The Role of Transdisciplinary Collaboration in Translating and Disseminating Health Research

Lessons Learned and Exemplars of Success

Karen M. Emmons, PhD, Kasisomayajula Viswanath, PhD, Graham A. Colditz, MD, DrPH

Abstract: In the past few decades, significant advances have been made related to understanding, preventing, and treating chronic disease. Given these many advances across multiple disciplines, it is unclear why the potential for yielding substantial reduction in disease has not been achieved overall and across various subgroups. Socioeconomic and racial/ethnic disparities in a wide range of disease outcomes persist, and a number of studies highlight the importance of further improving behavioral risk-factor prevalence on a population level. The goal of this paper is to explore the role of transdisciplinary collaboration in the translation of research related to these vexing public health problems, and, in particular, to explore factors that appear to facilitate effective and sustainable translation. Transdisciplinary collaboration also has great potential to speed the rate of adoption of evidence-based practices. Examples of transdisciplinary collaborations in academic and community settings are provided, along with factors that may influence the long-term outcomes of transdisciplinary efforts.

(Am J Prev Med 2008;35(2S):S204–S210)

Introduction

The past three decades have witnessed substantial progress in reducing the prevalence of preventable disease among adults in the U.S., with contributions from many disciplines.[1] Epidemiologic methods have advanced the understanding of the types, nature, and timing of exposures that increase disease risk.[2] Social and behavioral sciences have provided a perspective on disease causation that goes beyond biomedical approaches, drawing on social–epidemiologic approaches to understand the population distribution of diseases and conditions and using population-based approaches that extend intervention research beyond high-risk populations. Both basic and biomedical science have made significant advances in targeted treatment strategies. Still, the question remains: Isn't there potential for yielding even greater reductions in disease than have been achieved to date? For example, many diseases continue to have disproportionately high prevalence among racial and ethnic minority and lower-socioeconomic groups. In addition, the need to reduce behavioral risk-factor prevalence on a population basis has been recognized.[1,3] It has been estimated that community-based cholesterol interventions are cost effective if blood cholesterol levels are reduced by as little as 2%.[4] The full implementation of currently available cancer prevention and early-detection strategies at the population level could reduce U.S. cancer mortality by approximately 60%.[5,6]

Processes and mechanisms at one level (e.g., at the molecular level) may influence outcomes at another level (e.g., among population subgroups), thus calling for a more-synergistic approach to understanding and solving diseases and conditions. A transdisciplinary approach to research, as proposed by Rosenfield,[7] may be necessary if health promotion and chronic disease prevention efforts are to live up to their potential. A key goal of this paper is to explore the role of transdisciplinary collaboration in the translation of research related to public health, and, in particular, to explore factors that appear to facilitate effective and sustainable translation. Although some examples provided may influence bench-to-bedside translation, the primary focus in this paper is on addressing socioeconomic and racial/ethnic disparities and on closing the evidence-to-practice gap.

Public Health and Transdisciplinary Science

Public health is the ideal environment in which to develop transdisciplinary science. The social–ecologic model,[8] a framework that is widely used for exploring

From the Department of Medical Oncology, Dana-Farber Cancer Institute, and the Department of Society, Human Development, and Health, Harvard School of Public Health (Emmons, Viswanath), Boston, Massachusetts; and the Alvin J Siteman Cancer Center, Washington University School of Medicine (Colditz), St. Louis, Missouri

Address correspondence and reprint requests to: Karen M. Emmons, PhD, Dana-Farber Cancer Institute, 44 Binney Street, LW703, Boston MA 02115. E-mail: karen_m_emmons@dfci.harvard.edu.

0749-3797/08/$–see front matter
doi:10.1016/j.amepre.2008.05.009

the factors that influence health and health behavior, recognizes that health is affected by factors across levels of influence, including intrapersonal, interpersonal, organizational, community, and societal. Although there is work in many areas at each level, a transdisciplinary approach is much more likely to stimulate a search for opportunities for synergy across levels. There has long been a call for linking research and intervention approaches across levels,[1,9] but to date there has been relatively little work in this area. One concern is that tremendous inefficiency is introduced by not considering inter-connections across disciplinary boundaries. For example, if the primary focus of work in obesity and energy balance is on sociocultural factors, eventually the limits of not considering both environmental and physiologic factors will be realized. In addition, the authors agree with Abrams[10] that transdisciplinary approaches to addressing health disparities are crucial, precisely because the causes of disparities are multifactorial. As noted by Kaplan,[11] reducing and eliminating disparities calls for multidisciplinary models that account for how distal factors, such as social and economic policies, and proximal factors, such as genetic make-up and pathophysiology, simultaneously interact to affect population subgroups differently. Transdisciplinary science can contribute to understanding the mechanisms that potentially link these different determinants studied in and from different disciplinary realms and can develop action that may be necessary to ameliorate disease conditions. If a transdisciplinary approach to research in health disparities is not taken, the affected communities are likely to experience enduring disparities, frustration with the process of research, and perceived limited gain/benefit to research participation.

The Development of Transdisciplinary Initiatives

Ruddy and Rhee[12] have identified a number of features that facilitate the development of effective transdisciplinary teams. These include *institutional support* of both transdisciplinary approaches in general and in particular the specific endeavor in which transdisciplinary science is being applied; *team selection*, which includes representation by all relevant disciplines and community group members; *training*, which provide ongoing, cross-disciplinary education and opportunities for problem-based and experiential learning; *common goals*, which serve to functionally operationalize transdisciplinary science through the selection of measurable outcomes and evaluation approaches; and *multidirectional communication*, which recognizes the contributions of all team members on an ongoing basis. Several structural factors also facilitate the development of effective transdisciplinary teams, including having shared space, a reduction of institutional barriers, a strong history of collaboration, and educational and training opportunities for students and staff who can help to break down disciplinary barriers. Examples of how transdisciplinary collaborations have developed in both university and community settings illustrate these principles.

Transdisciplinary Initiatives in University Settings

The Dana-Farber/Harvard Cancer Center

The experience of establishing the Dana-Farber/Harvard Cancer Center (DF/HCC) provides an example of the importance of institutional support for and commitment to transdisciplinary engagement. For more than 30 years, the Dana-Farber Cancer Institute was a single-institution comprehensive cancer center. The National Cancer Institute (NCI) strongly encouraged the formation of a larger, matrix cancer center, consisting of the seven academic institutions and teaching hospitals in the Harvard system. Bringing together seven institutions with a strong history of competition was challenging. However, there was a strong sense of institutional readiness to engage in this activity, and a genuine interest in the scientific progress that could be made through cross-institutional and cross-disciplinary research.

Each of the institutions brought both unique and overlapping disciplinary strengths. For example, the Dana-Farber had large efforts underway in basic and clinical science. However, its population-science group was strong but small, and could not meet the growing demands for collaboration. Bringing the Harvard School of Public Health and the Brigham and Women's Hospital—with significant strength in population studies—into the cancer center expanded the available expertise in this area and provided opportunities for new translational research endeavors, in bench-to-bedside translation as well as in efforts to reduce the gap between the evidence base and practice-in-community settings. As a result, population science emerged as a major strength in DF/HCC activities.

Cancer center leadership placed a heavy emphasis on creating "nodal points," or the intersection and development of interdisciplinary research projects between disease-based programs (e.g., breast, prostate) and the basic disciplines of cancer research (e.g., cancer biology, epidemiology). These nodal points have provided a key infrastructure for productive interdisciplinary interaction. Internal pilot funds are available only for projects that create new nodal points. The review teams represent all disciplines, and include scientists with experience in transdisciplinary approaches. The approach has spawned new collaborations across a range of disciplines. For example, a recently funded project examines the role of vitamin D as a contributor to colorectal and prostate cancer disparities. A team con-

sisting of behavioral scientists, disease-based scientists, and epidemiologists are collaborating to look at vitamin D supplementation and uptake on disease markers among blacks. This study looks at the multiple levels of influence on colorectal cancer risk, and holds considerable promise for informing future cancer-prevention trials that seek to reduce racial disparities in cancer outcomes. This work would not have been likely had the DF/HCC not provided the initial opportunities for dialogue among these investigators and the pilot funding that led to other sources of support.

The organizational structure of the DF/HCC provided fresh opportunities for the development of a transdisciplinary approach. The leadership group includes representation from each of the disciplinary areas (e.g., population, clinical, and basic science), as well as from each of the institutional partners, and each of its members has a vote on key operational and budgetary matters. Because of the size of the DF/HCC (>1000 members in seven institutions spread across the city of Boston), there are significant barriers to collaboration in terms of geographic dispersion. So far this issue has been addressed by a commitment to regular meeting times and rotating meeting locations. That said, the lack of geographic proximity can provide a barrier because it prevents day-to-day, routine, unplanned, informal interactions, and may have implications for the design of interdisciplinary centers versus discipline-bound departments.

To facilitate cross-institutional collaboration, a common, centerwide administrative infrastructure was created. Regular meetings with institutional administrative representatives were designed to facilitate communication and streamline DF/HCC processes. Although progress has been made, many challenges remain. A particularly vexing problem is the fact that the partner institutions are separate fiscal entities, and thus require subcontracts for joint grant applications. This can sometimes discourage investigators from engaging in cross-institutional collaboration. However, one significant advance has been the creation of a single IRB that reviews all cancer-related protocols from the partner institutions. This greatly reduces the burden on investigators related to multiple IRB submissions resulting from cross-institutional collaborations.

When this effort is evaluated against the features of effective transdisciplinary collaborations identified by Ruddy and Rhee,[12] it is clear that there has been significant institutional support, careful team selection to support strong interdisciplinary interactions, the elucidation of common goals that help to operationalize transdisciplinary metrics, and multidirectional communication. However, the common metric for assessing the DF/HCC's success at creating transdisciplinary approaches has been the development of new funding, including program projects and large center grants. This remains less than ideal as a metric for assessing the impact of the cancer center's approach to fostering interdisciplinary research, as not all collaborations have the same level of interdisciplinary science. Other metrics are needed to truly measure the impact of this approach. Further, the question can be raised whether the transdisciplinary collaborations that have occurred are a function of the DF/HCC or would have occurred without it. Quite possibly some transdisciplinary partnerships would have developed out of mutual interest and openness to different disciplinary perspectives. However, in such a large setting, with >1000 cancer center members, there are many barriers to collaboration that the DF/HCC infrastructure can overcome. Further, in some parts of the university there is an emphasis placed on single-disciplinary approaches as the path to promotion. Because the DF/HCC provides a sanctioned setting in which researchers can consider the contribution of approaches outside of their individual areas, it has thus has made major contributions to changing the norms of collaboration throughout the system.

The *YourCancerRisk* Index

The Harvard Center for Cancer Prevention brought together clinicians, epidemiologists, behavioral scientists, and decision scientists to perform collaborative research, to train the next generation of leaders in cancer prevention, and to build communication platforms for bringing prevention messages to the public. The first major collaborative efforts focused on summarizing the causes[5] and prevention[13] of cancer and developing a series of tools that might help communicate the message that many forms of cancer are preventable. As colon cancer is largely preventable[14] and the relevant content was well-developed, this served as a useful starting point for bringing together epidemiologists, behavioral scientists, and risk-communication scientists.[15] The Harvard Colorectal Cancer Risk Assessment and Communication Tool for Research (HCCRACT-R)[15,16] was an interactive, computer-based tool used to provide individuals with their estimated personal risk for colorectal cancer, and can be used as a tool to study different risk-communication strategies. The risk-estimate calculation[16] was based on extensive review of scientific evidence and expert consensus on cancer-risk factors. It took into account both risk factors that are not modifiable (e.g., family history) as well as behavioral and lifestyle factors that can be changed to reduce risk (e.g., screening, physical activity, diet). The computer-based technology allowed developers to tailor the risk-communication messages based on the patient's risk profile. Details on the development and validation of the tool are provided elsewhere.[16]

The look, features, and functionality of the website were all influenced by transdisciplinary collaboration. For example, the original plans for the tool called for a

paper-and-pencil measure, based on the epidemiologists' assumption that most people could accurately complete the basic math needed to compute one's risk score. Formative research conducted by the behavioral scientists demonstrated that there was a high level of error, and thus the team worked together to develop the website, whose design integrated principles from multiple disciplines. Over time, the HCCRAT-R research tool was expanded into the *YourCancerRisk* website, through the collaboration of colleagues in health communication, behavioral science, and epidemiology. Ultimately, the site was further expanded into *YourDiseaseRisk*, which provides risk assessment and information across a broad range of diseases (www.yourdiseaserisk.wustl.edu/). Later modules were added that address factors at multiple levels of influence, such as intrapersonal- and community-level factors. The site has received numerous awards for its content and continues to receive almost 2000 unique visitor sessions per day, with an average visit time of 8 minutes (Figure 1).

To date, evaluation of the tool has focused on risk perception and planned behavior change.[17–19] A broader evaluation will be required to assess the full impact of the transdisciplinary design team on the value of the overall integrated risk-assessment tool. Evaluation within a health plan that uses computerized medical records may offer a valuable setting for formal evaluation and the assessment of cost effectiveness.

Transdisciplinary Initiatives in Community Settings

The challenges in conducting community-based transdisciplinary research are many, although somewhat different from university-based research. The issue for communities engaging in scientific research is not disciplinary in nature (as *disciplinary* is typically thought of) but instead relates to power and resource distribution as well as to the knowledge of local culture, needs, and preferences. A key consideration when extending a transdisciplinary approach from the university setting to the community is whether the community has expertise at many levels and does not just represent a site in which research can be conducted. Thus, the community is, in essence, a contributing discipline that needs

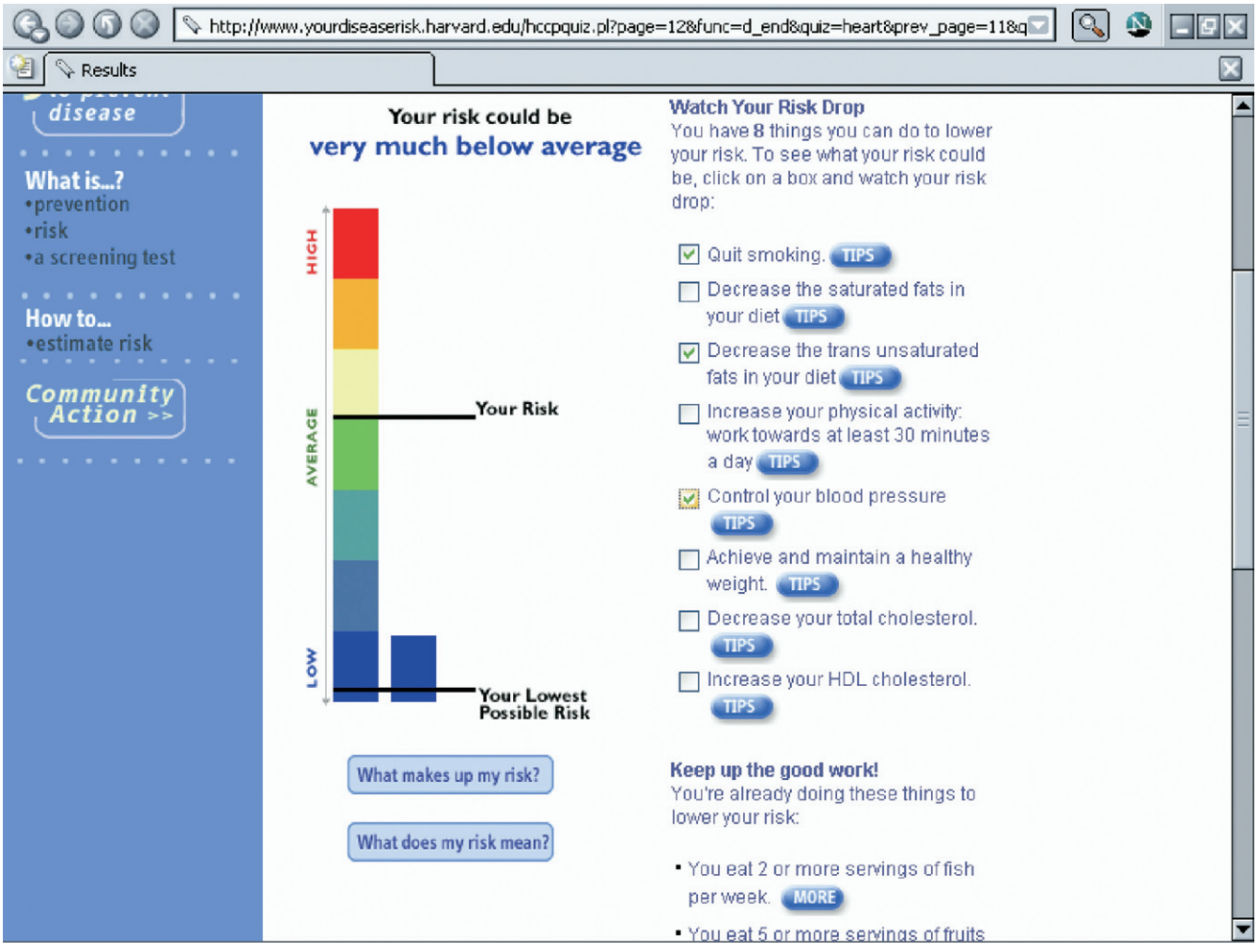

Figure 1. Sample screenshot from the *YourDiseaseRisk* website (www.yourdiseaserisk.wustl.edu/)

to be integrated into all aspects of project development. Institutional barriers often arise, most notably between the organizational and financial structures of university- and community-based organizations. Universities are intimately familiar with the federal research-funding system and know how to take the best advantage of federal research resources. Community organizations, however, are often at a disadvantage because they lack a research or fiscal infrastructure with an in-depth understanding of this system. Universities are also accustomed to having the bulk of a grant's budget go to their expenses; understandably, community groups are increasingly dissatisfied with this situation, or with being asked to "donate" their time and resources for research. Time is another dimension on which there are different cultures in university and community settings. University researchers are accustomed to the long lag-time between developing a research idea, obtaining funding for it, and being able to implement it; researchers are also accustomed to conducting large studies that typically take years to complete. Community members, on the other hand, often agree to be involved in research in order to address key community concerns that they want addressed in a timely manner. There are clearly differentials in timelines, expectations, and resources that can make community-based research collaborations very difficult.

Fortunately, there has been considerable emphasis on trying to develop models for effective collaboration between academic and community partners. The community-based participatory research approach developed by Barbara Israel and colleagues[20] exemplifies the importance of developing shared expectations, shared operating principles, and shared language in the context of academic–community partnerships. Four key principles of effective community-based participatory research partnerships that relate to transdisciplinary science stand out: (1) build on strengths and resources within the community, and understand that all participants have significant contributions to make; (2) integrate knowledge and action for the mutual benefit of all partners, so that the academic partners are not the only ones benefiting from the data being collected; it is crucial to recognize that knowledge is power, and all parties must share equally in that power; (3) promote a co-learning and empowering process that recognizes that all participants have the opportunity to learn from each other, and that the sharing of knowledge and empowerment strengthens the entire team; and (4) facilitate the collaborative, equitable involvement of all partners in all phases of the research. To the authors' knowledge, there has been little research investigating community readiness to engage in transdisciplinary science. However, if these principles are embraced, then the collaboration will by its nature spur transdisciplinary thinking, because of the emphasis on the integration of knowledge, co-learning, and empowerment. For example, Israel's work,[21] which focused on community-based participatory research approaches to asthma, has resulted in novel approaches to asthma management. High-level engagement of the community in intervention design and evaluation made it possible to broaden definitions of health and well-being beyond the individual and beyond health behaviors and health services and to understand health as produced within a social context.

The Massachusetts Community Network for Cancer Education, Research, and Training

The Massachusetts Community Network for Cancer Education, Research, and Training MassCONECT is another example of a transdisciplinary collaboration in a community setting that draws on principles of community-based participatory research. This effort unites behavioral scientists, epidemiologists, social epidemiologists, demographers, economists, and healthcare professionals with key community coalitions in three urban, low-income Massachusetts communities to advance cancer education, community-based participatory research, training, and cancer-control services. The particular focus of MassCONECT is on policy and clinical-service delivery to reduce cancer disparities in impoverished communities. It draws on sources of community strengths and assets through collaboration with existing community coalitions. Through the development of shared principles of engagement and collaboration, recognition is given to the value of all the areas of expertise represented, including all coalition members.

Further, a process for access to pilot funds has been developed that prioritizes interdisciplinary work and collaboration across coalitions, thus providing incentives for developing cross-disciplinary understanding and acceptance. Moreover, two of the pilot projects funded in the first year have emerged from interactions among scientists from different disciplines (social epidemiology and demography, and communication science) to map health disparities in the community and then to communicate the disparities through the media to influence public opinion about these disparities. Although a hands-off approach (e.g., maps produced by the social epidemiologist are then given to the communication scientists for working with the community) would be possible and perhaps easier, opportunities to integrate new learning from community perspectives into the current and future products would be limited.

New pilot projects emanate from the recent passage of legislation to mandate universal health-insurance coverage for all Massachusetts residents. The participating communities are enthusiastic that this reform may lead to better healthcare coverage and, ultimately, to better health outcomes among low-income communities. However, all recognize the need to be vigilant to

determine the impact of this legislation, and have been extremely concerned that federal programs for providing cancer-screening services for low-income populations are now at risk. Therefore, a partnership has formed that encompasses a MassCONECT community coalition; two community health centers; and academic researchers representing health policy, health communication, and healthcare delivery to examine the impact of the legislation on health outcomes from a variety of perspectives. This project gives the community a critical voice in the evaluation of a key public policy that is intended to provide a benefit that to date is unproven. The community's role, particularly from the service-delivery perspective, has already shaped the evaluation in ways that would not have resulted had a purely academic team addressed this problem.

It is too early to tell if MassCONECT will lead to a transdisciplinary approach in either science or in the delivery of healthcare services, but this is a goal of the effort. It is crucial that evaluation metrics be developed to gauge both a community's readiness to participate in transdisciplinary science and whether the community can reap adequate benefits from such collaboration.

The Role of Translation/Dissemination in Transdisciplinary Approaches

The long-term goal of any health-related research endeavor should ultimately be to improve the human condition by reducing disease risk and prevalence and improving the quality of life. It is imperative that these research findings about cancer-risk reduction be translated to community-based settings that have the potential to affect population health. Transdisciplinary approaches have great potential to speed the rate at which research can contribute to the understanding and improvement of health. Unfortunately, to date there has been relatively little adoption of evidence-based practices,[22–26] and, as a result, the potential of risk-reduction efforts for cancer prevention have been largely unrealized. Unless careful attention is paid to this issue, innovations that occur as a result of transdisciplinary approaches are likely to have the same fate.

A recent call for more focus on dissemination research[27,28] will help increase the adoption of best practices. However, there is very little research focused in this area, particularly in community settings and with underserved populations. The failure to understand infrastructure barriers to both program dissemination and to design interventions that can be adopted in a wide variety of community, public health, and clinical practice settings may contribute to the difficulty of broadly disseminating effective interventions. Combined with a limited research base to inform dissemination practice, the uneven adoption of evidence-based interventions to promote health and prevent disease can contribute to increasing health disparities.[29] Dissemination and implementation research can help answer the common question of how to take a program or intervention that was tested and proven effective in one population and disseminate it successfully into another population. In light of limited resources, there have been warnings that the slow integration of evidence-based interventions into the community will continue unless a specific focus on dissemination research is undertaken.[26] It is imperative that transdisciplinary research teams, from their inception, think about translation and dissemination, so that innovations that are sustainable, feasible in community settings, and potentially influential on population health can be realized. In particular, there is a need for new conceptual models to bridge the existing gaps in translational research, particularly related to efforts to reduce the evidence-to-practice gap.[26,29,30]

One outstanding example of a dissemination tool that is a product of many disciplines is the Cancer Control PLANET (Plan, Link, Act, Network with Evidence-based Tools). PLANET is a web-based portal (http://cancercontrolplanet.cancer.gov/index.html) developed by and jointly sponsored by the NCI, the CDC, the Agency for Healthcare Research and Quality, and the American Cancer Society. The portal is designed to provide evidence-based cancer control programs to program planners, program staff, and researchers, thus enhancing their access to tested interventions and relevant data for program planning. PLANET includes state cancer profiles, a guide to community preventive services, research-tested interventions, and planning guides. The website's content results from the work of dozens of intervention researchers, statisticians, geographers, and informaticians, and demonstrates how the synergy of work in several disciplines can be used to develop a tool for the dissemination for cancer control.

Summary

Transdisciplinary approaches are a key part of efforts to address vexing public health problems and to achieve effective and durable translation. However, transdisciplinary approaches require a systematic and thoughtful process in which transdisciplinarity is valued and supported (monetarily and otherwise) by leadership, and through which barriers are minimized. Although there is currently much rhetoric in academic circles about transdisciplinary approaches, it is much easier to talk about these approaches than to implement them in a meaningful way. Careful attention to implementation is needed if transdisciplinary approaches are to fulfill their potential.

No financial disclosures were reported by the authors of this paper.

References

1. Emmons KM. Paper contribution F: behavioral and social science contributions to the health of adults in the U.S. In: Smedley BD, Syme LS, eds. Promoting health: intervention strategies from social and behavioral research. Washington DC: National Academy Press, 2000.
2. Hankinson S, Colditz G, Manson JE, Speizer F. Healthy women, healthy lives: a guide to preventing disease, from the Landmark Nurses' Health Study. New York: Simon and Schuster, 2001.
3. Sorensen G, Emmons K, Hunt MK, et al. Model for incorporating social context in health behavior interventions: applications for cancer prevention for working-class, multiethnic populations. Prev Med 2003; 37:188–97.
4. Tosteson AN, Weinstein MC, Hunink MG, et al. Cost-effectiveness of populationwide educational approaches to reduce serum cholesterol levels. Circ 1997;95:24–30.
5. Colditz GA, DeJong W, Hunter DJ, Trichopoulos D, Willett WC, eds. Harvard report on cancer prevention supplement. Volume 1: causes of human cancer. Cancer Causes Control 1996;7(1S):1–59.
6. Willett W, Colditz G, Mueller N. Strategies for minimizing cancer risk. Sci Am 1996;275:58.
7. Rosenfield PL. The potential of transdisciplinary research for sustaining and extending linkages between the health and social sciences. Soc Sci Med 1992;35:1343–57.
8. Stokols D. Establishing and maintaining health environments. Toward a social ecology of health promotion. Am Psychol 1992;47:6–22.
9. Orleans CT. The behavior change consortium: expanding the boundaries and impact of health behavior change research. Ann Behav Med 2005;29(S):76–9.
10. Abrams DB. Applying transdisciplinary research strategies to understanding and eliminating health disparities. Health Educ Behav 2006; 33:515–31.
11. Kaplan GA, Everson SA, Lynch JW. The contribution of social and behavioral research to an understanding of the distribution of disease: a multilevel approach. In: Smedley BD, Syme SL, eds. Promoting health: intervention strategies from social and behavioral research. Washington DC: National Academy Press, 2000.
12. Ruddy G, Rhee K. Transdisciplinary teams in primary care for the underserved: a literature review. J Health Care Poor Underserved 2005;16:248–56.
13. Colditz G, DeJong D, Emmons K, Hunter D, Mueller N, Sorensen G, eds. Harvard report on cancer prevention: volume 2: prevention of human cancer. Cancer Causes Control 1997;8(1S).
14. Platz E, Willett W, Colditz G, Rimm E, Spiegelman D, Giovannucci E. Proportion of colon cancer risk that might be preventable in a cohort of middle-aged U.S. men. Cancer Causes Control 2000;11:579–88.
15. Emmons K, Koch-Weser S, Atwood K, Conboy L, Rudd R, Colditz G. A qualitative evaluation of the Harvard cancer risk index. J Health Commun 1999;4:181–93.
16. Colditz G, Atwood K, Emmons K, et al. Harvard report on cancer prevention: volume 4: Harvard cancer risk index. Risk Index Working Group, Harvard Center for Cancer Prevention. Cancer Causes Control 2000;11:477–88.
17. Waters E, Weinstein N, Colditz G, Emmons K. Formats for improving risk communication in medical tradeoff decisions. J Health Commun 2006;11:167–82.
18. Waters E, Weinstein N, Colditz G, Emmons K. Reducing aversion to side effects in preventive medical treatment decisions. J Exp Psychol Appl 2007;13:11–21.
19. Emmons K, Wong M, Puleo E, Weinstein N, Fletcher R, Colditz G. Tailored computer-based cancer risk communication: correcting colorectal cancer risk. J Health Commun 2004;9:127–41.
20. Israel BA, Schultz AJ, Parker EA, Becker AB. Review of community based research: assessing partnership approaches to improve public health. Annu Rev Public Health 1998;19:173–202.
21. Israel BA, Schulz AJ, Estrada-Martinez L, et al. Engaging urban residents in assessing neighborhood environments and their implications for health. J Urban Health 2006;83:523–39.
22. National Cancer Institute of Canada (NCIC). The language and logic of research transfer—finding common ground. Final report to the NCIC Board from the Joint Working Group on Translational Research and Knowledge Integration of the Advisory Committee on Research and the Joint Advisory Committee for Cancer Control. Toronto Ontario, Canada: NCIC, 2006.
23. Marincola FM. Translational medicine: a two-way road. J Transl Med 2003;1:1.
24. Mankoff SP, Brander C, Ferrone S, Marincola FM. Lost in translation: obstacles to translational medicine. J Transl Med 2004;2:14.
25. Ellis P, Robinson P, Ciliska D, et al. A systematic review of studies evaluating diffusion and dissemination of selected cancer control interventions. Health Psychol 2005;24:488–500.
26. Kerner J, Rimer B, Emmons K. Introduction to the special section on dissemination: dissemination research and research dissemination: how can we close the gap? Health Psychol 2005;24:443–6.
27. Glasgow RE, Bull SS, Gillette C, Klesges LM, Dzewaltowski DA. Behavior change intervention research in healthcare settings: a review of recent reports with emphasis on external validity. Am J Prev Med 2002;23:62–9.
28. Estabrooks PA, Glasgow RE. Translating effective clinic-based physical activity interventions into practice. AM J Prev Med 2006;31(4S):S45–56.
29. Klesges LM, Estabrooks PA, Dzewaltowski DA, Bull SS, Glasgow RE. Beginning with the application in mind: designing and planning health behavior change interventions to enhance dissemination. Ann Behav Med 2005;29(1S):66–75.
30. Glasgow RE, Bull SS, Piette JD, Steiner JF. Interactive behavior change technology: a partial solution to the competing demands of primary care. Am J Prev Med 2004;27(2S):80–7.