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 Administrative Databases to Track Medical and Dental School Matriculation for Health Careers Opportunity Program and Center of Excellence Program Participants

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EXECUTIVE SUMMARY

Health career educational "pipeline" programs and interventions target underrepresented minorities and students from socioeconomically disadvantaged backgrounds and attempt to enhance students' educational achievement and aspiration towards health careers to support their successful matriculation into health professions schools and training programs. The Health Resources and Services Administration (HRSA), Bureau of Health Professions (BHPr), has traditionally been one of the major sources of funding for educational pipeline programs in the United States. BHPr administers grants to support enrichment programs through its various divisions that share the goal of expanding opportunities for disadvantaged students in the health professions. BHPr's Division of Diversity and Interdisciplinary Education coordinates the Health Careers Opportunity Program (HCOP) and the Centers of Excellence (COE) Program, which are authorized under Title VII to fund educational interventions across the country.

Although previously published articles have described the specific activities that institutions have implemented with HCOP or COE support, no studies have evaluated whether students enrolled in these types of enrichment programs are actually more likely to participate in these activities than comparable students not enrolled in formal enrichment programs. In addition, few studies have evaluated meaningful outcomes, such as academic performance or matriculation into health professions schools, for students participating in HCOP- and COE-sponsored enrichment programs.

This report presents the findings of two new evaluation studies designed to better understand the impact of the HCOP and COE programs.

Evaluation Study 1: Evaluation of College Enrichment Programs at Four California Colleges

The first evaluation study consisted of a detailed investigation of enrichment programs at four California State University (CSU) campuses. Two of the four campuses had active HCOP awards at the time that the study was performed, and the other two had formerly received HCOP awards and continued to have some enrichment activities in operation, although not necessarily to the same degree as colleges with active HCOP awards. (The enrichment programs at these latter two schools are referred to as "HCOP-like" programs.)

The principal study aim was to determine whether formal enrollment in an HCOP or HCOP-like program was prospectively associated with better academic performance, as measured by college grade point average, among minority and disadvantaged students compared with the academic performance of counterparts who were not enrolled in enrichment programs. A secondary aim was to determine whether minority and disadvantaged students formally enrolled in an HCOP or HCOP-like enrichment program were more likely to participate in specific enrichment activities than their counterparts who are not enrolled in enrichment programs.

Key findings of Evaluation Study 1 are:

1. **Participation in an HCOP or HCOP-like enrichment program at these colleges is associated with achievement of a significantly higher GPA than would have been expected based on students' baseline characteristics and performance on standardized college admission tests.** Enrichment programs recruited students with lower mean scores on

standardized college admission and proficiency tests than students not enrolled in enrichment programs. Despite this vulnerable profile, enrichment program students were as likely as students not enrolled in these programs to achieve a GPA of a B grade or better. Regression models that controlled for students' admissions test scores and other confounding variables revealed a significant, positive association between enrichment program participation and mean GPA in college.

2. **Students enrolled in enrichment programs at the colleges studied are significantly more likely than students not enrolled in these programs to actively participate in a wide range of enrichment activities.** Of all the student variables measured in this study, enrollment in a college enrichment program was the single-most significant predictor of students' participation in a wide array of enrichment activities, and remained a highly influential predictor even after controlling for several other student characteristics such as the level of interest in a health career. After adjusting for other student characteristics, enrollment in an enrichment program demonstrated a particularly strong association with more structured types of enrichment activities such as faculty advising, faculty tutoring, and test-taking training. Qualitative analyses of in-depth interviews with a subsample of students in the study reinforced the findings of the survey results, providing additional insights into the value and importance that enrichment programs have for minority and disadvantaged students interested in health careers.

Evaluation Study 1 has several limitations. The study examined students at only four California State University campuses, and the findings may not be generalizable to enrichment programs and students in other college settings. Also, the study was observational in nature, and examined students' experiences in an array of "real world" enrichment programs that were not standardized across the colleges studied. The study's observational design means that caution should be exercised in making causal inferences from the associations found in the study.

Evaluation Study 2: Linking National Administrative Databases to Track Medical and Dental School Matriculation for HCOP and COE Participants

The second evaluation study examined the feasibility of tracking longer term educational outcomes for students participating in the HCOP and COE programs. The principal aim of this study was to determine whether student-level data collected as part of the uniform data set reported by HCOP and COE programs, the Disadvantaged Assistance Tracking and Outcome Report (DATOR), could be matched to centralized, national medical and dental databases to identify which participating students went on to successfully matriculate into medical or dental school. In addition to exploring the feasibility of matching these administrative databases, this study also sought to quantify the actual outcomes for students participating in the HCOP and COE programs in terms of the number of these students entering medical and dental schools in the United States.

Key findings of Evaluation Study 2 are:

1. **HCOP and COE programs are achieving a reasonable "yield" in terms of the proportion of participants successfully matriculating into medical and dental schools.**

Among the pool of HCOP and COE students who participated in these programs while in college in 2006 or 2007 and were reported in the DATOR system as having a career interest in medicine, nearly 30 percent had matriculated into medical school by 2008. In view of the fact that many of these students had not yet completed college by 2008, this appears to be a very respectable yield of medical school matriculants among the minority and disadvantaged college students participating in these pipeline programs.

2. **It is feasible to link students across DATOR, Association of American Medical Colleges, and American Dental Education Association databases to longitudinally identify program participants who subsequently matriculate into medical or dental school.** The inclusion of birth date and social security number, in addition to student name, allowed for relatively reliable matching of students across these databases using logical matching programs. This methodology for tracking outcomes using linking of centralized, national uniform databases offers a more efficient and objective means of measuring longitudinal student outcomes than relying on each grantee to track its own former participants over time.

Evaluation Study 2 has several limitations. The DATOR database does not permit identification of cohorts of students based on their expected year of college graduation. In addition, measurement of outcomes only included AAMC medical schools and ADEA dental schools, limiting the ability of the study to detect students who successfully matriculated into osteopathic medical schools, schools of pharmacy, or other health professions programs.

In summary, the results of these two evaluation studies suggest that HCOP, COE and similar types of college enrichment programs are facilitating minority and economically disadvantaged college students to actively participate in structured enrichment activities - educational, professional, and social. Participation in these programs is also associated with better college academic performance among at-risk college students interested in health careers, and longer term outcomes as measured by matriculation into medical or dental school appear to be achieving a reasonable yield.

INTRODUCTION

The health professions workforce is falling behind the growing diversity of the United States in terms of its ethnic and racial composition.[1] At the same time, minority and lower income communities suffer persistent health and health care disparities.[2] Research has found that minority physicians are more likely to work with minority and underserved communities, increasing access to quality care for those experiencing the greatest health inequities.[3,4] Reports from the Institute of Medicine,[5] the Sullivan Commission,[6] and other organizations have called for immediate and sustained efforts to increase the diversity of the health professions as a key strategy for reducing health care disparities.

In the United States, Latinos, African-Americans, Native Americans, and students from lower income brackets continue to be severely underrepresented in health professions schools and consequently in the health workforce.[1] Throughout the Nation, educational "pipeline" programs and interventions have been developed that target underrepresented minorities and students from socioeconomically disadvantaged backgrounds.[7] These interventions attempt to enhance minority and disadvantaged students' educational achievement and support their successful matriculation into health professions schools and training programs.

The Health Resources and Services Administration (HRSA), Bureau of Health Professions (BHPr) has traditionally been one of the major sources of funding for educational pipeline programs in the United States. BHPr administers grants to support enrichment programs through its various divisions that share the goal of expanding opportunities for underrepresented minorities and disadvantaged students in the health professions.[8] BHPr's Division of Diversity and Interdisciplinary Education coordinates HCOP and the COE program, authorized under Title VII to fund educational interventions across the country. HCOP grants awards to educational institutions, as well as awarding some funding directly to students, with the primary goal of identifying, recruiting, and supporting individuals from disadvantaged backgrounds to successfully pursue education and training in a health profession. HCOP-funded activities at educational institutions, often referred to as "enrichment programs," vary somewhat from institution to institution depending on local needs and contexts, but typically include some combination of academic support, service learning opportunities, advising, mentoring and other interventions designed to enhance students' academic and professional development. Many institutions emphasize enrichment programs for college students, although many 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 and ethnic minority students compared to the national average. Institutions awarded COE grants are capable of facilitating faculty and student research in minority health, strengthening the recruitment of minority faculty, and providing community-based clinical training in which students care for substantial numbers of minority patients. Targeted professions for HCOP and COE encompass the spectrum of health careers falling under the authority of Title VII, including allopathic and osteopathic medicine, pharmacy, dentistry, and the allied health professions.

A systematic, critical review of the literature on educational pipeline programs found that pipeline interventions are associated with positive outcomes for minority and disadvantaged students on several meaningful metrics, including academic performance and the likelihood of enrolling in a health professions school.[8] The studies evaluated interventions across a spectrum of pipeline stages, including high school, college, and post-baccalaureate stages, and involving a variety of targeted health professions and health science careers, including medicine, nursing, and biomedical research. Although these outcomes studies provide a good foundation for assessing the effectiveness of pipeline programs, this review concluded that relatively few well-designed studies have been published and that more high quality evaluation research is needed in this area. Specifically, very few well-designed studies have examined HCOP- and COE-sponsored interventions.

The paucity of research on activities funded by HCOP and the COE program means that many key evaluation questions have not been systematically studied with research methods that include control groups. For example, although institutions receiving HCOP and COE awards produce annual reports to BHPr that describe the students participating in the activities funded by the awards, few controlled studies have evaluated meaningful outcomes, such as academic performance and likelihood of matriculating into a health professions school, for students participating in HRSA-sponsored enrichment programs.[9] Prior evaluations also have not systematically assessed whether students enrolled in these types of pipeline programs are actually more likely to participate in specific enrichment activities, such as academic advising and test preparation sessions, than comparable students not enrolled in formal pipeline programs.

The report presents the findings of two new evaluation studies designed to better understand the impact of the HCOP and COE programs. The first evaluation study consisted of a detailed investigation of enrichment programs at four California States University (CSU) campuses. Two of the four campuses had active HCOP awards at the time that the study was performed, and the other two had formerly received HCOP awards and continued to have some enrichment activities in operation, although not necessarily to the same degree as colleges with active HCOP awards. (The enrichment programs at these latter two schools are referred to as "HCOP-like" programs.)

The principal aim for this study was to determine whether formal enrollment in an HCOP or HCOP-like program was prospectively associated with better academic performance, as measured by college grade point average, among minority and disadvantaged students compared with the academic performance of counterparts who were not enrolled in enrichment programs. A secondary aim was to determine whether minority and disadvantaged students formally enrolled in an HCOP or HCOP-like enrichment program were more likely to participate in specific enrichment activities than their counterparts who are not enrolled in enrichment programs.

The second evaluation study conducted for this project examined the feasibility of tracking longer term educational outcomes for students participating in the HCOP and COE programs. This principal aim of this study was to determine whether student-level data collected as part of the uniform data set reported by HCOP and COE programs could be matched to centralized, national medical and dental databases to identify which participating students went on to successfully matriculate into medical or dental school. In addition to exploring the feasibility of

matching these administrative databases, this study also sought to quantify the actual outcomes for students participating in the HCOP and COE programs in terms of the number of these students entering medical and dental schools in the United States.

STUDY 1

EVALUATION OF COLLEGE ENRICHMENT PROGRAMS AT FOUR CALIFORNIA STATE UNIVERSITY COLLEGES

METHODS

The general design for this study was a prospective cohort study of college students in pre-health courses and health professions programs at the four California State University (CSU) campuses included in the study, comparing experiences and outcomes for students formally enrolled in enrichment programs with those of control students not enrolled in enrichment programs. The use of a control group is important for enhancing the scientific validity of an evaluation study. Studies that only examine program participants are referred to as uncontrolled cohort studies. A limitation of an uncontrolled cohort study design is that it provides a weak level of scientific evidence for answering the question, "Did the enrichment program intervention 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 control group of students who share many of the same characteristics as the participating students but did not formally enroll in a pipeline program. Measuring outcomes among the control group serves as a referent point for determining the potential differential effect on outcomes that is associated with exposure to the intervention.

Selection of Study Sites

To recruit campuses, leaders of the HCOP programs were contacted at all three CSU campuses that had active HCOP grant awards at the time that the study was initiated. Two campuses agreed to participate (CSU Fresno and CSU Los Angeles) and one declined (CSU San Diego). We recruited two additional CSU campuses, CSU Sacremento and San Francisco State, with the intent of including additional campuses that enrolled minority students in comparable proportions to the two participating HCOP-funded CSU campuses. Although these campuses were initially conceptualized as serving as control sites because they did not have active HCOP awards, it soon became apparent that almost all major CSU campuses had at least some degree of enrichment programs in operation. For example, one campus operated a Biology Scholars Program and the other a Science Education Equity program, both designed to support minority and disadvantaged students in science and math courses. Both of these sites formerly had HCOP awards that had assisted in development of these programs. As a result, the unit of analysis for the study was individual students rather than entire campuses. At each of the four colleges, the study identified those students who were and were not formally enrolled in some type of enrichment program focusing on science and math courses and health career preparation and made comparisons between these two groups of students.

Student Recruitment

The study recruited students enrolled in undergraduate lower division science and math courses that fulfilled the prerequisite entry requirements for health professions graduate education. Self-administered questionnaires were distributed to students in class and professors allowed students

to complete the questionnaires during class time. Students were recruited for the study during the Fall 2005 term and Spring 2006 term. To achieve as full recruitment as possible of students participating in HCOP programs at the two CSU campuses with active HCOP programs, a list of students in these programs was obtained and HCOP students who were not approached in their classes were contacted to request that they complete study questionnaires.

Baseline Questionnaire

The baseline questionnaire instrument administered at the time students were recruited into the study collected demographic information such as self-reported race and ethnicity, age, gender, family income, and year in school, and data on career interests. Students were also asked whether they were enrolled in a formal enrichment *program*, and for those answering in the affirmative, the name of the enrichment program. The questionnaire also provided a list of 18 specific enrichment *activities* and asked students to report the frequency of use of each enrichment activity since the beginning of the semester in which the survey was completed. (See Appendix 1 for a list of enrichment activity questions.)

Selection of Students for Cohort Study

The study was designed to focus on the group of students among the overall pool of students taking math and science courses who would be eligible for HCOP-type enrichment programs, namely minority or economically disadvantaged students with an interest in a health career. Based on data reported in the baseline survey, students were selected for the cohort study if they met both of the following two criteria:

1) Reported an interest in pursuing a career in the health professions or were still undecided about their career path, and
2) Reported their ethnicity as non-White, or reported their ethnicity as White and also reported a family income of less than $45,000 per year.

Students who were still undecided about their career interest were included because they did not indicate that they were committed to a non-health career and were thus potentially still in a health career pipeline.

Students fulfilling both criteria were selected for the cohort study and were asked to participate in brief, Web-based, follow-up surveys approximately every 3 months after study enrollment. The follow-up questionnaires were designed to track ongoing enrichment activity utilization using the same activity items from the baseline questionnaire. The follow-up surveys were administered in December 2005-January 2006, February-March 2006, April-May 2006, and August-September 2006. Composite scores for frequency of utilization of enrichment activities were calculated as the mean value of the baseline score and the score for the last follow-up survey completed.

Additional Data Elements

In addition to data collected from survey questionnaires, data on students' academic performance were obtained from administrative files maintained by the registrar's office at each CSU. The academic data were retrieved by supplying each registrar's office with the student ID numbers

recorded on the baseline survey and having the registrar use this ID number to link the students in the study to their academic data. Data from the registrar's offices included the final grades for all courses completed at the CSU college up to the date that the searches were performed of the registrar data files. These searches were performed in the either Fall of 2005 or Spring of 2006. A grade point average (GPA) was computed from all available grades, and was considered the main outcome variable for the study.

The administrative data also included students' scores on college admission and college entrance proficiency tests: standardized test scores for the SAT and/or ACT, and scores on the CSU Entry Level Mathematics exam (ELM) and English Proficiency Test (EPT). For purposes of this study, these tests are collectively referred to as "admissions tests." A composite score was created using data from all available standardized test results. The composite admission test score was considered a baseline student characteristic, rather than an outcome variable, because these tests were completed before the student's matriculation at a CSU college.[†]

Analysis of Study Data

For the main study aim examining GPA, the key predictor variable was formal enrollment in an HCOP or HCOP-like college enrichment program and the outcome variable was college GPA. For the secondary aim (extent of enrichment activity participation), the key predictor variable also was formal enrollment in an HCOP or HCOP-like college enrichment program and the outcome variable was students' reports over time of their utilization of specific enrichment activities.

Data on the outcome variables were initially compared across the participating and control groups of students using the crude, or unadjusted, results. Multivariate models were then used to adjust for differences between the participating and control students in demographic characteristics and admission test scores, factors which might confound an association between program participation and GPA or involvement in enrichment activities. (See Appendix 2 for more details on analytic methods.)

The research protocol for this study was approved by the institutional research boards at University of California, San Francisco and the four CSUs included in the study.

[†] The composite admission test score was computed by categorizing each student's score on the SAT, ACT, ELM, and EPT into a quartile ranking based on the distribution of all study students' scores for a particular test, assigning each test score a value of 1 (lowest quartile) through 4 (highest quartile) based on the quartile ranking, and then averaging these scores for all the admission and proficiency tests taken by any individual student to arrive at the students' composite admission test score.

RESULTS

Description of Study Participants

A total of 2,195 students completed baseline surveys at four CSU campuses. The overall response rate was over 80 percent. Table 2 displays the range of academic enrichment programs available at the CSU campuses, based on the data reported by students in their baseline surveys. Programs that were unique to only one campus were placed into the "Other School Specific Organizations" category. As Table 2 indicates, these CSU campuses operate a variety of enrichment programs funded from diverse Federal, State, institutional, and other sources.

Table 2: Enrichment Programs

	Study College A	Study College B	Study College C	Study College D
College Assistant Migrant Program (CAMP)	+	+		
Education Opportunities Program (EOP)	+	+		
Louis Stokes Alliance for Minority Participation (LSAMP)	+	+	+	+
Health Careers Opportunities Program (HCOP)	+	*	*	+
Health Career Connection (HCC)	+		+	
Mathematics, Engineering, Science Achievement (MESA)	+	+		+
Upward Bound	+			
Ronald E. Mcnair Post-Baccalaureate Achievement Program	+			
MESA Engineering Program	+	+		
Minority Opportunities in Research (MORE)				+
American Medical Student Association		+		
Biology Scholars Program			+	
Pre-Medical or Pre-Dental Student Organization			+	+
Multi-cultural Organization of Science Students		+		
Minority Biomedical Research Support-Research Initiative for Scientific Enhancement (MBRS-RISE)			+	
Post-baccalaureate Research Education Program				+
Career Opportunities in Research Education & Training (COR)				+
Community Access and Retention Program (CARP)			+	

	Study College A	Study College B	Study College C	Study College D
Student Learning/Assistance Center			+	+
Chicanos for Creative Medicine (CCM)				+
Science Education Equity (SEE)		+		
Other School-Specific Organizations	+	+	+	

*indicates prior recipients of HCOP awards

Of the 2,195 students recruited for baseline questionnaires, 739 students met the inclusion criteria for the formal cohort study (minority or low-income White students with an interest in a health career) and responded to at least one follow-up survey. Of these 739 students, 186 were formally enrolled in an enrichment program. Table 3 displays the characteristics of the students in the cohort sample, based on whether they were formally enrolled in an enrichment program.

African-American, Latino students, and socioeconomically disadvantaged students, as well as those with lower academic performance prior to CSU enrollment as measured by admission test scores were significantly more likely than their counterparts to enroll in enrichment programs. Enrolled students were also significantly more likely than control students to have participated in high school and summer programs oriented towards health careers.

GPA and standardized test scores could not be obtained for 49 participants in the study cohort. These students did not differ significantly from students with GPA and test data in any baseline characteristics.

Table 3: Characteristics of students in the cohort sample, according to whether they were enrolled in an enrichment program

	Enrolled in Enrichement Program (%)* (N=186)	Not Enrolled in Enrichment Program(%)* (N=553)	p-values
Age, mean years	22.3	22.7	0.29
Male	55 (29.6)	185 (33.5)	0.32
Ethnicity			p<.01
African-American	25 (13.4)	22 (4.0)	
White	8 (4.3)	78 (14.1)	
Latino	75 (40.3)	106 (19.2)	
Southeast Asian	19 (10.2)	56 (10.1)	
Filipino	5 (2.7)	69 (12.5)	
Other Asian	24 (14.9)	112 (20.1)	
Multi-ethnic/racial	26 (14.0)	93 (16.8)	
Other/Declined to State	4 (2.2)	17 (3.2)	
Yearly Family Income			p<.01
< $16,000	46 (25.1)	69 (13.2)	
$16,000-$30,000	53 (30.0)	100 (19.2)	
$30,000-$45,000	25 (13.7)	119 (22.8)	
$45,000-$60,000	20 (10.9)	62 (11.9)	
> $60,000	39 (21.3)	172 (33.0)	
Stated Career Goal			0.05
Title VII Health Career	133 (71.5)	340 (61.5)	
Non-Title VII Health Career	34 (18.3)	136 (24.6)	
Undecided	19 (10.2)	77 (13.9)	
*Baseline Test Scores Average**			
SAT Composite, mean (SD)	909.1 (162.6)	981.6 (166.1)	<.01
ACT Composite, mean (SD)	18.6 (4.34)	21.7 (3.91)	<.01
English Proficiency Test, mean (SD)	140.4 (7.68)	144.3 (7.93)	<.01
Entry-Level Mathematics, mean (SD)	44.6 (11.1)	50.5 (13.0)	<.01
High School Program	65 (35.7)	145 (26.9)	0.02
Summer Program	99 (54.4)	71 (13.1)	<.01

* Sample for students with test score: SAT (enrichment n=124, no enrichment n=296), ACT (enrichment n=52, no enrichment n=60), EPT (enrichment n=55, no enrichment n=186), ELM (enrichment n=37, no enrichment n=152)

GPA Outcomes

Among the cohort sample, data on GPA were available for 176 of the 186 enrichment program students and 514 of the 586 students not enrolled in an enrichment program. Cohort students enrolled and not enrolled in enrichment programs had similar academic performance in courses during the two to three semesters after recruitment into the study, as measured by both mean GPA and the percentage of students achieving at least a B average (GPA≥3.0) (Table 4). However, these crude results may be misleading, insofar as students participating in enrollment programs tended to have baseline characteristics that predict lower academic achievement in college. For example, compared with students not enrolled in an enrichment program, enrolled students had significantly lower mean scores on SAT, ACT, and English and Math proficiency tests, and also were more likely to come from low income families (see Table 3 above). Achieving equivalent GPAs might therefore be a positive outcome, given the predisposing factors for lower grade achievement among enrolled students.

Table 4: Grade point averages according to enrollment in an enrichment program

	Enrolled in Enrichment Program (n=176)	Not Enrolled in Enrichment Program (n=514)	P Value
GPA, mean (SD)	2.64 (0.82)	2.71 (0.78)	0.36
GPA ≥ 3.0, %	37.5%	37.1%	0.94

To control for potential confounders of the association between enrichment program participation and GPA, a logistic regression model was employed. The model controlled for age, gender, composite admission test score, race-ethnicity, family income, and year in college. The results of the regression model shows that once these baseline characteristics are adjusted for, students participating in enrichment programs are significantly *more* likely than control students to achieve a have a GPA of 3.0 or better, as signified by the statistically significant adjusted odds ratio of 1.74 (Table 5). Table 5 also indicates the powerful association between the composite admission test score variable and GPA in college, with an odds ratio of 1.92 for each quintile increment in composite admission test score.

Table 5: Results of the regression model predicting GPA≥3.0

Variable	Odds Ratio	95% C.I.
Enrichment Program Enrollment	1.73	1.31-2.29
Composite Admission Test Score	1.93	1.34-2.79

95% C.I.=95% confidence interval
Other covariates included in the regression model were age, gender, race-ethnicity, and year of college.

To explore whether enrichment programs might exert a particularly beneficial effect on the academic performance of students who tended to have lower composite admission test scores

and enrolled in a program, a statistical model was developed to analyze an admission test score-enrichment program participation interaction. The results of the interaction model suggested that the positive association between program participation and GPA may be greater for students who enter college with lower scores on their admissions tests.

Enrichment Activities

The results of the analyses for the secondary study aim are summarized in Table 6, which describes the extent of student involvement in a variety of enrichment activities and compares the extent of utilization among cohort students enrolled and not enrolled in enrichment programs. The frequency of use of each specific item is calculated as the mean of the responses to these items on the baseline questionnaire and final follow-up questionnaire. The 18 activities listed in the first column are arranged in order of decreasing use by program-enrolled students; i.e. the activities that program-enrolled students used most (irrespective of the degree of use) appear at the top of the table, and the activities used least appear at the bottom.

Table 6: Frequency of utilization of specific enrichment activities

	Enrolled No Use (0Times)	Enrolled Limited Use (1-3 Times)	Enrolled Moderate Use (4-7 Times)	Enrolled Heavy Use (8+ Times)	Not Enrolled No Use (0 Times)	Not Enrolled Limited Use (1-3 Times)	Not Enrolled Moderate Use (4-7 Times)	Not Enrolled Heavy Use (8+ Times)	P value
Talked to other students for knowledge/advice or support	3.25	24.7	44.2	27.9	8.16	31.5	40.4	19.9	0.02
Provided mentoring to another student for advice or support	11	37.7	36.4	14.9	18.2	44.4	25.1	12.3	0.011
Met with an academic advisor	13.6	60.4	24	1.95	20.5	64	13.9	1.71	0.012
Met with a faculty member for advice	13.6	52.6	29.2	4.55	34.5	47.6	14.8	3.04	< .001
Met with other classmates in a study group	13.6	24.7	34.4	27.3	13.3	33.6	32.1	21.1	0.154
Took part in campus activities associated with professional exposure	26	50	18.2	5.84	62.4	27.9	7.97	1.71	<0.001
Visited professionals in the workplace	30.5	37	21.4	11	47.1	30.9	15.9	6.07	0.002
Attended meetings/events with health career clubs	31.8	40.3	21.4	6.49	65.5	25.8	7.21	1.52	<0.001
Attended optional discussion/review sessions	33.8	37	23.4	5.84	38	40.2	16.7	5.12	0.271

	Enrolled No Use (0Times)	Enrolled Limited Use (1-3 Times)	Enrolled Moderate Use (4-7 Times)	Enrolled Heavy Use (8+ Times)	Not Enrolled No Use (0 Times)	Not Enrolled Limited Use (1-3 Times)	Not Enrolled Moderate Use (4-7 Times)	Not Enrolled Heavy Use (8+ Times)	P value
organized by faculty/grad student									
Attended cultural/social events with a club	39	40.9	16.2	3.9	55.8	31.5	9.68	3.04	0.002
Tutored other students in coursework	40	35.1	17.5	8.44	44.6	35.5	13.5	6.45	0.403
Attended a health career seminar/course	41.6	41.6	13.6	3.25	66.6	28.1	5.12	0.19	<0.001
Met with a career counselor	45.5	44.8	8.44	1.3	63.4	32.1	3.98	0.57	0.001
Participated in workshops related to time management, computer skills or study skills	46.1	42.2	9.09	2.6	66.8	22.4	9.11	1.71	<0.001
Met with university staff to discuss budget/finances	46.8	42.2	10.4	0.65	60.5	32.5	5.88	1.14	0.012
Attended individual tutoring sessions led by faculty/grad student	48.1	31.2	17.5	3.25	52.3	27.5	15.6	4.17	0.655
Attended individual tutoring sessions led by another undergrad	50.7	24.7	21.4	3.25	58.2	24.7	13.9	3.23	0.132

	Enrolled No Use (0Times)	Enrolled Limited Use (1-3 Times)	Enrolled Moderate Use (4-7 Times)	Enrolled Heavy Use (8+ Times)	Not Enrolled No Use (0 Times)	Not Enrolled Limited Use (1-3 Times)	Not Enrolled Moderate Use (4-7 Times)	Not Enrolled Heavy Use (8+ Times)	P value
Attended a formal training session to improve testing skill	63	25.3	11	0.65	80.1	18.2	3.23	0.19	<0.001
Note: Frequency of use (%)									

The most frequently used activity was talking to other students for knowledge, advice or support. Program enrolled students consulted other students at a rate of 96.8 percent; non-program enrolled students consulted other students at a rate of 91.8 percent. For both groups of students, this was among the most heavily used activity. While both groups used this activity, the program enrolled students participated at a significantly higher rate than did students who were not enrolled in an enrichment program ($p= 0.02$).

The next most frequently used activity by program-enrollees was providing mentoring to another student for advice or support. Among enrollees, mentoring occurred at a rate of 89 percent; among non-enrollees the rate was 81.8 percent. The extent of participation in this activity among students providing mentoring was in the limited-to-moderate range use in both groups. Program-enrolled students participated in this activity at a significantly higher rate than students not enrolled in an enrichment program ($p=0.01$).

The third, fourth and fifth most frequently used activities by program-enrollees were meetings with advisors and student study groups. For meetings with academic advisors and faculty mentors, participation was primarily limited with a tendency toward moderate use among both groups. Program-enrollees were significantly more likely than non-enrollees to meet with advisors and mentors ($p=.01$, $p<.01$). For meeting with classmates in a study group, activity use was in the moderate range for both groups and there was no significant difference in use frequency for this activity between groups.

Both groups also visited professionals in the workplace. The program-enrolled students participated at a rate of 69.5 percent, and control students participated at a rate of 52.9 percent. The extent of participation was largely in the limited category. Again, program enrollees participated significantly more extensively than non-enrollees in this activity ($p< .01$).

The activity reported as least frequently used by both groups of students was attending a formal training session to improve testing skills. However, participation among program-enrolled students was much higher than for non-enrolled students ($p<0.01$). Program-enrolled students participated at a rate of 37 percent; non-program enrolled students participated at a rate of roughly 20 percent. When used, participation was mostly limited.

There was considerable variation in activity usage among the two groups for the other activities included in the investigation. For program enrollees, attendance at health club meetings, optional discussion sessions, cultural events, and health career seminars were relatively common activities. In contrast, among non-enrolled students, only attendance at optional discussion sessions made it into the upper half of activities most frequented. For program-enrollees, attending individual tutoring sessions was among the least utilized activities; among non-enrollees, individual tutoring was roughly in the mid-range of activity usage. Other activities that enrolled students used significantly more often than non-enrolled students were partaking in campus activities associated with professional exposure, tutoring other students, meeting with career or financial counselors, and participating in workshops.

In reviewing the results displayed in Table 5, there are some general patterns in the differences between program-enrolled and non-enrolled students. Overall, program-enrolled students

participated in enrichment activities much more frequently than students not enrolled in a program. Of the 18 activities listed, program-enrolled students participated at a rate of over 50 percent in 17. Among cohort students not enrolled in a program, participation at a rate of 50 percent or higher occurred for only 8 of the 18 enrichment activities listed. Furthermore, there was a statistically significant difference in the level of participation for 13 of the 18 activities investigated. Secondly, program-enrolled students also participated more extensively than non-enrolled students when they did participate in an activity. Considering the combination of moderate and heavy use of enrichment activities, program-enrollees participated at rates of 25 percent or higher in 9 of the 18 activities, compared to 4 out of 18 activities for non-enrollees.

The overall pattern of results displayed in Table 6 shows that program enrolled students placed more value than non-enrollees on the enrichment activities in which they participated. The highest mean rating for an activity was among program enrollees. The lowest mean rating for an activity was among non-enrollees. Program enrolled students rated 9 of the 18 activities above a mean score of 3.0; non-enrollees rated only 5 of the 18 activities above a mean score of 3.0. The highest mean ratings for both groups tended to occur for activities listed at the top of the table, which were the most frequently used activities. One exception was visiting professionals in their workplace to learn more about their occupation. For this activity, students indicated only limited to moderate utilization but a high rating of the usefulness of this activity.

The results presented in Table 6 are shown in more graphic form in Figure 1. The points in the figure indicate odds ratios from ordinal regression models including enrichment program participation as the only predictor variable. The lines extending from these points represent 95 percent confidence intervals. Each odds ratio can be interpreted as the odds of a student in an enrichment program participating with greater frequency in the listed activity, relative to a student not enrolled in an enrichment program. Numeric values greater than one indicate an increase in the odds of greater frequency of activity use among students enrolled in an enrichment program. The differences are statistically significant if the confidence interval does not cross 1.0. This unadjusted regression model produces results equivalent to the chi-square results shown in Table 6, with a significant association between program enrollment and use of activities for the 18 activities studied.

Figure 1: Unadjusted odds ratio estimates for the association between formal enrollment in enrichment program and the frequency of use of enrichment activities.

Variable	Point Estimate (Unadjusted)	Lower 95% CI	Upper 95% CI
Met Advisor	1.79	1.57	2.04
Professional Exposure	2.07	1.46	2.94
Career Counselor	3.79	2.73	5.24
Peer Advice	1.60	1.16	2.21
Provided Peer Advice	1.69	1.48	1.92
Faculty Advice	2.70	2.26	3.25
Undergrad Tutoring	1.40	1.36	1.44
Faculty/Grad Tutoring	1.07	0.75	1.51
Tutored Peers	1.29	0.85	1.98
Study Group Participation	1.37	0.90	2.08
Optional Review Sessions	1.26	1.04	1.53
Test-Taking Training	2.38	1.36	4.15
Time/Study Kill Workshops	1.98	1.45	2.69
Budget Counseling	1.70	1.27	2.26
Visited Health Professionals	1.83	1.66	2.00
Health Career Seminars	2.94	2.22	3.90
Health Professional Clubs	3.99	3.04	5.23
Cultural Events	1.91	1.38	2.63

Because students voluntarily chose to enroll in an enrichment program, rather than being randomized to participate, the associations shown in Table 6 and Figure 1 may be confounded by other student characteristics that predict both students' likelihood of enrolling in an enrichment program and participating in the types of activities that may be facilitated by an enrichment program. That is, students who enrolled in an enrichment program might have other characteristics that would have made them more likely than non-enrolled students to participate in enrichment activities even in the absence of a formal enrichment program. To attempt to control for potential confounding variables, multivariate ordinal logistic regression models were computed for each enrichment activity, with many of the students' baseline characteristics included as covariates in the model in addition to the main predictor, formal enrollment in an enrichment program. The covariates in the multivariate model included career interest, age, gender, race-ethnicity, participation in a high school health program or summer program, composite admission test score, and family income. The adjusted odds ratios for enrichment program enrollment as a predictor of the frequency of use of enrichment activities, after controlling for all these other variables, are shown in Figure 2.

Figure 2: Adjusted odds ratio estimates for the association between formal enrollment in enrichment program and the frequency of enrichment activities.

Variable	Point Estimate (Unadjusted)	Lower 95% CI	Upper 95% CI
Met Advisor	1.42	0.98	2.06
Professional Exposure	1.27	0.68	2.38
Career Counselor	3.94	2.26	6.88
Peer Advice	1.17	0.65	2.10
Provided Peer Advice	1.19	0.70	2.02
Faculty Advice	2.02	1.20	3.41
Undergrad Tutoring	0.89	0.58	1.37
Faculty/Grad Tutoring	0.72	0.42	1.24
Tutored Peers	1.04	0.71	1.50
Study Group Participation	1.16	0.59	2.28
Optional Review Sessions	1.09	0.72	1.65
Test-Taking Training	1.43	0.66	3.10
Time/Study Kill Workshops	1.14	0.87	1.48
Budget Counseling	1.40	0.92	2.14
Visited Health Professionals	1.54	1.08	2.20
Health Career Seminars	2.29	1.05	4.99
Health Professional Clubs	3.62	1.80	7.26
Cultural Events	1.96	1.32	2.92

In the adjusted models shown in Figure 2, enrichment program enrollment remained a statistically significant predictor for 10 of the 18 enrichment activities studied even after controlling for baseline student characteristics. Of note, the specific activities that remained significantly associated with program enrollment in the adjusted models were ones that tended to involve more structured types of activities. For example, the strongest associations in these models were for the activities of faculty advising, faculty tutoring, and test-taking training. As opposed to more informal types of peer-to-peer support activities, enrichment programs likely play a particularly strategic role in facilitating these more structured types of activities.

While program enrollment was strongly associated with use of many enrichment activities independent of baseline student variables, several of these baseline student characteristics were also associated with use of enrichment activities. Students with a strong interest in becoming physicians, and to a lesser extent allied health professionals, nurses or optometrists, demonstrated a greater use of many enrichment activities than students who were undecided about career intention, independent of students' enrollment in a formal enrichment program. Students involved in summer health career programs also demonstrated a significantly higher level of participation in many enrichment activities when compared with students who did not attend summer programs. The full results of the multivariate regression models are shown in Appendix 3, including the odds ratios for each of the covariates.

Qualitative Student Interviews

A final study component consisted of in-depth individual interviews with 20 students at the 4 CSU campuses to gain more qualitative insights about those aspects of college enrichment programs that students perceived to be especially valuable. Characteristics of the students interviewed are shown in Table 7. Ethnic and racial backgrounds included African-American, Burmese, White, Chinese, Ecuadorian, Ethiopian, Hmong, Japanese/African-American, Korean, Mexican/ Chicano, Panamanian/El Salvadorian, Persian/ Iranian, South Asian/ Indian and Vietnamese. Students were purposively sampled for interviews from both enrichment program enrollee and non-enrollee groups to allow comparison of student experiences between these two groups. Interviews were transcribed and the content coded and analyzed using rigorous qualitative methods to identify key themes. (See Appendix 4 for more details on the analytic methods.)

Table 7: Demographic and social characteristics of the 20 students who participated in qualitative interviews

Student Characteristic	No.
Enrolled in an enrichment program	13
Not enrolled in an enrichment program	7
Family income $\leq$ $45,000	16
Female	13
Male	7
Career interest in Dentistry	3
Career interest in Medicine	13
Career interest in Pharmacy	4

Enrollees consistently spoke very positively about the value of participation in an enrichment program. One student commented,

> "Of all the experiences or programs or activities the program most influential was the [enrichment program]. Hands down, because it touched so many areas of my life - not just academics, not just learning how to test-take - it was just everything about this program enlightened every, and enriched every part of my life. I'd say a majority of my stability, and my support does come from the people I surround myself with every day. And that just so happens to be the [enrichment program] people."

Mentoring was a major highlighted theme for all students interviewed. Students identified examples of key mentors including academic enrichment directors and counselors, seminar guest lecturers, health professionals, job-related mentors, peers, family members, educational faculty, and teaching assistants. Mentoring covered important topics such as health professional career choice, personal development, counseling on personal issues, motivation, studying, and time management.

> "The mentoring, is the major [strength of the enrichment program.] Having counselors or advisers that are really involved in the program, or really want to help students. People are committed to us."

Overall, students who had some mentorship relationship in place often expressed confidence in achieving their academic and professional goals, even in situations where they faced academic or financial difficulty. Peer mentoring also was a valued and common event that was reported by all students interviewed, consistent with the findings of the survey analysis.

Unlike the routine, required advising systems set up by some campuses, enrichment programs were perceived as providing more valuable advising services to engaged participants. Structured supervision fostered opportunities for early problem detection and intervention. This pro-active approach enabled students to continue building their confidence and strategize how to achieve their goals.

> "[Talking with the advisors] boosted [my confidence]! It really made me feel that…everything might be difficult, but you can do it. There's nothing gonna stop me. The only thing that could stop me is myself, if I don't believe in myself."

In some cases, the advising relationship was as strong as some family relationships, and the students spoke of the academic enrichment advisor as their "Den Mother."

> "I could go to her for anything at anytime; she was more like my mom than my advisor."

Students who did not participate in a formal enrichment program expressed a desire for more academic advising. They often described facing difficult decisions in this transition with few resources or guidance.

> "I still can't decide for myself. I still want someone to tell me what class I should take…I guess that's in my mind now. I can't really make career decisions for myself. I want someone to tell me what class I should take."

Students in enrichment programs had access to program-specific tutoring sessions in core science and math classes which are critical in health professional pre-requisite coursework. The majority of participants expressed satisfaction with these sessions.

> "I'm taking an organic chemistry this semester, and I'm taking the facilitation class through academic enrichment. And it's for my own benefit. It's kinda like tutoring, but you're just one step ahead of what's taking place in lecture. That's been helpful – that's boosted my grades up."

Students described career exposure experiences as helping them to change, expand or confirm their original interest in a particular health professional career. For example, all of the dental bound students described early career exposure allowed them to select dentistry as an attractive and compatible career path in place of an earlier identified health profession.

> ”I will say by shadowing my dentist [was the most influential experience affecting my decision to pursue dentistry]. It was the greatest opportunity because I feel like if I hadn’t shadowed her, that even though I had read the package that [the] career center had given to me, I still couldn’t see in real life how the dentistry field actually works.”

Students who were not enrolled in a formal enrichment program were left to coordinate career exposure activities on their own. They expressed a desire to have more career mentorship and exposure opportunities, and appeared confused about how to initiate, locate and navigate this process.

> “I don't know any physician personally. I wish I did. No I have never had an opportunity to job shadow - but I'm looking into that this summer, but I don't know where to start.”

Students also noted that enrichment programs reinforced various time management skills, including individual supervision, informal support and instructional sessions throughout the school year.

> “[The instructors and academic enrichment directors] made me be prepared. ‘Well, we’re doing this by next week.’ They’re like, ‘Well, we have a seminar due next week. Can you be there?’ I said, ‘All right, I'll be there.’ So when you have set assignments and a schedule, you have to make sure you're ready.”

STUDY 2
LINKING NATIONAL ADMINISTRATIVE DATABASES TO TRACK MEDICAL AND DENTAL SCHOOL MATRICULATION FOR HCOP AND COE PARTICIPANTS

METHODS

HCOP and COE grantees annually submit data on participating students to HRSA using a uniform database, the Disadvantaged Assistance Tracking and Outcome Report (DATOR). Grantees are required to report data on each individual student participating in activities supported by the grantee's HCOP or COE award, including student name, social security number, gender, race/ethnicity, targeted health professions, status in the educational pipeline, and financial assistance received through these programs. HRSA maintains an electronic file that is a compilation of all the data reported in the DATOR system by grantees. The DATOR uniform data set has undergone revisions over the past several years, including moving to a Web-based reporting format and clarifying guidelines for reporting requirements for purposes of better quality control of reported data. This study used data reported by grantees in their DATOR reports of 2006 and 2007, a period following some of the recent efforts to optimize the quality of the DATOR reporting system.

The first aim of the evaluation study involving data collected by the DATOR system was to determine the feasibility of matching student data from DATOR to national student databases maintained by the Association of American Medical Colleges (AAMC) and the American Dental Education Association (ADEA). The AAMC Division of Medical Student Services and Studies administers the American Medical College Application Service (AMCAS), which is a centralized system for all applications to U.S. medical schools accredited by the Licensing Commission on Medical Education. Individuals applying to medical school are assigned a unique identifier at the time of initiating the medical school application process, and the AMCAS database also contains longitudinal tracking information about each student's medical school application, admission, matriculation, and graduation status. ADEA administers a similar centralized database for U.S. dental schools. Unfortunately, Osteopathic medical schools and pharmacy schools in the United States do not maintain similar centralized national student databases.

Using data on individual students in the DATOR databases from 2006 and 2007, staff at the AAMC and ADEA searched their student databases to identify any of the DATOR students who had matriculated into medical or dental school, respectively, by the fall of 2008. Students were matched across these databases using name, date of birth, and last four digits of the social security number. If a student appeared in DATOR in both years (2006 and 2007), the student was only counted a single time and was assigned to the most recent year (2007) in which he or she was reported as participating in HCOP or COE.

For each of the 2 years of student cohorts reported in DATOR, the number and percent of students matriculating into AAMC medical schools and ADEA dental schools were calculated. DATOR includes a diverse array of students, ranging from elementary students to graduate students, and students with diverse career goals ranging from allied health to medicine. Because of this, the analysis was also restricted to only those students in DATOR who were most likely to

have been eligible to apply to and matriculate in medical or dental schools by 2008. Specifically, the analysis was restricted to students who were listed in DATOR as having a current educational status of attending a 4 year college, and who had a listed career interest of medicine or dentistry.

RESULTS

It was determined that it was feasible to link students across the DATOR and AAMC and ADEA databases to identify those matriculating into medical or dental school. The inclusion of birth date and social security number, in addition to student name, allowed for relatively reliable matching of students across these databases using logical matching programs.

Table 8 shows the matriculation outcomes for all students in the 2006 and 2007 DATOR cohorts. In 2006, 9,807 unique students were reported in the DATOR system, with the number growing to 15,547 in 2007. By 2008, over 9 percent of these students had matriculated into medical school and nearly 2 percent had matriculated into dental school; 11.6 percent of the 2006 cohort and 10.9 percent of the 2007 cohort matriculated by 2008 into either medical or dental school.

Table 8: All Students

DATOR Year	No. DATOR Students	No. of Students Matriculating at AAMC Medical Schools	% of Students Matriculating at AAMC Medical Schools	No. of Students Matriculating at ADEA Dental Schools	% of Students Matriculating at ADEA Dental Schools	No. Matriculating Med or Dental	% Matriculating Med or Dental
2006	9,807	946	9.6%	189	1.9%	1,135	11.6%
2007	15,547	1,423	9.2%	276	1.8%	1,699	10.9%

As noted above, the total cohort of DATOR students includes many students who would not be expected, because of their early stage in the educational pipeline or interest in non-medical and non-dental health careers, to matriculate into medical or dental school by 2008. The analyses were therefore repeated using only the DATOR students who would most reasonably be considered to be eligible for these educational outcomes by 2008: students participating in HCOP and COE programs while they were in college, and with a professed interest in medicine or dentistry as reported by the grantee institutions in the DATOR system. When restricted to this group of students, the yield for the percentage matriculating into medical or dental school is much higher.

In 2006, 2,199 students in DATOR met the inclusion criteria of attending college and having an interest in medicine, increasing to 2,404 students in 2007. Nearly 30 percent of these students had matriculated into AAMC medical schools by 2008 (Table 9).

Table 9: 4 Year College Students, Medicine Career Interest

DATOR Year	No. DATOR Students	No. of Students Matriculating at AAMC Medical Schools	% of Students Matriculating at AAMC Medical Schools
2006	2,199	649	29.5%
2007	2,404	671	27.9%

Note: cohort limited to students who were listed as active HCOP or COE participants during the reporting year.

Fewer DATOR students indicated an interest in dentistry than in medicine. Of the students in DATOR attending college and indicating an interest in dentistry, 2.0 percent of the 2006 cohort had matriculated into dental school by 2008, and 15.8 percent of the 2007 cohort had matriculated into dental school (Table 10). It is not clear why these outcomes differ so much between these 2 years of DATOR cohorts.

Table 10: 4 Year College Students, Dental Career Interest

DATOR Year	No. DATOR Students	No. of Students Matriculating at ADEA Dental Schools	% of Students Matriculating at ADEA Dental Schools
2006	245	5	2.0%
2007	423	67	15.8%

Note: cohort limited to students who were listed as active HCOP or COE participants during the reporting year.

It is important to note that even though the cohorts shown in Tables 9 and 10 were restricted based on the criteria described above, many of the students may still not have been eligible to matriculate into medical or dental school by 2008. For example, many of these students have been freshmen or sophomores in college, and would not have graduated from college by 2008. The DATOR system indicates whether students are in college, high school, or earlier educational levels, but it does not specify the grade level within these educational categories. This situation would lower the matriculation "yield" that could reasonably be expected for these cohorts by 2008.

To interpret the policy implications of these outcomes for students in the DATOR system, it is necessary to have some type of benchmark against which to judge these outcomes. Unfortunately, unlike the design for the CSU HCOP study described in the previous section of this report, there are no easily identifiable national cohorts of control students to compare with the students reported in the DATOR system as having participated in HCOP and COE programs. However, several reference points may provide some context for interpreting these outcomes for the DATOR students. One reference point is the number of matriculants to AAMC medical schools in relation to the number of baccalaureate degrees awarded to students majoring in biological sciences in a given year. Biological sciences are the most common college major among applicants to U.S. medical schools, and college graduates with this major therefore constitute one prominent pool of potential medical school applicants. In 2005-06, the latest year for which national data are available on baccalaureate degree awards in the United States.,

69,178 baccalaureate degrees were awarded to students graduating with a major in biological and biomedical sciences.[10] In 2005, 17,004 of the students matriculating into AAMC medical schools had a college major in the biological sciences.[11] Thus, approximately 14 percent of the college graduates with biological science majors matriculate into AAMC medical schools.

Another point of reference is the percentage of all applicants to medical school with biological science majors in college who matriculate into medical school. In 2008, 42 percent of applicants with biological science majors matriculated into medical school.[11] A final set of references is the percentage of minority student applicants to medical school who successfully matriculate. In 2008, 38 percent of African-American and 46 percent of Hispanic medical school applicants matriculated into medical school.[12]

As displayed in Table 9, nearly 30 percent of the active HCOP and COE participants who were college students with an interest in medicine matriculated into medical school by 2008. This percentage is greater than the 14 percent of all biological science college graduates matriculating into medical school, although this 14 percent represents a low benchmark in that it includes in the denominator many biological science majors who were not interested in applying to medical school. The higher 38 percent-46 percent benchmarks that are based on the percentage of applicants who successfully matriculated represents an upper bound benchmark, since the denominator for these benchmarks consists only of students who actually applied to medical school and the DATOR cohorts include many college students who did not yet graduate from college and were thus not yet eligible to matriculate into medical school.

DISCUSSION

Key Findings

These two evaluation studies provide several important insights into HCOP, COE and similar types of pipeline enrichment programs for minority and disadvantaged college students considering health careers.

Evaluation Study 1: Evaluation of College Enrichment Programs at Four California Community Colleges

The study found that participation in an HCOP or HCOP-like enrichment program at these colleges is associated with achievement of a significantly higher GPA than would have been expected based on students' baseline characteristics and performance on standardized college admission tests. Enrichment programs recruited students with lower mean scores on standardized college admission and proficiency tests than students not enrolled in enrichment programs. Despite this vulnerable profile, enrichment program students were as likely as students not enrolled in these programs to achieve a GPA of a B grade or better. Regression models that controlled for students' admissions test scores and other confounding variables revealed a significant, positive association between enrichment program participation and college GPA.

The association of program enrollment with GPA may in part be related to the specific types of enrichment activities sponsored by the programs. Students enrolled in enrichment programs at the colleges studied were significantly more likely than students not enrolled in these programs to actively participate in a wide range of enrichment activities. After adjusting for other student characteristics, enrollment in an enrichment program demonstrated a particularly strong association with more structured types of enrichment activities such as faculty advising, faculty tutoring, and test-taking training. Qualitative analyses of in-depth interviews with a sub-sample of students in the study reinforced the findings of the survey results, providing additional insights into the value and importance that enrichment programs have for minority and disadvantaged students interested in health careers.

The study also found that HCOP-funded programs operate in a dynamic college environment featuring a diverse array of enrichment programs. The study identified over 20 different enrichment programs at the four CSU campuses with at least some degree of focus on math and science achievement or health careers. These campuses demonstrated a commitment to operating enrichment programs for minority and disadvantaged students, and are resourceful in identifying sponsorship and funding for enrichment programs. Although it was beyond the scope of this study to analyze each individual enrichment program in detail, HCOP-funded programs appeared to have the most concentrated focus on preparation for careers in the health professions among the programs identified at these 4 campuses, and also appeared to have a particularly structured approach to enrichment activities. A diversity of programs may represent a strength, particularly in an environment of unstable funding for enrichment programs that make reliance on any one particular funding stream problematic. However, this diversity may also have disadvantages, such as by serving as a barrier to consolidation that might allow more economy of scale for

program operations and by presenting students with a potentially confusing array of program options. Certainly, the diversity of programs presents a major challenge for evaluation research by making it very difficult to find entire colleges that could function as control sites on the basis of not operating any meaningful type of enrichment program.

Although this study examined only four campuses, a strength of the study is its systematic and detailed approach to quantitatively evaluating several aspects of these programs and making comparisons between students enrolled in the programs and control students not enrolled in the programs. This study also has several limitations. The study examined students at only four California State University campuses, and the findings may not be generalizable to enrichment programs and students in other college settings. Also, the study was observational in nature, and examined students' experiences in an array of "real world" enrichment programs. The investigators had no control over the actual enrichment program interventions, and these interventions were not standardized across the campuses studied. The study's observational design also means that caution should be exercised in making causal inferences from the associations found in the study. For example, although the study found statistically significant associations between enrollment in enrichment programs and participation in specific enrichment activities, even after controlling for various baseline student characteristics, there may be other, unmeasured characteristics such as student motivation that confound these associations. Similarly, although the study prospectively measured students' GPAs over time following the baseline assessments of students, causal inferences about the relationship between baseline measurements of enrichment program enrollment and subsequent GPA must be made with caution.

Evaluation Study 2: Linking National Administrative Databases to Track Medical and Dental School Matriculation for HCOP and COE Participants

This study determined that it was feasible to link students across the DATOR and AAMC and ADEA databases to perform longitudinal tracking of individual students to identify those students matriculating into medical or dental school. The inclusion of birth date and social security number, in addition to student name, allowed for relatively reliable matching of students across these databases using logical matching programs. This methodology offers a more efficient and objective means of measuring longitudinal student outcomes than relying on each grantee to track its own former participants over time. Grantees have few resources to perform longitudinal tracking of students, and maintaining contact with former participants to collect long term outcomes such as health professional school matriculation is difficult even for motivated grantees, subject to low response rates and self-reported data from former participants which contribute to low data reliability. Evaluation Study 2 demonstrates the advantages of administrating a centralized uniform data set at the agency level and linking this data set to other centrally administered, national health professions school databases. This type of linking of national data sets provides a much more efficient and objective means for measuring long term student outcomes. The validity of this centralized measurement approach, however, is dependent on the uniform database including adequate student identifying data. Data elements such as social security number enhance the ability to match students across databases, since students' names may change due to marriage or other circumstances and matching character-based names is less reliable than matching numeric data elements. In addition, the validity of this approach

depends on grantees providing reliable information in their uniform data set reports to the agency.

The results of this evaluation study suggest that the HCOP and COE programs are achieving a reasonable "yield" in terms of the proportion of participants successfully matriculating into medical and dental schools. Among the pool of HCOP and COE students who participated in these programs while in college in 2006 or 2007 and indicated an interest in medicine, nearly 30 percent had matriculated into medical school by 2008. In view of the fact that many of these students had not yet completed college by 2008, this seems a very respectable yield of medical school matriculants among the minority and disadvantaged college students participating in these pipeline program.

This study has several limitations. As noted above, the DATOR database does not permit identification of cohorts of students based on their expected year of college graduation. In addition, measurement of outcomes only included AAMC medical schools and ADEA dental schools, limiting the ability of the study to detect students who successfully matriculated into osteopathic medical schools, schools of pharmacy, or other health professions programs.

CONCLUSION

The results of these studies support the conclusion that HCOP and similar types of college enrichment programs are facilitating minority and economically disadvantaged college students to actively participate in structured enrichment activities - educational, professional, and social. The results suggest that these programs enhance the academic performance of at-risk college students. Tracking of longer term outcomes using centralized administrative databases suggest that a reasonable number of HCOP and COE program participants are successfully matriculating into U.S. medical and dental schools. Together, these findings add to the evidence that structured health and science career-oriented enrichment programs at the college level, supported by HCOP, COE and other funding sources, are an important strategy for enhancing the opportunity for minority and disadvantaged students to succeed in the health professions educational pipeline.

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12. Association of American Medical Colleges. *Facts: Applicants, Maticulants and Graduates.* Table 8: Applicants to U.S. Medical Schools by Race, Selected Combinations within Hispanic or Latino Ethnicity, and Sex, 2006-2008. http://www.aamc.org/data/facts/2008/2006to2008det.htm

13. Association of American Medical Colleges. *Facts: Applicants, Maticulants and Graduates.* Table 9: Matriculants to U.S. Medical Schools by Race, Selected Combinations within Hispanic or Latino Ethnicity, and Sex, 2006-2008. http://www.aamc.org/data/facts/2008/2006to2008detmat.htm

Appendix 1: Engagement activity questions

1. Met with an advisor to discuss your goals and interests as a college student
2. Met with a career counselor to discuss possible career tracks
3. Participated in campus activities or events that offered in-depth exposure to a professional field (e.g. medicine, law, business management, dentistry, etc)
4. Talked in person with another student (mentor) for knowledge or advice, or for general support or encouragement.
5. Provided mentoring to another student for knowledge or advice, or general support or encouragement.
6. Met with a faculty member (mentor) for knowledge or advice, or for general support or encouragement.
7. Attended one-on-one tutoring sessions led by another undergraduate student at your university.
8. Attended one-on-one tutoring sessions led by a faculty, graduate student, or staff member at your university.
9. Tutored other students on their coursework.
10. Met with classmates or other students to study course material as a group.
11. Attended optional discussion and/or review sessions organized by your professor or teaching assistants in addition to your enrolled section.
12. Attended a formal training session to improve test-taking performance
.
13. Participated in any classes or workshops to help you manage time more efficiently, work on the computer, or to improve your study skills.
14. Met with university staff to discuss your budget and financial aid situation.
15. Visited professionals in their workplace to learn more about their occupation (e.g. doctor, lawyer, dentist, etc.)
16. Attended a seminar or course that had a clear health career focus.
17. Attended meetings or events sponsored by campus clubs with a health professions focus (e.g. medicine, dentistry, pharmacy, optometry, etc.)
18. Attended cultural or social events sponsored by a university club or association.

Appendix 2: Analytic methods for quantitative study components

For all analyses, initial comparisons of students were made using two-sided chi-square tests for categorical data and t-tests for continuous variables to test for significance of differences. Multivariate regression models were also used. For the analysis of the outcome of student college GPA, to control for potential confounders of the association between enrichment program participation and GPA, a logistic regression model was employed. The covariates included age, gender, composite admission test score, race-ethnicity, family income, and year in college. GPA $\geq$3.0 was the dependent variable and enrichment program participation was the key predictor variable. Regression analyses using an ordinal logistic model yielded odds ratio estimates for the effect of enrichment program participation on the frequency of activity utilization for each of the 18 engagement activity items. Covariates included year in college, family income, race-ethnicity, level of interest in a health profession career, gender, admission test composite score and participation in high school and summer health career programs. Regression error terms in all models were clustered by school and robust standard error terms are reported specifying the Huber/White/sandwich estimator of variance.

Appendix 3: Full results of adjusted models predicting frequency of use of enrichment activities

The data in the table below are the odds ratios from the regression models examining predictors of specific enrichment activities. The table provides the numerical data for the points shown in Figure 2 of the report. Each odds ratio can be interpreted as the change in odds of the average student participating with a greater frequency in the activity listed in the table column headings, holding all other predictor variables constant. Numeric values of less than one indicate a decrease in the odds of frequent use of an activity for the intersecting predictor variable and activity. For example, a 1 year increase in age results in a slight decrease in the odds of a student meeting with an advisor more frequently. Values greater than one indicate an increase in the odds of participating in a given activity, holding other variables constant. For example, students interested in medicine are more likely to meet with career counselors. When the odds ratio represents a statistically significant finding, with p-value<0.05, the number in the table appears in bold type.

	Met Advisor	*Career Counselor*	*Prof. Exposure*	*Peer advice*	*Provided Peer Advice*	*Faculty Advice*	*Undergrad Tutoring*	*Faculty/Grad Tutoring*	*Tutored peers*	*Study Group Participation*	*Optional Reviews*	*Test-Taking Training*	*Time/Study Skill Wkshop*	*Budget Counseling*	*Visited Health Prof.*	*Health Career Sem.*	*Health Prof. Clubs*	*Cultural Events*
Enrichment program	1.32	1.22	**3.82**	1.26	1.36	**2.09**	1.01	0.88	1.19	1.35	**1.22**	1.49	1.22	**1.43**	**1.47**	**2.44**	**3.66**	**2.11**
Career interest strength	1.00	1.04	1.04	**1.21**	1.30	0.95	1.12	1.10	1.19	1.18	**1.13**	1.21	0.96	**1.58**	1.15	1.07	1.19	1.05
Age	0.95	**0.92**	0.95	0.96	0.98	0.97	0.99	**1.01**	1.02	1.00	0.98	1.02	1.02	**0.95**	1.00	0.97	0.97	1.01
Year in college	1.10	0.98	1.28	1.11	1.24	0.99	0.93	**0.88**	**0.80**	0.96	1.09	0.94	0.66	0.93	**1.16**	**1.33**	**1.24**	0.93
Male	1.27	1.02	0.85	**0.81**	1.02	**1.36**	0.90	0.91	0.88	1.17	**1.17**	1.19	1.13	0.82	1.13	1.18	0.93	0.86
Allied/nursing/opt	1.33	1.12	1.33	**1.54**	**1.51**	**3.38**	1.21	0.93	0.77	1.25	0.60	1.10	**0.63**	0.75	**1.40**	0.95	1.58	0.94
Pharmacy/dental	1.10	0.95	1.47	1.44	**1.50**	1.62	1.32	0.98	1.04	1.14	1.06	0.90	0.59	**0.47**	1.31	1.64	1.23	0.94
Medicine	1.28	1.04	**3.26**	1.29	**1.51**	2.22	**1.73**	1.16	**1.79**	**1.52**	1.15	1.13	**0.56**	0.58	**1.78**	**2.76**	**2.60**	0.81
African-American	1.30	0.78	1.46	2.50	1.39	1.38	1.97	1.29	0.84	1.33	0.92	**0.52**	**1.05**	**1.48**	1.92	2.94	**1.50**	1.30
White.	**1.57**	0.36	0.91	1.25	0.85	**1.72**	1.24	1.32	1.14	0.95	1.46	**0.46**	**0.27**	**2.40**	1.78	1.26	1.77	1.30
Latino	**1.57**	0.70	1.14	1.46	1.11	1.49	1.30	0.98	1.05	1.06	0.94	**0.58**	1.00	**1.54**	1.79	1.93	**2.13**	**2.04**
South East Asian	1.44	0.83	**1.27**	**1.81**	**2.21**	1.34	1.27	1.41	1.79	**1.47**	1.38	0.97	1.65	1.19	2.31	2.38	**2.70**	**3.39**
Filipino	1.05	0.72	1.28	**2.43**	**1.85**	1.13	0.78	0.95	1.31	**2.37**	1.12	0.70	1.66	1.21	1.15	2.31	1.56	**2.20**
Other/Native-Am	1.29	**0.26**	0.46	1.55	0.78	**2.11**	0.83	0.81	1.00	1.31	1.26	1.13	1.73	**2.86**	2.10	1.64	1.41	**3.00**
Multiracial	0.92	**0.45**	1.42	1.71	1.74	0.78	1.08	**1.62**	1.15	**1.57**	1.21	0.80	1.39	**1.26**	1.86	1.86	1.50	1.20
HS health program	0.80	1.16	1.46	1.16	1.21	**1.17**	1.10	1.57	1.23	0.96	**1.55**	0.81	0.92	0.98	1.33	1.20	1.19	1.24
Summer program	1.04	**1.50**	1.28	1.50	**1.81**	**1.52**	1.27	1.46	1.37	1.28	1.22	**1.72**	**2.64**	1.14	1.19	**1.42**	**1.24**	**1.27**
Family Income	0.93	**0.87**	0.97	1.06	1.04	**1.07**	1.00	0.99	1.05	1.00	1.05	**0.85**	**0.89**	**0.73**	1.16	0.96	0.99	1.05
Admission Test Score	**0.73**	0.77	1.09	1.07	1.02	0.83	0.82	0.92	1.17	1.05	1.03	**0.61**	**0.62**	**0.75**	1.04	0.94	1.03	1.20

Appendix 4: Analytic methods for qualitative study component

Members of the study team, including members who did not conduct the actual interviews, performed the qualitative analysis of interview transcripts. The data analysis began with an inductive process with open coding of themes in the initial four recorded transcripts. A list of the concepts or domains representing these repeating themes comprised the first working draft of the code book. Refinement of the code book involved independent coding of eight additional transcripts by all coders. During this review, code redundancies were eliminated and collapsed, and definitions were clarified. A senior faculty researcher reviewed and verified all final codes and themes for relevancy. Once inter-coder agreement was calibrated during the coder training phase, a pilot pre-test inter-coder agreement measure was obtained in order to test the code book before indexing the complete data set. Final inter-coder agreement was approximately 75 percent. ATLAS.ti software was used for data management and analysis to facilitate searches and identify data patterns and relationships.

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