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Training the translational workforce: Expanding beyond translational research to include translational science

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Education Perspective

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Established in 2006, the national consortium of the Clinical and Translational Science Awards (CTSA) Program funded through the National Center for Advancing Translational Sciences (NCATS) seeks to accelerate the translation of discoveries into solutions to improve human health. From the start, developing and retaining a diverse, well-trained workforce was a key priority for the CTSA program.[1] Much of the initial work at CTSA hubs (CTSA grant-funded centers or institutes) focused on establishing and refining master's degree programs in clinical and translational research, each with their own requirements and focus areas. In 2011, in recognition of the need to establish a more consistent approach to equip trainees – such as junior faculty having mentored career development awards (KL2 scholars) and pre- and post-doctoral trainees participating in National Research Service Award training programs (TL1 trainees) – with the knowledge, skills, and abilities to participate in or conduct clinical and translational research, the CTSA Consortium defined a set of 97 core competencies categorized into 14 domains for Master's degree program curricula.[2] A recent study by Pusek *et al.* from a CTSA-supported working group describes an approach to tailor and prioritize the original set of 97 competencies,[3] which ranged from research methodology/study design, responsible conduct of research, and research operations to community engagement and cultural diversity. In addition to Master's programs, more streamlined curricula in the form of certificate programs have proliferated at many CTSA hubs. Moreover, a recent cross-sectional survey identified that several hubs have created new PhD programs after receiving CTSA funding.[4]

The main focus of these training competencies has been on clinical and *translational research* – defined by NCATS as the endeavor to traverse a particular step of the translation process for a particular target or disease – as opposed to on *translational science,* the field of investigation that seeks to understand the scientific and operational principles underlying each step of the translational process.[5] In this Perspective, we compare the set of characteristics identified for CTSA-affiliated translational researchers with those proposed for the discipline of translational science and offer suggestions for how the current CTSA training programs might be expanded to include both.

As thought leaders conceptualize the discipline of translational science, a vision of the ideal translational scientist has emerged as an investigator who focuses on the translational process per se and evaluates complex factors that impede or facilitate medical interventions. A recent commentary proposed a set of seven characteristics fundamental to translational scientists: (1) boundary crosser; (2) domain expert; (3) team player; (4) process innovator; (5) skilled communicator; (6) systems thinker; and (7) rigorous researcher.[6] This vision of translational scientists contrasts with that of translational researchers, who more often focus on a disease or content-specific area of investigation and/or adopt a particular phenotype (e.g. clinical investigator or data scientist), although phenotypes can certainly evolve across a career.

In truth, there is substantial overlap between the competencies identified for clinical and translational research training through CTSA-supported programs and the key characteristics for translational scientists, with both necessitating rigorous translational research training, domain expertise, mastery of team science, and communication skills (Fig. 1). More unique to the translational scientist skillset are boundary crossing – that is, breaking down silos and collaborating across disciplines and professions to expedite development of medical interventions – process innovation, and systems thinking that yields what has been termed a "multiplex outlook" focused on the underlying process of translation. This last skill perhaps highlights the fundamental difference in competencies: translational research trainees learn to conduct translational research, whereas translational science trainees study the process of translation.

Given the current focus of CTSA training programs, how can they evolve to more effectively support training in translational science? Should translational science training programs – introductory or comprehensive – add an emphasis on translational science? If so, to what extent?

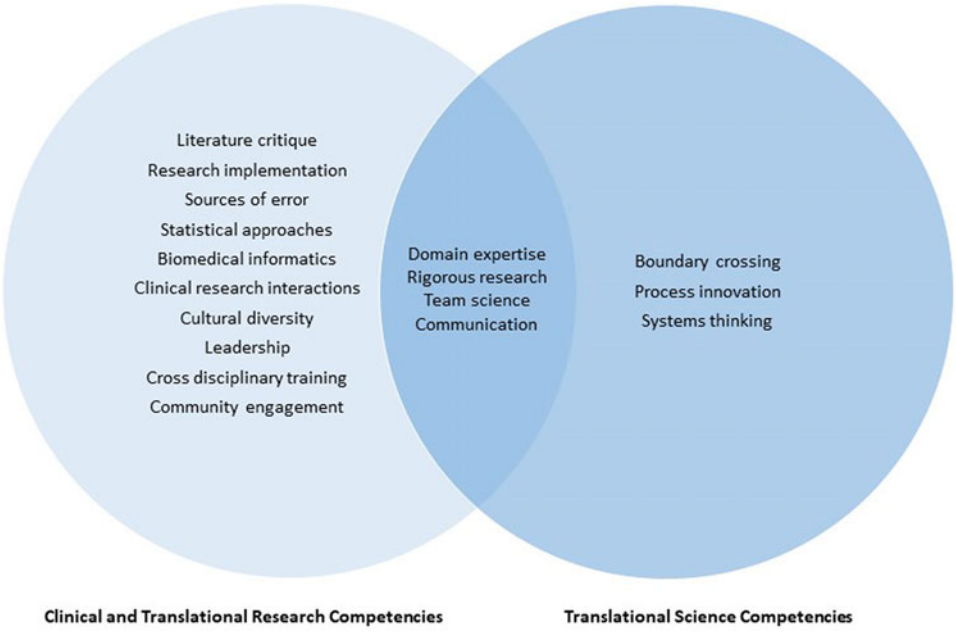

Fig. 1. Competencies for clinical and translational research vs. translational science. Adapted from references 2 and 6.

Which new translational science competencies (e.g., those related to systems thinking) would need to be defined and taught? And are there perhaps other new competencies that should be covered in certain programs? For example, dissemination and implementation is a core competency for translational research, and research communication is a core element of both translational research and translational science because evidence-based medicine is often adopted at glacial speed.[7,8] In contrast, scientific misinformation (e.g., regarding vaccination and stem cell therapies) travels at Internet speed.[9-12] And still other health-related recommendations, such as whether to take aspirin for primary prevention of cardiovascular disease[13,14] or whether eating eggs[15,16] or red meat is harmful, seem to be cyclical, engendering confusion at best and mistrust of science at worst.[17] As Arthur D. Little stated nearly 100 years ago, "In the past the world suffered grievously from lack of knowledge; today it suffers from its rejection or misapplication."[18] Should training programs, then, teach translational research and translational science trainees not just to communicate and implement evidence-based information but also to combat health misinformation[19] and to explain the iterative and sometimes cyclical process of science?

One potential strategy would be to direct portions of each CTSA hub's workforce development, KL2, or TL1 budgets to developing lectures, modules, certificates, or externships not only in translational research but also in translational science. Alternatively, because developing new curricula and training programs at each CTSA hub is inefficient and perhaps not feasible, especially for a new discipline with relatively few mentors, the CTSA Consortium could share course offerings and co-create courses among its hubs. Certain TL1 programs and translational science PhD programs may be well positioned to lead the effort. This effort could be supplemented by incorporating material developed by the growing global community of organizations dedicated to translational science.[20]

These and other issues need to be addressed as the field of translational science matures and distinguishes itself from, yet complements, its slightly older sibling, translational research. The immediate challenge is to develop these core materials to assist trainees and scholars to better understand the scientific and operational principles underlying each step of the translational process in the context of their research projects. Ultimately, promoting the science of translation stands to improve the translational process for all engaged in clinical and translational research.

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