

Dedicated to the Pipeline: KU Frontiers' Pursuit of Maintaining and Cultivating the Careers of Current and Future Physician-Scientists

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INTRODUCTION

The decline in the number of physician-scientists regionally and nationally represents a real and existential threat to the biomedical research community. The meager number of physicians substantially engaged in investigation is cause for concern, as the speed at which medical discovery translates to patient care depends on their commitment to conducting research. As a Clinical and Translation Science Association (CTSA)-funded institution, KU Frontiers is on the front lines of enriching the clinician-scientist and physician-scientist pipelines, by providing resources and robust training opportunities to junior, developing researchers. Through the KL2 Career Development Award and the TL1 Pre- and Postdoctoral Clinical and Translational Research Training Awards, KU Frontiers actively trains, educates and motivates the future leaders of medical advancement. The Frontiers training programs, along with the services and resources extended to trainees and scholars provides the structure and support needed to develop and foster physician-scientists, without whom medical innovation and discovery could be stunted and jeopardized.

Section 1: A Dwindling Physician-Scientist Population: What is the Problem?

Age is More Than a Number

The decline in the number of practicing physician-scientists has been well documented over the past 40 years. Data from the 1980s compared to that of 2014 indicates that the number of physicians dedicating substantial aspects of their professional time to research has declined from around 5% to 1.5%.¹ Further, the physician-scientist population is aging quickly, with 1.6 times more investigators over the age of 61 than under the age of 50 as of 2012.² The pipeline is aging and the number of physician-scientists between the ages of 31 and 50 has been declining.² This particular trend is alarming because of the unique and vital skillset physician-scientists bring to the realm of biomedical research. The ever-widening gap from bench to bedside dictates the need for physicians from a variety of disciplines who can use their expertise to navigate the world of discovery and clinical care. Historically, physician-scientists have been and need to be vital players in bridging the gap because of their ability to bring scientific innovation to the bedside of their patients quickly and efficiently to affect outcomes.

The Long Road Ahead

One of the most frequently noted barriers to becoming a physician-scientist is the training timeline. For those who desire to become a physician-scientist, the MD-PhD career path is a consideration. However, those interested in the MD-PhD report dissatisfaction with the length of the program, which can take an average of eight years to complete.³ With the realities of a hefty time commitment and mounting student debt, the MD-PhD route has become unappealing with only 609 students entering an MD-PhD program in the U.S. in 2013.⁴

The combination of mounting debt and a daunting timeline leads those with an interest in research with few other choices for investigative exposure. Medical students experience very limited (if any) time or training opportunities to perform research, with the same limitations plaguing the physician-scientist pipeline throughout most residency programs. Hopeful physician-scientists may not have a true opportunity to perform research until fellowship, which only underscores the missed opportunities to engage physicians early in their training.

Mentorship and Role Models

There are nuances to mentorship that make significant differences in the experience and outcomes of the mentoring relationship. The needs of a physician-scientist are unique to that particular career path. To optimize the growth of a junior physician-scientist, it is helpful to have a physician-scientist mentor. However, those opportunities are limited not only by the small number of physician-scientists, but the aging physician-scientist population who will be or currently are looking toward retirement.

In addition to the small number of mentors available, there is a need for increased diversity in terms of fields of study and ethnic and racial backgrounds in the physician-scientist pipeline. Both women and minority groups such as African Americans and Hispanics are underrepresented in the physician-scientist pipeline. Women make up 42% of MD-PhD graduates, yet recent data indicates that women make up only 22% of NIH grant recipients with the dual degrees.⁵ The disparity between white and non-whites (African American, Hispanic or Native American) is even more striking than that of men compared to women with only 5% of those combined minority groups receiving NIH funding as physician-scientists.⁵

Section 2: Combatting the Problem

Stage-Specific Exposure and Training

With the rising age of the physician-scientist population, it is important to expose those young in their medical training to research. KU Frontiers is committed to fostering trainees and scholars at the predoctoral, postdoctoral and junior faculty stages in their careers via the TL1 Research Training Program (pre- and postdoctoral tracks) and the KL2 Mentored Career Development Program (junior faculty). Each specific track offers a condensed (1 to 2-year), immersive research experience, with clearly delineated milestones for the

trainees and scholars to meet on their way to carving out a career as both a clinician and a scientist. With a primary concern of those interested in a career as a physician-scientist being the lengthy training time² the TLI and KL2 programs address that concern by protecting trainee's time from clinical duties and allowing them to focus on an intensive research experience to acquire the skills that their clinical programs didn't offer enough of or at all. At the conclusion of both the postdoctoral TLI program and the KL2 program, the expectation is for participants to have used their research projects and experience to apply for extramural funding to demarcate the beginning of their independent research careers.

Both the KL2 and TLI programs take an integrative approach to training, by bringing members of each program together to study and address the most critical components of becoming a successful researcher. As displayed in Table 1, Frontiers Scholar's Club addresses relevant and timely topics such as grant writing, career development and study design. The members of the TLI and KL2 programs work together in these sessions to better understand each area and how they will utilize it to prepare themselves to become independent researchers. The integration of the groups allows the junior researchers to not only learn from mentors and senior scientists, but to learn from each other and accelerate their progress on their way to becoming independent investigators.

Table 1. 2019-2020 sampling of Frontiers Scholar's Club sessions.

Scholar's Club sessions	Topics	Speakers
Session 1	ROI Mock Grant Review	Ed Ellerbeck, M.D., MPH , KL2 PI, Chair of Population Health; John Spertus, M.D., MPH , KL2 PI, Endowed Chair in Metabolic and Vascular Disease Research; Won Choi, Ph.D., MPH , TLI PI, Vice Chair of Education
Session 2	Tenure and Promotion	Kim Richter, Ph.D., MPH , Joy McCann Professor of Women I. Medicine and Science; Laura Martin, Ph.D. , Associate Professor and Associate Director of fMRI
Session 3	The Overlap of Between Research and Clinical Care: Addressing IRB and HIPPA Issues in Records-Based Research	Karen Blackwell , Director of Human Research Protections Program
Session 4	The Learning Health Systems Framework and the Implications for Research	Tamara Winden, Ph.D. , Chief Research Informatics Officer
Session 5	Manuscript Writing and Data Visualization	John Spertus, M.D., MPH , Endowed Chair in Metabolic and Vascular Disease Research
Session 6	Biostatistics, Epidemiology, Research Design (BERD): Understanding and Utilizing BERD Resources and Alternative Study Design	Matt Mayo, Ph.D., MBA , Founding Chair and Professor, Department of Biostatistics & Data Science

As an added benefit, the integration of the program also facilitates collaborative partnerships. In 2019, a member of the KL2 program and a postdoctoral TLI trainee were able to leverage their expertise

as a team and procure pilot funding on their first submission. The combination of stage-specific training and the integration of the KL2 scholars and TLI trainees continues to provide great value in a considerably brief amount of time.

Over the lifetime of the training programs, the efforts appear to be paying off as 58% of KL2 graduates currently have NIH funding, with three leading multi-site NIH projects. With only one graduated cohort of postdoctoral graduates, results are still up for debate. However, two of the most recent TLI graduates were awarded internal funding, with the other two graduates recently submitting for individual K awards. The trajectory of the programs is quite promising, as KU Frontiers remains steadfastly committed to providing immersive training experiences in a brief, manageable timeframe.

Adapt and Evolve

With the noted cost burden and time commitment associated with training as a physician-scientist, it is critical to think about innovative ways to cut down on both, while offering ample opportunities for physicians to get involved in research. For those who are not in a TLI or KL2 program, there needs to be accessible options to pique their interest and encourage their ambition and curiosity. The Department of Population Health at Kansas University Medical Center (KUMC) recently created a four-week didactic training course for residents and fellows interested in obtaining the foundational knowledge of the clinical research process. Admittedly, the knowledge and experience obtained from the class alone is not enough to solidify a career as a physician-scientist. However, the course will set the foundation for a resident or fellow to begin to conduct their own research, while working with a faculty mentor to produce an abstract and submit a publication within a six-month period.

Those enrolled in the first iteration of the course (residents and fellows) were young in their careers and eager to learn and do more. By fostering that drive and innate curiosity with a brief, intensive, crash course in research methods (e.g., protocol design, basic biostatistics, regulatory issues, etc.), KUMC and Frontiers are doing their due diligence by training physicians and arming them with the basic skillsets to do their own research and carve out a career with investigation as an important element.

Recruitment to Enrich the Pipeline

The TLI and KL2 programs spend several months each year recruiting the best and brightest from each of the Kansas and Missouri-based Frontiers affiliates, as well as nationally. The recruitment process is carefully and intentionally focused on enriching the pipeline of junior investigators, with an eye on both growth and diversification. Both programs have managed to attract female investigators at especially high rates, with 63% of women making up the KL2 program participants over its lifetime and 56% for pre- and postdoctoral TLI programs, respectively. Admittedly, both the KL2 and TLI programs have struggled with attracting underrepresented minorities to its programs. Tables 2 and 3 indicate the demographic makeup of each KL2 and TLI graduating cohort. While women are well represented, African Americans and Latinos are not, making up only 7.5% of our awardees in the combined KL2 and TLI graduated cohorts.

Table 2. TLI graduate demographics.

Graduates by year	Male	Female	Non-URM	URM
2012	2	2	4	0
2013	3	1	4	0
2014	3	1	4	0
2015	1	3	2	2
2016	2	2	4	0
2017	0	0	0	0
2018	0	2	2	0
2019	3	3	5	1

50% female; 10.7% URM

Table 3. KL2 graduate demographics.

Graduates by year	Male	Female	Non-URM	URM
2014	1	5	6	0
2017	2	4	6	0

75% female; 0% URM

Both the TLI and KL2 programs recognize the unique challenges of recruiting a diverse group of trainees into each program, particularly in Kansas and Missouri. Therefore, we refocused our approach to attracting diverse candidates in 2019 and re-engaged the Director of Diversity and Multicultural Affairs and the Office of Diversity and Inclusion to ensure the programs are reaching groups of students that historically have had limited opportunities in biomedical research. As a result, the 2019 award recipients for the pre- and postdoctoral TLI programs represent the most diverse cohort that we have ever worked with, with 50% of those onboarded in July of 2019 being from an underrepresented minority group (Table 4).

Table 4. Current TLI trainee demographics.

Current TLI trainees	Male	Female	Non-URM	URM
2019	1	5	3	3

83.3% female; 50% URM

Two of our current predoctoral awardees were both members of the KUMC Pre-Admissions Program and the Pre-Matriculation Program, which are run out of the Office of Diversity and Inclusion. The goal of both programs is to recruit and prepare underrepresented minorities to succeed as medical students, and prepare them for a career as physicians and physician-scientists. Having programs in place to assist students in overcoming barriers and addressing any concerns from minority groups in particular, has proven successful in engaging women and others from underrepresented minority groups.

Physician-Scientist Advisors

Engaging the right advisor can make a significant difference in a junior investigator's career, especially when pursuing a career as a physician-scientist.² With full appreciation for such a challenge, KU Frontiers selected two accomplished, active, physician-scientists to lead the KL2 program and to act as advisors for the participants. Although the KL2 and TLI awards are not limited to only physician-scientists, 50% of the training program participants are either studying to be physicians, while engaging in their research projects or are already physicians carving out careers as physician-scientists. With intentionality and care, the training programs have made a concerted effort

to have a support structure in place for those pursuing the physician-scientist career path.

The experience of becoming a physician-scientist is a unique and arduous career choice, and, reportedly, can feel a little uncomfortable, based on individuals not fitting in with medical or research colleagues, wholly.² To temper the risk of experiencing those feelings, the training programs are structured as the ideal environment for those who are interested in the physician-scientist career path. KU Frontiers and its programs continue to be well-positioned to cultivate and train the next generation of physician-scientists and enrich the pipeline at a most critical time.

CONCLUSION

KU Frontiers and its training programs are fully dedicated to accelerating research to better reach patients in an innovative and efficient fashion. With an eye on medical advancement, KU Frontiers is well-positioned to assist in adding to the dwindling physician-scientist pipeline. Its investment in stage-specific training opportunities, recruitment, diversity, expediency, mentorship and advising sets the foundation for investigators locally and nationally to springboard their careers and enhance the likelihood of impactful medical discovery.

In particular, KU Frontiers and its TLI and KL2 training programs continue to create an environment in which physician-scientists can flourish. It is the physician-scientist who is uniquely qualified to close the gap between making medical discoveries and providing innovative care to the patient's bedside based on those discoveries. With the declining number of physician-scientists posing a threat to the future of biomedical research, it is more important than ever to meet their needs and provide the right environment for them to grow into their research careers, and hopefully, grow in number. With a focus on innovation and steady growth, KU Frontiers and its training programs will continue providing intensive and expedited training experiences for those eager to carve out a path as clinicians and investigators.

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