News from NIH: resources for team-based research to more effectively address complex public health problems

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A perennial goal of the National Institutes of Health (NIH) is “to foster fundamental creative discoveries, innovative research strategies and their applications as a basis for ultimately protecting and improving health” [1]. In response to this goal, an increasing number of initiatives have emerged to promote cross-disciplinary team-based research. Cross-disciplinary research approaches aim to integrate knowledge from multiple disciplines and perspectives to generate innovative solutions to real-world problems. Scholars have identified three main types of cross-disciplinary research approaches, *multidisciplinary* (MD), *interdisciplinary* (ID), and *transdisciplinary* (TD), each of which is characterized by an increasing level of disciplinary integration [2]. As research initiatives move along this continuum toward greater integration, they are increasingly likely to rely upon team-based research to develop, conceptualize, and implement research initiatives. The Science of Team Science (SciTS) field has emerged in response to the need to better understand the circumstances that facilitate or hinder effective team-based research and assess the outcomes of this approach for scientific productivity, innovation, and translational applications [3–5]. Over the past decade, NIH has provided leadership to support cross-disciplinary team-based research by: (1) advancing the SciTS field, (2) developing tools and resources to facilitate collaboration, and (3) funding team-based research.

ADVANCING THE SciTS FIELD

Initially formed to assess the potential added value of large transdisciplinary initiatives supported by the National Cancer Institute (NCI), the NCI's SciTS team has been a leader in developing and advancing the SciTS field. In 2006, the team hosted a 2-day conference on the Science of Team Science that brought together experts in this nascent field to present an overview of the current state of research

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about team-based research and identify priority areas and future directions for the SciTS field. A subset of the conference papers served as the basis of a highly cited 2008 supplement to the *American Journal of Preventive Medicine* titled, “The Science of Team Science: Assessing the Value of Transdisciplinary Research” [6].

The NIH continues to support the SciTS field through multiple activities, perhaps the most visible of which is the Annual International SciTS Conference (2010–2013) [7]. This conference is hosted and chaired by members of the Northwestern University Clinical and Translational Sciences Institute and is funded by the National Center for Advancing Translational Sciences (NCATS) and NCI in addition to corporate and nonprofit organization sponsorship. The Annual International SciTS Conference aims to serve as a bridge between the evidence base developed in the SciTS field and the experiential knowledge of investigators, funders, and academic leaders regarding how to engage in, support, and facilitate team-based research. In so doing, it has served as a conduit for translating empirical findings about team science into evidence-based effective practices for scientific teams and funders of team science.

Furthermore, NIH has helped to advance the SciTS field by serving as a leader in generating an empirical evidence base for effective practices in team-based research and unique outcomes of this

approach. Through the NCI SciTS team's efforts to evaluate large NCI-supported transdisciplinary initiatives, the team has developed rigorous evaluation and research methods [8], measures [9], and models [2, 3], and produced groundbreaking findings about the added value of transdisciplinary team-based research [10]. For instance, a recent quasi-experimental longitudinal study conducted by the NCI SciTS team found that transdisciplinary center grants create benefits for both scientific productivity and collaboration, compared to traditional investigator-initiated grants [10].

DEVELOPING TOOLS AND RESOURCES TO FACILITATE COLLABORATION

The NIH has supported the development of an increasing number of resources, education, and training tools for NIH-supported investigators, administrators, and the broader scientific community to enhance the success of team-based research. For example, the NCI SciTS team recognized that given the diverse disciplinary origins of SciTS research and relevant literatures, novel approaches were needed to unify the evidence base in the SciTS field, reduce duplication of efforts to develop practical tools for team-based science and approaches to study team-based science, and facilitate cross-fertilization of ideas. To that end, the NCI SciTS team developed the Team Science Toolkit [11], a community-curated web-based tool that serves as a hub for investigators, academic administrators, funders, and other stakeholders to find and exchange resources and information. The Toolkit includes resources that help users manage, support, conduct, evaluate, and study team-based research initiatives such as promotion and tenure guidelines to recognize involvement in team-based research; syllabi for education and training in team-based research approaches; and methods, measures, and metrics for studying or evaluating team science initiatives.

Some of the tools that can be found on the Team Science Toolkit were developed at NIH, for example, "Collaboration and Team Science: A Field Guide" [12], which was developed by the NIH Office of the Ombudsman. This manual is designed to facilitate collaboration and includes case studies, guiding questions, and templates to help researchers develop, participate in, and lead successful scientific collaborations.

Other examples of tools found on the Team Science Toolkit were developed by scientists supported by NIH, such as, Teamscience.net [13], which was developed with support from the NIH Office of Behavioral and Social Sciences Research (OBSSR) and NCATS. Teamscience.net is a free and publicly available suite of evidence-informed e-learning resources designed to foster learning and skill development in Team Science. It provides examples of real-world scenarios unique to team-based research through four self-guided learning

modules intended to help researchers acquire and apply a basic knowledge of team science.

FUNDING TEAM-BASED RESEARCH

The life-cycle of a cross-disciplinary research project or initiative can be tracked over a number of distinct phases [1, 2], each of which can benefit from targeted support. For instance, in early phases, it is critical for researchers to work across disciplines and perspectives to identify the potential range of factors and pathways, or problem space, relevant to a particular scientific or societal challenge, determine priority research questions, and identify the expertise needed on the research team in order to address these research questions. To facilitate these processes, the NIH offers a currently open funding opportunity entitled "Scientific Meetings for Creating Interdisciplinary Research Teams (R13)" [14] for conferences and scientific meetings specific to gathering cross-disciplinary groups of investigators to explore potential avenues for integrative research, identify research questions, and develop related research initiatives. This opportunity is led by the *Eunice Kennedy Shriver* National Institute of Child Health and Human Development, in partnership with NCI, the National Institute on Aging, the National Institute on Drug Abuse and OBSSR.

Another approach used to support the early phases of cross-disciplinary research is the trans-NIH Common Fund's Interdisciplinary Roadmap Consortia program [15]. These multicomponent projects, now nearing completion, allowed teams of investigators to self-assemble to develop an interdisciplinary approach to addressing a complex health problem. Because the individual components (e.g., core services, research projects, training) are funded as separate but linked awards issued by the most scientifically relevant NIH Institute or Center, this program supports team-based research not only within the consortia, but also by the NIH staff from the multiple Institutes and Centers who jointly manage them. This joint management by project teams represents a marked change in the way NIH typically "does business". The program includes an ongoing evaluation component to assess progress and guide future activities in interdisciplinary science. The mid-course evaluation identified a number of processes and outcomes important for the success of these research collaborations. These included: frequent meetings with investigators from multiple disciplines to discuss research methods dedicated to a specific medical condition, expansion of the investigators' research vocabularies and portfolios, increase in scholarly activity and scientific productivity in new disciplines, co-mentoring of trainees by investigators affiliated with multiple disciplines, and sharing of resources [16].

NIH has been at the forefront of funding highly integrative initiatives, specifically aimed at promoting TD research. For example, the Transdisciplinary

Research on Energetics and Cancer (TREC) centers [17] are funded through the NCI to address the intersection of cancer and the growing obesity epidemic. Drawing on lessons learned from prior TD initiatives, the TREC centers were designed to foster TD collaboration and stimulate innovation and scientific progress. From the start of the initiative, there has been a clear capacity building agenda around TD integration of research within and across centers, supported by a dedicated Coordination Center with infrastructure capabilities to support collaboration across centers. For instance, there are budgeted resources for developmental pilot projects that enable new research collaborations and new lines of research to emerge within and across centers. Additionally, the TREC Coordination Center facilitates cross-center collaboration through training workshops, semi-annual grantee meetings, maintaining the initiative's website, and providing logistical and administrative support for the cross-center working groups on key topics.

NIH also supports team science efforts targeting translational science more specifically. The goals of the Clinical and Translational Science Awards (CTSAs) program, administered by NCATS, are to accelerate the process of translating laboratory discoveries into treatments for patients, to engage communities in clinical research efforts, and to train a new generation of clinical and translational researchers. The Institutional CTA Program, currently soliciting new applications [18], focuses on interdisciplinary translational research needs by integrating clinical and translational science across multiple departments, schools, and clinical research institutes representing a team science approach to research collaboration among institutional partners.

A more behavioral/social science-focused example of team-based research efforts to translate basic laboratory research into practical treatments and policies can be found in the Edward R. Roybal Centers for Translational Research in the Behavioral and Social Sciences of Aging [19]. Led by the National Institute on Aging with support from OBSSR, the Agency for Healthcare Research and Quality, the Social Security Administration, and the National Institute on Disability and Rehabilitation Research in the Department of Education, this program is intended to stimulate broadly based multidisciplinary research that improves the health, wellbeing, and productivity of older adults. One of the major goals of the Roybal Centers Program is to accelerate the speed at which new and exciting research in the behavioral and social sciences is moved out of the laboratory and into practical tools, programs, and policies that benefit the lives of older adults and help society adjust to an increasingly aging population.

CONCLUSION

These are but a few of the many examples of NIH Team Science activities aimed at advancing the SciTS field, developing tools and resources to facilitate collaboration, and funding team-based research. As

the newly emerging SciTS field builds an evidence base for understanding the keys to successful team-based research, this knowledge is being translated into enhanced strategies for funding agencies, such as NIH, to support team-based research. As NIH continues to strive to support cross-disciplinary team science, and evaluate its outcomes, we anticipate seeing an acceleration of scientific innovation and more rapid progress toward solving our pressing public health challenges.

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