The Team Science Toolkit: Enhancing Research Collaboration Through Online Knowledge Sharing

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Enhancing Research Collaboration Through Online Knowledge Sharing

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Introduction

Research teams, ranging from pairs of collaborators to large networks, are becoming the dominant paradigm in knowledge production. Across all research fields, teams now produce more frequently cited and higher impact research than individual authors.[1,2] This trend—known as "team science" or "team-based research"—has emerged as a strategy to address increasingly complex scientific problems, often by applying sophisticated conceptual and methodologic approaches that draw on multiple disciplines, fields, and professions.

Science teams bring together collaborators with a combined set of expertise that is uniquely suited to address particular scientific problems in innovative and effective ways.[3] These specialized teams may be large in size; may include collaborators distributed across geographic space and organizational boundaries and with expertise that spans multiple disciplines, fields, and professions; and may involve academic, community, and translational partners.[4] These complexities contribute to the potential added value of team science (TS) but may increase the number and magnitude of challenges the team must navigate, such as difficulties with group communication and management, conflicts related to epistemologic and methodologic differences, and challenges related to recognition of scholarly contributions.[5,6] These circumstances create an imperative to develop evidence-based strategies to address the challenges that may emerge in TS and facilitate success.

The Science of Team Science (SciTS) field is a rapidly emerging field of study focused on understanding and enhancing the processes and outcomes of TS and mitigating challenges. It aims to develop fundamental knowledge about TS and translate that knowledge into evidence-based strategies for success. To accomplish these goals, the field considers a wide range of multi-level influences on TS including intra- and inter-personal competencies for TS (e.g., attitudes and skills that support disciplinary integration and teamwork); team processes (e.g., development of a shared mission and goals, and shared understanding of each team member's knowledge and role); institutional policies and infrastructure (e.g., hiring and promotion policies and data management systems); and broader influences (e.g., availability of funding opportunities and publishing venues for products of cross-disciplinary team collaboration).[7]

The SciTS knowledge base has been enriched by contributions from psychology, management, communication, public health, computer science, and other disciplines and fields, as well as contributions from TS stakeholders such as investigators who have developed practical tools to enhance team processes and administrators who have developed policies to facilitate TS at their institutions.[8–13] Accessing the complete SciTS knowledge base has been a challenge, however, as conferences and journals typically reflect the boundaries around disciplines and fields, and there are limited opportunities for disseminating practical tools and strategies for TS. Overcoming these barriers is essential to unifying and advancing the SciTS field and expanding the availability of evidence-based tools and strategies for conducting, managing, facilitating, and supporting TS.

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0749-3797/$36.00
http://dx.doi.org/10.1016/j.amepre.2013.09.001

The Team Science Toolkit

Responding to the need for better knowledge dissemination and integration in the SciTS field, the National Cancer Institute's (NCI) SciTS Team developed the Team Science Toolkit (www.teamsciencetoolkit.cancer.gov). The Toolkit is an online knowledge management system that collects and integrates TS knowledge and resources and makes them readily accessible to the public. Capitalizing on the collective knowledge of the TS community, the Toolkit allows any user to upload publicly accessible materials. Given the SciTS field's rapid development, this user driven model creates and maintains a continuously evolving database of knowledge and resources. (Contributions are not vetted or approved by the NCI, and thereby, inclusion of a resource in the Toolkit does not imply endorsement by the NCI.) As of this publication, the Toolkit contains more than 800 resources.

The Toolkit's resources address the interests of a wide range of TS stakeholders, such as investigators and community and translational partners; administrators at academic institutions, businesses, and other organizations; funding agency staff; SciTS scholars and evaluators; and those seeking to learn more about TS and the SciTS field. The Toolkit contains three main types of resources: (1) practical tools to enhance, support, or facilitate TS; (2) measures and methods for studying or evaluating TS; and (3) TS-relevant publications and bibliographic citations, including scholarly publications and gray literature (e.g., unpublished technical reports).

Additional resources in the Toolkit include background on the SciTS field and a list of key SciTS resources that is periodically updated by the Toolkit's editorial board. Resources are organized by a set of common TS-related goals, including: learn about TS, form new collaborations and teams, lead and manage teams, engage translational and community partners, work in virtual teams, enhance team performance, bridge disciplinary and professional differences, provide institutional support, access or provide training and education in TS, support TS through funding opportunities, and evaluate or study TS processes and outcomes.

Users interact with the Toolkit via three main functions: Discover, Contribute, and Connect. The Discover function enables users to search the Toolkit for resources. Users may browse by type of resource or TS-related goal, search by keyword, or conduct advanced searches for multiple types of resources relevant to multiple goals. The Contribute function enables users to upload new resources to the Toolkit. Users can also comment on resources already in the Toolkit. The Connect function offers ways to connect with other Toolkit users, including blog posts by TS experts, a user-generated directory of TS experts, a TS listserv, and bulletin boards for user-generated news and events.

SIDEBAR 1

Leveraging the team science toolkit's resources

A federal funding agency is interested in TS as a strategy to foster the integration of multiple disciplinary approaches to address a scientific priority area. Agency staff members aim to develop a funding opportunity announcement (FOA) specifying collaboration plan components for investigators to include in their applications. They search the Toolkit for relevant resources and find a federal trans-agency report on collaboration planning.[14] They use this document to help identify components to include in the collaboration plan and criteria to consider during application review.

After the FOA is released, a principal investigator (PI) identifies it as an opportunity to expand her research program in novel directions. To write the collaboration planning section of her application, the PI searches the Toolkit and finds a discussion guide for new collaborators,[15] an operating manual for collaborations,[16] a resource for facilitating discussions among diverse team members,[17] and a self-assessment tool to help enhance team processes.[18] The PI also determines that her team would benefit from training in interdisciplinary TS competencies and proposes that prospective team members participate in training based on resources in the Toolkit.[19,20]

To help evaluate the success of the collaboration, the PI identifies a consultant through the Toolkit's expert directory. The consultant, a SciTS scholar, uses the Toolkit to identify published studies that explore issues of transdisciplinary integration,[21] cross-institutional collaboration,[22] and improvement-oriented evaluation[23] in similar initiatives. He also finds measures tested in prior studies that can be adapted for the evaluation, including a measure of collaboration readiness,[24] and measures and criteria for evaluating interdisciplinarity.[25]

After successfully obtaining grant funding, the PI's co-investigators express concerns about whether they can obtain adequate recognition for scholarly contributions within a team. They raise these concerns with their Dean, who searches the Toolkit and finds articles describing current trends in promotion and tenure (P&T) policies as relevant to TS[26] and P&T policy language recognizing TS from a similar institution.[27] The Dean uses these resources to work within the institution to make changes to P&T review guidelines.

The narrative in Sidebar 1 provides examples of how users can leverage the Toolkit's resources to support a variety of TS goals.

Conclusion

The Team Science Toolkit is a dynamic online "one-stop-shop" that consolidates and provides easy access to knowledge, practical tools, and strategies for TS. The Toolkit addresses key barriers to advancing TS and the SciTS field that result from the challenges of knowledge dissemination among a diverse and dispersed set of stakeholders. With engagement from investigators and their research partners, administrators, funding agency staff, and SciTS scholars and evaluators, the Toolkit

has the potential to reduce unnecessary replication of SciTS research and practical TS tools; stimulate innovation by enabling cross-fertilization among the many disciplines, fields, professions, and stakeholder groups contributing to the SciTS knowledge base; and highlight gaps in knowledge that point to future directions for the SciTS field. The Toolkit thereby can help to enhance the efficiency and effectiveness of TS, ultimately helping to maximize the scientific and translational benefits of TS initiatives.

The Team Science Toolkit is an initiative of the Behavioral Research Program within the Division of Cancer Control and Population Sciences of the National Cancer Institute. Additional support is provided by the Office of Behavioral and Social Science Research of the NIH. The authors gratefully acknowledge David Garner, Elliot Grant, and Sophia Tsakraklides of Westat for their contributions to the development, implementation, and maintenance of the Team Science Toolkit. This work was supported by contract No. HHSN2612012000281. This project has been funded in whole or in part with federal funds from the National Cancer Institute, NIH, under contract No. HHSN261200800001E. The content of this publication does not necessarily reflect the views or policies of the USDHHS, nor does mention of trade names, commercial products, or organizations imply endorsement by the U.S. Government.

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

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