

National Institutes of Health (NIH)
National Center for Advancing Translational Sciences (NCATS)
TRANSLATIONAL SCIENCE EDUCATION ROUNDTABLE

March 10–11, 2022, 1–4 p.m. EST

Purpose

This virtual roundtable was designed to explore the current state of translational science education and training and discuss the needs and opportunities for future educational activities. Invited discussants provided diverse perspectives on these topics based on their experiences in leading research, education and training activities across the translational spectrum.

The invited discussants were as follows: Michelle Arkin (University of California, San Francisco); Miriam Bredella (Harvard); Nora Disis (University of Washington); Tim Foley (Pfizer); Ken Getz (Tufts); Marcie Glicksman (EnClear Therapies); Andrew Lo (Massachusetts Institute of Technology); Ewy Mathé (NCATS); Wayne McCormack (University of Florida); Keith Norris (University of California, Los Angeles); Debra Regier (Children’s National Hospital); Caleb Smith (University of Michigan); Edwin van Wijngaarden (University of Rochester); and Annica Wayman (University of Maryland, Baltimore County). Additional NCATS staff attended in a listening capacity.

Day 1: March 10, 2022, 1–4 p.m. EST

Introduction

Jessica M. Faupel-Badger, Ph.D., M.P.H., Director, Education Branch; Office of Policy, Communications and Education, NCATS

Joni L. Rutter, Ph.D., NCATS Acting Director

Marie A. Westbrook, Ph.D., Principal Director and Workshop Moderator, Inspire Concepts LLC

Marie A. Westbrook, Ph.D., and Jessica M. Faupel-Badger, Ph.D., M.P.H, welcomed participants to the roundtable and thanked the organizers for planning the event. They described the four areas of focus for the day and emphasized that the dialogue at this event is intended to incorporate diverse points of view.

Joni L. Rutter, Ph.D., NCATS acting director, outlined the challenges facing the translational research field, including operational, administrative and scientific bottlenecks in the translational pipeline. Rutter described several NCATS efforts to address these challenges, including the investigation of diseases through studying their commonalities (i.e., the “more than one disease at a time” approach); formation of public-private partnerships; and use of platform-based approaches for accelerating research. She concluded by noting that translational science is solution-focused team science. For translational science to be successful and impactful, this knowledge around how to produce solutions to challenging problems in translation must be formalized and conveyed to others. Rutter requested that participants provide innovative ideas for training the next generation of translational scientists in response to the following questions:

- How would teaching the principles of translational science augment core competencies that have been identified?

- How do we turn core competencies and principles for translational science into consistent components of training and education for the next generation of translational scientists?
- How do we share knowledge that addresses the vast preclinical and clinical translational science pipeline?
- How do we innovate on and better coordinate training?
- How do we reach the full breadth of the translational science workforce with our education activities?

Faupel-Badger described the NCATS Education Branch, which was established in 2019 and provides leadership and coordination for translational science education activities across the Center, with the goals of improving the understanding of translational science, developing and disseminating evidence-informed tools and practices, and expanding and diversifying the translational science workforce. She shared that a focus of translational science is understanding scientific and operational principles that can be applied to enhance the speed and impact of the translation process. Faupel-Badger noted NCATS' efforts to identify crosscutting principles and approaches for solving generalizable translational challenges. She provided several research examples highlighting where these principles have been implemented and noted that these principles are featured in online translational science courses developed by NCATS and have been used to examine the peer-reviewed literature on translational science education and training. Faupel-Badger reiterated Rutter's charge for innovating thinking in training translational scientists.

Westbrook asked the invited discussants to introduce themselves and describe the present state of translational science education in a single word. Participants responded with such words and phrases as "collaboration," "maturing," "rigorous," "momentum building," "gap bridging," "metamorphosing," "resilient," "qualitative," "timely," "late" [referencing career stage for training], "evolving," "on the upswing," and "inflection."

Panel 1: Promoting an Understanding of the Benefits of a Translational Science Approach

Lead discussants: Nora Disis (Chair), Michelle Arkin, Ken Getz, Keith Norris, Debra Regier and Caleb Smith

Focus: Discuss how translational science is being conducted and how it could be used to generate content for education activities.

Questions posed to panel:

- How are we currently distilling generalizable translational science knowledge from our research experiences? What would enhance this work?
- How are we documenting experiential translational science knowledge to demonstrate the benefits of translational science approaches? What additional approaches could be used effectively?
- How is our knowledge of effective translational science practices and principles being conveyed? What additional opportunities could we leverage to advance dissemination of translational science practices and principles?

Panelists discussed the gaps and challenges in promoting translational science, including:

Visibility and the value of clinical and translational research and translational science

- Noting the recent progress in raising the awareness of clinical and translational research and the interest among graduate students and other early-career scientists, recognizing that many people pursue research careers because they want to help people.
- Certain outcomes of translational research often are undervalued by academic institutions. There is a need to define career paths and products of translational research, with such examples as toolkits and apps being highlighted, in addition to high-impact publications. There also is a need to value team science and team science contributions, especially in an academic environment.

Education and training to advance science along the translational spectrum

- Recognizing that many individuals are doing translational research within a given project and leaving a lot of research “on the table” with regard to translational science, including developing standard operation procedures, processes, and guidelines and approaching this with as much rigor as the initial project. These products convey information others need and are publishable. Scientists need to document and publish this “lost” information, recognizing that there are many different paths to solving a translational problem and the information about the steps and processes along the way can be just as valuable as the answer to the initial research question.
- There is a need to teach scientists that they can do translational science concurrently with their research in a given area.
- There is an interdependence in translational science across all levels — domain areas, teams, translational phases and community groups. Researchers need to be aware of and keep this interdependence in mind.
- Researchers must be educated on how to think translationally. The burden of the next translational step is on the upstream user. Information is published in journal articles but needs to be framed for the next user. There is a need to train people to think about how their work will be used 10 years from now and to highlight the applications of their work in their papers and other products.
- The ability to communicate and understand information from various disciplines is key to success in translational research. Individuals need to share their research knowledge more broadly with those across the translational spectrum for the research to advance. This collaboration is happening at the local level, but we need to create national communities of practice where this knowledge can be exchanged.
- The amount of information trainees receive can be overwhelming but also can be navigated with the help of mentor relationships and research communities. At the same time, there is a need for a canon to help establish the field of translational science, and these canonical resources, along with publications, should be established and disseminated.

Defining success and quantitative metrics for translational steps

- Quantitative metrics for the identification of translational steps (aided by natural language processing and other forms of artificial intelligence [AI]) will be essential for a rigorous systems science approach.
- Defining success in the early stages of translational research can be difficult because drug discovery efforts generally are distinctive and bespoke.

Patients and the public as part of the translational workforce

- Researchers need to be trained on ways to engage patients and the general public as members of the translation workforce; this level of transparency will help build trust with patients and within communities. Patients also are the experts in their disease and can bring valuable insight to the research.
- There is engagement with patients but less so with communities. There is a need to have broader outreach to community partners and authentic engagement with communities.
- The research community is making progress, but there is a need to better distill findings and communicate results in plain language for patients and treating physicians. Patients need credible and coordinated information resources. They also want more transparency and control of how their data will be used.
- Researchers sharing information about translational science with the public have an ethical responsibility to ensure that the research is presented in ways that are both accessible and accurate.
- Although translating research for lay audiences is important, education also can be provided to communities to raise their level of knowledge and awareness.

Panel 2: Disseminating Translational Science Knowledge in Current and Future Education Activities

Lead discussants: Wayne McCormack (Chair), Miriam Bredella, Tim Foley, Marcie Glicksman, Ewy Mathé, Edwin van Wijngaarden and Annica Wayman

Focus: Discuss how to incorporate teaching translational science approaches into current and future education and training activities.

Questions posed to panel:

- How can we advance the understanding of the benefits of translational science approaches through education activities?
- How can we incorporate translational science approaches and principles into the range of translational science knowledge and skills currently being taught?
- What new education activities are needed to further develop translational scientists (across career sectors and education and training stages) or to allow individuals to bring a translational science lens to their current work?

Panelists discussed various aspects of effective translational science education, including:

Observations about education and training in translational science

- Observations from a national survey of TL1 training programs, noting that such programs focus on training in translational research rather than translational science.
- For graduate education and training, translational scientists will be required to work within teams, and thus, their dissertation work should include being trained as part of a team. Graduate students also need to understand the process before they can become system innovators. Programs tend to emphasize the diversity of projects rather than diversity in translational phases or incorporating the full translational spectrum.

- The concept of translational research can be expressed using other phrases (e.g., the drug discovery and development process) that include activities sometimes omitted from translational science discussions (e.g., manufacturing, regulation).

Formal education challenges

- Disease-agnostic translational research might not capture the interest of trainees in the same way that single-disease science does, especially at the undergraduate level. The concept of translational science needs to be more tangible for students; they may grasp the concept better when thinking about how it can be applied to a specific disease.
- The lack of information about how the fields of science interplay with one another is a major gap in current undergraduate education programs. Dual mentorship or team mentorship is important at all stages for research to cross multiple translational phases.
- Universities are organized around specialized fields, whereas research groups are organized around problem-solving. This difference becomes apparent when merging both elements in translational science education. There are also barriers to launching formal degree-granting programs compared with certificate programs or other credentials or experiences.

Interdisciplinarity

- Students should be trained early in basic principles (e.g., biology, computational science) to build a foundation for later understanding the principles of interdisciplinary translational science.
- Translational science education covers broad topics and may conflict with the narrow focus of other programs. Merging subject-matter expertise into a curriculum covering these topics in sufficient breadth and depth is a challenge.
- Translational science education requires a breadth of knowledge (e.g., biology, biochemistry, data science, bioinformatics, statistics, biochemical engineering, biomanufacturing, ethics). The experiential and team aspects of translational science education should be accentuated. Trainees should be exposed to diverse activities and mentors, including clinicians and partners within industry and regulatory agencies.
- Opportunities for co-mentorship can be leveraged within cohorts of students with different scientific backgrounds. Exposure to people across fields and institutions can encourage creative thinking.
- Team science training can benefit not only the students but also the mentors, with research collaborations existing after individual students exit a program.

Specific skills

- Informatics education is critical for understanding translational research. Consideration of data input (e.g., data standards, processes, annotations, ethics) should be equal to or surpass that of data output. Negative data should be shared.
- Education should include the business of science and treat translational research as product development. The product is not necessarily a publication.
- Such skills as effective leadership and effective interdisciplinary science communication are essential for translational research.

Technology, opportunities and availability of education activities

- Virtual technology can enable opportunities for education and collaboration.

- Opportunities for self-directed learning need to include a variety of resources, such as online videos and webinars, hands-on education activities and funding programs. A resource for finding translational science mentors would be particularly useful.
- Translational science courses can be designed to address a translational science problem. It may take multiple courses or cohorts to develop solutions to the problem.
- Education opportunities need to incorporate principles of adult learning, including the need for people to know what is in it for them and to learn by doing.
- Resources are not equal at institutions across the country. Educational outreach efforts should be mindful of such disparities.
- There is a need to facilitate connections or networking opportunities between people with different backgrounds and translational products and to cultivate opportunities for early-career scientists from diverse fields to engage with each other.

Day 1 of the meeting was adjourned at 3:58 p.m. EST.

Day 2: March 11, 2022, 1–4 p.m. EST

Day 1 Summary

Marie A. Westbrook, Ph.D., Principal Director and Workshop Moderator, Inspire Concepts LLC

Marie A. Westbrook, Ph.D., noted that the previous day’s discussions identified both advantages and challenges in translational science education, although the challenges were listed more frequently. They fell into three distinct areas: culture change, communication and integration, and outreach.

Westbrook and discussants noted several observations with respect to the previous day’s discussions:

- Several discussants noted that having more challenges and opportunities than advantages to leverage is to be expected in an interdisciplinary and emerging field that spans multiple levels, such as translational science. These challenges, however, are balanced with optimism about the direction of the field.
- There is a need to heighten translational science knowledge and disseminate this nationally.
- Many translational research education resources already have been established. The present challenge is harnessing and disseminating national resources rather than duplicating them.
- Translational science is a mindset, and producers (of products and knowledge) need to think about “markets.”
- The ultimate goal of translational science is to improve human health, which requires advancing the research along the translational spectrum and engaging both other researchers and the public in this process. Translation goes beyond publishing research findings.
- The topic of early-stage compound design and discovery was not captured as richly as later processes in translational research. There was discussion of determining where translation starts — both from individual and institutional perspectives.

- One challenge that was not mentioned the previous day is how to define the translational workforce. There is a need for more clarity about translational research and translational science while also creating a broader tent for how people envision themselves as part of the workforce. Participants noted the reason many people enter biomedical education and training programs is broadly “wanting to help people.”
- Many people are doing translational science; we have to help them recognize and articulate this.

Panel 3: Building and Expanding the Translational Science Workforce Through New Education Activities

Lead discussants: Annica Wayman (Chair), Miriam Bredella, Ewy Mathé, Keith Norris, Wayne McCormack and Edwin van Wijngaarden

Focus: Discuss who we are reaching with current education and training opportunities and expanding the audience for translational science education.

Questions posed to panel:

- Who currently has access to translational science education and training? Who are we not reaching with our current education and training activities?
- What are the barriers to reaching these audiences?
- What are possible strategies to overcome these barriers or, otherwise, reach these audiences?
- Participants discussed the challenges and opportunities related to educating the translational science workforce, including:

Career paths and workforce needs

- The goal of translational science is to increase the efficiency of translational processes; therefore, partnering with companies and federal or regulatory agencies would help with expanding these educational opportunities. The educational needs of the translational science workforce vary by sector. These disparate needs intersect, for example, when undergraduate students with interdisciplinary translational science training enter graduate school or join the private sector. Companies are establishing translational science teams that are capable of bridging fields and sectors. Companies also are embracing the disease-agnostic approach to treating disease and will shift their training accordingly.
- Early-career researchers are being educated about translational research effectively; more efforts should be focused on undergraduate students, who are unclear about career paths in translational science, and late-career investigators, who might not have time for additional training. Translational science education is easier to provide earlier in the education process.
- Community colleges can provide translational science education, and programs are being developed in association with these institutions. Hiring requirements should change to enable people with associate degrees to obtain jobs in research, which will increase workforce diversity and ease the difficulties associated with career transitions.
- Individuals who are skilled in interdisciplinary or systems thinking should be engaged in all avenues possible. The workforce should aim to attract diverse people (e.g., promoting interactions with high school or undergraduate students, night classes to accommodate people with day jobs).
- Many academic researchers still have a bias against non-academic career pathways.

- Translational science outcomes will build acceptance. There is a need to educate colleagues on translational science and these outcomes.

Interdisciplinary emphasis of translational science and team science

- Early practical experience and interdisciplinary interactions (e.g., shadowing) will help engage and educate young people and motivate them to join the workforce.
- Such concepts as team science and the difference between translational research and translational science should be incorporated into translational science education.

Education opportunities and challenges

- Academic credentials associated with translational science might increase participation in translational science. However, increasing the amount of structured training that is necessary to join the translational science workforce will reduce workforce diversity. Not everyone has the resources or opportunities to acquire this training.
- Education should incorporate communication and operational skills, in addition to scientific components. Business education also should be integrated, which can be facilitated by engaging with business and law schools on campuses and with technology transfer offices. Investigators also can collaborate with industry. Larger institutions — such as NCATS — can facilitate these connections, especially for universities that are not as well connected to industry.
- Personal stories are powerful and useful for engaging and inspiring audiences in educational settings. Former students can be leveraged as invited speakers to share their experiences of pursuing careers in translational science.
- Translational science is a lifelong marathon that spans multiple disciplines. No single person ever will be an expert in all aspects of translational science. Communication skills are critical for collaborations.

Connections with patients and the public

- Education should include collaborations with the public and opportunities to connect with lay audiences, which might include workshops on disseminating science and the use of social media. With virtual meeting capabilities, knowledgeable and invested global communities (e.g., patient groups) also can be engaged.
- Patients are invested in translational science and are deeply knowledgeable. They can be incorporated into the translational science community, and their perspective can be useful in informing ethical decisions and developing implementation science and health policy.
- Connections fostered among various groups (e.g., patients, physicians, students, academic researchers, industry scientists, philanthropists) will establish mutually beneficial educational opportunities. For example, patient groups can provide researchers with insight into disease pathology, and pharmaceutical companies can guide researchers through regulatory hurdles.

Panel 4: The Future of Translational Science Education

Lead discussants: Andrew Lo (Chair), Michelle Arkin, Nora Disis, Tim Foley, Ken Getz, Marcie Glicksman, Debra Regier and Caleb Smith

Focus: Explore new trends that have implications for translational science education.

Questions posed to panel:

- What trends or changes in medical research and/or health care do we think will create opportunities for a deeper understanding and/or utilization of translational science approaches?
- How do we position ourselves to push new areas, think of new spaces and maneuver new technology to advance translational science faster?
- What have we not covered today that we need to consider for future translational science education needs and opportunities?

Panelists shared the following ideas about the future of translational science education:

- A foundational step for any discipline is the establishment of functional shared definitions. The present definition of translational research encompasses information that often is impossible to discern (e.g., intentionality on behalf of the investigators performing the research, future applications of the research).
- Translational research and science occur at interfaces among different research communities (e.g., scientific areas, phases of translation). Mapping these networks will provide useful diagnostics, metrics and definitions. The translational landscape could be transcribed into a connectome similar to The Cancer Genome Atlas and other web-based visualization and analysis tools. This connectome could help identify the strengths and gaps in the communities.
- Studies have shown that people employed in the compliance and finance sectors are likely to experience burnout; new technologies have been implemented to try to mitigate this problem. New technologies (e.g., AI, machine learning [ML], natural language processing) should be leveraged to ease the administrative burden of those employed in translational science. These technologies also must be employed to manage the vast quantities of data gathered for translational research.
- Data science should be built into translational science education. Integrating data science and personalized medicine through wearables is one example of a future trend in this area. Generated data should be usable for AI/ML, and the availability of these data should be advertised.
- Educational resources should be established to reach wide audiences; these resources will aid in integrating and standardizing knowledge. Comprehensive, on-demand, self-directed educational resources will enable researchers to learn at their own pace. Virtual resources provide an opportunity to reach broader, more diverse audiences. NCATS can contribute to addressing this need.
- Funding mechanisms in academia are not conducive to the sustained interdisciplinary efforts required for translational research and team science conducted within academic settings. More diverse sources of extramural funding are needed.
- Siloed institutes and disciplines impede translational science. Cross-institute translational science efforts and education should be expanded.
- Social media, virtual meeting technology and cloud-based platforms can be used to disseminate information to prioritized groups (e.g., patients, treating physicians, students) and convene disparate groups.
- NCATS is well positioned to facilitate efforts to connect parties that otherwise would not have had a chance to engage with one another. NCATS' involvement is especially important for institutions that do not have available access to business and entrepreneurial resources.
- Other schools and disciplines have researchers and practitioners who have a broad understanding of therapeutic treatments. These areas should be included in translational science efforts.

- Translational outcomes could be conceptualized as mini-breakthroughs or microsolutions that could be articulated (translational moments of significance) rather than waiting for more distant outcomes of clinical implementation or public health intervention.
- There is a need to quantify translational steps. For example, the import and export of knowledge (as the product) among communities can be studied.
- As noted previously, current training programs focus on clinical and translational research, with less emphasis on translational science. The emphasis on translational science may vary by career stage. Clinical and translational research is needed to identify successful translational approaches that could be applied more broadly. Clinical and translational researchers should be attuned to the broader translational science aspects of their work.

Faupel-Badger thanked the discussants for participating and noted the passion and energy that they brought to the roundtable discussions. She and Westbrook thanked the event organizers for their efforts.

The meeting was adjourned at 3:49 p.m. EST.