

# How can Epidemiology contribute to new aspirations and strategies for Public Health? Young Epidemiologist's View

Carina Rodrigues\*

EPI Unit - Institute of Public Health, University of Puerto, Portugal

\***Corresponding author:** Carina Rodrigues, EPI Unit - Institute of Public Health, University of Puerto, Portugal. Tel: +351222061820; Email: carina.rodrigues@ispup.up.pt

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## Commentary

How can Epidemiology contribute to new aspirations and strategies for Public Health? Epidemiology is a scientific discipline which has had a fundamental role on public and global health as well as on clinical medicine. The global aim of epidemiology is to study “The occurrence and distribution of health-related events, states, and processes in specified populations, including the study of the determinants influencing such processes, and the application of this knowledge to control relevant health problems” [1]. This type of information is essential and basic for the formulation of effective public health initiatives to improve populations' health, which is the target of epidemiology.

From the late 19<sup>th</sup> century to first half of 20<sup>th</sup> century, epidemiology had a determinant role on the control of the infectious disease (“Infectious disease era”), namely yellow fever, syphilis, cholera and tuberculosis. Since the second half of the last century, epidemiology has also made important contributions to the identification of the causes of chronic diseases, such as cancer, cardiovascular and respiratory diseases, with focus on risk factors at the individual level (“Risk factor era”) [2].

Although it may seem self-evident, the identification of risk factors at the individual level in population is not sufficient for epidemiologists to face the most pressing public health challenges of our time, for instance the increased prevalence of chronic diseases (e.g. obesity and diabetes), infectious diseases outbreaks (e.g. Zika), healthy aging, HIV/AIDS pandemic, changing environment, social inequalities, movements of and changes in populations [2,3].

Extraordinary advances in molecular genetics and developmental biology require to be considered in epidemiological research, on the other hand societal contexts could not be disregarded as well. “We need to be equally concerned with causal

pathways at the societal level and with pathogenesis and causality at the molecular level” [2]. In an era of globalization together with growing level of diseases complexity, the reductionist approaches focusing only on linear cause-and-effect relationships do not make sense. For this reason, it is essential to take into account the dynamic interconnections between the molecular, microbiologic, physiologic, anatomical, emotional, cognitive, behavioural, social, cultural, economic and environmental factors in understanding of both communicable and non-communicable diseases. Epidemiologists should have a holistic vision for health and disease. But how can epidemiology do it?

In my opinion, and following the perspectives of some other authors, as Geoffrey Rose (“The causes of the causes”- population perspective) [4] and of Mervyn Susser and Ezra Susser (“Chinese Boxes”) [2], a complex and comprehensive approach is required to be applied in epidemiological research, combining all fields of possible interactions: from micro-biological to macro-social aspects. This is called ecological epidemiology.

Glass and McAtee [5] suggested an analytic approach with two interrelated axes: time, and levels of nested hierarchies of social and biological organization. The time axis is based on the temporal influences over time and could be conceptualized at the individual-level as the life-course (from conception to death), or at the population-level in terms of historical changes. The second axis embodied biological and social systems. The biological hierarchy integrated genomic, molecular, cellular and multi-organ levels. The social hierarchy nested in the following levels: micro (groups, family, social networks, etc.); mezzo (work-sites, schools, communities, healthcare, etc.); macro (national/state and large-area dynamics) and global (geopolitical, economic and environmental dynamics) [5]. The multiple interactions between and within these different axes/levels induce and constrain individual behaviours [5] and, consequently, influence not only the determinants and

outcomes of health and disease, but also the strategies for disease prevention and health promotion.

Considering this perspective, the role of epidemiology is to develop a sophisticated multilevel framework on the way of thinking and doing epidemiological research, incorporating dynamic system models, with multiple levels of causation and taking into account the importance of gene-environment interactions and the exposures over the life course (e.g. disease later in life could reflect early exposures in uterus or in childhood). Thus, it is necessary to identify the causal processes at each level and to analyse how a process at one level (e.g. societal cohesion or cellular changes) can manifest at another level (e.g. disease in an individual) [6]. In fact, complex models could expedite novel hypothesis generation and early hypothesis testing, identifying key elements of complex systems to achieve a better understanding for the disease process.

For this reason, epidemiologic research requires a competent, well-trained and multidisciplinary workforce, integrating epidemiologists, clinicians, geneticists, molecular biologists, statisticians and social scientists. Additionally, it needs to combine several types of methods: qualitative, quantitative and mixed. Specifically, regarding the methodologies, it must be stressed the importance of to have access to data and to invest in creation and analysis of large databases ("Big data"), as well as of secondary data from different populations, with demographic, genetic, medical and environmental information (e.g. electronic health records, cohort studies, biobanks, etc.) [7]. The creation of crosscutting and multidisciplinary research partnerships and networks, as well as the use of new information systems, the increase of sophisticated computer software for examining massive amounts of data and the implementation of new technologies (e.g. biomedical technologies) will be a key role [7]. Although these could require more time, a larger team, more money and rigorous ethical control, these may be a powerful tool for epidemiology on 21<sup>st</sup> century.

In general, eco-epidemiology approach and its practice will allow to achieve a more comprehensive strategy for understanding disease patterns (how diseases are distributed in the population over time, between places and persons) and factors that cause it [5], unravelling the complex interplay between genetic and environmental factors and creating effective preventive measures

[7]. It does not mean that risk-factor epidemiology should be discarded. Inversely, this approach should be developed and applied preserving the contribution of past eras. The key approach is to perform an appropriate use of epidemiological research in both domains clinical and preventive medicine and public health, considering "Levels of causation, life course trajectories, kinds of causes, and types of diseases" [6] within a broader framework.

In conclusion, epidemiology is a very important tool in the detection and control of health problems, what unquestionably have been contributed to improvement of populations' health over the last decades. Nowadays, epidemiology needs to be dynamic, flexible, innovative and based on transdisciplinary approaches. The main challenge is to do the epidemiology an "Art". It means that it should be applied appropriately and creatively, considering several research designs, strategies of analysis, tools and different information sources to answer the specific public health problems between and within populations. With open minds, critical sense and intellectual rigor, the epidemiologists could contribute and support the new aspirations and strategies for Public Health, translating evidence into action, and, ultimately, reducing inequalities in health between and within countries.

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