ECONOMIC EPIDEMIOLOGY: THEORY AND EVIDENCE.

EPIDEMIOLOGÍA ECONÓMICA: TEORÍA Y EVIDENCIA.

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The purpose of this editorial is to highlight the importance and relevance of a new area in Health Economics: Economic Epidemiology. We also want to encourage further studies in this area, fostering contact between economists and epidemiologists, as their contributions are important for a better understanding of the evolution and dynamics of infectious diseases.

Economic epidemiology can be defined as a discipline and multidisciplinary area that analyses the relationship between preventive behaviour and the prevalence of diseases. It focuses on the economic causes and epidemiological consequences of the spread of infectious diseases that affect public health. The basic presupposition of this approach is that the rational behaviour of individuals affects the trajectory of an infectious disease in a population, which can bring unwanted consequences both at the individual and collective levels. Thus, Economics uses concepts little explored by the classical approach to infectious diseases within the epidemiological field [1].

Infectious diseases have a unique feature that makes them particularly difficult to analyse: the fact that they are transmitted from person to person. With this, individual behaviour becomes a central aspect within Economic Epidemiology, especially given the fact that individual choices, made about treatment and prevention, impact other individuals. In many situations there is a discrepancy between choices considered optimal by the individual and the collective. The impact of individual choices on others is a widely used concept in economics, known as externality. Because this concept is so central, the economic approach has the potential to contribute to the understanding of how human behaviour affects infectious diseases and what the governmental role is in controlling these diseases [2].

According to Gersovitz, M, *et al*., [3] two types of externalities related to infectious diseases can be identified. The first externality occurs with an infection from one person to another (a cascade effect) which can be called pure infection externality. This externality arises if an individual, when choosing their own levels of therapeutic and preventive efforts, does not consider the costs incurred by others who will be infected because of their infectiousness. The second externality is that of pure prevention that arises because of the preventive actions of an individual that can directly affect the probability that other people will become infected, even if the preventive action does not prevent the infection of the individual who is taking precautions. Usually, this second externality is more focused on infectious diseases that have a disease vector.

Economic Epidemiology relies on people's rational behaviour that seeks to maximize individual well-being based on incentives, restrictions, and information that reaches them. The importance given to the dynamics of human behaviour, within an epidemic, brings new explanations for the understanding of infectious diseases.

According to Philipson T, *et al*., [4], standard epidemiological models, in general, made unreasonable predictions about the growth of contagious diseases, such as AIDS, which is mainly transmitted through sexual behaviour. Therefore, economics can be used to increase the predictive

and explanatory power of such models by adding the assumption of rational behaviour. The main criticism of conventional epidemiological models is that they failed to consider the importance of incentives in shaping private responses, both in relation to infectious diseases and in relation to programs that seek to control them.

The reason for this, for example regarding AIDS, was the failure to recognize that the increase in the prevalence of a disease is (with certain caveats) the equivalent of an increase in the price in the markets of goods and services, which creates the risk of contracting the disease, inducing a behavioural response that would limit the further spread of it. With this, it can be understood that the study of contagious diseases assumes that the market for activities that create the risk of contracting infectious diseases (such as being in touch with an infected person) is like other markets studied by Economics [4].

The Economic approach seeks to examine the public and private responses regarding contagious diseases, focusing on human behaviour responses regarding changes in incentives. This means treating individual choices as being a rational decision in the sense that individuals respond to incentives, in this case, the prevalence of the disease. In addition, Economic Epidemiology can be used to predict and assess the effects of public policies regarding subsidies for medical research, vaccination, population education and subsidized distribution of medicines and tests for certain diseases.[4]

The Economic analysis takes as its starting point the maximizing behaviour of the individual. However, this does not mean that the social aspect is not relevant, since infectious diseases arouse self-protection not only because of their severity, but also because of their growth in society and their spreading pattern. Responsiveness or sensitivity to something is referred to in Economics as elasticity, which is defined as the percentage change in a given variable, given a percentage change in another. In this way, there would be a reciprocal relationship between self-protection and the prevalence of the disease, creating a response *loop*. Understanding this relationship helps identify these periods during an epidemic and the subsequent response that individuals may have to the disease. [5]

This hypothesis is illustrated in **Figure 1**.

This approach differs from the traditional epidemiological approach, where greater protection leads to less disease growth, ending the relationship without considering that it would function as a cycle and, therefore, does not consider the behavioural response of individuals that creates this response *loop* to the prevalence of the disease. Traditional epidemiological analysis certainly discusses how various patterns of behaviour affect disease occurrence, but it does not analyse the implications of how behaviour changes in response to new incentives created by the growth of a disease, nor does it analyse the effects of these changes on measures of public health [5].

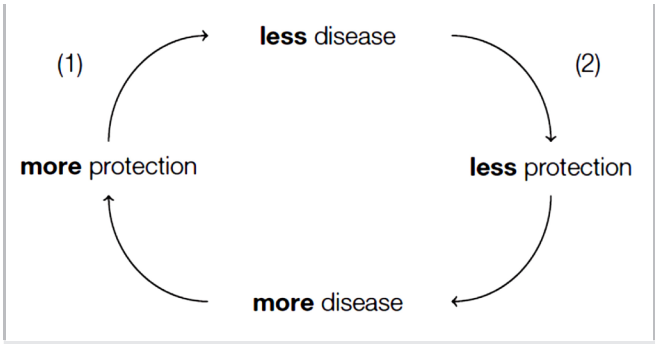

Figure 1 . Economic response loop to infectious diseases

Source: Bhattacharya J, et al., [5].
The reciprocal relationship between self-protection and disease prevalence: **(1)** self-protection limits the extent of the disease; **(2)** lower prevalence motivates less self-protection. This reciprocal relationship creates a feedback effect that mitigates the effects of self-protection on disease prevalence.

From an economic point of view, if a disease becomes more widespread in the population, that is, more prevalent, the demand for individual protection would increase in response.[6] This type of behaviour can have two implications: the growth of infectious diseases is self-limited, as it induces preventive behaviour; and, since the decline of a disease discourages prevention, public efforts make it increasingly difficult to eradicate infectious diseases, making vaccination campaigns, for example, self-limiting.[5] According to Philipson T, *et al.,* [6], if any campaign is successful, the prevalence of the disease decreases and, consequently, the population decreases its demand for self-protection. This *feedback* only occurs if people respond to the prevalence. Thus, we see the importance of determining the parameter regarding elasticity-prevalence.

The sensitivity to prevalence is called the elasticity-prevalence of private demand for disease prevention (elasticity-prevalence). Many epidemiological models do not consider that the demand for protection reacts to the prevalence of the disease, and with this, they end up assuming, even implicitly, that the prevalence-elasticity is equal to zero. [5] If the prevalence elasticity is low, zero, or close to zero, people will demand little prevention, resulting in higher future prevalence. On the contrary, if it is high, for example, greater than zero, then a larger amount will be required for prevention. Thus, there will be a low future prevalence. This demand for prevention alters the disease prevalence rate.[7]

The elasticity-prevalence serves as a basis for understanding the rational and strategic behaviour of individuals in relation to infectious diseases. When the prevalence elasticity is greater than zero, the governmental role differs from when it is low. The importance of this concept lies in the way the government uses it to formulate the magnitude of public policies, that is, who they should reach, for how long and the form of incentive used, such as opting for a subsidy on vaccination or ways to bring information and, consequently, education to people. Epidemics create incentives that play a key role in the occurrence of the

epidemic itself and in the public health measures designed to control it. **Table 1** below summarizes the main implications of this approach.

Table 1: Elasticity – Prevalence Values (Ep)

Ep Values	Prevention demand	Implications
Ep = 0 (Traditional approach)	Little prevention	More future prevalence
Ep near 0	Little prevention	More future prevalence
Low Ep	Little Prevention	More future prevalence
High Ep	More Prevention	Low future prevalence
Ep much higher than 0	More prevention	Low future prevalence
Ep > 1	More prevention	Low future prevalence

(Economic Approach) (Ex: demand for vaccine)
Source: Authors' own elaboration.

Elasticity-prevalence is considered a major contribution of economic epidemiology, for the understanding of the spread of infectious diseases.

Government measures aims to increase the demand for vaccination among the population, through price subsidies and other similar policies. Programs that seek to stimulate this demand are usually motivated by the low supply of vaccines, and the belief that demands for vaccine is price elastic. However, if demand for vaccine is elastic (sensitive) to disease prevalence, it will limit price elasticity. According to Philipson T, *et al*. [8], a price increase will lead to an increase in prevalence and, therefore, an indirect increase in demand for vaccines. In this way, the negative effect caused by the price will be compensated. If the demand for vaccine is highly elastic (sensitive) to prevalence, the demand will be highly inelastic (not sensitive) to price, making vaccine price a secondary barrier to the rate of increase in vaccinations. With this, the elasticity-prevalence is of foremost importance, since it alters the calculations of the impact of price subsidies aimed at stimulating demand.

The limitations that demand imposes on subsidies must always be considered, proposing a reassessment of such subsidies. When demand is elastic to prevalence, it has important implications for the timing of implementing public health programs, as public subsidies that encourage self-protective behaviour compete with transmissive behaviour, that is, if the public subsidy is applied too late, the private disincentive caused by prevalence has already modified behaviour. Therefore, a more careful analysis of the incentives that lead to the occurrence of vaccine-preventable diseases is needed, and the effect that public measures have on the control of infectious diseases, even those not preventable by vaccine. [9]

This brief editorial aimed to show how infectious diseases can be evaluated from the perspective of Economics. The Economic approach to epidemiology has not sought to diminish the importance of other approaches but seeks to highlight recent theoretical and empirical contributions that can be made by Economics, and which have not yet received due attention from many professionals mainly linked to Public Health and Economic policymakers in this area. The editorial sought to illustrate and indicate the importance of information, incentives, restrictions, and direct and indirect costs related to infectious diseases. All these points are critical for evaluating the real efficiency of public policies for infectious diseases.

With the advance of the new corona virus pandemic and other infectious diseases plaguing our region and countries, this area is gaining notoriety within the community of health economists and policymakers. Several efforts are being made to understand the behaviour of different populations in the face of the pandemic and what can be done to change individual incentives and restrictions to promote an improvement in public health. Understanding what drives people to take decisions regarding specific diseases opens a range of options and possibilities to contain the spread and the worsening of infectious diseases, in addition to help fight new epidemics.

Economic Epidemiology, its models, implications, and empirical evidence are still in the initial phase of its development, not having all its aspects fully explored. Thus, we hope that this editorial will encourage both health professionals, economists, epidemiologist, pharmacists and other medical researchers to carry out research in the area and public policymakers to use this original and novel approach as tool in the formulation and evaluation of public policies in health and in epidemiology in particular.

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