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The translational science promotion and research capacity (T-SPARC) framework: Developing institutional capacity for translational science

Jessica Sperling[1,2], Stella Quenstedt[1], Kristine Glauber[1], Perusi B. Muhigaba[1], Eman Ghanem[1], Tarun Saxena[1], Vonda Rodriguez[1], Cinthia Sanchez[1] and F. Joseph McClernon[1,3]

[1]Clinical and Translational Science Institute, Duke University School of Medicine, Durham, USA; [2]Social Science Research Institute, Duke University, Durham, USA and [3]Department of Psychiatry and Behavioral Sciences, Duke University School of Medicine, Durham, USA

Special Communication

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Corresponding author:
J. Sperling;
Email: Jessica.sperling@duke.edu

Abstract

Recent years have seen increasing focus, including by the National Institutes for Health (NIH), on developing the field of translational science (TS). TS focuses on improving the process of translational research (TR), including generating knowledge that can facilitate TR across specific diseases or translational stages. With TS as an emerging field, research organizations have an increasing need to understand how to develop capacity for and support the advancement of TS. To support such institutional and infrastructural change, this paper outlines a Translational Science Promotion and Research Capacity (T-SPARC) Framework. The T-SPARC Framework provides a foundation to 1) inform the development of TS-creating and science-supporting interventions and programs, and 2) examine the effectiveness of said interventions and programs. The framework outlines organizational levels that T-SPARC programs can target; mechanisms, or intervention activities, that can foster change; and outcomes, including specific attitudinal or behavioral changes, institutional changes, and domains on which TS changes can focus. T-SPARC's capacity-building focus builds upon earlier efforts focused on conceptualizing and defining TS. T-SPARC supports movement towards TS goals of reducing longstanding challenges in the TR process, thus accelerating the health impact of TR, and ultimately improving health outcomes.

Introduction

The translation of biomedical innovations into products that improve the health of individuals and the public is remarkably resource- and time-intensive. The average research & development costs of bringing a single new drug to market are $1.1 billion [1,2] and it takes around 8 years for clinical development (i.e., from first-in-human clinical studies to regulatory marketing authorization) alone [3]. Other products of translation (e.g., diagnostics, medical procedures, devices, behavior change recommendations, treatment guidelines, health policy) are also time-consuming and costly to bring into public use. A burgeoning field of study, translational science (TS), focuses on increasing the efficiency of translation by removing longstanding barriers and bottlenecks, thereby driving down costs and accelerating the pace of translation while maintaining or increasing quality. These goals are achieved by applying "research on research" or meta-research approaches to improve our understanding of the processes and systems that enable effective translation [4]. The National Center for Advancing Translational Sciences (NCATS) encourages TS across the nation's biomedical enterprise by requiring Clinical & Translational Science Award (CTSA) Hubs to foster and promote the development, evaluation, and dissemination of "scientific and operational innovations that improve the efficiency and effectiveness of clinical translation" [5]. In accordance with this national effort to promote TS, recent scholarly work has emphasized the importance of TS, defined how its goals are distinct from TR, and made clear the core principles of TS [6,7]. Additional select resources on the field of TS are included in a Supplement.

The U.S. biomedical research enterprise largely promotes and supports translational research (TR). However, both TR and TS – with a clear understanding of their conceptual distinctions, but also their strong connections – are critical to advancing TR, TS, and the health improvement goals underlying both. By understanding the common and persistent inefficiencies in TR, TS innovations present solutions to overcome them. Therefore, to fully promote and support TR, institutions must engage in TS. To fully realize the goals of increasing TS, research institutions

will need to build capacity for promoting, and supporting TS as a field of inquiry interrelated yet distinct from TR. Emerging research has focused on select areas of TS capacity-building, such as TS education [8–10]. Yet, there remain important questions about institutional best practices to support and develop TS [8]. Existing work on research capacity development more broadly indicates that expansion of research is often accomplished via a multi-pronged focus on areas including the development and strengthening of the workforce, policies & infrastructure, and strategic funding initiatives. A focus on institutional research capacity-building, as applied to TS, is necessary given the relative recency of TS as a field, and to most rapidly and effectively increase TS activity and outputs across the CTSA network and beyond.

To support institutional and infrastructural change towards advancing TS, this paper outlines a Translational Science Promotion and Research Capacity (T-SPARC) Framework. T-SPARC provides a foundation to inform the development of TS-advancing and supporting interventions and programs at the individual, team, institutional, and larger system levels and strategies for examining their effectiveness. It outlines (1) levels of actors that are most directly affected by an intervention, (2) specific mechanisms, or intervention activities, that can be implemented, and (3) resultant outcome areas, including attitudinal or behavioral changes, institutional changes, and domains in which TS changes can occur. This framework contributes to and builds upon recent efforts to advance TS [5–9]. In particular, it is intended to inform specific mechanisms and processes that can be used to further develop the field of TS and promotes the evaluation of these mechanisms and processes. Ultimately, it seeks to advance broader goals of reducing longstanding challenges in the translation research process and accelerating the health impacts of TR.

We present T-SPARC as a conceptual model with an applied orientation. We provide examples where we apply T-SPARC to existing and prospective TS capacity-building initiatives to demonstrate how this framework can capture the realities of practice, and we intend that T-SPARC informs development and knowledge of TS-advancing initiatives. Moreover, our framework is meant to inform and guide the evaluation of efforts to promote and build capacity for TS. Yet, as the TS field continues to grow, we posit this framework as foundational. For instance, we envision an iterative process whereby the advancement of new TS capacity-building efforts, and the generation of learning from evaluation of these efforts, can further inform the framework itself.

Development

T-SPARC was collaboratively developed by 9 members of the Duke University Clinical and Translational Science Institute (CTSI) primarily including individuals from CTSI Pilots, Team Science, Evaluation, and Administration teams, all of whom had identified the need for building institutional capacity for TS at our institution. The Pilots team as it is charged with soliciting, funding, and managing TS pilot awards recognized a need to enhance communication with investigators and other constituents on what constitutes a TS (vs TR) project, as it had previously funded TR awards. Team Science – which itself employs a "research on research" approach to understand the antecedents to effective team-based research and develop and implement interventions to improve the practice of team science – had been considering opportunities to leverage Team Science knowledge to advance TS. The Evaluation team had been involved in formative evaluation discussions about advancing TS within and beyond the CTSI, and it had engaged with Pilots and Team Science on the topic of promoting TS. The CTSI Administration team focuses on the NIH Clinical and Translational Science Award (CTSA) and is attuned to the CTSA's increasing focus on TS, including emphasis on TS in recent Funding Opportunity Announcements. All members of this group have at least 3 years of experience with TS and TR, with a maximum of 7 years in TS and 37 years in TR. Approximately half of team members hold leadership roles in Duke CTSI and all members are a part of the larger TR and TS (e.g., CTSA) network. In each of our lines of work, we encountered challenges with communication around TS, including its goals and its differences with TR. We identified opportunities for advancing TS at our institution, including leveraging a Science of Team Science approach and increased CTSA support for TS research. However, we realized we lacked a systematic or holistic framework for considering opportunities to advance TS and to evaluate these efforts. We determined that such a framework could expand our consideration of potential interventions and inform a broader strategic approach, taking us beyond efforts that were simply opportunistic. With this basis, we determined to further explore opportunities to develop such a framework.

This collaborative team held initial meetings on a monthly to bimonthly cadence from Spring 2023 to Fall 2024, with ongoing communication into 2025, and specific tasks and assignments between meetings. The team began with two key activities: (1) gathering and reviewing literature on TS, and (2) drafting an initial logic model that included steps to promote and advance TS with the broader goals of reducing longstanding challenges in the translation research process, thereby utilizing TS to increase TR efficiency and ultimately improving health outcomes. The team then identified two potential conceptual areas for centering the current effort. The first was a direct focus on *TS-advancing interventions* (i.e., building institutional capacity for TS), with proximal outcomes reflecting increased knowledge or research capacity for TS at an institution. Here, an intervention is an effort designed to enhance TS capacity, as TS-focused capacity-building activities/programs would ultimately affect the broader goals of TS [11]. The second was focused on *TS itself* (i.e., specific actions or efforts associated with the conduct of TS), with proximal outcomes reflecting changes in the conduct of TR. While both are critical, the team decided to pursue the former, as this is an upstream precursor to the latter. See Figure 1 for a depiction of potential foci, with the selected focus highlighted in blue. At this point, in Fall 2023, the team moved into a process of defining the key elements for the T-SPARC Framework.

Links between Translational Science Capacity-Building & Translational Research Outcomes. This figure describes conceptual links between a focus on TS-advancing interventions and TR outcomes.

Throughout this process, the team identified other frameworks, models, and literature to inform this work. First, as noted above, the focus and outcomes of TS were informed by literature on TS, including emerging work on TS as well as prior TR and TS frameworks [7,12]. Second, the focus on distinct targets of interventions was informed by the Social Ecological Model (SEM) [13]. which considers the effect of varied levels (individuals, community, and society) that help to inform current conditions; the Consolidated Framework for Implementation Research (CFIR) [14], which examines contexts affecting successful implementation of interventions (individual, internal, external); and frameworks and models of community and systems change, including those

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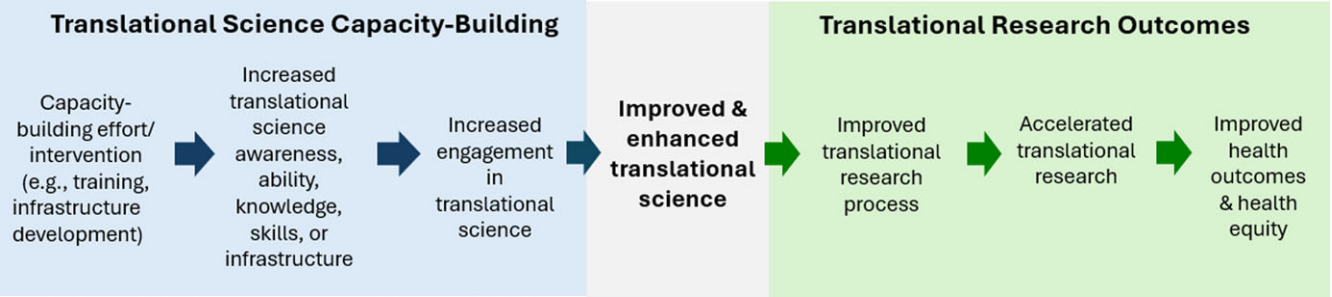

Figure 1. Links between translational science capacity-building & translational research outcomes.

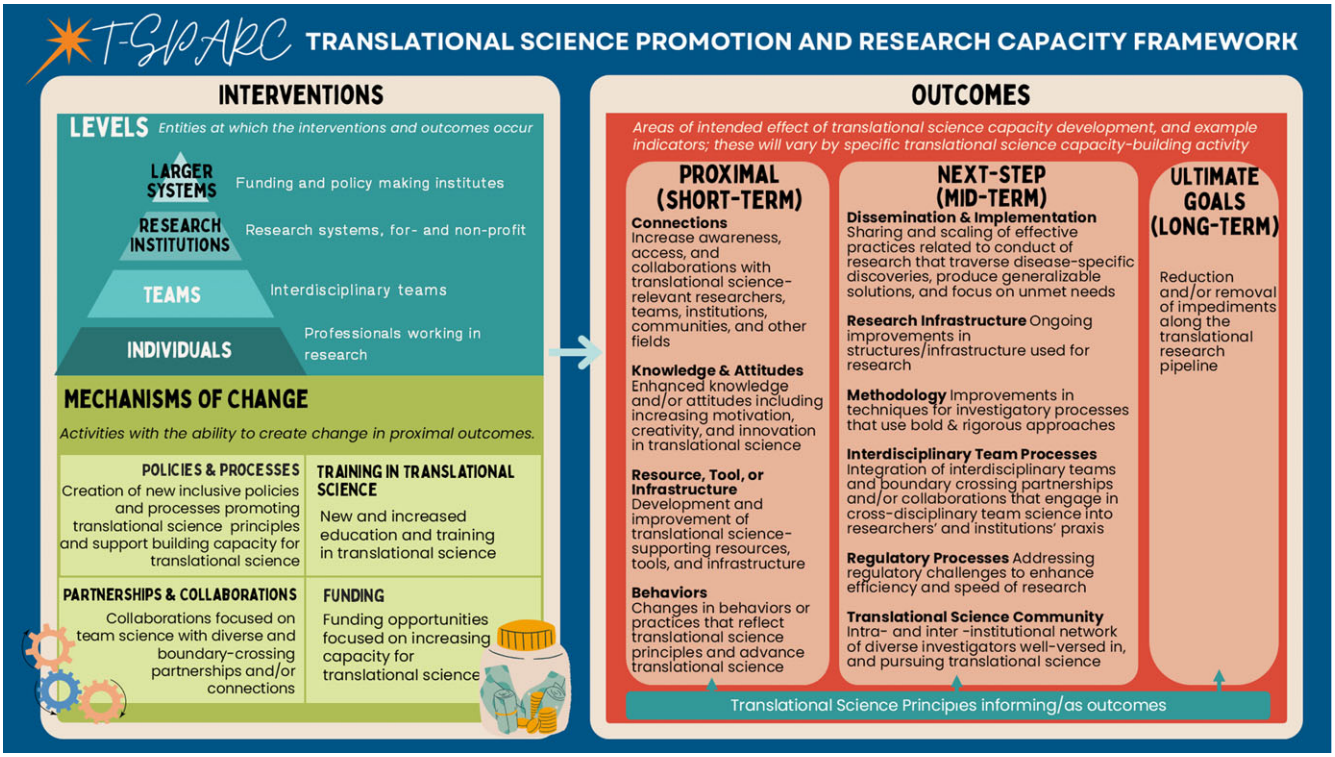

Figure 2. T-SPARC framework.

that focus on identifying parts of a system [15]. The team also considered literature addressing building the research capacity of colleges and universities to determine where research-improvement strategies could help to inform mechanisms facilitating TS capacity development [16,17].

The team also solicited input from others in the broader TS community to inform and refine the model. Most notably, an earlier version of this model was presented at an Annual Meeting of the Association for Clinical and Translational Science (specifically within the Evaluation Special Interest Group meeting). Feedback received further informed the framework's development, including the addition of a clearer focus on TS intervention outcomes. Beyond this direct input, the framework was informed by the authors' broader engagement in national TS communities and networks where challenges to advancing TS capacity emerged as part of broader TS discussions.

Framework

The resulting T-SPARC Framework (Figure 2; alternative visualization using traditional logic model format in Supplement), aimed to inform the development and evaluation of TS-advancing and -supporting interventions and programs, is organized into the following areas: a) levels for change (i.e., entities targeted by interventions), b) mechanisms for change (i.e., how this change can be brought about), and c) outcomes, or the substantive results and focus of change. Specific elements described below.

T-SPARC Framework. The T-SPARC Framework informs the development and evaluation of TS-advancing and supporting interventions and programs. It is organized into the following areas: a) levels for change (i.e., entities targeted by interventions), b) mechanisms of change (i.e., how this change can be brought about), and c) outcomes, or the substantive results and focus of change.

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TS-advancing interventions

Level

Interventions and programs can target distinct primary "levels" of actors within systems, or the entity most directly or proximally affected by an intervention. At the most macro level are the *larger systems*, including funding and policy-making institutes, such as the NIH. Next are the *research institutions*, including both for- and non-profit institutions, such as universities or CTSA hubs. At the more micro levels, targets of change include *interdisciplinary teams* (e.g., research project teams) and the *individuals*, which refers to professionals working in research (e.g., investigators, evaluators).

Mechanisms of change

The "mechanism" used, or specific intervention activity occurring in a TS capacity-building effort, can take varied forms. *Funding* consists of monies specifically intended for TS capacity-building efforts. This, for example, could take the form of funding for education and training programs, or for pilot programs that solicit and fund TS research. *Policies and processes* are specific cultural or administrative changes that promote TS principles and support building capacity for TS. *Partnerships & collaborations* include efforts that bring diverse entities, whether individuals, teams, or institutions, together into coordination or communication. Lastly, *training* consists of any education or training about TS overall, aspects of TS, or how to incorporate TS principles and methods into the work of entities at any level.

Outcomes

Identifying outcomes creates a foundation for conceptualizing a progression of TS capacity-building goals; outcomes can also inform TS intervention design to ensure that the intended outcomes of interventions and programs are aligned with or fulfill these goals. This framework integrates NCATS' TS principles [7] into proximal and next-step outcomes, utilizing them as informing overarching TS objectives.

Proximal outcomes

Proximal outcomes can provide clear foundation for evaluating successes of TS capacity-building initiative and can inform adjustments to improve such efforts and identification of efforts to scale. Figure 2 indicates areas of near-term results that could be achieved by TS interventions. *Connections* refers to knowledge of and access to other individuals, organizations, fields, and communities that could help advance TS, whether as potential collaborators for an investigator or as sources of added TS-related knowledge information. *Knowledge and Attitudes* speaks to changes in comprehension or perspective on TS, which can include changes in the motivation to engage in TS or view of relevance to one's research. *Resource, Tool, or Infrastructure* addresses specific developments or innovations in these areas as designed to enhance TS. *Behaviors* includes specific changes in action or practice based on the intervention. Table 1 provides additional example indicators. Specific proximal outcomes and indicators would depend on the mechanism and level. For instance, implementing Appointment, Promotions, and Tenure (APT) guidelines for recognizing TS research could be designed to increase motivation to study and conduct research on TS (Knowledge and Attitudes), increase perception of the value of TS (Knowledge and Attitudes), increasing the conduct of TS-related research (Behaviors), and/or produce a TS-supporting intervention (Resource, Tool, or Infrastructure).

Indicators can further be drawn from, and linked to, previous work in TS. For instance, while some of the indicators within the Translational Science Benefit Model (TSBM) [12] may not apply to T-SPARC evaluation (i.e. any indicator focused directly on health benefits, such as health care delivery), others can be used with modifications to their definitions. For example, the TSBM benefit "Guidelines" is defined as formal recommendations or principles to assist with patient care for specific clinical circumstances [18]. Within T-SPARC, a similar "Guidelines" benefit could be redefined as new formal recommendations to assist with TS implementation and practice; one could contend that NCATS Translational Scientific Principles [7] provide a real-world example of TS "Guidelines," as could development of more topic-specific guidelines (e.g., for effective community engagement practices) to advance TR or TS. Similar adaptations could be made to consider the TSBM benefit of "investigative procedures" that advance TR or TS (e.g., new investigative procedures addressing challenges across multiple research projects or conditions; methodologies for recruiting and/or retaining participants across content areas or disease states). Additional TSBM benefits, such as policies, standards, and non-profit or commercial entities, could be applied with the indicator focused on measuring the impact of TS instead of its original intended use of demonstrating health impact.

Data for TS capacity-building indicators can be drawn from varied sources including primary and secondary data on researchers, research professionals (e.g., individuals in research administration) and research teams; grant submission and publication records; and institutional practices, guidance, or resources. As examples, survey data showing an increase in the view that TS is relevant to ones' work could evidence effectiveness of a TS training; increases in multidisciplinary collaboration in grant submissions could evidence effectiveness of team science trainings or networking sessions intended to spark and facilitate boundary-spanning collaboration; publications showing an increase in TS research could evidence effectiveness of APT policy change rewarding TS research for investigators from varied disciplines. Specific appropriate data sources would be informed by the direct target of the TS capacity-building effort (level) and the specific outcome area considered (e.g., knowledge and attitudes vs. behaviors).

Next-step outcomes and ultimate goals

TS interventions and programs, with proximal outcomes as a pathway, can effect change in varied next-step outcome areas. Efforts advancing *interdisciplinary team process* integrate inter-disciplinary teamwork and boundary crossing partnerships into researchers' and institutions' praxis. A *research infrastructure* result focuses on improvements in the structures used for research discoveries (e.g., lab spaces, grant management). *Regulatory processes* improvements address regulatory challenges hindering progression through the translation pipeline by increasing the speed, efficiency, and efficacy of approval processes (e.g., those associated with institutional review boards). *Methodological* advances include improvements in techniques and tools used in research discoveries. A *dissemination & implementation* result concerns the scaling and integration of best research practices throughout the TS field, including the broad application of disease-specific discoveries, production of generalizable solutions, and projects that focus on unmet needs where relevant. Achievement of *TS community* occurs when there emerges a clear and intra- and inter-institutional network of investigators. Ultimately, this work is

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Table 1. Sample proximal outcome indicators

TS Knowledge & Attitudes (most relevant to: individuals, teams)	TS Connections (most relevant to: all)	TS Resource, Tool, or Infrastructure (most relevant to: larger systems, institutions)	TS Behaviors (most relevant to: individuals, teams, institutions)
• Increased awareness and perceived value of TS and TS principles • Ability to differentiate TS and TR • Ability to identify and understand TR roadblocks and inefficiency • Increased acknowledgment of TS's connection or relevance to current / future work and TR	• Knowledge of other TS-relevant researchers • Access to other TS-relevant researchers • Initiations of collaboration across disciplines beyond clinical/ health research (i.e. administrative, financial, and operational), across sectors (i.e. government, universities, and industry), and with the community (i.e. members and organizations) to accelerate TS and TR	• TS-supporting interventions/ efforts created • Demonstrated utility of TS-supporting interventions/ efforts (feasible to use as intended, operate effectively) • TS evaluation criteria in funding proposal with TS aims • New policies that enable creativity and innovation and do not penalize failures • Organizational policies that enable team science • Access to high-quality FAIR (findable, accessible, interoperable, reusable) data that enables advancement of TR or TS	• Incorporation of TS into research/work • TS-focused or TS-integrated proposals, projects • Development of diverse connections with others in TS-relevant fields • Development and implementation of innovations in scientific approaches, methods and technologies that accelerate TR • Contribution to research advances in under-investigated areas or addressing questions that have a disease agnostic research challenges (i.e. patient/ community engagement, predictive efficacy, and other TS-aligned unique research challenges) or disincentives (currently untreatable diseases) • Ability to engage colleagues from across disciplines, fields, and professions to develop diverse and boundary crossing teams

TS = translational science; TR = translational research.

aimed to reduce and/or remove impediments along the TR pipeline.

T-SPARC in practice: examples of use

T-SPARC can be used prospectively to inform capacity-building efforts' development, and applying it to existing efforts can help to clarify use and contextualize current or existing efforts within a broader strategy. Table 2 thus provides specific examples that apply T-SPARC to existing and potential TS capacity-building interventions. Each of these examples responds to multiple TS Principles, but all overtly address the principle of "Meet Unmet Needs" by ensuring a shared operational understanding of TS; providing a clear process for differentiating TS-focused research from TR-focused research; and providing a mechanism to encourage and support growth in quantity, quality, and impact of TS research and innovations. We address possible interventions or programs themselves, whether existing or potential; their primary target levels and mechanisms of change; and potential short-term outcomes. We do not include next-step and ultimate outcomes here as those may vary based on specific focus of an initiative and could converge across initiatives/programs.

As with many conceptual models and frameworks, there is intended flexibility in use. First, interventions and programs informed by T-SPARC need not be exclusive to one category within the levels, mechanisms of change, or outcomes. For instance, TS Research Events/Symposia can utilize multiple mechanisms including training in TS and partnerships/collaborations. A Collaboration Planning intervention can target multiple levels including individuals and teams. Second, interventions and programs can utilize different combinations of levels and mechanisms. Third, there can be shifting and cyclical development among mechanisms and proximal, or even longer-term, outcomes. For example, a funding or a collaboration mechanism may lead to a new research administrative process, and that new process may then serve as a mechanism that prompts change in methodological innovation. Our institution has applied this model to understand how TS capacity-building efforts, developed ad hoc by different teams, can build toward and become embedded in a broader strategy; in addition, it helped us identify new TS capacity-building interventions that could be pursued.

Discussion and conclusion

TS is an emerging field that requires targeted attention to build capacity for its development and its resultant impact on research and health improvement. This is especially important given that biomedical research institutions have traditionally focused on TR, which emphasizes developing interventions to treat specific diseases, rather than TS, which aims to improve the translation of research findings into practice. T-SPARC can guide and clarify how TS capacity-building can take place. It offers a combination of high-level conceptual framing and concrete, actionable directions while remaining flexible enough to reflect the iterative nature of research innovation. The framework is also designed to accommodate the diverse contexts and needs of various institutions involved in TS. Similar to our use, T-SPARC can help teams develop a broader strategy for TS capacity-building and identify new TS capacity-building interventions that could be pursued; it can provide direction for how CTSA hubs can provide direct support (e.g., in mentorship or training, in informing continuous improvement measurement of such initiatives) or can provide influence and advocacy (e.g., institutional tenure and promotion requirements). Beyond TS and CTSAs, this framework's concepts and organization may have relevance for other emerging and transdisciplinary research fields where capacity must be further developed.

While TS is an emerging field, existing infrastructure, programs, and resources can support TS development and should be leveraged. TS capacity-building is a part of broader research capacity-building efforts; TS advancement can thus build on existing research development capacities such as training

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Table 2. Example TS capacity-building efforts / interventions

Possible Intervention	Description	T-SPARC Elements*
APT Guidelines Rewarding TS Research	APT guidelines include recognition for TS research for investigators from varied disciplines.	**Mechanism(primary):** Policies and Processes **Level:** Individuals, Research Institutions **Example short-term outcomes:** Knowledge & Attitudes [increased motivation] and Behaviors [increased TS projects]
Indicators differentiating TR and TS research[6]	Collection of CTSA hubs identified one factor that could be identified using seven specific questions which was able to effectively identify a study focused on TS.	**Mechanism(primary):** Policies and Processes [provides structure guidance to help institutions identify what projects address TS] **Level:** Research Institutions [considering a CTSA hub as a user], Teams [if considering the specific team reviewing proposals] **Example short-term outcomes:** Knowledge & Attitudes [review team's knowledge or whether a research project addresses TS], Behaviors [funding decisions based on TS responsiveness]
Designated funding for TS research[5]	Dedicated pilot and seed funding mechanism to support TS projects.	**Mechanism(primary):** Funding **Level:** Research Institution [for UM1] and Individual [individual TS pilot studies] **Example short-term outcomes:** Knowledge & Attitudes [Increased awareness of TS, improved views of TS as related to one's work], Behaviors [increased pursual of TS research]
Translational Science Educational Retreat[8]	Facilitated retreat to promote a shared understanding of TS across CTSA hubs.	**Mechanism(primary):** Training in TS **Level:** Individuals [informs individuals perspective or knowledge] and Teams [retreats delivered to groups to foster discussion and a shared understanding] **Example short-term outcomes:** Knowledge & Attitudes [increased awareness of TS, enhanced knowledge of TS, improved views of TS as related to one's work, and greater self-efficacy in explaining or engaging in TS]
Research Events/ Symposia	Research events and symposia that highlight and disseminate TS efforts, outcomes, and challenges to the scientific community and the public.	**Mechanism(primary):** Training in TS, Partnerships and collaborations **Level:** Individuals, Research Institutions, Larger Systems **Example short-term outcomes:** Connections [knowledge sharing and trust building with communities], Behaviors [researchers practice community dissemination]
TS Scholar Database	Centralized, online database of individuals conducting or interested in conducting TS, including information about their specific interests and skills.	**Mechanism(primary):** Policies and Processes **Level:** Individuals, Teams, and Research Institutions **Example short-term outcomes:** Resource, Tool, or Infrastructure [creation of database], Connections [database connects cross disciplinary researchers]
Database of External TS Funding Opportunities	Curated database specifically providing information on external (NIH, NSF, foundation) funding opportunities in TS.	**Mechanism(primary):** Policies and Processes **Level:** Individuals and Research Institutions **Example short-term outcomes:** Knowledge & Attitudes [increased motivation for TS projects], Behaviors [increase in TS projects]
Centralized Data Collection	Conduct centralized, institutional surveys to identify barriers and roadblocks to translation. The results of these surveys become preliminary data for identifying TS research questions.	**Mechanism(primary):** Policies and Processes **Level:** Research Institutions **Example short-term outcomes:** Resources, Tool, and Infrastructure [new mechanisms for identifying TS needs], Knowledge & Attitudes [institutional knowledge on TS gaps/ opportunities]
TS Specific Cores	Fund and support a core specifically focused on disseminating and implementing TS discoveries at scale at the home institution and beyond.	**Mechanism(primary):** Policies and Processes; Funding; Partnerships and Collaborations **Level:** Individuals, Teams, and Research Institutions **Example short-term outcomes:** Connections [dissemination efforts lead to new connections/ partnerships], Knowledge & Attitudes [increased motivation to implement TS discoveries, increased knowledge by dissemination efforts], Resource, Tool, or Infrastructure [TS discoveries may lead to new resources], Behaviors [funding leads to more TS efforts]
TS Roadshows	Develop and present 1-hr presentations on TS at department and team meetings.	**Mechanism(primary):** Training in TS **Level:** Individuals and Teams **Example short-term outcomes:** Knowledge & Attitudes [better understanding / increased awareness of TS]

APT = Appointment, Promotion, and Tenure; TS = translational science; TR = translational research; CTSA = Clinical and Translational Science Award; NIH = National Institutes for Health; NSF = National Science Foundation. *We do not include next-step and ultimate outcomes here as those may vary based on specific focus of an initiative and could converge across initiatives/ programs.

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programs, organizational support structures, or internal funding mechanisms. TS concepts can be integrated into existing initiatives (such as embedding TS knowledge into existing training modules), or existing infrastructure can be used to design new, TS-specific programs (e.g., creating a dedicated TS training program based on other successful training initiatives). Additionally, existing institutional efforts to foster a culture of learning, innovation, and transdisciplinary collaboration in research can provide a solid foundation for TS advancement. Fields such as psychology, sociology, economics, and business disciplines (e.g., operations management), as well as work in areas including health systems research, implementation science, science of team science, and evaluation often have content that aligns with TS. Work within these fields can play a vital role in shaping TS practices and supporting its capacity-building efforts. Moreover, even if not explicitly labeled as "TS," some current research infrastructure or funding mechanisms may be advancing the goals of TS [19–21]. For instance, TS involves facilitating application of research findings to real-world settings; culture and diversity considerations help ensure treatments are effective across diverse populations, so existing capacity-building in these areas may support TS. It is important to identify these existing resources and, where possible, overtly frame them as TS-aligned to foster recognition and growth within the field. Finally, TS-aligned efforts and capacity-building opportunities should incorporate investigators and personnel across varied backgrounds and lived experiences, as well as diverse institutional roles and disciplines, given the value of multiple perspectives in informing this still-developing field.

While T-SPARC provides a foundation for TS capacity-building, we anticipate the advancement of new TS capacity-building efforts, and resultant additional practices and knowledge, could help to advance the framework itself. This is consistent with framework development as a norm, including in TR and TS; for instance, the NCATS TS Principles had shifted to incorporate an added principle as of Fall 2024 (adding "Diversity, Equity, Inclusion, Accessibility," moving from 7 to 8 principles (note that this principles was then removed in early 2025), and the TSBM has been amended in a similar fashion [22]. Furthermore, T-SPARC's guidelines for evaluation and measurement are not exhaustive and will require further development. We encourage the continued refinement of evaluative practices and the systematic evaluation of TS capacity-building initiatives to optimize and scale successful strategies. Selected related efforts underway, such as the a current NIH NCATS-supported working group aiming to develop a TS competency-based assessment tool for training of translational scientists [23,24]. Moreover, the framework focuses specifically on TS capacity-building; ongoing work should focus on ways to define, measure, and assess TS innovations' impacts on research and its role in improving health.

Supplementary material. The supplementary material for this article can be found at https://doi.org/10.1017/cts.2025.10056.

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