Report

Evaluation of the NIGMS R25 Bridges to the Doctorate Program

National Institute of General Medical Sciences

Panel Roster
CHAIR

James Benjamin Skeath, PhD
Professor
Department of Genetics
Washington University School of Medicine

Members

Suzanne E. Barbour, Ph. D.
Professor, Dean of The Graduate School
Department of Biochemistry and Molecular Biology
University of Georgia

* Liza D Cariaga-Lo, Ed.D.
Senior Advisor to the Provost
  for Academic Development, Diversity and Inclusion
Brown University

G. Roger Chalkley, PhD
Senior Associate Dean for Biomedical Research Education and Training
Vanderbilt University Medical School

Donald Gailey, PhD
Professor
Department of Biological Sciences
California State University, East Bay

Ambika Mathur, PhD
Associate Provost for Scientific Training, Workforce Development & Diversity
Dean of The Graduate School
Professor of Pediatrics
Wayne State University

* NIGMS Advisory Council Member

Executive Summary

The Bridges to the Doctorate Program (B2D) in NIGMS seeks to build a more diverse biomedical workforce by increasing the number of students at Master's degree-granting institutions who transfer to and complete PhD programs. The panel considered the outcomes of all 64 past and current programs since B2D's inception in 1992 and addressed three questions: 1) "*Was B2D successful in "bridging" Master's students to doctoral study?"; 2) "Did B2D successfully support underrepresented (UR) trainees in earning PhD degrees?";* and*, 3)"Was B2D successful in encouraging a diverse pool of students to enter the biomedical workforce?"* **The panel uniformly noted that incomplete and potentially inaccurate data provided by grantees** severely limited their ability to critically evaluate performance. **With the data provided, the panel felt the B2D program was moderately successful at bridging students into PhD degree programs, but underperformed in helping UR trainees earn a PhD degree.** The panel expressed mixed feelings on the success of B2D in promoting a diverse biomedical workforce. Most B2D trainees entered the workforce in biomedically relevant fields, but few appeared to obtain faculty research positions. Although the panel felt supporting research programs at Master's degree-granting institutions is important, **the panel's consensus was that if the program's goal is to increase the number of UR students who earn a PhD degree, the B2D program has not proven itself highly effective**.   The overall panel recommendations were as follows: 1) to benchmark the NIGMS B2D program against the NIGMS Post Baccalaureate Research Education Program (PREP) and NSF Louis Stokes Alliance for Minority Participation (LSAMP) Bridge to the Doctorate programs to identify the most successful and cost-effective mechanism(s) to increase UR PhD graduates, with the goal of reducing, remodeling, or phasing out the NIGMS B2D program; and, 2) to increase resource flow toward (centralized) data collection mechanisms that improve the longitudinal tracking of trainees and trainee outcomes.

Introduction

The B2D program was established in 1992 as part of an effort to build a more diverse biomedical workforce. The B2D Program is part of a broader Bridges to the Future initiative, the goal of which is to retain students from groups historically underrepresented in the biomedical sciences, including individuals with disabilities, and ethnic and racial minorities (from here on referred to as underrepresented, or UR, students). These programs are administered by the NIGMS program staff in the Division of Training, Workforce Development, and Diversity (TWD). To enhance the diversity of the biomedical workforce, the Bridges to the Future programs focus on key transition points within students' careers, when they most commonly leave the scientific training "pathway."

The B2D program focuses on the Master's degree to PhD degree transition by helping students at Master's degree-granting institutions transfer to PhD degree programs. The program builds partnerships between PhD degree-granting institutions and terminal Master's degree-granting institutions that enroll large proportions of UR students. These partner institutions recruit and train Master's degree students and create a transfer agreement that allows students to continue on to the PhD after completing a Master's degree. Ultimately, by increasing the number of UR students who transition from a Master's to a PhD degree and by supporting trainees financially and academically, more UR students may be retained in the biomedical workforce.

B2D R25 grants are awarded to a lead institution and at least one partner institution. This partnership must consist of at least one terminal Master's degree-granting and one PhD degree-granting institution. Universities recruit trainees and develop programs involving two main types of training activities: Courses for Skills Development (e.g., courses on research techniques or

advanced subject matter) and Research Experiences (e.g., mentored lab research). Awards can last for a maximum of five years, are renewable, and are limited to $300,000 in direct costs per year. The program includes funding for activities, including part-time student support, research training, tuition remission, equipment, conference presentation, and administrative faculty and personnel support.

In May 2018, NIGMS convened a panel of external experts as a working group of the National Advisory General Medical Sciences (NAGMS) Council to conduct an evaluation of the B2D program. As noted above, this panel focused on three broad questions, as well as a general discussion of the program, and concluded with an articulation of specific recommendations by each panel member.

Success of the B2D Program in bridging students to PhD degree-granting programs.

The first question the panel considered was "*Has the Bridges to the Doctorate program been successful in bridging Master's students to doctoral study?*"

Overall, the panel felt the B2D program was moderately successful at enabling trainees to bridge into PhD degree programs. Data provided indicated that 55% of the trainees who had completed Master's training bridged into PhD degree-granting programs, which approached the goal of 60% stated in the FOA (Figure 1, Appendix). *The committee, however, raised great concern on the incomplete and potentially inaccurate nature of the data provided. The lack, loss, absence, and coarse nature of the data made it difficult to critically and confidently evaluate the major questions posed and the overall performance and impact of the B2D program*. For example, the status of 21% of trainees who had completed Master's degree training was unknown based on the latest information provided by grantee institutions. *The inability of grantees to track and provide required information on such a large percentage of trainees reflected poorly on participating institutions and the overall mechanism*. The data also indicated *significant asymmetry in program success*. About a handful or two of the programs appeared successful in helping trainees earn a PhD degree, but most programs failed in this regard (Figure 2, Appendix). The panel also *expressed concern on the short half-life of most B2D programs (Figure 2, Appendix), which raised the question as to whether the B2D mechanism is generally viable at most targeted schools. The take home messages from the discussion were for the program to be more intentional, specific, and rigorous in collecting data on trainees, trainee outcomes, and institutional baselines, and for NIH to hold Program Directors' "feet to the fire" to do so.*

Doctorate Success of Trainees from Underrepresented Groups

The second question the panel considered was "*Did the program successfully support UR trainees in earning PhD degrees?*"

As with the first question, the incomplete and potentially inaccurate data provided by grantees made it difficult to reasonably answer this question. Still, *based on data provided the panel expressed concern that the B2D program was underperforming in helping UR trainees earn the PhD degree*. Data indicated that 57% of trainees who bridged into a PhD program earned a PhD degree (Figure 3, Appendix), which is well below the stated goal of 80% in the FOA and the 75-80% PhD degree completion rate observed at most top biomedical doctoral programs, but roughly approximates the Council of Graduate Schools 10-year PhD graduation rate of UR students in the life sciences. Additional data led the panel to question whether the 57% of bridged trainees who earned a PhD degree over-reported degree attainment. For example, ~9% of earned

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doctorates were in the field of nursing and education, not biomedical-related research fields, and two-thirds of trainees indicated by grantees as earning a PhD degree could not be independently verified by NSF's Survey of Earned Doctorates (Figure 4, Appendix). The panelists also raised concern that B2D trainees took an excessive time from graduate program entry to PhD completion, an average of 9 years – three years in a Master's program and six years in a PhD program (Table 1, Appendix). Rather than transferring into a PhD program at a partner institution and maintaining training and research momentum, B2D trainees appear to start the graduate education process over along with all incoming PhD students. Together these data *made the panel question whether partner PhD degree-granting institutions had developed effective mechanisms to accommodate B2D trainees for their prior Master's training and research and also to support the persistence and success of these trainees in their graduate programs.*

Success of Trainee Entrance into the Biomedical Workforce

The third question the panel considered was "*Was the program successful in encouraging a diverse pool of students to enter the biomedical research workforce?*"

The data provided divided trainees into four career outcomes: educational services; health care and social assistance; professional, scientific, and technical services; and all others. The panel felt *these groupings needed far greater resolution to rigorously assess program impact on promoting diversity in the biomedical workforce. At the resolution provided, the panel expressed mixed feelings with respect to the B2D promoting diversity in the biomedical workforce*: 60-70% of B2D trainees entered the biomedical workforce, rates significantly higher than the average population (Table 2, Appendix), but the number of B2D trainees who pursued faculty positions in academic research appeared small. Of 298 B2D trainees who had NIH identifier numbers, 14 had applied for NIH predoctoral fellowships, one had applied for an NIH postdoctoral fellowship, and one had applied for an NIH K99 Faculty transition award (Table 3, Appendix). *The panel viewed these latter numbers as discouraging.*

Additional Panel Recommendations

A general discussion of the B2D Program at the end of the review identified four key observations and/or recommendations.

- The panel viewed B2D Program success as highly asymmetric. A few of the 64 programs succeeded in supporting trainees to earn a PhD degree, but most failed to do this. A path forward could involve selecting the five or six most successful programs, performing an in-depth analysis on what makes these programs successful, and then evolving the B2D program to better align with the structure and activities of these programs. Here, significant attention should be paid to the importance of the PhD degree-granting partner institution, what they bring to the partnership/trainees, and whether their inclusion is essential for B2D success.
- Although the panel was not enthusiastic about B2D program success, it felt it was important to support research-based programs that help create a research environment and culture at Master's degree-granting institutions, particularly those that serve a large number of UR students.
- The panel voiced an urgent need to acquire complete, accurate longitudinal trainee data to facilitate critical evaluation of the B2D program. The current lack, loss, and coarse nature of data on many B2D trainees/programs greatly curtailed the panel's ability to critically and confidently evaluate the B2D Program's impact and performance. Increased support for data collection mechanisms that facilitate longitudinal tracking of trainees and

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their outcomes, such as centralized data collection centers, is essential for rigorous, critical assessment of training programs such as B2D. Increased attention to intentional collection of specific data from host institutions and nationally is critical for robust program assessment. Such baseline data on the rate at which Master's student's progress to completion of the PhD degree at host institutions and the rate at which college graduates with life-science majors enter the biomedical workforce, is essential for rigorous program assessment.

- The panel called for benchmarking in head-to-head comparisons the NIGMS B2D Program against the NIGMS Post Baccalaureate Research Education Program (PREP) (R25) and the NSF Louis Stokes Alliance for Minority Participation (LSAMP) Bridge to the Doctorate (BD) Fellowship program (and other similar programs) to determine the success of each program in helping UR students matriculate into and to complete PhD degree programs. An important metric in this analysis would be "cost per PhD degree," with the >$300K cost per PhD degree of the B2D program viewed as high by the panel.

Conclusions and Recommendations

The consensus of the panel was that if the primary goal of the B2D program is to increase the number of UR students who earn a PhD degree, then B2D had not proven itself highly effective. The two key recommendations of the panel were as follows: 1) benchmark the NIGMS B2D program against the NIGMS PREP and NSF LSAMP programs to identify the most successful, cost-effective mechanism(s) to increase UR PhD graduates, with a goal of reducing, remodeling, or phasing out the NIGMS B2D program; 2) direct additional resources toward enhancing data collection on trainees and trainee outcomes, as the absence of high-quality trainee data made it essentially impossible to critically evaluate the B2D program.

APPENDIX: Supporting Material

Figure 1: Bridging Outcomes: Top) Percentage of all B2D trainees and their status or outcome at time of last reporting by grantee institution. Bottom) Percentage of B2D trainees who completed training and their outcomes.
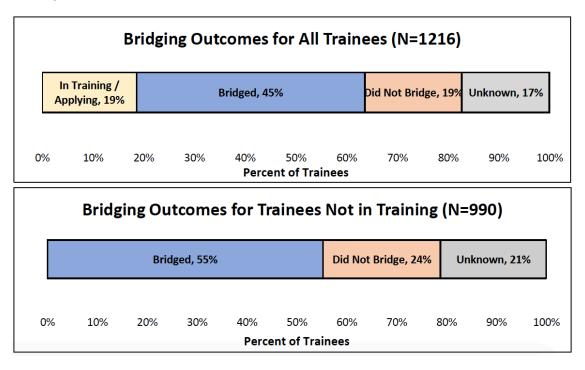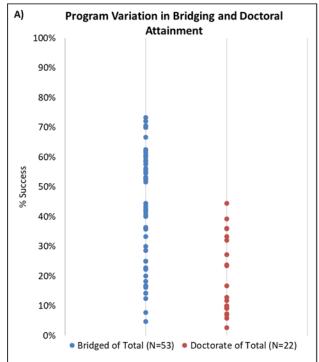
Figure 2) Program Variation in Success and Length: 64 programs have been awarded B2D grants since 1992. Panel A displays the distribution of program success (bridging, doctoral attainment), with percentages calculated from *all* trainees known to have participated in the program (programs with no reported bridging/doctoral outcomes are omitted). Panel B displays the distribution of program length, in years, calculated as the first budget start date for a program subtracted from the last budget end date for a program.
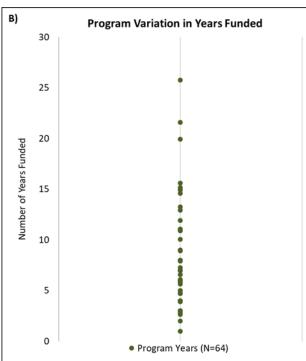
Figure 3) Doctoral Completion Outcomes: Top) Percentage of B2D trainees who bridged into a PhD program and their status or outcome. Bottom: Percentage of B2D trainees who had completed their training and their outcomes. N.B. "Unknown" refers to trainees who had been listed by the grantee as starting a PhD program, but who in a subsequent progress report or competitive renewal had been listed with an "Unknown" outcome or no information had been provided for the trainee.
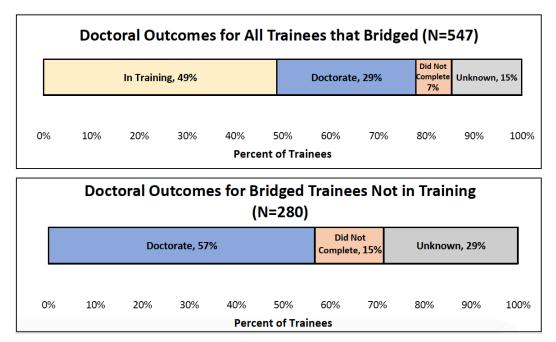

Figure 4) Comparison Between Grantee PhD Completion Data (NIH) and NSF's Survey of Earned Doctorates (SED). Of the 159 trainees reported by grantees to have earned a PhD, approximately 50 were independently validated to have earned a PhD by NSF's SED, but approximately 110 trainees listed as receiving a PhD by grantee institutions were not confirmed to have earned a PhD by NSF SED data. NSF SED data, however, did identify approximately 70 additional B2D trainees who had received a PhD who had not been listed as receiving a PhD by grantee institutional data to NIH.
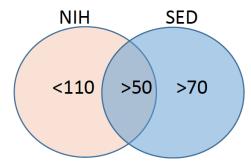
Table 1) Time to Degree for B2D Trainees. B2D trainees took on average 9.06 years to complete the PhD from entry into any graduate program and 6.19 years to complete the PhD from entry into a PhD program. Data from NSF's SED indicate that students in the life science typically take on average about 7 years to complete the PhD from entry into any graduate program and 5.7 years to complete the PhD from entry into a PhD program.

Time Between any Graduate Program Entry and Ph.D. Completion	
Years Elapsed from Any Graduate Entry to Ph.D. Completion (N=94)	
Average Time	9.06
Median Time	8.75
Standard Deviation	2.25

Time Between Ph.D. Program Entry and Ph.D. Completion.	
Years Elapsed from Ph.D. Entry to Ph.D. Completion (N=115)	
Average Time	6.19
Median Time	6.00
Standard Deviation	1.57

Table 2) Data from the Longitudinal Employer-Household Dynamics (LEHD) dataset reveal B2D trainees are over-represented in education (36%) and health care (26%) relative to the general population (8% and 14% respectively).

2014 LEHD Sector – By Cohort

2014 LEHD NAICS Code	Cohort 1992-1996	Cohort 1997-2001	Cohort 2002-2006	Cohort 2007-2011	Cohort 2012-2016	Cohort Overall	Estimated Population in Sector* Nearest Million
Educational Services (61)	42	73	45	33	62	255	8
Health Care and Social Assistance (62)	30	54	29	23	44	180	14
Professional, Scientific, and Technical Services (54)	12	19	13	6	5	55	8
All Others	54	57	27	26	50	214	72
Overall	138	203	114	88	161	704	102

NAICS Code Categories (bls.gov)

NAICS Code	Professions Included
Educational Services (61)	Elementary and Secondary Schools Junior Colleges Colleges, Universities, and Professional Schools Business Schools and Computer and Management Training Technical and Trade Schools Other Schools and Instruction Educational Support Services
Health Care and Social Assistance (62)	Ambulatory Health Care Services Hospitals Nursing and Residential Care Facilities Social Assistance
Professional, Scientific, and Technical Services (54)	Legal Services Accounting, Tax Preparation, Bookkeeping, and Payroll Services Architectural, Engineering, and Related Services Specialized Design Services Computer Systems Design and Related Service Management, Scientific, and Technical Consulting Services Scientific Research and Development Services Advertising and Related Services Other Professional, Scientific, and Technical Services

Table 3) 298 B2D trainees had NIH Identification numbers, allowing tracking of grant history. Of these 298 trainees, 18 had applied for NIH grants, primarily predoctoral NIH fellowships.

Number of Applicants by Type of Application

Grant Application Type	Number Trainees Submitting Applications
Predoctoral Fellowships (F30, F31)	14
Dissertation Research Support (R26)	2
Postdoctoral Fellowships (F32)	1
Loan Repayments (L50)	1
Postdoc to Faculty Transition (K99)	1
Global HIV/AIDS Non-Research Cooperative Agreements (U2G)	1