Original Report:
Research Training
at the Graduate Level

Preparing the Next Generation of Diverse Biomedical Researchers: The University of North Texas Health Science Center's Initiative for Maximizing Student Development (IMSD) Predoctoral Program

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The National Science Foundation (NSF) reports that underrepresented minority students are just as interested as their White counterparts in majoring in science upon entering college.[1] However, the numbers of those receiving bachelors' degrees, attending graduate school, and earning doctorates remain lower than their White peers. To close this gap, the National Institutes of General Medical Science's (NIGMS) Initiative for Maximizing Student Development (IMSD) at University of Texas Health Science Center (UNTHSC) supports the timely completion of PhD degrees by underrepresented students and their transition into successful biomedical research careers. Throughout UNTHSC's IMSD training program, we have designed interventions anchored by the central hypothesis that PhD attainment requires attentiveness to multiple factors (knowledge, psychosocial, financial and self-efficacy). An assessment of program outcomes demonstrates a progressive increase in trainee retention. Importantly, not-withstanding quantitative measurable outcomes, trainee and mentor evaluations express the value in addressing multiple factors relevant to their success. Since 1996, our cumulative success of underrepresented minority students completing the doctorate increased from 64% (1996) to 84% completion (2018). Herein, we describe the UNTHSC IMSD training approach spanning its performance over two five-year cycles (2004-2008; 2009-2013) and new interventions created from lessons learned that influenced UNTHSC's newly awarded IMSD program (2017-2022). *Ethn Dis*. 2020;30(1):65-74; doi:10.18865/ed.30.1.65

Introduction

Investigators from diverse backgrounds bring unique perspectives and experiences that enhance our understanding of the factors underlying racial and ethnic variations in health and health status in the United States.[2,3] The National Science Foundation (NSF) reports that underrepresented minority students are just as interested in majoring in science upon entering college as freshmen, but the numbers of those receiving bachelors' degrees, attending graduate school, and earning doctorates remain lower than their White counterparts.[4] A continuing decline among underrepresented minorities (URMs) graduating with a doctorate biomedical science degree will have broad consequences. Although these minority groups constitute nearly 30% of the US population, they comprise <14% of the practicing physicians and full-time medical school faculty combined.[5,6] In turn, fewer numbers of URM faculty conduct research and receive NIH research grant awards and the continuing paucity of URM faculty limits the number of faculty available to serve as mentors and role models for the next generation, perpetuating the cycle.[7]

In 2004, the University of Texas Health Science Center Initiative for Maximizing Student Development (UNTHSC IMSD) implemented a pre-doctoral training program hypothesized to increase the number of individuals from underrepresented

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groups attain a doctoral degree in the biomedical sciences. The objectives are to enhance trainee recruitment by: 1) sustaining strong partnerships with minority serving institutions (MSIs); 2) address individual barriers faced by trainees; and 3) emphasize the importance of culturally responsive mentoring. The UNTHSC IMSD's training approach encompasses two previous five-year cycles (2004-2008; 2009-2013, R25GM064365) and a newly awarded IMSD program (2017-2022, R25 GM125587) funded by the National Institute of General Medical Sciences (NIGMS) of the National Institutes of Health (NIH). Housed within NIGMS, is the Division of Training, Workforce Development and Diversity (TWD). The main objective of the TWD is to support research training, student development, and fellowship programs for undergraduate and predoctoral students who are underrepresented in the biomedical research workforce (https://www.nigms.nih.gov/research-areas/areas-of-research/training-workforce-development-and-diversity).

A continuing decline among underrepresented minorities (URMs) graduating with a doctorate biomedical science degree will have broad consequences.

Undergraduate students from minority-serving institutions (MSIs) majoring in STEM disciplines represent a diverse and talented pool with high motivation to pursue graduate training in the biomedical sciences. Therefore, we implemented an approach that takes advantage of strong relationships with MSIs and, to a broader extent, with non-MSI institutions across the United States. Such relationships were established and sustained by activities including campus visits by UNTHSC program directors (PDs) of UNTHSC Summer Undergraduate Internship Programs (eg, Ronald E. McNair, HBCU-UP, NHLBI Summer Multicultural Advanced Research Training, NIDA-funded Summer Research Internship programs) along with campus visits by our students and faculty. PDs and faculty provide seminars about their research and provide information on applying for entry into the UNTHSC Graduate School of Biomedical Sciences (GSBS) as a potential IMSD trainee. After progressing through the IMSD program, GSBS doctoral students visit their former undergraduate institution to share their own stories about graduate school, serving as a near peer role model for the prospective students.

We also recruited at scientific meetings hosted by professional societies. The Annual Biomedical Research Conference for Minority Scientists (ABRCMS) and Society for the Advancement of Chicanos and Native American Scientists (SACNAS) provide undergraduate students, largely URMs, a venue to showcase their research, gain valuable knowledge around graduate school, and learn about career opportunities in the biomedical sciences. IMSD PDs and UNTHSC GSBS representatives attend one or both conferences to recruit students into UNTHSC GSBS programs and network with meeting attendees (eg, academic advisors and institutional administrators). Another recruitment venue is through the UNTHSC Texas Center for Health Disparities (TCHD), which is funded by the National Institutes on Minority Health Disparities (NIMHD). One of TCHD's major functions is the training and education of undergraduate students in health disparity research through its Training and Education Core. Each year, undergraduate students attend the annual Health Disparity Conference as part of their summer research internship training program. This experience provides undergraduate students a deeper understanding of biomedical research as it relates to minority populations and, in many ways, motivates students to pursue research. Finally, we utilize web-based and social media resources for prospective IMSD applicants. All prospective IMSD trainees' contact information is maintained within a database in the UNTHSC Center for Diversity and International Programs (CDIP), which houses IMSD and other diversity programs. This database provides reporting on prospective students who have attended any of our summer outreach programs as well as identifies interest in our graduate school through our recruitment efforts.

The UNTHSC IMSD program provides several paths to become an IMSD trainee. All prospective IMSD trainees are accepted into the UNTHSC GSBS pre-doctoral program through an online applicant and interview process. Any GSBS student interested in becoming an IMSD trainee then submits a supplemental application, which is reviewed by IMSD PDs and the IMSD advisory board, comprising UNTHSC faculty. Trainees may be selected as an IMSD trainee as early as their first academic semester. Alternatively, UNTHSC GSBS pre-doctoral students successfully completing their core course work may apply through a similar application and review process. A third path allows students nearing the completion of their master's degree to transition into the IMSD as a doctoral student. The application entails a brief questionnaire emphasizing their research experiences (eg, publication, meeting attendance), immediate and long-term research and professional goals, and current academic standing if applicable. Applicants also provide a letter of referral from either their major professor or current graduate advisor if they have not yet joined a laboratory to pursue their doctoral research program. The provision of multiple entry pathways affords a broader participation of students ranging from those just entering their program to trainees entering their third year of graduate study.

The IMSD approach to training assures that trainees receive financial support, an individualized development plan, culturally aware mentored research experiences, and professional development that collectively promotes entry and persistence in biomedical research careers. The IMSD program offers trainees financial assistance throughout their pre-doctoral training. IMSD trainees receive 24 months of financial assistance inclusive of stipend, tuition, and health insurance directly from the UNTHSC IMSD program. The trainee's financial package is supplemented with support from their mentor's funded research program as well as the Dean's Office of GSBS through its MORE (Minority Outreach in Research and Education) Scholar's program instituted in 2004 during the initial funding of UNTHSC IMSD. In addition, IMSD trainees are encouraged to apply for other institutional and extramural training fellowships (eg, NIMHD-funded endowment, NIH-supported training fellowships, foundation grants) to support their pre-doctoral training program. All IMSD trainees are assured financial assistance for the duration of their doctoral training as long as they remain in good academic standing.

The IMSD program recognizes the potential need for academic and research skill preparation before and during a graduate student's pre-doctoral program. In collaboration with the IMSD program, GSBS created an online and campus pre-matriculation summer academic/research program during the UNTHSC IMSD's 2008-2013 funding cycle. Several online courses are offered in the summer for recent undergraduate and first year graduate students. These 1-2 semester credit hour (SCH) "primer" courses include: Essentials of Biochemistry, Essentials of Cell Biology, and Essentials of Human Genetics. IMSD trainees are also offered the opportunity to enroll and register in courses including laboratory rotations (totaling 6 SCH) during the 6-week summer session. During the fall semester, IMSD trainees are enrolled in the first-year GSBS core curriculum to begin their formal pre-doctoral program. Trainees also participate in a "Core Forum" (initiated in 2004), which organizes review sessions of the first-year courses. The weekly 1-hour sessions are facilitated by GSBS faculty, post-docs, and senior-level students. Attendance is required throughout the first year of the GSBS core curriculum. As part of the general graduate school academic program, all students have access to peer tutoring and other academic enhancement programs offered through the Office of Student Affairs' Center for Academic Performance. IMSD trainees also have available advisement through the Center for Diversity and International Programs, formerly the GSBS Office of Minority Affairs and Outreach (1993-2011). This latter entity continually monitors trainee progress and can affect immediate response should the trainee encounter difficulties. Within the first 18 months of residence in the program, trainees identify a major advisor and an affiliated academic department to complete their doctoral degree. The trainees and advisor develop an IDP that includes the academic course schedule and research goals supplemented with IMSD-specific activities as part of their degree plan. Progress of the trainee's IDP is discussed annually with the major advisor, dissertation advisory commit-

tee, and the IMSD Advisory Team.

Strong mentorship enhances a student's motivation, productivity, and long-term career success.[8,9] Since its inception, the IMSD program provides trainees with a multi-tier mentoring team approach that incorporates mentorship by their major advisor, peer mentoring, and coaching. Along with their primary advisor, IMSD trainees are paired with an appropriate senior graduate student who serves as a student mentor (Pair-a-MORE program). In 2017, this mentoring practice incorporated a group-based, structured mentor and mentee training session that focuses on key principles of establishing and maintaining effective mentee-mentor relationships adapted from "Entering Mentoring for Biomedical Sciences" by Pfund et al.[10] Additionally, IMSD mentors and trainees join the National Research Mentoring Network (NRMN) to receive additional web-based mentoring resources (https://nrmnet.net/#undergrad). The PDs and IMSD advisory team serve as IMSD coaches who, apart from their programmatic roles, provide trainees with ad hoc advising throughout their pre-doctoral program.

Professional development and social support are critical to a trainee's sustained motivation toward his/her career goals. Trainees participate in seminars and workshops offered in various academic departments at UNTHSC. The IMSD program facilitates its own works-in-progress sessions that incorporate research progress presentations, scientific writing sessions, and role model seminars attended by fellow trainees, advisors, the IMSD advisory team, IMSD PDs, and peer mentors. In addition, the graduate student associations periodically hold career opportunity days with panels of representatives from industry, academia, and publishing, as well as businesses with an interest in hiring science-trained individuals. IMSD trainees also receive financial support to attend local, regional, and national scientific meetings allowing them multiple opportunities to present their research and network within their scientific disciplines. Furthermore, IMSD trainees participate in the UNTHSC Summer Research Internship Programs as near-peer mentors and role models. Trainees are encouraged to establish working groups to host meetings, share materials, and network through the MyNRMN portal (https://nrmnet.net/mynrmn/).

Notwithstanding a need to promote academic and research enrichment activities for IMSD trainees, the provision of strong social support is critical to a trainee's persistence in predoctoral biomedical programs. The IMSD program facilitates opportunities for trainees to build a community support structure through the provision of resources used for organizing activities and promoting initiatives of their own. For example, IMSD trainees collaborate with other campus organizations cognizant of their critical presence to raise awareness among our students, faculty, and administrators on the value of diversity. In addition, trainees build social support networks by participating in UNTHSC student organizations. Herein, we describe UNTHSC IMSD's training approach created from lessons learned that influenced UNTHSC's newly awarded IMSD program.

Methods

IMSD Trainee Evaluation and Trainee Assessment

The UNTHSC IMSD program and process outcome evaluation measures the program's effectiveness and describes the achieved results in the target population to inform program administrators how well the program objectives were achieved and whether activities in subsequent programs should be continued, modified or expanded. Trainees entering the program receive pre-program assessments to identify trainee strengths and opportunities for improvement. These assessments are administered annually and are reviewed by their primary faculty advisor, IMSD advisory team, and PDs to inform the trainees IDP requirements needed for completing the doctorate. A mentor assessment of the trainee and a mentee assessment of her/his mentor is disseminated to measure how IMSD program impacts their mentoring relationship and mentee's performance. In addition, the PDs prepare an annual report, which is presented to the IMSD advisory team for programmatic review.

Trainees are tracked during their tenure in the program and over time annually after completion of the program to determine whether they pursued postdoctoral biomedical research or other relevant career paths. Trainees are contacted to determine their level of success in their new programs and asked to provide a post-program review that documents specific measurable outcomes (eg, publications, grant awards, honors, academic/professional appointments).

Data Collection and Analysis

Institutional data were collected from the Office of the Registrar. Program-specific data represent outcome from past and present trainees from three funding cycles; 2004-2008; 2009-2013, and 2017-2022. Appropriate statistical analysis was performed and indicated in the table captions.

Results

UNTHSC GSBS Doctoral Student Population during IMSD Funded Cycles (2004-2018)

The UNTHSC IMSD program has a significant impact on URM participation in the GSBS doctoral program. Table 1 provides the status of PhD enrollment and conferred PhD degrees within the GSBS at UNTHSC. On average, URMs represent 21% of GSBS PhD students (2003-2018). Forty-nine URMs have earned their PhD, representing 26% of the GSBS PhD graduates, of which, 30 (61%) were former IMSD trainees. The average time to degree for all our GSBS students is 5.2 years and 5.4 for URM students.

IMSD Trainee Characteristics

The UNTHSC IMSD training program was originally funded by NIGMS for two consecutive five-year cohorts (2004-2008 and 2009-2013) and was recently refunded for a third five-year cycle in 2017. To date, 54 trainees have participated in the UNTHSC IMSD program with 48 students spanning the first two funding cycles and 6 currently enrolled in the third cycle. Trainees have been predominantly female (56%), African American/Black (54%), followed by Hispanic/Latino (40%). Sixty-one percent (61%) were recruited from MSIs.

IMSD Trainee Retention

The main goal of the UNTHSC IMSD Program is to support the timely completion of PhD degrees by URM students and their subsequent transition into successful biomedical careers. During the initial five years of the UNTHSC IMSD program, 10 of 25 (40%) earned their PhD. The remaining trainees either withdrew (n=8) during their first year, earned a master's degree (n=4), or pursued other academic programs (n=3). By comparison, 74% of cohort 2 successfully earned a PhD. Five withdrew during their initial year and 1 trainee decided to pursue a master's degree. The average time to degree was 5.25 years across both cohorts (Table 2). To date, six trainees are enrolled in cohort 3 and are in good academic standing. These results suggest that the increase in PhD attainment was attributed to progressive program en-

Table 1. Matriculating students in participating GSBS biomedical science doctoral program (2004-2018)

Year	PhD students		Graduating students			
	URM	Non-URM	URM	Non-URM	Unspecified	Totals
2004	20 (21%)	97	0 (0%)	11	2	13
2005	22 (21%)	106	1 (14%)	2	4	7
2006	22 (19%)	116	1(11%)	8	0	9
2007	21 (17%)	121	1(7%)	11	3	15
2008	21 (19%)	111	3 (12%)	22	0	25
2009	21 (19%)	111	5 (29%)	12	0	17
2010	22 (16%)	118	0 (0%)	13	0	13
2011	27 (18%)	119	3 (27%)	8	0	11
2012	27 (19%)	115	3 (17%)	15	0	18
2013	31 (23%)	104	3 (23%)	10	0	13
2014	33 (32%)	103	3 (13%)	20	0	23
2015	17 (18%)	96	13 (57%)	10	0	23
2016	19 (18%)	101	6 (26%)	17	0	23
2017	13 (15%)	74	2 (13%)	13	0	15
2018	14 (21%)	53	5 (20%)	20	0	25
Grand Totals	330 (21%)	1545	49 (26%)	192 (70%)	9 (4%)	250
Average time to degree, years			URM 5.4		Non-URM 5.2	

Table 2. PhD attainment of trainees of the UNTHSC IMSD program

Characteristic	Cohort 1, N=25	Cohort 2, N=23	Cohort 3[a], N=6
Degree attained			
PhD	10 (40%)	17 (75%)	ND
Master's degree	4 (16%)	1(4%)	ND
Other	3 (12%)	0	ND
Withdrew	8 (32%)	5(21%)	ND
Average time to degree, yrs	5.0	5.5	ND

a. ND=no data, program currently in progress.

hancements (eg, pre-matriculation summer course and pre-assessment) initiated during each funding cycle.

IMSD Program Evaluation

In addition to the objective measurable outcomes, the IMSD program allowed trainees and mentors to express their opinion related to the effectiveness of the IMSD program. In doing so, we were able to interpret the mentees' and mentors' responses to determine which interventions worked best and capture important information from them on the need to improve training experiences. IMSD trainees and mentors submit a questionnaire upon completing the program intended to inform program directors of IMSD's training effectiveness. Trainees are asked to complete a 13-item assessment at the completion of their IMSD program; the assessment items include topics related to their beliefs of their progress as well as items rating the effectiveness of their mentoring experience and main programmatic activities. Overall, trainees rated themselves as gaining knowledge and skills as a result of their participation. In addition, trainees either agreed or strongly agreed that their mentor clearly communicated expectations and had a positive experience. Table 3 represents responses from cohort 2.

Mentors were asked to complete an 11-item assessment of their trainee. Mentors rated trainees as excellent in their commitment, drive, determination, and perseverance. Mentors rated skill set and knowledge-based characteristics of most trainees as satisfactory, very good, and excellent. Less than 10% of trainees were rated as needing improvement by the mentor on any of the assessment characteristics (Table 4).

Discussion

In its most recent five year Strategic Plan, NIGMS reported that the currently supported NIH trainee population does not represent America's ethnic diversity and set a goal "to develop a highly skilled, creative and diverse biomedical research workforce with an objective of promoting the identification of best practices."[11] Minority serving institutions remain significant venues in educating minority and underserved populations. In 2010, more than 29% of Blacks received bachelors' degrees from historically Black colleges and universities (HBCUs) and 35.7% of Hispanics earned bachelor's degrees from Hispanic-serving institutions (HSIs).[12] Unfortunately, the percentage of MSIs producing students who go on to receive doctoral degrees is in decline and increasingly non-MSI's compete for a more diverse student body. According to estimates of graduate education studies, only 3% of individuals graduating with a science doctoral degree are African American or Black, 4% Latino, and .4% Native American.[4] In contrast, science doctorates are earned by 76% White and 17% Asian.[13]

The UNTHSC IMSD programs' positive impact on diversity training in the biomedical and behavioral sciences stems from recognizing the role that MSIs have in generating students seeking career paths in biomedical sciences. Since 2004, 61% of our IMSD trainee graduates received their bachelor's degree from HBCUs and HSIs. We believe a hallmark of our success is our sustained partnerships with MSIs supporting an institutional Coordinated Plan.[14] This approach ensures partnerships that create a shared investment to ensure students at MSIs are aware and have the opportunity to pursue biomedical and behavioral science research careers. In 2011, UNTHSC ranked fourth by National Science Founda-

Table 3. Cohort 2 trainees' assessment of program

Trainees, n=23	Strongly agree	Agree	Neutral	Strongly disagree	Not applicable
Survey topic			**Mean % (Std. error)**		
Improvement in research skills	32 (4.6)[a]	62 (7.3)[a]	4 (3.6)	0	1 (1.2)
Improvement in scientific writing skills	23 (3.4) [a]	52 (4.1) [a]	4 (3.6)	0	0
Improvement in reading manuscript skills	37 (2.9) [a]	58 (1.5) [a]	19 (4.8)	0	2 (1.5)
Improvement in oral and poster presentation skills	32 (6.6) [a]	51 (6.6[a])	2 (1.3)	0	0
Research mentor clearly stated the expectations	50 (4.3) [a]	46 (6.7) [a]	7 (4.1)	1 (1)	.5 (.5)
Regular meetings with the mentor	49 (4.0) [a]	30 (1.6) [a]	2(.9)	6 (1.9)	.5 (.5)
Research mentor available to provide help	50 (5.1) [a]	34 (4.1[a])	13 (1.9)	1 (1.2)	.5 (.5)
Positive and fruitful interaction to provide help	48 (4.3) [a]	37 (2.9) [a]	12 (3.6)	2 (1.3)	.5 (.5)
Were Courses and Workshops Academically stimulating	20 (6.8) [a]	61 (3.4[a])	8 (3.0)	4 (2.3)	.5 (.5)
Did the courses and workshops facilitate the development of useful knowledge and skills	26 (5.6) [a]	64 (6.2) [a]	9 (.94)	0	.5 (.5)
Was your experience with faculty/instructors other than with your mentor positive	43 (3.3) [a]	54 (6.0) [a]	5 (2.9)	0	.5 (.5)
Were programmed activities properly planned and organized	16 (5.3) [a]	50 (4.5) [a]	3 (2.2)	2 (.95)	4 (2.3)
Was administrative support sufficient	38 (6.9) [a]	52 (2.0) [a]	26 (.47)	0	0

One-way ANOVA with multiple comparisons was used for data analysis. Data represent the mean std. error (n=23)
a. Indicates significant (P≤.5) difference between groups. Data represents years (2009-2013).

tion in training the number of minorities in biomedical doctoral training programs, which was slightly behind the three top-ranked MSIs.[1]

Although entry into pre-doctoral programs are significant, outcomes from the UNTHSC IMSD program suggest that retention is the lynchpin required to change the status quo of URMs and disadvantaged populations in the biomedical research workforce. During the initial five years of our program, greater than one-third of program trainees withdrew during their first year for reasons including academic termination, health problems, or pursuit of an alternative career. While these results were disheartening, a study by Allum et al, found that the completion rate for Black/

Table 4. Cohort 2 mentors' assessment

Mentors, n=18	Excellent	Very good	Satisfactory	Needs improvement	Unsatisfactory
Survey Topic			**Mean % (Std. error)**		
Commitment, drive, determination and perseverance	49 (2.5) [b]	33 (2.7) [a]	15 (4.1) [a]	3 (2.1)	0 (0)
Creativity and imagination, in terms of experimental interpretation as well as design	14 (8.9) [a]	20 (7.4) [a]	23 (7.8) [a]	2 (1.7)	0 (0)
Technical abilities	22 (8.0) [a]	41 (12.1) [b]	20 (8.7) [a]	6 (3.4)	0 (0)
Critically reading and understanding the literature	25 (8.2) [a]	36 (6.9) [a]	25 (3.7) [a]	2 (1.7)	0 (0)
Scientific writing skills	17 (6.9) [a]	35 (7.9) [a]	20 (4.6) [a]	5 (5.5)	0 (0)
Leadership qualities (in the lab and/or program)	28 (4.7) [a]	41 (4.4) [b]	15 (1.3) [a]	10 (7.6)	0 (0)
Appropriate demonstration of independence	33 (6.0) [a]	30 (9.7) [a]	33 (6.4) [a]	2 (1.7)	0 (0)
Oral communication skills (person to person)	49 (2.2) [a]	30 (10.4) [a]	9 (4.0) [a]	5 (3.8)	0 (0)
Oral presentation skills (in a group)	22 (5.8) [a]	34 (8.1) [a]	23 (6.6) [a]	1 (0.7)	0 (0)
Poster presentation skills	5 (4.5)	14 (4.6) [a]	9 (4.9) [a]	1 (0.7)	0 (0)
Representing data and result effectively	16 (6.8) [a]	30 (10.3) [a]	21 (9.7) [a]	3 (1.8)	0 (0)

One-way ANOVA with multiple comparisons was used for data analysis.
a. Indicates significant (P ≤ .5) difference between groups.
b. Indicate significant (P ≤ .05) difference from all groups. Data represents years (2009-2013).

African American doctoral students in science, was 43% compared with 56% for its White counterparts.[15] Likewise, the National Research Council (NRC) published aggregate six-year doctoral completion rates at research institutions by program and by institution. Findings from this study showed that among the 3,829 URM STEM doctoral students in the project population who started their doctoral studies, 44% of them earned doctorates within seven years, while 36% of them withdrew from their respective graduate programs during the same time period.[16]

Based on trainee assessments, we designed pre-matriculation courses and study skill workshops that supported IMSD fellows prior to and throughout the doctoral program.

We have learned from our internal assessment that initiating remedial academic/research training only after academic hardships are realized significantly reduces retention. Multiple individual and environmental factors define the trainee's readiness to enter graduate programs. Based on trainee assessments, we designed pre-matriculation courses and study skill workshops that supported IMSD fellows prior to and throughout the doctoral program. Our experience has been that IMSD trainees opting to attend UNTHSC prior to the fall semester benefitted greatly because they were exposed to graduate-level course work and research as well as became familiar with the faculty and institutional environment. As a result, 74% of cohort 2 trainees were retained and 100% of cohort 3 trainees have been retained in the current IMSD program. We are pleased to report that our median time to degree among IMSD trainees is 5-7 years in contrast to median time to degree of 6-8 years for doctoral students in Life Sciences, reported in the 2014 report on doctoral recipients from US universities between 1994-2014.[17] We believe progressive increases in retention was directly related to identifying the readiness of each trainee prior to entering the doctoral program.

The IMSD approach informs the opportunity to offer tailored enrichment courses prior to their formal doctoral training and the proper interventions needed on a case by case basis throughout a trainee's program. Interventions focused on individual factors are critical determinants of success, particularly among URMs.[18] In addition, self-identity with becoming a biomedical researcher is thought to impact pursuit and retention.[19] In 2017, the UNTHSC IMSD implemented several new practices that are anticipated to increase trainee outcomes. Applicants to the UNTHSC GSBS doctoral program are required to complete the Doctoral Assessment Readiness Tool (DART). This tool adapted from Harwood et al,[20] is constructed to encompass both quantitative and qualitative measures across various academic, environmental, and behavioral domains. The intent is to collect information about the applicants directly instead of letting them disclose vague information indirectly in a written essay. In developing this assessment tool, potential compounding variables are taken into consideration.

Strong evidence also shows that mentoring and networking are critical developmental factors associated with a successful biomedical research career. Yet, in a study of barriers, URMs reported inadequate mentoring and lack of networks as a major obstacle.[21] Few faculty members receive formal preparation for their roles as mentors and even fewer doctoral trainees learn how to be proactive mentees so that they can effectively advocate for themselves. Thus, mentor-mentee discordance in aspects such as race, ethnicity, gender, and social-cultural context are likely contributing factors to the complexity of the mentoring relationship. The UNTHSC IMSD has had a multitier mentoring approach in place, which includes near-peer mentoring and formal periodic training sessions. In 2014, the National Institutes of Health established the "Enhancing the Diversity of NIH-funded Workforce" program under the NIH Director's Common Fund (https://commonfund.nih.gov/diversity). As result, a nationwide consortium to provide mentoring, networking, and professional development was

created as the National Research Mentoring Network (NRMN). Current IMSD trainees engage in the resources offered for mentor and mentee training, including train-the-trainer workshops offered in-person or online. Mentors can join the MyNRMN portal that allows trainees to establish working groups to host meetings, share materials, and network across the NRMN portal.

Conclusion

In conclusion, minority groups continue to be underrepresented among applicants and recipients of doctorate degrees in the Life Sciences, including Biomedical Sciences.[4] Previous research has highlighted the benefits of diversifying higher education, suggesting that it increases the quality of learning, fosters intellectual development, reduces racial prejudice, and facilitates acceptance of diverse perspectives.[22] The UNTHSC IMSD program provides a critical presence and awareness among our students, faculty, and administrators of the value of diversity and how it influences innovative ideas in biomedical and behavioral research. In fact, many of the curricula, workshops, and interventions tailored for our URM students have been adopted institution-wide. UNTHSC's commitment to values (eg, Serve Others First, Integrity, Respect, Collaboration, and Be Visionary) supports the vision and investment in identifying the appropriate strategies and interventions that encourages the success of our IMSD trainees and all students. Several key areas of anticipated value include: the provision of a critical presence and awareness among our students, faculty and administrators of the value of diversity and how it influences innovative ideas in biomedical and behavioral research (eg, many of the curricula, workshops, and interventions tailored for our IMSD program will be adopted institution-wide); faculty recognize the importance of mentorship and mentor training that fosters the success of a diverse student population; and, the integration of interprofessional practice that allows URM trainees to see the connection between their research and having a positive impact on improving the health and welfare of their communities.

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Conflict of Interest

No conflicts of interest to report.

Author Contributions

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