CAMBRIDGE
UNIVERSITY PRESS

Building strong health and career trajectories through translational research

M. Elizabeth O'Leary[1] ●, Marina White[2], Julie Nihouarn Sigurdardottir[3], Hailey Scott[2], Angela Marcela Jaramillo-Ospina[4], Shameena Bake[5] and Kristin L. Connor[2] ●

[1]Department of Psychology & Neuroscience, Dalhousie University, Halifax, Canada; [2]Department of Health Sciences, Carleton University, Ottawa, Canada; [3]Department of Forensic and Neurodevelopmental Sciences, Institute of Psychiatry, Psychology & Neuroscience, King's College, London, UK; [4]Department of Psychiatry, Faculty of Medicine, McGill University, Montreal, Canada and [5]Department of Neuroscience and Experimental Therapeutics, School of Medicine, Texas A&M University, Bryan, USA

Abstract

Translational research (TR) is the movement of fundamental scientific discoveries into healthcare settings and population health policy, and parallels the goals of DOHaD research. Unfortunately, there is little guidance on how to become a translational researcher. To understand the opinions of DOHaD trainees towards TR, we conducted a workshop at the DOHaD World Congress 2022. We found that trainees were enthusiastic for their work to have translational impact, and that they feel that holistic, multidisciplinary solutions may lead to more generalisable research. However, there lacks support for TR career pathways, which may stall the execution of the long-term vision of the DOHaD agenda. We put forward recommendations for trainees to clarify their purpose in pursuing TR and for seeking relevant people and patronages to support their training paths. For mentors, training institutions, and scientific societies, we recommend developing TR-specific programmes, and implementing training opportunities, networking events, and funding to support these endeavours.

Introduction

Developmental origins of health and disease (DOHaD) research is inherently multidisciplinary in nature, comprising efforts from fundamental through to human clinical and social sciences. A major aim of DOHaD research is that sound scientific evidence culminates in improved lifecycle health and policy for societal impact. This aligns closely with the aim of translational research (TR). Translational research is required for lifecycle health promotion and disease prevention because, despite increased knowledge on early influential factors and later health and disease trajectories,[1,3] we have not observed a similar increase in implementation of this knowledge into health care or policy.[4] Translational research offers an opportunity to bridge research gaps that arise from traditional scientific approaches, thus maximising the potential for scientific findings to reach the population(s) that can most benefit from the discoveries. In practical terms, a translational approach focuses on systems-level understanding of (complex) problems and the ability to pursue a holistic vision.[5,6] This can contribute to forward movement on "wicked" problems, although a TR approach alone will not completely solve all grand challenges. Despite the need for more TR, there is a dearth of talent with unique skills to understand and undertake this type of work, largely because the training opportunities designed for pursuing TR and career paths are lacking. Just as TR provides a systems-level understanding of research problems, there must be a systems-level approach to training future translational researchers

Here we bring attention to the importance of TR in a lifecycle approach to health and the challenges and opportunities facing trainees interested in becoming translational researchers. We feel strongly that TR should be a focus for DOHaD trainees, as collaboration in multidisciplinary teams can lead to diverse skill development, broader networking opportunities, and ultimately, novel solutions for health promotion and disease prevention across the lifecycle. Through a workshop presented at the DOHaD World Congress 2022, and supported by prior literature, we sought to understand trainees' motivations for pursuing TR, their perspectives on the advantages TR holds over traditional research approaches, and the challenges faced as a trainee in this field. Further, we aimed to identify opportunities to improve the research training pipeline and career lifecycle for those interested in TR, and make recommendations to meet these goals at the level of the trainee, institution, and scientific society.

What is translational research?

Translational research is the movement of fundamental scientific discoveries into practice/policy/societal impact.[7] Translational research involves taking findings from fundamental science (e.g., cellular and animal models), and translating those studies into research involving people with lived experience, followed lastly by mobilisation and dissemination to stakeholders, such as patients, families, communities, caregivers, and policy influencers.[7] Evidence from TR has shown how excessive and persistent adversity early in life can overload biological systems and have long-term consequences for an individual's health,[8,9] and the resulting implications for health care and policy.[10] Translational research ultimately supports an environment of innovation by bringing together a community of stakeholders across disciplines and sectors, and with varied experiences, to ask new questions, develop and test new ideas, and implement and evaluate these, in an effort to solve complex problems.

Why is translational research important for (lifecycle) health?

A multidisciplinary approach is important for health research because it engages researchers and other stakeholders beyond traditional disciplinary silos. This process helps develop new or reframed questions about complex health challenges, and application and integration of advanced and varied research methods.[11] Ultimately, this supports the execution of thorough, multi-faceted studies.[12] Eventually, such studies and teams improve disease prevention, expedite diagnosis/treatment,[11] and enrich population health.[12] Further, evidence from the National Center for Advancing Translational Sciences transformative research programmes demonstrates the role that TR can play in reducing systemic bottlenecks.[13] A key barrier to implementing research findings is uptake by professionals and policy makers.[7] Minimising these bottlenecks helps to boost innovations that support public health demands.[13]

What does a translational researcher look like?

A proposed set of traits has been suggested as important for a researcher to possess to be effective at TR including: boundary crosser, domain expert, team player, process innovator, skilled communicator, systems thinker and rigorous researcher.[5] While any of these competencies could apply to a skilled investigator, it is the full range of these skills, possessed by one individual, that is crucial to TR.[5,13]

Current challenges

Traditional training programmes (typically at the graduate and postdoctoral levels) are often not tailored to TR career paths, and there is not a singular path one can follow to become a translational researcher, which further obscures this career trajectory.[13] With uncertainty surrounding how to approach a TR career pathway, research continuity and implementation may be reduced, ultimately compromising research impact. Knowing that TR is important to DOHaD research, we wanted to discuss what current trainees in DOHaD thought about TR and their ideas on how they can best be supported by their mentors, institutions, and societies.

Methods

A workshop titled *Building strong health and career trajectories through translational research* was developed and led at the DOHaD World Congress 2022 in Vancouver, British Columbia (by KLC). During the workshop, trainee/early career participants (predominantly graduate-level, however, participants ranged from undergraduate to new professors) first discussed the core skills required to be a translational researcher in DOHaD. Then, participants were asked to brainstorm around the following key questions: (1) What motivates our curiosity about TR and our desire to do this type of work? (2) What are the advantages of TR, over what you/we normally do to solve health and scientific problems? (3) What are the advantages of careers in/related to TR, over careers in fundamental or clinical research? (4) What are the challenges to doing TR? (5) How can your mentors and this society (DOHaD International Society) better serve you to engage in this research and/or build a career in/adjacent to TR? (6) Practically speaking, how do you do TR in DOHaD/lifecycle health? Notes were captured by five anonymous notetakers. Participants were also given questions to reflect on why they were interested in becoming translational researchers and how mentors in DOHaD research areas can support those who want to be translational researchers. The notes captured during the workshop were then independently reviewed by three co-authors (MW, AMJO, SB), who identified and synthesised key themes that emerged in response to each brainstorming question. Participants were aware they were in an interactive session where anonymized discussions/notes would be captured and may be collated in a meeting summary for publication, and were invited to participate in the summary write-up.

Results

Skills required to be a translational researcher in DOHaD

Workshop attendees first discussed the foundational skills required for TR in DOHaD, which we summarised into six categories (Fig. 1a). The core skills for TR identified during the workshop included being **an associator**, defined as the ability to conceptualise and understand challenges as multi-level and interconnected complex systems, and being a **knowledge mobiliser**, who can communicate scientific findings in accessible and useable ways to inform decision making. **Disciplinary expertise** in a relevant research area and the **ability to work at the interface** of at least two fields, as well as **interdisciplinary thinking skills**, were also highlighted as key skillsets for TR. Lastly, being a **collaborative** individual who values input from, and works well with, diverse and multidisciplinary teams, and being **adaptable and resilient** throughout a career path that is not typically well-worn, were also noted as key skills for TR. These skills are in alignment with, yet extend, core competencies previously identified.[14]

Trainee perspectives on translational research from breakout group discussions

Four categories emerged from the six questions posed to workshop attendees: (1) Motivation to pursue TR, (2) Advantages of TR, (3) Challenges of TR, and (4) Supports needed for TR trainees (Fig. 1b).

Trainee motivations to pursue TR included a desire to ensure their work has an impact, and an interest in seeing their research findings be implemented (i.e., ensure their work has maximum meaning). Trainees also expressed an interest in solving complex issues through multidisciplinary collaboration that incorporates equity, diversity and inclusion (EDI) principles.

Figure 1. Trainee perspectives on translational research in DOHaD. (*a*) Skills required to be a translational researcher in DOHaD. (*b*) Trainee perspectives on translational research, generated through breakout group discussions at the DOHaD World Congress 2022 trainee days. EDI, equity, diversity, and inclusion; TR, translational research.

When discussing the advantages of TR, trainees noted that TR could provide a quicker route to problem-solving if implementation is considered from the beginning of the research pipeline. Multidisciplinary teams/large collaborations may lead to better solutions (or may even be required to find solutions) and more widely translatable (or generalisable) research. These multidisciplinary teams could result in greater creativity in approaching research questions (because of the scope of research focus and the diverse collaborations). Lastly, there may be opportunities to seek

grants from multiple sources (depending on how the application is packaged).

Considering challenges in TR, trainees expressed that their departments and/or fields are often sequestered, resulting in difficulties finding a position that fulfils their interest in multidisciplinary science and TR. Additionally, it was noted that it can be challenging to find a programme/supervisor who can train across fields or who engages in TR themselves. Further, the time to train across multiple domains could take longer (or require a

different structure) than the typical graduate programme allows. With respect to possible careers in TR, having more TR-focused training could lead to being spread too thin, or having a broad, but shallow, understanding of one's core research area. It is also challenging to choose the right path for a career in TR because there are many possible directions, but no established trainee-to-researcher/career pipeline.

When identifying the supports needed for TR trainees, in-person networking events or workshops geared towards TR were noted. Trainees also expressed that scientific societies could offer funding opportunities to gain experiences in other labs and research groups. Mentors could help their mentees by having check-ins about the mentee's career path, and to discuss their purpose/motivation in pursuing (translational) research. Further, mentors could provide training to other trainees and help them access training resources (which may otherwise be cost prohibitive). Mentors should share their networks to help trainees make connections and start building their own network. These actions, on behalf of mentors and scientific societies, could help fulfil trainees' desire to make TR a core part of the graduate and postdoctoral experience.

Discussion

Here we provide the first report of DOHaD trainees' perspectives on TR training and career paths. We identified key themes derived entirely from trainee/early career researcher feedback at a workshop presented at the DOHaD World Congress 2022. Notably, trainees and early career researchers have a high level of enthusiasm to pursue a career in TR, fuelled by their motivation to apply their skills and knowledge at a multidisciplinary level to solve complex issues in DOHaD. A significant portion of the feedback also covered the gaps and current challenges trainees and early career researchers are facing. The major challenges outlined include a lack of exposure to multiple disciplines, difficulty in identifying mentors (across disciplines and with TR experience/expertise), limited access to career development programmes/opportunities, and the concern for long-term job stability.

Although programmes to advance TR have already been initiated in a few places, these approaches must be developed by more institutes and adapted or tailored to create training frameworks that suit the unmet needs of trainees specific to the institution or scientific society. For example, our workshop participants noted that even in institutions that prioritise TR, there are few opportunities for trainees from fundamental sciences to participate in multidisciplinary projects (including clinical, social or policy). Moreover, often these TR programmes fail to define their objectives, expectations on trainee competencies, and evaluation metrics, and this ambiguity consequently leads to poor outcome assessments and experiences.[15] Workshop participants put forth several suggestions to help them acquire the skills needed to improve their competency in different domains of DOHaD TR, including TR-specific training through graduate programmes and obtaining funding to train in other laboratories. Importantly, the diverse backgrounds of trainees and early career researchers,[15] both in terms of education and experience, and their future career goals, necessitates the need to formulate a customisable training curriculum. This is a laborious and time-consuming approach, that risks the ambiguity already seen in related programmes and makes implementing such training difficult.

To illustrate the importance of offering core courses to help trainees understand TR, an online case study evaluated the impact of translational science training on students at different career stages and across different disciplines.[16] The study found that when compared against their baseline assessments of students' knowledge of and interest in TR careers, there was a significant increase in these metrics after completing the training.[16] Similarly, a Multidisciplinary Translational Team (MTT) under the National Center for Advancing Translational Sciences (NCAT) programme, the Clinical Translational Science Awards (CTSA), which aimed to promote TR career development through MTT membership, assessed the outcomes of the MTT in a four-year follow-up evaluation. Findings showed higher TR-related competencies (e.g., research implementation, scientific communication, leadership, cross-disciplinary training) in trainees.[17] In addition to offering courses to trainees, there should be a focus on TR mentorship, due to the individualised nature of a TR trainee's path. Therefore, TR mentors may benefit from programmes aimed at developing their mentorship skills. For example, a multicentre randomised controlled trial of a mentorship training programme (where mentees were blinded to the mentor's training status) was conducted to evaluate the success of the programme in improving research mentoring skills for translational researchers.[18] The programme was found to be highly effective in increasing mentoring competency, as rated by mentors' self-reported scores and mentees' reports of their mentor on a validated assessment.[18] The mentors' measured competencies included: communication with their mentee, establishing mentee expectations, assessing mentees' research abilities, addressing diversity within mentoring relationships, fostering mentee independence, and promoting mentees' career development. Collectively, these examples show the implementation of TR courses and investment in mentorship skills can improve trainee[16,17] and supervisor/mentor[18] competencies.

Advancing translational research: the role of equity, diversity and inclusion (EDI)

Integration of EDI in the TR workforce is another important aspect that was included in the participant feedback. In the last two decades, the NCAT and their CTSA programme has initiated efforts to prioritise the inclusion of EDI in both mentor training and the selection of mentees at different institutions and centres to improve the impact of TR outcomes.[19] These initiatives aim to implement training programmes with key themes including institutional buy-in, proactive recruitment efforts, an equitable application process, and high-quality, diverse mentorship.[20]

A successful career in TR, particularly within the academic pathway, must focus on early training opportunities and life balance, including job security and stability. The academic culture for early career researchers and investigators still demands many compromises. This cohort often faces challenges weighing family planning against the prospect of maternity/paternity leave within a long PhD, little access to benefits, subsequent short (often two-year) contracts in highly competitive post-PhD award settings, and a degree of geographic mobility. This may add to an already demanding TR career path, which requires acquiring a wider range of skills and deeper knowledge in multiple disciplines, potentially protracting the time it takes to build expertise and competitive CVs and a network of TR collaborators. The consequence of these EDI challenges (although not specific to TR) may mean losing highly motivated and dedicated minds. Groups such as single parents or people with disabilities are especially affected by this as they have specific requirements towards their dependents or themselves.

Table 1. Call to action for trainees, supervisors/mentors, and DOHaD/scientific leaders to build strong career trajectories through translational research

	Calls to action		
	Trainees[1]	Supervisors/Mentors	DOHaD/Scientific leaders and societies
Target	• What motivates you? • What are you deeply curious or passionate about? • What can you be best at? • How can you leverage your current skill set/interests?	• Check in with trainees' wants and purpose • Develop individual development plans and review with each trainee annually	• Develop TR-specific career track programmes that promote accessible and flexible multidisciplinary collaborations, networking opportunities and provide a clear vision for scientific progress and contribution to impact
Team	• Who is doing translational research? • Who could mentor you? • Who could supervise/employ you? • What labs are working in fields or methods different from your own (that you want to learn about) so you can better work across them?	• Identify that you are a translational researcher in your biography across platforms (e.g. on LinkedIn, ResearchGate, university/lab websites) • Encourage/support trainees to pursue translational research activities (e.g. workshops, conferences, seminars, cross-lab training or collaborations) • Make TR a core component of graduate training in your department • Support education and training in EDI and prioritise EDI in recruiting and maintaining diverse research teams[2] • Support trainees in pursuing diverse career paths – academic and non-academic Help trainees navigate less traditional or clear career paths by facilitating training opportunities, collaborations, and diverse and cross-disciplinary skill development	• Account for early career researchers' needs for promotion, stability and job security • Consider the needs of and support groups at risk of leaving a career in research Advocate for gender and racial equity in your organisation Adopt EDI frameworks and good practices for STEMM higher education and scientific society activities (e.g. Athena Swan Charter in UK, Dimensions in Canada) Partner with organisations that bring awareness to biases and barriers for parents in STEMM (e.g. Mothers In Science)
Treasury	• What currency matters/drives the economy in your (prospective) profession? Grants, papers, reputation, other resources? • What sources of funding support translational/multidisciplinary work and innovative collaborations? Grants, scholarships, fellowships, travel awards, bursaries, e.g.: Brain Mobility Awards (International DOHaD Society) Mitacs programmes (e.g. Globalink Research Internship) Science-to-business programmes (e.g. Science to Business Network [S2BN]) CAPES-Print (Brazil) Emerging Leaders in the Americas Programme (ELAP) CIHR-funded Health Research Training Platforms e.g. Empowering Next-generation Researchers in perinatal and Child Health (ENRICH); Guiding interdisciplinary Research On cis- and trans-gendered Women's and girls health and Wellbeing (GROWW); The Canadian Mother-Child Collaborative Training Platform (CAMCCO-L) • What jobs pay to do this kind of work/develop the skills needed for this kind of work?	• Be a host lab for students and fellows from different labs/institutions to learn new techniques/skills or to access data/biobanks for collaborative research • Support trainees in their scholarship and fellowship applications • Provide competitive funding packages	• Maintain a database for collaboration opportunities, large or small! (e.g. data/biobanks, trainee exchange opportunities, methods training, protocol sharing) In easily accessible databases widely share TR opportunities, which networks of individuals and organisations are conducting TR, and TR training and skill development resources • Commit to having TR workshops at conferences (e.g. speakers with TR experience, basic and clinical researchers working in TR, industry collaborators, representatives in patient care, public health, health policy, and non-governmental organisations) • Offer networking events (e.g. TR-focused workshops, speed-networking events, webinars) to engage with partners working in TR and foster collaboration opportunities • Provide funding to support gaining experience in other labs/research groups, e.g.: Brain Mobility Awards from the International DOHaD Society UK Research and Innovation partnerships with the Medical Research Council funding streams and collaborations in Clinical and translational research

CIHR, Canadian Institutes of Health Research; DOHaD, developmental origins of health and disease; EDI, equity, diversity and inclusion; STEMM, science, technology, engineering, maths, medicine; TR, translational research.

[1]We suggest trainees and early career researchers use these questions to brainstorm and better understand their motivations for pursuing translational research and the environments and supports needed to engage in it throughout their career pipeline. Brain Mobility Awards: https://dohadsoc.org/trainees/#bma. Mitacs programmes: https://www.mitacs.ca/en/programs. Science to Business Network: https://www.s2bn.org/. CAPES-Print: https://propg.ufabc.edu.br/capesprint/. Emerging Leaders in the Americas Programme: https://www.educanada.ca/scholarships-bourses/can/institutions/elap-pfla.aspx?lang=eng. CIHR-funded Health Research Training Platforms: https://www.canada.ca/en/institutes-health-research/news/2022/03/health-research-training-platforms.html. UK Research and Innovation partnerships with the Medical Research Council: https://www.ukri.org/what-we-offer/browse-our-areas-of-investment-and-support/clinical-and-translational-research/. Examples provided are not an exhaustive list of training/funding opportunities.

[2]Natural Sciences and Engineering Research Council of Canada's guide on integrating equity, diversity and inclusion considerations in research: https://www.nserc-crsng.gc.ca/NSERC-CRSNG/Policies-Politiques/EDI_guidance-Conseils_EDI_eng.asp.

It should be noted that industry often appears to benefit from stable and more varied investment sources, clear mission statements, and career development schemes for their employees. Many academic institutions have recognised this and are now preparing early career researchers for non-academic career pathways, including through embedding academic-industry partnerships within PhD programmes or supporting internship opportunities with non-academic partners through graduate training centres. These opportunities to develop both soft and technical skills (e.g., leadership and data sciences) provide other career options to researchers. However, the trade-off may be the departure from a TR track for which they have trained for years.

Calls to action

Based on the workshop presentation and discussions, we present a call to action for trainees, their supervisors/mentors, and leaders in DOHaD/scientific societies to foster a path in, or adjacent to, TR, throughout a trainee's academic training and career (see Table 1). We encourage trainees to engage in our *3Ts for Transforming Translational Research Training* to better understand their strengths, needs, and opportunities related to a career in TR. We also suggest an initial set of recommendations for supervisors/ mentors and scientific leaders to better support trainees in their TR research learning and career planning.

DOHaD trainees suggest the following steps to support their TR career development: Develop TR training programmes that, at their foundation, (1) offer core courses to help trainees understand the TR processes and core competencies of a translational researcher, (2) teach core competencies, including providing individualised training paths and mentorship/guidance,[13] and evaluation of competencies through experiential learning opportunities (e.g., through inter-lab collaborations directly related to one's research project and/or as directed/independent studies), (3) demonstrate how a TR process can be applied to individual research projects[6,13] through TR mentorship meetings, and (4) provide networking and collaboration opportunities to facilitate diverse career paths (particularly important as trainees engaging in this type of research may not have peers or advisors with this experience or knowledge departmentally, institutionally, or locally) (Table 1).

To conclude, we ask all trainees and early career researchers interested in pursuing TR to consider this question: *How can your mentors and scientific society better serve you to engage in TR across your career lifecycle?* Armed with your ideas, reach out to your supervisors, mentors, graduate programme directors, and society leaders to start the conversation about how you can be best supported!

References

1. Abdul-Hussein A, Kareem A, Tewari S, *et al.* Early life risk and resiliency factors and their influences on developmental outcomes and disease pathways: a rapid evidence review of systematic reviews and meta-analyses. *J Dev Orig Health Dis.* 2021; 12(3), 357–372.
2. Barker M, Dombrowski SU, Colbourn T, *et al.* Intervention strategies to improve nutrition and health behaviours before conception. *Lancet.* 2018; 391(10132), 1853–1864.
3. Stephenson J, Heslehurst N, Hall J, *et al.* Before the beginning: nutrition and lifestyle in the preconception period and its importance for future health. *Lancet.* 2018; 391(10132), 1830–1841.
4. Hanson MA, Poston L, Gluckman PD. DOHaD – the challenge of translating the science to policy. *J Dev Orig Health Dis.* 2019; 10(3), 263–267.
5. Gilliland CT, White J, Gee B, *et al.* The fundamental characteristics of a translational scientist. *ACS Pharmacol Transl Sci.* 2019; 2(3), 213–216.
6. Tsevat J, Smyth SS. Training the translational workforce: expanding beyond translational research to include translational science. *J Clin Trans Sci.* 2020; 4(4), 360–362.
7. Translational Science Principles. National Center for Advancing Translational Sciences, 2022. National Institutes for Health. https://ncats.nih.gov/training-education/translational-science-principles (accessed 2023-06-29).
8. Auvin S, Dozières-Puyravel B, Avbersek A, *et al.* Radiprodil, a NR2B negative allosteric modulator, from bench to bedside in infantile spasm syndrome. *Ann Clin Transl Neurol.* 2020; 7(3), 343–352.
9. Vidale S, Campana C. Ambient air pollution and cardiovascular diseases: from bench to bedside. *Eur J Prev Cardiolog.* 2018; 25(8), 818–825.
10. DeSocio JE. Epigenetics, maternal prenatal psychosocial stress, and infant mental health. *Arch Psychiatr Nurs.* 2018; 32(6), 901–906.
11. Woolf SH. The meaning of translational research and why it matters. *JAMA.* 2008; 299(2), 211–213.
12. Marantz PR, Keller MJ, Meagher EA. A counterpoint to, training the translational workforce: expanding beyond translational research to include translational science. *J Clin Trans Sci.* 2020; 4(4), 363–364.
13. Faupel-Badger JM, Vogel AL, Austin CP, Rutter JL. Advancing translational science education. *Clinical Translational Sci.* 2022; 15(11), 2555–2566.
14. Paganotti L, Chidume T. *Translational Science in Medical Simulation*, 2022. StatPearls Publishing, Treasure Island.
15. Rubio DM, Schoenbaum EE, Lee LS, *et al.* Defining translational research: implications for training. *Acad Med.* 2010; 85(3), 470–475.
16. Vogel AL, Hussain SF, Faupel-Badger JM. Evaluation of an online case study-based course in translational science for a broad scientific audience: impacts on students' knowledge, attitudes, planned scientific activities, and career goals. *J Clin Trans Sci.* 2022; 6(1), 1–8.
17. Ameredes BT, Hellmich MR, Cestone CM, *et al.* The multidisciplinary translational team (MTT) model for training and development of translational research investigators: MTT model for training and development of translational investigators. *Clin Transl Sci.* 2015; 8(5), 533–541.
18. Pfund C, House SC, Asquith P, *et al.* Training mentors of clinical and translational research scholars: a randomized controlled trial. *Acad Med.* 2014; 89(5), 774–782.
19. Boulware LE, Corbie G, Aguilar-Gaxiola S, *et al.* Combating structural inequities — diversity, equity, and inclusion in clinical and translational research. *N Engl J Med.* 2022; 386(3), 201–203.
20. Shay LA, Schmidt S, Thurston AJ, *et al.* Advancing diversity, equity, and inclusion within clinical and translational science training programs: a qualitative content analysis of the training breakout session at the national CTSA program meeting. *J Clin Trans Sci.* 2022; 6(1), 1–6.