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Commentary

# Turning Disciplinary Knowledge Into Solutions

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A B S T R A C T

Turning disciplinary knowledge about preadolescents' and adolescents' exposure to risk factors for cancer as adults into solutions for preventing such an outcome requires that investigators from a variety of backgrounds and disciplines come together to share knowledge. Optimally, these collaborations would occur across two dimensions: (1) transdisciplinary, from the molecular or cellular level (e.g., animal studies of endocrine disruption) to the societal level (e.g., economic studies related to state tobacco policies); and (2) translational, using basic research findings in clinical and other sciences to implement prevention programs and public policy. Only when collaboration is commonplace can the disparate groups of investigators working on cancer prevention during preadolescence and adolescence gain a holistic picture of the risk factors, inform one another's work, and learn what we need to know to devise successful interventions for preventing cancer. Working transdisciplinarily also helps to ensure that messages to health professionals, policymakers, the news media, and the public are consistent and coordinated. At present, those investigating preadolescent and adolescent risk for adult cancer disseminate their knowledge individually, thus missing the opportunity to synthesize knowledge, coordinate dissemination, and implement prevention programs. In this article, we distinguish multidisciplinary, interdisciplinary, and transdisciplinary approaches; argue for the benefits of a transdisciplinary approach to devising successful solutions; and explore how to achieve transdisciplinary functioning.



"We are not students of some subject matter, but students of problems. And problems may cut across the borders of any subject matter or discipline." — Karl Popper, 1963

Research on cancer prevention and risk reduction among preadolescents and adolescents is diverse because each research investigation focuses on a particular point on a continuum from the cellular to societal influences on health (Figure 1), producing a range of knowledge from the effect of certain exposures on the mammary gland [1] to the effect of public policies aimed at reducing risky health-related behaviors [2]. Investigations of individual behaviors (e.g., changing diet [3], increasing physical activity [3], getting the human papillomavirus (HPV) vaccine [4], improving social relationships such as early family relationships [5]) fit between cellular and societal research. Investigations differ too in the phase of human development on which they focus and in the population groups they target. Some studies produce basic biologic, behavioral, or social knowledge; others investigate services and develop and test interventions to reduce risk and prevent cancer [6]. Yet despite advances in knowledge in many spheres, progress toward preventing or controlling cancer at the population level is woefully inadequate.

In August 2011, the Division of Cancer Prevention and Control at the Centers for Disease Control and Prevention (CDC) brought together an expert panel of investigators from a range of disciplines and approaches to acquiring knowledge. The purpose was to discuss the problem of preadolescent and adolescent exposures to risk for cancer during adulthood, with a shared aim of preventing cancer. The expert panel's charge was to accelerate progress toward cancer prevention and control by collaborating on research and interventions by looking for opportunities to change public perceptions and policy in order to reduce environmental causes of disease and by creating action plans to reduce cancer rates. Although most investigators on the panel

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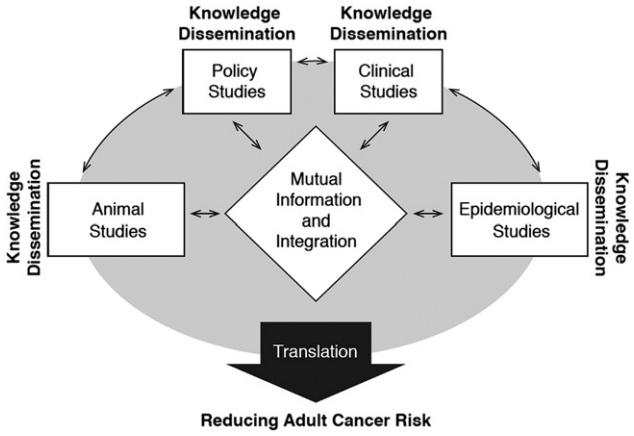


**Figure 1.** Dynamic model of cancer research that extends from discovery to translation into solutions for preventing cancer. Adapted from the Canadian Cancer Control Strategy.

were aware of one another's work before the meeting and a few had even worked together, it became clear that despite their shared aim, each member had a slightly different take on cancer prevention. This is not surprising because the group was assembled to facilitate an encompassing and holistic view of preadolescent and adolescent risk factors and exposures for adult cancer.

Expert panel members' investigations differ along a number of dimensions [7–11]. First, they differ in level of analysis, ranging from molecular and genetic investigations into the causes of cancer to societal investigations to reduce cancer rates. Members also varied in the types of research they do: basic, clinical, behavioral, or social science. And they differ in where their work is situated along the continuum from discovery in the laboratory to translation of findings into community programs to prevent cancer. Yet another difference was members' approaches to cancer prevention and control. Some work with animal models, some with clinical samples, and others with publicly available data. A few work in communities that range from Hispanics in rural Texas to adolescents living in public housing in Boston. Last, the focus of panel members' work is on different stages of human development, from in utero to late adolescence.

The major challenges to collaboration for the group were twofold. First, the group had to achieve a sufficient quality and degree of communication to be able to synthesize members' individual knowledge, form a holistic and inclusive picture of preadolescent and adolescent risk factors and exposures, and develop shared action plans and interventions for cancer prevention. In short, members had to broaden their individual perspectives and approaches to encompass this new and broader charge. Operating collectively to develop effective evidence-based solutions requires that each member acknowledge the other members' contributions and respect the cultures of other members' disciplines, which is the bedrock of cross-disciplinary communication. When this level of communication is achieved, individual knowledge and empirical findings can be synthesized and new intellectual space created that allows coordinated action plans and interventions to be developed.

The second challenge to collaboration involves turning integrated plans into consistent and coordinated cancer prevention and control messages for stakeholders, including health care professionals, policy makers, the news media, and the public. This is particularly challenging in light of the long latency period that can occur between preadolescent and adolescent exposure to carcinogens and the onset of cancer. At present, those investigating preadolescent and adolescent risk factors disseminate their knowledge individually, thus missing an opportunity to synthesize knowledge, coordinate dissemination of findings, and collaborate on implementation. The payoff to moving from investigating individually to investigating with a diverse yet coordinated team that is able to devise integrated solutions is great, however, and is an incentive to investigators to work outside the comfort zones of individual disciplines. In this article, we argue for the value of new approaches to collaborate to solve a complex problem such as preventing adult cancers and make an argument for knowledge synthesis as an effective means of problem-solving. We distinguish between multidisciplinary, interdisciplinary, and transdisciplinary approaches to collaboration; argue for the benefits of a transdisciplinary approach to devising successful solutions; provide guidance on how to achieve transdisciplinary functioning; and offer suggestions for developing and sustaining such an approach.

## Modes of Disciplinary Collaboration

Awareness is growing that the determinants of cancer interact in complex ways. To deal with these determinants, we need new ways of collaborating—ways that use input from all researchers in pertinent fields and enhance their ability to work together. In arguing for disciplinary collaboration, the Committee on Facilitating Interdisciplinary Research of the National Academies noted in 2005 that "how human societies evolve, make decisions, interact, and solve problems are all matters that call for diverse insights. Very fundamental questions are inherently complex" [12].

A related argument was made for cancer control research, namely that inputs are needed at multiple levels, from the molecular or cellular level of research to the societal level. Factors at each level are known to interact in complex ways to cause cancer and disparities in cancer rates [13]. Hiatt and Breen [14] make the case that collaboration has the potential to "yield a detailed and vivid snapshot of the impact of the web of causation and to rationalize interventions at various critical points in the resulting picture." Conversely, an inadequate understanding of the causes of cancer leads to inadequate solutions.

Collaborations among disciplines are generally divided into three types that differ in the extent to which investigators operate outside the boundaries of their individual disciplines. Differences occur in the extent to which researchers share the language of their disciplines, pool bodies of knowledge and theory, and jointly develop new methods of analysis. In multidisciplinary research, investigators come together to solve a research problem, but each discipline approaches the problem through a separate lens. These researchers leave the collaboration with no discernible change in their approach to science. For example, they might come together at the beginning of a research project with separate but related research questions, collect and analyze data independently, form independent conclusions based on their separate research questions, and then come together at the end of the project to try to make sense of it all. This practice is like trying to fit square pegs into round holes. Those who work interdisciplinarily transfer disciplinary knowledge to one another for the purposes of research and may, to