

Improving Diversity of Dental Students Through the Boston University Master's of Oral Health Sciences Postbaccalaureate Program

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Abstract: Boston University Goldman School of Dental Medicine (GSDM), in collaboration with Boston University School of Medicine, introduced the Oral Health Sciences (OHS) pipeline program in 2005 to enhance the academic preparedness of students from underrepresented minority (URM) groups for dental school admission. The aim of this study was to evaluate the OHS program's success in preparing URM students for dental school, as measured by acceptance to dental school and performance in the first and second years. Data on 2005-15 program enrollees were collected from admissions records, the registrar, and the Office of Institutional Research on students' race/ethnicity, undergraduate and OHS grade point average (GPA), and Dental Admission Test (DAT) scores. Acceptance to dental school and performance at GSDM for non-URM OHS graduates, URM OHS graduates, and non-OHS dental students were compared. A total of 55 URM students completed the OHS program during this period, with 49 successfully matriculating to a dental school in the U.S. and 33 attending GSDM. Average OHS GPA was higher for those URM students accepted to dental school than for those who did not gain admission (3.36 ± 0.30 vs. 2.94 ± 0.19). Evaluation of the academic performance of URM OHS students in the first year ($p=0.13$) and second year ($p=0.88$) at GSDM showed that these students performed as well as the non-OHS and non-URM OHS students. These results demonstrate that the OHS master's program serves as a successful credential-enhancing program for dental school applicants, while also serving as a pipeline to increase the number of qualified applicants from URM groups.

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Underrepresented minorities (from Black or African American, Hispanic or Latino, American Indian or Alaska Native, and Native Hawaiian or other Pacific Islander populations) make up less than 15% of dental school enrollees, while those minorities make up more than 30% of the

U.S. population.^{1,2} To decrease the health disparities gap,³⁻⁷ there is a need to recruit a more diverse population of students to dental school. Boston University (BU) Henry M. Goldman School of Dental Medicine (GSDM), in collaboration with Graduate Medical Sciences at Boston University School of Medicine

(BUSM), introduced the Oral Health Sciences (OHS) program in 2005 to address this need. The program was started initially as part of the national Pipeline, Profession, and Practice: Community-Based Dental Education program, and it aimed to enhance the academic preparedness of students from disadvantaged backgrounds and from all race/ethnicities underrepresented in the field of dentistry.^{6,8-10}

Academic enrichment programs for medical and dental school applicants exist in many formats including summer,^{6,7,11-14} certificate, postbaccalaureate,¹³ and master's degree^{8,14,15} programs. Summer programs such as the Summer Medical and Dental Education Program (SMDEP) funded by the Robert Wood Johnson Foundation at multiple sites nationwide continue to show success.¹² BUSM was one of the early leaders in enrichment programs, initiating the Early Medical School Selection Program (EMSSP) in 1983 as a way to increase applicants from underrepresented minority (URM) groups at BUSM and other medical schools across the country.¹⁶ Between 1983 and 2000, 60% of the students who enrolled in the EMSSP program eventually entered BUSM as medical students. Programs such as BUSM's Master's of Arts in Medical Sciences (MAMS)¹⁵ and Georgetown University's Special Master's Program in Physiology¹⁷ have been extremely successful as premedical credential-enhancing programs. MAMS graduates who obtained their MD degrees were found to have performed as well as traditional applicants in medical school.¹⁵

In 1992, the Bureau of Health Professions awarded the GSDM a one-year grant for "Excellence in Minority Education" to recognize the school's commitment to increasing URM enrollment.⁴ Following BUSM's successful EMSSP program, GSDM created the Experiential Center for Excellence in Learning (EXCEL) program in 1993 as a means to provide academic enrichment to students entering GSDM one month before their dental school matriculation.¹⁸ The program proved very successful, with 96% of students surveyed from 1996 to 2006 stating they felt the program strengthened their desire to pursue dentistry and 97% recommending that all students matriculating to GSDM participate in the EXCEL program.

However, in general, development of pre-dental enrichment programs has lagged behind premedical programs. As dental schools sought to increase the number of enrolled URM students, the Pipeline, Profession, and Practice: Community-

Based Dental Education program was initiated.^{9,19} Phase 1 of this program ran from 2002 until 2007, and 13 dental schools across the country were selected to participate. The Pipeline program was designed to increase diversity among dental students (and ultimately practitioners) by improving recruitment and retention of URM applicants and to increase access to dental care by expanding dental students' clinical training in community clinics and creating more culturally competent clinicians to work in underserved areas.

GSDM was one of the schools chosen to be part of the Pipeline program.⁹ With it, GSDM implemented a long-term recruitment strategy that included outreach at the middle and high school levels, internships at the high school and college levels, and scholarship opportunities for URM students interested in serving in areas that lacked oral health services such as rural areas.⁹ Applicants who were socioeconomically disadvantaged (defined as a family income of 100% of poverty or the first person in their family to attend college) were also recruited. A 12-week community-based education program was also instituted.^{9,20} This robust program was designed to sensitize dental students to the needs of underserved populations and expand care for patients in those clinics.

Various institution-based pipeline programs have been initiated at many schools including the University of North Carolina at Chapel Hill,²¹ Howard University,²¹ University of South Carolina,²² Baylor University,²³ University of California, San Francisco,^{8,15} and BU.^{8,9} The institution-based pipeline programs have similar goals as the OHS master's program at BU, with the majority focusing on increasing the overall diversity of dental school applicants, dental students, and subsequently, dental professionals.⁷ Major et al. found that URM students who completed dental school often began their practice in underserved areas, thereby increasing access to dental care in those areas and further promoting the mission of pipeline programs.²⁴ Admissions programs at most U.S. dental schools now assess all applicants in a holistic manner, going beyond a sole reliance on grade point average (GPA) and test scores to include qualitative attributes such as leadership, community involvement, and outreach experiences.^{12,25} Overall, pipeline programs highlighted the need for URM applicants to gain not just academic preparation, but also professional role models, academic support, and access to financial advising.^{6,9,20,26}

In 2005, GSDM, in collaboration with Graduate Medical Sciences at BUSM, extended the pipeline initiative and developed a special master's program to provide URM applicants a second chance to improve their credentials for admission to dental school.^{8,27} That program aimed to enhance the academic preparedness of students who had applied to dental school and not been accepted. The OHS program began as a pre-dental track within the well-known premedical MA in Medical Sciences program,¹⁵ but in 2012 it transitioned to its own master's program.

The goals of the OHS master's program have always been multifactorial. Initially, the OHS program specifically focused on providing URM applicants the opportunity to improve their academic credentials for dental school admission. More recently, the program has expanded to include not only students of all race and ethnicities but of diverse education and economic status as well and has aimed to increase the number of clinicians interested in providing dental care to underserved areas.^{8,27} Students who apply to the OHS master's program often have applied to dental school previously but were un-

successful in gaining admission. The program prepares students academically for future success in dental school in a rigorous 32-credit biomedical sciences curriculum that can be completed in one or two years. The curriculum includes a thesis or capstone project, three GSDM first-year dental classes (Biochemistry, Physiology, and Microbiology & Immunology) taken with dental students, and electives. OHS students who then matriculate to GSDM receive advanced standing for those three courses. Other courses are Prevention and Oral Health Promotion in Dentistry, which introduces students to public health dentistry and is taught by GSDM faculty; Evidence-Based Dentistry; and electives such as Pathology, Biostatistics, and Pharmacology. Additionally, we have a longitudinal mentoring program in which DMD students who are OHS program alumni serve as mentors to current OHS students (Figure 1). The OHS program assists future dental students by providing not only a strong background in biomedical sciences, but also focuses on the development of critical thinking and professional skills.⁸

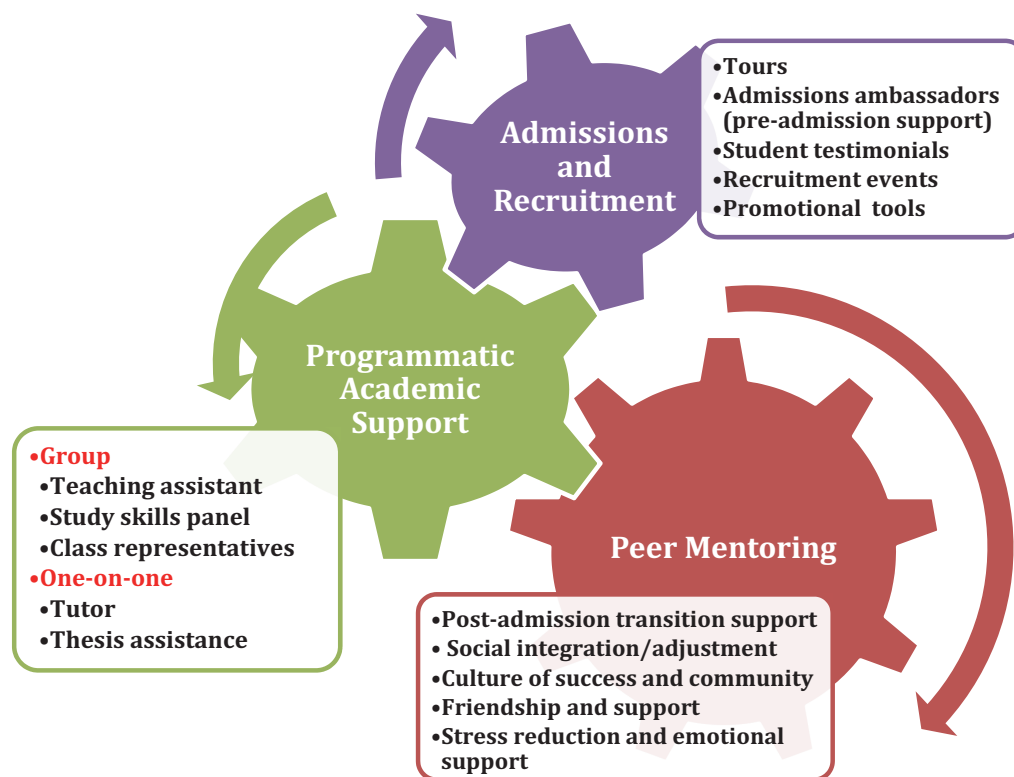


Figure 1. Longitudinal peer mentoring model

The OHS program now has ten years of data with which to assess its success in meeting its original mission: to enhance student diversity by increasing the number of minority applicants recruited to and retained in dental school. The aim of this study was thus to evaluate the OHS program's success in preparing URM students for dental school, as measured by acceptance to dental school and performance in the first and second years.

Methods

This study was determined to be exempt from oversight by the Institutional Review Board of Boston University Medical Campus, Protocol #H-33295. Confidentiality was maintained by strict data collecting procedures, including a secure database for ongoing use and strict coding of data. Students enrolled in the OHS program in 2005-15 were evaluated, and data on their race/ethnicity, gender, socioeconomic status, undergraduate institution attended (UG), undergraduate grade point average (UGPA), and Dental Admission Test (DAT) scores (Academic Average) were collected from admissions records at OHS and GSDM and BU's Office of Institutional Research. If the OHS students took the DAT more than once, the best Academic Average DAT score was used. OHS student GPA (OHS GPA) data and GPAs from the first and second years of the DMD program were obtained through the registrar. Success in the OHS and DMD programs for URM OHS students compared to non-URM OHS students was assessed by three primary measures: overall academic performance

in the master's program; successful matriculation to dental school; and success in the first and second years of the DMD program.

We evaluated whether admissions criteria for URM OHS students can be used to guide decisions on enrollment. We then assessed the number and the academic performance of URM OHS graduates' gaining admission to dental school following completion of the OHS program. Lastly, we compared the academic performance of URM OHS and non-URM OHS graduates matriculating to GSDM (URM OHS DMD and non-URM OHS DMD) with those entering dental school not having participated in the OHS program (non-OHS students).

Descriptive and bivariate analyses were performed. Students' acceptance to dental school, UGPAs, DAT scores, and OHS GPAs were compared for URM OHS and non-URM OHS students. Academic performance in the DMD program of URM OHS, non-URM OHS, and non-OHS students at GSDM was assessed, and the overall GPA for all three cohorts was compared in the first and second years of the DMD curriculum. ANOVA with Dunnett post-hoc test and the Wilcoxon Rank Sum Test were performed using SAS, version 9.3 (SAS Institute Inc., Cary, NC, USA). Statistical significance was set at $p < 0.05$.

Results

The demographic characteristics of the 182 students in the OHS program from 2005 through 2015 are shown in Table 1. OHS matriculants were balanced by gender (51.6% female vs. 48.4% male),

Table 1. Demographic characteristics of students enrolled in Oral Health Sciences program, 2005 to 2015

Characteristic	Number	Percentage
Gender		
Male	88	48.4%
Female	94	51.6%
Disadvantaged status		
Economically disadvantaged	23	12.6%
First generation to attend college	18	9.9%
Race/ethnicity		
White	76	41.8%
Asian	41	22.5%
American Indian, Alaska Native, or Pacific Islander	3	1.7%
Black or African American	17	9.3%
Hispanic or Latino	32	17.6%
Mixed race	3	1.7%
Race not declared	10	5.5%
Total underrepresented minority	55	30.2%

while 30.2% self-identified as URM. Of this cohort, 17.6% were Hispanic or Latino, 9.3% Black or African American, 1.7% American Indian, Alaska Native, or Pacific Islander, and 1.7% more than one race/mixed. Ten (5.5%) declined to declare race/ethnicity. Additionally, 23 (12.6%) students were economically disadvantaged, and 18 (9.9%) were the first in their family to attend college.

OHS program completion was robust with 177 of 182 students completing the program within two years (97.3%) (Table 2). Five students (2.7%) withdrew from the program prior to completion (for personal reasons or dismissal due to academic performance); two of these were URM students. The overall success rate of OHS graduates in gaining acceptance to dental school was 92.3% (168 of 177). Of the nine program graduates who failed to gain admission to dental school, four were URM students.

Fifty-one (out of 55 total) URM OHS students completed the OHS program, and 49 of them (96%) successfully matriculated to dental school (Table 2). Of the OHS URM graduates who did not matriculate to dental school, two applied and were not accepted, and two chose not to apply. There was no significant difference in percent of URM students for withdrawals, dental school matriculation, and dental school non-matriculation when compared to non-URM students (chi square=1.18, p=0.55). Of the 177 students who graduated from the OHS

program, 123 went on to matriculate at GSDM, with 33 self-declaring URM status. Sixteen URM OHS graduates matriculated at other U.S. dental schools, including Columbia University's College of Dental Medicine, Meharry Medical College School of Dentistry, New York University College of Dentistry, and Tufts University School of Dental Medicine. Of those matriculating at GSDM, 17.9% were Hispanic or Latino, 4.1% Black or African American, 2.4% American Indian, Alaska Native, or Pacific Islander, and 2.4% more than one race/mixed.

Students' past academic performance (measured as UGPA and DAT score) and current academic performance (measured as GPA in the OHS master's program) for all students as well as for the URM and non-URM cohorts are shown in Table 3 and Table 4. Overall, students accepted to dental school performed stronger academically in the OHS program as evidenced by a higher GPA than those who did not gain admission to any dental school (3.51 ± 0.30 vs. 2.94 ± 0.24 ; $p < 0.001$). This was also true for DAT scores, with those graduates who gained admission to dental school exhibiting more competitive DAT scores than those who did not (18.5 ± 2.1 vs. 16.9 ± 1.7 ; $p < 0.01$). There was no significant difference in UGPA between OHS graduates who were accepted to dental school and those denied admission (3.07 ± 0.27 vs. 2.97 ± 0.39 ; $p = 0.32$). Additionally, there were no significant differences in UGPA by URM designation

Table 2. Educational status of enrollees in Master's in Oral Health Sciences (OHS) program, by underrepresented minority (URM) status, 2005-15

Status	Number	Percent of Total OHS Enrollees	Number Not Declared As URM	Number Self-Declared As URM
Total	182		127	55
Withdrawals (from OHS)	5	2.7%	3	2
Master's completed; no matriculation to dental school	9	5.0%	5	4
Master's completed; matriculation to dental school	168	92.3%	119	49

Note: Of those who matriculated to dental school, 123 (33 URM and 90 non-URM) enrolled at Boston University Goldman School of Dental Medicine.

Table 3. Mean academic performance of all students enrolled in Oral Health Sciences (OHS) program, 2005 to 2015, by admitted to or not admitted to dental school

Academic Measure	Admitted to Any Dental School (N=167)	Not Admitted to Dental School (N=15)
Undergraduate grade point average	3.07 ± 0.27	2.97 ± 0.39
Dental Admission Test (DAT) score	18.5 ± 2.1	$16.9 \pm 1.7^*$
OHS program grade point average	3.51 ± 0.30	$2.94 \pm 0.24^*$

*Significantly different from students admitted to dental school ($p < 0.01$) by ANOVA and Wilcoxon rank sum test.

Table 4. Mean academic performance of students enrolled in Oral Health Sciences (OHS) program, 2005 to 2015, by underrepresented minority (URM) status and by admission or not admission to dental school

Academic Measure	Students Not Declared As URM		Students Declared As URM	
	Admitted to Any Dental School (N=119)	Not Admitted to Any Dental School (N=8)	Admitted to Any Dental School (N=49)	Not Admitted to Any Dental School (N=6)
Undergraduate grade point average	3.07±0.26	3.04±0.51	3.06±0.29	2.89±0.19
Dental Admission Test (DAT) score	18.9±2.0	17.0±1.9*	17.6±2.1*	16.7±1.5*
OHS program grade point average	3.57±0.28	2.93±0.29*	3.36±0.30*	2.94±0.19*

*Significantly different from non-URM students admitted to dental school ($p < 0.05$, analysis of variance; p -values adjusted with Dunnett post-hoc test).

or dental school matriculation status. URM OHS students who matriculated at any dental school had significantly lower DAT scores (17.6) and OHS GPA (3.36) than non-URM OHS students (18.9 and 3.57, respectively). But among students who did not matriculate, there were no differences in DAT scores or OHS GPA by URM status.

Academic performance in the first two years of BU's dental curriculum for OHS alumni, both non-URM and URM, was further compared to non-OHS DMD student performance (i.e., those students who matriculated at GSDM without completing the OHS program). OHS students, including URM students, performed as well as non-OHS students in the first ($p=0.13$) and second ($p=0.88$) years (Table 5).

Discussion

These results show that the OHS master's credential-enhancing pipeline program at BU has been successful in its mission of increasing the number of qualified applicants from groups historically underrepresented in the dental profession such as URM and economically disadvantaged. Since its inception in 2005, the OHS program continues to

fulfill its primary mission and has graduated a total of 54 URM students with 48 matriculating to dental schools across the country (a matriculation success rate of 89%). Many of these students have opted to remain at GSDM for their dental education, and OHS exit data suggest that their primary reasons for choosing GSDM over other schools are the following: the advanced standing status these students receive in the three DMD courses they took in the OHS program; the feeling of community, partially due to the strong peer mentoring program; and the comfort in already knowing the culture, students, and faculty of GSDM. Since many of the OHS students have previously been denied admission to dental school, academic advising and support during the OHS program and the AADSAS application process were also positive factors.

This study found no differences between non-URM and URM students in withdrawals, dental school matriculation, or dental school non-matriculation. Additionally, no differences in students' UGPAs were found, so we concluded UGPA was not a strong predictor of success in OHS for both the URM and non-URM students. Interestingly, results showed that DAT scores were significantly lower in the URM cohort versus the entire OHS cohort or when compared

Table 5. First- and second-year dental school performance of underrepresented minority (URM) and non-URM students who graduated from the Oral Health Sciences (OHS) program and of all Boston University (BU) dental students, 2005-15

Dental Student Group	1 st Year GPA	2 nd Year GPA
URM OHS students	3.34±0.44 (N=19)	3.28±0.23 (N=15)
Non-URM OHS students	3.49±0.33 (N=70)	3.28±0.27 (N=56)
All BU dental students	3.44±0.10 (N=1,118)	3.40±0.05 (N=1,112)

Note: URM students' mean GPA was not significantly different from non-URM students' mean GPA in either year based on Wilcoxon Rank Sum test: $p=0.13$ (year 1), $p=0.88$ (year 2).

to national data reported by ADEA.^{28,29} However, this difference appears to have had little impact on dental admission (Table 3) or performance in dental school (Table 4), provided overall OHS academic performance was strong.

Since graduates of the OHS program who matriculate to GSDM receive advanced standing in three first-year courses, they have a less rigorous course load during these years, which helps by allowing them more time to study for other classes. These students' advanced standing status in those courses also gives them the flexibility to participate in such activities as student government, tutoring, and research. In the second year, this advantage disappears; nevertheless, the OHS students, both URM and non-URM, performed comparably to the non-OHS students (Table 4), suggesting that the OHS program prepares students for the rigors of dental school.

Although pipeline programs have positively impacted the number of URM enrollees in dental school, a low number of URM dental students and practitioners still exists.^{5-7,12,13} As of 2016, the number of applicants to dental school from URM populations (15.2%) still lags behind the national goal.³⁰ There is widespread agreement that attempts to diversify faculty along with effective recruitment and retention strategies for URM students must continue.^{7,31,32}

Strong mentoring has been found to be a key element in the success of URM students in many programs, ranging from mentoring models utilizing one-on-one formal matching to more informal approaches.³³⁻³⁵ Our longitudinal mentoring program in which OHS DMD students, who are program alumni, serve as near-peer mentors to current OHS students has been beneficial (Figure 1). Opportunities for OHS DMD students include serving as a teaching assistant, tutor, discussion leader, or one-on-one mentor. Opportunities for current OHS students include serving as an admissions ambassador, campus tour leader, and recruitment event assistant.³⁶ Additionally, since the OHS students are similar in age, experiences, and professional goals, there exists an underlying equality that enhances a culture of acceptance, collaboration, and inclusion. OHS DMD students who serve as peer mentors and teaching assistants enhance their leadership and interpersonal skills and their command of the academic discipline to assist students through review sessions, panel discussions, informal meetings, and one-on-one tutoring.

Preliminary survey results of our peer mentoring program found that the OHS DMD mentoring program benefits the OHS master's students as well

as the OHS DMD students with strong attendance of OHS students at group review sessions (46%), strong participation by OHS DMD students as individual tutors wanting to give back to the OHS program (22%), and utilization of study skills support (84%) provided by peers and faculty.³⁶ This program, in place since 2013, is still preliminary; but, moving forward, we aim to formally assess the program.

The study had several limitations that will be addressed in future analyses. Data collection at times was limited due to inconsistent early record-keeping and reliance on students to disclose pertinent information on admission records. Additionally, due to the transition from paper to online admissions data, some of the UGPAs from 2005-09 were not available. Another limitation is that all comparisons to GSDM performance were based on all enrollees, and the data were not sorted for enrollees who may have completed other advanced degrees (postbac, master's, or doctorate). Additionally, comparison of first- and second-year GPAs for OHS and non-OHS students included overall GPA at the end of each year for enrolled courses; therefore, the non-OHS GPA included 15 courses, while for the OHS students, GPA included only 12 courses since the advanced standing courses were not included. We also lacked significant National Board Dental Examination data for URM DMD students at GSDM due to the small sample size. This information will be important to assess these students' success through dental school, separate from didactic coursework. Finally, only 30% of the OHS enrollees' being URM might be considered a limitation of the OHS program. Reasons for this seemingly lower percentage is that, in its early years, the program also focused on recruiting economically disadvantaged students and those in the first generation to go to college. Another reason is that, with the program change in 2012, a shift to fewer URM enrollees was seen.

Conclusion

The results of this study show that the OHS master's program at BU serves as an excellent credential-enhancing program for dental school applicants, while also serving as a pipeline to increase the number of qualified applicants from underrepresented minority groups to GSDM and dental schools nationally. A strong performance in the OHS master's program was found to be predictive of successful admission to dental school for students,

helping them to overcome lower UGPAs and DAT scores. The rigorous OHS curriculum serves to prepare students for future success in dental school by providing additional biomedical science coursework to compensate for uneven academic preparation. By providing a strong curriculum and advising system (both peer and faculty) to support students, the OHS program allows students to gain both confidence and academic and professional skills essential for future success in dental school and as practitioners.

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REFERENCES

1. U.S. Census Bureau. Quick facts. At: www.census.gov/quickfacts/fact/table/US/PST045217. Accessed 13 Feb. 2018.
2. American Dental Education Association. Enrollees by URM and non-URM status in U.S. dental schools, 2000 to 2016. At: www.adea.org/data/students/. Accessed 2 Feb. 2018.
3. Missing persons: minorities in the health professions. A report of the Sullivan Commission on Diversity in the Healthcare Workforce. 2004. At: www.aacn.nche.edu/Media/pdf/SullivanReport.pdf. Accessed 20 Jan. 2016.
4. Sinkford JC, Valachovic RW, Harrison SG. Underrepresented minority dental school enrollment: continued vigilance required. *J Dent Educ* 2004;68(10):1112-8.
5. Andersen RM, Friedman JA, Carreon DC, et al. Recruitment and retention of underrepresented minority and low-income dental students: effects of the pipeline program. *J Dent Educ* 2009;73(2 Suppl):S238-58,S375.
6. Formicola A, Bailit H, D'Abreu K, et al. The dental pipeline program's impact on access disparities and student diversity. *J Am Dent Assoc* 2009;140(3):346-53.
7. Formicola AJ, D'Abreu KC, Tedesco LA. Underrepresented minority dental student recruitment and enrollment programs: an overview from the dental pipeline program. *J Dent Educ* 2010;74(10 Suppl):S67-73.
8. Boston University. BU's M.S. in Oral Health Sciences program. At: www.bumc.bu.edu/gms/oral-health-masters/. Accessed 15 Jan. 2016.
9. Crall JJ, Hewlett ER, Friedman JA, et al. The pipeline program at Boston University Goldman School of Dental Medicine. *J Dent Educ* 2009;73(2 Suppl):S58-68; discussion S68-9.
10. Markel G, Woolfolk M, Inglehart MR. Feeding the pipeline: academic skills training for pre dental students. *J Dent Educ* 2008;72(6):653-61.
11. Gravely T, McCann A, Brooks E, et al. Enrichment and recruitment programs at dental schools: impact on enrollment of underrepresented minority students. *J Dent Educ* 2004;68(5):542-52.
12. Alexander CJ, Mitchell DA. The role of enrichment programs in strengthening the academic pipeline to dental education. *J Dent Educ* 2010;74(10 Suppl):S110-20.
13. Wides CD, Brody HA, Alexander CJ, et al. Long-term outcomes of a dental postbaccalaureate program: increasing dental student diversity and oral health care access. *J Dent Educ* 2013;77(5):537-47.
14. Johnson KP, Woolfolk M, May KB, Inglehart MR. Effect of an enrichment program on DAT scores of potential dental students from disadvantaged backgrounds. *J Dent Educ* 2013;77(8):1063-71.
15. Franzblau C, Broitman S, Moss M, et al. Success of a pre-medical master's degree program in preparing students for medical careers. *Procedia Soc Behav Sci* 2013;93:405-14.
16. Edelin KC, Ugbohue A. Evaluation of an early medical school selection program for underrepresented minority students. *Acad Med* 2001;76(10):1056-9.
17. Special master's program in physiology. Georgetown University. At: smp.georgetown.edu/. Accessed 13 Feb. 2018.
18. Friedman PK. The EXCEL program: strengthening diversity. *J Dent Educ* 2001;65(5):427-35.
19. Mascarenhas AK, Freilich S, Henshaw M, et al. The pipeline program at Boston University Goldman School of Dental Medicine: comments. *J Dent Educ* 2009;73(2 Suppl):S68-9.
20. Gutierrez JJ, Nakazono TT, Carreon DC, Andersen RM. Introduction to case studies of the pipeline programs at fourteen U.S. dental schools. *J Dent Educ* 2009;73(2 Suppl):S52-7.
21. Andersen RM, Atchison KA, Hewlett ER, Grant-Mills D. The pipeline program at Howard University College of Dentistry. *J Dent Educ* 2009;73(2 Suppl):S70-81; discussion S81-2.
22. Deas D, Pisano ED, Mainous AG, et al. Improving diversity through strategic planning: a 10-year (2002-12) experience at the Medical University of South Carolina. *Acad Med* 2012;87(11):1548-55.
23. Lacy ES, McCann AL, Miller BH, et al. Achieving student diversity in dental schools: a model that works. *J Dent Educ* 2012;76(5):523-33.
24. Major N, McQuistan MR, Qian F. Changes in dental students' attitudes about treating underserved populations: a longitudinal study. *J Dent Educ* 2016;80(5):517-25.
25. Price SS, Grant-Mills D. Effective admissions practices to achieve greater student diversity in dental schools. *J Dent Educ* 2010;74(10 Suppl):S87-97.
26. Nivet MA. Reflections on the dental pipeline program's efforts regarding underrepresented minority dental students. *J Dent Educ* 2010;74(10 Suppl):S121-3.
27. Alhumaid JA. Effectiveness of the Boston University pre dental postbaccalaureate program on dental school academic performance. Boston: Boston University Libraries Theses and Dissertations, 2011.

28. American Dental Education Association. Grade point averages of dental school enrollees, 2000 to 2015. At: www.adea.org/publications-and-data/data-analysis-and-research/applicants-enrollees-and-graduates.aspx. Accessed 22 June 2016.
29. American Dental Education Association. Applicants, enrollees, and graduates, 2000-15. At: www.adea.org/publications-and-data/data-analysis-and-research/applicants-enrollees-and-graduates.aspx#collapse0. Accessed 24 June 2016.
30. Johnson GM, Polk HH, Van da Huvel SD, et al. A comparison of seven pre dental postbaccalaureate programs in gaining dental school acceptance for their students. *J Dent Educ* 2017;81(5):526-33.
31. Brunson WD, Jackson DL, Sinkford JC, Valachovic RW. Components of effective outreach and recruitment programs for underrepresented minority and low-income dental students. *J Dent Educ* 2010;74(10 Suppl):S74-86.
32. Wells A, Brunson D, Sinkford JC, Valachovic RW. Working with dental school admissions committees to enroll a more diverse student body. *J Dent Educ* 2011;75(5):685-95.
33. Lopez N, Johnson S, Black N. Does peer mentoring work? Dental students assess its benefits as an adaptive coping strategy. *J Dent Educ* 2010;74(11):1197-205.
34. Singh S, Singh N, Dhaliwal U. Near-peer mentoring to complement faculty mentoring of first year medical students. *J Educ Eval Health Professions* 2014;11:12.
35. Colvin JW, Ashman M. Roles, risks, and benefits of peer mentoring relationships in higher education. *Mentor Tutor Partnership Learn* 2010;18(2):121-34.
36. Davies TA. Longitudinal mentoring in a higher education setting. *MedEdPORTAL* At: www.mededportal.org/col-laborative/resource/4304. Accessed 21 June 2016.