

Commentary: Epidemiology and futurology—why did Rothman get it wrong?

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Ken Rothman is a household name for epidemiologists all over the world. The appearance of his book ‘Modern Epidemiology’¹ in the mid-1980s consolidated his reputation as a major thinker in our discipline. I remember finding his book truly inspirational when I first read it as a junior epidemiologist.

Rothman’s commentary on ‘The rise and fall of Epidemiology, 1950–2000 A.D.’² however, made many epidemiologists worry. This paper, published in 1981, reads as if it had been written in the beginning of the 21st century, for presentation at the ‘John Graunt Literary Society’ at Harvard in 2004, pretending to look back at the downfall of our discipline.

According to Rothman, after the early contributions of Graunt and Farr, the field of epidemiology was ‘quiescent’ until the end of the World War II, when several large-scale studies were started in the USA. The 1950s–80s represented a boom for epidemiology, and Rothman provides several examples of highly visible discoveries and controversies involving North American epidemiologists during this period.

His commentary then shifts gears, starting to describe ‘the demise of epidemiology’. Ever tighter ethical restrictions enforced by institutional review boards either precluded large-scale studies or increased their duration to such an extent that, according to Rothman, few young researchers were being attracted to the field. Rather than doing actual research, lobbying in political and legal arenas became the most attractive career choice for epidemiologists. Concerns about potential legal actions by study participants further threatened field studies. His paper ends with an exercise in futurology: ‘a scientific discipline that evolved slowly and flourished briefly for several decades is now nearly gone, leaving behind some knowledge of disease prevention, a few controversial alarms, and a collection of techniques for assessing the health consequences of people’s actions.’

It is easy to criticize with the benefit of hindsight, but Rothman clearly had it wrong. Epidemiology is currently thriving in most of the world. Whereas from 1970–79, 4.1% of PubMed citations included the word ‘epidemiology’ in any field, this increased to 4.3% in 1980–89, 7.5% in 1990–99 and 8.8% in 2000–06. In addition, many new areas of application appeared or increased markedly since 1980—clinical, environmental, genetic and life-course epidemiology, to name a few. In terms of methodological advances, meta-analyses, cluster-randomized trials, multi-level methods are among the many developments.

But why did Rothman get it wrong? The most obvious explanation is that he did it on purpose. His alarmist tone, in a high-profile editorial in the top medical journal in the US, was aimed at drawing attention to unreasonable ethical guidelines, as well as the rampant ‘legalization’ in US culture. It is not devoid of irony, however, that Rothman himself has fulfilled his prophecy by providing expert advice in legal battles—for example, his controversial roles in a suit involving Texaco and indigenous groups in Ecuador,³ and in challenging the need for extra scrutiny for pharmaceutical-industry funded trials.⁴

Whether or not Rothman got it wrong on purpose, there are at least two additional explanations for the failed prediction. The first is that his definition of epidemiology was too narrow. The second that his definition of the world was too narrow.

A strict definition of epidemiology would be the study of exposure–outcome relationships, with an emphasis on biological, chemical and physical agents. Accepting this definition, one might conceive that after a certain point future progress will be limited because most important relationships will have been identified.⁵ For example, one may argue that all major risk factors for lung cancer have already been recognized. New epidemiological findings would then depend on either the emergence of new exposures or diseases, or else on improvements in the measurement of diseases, exposures or susceptibility. Even if a narrow definition of epidemiology is adopted, Rothman may have underestimated its potential for future development.

Fortunately, epidemiology has grown well beyond the study of such proximate agents of disease. Social and behavioural sciences increasingly contribute to epidemiological studies on ‘the causes of the causes’, for example, why do some people smoke or overeat while others do not.^{5–7} Epidemiological tools are increasingly used for impact evaluation^{8,9} and burden of disease estimations,⁹ among many other applications.

In particular, Rothman’s diatribe was centred on barriers imposed by multiple institutional review boards involved in studies that required the participation of a large number of hospitals—for example, collaborative case-control studies. However, these only account for a fraction of all epidemiological studies. Such restrictions do not affect cross-sectional surveys, nor case-control or cohort studies in countries with a health information system that pools data from multiple institutions—as is the case for several countries outside the USA.

This leads us to the second reason for the wrongful prediction: the paper is utterly USA-centred. After the brief reference to Graunt and Farr, Rothman overlooks developments outside the USA. At the time when the commentary was written, major epidemiological investigations, in particular

cohort studies, were well under way in Northern Europe. Ethical regulations have become stricter throughout the world—fortunately so!—but this has not significantly hindered large-scale studies. Also fortunately, legal action does not seem to constitute a major threat to research outside the USA.

In particular, epidemiological studies have markedly increased in Latin America and Asia, firstly with important contributions of researchers from North America and Europe, but in the last couple of decades with a steadily growing participation of local scientists. For example, our last national epidemiological conference in Brazil attracted over 4000 participants. Many studies on infectious and nutritional epidemiology are under way in Africa, mainly on AIDS and malaria; although these investigations are still mostly led by expatriates, African scientists are building up their own research centres and networks.

I am not sufficiently familiar with the situation in the USA to gauge whether Rothman's article had a major impact. It received a modest 36 citations in the Web of Science since its publication, and the only letter that appeared in the following issues of the *New England Journal of Medicine* was from Alvan Feinstein, who challenged the contribution of William Farr to epidemiology because of his backing of the miasma theory.¹⁰ Hardly a topic of current interest!

Futurology is a high-risk occupation. Again with the benefit of hindsight, looking at Rothman's paper after a quarter century shows that ethical guidelines helped improve epidemiology, and that our discipline evolved much beyond the

study of proximate exposures and of hospital-based studies. Long live epidemiology!

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Commentary: The rise and rise of corporate epidemiology and the narrowing of epidemiology's vision

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Reports of the impending death of epidemiology¹ have proven premature. The year 2000 dawned, and our computer systems, and our system of epidemiological research, both continued to function. When judged by the numbers of epidemiology journals, publications and academic positions, the field is clearly thriving.

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Nevertheless, to have survived is not necessarily enough, and more is not necessarily better. The Rolling Stones have also survived since the 1960s, and sell more albums and concert tickets than ever, even though their ages passed their IQs in the 1990s and Keith Richards was lost to follow-up back in about 1975. When the current state of epidemiology is assessed in terms of quality rather than quantity, it is arguable that Ken Rothman's pessimistic vision of decline¹ has partly been realized. The 'golden age' of risk factor epidemiology seems to have passed. The major discoveries (e.g. tobacco smoking and