Chapter 1
Epidemiology: Grappling with the Concept

Abstract  Public health as a segment of healthcare naturally is healthcare in the public domain, as distinct from healthcare outside of society’s purview; and the care naturally is paramedical care together with medical care – hence the term ‘health,’ rather than ‘medicine,’ in ‘public health.’

Medicine encompasses community medicine in addition to clinical medicine. This segment of medicine inherently is public-health medicine, whereas clinical medicine falls under public health only to the extent that national health insurance has been introduced.

Community medicine used to be focused on epidemics of communicable diseases; and a natural term for this segment of medicine thus was epidemiology. As the concerns in community medicine were extended to encompass endemic occurrence of communicable – and also of non-communicable – illnesses, ‘endemology’ could have been introduced as a term for this extension; but instead, the concept of epidemiology was expanded to community medicine in the thus-expanded meaning of it.

Epidemiological research naturally is research to advance (the practice of) community medicine – of epidemiology, that is. This research includes ‘bench’ or ‘basic’ research aimed at the development of vaccines, for example; and it falls under various medical sciences instead of constituting a science unto itself.

All of this presumably is natural and quite obviously true in the judgements of beginning students of epidemiological research, but it is here said for the troubling reason that concepts of epidemiology and epidemiological research different from these are endemic in today’s epidemiologic academia.

The purpose of this chapter is to help the beginning student to find proper orientation in this academia.
1.1 Epidemiology as Practice of Healthcare

“There Black Death of 1348 and 1349, and the recurrent epidemics of the fourteenth and fifteenth centuries, were the most devastating natural disasters ever to strike Europe [ref.]. . . . Europe about 1420 could have counted barely more than a third of the people it contained one hundred years before.” So writes David Herlihy in his *The Black Death and the Transformation of the West* (1997; p. 17).

Herlihy continues: “The devastating plagues elicited a social response that protected the European community from comparable disasters until the present” (p. 17). And: “One hundred years ago, the great bacteriologist Louis Pasteur declared: ‘It is now in the power of man to cause all parasitic diseases to disappear from the world’ [ref.]” (p. 18).

Regarding Pasteur’s grand vision, it is instructive to consider the history of epidemics of smallpox, also known as *variola*.

As there never was any effective treatment for this commonly-fatal communicable disease, healthcare directed to it always focused on *prevention*. Pre-scientifically this was a matter of ‘variolation’: immunization against variola by means of ‘inoculation’ (i.e., injection of attenuated matter from variola patients’ pustules, to produce a mild case of the disease). Records of this practice in China date back to the sixth century BCE, but in Britain and its American colonies it became rather commonplace only in the early 1700s. While fully effective, it remained controversial on account of concerns about its safety (unintended causation of severe, commonly fatal cases of the disease).

The dawn of science relevant to the practice of variolation was heralded by Benjamin Franklin’s work on this. His “goal was simple and straightforward. He wanted to give anxious patients evidence that it was safe to have their children inoculated. The data he assembled were most impressive. . . .” This, and more, on Franklin’s work on variolation can be found in I. Bernard Cohen’s *The Triumph of Numbers: How Counting Changed Modern Life* (2005; p. 90 ff.).

Then came what has been, arguably at least, the most spectacular scientific breakthrough in medicine, resulting in the introduction and adoption of *vaccination* as the replacement of inoculation in the prevention of smallpox. (‘Vaccinia’ was a synonym for ‘cowpox,’ the smallpox vaccine being based on matter from pustules of cowpox – a disease similar to but milder than smallpox.) The scientific breakthrough introducing vaccination was not a “triumph of numbers” (cf. above): it resulted from Edward Jenner’s work on a single (young) person. But the resulting triumph in medicine was, ultimately, complete: a concerted global program of vaccination, launched by the World Health Organization, resulted in eradication – complete elimination – of the smallpox virus from human populations.

In his *Civilization: The West and the Rest* (2011), Niall Ferguson asserts that “what distinguished the West from the Rest – the mainsprings of global power – were six identifiably novel complexes of institutions and associated ideas and behaviours” (p. 12). One of these he specifies (p. 13) as:
Medicine – a branch of science that allowed a major improvement in health and life expectancy, beginning in Western societies, but also in their colonies.

A historiographer as he is, Ferguson is to be forgiven for this excessive deference to medical sources, which commonly (and intentionally?) confuse physicians’ practice of healthcare – which we take to be the true concept of medicine – with medical science. “Major improvement” in Western and other societies from practices based on medical science is, however, an incontrovertible fact of history.

Ferguson addresses both medical science and the practice of medicine only in reference to that segment of medicine which produced the historically so consequential, major improvements in human health, namely community medicine.

For this segment of medicine he uses its umbrella term ‘public health,’ which means healthcare in the public domain, and subsumes also paramedical care. He sketches the enormous accomplishments of European medical science in providing the basis for highly effective community programs to prevent infectious diseases, tropical and other, and the startling gains in population health that have been achieved by means of those programs.

Neither that science nor those practices does Ferguson characterize as epidemiological, nor as epidemiology; in fact, neither one of these terms can be found anywhere in that admirably erudite book. Once aware of this, a student in an introductory course on epidemiological research might be driven to ask: Is this an oversight? or, Is it that there indeed is no epidemiology in the meaning of physicians’ epidemiological – community-level – practice of healthcare, served by epidemiological research, while clinical research obviously is in the service of physicians’ practice of clinical healthcare?

Looking for the answer, the student might explore, for example, the websites concerning Ottawa Public Health, the agency providing medical and paramedical healthcare for the community/population of Canada’s capital city. This agency is constituted and functioning in accordance with the Health Protection and Promotion Act of the province of Ontario, in which Ottawa is located. “The purpose of this Act is to provide for the organization and delivery of public health programs and services, the prevention of the spread of disease and the promotion and protection of the health of the people of Ontario.” Among the “Mandatory health programs and services” this Act specifies, quite notably, “Collection and analysis of epidemiological data” (italics ours).

Pursuant to this Act, Ottawa Public Health is headed by a Medical Officer of Health, who is a “physician with provincially legislated powers to promote and protect the public’s health” (italics ours). The other personnel of this agency is composed of “specialized teams of health professionals and support staff, including . . . physicians, epidemiologists, . . .” (italics ours).

This agency periodically publishes the City of Ottawa Health Status Report. The latest one, from 2006 (as of Dec. 2011), presents “a wide range of health-related information on mortality, morbidity, communicable diseases, reproductive outcomes,
environmental indicators, and behavioral risk factors.” It deserves note, in the present context, that of this report’s four authors (under the direction and guidance of the Medical Officer of Health), three are specified to be epidemiologists – as might be wholly unsurprising, given what the report is about. And let’s be clear: they are not reporting on epidemiological research (scientific) but on their practice as epidemiologists.

It thus is evident that epidemiology in at least one meaning of the term is community medicine, practice of this. In fact, this could well be the only meaning of the term: Research for clinical medicine is termed clinical research; but this research is not thought of as constituting one of the meanings – much less the only meaning – of ‘clinical medicine.’ By analogy, it would seem natural to think of epidemiological research as being extrinsic to that which it serves, namely epidemiology in the meaning of community medicine, its practice; it would seem natural to think that the research is not epidemiology by virtue of being in service of epidemiology. In these terms, just as a clinical researcher is not inherently a clinician, so an epidemiological researcher is not inherently an epidemiologist.

The work of Ottawa Public Health illustrates the essence of epidemiology as a genre of the practice of healthcare: not only is it community medicine but, as such, it inherently is (a physician’s practice of) public health as a matter of community-level preventive medicine. More on this in the last chapter (ch. 14) of this book.

Eminent in public-health practices in respect to non-communicable diseases have been those centering on occupational populations. As Robert Proctor points out in his The Nazi War on Cancer (1999), “German physicians had a long tradition in industrial hygiene, and Nazi physicians continued this practice”; and the very major anti-cancer program of that era (1933–1945) in Germany had an “emphasis on occupational carcinogenesis” (p. 73).

In a 1973 book entitled Occupational Health Practice, M.L. Newhouse and R.S.F. Schilling (the Editor) have a chapter on “Uses and methods of epidemiology.” They say that for an occupational health service “to achieve higher standards of health in a working community, it is essential to observe people as groups by using the methods of epidemiology, ‘a branch of medical science . . .’” (p. 169). To them – and by no means alone – occupational-health practice is not practice of epidemiology but, instead, involves use of it, of the methods of that “science.” They refer to a textbook source with a telling title: Uses of Epidemiology (Morris JN, 1964).

The physicians who, in Ottawa and elsewhere, produced the community diagnoses about, say, the SARS and H1N1 (‘swine flu’) epidemics and directed the population-level programs to control these, and physicians who are caring for, say, occupational populations as populations (rather than individually), we really think of as epidemiologists in the practice of epidemiology – of community-medicine, that is. We really do not think of them as ‘users’ of epidemiology in something that is not epidemiology.
1.2 Epidemiology as Health Research

Oncology, in one meaning of the term, is a discipline (‘specialty’) of medicine; it is the discipline of a physician’s practice of cancer-related healthcare, clinical or community-level practice. Oncology also is a science; it is the medical science aimed at advancing the practice of oncology. Oncological research is ‘applied’ science in this meaning; and this it is regardless of how ‘basic’ it is – as when aimed at, say, potential development of a proteomic ‘biomarker’ for latent-stage diagnoses about a cancer or a protein to ‘turn off’ an activated proto-oncogene in the treatment of a cancer.

By analogy, this: Insofar as the practice of community medicine is viewed as being epidemiology, epidemiological research is naturally taken to be research – any research, however ‘basic’ – aimed at advancement of the practice of community medicine. We hold to the predicate in this (sect. 1.1 above), and we therefore hold this inclusive conception of epidemiological research.

The earliest, and arguably the most spectacular, example of epidemiological research, in these terms, is the study for which Edward Jenner is so famous (sect. 1.1). He injected into a little boy, who had not experienced smallpox, matter from a cowpox lesion of someone else; and when Jenner a few weeks later inoculated this boy with smallpox matter, the boy did not come down with smallpox – the boy evidently had been immunized against this much more serious disease. (Jenner had developed, as a practitioner, the impression that those having undergone cowpox had been resistant to smallpox.) And recent examples include, among others, the research culminating in the availability of a vaccine for the prevention of HPV infection and, thereby, prevention of cervical cancer.

The concepts of oncological and epidemiological research are not fully analogous, however. Oncological research in the aggregate amounts to a science (called oncology), in the research (rather than knowledge) meaning of that science. This is because oncological research has a coherent, singular subject-matter or ‘material object,’ namely malignant neoplasm. Epidemiological research, very different from this, can address a material object from any one of a large number of health sciences – oncology, immunology (as in Jenner’s case), etc. As a consequence, epidemiological research is not definitional to a science (called epidemiology); it – like morphological research, for example – is subsumed under a variety of sciences.

Students of epidemiological research are prone to be left confused about the essence of this line of research, at least early in their studies. To wit, one of us wrote his thesis for the degree of Master of Public Health, in 1964, on Epidemiology and Its Method, which at the time were topics of vigorous debate in the American Journal of Public Health. Drawing from the various then-prevailing definitions, he merely synthesized them – in the framework of explicit principles – as amounting to this: “Epidemiology is the science of the occurrence of health and illness; the scope of epidemiology is the entirety of the occurrence of health and illness; and the method of epidemiology is essentially the scientific method but may have some distinctive characteris-
tics.” He thus found, most notably, that to his elders epidemiology was a *science*, and only this, rather than the practice of community medicine, this alone (cf. Schilling in sect. 1.1). He refrained from expressing his own views about these ideas of his elders (even though he hadn’t been brought up in the Presbyterian culture).

David Lilienfeld – son of the eminent epidemiologist Abraham Lilienfeld – when he still was a college student in the 1970s, took a more-than-casual interest in what his father’s field really was. He delved deep into the literature on the matter; and he brought to view 23 published definitions of epidemiology, the first one from 1927. Dissatisfied with them all, he added one of his own: epidemiology is “a method of reasoning about disease that deals with biological inferences derived from observations of disease phenomena in population groups.” (The culture surrounding his youthful development – different from that of the youngster alluded to above – presumably was the one which, quite uniquely, encourages critical study of the Scripture, even.)

We present, in Table 1.1 below, seven notable definitions of epidemiology, from 1956 to the present. The strong impression from these definitions, disappointing to us, is that epidemiology is seen to be a matter of research alone, and this, even, without any inherent service relation to the practice of healthcare – different from, say, that of oncological research in relation to the practice of oncology (cf. above). It seems that the research is seen to be conducted for the sake of the research itself, as though there were no practice of epidemiology being served by the research (cf. sect. 1.1).

It really does seem, on the basis of those definitions, that among epidemiological researchers of late there hasn’t been any conception of epidemiology as practice of healthcare. Sight seems to have been lost of the field pioneered by Hippocrates pre-scientifically, as most notably described in his *Of the Epidemics*; this field made vastly more consequential by the spectacular scientific contributions to it by Edward Jenner, John Snow, Louis Pasteur, and Robert Koch, among others; this field later extended to combating also epidemics of non-communicable illnesses such as congenital malformations, cancers, degenerative cardiovascular diseases, and diabetes; this field now combating even endemic rates of population occurrence of whatever type of illness. These practices do exist (sect. 1.1), and they are very important. But these practices of community medicine, according to the definitions in Table 1.1, are not epidemiology; and Ottawa Public Health, when it periodically reports on the health of the city’s residents, as determined in its practices there, is not, according to those definitions, reporting on epidemiology. (Cf. sect. 1.1.)

According to most of those definitions in Table 1.1, epidemiology is merely the ‘study’ of something, sometimes alternatively (and unjustifiably; cf. above) said to be the ‘science’ of that something; and to this has recently – and only exceptionally – been added application of the results of that study. We take those definitions to be intended to mean that epidemiology is, in the only meaning of the term, a line of research – population-level research on the rates of occurrence of phenomena of human health.

In those definitions there is no expression of the conception of a certain type of practice of healthcare as inherently being epidemiology, even when its knowledge-base does not derive from epidemiology-the-study. The knowledge-base
Table 1.1  Select definitions of epidemiology

Maxcy KF. Epidemiology. In: Maxcy KF (Editor). *Rosenau Preventive Medicine and Public Health*. 8th edition. New York: Appleton-Century-Crofts, 1956:

“that field of medical science which is concerned with the relationships of the various factors and conditions that determine the frequencies and distributions of an infectious process, a disease, or a physiological state in a human community” (p.1289)

MacMahon B, Pugh TF, Ipsen J. *Epidemiologic Methods*. Boston: Little, Brown and Company, 1960:

“the study of the distribution and determinants of disease prevalence in man” (p.3)

Lilienfeld AM. *Foundations of Epidemiology*. New York: Oxford University Press, 1976:

“the study of the distribution of a disease or a physiological condition in human populations and of the factors that influence this distribution” (p. 3)

Sartwell PE, Last JM. Epidemiology. In: Last JM (Editor). *Maxcy-Rosenau Preventive Medicine and Public Health*. 11th edition. New York: Appleton-Century-Crofts, 1980:

“the study of the distribution and dynamics of disease in populations” (p. 9)

Last JM (Editor). *A Dictionary of Epidemiology*. 1st edition. Oxford: Oxford University Press, 1983:

“the study of the distribution and determinants of health-related states and events in populations, and the application of this study to control of health problems”

Rothman KJ, Greenland S, Lash TL. *Modern Epidemiology*. 3rd edition. Philadelphia: Lippincott Williams & Wilkins, 2008:

“the study of the distribution of health-related states and events in populations” (p. 32)

Porta M (Editor), Greenland S, Last JM (Associate Editors). *A Dictionary of Epidemiology*. 5th edition. Oxford: Oxford University Press, 2008:

“the study of the occurrence and distribution of health-related states or events in specified populations, including the study of the determinants influencing such states, and the application of this knowledge to control the health problems”

of ‘mass’ screening for tuberculosis has been entirely clinical and, thus, not even in part the result of epidemiological “study.” Such screening therefore has not been epidemiology according to any of those definitions. Nor were the recent population-level efforts to control the SARS and H1N1 (‘swine flu’) epidemics epidemiology, as they were programs of the practice of vaccination, not ones of any “study.”

With academics having lost sight of epidemiology as practice of healthcare (of community-level preventive medicine), epidemiological research does not get to be defined according to what it is intended to serve. It used to be commonly defined by the use of ‘the epidemiological method’ (cf. above), but more recently it is commonly defined in terms of something about its objects of study. And whereas all phenomena of health are in its purview, as potential material objects of the research, the felt need now is to define epidemiological research by its formal objects, the (characteristic) form of its objects (on whatever phenomena of health). This is what the definitions in that Table 1.1 are about.
However well this is done, the implication is that excluded from epidemiological research is the ‘basic’ or ‘bench’ research that underpins, for example, the development of vaccines. In these terms – by the form of its objects – one can define only a part of what we take to be epidemiological research (cf. above). This, we hold, should be the idea. For by no means is all of the research relevant to dealing with communicable-disease epidemics, for example, singular in the form of its objects, just as, say, oncological research isn’t.

Insofar as there is taken to be a definitional form of the objects of epidemiological research, this has to do with research on phenomena of health on the population – ‘mass’ – level, the level of community medicine. Relative to the clinical level, phenomena of health on this higher level have new, ‘emergent’ properties. On the clinical level a given phenomenon of health characterizes an individual at a particular moment in time; the phenomenon either is or is not associated with that person-moment; it either is or is not occurring in it; it has no frequency of occurrence at that person-moment. On the population level, by contrast, any given phenomenon of health inherently occurs, and doesn’t occur, in association with a multitude of person-moments. It has, thus, the emergent quality of the frequency – the rate – of this occurrence. This is the central element in the form of the objects in epidemiological research on the population (rather than ‘bench’) level.

A health phenomenon’s rate of occurrence (on the population level) is, inherently, a quantitative phenomenon; but the rate quite generally is non-singular in magnitude. Its level varies according to various determinants of this level; it is a function of its determinants. Therefore, epidemiological research, when addressing rates of occurrence of phenomena of health, necessarily has occurrence relations as its objects: a health phenomenon’s rate of occurrence in relation to – as a function of – its determinants, this in a defined domain of people.

Given those definitions in Table 1.1 above, it should be noted that population-level epidemiological research is not about the “distributions” of the phenomena of health; and that the determinants of the rates of occurrence of phenomena of health are not objects of epidemiological research – only rates’ relations to these are. On the clinical level, cases of a phenomenon of health inherently have a distribution by gender and age, for example, while on the population level the phenomenon has a rate of occurrence that may, or may not, depend on gender and age. And, for example, behavioral determinants of the occurrence of phenomena of health are objects of study in behavioral and social sciences and not in epidemiological research, which is biomedical science (though not constituting a science; cf. above).

1.3 Epidemiology as a Research Discipline

There is no single discipline of how to conduct oncological research – no textbooks nor any ‘training’ courses on what, as to form at least, to study and how. In ‘basic’ oncological research in particular, progress is not a consequence of professionalism in the research. Instead, progress derives from the process of creative conjectures
1.3 Epidemiology as a Research Discipline

and their critical testings, as the philosopher Karl Popper explains in his venerable *Conjectures and Refutations* (1963). In these terms there may be no limits to scientific progress, as the polymath David Deutsch argues in his *The Beginning of Infinity* (2011). A wonderful “biography” of oncological research is *The Emperor of All Maladies* (2010) by Siddharta Mukherjee.

When a line of health research is defined by the *form* of its objects, without coherence of the material objects, as epidemiological research now commonly is (sect. 1.2 above), there is a corresponding opportunity together with, as usual, a corresponding risk. That the focus in this research is on objects of a singular form—that of occurrence relations (sect. 1.2) —provides for the development of a more-or-less coherent body of theory to guide research on objects of that form, a learnable *research discipline* for professional study of phenomena of health on the population level – and of non-health phenomena just the same. An associated risk is a certain *formalism* in the research – replacement of creative and critical thought by mere conformity with the prevailing professional norms, unjustifiable ones included.

The discipline of how to conduct population-level health research is the subject of several contemporary textbooks of “Epidemiology” (e.g., MacMahon and Trichopoulos, 1996, and Rothman et alii, 2008), implying that this discipline is the denotation – the only one – of “epidemiology.” To us this is, however, only one – the most recent, a third – meaning of the term (cf. sects. 1.1, 1.2), and a questionable one at that.

The Enlightenment maxim *Sapere aude!* (‘Dare to reason!’), eminently propagated by the philosopher Immanuel Kant among others, should be understood to apply to the prevailing teachings about epidemiological occurrence research as well. After all, questioning received knowledge (scholastic) was at the very core of Enlightenment; and the Enlightenment outlook in turn was the springboard of the enormous progress in science subsequent to the advent of this outlook in the seventeenth century, as Ferguson explains (sect. 1.1) – even if, arguably at least, its antecedent scientific progress was at the root of Enlightenment. (In the pre-Enlightenment era, Copernicus dared publish only post-humously, while Galileo was more courageous than that and suffered for it.)

When people in our ‘post-industrial’ societies concern themselves with that which is the concern in community medicine – in epidemiology in this meaning of population-level practice of preventive healthcare (sect. 1.1) – they think of their *nutrition* – diet and dietary supplements – first and foremost. It therefore is particularly illustrative of epidemiological research in this disciplinary sense of it, to examine its accomplishments with focus on nutrition: what is known? what is the basis of this knowledge from epidemiological research? and what does this say about the scientific prowess of our contemporary discipline of epidemiological research?

We devote much of chapter 2 of this book to this topic. It illustrates the stagnation that in research tends to flow from formalism – and from its associated academic routine of counting publications instead of contributions. The *central flaw* in today’s disciplinary framework of epidemiological research is, as we will illustrate, its
focus on the methodology of the research, without regard for disciplined objects design before methods design. (Stagnation consequent to formalism in societal development was a major concern of the Soviet leader Michael Gorbachev when he launched his famous programs of openness/glasnost and restructuring/perestroika.)

1.4 Epidemiology as a Subject of Study

As set forth in the three sections above, there now is epidemiology in three different meanings of the term; and there could just as well be a fourth one: given that there is epidemiology in the meaning of the theory – concepts and principles (and terminology) – of epidemiological research (sect. 1.3 above), a related, more proximal but very different meaning of ‘epidemiology’ would be that of the theory of epidemiological practice, a theoretical discipline yet to be introduced, even though that of clinical practice has been – in Up from Clinical Epidemiology & EBM (2011) by one of us.

Given the prevailing triad of meanings of ‘epidemiology’ (sects. 1.1, 1.2, 1.3 above), a student now pursuing an academic degree in epidemiology unspecified (as now is usual) needs to be clear on which one of the prevailing three meanings of the term is the one of his/her chosen future career. For this is a prerequisite for understanding how the studies preparatory to the career should be composed from the three epidemiologies that now may be available for study.

As for epidemiology in the meaning of a discipline of research, the most important orientational questions are these: Does a future practitioner of community medicine need to study this? and, To what extent does study of this discipline constitute the necessary preparation for a career in epidemiological research? To that first question our answer is simple: Not really, but an introductory course might be a justifiable investment of time and effort, with merely impressionistic education the aim of this. (The future practitioner really would need to study the theory – concepts and principles – of the practice, were such study to be available, and then the current knowledge-base of this practice and how to update this knowledge.) And to that second question our answer, below, is rather involved. Preparation for a career on the theory of population-level epidemiological research – the development and teaching of this – is a very uncommon concern of the student, and it thus is not our express concern in this book, even though an introductory course on epidemiological research is very useful for the future theoretician as well.

The student whose future career will be one of population-level epidemiological research needs to make good choices in relevant areas. One of these – now receiving much too little attention – has to do with the substantive focus in the studies, including in any thesis work (of which the subsequent research commonly is an unwitting extension). For (s)he needs to understand that society does not sponsor the research in order that the researchers can indulge in their interests; there needs to be a societally justifiable purpose in the research (cf. Preface). Consider two examples:
One of us, as a doctoral student of epidemiology, half-a-century ago, thought that a good topic for his PhD thesis in epidemiology would be the rate of biological ageing, this in causal relation to various aspects of lifestyle. In fact, he thought that this would be a good line of research for his entire career, and for a number of other researchers as well. These judgements sprang from his consideration of the public’s great concern to retard the process together with his vision of the feasibility of studying it – feasibility critically in terms of how an operational scale for the rate of ageing could be developed. He therefore studied, on his own and in depth, the biology of ageing. But in the end he did not pursue this research, because he judged that his preordained career line, one in that prevailing third meaning of ‘epidemiology’ – before extending it to the theory of clinical research – is better served by further studies in ‘biostatistics’ and thesis work in this area. (This judgement he did implement.)

Another example to consider is the entire realm of ‘social epidemiology,’ now in notable ascendancy. In it, the concern is to study population health in relation – causal relation – to such ‘social’ characterizers of people as their race and level of income, for example. But for health effects of race to represent even a theoretically admissible choice – let alone a good one – for epidemiological research, it should be that race effects on health (or whatever else) are imaginable; but they aren’t, given that for a person’s actual race there was no alternative: a given, real person could not have been conceived and born as a representative of some alternative race; for a given person the racial implication of the pair of parental gametes is an immutable given. And if it be granted – even if only for the sake of argument – that the relative effects of alterative distributions of income on population health are meaningfully studyable, meaningful questions would arise. For example: Would this research possibly help justify societal policies concerning, say, minimum wage? Would it even be considered? Or is it, instead, that poverty is, and is to be viewed as, a problem as such, and not because of what it causes as health effects, for example. More on this in section 2.6.

A student preparing for a career in epidemiological research should enter into a career-long program of self-development with a view to maximizing good choices for the substantive topics of his/her research. Central to this pursuit is understanding what the best source of advice is, namely, the practitioners out there. So, if the student would contemplate, and have difficulty perceiving, the relative merits of the two lines of research in the examples above, (s)he should ask epidemiologists of the first – practicing – type (sect. 1.1) this: For you to better serve the protection of your client population’s health, which one of these two would you rather learn from epidemiological research: the effects of carbohydrate-rich diets on individuals’ rates of biological ageing, or the health effects of low wages?

Thus, a student preparing for a career in community-level health research (biomedical; sects. 1.2, 2.6) needs to get to the habit – career-long habit – of maintaining up-to-date familiarity with the goings-on in the practice of community medicine, notably with a view to familiarity with the gaps in the knowledge-base of the practices as seen by the practitioners themselves. The academic program should include arrangements for the students’ inquisitive mingling with practitioners.
Parallel with this program of maintaining awareness of the goings-on in the ‘field’ there is, of course, the need for a counterpart of this in respect to epidemiological research, which, ideally at least, is in the service of the practice. The research at large deserves only superficial following, to remain up-to-date on what the topics are. On the other hand, research in one’s own area of subject-matter needs to be followed both inclusively and in depth, the relevant ‘basic’ research included.

No good purpose in the education of epidemiological researchers, we think, is served by a general course addressing research on select topics in ‘substantive epidemiology,’ given the great diversity of subject-matter in the students’ future lines of epidemiological research – or, for that matter, of epidemiological-type research that actually is extraepidemiological. Equally meaningless are seminar presentations of studies on a limitless mélange of subject-matter, empty of content that the audience at large should consider for self-development as epidemiological researchers.

Last, but by no means least, the most obvious point here: For future researchers on population-level topics of the epidemiological form (as superficially specified in sect. 1.3 above) the generally directly-relevant preparatory studies toward good choices are ones of the theory of that research. Epidemiology in this research-discipline sense is what the studies principally are about. Study of it should be materially – indeed, critically – helpful in efforts to optimize decisions about what, exactly, to study – a matter of the studies’ objects design – and also how to study it – a matter of the studies’ methods design – so long as at issue is population-level (rather than ‘basic’) research.

It may not be obvious, however, what these theory studies, even in their broadest outlines, are or should be about. But even before this question there is the one about the necessary prerequisites for these studies. The student should master certain general concepts of medicine and science, but the availability of a suitable reference text should allow inquiry into these as needed, rather than necessarily in advance of the studies on the theory specific to population-level epidemiological research. (Cf. Preface.)

The student absolutely needs a background in (probability theory and then) statistics. For as mathematics is to physics, so statistics is to population-level epidemiological research. Major background study of mathematics is an absolute prerequisite for any serious study for a career in physics; but: mathematics is not the theory – the embodiment of the concepts and principles – of physics, nor is physics an outgrowth of mathematics (a field of meta-mathematics, as it were). The objects of population-level epidemiological research are generally about frequencies (sect. 1.2) and hence statistical in form; such epidemiological research therefore is statistical research in form (while medical in substance). But as with mathematics in relation physics, statistics is not, nor does it subsume, the theory of population-level epidemiological research.

Students of epidemiological research thus need to have suitable preparatory education in (probability theory and) statistics, and of course the necessary mathematical preparedness for this. The suitable education in statistics would mainly focus on topics of ‘multiple regression’; and it would not confuse and mislead
the students with endogenously statistical ideas about research – with ‘survey research,’ ‘sample size determination,’ ‘multiple hypothesis testing,’ and ‘data-suggested hypotheses,’ among others. For, to say it again, statistics is not, nor does it subsume, the theory of statistical science.

The rest of this book is, in the main, quite extensive an exposition of what we think these theory studies should be about, on the introductory level. But in utterly succinct terms, as insinuated above, it can be said that at issue really are only two broad topics: objects design and methods design for population-level epidemiological research. With these broad topics suitably construed, theory of epidemiological ‘data analysis’ (really, synthesis of the data to the study result) becomes essentially a non-topic.

As a student setting out to prepare for a career in epidemiological research grapples with the concept of epidemiology per se and that of epidemiological research in relation to this – these frustrating topics at the very outset of the studies – (s)he would do well, we think, being mindful of two principles bearing on this.

1. Critical for progress in any field of science generally is propitious definition of the field in question. Highly illustrative of this is the historical fact that chemistry started its spectacular progress only once Robert Boyle distinguished between mixtures and compounds; defined elements as constituents of compounds, introducing the term ‘analysis’ for the study of these compositions (cf. ‘data analysis’ as a term for data synthesis, above); and defined chemistry itself by its being not about mixtures but about compounds. These ‘revolutionary’ ideas he set forth in his book fittingly entitled The Sceptical Chymist (1661).

   The student of epidemiological research should reflect on the relative merits of defining epidemiological research as (a) the study of the distribution and determinants of phenomena of health in human populations (or some variant of this), or as (b) research – including ‘basic’ research – for advancement of the practice of community medicine, of epidemiology in this meaning.

2. “Read not to contradict, nor to believe, but to weigh and consider” (ref. 1 below). In his/her understanding of the theory of epidemiological research, the student of this will ultimately be alone, solely responsible for his/her own (sic) understanding. “For the vision of one man lends not its wings to another man” (ref. 2 below). (A practitioner of epidemiology, by contrast, needs to defer to experts’ shared beliefs – knowledge in this meaning – on the substantive topics that are relevant.)

References

1. Bacon F. Of studies. In: Bacon F. The Essays or Counsels Civil and Moral. Edited with an Introduction and Notes by Brian Vickers. Oxford: Oxford University Press, 1999; p. 134.
2. Gibran K. On teaching. In: Gibran K. The Prophet. New York: Alfred A Knopf, 1970.