CORRESPONDENCE
pISSN 0976 3325 | eISSN 2229 6816
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Why We Should Study Infectious Disease Epidemiology?

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Key word: Epidemiology, Infectious Disease, Immunity, Prevention

What is epidemiology and why should one spend time studying it? Most standard definitions of epidemiology mention something like 'the study of distribution and determinants of diseases in the population', which is an adequate formulation, even if somewhat abstract.

Epidemiology is about putting people into groups. We are all individuals, and no two patients are ever exactly alike. Even the largest forest consists of trees each of which is unique. However, we all have a number of characteristics that group us with other people: we are either man or woman, we are of a certain age, we live in a certain area, we have certain dietary habits and behaviours, and so on, and we share those characteristics with varying numbers of our fellow humans. Epidemiology identifies such groups, ignoring the uniqueness of its members, and tries to discover whether this division of people into groups tells us something more than we could have learnt by just observing each person separately. Since epidemiology is a branch of medicine, our interest is usually to describe, analyse or understand the patterns of disease in such groups. The most common situation is when we find one group of people who are ill with some disease and another group who are not: What is the difference between these groups? Is there some characteristic that seems to differ between them?

Epidemiology is thus largely a matter of perspective, and a colleague of mine, who is one of the best clinicians I have met, once told me: 'I will never be a good epidemiologist – I cannot see the forest, I can only see the trees. This is a perfectly justifiable position, and medicine needs both types of people.

On the basic level, epidemiology just starts with a description of the cases of a disease. When do they appear? Where? What ages are they? Is there any group-defining characteristic that they have in common? Obviously, in such descriptions the individual cases are not of prime interest, but rather the collective pattern of disease that they form. Such straightforward descriptive epidemiology almost always reveals interesting patterns that we would not have observed if we had not collected the cases and ordered them in a structured fashion. To the inquisitive mind (and unless you had one you would not be reading this book) the question 'why?' pops up immediately. Why were there so many cases in a certain area? Why were there more women than men? Why were there no sick children? Why are there more cases this year than last? Such questions lead to the next step in the epidemiological analysis. We move on to analytical epidemiology which usually means that we try to systematically compare the group of disease cases with another group of healthy people. We test the clues offered by the descriptive study by searching for differences in characteristics between the ill and the healthy: Did the cases of gastroenteritis eat something that the others did not? Did the children who contracted measles go to a different school from those who did not? Is it more common to find evidence of past Coxsackie virus infection in children with diabetes than in healthy children? Do adults who develop varicella usually get a more severe infection than children? If our analytical study has been well designed, and if the clues we are investigating are appropriate, we may find strong support for a certain aetiology, a certain pathological mechanism or a certain source.

The final step is to convert our knowledge about this disease into preventive action. Can hygiene measures be instigated by society? Can we influence people's behaviour to lessen their risk of falling ill? Is there any prophylactic treatment? Could a vaccine be developed? Here again, epidemiology might be called upon to evaluate the effects of preventive measures:

How to cite this article: Patel P. Why We Should Study Infectious Disease Epidemiology?. Natl J Community Med 2021;12(1):15-17

Financial Support: None declared **Conflict of Interest:** None declared

Date of Submission: 10-01-2021; **Date of Acceptance**: 27-01-2021; **Date of Publication**: 31-01-2021

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Did they have the effect on pattern of disease that we had hoped for?

All these steps with the exception of vaccination apply equally to non-infectious and infectious disease epidemiology.

There are, however, two features that are unique to infectious diseases:

1. A case may also be a risk factor.

2. People may be immune.

Concerning the first feature, in most non-infectious disease epidemiology the division between the risk factors for disease and the cases themselves is unambiguous. Smoking is a risk factor, and a patient with lung cancer is a case. Radiation is a risk factor, and a patient with leukaemia is a case. High alcohol intake is a risk factor, and a patient with cirrhosis is a case. In all these examples, the risk factors belong to a completely different universe from the cases. A person's risk of developing coronary heart disease is not influenced by her neighbour's myocardial infarction. Neither does intensive treatment of coronary thrombosis patients in hospital diminish the overall rate of new cases of this disease in the population.

For influenza, however, my risk of disease during the coming winter will be greatly affected by the number of influenza patients around, and if many of the people I meet have been vaccinated, my risk of contracting influenza will decrease even if I myself have not been vaccinated. Treatment of a tuberculosis case will dramatically lessen the risk of disease in members of the patient's family. For many of the infectious diseases, someone who is a case will at the same time be a risk factor for disease in other people. The clear distinction between the two categories 'risk factor' and 'case' becomes blurred. The fact that a case may be a source of disease in others also means that contact patterns in society – Who meets whom? How? How often? – become very important issues if we want to understand the epidemiology of infectious diseases. Some scientists working in non-infectious disease epidemiology get annoyed when I point out that they are dealing with a simplified version of the science, namely one where transmission of disease between cases does not have to be accounted for.

The second feature, immunity, is also unique to infectious diseases. Someone who has had measles will never get it again, even if she strolls through ward afterward with measles patients. For most non-infectious risk factors, such as toxins or radiation, there will be levels when everyone exposed will fall ill. (It could be argued that some kind of resistance to such risks also exists: Why do some people remain healthy after having smoked two packets of cigarettes a day for 50 years? However, little is known about this type of resistance.).

These two points contain the major differences between the two branches of epidemiology, but there are a few more:

3. A case may be a source without being recognized as a case.

By this I mean that asymptomatic, or subclinical, infections play an important role in the epidemiology of many infectious diseases. Ignorance of their existence would make many outbreaks and transmission chains inexplicable.

4. There is sometimes a need for urgency.

Most of present non-infectious disease epidemiology concerns itself with environmental and behavioural risk factors for disease. Investigations are often big and lengthy and their results may enter into public health programmes that often take years to implement. With outbreaks of infectious diseases, the time frame is sometimes more like hours or days before some preventive action has to be decided on. This may give little time for elaborate analyses.

5. Preventive measures (usually) have a good scientific basis.

Much is known about the bacteria, viruses and other parasites that cause disease, about their transmission, and about how they should be stopped, even if this knowledge may not always have the desired public health impact. Someone who, like myself, has been observing the 40-year debate on the dangers of cholesterol – or the discussion about what causes asthma in children – from the sidelines can easily feel content to be in the field of infectious diseases. With some exaggeration, one could say that infectious disease epidemiology is concerned largely with the investigation of preventive factors, whereas non-infectious disease epidemiology is still struggling with risk factors.

Some authors denote what I have termed 'non-infectious' earlier, 'chronic' disease epidemiology, implying inter alia cancer and cardiovascular disease. This is not very accurate, since several of the infectious diseases are just as chronic as many of the non-infectious ones.

EPIDEMIOLOGY AND DIAGNOSIS

When dealing with patients with infectious diseases, we use epidemiology all the time, without even thinking about it. Taking a patient history, we ask questions such as:

- Does anyone else in the family cough?
- How long after the dinner did you start to feel sick?
- Have you been to the tropics?
- How long is it since her brother had a rash?

The answers to all these questions aid our diagnosis. Compare this to how useful the question 'Do you know of any neighbour with similar chest pain?' would be to decide if the patient in front of us has a myocardial infarction or not. Or what help we would get from the question 'Did her brother break his ankle recently?' in deciding whether the patient has a fracture or just a strained ligament.

Our almost subconscious knowledge about incubation times, transmission routes, geographical risk zones, and so on, is an important tool in diagnosis, but few clinicians I have met seem to realize to what extent they are using epidemiological facts when they interview a patient in the emergency room or in the clinic.

CONCLUSION

Most aspects of infectious disease epidemiology are similar to those of non-infectious disease epidemiology. The terminology, the concepts and the analysis are basically the same. However, the five special features outlined here – and especially the added complication that disease can spread from one case to another – not only makes this branch of epidemiology much more intellectually challenging but also increases the risk of scientific mistakes. Those who want to devote some serious effort to the study of infectious diseases should do well to consider those special aspects.