

Commentary

Improving Adolescent and Young Adult Health — Training the Next Generation of Physician Scientists in Transdisciplinary Research

S. Jean Emans, M.D.^{a,*}, S. Bryn Austin, Sc.D.^a, Elizabeth Goodman, M.D.^b, Donald P. Orr, M.D.^c, Robert Freeman, Ph.D.^d, David Stoff, Ph.D.^e, Iris F. Litt, M.D.^f, Mark A. Schuster, M.D., Ph.D.^g, Robert Haggerty, M.D.^h, Robert Granger, Ed.D.ⁱ, and Charles E. Irwin, Jr, M.D.^j, the participants of the W.T. Grant Foundation conference on Training Physician Scientists

^aDivision of Adolescent Medicine, Children's Hospital Boston, Boston, Massachusetts

^bChild and Adolescent Obesity Program, Floating Hospital, Tufts Medical Center, Boston, Massachusetts

^cSection of Adolescent Medicine, Indiana University School of Medicine, Indianapolis, Indiana

^dDivision of Epidemiology & Prevention Research, National Institute on Alcohol Abuse and Alcoholism, Bethesda, Maryland

^eCenter for Mental Health Research on AIDS, National Institutes of Mental Health, Bethesda, Maryland

^fDepartment of Pediatrics, Division of Adolescent Medicine, Stanford University, Stanford, California

^gDivision of General Pediatrics, Children's Hospital Boston, Boston, Massachusetts

^hUniversity of Rochester School of Medicine and Dentistry, Rochester, New York

ⁱWilliam T. Grant Foundation, New York, New York

^jDivision of Adolescent Medicine, UCSF School of Medicine, San Francisco, California

To address the critical shortage of physician scientists in the field of adolescent medicine, a conference of academic leaders and representatives from foundations, National Institutes of Health, Maternal and Child Health Bureau, and the American Board of Pediatrics was convened to discuss training in transdisciplinary research, facilitators and barriers of successful career trajectories, models of training, and mentorship. The following eight recommendations were made to improve training and career development: incorporate more teaching and mentoring on adolescent health research in medical schools; explore opportunities and electives to enhance clinical and research training of residents in adolescent health; broaden educational goals for Adolescent Medicine fellowship research training and develop an intensive transdisciplinary research track; redesign the career pathway for the development of faculty physician scientists transitioning from fellowship to faculty positions; expand formal collaborations between Leadership Education in Adolescent Health/other Adolescent Medicine Fellowship Programs and federal, foundation, and institutional programs; develop research forums at national meetings and opportunities for critical feedback and mentoring across programs; educate Institutional Review Boards about special requirements for high quality adolescent health research; and address the trainee and faculty career development issues specific to women and minorities to enhance opportunities for academic success. © 2010 Society for Adolescent Medicine. All rights reserved.

In November 2008, a group of adolescent medicine and academic program leaders, representatives from foundations, National Institutes of Health (NIH), Maternal Child Health

Bureau (MCHB), and American Board of Pediatrics, investigators, and other thought leaders met at the William T. Grant Foundation to review the critical shortage of physician scientists in the field of adolescent and young adult medicine, to examine the barriers and facilitators for the success of investigators in the field, and to develop recommendations for improved training and support. The participants acknowledged significant unmet needs of adolescents [1,2] and the ground-breaking work of the Committee on Adolescent Health Care Services and Models of Care for Treatment, Prevention, and Healthy Development (formed by the

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*Address correspondence to: S. Jean Emans, M.D., Division of Adolescent/Young Adult Medicine, Children's Hospital Boston and Harvard Medical School, 300 Longwood Avenue, Boston, MA 02115.

E-mail address: jean.emans@childrens.harvard.edu

National Research Council/Institute of Medicine and funded by the Atlantic Philanthropies) [3]. The National Research Council/Institute of Medicine report identified gaps in care delivery and offered recommendations for clinical training and models of care as well as the recognition of scholar/educators “who contribute to the research/science of adolescent health services” (p. 246) – addressing “missing opportunities” [3]. The meeting at the W.T. Grant Foundation focused specifically on issues related to training physician scientists. The paucity of adolescent medicine physician scientists being trained, coupled with impending retirement of many of the senior physician scientists, has created a crisis. The field is at a crossroad. This summary provides an opportunity to understand the requirements for preparation of successful investigators and to provide a framework for recommendations to enhance models of training and mentoring.

Adolescent Medicine Fellowship Training Programs: A Critical Element in the Pathway Toward Successful Clinician Scientists

Adolescent Medicine is recognized as a specialty by the American Boards of Pediatric (ABP), American Board of Internal Medicine, and American Boards of Family Medicine. As of 2009, 744 physicians (547 in pediatrics, 66 in internal medicine, and 131 in family medicine) have been certified. There are currently 26 Accreditation Council for Graduate Medical Education (ACGME) fellowship programs in Adolescent Medicine.

The requirements differ among the Boards; the American Board of Internal Medicine and American Boards of Family Medicine require 2 years of training, whereas ABP requires three. The ABP goal of fellowship training is “the development of future academic pediatricians while recognizing multiple career paths available to them” [4]. The additional year is designed to provide a broad foundation for scholarly activity. Internal Medicine and Family Medicine physicians have no specific research requirement (although training programs may require 3 years for all fellows). The ABP offers several mechanisms to allow exceptional individuals to shorten the general pediatrics residency before entering a fellowship. Most fellows join the fellowship with minimal or no research experience and require intensive training in research. More Adolescent Medicine fellows are enrolled in a graduate program (M.P.H. or M.Sc.) during fellowship (54%) as compared with all ABP fellows (14%). In a summary of areas of scholarly activity from ABP for the most recent examination, adolescent medicine fellows chose clinical biomedical science (69%), health services research (8%), quality improvement research (8%), public policy (8%), and other (8%).

The number of graduates of Adolescent Medicine fellowships has been stable at 20–24 during the past 10 years as compared with a 60%–90% growth in many other pediatric specialties. In 2008, there were 28 first-year Fellows enrolled

in the ACGME programs. Although most graduates enter academic careers as clinician educators, few become physician scientists. For example, only 10 of 56 (18%) physician graduates from Leadership Education in Adolescent Health (LEAH) training programs at Baylor College of Medicine, Harvard Medical School (Children’s Hospital Boston), Indiana University, University of Minnesota, University of Rochester, and University of California, San Francisco during the past 5 years were spending more than 50% of their time in funded research. Although this number does not include physician scientists trained in other adolescent medicine fellowship programs, or those doing research with <50% protected time, or those trained in another field, the low numbers of physician scientists are evident and the causes multifactorial. Not unique to Adolescent Medicine, high debt from medical school and NIH funding challenges may lead physicians to choose safer clinical educator trajectories. In a survey across pediatric subspecialties, 52% of fellows and 42% of early subspecialists would have chosen a 2-year fellowship without research or scholarly activity [5,6]. In addition, 90% Adolescent Medicine Fellows are women. Because women in medicine have traditionally faced more barriers in juggling work/life balance and in funding and academic advancement than men, Adolescent Medicine fellows may lack role models or appropriate mentoring on navigating the career trajectory for success in research. Although Board certification has clearly increased the quantity and quality of research training, many of the fellowship programs in Adolescent Medicine do not have the research environment, extramural funding, supportive department and institution, and faculty resources, including interdisciplinary PhD faculty, to effectively mentor future physician scientists.

Funding has also been a challenge in fellowship training. The Maternal and Child Health Bureau funds seven LEAH programs through T71s. The multidisciplinary LEAH grants have unique public health, continuing education, and technical assistance goals, objectives, and competencies with translation of knowledge to practice. Research may assume a smaller role for trainees than for those in NIH T32 programs in other pediatric subspecialties, and budgetary constraints at the federal level have led to level funding for the LEAH programs for the past 17 years. The constant demands of achieving clinical competence, completing course work, and allotting time for research can be problematic. Although there are some departmental NIH T32s that have provided support for Adolescent Medicine fellows, this remains an uncommon (and underutilized) but valuable mechanism for support for fellowship or post-fellowship research training in adolescent medicine.

In addition to addressing the research training in adolescent medicine fellowship programs, the group recognized that expanding collaboration and mentoring of other physician researchers interested in adolescent health and trained in general pediatric academic, health services or complementary fields, or in the Robert Wood Johnson Clinical Scholars

programs (RWJCSP) was essential to increase the extent and quality of adolescent health research. Tracking of fellows across programs and in other pediatric and nonpediatric subspecialties will provide data to examine additional barriers to the trajectory of physician scientists, highlighted in a 2009 publication of the Association of Professors of Medicine [7].

Supporting physicians as scientists is an urgent and critical need because of their unique and important perspective on health and wellness. Adolescent medicine physicians are able to bring their practical experiences with physical and mental illness and its consequences, a focus on individual and population level issues, and knowledge of the educational and public health systems to the formulation of research questions. This multifaceted perspective is important and needs to be nurtured and added to the team of investigative scientists if we are to improve adolescent health and well-being in the 21st century.

Trajectory of a Successful Transdisciplinary Researcher

The trajectory or pipeline for training physician scientists, from undergraduate education through to independent scientist, is shown in Figure 1. The intersecting arrows identify windows of opportunity, or “critical periods” in the training pipeline to “deliver an exposure” [8] – that is, to cultivate trainees’ interest and competence in adolescent health research. These exposures can have undermining or promoting effects on the development of a trainee and subsequent successful attainment of a career as an independent physician scientist (Figure 1).

Figure 1 makes note of funding and other resources, such as access to and dedicated time for research involvement, which may facilitate both expanding the number of trainees who enter the pipeline and the number who successfully navigate the journey to become independent research scientists specializing in adolescent health. Key to success is the environment early in one’s career at an institution or department that provides protected time, mentoring of both science and career development (including life/career integration), start-up funding, and a stimulating academic environment [9].

Why Transdisciplinary Training?

Health in the 21st century is a complex interplay of forces from the genetic to the relational to the political. Therefore, protecting the health of today’s youth requires a multilevel, multidimensional framework. No discipline-specific method or theory alone will be sufficient to tackle this level of complexity [10]. Preventing the accumulation of health risks, onset of health problems, or initiation of harmful behaviors in adolescence and reducing disparities will require creative synthesis of myriad theoretical models and methodological approaches developed in disciplines as varied as proteomics and political science, genetics and geography, systems science and sociology – transdisciplinary training. The transdisciplinary approach creates opportunities and challenges

for scientists to develop cross-cutting collaborations and research initiatives. Committed mentorship and funding are required to support transdisciplinary training so that the physician can enhance transdisciplinary science by bringing depth in the clinical realm and in physiological processes within multilevel pathways to illness to answer the many questions that remain as to how macro and meso exposures, such as poverty, social inequities, or social supports, “get into the body,” that is, how they affect physiologic processes that eventually manifest in the health of the individual [11]. The skills and supports adolescent medicine physicians need to become competitive transdisciplinary scientists are similar to those faced in other fields, of which cross-training, collaboration skills, and mutual respect are paramount [12]. Cross-training includes formal coursework and informal educational opportunities in theoretical approaches, methodologies, and disciplinary language of other fields. For example, joint programs could specifically target research on health status and health services delivery models to enhance inadequate preventive screening [1–3], or address cutting edge issues such as the implications of “ehealth” [13]. Leadership from adolescent medicine, departments, and institutions must reach out to divisions, departments, and schools that are not usually considered within the purview of training programs. Likewise, leadership from partner disciplines will need to be willing to embrace training and cross-disciplinary mentorship in adolescent health.

Outreach across disciplines and cross-disciplinary training is difficult and costly but brings multiple opportunities to the field. Similar career trajectories for other disciplines would likewise benefit from definitions of critical pathways of success. Leadership from funders will be essential to ensure support for the needed infrastructure for transdisciplinary training across all stages of adolescent medicine physician scientist training. Furthermore, career support from senior scientists will help adolescent medicine physicians to pursue novel transdisciplinary research initiatives.

Cross-Disciplinary Training in the NIH Context

As has become increasingly clear, many of the Nation’s most pressing health problems including those in adolescent health involve disease processes that are jointly influenced by biological, behavioral, social, and environmental factors. Indeed, NIH made an effort some time ago to embrace the concept of a “multidisciplinary” approach in studying and attempting to cure disease. Although “multidisciplinary” and similar terms have not always been used consistently or with particularly great precision, such a perspective typically implied that, at minimum, a diversity of disciplines were involved in studying a particular health-related issue. An “interdisciplinary” approach—referring to a strategy of drawing from, and integrating, two or more academic disciplines, fields, or departments to develop a greater understanding of a problem too complex to be understood by one discipline alone—subsequently was championed as

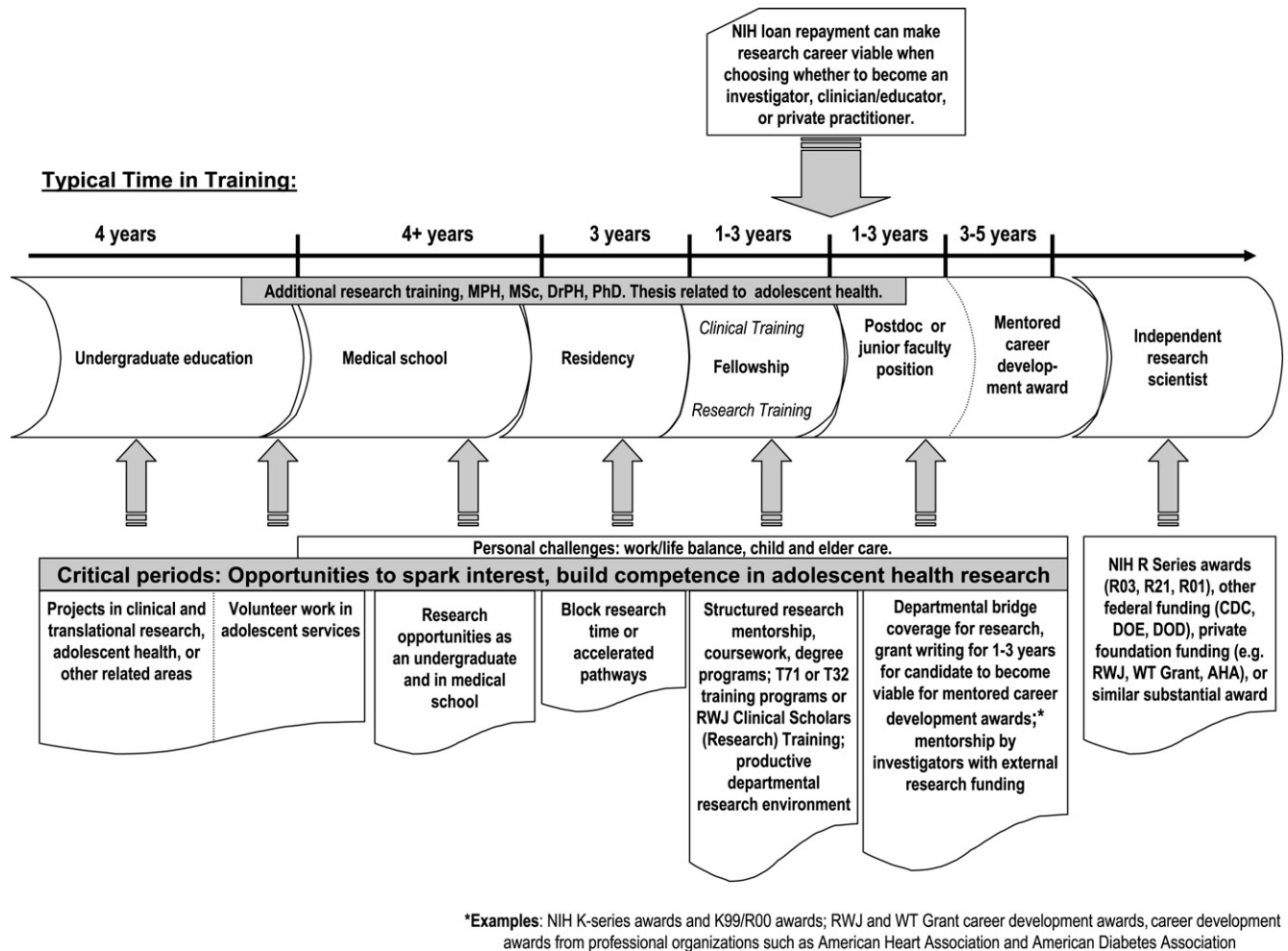


Figure 1. Pathway to becoming an independent adolescent medicine physician scientist.

a more sustained and systematic way of approaching disease complexity. The process whereby interdisciplinary work may eventuate in an entirely new discipline—for instance, the way in which the field of genomics grew out of genetics, molecular biology, analytical chemistry, and informatics—is characteristic of a “transdisciplinary” approach.

To keep pace with these scientific developments, a number of NIH Institutes and Centers (ICs) have moved in recent years to an organizational structure that seeks to break down disciplinary “silos” (as represented by, for e.g., “branches”) and replace—or augment—them with something along the lines of “transdisciplinary work teams” (or similar structure). Furthermore, NIH Funding Opportunity Announcements increasingly have been reflecting this broadened scientific view. Thus, the stated mission of the National Institute on Alcohol Abuse and Alcoholism’s Underage Drinking Research Initiative [14] is “... to support research that will provide a more complete and integrated scientific understanding of the environmental, biobehavioral, and genetic factors that promote initiation, maintenance, and acceleration of alcohol use among youth...”. More generally, one can have a glimpse of the transdisciplinary

perspective in the NIH Institutes’ growing recognition that disease outcomes are best understood as products of interaction between genes and the environment, with implications for disease understanding, prevention, and treatment. The NIH *Genes, Environment and Health Initiative* [15], for instance, comprises a genetics program dedicated to analyzing genetic variation in groups of patients with specific illnesses [16] and an exposure to biology program aimed at producing and validating new methods for monitoring environmental exposures that interact with a genetic variation to result in human diseases [17]. At the same time, a movement may be discerned across many of the institutes to foster the greater integration of the theory, methods, and insights derived from the basic behavioral sciences—for example, observational and qualitative studies, epidemiological surveys, and experimental studies—into the development of preventive health interventions.

Much of the impetus for this embrace of the inter- and transdisciplinary scientific perspectives at NIH can be traced to the September 2004 launch of the NIH Roadmap for Medical Research, intended to address roadblocks to research and transform the way biomedical research is conducted by

overcoming specific hurdles and filling defined knowledge gaps. Roadmap programs span all areas of health and disease research and boundaries of NIH Institutes and Centers (ICs) [18,19].

Given the growing interest at NIH in transdisciplinary science, how might a young physician scientist go about acquiring the commensurate knowledge increasingly important for conducting high-impact research? Aside from what might be considered the “institutionalized” route for acquiring training in a new discipline (e.g., K08, K23 awards), there are at least several strategies that the newly-minted physician-scientist might opt for:

1. NIH encourages multiple principal investigators and recognizes that health-related research increasingly involves teams that vary in size, hierarchy, location of participants, goals, disciplines, and structure [20]. Thus, a multiple principal investigators proposal might be submitted by a basic behavioral scientist who has teamed with an interventionist or a biomedical scientist.

2. Administrative or competitive supplements to current grants allow an investigator to acquire familiarity with a new field of study. A recent Roadmap Initiative called for the granting of supplemental awards specifically for methodological innovations—in research design, data collection, measurement, and data analysis—in the behavioral and social sciences intended to facilitate conduct of research at the intersection of the behavioral, social, and biomedical sciences [21].

3. NIH-supported workshops provide opportunities for the early scientist to gain specific skills or participate in programs to which investigators from a variety of fields have been invited for the purpose of discussing potential future research directions of interest to the sponsoring IC. Workshops often yield unusually wide ranging, informal discussions that are likely to be at the cutting edge of transdisciplinary thinking in the biomedical and behavioral sciences.

4. Young investigators can become involved in an NIH-supported Center grant. A P30 Core Center Grant (others are the P60 [Comprehensive Center] and P50 [Specialized Center]) is an institutional award that brings together multidisciplinary groups of scientists to identify unique scientific opportunities and tackle compelling problems in a particular health-related field. By providing an administrative framework within one or several central themes, new technologies and approaches can be brought to bear on new and existing research projects.

5. NIH Interdisciplinary Research Initiatives – The NIH Roadmap has been particularly concerned with the development of a cadre of scientists fluent in the language and skills of inter- and transdisciplinary research, and Roadmap announcements are likely to be of particular interest, which are as follows:

- (a) Initial awards under this initiative funded planning grants for interdisciplinary research, with the P20 (Exploratory Center) mechanism used to establish

centers that combined aspects of individual disciplines to provide new ways of addressing complex problems in the biomedical sciences [22].

- (b) Other innovative training programs envisioned include the development of methodologies intended to integrate behavioral and social science into interdisciplinary research; development of a cadre of scientists able to integrate diverse approaches and work in interdisciplinary teams; development of an interdisciplinary workforce through training at the undergraduate through postdoctoral levels; and development of short, interdisciplinary training programs for scientists at all career levels, including Short Laboratory Courses and Short-Term Research Institutes, designed to promote creative problem-solving.

6. The Pediatric Scientist Development Program (PSDP) and the Child Health Research Career Development Award are two K12 programs that have been particularly successful at facilitating the careers of physician scientists. The PSDP program typically begins after 12–24 months of clinical fellowship training. Very limited or no clinical time is allowed. The PSDP graduates have demonstrated high productivity and a high rate of NIH funding. The Child Health Research Career Development Award expanded from 6 centers in 1990 to 20 centers in 1997, using P30 initially and later the K12 for funding. The graduates were successful in achieving academic promotions, and 80% of the scholars in the most successful centers obtained NIH funding (R, U, and K awards). These models included the elements of support and mentorship that are essential for career success.

Charting a Research Trajectory for Physician Scientists: Successful Foundation Models for Training and Career Development

A number of foundations have played a significant role in promoting various aspects of training and research to advance adolescent health and fund innovative efforts. Some medical schools are requiring mentored scholarly activity and encouraging more joint degree programs and investigator tracks and commitment to life-long learning.

1. The Macy Foundation has played a major role in supporting innovation including launching the Harvard Macy Courses and focusing on improving interdisciplinary health professional education. Smaller foundations have also had an effect on medical student, fellow, and faculty education including areas important for adolescent health.

2. The Klingenstein Third-Generation Foundation grants (<http://www.ktgf.org>) support both medical students and junior faculty. They support entry into child and adolescent psychiatry through student mentorship, hands-on clinical experiences, and research opportunities and fellowship programs for junior faculty in the field of childhood and

adolescent mental health, specifically in Attention Deficit Hyperactivity Disorder and depression.

3. The RWJCSP provides a unique trajectory for physicians to enter a 2-3 year academic fellowship postresidency and then, if interested in adolescent health, either enter the clinical training of an ACGME Fellowship (becoming Adolescent Medicine Board certified) or directly accept a General Pediatrics faculty academic position concentrating on adolescent medicine. The RWJCSP program builds on a 40-year history of training Fellows in transdisciplinary research. Since its inception, more than 1,000 clinician scientists from a variety of medical specialties have been trained to conduct health services research (including 15 in Adolescent Medicine). Twenty-eight scholars are chosen annually to work at University of California, Los Angeles, University of Michigan, Yale University, and University of Pennsylvania. The faculty in the RWJ program is drawn from the humanities, social sciences, health policy, as well as medicine, and receives a stipend for their teaching activities. Given the success of this program, there are implications for Adolescent Medicine training programs. The essential ingredients of successful training programs for future adolescent medicine scientists are relative freedom to engage in mentored research with a minimum of clinical responsibility during the training period, a dedicated, supported transdisciplinary faculty teaching a broader range of content leading to an M.P.H., emphasis on research productivity and networking, a productive national meeting that enhances critical feedback and collaboration, and solid mentoring in a strong research environment.

4. The William T. Grant Scholars Program is designed to foster the professional development of highly promising early-career researchers in the social, behavioral, or health sciences. Each Scholar award supports the pursuit of a five-year research program that has dual goals—producing high-quality evidence on questions that are important to theory and either policy or practice and significantly expanding the scholar's expertise. In addition to planning a series of research studies, all applicants propose mentors and accompanying mentoring plans to aid them as they develop skills and expertise in different disciplines, methods, and/or content areas. Scholars come together for two intensive working meetings each year; a member of the Foundation's senior staff reviews each scholar's ongoing work, remaining alert for developmental opportunities. All mentors are asked to submit annual reports describing their work with each Scholar; and there is an annual competition to award supplemental grants to Scholars to improve their abilities to mentor junior Scholars of color.

Given the program's emphasis to scholar development, lessons have emerged that may inform other efforts to develop early-career researchers. The foundation's interests are specific and coherent. This common focus helps Scholars in the same or proximal cohorts to work and publish together. Diversity of background, discipline, and demography among Scholars are all considered as strength. The selection process

and subsequent activities are designed to create and leverage opportunities for the Scholars to encounter different ways to approach empirical work. The Scholars have uniformly had exceptional early success and their home institutions regard them as rising stars. They often comment on how useful and unusual it is, especially when pre-tenure, to be able to be candid in public about what they do not know or do not understand. Given the Foundation's interest in "use-inspired" research, many of the grantees have proven that they can effectively bridge research and policy or practice, making the program attractive to M.D.s, given their intensive early-career preparation in clinical work. The challenge for M.D.s is to demonstrate a research track record that is competitive with that of other early career social scientists. For those who attain that threshold, the program is an excellent opportunity to further develop a research program and the accompanying skills.

Mentoring as a Strategy for the Career Success of Diverse Investigators

As the population of the United States continues to become more ethnically diverse, there is a growing recognition that diversity in the research workforce is linked with improving health care quality and access for socially disadvantaged racial and ethnic groups across the lifespan. Government agencies, as well as private foundations and educational institutions, will continue to be challenged to develop effective programs for recruiting, training, and retaining high-quality research scientists from currently under-represented racial and ethnic groups. Despite a number of government-sponsored initiatives, progress in diversifying the scientific workforce has been hindered by challenges that these scientists face. Many have noted that inadequate mentoring is a critical obstacle contributing to insufficient diversification of the scientific workforce and, furthermore, it has been identified as one of the most important barriers to successful NIH funding [23]. NIH Minority supplements have also been an important method to encourage young investigators to work with senior mentors.

Mentees, mentors, and institutions face a number of challenges in building effective mentoring programs to overcome the barriers faced by not only under-represented racial and ethnic groups, but also by other subpopulations engaged in career development.

1. *Can We Improve the Supply of Trained Mentors?* The shortage of qualified mentors is probably the most obvious challenge we face, and at the same time the most limiting. Innovative approaches are needed to take full advantage of experienced, disparities-knowledgeable faculty and create new opportunities for mentoring. Programs might be initiated using online distance learning and peer mentoring, thereby not placing additional burdens on the already slim pool of senior mentors. We also need to address the critical gap in training of future faculty mentors to improve communication skills essential for good mentoring.

2. **Can We Create a Culture of Mentoring?** At an institutional level, a culture of mentoring needs to be created and fostered as a revered core value that is expected, measured, and rewarded, such that both mentee and mentor benefit from the relationship. Team mentoring, consisting of a network of mentors endorsing the mentee's personal and career development, would facilitate a culture of mentoring at the faculty level. A network of multifaceted mentors may be called for because one individual cannot realistically fulfill all of the roles of a mentor (e.g., coach, advisor, supporter, teacher, friend, sponsor, consultant, critic, role model).

3. **Can We Develop an Evidence-Based Approach to Effective Mentoring?** The failure to appreciate the complexities and importance of mentoring relates to the usual "on-the-job" training, wherein most mentors have not received formal training in mentorship but have instead learned their craft largely by means of exposure to their own mentors and on the job, which includes trial-and-error learning. Mentoring programs are not taking advantage of research concepts and practices from relevant areas of scholarship including adult education, counseling, psychology, and other social sciences. It will be important to address this challenge through supporting mentoring as a valued area of rigorous research and scholarship so that future mentoring programs can build on the knowledge base of social science research. There is a need to apply evidence-based practices to mentoring and career development of faculty in biomedical careers.

4. **Can Mentoring Prevent the Pipeline From Leaking?** With each step up the academic ladder, from high school to full professorships, the proportion of individuals from under-represented racial and ethnic communities in science drops substantially. Active recruiting and retention strategies for mentorship programs targeting these transition points are essential to address the challenges of this leaky pipeline.

5. **Can We Strengthen Institutional Commitment?** Successful diversity-mentoring programs require institutional commitment and organizational changes that provide coordination of multiple training programs, support professional advancement of faculty from under-represented groups, and value partnerships with institutions such as Historically Black Colleges and Universities.

6. **Can We Engage Students in the Excitement of Science?** One of the greatest challenges for improving the diversity of the workforce is to make science more attractive to students through sparking a sense of excitement. Mentors should be encouraged to set up a dialectic of learning activities in which mentees move back and forth between having rich new experiences and engaging in learning by doing, rather than observing, to set up and conduct their own research experiments. Brainstorming, cooperative and collaborative efforts, problem solving, critical thinking, and case studies are the hallmarks of this type of approach.

7. **Can We Reward and Compensate Mentoring?** One of our greatest challenges is to establish a definition of what constitutes good scientific mentoring. The mentoring process

needs to be recognized with equal importance to scholarship, teaching, and service because it is an essential process that promotes career development of others. Incentivizing and rewarding mentoring may help to accomplish this. We might recommend certain conditions under which support for mentors may occur, such as during the start up period of an award, when mentorship is not otherwise available to trainees or when the mentor is overburdened with other responsibilities.

In a recent special supplement, new mentoring programs were described and critically analyzed to address these challenges and provide unique opportunities that diversify the workforce on mental health and HIV/AIDS [24]. In concert with mentoring program, partnerships must be built across all levels of government and between a range of public-sector and private-sector institutions and departments if resources are to be harnessed for improving the health and well-being of socially disadvantaged racial or ethnic populations.

Recommendations

1. Incorporate more teaching and mentoring in adolescent health research into medical school education

Medical students would benefit from being exposed to both the special issues of adolescents and the rigor of scientific investigation early in their careers. Adolescent health researchers should reach out to students and provide mentoring around projects that will make a difference in the lives of adolescents and families. Students can be encouraged to consider a M.D. or Ph.D. or M.D. or M.P.H. in population and behavioral sciences, health services, and public health, especially in medical schools with strong clinical research faculty support and mentorship. The Society for Pediatric Research summer fellowships for medical students is an example of a successful program to foster interest in research. Faculty and societies should encourage and support students to participate in national and/or local meetings.

2. Explore opportunities and electives that can enhance clinical and research training of residents in adolescent health issues

During rotations in adolescent medicine, residents should be encouraged to critically analyze systems of care or to examine policy questions. Research electives can be used to develop short-term projects or to undertake a quality improvement effort. Innovations in residency training can be piloted and disseminated through initiatives such as the Residency Review and Redesign (R3P) project [25]. Residents can be encouraged to present research at Poster days, learn presentation skills, and to network with peers and faculty. Scholarships given to attend annual meetings such as the Society for Adolescent Medicine or Pediatric Academic Societies can demonstrate for residents the excitement in adolescent health research and the vastness of this field.

3. Broaden the educational goals for Adolescent Medicine fellowship research training and develop an intensive transdisciplinary research track

The elements of the transformative transdisciplinary education that successful, diverse physician scientists need for the 21st century should be included in training programs (e.g. course work in other disciplines, collaborative projects, and cross-disciplinary mentoring). Scientists working together should emphasize that adolescent research includes biomedical, behavioral, epidemiologic, and contextual questions. Fellowship programs in universities with faculty resources should be encouraged to develop a more concentrated transdisciplinary research track with foundation or federal funding, balancing clinical training with more emphasis and protected time for those committed to pursuing a research career.

4. Redesign the career pathway for the development of faculty physician scientists transitioning from fellowship to faculty positions

For those adolescent medicine specialists interested in transdisciplinary research, support for expanded training needs to continue beyond fellowship through the first two to three years of junior faculty positions. Junior faculty should be counseled to locate at an institution where the research environment, mentoring, protected time, institutional initiatives that recognize career/life balance, and start up resources facilitate success. Collaboration among pediatric subspecialties at the fellow and faculty level can greatly enhance the research environment for new investigators. Funding innovative research and, more importantly, mentoring by established researchers (through K24s and other sources) are key elements in supporting this transition.

5. Expand formal collaborations between LEAH/other Adolescent Medicine Fellowship Programs and federal, foundation, and institutional programs

LEAH and Adolescent Medicine Fellowship Programs and Divisions could benefit from strengthened formal and informal partnerships with federal and foundation programs that could serve as either pipelines or sources of support for physicians committed to transdisciplinary adolescent health research. Programs include RWJCSP, Centers for Disease Control and Prevention Centers, WT Grant Scholars program, other Foundation fellowships, and Health Services Research training programs. For example, a partnership with RWJCSP could lead to enhanced research training for junior investigators, and with completion of clinical training in an Adolescent Medicine fellowship program additional subspecialists. Programs that provide transdisciplinary training or cross institute T32s could expand training in adolescent health. Health Resources and Services Administration/Maternal and Child Health (HRSA/MCH), NIH, Clinical and Translational Science Centers (CTSCs), and other

federal and foundation funders should continue to develop mechanisms for promoting the career development of diverse junior investigators through summer institutes (e.g., research and grantsmanship), loan repayment, minority supplements, K awards, and other early career awards.

6. Develop research forums at national meetings and opportunities for critical feedback and mentoring across programs

Training programs, HRSA/MCH, NIH, and other federal and foundation funders should work together to support diverse trainees and junior investigators and to help them develop networking and mentoring opportunities. Replicating some of the elements of the annual and semiannual research meetings that are part of the WT Grant, RWJ, and MCHB Behavioral Pediatrics programs could provide more depth to research projects undertaken by adolescent medicine fellows. Opportunities to present at national meetings and establish peer mentoring relationships and research collaborations under the guidance of senior investigators could greatly enhance the success of trainees and junior faculty. Society for Adolescent Medicine, Pediatric Academic Societies, and other research organizations should establish additional programs that invite and attract diverse students, residents, and fellows to consider academic careers in adolescent health. Models of fostering research careers and mentoring through national meetings should be explored with MCH and other funders.

Educate Institutional Review Boards about the special requirements for high quality adolescent health research

With the establishment of CTSCs in many universities across the United States, it will be critical to ensure that Institutional Review Boards are educated about the special needs and requirements for adolescent patient-oriented research. Pediatric hospitals with strong adolescent programs will need to educate the adult hospitals that are partners in the CTSCs about adolescent protocols and confidentiality. Ethics courses in college and medical school should focus on the special issues of adolescents and address the barriers to research in this understudied population.

Address the trainee and faculty career development issues specific to women and minorities to enhance the opportunities for academic success

Because a high proportion of Adolescent Medicine Fellows and pediatric and adolescent health researchers are women, it is important to address the barriers that women face in their academic careers. Mentoring, institutional resources and policies, access to child care, fellowships, and other supports are essential to ensure faculty development. Similarly, a high priority must be placed on encouraging the successful academic careers of minority physician scientists. Continuing efforts are needed on the local and

national level to enhance funding, mentoring, and work-life integration for future adolescent medicine researchers.

Such transformative efforts, if carried out in a high quality research environment, have the high potential of creating a new cadre of successful, creative, and diverse transdisciplinary investigators who can work across disciplines and collaborate with public health, education, sociology, and the many other disciplines committed to improving adolescent/young adult health and well-being.

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