Transdisciplinary approaches enhance the production of translational knowledge

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The primary goal of translational research is to generate and apply knowledge that can improve human health. Although research conducted within the confines of a single discipline has helped us to achieve this goal in many settings, this unidisciplinary approach may not be optimal when disease causation is complex and health decisions are pressing. To address these issues, we suggest that transdisciplinary approaches can facilitate the progress of translational research, and we review publications that demonstrate what these approaches can look like. These examples serve to (1) demonstrate why transdisciplinary research is useful, and (2) stimulate a conversation about how it can be further promoted. While we note that open-minded communication is a prerequisite for germinating any transdisciplinary work and that epidemiologists can play a key role in promoting it, we do not propose a rigid protocol for conducting transdisciplinary research, as one really does not exist. These achievements were developed in settings where typical disciplinary and institutional barriers were surmountable, but they were not accomplished with a single predetermined plan. The benefits of cross-disciplinary communication are hard to predict *a priori* and a detailed research protocol or process may impede the realization of novel and important insights. Overall, these examples demonstrate that enhanced cross-disciplinary information exchange can serve as a starting point that helps researchers frame better questions, integrate more relevant evidence, and advance translational knowledge more effectively. Specifically, we discuss examples where transdisciplinary approaches are helping us to better explore, assess, and intervene to improve human health. (Translational Research 2017;182:123–134)

Abbreviations: SNP = single nucleotide polymorphism; MDR = multifactor dimensionality reduction; DAG = directed acyclic graph; GWAS = Genome Wide Association Study; DiCE = diverse convergent evidence; L.E.A.D. = Locate Evidence, Evaluate It, Assemble It, and Inform

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Decisions; IARC = International Agency for Research on Cancer; NTP = National Toxicology Program; CEBS = Chemical Effects in Biological Systems; IOM = Institute of Medicine; CISNET = Cancer Intervention and Surveillance Modeling Network; CSTA = Clinical and Translational Science Awards program

Glossary

Multidisciplinary
The aggregation of fully formed ideas that come from distinct fields

Interdisciplinary
The integration, adaptation, and harmonization of ideas that come from distinct fields

Transdisciplinary
The generation and utilization of research frameworks and admixed ideas that could not come from, or fit into, any one field

Cross-Disciplinary
A general term referring to the unspecified involvement of more than one discipline

Perspective
Intellectual orientation or viewpoint that can vary in its capacity to assess and adapt to external input

Strategy, Approach, Process, or Method
A general code of conduct or way of proceeding that does not have a rigid, prespecified, or detailed sequence or parameters

Protocol or Procedure
A specific code of conduct or way of proceeding that has a rigid, prespecified, and detailed sequence and parameters

Communication
A general term referring to the exchange of information, strategies, protocols, hypotheses, or ideas (through talking, reading, graphical image presentation, etc.)

Information
Data and facts

Knowledge
Understanding of the relevant causal mechanisms that generated the data and facts (note that information and knowledge have similar meanings and are often used to define each other; however, here we emphasize that knowledge implies an understanding of why the data or facts are as they are)

Complex Systems
Systems with multiple interacting components and emergent properties that often cannot be accurately characterized with narrow or rigid research frameworks

Marginal Association
The association between one exposure (factor) and one outcome (disease) independent of other variables. If potential biases and other observational data imperfections are properly accounted for, this association is thought to provide evidence for or against the involvement of the exposure with the disease.

INTRODUCTION

The primary goal of translational biomedical research is to elucidate the determinants of disease and apply this knowledge to improve clinical or population health practices. Epidemiologists have been successful in advancing this goal, particularly in the context of conditions with causal factors that have consistently detectable marginal associations. However, in the context of etiologically heterogeneous complex disease, causal factors may not have reproducibly detectable marginal associations because these diseases have multiple interacting determinants. As a result, progress in this area has been much slower. Here, we take the perspective of epidemiologists and hope to generate further discussion by exploring a general approach for increasing our ability to address multifactorial health problems. Specifically, we advocate that epidemiologists take a transdisciplinary approach, and propose that enhancing the opportunity for cross-disciplinary information exchange can help by making relevant perspectives from multiple distinct fields available for scientific reasoning at each stage of the research process, but perhaps most importantly at the outset of defining a problem and designing a research strategy. This increases our chances of realizing information synergies, thereby allowing us to frame better questions, gather more comprehensive data, and better exploit existing information to guide health decisions.

This general approach addresses the key issues identified in two sets of recent commentaries concerning the future of epidemiologic research. The first group of commentaries proposes that innovative thinking will be central to progress in epidemiology and translational