

MINI REVIEW

Training and cultivating the translational science workforce: Responses of Clinical and Translational Science Awards program hubs to the COVID-19 pandemic

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Abstract

The coronavirus disease 2019 (COVID-19) pandemic has dramatically changed our lives and the delivery of healthcare. The pandemic also led to widespread disruption in the research activities and training of pre-doctoral, post-doctoral, and early career faculty researchers. This mini-review uses the Local Adaptive Capacity Framework to describe successful practices, challenges, and lessons learned on how Clinical and Translational Science Award (CTSA) hubs have used their expertise, resources, and collaborations to advance clinical and translational science research and workforce development while facing and adapting to a pandemic. Data for this mini-review were taken from the scientific literature (23 articles) and the Research Performance Progress Reports of 50 unique CTSA hubs (40 TL1 and 50 KL2 awards). Institutions responded in innovative ways to the disruption of the COVID-19 pandemic. Electronic and virtual platforms were used to overcome challenges related to physical distancing, laboratory closures, and travel bans. The importance of mentorship and well-being led to the creation of new virtual programs to expand mentoring and networking beyond the home institution and to promote well-being and resilience. These solutions to translational workforce development can be implemented to address future public health emergencies.

INTRODUCTION

The Clinical and Translational Science Award (CTSA) program, funded by the National Center for Advancing Translational Sciences (NCATS), aims to accelerate the translation of scientific discoveries to improve patient care across the United States.¹ Institutions that are awarded CTSA are referred to as “hubs” and the linked CTSA institutional training award (TL1) and institutional career development award (KL2) support multidisciplinary

training and research in clinical and translational (CT) science for pre/post-doctoral trainees (“trainees”) and early career faculty investigators (“scholars”), respectively.

The coronavirus disease 2019 (COVID-19) pandemic has dramatically changed our lives and the delivery of healthcare. As a result of the COVID-19 pandemic, there has also been widespread disruption in the research activities and training of pre-doctoral, post-doctoral, and early career researchers.² Surveys on the impact of the pandemic on this population identified institutional and structural

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as well as personal barriers that negatively impacted their careers.^{2,3} Many institutions were no longer able to guarantee protected time for research and career development, leading to a significant disruption of research and impaired ability of trainees and scholars to achieve their research goals. As many laboratories closed, researchers no longer had access to critical research resources, including scientific instruments, supplies, and patient samples and data. Many institutions redeployed clinically credentialed researchers to care for patients with COVID-19 or asked them to redirect their research efforts toward COVID-19.^{2,4} Published work has shown that these professionals worried about their own health, managing childcare issues, and the work-from-home environment.^{2,3}

A goal of the CTSA program is to “provide a national resource for the rapid response to urgent public health needs.”⁵ This requires CTSA hubs to be agile and equipped to respond to crises, including COVID-19. The aim of this mini-review is to identify, curate, and share examples of practices, challenges, and lessons learned on how CTSA hubs have used their expertise, resources, and collaborations to advance CT research and workforce development while dealing with and adapting to a public health emergency.

Data for this minireview were taken from the scientific literature (23 articles) and the Research Performance Progress Reports (RPPRs) of 50 unique CTSA hubs (40 TL1 and 50 KL2 awards) reporting on activities that occurred in 2020, coinciding with when major research-intensive universities closed and modified operations due to the COVID-19 pandemic. Given restrictions on how information from RPPRs can be used and disseminated, secondary data from CTSA hubs were utilized, but the respective institutions were anonymized. Adaptations and challenges cited due to the pandemic were identified through keyword searches of the RPPRs of terms, such as “COVID” and severe acute respiratory syndrome-coronavirus 2 (“SARS-CoV-2”) and subsequently reviewed for relevance and summarized by the authors. Finally, the manuscript was reviewed by a panel of translational workforce development expert reviewers and stakeholders from different CTSA, and it was further updated based on their valuable feedback.

LOCAL ADAPTIVE CAPACITY FRAMEWORK

We used the Local Adaptive Capacity (LAC) Framework⁶ to illustrate how CTSA hubs responded to the disruption of the COVID-19 pandemic with the hope that these results can help guide strategic planning and decision making in future health and environmental crises. Adaptive capacity refers to “the ability of a system to adjust to [crises], to moderate potential damages, to take advantage of

opportunities, or to cope with the consequences.”⁶ The LAC framework was originally developed to characterize assets and processes promoting climate change resiliency and therefore was felt to be useful in analyzing disruptions and responses related to the COVID-19 pandemic. The LAC framework contains the following domains: (1) asset base; (2) institutions and entitlements; (3) knowledge, information, and learning; (4) innovation; and (5) flexible forward-looking decision making and governance.

Asset Base

An Asset Base, in the context of training the translational science workforce, refers to the physical, intellectual, and financial resources that enable trainees to continue their proposed mentored research agenda while building their capacity to become independent researchers. Limiting interpersonal contact to stem the spread of SARS-CoV-2 affected both human subjects research and research conducted in laboratories across the country.^{2,7} Yet, given the time-limited appointments on TL1 and KL2 awards, there was added pressure to leverage existing assets to the changing needs created by the pandemic to allow research projects to continue and careers to grow.

Key assets that facilitated conducting human subjects research during the pandemic included physical, electronic, and digital/online resources. For instance, hubs reported using electronic health record patient portals to identify and contact eligible participants and developing new recruitment strategies that relied on social media, such as Facebook groups and Twitter. The use of social media as a tool also assisted in maintaining contact with participants after enrollment. Existing electronic tools, such as REDCap or other platforms, were used to obtain consent electronically for study participation. Data collection for human studies was facilitated through the use of Health Insurance Portability and Accountability Act (HIPAA)-compliant video conferencing, where permitted. In studies where the data collection, assessments, or treatments could not be delivered remotely, modifications in research procedures, such as purchasing specialized personal protective equipment for research participants and researchers, were required. In response to a shortage of hand sanitizer, some researchers converted their laboratory to produce hand sanitizer.

Electronic asset bases provided resources for trainees and scholars to repurpose previously planned research into activities that continued to build their academic careers. One institution reported a cache of existing non-COVID data, including large population-based data and electronic health records. This resource allowed trainees to initiate retrospective research studies with analogous research questions to their previously planned prospective studies.

Prioritized access to institution's data warehouse for TL1 trainees and KL2 scholars and video consultations with staff were made readily available to address any issues.³ One hub reported having a “matchmaking” service to identify qualified investigators and staff from closed laboratories and unite them with laboratories that remained open due to their focus on priority areas for COVID-19 research. These resources helped facilitate the continuity of both research and training agendas of CTSA trainees and scholars.

The resourcefulness of trainees, scholars, and their institutions was also seen in other areas, such as queuing up study procedures so that the studies could launch after COVID-19 restrictions were lifted. Examples of their resourcefulness include the approval of research activities, or training of research assistants and standardized patient actors, and using their existing expertise for outreach. Trainees and scholars were creative in finding substitutions for activities that were hindered by COVID-19 restrictions, such as chart reviews on cohorts that could not be studied directly or writing review articles. Some trainees and scholars pivoted their research into other areas if their original research was not possible due to COVID-19 restrictions. In addition, trainees conducted media interviews and posted on Twitter to educate the lay public on proper mask wearing, how to interpret disease data, and the impact of COVID-19 in local areas. Clinicians from specialized areas, redeployed to COVID-19 inpatient care, also took advantage of this time by publishing their experience.

Finally, providing indirect and direct financial COVID-19 relief to researchers was also reported. Direct research support was most commonly provided through COVID-19 relief grants or supplements that allowed laboratories to cover mouse colony losses, replace expired supplies, fund staff for longer recruitment windows, and cover other similar unexpected expenses. CTSA hubs extended its period of support for training due to COVID-19 research disruptions.³ Other types of support that was provided included training for researchers who chose to significantly change their research to new areas, such as COVID-19, during the pandemic. In addition to research hardships, many researchers experienced personal financial hardship due to the pandemic.⁸ Providing trainees with assistance in accessing hardship funds through established programs, such as Employee Assistance programs, was one of the approaches taken by institutions to address financial hardship.

Institutions and entitlements

Institutions and entitlements, in the context of translational science workforce development, refer to the institutional environment that allows trainees access to assets that support their research and career development (e.g.,

mentors, training, and other educational activities). The challenges of the COVID-19 crisis emphasized the importance of mentorship and support beyond the traditional mentor-mentee dyad. Teaching and educational activities quickly moved to virtual platforms that allowed expansion of social networks and collaborations beyond the home institution.⁹ The move to virtual meetings also led to implementing programs that allowed scholars and trainees to serve as virtual visiting professors and to expand their network beyond the home institution without the need to travel.¹⁰ These initiatives were particularly helpful for women, who often serve as primary caregivers for their children.¹¹ The focus on well-being and resilience was a common thread of mentoring and careers development experiences during COVID-19.^{12,13}

Many programs implemented virtual support groups in which trainees could discuss their struggles and ask for help with their research. For example, one program focused on purposeful reflection, discussion, and experimentation to enhance work-life integration among scholars and to provide scholars with skills to improve work-life integration during their time as a scholar and beyond.¹⁴ Many programs implemented virtual well-being resources and provided one-on-one counseling and support. An example of a virtual synchronous well-being program is the Stress Management and Resilience Training Relaxation Response Program,¹⁵ which was adapted for researchers and moved to the virtual platform. The program aims to help trainees and scholars to develop a self-care routine to manage stress, improve their outlook, and enhance their quality of life.

Most programs provided virtual mentorship and networking sessions to address the challenges with regard to reduced protected time and access to data and resources. Numerous institutions implemented peer-mentoring to increase connectivity among trainees and provide another avenue for career advice and scientific discussion in addition to that provided by their primary research mentors.¹⁶ These activities promoted an ongoing development of learning communities through facilitated virtual experiences.

Programs restructured mentoring during the final year of the TL1 and KL2 programs to address the challenges of senior trainees and scholars created by the pandemic. Mentoring was particularly important for advising senior trainees on how to adjust the amount of protected research time to be able to complete the proposed project and how to develop new collaborations beyond the TL1 and KL2 awards, respectively. The timing and structure of mentoring were also modified to better accommodate childcare responsibilities.

The COVID-19 pandemic also highlighted the disproportionate impact of the dual pandemics, COVID-19 and

systemic racism, on early career researchers of color.¹⁷ The Building Up A Diverse Workforce for Biomedical Research (“Building Up”) Trial, a cluster-randomized trial at 25 institutions, aims to address the “leaky career pathway” for early career researchers under-represented in the biomedical research workforce through a dedicated mentoring intervention.¹⁸ Regulatory approval and recruitment for this trial happened during the simultaneous COVID-19 pandemic and the anti-racism movement, requiring the principal investigator and her team to reformat their trial to provide accommodations to even more challenging, uncertain, and stressful conditions. Some of these changes included simplifying single institutional review board (IRB) forms; modifying study practices; and increasing communications within institutions. Several lessons were learned, namely that pandemic recruitment is challenging but not impossible and that once identified, barriers to diverse recruitment, such as required letters of support and the required percentage of protected time, should be mitigated.¹⁸

All institutions required a switch from in-person to online education and developed online educational programs to maintain teaching. Trainees and scholars were able to enroll in webinars and other e-learning opportunities that expanded beyond their home institution. This pivot also led to implementing cross-intuitional programs, which allowed pre/post-doctoral researchers and early career faculty to share their research, exchange ideas, extend cross-hub peer-mentoring support, to cultivate and expand their professional circle, and to potentially become future collaborators.¹⁰ These online asynchronous trainings will likely stay beyond the pandemic.

Knowledge, information, and learning

During the pandemic, the collection, analysis, and dissemination of knowledge and information was largely conducted through group forums, one-on-one meetings, and through the collection, analysis, and publication of survey data. Forums facilitated through the use of virtual conferencing platforms allowed researchers and trainees to exchange ideas, such as how different offices were handling clinical trials and in-person enrollment during the pandemic. Other discussion topics included the conversion of projects to telehealth and how IRBs were reviewing those projects. Trainees and scholars also shared their concerns, challenges, and needs, and provided mutual guidance about how to identify appropriate research resources.³

The most visible and widespread form of information generation and sharing was the dissemination of survey results on the impact of the pandemic on trainees and early career faculty.¹⁹ This information was largely intended to

inform the type of adaptation activities trainees needed due to the pandemic. At the beginning of the pandemic, McCormack and colleagues² launched a survey to assess the immediate impact of the pandemic on career development activities of TL1 trainees and KL2 scholars and how their institutions were responding to challenges. Access to essential physical resources, patient populations, and supplies to conduct both laboratory and human subjects research was widely reported among trainees as immediate impacts. Yet, the study also identified several strategies to maintain productivity, such as better time management, more virtual connections, and continuing research activities that did not require interactions with research subjects (e.g., retrospective chart reviews). Scholars in the research community have surveyed and disseminated information on the impact of COVID-19 on research careers showed that women, faculty, and trainees under-represented in medicine, and early career researchers and trainees were disproportionately affected by the pandemic. The surveyed groups were concerned about research productivity, career trajectory and financial status.^{8,19,20}

Innovation

The COVID-19 pandemic has enabled and accelerated innovations to workforce development and built its adaptive capacity in pragmatic ways, such as virtual educational offerings and meetings, which have improved access and facilitated collaborations with mentors and colleagues outside the institutional walls. These programs have also provided more opportunities for women to be involved in national and international visiting professorships.¹¹ Innovative approaches to dealing with the pandemic include the emphasis on well-being, resilience, and critical skills for the translational science workforce. Moving forward, it will be important to maintain the innovative initiatives that have allowed trainees to be engaged in career development opportunities that were not available prior to the pandemic.

Flexible forward-looking decision making and governance

Flexible and forward-looking decision making and governance was critical for supporting the CT workforce while dealing with the pandemic, emphasizing the importance of being proactive in preparing for the next national emergency. With regard to forward-looking decision making and governance, researchers are pressing for changes in institutional and academic departments, such as redefining the characteristics that define success in academia.^{21–23} For instance, Butler²¹ provides several

suggestions, such as moving away from quantitative measures of productivity, expanding the metrics that are required for academic promotion and tenure, and allowing for more individualized timelines for promotion and tenure. Other forward-looking changes suggested by researchers include: creating an infrastructure for identifying family care, particularly when schools and daycares are closed,²⁴ optimizing flexible working arrangements,²⁵ and creating short-term, flexible research support for those impacted by circumstances such as increased childcare responsibilities.²⁵

A report on COVID-19 and Academic Governance by the American Association of University Professors (AAUP; <https://www.aaup.org/special-report-covid-19-and-academic-governance>) contend that maintaining a robust shared academic governance between university administration and faculty is the key to surviving the next national crisis. A balanced demographic representation of faculty at all levels and academic ranks has been emphasized to help ensure that appropriate support is provided to groups historically under-represented in academic leadership and who are particularly vulnerable to the impact of these crises. The AAUP also maintains that it will be critical for institutions to not only implement changes, but also monitor data prospectively as changes are implemented, such as demographic

breakdowns in tenure and promotion and allocation of new teaching and service loads to ensure equity and promote resilience during the next public health emergency.²² A more balanced demographic representation could result in the expansion of funding opportunities for primary caregivers. The growth of such funding opportunities could directly aid those individuals that are disproportionately affected by the pandemic.

A notable example is the [largest US collaborative funding effort for equity in biomedicine](#) (including the Doris Duke Charitable Foundation, the American Heart Association, the Burroughs Wellcome Fund, the John Templeton Foundation, the Rita Allen Foundation, and the Walder Foundation) aiming to accelerate the progress of 22 medical schools in cultivating a diverse research workforce via supporting over 250 early career biomedical researchers with caregiving responsibilities exacerbated by the pandemic. The creation of an infrastructure for identifying family care resources while schools and childcare facilities are closed, and optimization of flexible working arrangements could also better support parents and caregivers who make critical contributions to the CT research enterprises of institutions across the country.

Table 1 provides an overview of the challenges, lessons learned, and approaches to training and cultivating the

TABLE 1 Challenges for translational workforce development in the context of emergency and approaches to address them using the LAC Framework

Challenges for translational workforce development in the context of emergency	Approaches for translational workforce development in the context of emergency
Limited interpersonal contact during the pandemic affecting career development and research of trainees and scholars	Leveraging existing, redesigned, and newly developed resources to facilitate continuity of both research and training agendas. Utilizing physical, electronic, and digital/online assets that facilitate human subjects research. Provision of indirect and direct financial relief to trainees/researchers. (Asset Base)
Reduced/canceled traditional, in-person, educational activities. Lack of interpersonal connectivity. Decreased sense of a learning community in a mostly digital world.	Moving teaching/educational activities to virtual platforms. Online resources and virtual support groups focused on well-being and resilience. Virtual: group mentoring hours, peer-mentoring, happy hours, networking sessions. (Institutions and Entitlements)
Temporary halt to research operations or prioritization of COVID-19 research. Concern about how research and training progress.	Using online group forums and one-on-one meetings to share trainees' concerns, challenges, and needs, and provide mutual assistance. Utilizing surveys on the impact of the emergency on trainees/scholars to inform adaptation activities. (Knowledge, Information, and Learning)
Disruption of training, teaching, research, and interpersonal, and personal connections caused by an emergency/pandemic	Rapid introduction of virtual educational offerings, virtual meetings, and virtual visiting professorship programs that improve access and facilitate collaborations with mentors and external colleagues. Emphasizing well-being, resilience, and critical skills for the translational science workforce. (Innovation)
Negative impact on tenure and promotion processes and outcomes by prolonged emergencies, particularly on groups historically under-represented in academic medicine	Conducting a needs assessment to redefine the characteristics of success in academia. Expanding the range of products that “count” toward tenure and promotion and allowing for more individualized timelines for tenure and promotion, and breaking down the gate-keeping that favors the majority. Ensuring equity by monitoring demographic breakdowns in tenure/promotion and allocation of new teaching and service loads. (Flexible Forward-Looking Decision Making)

Abbreviations: COVID-19, coronavirus disease 2019; LAC, Local Adaptive Capacity.

translational science workforce in the context of emergency using the LAC framework.

Limitations of our mini-review include the lack of assessment of how small and large CTSA hubs have dealt with the challenges of the COVID-19 pandemic. Furthermore, we did not evaluate differences in response of hubs by geographic location.

CONCLUSIONS

The COVID-19 pandemic has caused widespread disruptions in research activities and training of the CT workforce. Institutions, mentors, and trainees responded in innovative ways to these disruptions, using electronic and virtual platforms to overcome challenges related to physical distancing, laboratory closures, and travel bans. The pandemic also emphasized the importance of mentorship and well-being with the creation of new virtual programs to expand mentoring and networking beyond the home institution. Harnessing these successful adaptations in research and education presents a unique opportunity to advance workforce development and improve research operations in a post-COVID-19 world. Critically, they would also help better prepare CTSA hubs for future health crises and other emergencies. This mini-review is a call for future research, development, and innovation by the translational science and workforce development community in the increasingly important but often neglected area of adaptive capacity and preparedness.

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CONFLICT OF INTEREST

The authors declared no competing interests for this work.

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