A Conceptual Model to Help Plan, Manage, and Enhance Transdisciplinary Team Science

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The Transdisciplinary Team Science Approach

Transdisciplinary (TD) team science has emerged as a promising approach to address complex scientific questions and real-world problems with mutifactorial causes and influencing factors. The TD team science approach also effectively responds to the increasing specialization and fragmentation of scholarship by reintegrating expertise within a scientific team.

TD team science brings together scholars from multiple disciplines, and translational and community partners, to integrate concepts, theories, methods and translational strategies drawn from their breadth of expertise to address shared research questions. Their work aims not only to synthesize a range of relevant approaches, but also to ***extend*** them to yield innovative methodological applications and scientific findings. By involving translational and community partners, TD team science also aims to generate findings with added practical relevance to solving real-world problems.

In order to be successful in the TD approach, investigators need guidance specifying how to plan for, develop, and implement the TD approach. This is particularly the case because undergraduate and graduate scientific training continues to consist primarily of discipline-based education, with an emphasis on contributing to disciplinary methods and knowledge.

The Need: A Comprehensive Conceptual Model for TD Team Science

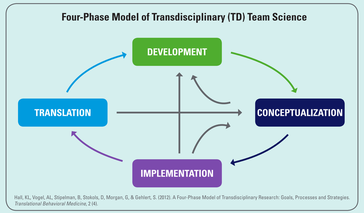
A growing body of empirical literature is generating findings with important practical relevance to engaging in successful TD team-based approaches. Created by scholars in fields ranging from Communications to Management to Public Health, this literature identifies key factors at the levels of the individual, team, organization, etc., that influence the processes and outcomes of teams. But there is a need for a comprehensive conceptual model that synthesizes this literature and translates it into practical guidelines for TD team science. This poster presents such a model.

The Four-Phase Model of TD Team Science

Developed by the National Cancer Institute's (NCI) Science of Team Science team and collaborators, the ***Four-Phase Model of TD Team-Based Research*** describes a sequential process for engaging in TD team science, and identifies key team processes and scientific benchmarks along the way.

It includes four generally sequential phases—***development, conceptualization, implementation, and translation***—with the processes and outcomes of each phase influencing the subsequent phases. But there may be recursive loops, as well, as depicted in the figure. For example, insights about new research directions or translational applications that emerge during the second through fourth phases may lead to mid-project changes in the composition of a TD team in order to bring in additional areas of expertise.

The four-phase model can be used as a "roadmap" to guide effective TD team science, or to inform improvement oriented evaluation during an ongoing TD team science endeavor. Ultimately, it can help to support enhanced achievement of scientific and translational goals.



Applying the Model: A Case Study of Success, and Related Practical Resources

In this poster, we present the four-phase model, and use it to explore the experiences of a successful TD team science initiative—the Center for Interdisciplinary Health Disparities Research (CIHDR) at the University of Chicago. This case study highlights real-world examples of the successful team processes and scientific benchmarks in each phase of the model. We then identify key resources—publicly available in the Team Science Toolkit website—that can be used by TD teams as they progress through the four-phase model.

CIHDR was a highly successful TD research initiative supported by the National Institutes of Health (NIH), Centers for Population Health and Health Disparities (CPHHD) initiative, from 2003-2008. The CPHHD initiative responded to an NIH strategic priority to address disparities and inequities in the prevalence and outcomes of cancer and heart disease. It funded research centers that used TD multi-level team-based approaches to address the determinants of health disparities. CPHHD funded eight research centers from 2003-2008, and ten research centers from 2009-2014 (including 3 previously funded and 7 new centers).

The Team Science Toolkit is a web-based one-stop-shop for knowledge, information, and practical resources to support efficient and effective team-based science, developed by the National Cancer Institute. (For more information, visit our poster about the Toolkit.) We identify practical tools and strategies available in the Toolkit to support team processes and scientific benchmarks essential to each phase.

PHASE

DEVELOPMENTAL PHASE

The ***developmental phase*** involves the formation of a group of collaborators who take initial steps toward developing a research collaboration.

Scientific benchmarks are to establish a shared understanding of: (1) the shared scientific problem space—including what concepts fall inside and outside its boundaries, and (2) the group's mission.

Key team processes are: (1) to generate a shared mission and goals, (2) to develop critical awareness, (3) to externalize group cognition, and (4) to develop a group environment of psychological safety.

CONCEPTUALIZATION PHASE

In the ***conceptualization phase***, collaborators work together to formulate a TD research agenda and approach.

Scientific benchmarks are to develop novel research questions or hypotheses, a conceptual framework, and a research design that integrates and extends approaches from the contributing disciplines, fields, and professions.

Key team processes are: (1) to create a shared mental model, (2) to generate shared language, (3) to develop compilational transactive memory, and (4) to develop a TD team orientation.

IMPLEMENTATION PHASE

The ***implementation phase*** involves executing the planned research.

Scientific benchmarks are to launch, conduct, and refine the planned TD research. In addition, this phase may lead to ideas for elaborations, "spin-offs" or translation of the planned research.

Key team processes are: (1) to develop shared understanding of who knows what (compilational transactive memory) who does what (compositional transactive memory), and how things get done (taskwork transactive memory); (2) to engage in conflict management; and (3) to engage in team learning.

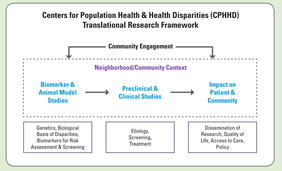
TRANSLATION PHASE

The ***translational phase*** applies research findings to advance progress along the discovery-to-delivery pathway. As the TD team science approach can be used at any level of analysis, from basic science to implementation science, translational activities can occur at any level of analysis.

Key team processes are: (1) to adapt the team, as needed, for translational goals, (2) to generate shared goals for the translational endeavor, and (3) to develop shared understanding of how goals will be pursued.

CIHDR CASE STUDY

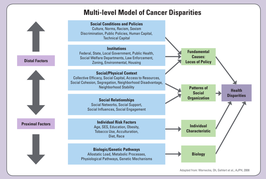
CENTERS FOR POPULATION HEALTH AND HEALTH DISPARITIES CPHHD



An investigator at the University of Chicago called a meeting of two existing research groups at the University—one in pediatric asthma, and one in breast cancer (BC)—that showed interest in health disparities research. It became clear that scholars from a range of disciplines were interested in BC disparities and that their interests complemented one another.

Over a series of conversations, the new group agreed to focus on ***social influences on disparities in BC mortality between African American and white women***—groups that represented the majority of BC patients at the university. They also decided focus on the hospital catchment area of the South Side of Chicago. They had a strong interest in the interacting effects of multi-level factors—not solely social environment—that influenced disparities in BC mortality. They successfully obtained CPHHD support for the CIHDR, to embark on these research activities.

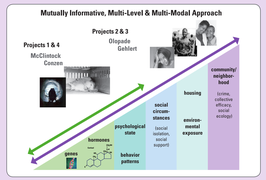
The image to the left depicts the shared problem space developed by the CPHHD initiative.



Investigators in the group had expertise in the social environment, and BC tumor analysis. They wished to develop a research agenda that looked at multi-level influences including: the social/physical context, social relationships, individual risk factors, and biologic/genetic pathways. They recruited a behavioral scientist who studied the interaction of genetics and social environment. They also recruited a molecular biologist who studied physiological pathways.

Together, they honed their research agenda and approach. They would examine the impact of social environment on BC disparities, as mediated by stressful experiences, which were somatized as physiological biomarkers for BC cancer risk (e.g., cortisol levels), as moderated by behaviors (e.g., smoking) and genetic mechanisms. They developed four research projects—using approaches from medicine, epidemiology, social work, psychology, biology, and genetics—to examine these interacting influences on disparities in BC mortality.

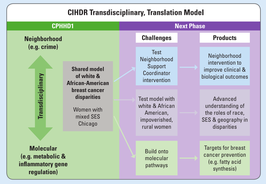
The image to the left depicts the conceptual model of cancer disparities developed by CPHHD supported investigators.



Early in this phase, as leaders of the four research projects described their center to colleagues, they developed their understanding of the scientific content of each project, and how it contributed to the center's overarching research agenda.

Through trial and error, they developed their team work style. They recognized the importance of meetings of all center staff. They instituted a monthly large-group meeting in which each project presented in a given month. Listening to how one another's projects had advanced recreated collaborators' initial enthusiasm. It also helped to build mutual understanding, identify connections among projects, promote team learning, and reinforce TD goals. A focus on shared TD goals helped to diffuse conflict, whereas a natural tendency to regress toward unidisciplinary approaches produced conflicts over resources.

The image to the left depicts the four interacting projects that comprised CIHDR research activities.



Scientist-clinicians and community partners in the research team were driven to make positive change in the community. As it was a challenge to get scientists and community members to the same locations, whenever CIHDR members presented their work to colleagues at the University, they gave the same presentation at the Rainbow PUSH Headquarters about a mile away.

The community audiences pushed the investigators to formulate practical interventions that addressed their findings about the powerful influence of stress on cancer risk biomarkers. This is something that audiences of investigators did not do.

This led the CIHDR team to develop a translational agenda that involved community-based interventions at the neighborhood level that aimed ultimately to improve clinical and biological outcomes. The model was developed with community input. CIHDR then started implementing these interventions.

The image to the left depicts the CIHDR translational model.

TEAM SCIENCE TOOLKIT RESOURCES

Team Science Toolkit
www.teamsciencetoolkit.cancer.gov

Comparing RN Tools

https://www.teamsciencetoolkit.cancer.gov/Public/TSResourceTool.aspx?tid=1&rid=742

This resource compares 46 Research Networking (RN) tools on a variety of metrics, including: how data are imported, systems interoperability, whether they are open source, and where they are currently being used.

toolbox

https://www.teamsciencetoolkit.cancer.gov/public/TSResourceTool.aspx?tid=1&rid=402

The Toolbox Project's facilitated workshops use a structured dialogue process to help members of cross-disciplinary teams build mutual understanding and develop the skills needed for effective communication and collaboration.

National Institutes of Health OMBUDSMAN

www.teamsciencetoolkit.cancer.gov/public/TSResourceTool.aspx?tid=1&rid=53

This "Prenuptial Agreement" for Scientists offers a discussion guide for potential or new collaborators to help them anticipate, discuss, and resolve possible areas of disagreement common to may collaborations.

Collaboration & Team Science: A Field Guide

www.teamsciencetoolkit.cancer.gov/public/TSResourceTool.aspx?tid=1&rid=267

The book-length publication, "Collaboration and Team Science: A Field Guide", provides guidance for key stages in a successful collaboration, including: building a research team, fostering trust, strengthening team processes, and sharing recognition.

Supportive Organizational Context

www.teamsciencetoolkit.cancer.gov/public/TSResourceTool.aspx?tid=1&rid=60

The no-cost online "Team Diagnostics" Survey is structured on Hackman's book, "Leading Teams". Once all team members respond, the website generates a report of the team's strengths and weaknesses. Anonymized data belong to the developers.

COLLABORATION SUCCESS WIZARD

The Collaboration Success Wizard is an online diagnostic survey for geographically distributed teams. It probes factors that may strengthen or weaken collaboration, and provides both personal and project-level reports to help build successful collaborations.

Accelerate
Access CTSI services to enable research

http://www.teamsciencetoolkit.cancer.gov/public/TSResourceTool.aspx?tid=1&rid=750

This web resource created by UCSF helps new and established faculty understand how to engage in alliances with companies, protect their research/publication rights and intellectual property, and avoid conflict of interest when consulting for companies.

Research Integration Using Dialogue Methods

https://www.teamsciencetoolkit.cancer.gov/public/TSResourceTool.aspx?tid=1&rid=1561

The book, "Research Integration Using Dialogue Methods" identifies dialogue methods to support successful communication among researchers and translational partners. It links each dialogue method to a particular task and provides related case studies.

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