

Research Accountability Groups and Mentoring Minutes: The M³ Approach to Promote Public Health Infectious Diseases Research for Diverse Graduate Students

Harolyn M. E. Belcher

Kennedy Krieger Institute, Baltimore, Maryland and
 Johns Hopkins University School of Medicine

**Damani A. Piggott,
 Renata Arrington Sanders,
 and Maria Trent**

Johns Hopkins University School of Medicine

Efforts to recruit and retain public health researchers should include scholars that reflect the demographics of the United States. Innovative research mentoring programs that integrate one-to-one and small group learning experiences may result in improved engagement and research productivity among graduate school scholars from underrepresented populations in public health research fields. This study analyzed leadership characteristics and research productivity of 54 graduate scholars who participated in the Dr. James A. Ferguson Emerging Infectious Diseases Fellowship Program (Ferguson Fellowship). Ferguson Fellows participated in 9-week research experience before and after implementation of a multimodal mentorship (M³) designed to support submission of research abstracts to national scientific conferences. M³ strategies included: (a) weekly research content mentoring, (b) myIDP, (c) professional development (process) mentoring, and (d) Research Accountability Groups. Overall, transformational leadership characteristics improved following completion of the Ferguson Fellowship ($M = 3.71, SD = 6.37, t(33) = 3.39, p < .01$). Transformational leadership characteristics of Ferguson Fellows who received M³ improved significantly ($M = 3.88, SD = 6.63, t(24) = 2.93, p < .01$) during the program. Fellows who received M³ had almost 4 times (OR = 3.88; 95% CI [1.21, 12.47], $p < .05$) higher odds of submitting research to scientific meetings compared to their peers who did not participate in M³. Providing process mentoring and research accountability groups were associated with increased research self-efficacy. Graduate scholars from underrepresented populations may benefit from multimodal mentoring strategies that provide scholars with individualized research and professional development support based on the scholar's needs.

Public Policy Relevance Statement

Increasing the number of researchers from populations currently underrepresented in the biomedical and public health fields is critical to the reduction of health disparities, in part because they are likely to examine culturally relevant questions and employ innovative research designs. Weekly individualized mentoring and group research accountability sessions designed to complement research training may increase research productivity and transformational leadership qualities necessary for graduate scholars from underrepresented populations to successfully pursue research careers.

Harolyn M. E. Belcher, Center for Diversity in Public Health Leadership Training, Kennedy Krieger Institute, Baltimore, Maryland and Department of Pediatrics, Johns Hopkins University School of Medicine; Damani A. Piggott, Department of Internal Medicine, Johns Hopkins University School of Medicine; Renata Arrington Sanders and Maria Trent, Department of Pediatrics, Johns Hopkins University School of Medicine.

This publication was supported by the Cooperative Agreement 1 NU50MN000004-02 and 6 NUMN000025-06-02, funded by the Centers for Disease Control and Prevention and the Robert Wood Johnson

Foundation, 74691. Its contents are solely the responsibility of the authors and do not necessarily represent the official views of the Centers for Disease Control and Prevention or the Department of Health and Human Services. We thank all of the scholars and mentors who participated in the Dr. James A. Ferguson Emerging Infectious Diseases Fellowship Program.

Correspondence concerning this article should be addressed to Harolyn M. E. Belcher, Center for Diversity in Public Health Leadership Training, Kennedy Krieger Institute, 716 North Broadway, Baltimore, MD 21205. E-mail: belcher@kennedykrieger.org

It is estimated that over 42% of state public health agency employees plan to leave or retire from the government public health workforce before 2020 (Sellers et al., 2015). As the United States becomes a more diverse nation, it is critical that an emerging pool of scholars, reflective of U.S. demographics, becomes equipped with the skills necessary to optimally contribute knowledge to promote the public's health. Empirical data support the value and need for having a diverse pool of scholars to fill anticipated public health and biomedical research vacancies (Grumbach & Mendoza, 2008; Institute of Medicine, 2011; McGee, Saran, & Krulwich, 2012; Saha & Shipman, 2006). Specifically, evidence suggests that (a) health professionals from historically disadvantaged racial and ethnic populations are more likely than their White colleagues to work in communities that are underresourced (Bach, Pham, Schrag, Tate, & Hargraves, 2004), (b) race concordance between patient and physician improves communication and lowers the likelihood of having unmet health needs for Black Americans (Cooper et al., 2003; Saha, Komaromy, Koepsell, & Bindman, 1999), (c) race concordance between researcher and research participant increases trust and enrollment (Mouton, Harris, Rovi, Solorzano, & Johnson, 1997), and (d) diverse learning environments increase creative abilities to solve problems (Maddux, Adam, & Galinsky, 2010). The benefits of increasing diversity of the public health and research workforce may also lead to successful strategies to effectively address health disparities (Maddux et al., 2010; McGee et al., 2012).

Despite ongoing efforts, diversification of the biomedical research and public health workforce continues to be elusive. Black, Native American/Alaska Native, Native Hawaiian/Pacific Islander, and Hispanic scholars, scholars who are sexual minority or gender nonconforming, scholars with disabilities, and scholars who are deaf or hard-of-hearing continue to be identified as underrepresented populations (URPs) in the biomedical research workforce (National Science Foundation, 2015; Sellers et al., 2015; Valentine & Collins, 2015). The Chief Officer for Scientific Workforce Diversity and the Director of the National Institutes of Health state that "recruiting and retaining a diverse set of minds and approaches is vital to harnessing the complete intellectual capital of the nation" (Valentine & Collins, 2015, p. 12240). Public health professionals from URPs can play an important role in increasing research impact and innovation (Freeman & Huang, 2014; Hong & Page, 2004). In sum, researchers from URPs have significant potential to improve health for all U.S. citizens.

Identifying Challenges to Research Career Success for Scholars From URPs

Among the challenges for scholars from URPs, understanding and negotiating the "culture" of academic institutions are most complex (Syed, 2010; Syed, Azmitia, & Cooper, 2011). Failure to understand academic and research cultures may lower self-efficacy and leave the scholar feeling isolated, especially as they transition to research-intensive graduate environments. Scholars from URPs may also experience unconscious bias, poverty, racism, microaggressions, and low educational preparation, which may undermine the scholar's ability to excel (Bright, Price, Morgan, & Bailey, 2018).

Scientific presentations and peer-reviewed publications are the "currency" for research career development, achievement, and

success. Presentations and publications are necessary to inform practice, policies, and academic promotion. Scientific writing skills, however, may be particularly elusive for first-generation college scholars and scholars who did not attend R1 or R2 research universities. Beginning graduate school and postgraduate or junior faculty scholars may be inadequately prepared to transition from writing undergraduate term papers to producing scientific peer-reviewed publications. A survey of over 230 undergraduates from 37 disciplines found that undergraduates wanted more opportunities to write, discuss broader concepts, and work with "real data" (Fry, 2009). Further, undergraduates expressed the desire to participate in interdisciplinary courses focused on writing.

Identifying and addressing variability in scholars' educational experiences and research skills are necessary to provide a foundation for research success. Effective mentoring can assist scholars in overcoming identified challenges, facilitate networking, and encourage scholars' strengths and independence.

Mentoring: A Strategy to Promote Research Success

The foundation of mentoring is trust and communication. Mentoring creates a learning environment that provides supportive professional advancement opportunities for the scholar. Mentoring facilitates personal development, negotiation skills in academic and research environments, career guidance, and research productivity (Sambunjak, Straus, & Marusić, 2006).

Mentoring may be primarily instrumental (providing instruction and research skill development) or psychosocial (providing support, professional guidance, and fostering career and networking opportunities). Studies have demonstrated that students' perceptions of their mentor's quality and concern were related to performance at the graduate level (Girves & Wemmerus, 1988).

Despite the importance of the mentoring relationships, systematic research examining the impact of various formats and modalities of mentoring (e.g., one-to-one, small group, combined approaches) on research scholar productivity is sparse. Opportunities for graduate scholars to have structured mentored research experiences that complement their academic studies and career goals may improve the scholar's potential to pursue research and public health careers successfully.

Mentoring Graduate Students From URPs: The Dr. James A. Ferguson Emerging Infectious Diseases Fellowship

Instituted in 1989, the James A. Ferguson Emerging Infectious Diseases Fellowship (Ferguson Fellowship) was designed to increase interest in public health research careers by providing mentored infectious diseases research experiences for medical and veterinary students, especially those from racial and ethnic populations underrepresented in the public health research field. Over the ensuing decades, eligibility criteria for the Ferguson Fellowship were expanded to include graduate students in pharmacy, dentistry, and public health. The Ferguson Fellowship also provides scholars with opportunities to explore a broad range of public health career options.

The Ferguson Fellowship is supported by a cooperative agreement administered by the Office of Minority Health and Health

Equity at the Centers for Disease Control and Prevention (CDC) and funded by the National Center for Emerging Infectious and Zoonotic Diseases and National Center for HIV/AIDS, Viral Hepatitis, STD, and TB Prevention. In 2012, the Ferguson Fellowship cooperative agreement was awarded to Kennedy Krieger Institute. Ferguson Fellows participate in infectious diseases research at Kennedy Krieger Institute, Johns Hopkins University School of Medicine, Maryland State Health Department, and the CDC in Atlanta, GA.

Before 2012, Ferguson Fellows presented their research to peers and research mentors at the CDC. Under the cooperative agreement with the Kennedy Krieger Institute, Ferguson Fellows' research productivity goals included the expectation that fellows would submit their research for presentation to a national scientific meeting. From 2012–2013, the Ferguson Fellows received research site mentoring, but given the increased research productivity expectations, an enhanced multimodal mentoring strategy was developed and instituted after the second year of the cooperative agreement.

The Model: Multi-Modality Mentoring (M³)

M³ was initiated in 2014 to improve the rate of submissions of research abstracts to national scientific meeting. M³ consists of: (a) Research Site Mentoring, (b) collaborative myIDP development, (c) Mentoring Minutes, and (d) Research Accountability Groups. Research Site Mentors from Johns Hopkins University Medical Institutions, Kennedy Krieger Institute, Maryland State Health Department, and CDC provide instrumental content mentoring for the Ferguson Fellows during supervised research projects. Research Site Mentors are matched with Ferguson Fellows based on mutual areas of research interest and the Ferguson Fellow's research skills and experience.

myIDP is a web-based individual development plan platform, designed by Fuhrmann, Hobin, Lindstaedt, and Clifford at the University of San Francisco. The co-developers licensed myIDP to the American Association for the Advancement of Science (<https://myidp.sciencecareers.org/>). Ferguson Fellows complete myIDP in collaboration with the Research Site Mentor to align the Research Site Mentor's and Ferguson Fellow's research and program SMART (Strategic, Measurable, Attainable, Relevant, and Time-Limited) goals. MyIDP also encourages the fellow to self-reflect and rates his or her science skills, knowledge, career objectives, and values. During the summer, Ferguson Fellows are encouraged to record information about their mentoring team, results from informational interviews, and progress on project, scientific skill development, and career goals. The myIDP system gives the Ferguson Fellow periodic electronic reminders based on SMART goals that the fellow predetermined.

Mentoring Minutes are weekly professional and leadership development and research monitoring sessions conducted on a one-to-one basis, in person or virtually, with the Ferguson Fellow and one of the Ferguson Fellowship codirectors. During Mentoring Minutes, Ferguson Fellowship codirectors review professional and myIDP research goals and develop strategies to accomplish identified goals. Barriers to completion of research projects are identified and Ferguson Fellowship codirectors work with the Ferguson Fellows to develop and role play solutions.

Research Accountability Groups (RAGs) are weekly structured Ferguson Fellowship meetings that have research deliverables outlined on a shared Google Sheet. Ferguson Fellows report their weekly research progress to their Ferguson Fellowship peers. Research progress is then uploaded onto the shared RAGs' Google Sheet. Ferguson Fellows receive peer feedback and questions facilitated by the Ferguson Fellowship codirectors. This process is designed to give the fellows opportunities to develop critical thinking and practice with oral research presentations. RAGs also allow reciprocal sharing of strategies and challenges involved in laboratory, clinical, and community-based research.

Model Aims

Consistent with the overall goal of the Fellowship, the model sought to assist graduate students in the development of research for presentation at national scientific meetings. In recognition of the important role that leadership plays in promoting successful research, the model also sought to foster leadership skills that are promotive of academic success. Bass and Riggio (2006) identified three styles of leadership—transformational, transactional, and laissez-faire. Transformational leadership includes the ability of the leader to inspire and encourage followers' development by aligning goals with the needs of the followers, the leader, and the organization, whereas transactional leaders use contingent rewards and disciplinary actions to encourage desired behaviors and laissez-faire is an absence of leadership. Of these leadership styles, studies suggest that transformational leadership skills are associated with increased effort, effectiveness, and satisfaction among health care researchers (Patel et al., 2016).

Study Purpose

Programs like the Ferguson Fellowship that offer enhanced mentored research experiences and national scientific presentation opportunities may fill a significant training gap for scholars from URPs who aspire to transition from graduate school into successful careers in biomedical and public health research. The objective of this comparison study was to evaluate Ferguson Fellows' leadership qualities and the odds of submitting research for presentation at national scientific meetings following implementation of M³. It was hypothesized that the M³ would be associated with (a) increased submission of summer research projects to national scientific meetings and (b) increased transformational leadership characteristics compared to Ferguson Fellows' research productivity and leadership characteristics prior to M³ implementation.

Method

Participants

Institutional Review Board approval was granted by Johns Hopkins Medical Institutions—Institutional Review Board (Title: Center for Diversity in Public Health Leadership Training Program Evaluations; Protocol Number: NA_00069693). All scholars enrolled in the Ferguson Fellowship from 2012 to 2016 were included in this analysis. Most of the 54 students were female ($n = 43, 79.6\%$) and Black ($n = 28, 51.9\%$; Table 1). The mean age for

Table 1. Demographic Characteristics of the Ferguson Fellows, *N* = 54

Characteristic	Number (%)	Mean (<i>SD</i>)
Age (Years)		26.3 (4.6)
Sex (Female)	43 (79.6)	
Ethnicity Hispanic	11 (20.4)	
Race, Ethnicity		
Black, Non-Hispanic	28 (51.9)	
Black, Hispanic	3 (5.6)	
White, Non-Hispanic	2 (3.7)	
White, Hispanic	2 (3.7)	
Asian, Non-Hispanic	7 (13.0)	
American Indian or Alaska Native, Non-Hispanic	2 (3.7)	
American Indian or Alaska Native, Hispanic	1 (1.9)	
Multiracial, Non-Hispanic	3 (5.6)	
Multiracial, Hispanic	2 (3.7)	
Other, Non-Hispanic	1 (1.9)	
Other, Hispanic	3 (5.6)	
First Generation College	14 (25.9)	
Student Type		
Master of Public Health	20 (37.0)	
Pharmacy	14 (25.9)	
Medicine	13 (24.1)	
Veterinarian	6 (11.1)	
Doctoral, Health Behavior	1 (1.9)	

students was 26.3 years (*SD* = 4.6). Over one quarter (*n* = 14, 25.9%) were first-generation college students. Of the five degree programs (i.e., veterinary, medical, dental, pharmacy, public health) eligible for the Ferguson Fellowship, most graduate students (*n* = 20, 37.0%) were in the public health programs.

During the application process, potential Ferguson Fellows were asked to identify the area of research they would like to participate in; for example, epidemiology, laboratory research, emergency preparedness, clinical, pharmacology, or community. Ferguson Fellows' applications were scored using a rubric that included their experience and knowledge of health disparities, research experience, leadership, community and academic participation, discipline, career goals, reflective essays, and letters of recommendation. Following the selection of semifinalists, a phone interview was conducted. Upon selection of the scholar to the Ferguson Fellowship, careful attention was taken to match the student's research interest with those of the research mentor.

Procedure

M³. M³ consisted of (a) Research Site Mentoring, (b) myIDP development, (c) Mentoring Minutes, and (d) Research Accountability Groups, which were initiated in the summer of 2014.

Research mentors. Several strategies were used to recruit research mentors. A recruitment informational webinar was developed and advertised via e-mail to researchers at Johns Hopkins University Medical Institutions, Kennedy Krieger Institute, and CDC. The webinar was archived for potential mentors who were unavailable to view the synchronous webinar. Research mentors were also invited to a luncheon to obtain information about the Ferguson Fellowship and participate in a question and answer

session. Potential research mentors completed a Mentor Agreement that requested demographic information, a description of the proposed summer research for the Ferguson Fellow, a list of necessary skills for the student to have to participate in the research, the mentor's previous experience with mentoring graduate students, and mentor contingency plans in the event of deployment, meetings, or other events that could take the primary mentor away for extended time during the summer. Mentors were selected to participate in the Ferguson Fellowship program based on their history of successful research mentoring and summer research proposal description. Mentored research projects included lab research (e.g., optimization of infectious organism detection assays and analysis of immunization effectiveness), epidemiology, the effectiveness of treatment adoption and adherence for high-risk populations, and development and evaluation of community HIV and sexually transmitted infection screening and counseling.

Ferguson Fellows met weekly with their research mentors and research team. The Ferguson Fellows continued to work with the research mentor following the end of the on-site summer research experience to complete the final abstract for submission to a scientific meeting. When the abstract was accepted, the research mentor worked with the Ferguson Fellow via a combination of video-conferencing and telephone calls to optimize the Ferguson Fellow's presentation for the scientific conference. Research mentorship was voluntary. Research mentors did not receive remuneration.

myIDP. Each Ferguson Fellow completed myIDP in collaboration with their research mentors. A print-out of the Ferguson Fellow's myIDP allowed the Ferguson Fellow to periodically review goals over the summer during research mentor meetings and Mentoring Minutes.

Mentoring Minutes. Ferguson Fellows receive adjunct weekly mentoring from the Ferguson Fellowship codirectors to complement the instructional content-oriented research mentoring. If the research mentor was unavailable because of conferences, deployment, or vacation, Ferguson Fellowship codirectors developed plans with research mentors to support the Ferguson Fellow's continued research progress.

Research Accountability Groups. The RAGs consisted of a structured format during Weeks 1 through 8 (see Table 2) that provided a framework to produce a scientific abstract and PowerPoint presentation based on the student's research progress during the initial 8 weeks of the research project. Challenges to research progress were identified and discussed during the RAGs. Questions to be addressed by the primary research team were

posed. Seminars on research presentations, professional development, steps to create peer-reviewed articles, and lectures by leaders in the research field followed the RAGs.

Measures

Demographics. Information was collected on student demographics such as university of origin, academic discipline, sex, and age. Submission and acceptance of research abstracts to national scientific meetings were collected to summarize Ferguson Fellows' research accomplishments.

Multifactor Leadership Questionnaire (MLQ). The MLQ (Avolio & Bass, 2004; Avolio, Bass, & Jung, 1999) was

Table 2. RAG Discussion Objectives and Research Activities

Week	RAG discussion objectives	Research skill activity
Week 1	Research question/Hypothesis/Study procedures/Techniques	<ol style="list-style-type: none"> 1. Meet with the research mentor to discuss the research project 2. Conduct a literature review 3. Develop measurable research questions
Week 2	Literature review/Study design/Experiments/Data collection	<ol style="list-style-type: none"> 1. Review the research question with the research mentor 2. Develop an outline for Background/Introduction 3. Develop and propose a research design and analysis strategy 4. Review research design with your research mentor 5. Begin experiments 6. Develop a database 7. Data collection
Week 3	Literature review/Experiments/Data collection	<ol style="list-style-type: none"> 1. Summarize literature review 2. Data collection 3. Data input
Week 4	Experiments/Data collection	<ol style="list-style-type: none"> 1. Data collection 2. Data input 3. Review and confirm the data analysis plan with your research mentor 4. Develop Background/Introduction for Abstract
Week 5	Experiments/Data collection/Analysis/Tables/Figures	<ol style="list-style-type: none"> 1. Data collection and input 2. Begin data analysis 3. Begin development of tables and figures 4. Develop PowerPoint slides for Background/Introduction 5. Begin Methods section description for PowerPoint slides
Week 6	Experiments/Data collection/Analysis/Tables/Figures/Discussion	<ol style="list-style-type: none"> 1. Begin developing tables 2. Complete Methods section for Abstract 3. Outline and draft Results Abstract 4. Develop PowerPoint slides for Results
Week 7	Abstract and PowerPoint Rehearse research presentation for peers and Ferguson Fellowship Directors review and recommendations	<ol style="list-style-type: none"> 1. Complete Results for Abstract 2. Develop tables and figures for PowerPoint slides 3. Draft Discussion and Public Health Significance for Abstract 4. Review Abstract and PowerPoint slides with research mentor 5. Submit Abstract for CDC review process
Week 8	Final Abstract Rehearsal of research presentation for peers and Ferguson Fellowship Directors review and recommendations	<ol style="list-style-type: none"> 1. Finalize recommended Abstract edits following CDC review 2. Finalize tables and figures for PowerPoint slides 3. Complete PowerPoint slides for the Ferguson Fellowship Research Symposium
Week 9 Academic year	Ferguson Fellowship Summer Research Symposium Refine research findings working with research mentor and finalize Abstract for national scientific meeting	<ol style="list-style-type: none"> 1. Research presentation 2. Review and finalize Abstract with research mentor (submit to CDC for clearance if necessary) 3. Submit Abstract to a national scientific meeting

used to measure student leadership qualities. The MLQ is widely used to measure leadership. The MLQ (5X-Short) was validated in the 45-item form for research purposes and has been used in over 300 research programs, doctoral dissertations, and master's theses internationally between 1994 and 2004. The nine-factor structure of the MLQ (5X) was validated by discriminatory and confirmatory factor analysis. The nine factors include idealized influence (attributed), idealized influence (behavior), inspirational motivation, intellectual stimulation, individualized consideration, contingent reward, management-by-exception (active), management-by-exception (passive), and laissez-faire. Research conducted by Avolio and Bass (2004) supports the reliability of each data set of the MLQ 5X measuring the various leadership factors. The MLQ measures characteristics that are attributed to several leadership types. For this study, we were interested in Transformational, Transactional, and Laissez-Faire leadership types. Transformational leadership includes the first five factors, namely: (a) idealized attributes, (b) idealized behaviors, (c) inspirational motivation, (d) intellectual stimulation, and (e) individualized consideration. Transactional leadership includes: rewards achievement (Contingent Reward) and monitors deviations and mistakes (management-by-exception). Laissez-Faire leadership includes avoiding involvement. Cronbach's alpha value for the scale was .96 for Ferguson Fellows.

Qualitative Ferguson Fellowship evaluation. Ferguson Fellows were asked to evaluate their mentorship experience at 4 weeks and following the completion of the summer fellowship. The evaluation included Likert responses to questions related to research and professional development activities and essay questions. Essay responses were used to identify themes related to M³ mentorship experiences.

Data Analysis

Ferguson Fellows' characteristics were summarized using descriptive statistics. Wilcoxon signed-ranks test and *t* tests were conducted to evaluate differences between leadership styles (i.e., transformational, transactional, and laissez-faire) before and after the Ferguson Fellowship using a retrospective pretest–posttest design (Lam & Bengo, 2003). Comparison of pre and post-Ferguson Fellowship leadership characteristics before (2012–2013) and after (2014–2016) M³ was implemented was conducted. Logistic regression analysis was used to estimate the odds of submitting and acceptance of research abstracts before and after the implementation of M³. Alpha was set at .05.

Results

Description of Ferguson Mentors and Research Assignments

During the study period, there were a total of 21 unique mentors. The majority were female, ($n = 15$, 71.4%). Almost half of the research mentors were from Johns Hopkins University School of Medicine ($n = 10$, 47.5%), 42.9% ($n = 9$) were from CDC, and the remaining mentors were from the Maryland State Health Department ($n = 1$, 4.8%) and the Federal Bureau of Prisons ($n = 1$, 4.8%). Slightly over half of the researcher mentors were White, 52.4% ($n = 11$), 33% were Black ($n = 7$), one was Asian, one was American Indian, and one was Hispanic.

Leadership Qualities

Self-assessment of leadership qualities demonstrated significant increases in mean transformational leadership characteristics comparing pre-Ferguson Fellowship to post-Ferguson Fellowship responses ($M = 3.71$, $SD = 6.37$), $t(33) = 3.39$, $p < .01$ (see Table 3). There were no differences noted in pretest and posttest Ferguson Fellowship mean transactional leadership characteristics ratings and a slight decrease in laissez-faire leadership characteristics ($M = -.38$, $SD = 1.10$), $t(33) = 2.02$, $p = .05$. When comparing pretest with posttest leadership characteristics for fellows who received M³ and fellows who did not receive M³, only Ferguson Fellows who received M³ demonstrated significant increases in transformational leadership characteristics ($M = 3.88$, $SD = 6.63$), $t(24) = 2.93$, $p < .01$. No other leadership characteristics demonstrated significant differences by M³ participation status.

Abstract Submissions

Most of the Ferguson Fellows, 63% ($n = 34$), submitted research abstracts to national scientific meetings. In total, 28 (84.8%) of the 34 submitted abstracts were accepted for conference presentations (see Table 4). Following the implementation of M³, abstract submission to scientific conferences increased from a low of 46.2% in 2012 to 80% in 2014 (see Figure 1). Ferguson Fellows who participated in M³ had 3.9 higher odds (OR = 3.88, 95% [CI 1.21, 12.47], $p < .05$) of submitting their research to a national scientific meeting compared to fellows who did not participate in M³. There was no significant difference in acceptance of research abstracts comparing abstract acceptance before and after implementation of M³ ($p > .05$).

Table 3. Change in Ferguson Fellows' Leadership Qualities, $N = 34$

Leadership quality	Baseline Mean (SD)	Post fellowship Mean (SD)	Mean difference (95% CI)	<i>p</i> -value
Laissez-Faire	3.11 (3.19)	2.74 (2.73)	-.38 [-.77, .00]	.05
Transactional	23.71 (7.33)	24.00 (6.63)	.29 [-.70, 1.28]	.55
Transformational	61.88 (7.95)	65.59 (7.08)	3.71 [1.48, 5.93]	<.01

Table 4. 2012–2016 Ferguson Fellowship Submission and Presentation of Research by Cohort Year, $N = 54$

Research Abstract Submission Status	2012	2013	2014	2015	2016	Total
Cohort total	13	11	10	9	11	54
Submitted abstracts	6 (46.2%)	5 (45.5%)	8 (80.0%)	7 (77.8%)	8 (72.7%)	34 (63.0%)
Accepted abstracts	6 (100%)	3 (60.0%)	7 (87.5%)	6 (85.7%)	6 (75.0%)	28 (84.8% of total submitted abstracts)

Qualitative Responses From Program Evaluations

Themes related to Mentoring Minutes, RAGs, and integrated M³ approach were summarized. Comments regarding the Mentoring Minutes were uniformly favorable. As noted by one of the Ferguson Fellows about Mentoring Minutes:

... an amazing mentor—never have I met someone who is so invested in seeing the students complete projects and reach out for opportunities. . . . extremely responsive [with] comments and advice, even though [the Ferguson Fellowship faculty] was not my site mentor.

Comments related to the RAGs were mixed. Some Ferguson Fellows felt that graduate students, especially those involved in laboratory research, did not need the structure of the RAGs.

The RAG was not conducive to progress on my project or to my work style. I could see it being helpful to some students . . . but not as much for graduate/professional level students doing lab research.

Another Ferguson Fellow stated:

The RAG sessions that the Ferguson Fellows had every Wednesday was also very beneficial to my learning this summer. In my previous research experiences, I never had a class where someone outlined how to write a research article every step of the way. [Ferguson Fellowship faculty] did an extremely good job explaining this, and now I am more confident about my abilities as a researcher. I also now understand about how feasible it is to write and publish a paper.

Overall, Ferguson Fellows were very positive about the innovative M³ Model activities and resources integrated in the Ferguson Fellowship. They described the Ferguson Fellowship as being a supportive collegial learning environment.

I cannot even express how much this program has taught me about networking (which I shied away from before), the CDC, mentoring, and qualitative research. . . . I also believe I've made some lifelong friendships during the fellowship, which is amazing and unexpected. The atmosphere is so hopeful and collaborative, which is something I've never experienced before in a summer program.

Discussion

First funded as a cooperative agreement with the National Center for Emerging Zoonotic and Infectious Diseases in 1989, the Ferguson Fellowship introduces clinical and public health graduate scholars, especially those from URPs, to infectious diseases research and multiple public health career paths. Scientific writing and oral presentation abilities are fundamental skills that undergird the success of scholars planning to become leaders in biomedical and public health research. Scientific writing and oral presentations also lead to knowledge exchange, which informs effective public health policies. Presenting at national meetings gives the Ferguson Fellow increased opportunities to learn about the latest research in their fields of interest, network with senior researchers, and explore fellowship and career opportunities. As hypothesized, the enhanced multimodal mentoring M³ model was associated

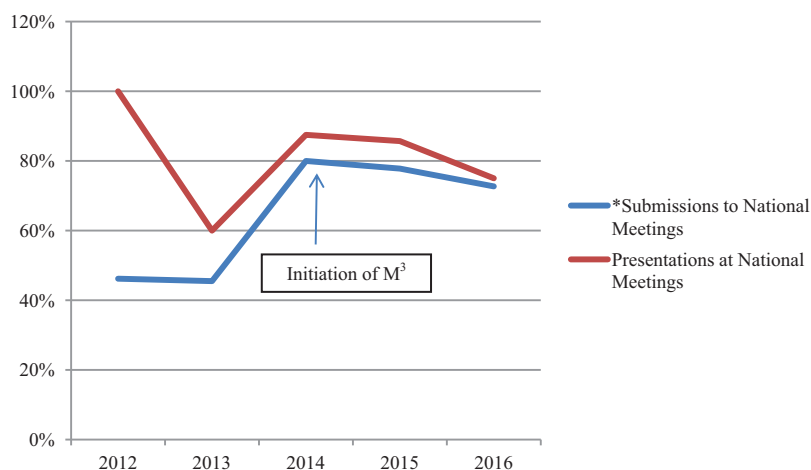


Figure 1. Submissions and presentations of research abstracts at national research meetings pre- and post-implementation of M³. The figure illustrates the odds of submitting research abstracts to national meetings was 3.88 times (95% CI [1.21,12.47], $p < .05$) higher for Ferguson Fellows who participated in M³ compared to those who did not receive M³. See the online article for the color version of this figure.

with increased submissions of summer research to national scientific meetings compared to Ferguson Fellows who participated in the Ferguson Fellowship prior to implementation of M³.

As the United States becomes more diverse, recruitment and training initiatives to support URPs in the research and public health workforce have increased. Although these initiatives have resulted in increases in the representation of URPs in the research and health workforce, people of color and women remain disproportionately represented in entry-level academic and lower-skilled health occupations versus senior leadership roles (Pololi, Cooper, & Carr, 2010; Snyder, Frogner, & Skillman, 2018; Whittaker, Montgomery, & Martinez Acosta, 2015). Effective programs designed to improve the number of URPs frequently provide necessary skill building, research, networking, and mentorship opportunities to aid career advancement (Smith, Nsiah-Kumi, Jones, & Pamies, 2009). Mentoring is an essential activity that supports academic and research career advancement and retention (Pololi et al., 2015). Summer research programs that focus solely on exposing students to research may not yield the desired outcome of increasing biomedical researchers from URPs. Rather, programs that use an integrated mentoring team approach may improve fundamental professional skills and open new opportunities that will sustain commitment and success in public health research careers (Snyder et al., 2018). Multimodal research mentorship is one such integrated approach that may foster success and advancement among early career researchers, especially those from URPs.

The mentoring modalities used in the M³ Model include individual (a) research mentors, (b) collaborative myIDP development, (c) Mentoring Minutes with Ferguson Fellowship codirector mentors for professional development and support, and (d) RAGs peer-group mentoring sessions facilitated by Ferguson Fellowship codirectors. This intensive, integrated system of mentoring builds a mentoring team of senior researchers, Ferguson Fellowship codirectors, and Ferguson Fellowship peer mentors.

Research mentors who provide laboratory and research opportunities for Ferguson Fellows volunteer their time and serve primarily as content and instructional mentors. Each week the Ferguson Fellow receives instructional mentoring through interactions with their research mentor and research team members. Fellows learn laboratory techniques, community-based research, or clinical skills necessary to conduct public health and biomedical research through training and apprenticeship experiences with their research mentor and research team. Given the increasing complexity of infectious diseases research, the mentorship emphasis for the research mentor is to ensure the Ferguson Fellow is competent to conduct research protocols and data analyses; this often leaves little room to provide career guidance and facilitate networking.

The Ferguson Fellowship codirector mentors complement the role of research mentors and provide support for the Ferguson Fellow in a variety of ways. First, the Ferguson Fellowship codirector mentor encourages the Ferguson Fellow to discuss the public health significance of their research and the association of their research with addressing health disparities. Second, the Ferguson Fellowship codirector mentor identifies and assists the Ferguson Fellow in developing solutions to barriers to the successful completion of research. Third, the Ferguson Fellowship codirector mentor discusses the Ferguson Fellow's academic and career goals and aspirations and facilitates networking within the academic, community public health, and CDC environments. The Ferguson

Fellowship codirectors' experiences matriculating in both HBCUs and R1 research institutions give the Ferguson Fellowship codirectors a unique perspective and personal understanding of the benefits and challenges of these institutions and successful strategies for negotiating the "cultures" of both types of institutions.

The addition of the weekly one-to-one Mentoring Minutes with the Ferguson Fellowship codirectors serving as both *psychosocial mentors* for counseling and advising and *process mentors* for academic and career development provides the Ferguson Fellow with a mentoring team that is tailored to the Ferguson Fellow's needs. Mentoring Minutes give the Ferguson Fellow an opportunity to discuss alternate research strategies, request assistance with analyses, or ask questions that they may be uncomfortable discussing with their research team. During Mentoring Minutes, fellows may talk about work-life balance, rehearse oral presentations, seek assistance with networking, or review their professional "mission."

The Ferguson Fellowship peer group RAG meetings with Ferguson Fellowship codirector facilitation allow the Fellows to share their research progress and problem solve together. The RAGs foster leadership skills and promote reciprocal knowledge transfer and translation of laboratory science to clinical research. This exchange of knowledge encourages understanding of laboratory, clinical, and community-based research that may lead to more comprehensive and "real-world" research questions and solutions. Participation in the RAGs gives an opportunity for Ferguson Fellows to support, encourage, and learn from one another.

Notably, Ferguson Fellows include a variety of disciplines with varying exposure to research and varying research support needs. Research skills for scholars in their first year of clinical graduate training may range from very limited to peer-reviewed publications. Given the variation in research experience found among the Ferguson Fellows, it is understandable that there were differences in perceived need for RAGs. Ferguson Fellows with more research experience were encouraged to take leadership and near peer mentorship roles.

Leadership and initiative were supported during the Ferguson Fellowship. Increased transformational leadership qualities were associated with M³ participation. Transformational leaders work with team members to identify a mission, create a vision to guide the mission, inspire team members, and collaborate with the team to realize the vision (Bass, 1990). Transactional leaders focus on supervision, organization, and compliance (Bass, 1990). Transactional leaders are interested in maintaining the status quo, while laissez-faire leaders take a relaxed approach, allowing the team members to be independent (Bass, 1990). Transformational leadership is often seen as the most optimal leadership style compared to transactional and laissez-faire leadership (Patel et al., 2016; Stone, Belcher, Attah, D'Abundo, & Gong, 2017). Transformational leadership characteristics are especially important for young researchers given evidence that transformational leadership is associated with leaders who are inspiring, foster innovation, and advance improved engagement and commitment to organizational goals among team members (Bass, 1990; Pololi et al., 2015).

Although the conference abstract acceptance rate for presentations was high before M³, the overall number of abstract submissions to conferences for Ferguson Fellows was less than 50%. M³ was associated with increases in abstract submissions without decreases in the percentage of accepted abstracts for presentation.

Scholars from URPs may vary in their academic preparedness to conduct research. Having an individualized approach to mentoring, therefore, is critical. The M³ model addresses many of the issues identified in summer research and mentoring programs, including lack of a mentoring formal structure, uncertainty about who should initiate the mentoring relationship, and unclear roles (Ssemata, Gladding, John, & Kiguli, 2017). Scholars have unique learning and communications styles. Offering a variety of mentoring modalities and mentors allows more opportunities to meet the Ferguson Fellows' unique needs. Studies document scholar's perceptions of improved effectiveness of mentoring when the scholar has more than one mentor (McGinn et al., 2015). The combination of structured dialogue during RAGs and open communication and trust building during Mentoring Minutes allows early identification and amelioration of challenges to research success. RAGs promote collaboration. The RAG format gives the fellows an opportunity to use their critical thinking skills to assist one another in problem solving, facilitated by the Ferguson Fellowship faculty. Working together to propose solutions may help to build confidence, leadership, and self-efficacy.

As with all studies, there are strengths and weaknesses. The size of the sample limited the authors' ability to examine differences in submission rates before and after implementation of M³ based on student's characteristics and disciplines. Although most of the Ferguson Fellows completed the self-assessment of leadership characteristics, there were missing data which may result in a Type II error when comparing differences in transformational leadership characteristics by M³ status. Given that the implementation of M³ is recent, additional longitudinal analyses will be necessary to determine whether these research mentorship enrichment activities lead to increased peer-reviewed publications and biomedical and science careers. A strength of the study is the comparative evaluation design of this innovative mentoring and research support system that complements a long-standing graduate summer research program.

Future Directions

The findings from this study support the increased research productivity associated with the implementation of additional process mentoring (Mentoring Minutes), myIDP, and structured group research accountability meetings (RAGs). Addressing and structuring programs to be flexible to each scholar's strengths and weaknesses is paramount for creating an inclusive learning environment for success. Summer research programs that include URPs and multiple academic disciplines may benefit from additional research, psychosocial, academic, and career mentoring support. Many of the topics that the Ferguson Fellowship codirectors discuss with fellows would not otherwise be addressed in traditional academic and summer research program settings. Future studies should include longitudinal analysis of Ferguson Fellows' publication, academic, and career paths. Systematic evaluation of scholar outcomes associated with summer research program activities will identify and inform effective strategies to support the engagement and retention of URPs in biomedical and public health research careers.

Keywords: mentoring; underrepresented researchers; graduate school students

References

- Avolio, B. J., & Bass, B. M. (2004). *Multifactor Leadership Questionnaire: Manual and sampler set*. Menlo Park, CA: Mind Garden.
- Avolio, B. J., Bass, B. M., & Jung, D. I. (1999). Re-examining the components of transformational and transactional leadership using the Multifactor Leadership Questionnaire. *Journal of Occupational and Organizational Psychology*, 72, 441–462. <http://dx.doi.org/10.1348/096317999166789>
- Bach, P. B., Pham, H. H., Schrag, D., Tate, R. C., & Hargraves, J. L. (2004). Primary care physicians who treat Blacks and Whites. *The New England Journal of Medicine*, 351, 575–584. <http://dx.doi.org/10.1056/NEJMsa040609>
- Bass, B. M. (1990). From transactional to transformational leadership: Learning to share the vision. *Organizational Dynamics*, 18, 19–31. [http://dx.doi.org/10.1016/0090-2616\(90\)90061-S](http://dx.doi.org/10.1016/0090-2616(90)90061-S)
- Bass, B. M., & Riggio, R. E. (2006). *Transformational leadership*. New York, NY: Psychology Press. <http://dx.doi.org/10.4324/9781410617095>
- Bright, C. M., Price, M. A., Morgan, R. C., Jr., & Bailey, R. K. (2018). The report of the W. Montague Cobb/NMA Health Institute Consensus Panel on the plight of underrepresented minorities in medical education. *Journal of the National Medical Association*, 110, 614–623. <http://dx.doi.org/10.1016/j.jnma.2018.03.012>
- Cooper, L. A., Roter, D. L., Johnson, R. L., Ford, D. E., Steinwachs, D. M., & Powe, N. R. (2003). Patient-centered communication, ratings of care, and concordance of patient and physician race. *Annals of Internal Medicine*, 139, 907–915. <http://dx.doi.org/10.7326/0003-4819-139-11-200312020-00009>
- Freeman, R. B., & Huang, W. (2014). Collaboration: Strength in diversity. *Nature*, 513, 305. <http://dx.doi.org/10.1038/513305a>
- Fry, C. (2009). *Vision and change in undergraduate biology education: A view for the 21st Century Student Conversation Preliminary Report*. Washington, DC: American Association for the Advancement of Science. Retrieved from <http://visionandchange.org/files/2010/03/VC-Preliminary-Reports-from-Conversations1.pdf>
- Girves, J. E., & Wemmerus, V. (1988). Developing models of graduate student degree progress. *The Journal of Higher Education*, 59, 163–189. <http://dx.doi.org/10.2307/1981691>
- Grumbach, K., & Mendoza, R. (2008). Disparities in human resources: Addressing the lack of diversity in the health professions. *Health Affairs*, 27, 413–422. <http://dx.doi.org/10.1377/hlthaff.27.2.413>
- Hong, L., & Page, S. E. (2004). Groups of diverse problem solvers can outperform groups of high-ability problem solvers. *Proceedings of the National Academy of Sciences of the United States of America*, 101, 16385–16389. <http://dx.doi.org/10.1073/pnas.0403723101>
- Institute of Medicine. (2011). *The future of nursing: Leading change, advancing health*. Washington DC: Author. Retrieved from <https://www.nap.edu/download/12956>
- Lam, T. C. M., & Bengo, P. (2003). A comparison of three retrospective self-reporting methods of measuring change in instructional practice. *American Journal of Evaluation*, 24, 65–80. <http://dx.doi.org/10.1177/109821400302400106>
- Maddux, W. W., Adam, H., & Galinsky, A. D. (2010). When in Rome . . . Learn why the Romans do what they do: How multicultural learning experiences facilitate creativity. *Personality and Social Psychology Bulletin*, 36, 731–741. <http://dx.doi.org/10.1177/0146167210367786>
- McGee, R., Jr., Saran, S., & Krulwich, T. A. (2012). Diversity in the biomedical research workforce: Developing talent. *The Mount Sinai Journal of Medicine*, 79, 397–411. <http://dx.doi.org/10.1002/msj.21310>
- McGinn, A. P., Lee, L. S., Baez, A., Zwanziger, J., Anderson, K. E., Seely, E. W., & Schoenbaum, E. (2015). Mentoring in clinical-translational research: A study of participants in master's degree programs. *Clinical and Translational Science*, 8, 746–753. <http://dx.doi.org/10.1111/cts.12343>

- Mouton, C. P., Harris, S., Rovi, S., Solorzano, P., & Johnson, M. S. (1997). Barriers to Black women's participation in cancer clinical trials. *Journal of the National Medical Association, 89*, 721–727.
- National Science Foundation. (2015). *Digest 2015: Women, minorities, and persons with disabilities in science and engineering*. Arlington, VA: Author. Retrieved from <http://www.nsf.gov/statistics/2015/nsf15311/digest/theme3.cfm#mindegrees>
- Patel, V. M., Ashrafian, H., Uzoho, C., Nikiteas, N., Panzarasa, P., Sevdalis, N., . . . Athanasiou, T. (2016). Leadership behaviours and health-care research performance: Prospective correlational study. *Postgraduate Medical Journal, 92*, 663–669. <http://dx.doi.org/10.1136/postgradmedj-2016-134088>
- Pololi, L., Cooper, L. A., & Carr, P. (2010). Race, disadvantage and faculty experiences in academic medicine. *Journal of General Internal Medicine, 25*, 1363–1369. <http://dx.doi.org/10.1007/s11606-010-1478-7>
- Pololi, L. H., Evans, A. T., Civian, J. T., Vasiliou, V., Coplit, L. D., Gillum, L. H., . . . Brennan, R. T. (2015). Mentoring faculty: A U.S. national survey of its adequacy and linkage to culture in academic health centers. *The Journal of Continuing Education in the Health Professions, 35*, 176–184. <http://dx.doi.org/10.1002/chp.21294>
- Saha, S., Komaromy, M., Koepsell, T. D., & Bindman, A. B. (1999). Patient–physician racial concordance and the perceived quality and use of health care. *Archives of Internal Medicine, 159*, 997–1004. <http://dx.doi.org/10.1001/archinte.159.9.997>
- Saha, S., & Shipman, S. (2006). *The rationale for diversity in the health professions: A review of the evidence*. Rockville, MD: U.S. Department of Health and Human Services.
- Sambunjak, D., Straus, S. E., & Marusić, A. (2006). Mentoring in academic medicine: A systematic review. *Journal of the American Medical Association, 296*, 1103–1115. <http://dx.doi.org/10.1001/jama.296.9.1103>
- Sellers, K., Leider, J. P., Harper, E., Castrucci, B. C., Bharthapudi, K., Liss-Levinson, R., . . . Hunter, E. L. (2015). The Public Health Workforce Interests and Needs Survey: The first national survey of state health agency employees. *Journal of Public Health Management and Practice, 21*(Suppl. 6), S13–S27. <http://dx.doi.org/10.1097/PHH.0000000000000331>
- Smith, S. G., Nsiah-Kumi, P. A., Jones, P. R., & Pamies, R. J. (2009). Pipeline programs in the health professions, part 2: The impact of recent legal challenges to affirmative action. *Journal of the National Medical Association, 101*, 852–863. [http://dx.doi.org/10.1016/S0027-9684\(15\)31031-2](http://dx.doi.org/10.1016/S0027-9684(15)31031-2)
- Snyder, C. R., Frogner, B. K., & Skillman, S. M. (2018). Facilitating racial and ethnic diversity in the health workforce. *Journal of Allied Health, 47*, 58–65.
- Ssemata, A. S., Gladding, S., John, C. C., & Kiguli, S. (2017). Developing mentorship in a resource-limited context: A qualitative research study of the experiences and perceptions of the Makerere University student and faculty mentorship programme. *BMC Medical Education, 17*, 123. <http://dx.doi.org/10.1186/s12909-017-0962-8>
- Stone, J. D., Belcher, H. M. E., Attoh, P., D'Abundo, M., & Gong, T. (2017). Association of health professional leadership behaviors on health promotion practice beliefs. *Disability and Health Journal, 10*, 320–325. <http://dx.doi.org/10.1016/j.dhjo.2016.12.015>
- Syed, M. (2010). Memorable everyday events in college: Narratives of the intersection of ethnicity and academia. *Journal of Diversity in Higher Education, 3*, 56–69. <http://dx.doi.org/10.1037/a0018503>
- Syed, M., Azmitia, M., & Cooper, C. R. (2011). Identify and academic success among underrepresented ethnic minorities: An interdisciplinary review and integration. *Journal of Social Issues, 67*, 442–468. <http://dx.doi.org/10.1111/j.1540-4560.2011.01709.x>
- Valantine, H. A., & Collins, F. S. (2015). National Institutes of Health addresses the science of diversity. *Proceedings of the National Academy of Sciences of the United States of America, 112*, 12240–12242. <http://dx.doi.org/10.1073/pnas.1515612112>
- Whittaker, J. A., Montgomery, B. L., & Martinez Acosta, V. G. (2015). Retention of underrepresented minority faculty: Strategic initiatives for institutional value proposition based on perspectives from a range of academic institutions. *Journal of Undergraduate Neuroscience Education, 13*, A136–A145.