Invited Commentary: The Epicenter of Translational Science

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Epidemiology is at the center of translational science. Uniquely among biomedical disciplines, the methods and perspective of epidemiology span research from discovery to effective interventions and ultimately to their dissemination and implementation. However, shorthand designations for various phases of translational science, such as “T1, T2, T3, and T4,” may be proliferating past the level of their usefulness. It is worthwhile to reflect on the actual nature of the science undertaken by epidemiologists along the continuum of discovery to application. The new challenge for epidemiology is the integration of knowledge and effective interventions into various societal settings working with allied disciplines not necessarily in the biomedical domain to ensure that these interventions have their intended effects on individual and public health.

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The need for more effective applications of scientific discovery is not a new one. We can go back to the beginning of the National Institutes of Health when the National Cancer Institute was signed into law in 1937 and read that Congress intended it to carry out intramural research and support extramural research and “the useful application of their results” (1). The last century saw swings in the pendulum of support for science in this country between investigator-initiated or curiosity-driven science and applied science in the Manhattan Project and reaching the moon (2), but applied science has continued to be a strong national imperative. We are now hearing the term “translational science” at every turn, and much of the work of our biomedical scientific enterprise is now driven by the National Institutes of Health (NIH) Roadmap Initiative introduced by Elias Zerhouni in 2003 (3). Congress is asking for a more rapid return on the public dollar, and scientists themselves are impatient with the length of time and the effort needed to translate research discoveries into the useful application of their results.

Where does epidemiology fit into this picture? Muin Khoury et al. (4) have advanced the idea that epidemiology should be right in the middle of it. They offer a schema on how we can think about the role of epidemiology in this process and suggest that there is value in the term “translational epidemiology.” I am certainly in alignment with the central thrust of this perspective and think that epidemiology is at the epicenter of translational science (5). Epidemiology is almost unique among biomedical disciplines in being able to function successfully from early discovery research to applications. Because epidemiology is more than a set of methods and has such a wide perspective on human health and disease, epidemiologists work easily in team science and transdisciplinary settings from cell to society (5).

I wonder, however, about the rather rapid proliferation of terms in this area in the last 10 years. Perhaps it is worth thinking a bit about the meaning and value of these new categories of “translational epidemiology” and “T1–T4 research.” Let’s start with discovery research and efforts to establish causal relations in analytical and experimental epidemiology. This is certainly what most epidemiology has been about since its nascence in the 19th and early 20th centuries. The category designations of “T0” (discovery research) and “T1” (from discovery to applications) cover this territory although, for audiences outside epidemiology and the population sciences, it is worth repeating (and repeating) that T1-type research is more than just “bench to bedside” in the drug development paradigm and conceptually includes “candidate applications” in behavioral, social, and policy interventions (6). Even our current leaders in the biomedical science enterprise fail to include this perspective (7).

When we then take “T2” research as defined by the Institute of Medicine and others (“the translation of results from clinical studies into everyday clinical practice and health decision making”) (6, p. 211; 8) and split it into T2...
and T3 (9, 10) and thence split T3 into T3 and T4 as Khoury et al. (4) suggest, what do we gain? Is there a useful distinction to be made for epidemiologists in training and research in the T2–T4 transition? In trying to answer this question, it is useful to think about what the epidemiologist might actually do in the area of T2–T4 research. Certainly the discipline has many examples of applications of the T2 variety as defined by either the Institute of Medicine (8) or Khoury et al. (4). Experimental designs have been the stuff and substance of numerous contributions in clinical epidemiology and prevention research, the Women’s Health Initiative being one recent good example. What is really new for translational science and epidemiology is the next step. The problem in plain English is the need to get proven interventions, based on some sort of quality evidence, into actual practice. This may be into the primary care setting (9, 11), clinic or hospital, a health system, a public health department, legislation, policy, or any other of the many settings in society where decisions about our health and health care take place. This is the “T3” arena of implementing findings from research into health services and outcomes research, where one is trying to understand the impact of the implementation of a new therapy, service, or program (12). The American College of Epidemiology’s Policy Committee has recently embarked on a systematic effort to document how epidemiologic research has been used to build effective policy (13), and the documentation of more examples will help to develop this new field. Comparative effectiveness research, which has attracted much attention recently, occupies some space here and will depend heavily on epidemiologic methods and perspectives.

It is with the split into “T3” and “T4” that I think we may be going beyond the usefulness of these categories. Surveillance or monitoring the status of the disease burden or behavior (Khoury et al.’s T4) is certainly a valuable tool within this process of implementation research but perhaps not a meaningful separate category. The role of the epidemiologist in dissemination and implementation research may be not so much in contributing any sort of novel research methodology, but in using accepted methods coupled with the unique perspective that epidemiologists have in looking at the “big picture” and being able to understand the interactions of factors within a complex system (10).

A recent Institute of Medicine report provides an evidence framework for complex public health challenges using the example of the obesity epidemic (14). One of the main messages in that report was that, for such complex challenges in implementation where evidence from randomized controlled trials may not exist or even be possible to collect, other sorts of evidence from quasi-experimental trials, to mixed-methods research, to expert panels may need to be used for making decisions with the best available evidence, not the best possible evidence (15). Epidemiologists can play a key role in assessing and integrating this type of research, which is really the final step to application and knowledge integration (16, 17). To make a distinction between “assessing the implementation and dissemination of guidelines into practice” and “assessing the effectiveness of interventions on health outcomes,” as suggested by Khoury et al. (4), requires more discussion in the field and more examples of how these processes differ in terms of approach and the epidemiologic skills needed.

Except for this point, the schema submitted by Khoury et al. (4) in their paper works well in outlining the interacting phases of translational science. They rightly point out that the process of discovery to application is not linear but multidirectional, continuously feeding back to earlier phases to answer new questions or seek refinements. This schema is consistent with earlier descriptions of cancer control research, first by the Canadians in 1994 and then in the United States (18, 19), and is a perspective that works well in any problem area, not just genomics or cancer. Such frameworks also work well to break down the traditional division between clinical medicine and public health. We need to think about the translation of evidence as an endeavor that unifies science and seeks “consilience” between the biologic and social sciences (20). Efforts to create separate frameworks for translational science in public health (10) as a separate endeavor work against a more unified transdisciplinary approach to problem solving.

No matter what the schema, framework, or model used to describe the process of research leading to useful applications, one thing seems clear. Epidemiology is at the epicenter of this process, and our challenges for the future in both research and training cover the whole spectrum. The field needs to continue to seek the causes of disease through traditional epidemiologic approaches and to prove the effectiveness of interventions as it always has done. Now, however, epidemiology should address more vigorously the challenge of integrating knowledge and effective interventions into various societal settings, working with allied disciplines such as social psychology, urban planning, organizational theory, qualitative sciences, and public policy (5, 6) to ensure that these interventions have their intended effects on individual and public health.

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REFERENCES

1. 75th Congress. Senate Bill 2067. Public Law 244. Approved August 5, 1937.


