1. (2010). "Second Annual International Science of Team Science (SciTS) Conference." from http://scienceofteamscience.northwestern.edu/sites/default/files/SciTS%20Conference%20Overview%202011.pdf (for the preliminary notice of the conference) http://scienceofteamscience.northwestern.edu (for Science of Team Science web site from Northwestern U.)**.**

2. Adler, N. E. and J. Stewart (2010). "Using team science to address health disparities: MacArthur network as case example." Annals of the New York Academy of Sciences **1186**(The Biology of Disadvantage: Socioeconomic Status and Health): 252-260.

   In this paper, the director and the administrator of the MacArthur Network on Socioeconomic Status and Health reflect on the evolution of the network. Against the backdrop of the science of "team science," they describe the history and process of the network including the forging of a group agenda, the development of a creative, productive group working style, and the outcomes arising from these processes.

3. Bennett, L. M., H. Gadlin, et al. (2010). Collaboration and Team Science: A Field Guide. Bethesda, MD, National Institutes of Health. **April 2010**.

   Over the last decade, there has been a surge of interest and investment in multi- and interdisciplinary team science programs from public agencies and private organizations alike. Today it is widely accepted that “collaborations become necessary whenever researchers wish to take their research programs in new directions” (Macrina, 1995). As a result, innovations and advances that were not possible within one laboratory working in isolation are now emerging from collaborations and research teams that have harnessed techniques, approaches, and perspectives from multiple scientific disciplines and therapeutic areas. Team science has been described as a collaborative and often cross-disciplinary approach to scientific inquiry that draws researchers who otherwise work independently or as coinvestigators on smaller-scale projects into collaborative centers and groups.

4. Falk-Krzesinski, H. J., K. Börner, et al. (2010). "Advancing the Science of Team Science." Clinical and Translational Sciences **3**(5): 263-266.

   In an effort to enhance the understanding of how best to engage in team science to promote collaborative translational research and meet society’s needs, the First Annual International Science of Team Science (SciTS) Conference was convened on April 22-24, 2010 in Chicago, Illinois. The event was produced by Research Team Support (RTS) of the Northwestern University Clinical and Translational Sciences (NUCATS) Institute, in partnership with the NIH National Cancer Institute, Division of Cancer Control and Population Sciences and the Lambert Family Communication Conference of the School of Communication at Northwestern University. A Program Conference Committee of twelve renowned investigators in SciTS served as advisors.

5. Finholt, T. A. and G. M. Olson (1997). "From laboratories to collaboratories: A new organizational form for scientific collaboration." Psychological Science **8**(1): 28-36.

   This article explores the potential impact of collaboratories on psychology. A collaboratory is a computer-supported system that allows scientists to work with each other, facilities, and databases without regard to geographical location. The impact of collaboratories is discussed in terms of

changes in the organization and practice of scientific work as this work moves from physical to virtual settings. Examination of prototype collaboratories in the physical sciences shows that use of collaborateries produces changes through improved access to scarce resources, support for joint work among distant colleagues, and opportunities for broader participation in research by students. Similar results in psychology are predicted if psychologists exploit collaboratories' capabilities to design new ways of conducting research, rather than adopting collaboratory technology as an extension of the status quo.

6. Fuqua, J., D. Stokols, et al. (2004). "Critical issues in the study of transdisciplinary scientific collaboration." Subst Use Misuse **39**(10-12): 2073-2074.

7. Fuqua, J., D. Stokols, et al. (2004). "Transdisciplinary collaboration as a basis for enhancing the science and prevention of Substance use and "Abuse"." Subst Use Misuse **39**(10-12): 1457-1514.

   Transdisciplinary scientific collaborations (TDSCs) have the potential to strengthen substance use and misuse research and prevention. Despite its growing prominence as a mode for scientific research, research on TDSC remains in a nascent form and its value to the field of substance use and misuse merits further exploration. The overarching purpose of this article is to examine the potential contributions of transdisciplinary science to research and prevention using conceptualizations, methods, and evidence from a case study of two university-based research centers. The article provides (a) a discussion of the societal context and historical developments that have prompted increasing interest in TDSC; (b) a definition and conceptualization of TDSC; (c) a methodological approach for studying TDSC; (d) initial findings from the case study that reflect instances of transdisciplinary intellectual integration and it examines implications of these methods and findings for future research and policy development relevant to substance use and misuse.

8. Guimerà, R., B. Uzzi, et al. (2005). "Team Assembly Mechanisms Determine Collaboration Network Structure and Team Performance." Science **308**: 697-702.

   Agents in creative enterprises are embedded in networks that inspire, support, and evaluate their work. Here, we investigate how the mechanisms by which creative teams self-assemble determine the structure of these collaboration networks. We propose a model for the self-assembly of creative teams that has its basis in three parameters: team size, the fraction of newcomers in new productions, and the tendency of incumbents to repeat previous collaborations. The model suggests that the emergence of a large connected community of practitioners can be described as a phase transition. We find that team assembly mechanisms determine both the structure of the collaboration network and team performance for teams derived from both artistic and scientific fields.

9. Hall, K. L., A. X. Feng, et al. (2008). "Moving the science of team science forward: collaboration and creativity." American Journal of Preventive Medicine **35**(2 Suppl): S243-249.

   Teams of scientists representing diverse disciplines are often brought together for purposes of better understanding and, ultimately, resolving urgent public health and environmental problems. Likewise, the emerging field of the science of team science draws on diverse disciplinary perspectives to better understand and enhance the processes and outcomes of scientific collaboration. In this supplement to the American Journal of Preventive Medicine, leading scholars in the nascent field of team science have come together with a common goal of advancing the field

with new models, methods, and measures. This summary article highlights key themes reflected in the supplement and identifies several promising directions for future research organized around the following broad challenges: (1) operationalizing cross-disciplinary team science and training more clearly; (2) conceptualizing the multiple dimensions of readiness for team science; (3) ensuring the sustainability of transdisciplinary team science; (4) developing more effective models and strategies for training transdisciplinary scientists; (5) creating and validating improved models, methods, and measures for evaluating team science; and (6) fostering transdisciplinary cross-sector partnerships. A call to action is made to leaders from the research, funding, and practice sectors to embrace strategies of creativity and innovation in a collective effort to move the field forward, which may not only advance the science of team science but, ultimately, public health science and practice.

10. Hall, K. L., D. Stokols, et al. (2008). "The Collaboration Readiness of Transdisciplinary Research Teams and Centers: Findings from the National Cancer Institute's TREC Year-One Evaluation Study." American Journal of Preventive Medicine **35**(2, Supplement 1): S161-S172.

    Growing interest in promoting cross-disciplinary collaboration among health scientists has prompted several federal agencies, including the NIH, to establish large, multicenter initiatives intended to foster collaborative research and training. In order to assess whether these initiatives are effective in promoting scientific collaboration that ultimately results in public health improvements, it is necessary to develop new strategies for evaluating research processes and products as well as the longer-term societal outcomes associated with these programs. Ideally, evaluative measures should be administered over the entire course of large initiatives, including their near-term and later phases. The present study focuses on the development of new tools for assessing the readiness for collaboration among health scientists at the outset (during the first year) of their participation in the National Cancer Institute's Transdisciplinary Research on Energetics and Cancer (TREC) initiative. Indexes of collaborative readiness, along with additional measures of near-term collaborative processes, were administered as part of the TREC Year-One evaluation survey. Additionally, early progress toward scientific collaboration and integration was assessed, using a protocol for evaluating written research products. Results from the Year-One survey and the ratings of written products provide evidence of cross-disciplinary collaboration among participants during the first year of the initiative, and also reveal opportunities for enhancing collaborative processes and outcomes during subsequent phases of the project. The implications of these findings for future evaluations of team science initiatives are discussed.

11. Jones, B. F., S. Wuchty, et al. (2008). "Multi-University Research Teams: Shifting Impact, Geography, and Stratification in Science." Science **322**(5905): 1259-1262.

    This paper demonstrates that teamwork in science increasingly spans university boundaries, a dramatic shift in knowledge production that generalizes across virtually all fields of science, engineering, and social science. Moreover, elite universities play a dominant role in this shift. By examining 4.2 million papers published over three decades, we found that multi- university collaborations (i) are the fastest growing type of authorship structure, (ii) produce the highest-impact papers when they include a top-tier university, and (iii) are increasingly stratified by in-group university rank. Despite the rising frequency of research that crosses university boundaries, the intensification of social stratification in multi- university collaborations suggests a concentration of the production of scientific knowledge in fewer rather than more centers of high- impact science.

12. Kessel, F. and P. L. Rosenfield (2008). "Toward Transdisciplinary Research: Historical and Contemporary Perspectives." American Journal of Preventive Medicine **35**(2, Supplement 1): S225-S234.

    Over the past two decades a variety of national and international efforts has sought to bring together health and social scientists to address complex health issues. This paper reviews how the notion of transdisciplinary research has emerged; discusses research programs that have successfully traversed discipline boundaries in sustained fashion; considers facilitating and constraining factors that have emerged from the analyses of this process; and suggests next steps for conceptualizing, organizing, and assessing transdisciplinary research based on the notion of heterarchy.

13. Keyton, J., D. J. Ford, et al. (2008). "A mesolevel communicative model of collaboration." Communication Theory **18**(3): 376-406.

    Generally theorized and empirically examined as an organization phenomenon, collaboration may be more productively explored from a mesolevel model that simultaneously addresses group, organizational, and public frames. Examining how individuals communicate in those frames revealed four discursive productions of collaboration, which were previously undertheorized. Thus, we propose a communicative model that details the simultaneously occurring communication at multiple levels that gives rise to the emergence and effectiveness of collaborating talk. In this model, communication is no longer described as one of the component(s) of collaboration; communication is elevated to the essence of collaboration. Working from observations and records of a 9-month interorganizational collaboration, this article develops a mesolevel communicative model of collaboration and demonstrates that the bulk of collaborative communication occurs at the team level-indeed, the level where relationships among individuals and organizations is revealed and acted upon.

14. Mâsse, L. C., R. P. Moser, et al. (2008). "Measuring Collaboration and Transdisciplinary Integration in Team Science." American Journal of Preventive Medicine **35**(2, Supplement 1): S151-S160.

    PURPOSE: As the science of team science evolves, the development of measures that assess important processes related to working in transdisciplinary teams is critical. Therefore, the purpose of this paper is to present the psychometric properties of scales measuring collaborative processes and transdisciplinary integration.

    METHODS: Two hundred-sixteen researchers and research staff participating in the Transdisciplinary Tobacco Use Research Centers (TTURC) Initiative completed the TTURC researcher survey. Confirmatory-factor analyses were used to verify the hypothesized factor structures. Descriptive data pertinent to these scales and their associations with other constructs were included to further examine the properties of the scales.

    RESULTS: Overall, the hypothesized-factor structures, with some minor modifications, were validated. A total of four scales were developed, three to assess collaborative processes (satisfaction with the collaboration, impact of collaboration, trust and respect) and one to assess transdisciplinary integration. All scales were found to have adequate internal consistency (i.e., Cronbach alpha's were all >0.70); were correlated with intermediate markers of collaborations (e.g., the collaboration and transdisciplinary-integration scales were positively associated with the

perception of a center's making good progress in creating new methods, new science and models, and new interventions); and showed some ability to detect group differences.

CONCLUSIONS: This paper provides valid tools that can be utilized to examine the underlying processes of team science--an important step toward advancing the science of team science.

15. Newman, M. E. J. (2001). "The structure of scientific collaboration networks." Proceedings of the National Academy of Sciences of the United States of America **98**(2): 404-409.

    The structure of scientific collaboration networks is investigated. Two scientists are considered connected if they have authored a paper together and explicit networks of such connections are constructed by using data drawn from a number of databases, including MEDLINE (biomedical research), the Los Alamos e-Print Archive (physics), and NCSTRL (computer science). I show that these collaboration networks form "small worlds," in which randomly chosen pairs of scientists are typically separated by only a short path of intermediate acquaintances. I further give results for mean and distribution of numbers of collaborators of authors, demonstrate the presence of clustering in the networks, and highlight a number of apparent differences in the patterns of collaboration between the fields studied.

16. Olson, G. M. and J. S. Olson (2000). "Distance Matters." Human-Computer Interaction **15**: 139-178.

    Giant strides in information technology at the turn of the century may have unleashed unreachable goals. With the invention of groupware, people expect to communicate easily with each other and accomplish difficult work even though they are remotely located or rarely overlap in time. Major corporations launch global teams, expecting that technology will make "virtual collocation" possible. Federal research money encourages global science through the establishment of "collaboratories. " We review over 10 years of field and laboratory investigations of collocated and noncollocated synchronous group collaborations. In particular, we compare collocated work with remote work as it is possible today and comment on the promise of remote work tomorrow. We focus on the sociotechnical conditions required for effective distance work and bring together the results with four key concepts: common ground, coupling of work, collaboration readiness, and collaboration technology readiness. Groups with high common ground and loosely coupled work, with readiness both for collaboration and collaboration technology, have a chance at succeeding with remote work. Deviations from each of these create strain on the relationships among teammates and require changes in the work or processes of collaboration to succeed. Often they do not succeed because distance still matters.

17. Olson, G. M., A. Zimmerman, et al. (2008). Scientific collaboration on the Internet. Cambridge, Mass., MIT Press.

18. Olson, J. S., E. C. Hofer, et al. (2008). A theory of remote scientific collaboration (TORSC). Scientific collaboration on the Internet. G. M. Olson, A. Zimmerman and N. Bos. Cambridge, MA, MIT Press.

19. Rosenfield, P. L. (1992). "The potential of transdisciplinary research for sustaining and extending linkages between the health and social sciences." Social Science & Medicine **35**(11): 1343-1357.

    The last decade of the twentieth century is witnessing a profusion of projects drawing together social and health scientists to study and recommend solutions for a wide range of health problems.

The process--practices in both developed and developing countries--is usually called multidisciplinary or interdisciplinary research. Its historical precedents are briefly reviewed in this paper along with the types of problems addressed. From a review and discussion of a sample of projects selected from two major proponents of this approach to research, the Social and Economic Research Component of the UNDP/World Bank/WHO Special Programme for Research and Training in Tropical Diseases and the Applied Diarrheal Disease Research Project, conclusions are drawn about the nature of contributions from such efforts--very useful for short-term problem solving, less so for longer-term programmatic changes, especially beyond the health sector, and even more limited in impact on theory building for coping with the changing human condition. The recognition of such limitations is now widespread in the social and natural sciences beyond the health sector, in population, ecology, and the humanities. Following these observations, I argue for a new approach to transcend the disciplinary bounds inherent in multi-and interdisciplinary research. A transdisciplinary approach can provide a systematic, comprehensive theoretical framework for the definition and analysis of the social, economic, political, environmental, and institutional factors influencing human health and well-being. The academic and career challenges for such researchers, while considerable, may be overcome since there is now flexibility in research-supporting organizations to encourage new ideas in international health, such as that of essential national health research.

20. Stokols, D. (2006). "Toward a Science of Transdisciplinary Action Research." American Journal of Community Psychology **38**: 63-77.

    This paper offers a conceptual framework for establishing a science of transdisciplinary action research. Lewin's (1951) concept of action research highlights the scientific and societal value of translating psychological research into community problem-solving strategies. Implicit in Lewin's formulation is the importance of achieving effective collaboration among behavioral researchers, community members and policy makers. The present analysis builds on Lewin's analysis by outlining programmatic directions for the scientific study of transdisciplinary research and community action. Three types of collaboration, and the contextual circumstances that facilitate or hinder them, are examined: (1) collaboration among scholars representing different disciplines; (2) collaboration among researchers from multiple fields and community practitioners representing diverse professional and lay perspectives; and (3) collaboration among community organizations across local, state, national, and international levels. In the present analysis, transdisciplinary action research is viewed as a topic of scientific study in its own right to achieve a more complete understanding of prior collaborations and to identify strategies for refining and sustaining future collaborations (and their intended outcomes) among researchers, community members and organizations.

21. Stokols, D., K. L. Hall, et al. (2008). "The science of team science: overview of the field and introduction to the supplement." American Journal of Preventive Medicine **35**(2 Suppl): S77-89.

    The science of team science encompasses an amalgam of conceptual and methodologic strategies aimed at understanding and enhancing the outcomes of large-scale collaborative research and training programs. This field has emerged rapidly in recent years, largely in response to growing concerns about the cost effectiveness of public- and private-sector investments in team-based science and training initiatives. The distinctive boundaries and substantive concerns of this field, however, have remained difficult to discern. An important challenge for the field is to characterize

the science of team science more clearly in terms of its major theoretical, methodologic, and translational concerns. The articles in this supplement address this challenge, especially in the context of designing, implementing, and evaluating cross-disciplinary research initiatives. This introductory article summarizes the major goals and organizing themes of the supplement, draws links between the constituent articles, and identifies new areas of study within the science of team science.

22. Stokols, D., R. Harvey, et al. (2005). "In vivo studies of transdisciplinary scientific collaboration: Lessons learned and implications for active living research." American Journal of Preventive Medicine **28**(2, Supplement 2): 202-213.

    The past 2 decades have witnessed a surge of interest and investment in transdisciplinary research teams and centers. Only recently, however, have efforts been made to evaluate the collaborative processes and scientific and public policy outcomes of these endeavors. This paper offers a conceptual framework for understanding and evaluating transdisciplinary research, and describes a large-scale national initiative, the National Institutes of Health Transdisciplinary Tobacco Use Research Centers (TTURCs) program, undertaken to promote cross-disciplinary scientific collaboration in the field of tobacco use science and prevention. A 5-year evaluation of collaborative processes and outcomes observed across multiple TTURC centers conducted during 1999 to 2004 is described. The findings highlight key contextual circumstances faced by participating centers (i.e., the breadth of disciplines and departments represented by each center, the extent to which members had worked together on prior projects, spatial proximity among researchers' offices, and frequency of their face-to-face interaction) that influenced their readiness for collaboration and prompted them to follow different pathways toward transdisciplinary integration. Implications of these findings for developing and evaluating future transdisciplinary research initiatives in the field of active living research are discussed.

23. Stokols, D., S. Misra, et al. (2008). "The Ecology of Team Science: Understanding Contextual Influences on Transdisciplinary Collaboration." American Journal of Preventive Medicine **35**(2, Supplement 1): S96-S115.

    Increased public and private investments in large-scale team science initiatives over the past two decades have underscored the need to better understand how contextual factors influence the effectiveness of transdisciplinary scientific collaboration. Toward that goal, the findings from four distinct areas of research on team performance and collaboration are reviewed: (1) social psychological and management research on the effectiveness of teams in organizational and institutional settings; (2) studies of cyber-infrastructures (i.e., computer-based infrastructures) designed to support transdisciplinary collaboration across remote research sites; (3) investigations of community-based coalitions for health promotion; and (4) studies focusing directly on the antecedents, processes, and outcomes of scientific collaboration within transdisciplinary research centers and training programs. The empirical literature within these four domains reveals several contextual circumstances that either facilitate or hinder team performance and collaboration. A typology of contextual influences on transdisciplinary collaboration is proposed as a basis for deriving practical guidelines for designing, managing, and evaluating successful team science initiatives.

24. Uzzi, B. and J. Spiro (2005). "Collaboration and creativity: The small world problem." American Journal of Sociology **111**(2): 447-504.

    Small world networks have received disproportionate notice in diverse fields because of their suspected effect on system dynamics. The authors analyzed the small world network of the creative artists who made Broadway musicals from 1945 to 1989. Using original arguments, new statistical methods, and tests of construct validity, they found that the varying "small world" properties of the systemic-level network of these artists affected their creativity in terms of the financial and artistic performance of the musicals they produced. The small world network effect was parabolic; performance increased up to a threshold, after which point the positive effects reversed.