Mathematical Modeling in Public Health Successes & Challenges

Abstract
Decision making in Public Health, e.g. regarding disease screening or vaccination strategies, should be evidence based. Evidence can come from clinical trials, epidemiological studies, and routinely collected data. Yet, available empirical evidence in Public Health is rarely sufficient or specifically tailored towards a specific decision problem. The solution is to use mathematical modeling to integrate all available evidence and understanding regarding a problem. This use of modeling can be traced back to Daniel Bernouilli (1766) who used mathematical modeling to argue that the benefits of vaccination against smallpox exceeded its risk. Later Ross used mathematical modeling to argue that there is a threshold >0 in mosquito density below which malaria transmission would be interrupted. Currently, mathematical modeling is an active and extensively researched field that has been successfully applied in many areas of public health. Its greatest successes are in the area of infectious diseases where the complexities of spread – e.g. vaccinating one person may protect his contacts- make "intuitive" arguments unreliable. Yet, challenges remain. Empirical knowledge is rarely without gaps and simplifications are always needed. Ensuring that such simplifications do not affect the conclusions drawn from the model is as much an art as a science.