

# Assessing and Evaluating Multidisciplinary Translational Teams: A Mixed Methods Approach

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## Abstract

A case report illustrates how multidisciplinary translational teams can be assessed using outcome, process, and developmental types of evaluation using a mixed-methods approach. Types of evaluation appropriate for teams are considered in relation to relevant research questions and assessment methods. Logic models are applied to scientific projects and team development to inform choices between methods within a mixed-methods design. Use of an expert panel is reviewed, culminating in consensus ratings of 11 multidisciplinary teams and a final evaluation within a team-type taxonomy. Based on team maturation and scientific progress,

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teams were designated as (a) early in development, (b) traditional, (c) process focused, or (d) exemplary. Lessons learned from data reduction, use of mixed methods, and use of expert panels are explored.

### **Keywords**

team science, logic models, process evaluation, translational teams, mixed methods

The growth in science and engineering teams has dramatically accelerated since 1975, and research collaborations that include multiple institutions are now the fastest growing authorship structure (Jones, Wuchy, & Uzzi, 2008). This transition has been accelerated by the recognition that specialized scientific fields must develop collaborations to enhance creativity and accelerate discovery to address major societal health problems (Disis & Slattery, 2010). Research products developed by scientific teams indicate more frequent citations and greater impact than that from siloed investigators (Wuchty, Jones, & Uzzi, 2007).

The Clinical and Translational Sciences Award (CTSA) is a National Institutes of Health (NIH) Roadmap initiative (Zerhouni, 2006), intended to stimulate the production and effectiveness of translational research. Translational research attempts to identify potential treatments from therapeutics or interventions derived from basic laboratory research, examine findings when applied to routine clinical practices, and convert treatments into standards of practice or public health policy (Sung et al., 2003; Westfall, Mold, & Fagan, 2007). A major strategy used by the CTSA effort is to promote team-based multidisciplinary research.

Multidisciplinary research teams are a variant of work teams (Sundstrom, DeMuse, & Futrell, 1990, p. 120) that focus on collaborative processes (Hall, Feng, Moser, Stokols, & Taylor, 2008). Collaboration is used by team members applying unique expertise to the scientific problem, integrating their efforts, and sharing data or ideas (Bennett, Gadlin, & Levine-Finley, 2010). Fiore (2008) has distinguished between various types of collaborative scientific teams. He notes that there are cross-disciplinary research efforts involving scientist from different disciplines, but not requiring integration between them, as well multidisciplinary research where there is coordinated effort using multiple disciplines to achieve a common goal. Fiore finds that multidisciplinary research requires complementary activity but not necessarily integration; whereas interdisciplinary research involves design of new approaches, integrated analysis, and utilizing

perspectives from each participating discipline. Hall et al. (2012) notes that transdisciplinary research involves “not only the integration of discipline-specific approaches, but also the extension of these to generate fundamentally new conceptual frameworks, hypotheses, theories, models, and methodological approaches that transcend their disciplinary origins” (p. 426).

Recently, an implementation model for multidisciplinary translational teams (MTTs) has been proposed (Calhoun et al., 2013). The MTT is a hybrid structure that involves academic goals for knowledge generation and training with product-driven goals to develop devices or interventions for clinical application. MTTs are composed of a strategic core of multidisciplinary investigators dynamically engaged in training, capacity development, and product generation (Calhoun et al., 2013). The interdependence and heterogeneous membership promotes innovation and effectiveness (Van der Vegt & Janssen, 2003). These dynamic, multilayered (i.e., multiple discipline and multiple institution), and stage-dependent processes pose major challenges in evaluating the processes, outcomes, and skill acquisition of its members. As noted by Hall et al. (2012) and by Calhoun et al. (2013), translational teams evolve in terms of team processes as they mature, and make adaptive changes in relation to differing stages of the translational continuum (i.e., from discovery to treatment), thus making them complex.

In this article, we examine the appropriateness of methods, and a case illustration of assessing and evaluating MTTs. We define “team assessment” as the collection of data to measure a team’s progress (e.g., team surveys, observation of meetings, milestone analysis, etc.), and “team evaluation” as the process of determining significance of team activities (e.g., comparative placement on evaluation model, return on investment, etc.). Several evaluation objectives are addressed by this article. First, we identify and describe useful qualitative and quantitative methods to assess teams in a complex and changing environment using different types of evaluation. Second, we provide a case example of team evaluation by reducing data involving team outcomes, team processes, and opportunities for team development, and using an integrated scientific team evaluation model and an expert panel to facilitate helpful feedback and overall team management.

## **Assessing and Evaluating Team Science**

### *Team Science*

Team science can be defined as “cross-disciplinary engagement and collaborations around the longer-term interaction of groups of investigators”

(Falk-Krzesinski et al., 2010, p. 263) and as “ambitious multiyear initiatives to promote cross-disciplinary collaborations in research and training” (Stokols, Hall, Taylor, & Masse, 2008, p. S77) which can be used to address complex and important public health, social, and environmental problems. Because translational research utilizes team science processes and structures (Börner et al., 2010), identification of appropriate evaluation models, methods, and techniques is much needed (Hall et al., 2008; Masse et al., 2008). Recent work illustrates a range of methods to evaluate team science, including survey methods (Masse et al., 2008), social network analysis (Aboelela, Merrill, Carley, & Larson, 2007), action research (Stokols, 2006), interviews and focus groups (Stokols et al., 2003), and improvement-oriented approaches using multiple methods (Gray, 2008). Effort is now needed to determine what components of team functioning and effectiveness are most applicable to translational science (Falk-Krzesinski et al., 2010, 2011; Rubio et al., 2010).

Börner et al. (2010) and others (Klein, 2006; Stokols et al., 2003; Trochim, Marcus, Masse, Moser, & Weld, 2008) have suggested that a mixed-method approach is necessary to capture and assess the complexity of team science. Application of mixed methods applied to evaluation research requires integrative research designs, specific sampling strategies, sophisticated data analysis, and great care in data inference (Creswell & Clark, 2011; Tashakkori & Teddlie, 2010). Mixed-methods research produces more evidence than either qualitative or quantitative approaches could by themselves, and the “combination of strengths of one approach make up for the weaknesses of the other approach” (Creswell & Clark, 2011, p. 2).

### *Types of Evaluation*

Selecting the appropriate evaluation framework is dependent on the purpose of the evaluation (Hansen, 2005). To address the complexities involved in assessment and evaluation of an MTT, we draw on concepts and techniques from outcome-based evaluation, process evaluation, and developmental evaluation. We use these types of evaluation due to their applicability to team science questions most relevant to translational research. Table 1 illustrates these evaluation types and exemplary questions important for the generation of evaluative criteria and method selection.

Outcome-based evaluation is a systematic determination if a program has achieved its goals (Hoggarth & Comfort, 2010). For example, use

**Table I.** Multiple Types of Team Evaluation and Exemplary Questions for Translational Science.

Outcome evaluation	Process evaluation	Developmental evaluation
Are agreed upon milestones and timelines being achieved?	How is the team interacting and communicating?	How are task-related behaviors at each stage of development being performed?
Are agreed upon outcomes (e.g., publications, patents, training, etc.) being addressed?	Are meetings regular, agenda based, and well attended?	How are roles we expect members to fulfill being performed?
Are innovations or breakthroughs that are translational in nature being achieved?	Are internal and external parties being engaged collaboratively?	How are individual and team areas of expertise being developed?

of logic models (Frechtling, 2007) as a planning document embodies the outcomes-based evaluation approach, where short-, medium-, and long-term outcomes are identified and used to develop activities and inputs required to accomplish them (Hoggarth & Comfort, 2010). Relevant assessment methods useful for quantifying MTT outcomes could include artifact/unobtrusive measures assessment, an assessment focused on the products of the MTT, or bibliographic assessment, a tool that would suggest the impact of the MTT in the larger scientific context.

Process evaluation is an iterative process that focuses on revealing program effectiveness (Saunders, Evans, & Joshi, 2005). Relevant assessment methods could include direct observation, structured interviews, surveys, and social network analysis on program processes and program implementation. This information stimulates discussion, inquiry, and insight into adopting programmatic change.

Developmental evaluation is a technique focused on continuous improvement supporting team adaptation under dynamic and evolving conditions in real time (Patton, 2010). Developmental evaluation provides information on emergent processes that inform innovative approaches that generate insights into systems-level understanding of effective processes. In a manner distinct from process evaluation, this type of evaluation allows for direct, user-based feedback and focuses the participants to implement innovative change with the team.

## **Case Illustration of Mixed Methods Assessment to Inform an Integrative Evaluation Model**

### *Use of Logic Models*

Recent evidence suggests that logic models can be applied to complex scientific endeavors (Norman, Best, Mortimer, Huerta, & Buchan, 2011). Two specific logic models were developed for each MTT (Institute for Translational Sciences, 2013). First, each Team Principal Investigator and Team Project Manager developed a project-based logic model that addressed their collaborative research project. In these cases, logic models depicted short-term (1–3 years), medium-term (4–6 years), as well as long-term (7–10 years) outcomes that reflected anticipated changes in standards of care, diagnosis, management of specific disease populations, and stated recognition within a given scientific or treatment community. A second logic model was generally developed for all MTTs to evaluate processes and developmental outcomes involving a seven-step team development cycle, inclusive of team establishment and vision, team process surveys, team self-assessment, developmental plans, team coaching, team behavior observation, and external review.

### *Choice of Assessment Methods*

A selection of social science research methods and designs is available to the study of scientific teams (Gravetter, 2003; Hollingshead & Poole, 2012; Trochim, 2005). We believe that there are eight assessment methods most applicable for team assessment (Institute for Translational Sciences, 2013), inclusive of artifacts/unobtrusive measures, bibliographic measures, process observation, social network analysis, surveys, structured interviews, focus groups, and cases analysis. Moreover, each method can be considered qualitative or quantitative, serving the needs of outcome, process, and developmental types of evaluation. The research questions in Table 1 are illustrative of a mixed-methods approach because “they help blend the two approaches (qualitative and quantitative) from the outset of the research” (Teddle & Tashakkori, 2009, p. 126). The questions, and attendant logic model metrics, specified how the qualitative and quantitative sources of data could be integrated together to address questions that could otherwise not be addressed by independent means. Our questions were specifically designed to address whether MTTs were progressing scientifically as well as maturing multidisciplinary entities.

We assessed MTTs primarily using artifacts, process observation, surveys, and bibliographic means using criteria detailed in Table 2. These methods ranged from highly quantitative surveys to highly qualitative thematic analysis reports generated by an experienced observer of scientific groups. We administered the “Our Team Survey,” a quantitative web-based team assessment of 71 items measuring 14 different factors of team processes, which has been extensively validated (Wilson, 2003). Six specific factor scales were used to inform our select criteria, inclusive of clarity of goals and priorities, consensus planning, management feedback, team atmosphere, domination, and management support (Table 2). Illustrative of a more qualitative method was our use of a team development planner (Institute for Translational Sciences, 2013). Here, ranking scales and identification of developmental goals for a given team is representative of “information that is presented in both narrative and numerical forms” (Teddlie & Tashakkori, 2009, p. 129). These data were used to populate portions of the maturation/development criteria (e.g., new opportunities, challenges) depicted in Table 2.

### *Data Reduction Process*

Select scales and questions were used to inform evaluation criteria on research/scientific and maturation/development factors (Table 2). For example, only certain scales (e.g., domination, consensus, and management support) from the quantitative Our Team Survey were used to describe transformative and empowered leadership. An example of how each team’s vision and goals were assessed involved using stated goals in progress reports and in team agendas, which were qualitative in nature. Data illustrating each of the four research/scientific factors and the four maturation/development factors were separately compiled for each MTT.

### *Creation of an Evaluation Model for Scientific Teams*

General approaches to team research (Cohen & Bailey, 1997; Guzzo & Dickson, 1996; Ilgen, Hollenbeck, Johnson, & Jandt, 2005; Mathieu, Maynard, Rapp, & Gilson, 2008; Sundstrom et al., 1990) have well documented a variety of teams, but these categories do not capture the nature and variation of scientific teams. Perhaps the closest description of a scientific team category is that of an ad hoc project (Devine, Clayton, Phillips, Dunford, & Melner, 1999). Unfortunately, there is no universally accepted model or criteria that is entirely team-specific that is useful to distinguish scientific

**Table 2.** Evaluation Factors Used to Evaluate Multidisciplinary Translational Teams.

Research/scientific factors (criteria)	Methods used	Qualitative/quantitative	Type
Research plan Novel and sophisticated plan, conceptually and/or technically innovative	Artifacts (scored grant application, annual progress reports)	Qualitative and quantitative	Outcome
Research generation Productivity, data collection, analysis, and appropriate use of key resources	Artifacts (completion of formal milestones; accomplishment of short-, medium-, and long-term outcomes; time and resource utilization)	Qualitative and quantitative	Outcome
Research communication/program growth Progress in dissemination, publication, and grant success	Bibliographic (number of publication, impact of publications, grants obtained extramurally)	Quantitative	Outcome
Progress across translational domains Clinical and community impact	Artifacts (completion of formal milestones; accomplishment of short-, medium-, and long-term outcomes)	Qualitative and quantitative	Outcome
Team vision, charter, and goals	Artifacts (annual progress reports, meeting notes)	Qualitative and quantitative	Process
Well-established identity, future thatis shared by all, resulting from team deliberations	Survey (web-based scales involving consensus, clarity of goals/priorities)	Quantitative	Process

*(continued)*



**Table 2.** (continued)

Research/scientific factors (criteria)	Methods used	Qualitative/quantitative	Type
Transformative and empowered leadership Leader solicits input, integrates perspectives, and facilitates consensus	Process observation (team coach observations of team principal investigator and project manager behavior/collaboration) Survey (web-based scales involving consensus, domination, management support)	Qualitative	Developmental
Meeting management and coordination Team members meet regularly and explore new opportunities, challenges, and synergies	Process observation (team-based observations of team interaction patterns and decision making) Survey (web-based scales involving clarity of goals, management feedback, team atmosphere) Artifacts (team development planners, needs assessment/self-assessment)	Quantitative	Process, developmental
External communication and collaboration Facilitated communication with collaborators that enhances research productivity	Artifacts (annual progress reports, meeting notes) Process observation (team coach observation of inclusion of disciplines)	Qualitative and quantitative Qualitative	Process Process, developmental

teams categorically, despite numerous suggestions for evaluation criteria, and their utility for evaluation of team science (Falk-Krzesinski et al., 2011; Hall et al., 2008; Rubio et al., 2010). There is a tremendous need therefore for an evaluative model that is specific to scientific teams, particularly for those NIH programs that focus on team-based initiatives. A common framework is therefore needed to provide guidance in data reduction and criteria variability.

Based on the four research/scientific factors and the four maturational/developmental factors (Table 2), we established a prototype evaluation model to be used to synthesize the reduced assessment data into an overall team evaluation (Institute for Translational Sciences, 2013). We desired to create a model that not only differentiates between teams but also could be graphically displayed. A two-by-two matrix was constructed to depict teams as one of the four types: an exemplary team, a process team, a traditional team, and an early in development team. These team types result from assessing teams and subsequently evaluating them along a continuum of high to low on their team maturation/developmental factors and high to low on their research and scientific progress.

### *Use of an Expert Panel*

The use of expert panels to evaluate research programs is well established within the scientific community (Coryn, Hattie, Scriven, & Hartman, 2007; Lawrenz, Thao, & Johnson, 2012). We utilized expert panels to judge the reduced assessment data and to balance the objective data with contextual specificity and interdisciplinary focus (Huutoniemi, 2010; Klein, 2006). This panel included the Principal Investigator, the Director and Assistant Director of Research Coordination, a consulting team coach, and a consulting evaluator, representing a range of disciplines (medicine, clinical research, psychiatry, psychology, and management).

Each expert panel member was asked to independently review logic models, measurement plans, and all assessment data to determine an initial rating for 11 different MTTs using a scoring template (Institute for Translational Sciences, 2013). Here, each expert panel member rated a given team's performance as 0 (*not present*), 1 (*low*), 2 (*medium*), or 3 (*high*). Thus, each team could be given a score of 0–12 for each of the two criteria categories (research/scientific and maturation/development) by summing the subscore for each specific criterion. After each panel member articulated their initial views, differences in the ratings were discussed, assessment data reexamined, and a panel consensus was reached.

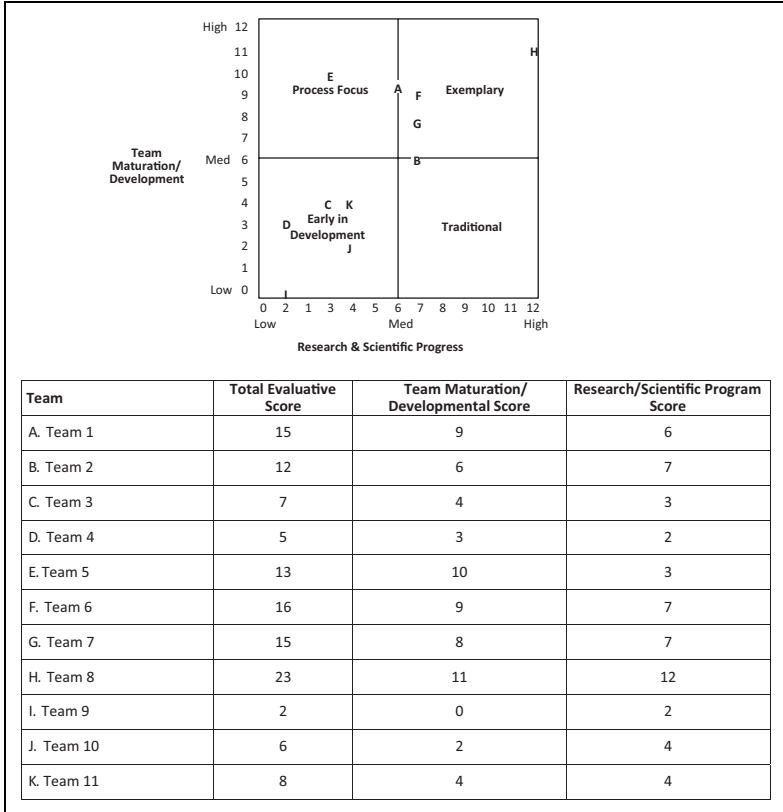
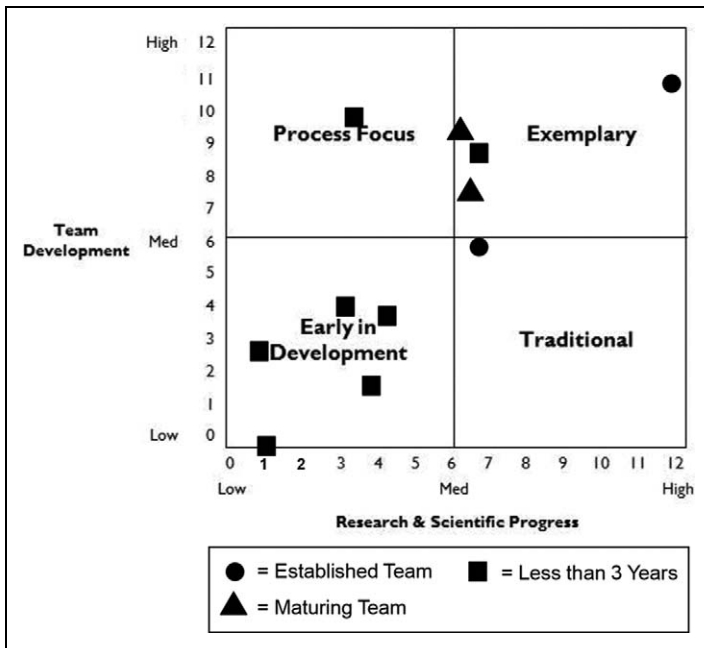


Figure 1. Simplified team evaluation model matrix distribution.

### Results of Mixed-Methods Data Synthesis

Figure 1 illustrates the results of the expert panel evaluation. Team scores ranged from 0 to 11 on the team maturation/development dimension, and from 2 to 12 on the research/scientific dimension. Five teams were placed in the “early in development” category, one team was categorized as a “process focus” team, and three teams were categorized as “exemplary.” Two teams were combinations of team types.

Due to the number of teams judged to be “early in development,” the 11 teams were then illustrated by their categorization resulting from evaluation, and their relative tenure. Because the MTTs consisted of existing research teams with a relatively long history (over 5 years), maturing teams



**Figure 2.** Distribution of multidisciplinary translational team evaluations by team tenure.

(between 3 and 5 years), and new teams (less than 3 years), the distribution shown in Figure 2 suggests that MTTs are sensitive to their maturational stages when evaluated.

## Discussion

Developing a robust and uniform strategy for assessing and evaluating translational teams will be key for process improvement for the CTSA program. The nonlinear nature of MTT development consisting of dynamic cycles of activity (i.e., team development) makes the establishment of an overall evaluation model problematic. The finding that team tenure was central to team evaluation is illustrative.

Several lessons were learned from this effort. We found that a mixed methods design is a practical necessity when applying numerous types of evaluation (Greene, Caracelli, & Graham, 1989; Johnson, Onwuegbuzie, & Turner, 2008). Program evaluation based on quantitative measures, such

as improvements in population health, are too long term to provide meaningful dynamic input to realistically inform changes in MTT processes over shorter grant cycle times. Instead, we propose that qualitative assessment of the academic environment would provide more useful information. In fact, structured interviews of the impact of the adoption of MTTs within a CTSA reveal a striking cultural change (Kotarba, Wooten, Freeman, & Brasier, 2013).

Second, selection of evaluation criteria is critical. While there is no established evaluative model, we found it useful to limit the number of criteria such that it could be used to inform a model that is easy to use and easy to understand. While a broadened array of criteria for contextual and collaborative variables is available (Stokols et al., 2008), each translational team evaluator should select the evaluative criteria that best relate to its overall objectives. However, achieving a balance between the more traditional scientific criteria with social–psychological criteria will play an important role in facilitating the goals of training and capacity building that is desired by the NIH. Perhaps agreement on the overall dimensions (scientific and maturational), along with flexibility in the choice of specific criteria to evaluate such overall dimensions, might provide both consistency and flexibility.

Third, effective data reduction and facilitation is likely essential to enabling expert panels to consider and evaluate teams using multiple and complex criteria, given the literature (Olbrecht & Bornman, 2010) that has reported panels plagued with statistical and decisional biases. We propose that expert rater panels may be an effective means to reinforce ideal MTT processes. However, the use of expert panels to effectively evaluate teams will require substantive research and investigation. Thus, while we used mixed methods, used specific evaluation factors and criteria, reduced the data for independent rating of each team, the use of a consensus seeking model for team evaluation and categorization is worthy of further investigation.

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