



Epidemiological Fallacy: A Common Mistake among Epidemiologists

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When epidemiologists perform duty relating to outbreak investigation, surveillance function, or any type of epidemiological research activity, the first performance is the collection of data. The next steps are analysis and interpretation of the data, production of meaningful opinion, and provision of recommendations which may lead to the development of management policy, either by epidemiologists themselves or by policy makers. While the data are considered as immutable facts, all the subsequent steps are not. The same set of data may be interpreted differently by different persons; and thus, the resulting policy recommendations may be completely different. It is not uncommon to see that wrong policies are produced based on wrong interpretation. This undesirable phenomenon is described as epidemiological fallacy which can range from confounding to ecological inference errors. The epidemiological fallacies are not mere academic flaws; they have real-world consequences, frequently leading to ineffective policies, wasted resources, and unnecessary public alarm.

There are many categories of epidemiological fallacies and many world-class examples which can be studied through Internet search. There are also situations of which the underlying truth have never been revealed. One significant example is a finding from the national human immunodeficiency virus (HIV) sentinel surveillance program in Thailand, initiated by Division of Epidemiology, Ministry of Public Health, in 1989. During the first few years of the program, in addition to the usual at-risk populations like female sex workers, men who have sex with men, drug users, sexually transmitted infection (STI) clinic attendees, blood donations, and young people; blood samples were also collected from prisoners which were categorized into new inmates and released prisoners. It was constantly observed that prevalence of HIV among released prisoners was always significantly higher than that of the new inmates. Such situation was unofficially interpreted as HIV transmission in prisons. These findings were collected and the reports were circulated among responsible group of epidemiologists. The data were also reported at the 10th International Conference on AIDS in Yokohama in August 1994. During the presentation, the audiences expressed their concern on the poor management of prison authorities who failed to control HIV spreading in prison settings. Because of the blame, as a consequence, Thailand's Department of Corrections discontinued the participation in the national HIV surveillance program. The underlying explanation of the differences of HIV infection rates in the two groups of prisoners has not been revealed. Even today, epidemiologists and technocrats still believe that the situation was due to a failure in the prevention and control program in prison settings, without realizing that the two prisoner groups were not the same. Not many people know that during the first few years of HIV epidemic in Thailand, demographic and clinical data of all reported HIV positive people were collected at the Center for the Prevention and Control of AIDS (the current Division of AIDS and STIs) in a spread-sheet computer program called the Lotus 1-2-3. Very few people had access to the program. By personal observation at the data, it was found that all the HIV positive prisoners, either the new entries and the released ones, were already listed in the database; and their risk behavior was narcotic drug injection. They were tested multiple times in drug rehabilitation clinics and in prisons. Thus, the fact about the difference in HIV prevalence between the new and the released prisoners is that all of them were already infected before becoming prisoners, and proportion of them in the two prisoner groups was difference. The proportion of drug-users in released prisoners is always higher than that of

the new inmates. From this description of the case, it is clear that common-sense interpretation of epidemiological data at first glance had led to wrong information and wrong decision. While the prevention program in correctional facilities is important and necessary, the understanding the real situation can increase knowledge on the etiology of HIV transmission and improve collaboration between public health authorities and the correctional settings.

Another example is also about HIV/AIDS. Since 1991, Thailand has implemented the 100% condom use program which had resulted in massive reduction on sexual transmission of HIV. The condoms procured by Department of Disease Control during that period, which were always insufficient, were provide mainly to female sex workers, the target group of the condom program. In the year 2000, epidemiological data showed that the sources of STI (a marker of HIV risk) among men was changed from 97% through sex workers and 3% through all other categories to 80% from sex work and 20% from others. Such change was interpreted as an increasing risk of transmission among the general population; and as a result, the Ministry of Public Health had announced in that year a policy to reduce condom supply to sex workers and deviated an increasing proportion to young people. Careful analysis revealed that the proportion change was due to different speed of reduction in the two groups: faster reduction in the sex work transmission and slower reduction in the others. Detailed calculation of data from annual reports of Venereal Disease Division, Department of Communicable Disease Control, revealed the real number of cases reduced in both groups: from 95,000 cases to 11,200 cases in sex-work group (a big reduction) and 5,000 cases to 2,800 cases in the others. The real numbers of reduction confirmed the success of the 100% condom program which effectively reduce HIV transmission from sex work, with spill-over effect on the reduction of non-sex-work transmission. Therefore, reducing condom supply to sex workers would cause serious negative effect on the national prevention program.

The two fallacies described above can be a clear message to remind that epidemiologists must remain critical skeptics of their data and methods. The fallacies are not merely theoretical. They have real-world implications for scientific understanding and public health policy. To mitigate these risks, some practices are useful such as being explicit about causal assumptions, performing in-depth analysis of the observed situation and the data, acknowledging the limitations of inferences, and being aware of selection bias. Through understanding and communicating these fallacies, epidemiologists can uphold the integrity of their field and ensure that evidence is used appropriately to improve effectiveness and efficiency of public health programs.