

## Creating the Future: Training the Next Generation of Translational Science Teams

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**M**ayo Clinic recently launched a new strategic plan campaign with the theme “Creating the Future.” While the theme is intended to inform and energize the entire Mayo enterprise, it resonates especially throughout the Mayo Clinic Center for Translational Science Activities (CTSA).

The Mayo Clinic CTSA was established in 2006 with a first-round Clinical and Translational Science Award from the National Center for Research Resources (NCRR), National Institutes of Health (NIH). In its first 18 months, the CTSA has had a transformative effect on many areas at Mayo Clinic, including the education and career development opportunities for trainees and faculty.

With the wide latitude given under the CTSA initiative, each of the 38 currently-funded institutions has created a unique structure and focus. The Mayo Clinic CTSA is organized into 4 main components: Research Resources, which includes its General Clinical Research Center (GCRC) and core labs; a Service Center that provides centralized administrative and research study support; a Community Engagement arm that seeks to broaden the diversity of investigators, funders, and research participants and to engage multiple collaborators in community-based participatory research; and Education Resources, which provides education, training, and career development for all study team members, from continuing education and diplomas to postdoctoral degrees. This article will focus on the structure and accomplishments of the Education Resources component and will share lessons learned that may be of value to other institutions.

### Laying the Foundation

The foundation of the CTSA Education Resources was laid in 1999 when Mayo Clinic established the Clinical Research Training Program (CRTP) led by Sherine E. Gabriel, MD, MSc, and supported by a K30 Clinical Research Curriculum Award from the National Heart, Lung, and Blood Institute (NHLBI). The CRTP offered a postdoctoral master’s degree or a certificate in clinical research. The master’s degree was a 2-year program consisting of course work and a mentored research experience; it included a requirement that the candidate write and defend a thesis. The certificate was a 1-year program consisting of course work and a mentored research experience; it included a requirement that the candidate write a publishable manuscript describing the results of the project. The K30 award consolidated and extended existing course work in epidemiology, biostatistics, and clinical research methods to support the master’s degree and certificate programs. The CRTP grew quickly and is currently the largest

degree program offered by the Mayo Graduate School, with 40 to 50 candidates enrolling each year.

In 2005, Mayo Clinic received a K12 Roadmap Multidisciplinary Clinical Research Career Development Award from the National Institute of Child Health and Development (NICHD; principal investigator: Dr. Gabriel). This award provided salary support and research funds to 6 to 8 MD or PhD scholars per year to earn a master’s degree in clinical research and to conduct a research project.

With receipt of the CTSA award in 2006, both the K30 and K12 programs were absorbed into the new award. The CRTP continues to grant a master’s degree or a certificate in clinical and translational science (CTS) and the K12 program has become a KL2 program. The core mission of these programs—to train the next generation of clinical investigators to conduct multidisciplinary, team-based research in order to effectively translate scientific knowledge into improved health—remains unchanged. These programs represent the education and training core of the CTSA.

While this central mission has remained unchanged, the process of applying for a CTSA award and the post-award transition to the CTSA mechanism gave Mayo Clinic the opportunity to evaluate its programs. The evaluation included some pointed questions: Does our curriculum and program structure encourage a cross-disciplinary mindset? Do our mentored

experiences provide the support young investigators need to launch their careers successfully? Most importantly, are we preparing our graduates to lead the research teams of tomorrow?

After a thorough assessment of curriculum and program structure, we concluded that to create the future of medicine and medical research, education efforts must ensure that the next generation of investigators not only have depth of expertise in their primary discipline but can also see the possible connections across and between disciplines to translate research discoveries into real-world treatments. Thus, we expanded our programs and refocused our evaluation efforts in alignment with this philosophy.

### Innovation and Integration Lead To Transformation

How does a large academic medical center with a multi-school College of Medicine and a wide-ranging list of stakeholders transition to a new educational paradigm while preserving the best current practices? Mayo Clinic found this requires careful planning, a spirit of innovation, and a firm commitment to integration at all levels.

Led by Dr. Gabriel, director of education resources and a co-investigator for the CTSA, planning for the new direction and structure of Education Resources began long before the grant



The Mayo Clinic CTSA overcame traditional barriers to academic collaboration to create an integrated approach to training the next generation of clinical and translational researchers.

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award notice arrived. In fact, Mayo's grant application for the CTSA award envisioned a reorganization of courses and staff into overarching programs to support learners at 3 distinct levels (Figure 1): a predoctoral program to provide the required PhD-level education and clinical research training for medical students; a postdoctoral program to house the existing postdoctoral master's degree, certificate, and KL2 career development opportunities; and a research management program to provide associates in applied science (AAS), post-baccalaureate degrees, diplomas, and continuing education for study coordinators and other members of study teams.

## Innovation

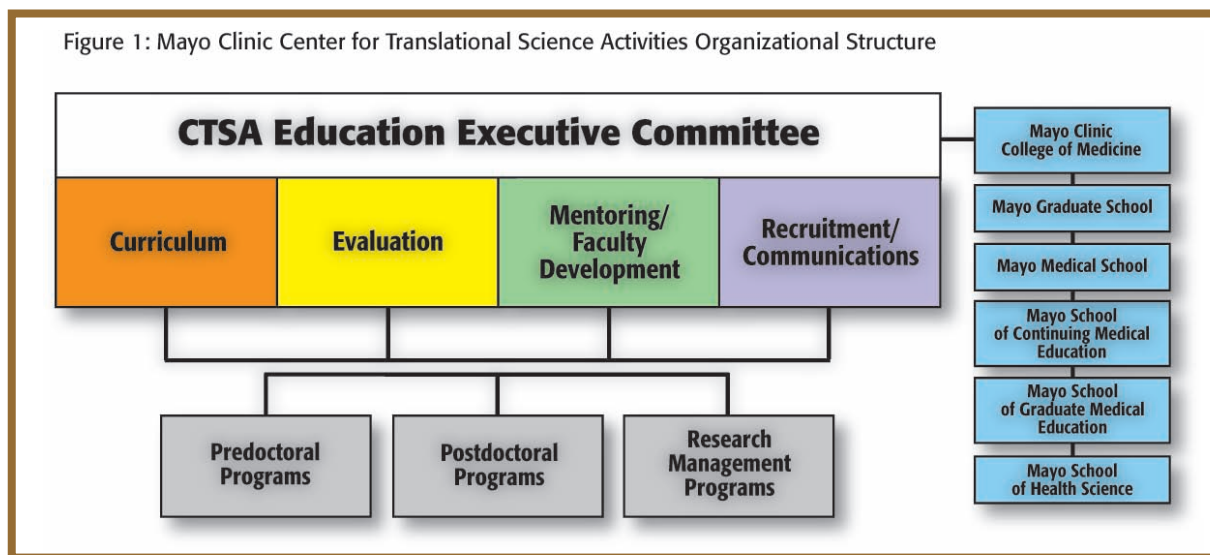
To meet the ambitious goal of training the next generation of clinical and translational research teams would require expansion in several areas: learner groups, learner curriculum, learning settings, and delivery methods.

**Expanded learner groups:** Our first priority was to establish a PhD program in CTS for post-baccalaureate and medical school students. In addition, we expanded our predoctoral offerings to medical students, who often receive little exposure to the principles and practice of clinical research during their training.

patient-based translational science, and laboratory-based translational science. We also expanded the curriculum across all programs (predoctoral, postdoctoral, and research management) to focus on 3 additional key topics: 1) expanding foundational skills for translation to include informatics, behavioral science, and translational sciences; 2) health disparities and community-based research; and 3) methodologies for improving the science of health care delivery. We believe that strengthening investigative teams' skills in these areas will not only speed translation of discovery into clinical research, but will also address the T2 gap by ensuring that novel treatments actually reach traditionally underserved populations.

**Expanded settings:** The main Mayo Clinic campus is located in Rochester, Minnesota, a city of about 100,000 located 75 miles from the Minneapolis/St. Paul metropolitan area. While Rochester is growing quickly and becoming increasingly diverse, it is in a decidedly rural setting. To provide scholars and faculty the opportunity to work with the widest range of cultures and populations and to learn from and apply best practices to the work we are doing in our own community, Mayo has formed strong collaborations with several other institutions.

We enhanced a long-standing and productive relationship



A new course, "Introduction to Clinical Research," is now required for first year medical students at Mayo Medical School (MMS) and the University of Puerto Rico School of Medicine (UPRSOM) (see "Expanded Settings" below).

We view it as equally important to train and equip the allied health professionals who will be a part of the study teams of the future. Mayo has reorganized and expanded its unique AAS and diploma program in clinical research coordination, which is offered in cooperation with the local community college and the Mayo School of Health Sciences, to include extended field experience for students. CTSA Education Resources is also taking a leading role in developing training and continuing education opportunities for study coordinators and investigators as part of an institutional initiative to strengthen research management skills and practices.

**Expanded curriculum:** Curriculum development for the new PhD program presented the most immediate challenge. Building on the foundation of our existing master's degree in clinical research, we created 3 areas of concentration to allow students to customize their degree: population-based translational science,

with UPRSOM to expand bidirectional education and training opportunities for students at both institutions. As mentioned above, MMS and UPRSOM both offer the CTSA's "Introduction to Clinical Research" course, and the 2 institutions have an exchange program whereby medical students from each school can conduct short research projects at the partner institution. The CTSA provides stipends and research funds, awarded on a competitive basis, to support these projects.

Another key collaborator is the Center for Minority Health (CMH), led by Stephen Thomas, PhD, in the Graduate School of Public Health at the University of Pittsburgh (another institution that received a 2006 NCRR CTSA). In 2007, the CMH was designated as a Research Center of Excellence in Minority Health Disparities by the National Center on Minority Health and Health Disparities. In addition to providing assistance with curriculum development, Mayo has collaborated with CMH to offer students an "Urban Immersion" field experience in Pittsburgh, which includes participation in CMH's innovative community-engagement events and programs, such as "Take a Health Professional to the People Day" and the Healthy Black Families Project.<sup>1,2</sup> This experience

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## The Future: Beyond Lupus

Congressman Tim Murphy (R-PA) relies on his 3 decades as a child psychologist to advocate for meaningful reforms in the US health care system. As one of only a handful of members of Congress with a background in health care, he is co-chair of both the 21st Century Health Care Caucus and the Mental Health Caucus, giving him a platform to educate other members of Congress and the public on ways to make health care more affordable and accessible for all families. During his keynote address at the opening of the Lupus Patient Care and Translational Research Center, he remarked: “This center shows us what we need to be doing with health care in America. This center sets a model that the rest of the world can look to. This isn’t doing the same thing and expecting different results. It is doing something different and seeing how hope reaches higher, how faith becomes more expansive, and how ideals and curiosity become reality for our patients and the rest of the world.”

This experience has not only given us pause to consider the traditional divisional structure of academic medical centers, but it has also caused us to consider the future of the general rheumatologist in caring for patients with diseases such as lupus. As health care continues to become further specialized with the blending of

**Lupus as the prototypic systemic autoimmune disease presents a mystery that spans numerous scientific disciplines.**

therapeutics and diagnostics (theranostics), it is possible that the practice of rheumatology will also become further specialized. Lupus has little if anything in common with osteoarthritis, gout, and many of the other disorders traditionally in the domain of the general rheumatologist, either as a differential diagnosis or with regard to management. However, the rheumatologist caring for lupus patients should be intimately familiar with—and should work closely with—experts in the cardiovascular, cerebrovascular, dermatologic, obstetric, and osteoporotic fields, while monitoring for other complications of the disease, such as an increased risk of malignancy. These observations suggest that patients with lupus will benefit most from future efforts focused on the multispecialty practice of “lupology.”

Challenging the status quo will always be met with resistance and present challenges. However, we believe that the success of alternative models such as LUCE will facilitate further restructuring of American medical institutions for the ultimate benefit of our patients.

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helps participants enhance their cultural confidence in building relationships with minority communities.

Finally, as a result of the K12 Award in 2005, Mayo Clinic, the University of Minnesota, and the University of Wisconsin-Madison formed the Upper Midwest Consortium (UMC), a forum to facilitate inter-institutional collaboration in education for scholars and research collaborations between institutions. This year the UMC expanded to include the Universities of Iowa, Kansas, Nebraska, North Dakota, and South Dakota.

**Expanded delivery methods:** To accommodate the growing number and diversity of learners served by CTSA Education Resources, we have launched an ambitious effort to provide course work in an online environment. Two full-time instructional design specialists have developed online versions of the introductory epidemiology and biostatistics courses included in the certificate program, and we plan to expand this effort to include all required courses for the program. The online certificate will become the centerpiece of education efforts for the emerging Mayo Health System Practice-Based Research Network, which will help physicians in more than 65 communities surrounding Rochester to conduct primary care-focused research as part of their regular practices. While more than 80% of these physicians have expressed interest in clinical research, most of them have little or no training in research methods or management. Education and training will be critical to the success of this community engagement activity.

## Integration and Transformation

In order to break down the long-standing “silos” of clinical and research disciplines and separately-funded education programs, it was necessary for Education Resources to integrate horizontally across its own programs and committees, vertically with the rest of the CTSA components, and globally with the other education and research entities in the institution.

Prior to the CTSA, the education programs had existed as distinct entities, in part related to the separate funding

mechanisms, each having its own administrative support and committee structure. During the planning and post-award phases of the CTSA application, the Education Resources team began an overhaul of the committee structure and administrative staffing model, identifying 4 cross-cutting functions essential to all programs. Several existing committees were integrated to form cross-cutting committees: curriculum, evaluation, recruitment/communications, and mentoring/faculty development (*Figure 1*). In addition, 3 program-oriented committees coordinate the specific activities of the predoctoral, postdoctoral, and research management programs. An executive committee oversees all of these committees and coordinates interactions and activities with other schools included in the Mayo Clinic College of Medicine.

Like every reform effort, the drive to transform the way clinical research is conducted and the way the products of such research are translated into practice will die in one generation unless the torch is passed to the next generation of investigators through effective education and mentoring. Education can lead and drive this transformation, creating experts in new fields and providing the common language for multidisciplinary teams to communicate, collaborate, and ultimately integrate. Eighteen months into our efforts in the new CTSA era, we continue to strive to identify and implement ways to truly transform our educational programs to achieve this goal.

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