SALUD COLECTIVA, Buenos Aires, 8(Suppl 1):S5-57, November, 2012

# What does the epidemiology of infectious diseases have to teach the epidemiology of chronic diseases?

## ¿Qué puede enseñarle la epidemiología de las enfermedades infecciosas a la epidemiología de las enfermedades crónicas?

***Diez Roux, Ana V.*[1]**

The study of infectious diseases has been one of the pathognomonic characteristics of epidemiology throughout history. Many examples that illustrate epidemiological concepts used in teaching are based upon cases of infectious diseases. John Snow of England, often considered to be one of the pioneers of the epidemiological method, devoted himself to investigating the causes of cholera in 19th Century London. Ignaz Semmelweis, of Hungary, discovered that infectious agents were the main cause of puerperal fever. Louis Pasteur, of France, identified the bacteria responsible for several diseases and developed the first vaccines. Heinrich Hermann Robert Koch, of Germany, isolated the microorganisms that caused anthrax (*Bacillus anthracis*), tuberculosis (*Mycobacterium tuberculosis*), and cholera (*Vibrio cholera*e), and formulated the postulates that today bear his name and are used to determine whether a microorganism is the cause of a disease.

In present times, the best known cases of breakthroughs in epidemiology are related to infectious diseases: the identification of the AIDS virus and associated risk factors, the control of the recent SARS (severe acute respiratory syndrome) and influenza epidemics, and even the recent identification of a fungus as the cause of meningitis cases associated with intrathecal corticosteroid injections in the US. The name of the discipline itself makes reference to "epidemics" and its original meaning referred to the study of infectious diseases (it is believed that the term "epidemiology" was used for the first time in Spanish documents dating from the 15th Century). Even today, chronic diseases, including cancer and cardiovascular diseases – which, in almost every country represent higher causes of morbidity and mortality than infectious diseases at the population level – are defined as "non-communicable diseases," as if they were the exact opposite of infectious diseases. Still, the general public tends to identify epidemiology almost exclusively with the study of large-scale epidemics of infectious diseases.

This relationship of epidemiology to infectious diseases has had a profound impact on its concepts and methods. Germ theory – which displaced miasmatic theory and prompted the search for microbial organisms that caused distinct pathological processes – has undeniably influenced the concept of cause in epidemiology and has stressed the notion of necessary and sufficient cause (the presence of the germ) characteristic of classic causal thinking. This concept of cause was then ascribed, to a certain extent, to the conceptualization of individual risk factors (for example, personal behaviors) as necessary and sufficient causes of chronic diseases, especially in the paradigmatic case of the cardiovascular disease. In fact, the ultimate objective of many current epidemiologic study designs and analyses – isolating the possible causal effect of a certain factor – can be paralleled with the idea of isolating the pathogen that

[1]PhD in Epidemiology. Professor and Director of the Epidemiology Department, Head of the Center for Social Epidemiology and Population Health; School of Public Health; University of Michigan, USA.

SALUD COLECTIVA, Buenos Aires, 8(Suppl 1):S5-S7, November, 2012

causes an infectious disease. In that sense, although the origins of epidemiology in infectious disease have promoted the search for a specific cause – which has proved to be useful for public health in general – it has also promoted reductionism, leading to a limitation in the explanatory capacity of epidemiology, not only for other health problems but also for many infectious diseases.

The epidemiological study of infectious diseases has, in many cases, stressed the identification of the microorganism causing the disease as being the sole, necessary and sufficient cause. However, it is also true that the epidemiological study of infectious diseases has increasingly acknowledged the inadequacy of those reductionist explanations. One way of overcoming monocausal reductionism is by recognizing the importance of the host's characteristics in modifying the effect of the microorganism's presence. In his book *The Mirage of Health,* René Dubos discusses in detail how the presence of a pathogen is not a sufficient condition to cause a disease in the majority of cases. Other characteristics must also be present in the host, characteristics that are frequently influenced by the host's environment. In fact, there are many cases of pathogens living within the host without causing a disease (*Mycobacterium tuberculosis* is a classic example of this). The disease only manifests itself in the case of disturbances in the immune system associated with, for example, nutritional deficiencies or being exposed to situations stressful to the organism. A second way in which the epidemiology of infectious diseases has overcome monocausal reductionism is by acknowledging the importance of the environment in a microorganism's reproduction and transmission. This means that the probability of acquiring both the pathogen and the disease are strongly influenced by the social and physical environment surrounding an individual. Both processes – the influence of the characteristics of the host on the organism's response to the presence of a pathogen and the influence of the environment on the probability of an individual acquiring a pathogen – imply the use of a multiple causation model with different levels of influence. The articles compiled in this monographic issue of *Salud Colectiva* on infectious diseases clearly illustrate the need to consider multiple levels of influence and to contextualize the epidemiologic study of infectious diseases.

However, there is a third way of overcoming the monocausal reductionism that has acquired growing importance in recent years, not only in the field of epidemiology of infectious diseases but also in other fields of epidemiology. The communicable nature of infectious diseases implies, by definition, that an individual's condition influences the health of those around them. In other words, there are many dependency patterns among individuals, and an individual's state of health or illness is not independent of the status of those who live in the same environment or who belong to the same social networks. This implies the presence of mutual influence, feedback patterns and non-lineal relationships, all aspects that characterize dynamic systems. Grasping the effect of a specific factor often requires a thorough understanding of the basic rules that characterize the way in which a system functions. For this reason the epidemiology of infectious diseases has been at the forefront of techniques for modeling complex systems in epidemiology and in public health in general.

It is interesting to observe that the need to conceive population health and epidemiologic phenomena in general as a result of the functioning of a system has become increasingly relevant in other areas of epidemiology. Recent studies, for example, have suggested the possibility that behaviors associated with chronic diseases are "transmissible" through social networks, analogous to the way a pathogen is transmitted. There has also been much discussion of the need to use concepts and tools derived from the study of complex systems in the practice of epidemiology and of public health in general. However, such tools and concepts may subsequently pose problems, especially when using them to understand phenomena more complex than a pathogen's transmission through social networks.

It is important to highlight that, throughout history, the difference between communicable diseases and chronic diseases has become more subtle and artificial. For example, it is known that many diseases regarded as chronic diseases par excellence, such as arteriosclerosis or heart conditions in general, can have infectious origins. At the same time there are infectious diseases such as AIDS that, over time and with the development of new medical treatments, have in fact become chronic diseases. To summarize, both chronic diseases and infectious diseases have determining factors at multiple levels and ultimately are the manifestation of the functioning of complex systems in which individuals interact with each other

and with their environment over time. The articles included in this monographic issue invite the reader to reflect upon the influences of the different factors, ranging from the social and economic organization of a society to the biological characteristics of a pathogen over the epidemiological patterns. The integration of the factors that would allow us to synthesize the most important relationships and to identify the most useful actions to improve health is still epidemiology's most important task.

**CITATION**
Diez Roux AV. What does the epidemiology of infectious diseases have to teach the epidemiology of chronic diseases? [Editorial]. Salud Colectiva. 2012;8(Suppl 1):S5-S7.



The translation of this article is part of an interdepartmental collaboration between the Undergraduate Program in Sworn Translation Studies (English < > Spanish) and the Institute of Collective Health at the Universidad Nacional de Lanús. This article was translated by Cristian Herrlein and Lucas Orellana, reviewed by María Victoria Illas and modified for publication by Joseph Palumbo.