Pipeline Programs to Improve Racial and Ethnic Diversity in the Health Professions:

An Inventory of Federal Programs, Assessment of Evaluation Approaches, and Critical Review of the Research Literature

U.S. Department of Health and Human Services, Health Resources and Services Administration, Bureau of Health Professions

U.S. Department of Health and Human Services, Office of Public Health and Science, Office of Minority Health

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Executive Summary

This report, performed under contract to the U.S. Department of Health and Human Services (HHS), Health Resources and Services Administration and HHS' Office of Public Health and Science (OPHS), Office of Minority Health (OMH), examines programs focused on intervening in the educational pipeline to enhance opportunities for racial/ethnic minority and disadvantaged students to enter careers in the health professions and health sciences. The report focuses on what is known about these programs, highlighting key issues in the science and art of evaluation, reviewing available evidence from prior evaluation research, and discussing options for conceptualizing and designing future evaluations.

FINDINGS

I. Status of HHS Pipeline Programs

A. HHS has many existing assets in pipeline programs. Many HHS agencies currently include as part of their portfolio of programs a focus on educational pipeline interventions to enhance opportunities for racial/ethnic minority and disadvantaged students to enter careers in the health professions and health sciences.

B. There is room for more coordination and information sharing across agencies and programs. Agencies appear to operate their pipeline programs in relative silos, with little opportunities for coordinating interventions across agencies or developing a learning community among agencies to share best practices and other insights from each agency's pipeline programs.

II. Evaluation Approaches and Strategies

A. Process evaluations have been the mainstay of traditional HHS approaches to evaluation, and have some value as a means of assuring accountability in the use of award funds and informing quality improvement efforts. Although process evaluations cannot answer questions of program effectiveness in achieving desired outcomes, they can provide important information about who was served by the interventions and what activities were performed in fulfilling the terms of an award. They can also reveal barriers and facilitators to implementing interventions that may be informative for program planning and providing feedback for performance improvement.

B. Outcomes evaluations are desirable for assessing program and intervention effectiveness, but come at the cost of greater expense and technical complexity relative to process evaluations. In general, the more rigorous the scientific method for an outcomes-oriented evaluation study, the more costly and technically challenging it is to perform the study and the greater the need to rely on external evaluators. Study designs for outcomes evaluations lie on a continuum of scientific rigor, ranging from the least rigorous design of an uncontrolled,

observational cohort study to the most rigorous design of a randomized, controlled experiment. Randomized controlled trials are especially difficult to perform in the case of pipeline interventions, in addition to raising ethical concerns about randomization to intervention and control groups. In some select circumstances, randomized trials may be considered as an evaluation design. Observational studies are more feasible to perform, although not without their own challenges including concerns about unmeasured selection effects and confounding factors that may bias results. Opportunities exist to perform more rigorous "quasi-experimental" controlled observational studies to evaluate pipeline programs by identifying and collecting data on appropriate control groups to compare with data collected on intervention groups.

C. **Uniform Data Sets are useful for systematically collecting information on intervention processes, and may also have value for creating a database that may be linked by external evaluators or agencies to other databases to perform outcomes evaluations.** Creating standard formats for Web-based reporting by awardee institutions has merit for systematically and uniformly collecting process data from institutions receiving awards to implement pipeline interventions. Examples of well designed, Web-based Uniform Data Sets are: the Disadvantaged Assistance Tracking and Outcome Report (DATOR) Uniform Data Set, developed by the HRSA, which focuses on collecting data on individual participants in HRSA programs; and the OHM Uniform Data Set, which currently focuses on collecting data on the activities conducted by OMH-sponsored grant programs. The primary limitation of Uniform Data Sets is the difficulty of designing standardized data collection tools that are responsive to the tremendous variety of pipeline interventions and programs across institutions funded by HHS. Although Uniform Data Sets will rarely suffice in and of themselves as a tool for collecting data on pipeline program outcomes, they may play a valuable role in providing a substrate of data that can be capitalized on for more far-reaching outcomes evaluations.

D. **Program evaluations face a tension between evaluation in the service of performance feedback and in the service of performance judging.** Evaluation can serve different goals, and it is important for evaluators and sponsoring agencies to be clear about the goals of specific evaluation efforts. For government programs using taxpayer dollars, there is a premium on evaluation as a means of assuring accountability in stewardship of public programs; this often heighten the stakes involved in evaluation research when funding decisions for overall programs and institutions competing for funding may hinge on the results of outcomes studies. Other models place less emphasis on evaluation as a means to judge in quantitative terms the effectiveness of programs, and frame evaluation as a tool for providing constructive feedback to awardee institutions in the spirit of continuous quality improvement.

III. Literature Review on Pipeline Interventions

A. There is a critical mass in the literature of 24 evaluation studies meeting a minimum standard of scientific evidence to evaluate quantitative outcomes of pipeline program interventions. These studies consistently indicate that pipeline interventions are associated with positive outcomes for racial/ethnic minority and disadvantaged students on several meaningful metrics, including academic performance and the likelihood of enrolling in a health professions school. A systematic, critical review of the literature on pipeline programs identified 24 studies meeting a minimum standard of scientific evidence, all but one of which reported positive outcomes associated with racial/ethnic minority and disadvantaged students' participation in structured pipeline programs. These studies address interventions across a spectrum of pipeline stages, including high school, college, and postbaccalaureate stages, and involving a variety of targeted health professions and health science careers, including medicine, nursing, and biomedical research.

B. Although these outcomes studies provide a good foundation for assessing the effectiveness of pipeline programs for racial/ethnic minority and disadvantaged students, there are some important limitations of the existing evaluation literature and the field would benefit from more high quality evaluation research. Overall, there has been a limited volume of well designed evaluation studies reported in the literature. Studies have failed to assess the specific ingredients in pipeline programs or perform formal cost-effectiveness analyses to judge the benefit of interventions relative to their costs.

POLICY OPTIONS

1. **Ensure a balance in HHS-sponsored pipeline programs so that these programs address racial/ethnic minority and disadvantaged student needs across a spectrum of health professions and health careers.** It is important to maintain a balance in investment across programs, including biomedical research, public health, and Title VII and Title VIII targeted health professions.

2. **Identify an agency in HHS to serve a facilitating role in promoting greater coordination among, and information sharing across, HHS agencies in the administration of pipeline programs.** This facilitating role could include functions such as commissioning updated inventories of HHS pipeline programs, disseminating evidence on intervention effectiveness, sharing tools for Uniform Data Sets and related methods for data collection, and convening agency representatives to share best practices and barriers and facilitators to implementing interventions.

3. **Continue to develop and refine Uniform Data Sets for pipeline programs for racial/ethnic minority and disadvantaged students, focusing on collection of key process data elements such as data on the individuals served by program interventions and the specific intervention activities implemented.** The content of Uniform Data Sets could be guided by the questions, "What are the most critical

process items to measure to ensure that awardee institutions are accountable in performing pipeline activities funded by HHS programs?" and "What key data elements could be compiled into a database that would serve particular value as a resource for longitudinal outcomes studies when linked to other databases?" For example, the inclusion in the HRSA Disadvantaged Assistance Tracking and Outcome Report (DATOR) Uniform Data Set of the last four digits of participants' social security number, in addition to their name, is particularly useful for linking DATOR records at the individual student level to other databases such as the Association of American Medical Colleges' database on medical school matriculation. Other key participant characteristics that could be included in these types of Uniform Data Sets include race/ethnicity, gender, age, and at least some measure of family socioeconomic status such as parental education. Collection and maintenance of databases containing identifying information on individual students must be done in a secure manner that is highly vigilant about protecting the confidentiality of these data. To create even greater opportunities to use Uniform Data Set databases not just for uncontrolled cohort studies, but for controlled cohort studies, Uniform Data Sets could be expanded to include data on program applicants who did not actually enroll in the sponsored program activities and could serve as control groups to compare with students who participated in program interventions, enhancing the value of Uniform Data Sets for creating registries of control and intervention students that could be used for more rigorous, observational evaluation studies. Development of Uniform Data Sets needs to occur in a deliberate manner that acknowledges that standardized data collection tools run the risk of being insensitive to the unique contexts and project scopes of the varied institutions and activities supported by HHS programs; creating opportunities for ongoing feedback from reporting institutions, such as through "user group" advisory committees and pilot testing of measures prior to finalization, is important for development of feasible data collection tools that will encourage reliable reporting of data elements by funded institutions.

4. **Establish a reasonable minimum standard for routine evaluations to be conducted by the institutions and organizations awarded funds from HHS to implement racial/ethnic minority student pipeline programs, consisting of the requirement that these organizations explicitly map out a logic model for their planned intervention(s) and collect and report basic data on processes and intermediate outcomes based on these logic models.** Logic models can help individuals and organizations implementing interventions to be explicit about the activities they plan to implement and the participants who will be targeted by these interventions, and also to articulate how they anticipate that these interventions will lead to changes in specified intermediary and ultimate outcomes. As part of developing these logic models, applicants could be expected to identify metrics for measuring and reporting data on processes and intermediary outcomes. Applicants could be allowed to include qualitative, as well as quantitative, approaches to assessing achievement of intermediary outcomes. Applicants could also be asked to consider metrics on ultimate outcomes, with the understanding that in many, if not most cases, it may not be reasonable or feasible to expect the applicant organization

itself to actually collect more "distal" outcome measures requiring major, ongoing efforts in data collection. This recommended approach would result in making an uncontrolled cohort study design using data reported by awardees the minimum standard for all routine evaluations. Although this is not a type of design that permits causal inferences to be made about intervention effectiveness, it is useful for encouraging clearer conceptualization at the time of planning interventions of the hypothesized link between processes and intermediary outcomes and for providing subsequent feedback about whether basic intervention objectives are being met.

5. **Recognize that evaluations using more rigorous, controlled study designs are unlikely to be accomplished as part of the routine evaluation approach described in Recommendation 4, and require deliberate, proactive planning on the part of funding agencies, external evaluators, and intervention sites to design and execute controlled, outcomes-based research studies.** Although the goal of producing more outcomes-oriented evaluations of HHS programs has merit, the effort and expense of conducting more rigorous evaluation research should not be underestimated. In determining the feasibility of conducting a rigorous evaluation study for a specific program or set of interventions, the following questions need to be answered:
   - Can a control group be identified that will be reasonably comparable in underlying characteristics to the intervention group?
   - Are relevant data on control and intervention group baseline characteristics available from an existing edatabase, such as a Uniform Data Set or a school's student registration database, or do they need to be specially, prospectively collected for the study?
   - Are the program interventions clearly defined and likely to be implemented faithfully? If the interventions are to be implemented at more than one site, is there reasonable assurance that the interventions and data collection tools will be sufficiently standardized across sites so that the data may be pooled across sites?
   - Are intermediate and ultimate outcome measures clearly defined and feasible to collect? Are the outcome data available from existing databases, or do they need to be explicitly collected for the study? Can a registry of control and intervention group members be linked to other existing databases that may contain data on outcomes? How long is the expected time lag from participation in an intervention to achievement of the key outcomes? If there is a long time lag, can the study be done feasibly on a retrospective basis rather than on a prospective basis?
   - How much contamination effect is expected for members of the control group? How likely is it that the control group will be exposed to interventions that are not under the control of the program or study administrators that will potentially create a major negative bias for detecting differences in outcomes between control and intervention groups?
   - How expensive will it be to collect or access the data required to conduct the study? Is the necessary funding available to perform the evaluation?
   - How much cooperation is required from participating sites for the study to be feasibly performed, and are there incentives or administrative requirements for sites to participate?

- Do the individuals charged with executing the evaluation have the requisite skills and technical capabilities to perform the study?

All of these questions need to be thought through in advance of performing a controlled evaluation study. The answers to these questions will determine the feasibility of performing the evaluation study.

Randomized trials of pipeline interventions are rarely feasible. They also raise ethical concerns about using randomization procedures to deny some needy students access to an intervention that may have face validity for being of value to the student. A circumstance in which a randomized trial may be a reasonable design option is when a new program is initiated or is expanded to new sites, allowing the program to be implemented in a more controlled manner with a prospectively designed evaluation study built into the implementation phase of the program, and when it may be reasonable to use a staggered design such that sites initially randomized to the control group subsequently become delayed intervention sites.

Chapter 1: Introduction

This report, performed under contract to the U.S. Department of Health and Human Services (HHS), Health Resources and Services Administration and HHS' Office of Public Health and Science (OPHS), Office of Minority Health (OMH), examines programs focused on intervening in the educational pipeline to enhance opportunities for racial/ethnic minority and disadvantaged students to enter careers in the health professions and health sciences. The report focuses on what is known about these programs, highlighting key issues in the science and art of evaluation, reviewing available evidence from prior evaluation research, and making recommendations about approaches to conceptualizing and designing future evaluations.

Chapter 2 provides a comprehensive inventory of those HHS programs (FY 2004 – FY 2006) that included educational pipeline interventions for racial/ethnic minority and disadvantaged students, summarizing key information on the dozens of Federal programs in this area. Chapter 3 offers a conceptual framework for considering the pros and cons of different approaches to evaluation of pipeline interventions, discussing the range of approaches that may be used for collecting process and outcomes data and for designing evaluation studies, and weighing the relative tradeoffs of these approaches in terms of scientific rigor, technical feasibility, expense, and other dimensions. Chapter 4 consists of a systematic, critical review of the existing research literature on evaluations of pipeline interventions, focusing on studies meeting a minimum standard of scientific rigor to evaluate quantitative program outcomes. The chapter rates the quality of each study and summarizes each study's key results. The report concludes in Chapter 5 with a summary of the key findings of the report and a series of policy options.

Chapter 2: Inventory of Department of Health and Human Services Health Professions Pipeline Programs

This chapter provides an inventory of HHS programs that included a focus on enhancing opportunities for racial/ethnic minority and disadvantaged students in the health professions educational pipeline from FY 2004 - FY 2006. A systematic effort was undertaken to collect the information in this inventory, including analyzing information on HHS agency Web sites and communicating with key contacts at many of these agencies. The inventory includes data on the type of program, funding level, pipeline level and health professions targeted by the program, and the major pipeline intervention strategies supported by the program. The chapter begins with a summary of the inventory highlights, followed by more detailed tabular presentation of the inventory data (beginning on page 13; legend on page 26).

Health Resources and Services Administration (Table 2.1)

Key features of agency's programs:

- Programs target a range of health professions – medicine, dentistry, nursing, public health, allied health, pharmacy, etc.
- Strategies usually incorporate a combination of academic support and professional opportunities, and several programs (e.g., Health Careers Opportunity Program [HCOP], Centers of Excellence [COE], Scholarship for Disadvantaged Students) also offer financial support in the form of stipends or scholarships to individual students.
- Programs target all levels of the health education pipeline including K-12 efforts through HCOP, Health Education and Training Centers, Area Health Education Centers.

The Bureau of Health Professions (BHPr) administers programs through its various divisions that include expanding opportunities for underrepresented minorities and disadvantaged students in the health professions. Grantee institutions are schools, universities, or other institutions with a clear focus on health professional development. Grants are awarded based on the institution's expressed commitment and capacity to support individuals from disadvantaged backgrounds and underrepresented minorities.

The Bureau of Health Professions coordinates HCOP and COE, two programs that have received funding under Title VII of the Health Professions Educational Assistance Act of 1976 to sponsor educational interventions across the country. The primary goal of HCOP is to identify, recruit, and support individuals from disadvantaged backgrounds for education and training in a health profession. Program elements include academic enrichment opportunities for enrolled students that include but are not limited to mentoring, summer bridge courses, training for filing financial aid and curricular counseling. In addition, HCOP also engages enrollees through professional enrichment experiences that involve exposure to primary health care and inviting local health professionals to address students in seminars or panel discussions. Targeted professions span the spectrum of health careers falling under the authority of Title VII, including

allopathic and osteopathic medicine, pharmacy, dentistry, and the allied health professions. Program sites focus on college student enrichment but also offer structured activities for middle and high school students.

The COE program supports designated health professions schools under the U.S. Public Service Act that have significantly higher enrollments of underrepresented racial/ethnic minority students compared to the national average. The Hispanic COE gives priority to programs that serve Hispanics and the Native American COE gives priority to programs that serve American Indians and Alaska Natives. Eligible institutions must offer degrees in one or more of the following fields: allopathic and osteopathic medicine, dentistry and pharmacy and graduate programs in behavioral or mental health (clinical and counseling psychology, clinical social work, marriage and family therapy). Institutions awarded with COE grants are capable of facilitating faculty and student research in racial/ethnic minority health, strengthen the recruitment of racial/ethnic minority faculty, and provide community-based clinical training in which students care for substantial numbers of racial/ethnic minority patients.

BHPr has also sponsored assistance programs to lessen the financial burden on individuals in the health professions pipeline. In 2006, the Minority Faculty Fellowship Program and the Faculty Loan Repayment Program (FLRP) merged. The goal of this program is to recruit faculty from disadvantaged backgrounds to serve at least two years at eligible health professions schools. The federal government offers a $20,000 credit to the faculty member's educational debt which the employing institution agrees to match. Participants in the FLRP receive training that will equip them to continue their academic development.

BHPr's Scholarships for Disadvantaged Students Program (SDS) is another financial aid mechanism awarded to health professions schools that demonstrate a commitment to enrolling and graduating disadvantaged students. The distribution of funds is weighted heavily toward schools that promote training of primary care practitioners, enroll underrepresented racial/ethnic minorities, and produce individuals that serve in medically underserved communities. Scholarships recipients must be U.S. citizens or permanent residents and demonstrate financial need.

BHPr funded the Area Health Education Centers (AHEC), the Health Education and Training Centers (HETC) and Public Health Workforce Development. The primary function of the AHEC and the HETC programs were to improve the supply, distribution, diversity and quality of the health workforce by establishing academic and community partnerships. The HETC institutions specifically focus on institutions along the U.S.-Mexico border and the State of Florida. Both programs provide cooperative agreements to medical and nursing schools to encourage the establishment and maintenance of community based training programs in off-campus rural and underserved areas. Interdisciplinary teams of students, faculty and practitioners are trained in community-based settings such as community/migrant health centers, rural health centers, National Health Service Corps sites, local health departments and other underserved area sites. Emphasis is placed also on enhancing the diversity of the health personnel workforce and

improving the practice environment and the quality of care available in underserved areas.

BHPr oversees the Public Health, Preventive, Medicine, and Dental Health Programs. Grants are issued to support the education and training of the public health workforce and emphasize the placement of public health professionals, preventive medicine specialists, and public health dentists in medically underserved areas and the improvement of ethnic diversity in the workforce. The training opportunities provided through these programs support capacity building at the State and local levels to provide care and resources to underserved populations.

BHPr's Division of Nursing administers the Nursing Workforce Diversity Program (NWDP). An estimated half million registered nurses from racial/ethnic minority groups would be needed if the nurse workforce population were to represent the general U.S. population. The NWDP is a significant effort to diversify the racial/ethnic composition of the nursing workforce by targeting all sections of the educational pipeline including recruitment activities for K-12 students designed to increase interest in the nursing profession and the provision of scholarships and counseling for students enrolled or preparing to enroll in nursing programs. Grantees are typically schools of nursing or academic health centers that provide services to rural and underserved populations. Roughly 60 percent of individuals receiving NWDP support are racial/ethnic minorities.

Office of Minority Health (Table 2.2)

Key features of agency's programs:

- Plays an advisory role in HHS, coordinating White House Initiatives, capacity building for racial/ethnic post-secondary institutions, and related activities

The Office of Minority Health (OMH) acts as an advisory arm in HHS on issues pertaining to health policy and program activities involving American Indians and Alaska Natives, Asian Americans, Blacks/African Americans, Hispanics, and Native Hawaiians and Other Pacific Islanders. OMH coordinates policies and programs within HHS to improve the health of racial/ethnic minorities and to address racial/ethnic health disparities. This includes coordination of HHS efforts related to racial/ethnic minority initiatives including the White House Initiatives on Educational Excellence for Hispanic Americans, Historically Black Colleges and Universities (HBCU), and Tribal Colleges and Universities(TCU). These initiatives are the result of presidential orders asserting the commitment of the Federal Government to support and sponsor the mission of educational institutions serving large numbers of racial/ethnic minorities. In partnership with the Department of Education, HHS contributes to the capacity of racial/ethnic post-secondary institutions through the development of infrastructure acquisition for instruction and research, increased student and faculty fellowships, undergraduate and graduate internships, and part-time and permanent employment opportunities.

Centers for Disease Control and Prevention (Table 2.3)

Key features of agency's programs:

- Coordinates programs focusing on public health and biomedical sciences careers for racial/ethnic minority and disadvantaged students.
- Strategies focus on professional growth experiences through research placements or internship/fellowship programs such as the Starlab program that is an early career exposure program for middle and high school students.
- Pipeline levels include all levels from K-12, to collegiate, to graduate school.

The Centers for Disease Control and Prevention (CDC) created its own Office of Minority Health (OMH) in 1988 to work closely with State, tribal, and local governments, as well as nonprofit organizations, to improve health status and eliminate health disparities among Americans of all racial and ethnic groups. In 2005, CDC's OMH became the Office of Minority Health and Health Disparities (OMHD). The OMHD supports training opportunities for qualified students from disadvantaged backgrounds who express interest in the health professions. The primary strategy for this support involves cooperative agreements with external partners such as the Minority Health Professions Foundation (MHPF), Morehouse College, Hispanic Serving Health Professions Schools (HSHPS), and the Kennedy Krieger Institute.

The MHPF is a nonprofit, educational, scientific, and charitable organization that provides support for professional education, research, and community service that promote optimum health among racial/ethnic minorities and the underserved. The Foundation collaborates with member institutions of the Association of Minority Health Professions Schools, which are drawn from historically black colleges and universities. CDC sponsors four student training opportunities through MHPF. First, the Annual Symposium on Career Opportunities in Biomedical Science and Health Professions allows a diverse group of underrepresented racial/ethnic minority high school and undergraduate students to interact with well-known racial/ethnic minority professionals to encourage them to enter the biomedical and health fields. Over a 3-day period, participants attend educational workshops, exhibit/poster sessions, and video presentations aimed at motivating students to focus on biomedical careers. Second, MHPF coordinates the Dr. James A. Ferguson Emerging Infectious Diseases Fellowship Program that recruits racial/ethnic minority students to a rigorous 8-week public health research program at the National Center for Infectious Diseases located at the CDC. Students gain experience in infectious disease research areas, conduct a literature review and report their work at the conclusion of the fellowship. Third, the Starlab program targets middle and high school students enrolled in metro-Atlanta schools for a 6-week summer program. Participants are exposed to hands-on laboratory demonstrations and interact with racial/ethnic minority scientists from local colleges and agencies. Lastly, MHPF coordinates the Public Health Summer Fellows Program for college students interested in graduate level public health programs. The program is a collaboration between Morehouse College, the Rollins School of Public Health and Emory University.

OMHD also partners with Morehouse College in the operation of the Public Health Sciences Institute. The Institute offers internship and fellowship programs designed to recruit underrepresented racial/ethnic minority students into the fields of biostatistics, epidemiology, and occupational safety. Students have the option of participating in an 11-week intensive summer program or extending this data analysis training over the course of 2 years. In addition, OMHD holds a cooperative agreement with Hispanic Serving Health Professions Schools, a nonprofit group representing over 22 medical schools and 5 schools of public health nationwide serving 40 percent of Hispanic medical school graduates and 15 percent of Hispanic public health graduates. HSPS offers both summer and 6-month internship programs for Hispanic students interested in developing skills in epidemiology, preventive medicine, and public health.

The CDC OMHD funds the Research Initiatives for Student Enhancement (RISE) Program at the Kennedy Krieger Institute in Baltimore, Maryland. This internship program is open to graduate and medical students from historically black colleges and universities who are interested in conducting research in public health. Students are paired with research mentors and take courses at the Johns Hopkins University Bloomberg School of Public Health. The RISE program also provides an internship program for post baccalaureate students preparing to apply for graduate school.

Additional racial/ethnic minority pipeline programs at the CDC include:

- Partnership with National Center for Environmental Health to increase racial/ethnic minority interest in the environmental sciences.
- Partnership with Office of Workforce and Career Development, mainly to train working professionals in advanced skills for the public health workforce. Though these programs do not specifically target racial/ethnic minority students, minorities are a component of each training opportunity.
- Partnership with National Center for Chronic Disease Prevention and Health Promotion on small scale efforts to promote racial/ethnic minority placement in research and leadership appointments. Most of these programs fund less than 20 students per year.

National Institutes of Health (Table 2.4)

Key features of agency's programs:

- Preponderance of diversity pipeline programs and grants support activity in biomedical research geared for scientific investigators that are either in doctorate training or have completed doctorate training. These programs usually offer funding support for research.
- Several programs target college and high school students and aim to provide a research experience to expose them to biological areas of interest. For example, the Short-Term Education Program (STEP) in the National Institute of Diabetes and Digestive Kidney Diseases provides short-term internships for high school and college students. Similarly, the National Cancer Institute awards 22 research

supplements per year to support high school students from underrepresented groups to participate in the CURE program.

- The Research Supplements to Promote Diversity in Health-Related Research is a program that stretches across institutes that enables principal investigators to support research training on their projects by using funding supplements to support racial/ethnic minority students, post doctoral fellows, or junior faculty. These funds are granted on the condition that the principal investigator already has funding for scientific projects.
- For institutional support, the National Institutes of Health supports Bridges to the Baccalaureate and Bridges to the Doctorate Programs to encourage partnership between degree granting institutions such that racial/ethnic minority students may make an easier transition to higher education.
- The National Center for Minority Health and Health Disparities awards research grants for the study of health disparities.

The National Institutes of Health (NIH) is the primary Federal agency for conducting and supporting medical research. NIH has expressed commitment to increasing the diversity of the health sciences research workforce through the implementation of several efforts to recruit underrepresented racial/ethnic minority individuals into research career tracks and to support their career advancement. Although the major thrust of these NIH programs are to promote the development of research careers in biomedical and health sciences, some students involved in these programs ultimately choose more clinically oriented careers in the health professions.

One of the touchstone roles of NIH is the funding of stipends for researchers at various career levels. The Ruth L. Kirschstein National Research Service Awards (NRSA) for pre-doctoral candidates, formerly known as the NIH Pre-doctoral Fellowship Awards for Minority Students in PhD tracks, helps ensure that diverse pools of highly trained PhD-level scientists will be available to carry out biomedical, behavioral, health services, or clinical research. Individuals from racial and ethnic groups shown to be underrepresented in health-related sciences and individuals coming from financially or socially disadvantaged backgrounds are eligible for the awards that provide support to students for up to 5 years.

Research Supplements to Promote Diversity in Health-Related Research is a broad program that stretches across all the awarding components of the NIH. Any principal investigator at a domestic institution who holds an active grant may submit an application to receive administrative supplements to support and recruit students, post doctorates, and junior investigators. The awards are intended to increase the number of qualified individuals from underrepresented groups in the health-related research by expanding opportunities for investigators to support research experiences.

Each institute in the NIH administers these research supplements according to their particular mission. For example, the National Cancer Institute's Comprehensive Minority Biomedical Branch is the Continuing Umbrella or Research Experiences (CURE) Program for underrepresented racial/ethnic minority populations. CURE encourages

Cancer Centers supported by the National Cancer Institute to expose promising high school and undergraduate students from underrepresented populations to state-of-the-art biomedical research in basic, clinical, and population sciences, and to promote the careers of such individuals in cancer research. CURE provides funding to institutions to support these activities. Additionally, CURE coordinates the Research Supplements for Underrepresented Minorities (RPGs) program that provides support directly to principal investigators for each high school student that participates in their laboratory research. With the support of guidance counselors, students identify a principal investigator that applies on their behalf.

Several NIH Institutes and Centers reserve the use of the Mentored Research Scientist Development Award (K01) for faculty from underrepresented racial/ethnic minority groups or faculty at minority-serving institutions who may want to enhance their research skills and knowledge through a period of supervised training at a research center. The National Institute for Nursing Research, the National Institute for Neurological Disorders and Stroke, and the National Heart, Lung, and Blood Institute are examples of this award structure.

The National Institute of General Medical Sciences (NIGMS) administers research and research training programs aimed at increasing the number of racial/ethnic minority biomedical and behavioral scientists through the Division of Minority Opportunities in Research (MORE). One of the major programs is the Minority Biomedical Research Support (MBRS) program, which is comprised of three components. The Support of Continuous Research Excellence (SCORE) program seeks to increase the competitiveness of investigators at minority-serving institutions by enhancing the pace and productivity of their projects. Three types of investigator-initiated awards offer financial assistance to conduct biomedical or behavioral research. The Research Initiative for Scientific Enhancement (RISE) program supports institutional grants to develop activities that include research experiences, specialty courses with a focus on critical thinking, scientific reading comprehension and writing skills, and evaluation. The Initiative for Maximizing Student Diversity assists research-intensive institutions to develop or expand existing academic developmental programs, including student research internships, in order to prepare students from underrepresented groups for competitive research careers and leadership positions.

NIGMS also oversees the Minority Access to Research Careers (MARC) Branch that aims to strengthen the science curricula and to increase the research training opportunities for students and faculty at 4-year minority-serving colleges, universities and health professional schools. The Undergraduate Student Training in Academic Research (U*STAR) awards are made to institutions offering a baccalaureate degree. Grantee institutions select trainees from a pool of honor students who intend to pursue postgraduate education leading to a PhD degree. The Post baccalaureate Research Education Program (PREP) awards are made to institutions offering graduate programs in biomedical or behavioral sciences. PREP scholars must be recent baccalaureate graduates in a biomedically related science and express intent to pursue graduate studies leading to a research doctorate.

Lastly, through the Bridges to the Future Programs, NIGMS provides support to institutions to help students make the transition from community college to 4-year institutions through the Bridges to the Baccalaureate Degree initiative and the transition from master's degree programs to PhD programs through the Bridges to the Doctoral Degree initiative. Both initiatives aim to promote partnerships between educational institutions in order to offer maximal support to students interested in scientific careers. Grantee institutions must have a significant enrollment of underrepresented racial/ethnic minority students.

In 2000, the National Center on Minority Health and Health Disparities (NCMHD) was established to promote racial/ethnic minority health and to lead, coordinate, and support the NIH effort to eliminate health disparities. Many NCMHD programs open opportunities for racial/ethnic minority and disadvantaged individuals to participate in research activities. The Extramural Clinical Research Loan Repayment Program for Individuals from Disadvantaged Backgrounds permits up to $35,000 in loan payments per year to health professionals participating in clinical research. Furthermore, the NCMHD Research Endowment Program is focused on institutions that educate significant numbers of racial/ethnic minority and economically disadvantaged students. The Program provides funding to these institutions to strengthen teaching programs in biomedical sciences and to enhance the recruitment and retention of student and faculty from underrepresented racial/ethnic minority groups. Along similar lines, the NCMHD Centers of Excellence in Partnership for Community Outreach, Research on Health Disparities and Training (Project EXPORT) Program awards support establishment of new university partnerships between academic centers and community based organizations. Funding for Project EXPORT also supports novel research on health disparity disease conditions and training programs to increase the number of underrepresented and disadvantaged students entering the health professions and conducting research on health disparities (i.e., conditions that place a greater burden of preventable disease and premature death on racial/ethnic minority and other disadvantaged groups).

National Science Foundation (Table 2.5)

Key features of agency's programs:

- Racial/ethnic minority pipeline programs do not target any particular health profession but rather aim to enrich the science, engineering, and math education environments in K-12 and college. No programs are specific for the health professions.
- Special programs focus on HBCUs and TCUs.
- The most widespread programs are the Louis Stokes Alliances for Minority Participation and the Math and Science partnerships, which provide enrichment opportunities for underrepresented racial/ethnic minority students enrolled in rigorous scientific courses.

The Division for Human Resource Development serves as the focal point for the National Science Foundation's (NSF) agency-wide commitment to sponsor programs enhancing the quality of science, technology, engineering and mathematics (STEM) education and research. The Alliances for Broadening Participation in STEM (ABP) program is a combination of the Louis Stokes Alliances for Minority Participation (LSAMP) and the Alliances for Graduate Education and the Professoriate (AGEP). The LSAMP component focuses on increasing bachelor's of science degree production in STEM fields and progression of students to graduate school entry. The objectives of AGEP are to develop and implement innovative models for recruiting, mentoring, and advancing racial/ethnic minority students in STEM doctoral programs and to develop strategies for supporting underrepresented racial/ethnic minorities who want to pursue academic careers. Award recipients may use funds to develop more effective measures to recruit racial/ethnic minority students, develop mentorship programs, or augment career counseling or career placement services.

Through the HBCU Undergraduate Program and the TCU Program, NSF supports the important role that these minority-serving institutions of higher education play in increasing participation and leadership in STEM education and research. Grants to HBCU institutions and tribal colleges encourage the implementation of innovative, nontraditional models for undergraduate education and faculty development opportunities. NSF also offers planning grants to assist school faculty and administrators to conduct analyses of their educational programs in order to develop a successful implementation grant application. Lastly, the HBCU Undergraduate Program also provides grants to social scientists and education researchers to evaluate STEM undergraduate education.

Another avenue for minority-serving institutions to receive NSF support is through the Centers for Research Excellence in Science and Technology (CREST). Award recipients seek to improve their educational and research infrastructure in order to sustain national competitiveness in science or engineering research by creating new centers or supporting existing centers that integrate education and research. Project activities supported by NSF may include cooperative efforts between the applicant institution and industry, federally funded laboratories, or other national, State, local, or regional research and development institutions. One part of CREST consists of the HBCU Research Infrastructure for Science and Engineering (RISE) initiative that aims to increase the number of racial/ethnic minority doctoral students and to develop the research capability of HBCUs.

<u>Indian Health Services (Table 2.6)</u>

Key features of agency's programs:

- Program scholarships are available at the college level and during health professional school to students contingent on American Indian/Alaska Native (AI/AN) status.
- Other programs, such as the Navajo Area Jobs and Recruitment, give preferential job placement to AI/AN health professionals.

- The University of North Dakota hosts several programs that aim to boost AI/AN enrollment in nursing, psychology, and other health professions. The Indians into Medicine (INMED) program aims to assist AI/AN students as undergraduates through year-long (including summer) academic and professional counseling. The Retention of American Indians into Nursing (RAIN) program targets pre-nursing students.

The Indian Health Service (IHS) offers scholarships to students at various stages of pursuing their health professions career goals. The Health Professions Preparatory Scholarship and the Health Professions Pre-graduate Scholarship Program are applicable for AI/ANs enrolled in prerequisite courses that will prepare them for acceptance into a health professions program. Students interested in several allied health fields, nursing, and pharmacy are eligible for the Preparatory Scholarship whereas students enrolled in baccalaureate programs in pre-medicine, pre-dentistry, or pre-podiatry are eligible for the Pre-graduate Scholarship. The Indian Health Professions Scholarship is awarded to AI/AN students that are currently enrolled in a health professions program. Upon receipt of the award, students are obligated to a service contract that requires one year of service for each year of scholarship with a minimum service period of 2 years.

Other examples of educational pipeline programs that are receiving IHS funding are the INMED program, the RAIN program, and the Indians into Psychology Doctoral Education (INPSYDE) program, all administered by the University of North Dakota. These programs offer educational support to increase the number of AI/AN health professionals in underserved AI/AN communities. The programs offer tutoring services and academic support for college students. INMED also coordinates comprehensive academic summer enrichment programs for middle school, high school, college transfer, and premedical students.

Another strategy utilized by the IHS is preferential job placement for AI/AN health professionals seeking employment on reservations or other tribal areas. The Civil Service and Commissioned Corps systems recruit and place physicians, dentists, nurses, and pharmacists on land designated as Navajo areas. Employment offers include attractive benefits packages and opportunities for job advancement. Preference is given to qualified AI/AN candidates in all personnel categories.

Substance Abuse and Mental Health Services Administration (Table 2.7)

Key features of agency's programs:

- Allocates funding to professional societies and associations to provide financial support for racial/ethnic minority doctoral level students in psychiatry, psychology, and social work. Awards are given to fellows that are interested in mental health or substance abuse service delivery as providers or through indirect means such as research, teaching, or administration.

The Substance Abuse and Mental Health Services Administration's Minority Fellowship Program supports graduate level training in the four traditional mental health and

substance abuse disciplines: Psychiatric Nursing, Psychiatry, Psychology, and Social Work. The program focuses on providing training support to members of underrepresented racial/ethnic minority groups. This support is provided through grants to four major professional associations: the American Nursing Association, the American Psychiatric Association, the American Psychological Association, and the Council on Social Work Education, who in turn administer these fellowships on a competitive basis. Fellows are selected based on their interest in mental health and substance abuse service delivery through providing care, administration, teaching or services research.

Table 2.1: Health Resources and Services Administration, Bureau of Health Professions

Program Name	Total National Funding in Thousands			Total Number of Award Recipients		Pipeline Level(s)	Major Strategies	Professions Targeted
	FY2004	FY2005	FY2006	FY2005	FY2006			
Health Careers Opportunity Program	$36,160	$35,646	$3,957	80 institutions	58 institutions	K-12, Undergraduate students	Academic support, Career shadowing, Psychosocial support, Scholarship and stipends	Medicine, Allied health, Pharmacy, Dentistry, Other
Centers of Excellence	$33,657	$33,609	$11,872	34 institutions	4 institutions	K-12, College, Health professions students, Faculty	Academic support, Professional opportunities, Financial support	Medicine, Dentistry, Pharmacy, Graduate programs in behavioral and mental health
Faculty Loan Repayment Program/Minority Faculty Fellowship Program	$1,313	$1,302	$1,288	42 awardees	40 awardees	Faculty	Financial support	Non-specific health professions
Scholarships for Disadvantaged Students	$47,510	$47,129	$46,625	15,105 students	15,744 students	Health professions students	Financial support	Non-specific health professions
Area Health Education Centers	$29,206	$28,971	$28,681			K-12, College, Health professions students, Faculty	Academic support, Professional opportunities, Community partnership building	Non-specific health professions
Health Education and Training Centers	$3,851	$3,820	$0			K-12, College, Health professions students, Faculty	Academic support, Professional opportunities, Community partnership building	Non-specific health professions
Public Health Workforce Development	$9,170	$9,097	$7,915	Public Health Traineeships, 8,832; Preventive Medicine Residency Training, 66; Dental Public Health, 7; Public Health Training Centers, 14	Public Health Traineeships, 7,684; Preventive Medicine Residency Training, 57; Dental Public Health, 5; Public Health Training Centers, 14	Health professions students, Postdoctoral	Financial support, Professional opportunities	Medicine, Dental, Public Health

Program Name	Total National Funding in Thousands			Total Number of Award Recipients		Pipeline Level(s)	Major Strategies	Professions Targeted
	FY2004	FY2005	FY2006	FY2005	FY2006			
Nursing Workforce Diversity Program	$16,402	$16,270	$16,096	20,740 minority participants	20,740 minority participants	K-12, Nursing students	Academic support, Financial support	Nursing

Table 2.2: Office of Minority Health

Funding Source	*Program Name*	*Total National Funding for Last Cycle (year) $ in thousands*			*Total Number of Award Recipients*		*Pipeline Level(s)*	*Major Strategies*	*Professions Targeted*
		FY2004	*FY2005*	*FY2006*	*FY2005*	*FY2006*			
	White House Initiative on Educational Excellence for Hispanic Americans						K-12, College	Provides coordination and oversight of grant activity, community partnership building	Non-specific health professions
	White House Initiative on Historically Black Colleges and Universities	$222,800	$238,600	$240,500 (request)			K-12, College	Enhancing institutional planning/development, strengthening fiscal stability, improving institutional infrastructure	Non-specific health professions
	White House Initiative on Tribal Colleges and Universities	$23,300	$23,800	$23,800 (request)		36 colleges	College	Provides monitoring and oversight of grant activity to TCU's, community partnership building	Non-specific health professions

Table 2.3: Total National Funding for FY2005 in thousands

Funding Source	*Program Name*	*Total National Funding for Last Cycle (year) $ in thousands*			*Total Number of Award Recipients*		*Pipeline Level(s)*	*Major Strategies*	*Professions Targeted*
		FY2004	*FY2005s*	*FY2006*	*FY2005*	*FY2006*			
CDC/Office of Minority Health and Health Disparities (OMHD)	Public Health Sciences Institute (PHSI)	$1,099	$881	$755	1 institution Morehouse College	1 institution Morehouse College	Undergraduate	Internship programs for encouraging careers in Biostatistics, Epidemiology and Occupational Safety and Health	Public Health
	Dr. James A. Fergusome Emerging Infectious Disease Fellowship	$237	$247	$172	1 institution Minority Health Professions Foundation (MHPF)	1 institution MHPF	Graduate	Increase students' knowledge of public health and public career paths and to introduce fellows to careers addressing infectious diseases and racial/ethnic health disparities	Public Health
	The Public Health Summer Fellows (PHSF)	$166	$130	$125	1 institution Morehouse School of Medicine (MSM)	1 institution MSM	Undergraduate	Expose students to community-based opportunities and careers in public health	Public Health
	Starlab	$70	$75	$61	1 institution MHPF	1 institution MHPF	Middle and High School	Prepare middle and high school students for careers in public health and biomedical sciences	Public Health and Biomedical Sciences
	Research Initiatives for Student Enhancement (RISE)	N/A	$300	$300	1 institution Kennedy Krieger Institute (KKI)	1 institution KKI	Undergraduate, Graduate, Medical Students	Provide research education and training for graduate and medical students attending HBCUs who are interested in pursuing research experiences in the field of public health	Public Health

Funding Source	*Program Name*	*Total National Funding for Last Cycle (year) $ in thousands*			*Total Number of Award Recipients*		*Pipeline Level(s)*	*Major Strategies*	*Professions Targeted*
		FY2004	*FY2005s*	*FY2006*	*FY2005*	*FY2006*			
	Annual Symposium on Career Opportunities in Biomedical Sciences	$245	$230	$330	1 institution MHPF	1 institution MHPF	High school students. College	Cultivates scholars by exposing students to a broad spectrum of career opportunities in biomedical sciences	Public Health, Biomedical Sciences
	Regional Research Center for Minority Health	$55	$55	$0	1 institution MSM	N/A	Undergraduate, Graduate, Faculty, Researchers	Conduct and participate in research with professionals already in the field	Public Health
	Hispanic Serving Health Professions Schools (HSHPS)	$600	$600	$919	1 institution HSHPS	1 institution HSHPS	Undergraduate, Graduate, Medical Students	Provide academic and professional development training to Hispanic students and recent graduates who are interested in improving the health status of Hispanics across the country	Medical Schools and Schools of Public Health
CDC/Agency for Toxic Substances and Drug Registry (ATSDR)	Environmental Medicine Rotation Program (EMRP)	$45	$45	$0	1 institution MSM	N/A	Medical Residents	Exposes minority medical residents interested in primary care to issues related to health and environmental hazards and improves medical expertise available to the agency	Public Health, Environmental Medicine

Funding Source	*Program Name*	*Total National Funding for Last Cycle (year) $ in thousands*			*Total Number of Award Recipients*		*Pipeline Level(s)*	*Major Strategies*	*Professions Targeted*
		FY2004	*FY2005s*	*FY2006*	*FY2005*	*FY2006*			
CDC/NCEH	A National Model of Excellence in Diversity Recruitment and Retention for Environmental Science	$120	$124	$127	1 institution Eastern Kentucky (EKU)	1 institution EKU	High School, Community College Students	Targeted recruitment, mentoring and professional opportunities	Environmental Public Health Science Profession
CDC/National Center for Chronic Disease Prevention and Health Promotion (NCCDPHP)	Directors of Health Promotion and Education (DHPE) Internship Program	$225	$328	$245	5 students	13 students	Undergraduate, Graduate	Strengthen the academic and professional development of students by creating partnerships between minority-serving institutions and public health community	Public Health (Reproductive Health focus)
	ASPH/CDC Prevention Research Center (PRC) Fellowship Program	$300	$300	$300	11 students	4 students	Graduate, Medical Students	Professional opportunities for public health research, financial support	Public Health
	American Indian Science and Engineering Society (AISES)*	$11	$10	$0	1 student		Graduate, Ph.D.	Student internship to gain knowledge and understanding of federal agencies and their operations	Public Health
	Emerging Leader Program (ELP)*	$0	$0	$0	3 students		Professional	Professional opportunities, training	Public Health
	Hispanic Associations of Colleges and Universities (HACU)*	$23	$0	$0	2 students		Undergraduate, Graduate	Financial support, Professional opportunity	Public Health

Table 2.4: Total National Funding for FY2005 in thousands

Funding Source	*Program Name*	*Total National Funding for Last Cycle (year) $ in thousands*			*Total Number of Award Recipients*		*Pipeline Level(s)*	*Major Strategies*	*Professions Targeted*
		FY2004	*FY2005*	*FY2006*	*FY2005*	*FY2006*			
Office of the Director	Undergraduate Scholarship Program				23 scholarships; 4 service paybacks	20 scholarships; 20 service paybacks	College, Post-Baccalaureate, Pre-Doctoral, Post-Doctoral	Professional opportunities, Financial support	Non-specific research
Office of the Director	Intramural Clinical Research Loan Repayment Program for Individuals from Disadvantaged Backgrounds				13	20	Post-Doctorate	Financial support, Educational loan repayment	Health professionals
NIH-wide: NCI, NCCAM, NCRR, NEI, NHLBI, NHGRI, NIA, NIAAA, NIAID, NIAMS, NIBIB, NICHD, NIDCD, NIDCR, NIDDK, NIDA, NIEHS, NIGMS, NIMH, NINDS, NINR, ODS	Ruth L. Kirschstein National Research Ser vice Awards for Individual Pre-Doctoral total Fellowships (F31) to Promote Diversity in Health-Related Research						Graduate students	Financial support	Biomedical research
NIH-wide: All Institutes or Centers	Research Supplements to Promote Diversity in Health-Related Research						High school students, Undergraduate students, Post-Master's and Post-Baccalaureate degree students, Postdoctoral researchers; Faculty level researchers	Professional opportunities, Financial support	Biomedical research

Funding Source	*Program Name*	*Total National Funding for Last Cycle (year) $ in thousands*			*Total Number of Award Recipients*		*Pipeline Level(s)*	*Major Strategies*	*Professions Targeted*
		FY2004	*FY2005*	*FY2006*	*FY2005*	*FY2006*			
NIH-wide: NHLBI, NIHDS, NINR	Mentored Career Development Award to Promote Faculty Diversity in Biomedical Research (K01)						Faculty members	Financial support, Professional development, Professional opportunities	Biomedical research
NIH-wide: NIA, NIAAA, NIAID, NIAMS, NIBIB, NCI, NICHD, NIDCD, NIDDK, NIDA, NIEHS, NEI, NIGMS, NHLBI, NHGRI, NIMH, NINDS, NINR, NCCAM, NCRR, ODS	Ruth L. Kirschtein National Research Service Award (NRSA) Institutional Research Training Grants (T32)						Graduate students, Post-Doctorates	Professional opportunities, Financial support	Biomedical research
National Cancer Institute	NCI Cancer Center Supplements for High School/Undergraduate Student Research Experiences (P30S)				19	22	K-12, College	Professional opportunities	Biomedical research
NCI	Minority Supplements to the NCI Cancer Education and Career Development Program (R25T5)				3	4	Graduate students	Financial support	Biomedical research
National Health, Lung, and Blood Institute	Biomedical Research Training Program for Individuals from Underrepresented Groups				supported 6 students	supported 11 students	College, Post-baccalaureate, Graduate students	Financial support, Professional development	Biomedical research

Funding Source	*Program Name*	*Total National Funding for Last Cycle (year) $ in thousands*			*Total Number of Award Recipients*		*Pipeline Level(s)*	*Major Strategies*	*Professions Targeted*
		FY2004	*FY2005*	*FY2006*	*FY2005*	*FY2006*			
NHLBI	NHLBI Minority Undergraduate Biomedical Education Programs (R25)				2 students		Undergraduate	Financial support, Mentoring, Professional Opportunities	Biomedical research
NHBLI	NHLBI Summer Institute Program to Increase Diversity in Health-Related Research (R25)						Faculty, Scientists	Professional development	Biomedical research
NHBLI	Short-term Training Program to Increase Diversity in Health-Related Research (R25)-previously T35				36 students		Undergraduate, Health Professional Students	Financial support, Professional opportunities	Biomedical research
National Institute on Aging	BAP Minority Investigator Travel Assistance Program						Graduate students, Post-doctoral, Fellows	Financial support	Biomedical research
National Institute of Allergy and Infectious Disease	NIAID Enhancement Awards for Underrepresented Minority Scientists		$1,052 (labeled Minority Biomedical Research Support in Budget)	$1,040	4 grantees--RFA-one year only		Junior level faculty	Financial support, Professional opportunities	Biomedical research
NIAID	Intramural NIAID Research Opportunities Program				23 students	21 students	College, Post-baccalaureate, Graduate students, Post-doctorate	Professional opportunities	Biomedical research
National Institute of General Medical Studies	Minority Biomedical Research Support (MBRS)		$102,104	$100,981	143 students	142 students	College, Graduate students	Institutional support, Professional opportunities	Biomedical research
NIGMS	Minority Access to Research Careers (MARC)				664 undergraduate students @ 56 institutions, 157		College, Graduate students	Institutional support, Professional opportunities	Biomedical research

Funding Source	*Program Name*	*Total National Funding for Last Cycle (year) $ in thousands*			*Total Number of Award Recipients*		*Pipeline Level(s)*	*Major Strategies*	*Professions Targeted*
		FY2004	*FY2005*	*FY2006*	*FY2005*	*FY2006*			
					pre-doctoral fellows, and 2 faculty fellows				
NIGMS	MORE Faculty Development Awards				1 investigator	1 investigator	Junior level faculty	Professional opportunities	Biomedical research
NIGMS	Institutions Research and Academic Career Development Awards (IRACDA)				6 institutions	7 institutions	Post-doctorate	Professional opportunities	Biomedical research
NIGMS	Fellowship Awards for Minority Students						College, Graduate students	Financial support	Biomedical research
NIGMS, co-sponsored by NCHMHHD	Bridges to Baccalaureate Program						College	Institutional support, Financial support, Psychosocial support	Non-specific health science
NIGMS, co-sponsored by NCHMHHD	Bridges to Doctoral Degree Program						Post-baccalaureate, Graduate students	Institutional support, Financial support, Psychosocial support	Non-specific health professions, Ph.D.
Fogarty International Center & National Center on Minority Health and Health Disparities	Minority Health Disparities International Research Training Program Grant						College, Post-baccalaureate, Graduate student	Financial support, Professional opportunities	Non-specific health professions

Funding Source	*Program Name*	*Total National Funding for Last Cycle (year) $ in thousands*			*Total Number of Award Recipients*		*Pipeline Level(s)*	*Major Strategies*	*Professions Targeted*
		FY2004	*FY2005*	*FY2006*	*FY2005*	*FY2006*			
National Institute Deafness and Other Communications Disorders	Formal Collaboration between NICHD Division of Intramural Research (DIR) and Howard University in Washington, DC						College, Graduate students, Post-doctorate	Professional opportunities, Financial support	Biomedical research
National Center for Research Resources	Research Centers in Minority Institutions (RCMI) Program				18 institutions		Graduate school	Institutional support, Financial support, Psychosocial support	Non-specific health professions
NCRR	Science Education Partnership Award (SEPA) [R25]	$8,108,318 granted to eight programs in seven different states. Four of them are formal educational programs, while four informal educational programs	$22,408,570		21 programs in 13 different states plus Washington, DC. 14 of these are formal educational program, while seven are informal educational programs	Awards were granted to seven programs in seven different states. Six of these are formal educational programs (i.e. class curricula), while one is an informal educational program (i.e. museum exhibits, films, websites, etc)	K-12	Program development, Educational resources	Non-specific health professions
National Institute of Environmental Health Sciences	Minority Worker Training Program (MWTP)						College	Professional opportunities	Non-specific health professions

Funding Source	*Program Name*	*Total National Funding for Last Cycle (year) $ in thousands*			*Total Number of Award Recipients*		*Pipeline Level(s)*	*Major Strategies*	*Professions Targeted*
		FY2004	*FY2005*	*FY2006*	*FY2005*	*FY2006*			
National Center on Minority Health and Health Disparities	Extramural Clinical Research Loan Repayment Program for Individuals from Disadvantaged Backgrounds (ECR-LRP)						Post-baccalaureate, Graduate students, Professionals	Financial support	Non-specific health professions
NCMHD	NCMHD Research Endowment Program		$15,900,000		4 institutions		Students and faculty from health disparity populations	Financial support	Biomedical research, Health disparities research
NCMHD	NCMHD Centers of Excellence in Partnerships for Community Outreach, Research for Health Disparities and Training (Project EXPORT) Program		$8,000,000		5 academic institutions		University and Professional; Individuals from health disparity populations	Financial support, University-community partnerships	Biomedical research
NCMHD	NCMHD Minority Health and Health Disparities International Research Training (MHIRT) Program in partnership with the Fogarty International Center		$5,400,000		24 institutions		Undergraduate, Graduate, Health Professions Students	Funding for research training opportunities. Students will travel and work with investigators in countries such sa Mexico, Uganda, Ghana, Australia, Peru, Spain, and South Africa.	Biomedical, Clinical, Behavioral research

Funding Source	*Program Name*	*Total National Funding for Last Cycle (year) $ in thousands*			*Total Number of Award Recipients*		*Pipeline Level(s)*	*Major Strategies*	*Professions Targeted*
		FY2004	*FY2005*	*FY2006*	*FY2005*	*FY2006*			
NCMHD	NCMHD Research Infrastructure in Minority Institution (RIMI) Programs		$3,800,000		5 minority-serving institutions		Undergraduate and Master's level with emphasis on the life sciences, behavioral sciences, and/or other health-related areas	Financial supporting building research capacity in predominantly minority-serving academic institutions.	Life sciences, Behavioral sciences, Health related areas
National Institute of Nursing Research	Minority Supplements for High School, Undergraduate, Graduate, Post-Doctoral, or Faculty						College, Post-baccalaureate, Pre-doctorate, Post-doctorate	Academic support, Professional opportunities	Nursing
NINR	Nursing Partnership Centers on Health Disparities (P20)						Post-doctorate	Professional opportunities	Nursing
National Institute of Mental Health	NIMH- Minority Research Infrastructure Support Program (R24)						Non-specific research institutions	Institutional support, Financial support, Professional opportunities	Mental health research
NIMH							College	Financial support, Professional opportunities	Biomedical research, Behavioral research
National Institute of Diabetes and Digestive and Kidney Diseases	NIDDK Small Grants for Underrepresented Investigators						Scientific investigators	Financial support, Professional opportunities	Biomedical research
NIIDDK	National High School Student Summer Research Program				75 students	75 students	High school	Financial support, Professional opportunities	Biomedical research

Funding Source	*Program Name*	*Total National Funding for Last Cycle (year) $ in thousands*			*Total Number of Award Recipients*		*Pipeline Level(s)*	*Major Strategies*	*Professions Targeted*
		FY2004	*FY2005*	*FY2006*	*FY2005*	*FY2006*			
NIDDK	NIDDK Office of Minority Health Research Coordination Sponsored Intramural Summer Internship Program				12 students	12 students	College	Financial support, Professional opportunities	Biomedical research
NIDDK	NIDDK Office of Minority Health Research Coordination Sponsored Extramural Summer Internship Program				10 students	6 students	College	Financial support, Professional opportunities	Biomedical research
NIDDK	Gateways to the Laboratory/NIDDK Honors Program				1 student	2 students	College	Financial support, Professional opportunities	Biomedical research, M.D./Ph.D.. program
NIDDK	Short-Term Education Program for Underrepresented Persons (STEP-UP)				49 students/6 institutions	52 students/6 institutions	High school, College	Financial support, Professional opportunities	Biomedical research
NIDDK	Association of American Indian Physicians (AAIP) Scholarship Awards				11 students	16 students	College	Financial support, Professional opportunities	Biomedical research
NIDDK	National Hispanic Medical Association (NMA) Fellowship Program				10 students	7 students	College	Financial support, Professional opportunities	Biomedical research
NIDDK	National Medical Association (NMA) Fellowship Program				40 residents/fellows	31 residents/fellows	Residents, Fellows	Professional opportunities	Biomedical research

Funding Source	*Program Name*	*Total National Funding for Last Cycle (year) $ in thousands*			*Total Number of Award Recipients*		*Pipeline Level(s)*	*Major Strategies*	*Professions Targeted*
		FY2004	*FY2005*	*FY2006*	*FY2005*	*FY2006*			
NIDDK	Network of Minority Research Investigators (NMRI)				70 junior and senior investigators	65 junior and senior investigators	Scientific investigators	Professional opportunities	Biomedical research
National Institute of Neurological Disorders and Stroke	Collaborative Neuroscience Sciences (CNS) Award (S11)				11 investigators	11 investigators	Scientific investigators	Financial support	Biomedical research, Behavioral research
NIH-wide: NIHDS, NIDA, NIMH	Neuroscience Scholars Program (R25)				38 scholars	38 scholars	Undergraduate, Graduate, Medical students, Post-doctoral fellows, Other junior scientists	Financial support, Professional opportunities	Biomedical research
NIH-wide: NCMHD, NCRR, NHLBI, NIDA, NIMH, NIHDS	Specialized Neuroscience Research Programs (SNRP)				12	12 (10 grantees posted on website)	Faculty, Students, Fellows	Financial support, Partnership building	Biomedical research, Behavioral research

Table 2.5: National Science Foundation

Funding Source	*Program Name*	*Total National Funding for Last Cycle (year) $ in thousands*			*Total Number of Award Recipients*		*Pipeline Level(s)*	*Major Strategies*	*Professions Targeted*
		FY2004	*FY2005*	*FY2006*	*FY2005*	*FY2006*			
Directorate of Education and Human Resources	Math and Science Partnership	$138,710	$79,360	$63,180	80 awards		K-12	Academic support	Non-specific science and math
	Science, Technology, Engineering, Mathematics Talent Expansion Program (STEP)		$25,280	$25,270	20 new awards		College	Academic support	Non-specific science and math
	Assistance for Broadening Participation in STEM: Louis Stokes Alliances for Minority Participation		$35,020	$35,000			College	Academic support, Professional opportunities, Institutional partnership building	Non-specific science and math
	Alliance for Broadening Participation in STEM: Alliances for Graduate Education and Professoriate	$6,000	$14,790	$14,500			Graduate school	Psychosocial support	Non-specific science and math
	Historically Black Colleges and Universities Undergraduate Program (HBCU-UP)		$25,220	$25,180			College	Academic support	Non-specific science and math
	Centers of Research Excellence in Science and Technology		$15,870	$17,900			Post-baccalaureate, graduate school	Professional opportunities	Non-specific science and math

Funding Source	*Program Name*	*Total National Funding for Last Cycle (year) $ in thousands*			*Total Number of Award Recipients*		*Pipeline Level(s)*	*Major Strategies*	*Professions Targeted*
		FY2004	*FY2005*	*FY2006*	*FY2005*	*FY2006*			
	Tribal Colleges and Universities Program		$9,840	$9,270		9 institutions - 6 implementation awards, 3 planning grants	College	Academic support	Non-specific science and math
	Presidential Awards for Excellence in Science, Mathematics and Engineering Mentoring		$290	$200		20 total - 10 individual, 10 organizational	K-12, College, Post-baccalaureate, Graduate school	Psychosocial support	Non-specific science and math
	Model Institutions for Excellence-Phase 111	$6,600	2.5 million per institution over three years		4 institutions: Metropolitan, Universidad, Oglala Lakota College, University of Texas at El Paso, and Xavier University in New Orleans		College	Financial support	Non-specific science and math

Table 2.6: Indian Health Services

Funding Source	*Program Name*	*Total National Funding for Last Cycle (year) $ in thousands*			*Total Number of Award Recipients*		*Pipeline Level(s)*	*Major Strategies*	*Professions Targeted*
		FY2004	*FY2005*	*FY2006*	*FY2005*	*FY2006*			
	Health Professions Preparatory Scholarship Program for Indians			$3,678		122 agreements	College	Financial support	Non-specific health professions
	Indian Health Professions Scholarship			$10,512		347 contracts	Students enrolled in health professions and allied health professions	Financial support	Non-specific health professions
	Health Professions Pre-Graduate Scholarship Program						College	Financial support	Medicine, Dentistry, Podiatry
	Quentin N. Burdick Recruitment/Retention of American Indians into Nursing (RAIN) - May be grantee and not IHS grantee			$1,734		6 grants	College	Financial support, Academic support, Psychosocial support	Nursing
	INMED Program - May be grantee and not IHS grantee			$1,085		2 grants	K-12	Academic support, Professional support	Non-specific health professions
	American Indians Into Psychology Programs (Indians into Psychology Doctoral Education - INPSYDE) - May be grantee and not IHS grantee			$750		3 grants	College, Graduate Students	Academic support, Professional support	Mental health professionals
	Student Loan Repayment Program for Podiatry						Post-Baccalaureate	Financial support	Podiatry

Funding Source	*Program Name*	*Total National Funding for Last Cycle (year) $ in thousands*			*Total Number of Award Recipients*		*Pipeline Level(s)*	*Major Strategies*	*Professions Targeted*
		FY2004	*FY2005*	*FY2006*	*FY2005*	*FY2006*			
	Navajo Area Jobs and Recruitment - Civil Service and Commissioned Corps					3500 positions	Practicing clinician	Preferential employment	Medicine, Dentistry, Nursing, Pharmacy

Table 2.7: Substance Abuse and Mental Health Services Administration

Funding Source	*Program Name*	*Total National Funding for Last Cycle (year) $ in thousands*			*Total Number of Award Recipients*		*Pipeline Level(s)*	*Major Strategies*	*Professions Targeted*
		FY2004	*FY2005*	*FY2006*	*FY2005*	*FY2006*			
Center for Mental Health Services	Minority Fellowship Program	$2,660	$4,013	$3,928			Graduate students	Financial support	Nursing, Psychiatry, Psychology, Social Work
Center for Substance Abuse Prevention	Minority Fellowship Program	$63	$60	$62	21 fellows	20 fellows	Graduate students	Financial support	Nursing, Psychiatry, Psychology, Social Work
Center for Substance Abuse Treatment	Minority Fellowship Program	$540	$535	$531			Graduate students	Financial support	Nursing, Psychiatry, Psychology, Social Work

Legend of Pipeline Level(s):

K-12: students in grades K-12 (may specify high school only)
College: any 2 or 4 year undergraduate institute/student
Post-baccalaureate: students who have gradated college but not yet entered a graduate program
Pre-doctoral: a student who is in a graduate or professional education program

Chapter 3: An Overview of Evaluation Approaches and Strategies

Does the program make a substantial difference? This is the critical question asked of program evaluations. HHS and other decision-makers want to know whether their investments in programs yield meaningful benefit to the public. The public and other stakeholders share an interest in knowing what interventions are effective in producing desired objectives such as better quality of health care or elimination of health disparities. Individuals and organizations that receive funding to implement and administer interventions also want to know whether their efforts are producing the desired outcomes: everyone benefits from feedback that provides insights into how to improve the delivery of services.

This chapter examines approaches to evaluating programs to recruit racial/ethnic minorities into the health professions. It begins with a conceptual framework for thinking about program evaluation, followed by a discussion of standards of evidence in evaluation research that addresses the relative tradeoffs of different evaluation research designs and methods in terms of scientific rigor, technical feasibility, cost, and ethics.

CONCEPTUAL FRAMEWORK: OUTCOMES, PROCESSES, AND LOGIC MODELS

The bottom-line answer to the question, "Does the program make a substantial difference?" typically involves evaluating program efficacy or effectiveness as defined by achieving some measurable "outcome." For programs that intend to recruit racial/ethnic minorities into the health professions, one of the most obvious outcomes of interest is whether the interventions resulted in more racial/ethnic minorities entering health professions training programs and the health care workforce. For example, an outcomes-oriented evaluation of a college enrichment program involving academic support and research exposure for racial/ethnic minority pre-dental students might measure the outcome of whether these interventions resulted in more racial/ethnic minority students successfully matriculating into dental schools.

A related dimension of evaluation research is to assess what was actually done. This dimension is commonly referred to as "process" evaluation. A process evaluation focuses on implementation issues such as enumerating the activities and services delivered, assessing the degree to which these activities reached the intended target population, and determining whether the interventions were implemented with fidelity to the planned intervention design. Using the example of a pre-dental pipeline program, a process evaluation might address how many tutoring sessions were delivered, the curriculum used for the tutoring sessions, how many students attended the sessions, whether the participating students were representative of the intended target population, and how satisfied the students were with the tutoring curriculum.

"Logic models" link processes and outcomes. These types of models attempt to make explicit the rationale for selecting various interventions, or processes, and how these processes could logically be expected to produce the desired outcomes.

Figure 3.1: Basic Logic Model

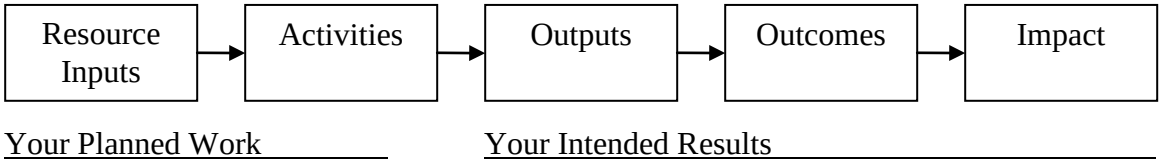

Figure adapted from WK Kellogg Foundation, *Logic Model Development Guide*[1]

In the pre-dental example, a logic model would articulate that tutoring sessions are intended to result in an increased likelihood of racial/ethnic minority students competing successfully for dental school admission. Resources might include tutors and grant funding; activities would focus on the tutoring curriculum; outputs would track the number of participating students and tutoring sessions provided; outcomes might include science course grades and Dental Admissions Test (DAT) scores (immediate outcomes) and matriculation into dental school (long-term outcome); and the impact would be a more diverse health professions workforce. By including intermediate outcomes, logic models can provide a more comprehensive view of the proposed causal pathway leading from intervention to the desired ultimate outcomes. Ideally, logic models are based on preexisting evidence of the relationship between intermediate and ultimate outcomes. To the extent that it is known that better grades in pre-dental courses and higher DAT scores are associated with a greater likelihood of a student being admitted to dental school, the better the "logic" of the logic model.

The stronger the existing evidence-base linking processes to intermediate outcomes, and linking intermediate outcomes, in turn, to ultimate outcomes, the greater the validity of focusing ongoing evaluation on the more "proximal" components of the logic model. An example from clinical medicine illustrates this point. Randomized clinical trials have established with a high quality of scientific evidence that prescribing aspirin to patients having heart attacks results in improved survival among these patients. Current approaches to routinely evaluating quality of hospital care for patients with heart attacks therefore rely heavily on measuring process indicators such as the prescribing of aspirin, and not necessarily on repeatedly evaluating heart attack survival outcomes data for each hospital. One of the attractions of focusing evaluation efforts on measuring process and intermediate outcome data, rather than on ultimate outcome data, is that it is usually less costly and more feasible to measure these more proximal data points. Intermediate outcomes can be especially important for longitudinal programs that need outcome data early for program improvement and reporting purposes.

Unfortunately, as discussed in chapter 4, there is a paucity of good scientific evidence on intervention efficacy in the area of health professions diversity programs. This situation is not unique to this topic area, but is a more general concern for the broad array of programs administered by HHS and other government agencies—and for complex social interventions in general. This concern in part gave rise to the Government Performance and Results Act (GPRA) of 1993 and its call for assessing performance in achieving more "outcomes-oriented goals and objectives."

EVALUATION DESIGN: QUANTITATIVE METHODS

1. Deciding What to Measure and How to Measure It

a. Process Measures

Historically, HHS and other funders have overwhelmingly relied on process evaluations of their program. As noted above, evaluations of health professions pipeline programs based solely on process measures have somewhat limited utility given the lack of a more robust base of evidence on the efficacy of specific processes and interventions to increase racial/ethnic minority participation in the health professions. This lack of evidence has motivated calls for more outcomes-oriented evaluations. That said, process evaluations are not without value. At the most basic level, process evaluations are a means for funders to know whether the recipient of funds actually delivered the services to fulfill their award obligations. An evaluation of processes alone may not provide a basis for assessing program effectiveness in terms of achieving desired outcomes, but process evaluations fulfill an important need for assuring accountability in the use of award funds. As a result, process evaluations are almost always a core component of routine program performance measurements. Moreover, collection of process data fills an important role in evaluations focusing on outcomes because of the desire to assess the link between interventions performed and outcomes achieved. Process evaluations can also help programs to improve their services and refocus on outcomes.

i. *Processes: What to Measure*

The main categories of data to measure for process evaluations are measurements of "who participated," "what activities were performed," and the "quality of the activities." The Uniform Data Set developed by HRSA, BHPr for programs in the Division of Health Careers Diversity and Development is a good example of a systematic approach to routine measurement of who participated in program activities (Figure 3.2). This Disadvantaged Assistance Tracking and Outcome Report (DATOR) requires award recipient organizations to use a standardized, Web-based form to report data on individual students participating in program sponsored activities, including data on the student's name, last four digits of the social security number, race-ethnicity, and educational level. Collecting data at the level of individual students has particular value for constructing a database of program participants that can be used for tracking these students when performing outcomes assessments (discussed more below in section b). When there is less need in creating an individual student-level database for tracking outcomes, collecting more aggregate data may suffice for purposes of process evaluation. For example, the DATOR database might prove extremely useful for evaluating outcomes such as matriculation into a health professions school for college students formally enrolled in an HCOP program, in addition to its utility as a purely process measure for understanding the reach of HCOP activities at a particular institution and whether the institution successfully enrolled individuals from the targeted populations. Collecting such individual-level data would probably be excessively cumbersome for

assessing less formal HCOP activities such as a onetime career fair at a high school, where simply knowing in the aggregate the number and demographic characteristics of students attending the fair—or even just knowing the demographic profile of the overall student body of the school—would suffice as a process measure.

Figure 3.2: HRSA DATOR Uniform Data Set

Table DHCDD – 3
Disadvantaged Assistance Tracking & Outcome Report (DATOR)

								Pre-professional Training			Professional Training		Workforce	Financial Support
Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7	Column 8	Column 9	Column 10	Column 11	Column 12	Column 13	Column 14	Column 15
Student Participant Name: (Last, First, MI)	SSN (Last 4 digits)	Date of Birth (mm/dd/yy)	Gender	Race	Ethnicity	Home of Record at Time of Entry to your Program	Active or Former Participant	Targeted Health Professions	Educational Institution	Student Status	Type of Program	Student Status	Employment Status	Type of Support **

*** Financial assistance is received for this reporting period only.*
NOTE: Rows can be added within the above table to accommodate names of student/participants, etc.

Form HRSA-T-97-1 38

In addition to counting the "who," process evaluations should also measure the "what:" what activities were actually performed? The Uniform Data Set recently developed by HHS, OMH provides a good illustration of a standardized approach to measuring process activities. This Uniform Data Set requires award recipients to complete a Web-based report to quantify the types and numbers of activities performed, such as number of health education sessions, community outreach activities, etc. Ideally, process evaluations should include some measurement of the quality, as well as quantity, of activities

performed. An example of a quality indicator is participant satisfaction with program sponsored activities.

ii. *Processes: How to Measure*

Among the issues to consider about how to measure process items are:

- Who should collect the data,
- To what degree should the data collection be standardized, and
- How should the data be reported?

Typically, funders delegate the task of collecting data on processes to award recipients. Individuals who administer and implement the funded interventions are usually in the best position to routinely and efficiently identify, collect and report data on participants and sponsored activities as a matter of course in performing the interventions. Rarely, external evaluators will take on the task of primary collection of this basic process data for a particular study.

The types of Uniform Data Sets cited above for HRSA and OMH programs represent an attempt to create a more uniform approach to collecting process data. Standardization of the data being measured has many appeals. It provides a level playing field for assessing process performance for award recipients within a program area, permits the program leadership to define in advance the relevant data items to be collected, and allows data from different award recipients to be consolidated into an overall program level report. Pooling standardized data increases the numbers and can lead to more statistically powerful results. While standardization has potential advantages, it also has some disadvantages, chief among them the problem of a "one size fits all" approach to a Uniform Data Set that may not be sensitive to differences in the scopes of interventions within a broad program area and the particularities of how individual awardees adapt interventions to their local needs and context. For example, an activities data collection tool for programs in the BHPr Division of Health Careers Diversity and Development would need to develop a set of predefined activities that would adequately capture the major interventions performed for a diverse set of programs with activities ranging in scope from science and health education workshops for elementary school students to support for career development for medical school faculty members. The 2002 report to OMH by the Development Services Group, Inc about developing a Uniform Data Set for OMH programs sensitively highlights the tradeoffs between standardized and individualized reporting requirements and the goal of avoiding either excessively rigid or excessively unstructured approaches to data collection.[2] The more varied the scope and goals of the programs and the interventions funded by a program, the more challenging it is to develop a uniform set of routinely collected metrics on process activities.

The Development Services Group, Inc. report, conducted under contract to OMH, also provides an excellent summary of the pilot testing of a Uniform Data Set through a Web based data reporting tool, with extensive feedback from the award recipients about the ease and feasibility of a Web-based reporting modality. Feedback was very supportive of

this approach, and OMH, HRSA, and other agencies have increasingly, and appropriately, moved to Web-based formats for collection of evaluation data.

b. *Outcome Measures*

The desire to answer questions about program outcomes pushes evaluation efforts beyond the types of routine, awardee-generated process assessments that have been the mainstay of conventional program evaluations. While outcome evaluations offer the promise of more meaningful measurement of program impact, they also raise additional challenges for data collection and measurement.

i. *Outcomes: What to Measure*

One of the first tasks for an outcome evaluation is to define the critical "bottom line" program outcomes of interest. Although these outcomes may at first seem self-evident, closer inspection often reveals that this decision is not as straightforward as it might appear. Earlier in this chapter, we suggested that an important outcome measure for racial/ethnic minority pipeline programs is the number of racial/ethnic minorities entering health professions training programs and the health care workforce. However, some stakeholders might not consider this to be truly an "ultimate" program outcome. These stakeholders might suggest that a more meaningful outcome measure would be whether the program reduced health disparities for racial/ethnic minority populations, arguing that such a patient-oriented focus would be the most appropriate metric for determining the effectiveness of HHS programs. Stated another way, there is often debate about how distally the logic model should extend when deciding upon key outcome measures. Is it sufficient to measure the number of racial/ethnic minority students in a pre-dental program who go on to become dentists as the key outcome variable? Or does an evaluation need to measure the number of racial/ethnic minority patients cared for by these dental graduates, or changes in the oral health status of the communities served by these graduates? These patient-oriented outcomes tend to be so distantly removed from the timing of the program sponsored intervention (e.g., a minimum of 7 years between the time that a premedical racial/ethnic minority student completes a college HCOP program and graduates from residency training to enter clinical practice as a physician), and so multifactorial in their determinants, that most evaluators would consider measuring such distal outcomes well beyond the scope of a routine pipeline program assessment. Rather, the implications of program effectiveness on patient outcomes might be better inferred from what is already known from research on intermediary and ultimate outcomes. For example, given the consistent research evidence that racial/ethnic minority clinicians are more likely than nonminority clinicians to care for racial/ethnic minority and disadvantaged patients, it would be reasonable to assume based on this evidence that increasing the numbers of racial/ethnic minority clinicians would result in improved access to care for racial/ethnic minority and disadvantaged patients, without having to directly prove this outcome as part of a program evaluation.

Even when looking only at participant-focused outcomes, there may be controversy in defining the most relevant outcome measures. For example, should an evaluation of a

pre-dental intervention measure the number of racial/ethnic minority students matriculating into dental school? Graduating from dental school? Becoming licensed to practice and entering the workforce? The answers to these questions depend on factors such as the relative availability of data to measure these different outcomes and the willingness to wait the required lag time for achievement of more delayed outcomes.

The challenge of defining and measuring outcome indicators is one of the rationales for including intermediary outcome measures in evaluations. For example, for evaluation of an HCOP sponsored pre-dental college intervention, it might be more feasible to collect data on student grades and DAT scores while the students were still enrolled in the HCOP program than to track a cohort of these students longitudinally to determine whether they matriculated into and graduated from dental school. Moreover, these intermediate outcomes would be available more contemporaneously with the students' program participation than more delayed outcomes such as dental school graduation. Logic models and reviews of the research literature are often helpful for identifying many potential intermediate outcomes that may be of interest. For example, intermediate outcomes that might be considered in an evaluation of pre-dental interventions include measurement of students' knowledge (e.g., familiarity with dentistry and dental school application requirements), attitudes (e.g., career intentions, confidence in their ability to succeed, perceptions of peer and college supports), skills (e.g. interview skills), engagement (e.g., participation in a research project or clinical program), satisfaction (e.g. perceived benefit of program), and academic performance (grades, test scores).

ii. *Outcomes: How to Measure*

Approaches to collecting outcome data share many of the same "how to" issues discussed above in the section on measuring process measures. For example, decisions must be made about the degree of standardization of outcomes measurements. Should the same outcome measures be used for all interventions conducted for a program area, or should selection and definition of these measures be tailored to individual interventions and settings? Another issue is the question of who should collect the data. In many cases, collection of the relevant outcome data will simply be beyond the wherewithal of the award recipient organization. A high school that operates a health professions academy will usually not have the resources to track cohorts of its graduates in an ongoing fashion over many years to determine how many of the graduates go on to graduate from college and enter a health professions school. Measurement of intermediate outcomes may be more feasible for the award recipient organization to perform, but even here, measurement demands may exceed the capacity of the awardee organization. For example, an awardee's organization might be able to collect data on course grades or standardized tests, but might not have the capacity to administer, collect, and enter data from a multi-item questionnaire assessing student attitudes, knowledge, academic engagement, and related metrics. One additional limitation to relying on outcomes data collected by award recipients is the potential for compromise of data validity. This may be a particular liability when award recipient organizations are asked to report primary data that are difficult to collect (e.g., long-term educational outcomes for participants) and are susceptible to bias in favor of reporting more positive outcomes. Because of these

many challenges, it is often neither feasible nor advisable to depend on Uniform Data Sets with awardee-reported primary data as the principal source of data on outcomes. Reliable measurement of outcomes data often requires investment of resources in an external evaluation team charged with the responsibility for systematically and objectively collecting these data.

One efficient means of collecting outcomes data is to find an existing source of secondary data. Secondary data refers to data that have already been collected and compiled, ideally in a computerized database, as opposed to primary data which refers to data newly collected for the particular project in question. For example, the Association of American Medical Colleges (AAMC) maintains the American Medical College Application Services (AMCAS) database, which contains a record for all individuals who have applied to a medical school accredited by the Licensing Commission on Medical Education. The AMCAS file includes information on whether the student matriculated into and graduated from medical school, in addition to many other student variables. The AAMC has generally been open to considering requests for its staff to perform analyses of the AMCAS files for research purposes. Research protocols must receive approval from an Institutional Review Board, and compensation for the effort of AAMC staff to perform the requested data analyses may be required. An example of a study that used AMCAS data is a recently published evaluation of University of California premedical post baccalaureate programs. This study linked data on students who had participated in the post baccalaureate programs and a group of control students with student-level data in the AMCAS file to determine which students had matriculated into medical school.[3] Another example of a useful secondary data set is the American Medical Association (AMA) Physician Master file, which contains a record for all U.S. physicians and includes information on medical school of graduation, specialty, practice location, and professional activity. Investigators may purchase electronic copies of Master file data through a vendor under contract to the AMA.

Although use of secondary data for program evaluations can achieve efficiencies for measuring outcomes, these efficiencies are usually only achieved when the performance of the evaluation is centralized. For example, instead of individual HCOP awardees approaching the AAMC, a central repository of HCOP student data would enable HRSA or an outside evaluator to make arrangements with the AAMC to match these data to the AMCAS file under one consolidated request. Even with the AMA Physician Master file, which is available for purchase and use by independent evaluators, the cost of purchasing and programming the Master file makes it impractical for individual award recipient organizations to perform their own analyses of Master file data.

2. *Designing Quantitative Outcome Evaluations: Levels of Scientific Rigor*

Once a decision has been made about the relevant outcomes to measure, there remains the question of the overall research design to be used for an evaluation. The choices for evaluation designs fall into four major categories, listed in order of ascending scientific rigor:

- Uncontrolled cohort studies,

- Pre/post intervention observational studies,
- Controlled observational cohort studies, and
- Randomized controlled trials and other experimental designs.

a. *Uncontrolled cohort studies*

The most rudimentary design for an outcome evaluation is an uncontrolled cohort study. In this approach, a cohort of individuals exposed to an intervention is identified (e.g., college students who participated in an HCOP program) and relevant outcomes for this cohort are measured (e.g., matriculation into a health professions school). Outcome data are typically summarized as the percent of the individuals exposed to the intervention who achieved a specified outcome (e.g., the percentage of HCOP participants who matriculate into a health professions school).

Benefits: This approach is often the most feasible for programs with limited resources. Outcomes can provide important information on what aspects of the intervention worked best and if the goals and objectives were achieved. Intermediate outcomes can also be used to help improve implementation. In some instances, an uncontrolled cohort evaluation may yield such dramatic findings that the results are persuasive even without data on a control group. For example, if it were general knowledge that virtually no students from an inner city high school ever went on to become registered nurses, pharmacists, dentists, and physicians, and that in the decade following implementation of a special health professions career academy at the high school, 25 students from that high school became health professionals, this finding might have some "face validity" in suggesting an effective intervention. Uncontrolled outcome evaluations may also have some value for assessing whether programs have achieved a benchmark level of yield for their outcomes. For example, a program could specify some minimum level of outcome achievement that is expected for award recipients, such as a minimum percentage of program participants who go on to apply to health professions schools. Recipients falling below this benchmark would then merit further scrutiny to determine the extent to which these poor outcomes were attributable to inadequate execution of program interventions, enrollment of especially high risk populations, or other factors.

Challenges: The fundamental limitation of the uncontrolled cohort study design is that it provides a weak level of scientific evidence for answering the question, "Did the intervention make a difference?" The unstated part of this question is "…make a difference, *relative to what would have otherwise occurred in the absence of the intervention*?" To satisfactorily answer this question requires inclusion of outcome data on a comparable control group, serving as the referent point for determining the differential effect on outcomes that may be attributable to exposure to the intervention. For example, an uncontrolled cohort study might report that 70 percent of racial/ethnic minority students participating in a college HCOP program subsequently matriculated into medical or dental school. A 70 percent success rate might, at face value, appear to indicate an effective program given that fewer than 50 percent of racial/ethnic minority applicants are admitted to medical or dental school. However, HCOP participants are unlikely to resemble the "typical" racial/ethnic minority student applicant to medical or

dental school. As Carline has pointed out in an incisive review of college pipeline programs, "Although enrichment programs for college students claimed to send significantly larger percentages of their participants on to medical or other health sciences careers, few program evaluations compared the program cohorts with control groups…many programs selectively enrolled the best of the underrepresented minority pool. It is not surprising then that these participants did better than other minority students in competition for medical school positions."[4] In some cases, the direction of the selection bias is not entirely clear. For example, HCOP programs might attract students who are particularly motivated to pursue a career in the health professions, and might therefore be more likely to successfully apply to a health professions school even without participating in an HCOP program. On the other hand, HCOP programs might attract students who are having academic difficulty and perceive that they would benefit from the academic enrichment provided by an HCOP program; absent an HCOP program, these students might be even less likely than the average racial/ethnic minority premedical or predental student to successfully gain admission to a health professions school.

b. *Pre/post intervention observational studies*

Pre/post designs measure outcomes for the same study subjects before and after exposure to an intervention. For example, a pre/post design might measure students' Medical College Admissions Test (MCAT) scores on tests taken before and after participation in a post baccalaureate premedical program.

Benefits: More rigorous than the uncontrolled cohort, this design attempts to introduce a form of control group. By definition, pre/post studies use the "pre-intervention" phase for the same individuals as the control group. In the MCAT example, each student essentially serves as his or her control in the form of the student's performance on the MCAT test prior to post baccalaureate program enrollment.

Challenges: Pre/post intervention evaluations require assessment of outcomes that are amenable to repeated measures over time. Multiple sittings for the MCAT meet this criterion. Other outcomes are less amenable to repeated measures. For example, matriculating into nursing school is a onetime event. At the individual student level, it would not be logical to design a study to examine pre- and post-intervention matriculation into nursing school; that is, if the student had already successfully matriculated into nursing school, he or she would have no need for an intervention designed to increase the likelihood of matriculating into nursing school. For this reason, pre/post study designs often assess intermediate outcomes such as test scores, course grades, and student attitudes. One way to circumvent this limitation is to design pre/post studies that examine an institution or other aggregated unit of analysis, rather than the individual student. For example, a pre/post design might measure the outcome of the annual percentage of racial/ethnic minorities at a college applying to health professions schools before and after an HCOP intervention was implemented at the college. In this example, the repeated outcome measure would be the annual percentage of graduating students who applied to a health professions school.

Another limitation of pre/post studies that applies regardless of the unit of analysis is the problem of potential confounding due to secular trends and repeated measurement. Although MCATs can be repeated multiple times, students who retake the MCAT exam may show improvement in scores simply due to becoming more acclimated to the MCAT. In the example of the pre/post evaluation conducted at the level of a college implementing an HCOP program, the increase in applications to health professions schools over time might reflect a more general, or secular, trend towards a greater attractiveness of heath careers that induced more college students to apply to health professions schools, irrespective of whether the college implemented a new HCOP program. The most rigorously designed pre/post evaluations include an external control group to account for these types of secular and repeated measures effects that may confound study findings. For example, a rigorous pre/post study of MCAT scores before and after an intervention would ideally also measure MCAT scores for students who took the MCAT exam twice but did not participate in a post baccalaureate intervention.

c. *Controlled Observational Cohort Studies*

Cohort studies analyze outcomes for a group exposed to the intervention compared with a concurrent group not exposed to the intervention. For example, a controlled observational cohort evaluation of an intervention to engage racial/ethnic minority college students as assistants in summer research projects might compare the percentage of students participating in the research activity who apply to medical school or a graduate biomedical science doctoral program relative to the percentage among a similar group of students who did not participate in the research program.

Benefits: Instead of evaluating an intervention using the same group as controls and participants over time, this design compares the intervention group (exposed) to a concurrent and *similar* control group (unexposed). This allows for direct comparison of outcomes. With a controlled cohort, evaluators can begin to answer the question "Did the intervention make a difference, relative to what would have otherwise occurred in the absence of the intervention?"

Challenges: The key operative word in this case is "similar." When individuals are not randomly assigned to participate in an intervention, there will almost invariably be important differences between individuals who do and do not participate in the intervention. To account for these differences in the underlying characteristics of intervention and control groups, evaluators rely on statistical methods such as multivariate regression analysis to adjust for differences in measurable characteristics. For example, participants in a summer research program might on average have higher grades at baseline in science courses than students who do not choose to participate in a summer research program (or who were interested but were not selected to participate). Regression methods can adjust for these types of differences in measurable baseline student characteristics.

More challenging is accounting for potential differences in unmeasured characteristics. Students who participate in a summer research program may be more motivated to pursue a health or science career; differences in motivation would be difficult to systematically measure and adjust for in regression models. Evaluators are beginning to explore the use of other statistical techniques, such as instrumental variable models, propensity scores, and other econometric methods, in an attempt to better account for confounding from unmeasured variables in observational studies.

d. *Randomized Controlled Trials and Other Experimental Designs*

Controlled pre/post studies and cohort studies are often referred to as "quasi-experimental" study designs. True experimental designs require random assignment of individual students or institutions to intervention and control groups.

Benefits: The rationale for randomization is that it eliminates the bias associated with self-selection of individuals into intervention and control groups and the potential unmeasured confounding that may compromise the validity of findings from observational studies. In the most rigorous forms of randomized controlled trials used in clinical studies, the randomization occurs in a blinded manner such that neither the study participant nor treating clinician knows whether the individual has been assigned to the intervention or control group. Blinding is intended to eliminate the bias associated with participants and investigators knowing an individual's group assignment. The "gold standard" design for clinical research is the placebo-controlled, blinded, randomized trial. The blinded, randomized trial has achieved almost iconic status in the movement for evidence-based medicine, with many clinical scientists considering the results of these types of studies to be the only truly valid evidence upon which to judge treatment efficacy and develop evidence-based clinical guidelines. This enthusiasm has been bolstered by episodes in which results of randomized clinical trials differed quite markedly from the findings of well-conducted observational studies. A relatively recent example is investigation of the cardiac effects of hormone replacement therapy for postmenopausal women. Initial controlled, observational cohort studies suggested that hormone replacement therapy had a cardioprotective effect. A subsequent large randomized clinical trial found just the opposite outcome, concluding that hormone replacement therapy resulted in a greater incidence of adverse cardiac outcomes.

The enthusiasm for randomized trials as a gold standard of scientific evidence has extended beyond the realm of clinical medicine to intervention research in public health, social science, education, and other fields. For example, the Surgeon General's 2001 report, *Youth Violence: A Report of the Surgeon General - A Public Health Approach*[5] reviewed the evidence on educational and community-based interventions to reduce youth violence. In a section entitled "Standards of Scientific Evidence for Multidisciplinary Research," the report states, "Experimental research is the preferred method for assessing cause and effect as well as for determining how effectively an intervention works…A study with a randomly assigned control group enables researchers to conclude that observed changes in the experimental group would not have happened without the intervention and did not occur by chance. The difference in outcome between

the experimental and control groups … can then be attributed to the intervention."[5] The report cites several evaluation studies using experimental designs, including those randomizing families to receive home visits from a nurse or paraprofessional,[6] adolescents to participate in different forms of counseling and psychotherapy,[7] and classrooms within elementary schools to participate in structured behavior management interventions. Several recent large evaluations in the field of education have also used experimental designs with random assignment of elementary school students to after-school programs and high school students to career academies.[8]

Challenges: Despite the scientific merits of experimental designs, this approach also has some noteworthy drawbacks. These include cost and feasibility, ethical concerns, and technical limitations.

Randomized experiments are expensive to perform. Compared to even rigorously conducted quasi-experimental observational studies, randomized trials require an additional magnitude of expense due to the need for extensive selection and enrollment of study participants on a prospective basis, standardization of interventions, tracking of participants over time (in many cases, prospectively for many years), and ongoing collection of outcome data. The active cooperation of participating sites is required to permit randomization and adherence to study protocols. Experimental studies require a highly skilled team of external evaluators, substantial and usually multi-year funding, and cooperative intervention sites.

Randomized trials also raise ethical concerns due to the withholding of the active intervention from study participants in the control arm of the experiment. In clinical trials, one of the ethical principles underlying the acceptability of randomization is that the intervention does not yet have proven benefit, and may even be harmful. Although this principle may also apply when an educational intervention such as a pipeline program has not yet been proven to be efficacious, its application tends to be more problematic in educational settings, particularly for interventions targeting racial/ethnic minority and disadvantaged students. In this context, interventions may have a strong appeal to the targeted population as having at least some degree of self-evident benefit. Using a randomization process to select which disadvantaged students will receive an intervention that includes extra resources for academic supports, in settings in which these students commonly face underresourced learning environments and a dearth of educational support, may understandably raise reservations about the ethical acceptability of an experimental evaluation design.

Evaluators have developed strategies to randomization that attempt to mitigate some of these ethical concerns. One approach that may be used when the student demand for participation in an pipeline program exceeds the available slots is to not randomize from the entire group of applicants, but to first select a group of applicants who are best qualified for the program and then to randomize from among this "top tier" group, assuming that there are at least twice as many qualified applicants as available positions. The argument against this strategy is that it may still be unfair to the most qualified applicants since it does not base the final selection exclusively on appraisal of the

candidate's qualifications. The counter argument is that such judgments of qualifications inevitably involve some degree of subjectivity on the part of those making these judgments, and therefore using a lottery process to select from among a group of well qualified applicants is not necessarily less fair than relying on selection decisions that may not be completely objective.

A related strategy is to use randomization as part of a staggered selection process. In this approach, the control group is not completely excluded from participation in the intervention program, but its exposure to the intervention is delayed. For example, a staggered randomization design might randomize one group of graduating college seniors interested in biomedical research careers to an intensive summer intervention right after graduation to support their application to PhD programs, and another group to receive the same intervention the following summer, and measure the outcome of admission to a PhD program within the first year after graduation. The delayed intervention group would serve as the control group for the immediate intervention group during the first year of follow-up of admissions outcomes, but still have the benefit of participating in the program a year later. This staggered design is only feasible when the outcome of interest occurs within a relatively short time following exposure to the intervention, so that differences in outcomes between the immediate intervention and control group can be detected before the control group receives the delayed intervention.

Randomization also raises less ethical concerns when the experiment is not an all or none proposition comparing exposure to an intervention with a complete absence of intervention for the control group. An alternative approach is to compare two different interventions that both may have value, or to evaluate exposure to different combinations or intensities of interventions. For example, a study could randomize racial/ethnic minority nursing students into two groups, one group to receive an academic advising and mentoring intervention, and the other group to receive the same intervention but also a series of learning assessments and test taking skills workshops. This type of design provides a rigorous evaluation model for investigating the added value of a particular intervention, but cannot answer whether the core intervention package is better than no intervention.

A final strategy to randomization is to not randomize at the individual student level, but at the institution level. For example, an experimental design for evaluating high school health career academies could identify a group of high schools qualified to administer new academies and randomly select several schools to receive funding to establish academies and have the other schools serve as controls, rather than randomizing individual students within schools to participate in the school's newly established academy. This approach may diminish some of the ethical concerns about randomization at the individual student level from among a group of student peers at the same school, although it obviously raises some of the same concerns about fairness to applicant institutions. A drawback of randomization at the institutional level is that there is very little incentive for an institution to participate in the evaluation if it is assigned to the control group. One way to address this lack of incentive is to use the approach described above of offering at least some type of intervention at the control schools that may have

value, but is expected to have much less impact on outcomes than the full intervention. For example, control schools might receive a series of teacher development workshops in math and science curricula. A staggered design can also be used, so that the control schools go on to receive the full intervention at a later date. Randomization at the institution level requires a large sample of institutions in order to have sufficient statistical power to detect meaningful differences in outcomes, adding to the costs and logistical demands of the evaluation.

In addition to concerns about cost, feasibility, and ethics, the classic randomized trial design is also susceptible to criticisms about its scientific merit and value to program planners. Criticisms have been raised in particular about the applicability of randomized trials to complex social phenomena such as student academic success and career advancement that have multifactorial determinants, and to interventions that are not as neatly packaged as a uniformly manufactured pill and an identical appearing placebo. Not only is it virtually impossible to blind participants and investigators to intervention vs. control group assignment for the types of interventions used in pipeline programs, but it is nearly as difficult to ensure that the control group is not inadvertently exposed to the intervention—or to another intervention outside the control of the evaluation study that may have similar effects on outcomes. Given the close social networks that exist among students, there is inevitably some degree of "contamination" of controls when a group of students at a school are randomized to an intervention and others to a control group, and the students come from similar social backgrounds and share similar career and academic interests. Students who acquire new study techniques, career planning strategies, awareness of research or clinical project opportunities, and similar skills from participating in the program intervention are likely to impart some of these same skills and insights to their peers in the control group. Students in the control group may also take advantage of other enrichment opportunities at their institution that may be sponsored by an entirely different agency but promote some of the same academic and career development objectives as the intervention program that is the subject of the evaluation. All of these contamination effects will tend to reduce the differences in outcomes between intervention and control students that may be detected by an evaluation, even if the intervention truly has a beneficial effect, with the result that the study may erroneously conclude that the intervention is ineffective.

Randomization at the level of institutions, rather than students within institutions, may protect against the contamination that can occur from interventions being secondarily transmitted through peer networks or other mechanisms at the same school. Nonetheless, contamination may still occur due to a lack of control over the activities being conducted at control institutions. For example, an institution assigned to a control group may decide to apply to another funder to develop the same type of intervention that the institution hoped to develop under the sponsorship of the agency funding the experimental evaluation study. Educational institutions are complex adaptive systems, and it is extremely difficult to hold conditions static at institutions assigned to a control group. As a sheer matter of survival and evolutionary progress, educational institutions are constantly applying for grants, developing new programs, building diverse funding streams to support their programs, and undergoing a process of change and reinvention.

This makes for a very challenging environment for successfully conducting experimental trials of pipeline interventions.

Interestingly, some of these same criticisms are beginning to be voiced about a potential overreliance on the traditional form of randomized clinical trials as the be-all and end-all of rigorous scientific evidence in medicine.[9,10] While still acknowledging the value of randomized clinical trials, critics are pointing out some of the shortcomings of this method—shortcomings that include many of the technical limitations discussed above. Concerns have been raised that clinical trials take place with patients, settings and conditions that are artificial and unrepresentative of the "real world" environment in which medical care is actually delivered. Clinical trials are usually highly selective about which patients are considered eligible to participate, resulting in study populations that are not representative of the majority of patients with the condition under study. For example, trials of treatment for diabetes typically exclude patients with mental health problems. However, a large proportion of diabetic patients have depression. The effects of treatments may be very different when patients with diabetes have co- morbidities such as depression. Clinical trials benefit from highly structured operations, including specialized research personnel who monitor patients in the study and make sure they attend follow-up assessments. These resources are not as available in the real world application of treatments in typical practice settings, raising questions about the generalizability of findings from controlled clinical trials to the broader practice environment. Even in the world of evidence-based medicine, there is a rethinking of some core tenets of intervention research and deeper appreciation of the complexity of evaluation science.

EVALUATION DESIGN: NEW DIRECTIONS

Partly in response to some of the challenges and limitations of quantitative evaluation methods described above, some funders have moved towards a different paradigm for evaluation. Several private foundations involved in health philanthropy have been at the vanguard of advocating for more participatory evaluation models that engage awardees and the community in thinking through evaluations tailored to their unique needs and contexts. These models rely on mixed methods that feature a more prominent role for qualitative research methods and emphasize evaluation in the service of program improvement rather than primarily for judgment of bottom-line outcomes. This approach is exemplified by the WK Kellogg Foundation in its *Evaluation Handbook*. In the *Handbook*, the Foundation states, "We … believe that evaluation should not be conducted simply to *prove* that a project worked, but also to *improve* the way it works. Therefore, [we] do not view evaluation only as an accountability measuring stick imposed on projects, but rather as a management and learning tool for projects, for the Foundation, and for practitioners in the field who can benefit from the experiences of other projects." The Foundation also explains in the *Handbook* its decision to eschew Uniform Data Sets and standardized measurement tools in its evaluation approach. "We believe community-based organizations should ground their evaluations in the real issues of their respective communities. Therefore, evaluation efforts should also be community based and contextual (based on local circumstances and issues). The primary purpose is

to identify problems and opportunities in the project's real communities, and to provide staff and stakeholders with reliable information from which to address problems and build on strengths and opportunities."[11]

An eloquent recounting of one foundation's evolution of its approach to evaluation and its grappling with the limits of the scientific method is provided by Ruth Tebbets Brousseau in the monograph *Reflections on Evaluating Our Grants*[12] published by The California Wellness Foundation in 2004. Brousseau comments on the Foundation's experiences with its initial approach to evaluation, which relied heavily on rigorously designed, quantitative evaluation studies:

> We found that programs using the scientific model were difficult and expensive to implement in community settings. The increment of knowledge gained was often small in comparison to the cost of the grant. In many of the grants that funded academic researchers to evaluate community programs, we heard vociferous complaints from communities about the ways in which the demands of the evaluators were at odds with the needs of agencies and service providers. Illustrative of this was the evaluation of the Violence Prevention Initiative's community action grants. After five years and millions of dollars, the evaluation could not identify any community-level impacts or effects attributed to the interventions.[12]

Brousseau goes on to describe a shift in evaluation approach at The California Wellness Foundation, emphasizing a mixed-method, quality improvement, and local capacity building model along the lines advocated by the Kellogg Foundation. In this model, the evaluator is viewed more as a "coach" to grantees in developing tools for ongoing feedback on performance than as an external judge of the grantee's success in achieving predefined outcomes. Brousseau concludes,

> Much of our evolution in grant making and our assessment of it at TCWF has revolved around questions of causality; and in philanthropy, it generally appears that determining if a grant resulted in an anticipated outcome is commonly seen as the gold ring to reach for. A great deal of our collective energy, and that of our grantees, is spent in the reach. Even when we admit that assigning causality is hard or even impossible to determine, this admission is often followed by the self-admonition that we should keep trying. What if we were to simply admit that for many foundation grants, assigning causality and identifying outcomes are either impossible to assess or simply not worth the cost? The desire to measure outcomes, and to know precisely how much of an effect results from a grant or grant making program, stems from a positive motivation for funders to look critically at the work we fund — and the current emphasis on accountability is continuing to fuel this movement. As well motivated as the quest for outcomes is, it often backs us into a corner that results in disappointment, defensiveness and inability to see other positive effects. This single-minded emphasis on causal attribution assuredly serves to dampen creativity for other methods of understanding, assessing and communicating the work accomplished through grants.[12]

With their more nuanced and grantee-centered model of evaluation, these foundations are adopting an approach that is quite different from the federal government's desire for more outcomes-oriented evaluation as called for in the Government Performance and Results Act. In part, this difference reflects the contrasting contexts of government and foundation sponsorship of programs, with government programs using taxpayer dollars and operating in a public arena that demands a different approach to program stewardship and accountability than that called for in private philanthropy. Although it is unlikely that government policymakers would find it either appropriate or acceptable to agree with the assertion that outcomes are "impossible to assess," Brousseau's reflection on evaluation does raise several issues that are relevant to evaluations of government programs.

First, Brousseau forthrightly acknowledges the difficulty of performing rigorous, quantitative outcomes evaluations. The California Wellness Foundation is not alone in having paid for major, outcomes-oriented evaluations that frustrated sponsors and evaluators alike because of the formidable difficulties in designing and executing rigorous evaluation science in these subject areas. As the review of the literature on pipeline program evaluations in Chapter 4 indicates, it is possible to perform rigorous, outcome-oriented evaluations of pipeline programs in certain situations. However, careful consideration needs to be paid to identifying the particular research questions and contexts that are conducive to successful performance of rigorous evaluations, rather than approaching every evaluation with a "one size fits all" model.

Second, evaluators are increasingly appreciating the value of qualitative research methods. Although funders have had a justifiable reluctance to rely on qualitative reports as a core evaluation method, the science of qualitative research has evolved with investigators applying more systematic methods to recruitment and analysis for interviews and focus groups to attempt to minimize bias. Qualitative methods cannot provide definitive answers about program outcomes, but they can yield important insights into how interventions were implemented and the value of these interventions as perceived by students and other stakeholders. Qualitative research also often helps to generate new hypotheses that may be tested using more quantitative methods, such as by informing items to be included in survey questionnaires. Many evaluators are now using what is referred to as "mixed methods" designs that include both quantitative and qualitative techniques, with these methods complementing each other to produce a richer evaluation product than might be provided by either method alone.

Finally, Brousseau identifies an important tension between evaluation as performance feedback and as performance judging. Evaluation as judging is inevitable in the high-stakes environment of government policymaking where decisions must be made about how to get the most value out of public funds and evaluation is expected to provide evidence upon which to base these decisions. Yet even in this context, public funders may find it useful to include a spirit of evaluation as quality improvement in their approach to program assessments. When there is agreement that interventions are addressing a priority need and being conducted in good faith, evaluation results that reveal that outcomes are less than desired can be a useful tool for providing feedback to

program leaders and individual awardees and may point to ways to modify interventions to enhance their effectiveness.

CONCLUSION

Does the program make a difference? Awardees, funders, the public and other stakeholders invested in programs aimed at recruiting racial/ethnic minorities into the health professions want to know the answer to this question. This chapter has explored how to try to answer the question by outlining the conceptual framework for evaluations, exploring the benefits and challenges of alternative quantitative research designs, and discussing new directions in research design.

Chapter 4: Critical Review of the Research Literature on Pipeline Programs

This chapter reports the results of a systematic, critical review of the research literature on evaluations of pipeline programs. To perform this task, a thorough computerized literature search was conducted to identify evaluations of interventions that included a focus on increasing educational opportunities for underrepresented racial/ethnic minorities in the health professions, math and science. Studies were only included in the final literature review if they: 1) included quantitative, outcomes measures, and 2) met a minimum standard for scientific rigor in study design, as described in greater detail below.

METHODS

The review was guided by literature searches on the Medline and the Educational Resources Information Center (ERIC) online databases, using the following key words: health careers, minority, underrepresented, medical, math, science, education, pipeline, partnership, underserved communities, access, program, and enrichment. A reference librarian was also consulted to optimize search efforts. Discussions were held with colleagues and experts in the field in attempts to uncover the largest sample of relevant studies. Additionally, members of the study team directly communicated with representatives of the HHS agencies with programs listed in the inventory in Chapter 2, to attempt to identify any evaluations of HHS pipeline programs that had been commissioned by these agencies, including unpublished reports.

This search resulted in identification of a wealth of published articles on programmatic interventions at U.S. educational institutions to assist students from racial/ethnic minority and disadvantaged backgrounds interested in health professions careers in persisting in their studies and advancing in the academic pipeline. Most of the literature focused on descriptions of intervention processes, rather than on assessments of quantitative outcomes. Other articles described theoretical models that can be used to understand why students drop out or continue their college education. Far fewer studies reported evaluations using controlled study designs to examine quantitative outcomes. Agency representatives contacted for this project identified few commissioned, unpublished reports of their HHS programs, and those that were identified failed to evaluate quantitative outcomes or use study designs that met the minimum standard of scientific evidence required to be included in the systematic literature review.

Rating the Quality of the Evidence

A rating scheme developed for a prior systematic review[13] was used to assess the scientific quality of each study. Studies were first grouped according to their overall study design. With the exception of a single randomized experimental trial, all studies were observational in nature. Observational studies used two general designs: 1) cohort studies, and 2) pre/post intervention studies. Both cohort and pre/post studies were then rated on two basic criteria: 1) the rigor of the study design (criteria "D"), and 2) the

statistical methods used in the analysis (criteria "S"). Table 4.1 summarizes the rating scheme for the "D" and "S" criteria.

Table 4.1: Quality of Research Evidence: Scoring Methods

STUDY DESIGN ("D" Score)

Cohort Studies

1 = control group, individual level baseline data on both intervention and control group, formal adjustment (matching or regression methods) for potential differences in baseline characteristics

2 = control group, individual level baseline data on both intervention and control group, but no formal adjustment for potential differences in baseline characteristics

3 = control group without measurement of baseline characteristics

4 = no control group

Pre/Post Studies

1 = pre/post data both on intervention and external control groups

2 = no external control group data

STATISTICAL ANALYSIS ("S" Score)

1 = adequate statistical power and formal tests of significance

2 = inadequate statistical power, formal tests of significance performed (but usually not significant due to low power)

3 = no formal tests of significance

A randomized, controlled trial was awarded a rating of 1 for study design. For cohort studies, a rating of 1 for design required that the study included a control group, that individual-level baseline data were measured and reported for both the intervention and control groups, and that the study formally adjusted for potential differences between intervention and control groups in baseline characteristics (either by matching on key baseline variables or using regression models in the analysis). A grade of 2 for design was assigned if the cohort study used a control group and measured baseline characteristics of intervention and control groups, but did not formally adjust for any

possible differences in baseline characteristics. Studies that included a control group but failed to measure or comment on baseline characteristics of intervention and control groups received a design grade of 3. Studies with no control group were assigned a grade of 4.

Ratings of study design for pre/post studies differed from those for cohort studies. Pre/post studies have by definition at least one form of control group—the pre-intervention phase. However, the most rigorous pre/post studies also include an external control group to control for secular trends that may confound the study findings. For example, a rigorous pre/post study of MCAT scores before and after an intervention would ideally also measure MCAT scores for students who took the MCAT exam twice but did not participate in the intervention. Pre/post studies that used an external control group were given a design grade of 1, and those that did not use an external control group received a grade of 2.

Studies were assigned a statistical grade of 1 if they had adequate statistical power to detect a meaningful difference in outcomes and performed formal tests of significance. Studies that used formal tests of significance but had small sample sizes and therefore low statistical power were given a grade of 2. Many of the studies receiving a statistical grade of 2 reported fairly large differences in outcomes between intervention and control groups but simply included too few participants to permit these differences to achieve statistical significance. A grade of 3 was assigned to studies that did not report any formal tests of significance. Because the studies reviewed varied so widely in their quality, design, subject matter, and outcomes analyzed, it was not possible to perform a quantitative meta-analysis.

To simplify the final summary displays of studies, studies were classified into one of three aggregate groups. A “high quality study” is one in which: i.) a control group is used to compare with the intervention group (grade D1), and ii.) a formal statistical test of significance is used to compare outcomes among the intervention and control groups (grade S1). A “good quality study” is one with either a grade of D2 or S2. Studies with a grade of S3 were classified as “fair quality studies” regardless of the grade for study design. Studies that lacked control groups (D4) were excluded from the systematic review.

The following sections of this chapter provide the results of the systematic review. More detailed summaries of the 24 studies included in this review are presented in the Appendix.

REVIEW OF THE EVIDENCE

High School

High Quality Studies (3)

Used control groups and formal statistical tests of significance to compare outcomes among intervention and control students.

Study	Study Grade	Program/ Intervention, Site	Profession	Strategies	Outcome	Results
Campbell 1998	Cohort D1S1	Gateway to Higher Education, New York City Public Schools	Math and science	Academic enrichment, Professional exposure, Psychosocial support, Advising	SAT-taking, Graduation, College attendance	Increased SAT-taking, graduation, and college attendance
Herrera-Mata & Youngclarke (unpub)	Cohort D1S1	Doctors Academy, Fresno, CA	Medicine	Academic enrichment, Professional exposure, Psychosocial enrichment, Advising	High school GPA, Test scores, Graduation, Total credits completed	Increased GPA, Graduation, SAT-taking, and credits completed
Philips 1981	Cohort D1S1	AHEC, UTMB	Multiple	Professional opportunities	Health prof school/job	Increased enrolled/ working in health prof (esp nursing)

Good Quality Studies (1)

Used a control group but control group not well defined, or used a control group but did not perform formal statistical tests of significance

Study	Study Grade	Program/ Intervention, Site	Profession	Strategies	Outcome	Results
Thomson 1992	Pre/Post D2S1	HPSA, Baylor	Allied Health	Academic support, psychosocial support	Test scores, career knowledge	Increased MGIPS scores and career knowledge

Fair Quality Studies (2)

Studies lack both an external control group and formal statistical tests of significance. Pre/post testing was done in some cases to achieve some objective measure of program effect.

Study	Study Grade	Program/ Intervention, Site	Profession	Strategies	Outcome	Results
Bediako 1996	Pre/Post D2S3	Ventures in Education	General	Academic support, psychosocial support	Health prof school application, admission, matriculation	Increased all outcomes
Slater 1991	Cohort D3S3	Gateway to Higher Education	General	Mentoring, academic support, psychosocial support, professional opportunities	Test scores	Improved test scores

Six controlled studies have evaluated outcomes of interventions at the high school level that were specifically designed to promote underrepresented racial/ethnic minority and disadvantaged student entry into the health professions. All showed that the interventions had positive effects, although the studies vary in their methodological rigor and meaningfulness of the outcomes measured. The best of this group of studies was conducted by Philips et al,[14] who evaluated an intervention at the University of Texas Medical Branch (UTMB). This intervention gave high school and college students a summer experience to expose students to a variety of health careers and to build academic, communication, and interpersonal skills. The intervention was funded in the early stages of the BHPr AHEC program (and remains one of the few AHEC interventions to have been evaluated in a well-controlled study). This cohort study investigated career outcomes for intervention participants and nonparticipant controls. The control group consisted of students who had applied to the UTMB summer session but had not been accepted because of space constraints. Controls were matched for sex, age, ethnicity and parental occupation. Six years after participating in (or applying to) the UTMB intervention, a greater proportion of participants than of controls were employed in health professions (38 percent vs. 10 percent, p=.001), with most employed in nursing. This study is particularly noteworthy for its matched control group design and its measurement of the "hard" outcome of ultimate success in entering a health profession.

The City University of New York and the New York City Board of Education sponsor the Gateway to Higher Education program in five New York City high schools. The interventions provide comprehensive academic enrichment and support. Two published studies have reported evaluations of the Gateway program. The high quality study by Campbell et al[15] used a retrospective cohort design with matched controls, matching on anticipated graduation year, gender, race/ethnicity, and seventh grade standardized test scores in math and reading. The study showed increased rates of graduation, Scholastic Aptitude Test (SAT)-taking, Regent Exam-taking, and college matriculation among program participants. It also showed that among test takers, program participants attained higher scores on these exams. This controlled study suggests a robust, positive effect of the Gateway program on key academic metrics in high school. An evaluation of the Gateway program published prior to the Campbell et al article used a weaker study

design to assess similar outcome measures. In this earlier study, Slater and Iler[16] found that intervention participants had higher pass rates on the New York State Regents exam than other students at the same high schools, and had a higher mean SAT score than the national mean SAT score for all SAT-takers and the national mean SAT score of African-Americans. No attempt was made to control for the selection of higher achieving students into the Gateway interventions, making it difficult in this earlier study to attribute outcomes to the intervention rather than selection bias.

The study by Herrera-Mata and Youngclarke[17] of the Fresno "Doctor's Academy" shares some common elements with the study of the Gateway to Higher Education program. Like the Campbell et al study, the Fresno study examined the effects of a high school academy with a science and health professions emphasis. Investigators used a retrospective controlled cohort study. In the analysis, regression models were used to adjust for baseline differences between participants and controls. The Fresno study has a much smaller sample size, examining only a single school with an academy that has been in existence for a much shorter period than New York City's Gateway program. Although the results of the Fresno study are less dramatic than those of the New York City Gateway study, they support the conclusion that high school academies can enhance academic achievement on numerous short-term academic measures among participating students.

Thomson, Denk et al[18] evaluated the Health Professional Summer Academy directed by the Baylor College of Medicine. At the time of this study, Baylor participated in a partnership with the local school district for special High Schools for the Health Professions. Although these schools emphasized preparing students for the more competitive health professions, Thomson and colleagues recognized that the schools should also address the needs of students at these schools who were not at the top of their classes. The 3-week Health Professional Summer Academy was open to entering ninth graders who were at the bottom third of their classes in academic ranking and was designed to increase interest in and skills for allied health careers. Students' scores on the Middle Grades Integrated Process Skills test were measured before and after the intervention. Mean scores improved significantly on the post intervention tests. Scores also improved on a test measuring knowledge about health careers. There was no control group and no follow-up to know whether participants entered allied health or other health fields.

A study using a relatively weak design examined the Josiah Macy, Jr. Foundation-funded Ventures in Education program. This program supported curricular enrichment interventions at over 50 high schools throughout the United States serving disadvantaged students. The interventions consisted of a strong, basic academic curriculum, including college preparatory math and science, as well as tutoring and counseling, but did not attempt to "break new educational ground" in curricular innovation.[19] An evaluation of students participating in Ventures interventions at five of the schools funded in the early phase of the program found that 11.1 percent applied to medical school, 7.6 percent were accepted, and 7.3 percent matriculated.[19] The researchers asserted that "All of these percentages were considerably greater than zero, which is the approximate percentage of

students at these high schools who…applied to, were accepted by, and matriculated into medical school before the Ventures program." However, the researchers did not systematically track high school graduate outcomes prior to the Ventures program, nor did they specify how students were selected within participating schools for the special Ventures interventions. Although the medical school outcomes seem impressive, the study design raises questions about the validity of the pre-Ventures control group measurements and lack of adjustment for likely selection bias.

High School Evidence: Summary

Six sound quality studies of high school pipeline programs have been identified in the literature. Four of these studies demonstrated statistically significant beneficial outcomes. The study by Philips et al[14] revealed that a summer experience to expose high school students to a variety of health careers and to build academic, communication, and interpersonal skills ultimately was associated with increased rates of participants entering work in the health professions. This study achieved the goal of tracking the most desired, and seemingly most difficult, outcome: health care workforce entry. Two high quality studies (Campbell et al[15] and Herrera-Mata and Youngclarke[17]) indicate that comprehensive high school academies increase student achievement on several outcome measures, including persistence in the pipeline by matriculating to college.

College

High Quality Studies (10)

Used control groups and formal statistical tests of significance to compare outcomes among intervention and control students

Study	Study Grade	Program/ Intervention, Site	Profession	Strategies	Outcome	Results
Barlow & Villarejo 2004	Cohort D1S1	BUSP, UC Davis	Science, math	Academic support, professional opportunities, psychosocial support, financial support	College calculus, gen chem grades	Increased chem, calculus grades
Cantor 1998	Cohort D1S1	MMEP (multisite)	Medicine	Academic support	Med school acceptance	Increased med school acceptances
Carline 1999	Cohort D1S1	Gen'l enrichment programs	Medicine	Academic support	Score on interview for UW med school	No difference in interview score
Fullilove &Tressman 1990	Pre/Post D1S1	Math Workshop Program, UCB	Math	Academic support	1st yr math grades, BS	Increased math grades and BS degrees
Hesser 1996	Pre/Post D1S1	MAAP, Med College of GA	Nursing	Academic support, psychosocial support	Retention, grades, board passage	Increased GPA (trend to increased grad rate and board passage)
Hesser 1993	Pre/Post D1S1	MAAP, Med College of GA	Allied Health	Academic support, psychosocial support	Retention in school	Increased graduation rate

Maton 2000	Cohort D1S1	Meyerhoff Scholars, UMD	Science, math, engineering	Academic support, financial support, mentoring, psychosocial support, professional opportunities	College GPA, SME grad school, med school	Increased science GPA, entry into SME grad school, med school entry
Nagda 1998	Random-ized trial D1S1	Undergrad Research Opportunity Program, Univ of Michigan	Multiple	Partner student and faculty mentor through research experience	Persistence in college	Subgroup of students showed increased rate of retention
Strayhorn 2000	Cohort D2S1	MEDP, UNC	Medicine	Academic support	Med School acceptance and grad	Increased med school acceptance and grads
Thomson 2003	Cohort D1S1	PHC, Baylor and UT-PA	Medicine	Academic support, summer program, financial aid, secured med school admission	Matriculation to medical school	Increased matriculation to medical school

Good Quality Studies (1)

Used a control group but control group not well defined, or used a control group but did not perform formal statistical tests of significance

Study	Study Grade	Program/ Intervention, Site	Profession	Strategies	Outcome	Results
Matsui 2003	D2S1	Biology Scholars Program, UC Berkeley	Science	Academic support, social support, research opportunities, mentoring	College graduation with biology major, GPA among grads	Increased biology grads, higher GPAs

Fair Quality Studies (3)

Studies lack both an external control group and formal statistical tests of significance. Pre/post testing was done to achieve some objective measure of program effect.

Study	Study Grade	Program/ Intervention, Site	Profession	Strategies	Outcome	Results
Lewis 1996	Pre/Post D2S3	HCOP, SDSU	General (med)	Academic support, mentoring, psychosocial support	Health prof appl and acceptance	Increased all outcomes
Pisano 1983	Pre/Post D2S3	MEdREP, Tulane	Medicine	Academic support	MCAT scores	Improved MCAT scores
Pisano 1983	Cohort D3S3	MEdREP, Tulane	Medicine, other	Academic support	Acceptance to MODVOPP school	Increased acceptances

Considerably more high quality research has investigated college interventions. Seven studies evaluated college enrichment interventions to prepare students for post baccalaureate health professions schools; five of these interventions specifically targeted medical school entry. Another group of four studies examined college interventions designed to improve math and science achievement without a specific health professions focus. Two additional studies evaluated interventions at a single institution to enhance educational success at baccalaureate-level health professions training programs, one in allied health and one in nursing. Almost all of these studies found that interventions had a positive effect, although the methodological rigor and quality of the evidence is not consistently high across studies.

Preparation for Postbaccalaureate Level Health Professions Schools

Cantor et al,[20] in one of the best-designed educational evaluation studies, investigated the Minority Medical Education Program (MMEP) funded by the Robert Wood Johnson Foundation and coordinated by the AAMC. This competitive, 6-week residential summer educational program for premedical college students focuses on training in the sciences and improvement of writing, verbal reasoning, studying, test taking, and presentation skills. The MMEP program funds interventions at several medical schools, with interventions relatively standardized across sites. Investigators compared rates of medical school acceptance among MMEP participants and nonparticipants, using regression methods to carefully adjust for differences in many baseline characteristics between participants and nonparticipants. On unadjusted analysis, 49.1 percent of MMEP participants and 41.6 percent of nonparticipants were accepted into medical school (odds ratio=1.37). On adjusted analysis, the odds ratio of acceptance was 1.69 for participants relative to nonparticipants.

Strayhorn[21] examined a premedical college enrichment intervention at a single institution, the Medical Education Development Program at the University of North Carolina at Chapel Hill. Seventy-six percent of students who participated in the 9-week summer intervention were accepted into medical school. This percentage compares favorably to the acceptance rate nationally for all underrepresented racial/ethnic minority medical school applicants (47 percent) and non-underrepresented minority applicants (54 percent) during the same time period. However, unlike Cantor et al,[20]Strayhorn did not formally adjust for possible differences between intervention participants and nonparticipants. Strayhorn did observe that the average grade point average and MCAT scores of intervention participants were similar to those of all underrepresented racial/ethnic minority medical school applicants nationally, suggesting that there may not have been a major selection bias for intervention participants.

Only a single study among all the research reviewed reported that an intervention was not effective. Carline et al[22] examined underrepresented racial/ethnic minority applicants to the University of Washington School of Medicine and determined which applicants had participated in some type of premedical college enrichment program. The investigator hypothesized that because these interventions often provide training in interviewing skills, intervention participants would received higher scores than nonparticipants on their interview evaluations at University of Washington. However, no difference in

interview scores was detected. This study is somewhat limited by its focus on only a single institution and on the single intermediary outcome of interview scores.

Two studies with weaker methodologies investigated the Medical Education Reinforcement and Enrichment Program (MEdREP) at Tulane University School of Medicine. This summer program provided clinical experiences, MCAT preparation, and other forms of academic enrichment. Pisano and Epps[23] compared MEdREP participants in 1976 with applicants from the same year who did not participate in the intervention. Sixty-five percent of participants were accepted to a health professions school compared to 37 percent of nonparticipants. No possible differences in baseline characteristics between participants and the control group were reported, nor were formal tests of significance performed. In a separate publication on the same intervention, Pisano and Epps[24] also performed a pre/post study of MCAT scores. Among MEdREP participants who had taken the MCAT prior to the intervention, scores improved when they retook the exam after the intervention. However, sample sizes were small, there was no comparison group to adjust for possible effects of simply taking the exam for the second time, and no tests of statistical significance were performed.

In contrast to the relatively brief summer enrichment interventions that were the subject of the studies discussed above, two studies examined more sustained college health professions enrichment interventions. The Thomson, Ferry et al[25] study examined the Premedical Honors College Program, a special premedical track at the University of Texas-Pan American (UT-PA) administered by Baylor College of Medicine and UT-PA and funded in part by BHPr. Through a highly competitive selection process each year high school seniors graduating from South Texas schools are accepted into the Premedical Honors College Program at UT-PA. There they receive a rigorous structured curriculum focused on science, math, communications and technology as well as academic and career counseling. Program participants receive conditional acceptance to Baylor School of Medicine at program entry, contingent on successfully completing the Premedical Honors College Program (PHC) and meeting Baylor School of Medicine prerequisites and minimum required MCAT scores. Program participants receive full tuition and fee waivers for both college at UT-PA and medical school at Baylor.

The study employed a retrospective controlled cohort design with the comparison group composed of those students who were selected to interview for the PHC but who did not matriculate into the program. It showed that the odds of medical school matriculation were seven times higher for PHC students than for nonPHC students. This is perhaps one of the strongest published studies of a health professions preparation program, demonstrating that a well-articulated and comprehensive program conducted in partnership between a private medical school and a public university college program can significantly increase the number of disadvantaged students from a region matriculating into medical school. There was also the suggestion that the entire premedical culture at UT-PA may have been influenced by the Premedical Honors Program. The ability of this study to include an ecological analysis, measuring historical trends in an entire region's "output" of medical students, is a particular strength.

The San Diego State University HCOP funded by BHPr was studied by Lewis.[26] This college intervention used multiple intervention strategies to attempt to promote successful application to schools in a variety of health professions. In 1986-1990, prior to the HCOP intervention, 46 underrepresented racial/ethnic minority students from San Diego State University applied to health professions and 38 were accepted (83 percent acceptance rate). In 1991-1995, during the HCOP intervention, 95 underrepresented racial/ethnic minority students applied to health professions schools and 78 were accepted (82 percent acceptance rate). Mean college grade point averages for underrepresented racial/ethnic minority pre-health students also improved following implementation of the HCOP intervention. Weaknesses of this study are the lack of formal tests of significance for comparing the pre- and post-HCOP outcomes, and lack of data on trends in the overall numbers of underrepresented racial/ethnic minority students enrolled at San Diego State University which might affect the number of underrepresented racial/ethnic minority applicants over time. The intervention appears to have primarily been associated with increases in the number of applicants and not in the acceptance rate, and the former may be confounded by possible growth in overall underrepresented racial/ethnic minority enrollment at the school.

College Math and Science Enrichment

Five studies examined interventions to improve underrepresented racial/ethnic minority achievement in math and science courses in college without an explicit goal of encouraging health careers. Maton et al[27] investigated the Meyerhoff Scholars Program at the University of Maryland Baltimore County (UMBC). This highly competitive program provides a comprehensive array of intervention strategies including academic enrichment, financial aid, advising and social support. The objective is to increase the number of underrepresented racial/ethnic minority students pursuing graduate doctoral degrees in science, engineering, and math. Maton et al performed a comprehensive and well-designed study that included both a cohort design and a pre/post study design. For the first study component, the investigators compared three years of Meyerhoff Scholars with students who were accepted but declined to participate in the Meyerhoff Programs during the same years. Meyerhoff Scholars were nearly twice as likely as control students to graduate in science, engineering or math majors (83 percent vs. 46 percent), were five times more likely to enter a graduate school program in science, engineering or math, and had significantly higher college grade point averages in science, engineering and math courses than controls. The investigators also compared the Meyerhoff Scholars to a group of UMBC students from the pre-intervention era, with the control students selected to match Meyerhoff Scholars on a variety of demographic and baseline academic characteristics. Results were similar to the cohort study, with higher science, engineering and math achievement and graduate school matriculation.

The study by Nagda et al[28] examined whether the Undergraduate Research Opportunity Program at the University of Michigan, an intervention to create a research partnership between faculty members and college students, can prevent attrition from college among underrepresented racial/ethnic minority and disadvantaged students. Although this intervention did not specifically have a health professions pipeline focus, but rather incorporated student research activities in diverse fields, this study is noteworthy for both

its methodology and results. Its methodological contribution is that it is one of the few college intervention studies to use an experimental design with randomization of students meeting eligibility criteria to intervention or control groups. Although random assignment of students raises ethical questions, the authors of the study justified this method on the basis of there being only a limited capacity to accept students into the program. The authors believed that for students meeting the basic eligibility criteria, random assignment represented a fair approach to selecting students for participation given the finite resources available. The results of this study also indicate that some interventions may have an effect that differs according to the students' race-ethnicity. The college research mentorship intervention had a positive effect on retention of African- American but not Latino students.

Three more selective interventions to improve college math and science achievement have also been evaluated using rigorous research methods. The Math Workshop Program at the University of California (UC), Berkeley developed small study groups and additional academic supports to promote success in the freshman year math course. Fullilove and Treisman[29] performed a high quality study that compared intervention participants with contemporary nonparticipants and historical controls at UC Berkeley. Subanalyses were performed after stratifying intervention and control students according to baseline demographic and educational characteristics. Intervention students were much more likely to receive higher grades in freshman year math and to ultimately graduate from UC Berkeley.

More recently Barlow and Villarejo[30] evaluated the Biology Undergraduate Scholars Program at University of California, Davis. This intervention included a summer pre-matriculation session followed by a multidimensional intervention involving primarily calculus and chemistry courses during freshman and sophomore years. The study design was a retrospective cohort with a comparison group of UC Davis racial/ethnic minority freshmen who were invited to participate in the program, but declined participation. The study used methods to adjust for baseline differences between intervention and control students. The study showed that the program can improve the odds of underrepresented racial/ethnic minority and disadvantaged students completing pre-health career math and science "gateway" courses with grades that would allow these students to be more competitive for admission to graduate health professions schools. The study also demonstrated that such a program can motivate students to persist and graduate in a science major.

A study of somewhat lower quality was performed of a similar program, the Biology Scholars Program (BSP), at UC Berkeley. Matsui et al[31] evaluated this program designed for college students from underrepresented backgrounds with an interest in the biological sciences. The program has "the goal of creating a community of scholars with both high academic expectations and high academic support," including academic and social supports, mentoring, and research experiences. Matsui et al examined students entering UC Berkeley who reported an intention at matriculation of majoring in biological sciences, and found that BSP students were significantly more likely than non-BSP students to graduate with a biology degree. These outcomes held for the 49 percent of

BSP students who were African American or Latino, in comparison with their non-BSP minority counterparts. Among students graduating with biology degrees, the BSP students also had higher mean grade point averages than their non-BSP counterparts.

Achievement in Baccalaureate Level Health Professions Schools

In the 1980s, the Medical College of Georgia implemented the Minority Academic Advising Program to improve retention of underrepresented racial/ethnic minority students in the allied health and baccalaureate nursing training programs. Hesser et al[32,33] used a pre/post design to evaluate the outcomes of this intervention, using non-underrepresented minority student data to control for secular trends at the College. In allied health, graduation rates for African-American students increased from 72 percent before the intervention to 83 percent after the intervention. Graduation rates for non-African-American students remained relatively constant during the same period. In nursing, the mean grade point average for African-American students increased significantly and the Grade Point Average (GPA) gap between African-Americans and other students narrowed. Graduation rates for African-American nursing students, which were already high (92 percent) in the pre-intervention period, increased somewhat to 97 percent, a change which did not reach statistical significance. Passing rates at first sitting for nursing board exams increased from 49 percent to 64 percent over the pre- and post-intervention periods, although this difference also did not achieve statistical significance due to the small sample size.

College Evidence: Summary

Fourteen formal evaluation studies of undergraduate pipeline programs have been identified in the literature. Ten of these studies are of the highest quality; and all of these demonstrated statistically significant outcomes. The strongest finding in support of college level pipeline programs comes from the study by Thomson et al.[25] The finding is particularly noteworthy because the program itself is especially comprehensive and effective. The program addresses multiple aspects of student needs across the span of undergraduate life. The results demonstrate a large impact on number of matriculates to medical school in an entire geographical region and over the course of many years.

Of the remaining nine high quality studies, six are evaluations of health professions pipeline programs. As a group, five of these studies demonstrated benefits in increasing college math/science grades, grade point average, and entry to medical school. The sixth remaining high quality study in this category showed no benefit of pipeline program participation on the interview score for medical school application. The three high quality studies of pipeline programs that were not specifically targeting health professions all showed beneficial outcomes from the programs evaluated. The positive outcomes included increased math/science grades, grade point average, entry to medical and graduate school, and overall retention.

Post Baccalaureate and Health Professions School Pre-matriculation Stage

High Quality Studies (1)

Used control groups and formal statistical tests of significance to compare outcomes among intervention and control students

Study	Study Grade	Program/ Intervention, Site	Profession	Strategies	Outcome	Results
Grumbach & Chen 2006	Cohort D1S1	Mulitple Universities of California	Medicine	MCAT prep, Academic support. Personal advising	Matriculation to medical school	Increased odds of matriculation to medical school

Good Quality Studies (2)

Used a control group but control group not well defined, or used a control group but did not perform formal statistical tests of significance

Study	Study Grade	Program/ Intervention, Site	Profession	Strategies	Outcome	Results
Ugbolue 1987	Cohort D2S1	PEP, BU	Medicine	Prematriculation	Academic support, psychosocial support	1st yr grades and retention
Hesser 1992	Cohort D2S2	SPP, Medical College of GA	Medicine	Prematriculation	Academic support, psychosocial support	1st year grades, retention

Fair Quality Studies (1)

Lacked either an external control group or formal statistical tests of significance

Study	Study Grade	Program/ Intervention, Site	Profession	Strategies	Outcome	Results
McGlinn 1999	Pre/Post D1S3	MEDPREP, S. IL. School of Med	Medicine	Academic support, psychosocial support, professional opportunities	MCAT scores	Increased MCAT scores

The study by Grumbach and Chen[3] examined whether participation in the University of California's post baccalaureate premedical programs increases the likelihood of matriculation to medical school. The study included data from several University of California post baccalaureate programs, each one slightly different from the others. It employed a retrospective controlled cohort design with a comparison group of applicants to the post baccalaureate programs but who did not participate in the programs. The study showed that the odds of medical school matriculation were 6.3 times higher for program

participants than for nonparticipants in the adjusted model. And, when controlling for MCAT scores, the odds of medical school matriculation were 8.1 times higher for participants than for nonparticipants. This study verified that well-structured programs targeting students in their post baccalaureate year can substantially improve the odds of underrepresented racial/ethnic minority and disadvantaged students matriculating into medical school.

Two studies examined pre-matriculation interventions to enhance retention and academic success of underrepresented racial/ethnic minority students accepted into medical school. Ugbolue et al[34] evaluated the Pre-entrance Enrichment Program at the Boston University School of Medicine, also supported by BHPr HCOP funds. Underrepresented racial/ethnic minority participants were compared to underrepresented minority nonparticipants, although no adjustment was made for differences in baseline characteristics and sample sizes were small. Participants received higher grades in first year medical school classes and had a non-significant trend towards a higher rate of successful passing into the second year. Hesser and Lewis[35] evaluated a similar intervention at the Medical College of Georgia. Both intervention and control students had over 90 percent retention rates for the first year of medical school, although there was a slight trend for intervention students to be less likely to leave, withdraw or repeat the first year. There was also a non-significant trend of higher biochemistry grades for intervention students. The sample sizes were small, limiting the study's statistical power.

The study by McGlinn et al[36] of the Medical/Dental Education Preparatory Program (MEDPREP) at Southern Illinois University School of Medicine examined an intermediary outcome, MCAT scores, rather than actual entry into medical school. MEDPREP, funded in part by the BHPr HCOP program, is an extensive and multifaceted intervention intended to increase the competitiveness of college graduates applying to medical school and other health professions schools. McGlinn et al examined MCAT scores of participants pre- and post-intervention, comparing these scores to all MCAT examinees in the same year who had also previously taken the MCAT. Intervention students had much greater improvement in MCAT scores than did all MCAT retakers, although no formal tests of significance were performed on these differences.

Post Baccalaureate Evidence: Summary

Of the four studies of post baccalaureate pipeline programs identified in the literature, two demonstrated statistically significant beneficial outcomes. The strongest finding comes from the most recent study by Grumbach and Chen[3] which reveals that post baccalaureate programs in California do serve their ultimate goal of increasing the odds of matriculation to medical school for underrepresented racial/ethnic minority and disadvantaged students.

SUMMARY

Although there remain relatively few well-designed, quantitative evaluations of pipeline programs focused on racial/ethnic minority and disadvantaged students interested in health careers or in math and science fields, the 24 studies reviewed in this chapter

suggest that these types of interventions are associated with meaningful improvement in students' academic performance and the likelihood of successfully advancing into a health professions career. It is encouraging that in the four years since the publication of another systematic review of the pipeline literature,[13] several additional studies have been published in peer-review journals that achieve a high quality of scientific rigor in evaluating pipeline interventions.

Findings from the best quality evaluation among the 24 studies reviewed in this chapter indicate that:

- High school "academy" programs enhance students' academic achievement as measured by short-term outcome measures like grade point average, SAT scores, and scores on standardized tests of language, and they lead to higher rates of graduation from high school and matriculation to college;
- Special summer enrichment programs can boost the success of underrepresented racial/ethnic minority premedical students in applying to medical school by approximately 25 percent;
- A well-articulated and comprehensive program conducted in partnership between a private medical school and a public university college program can significantly increase the number of disadvantaged students from a region matriculating into medical school;
- A well-structured program targeting college students in their early college years can improve the odds of underrepresented racial/ethnic minority and disadvantaged students completing pre-health career math and science "gateway" courses with grades that would allow these students to be more competitive for admission to graduate health professions schools, and it can motivate students to persist and graduate in a science major;
- College research mentorship has a positive effect on retention of certain subgroups of underrepresented racial/ethnic minority and disadvantaged students; and
- Comprehensive post baccalaureate programs can increase rates of matriculation to medical schools.

Other findings from less rigorous analyses of pipeline programs suggest that:

- Special college interventions that are sustained throughout the college period can increase matriculation rates of underrepresented racial/ethnic minority and disadvantaged students into medical school and other health professions schools.
- The positive impact on matriculation to graduate professional schools of college programs that are sustained throughout the college period is greater than that of short-term summer interventions.
- Interventions at baccalaureate-level health professions training programs can enhance retention and successful graduation for underrepresented racial/ethnic minority students.
- Postgraduate level, pre-matriculation interventions for accepted underrepresented racial/ethnic minority students may also promote success in the first year of health professions school.

Some of the findings from less rigorous, unpublished analyses of programs that were previously reported[13] have been strengthened, either by augmentation of the scientific rigor of the evaluations, or by revealing added positive benefits from the programs investigated. As previously mentioned, the finding that post baccalaureate interventions improve MCAT scores has been bolstered by the more recent finding that post baccalaureate interventions actually increase matriculation to medical school. The previous finding that college interventions can improve underrepresented racial/ethnic minority achievement in science and math courses has been augmented to show that such interventions promote completion of said "gateway" courses with competitive grades that enhance applications to graduate health professions schools, while encouraging students to persist and graduate in their science majors. And the evaluation of the pipeline program in Texas where undergraduate and medical schools partnered with the state government has now been published in a peer-reviewed journal.

It cannot yet be concluded with confidence that interventions implemented at the high school level increase underrepresented racial/ethnic minority entry into the health professions. However, there remains the suggestion that outreach interventions at this level in the pipeline do instill interest in health careers and are associated with better academic outcomes such as college matriculation. Whether that interest and academic progress is sufficient to carry high school students through to health careers has yet to be directly demonstrated.

Another limitation of the existing evaluation literature is that research has not isolated the specific elements of successful pipeline interventions that account for their effectiveness. Interventions almost always include a constellation of strategies, and evaluations measure the effects of the entire package of strategies. No published evaluations have used multi-armed designs to tease out the effects of the individual components of interventions. Many conceptual models have been proposed for understanding the factors that might influence the general academic success of racial/ethnic minority and disadvantaged students, particularly at the college level. The models point to the theoretical value of preenrollment workshops or summer bridge transition programs for entering first year college students, college orientation at the start of college, academic advising and personal counseling, tutoring, faculty mentoring, basic skills instruction and writing workshops, workshops on note taking strategies, time management, library search skills, and financial aid and career counseling. Many of the interventions that appear to be effective based on the high-quality studies reviewed in this chapter used a combination of many of these types of intervention strategies. However, further research will need to examine the relative contribution of specific intervention components to the effectiveness of these multi-pronged interventions.

CONCLUSION

Funders and users of pipeline programs that seek to increase the number of underrepresented racial/ethnic minority and disadvantaged students in the health professions continue to look to scientific evidence to provide insights into the effectiveness of pipeline interventions. Although there are hundreds of studies and

evaluations of diversity-oriented pipeline programs, only a small percentage of those studies meet acceptable standards of scientific rigor. Of the 24 studies reviewed in this chapter, 16 satisfy the standard of the highest scientific rigor, i.e., they employ both an external control group and a formal test of statistical significance. All but one of these 16 studies show a benefit from the pipeline program evaluated.

It is evident from the literature that in most instances, institutions and organizations do not employ rigorous evaluation methods and procedures to arrive at more conclusive evidence of intervention effectiveness. Chapter 2 of this report discusses the many reasons why it is difficult to perform rigorous, quantitative evaluation research on the outcomes of educational interventions. Given these challenges, rather than viewing the 24 studies reviewed in this chapter as a disappointing number of studies, it may be reasonable to be encouraged that at least 24 studies using relatively rigorous scientific methods have been published in the literature. The high quality studies reviewed in this report do indicate that some evaluators are able to use methods that achieve a reasonable degree of scientific rigor and validity to assess quantitative outcomes. These high quality studies suggest that pipeline program interventions can exert a meaningful, positive effect on student outcomes.

Chapter 5: Key Findings and Policy Options

FINDINGS

I. Status of HHS Pipeline Programs

A. HHS has many existing assets in pipeline programs. Many HHS agencies currently include as part of their portfolio of programs a focus on educational pipeline interventions to enhance opportunities for racial/ethnic minority and disadvantaged students to enter careers in the health professions and health sciences. These programs cover a broad scope of targeted health professions and health science careers, as well as intervening along the full length of the educational pipeline from elementary school to graduate and professional school.

B. There is room for more coordination and information sharing across agencies and programs. Agencies appear to operate their pipeline programs in relative silos, with little opportunities for coordinating interventions across agencies or developing a learning community among agencies to share best practices and other insights from each agency's pipeline programs.

II. Evaluation Approaches and Strategies

A. Process evaluations have been the mainstay of traditional HHS approaches to evaluation, and have some value as a means of assuring accountability in the use of award funds and informing quality improvement efforts. Although process evaluations cannot answer questions of program effectiveness in achieving desired outcomes, they can provide important information about who was served by the interventions and what activities were performed in fulfilling the terms of an award. They can also reveal barriers and facilitators to implementing interventions that may be informative for program planning and providing feedback for performance improvement.

B. Outcomes evaluations are desirable for assessing program and intervention effectiveness, but come at the cost of greater expense and technical complexity relative to process evaluations. In general, the more rigorous the scientific method for an outcomes-oriented evaluation study, the more costly and technically challenging it is to perform the study and the greater the need to rely on external evaluators. Study designs for outcomes evaluations lie on a continuum of scientific rigor, ranging from the least rigorous design of an uncontrolled, observational cohort study to the most rigorous design of a randomized, controlled experiment. Randomized controlled trials are especially difficult to perform in the case of pipeline interventions, in addition to raising ethical concerns about randomization to intervention and control groups. In some select circumstances, randomized trials may be considered as an evaluation design. Observational studies are more feasible to perform, although not without their own challenges including concerns about unmeasured selection effects and confounding factors that may bias

results. Opportunities exist to perform more rigorous "quasi-experimental" controlled observational studies to evaluate pipeline programs by identifying and collecting data on appropriate control groups to compare with data collected on intervention groups.

C. **Uniform Data Sets are useful for systematically collecting information on intervention processes, and may also have value for creating a database that may be linked by external evaluators or agencies to other databases to perform outcomes evaluations.** Creating standard formats for Web-based reporting by awardee institutions has merit for systematically and uniformly collecting process data from institutions receiving awards to implement pipeline interventions. Examples of well designed, web-based Uniform Data Sets are: the Disadvantaged Assistance Tracking and Outcome Report (DATOR) Uniform Data Set developed by the HRSA Division of Health Careers Diversity and Development, which focuses on collecting data on individual participants in HRSA programs; and the OHM Uniform Data Set, which currently focuses on collecting data on the activities conducted by OMH-sponsored grant programs. Development of Uniform Data Sets benefits from user group input and pilot testing to address issues of feasibility of data collection and user "friendliness." The primary limitation of Uniform Data Sets is the difficulty of designing standardized data collection tools that are responsive to the tremendous variety of pipeline interventions and programs across institutions funded by HHS. Although Uniform Data Sets will rarely suffice in and of themselves as a tool for collecting data on pipeline program outcomes, they may play a valuable role in providing a substrate of data that can be capitalized on for more far-reaching outcomes evaluations. For example, Uniform Data Sets that collect essential identifying information on program participants (e.g., last four digits of the social security number) can be used in studies that longitudinally track participants and match students to other data sets (e.g., databases on health professions school enrollment) to determine delayed outcomes such as matriculation in health professions schools.

D. **Program evaluations face a tension between evaluation in the service of performance feedback and in the service of performance judging.** Evaluation can serve different goals, and it is important for evaluators and sponsoring agencies to be clear about the goals of specific evaluation efforts. For government programs using taxpayer dollars, there is a premium on evaluation as a means of assuring accountability in stewardship of public programs; this often heighten the stakes involved in evaluation research when funding decisions for overall programs and institutions competing for funding may hinge on the results of outcomes studies. Other models place less emphasis on evaluation as a means to judge in quantitative terms the effectiveness of programs, and frame evaluation as a tool for providing constructive feedback to awardee institutions in the spirit of continuous quality improvement. These models tend to be more accepting of evaluation designs that lack quantitative scientific rigor and use qualitative and mixed methods to generate insights into the implementation of interventions and the experiences of those participating in and implementing interventions.

III. Literature Review on Pipeline Interventions

A. There is a critical mass in the literature of 24 evaluation studies meeting a minimum standard of scientific evidence to evaluate quantitative outcomes of pipeline program interventions. These studies consistently indicate that pipeline interventions are associated with positive outcomes for racial/ethnic minority and disadvantaged students on several meaningful metrics, including academic performance and the likelihood of enrolling in a health professions school. A systematic, critical review of the literature on pipeline programs identified 24 studies meeting a minimum standard of scientific evidence, all but one of which reported positive outcomes associated with racial/ethnic minority and disadvantaged students' participation in structured pipeline programs. These studies address interventions across a spectrum of pipeline stages, including high school, college, and postbaccalaureate stages, and involving a variety of targeted health professions and health science careers, including medicine, nursing, and biomedical research.

B. Although these outcomes studies provide a good foundation for assessing the effectiveness of pipeline programs, there are some important limitations of the existing evaluation literature and the field would benefit from more high quality evaluation research. Overall, there has been a limited volume of well designed evaluation studies reported in the literature. In addition, studies have failed to assess the specific ingredients in pipeline programs; instead, virtually all evaluations study multifaceted interventions, making it difficult to know which particular components of interventions may be most valuable (e.g., academic supports, career exposure, mentoring). Finally, no evaluation studies have performed formal cost-effectiveness analyses to judge the benefit of interventions relative to their costs.

POLICY OPTIONS

1. **Ensure a balance in HHS-sponsored pipeline programs so that these programs address racial/ethnic minority and disadvantaged student needs across a spectrum of health professions and health careers.** It is important to maintain a balance in investment across programs, including biomedical research, public health, and Title VII and Title VIII targeted health professions.

2. **Identify an agency in HHS to serve a facilitating role in promoting greater coordination among, and information sharing across, HHS agencies in the administration of pipeline programs.** This facilitating role could include functions such as commissioning updated inventories of HHS pipeline programs, disseminating evidence on intervention effectiveness, sharing tools for Uniform Data Sets and related methods for data collection, and convening agency representatives to share best practices and barriers and facilitators to implementing interventions. Ideally, such a coordinating effort would also reach out to programs in federal agencies beyond just those in HHS, such as programs administered through the U.S Department of Education.

3. **Continue to develop and refine Uniform Data Sets for pipeline programs, focusing on collection of key process data elements such as data on the individuals served by program interventions and the specific intervention activities implemented.** The content of Uniform Data Sets should be guided by the questions, "What are the most critical process items to measure to ensure that awardee institutions are accountable in performing pipeline activities funded by HHS programs?," and "What key data elements could be compiled into a database that would serve particular value as a resource for longitudinal outcomes studies when linked to other databases?" For example, the inclusion in the HRSA DATOR Uniform Data Set of the last four digits of participants' social security number and birth date, in addition to their name, is particularly useful for linking DATOR records at the individual student level to other databases such as the AMCAS database on medical school matriculation. Other key participant characteristics that should be included in these types of Uniform Data Sets include race-ethnicity, gender, age, and at least some measure of family socioeconomic status such as parental education. Collection and maintenance of databases containing identifying information on individual students must be done in a secure manner that is highly vigilant about protecting the confidentiality of these data. To create even greater opportunities to use Uniform Data Set databases not just for uncontrolled cohort studies, but for controlled cohort studies, Uniform Data Sets could be expanded to include data on program applicants who did not actually enroll in the sponsored program activities. For example, HCOP institutions could report on students who applied to a school's HCOP but did not enroll in the HCOP, either because they were not admitted to the program or were admitted and elected not to participate. Similar approaches could be used for creating Uniform Data Sets for programs such as CDC and NIH sponsored pipeline programs. Data on applicants who did not actually participate in sponsored programs could be used to create control groups to compare with students who participated in program interventions, enhancing the value of Uniform Data Sets for creating registries of control and intervention students that could be used for more rigorous, observational evaluation studies. Development of Uniform Data Sets needs to occur in a deliberate manner that acknowledges that standardized data collection tools run the risk of being insensitive to the unique contexts and project scopes of the varied institutions and activities supported by HHS programs; creating opportunities for ongoing feedback from reporting institutions, such as through "user group" advisory committees and pilot testing of measures prior to finalization, is important for development of feasible data collection tools that will encourage reliable reporting of data elements by funded institutions. In addition, Uniform Data Sets should include a section allowing respondents to enter free text information to report qualitative findings about their activities and evaluations.

4. **Establish a reasonable minimum standard for routine evaluations to be conducted by the institutions and organizations awarded funds from HHS to implement racial/ethnic minority pipeline programs, consisting of the requirement that these organizations explicitly map out a logic model for their planned intervention(s) and collect and report basic data on processes and intermediate outcomes based on these logic models.** Logic models can help

individuals and organizations implementing interventions to be explicit about the activities they plan to implement and the participants who will be targeted by these interventions, and also to articulate how they anticipate that these interventions will lead to changes in specified intermediary and ultimate outcomes. As part of developing these logic models, applicants could be expected to identify metrics for measuring and reporting data on processes and intermediary outcomes. Applicants could be allowed to include qualitative, as well as quantitative, approaches to assessing achievement of intermediary outcomes. Applicants should also be asked to consider metrics on ultimate outcomes, with the understanding that in many, if not most cases, it may not be reasonable or feasible to expect the applicant organization itself to actually collect more "distal" outcome measures requiring major, ongoing efforts in data collection (e.g., longitudinal tracking of students over many years after participating in a pipeline intervention to measure distant educational outcomes). This approach would result in making an uncontrolled cohort study design using data reported by awardees the minimum standard for all routine evaluations. Although this is not a type of design that permits causal inferences to be made about intervention effectiveness, it is useful for encouraging clearer conceptualization at the time of planning interventions of the hypothesized link between processes and intermediary outcomes and for providing subsequent feedback about whether basic intervention objectives are being met. Some awardees might opt to also include uncontrolled, pre/post designs as part of such a routine evaluation approach, when they can identify metrics for intermediary outcomes that are amenable to such an approach (e.g., pre/post surveys of student knowledge, self-reported skills acquisition, or career interests).

5. **Recognize that evaluations using more rigorous, controlled study designs are unlikely to be accomplished as part of the routine evaluation approach described in Recommendation 4, and require deliberate, proactive planning on the part of funding agencies, external evaluators, and intervention sites to design and execute controlled, outcomes-based research studies.** Although the goal of producing more outcomes-oriented evaluations of HHS programs has merit, the effort and expense of conducting more rigorous evaluation research should not be underestimated. In determining the feasibility of conducting a rigorous evaluation study for a specific program or set of interventions, the following questions need to be answered:
   - Can a control group be identified that will be reasonably comparable in underlying characteristics to the intervention group?
   - Are relevant data on control and intervention group baseline characteristics available from an existing database, such as a Uniform Data Set or a school's student registration database, or do they need to be specially, prospectively collected for the study?
   - Are the program interventions clearly defined and likely to be implemented faithfully? If the interventions are to be implemented at more than one site, is there reasonable assurance that the interventions and data collection tools will be sufficiently standardized across sites so that the data may be pooled across sites?

- Are intermediate and ultimate outcome measures clearly defined and feasible to collect? Are the outcome data available from existing databases, or do they need to be explicitly collected for the study? Can a registry of control and intervention group members be linked to other existing databases that may contain data on outcomes? How long is the expected time lag from participation in an intervention to achievement of the key outcomes? If there is a long time lag, can the study be done feasibly on a retrospective basis rather than on a prospective basis?
- How much contamination effect is expected for members of the control group? How likely is it that the control group will be exposed to interventions that are not under the control of the program or study administrators that will potentially create a major negative bias for detecting differences in outcomes between control and intervention groups?
- How expensive will it be to collect or access the data required to conduct the study? Is the necessary funding available to perform the evaluation?
- How much cooperation is required from participating sites for the study to be feasibly performed, and are there incentives or administrative requirements for sites to participate?
- Do the individuals charged with executing the evaluation have the requisite skills and technical capabilities to perform the study?

All of these questions need to be thought through in advance of performing a controlled evaluation study. The answers to these questions will determine the feasibility of performing the evaluation study.

Randomized trials of pipeline interventions are rarely feasible for the reasons described in Chapter 3, and also raise ethical concerns about using randomization procedures to deny some needy students access to an intervention that may have face validity for being of value to the student. A circumstance in which a randomized trial may be a reasonable design option is when a new program is initiated or is expanded to new sites, allowing the program to be implemented in a more controlled manner with a prospectively designed evaluation study built into the implementation phase of the program, and when it may be reasonable to use a staggered design such that sites initially randomized to the control group subsequently become delayed intervention sites.

References

1. WK Kellogg Foundation. 2004. *Logic Model Development Guide*. Battle Creek, MI: WK Kellogg Foundation.
2. Development Services Group. 2002. *Development of a Uniform Information/Data Set and Collateral Products for Assessing Impacts of OMH-funded Activities*. Office of Minority Health, U.S. Department of Health and Human Services.
3. Grumbach, K and E Chen. 2006. "Effectiveness of University of California Post Baccalaureate Premedical Programs in Increasing Medical School Matriculation for Minority and Disadvantaged Students." *Journal of the American Medical Association* 296(9):1079-1085.
4. Carline, JD, DG Patterson, LA Davis, and P Oakes-Borremo. 1998. "Enrichment programs for undergraduate college students intended to increase the representation of minorities in medicine". *Academic Medicine* 73:299-312.
5. U.S. Department of Health and Human Services. 2001. *Youth Violence, a Report of the Surgeon General.* Substance Abuse and Mental Health Services Administration, U.S. Department of Health and Human Services.
6. Olds, D, CR Henderson Jr, R Cole, J Eckenrode, H Kitzman, D Luckey, L Pettitt, K Sidora, P Morris, and J Powers. 1998. "Long-term effects of nurse home visitation on children's criminal and antisocial behavior: 15-year follow-up of a randomized controlled trial." *Journal of the American Medical Association* 280:1238-1244.
7. Chamberlain, P, LD Leve, and DS Degarmo. 2007. "Multidimensional treatment foster care for girls in the juvenile justice system: 2-year follow-up of a randomized clinical trial." *Journal of Consulting and Clinical Psychology* 75:187-193.
8. Burdumy, J, M Dynarski, and J Deke. 2005. *When Elementary Schools Stay Open Late: Results from The National Evaluation of the 21st Century Community Learning Centers Program*. Mathematica Policy Research, Inc.
9. Brody, H, FG Miller, and E Bogdan-Lovis. 2005. "Evidence-based medicine: watching out for its friends." *Perspectives in Biology and Medicine* 48:570-584.
10. Etheridge, LM. 2007. "A rapid-learning health system." *Health Affairs* web exclusive DOI 10.1377/hlthaff.26.2.w107
11. WK Kellogg Foundation. 1998. Evaluation Handbook. Battle Creek, MI: WK Kellogg Foundation. Available at http://www.wkkf.org/DesktopModules/WKF.00_DmaSupport/ViewDoc.aspx?fld=PDFFile&CID=281&ListID=28&ItemID=2810770&LanguageID=0
12. Brousseau, RT. 2004 *Reflections on Evaluating Our Grants*: The California Wellness Foundation. Available at http://www.tcwf.org/pub_reflections/mar_2004.htm
13. Grumbach, K, J Coffman, E Rosenoff, C Muñoz, P Gandara, and E Sepulveda. 2003. *Strategies for improving the diversity of the health professions*. Woodland Hills, CA: The California Endowment. Available at http://futurehealth.ucsf.edu/pdf_files/StrategiesforImprovingFINAL.pdf.

14. Philips, BU, JM Mahan, and RR Perry. 1981. “Minority Recruitment to the Health Professions: A Matched Comparison 6-Year Follow-up.” *Journal of Medical Education* 56(9 pt 1):742-747.

15. Campbell, PB, E Wahl, M Slater, E Her, B Moeller, H Ba, and D Light. 1998. “Paths to success: an evaluation of the gateway to higher education program.” *Journal of Women and Minorities in Science and Engineering* 4(2&3):297-308.

16. Slater, M and E Iler. 1991. “A program to prepare minority students for careers in medicine, science, and other high-level professions.” *Academic Medicine* 66(4):220-225.

17. Herrera-Mata, L and D Youngclarke. 2007. “An evaluation of the Doctor’s Academy.” unpublished.

18. Thomson, WA, JP Denk, LM Miller, B Ochoa-Shargey, and M Jibaja-Rusth. 1992. “Results of a summer academy to increase minority student access to allied health and other health professions.” *Journal of Allied Health* 21(2):79-93.

19. Bediako, MR, BA McDermott, ME Bleich, and JA Colliver. 1996. “Ventures in education: a pipeline to medical education for minority and economically disadvantaged students.” *Academic Medicine* 71(2):190-192.

20. Cantor, JC, L Bergeisen, and L Baker. 1998. “Effect of an intensive educational program for minority college students and recent graduates on the probability of acceptance to medical school.” *Journal of the American Medical Association* 280(9):772-776.

21. Strayhorn, G. 2000. “A preadmission program for underrepresented minority and disadvantaged students: application, acceptance, graduation rates and timeliness of graduating from medical school.” *Academic Medicine* 75(4):355-361.

22. Carline, J, D Hunt, D Patterson, and C Garcia. 1999. “Participation in Enrichment Programs and It’s Effect on Interview Scores of Applicants to the University of Washington School of Medicine.” *Academic Medicine* 74(4):360-362.

23. Pisano, JC and AC Epps. 1983a. “The impact of a medical-school-based summer program on the acceptance of minority undergraduate students into health professional schools.” *Journal of the National Medical Association* 75(1):17-23.

24. Pisano, JC and AC Epps. 1983b. “The impact of MCAT intervention efforts on medical student acceptance rates.” *Journal of the National Medical Association* 75(8):773-777.

25. Thomson, WA, PG Ferry, JE King, C Martinez-Wedig, and LH Michael. 2003. “Increasing access to medical education for students from medically underserved communities: one program’s success.” *Academic Medicine* 78(5):454-459.

26. Lewis, C. 1996. “A State University’s Model Program to Increase the Number of its Disadvantaged Students Who Matriculate into Health Professions Schools.” *Academic Medicine* 71(10):1050-1057.

27. Maton, K, F Hrabowski, and C Schmitt. 2000. “African-American College Students Excelling in the Sciences: College and Postcollege Outcomes in the Meyerhoff Scholars Program.” *Journal of Research in Science Teaching* 37(7):629-654.

28. Nagda, BA, SR Gregerman, J Jonides, W von Hippel, and JS Lerner. 1998. “Undergraduate student-faculty research partnerships affect student retention.” *Review of Higher Education* 22(1):55-72.

29. Fullilove, R and PU Treisman. 1990. “Mathematics Achievement Among African American Undergraduates at the University of California, Berkeley: An Evaluation of the Mathematics Workshop Program.” *Journal of Negro Education* 59(3):463-478.

30. Barlow, EL and M Villarejo. 2004. “Making a difference for minorities: evaluation of an educational enrichment program.” *Journal of Research in Science Teaching* 41(9):861-881.

31. Matsui, J, R Liu, and CM Kane. 2003. “Evaluating a Science Diversity Program at UC Berkeley: More Questions Than Answers.” *Cell Biology Education* 2:117-121.

32. Hesser, A, L Lewis, B Abbott, and B Vericella. 1993. “Evaluation of a supplementary retention program for black allied health sciences students.” *Journal of Allied Health* 22(2):175-182.

33. Hesser, A, E Pond, L Lewis, and B Abbott. 1996. “Evaluation of a supplementary retention program for African-American baccalaureate nursing students.” *Journal of Nursing Education* 35(7):304-309.

34. Ugbolue, A, PN Whitley, and PJ Stevens. 1987. “Evaluation of a pre-entrance enrichment program for minority students admitted to medical school.” *Journal of Medical Education* 62(1):8-16.

35. Hesser, A and L Lewis. 1992. “Evaluation of a summer prematriculation program for black and other nontraditional students.” *Academic Medicine* 67(4):270-272.

36. McGlinn, S, EW Jackson, and HR Bardo. 1999. “Post Baccalaureate Medical/Dental Education Preparatory Program (MEDPREP) at Southern Illinois University School of Medicine.” *Academic Medicine* 74(4):380-382.

Appendix: Evaluation Study Summaries

Barlow, EL and M Villarejo. 2004. "Making a difference for minorities: evaluation of an educational enrichment program." *Journal of Research in Science Teaching* 41(9):861-881.

Grade:	Cohort D1 S1
Program:	Biology Undergraduate Scholars Program (BUSP)
Pipeline Level:	Undergraduate, freshmen and sophomores
Profession:	Biological sciences

Program Interventions:

1. Supplemental workshops in chemistry and calculus with no more than 25 students per session,
2. Quarter-long pre-chemistry course prior to enrolling in General Chemistry,
3. Participation in laboratory research—for practical and financial support,
4. Academic and personal advising.

Evaluation Design:

Retrospective cohort study with a comparison group (UC Davis racial/ethnic minority freshmen interested in biological sciences major who were invited to participate in the program, but declined participation). Multivariate linear and logistic regression models were used to estimate the impact of the specific interventions on the various outcomes. For long-term effects of the program, descriptive analysis was used.

Outcome(s) Measured:

1. Persistence in lower division math and science courses,
2. Performance in lower division math and science courses,
3. Graduation outcomes,
4. Postgraduate activities.

Results:

1. After controlling for baseline difference between intervention and control students, BUSP students were more likely than control students to successfully complete General Chemistry (Adjusted Odds Ratio 3.1, $p<0.01$), Calculus (Adjusted OR 2.2, $p<0.01$) and Biology (Adjusted OR 1.7, $p<0.01$). Comparisons are only among students who enrolled in these courses.
2. Among the BUSP students, those who actively participated in the supplemental workshops earned higher calculus and chemistry GPAs than those who did were less engaged in the program (mean GPAs 0.17-0.39 among active participants, $p<0.05$).
3. Program participants had a non-significant trend towards a greater likelihood of graduating from UCD (Adjusted OR 1.3, $p>0.05$), and they were significantly more likely than controls to graduate with a degree in biology (Adjusted OR 1.5, $p<0.01$) and had a non-significant trend to graduate as a biology major with a GPA$\geq$3.0 (Adjusted OR 1.5, $p>0.05$).

4. Among program participants, undergraduate research involvement greatly increased the odds of positive graduation outcomes.

Statistical Analysis:
Multivariate linear and logistic regression models were used to estimate the impact of supplemental workshops, research experiences, and overall program participation on persistence and performance in basic math and science courses and graduation outcomes. In the regression models, the following variables were controlled for due to their known association with academic performance and graduation outcomes: sex, race/ethnicity, math and verbal SAT scores, high school GPA, and admissions status. Data on the long-term effects of program participation were incomplete and not rigorously assessed in the study.

Funding:
1. Howard Hughes Medical Institute Undergraduate Biology Education Program
2. Initiative for Minority Student Development
3. National Institute of General Medical Sciences

Bediako, MR, BA McDermott, ME Bleich, and JA Colliver. 1996. "Ventures in education: a pipeline to medical education for minority and economically disadvantaged students." *Academic Medicine* 71(2):190-192.

Grade: Pre/Post D2 S3
Program: Ventures in Education
Pipeline Level: High School
Profession: General health sciences

Program Interventions:
1. Challenging academic curriculum,
2. Educational enrichment,
3. Tutoring.

Evaluation Design:
Pre/Post comparing Ventures graduates outcomes to school-wide rates before program implementation. Study lacks formal test of significance.

Outcome(s) Measured:
Health professions school applications and matriculation, used AAMC SAIMS (Student and Applicant Information Management System) database for outcomes.

Results:
1. Analyzed outcomes of Ventures graduates from the first five classes (1985-89) of the original five participating high schools (n=981 students):
    136 (13.9 percent) took the MCAT,
    109 (11.1 percent) applied to medical school,
    75 (7.6 percent) were accepted to a medical school,

72 (7.3 percent) matriculated to medical school.

2. Before program was implemented approximately zero percent of students at these high schools took MCAT or eventually matriculated to medical school. Approximately .06 percent of the general population matriculates to medical school. Compared to the general population, medical school matriculation for participants was approximately one percent ($p<.05$).

Statistical Analysis:
No formal tests of significance comparing students in the same high schools before Ventures implementation, or comparing non-Ventures students enrolled during the same period.

Campbell, PB, E Wahl, M Slater, E Her, B Moeller, H Ba, and D Light. 1998. "Paths to success: an evaluation of the gateway to higher education program." *Journal of Women and Minorities in Science and Engineering* 4(2-3):297-308.

Grade: Cohort D1 S1
Program: Gateway to Higher Education
Pipeline Level: High school
Profession: Careers in math and science

Program Interventions:
1. Extended school day with double period of math or science and after-school tutoring.
2. Extended school year with summer programs for entering freshmen, juniors and seniors.
3. Math and science courses composed solely of Gateway students, with maximum enrollment of 25 students.
4. Curriculum designed to keep students on a college track and requiring that all science courses have a laboratory component.
5. The expectation that all Gateway students will take the SAT I, the SAT II, and advanced placement courses.
6. The provision of information about colleges and college experiences via college visits and an annual Gateway college fair that provides parents and students with information about admissions and financial aid.
7. The provision of broader experiences, including exposure to professionals in science, internships, and trips to museums, the theater, and symphonies.

Evaluation Design:
Retrospective cohort with matched controls. Matching was done on anticipated graduation year, gender, race/ethnicity, seventh grade New York City Math Test score, and the seventh grade Degrees of Reading Power test score.

Outcome(s) Measured:
1. High school graduation,
2. Course taking,

3. SAT taking,
4. College attendance,
5. Other areas of high school performance.

Results:

1. Ninety-three percent of the Gateway students who entered ninth grade in 1989 graduated from high school compared to 73 percent of the comparison students ($p<0.001$).
2. Gateway students consistently took Statewide Regents Exams at a higher rate than students in the comparison group. For the Chemistry Regents Exam 96 percent of Gateway students took the test compared to 24 percent of comparison students. For the Physics Regents Exam 76 percent of Gateway students took the test compared to 14 percent of comparison students.
3. Gateway students were more than five times more likely than the matched controls to have taken the SAT; 93 percent of Gateway students took the SAT at least once, compared to only 15 percent of comparison students (Chi square=34.98, $p<0.001$). Furthermore, all Gateway students who took the SAT (93 percent of total group) either took the PSAT and the SAT, or took the SAT more than once; this was the case for only three of the comparison students. Mean SAT scores were higher among Gateway students than among controls (930 vs. 836, $p=.03$).
4. Seventy-seven percent of Gateway students went on to college; and of the students who remained in Gateway throughout high school, 92 percent attended college. No similar data were available for comparison group.
5. Qualitative data suggests that Gateway teachers and students see Gateway students as motivated and competent in the academic setting. Students are engaged in their communities and assume leadership roles.

Statistical Analysis:

Intervention and control groups were retrospectively matched on anticipated graduation year, gender, race/ethnicity, seventh grade New York City Math Test score, and the seventh grade Degrees of Reading Power test score. Chi-square and t-tests were used to compare program participants and matched controls on the various outcomes.

Funding:

New York City Public Schools

Cantor, JC, L Bergeisen, and L Baker. 1998. "Effect of an intensive educational program for minority college students and recent graduates on the probability of acceptance to medical school." *Journal of the American Medical Association* 280(9):772-776.

Grade:	Cohort D1 S1
Program:	Minority Medical Education Program (MMEP) (8 sites)
Pipeline Level:	Undergraduate, and recent graduates
Profession:	Medicine

Program Interventions:
Six-week residential summer educational program focused on:
1. Training in the sciences,
2. Improvement of writing, verbal reasoning, studying, test taking, and presentation skills.
3. Focus is on enrichment not remediation.

Evaluation Design:
Cohort study, compared participants to nonparticipant minority applicants to medical school using AAMC Student and Applicant Information Management System.

Outcome(s) Measured:
Probability of acceptance to at least one medical school.

Results:
In the 1997 medical school application cohort 49.3 percent of MMEP participants were accepted compared with 41.6 percent of minority nonparticipants (p=.002; n=452 participants and 3378 nonparticipants). Program effects were also observed in students who participated in the MMEP early in college as well as those who participated later.

Statistical Analysis:
Thorough statistical analysis and adjustment of socioeconomic variables, academic factors that were observable prior to MMEP participation, plus variables that may have been influenced by MMEP participation.

Note:
Many non-MMEP underrepresented racial/ethnic minority students may have participated in other enrichment programs.

Carline, J, D Hunt, D Patterson, and C Garcia. 1999. "Participation in Enrichment Programs and It's Effect on Interview Scores of Applicants to the University of Washington School of Medicine." *Academic Medicine* 74(4):360-362.

Grade: Cohort D1 S1
Program: Unspecific (Participation in any enrichment program, either academic or research)
Pipeline Level: College
Profession: Medicine

Program Interventions:
Academic and research enrichment.

Evaluation Design:
Retrospective Cohort: Compared underrepresented racial/ethnic minority applicants to University of Washington School of Medicine (UWSOM) between 1993-1995, enrichment participants vs. no enrichment participation.

Outcome(s) Measured:
Interview scores:

n=227 underrepresented minority applicants interviewed by UWSOM between 1993-1996,
97 participated in some type of enrichment program,
130 had not participated in any formal enrichment program.

Results:
1. Participation in any type of enrichment program had no effect on an applicant's interview score. (participants = 51.16, non participants = 49.23).
2. Only statistically significant predictive variables were sex (women received higher scores) and MCAT verbal reasoning score (higher verbal reasoning scores were associated with higher interview scores).
3. Participants had lower GPAs (3.24 vs. 3.34), lower MCAT verbal reasoning (8.65 vs. 9.14) and MCAT physical sciences (8.27 vs. 9.06) scores than nonparticipants.
4. Found small (not statistically significant) effect that applicants were more likely to get interviews if they had participated in enrichment programs.

Statistical Analysis:
Statistical tests of significance performed for all outcomes measured.

Fullilove, R and PU Treisman. 1990. "Mathematics Achievement Among African American Undergraduates at the University of California, Berkeley: An Evaluation of the Mathematics Workshop Program." *Journal of Negro Education* 59(3):463-478.

Grade: Pre/Post D1 S1
Program: Mathematics Workshop Program, University of California, Berkeley
Pipeline Level: College
Profession: General mathematics

Program Interventions:
Academic enrichment via workshop in mathematics problem-solving.

Evaluation Design:
Cross section comparing workshop participants to nonparticipants and to historical control group.

Outcome(s) Measured:
1. Final grade in math course,

2. Persistence and graduation of African-American participants versus nonparticipants.

Results:
Analyzed data from 646 African American students who enrolled in Math 1A between 1973 and 1984. Since the program was implemented in 1978, the 1973-1977 group served as a historical control group. Achievement analyzed by categorization as "workshop student."

1. Fifty-four percent of participants earned course grade of B- or better versus 16 percent of nonparticipants and 22 percent of control group during 1978-1982 ($P<0.0000$).
2. Fifty-eight percent of participants earned grade B- or better versus 23 percent of nonparticipants ($P<0.0000$) during 1983-1984.
3. Sixty-five percent of participants were still enrolled or had graduated as Fall 1985 versus 41 percent nonparticipants and 39 percent of historical control group.

Statistical Analysis:
Chi-square test was used to test the association between groups and outcome measures.

Grumbach, K and E Chen. 2006. "Effectiveness of University of California Postbaccalaureate Premedical Programs in Increasing Medical School Matriculation for Minority and Disadvantaged Students." *Journal of the American Medical Association* 296(9):1079-1085.

Grade:	Cohort D1 S1
Program:	University of California Post Baccalaureate Re-Applicant and First-Time Applicant Programs
Pipeline Level:	Post Baccalaureate
Profession:	Allopathic Medicine

Program Interventions:
1. Summer intensive MCAT preparation,
2. Academic year of science courses,
3. Personal advising, interview preparation, personal statement editing,
4. Topical seminars and site-based learning opportunities.

Evaluation Design:
Retrospective controlled cohort design with a comparison group of applicants to the post Baccalaureate programs but who did not participate in the programs.

Outcome(s) Measured:
Matriculation into medical school.

Results:
1. The odds of medical school matriculation were 6.3 times higher for program participants than for nonparticipants in the adjusted model.

2. The odds of medical school matriculation were 8.1 times higher for participants than for nonparticipants in the model that further controls for MCAT scores.

Statistical Analysis:
Logistic regression analysis with chi-square analysis showing statistical significance.

Funding:
HHS, Health Resources and Services Administration, Bureau of Health Professions

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Herrera-Mata, L and D Youngclarke. 2007. "An evaluation of the Doctor's Academy." unpublished.

Grade: Cohort D1 S1
Program: Doctors Academy
Pipeline Level: High school
Profession: Medicine and other health care professions

Program Interventions:
1. Academically enriched four-year high school curriculum,
2. Shadowing with various health care professionals,
3. Mentoring; advising; counseling,
4. Education and assistance with college application process,
5. Test-taking skills,
6. Writing personal statements,
7. Field trips,
8. Research experience.

Evaluation Design:
Retrospective controlled cohort study; baseline differences between participants and controls adjusted for using regression models.

Outcome(s) Measured:
1. High school senior grade point average, unadjusted and augmented,
2. Eleventh grade standardized test scores in reading, language, and mathematics,
3. Cumulative credits received by end of expected senior year,
4. Expected graduation year,
5. Attendance/Truancy rate.

Results:
1. Program participation had a significant positive influence on augmented grade point average and cumulative credits ($p=.011$ and $p=.012$, respectively).
2. Eighth grade standardized test score in reading had a significant positive influence on all continuous outcomes measured, i.e., 11^{th} grade standardized test scores in reading, language, and math, unadjusted and augmented grade point averages; and cumulative credits.

3. Program participants tend to graduate on time (p=.028).
4. When baseline attendance patterns were accounted for, program participation did not impact truancy rate.

Statistical Analysis:
Comparison group identified. Statistical tests of significance performed for all outcomes measured. Multiple linear regression analysis performed for all continuous outcome variables, controlling for previous academic achievement. Chi square test completed for expected graduation year. Repeated measures performed for truancy rate, controlling for previous attendance.

Funding:
HHS, HRSA, BHPr, Division of Diversity and Interdisciplinary Education, Health Careers Opportunity Program, The California Endowment

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Hesser, A and L Lewis. 1992. "Evaluation of a summer prematriculation program for black and other nontraditional students." *Academic Medicine* 67(4):270-272.

Grade: Cohort D2 S2
Program: Summer Prematriculation Program (SPP) at the Medical College of Georgia
Pipeline Level: Prematriculation
Profession: Medicine

Program Interventions:
1. Provides an introduction to basic science courses taken in the first year,
2. Develops medical and learning skills,
3. Academic and social interactions with classmates and faculty.

Evaluation Design:
Cohort study comparing participating invitees and nonparticipating invitees from the 1980-89 entering classes. All entering Black medical students and other entering nontraditional students deemed at risk are invited to participate.

Outcome(s) Measured:
1. Medical school grades,
2. Pass rates,
3. Retention rates.

Results:
n=115 participants, n=82 comparaison non-participants. No statistically significant differences found across outcomes measured.
1. Participants had lower MCAT scores than nonparticipants, but higher biochemistry grades, (Intervention group = 2.52 (SD=.8), Control = 2.26 (SD=.9)).
2. Overall pass rates for the two groups:
   Fall: Intervention group- 94.8 percent Control group- 93.2 percent

Winter: Intervention group- 94.2 percent Control group- 92.4 percent.

3. The intervention group had a higher rate of advancing to the second year of medical school (82 percent compared to 77 percent in the control group).

Statistical Analysis:
Statistical analysis performed on baseline and performance measures. For all types of data collected there were no statistically significant differences. Authors indicate that several factors may have obscured the results, including the effects of tutoring services open to all matriculating students in jeopardy. Statistical power was limited. The letter grading scale (wherein F=0, A=4) restricted the numerical score differences.

Hesser, A, L Lewis, B Abbott, and B Vericella. 1993. "Evaluation of a supplementary retention program for black allied health sciences students." *Journal of Allied Health* 22(2):175-182.

Grade: Pre/Post D1 S1
Program: Minority Academic Advising Program (MAAP), at the Medical College of Georgia (MCG)
Pipeline Level: College
Profession: Allied Health

Program Interventions:
1. Retention program,
2. Advising to help with academic, personal, social, financial, vocational and other concerns.

Evaluation Design:
Pre/Post, compares retention variables of Black undergraduates across two time periods, preMAAP, 1978-1982, and MAAP time period, 1984-1988.

Outcome(s) Measured:
Retention in school.

Results:
1. Baseline: SAT scores were equivalent between the Black students in the PreMAAP group and MAAP group.
2. The Black student graduation rate increased 11 percent between the two groups from 72 percent to 83 percent after MAAP implementation. (p=.051). Comparison group (nonBlack students) went from 86 percent to 85 percent.

Statistical Analysis:
Extensive statistical analysis of results between Pre-MAAP and MAAP periods, and the sample group (Black students) and comparison group (non-Black).

Hesser, A, E Pond, L Lewis, and B Abbott. 1996. "Evaluation of a supplementary retention program for African-American baccalaureate nursing students." *Journal of Nursing Education* 35(7):304-309.

Grade:	Pre/Post D1 S1
Program:	Minority Academic Advising Program (MAAP), at the Medical College of Georgia
Pipeline Level:	Undergraduate
Profession:	Nursing

Program Interventions:
1. Supplementary retention activities,
2. Special advising efforts to address academic, personal, social and financial issues.

Evaluation Design:
1. Pre/Post for underrepresented minorities at the institutional level,
2. Cohort study comparing pre-MAAP cohort.

Outcome(s) Measured:
1. Retention to graduation rate,
2. GPA, board-passing rate on first try.

Results:
1. Baseline: African-American students in MAAP had lower SAT scores than comparison group.
2. Graduation rate for Black students, 92.1 percent before MAAP implementation, after implementation 97.4 percent (not statistically significant).
3. Black student nursing program GPAs improved, from 2.91 to 3.13 (from preMAAP to MAAP period. (p=.002).
4. The disparity in nursing program GPAs between Black students and nonBlack students decreased, from .45 points lower for Black students to a .21 difference. (Although this difference remained statistically significant)**.**
5. First time board-passing rates increased for Black students, from 49 percent before MAAP, to 64 percent after implementation (not statistically significant).
6. Cohort comparisons between Black and non-Black students:
    a. On general performance measures (nursing program GPA and Nursing Boards first time pass rates) non-Black students continued to perform better than Black nursing students.
    b. The graduation rates of Black students did improve, exceeding non-Black students, (97.4 percent vs.96.1 percent, not significant). Pre-MAAP, Black rates were 92.1 percent compared to 96 percent for non-Black students.

Statistical Analysis:
Extensive statistical analysis of results between Pre-MAAP and MAAP periods, and the sample group (Black students) and comparison group (non-Black).

Lewis, C. 1996. "A State University's Model Program to Increase the Number of its Disadvantaged Students Who Matriculate into Health Professions Schools." *Academic Medicine* 71(10):1050-1057.

Grade: Pre/Post D2 S3
Program: San Diego State University Health Careers Opportunity Program (HCOP)
Pipeline Level: Undergraduate
Profession: Multi-profession, (Dental, Medicine, Veterinary, and Physician Assistants)

Program Interventions:
Multiple components, including:

1. A summer academic program (before first year),
2. Enrichment instruction,
3. Mentoring, counseling/advising structure,
4. Research and summer programs,
5. Alumni conference,
6. Test preparation (MCAT, DAT, GRE).

Evaluation Design:
Institutional-level pre/post study without parallel control group. Study lacks control and formal test of significance.

Outcome(s) Measured:
1. Pass rates for entry-level competencies, GPA, and applications and acceptance to health professions schools.
2. The aggregate GPA of HCOP students was compared to racial/ethnic minority pre-health students in the years before HCOP implementation. The number of minority applicants and acceptances to health professions schools (not counting those to nursing or public health) were analyzed as well.
3. Additional outcomes: Mentoring journals (that mentors kept, recording interactions with proteges) indicate that students' feelings of confidence and success are correlated with a higher GPA.

Results:
1. Summer Academic Program participants had higher pass rates for the math and writing entry level competency tests compared to other SDSU students those years.
2. GPA of minority pre-health students before HCOP (53 students) in 1988 = 2.59.
3. GPA of HCOP minority pre-health students = 3.04 (51 students, 1992); 3.23 (77 students, 1993); 3.05 (77 students, 1994); 3.05 (83 students, 1995).
4. Underrepresented minority applicants to health professions schools:
   Pre-HCOP (1986-90) 46 applicants, 38 acceptances (83 percent acceptance rate);
   Post-HCOP (1991-95) 95 applicants, 78 acceptances (82 percent acceptance rate).

Statistical Analysis:

No tests of significance for HCOP vs. non-HCOP performance. No data on overall underrepresented racial/ethnic minority enrollment at SDSU, non-underrepresented minority application/acceptance trends at SDSU, or of a non-HCOP control school.

Maton, K, F Hrabowski, and C Schmitt. 2000. "African-American College Students Excelling in the Sciences: College and Postcollege Outcomes in the Meyerhoff Scholars Program." *Journal of Research in Science Teaching* 37(7):629-654.

Grade: Cohort D1 S1
Program: Meyerhoff Scholars Program at the University of Maryland, Baltimore County (UMBC)
Pipeline Level: Undergraduate
Profession: Science and engineering. The program's focus is on increasing the number of Ph.D. level researchers in science, engineering and math (SEM).

Program Interventions:
1. Comprehensive financial aid,
2. A summer enrichment program the pre-freshman summer,
3. Promotion of study groups,
4. Academic and social support system for students,
5. Advising, tutoring, and exposure programs.

Evaluation Design:
Controlled cohort study. Compared Meyerhoff students to those accepted to the program who declined and went to another university. Also compared students in the first three UMBC Meyerhoff Program cohorts to a preMeyerhoff sample of African-American students who met the entrance requirements of the program. Used a sample of matched controls as well.

Outcome(s) Measured:
1. GPAs,
2. Grades in "gateway" courses,
3. Science and engineering GPAs,
4. Graduation rates in science, engineering or math (SEM) disciplines.

Results:
1. Comparison between accepted students matriculating in the Meyerhoff program (n=93) and those students who declined and entered another university (n=35): Meyerhoff students were nearly twice as likely to graduate in SEM majors as those declined the program. (83 percent vs. 46 percent, $p<0.01$). Meyerhoff students achieved significantly higher SEM GPAs that the declined sample (3.16 vs. 2.89, $p<0.01$). There were no significant differences between the two groups in terms of overall GPA. Meyerhoff students were more likely to attend SEM graduate school. Relatively equal numbers attended medical school.
2. UMBC Comparison Samples:

Matched historical comparisons of African-American, Asian, Caucasian and Meyerhoff students (pre-Meyerhoff period vs. current samples). The matched Meyerhoff participants had significantly higher graduation rates in SEM majors than the historical comparisons or the concurrent comparisons of Asian and Caucasian students. Meyerhoff group had a 90 percent graduation rate in the SEM majors, compared to 55 percent of matched African Americans pre-Meyerhoff, and compared to 42 percent of Asians, and 29 percent of Caucasians during the Meyerhoff period ($p<.01$). Adjusted overall GPAs were higher in the Meyerhoff group (3.30) than in the historical African-American group (2.84) or the current Asian (3.17) or Caucasian (3.07) group ($p<.01$).

Statistical Analysis:
Thorough statistical analysis. Also analyzed males and females separately with similar results. Groups were matched for gender, SAT-Math, SAT-Verbal, high school GPA, number of freshman science courses and (within time period) time of entry.

Matsui, J, R Liu, and CM Kane. 2003. "Evaluating a Science Diversity Program at UC Berkeley: More Questions Than Answers." *Cell Biology Education* 2:117-121.

Grade: Cohort D2 S1
Program: Biology Scholars Program (BSP) at University of California, Berkeley
Pipeline Level: Undergraduate
Profession: Biological sciences. The program's focus is on increasing the academic success of racial/ethnic minority students in the biological sciences.

Program Interventions:
1. Academic support for lower division biology courses,
2. Academic and career seminars,
3. Social events,
4. Research opportunities,
5. Advising and mentoring.

Evaluation Design:
Controlled cohort study. Compared cohorts of BSP and nonBSP students entering UCB who indicated an intention to major in biological sciences at the time of their college application. Included students graduating between 1994-1999.

Outcome(s) Measured:
1. Whether students graduated with a biology major,
2. Among biology graduates, overall GPA.

Results:
1. Study included 143 BSP students and 1904 non-BSP students. 49 percent of BSP students were African-American or Hispanic, compared with 8 percent of nonBSP students.

2. BSP students were significantly more likely than non-BSP students to graduate with a biology degree. These differences in outcomes between BSP and non-BSP students remained when analyses were stratified by specific racial-ethnic groups.
3. In addition, among those students graduating with biology degrees, BSP racial/ethnic minority students had a significantly higher mean GPA than their minority counterparts who had not participated in BSP.

Statistical Analysis:
Although the study assessed baseline differences between BSP and non-BSP characteristics in high school GPA and SAT scores, the analyses did not use regression methods to formally adjust for these differences. Outcomes were assessed using statistical tests of signifcance to compare unadjusted outcome measures. However, analyses were stratified by race-ethnicity, to allow race-ethnic specific comparisons between BSP and non-BSP students on outcome measures.

McGlinn, S, EW Jackson, and HR Bardo. 1999. "Post-Baccalaureate Medical/Dental Education Preparatory Program (MEDPREP) at Southern Illinois University School of Medicine." *Academic Medicine* 74(4):380-382.

Grade:	Pre/Post D1 S3
Program:	Medical/Dental Education Preparatory Program (MEDPREP) at Southern Illinois University School of Medicine
Pipeline Level:	Postbaccalaureate
Profession:	Medical/Dental

Program Interventions:
1. Assists students in improving their credentials to health professions schools,
2. Designs individual curricula,
3. Offers academic and personal counseling.

Evaluation Design:
Pre/Post. Compares scores of participants to all others repeating the MCAT from April 1993 to August 1994. Study lacks formal test of significance.

Outcome(s) Measured:
MCAT scores.

Results:
On each section of the MCAT repeaters who participated in MEDPREP achieved larger gains on average than all repeaters (nearly two to six times greater than the overall changes). Mean score changes on MCAT:

Biological Sciences:	MEDPREP repeaters	Δ=2.24	(SD=1.6)
	All repeaters	Δ=.55	(SD=1.5)
Physical Sciences:	MEDPREP repeaters	Δ=1.18	(SD=1.5)
	All repeaters	Δ=.51	(SD=1.4)
Verbal Reasoning:	MEDPREP repeaters	Δ=1.23	(SD=1.9)

	All repeaters	Δ=.62	(SD=1.6)
Writing Sample:	MEDPREP repeaters	Δ=1.59	(SD=2.1)
	All repeaters	Δ=.28	(SD=1.8)

Statistical Analysis:
No tests of significance. No adjustment of other confounding factors.

Nagda, BA, SR Gregerman, J Jonides, W von Hippel, and JS Lerner. 1998. "Undergraduate student-faculty research partnerships affect student retention." *Review of Higher Education* 22(1):55-72.

Grade: Cohort D1 S1
Program: Undergraduate Research Opportunity Program (University of Michigan)
Pipeline Level: Undergraduate
Profession: Multiple, not specific

Program Interventions:
1. Student recruitment,
2. Peer advising,
3. Peer research interest group,
4. Faculty recruitment,
5. Faculty-student matching,
6. Research presentations,
7. Academic credit and assessment.
8. The program's "major goal is to broker intellectual relationships between faculty and first-year and sophomore undergraduates through research partnerships."

Evaluation Design:
Prospective randomized trial with stratification. Participants were randomly selected from among applicants meeting basic eligibility criteria, and participants and controls (chosen from among eligible applicants not accepted into the program) were matched for race/ethnicity, SAT/ACT scores, and high school (or first-year college) grades.

Outcome(s) Measured:
1. Persistence in college,
2. Effect of pre-entry grade point average on retention,
3. Effect of year in school on retention.

Results:
1. African-American students in the program demonstrated a significantly lower attrition rate than controls (10.1 percent vs. 18.3 percent, $p<0.03$). Hispanic students in the program had a similar attrition rate as controls (11.6 percent vs. 11.3 percent). White students in the program had an insignificantly lower attrition rate than controls (3.2 percent vs. 6.1 percent).

2. Retention of "low-GPA" African-American students was most positively affected by the program. Program effects on retention of high-GPA African-Americans, low- or high-GPA Hispanics, and low- or high-GPA Whites, were not significant.
3. African-American students participating in the program in either the first or sophomore year showed higher, though not significant, retention rates compared to the control group. Hispanic and White students showed no significant differences in retention as freshmen when compared to controls, but as sophomores they showed a marginally significant effect (p=.07 and p=.10, respectively).

Statistical Analysis:
Experimental and control groups were matched on race/ethnicity, SAT/ACT scores, and GPA prior to entering the program (high school or first-year college, depending on participant's point of entry). Chi-square tests were performed for all outcomes measured.

Funding:
1. The State of Michigan Office of Minority Equity
2. The Fund for the Improvement for Postsecondary Education (FIPSE) of the Department of Education

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Philips, BU, JM Mahan, and RR Perry. 1981. "Minority Recruitment to the Health Professions: A Matched Comparison 6-Year Follow-up." *Journal of Medical Education* 56(9 pt 1):742-747.

Grade:	Cohort D1 S1
Program:	University of Texas Medical Branch (UTMB) Area Health Education Center (AHEC)
Pipeline Level:	Undergraduate
Profession:	Multiple Professions

Program Interventions:
1. Summer program,
2. Exposure programs, allowing participants to rotate through hospitals and teaching facilities,
3. Program focused on academic, communication, and interpersonal skills.

Evaluation Design:
Cohort study. Six-year follow-up of participants and nonparticipants who had applied to the program, but who had not been accepted (because of space constraints). Seventy-eight participants and 78 control individuals were sent questionnaires; 59 and 50 were returned, respectively. Controls were matched for sex, age, ethnicity and parental occupation.

Outcome(s) Measured:
1. Employment in a health profession,
2. Location of employment (Texas AHEC area or not),
3. Attainment of career choice.

Results:
1. A greater proportion of participants were employed in health professions than the control group (38 percent compared to 10 percent, (p=.001)).
2. While not statistically significant, the results also suggest that respondents employed in health professions tended to be employed in the Texas area (71 percent).
3. Location of education (AHEC area or not) was found to also be a factor in employment location.

Statistical Analysis:
Controls were matched for sex, age, ethnicity and parental occupation. No significant difference between participants and nonparticipants were found for those variables. Rigorous statistical analysis.

Pisano, JC and AC Epps. 1983a. "The impact of a medical-school-based summer program on the acceptance of minority undergraduate students into health professional schools." *Journal of the National Medical Association* 75(1):17-23.

Grade:	Cohort D3 S3
Program:	Medical Education Reinforcement and Enrichment Program (MEdREP), Tulane University School of Medicine
Pipeline Level:	Undergraduate, sophomores and juniors
Profession:	Medicine and other health care fields (MODVOPP)

Program Interventions:
1. Ten-week summer program,
2. Academic enrichment clinical exposure and preparation for the MCAT and preceptorship experience,
3. Competitive application process.

Evaluation Design:
Compared 1976 participants to 1976 nonparticipating applicants. Also compared application rates of all participants (1972-1979). Study lacks formal test of significance.

Outcome(s) Measured:
Application and acceptance rates to MODVOPP schools.

Results:
1. Overall participants had higher GPAs and acceptance rates to health professions schools than nonparticipants:
   1972-79 participants (n=303):
      science GPA=3.04, accepted to MODVOPP schools=70 percent;
   1976 participants (n=46):
      science GPA=3.01, accepted to MODVOPP schools=65 percent;
   1976 nonparticipating applicants (n=212):
      science GPA=2.82, Accepted to MODVOPP schools=37 percent.

2. Data indicates that even those participants with low relatively low GPAs had fairly high acceptance rates to health professions schools. (e.g., 64 percent acceptance rate for participants with science GPAs less than 2.6)

Statistical Analysis:
No tests of significance done between groups.

Pisano, JC and AC Epps. 1983b. "The impact of MCAT intervention efforts on medical student acceptance rates." *Journal of the National Medical Association* 75(8):773-777.

Grade: Pre/Post D2 S3
Program: Medical Education Reinforcement and Enrichment Program (MEdREP) at Tulane School of Medicine
Pipeline Level: Undergraduate, sophomores and juniors
Profession: Medicine and other health care fields (MODVOPP)

Program Interventions:
1. Ten-week summer program,
2. Academic enrichment clinical exposure and preparation for the MCAT and preceptorship experience,
3. Competitive application process.

Evaluation Design:
Compares MCAT scores before and after a MEdREP MCAT review. Also compares participants to national minority mean. Study lacks control group and formal test of significance.

Outcome(s) Measured:
MCAT scores.

Results:
1. Pre/Post test participants n=54. Average score before review: 34.8; after the review: 41.9.

Forty-eight participants (89 percent) showed an improvement on overall MCAT score, one student had no change, five students (2 percent) decreased their scores.

2. Participants who only took the test after the review course scored the same (41.2) as those who had taken the test prior to the test (improvement in scores unlikely to be a result on simple exposure to the MCAT).

Statistical Analysis:
No statistical tests of significance.

Slater, M and E Iler. 1991. "A program to prepare minority students for careers in medicine, science, and other high-level professions." *Academic Medicine* 66(4):220-225.

Grade: Cohort D3 S3

Program: Gateway to Higher Education
Pipeline Level: High School
Profession: General health sciences

Program Interventions:
Comprehensive academic enrichment and support.

Evaluation Design:
Compares Gateway students to peers in their schools. Study lacks formal test of significance.

Outcome(s) Measured:
1. New York State Regents subject test scores,
2. PSAT,
3. SAT.

Results:
1. Gateway students had higher pass rates than their peers on the New York State Regents examination.
2. Comparing outcomes to national averages, the Gateway seniors as a whole had an average SAT score which was 75 points higher than the national average (978 vs. 903).
3. Of Black students, Gateway students exceeded the national average for Black students by 237 points (974 vs. 737).

Statistical Analysis:
Gateway selects higher achieving students, no comparison to a similar group (although the Gateway participants are included in the Peers averages).

Strayhorn, G. 2000. "A preadmission program for underrepresented minority and disadvantaged students: application, acceptance, graduation rates and timeliness of graduating from medical school." *Academic Medicine* 75(4):355-361.

Grade: Cohort D2 S1
Program: Medical Education Development Program (MEDP) at University of North Carolina at Chapel Hill
Pipeline Level: Undergraduate
Profession: Medicine

Program Interventions:
Nine-week intensive academic program.

Evaluation Design:
Prospective cohort study.

Outcome(s) Measured:
Medical School:
1. Application,
2. Acceptance,
3. Graduation,
4. Years of medical school.

Results:
1. Students with better MEDP performance rating increase odds of application, acceptance, and graduation.
2. MEDP participant acceptance rate significantly higher than national underrepresented racial/ethnic minority and non-underrepresented minority rates (76 percent compared to 47 percent and 54 percent respectively).

Statistical Analysis:
Crude comparison without adjustment for selection effects, although average GPA and MCAT of underrepresented racial/ethnic minority MEDP participants approximately the same as the national averages for underrepresented racial/ethnic minorities.

Thomson, WA, JP Denk, LM Miller, B Ochoa-Shargey, and M Jibaja-Rusth. 1992. "Results of a summer academy to increase minority student access to allied health and other health professions." *Journal of Allied Health* 21(2):79-93.

Grade:	Pre/Post D2 S1
Program:	Baylor College of Medicine, Health Professional Summer Academy
Pipeline Level:	High School
Profession:	Allied Health

Program Interventions:
Three-week summer program for entering ninth grade students at two Texas high schools (Students eligible for program if in bottom one-third of academic ranking).

Evaluation Design:
Pre/Post test. Compares scores on test administered to participants before intervention to scores after intervention. Average scores for two academy sites reported. Study lacks control group.

Outcome(s) Measured:
1. Results of the Middle Grades Integrated Process Skills (MGIPS) Test. The MGIPS test is designed for students in middle school to measure student knowledge of science skills (Maximum score on the MGIPS test is 36),
2. Also administered the Health Professions Questionnaire, designed to determine student's knowledge and perceptions of allied health and other health careers.

Results:
1. Students scores improved after program. Total combined (Houston and South Texas students) average (n=165) on MGIPS: preprogram: 20.81, postprogram: 24.33 ($p<0.001$).
2. Houston students improved less on the test than the South Texas cohort:
   Houston students- pre= 21.58, post=22.13 (not statistically significant);
   South Texas- pre=20.29, post=25.84 ($p<0.001$).

Statistical Analysis:
Tests of significance performed. No test to estimate improvement due to previous test experience.

Thomson, WA, PG Ferry, JE King, C Martinez-Wedig, and LH Michael. 2003. "Increasing access to medical education for students from medically underserved communities: one program's success." *Academic Medicine* 78(5):454-459.

Grade: Cohort D1 S1
Program: The Premedical Honors College (PHC)
Pipeline Level: Undergraduate through Medical school
Profession: Medicine

Program Interventions:
1. Acceptance into undergraduate PHC program at University of Texas-Pan American guarantees conditional acceptance to Baylor College of Medicine,
2. Undergraduate curriculum focused on math, science and communication (Biology or chemistry major required),
3. Tutoring, structured enrichment activities, other academic support services,
4. Clinical learning activities through preceptorships and site-based learning opportunities in area hospitals and clinics,
5. Summer programs in medical practice and biomedical research,
6. Post-freshman year 6-week summer program includes coursework in anatomy and physiology, as well as preceptorships with BCM faculty,
7. The program pays for full school tuition and fees. Many incidental costs, like books and airfares, are also covered.

Evaluation Design:
Retrospective controlled cohort design with the comparison group composed of those students who were selected to interview for the PHC but who did not matriculate into the program.

Outcome(s) Measured:
Matriculation into medical school.

Results:
1. The odds of medical school matriculation was seven times higher for PHC students than for non-PHC students (OR=7.030).

2. Comparison of the total number of UT-PA students matriculating to medical school in 1996 (pre-PHC) to 2001 (post-PHC).

Statistical Analysis:
Log linear analysis with odds ratio calculated with Chi-square analysis showing statistical significance (Chi-square=28.75, $p<0.0005$).

Funding:
1. HHS, BHPr, Division of Disadvantaged Assistance
2. The Houston Endowment
3. The Robert Wood Johnson Foundation

Ugbolue, A, PN Whitley, and PJ Stevens. 1987. "Evaluation of a pre-entrance enrichment program for minority students admitted to medical school." *Journal of Medical Education* 62(1):8-16.

Grade: Cohort D2 S1
Program: Pre-enterance Enrichment Program (PEP), Boston University
Pipeline Level: Pre-matriculation
Profession: Medicine

Program Interventions:
Six-week pre-matriculation academic enrichment for racial/ethnic minority and disadvantaged students admitted to Boston University School of Medicine**.**

Evaluation Design:
Cohort Study, comparing first-year performance of minority participants to minority nonparticipants.

Outcome(s) Measured:
First-year grades, retention rates.

Results:
n=52 participants and 45 minority nonparticipants, from 1979-80 through 1984-85.
1. Baseline: Participants had lower MCAT scores than nonparticipants, while the two groups had similar undergraduate GPAs. No socioeconomic, or racial and ethnic, differences between the two groups.
2. Post-intervention: Participants had significantly higher proportions of pass and honors grades than minority nonparticipants: in Endocrinology 80 percent vs. 54.8 percent; in Histology 66 percent vs. 45.2 percent ($p<.05$); other courses showed differences that were not statistically significant).

Statistical Analysis:
Statistical analysis for many variables, but small n may have reduced statistical significance.

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An Annotated Bibliography: Evaluation of Pipeline Development Programs Designed to Increase Diversity in the Health Professions, March 2006.

Evaluating Programs to Recruit Minorities into the Health Professions
Report of Two Evaluation Studies
Study 1: Evaluation of College Enrichment Programs at Four California Community Colleges
Study 2: Linking National Administration Databases to Track Medical and Dental School Matriculation for Health Careers Opportunity Program and Center of Excellence Program Participants, April 2009.