National Advisory Dental and Craniofacial Research Council
Oral Health Research Workforce Working Group

Final Report

Table of Contents

Executive Summary

Introduction

The National Advisory Dental and Craniofacial Research Council (NADCRC) Oral Health Research Workforce Working Group was charged with developing and recommending evidence-based approaches to sustainably recruit, train, and retain researchers who have knowledge and skills to build a robust dental, oral, craniofacial (DOC) and clinician-scientist research workforce. For DOC research, clinician-scientists are primarily dentist scientists but also include scientists with other clinical specialties. In carrying out its charge, the NADCRC Oral Health Research Workforce Working Group, hereafter, referred to as the Working Group, recognized that there is little information available to assess factors that would lead to a robust and sustainable DOC research workforce. To address this issue, the Working Group met with several distinct stakeholder groups to identify these factors. An overview of the National Institute of Dental and Craniofacial Research (NIDCR) Research Training and Career Development Programs was provided by National Institutes of Health (NIH) staff. A Request for Information (RFI; NOT-DE-22-019) was sent to the general public including the DOC research community for public input. Several listening sessions were held both in person and virtually with multiple stakeholder groups, including former and current NIDCR trainees, dental school deans, oral health industry leaders, and professional society and foundation leaders. One session each was held with directors of university training programs, and research training program officers representing the NIH, the National Science Foundation (NSF), and foundations associated with improving oral health. In addition, listening sessions were conducted with former NIDCR-supported trainees who did not pursue research careers.

The listening sessions and RFI responses provided detailed information from multiple perspectives on the current landscape of training and career paths for DOC researchers. The factors that limited training and the formation of a robust DOC research workforce as identified by key stakeholders are summarized in the "Challenges" section of the Executive Summary. Specific details are available in the "Background" section of the Working Group Report. The Working Group developed recommendations to address these challenges, which are listed in the "Recommendations" section of the Executive Summary and described more fully in the body of the report. The recommendations reflect the reality that budgetary constraints could impact the eventual implementation of the steps by NIDCR and partly drove the emphasis on enhancing how NIDCR works with other groups and on the assessment of programs and outcomes to increase efficiency. The recommendations encompass four different approaches: 1. Programmatic Approaches; 2. Enhancement of Career Opportunities; 3. Working with Professional Societies, Foundations, Dental Schools, and Industry; and 4. Assessment of Research Training and Career Development Outcomes. The recommendations for approach #3 include the development of an office to facilitate collaboration. There are many examples of NIH institutes, centers, and offices working with professional societies and foundations to achieve their shared goals. Thus, the Working Group held listening sessions with leaders of several professional societies, foundations, and the oral health industry. Representatives offered consensus and an eagerness to participate with NIDCR but indicated that the path to accomplishing this was limited by the lack of a specific contact person or office. To facilitate approach #4, the recommendations included the development of a center to provide a more granular and sustained assessment of the DOC research workforce needs, DOC research training programs, and trainee success factors. Collectively, the implementation of these approaches will help optimize research training and career development and the requisite funds and human capital.

This report was developed by the Working Group, with final edits provided by NIDCR to comply with administration policies.

Challenges

Training and Career Opportunities

- Training rigor varies across different programs, leading to differences in achieving competencies that are requisite to secure ongoing research grant support.
- Programs often do not provide adequate exposure and training in key areas such as experimental techniques, entrepreneurial skills, and clinical research.
- Limited awareness of career path options and lack of guidance on which path to take may limit the success of trainees. This is a notable problem for dual degree trainees at transition points, with the transition from specialty training to early faculty positions seen as particularly problematic.
- Limited research training for clinicians negatively impacts the ability of clinicians to pursue DOC research careers.
- The lack of defined positions that include both clinical instruction and significant protected research time restricts career opportunities for clinician-scientists.
- Dual degree scientists face multiple challenges in maintaining research as a significant component of their career. Obstacles include:
    - Disproportionately fewer suitable academic positions that support research activity and growth, as compared with strictly clinical positions
    - Low grant success rates that lead to uncertainty of sustainable research funding
    - Research Career Development Awards (K awards) do not provide sufficient funds for independent research activities
    - A need for greater exposure to clinical research
    - Inadequate awareness of the NIH/NIDCR funding opportunities
- Dental schools do not provide early career investigators (including Early Stage Investigator (ESI)) options where there is support for both their research and clinical skills simultaneously to drive their clinical/translational and basic science research goals at 75% research effort.

Mentoring

- Mentorship is inconsistent and may be too narrow or lacking across career levels.
- Mentorship is particularly lacking in supporting career transitions, especially during the transition to independence for clinician scientists.
- There are inadequate incentives for mentors to devote quality time and effort to mentees, particularly for early career investigators who need more guidance in grant writing.
- The opportunities for training, feedback, and monitoring of mentors are limited.
- There is a lack of evidence-based mentoring models being used. The extent of broad participation among a pool of mentors and the use of evidence-supported mentoring models or structures (e.g., mentoring groups) is unknown.
- A limited availability of DOC research mentors with varied backgrounds exists.

Outreach and Recruitment

- Programs that engage students in DOC research are inconsistent and their effectiveness is not adequately assessed.

- The effectiveness of various recruitment strategies, including the ideal timing and structure of outreach (ranging from middle school to dental school) is unknown.
- No clear information or guidance is available to identify the characteristics and attributes of dual degree applicants who are most likely to pursue a research-oriented career.

Research Environment

- There is a lack of clarity regarding research training goals and the definition of success.
- Only a small proportion of dental schools have adequate research infrastructure and opportunities to support the development of DOC researchers.
- Trainees often feel a lack of connection to the broader research community.
- Lack of flexibility during clinical training to allow continued research productivity and to reduce curriculum redundancy hinders training.
- Dental schools often lack a sustainable and flexible structure to support faculty in DOC research careers, as clinical revenue takes precedence.
- Clinician-scientists are often overburdened with clinical duties, and effective protected time for research is less than agreed upon at hiring.

Financial Limitations

- There are financial concerns, including loan indebtedness.
- There is uncertainty of sustained grant support.
- There is an imbalance in private practice/academic compensation that represents genuine disincentives for a DOC research career.

Recommendations

Programmatic Approaches

- Develop defined funding opportunities that foster collaborations between an early career investigator as principal investigator (PI) and an established researcher as co-investigator.
- Expand and increase awareness of the NIH Loan Repayment Programs (LRPs) aligned with DOC research.
- Provide financial incentives for dual-degree graduates to stay in academia that would facilitate the transition from training to faculty positions.
- Allocate funding to support local, regional, and virtual research conferences tailored for trainees and early career investigators while strongly encouraging participation for NIDCR-supported trainees.
- Work with professional societies and foundations to fund new mentoring programs that provide research and career guidance to trainees and early career investigators.
- Support K-12 research training and educational initiatives aimed at developing and nurturing sustained interest in DOC research.
- Develop research training programs for clinicians at various career stages.
- Stipulate that all programs provide rigorous mentorship, including mentor training and evaluation, and monitoring of trainee mentorship. NIDCR should develop resources to assist programs in this effort.
- Promote initiatives that foster innovation through multiple avenues including working with industry to enhance training from concept to product development.

Enhancement of Career Opportunities

- The Working Group concurs with the previous NIH Advisory Committee to the Director (ACD) Biomedical Research Workforce Working Group report (https://acd.od.nih.gov/documents/reports/Biomedical_research_wgreport.pdf), and suggests several new directions of support that could be leveraged by NIDCR:
    - Eliminate pauses in NIDCR's Notices of Funding Opportunities (NOFOs) of Institutional Training (T) Grant Support.
    - Encourage the development of research careers after clinical training by supporting the clinical training through loans that will be forgiven if the individual enters and stays in an academic research career for a minimum number of years (e.g. five years).
    - Encourage exploration of novel career options by developing grant or supplemental awards that provide unique educational experiences during training.
    - Incorporate opportunities for postdoctoral trainees supported on NIDCR training grants (T32, T90, R90) to pursue research in industry- or other agency-supported internships up to 12 months in duration.
    - Support funding opportunities for training programs that develop biomedical science entrepreneurship.
    - Build programs that focus on translational science and provide education about clinical regulatory skills to stimulate technological innovation from bench to patient.
- Develop interdisciplinary training opportunities for clinician-scientists that combine oral health with other fields such as data science, public health, engineering, business administration, medicine, nursing, and pharmacy.
- Develop additional research opportunities for clinician-scientists that emphasize the connection between DOC health with systemic health.
- Provide sustained funding opportunities for clinical researchers that provide substantial protected research time.
- Develop opportunities for trainees and early career investigators to participate in large-scale computational approaches to DOC research.
- Post all NIDCR funding opportunities on a website or social media in a user-friendly format accessible to trainees and early career investigators.

Working with Professional Societies, Foundations, Dental Schools, and Industry

- Establish a specific office (with a contact person within NIDCR) to interface and form a closer working relationship with the leadership of professional societies, foundations, and the oral health industry.
- This office will be responsible for the following areas:
    - Facilitating networking opportunities between NIDCR-funded trainees and investigators with professional society members.
    - Promoting knowledge of NIDCR-funded research and increasing interactions between NIDCR program officers and professional society leadership.
    - Developing and promoting joint programs to enhance the robust mentorship of clinician-scientist trainees and early career investigators.
    - Developing creative programs that foster research for early career investigators, including faculty and postdocs, with substantial clinical engagement. This can be achieved by establishing positions that embrace both activities, including partial grant-supported protected research time.

- Developing messages to promote the importance of DOC research and research opportunities. These messages can be shared through social media, student events, research meetings and other appropriate outlets.
- Developing outreach to enhance/increase pathway programs for DOC research. These strategies should include programs targeting Kindergarten through 12th grade, undergraduates, dental students, residents, and clinicians interested in research.

Assessment of Research Training and Career Development Outcomes:

- The Working Group recommends that NIDCR clearly define and state short- and long-term goals and expected outcomes for research training and career development programs in the NOFO and NIDCR webpages for the understanding of internal and external stakeholders. The goals should align with the appropriate career stage, including consideration of the next logical steps and timeframe as defined by program-specific metrics of success.
- In coordination with individual Program Directors of NIDCR Institutional Training Grants and other institutional awards, the Coordination Centers should host annual activities to support program leadership and trainee research and career development.
- The Working Group recommends that NIDCR establish a funding opportunity for a coordination and evaluation center, which should serve as a central data repository, coordinate evaluation, regularly monitor metrics for necessary adjustments in real-time, and track trainee progress and outcomes.
    - Examples for regular monitoring might include:
        - Biannual site visits (in-person or virtual)
        - Feedback sessions between NIDCR Program Officers and NIDCR-supported trainees/scholars and mentors
    - The coordination and evaluation center should monitor trainee progress and outcomes, and consult with individual organizations and programs to guide self-assessment and evaluation. The center will have the following responsibilities:
        - Collect qualitative and quantitative data regarding training and career development experiences. The data should reflect the training experiences, including the adequacy of mentoring, the trainees' opinion of research training experience, the trainees' guidance during transition phases, and the trainees' involvement in the larger research community. The evaluation should include psychosocial factors, such as a sense of belonging and research identity.
        - Analyze the data to understand the impact of the various parameters on the retention of trainees in DOC-related research careers.
        - Provide the results of data analyses to NIDCR to support regular assessment of training and career development programs. The data should be used to modify the training programs and adjust the level of NIDCR support for specific types of research training/career development activities.

Background

In 2022 Dr. Rena D'Souza, the then Director of the National Institute of Dental and Craniofacial Research (NIDCR), called for the formation of an Oral Health Research Workforce Working Group as part of the National Advisory Dental and Craniofacial Research Council (NADCRC). The NADCRC Oral Health Research Workforce Working Group, hereafter referred to as the Working Group, was charged with developing and recommending evidence-based approaches to sustainably recruit, train, and retain researchers who have knowledge and skills to build a robust dental, oral, craniofacial (DOC) and clinician-scientist research workforce. For DOC research, clinician-scientists are primarily dentist scientists but also include scientists with other clinical specialties.

To accomplish this goal, the Working Group gathered information from several sources, including staff presentations on NIDCR extramural research training and career development programs and outcomes, a Request for Information (RFI) on augmenting research training and engaging scientists in DOC research careers (see NOT-DE-22-019), and several listening sessions with key stakeholders. The information obtained is documented in this report, which serves as a repository of insights, observations, and data that collectively offer recommendations to enhance the research training, career development, and retention of highly skilled DOC researchers.

The background is divided into four sections based on the source of information. The first section provides an overview of the state of the DOC research workforce, current NIDCR training programs, and outcomes that are derived from NIH data and public sources. The second section is based on the information submitted in response to an NIDCR RFI (NOT-DE-22-019) that was developed by the Working Group, made available to the public, and sent to the NIDCR community in addition to information from the listening sessions held with deans of dental schools and oral health leaders. The third section is based on the information gathered from the listening sessions with NIDCR key stakeholders including former and current NIDCR trainees and university and NIDCR training program directors. The fourth section is based on the information from the listening sessions with leaders of professional societies and foundations affiliated with the oral health community. The information in the background narrative was used to develop actionable recommendations to shape the future trajectory of the DOC research workforce. Within this narrative, particular attention is paid to the challenges which are highlighted in the executive summary.

Several common themes were identified by multiple stakeholder groups.

1. Lack of awareness of current NIDCR funding opportunities
2. Lack of support from budget-constrained dental schools to provide protected time for research
3. A need for greater mentorship, particularly during the transition from training to independence
4. High levels of student educational debt that influence career options
5. A need for additional opportunities for engagement at all levels of DOC research
6. A need for greater networking opportunities during training and for early career investigators

1. Review of Current Training and Career Development Programs

Overview of NIDCR's Current Research Training and Career Development Initiatives

NIDCR is dedicated to building an comprehensive and robust biomedical workforce through its research training and career development programs. NIDCR offers and participates in a wide variety of funding

initiatives across all career levels. Trainees include dental students, dental students also pursuing PhD degrees, PhD students, postdoctoral fellows, and postdoctoral dentists.

To foster scientific cohorts and community building, NIDCR offers institutional training awards for students and postdoctoral scholars (including clinician scientists) who are U.S. citizens, non-citizen nationals, or permanent residents; non-citizen postdoctoral scholars and dentists are eligible to participate in the R90 component of a T90/R90 institutional award. The goal of these programs is to provide long-term research training experiences for students and postdoctoral scientists seeking to develop independent research careers in DOC research and build a strong community through networking and other activities. NIDCR also has a program uniquely designed for dentist-scientist research training: NIDCR Dental Specialty and PhD Programs (DSPP) (K12).

There are challenges in the transition from predoctoral to postdoctoral research training and from postdoctoral research to an independent investigator position in academia. To support these transitions, NIDCR sponsors transitional funding initiatives. It is anticipated that the successful completion of transitional award programs will enable trainees to obtain an independent research faculty position and prepare competitive applications for NIDCR career development and Research Project Grant (RPG) awards. These awards can also offer protected time to complete supervised research work, publish results, and search for an independent research position.

Mentored career development awards are available for predoctoral students, postdoctoral fellows, and early career investigators. These initiatives include opportunities for postdoctoral and junior faculty dentist scientists looking to re-enter the DOC research community, apply quantitative science, data and physical science research to DOC research topics, and pursue patient-oriented research.

Recognizing the considerable educational debt of an average dental school graduate, NIDCR participates in the NIH loan repayment program (LRP), which is a set of programs established by Congress that are designed to ease financial burdens on aspiring investigators. By easing financial stressors, NIDCR aims to retain highly qualified investigators, including health professionals, in biomedical or biobehavioral research careers. NIDCR considers NIH LRP (Extramural) applications from investigators who are engaged in DOC research and match program areas described in five of the six NIH Extramural LRPs: Clinical Research Program, Clinical Research for Individuals from Disadvantaged Backgrounds, Pediatric Research Program, Health Disparities Research Program, and Research in Emerging Areas Critical to Human Health (REACH). Awards are based on an applicant's potential to build and sustain a research career.

It is important to note that this section provides an *overview* of relevant NIDCR research training and career development programs. NIDCR sponsors and participates in many additional programs and initiatives that are not discussed here. Please see https://www.nidcr.nih.gov/careers-training for comprehensive details on all programs.

Assessment of NIDCR Training and Career Development Programs

NIDCR supports research training, research career development, and research education programs, along with NIH LRPs, to promote a robust DOC research workforce. The outcomes of these programs are analyzed periodically to assess their effectiveness in achieving program goals. For dentist scientists, the program goals include: completion of predoctoral dual degree DDS/DMD-PhD programs; transition from predoctoral to postdoctoral research careers or from postdoctoral to early career faculty or equivalent research positions in academic, government or industry, other organizations, etc.; obtaining NIDCR/NIH grants or other independent awards, such as mentored research career development awards (K),

research career transition awards (e.g., F99/K00, K99/R00), or an independent RPG after their initial NIDCR research training or career development award; and the number of research publications attributed to the NIDCR awards. Since 2000, NIDCR has examined outcomes of NIDCR institutional training programs (Ts), individual fellowships (Fs), individual career development awards (K08, K23), and K99/R00 postdoctoral to tenure track faculty transition awards.

Outcomes of NIDCR Dual Degree DDS/DMD-PhD) Predoctoral Training: NIDCR supports Ruth L. Kirschstein National Research Service Awards (NRSA) T32/T90 predoctoral dual degree DDS/DMD-PhD training in which the Program Directors/Principal Investigators (PDs/PIs) appoint trainees to the T32/T90 grant based on the selection process described in the application. The number of trainees supported by each T32 or T90/R90 is currently no more than 10 individuals inclusive of all predoctoral trainees (dual degree and PhD) and postdoctoral trainees, which may include individuals with a PhD, DDS/DMD, dual degree dentist scientists, and those earning a PhD or master's degree. Predoctoral dual degree students, PhD students, and postdoctoral researchers can also apply for independent fellowship support, in response to the Ruth L. Kirschstein NRSA F30, F31, and F32 programs, respectively.

The sample sizes for the following analyses are low and therefore should be interpreted with caution. In order to maintain privacy, except for individual awards, counts less than 12 are not identified and are shown as "< 12".

NIDCR performed an analysis of dual degree DDS/DMD-PhD training outcomes of individuals supported by T32/T90 and F30 awards whose last year of training on these awards was in years 2000-2010 (n=71) and 2011-2020 (n=123). Outcome information was collected at the time when the trainee's T32/T90/F30 support ended, and updated in 2019-2020.

In the 2000-2010 cohort, 17% (n<12) T32/T90 trainees and 37% (n=13) of the F30 recipients completed their dual degree training and achieved research intensive/research related/industry positions. In the 2011-2020 cohort, 38% (n=20) of the T32/T90 trainees and 66% (n=47) of the F30 recipients pursued postdoctoral research, advanced training in a dental specialty (dental specialty training) or obtained research-intensive, research-related, or industry positions. The remainder of the trainees in both cohorts primarily pursued private dental practice, may not have earned a PhD, pursued other careers, or their occupation could not be determined.

Among all of the T32/T90 and F30 dual degree trainees who completed the program and applied for subsequent grants (n=151), 9% (n=14) were awarded a mentored K and less than 8% (n<12) were awarded an RPG.

NIH Mentored Career Development Awards: NIDCR offers the Mentored Clinical Scientist Research Career Development Award (K08) and the the Mentored Patient-Oriented Research Career Development Award (K23) to support 3-5 years of mentored research training for clinically trained professionals who have the commitment and potential to develop into productive and independent investigators. K08 and K23 award recipients may hold a concurrent K08/K23 award and an RPG when recognized as a PI or subproject Director of a multi-project NIH grant (see NOT-OD-08-065). Therefore, the analysis of awardees with subsequent grants includes K award recipients who have active K awards.

Between 1996 and 2020, NIDCR awarded 76 K08 grants to dentists: 84% (n=64) were dual degree DDS/DMD/BDS-PhD dentist scientists and 16% (n=12) were dentists without a PhD. Among these K08

award recipients, 35% (n=27) of the awardees successfully competed for an RPG, of which 26% (n=20) of the awards were R01 or equivalent awards.

Between 1999-2020, 48 dentist scientists were NIDCR K23 award recipients: 73% (n=35) awardees were dual degree dentist scientists, and 27% (n=13) awardees were dentists without a PhD. Among these K23 awardees, 52% (n=25) of the awardees successfully competed for an RPG, of which 40% (n=19) of the awards were R01 or equivalent awards.

The proportion of dentists (individuals with a DDS/DMD/BDS or other equivalent dental degrees) vs. non-dentists (individuals with other clinical degrees, e.g., MD, MD-PhD, DVM, clinical PhD), is similar between the K08 and K23 awards recipients. Among 107 K08 award recipients, 71% (n=76) of the awardees had a dental degree. Similarly, among 66 K23 awardees, 73% (n=48) of the awardees had a dental degree.

K08/K23 Dentist Scientist Career Outcomes:
Of the 59 K08 award recipients whose K award ended by 2020, 24 (41%) awardees were in research intensive careers, 20 (34%) awardees were in research-related careers, 14 (24%) awardees were in private practice, and the remainder were unknown.

Of the 41 K23 award recipients whose K awards ended by 2020, 22 (54%) awardees were in research intensive careers, 12 (29%) awardees were in research-related careers, and the remainder were in private practice.

NIDCR Dual Degree Dentist Scientist Pathway to Independence Award (K99/R00): Since 2009, NIDCR has funded 27 K99/R00 postdoctoral (K99 phase) to tenure track faculty (R00 phase) career transition awards. The reported data begin with the initial K99 awards in fiscal year (FY) 2010 through FY 2022, and looking at outcomes as of January 2024. Among the K99 awards during this time frame, 14 of the 27 PIs had transitioned to the R00 independent phase prior to 2021. Among these 14 R00 award recipients, 93% (n=13) successfully competed for a subsequent RPG and 86% (n=12) of the RPG awards were R01 or equivalent awards.

Forecasting Future Needs
The advancement of DOC research critically depends on a strategic focus on essential scientific areas and addressing the challenge of a diminishing research workforce. DOC research encompasses a broad spectrum, including fundamental, applied, laboratory, and clinical studies essential for developing new diagnostics, therapies, treatments, and cures. The NIDCR Strategic Plan 2021-2026 (https://www.nidcr.nih.gov/sites/default/files/2022-01/NIDCR-Strategic-Plan-2021-2026.pdf) emphasizes the importance of understanding the integrated relationship between oral and systemic health, necessitating expertise across various domains such as developmental biology of the craniofacial complex, oral microbiome research, cancer biology, pain management, regenerative medicine, and innovative materials and biomaterials for reconstruction.

To meet these objectives, DOC researchers need a varied skill set, including mathematics, engineering, microbiology, immunology, data science, and high-resolution imaging. These skills are vital for analyzing complex datasets, such as microbiome analyses and single-cell RNA sequencing, and for drug and biomolecular interaction studies. The strategic focus on developing precise, personalized treatments highlights the need for computational skills, advanced diagnostic tools, and engineering solutions to tailor treatments to individual patient profiles. Furthermore, translating and implementing research

findings into clinical practice and healthcare improvements requires training new investigators. This training includes clinical research design, biostatistics, and organizational management skills necessary for leading multisite and multisystem clinical trials. These efforts aim to address critical healthcare questions, overcome societal barriers to care, and improve health outcomes for all populations.

There are concerns about the future of the DOC research workforce, attributed to financial strains, childcare burdens, and the competitive nature of academia and grant funding, which poses a significant challenge. Addressing these issues is crucial for retaining and nurturing early career scientists, ensuring the existence of a vibrant, innovative community capable of advancing DOC science. This involves providing support for young families with caregiving responsibilities, and mitigating the financial and professional uncertainties associated with a career in research. Moreover, there is a critical need for mentoring at all levels of training, particularly to assist in the transition process.

In summary, advancing DOC science requires a comprehensive, strategic approach that not only expands scientific knowledge and technological innovation but also supports the promotion of a skilled research workforce. Through collaboration, targeted training, and support for researchers at all career stages, the field can continue to evolve and significantly impact health outcomes. In addition, as noted in this report, comprehensive reviews and predictions of the needs of the future DOC workforce should be prioritized since “the needs” are currently not clearly defined.

2. RFI and Listening Sessions with Dental School Deans and Oral Health Leaders from Professional Societies and Industry

Sources of Information

An RFI entitled “Request for information on augmenting research training and engaging scientists in Dental, Oral, and Craniofacial Research Careers” was issued on October 11, 2022 (NOT-DE-22-019). In response, the DOC research community provided information on their awareness of NIDCR funding opportunities, dental school initiatives, and institutional collaborations. In addition, listening sessions were held with dental school deans and oral health leaders who provided information on their experiences of successful initiatives, opportunities for improvement, and new strategies for the development of the DOC research workforce. The information from the RFI and listening sessions was analyzed, common themes prioritized, and is presented below in four categories.

Expand Research Opportunities Across the Continuum of Education and Career Levels

Research training and engagement for scientists in DOC research careers should be augmented, including engagement of students from K-12, undergraduates, graduate students, and post-doctoral fellows. These programs will be especially beneficial for historically black colleges and universities (HBCUs) and other institutions with limited resources but should encompass all institutions to ensure broader access.

Successful Initiatives and Program Awareness

Several initiatives were deemed successful, including early capture of interest in science (through recruitment of academically-oriented undergraduate students) and demonstration of the benefits of dual-career training, both in academic and industrial contexts. To improve the success of DOC research workforce training, curricular flexibility, tuition grants from universities, and LRPs are all extremely important. Co-funding or in-kind support for programs between NIDCR and institutions have helped

engage and retain early career faculty throughout their career progression. These initiatives include infrastructure grants and programs to improve the quality of mentoring and protected time for early career faculty. While some programs already exist, their awareness is low. Furthermore, there is a need for a single centralized resource that will integrate all the available funding opportunities in a way that is comprehensible for students and mentors. Lastly, a key suggestion was that NIDCR invest in an office and personnel to provide an annual assessment of training programs and the key factors that contribute to career success.

Career Transitions

The goal of any training program should be to promote and support the transition of scholars from one career level to the next. This can be achieved by helping trainees overcome challenges to degree completion and motivating clinical or basic science researchers to pursue training and career development activities that enhance or complement their expertise. The focus should be to capture the interest of individuals from a broad range of disciplines or clinical specialties to pursue DOC research or collaborate with DOC research investigators. To achieve this, the following two important areas should be pursued: 1. Expansion of trainee participation in NIDCR-funded training programs and 2. Identification of existing or development of effective mentorship experiences for DOC trainees and early career investigators. These two foci could be achieved by establishing national, regional, or local networks or interest groups and building/strengthening research capacity in academic institutions. In addition, the development of well-defined metrics to evaluate trainees, trainee experiences, mentor/mentorship quality, and training program outcomes are of particular importance.

Emerging Research Areas

Emerging research areas in need of additional funding are oral public health, artificial intelligence, big data, bioengineering, and bioinformatics. One urgent need is the development of programs that promote interdisciplinary collaboration, such as engineering, nursing, innovation-oriented programs, etc., as well as the development of programs directed at increasing entrepreneurship, from ideation to commercialization. These programs would embed basic scientists with end users to collaborate from idea inception to execution, which could facilitate translation and prevent pitfalls such as the development of impractical technologies.

3. Current Trainees, Former Trainees, and University Training Program Directors

Sources of Information:

The sources for this section were a series of listening sessions that were conducted with current trainees, former trainees, and university training program directors. An additional source was conversations with three former trainees who were no longer engaged in research/science. The highlights of this information are presented below in four categories.

Recruitment, Admissions, and Program Structure

University program directors advocated for changes in outreach to potential dual degree applicants and engagement of students with DOC research at the high school, college, and postbaccalaureate levels. They noted their lack of success in using social media platforms for recruitment and noted that program information posted on university websites often attracts foreign nationals but few U.S. citizens, which is problematic for some training programs.

Since only an estimated 30% of DDS/PhD trainees stay in the oral health research workforce, an analysis of the recruitment of these trainees is sorely needed. University training program directors highlighted the importance of a separate interview process for dual degree students with a high emphasis on research commitment and demonstrated evidence of scientific curiosity as a key factor for successful recruitment. This prevents exceptional applicants with less-than-average clinical dentistry exposure from being excluded based on the DDS selection process. The directors also pressed for changes in how students are recruited to DDS/PhD programs. Instead of recruiting current dental students into DDS/PhD programs with hopes of inspiring interest in a research career, they have found success through an alternate approach recruiting senior PhD students with solid scientific training and demonstrated curiosity into the DDS program.

Program directors highlighted the need to streamline dual degree programs and reduce redundancy in the curriculum to improve trainee experience. Some directors advocated that a sequential program, starting with the PhD and finishing with the DDS/DMD, allows for a transition back to research in the fourth year of the dental program, which allows continued research progress and preparation for postdoctoral research/clinical training. While this is one model of dual degree training, other program directors have advocated for alternative models of DDS/PhD program structure.

To ensure greater parity in obtaining NIDCR funding, the directors advocated for targeted NIDCR funding to under-resourced institutions. This would make NIDCR funding and access to resources available to institutions serving a wide variety of students, to increase participation in NIDCR-funded programs. The NIDCR-funded Practice-Based Research Integrating Multidisciplinary Experiences in Dental Schools (PRIMED) program, pairing research-intensive institutions with under-resourced schools to create clinical research opportunities for dental students, postdocs, and faculty is a key example. More programs with this strategy could increase the engagement of underrepresented dental students in clinical research.

Trainee Experience and Mentoring

Most trainees expressed general satisfaction with their DMD-DDS/PhD training. Trainees enjoyed interactions with NIDCR program officers and the NIH/NIDCR professional development activities. NIH LRPs and the F30/31/32 funding mechanisms are highly valued. When considering the training program itself, trainees felt that the integration of the dental and PhD curriculum was often inflexible and unsupportive of research activity. The uneven quality of programs across institutions was noted, and trainees suggested NIDCR provide more monitoring of NIDCR training programs with unified training expectations. Both trainees and program directors emphasized that an individual F or K award enhances their confidence in their ability to progress in the academic pipeline. While individual F and K awards provide stability and financial assistance, the K award was frequently considered to provide insufficient research support for early career faculty.

Regarding mentorship, many trainees commended their mentors. However, some trainees felt that their mentoring was inadequate, commonly relying heavily on a single primary mentor and without cohesive mentoring standards. Both trainees and program directors agreed that clinician-scientists frequently encounter insufficient mentoring as they move through career transition points. Both trainees and Program Directors advocated for the use of mentoring committees and emphasized the need for mentorship at each career stage, particularly during transitions. This information was gathered from listening sessions pointing out the need for establishing a formal process to evaluate mentoring.

Building Community

A frequent comment from current and former trainees was the lack of connection with the broader research community, and trainees sometimes felt siloed in dental schools. Programs that not only provide mentoring but also promote networking were suggested to build a community of students/scholars at similar levels. Trainees suggested that NIDCR assist in the development of regional and/or national trainee communities. Trainees could come together for training activities including workshops, seminars, and career development guidance.

Career Opportunities

DOC research trainees and fellows frequently face great uncertainty in their career paths, and many felt unaware of career options. At the outset, the length of time in training is an ongoing critical concern for many DOC research trainees, as it can lead to burnout and/or financial obstacles that limit career options. As mentioned above, trainees moving to specialty training/early faculty positions/postdoctoral fellowships experienced no clear path or guidance on how to move to the next stage. Trainees felt that many faculty positions have insufficient support for research and mentoring, and most open positions require substantial clinical teaching. Clinical research was identified as a key area of growth for DOC research but is similarly lacking in a clear career path. Obstacles to growth in clinical research careers include a lack of protected research time for clinicians in dental schools and/or the lack of adequate exposure to clinical research training. Overall, these concerns suggest a possible misalignment between the expectations of NIDCR for trainees and the career paths available to them.

4. Professional Societies and Foundations

Sources of Information

A listening session was held with program officers responsible for training programs at NIH, NSF, and professional societies and foundations. Two listening sessions were held with leaders of professional societies, foundations, and oral health companies. The comments were organized into four categories: mentorship, outreach, research community, and financial support.

Mentorship

Mentorship was frequently mentioned as a key factor in the establishment of independent research among trainees and early career investigators. Lack of mentorship was linked to difficulty in the transition to independence. Early career investigator applicants often need mentoring teams or one-on-one mentoring support to prepare competitive RPGs such as R01s and R21s. Trainee attrition is substantial and may be remedied by career-stage-specific mentorship. The number and quality of mentors may be increased by fostering collaborative interactions between NIDCR and professional societies and foundations. Other suggestions to attract DOC research mentors include 1) incentivizing PIs to assume training and mentoring responsibilities and 2) working with professional societies and foundations to identify and train DOC research mentors. Current gaps that professional societies and foundations could help address include 1) an insufficient number of effective DOC research mentors and role models, 2) a lack of awareness and outreach programs to connect students/residents with NIDCR-funded investigators, and 3) an insufficient number of mentors and role models reflecting the needs of individuals from various backgrounds who aspire to DOC research careers. Responding to these gaps offers the opportunity to support a robust DOC research workforce.

Outreach as a Solution:

A lack of awareness makes it difficult to attract students who aspire to a DOC research career. A contributing factor is the lack of exposure to DOC research from middle school to dental school. The lack of awareness among dental students may reflect the limited research activities in many dental schools. Many dental schools and institutions with limited resources, in general, lack sufficient research infrastructure and opportunities for research training and career development. Trainees and early career investigators often report that the path to a DOC research career is too steep. Professional societies and foundations could address these gaps by working with NIDCR to increase awareness of and excitement about DOC research careers through outreach and targeted recruitment.

Building Research Community:

More engaged cohorts need to be developed to build community. A good model is the AADOCR MIND the Future program (https://www.aadocr.org/awards/mind-the-future), which aims to increase the number of scientists in DOC research. This type of program should be expanded and sponsored by other organizations in coordination with NIDCR. In addition, dental schools need to increase their research presence and take ownership of future dental science and practice. Given the prevalence of electronic medical and dental records, an abundance of clinical expertise, and patient treatment at dental schools, there should be many opportunities to foster clinical research careers. A major barrier presented by dental schools to achieving DOC research careers is the lack of protected research time for clinicians in dental schools and the lack of DOC research training for clinicians. Dental schools and professional societies could address this issue by providing clinicians with research training opportunities and also by creating hybrid faculty positions that combine teaching and research opportunities. Recognizing the shortage of qualified DOC research investigators, the Working Group recommends that NIDCR explore funding opportunities for the training and career development of international scholars as another source of future U.S.-based DOC investigators.

Financial Support:

One challenge in developing a skilled DOC research workforce is inadequate institutional support for research training and career development. Financial instability for all DOC research trainees makes a DOC research career unappealing. For clinician-scientists at the postdoctoral level, traditional postdoctoral fellowship salaries do not provide income commensurate with their clinical skills, often leading to attrition to private practice. NIDCR, along with other institutions, should consider ways to ensure financial stability for grant recipients if programs are allowed to expire or be replaced. The NIH LRP and other similar programs are essential aspects of enhancing DOC research careers. Lastly, lack of institutional commitment to K awardees, particularly failure to meet NIDCR guidelines for protected research time was cited as problematic.

Recommendations

The Working Group developed several recommendations to enhance DOC research training and career development. These recommendations were made in response to challenges that were identified by the public or by key DOC research stakeholder groups. The recommendations were driven by five major considerations: 1) To increase participation in the DOC research workforce; 2) To promote research opportunities for clinician scientists; 3) To enhance access to mentoring and the quality of mentoring; 4) To improve the training experience; and 5) To develop accurate and informed assessment of factors that lead to trainee and program success. The recommendations reflect different approaches to addressing these challenges. They include programmatic approaches; enhancement of career opportunities; coordination with professional societies, foundations, and industry; and assessment of research training and career development programs.

1. Programmatic Approaches

The recommendations address ways in which NIDCR research training and career development programs can be augmented by improving accessibility and awareness through outreach, addressing the need for greater mentoring, increasing the number of paths for clinicians to develop research-based careers, and engaging with professional societies and industry that share common goals with NIDCR to synergize and enhance NIDCR-funded programs. In addition, recommendations were made to mitigate a sense of isolation noted by trainees and early-career investigators, to address a lack of networking opportunities, and to make DOC research careers more appealing.

<u>Specific Recommendations:</u>

- Develop funding opportunities that foster collaborations between NIH early career investigators as PDs/PIs and an established researcher as co-investigator. The rationale for this approach is to provide sustained mentorship to the early career investigator (grant writing, study design, and administrative roles) and provide incentives for experienced researchers to serve as long-term mentors.
- Expand and increase awareness of the NIH LRPs and their relationship to DOC research. One significant barrier for past trainees to continue in academia is the financial burden of clinical education. The current maximum LRP of $50,000 is not sufficient, and funding should be increased to meet the inflation rate. The expected outcome is retention in the DOC research workforce.
- Provide incentives for dual degree graduates to stay in academia that would facilitate the transition from training to a faculty position. The overall goal would be to provide funding programs to clinician-scientists in the last phase of training to increase their entrée into a research career.
- Allocate funding to support local, regional, and virtual events tailored for trainees and early career investigators, requiring participation by NIDCR-supported trainees. These events would feature speakers and workshops relevant to trainees and provide forums to stimulate collaboration, peer-to-peer interaction, and symposia to broaden collaborative engagement.
- Work with professional societies and foundations to fund new mentoring programs. NIDCR, in conjunction with these organizations, should design targeted programs that leverage the expertise of their members to provide mentorship in research skills and career advancement for trainees and early career investigators. The content and objectives of these mentoring programs would be tailored to the specific interests and expertise of the professional society members.

Such coordinated efforts are expected to enhance the experience of clinician scientists during training and the transition to independence.

- Support K-12 research training and educational initiatives aimed at developing interest in DOC research. These efforts would be aimed at community-building and making careers in dentistry and dental research attractive.
- Develop research training programs for clinicians at various career stages. These programs could take the form of master's degree programs or postdoctoral or post-residency “research certificate programs.” The intent is to guide clinicians who are not dual degree scientists toward academic careers that integrate research and clinical practice.
- Promote training programs that foster innovation through working with industry, aiming to develop projects from concept to development with insights from industry experts. Such initiatives could be integrated into specialized training programs with a biotechnology emphasis, offering practical industry experience through "R&D residencies" and coordination with Clinical and Translational Science Awards (CTSAs).

2. Enhancement of Career Opportunities

Many dentist-scientist trainees enter their training programs with excitement about the possibility of combining clinical and research interests into fruitful academic careers aimed at solving pressing clinical problems. Despite this initial excitement, only an estimated 30% of trainees on F or T grants continue in the DOC research workforce. Many of the challenges faced by clinician-scientists are longstanding, and some of the problems highlighted in the 2014 Physician-Scientist Workforce Working Group report have worsened for current trainees. As DDS/DMD programs currently rank as one of the most expensive professional degree programs, some trainees are attracted to the DDS-PhD program because of the financial incentive of a heavily subsidized clinical education. It is critical that DDS-PhD programs identify trainees truly committed to DOC research-focused careers by removing the incentive to obtain a subsidized clinical education with the goal of private clinical practice. An emphasis on loan repayment rather than subsidized education may accomplish this goal.

As significant attrition of trainees occurs during postdoctoral training, it is important to support clinician-scientists during this critical phase. Programs with proven success during this phase, such as the NIDCR Dental Clinical Research Fellowship program, offer competitive salaries and the opportunity for trainees to develop their independent clinical/translational and basic science research programs with significant protected research time. More programs that use this model at dental schools could help retain these clinician-scientist trainees.

It is crucial to equip trainees with contemporary knowledge and research skills in emerging fields such as gene editing and data science (e.g., artificial intelligence and machine learning) that can be applied to DOC research. The NIDCR Strategic Plan 2021-2026 emphasizes hastening the process from research discovery to clinical application. To accomplish this, educational offerings should include the regulatory framework essential for clinical studies along with entrepreneurial strategies for product development. Finally, opportunities must be created to re-engage dental school clinical faculty in clinical research.

Specific Recommendations:

- The Working Group concurs with the NIH Advisory Committee to the Director (ACD) Biomedical Research Workforce Working Group report about new directions of support that could be leveraged by NIDCR, such as:
    - Eliminate pauses in NIDCR NOFOs for Institutional Training grant support.

    - Increase funding for NIH LRPs if the individual enters a research career and link the amount of repayment to the number of years in research.
    - Encourage exploration of novel career options and develop grant programs or administrative supplement awards that provide unique educational experiences during training.
    - Incorporate opportunities for postdoctoral trainees supported on NIDCR Institutional training grants (T32, T90, R90) to pursue industry- or other agency-supported internships for up to 12 months in duration.
    - Support funding opportunities for training programs that develop biomedical science entrepreneurship.
    - Build programs that facilitate the development of translational science and clinical regulatory skills to stimulate technological innovation from bench to patient.
- Develop multidisciplinary training opportunities for clinician-scientists that combine oral health with other fields such as data science, public health, engineering, medicine, nursing, and pharmacy.
- Develop research training programs for clinician-scientists that connect dental, medical, and oral health with overall systemic health.
- Facilitate clinical research by dental school faculty by providing funding opportunities, with appropriate safeguards, that are specifically designed for clinical researchers and provide 40-50% protected time. This could involve cost-sharing with dental schools to support clinician-scientists who have clinical responsibilities.
- Develop opportunities for trainees to participate in large-scale computational approaches to DOC research.
- Post all funding opportunities on the internet in a single NIDCR location and in a simple format that is easily understood by early career investigators and clinicians.

3. Working with Professional Societies, Foundations, and Industry

Several professional societies, foundations, and members of the corporate oral health industry share common goals with NIDCR, including an expanded and robust DOC research workforce. The Working Group met with leaders of these organizations and was gratified by the high level of enthusiasm they expressed to work with NIDCR to accomplish shared goals. Commonly cited in these meetings was an aspiration to elevate the dental profession through research and concurrence with the imperative to develop clinicians with research skills. Specific areas of where professional societies and foundation leaders can work with NIDCR are reflected in the recommendations below. Currently, there are few, if any, known ways to coordinate activities to achieve these shared goals. Professional societies, foundations, and oral health companies have developed successful approaches to connect with researchers, clinicians, and individuals from different backgrounds and have the resources to support research training and research projects. Coordination between NIDCR and professional societies and other organizations is likely to be an effective strategy to leverage resources and collectively build a productive DOC research workforce. A key feature in accomplishing this goal is establishing a central contact or office to interface with these oral health-related stakeholders. Because NIDCR has a central role in supporting DOC research training, it should serve as a hub to maximize resources by working with these organizations. This recommendation was supported by several oral health leaders who firmly believe there is a critical need for this effort, which has the potential to facilitate the coordination needed to develop interactions with NIDCR.

Information obtained by the Working Group indicated that there were several obstacles faced by NIDCR trainees and early career investigators that could be addressed by NIDCR and professional societies working together to achieve common goals. Trainees and early career investigators can experience a sense of isolation and lack of interaction with their peers, clinician-scientists, and established investigators. This is particularly significant in dental schools and other institutions that do not have a robust research infrastructure. Professional societies and foundations can be pivotal in connecting NIDCR-supported trainees and early career investigators, fostering networking opportunities, and enriching the scientific and research cultures. These interactions can provide benefits by increasing exposure to innovative concepts and state-of-the-art techniques that advance basic and clinical research, which are vital to the mission of NIDCR. Effective and sustained mentoring was also identified as crucial for enhancing the training and pathway to independence for DOC researchers. The AADOCR MIND the Future program, funded by NIDCR, serves as a successful model on how professional societies can leverage their membership to establish a community of scholars, promoting networking and mentoring to foster research career development. Extending this approach or developing other models may enable societies and foundations to impact the success of NIDCR-supported trainees and early career investigators. In addition, several professional societies and foundations successfully engage communities that experience oral health disparities through outreach programs. By working with these organizations, NIDCR could enhance its outreach. Lastly, the close links that many dental professional societies maintain with clinicians during and after clinical training can prove invaluable to NIDCR in advancing clinical research and developing and nurturing clinician-scientists.

Specific Recommendations:

- Establish a specific office with a contact person within NIDCR to work with the leadership of professional societies, foundations, and the oral health industry to formulate, coordinate, and synchronize activities and leverage each participant's resources aimed at joint efforts to build a robust DOC workforce.
- The NIDCR office will be responsible for coordinating interaction among these organizations to:
    - Facilitate networking opportunities between NIDCR-funded trainees and investigators with professional society members.
    - Promote knowledge of NIDCR-funded research by increasing interactions between NIDCR program officers and professional society leadership.
    - Develop and promote programs to enhance the mentorship of clinician-scientist trainees and early career investigators.
    - Foster research for early career investigators, including faculty and postdocs, with substantial clinical engagement by developing creative programs. This can be achieved by establishing positions that embrace both activities, including partial grant-supported protected research time.
    - Develop messages to promote the importance of DOC research and research opportunities. These messages can be shared through social media, student events, research meetings, and other appropriate outlets.
    - Develop outreach to enhance/increase pathway programs for DOC research and to expand recruitment. These strategies should include programs targeting K through 12, undergraduates, dental students, residents, and clinicians interested in research.

4. Assessment of Research Training and Career Development Outcomes

Defining goals and metrics of success of NIDCR research training and career development programs is the foundation for assessing and evaluating their success. Based on the conversations with current and former NIH training directors, improved articulation of expected goals, objectives, and program

outcomes would benefit from assessment. There are concerns that internal and external stakeholders might misinterpret the definitions of training program success. Therefore, the Working Group recommends that NIDCR prioritize a clear definition of goals and the establishment of standard metrics of success.

The development of standard metrics for training programs requires coordination of tracking and data collection. To fulfill this need, a coordinating and evaluation center should be established that will operate in coordination with research training and career development leadership (both at NIDCR and grantee institutions) to support program evaluation. The coordination center will have several roles, including the establishment and monitoring of critical common metrics that indicate success. Leadership and key personnel of the coordination center would be expected to have broad experience working collaboratively to assess and evaluate biomedical research training and mentoring activities, including those involving individuals from a variety of backgrounds. The center should have expertise in multi-site evaluation, coordination, communication, and consensus-building among various groups of stakeholders. The center should have knowledge and expertise regarding factors that contribute to decisions to pursue or not to pursue research careers and the current evidence base related to research training and mentoring practices and assessment and evaluation approaches.

Individual training programs often have difficulty with impartial and adequately standardized self-assessment. A centralized coordination center could work with NIDCR training program directors to design meaningful ways to assess program effectiveness and responsiveness. The assessment would be tailored to the individual environments/programs, as well as program-wide goals. The coordination center could work to enhance research training and engagement at awardee institutions, modifying approaches as needed to increase their overall impact and support awardee cooperation and sharing of effective practices.

Specific Recommendations:

- The Working Group recommends that NIDCR clearly define and state short- and long-term goals and expected outcomes for research training and career development programs in funding opportunities and NIDCR webpages for the understanding of internal and external stakeholders. The goals should align with the appropriate career stage, including consideration of logical next steps and timeframe as defined by program-specific metrics of success.
- In coordination with individual program directors of NIDCR institutional training grants and other institutional awards, the coordination center should host annual activities to support program leadership and trainee research and career development.
- The Working Group recommends that NIDCR establish a funding opportunity for a coordination and evaluation center, which should serve as a central data repository, coordinate “consortium-wide” evaluation, regularly monitor metrics for necessary adjustments in real-time, and track trainees. Examples for regular monitoring might include:
    - Biannual site visits (in person or virtual)
    - Feedback sessions between NIDCR program staff and NIDCR-supported trainees/ scholars and mentors
- The coordination center should serve as a monitor and also consult with individual organizations and programs to guide self-assessment and evaluation. The center will have the following responsibilities:
    - Collect qualitative and quantitative data regarding training and career development experiences. The data should reflect training experiences, including adequacy of

mentoring, trainee opinions of research training experience, trainee guidance during transition phases, and trainee involvement in the larger research community.

- The data should be analyzed to understand the impact of the various parameters on the retention of trainees in DOC-related research careers.
- The coordination center should provide the results of the data analyses to NIDCR to support regular assessment of training and career development programs. The data should be used to modify the training programs and adjust the level of NIDCR support for specific types of research training/career development activities.

Methodology to Obtain Background Information

The methodology for gathering information for the background narrative included presentations by NIDCR representatives, an RFI, several listening sessions, and discussions with former trainees.

1. Current NIDCR Programs and Outcomes

Details were provided by NIDCR.

2. Request for Information (RFI)

An RFI was sent to the DOC research community for feedback on their awareness of NIDCR funding activities, dental school initiatives, and institutional collaborations. Twenty-nine responses were received.

3. Listening Sessions

a. With former NIDCR-supported trainees identified by Working Group members or through the NIH RePORTER database. Ten former trainees were invited: seven accepted and three declined.
b. With current NIDCR-supported trainees, identified by Working Group members or through the NIH RePORTER database. Fourteen were invited: seven accepted, four declined, and three did not respond.
c. With university training program directors, identified by Working Group members. Ten directors were invited: seven accepted, one declined, and two did not respond.
d. With program officers from NIH, NSF, and professional societies/foundations. Out of 13 invitees, 11 participated. The focus was on challenges and opportunities in enhancing the DOC workforce, with an emphasis on recruitment, training, and retention.
e. With deans and oral health leaders. All eight invitees participated, discussing potential NIDCR collaborations to enhance the DOC workforce.
f. At the American Association for Dental, Oral, and Craniofacial Research (AADOCR) conference with deans and oral health company leaders, focusing on partnerships promoting early career success for DOC researchers.
g. At AADOCR conference with leaders of professional societies, foundations, and oral health product developers, discussing potential areas of collaboration with NIDCR.
h. Via Zoom with leaders of professional societies and foundations to explore collaboration opportunities with NIDCR.

4. Discussions

Listening sessions were held with former trainees no longer engaged in science. Trainees were contacted through program directors of the current NIDCR-funded T32 or T90/R90 programs. Nine were contacted; three agreed to participate.

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