Physics and Public Health Policy Design: It is a Two-way Street

Babak Pourbohloul & Krista English

Over the past two decades, physicists have made substantial contributions to understanding communicable disease epidemic processes. In the 1980's and 90's, there were few publications at the interface of physics and public health. In recent years the rate of publication continues to grow significantly in "interdisciplinary physics" section of journals, such as Physical Review Letters, Phys. Rev X and Phys. Rev. E, among others. Some of these papers highlight the scientific advancement within the physics community to translate the contagion/percolation phenomena by making them relevant to better understanding epidemic processes. These advancements may lead toward the development of novel quantitative decision-support frameworks. Such frameworks are highly sought after to evaluate existing public and global health programs, identify new programs, or optimize programs for effectiveness and cost-effective.

Initially viewed as "forced marriage", the organic convergence between these two seemingly divergent disciplines, of physics and public health, has evolved during this decade-long transition. This convergence facilitated the integration of tools from theoretical and computational physics into the public health decision-making process; thus, expanding the application of quantitative sciences to global health policy design. This requires the development of methodologies, whose complexity (or reductionism) is compatible with the public health question at hand. Simultaneously, this process necessitates the development of a common taxonomy for effective communications between disciplines. Broad claims that "all models are wrong" may have the unintended consequence of contributing to scepticism and resistance to the integration of models in decision-making process. It is equally important to recognize that not all stylized models produce results that may be used for policy recommendation and they should be objectively scrutinized.

We summarize the methodological and practical developments that have taken shape within our public health agency over the past 15 years to address a range of real-life public health challenges towards creating integrated decision-support tools for policymakers.

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Dr. Pourbohloul is trained as a theoretical physicist (chaos theory and nonlinear dynamics) and for the past fifteen years has been active in the development and application of complex quantitative methods in public and global health systems policy design. He has been the Principal Investigator on several international modeling projects in the application of mathematical and computational tools to mitigate emerging infectious disease outbreaks and was designated as Director of the *World Health Organization Collaborating Centre for Complexity Science for Health Systems (CS4HS)*. He aims to develop and employ methods of complex systems analysis, through multidisciplinary collaborations, to optimize health policy design at the local, national and international levels.

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Krista English is the co-Lead in setting the strategic directions of both the Division of Mathematical Modeling and the *W.H.O. Collaborating Centre for Complexity Science for Health Systems (CS4HS)* in developing new programs to establish international collaborations. Utilizing the skills gained through her doctoral study on organizational complexity, Ms. English investigates how the flow of information and knowledge within and between public health agencies may impact decision-making at times of crises, such as pandemics. She has been the co-Principal Investigator on several international modeling projects sponsored by *USAID*, *W.H.O.* and *Canadian Institutes of Health Research (CIHR)*, among others. She co-led modeling activities across 25 public health and academic institutions during the influenza pandemic in 2009 in support of public health policy decision making, which resulted in the group's designation, by the Canadian government, as Canada's *Pandemic Outbreak Team Leader in Mathematical Modeling*.