmission policy, Professor Bourouiba initiated discussions with the USDA and FDA on the topic of crop and foodborne pathogen control in fresh produce. She was able to identify individuals associated with both organizations through conferences focusing on disease transmission and public health, where government researchers often attended. She approached these researchers with the idea of developing both academic and policy-focused collaborations. By continuing to engage with these officials, she identified the broad food safety policy ecosystem above. Again, because prioritization is a necessary part of outreach, her work has largely focused the USDA and CDC, as they are involved in informing and developing health and agricultural policies in the United States. Simultaneously, she still maintains and continues to build connections to the broader policy ecosystems for both human health and agricultural and food safety.

POLICY WINDOWS

In seeking out policy windows Professor Bourouiba found that the timelines varied based on which organization she interacted with and which component of her research was relevant to their goals for both her health policy and agricultural policy work. Unlike some other policy ecosystems, which often act on very short timescales, she had the benefit of working with stakeholders who act on timelines that span months or years. During her efforts, she learned that there was rarely a specific policy window during which she had to act to effect change due to the timescale on which policy decisions occurred in the organizations that she engaged with. Instead, she had to look for signs of inertia from stakeholders who were interested in changing these guidelines or regulations based on latest research developments. Engaging with the full landscape of stakeholders allowed her to be “at the table” when discussions around regulation or guideline changes were occurring.

LESSONS LEARNED

When Professor Bourouiba first began engaging with policy stakeholders, she faced many of the typical challenges in communicating that most academics do. She sometimes found herself talking too much about science and not enough about its implications, saving her conclusions for the end, and providing information that was too specific. She worked with the PL@CIS to translate her research in a way that clearly stated its relevance to policymakers.

She describes this skill as being acquired through a process of trial and error, where she would gauge reactions and ask her audience for feedback to ensure that she was communicating the critical information needed for them to assess impact of the research in the policy and guideline landscape. Now, Professor Bourouiba begins by discussing the implications of her work for her audience framed in the particular context of the discussion and group involved. She likens the experience to learning another “language” that policymakers communicate with and recommends academics begin to understand this language early in the engagement process.

BUILDING RELATIONSHIPS

Through her work with the PL@CIS, Professor Bourouiba came to realize that building relationships with policymakers involves reaching out early and maintaining contact. She notes that the best way to develop these

relationships is often through in person meetings, which has required her to make regular in-person visits with various stakeholders. In addition, Professor Bourouiba often invites these stakeholders to visit her lab and has her students interact with them to foster continued partnerships. Such a strategy has led regular bidirectional communication between Professor Bourouiba and policy audiences and has begun to inform the work of a variety of organizations.

IMPACT

As a result of all of the outreach to policymakers and stakeholders, Professor Bourouiba has not only built relationships but her research is already beginning to have impact. For example, due to her work on agricultural policy, and the special session on Plant Health and Global Economy at the 2018 International Congress on Plant Pathology she organized, she successfully engaged academic and industry researchers in discussions on policy engagement, and new partnerships were identified as a result. She has also been invited to give lectures, provide recommendations, and to attend roundtable discussions at a number of organizations (private and governmental) on the assessment of guidelines, protocols, and risk assessments to limit the development and spread of foodborne diseases. Similarly, in her work on human health, she had engaged in a variety of discussions on the development of new guidelines for the prevention of disease transmission in hospitals and other training materials and guidelines for medical systems.

Looking at the impact of her policy engagement on her academic research, Professor Bourouiba stated that (1) her policy engagement has helped her mentor her own students by showing them how their research can translate to policy development and (2) her knowledge of the policy arena has helped her focus the direction of her research on ideas that might translate into guidelines and policy developments. For example, discussions with policymakers and practitioners showed that research was needed to improve decontamination procedures in hospital patient rooms. Therefore, her group directed future research efforts to the configuration of indoor healthcare settings and to translating this work into specific hospital scenarios. Her engagement work from the past several years has recently come together in her most recent proposal, which aims to support the Fluids and Health 2019 meeting. The goal of this inaugural meeting is to create a new interdisciplinary community of researchers focused on developing new the fundamental insights necessary to address policy challenges in the areas of public health and food safety practices.

By introducing researchers to policymakers and vice-versa, she is working to foster collaboration and long-term policy engagement within her field. The goal of this work is to develop a research community that can identify and solve some of the most challenging policy problems impacting human health.