Fostering Success in Transdisciplinary Team Science: Lessons Learned from TREC 1 Participants

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OUTLINE

- The Challenge: Fostering transdisciplinary (TD) integration among obesity researchers and cancer researchers
- The Response: NCI TREC initiative
- Lessons Learned from TREC 1 Grantees related to pursuing TD integration --
  - Challenges
  - Facilitating Factors and Strategies for Success
  - Impacts
- Practical tools and strategies to facilitate team-based TD research
CHALLENGE: OVERCOMING SILOS AND STAGNATION IN RESEARCH

And many, many more silos – management science, communications, sociology, molecular biology, etc., etc. ...
Interventions to Foster Integration: Transdisciplinary (TD) Center Initiatives

- Transdisciplinary Research on Energetics and Cancer (TREC) U54 - $74,811,868
- Centers of Excellence in Cancer Communication Research (CECCR) P50 & P20 - $83,880,445
- Centers for Population Health and Health Disparities (CPHHD) P50 - $66,298,321
- Transdisciplinary Tobacco Use Research Centers (TTURC) P50 - $68,995,753
While TD research is the ideal, due to multiple constraints (e.g. P&T policies, disciplinary silos, data harmonization challenges) and varying degrees of scientific readiness of different areas of research...

UD, MD, ID, and TD forms of research typically occur in varying degrees and at different times within and across initiatives.

Success = increased integration, scientific value-add.
TREC 1 Initiative – Transdisciplinary Research in Energetics and Cancer

• **Purpose:** To foster the TD integration of social, behavioral, and biological sciences to address the intersection of obesity, physical inactivity, poor diet, and cancer prevention

• **Example:** How do physical activity, hormonal levels, metabolic factors, and body mass index interact to impact biomarkers for cancer in women?

• **5 year initiative,** 2005-2010, $54 million total funding (refunded with new cohort, 2011-2016, “TREC2”)

• **4 research centers, 1 coordination center**
  Case Western Reserve University
  University of Minnesota
  University of Southern California
  Fred Hutchinson Cancer Research Center (also served as coordination center)
TREC 1 Initiative – Support for TD Science

• At each center:
  • Center Director
  • 3 - 5 TD “primary research projects”, each at a different level of science (e.g. public health, clinical, animal model), akin to R01s
  • “Cores” to provide integrated support for: biostatistics, TD training

• Opportunities for new TD research within /across centers:
  • Semi-annual grantee scientific meetings
  • Annually, funds for developmental pilot projects (1 year grants)
  • Cross-center working groups (e.g. Nutrition Assessment; Molecular Pathways; Environment; Biomarkers)

• Training opportunities within and across centers

• Coordination center supporting cross-center collaboration, training, and meetings
STUDY OF “LESSONS LEARNED” AMONG TREC 1 GRANTEES

- Goal: Document “lessons learned”, including --
  - Challenges of working toward TD research in energetics and cancer
  - Facilitating factors and strategies for success
  - Impacts of participation in TREC 1

<table>
<thead>
<tr>
<th>One-on-one semi-structured interviews with 31 TREC 1 grantees</th>
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<tbody>
<tr>
<td>Research Center Directors</td>
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<tr>
<td>Primary Research Project PIs</td>
</tr>
<tr>
<td>Developmental Project PIs</td>
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<tr>
<td>Biostatistics Core Staff</td>
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<tr>
<td>Training Core Directors</td>
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<tr>
<td>Trainees</td>
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<tr>
<td>Coordination Center Staff Members</td>
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- Does not sum to 31 because some individuals held multiple roles

- Interviews transcribed, content analysis, NVIVO9 QDM software
CHALLENGES

- Conceptual and scientific challenges –
  - TD research “stretches” investigators, forcing them out of their “comfort zones”
  - Lack of clarity about “what TD is” and “how you get there”
  - TD research is more complex – more variables, assays, larger sample size, multiple endpoints

- Disconnects between different disciplinary cultures –
  - Values – e.g., what are considered “good” research questions, variables, methods?
  - Terminology
  - Work styles (team vs. individual work, publishing), methods
Challenges

- **Management challenges** –
  - More *scientific complexity* created more potential for novel and holistic findings, but research was more time consuming and expensive
  - **Large teams** with varied expertise created more opportunities for innovation, but posed challenges for project planning, management, speed
  - **Cross-institutional (distance)** posed challenges for communication, which slowed the research process. Also created challenges for data harmonization – e.g., ways of collecting/storing data, related work processes such as laboratory contracts.
CHALLENGES

- Academic incentive and recognition systems slow to evolve –
  - Lack of systems for cross-departmental, cross-school collaborations
  - P&T review processes may not adequately recognize team collaboration
  - Unclear where to publish TD work, limited funding opportunities
  - Colleagues unfamiliar with TD research influence multiple areas of career advancement – IRB, grant application review, manuscript review
Facilitating Factors and Strategies for Success: Individual and Team Level

- **A “TD Ethic”**
  - “Critical awareness” of the strengths and weaknesses of one’s own discipline and all disciplines
  - Belief in the added scientific value of TD research & teamwork
  - “Openness” to exploring other areas of science – feeling “enriched” by this approach

- **Team Processes**
  - Articulating concrete shared goals (grants, papers)
  - Developing mutual understanding of one another’s disciplinary values, via frequent communication & “teaching” opportunities
  - History of effective collaboration, “chemistry”
FACILITATING FACTORS AND STRATEGIES FOR SUCCESS: TREC CHARACTERISTICS AND CENTER MEMBERS

- **TREC Characteristics**
  - **Funding agency expectations** for TD integration – FOA and throughout the funding period
  - **TREC structure supported new collaborations** – semi-annual meetings, cross-center working groups, DPPs, cross-center training opportunities

- **Center Members**
  - **Center directors and senior investigators** created environment conducive to TD collaboration –
    - Created vision via center level meetings, were “matchmakers” among potential collaborators, championed TD at institution, obtained resources for TD research
  - **Biostatistics core staff** bridged disciplinary approaches, collaborators
  - **Trainees** introduced innovations, bridged projects within and across centers
FACILITATING FACTORS AND STRATEGIES FOR SUCCESS: CROSS-CENTER COLLABORATION

- **Motivation** - To address the challenges of cross-institutional partnerships, the benefits should outweigh the costs of changing the way you “do business”
  - Benefits – scientific goals that can best be addressed collaboratively
  - Costs -- learning curve, uncertainty, effort, time, money

- **Interaction** - to facilitate cross-center collaboration
  - Regularly scheduled interaction – takes time to develop shared goals and plans for moving forward
  - Face-to-face meetings
  - Both informal and formal sharing of information
Training: Strategies for Success
TRAINING STRATEGIES FOR SUCCESS: Support for Trainees at the TREC 1 Initiative Level

- Involvement of trainees in TREC 1 mechanisms to support new TD research collaborations (not specific to trainees) fostered professional development
  - Semi-annual scientific meetings and conferences
  - Cross-center Working Groups
  - Developmental Pilot Projects (DPPs)

- Results
  - Advanced education in energetics and cancer
  - Created opportunities for networking and mentoring within and across centers
  - One-year DPPs provided “on the job training” in key research skills – from start to finish (grant writing to publishing)
TRAINING STRATEGIES FOR SUCCESS:
Support for Trainees at the TREC 1 Initiative Level

- TREC 1 support specifically for trainees -- DPPs, KEEP funds -- helped trainees create new collaborations and develop new research avenues -- ultimately making valuable research contributions
  - Both senior and junior scientists reported that trainees drove a great deal of new TD research via DPPs
  - Trainees created “bridges” among more senior scientists within and across centers, e.g. working at the intersection of senior scientists’ areas of expertise
  - Trainees created fruitful collaborations with other trainees across research centers -- DPPs, R03s
TRAINING STRATEGIES FOR SUCCESS: Support for Trainees at the Center Level

- Integrating trainees into center-level meetings created educational and networking opportunities

- Mentoring: Center directors brokered collaborations involving trainees; mentors encouraged trainees to write grant app’s, reach out to TREC 1 investigators at other institutions; being part of a research team provided real-world learning opportunities in TD research

- Funds provided to trainees (at some centers) supported research expenses, training, and travel

- Trainings, courses, journal clubs, and symposia helped trainees develop TD skills and general career skills, and elaborate research ideas in supportive environment
Impacts of Participating in TREC 1 Initiative

- Reinforced TD Ethic, Approaches
- New Boundary-Crossing Collaborations
- Scientific Progress
- Institutional Culture Change, Resource Development
- Career Development, Advancement
IMPACTS OF PARTICIPATING IN TREC 1

- Reinforced TD ethic and approach, decrease in specialization
  - Willingness to continue learning in other areas of science and apply concepts, theories and methods from other disciplines
  - “Transformed” their attitudes about TD research, their research approach
  - Plans to use TD approach in future research

- Established new boundary-crossing collaborations

- Greater support for TD research at institution: culture and resources
  - Cross-disciplinary hiring, new courses in energetics and cancer
  - New infrastructure for teamwork, e.g. data management systems, equipment
  - Inspired TD research elsewhere at institution, especially at the cancer center

- Career development and advancement
  - Sr scientists – keynote talks, important papers, promotions, grants
  - Jr scientists – mentoring, skills development, planted flag, promotions, grants
Scientific Impacts of Participating in TREC 1

- **TD approaches created advances in research design and methods**
  - New conceptual frameworks and research questions,
  - Applied research methods in new areas
  - Developed new measures, instruments, and software

- **Important findings in previously unexplored areas, e.g.:**
  - Intersection of sleep, obesity, and cancer
  - Intersection of residential neighborhood GIS indicators, young adult food purchasing and eating patterns

- **Cross-fertilization of research areas via publications in journals and presentations at conferences in other fields, e.g. obesity researchers presenting at cancer conferences**
  - Has the potential to advance science in both fields
Leading them into **new TD areas of research** – influencing or altering their research interests, confirming their interest in energetics and cancer

Making them into “**TD researchers**”, both by working in the interstices between disciplines, and using TD methodological approaches

Facilitating **new collaborations** and **innovative TD research projects** they were leading

Helping them get experiences that made them **more competitive on the job market** – research topics and methods, team work, writing grant app’s and manuscripts

Making them more successful in obtaining **grants** that supported career advancement – DPPs, R03s, K awards
Practical Tools and Strategies to Facilitate Team-Based TD Research

- Resources are available to support TD team research approaches, including:
  - Practical tools and strategies that investigators can apply to enhance the TD research process, and ultimately the scientific outcomes
  - Practical tools and resources that funding agencies, journals, and academic institutions can use to support or facilitate TD team science approaches
GOALS AND PROCESSES ACROSS PHASES OF TD TEAM SCIENCE

Four-Phase Model of Transdisciplinary (TD) Team Science

A “One-Stop Shop” for Team Science

- **Consolidates information** on team science and the SciTS field in one accessible location

- **Integrates resources** from multiple disciplines and fields, e.g., psychology, management, public health, communications

- Includes a user-generated set of resources, e.g. **practical tools** and strategies for TS, **measures and metrics** for studying TS, bibliographic citations and **publications**

- Includes sections curated by the NCI, e.g. **expert blogs**, key resources about TS and the SciTS field
Discover:
  • Learn from colleagues by exploring Toolkit resources contributed by other users
  • Download resources that can support your team science goals

Contribute:
  • Share your knowledge of team science and the Science of Team Science
  • Upload resources such as: documents, links, information, or comments on resources already in the database

Connect:
  • Connect with colleagues who share your interests in team science via our expert blogs, news and events bulletin boards, expert directory and listserv
## How Can the Toolkit Help You?

<table>
<thead>
<tr>
<th>If you are:</th>
<th>And you want to:</th>
<th>Use the Toolkit to find resources such as:</th>
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</thead>
</table>
| An **investigator** using team science approaches     | **Find practical tools and strategies to help support successful team science projects** | • Publications on effective team science approaches  
• Model “prenuptial agreements” for new collaborations  
• Strategies for team communication and data sharing  
• Training resources to build team science competencies |
| A **team science evaluator or scholar**               | Evaluate or study team science processes, outcomes, and contextual influences | • Survey instruments and interview guides  
• Measures, metrics and algorithms  
• Reliability, validity and scoring methods |
| An **administrator** at an academic institution, business, or other organization | Support team science approaches and scholarship at your institution | • Promotion and tenure policies recognizing team science  
• Collaboration techniques to bridge departments and organizations |
| A **funding agency official**                         | Provide support for team science                           | • Funding announcements  
• Protocols for data sharing and co-authorship |
DEVELOPING SKILLS FOR TEAM SCIENCE

Syllabus: Team Science Graduate Course at Northwestern University

Syllabus: Small Teams, Department of Psychology, University of Pittsburgh
Collaboration and Team Science: A Field Guide

Partial Table of Contents --
- Building a Research Team
- Fostering Trust
- Developing a Shared Vision
- Communicating About Science
- Sharing Recognition and Credit
- Handling Conflict
- Strengthening Team Dynamics
- Navigating and Leveraging Networks and Systems
- Challenges....
- References and Additional Resources
- Appendix: Collaborative Agreement Template
REDUCING CONFLICT

“Prenuptial Agreement” for Scientists

- Offers discussion questions to help collaborators commence a project by anticipating, discussing, and resolving possible areas of disagreement common to many collaborations.
- Helps them define expectations related to goals, roles, products, authorship, etc.

Example Questions:

- What are the expected contributions of each participant?
- What will be your mechanism for routine communications among members of the research team (to ensure that all appropriate members of the team are kept fully informed of relevant issues)?
- What will be the criteria and the process for assigning authorship and credit?
- When and how will you handle intellectual property and patent applications?
- How and by whom will data be managed? How will access to data be managed? How will you handle storage and access to data after the project is complete?

The Toolbox Project is intended to provide a philosophical yet practical enhancement to cross-disciplinary, collaborative science. Rooted in philosophical analysis, Toolbox workshops enable cross-disciplinary collaborators to engage in a structured dialogue about their research assumptions. This yields both self-awareness and mutual understanding, supplying CDR collaborators with the robust foundation needed for effective collaborative research. Based on the principles set forth in Eigenbrode et al (2007) and other sources, we offer facilitated workshops based on the Toolbox to help your team examine the dimensions of its collaboration and communication from a philosophical perspective.

“Team Diagnostics” Survey

- Online survey. Free to access, data belong to developers.
- Completed by all team members. Generates a summary report diagnosing team’s strengths and weaknesses.
- Based on five-factor model of team effectiveness in Richard Hackman’s authoritative book, "Leading Teams" (2002), the survey assesses teams on five “conditions of effectiveness”.

Online **diagnostic survey** for geographically distributed collaborations.

Probes **factors that may strengthen or weaken the collaboration**. The Wizard provides both personal and project-level reports to help **build successful and productive collaborative projects**.

While the evaluation of accomplishments in research, clinical scholarship, and educational scholarship has traditionally focused on a faculty member’s individual achievements (e.g., first and senior authorships, funding as the principal investigator on grant awards, invitations to make presentations on national or international forums, etc.), it has become increasingly clear that the present and future of biomedical science is placing more and more emphasis on interdisciplinary team activities.

Therefore, when relevant, a faculty member’s contributions to interdisciplinary teamwork will be given careful consideration.

- Factors such as originality, creativity, indispensability, and unique abilities will be considered when making this evaluation.
- The candidate is expected to include in the promotion packet a description of his/her role in the overall activities of the team.
- The departmental review process will include a solicitation of information regarding the candidate from the director of the project, the principal investigator, as well as any others who have first-hand knowledge that would clarify the candidate’s role in the overall team effort.
- Finally, the Chair's letter must spell out such collaboration(s) in considerable detail, especially if interdisciplinary team activities are felt to be an important aspect of the case being made for the specific promotion.

The Science of Team Science: Assessing the Value of TD Research (2008)

Provides an overview of key research and conceptual developments in the SciTS field, 2008

The most highly cited and downloaded AJPM supplement in the past two decades.

Two of the articles were among the top 15 most highly cited articles in that time period in AJPM, contributing to the journal’s impact factor for 2010.
Special Issue Editors:

**Bonnie Spring, PhD**, Northwestern University

**Holly Falk-Krzesinski, PhD**, Northwestern University

**Arlen C. Moller, PhD**, Northwestern University

**Kara Hall, PhD**, National Cancer Institute


Consensus study on the Science of Team Science will address:

- Team dynamics, management, and effectiveness;
- Institutional and organizational supports;
- The context of team science, including relevant science policies; and
- Implications for education, training, workforce

Final report, due fall 2014, will review and synthesize all available research and other information on effective collaboration in science teams, research centers, and institutes.

Committee members represent diverse disciplines, including management, communications, IT, psychology, social ecology, medicine.

Conducted by the NAS National Research Council Board on Behavioral, Cognitive, and Sensory Sciences, the Board on Human-Systems Integration and the Board on Science Education.
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**History of the NCI SciTS Team with links to team products:**
[www.teamsciencetoolkit.cancer.gov/Public/ToolkitTeam.aspx](http://www.teamsciencetoolkit.cancer.gov/Public/ToolkitTeam.aspx)

**SciTSlist listserv, hosted by NIH. Subscribe in one click at:**
[www.teamsciencetoolkit.cancer.gov/Public/RegisterListserv.aspx](http://www.teamsciencetoolkit.cancer.gov/Public/RegisterListserv.aspx)
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- TREC 1 Coordination Center staff Dr. Mark Thornquist and Ms. Carolyn Ehret, for logistical support in recruiting and scheduling interviews

- Ms. Yvonne Grant for reflections and insights

- Dr. Annie Feng for support in designing interview guides

- TREC 1 investigators and trainees who shared their experiences and insights in interviews for this study
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