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Facilitating transdisciplinary research: The experience of the transdisciplinary tobacco use research centers

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Cigarette smoking is the largest preventable cause of death and morbidity in the United States. Heightened recognition of this public health concern has led researchers from multiple and varied disciplines to address this complex and multidimensional behavior. The need for an alternative research paradigm, focusing on a transdisciplinary approach that integrates work across disciplines in order to advance the field most quickly, has been identified. This recognized need led to the development of the Transdisciplinary Tobacco Use Research Centers (TTURC) initiative, funded jointly by the National Cancer Institute, the National Institute on Drug Abuse, and The Robert Wood Johnson Foundation. This paper discusses the formation and early implementation stages of the initiative, including meetings that led to the development of the TTURCs, funders' and research centers' perspectives on implementation, and early observations about the products of the initiative.

Introduction

Cigarette smoking remains firmly entrenched in American society today, although the demographics of smokers differ from those when the first Surgeon General's Report on Smoking was published nearly 40 years ago (Morgan, Fiero, Matthews, & Leischow, 2002). Approximately 48 million adult Americans, representing 25% of the population, are smokers (U.S. Department of Health and Human Services, 2000; Fiore et al., 2000). Overall, smoking prevalence and the trajectory of tobacco use initiation among America's youth are alarming, with 29.5% of 12th graders reporting smoking in the previous 30 days (Morgan, Fiero, Matthews, & Leischow, 2002; National Cancer Institute [NCI], 2001a). Although adolescent rates of smoking have recently decreased, they are still greater than a decade ago and presage continued high death rates from lung cancer in the years ahead (NCI, 2001b). This pattern is particularly noteworthy given the increase in policies regulating smoking, tobacco industry litigation, and (presumably) heightened public awareness of the negative health consequences of smoking. Worldwide, the extent of the tobacco epidemic is staggering, with estimates indicating that there are currently more than 1 billion smokers (World Health Organization, 1996).

The consequences and costs of tobacco use are significant and severe. Smoking has been the chief preventable cause of illness and death in the United States for more than three decades and is responsible for 20% of all-cause mortality (more than 400,000 deaths annually in the United States). Smoking is a leading cause of death from coronary heart disease, chronic obstructive pulmonary disease, stroke, and lung cancer. Worldwide, tobacco causes more than 3 million deaths every year (Peto, Lopez, Boreham, Thun, & Heath, 1992; NCI, 2000).

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The increasing recognition of the complex, multidimensional nature of tobacco use and related disease, coupled with heightened public health concern about the intransigence of the tobacco problem, propelled the scientific community to seek new research models and paradigms. Transdisciplinary research, as one new model was labeled, was seen as having the potential to accelerate both discovery and its translation to practice (Tobacco Research Implementation Group, 1998; Turkkan, Kaufman, & Rimer, 2000; Swan & Balfour, 1999b; Working Groups of the Youth Tobacco Prevention Initiative, 1998; Wynder, 1998).

This paper describes the development and early implementation stages of the Transdisciplinary Tobacco Use Research Centers (TTURC) initiative, a collaboration of the National Cancer Institute (NCI), the National Institute on Drug Abuse (NIDA), and The Robert Wood Johnson Foundation (RWJF). It begins by discussing seminal meetings and working groups that were key in the development of the initiative and the identification of tobacco research priorities. This is followed by a discussion of the implementation of the initiative from both the funders' and the centers' perspectives. The paper concludes with some early observations on the products of the initiative and comments on how its success will be measured.

The immediate genesis of the Transdisciplinary Tobacco Use Research Centers was linked to the recognition among many leaders in the field that interventions had plateaued in impact, and that new approaches were needed to refresh the science (e.g., see Shiffman, 1993). These leaders identified the limitations of research conducted in academic "silos" (Kaufman & Feiden, 1999), with researchers working in isolation. For example, geneticists searching for inherited traits, biologists examining the effects of nicotine on brain neurotransmitters, psychologists delving into personality traits, and so on, are working in isolation from one another and are lacking the potential benefit that could result from synergy. Although the research of individuals and teams has advanced tobacco research, it was hypothesized that further advances would come from greater integration across disciplines. This thinking, combined with advances in molecular biology, genetics, pharmacology, and behavioral science, provided new opportunities for integrative research on tobacco use and nicotine addiction. A series of conferences and workshops cemented these ideas and led to the development of the TTURC initiative.

The Sundance, Utah, conference "New Partnerships and Paradigms for Tobacco Prevention Research," sponsored by The Robert Wood Johnson Foundation in 1997, brought together scientists and practitioners representing varied disciplines, to discuss transdisciplinary approaches to understanding nicotine and tobacco use (Swan & Balfour, 1999b). The primary focus of this conference was on the resurgence of smoking and nicotine dependence among youth. Participants proposed that the integration of biological and psychological insights, coupled with an understanding of policy, could lead to greater advances in knowledge of addiction, as well as in prevention and successful treatment. This sentiment was echoed in the 1998 national conference "Addicted to Nicotine: A National Research Forum," with NIDA and RWJF as lead sponsors, together with NCI and other NIH institutes. This meeting brought together scientists representing the broad landscape of tobacco use and nicotine addiction research and included presentations ranging from genetics and neuroscience to prevention and treatment (Swan & Balfour, 1999b). At both of these meetings, participants strongly supported adoption of transdisciplinary research models as critical to advance the field.

In 1998, the Tobacco Research Implementation Group (TRIG) was created in 1998 to establish NCI's tobacco-related cancer research priorities for the next 5 to 7 years. The interdisciplinary group of scientists represented multiple agencies and institutions, including NIH, academia, and private foundations. The TRIG adapted the Biopsychosocial Model to reflect the complex interplay of social, psychological, and biological/genetic factors that influence nicotine addiction. Social influences are broad, including peer and family modeling, tobacco industry marketing, and media influences. Depressed or anxious mood and attention deficit hyperactivity disorder are examples of psychological factors that affect smoking, from initiation to maintenance to cessation. Genetic factors have been linked to nicotine metabolism and difficulty quitting. The effects of these overarching determinants are mediated by behavioral, neurochemical, and physiological factors to influence tobacco use, dependence, cessation, and relapse in the individual (see Figure 1). These individual factors, however, do not operate independently of one another, and their interaction must be considered dynamic over the entire "career" of a smoker (Haire-Joshu, Morgan, & Fisher, 1991).

The TRIG identified the key priorities for tobacco control research, shown in Table 1 and published in a report, *The National Cancer Institute Tobacco Research Implementation Plan, Priorities for Tobacco Research Beyond the Year 2000* (Tobacco Research Implementation Group, 1998). The top recommendation was the development of transdisciplinary tobacco research centers, envisioning them as the most effective way to achieve NCI's priorities in all areas of tobacco research: "Transdisciplinary Tobacco Research Centers should be created to study the initiation of tobacco use, prevention of tobacco use, addiction to tobacco, and/or treatment of tobacco addiction and tobacco-related cancers." This recommendation was based on a firm belief that centers

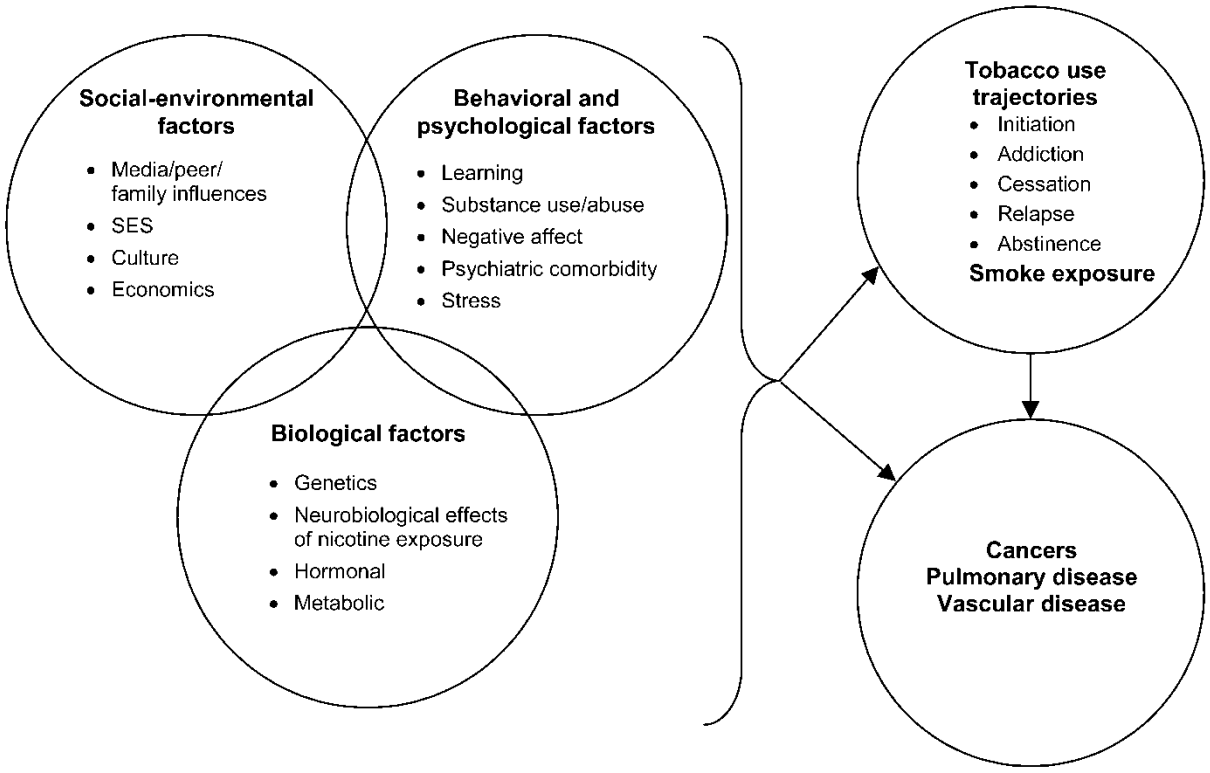

Figure 1. Biopsychosocial model of tobacco use and tobacco-related disease.

based on the transdisciplinary model would be in a unique position to: (a) increase understanding of the complex interplay of biological, psychological, and social factors in tobacco dependence; (b) apply this knowledge to develop prevention and treatment interventions that address the biological, neuropharmacological, and behavioral determinants of tobacco dependence; and (c) translate and disseminate this knowledge to the community, by identifying and addressing emerging health policy and bioethical issues raised by this new research model.

The TRIG report also identified the pressing research needs that could be best addressed by the transdisciplinary model. These included research to understand trajectories of adolescent smoking initiation and progression, and the development of treatments for tobacco dependence that are tailored to smokers' unique genetic and psychosocial profiles. The report also highlighted the need to improve and disseminate tobacco control programs at the community and state levels, a goal best addressed by centers that promote close working relationships among basic scientists, clinicians, behavioral scientists, and health policy researchers.

The development of the TTURC initiative

Convergence of thinking was evident at the Sundance and Addicted to Nicotine conferences, in

Table 1. Top five tobacco research priorities identified by the Tobacco Research Implementation Group

1. Transdisciplinary Tobacco Use Research Centers should be created to study the initiation of tobacco use, prevention of tobacco use, addiction to tobacco, and/or treatment of tobacco addiction and tobacco-related cancers.
2. Basic biobehavioral research should be conducted to understand the sociocultural, psychological, physiological, and genetic factors that influence the initiation of tobacco use, progression to nicotine addiction, and smoking cessation among children, adolescents, and adults.
3. Research concerning the treatment of nicotine addiction should be conducted to find the best ways to tailor tobacco cessation interventions to specific sociocultural, psychological, physiological, and genetic subgroups.
4. Research should be conducted to improve community and state tobacco control programs and to increase the effectiveness of these programs for populations at disproportionate risk.
5. Research should be conducted to identify mechanisms for optimal dissemination of proven prevention and treatment interventions at the community and state levels.

the recommendations of the NCI TRIG, and among leaders in tobacco use research. Specifically, transdisciplinary science, policy research, and communications to appropriate audiences were viewed as necessary to move the tobacco control research field forward. This recognized need facilitated the NCI, NIDA, and RWJF partnership and the inception of the TTURC initiative. Leaders from the three institutions worked together to formulate the initiative, with each funding agency allocating monies to fund the collaborative effort.

The Request for Applications (RFA) for the TTURC initiative was published by NIH (with funding from NCI and NIDA) in 1998 and used the NIH specialized center grant (P50) mechanism (http://grants2.nih.gov/grants/guide/rfa-files/RFA-CA-98-029.html). In the NIH center grant proposals, applicants were required to demonstrate a transdisciplinary approach, propose a minimum of three major projects organized around a unifying research theme, and include a career development program, developmental/pilot research program, and creative strategies to foster collaboration with other centers. The career development component was added in recognition of the urgent need for new investigators in the area of tobacco control research. Career development was not limited to doctoral or postdoctoral scientists; cross-training of established investigators was also encouraged. The provision of developmental/pilot funds allowed exploration of novel directions, especially those that might arise with the progression of the major projects. Cross-center collaborations were seen as critical to enhancing the capacity of the TTURC initiative as a whole, to catalyze problem solving, and to lead to more rapid advances in knowledge. After a competitive review of proposals, seven academic institutions were awarded center grants by NIH in 19 999 (http://tturcpartners.com/).

To increase the speed with which research findings affect public health and policy, RWJF authorized funding for communication and policy research at the seven NIH-funded centers. Specifically, RWJF offered each center the opportunity to apply for funds to support a communications director whose function would be to assist in translating the scientific findings at each center for the public and policy-makers and to establish mechanisms to coordinate communication within and across the centers. Additional RWJF funds were available to support policy-relevant research linked with the NIH-supported science at each center. To our knowledge, this is the first time support has been provided for this purpose, and the arrangement represents a novel private-public partnership.

RWJF also provided funding to establish the *Partners with Tobacco Use Research Centers: Advancing Transdisciplinary Science and Policy Studies* (Partners) program at the University of Illinois at Chicago. The Partners program facilitates the reviewing, awarding, and monitoring of the communications and policy research grants. It also serves a central coordinating function for the initiative, helping to bridge communications across centers and funders, to organize joint activities and twice-yearly TTURC meetings, and to provide a clearinghouse of information to the TTURCs and other audiences.

Research at each funded TTURC site is organized around a theme (see Table 2). Within each center, broad-based research is being conducted across a range of disciplines, including genetics, psychology, health policy, medicine, economics, and neuroscience. As of fall 2002, major research projects and a number of pilot studies were being conducted at the seven centers. All seven centers have established communications components, with communications directors. Additionally, five centers have received funding for policy research.

Building a transdisciplinary research center: The funders' perspective

Underlying the TTURC initiative is the premise that communication, exchange of ideas and resources, and collaborations among scientists and across disciplines increase the potential for scientific breakthroughs. These characteristics are important within a research center and are thought to be supercharged by communications and collaborations across multiple centers. In fact, cross-center collaborations were considered important enough during the planning stages of the initiative to have been written into the RFA. The question for NCI, NIDA, and RWJF, as funders of the initiative, was how to facilitate, even catalyze and provoke, such interactions.

Table 2. Centers and research themes

Brown Medical School/Miriam Hospital
Genetic and biopsychosocial risk factors and trajectories of tobacco use/dependence across generations of families
University of California, Irvine
Identifying factors underlying individual differences in tobacco use susceptibility
University of Southern California
Preventing tobacco use among youth of diverse cultures
University of Pennsylvania/Georgetown University
Bio-behavioral basis of smoking initiation, smoking treatment, and harm from tobacco exposure
University of Minnesota
Treating smokers who have been resistant to conventional methods of intervention or who have not been previously targeted
University of Wisconsin Medical School
Understanding and preventing relapse to tobacco use
Yale University
Treatment of tobacco addiction

Having multiple funders at the table in the planning and implementation stages of the TTURC initiative has been a both rich and challenging experience. The richness reflects the diverse resources available at each institution, including combined financial resources, as well as the scientific research experience and commitment of government agencies (NCI, NIDA) and a private foundation (RWJF), and experience in translational research and linking science findings to end users (e.g., policy-makers and decision-makers). Similar to the stretching at each of the individual centers to work across disciplines, as described later in more detail, the funders have also had to stretch to work together on this initiative. For each funder, being a partner in this team effort has meant working on equal footing with other institutions whose procedures, protocols, and philosophies, while directed at similar goals, are often quite different.

For the funders, the TTURC initiative has been more of a hands-on endeavor than most projects, which reflects not only the funders' high level of investment but also their understanding of the challenges inherent in such an initiative. Recognizing that transdisciplinary work requires the removal of well-established disciplinary boundaries of traditional research, the funders have sought to help the researchers and centers resist the tendency to revert to the comfort zone of their individual disciplinary backgrounds. The heightened level of funder involvement compared with many NIH initiatives, multiplied by three, has required that extra emphasis be placed on the collaborative nature of the relationships among the funding agencies, predominantly in the form of increased focus on communication among key players. For example, it has been important for funders to spend time up front discussing goals, procedures, and constraints, in order to reach consensus and move the initiative forward.

A challenge facing all of the centers was how to build relationships, not only within their centers and across scientific disciplines but also outward to other TTURCs. High value is placed on the development of links between less senior investigators, given recognition that it is these individuals who will carry tobacco use research forward into the next decade. To assist the development of these relationships, the funders have sought to foster opportunities for relationship formation. The single most effective means for linking researchers has been face-to-face meetings held twice yearly for members of the TTURC community, including TTURC PIs and researchers, communications directors at the centers, consultants to the initiative, and representatives of the funding agencies.

In addition to the semiannual meetings, other communication vehicles have been established, including e-mail lists (both general and topic/interest specific), a central Web site (http://www.tturcpartners.com), conference calls with TTURC directors, and topic-specific work groups. As the work at each of the centers has progressed, special meetings have included participants from multiple TTURCs. Topics at these meetings and workshops have included tobacco measures, communications in tobacco, and tobacco policy research. Opportunities for interaction and collaboration among members of the TTURC community have also been created at national conferences, such as the World Conference on Tobacco or Health and the annual meeting of the Society for Research on Nicotine and Tobacco. In addition, the Partners coordinating center has distributed a quarterly newsletter, *The Networker*, which seeks to keep members of the TTURC community informed of work at each center by highlighting individual investigators, projects, successes, and events.

Numerous communication vehicles are currently being used to increase awareness of the work being completed at the various centers, to provide a starting point for the formation of relationships across centers and across disciplines, and to foster the development of these relationships and cross-center collaborations. This paper series is one example of such a product of this collaborative, cross-center initiative.

Building a transdisciplinary research center: The centers' perspective

Assembling the Transdisciplinary Tobacco Use Research Centers was a complex endeavor. As the process began, the centers' leadership was influenced greatly by the scholarship of Kahn and Prager (1994), who emphasized that a successful transdisciplinary enterprise requires an optimal mix of people and environment, along with patient, persistent attention to the processes needed to forge a new approach to science. As each center developed, the interactive and synergistic nature of this process was evident. Above all, the process took time and the willingness to let it unfold. This section presents a cross-section of center experiences in building a transdisciplinary research center.

Assembling the application

People and institutions

The first step in creating a TTURC application was to identify a core group of people who were able and willing to participate. Approaches to assembling transdisciplinary teams varied across the centers. For example, some centers already had a critical mass of willing collaborators, while others assembled teams that had little or no experience working together. In recruiting potential TTURC collaborators, each center sought a mix of disciplinary

representatives, including investigators from the basic sciences (e.g., biology; behavioral, social, and population sciences); translational applications to clinical research (e.g., health promotion, applied psychology, clinical medicine); and public health (e.g., ethics, health economics, health care policy). Development of the TTURC application required input not only from the scientists but also from individuals vital to the centers' infrastructure, including those with expertise in research administration, communications, education and training, data management, and methodology.

Transdisciplinary endeavors require collaboration, openness, trust, self-confidence with one's own discipline, and a comfort level that facilitates mutual respect and two-way communication (Abrams, 1999; Kahn & Prager, 1994). The scientists involved in this type of work either have a natural predilection for cross-disciplinary collaboration or have learned to appreciate the advantages of stepping outside their disciplines. Those involved not only have to be open to perspectives from different disciplines but also must be able to assimilate and synthesize various disciplinary perspectives into new ideas.

Leadership was key to the development of a successful center. Typically, the leadership core comprised a few senior investigators who not only were well established within their respective fields but also had the interpersonal qualities necessary to set the tone for transdisciplinary cooperation. The leadership core served to steward the nascent center. Critical objectives for leadership at this stage included facilitating the transition from dialogue about potential ideas and projects to deciding what research could achieve, given a group's particular strengths; arbitrating difficult discussions about the scope and boundaries of the research; and ensuring that the application process went as smoothly as possible by overseeing the production of the research proposal.

The leadership at each center sought a mix of senior and junior investigators who had the potential to work in transdisciplinary collaborations. Senior investigators were able to take the risk of stepping outside the comfort of their disciplines, which more junior researchers were less able to do. Senior researchers also brought the clout necessary to negotiate within and across disciplines and institutions to develop strong research programs. Although many senior researchers were initially excited about the transdisciplinary opportunity afforded by the TTURCs, barriers kept some from becoming involved, including concerns about the impact of this new endeavor on one's current research activities, and institutional demands from within one's discipline or academic department.

Conceptual framework

Once the leadership core was established, each center's theme and projects began to form. A variety of approaches were taken to develop an integrated vision for each center. Some centers began with a theme and then identified concordant projects. Other centers began with a set of project concepts and sought a unifying theme. And, in some centers, a transdisciplinary group of investigators forged both themes and projects together dynamically in brainstorming sessions.

Each approach had its advantages and disadvantages. The first approach made it easier to form a thematically integrated package but may have precluded some innovative science that did not fit within the predetermined theme. The second approach ensured the committed excitement of the individual investigators but may not have allowed them to discard particular projects. The brainstorming approach allowed for spontaneous formation of new ideas that may have been inhibited in the other two approaches, but it also was much more time-consuming.

The ultimate goal of each center was to establish an environment that stimulated transdisciplinary interchanges that could foster additional research projects stretching beyond the aims of the original funded studies. Investigators who were working for the first time with new disciplines not only had to learn about those disciplines but also had to think through the possibilities for fusion of their own discipline's ideas and methods with those of the other disciplines. Kahn and Prager labeled this process "wallowing" and described it in terms that evoke the image of the primordial soup that presaged the beginnings of life. This extended period of discussion and assimilation is integral to the transdisciplinary process. Optimally, this interaction evolved into the development of a common language and a fusion of scientific methods. As with any complex endeavor, coalescence can take longer than expected and is a continuing process that evolves over time.

Devising a common conceptual framework across disciplines was difficult and entailed tradeoffs. The study of nicotine and tobacco use runs a wide gamut from molecular to population studies. In developing a transdisciplinary framework for a center, each group of investigators had to determine how broadly or narrowly to define their common model. Some centers chose to cast their research net widely across disciplines, while others delved deeper within fewer disciplines. Both approaches fit within the transdisciplinary model. Leaders had to manage a balance between depth and breadth as each center's theme evolved, in order to optimize the potential of scientific

inquiry while remaining realistic about the strengths, gaps, and logistics of undertaking such a research endeavor.

Building a team and infrastructure

Transdisciplinary interaction did not happen spontaneously at the centers; it had to be explicitly nurtured and programmed into the goals and structure of each center. The TTURC initiative differed from a typical project in that interdisciplinary collaboration—both within and across projects—was required to break the boundaries of single-discipline research. Achieving transdisciplinary collaboration required a substantial effort to build teams of scientists from diverse backgrounds who, in many cases, had not had the experience of working together previously. For example, a study of gene-environment interactions in nicotine dependence might require neuropharmacologists and geneticists to identify relevant biological pathways, as well as social and behavioral scientists to identify the relevant cofactors and phenotypes for nicotine dependence. Such a project is most likely to succeed if team members work together to generate hypotheses for the complex interactions among these different variables.

The success of developing a productive transdisciplinary team hinges not only on the people involved but also on the quality of the environment in which they interact. The environment provides the conditions under which individuals can comfortably forge professional and personal relationships that may lead to new scientific breakthroughs. To establish this type of environment required everyone to feel comfortable interacting with each other. Different venues were used to increase participants' comfort levels. These included brief informal presentations on different disciplinary topics, supplemented with basic readings and glossaries of terms to help everyone develop a common language. Many centers added a seminar series on research related to tobacco and nicotine dependence to further develop new ideas and collaborations. Both internal and invited speakers presented their work and then engaged center members in discussion on the strengths and limitations of the methods, as well as on ideas for integrating other disciplines.

Continuity of contact among center researchers was critical, with weekly meetings for individual projects and monthly meetings of all center investigators as a typical schedule. Among the positive outcomes of these meetings were unexpected suggestions on a topic from people working in a completely different area of research. Retreats were an ideal way to forge new links and strengthen existing relationships. Early in the centers' development, these meetings focused on conceptual models, project development and measurement issues. Once the projects were underway, these forums provided an important venue for presenting preliminary data and obtaining feedback on future directions.

Continuing institutional commitment for the transdisciplinary center was vital through each stage—from development of the application to the initial building and growth, and through ongoing administration of the centers. Although many institutions may welcome the revenues that are associated with large centers, those institutions must be willing and able to provide additional supports to facilitate and reward transdisciplinary work by removing institutional impediments to collaboration. For example, junior and mid-career investigators were often employed by academic departments, which had their own criteria for promotion and allocation of resources to investigators. Because transdisciplinary work requires one to work outside one's discipline (e.g., department), the institution had to be willing to provide the framework for these outside-the-department collaborations to occur without jeopardizing the individual investigator's resources and opportunities for advancement. In particular, the institution had to understand that transdisciplinary research requires more time than traditional single-discipline research and that established promotion criteria that focus exclusively on first-authored publications create disincentives, particularly for faculty who are earlier in their careers, to work with senior investigators from other disciplines.

There is no single formula or template for success of the transdisciplinary centers. From the outset, the centers varied in disciplinary representation, scope of science, and history of collaboration. Table 3 summarizes some of the key features (and lessons learned) that facilitated the development and growth of the transdisciplinary centers.

Illustrations of transdisciplinary impact of the initiative

In the initial months following the award, the centers focused on developing infrastructure and building teams, as described earlier. Partnerships and collaborations across centers occurred somewhat later in the developmental process. An initial vehicle for nurturing these partnerships was the formation of

Table 3. Key elements for successful transdisciplinary research

Regular structured communications across disciplines
Respect for others' models and methods
Development of common language
Sound institutional commitment and support
Funds for emerging areas of research and training
Adequate attention to and funds for infrastructure
Emphasis on expanding science to engage other centers and new disciplines

Table 4. Collaborations across TTURCs

Penn – USC	Gene-culture/environment interactions in tobacco use
USC – UCI	Culture, mood, and smoking
Brown – Penn	Genetic studies of treatment response
UCI – USC – Brown	Process of transdisciplinary research
Penn – USC	Genetic studies of smoking in China
Yale – Brown	Neurobehavioral regulation smoking and affect
USC – Yale	Economic factors affecting smoking in China
UW – UM – Brown	Measures of dependence development
ALL	Special journal issue devoted to transdisciplinary research

cross-center work groups to discuss cross-cutting issues and concerns. Early work groups' issues included tobacco measures (to establish common terms and share measures across studies) and cost-effectiveness (to look at current cost-effectiveness studies and opportunities to expand these projects).

All of the centers engage in cross-center collaborations (see Table 4). These collaborations have increased the ability to answer intriguing, emerging questions (e.g., by pooling data sets) or have extended research capacity (e.g., securing an NIH supplement to fund DNA assays of data sets common to two centers). Several centers are working to characterize the transdisciplinary process within their institutions (see Stokols et al., this issue). In a superb example of teamwork, six centers collaborated in submitting a response to an RFA for international research on tobacco control.

The TTURC initiative also has had impacts beyond the centers. The initiative has served as a template for several more recent NIH initiatives. For example, The Centers of Excellence in Cancer Communications Research initiative is using the P50 mechanism and includes a pilot component and a requirement for at least three major projects per application. It has been common to hear from investigators that the RFA and the TTURC models have changed the way they approach tobacco control science (e.g., "We are working with people we never worked with before"). Finally, at least two transdisciplinary program project research applications concerning tobacco use and etiology were spawned by the TTURC initiative.

Summary

The devastating impact of tobacco use continues as a major national public health problem. Integrative research across disciplines, embodied by the TTURCs, promises to yield greater understanding of tobacco use and improved interventions. The transdisciplinary focus and the scope of this initiative (seven interacting centers funded for 5 years) represent both a bold venture and an experiment for the funding organizations. The scope of the investment by NIH should not be interpreted as movement away from other approaches. Significant progress in tobacco control will require continued commitment to unidisciplinary and multidisciplinary research by scientists and funding institutions.

The eventual effects of these centers will not be known for some time. It will take 5 to 10 years for the truly innovative end products to appear. Yet, both the funders and the scientific community want some early indicators of success. This desire challenges the centers and the funders to devise new methods to quantify or otherwise assess the value of the transdisciplinary process as it progresses (see Stokols et al., this issue). For the time being, markers of success will be the ingenuity of new research approaches. The ultimate test will be whether public health is improved.

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