Philosophy of Infectious Disease Epidemiology: Modeling, Values, and Policy Advice

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1. Summary of the Research Plan

Attempts to control pandemic disease caused by a transmissible pathogen such as SARS-CoV-2 rely in part on elaborate epidemiological models. Even though there exists a large philosophical literature on scientific modeling, the specific epistemology of these epidemiological models is currently not sufficiently understood. Furthermore, there are many unsolved practical issues about how such models should inform policy. In particular, we are lacking an explicit understanding of **what makes models adequate for policy purposes**. Simply requiring that such models and their results be predictively accurate, valid or empirically confirmed does not do justice to the complexities of model evaluation. For prediction in the sense of forecasting is not the only, perhaps not even the main function of epidemiological models in policy advice. As scientists often emphasize, their modeling efforts produce **scenarios** that *would* obtain if certain assumptions *were* satisfied. While specific forecasts of infection incidence or mortality are usually not very accurate or sometimes even wide off the mark, this doesn't necessarily mean that the models used by epidemiologists are useless. For the computed scenarios – counterfactual in nature as they are – could still be useful for **deciding between different policy options**. A central aim of this project is to determine what *makes* epidemiological models of virus transmission adequate for policy purposes, and how their adequacy can be assessed. The main rationale of this investigation is to treat epidemiological modeling as a kind of **counterfactual or what-if reasoning** and to epistemologically investigate what makes such reasoning **sound**. What defines a realistic or credible counterfactual scenario in the first place? What role can traditional model selection criteria such as **parsimony** or **robustness** play in model evaluation? And finally, is there a role for **non-epistemic values** in model evaluation, as many leading philosophers of science today believe? Finding justified answers to these questions is the specific aim of **Part I** of the proposed project.

In addition to these epistemological issues, there are also unresolved issues as to how the results of scientific modeling should **inform public health policy**. Under what conditions can a scientific result be considered as sufficiently **reliable** to serve as a basis for policy decisions that affect the lives of millions of people and that may have drastic effects on public health as well as on the economy? What kinds of **precautions** should scientists take when publicizing modeling results that are ridden with **uncertainty**? In general, how should **discourse between scientists, policymakers and the general public** be organized in order to secure **democratic legitimation** of government interventions? Such questions have been widely discussed, including by philosophers of science, in the context of climate modeling but much less so in relation to infectious disease epidemiology. Therefore, **Part II** of the project aims at providing normatively adequate answers to such questions.

Expected results from Part I include the identification of criteria of adequacy for policy-relevant epidemiological models and modeling results, especially counterfactual scenarios. Part II will provide a normative account of the due organization of discourse between science, policymakers and the public. The **impact** on the field of philosophy of science is the advancement of the epistemology of scientific modeling especially of what-if scenarios, and of the normative grounds for scientific policy advice. The **social relevance** of the project lies in its contributing to a better understanding of how science should and should not inform public health policy for the control of dangerous infectious diseases in a democratic society.

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