Seeking Equity; Pathway Programs in Liaison Committee on Medical Education Medical Schools for Minoritized Students

Dotun Ogunyemi[1], Claire Westermeyer[2], Mason Eghbali[2] (iD),
Priyesh Patel[2], Sarah Struble[2], Sagarika Arogyaswamy[2], Amir Teixeira[2],
Niren Raval[3], Michael Gentry[4], Tommy Lee[5] and Sarkis Arabian[6]

[1]Graduate Medical Education, Arrowhead Regional Medical Center, Colton, CA, USA. [2]School of Medicine,
California University of Science and Medicine, Colton, CA, USA. [3]Department of Family Medicine,
Arrowhead Regional Medical Center, Colton, CA, USA. [4]Department of Radiology, Arrowhead Regional
Medical Center, Colton, CA, USA. [5]Department of Surgery, Arrowhead Regional Medical Center, Colton,
CA, USA. [6]Department of Internal Medicine, Arrowhead Regional Medical Center, Colton, CA, USA.

ABSTRACT

OBJECTIVES: There is a paucity of data on pathway programs that seek to increase underrepresented in medicine (URiM) students in medicine. Therefore, this investigation aimed to describe the status and associations of pathway programs at US medical schools.

METHODS: From May to July 2021, the authors obtained information by (1) accessing pathway programs listed on the Association of American Medical Colleges (AAMC) website, (2) reviewing websites of US medical schools, (3) calling medical schools to obtain further information. The data retrieved from the medical school websites was compiled into a 27-item checklist based on the maximum number of different items that was extracted from any of the medical school websites. The data included program characteristics, curricula, activities, and outcomes. Each program was assessed on the number of categories of which information was available. Statistical analyses determined significant associations of URiM-focused pathways and other factors.

RESULTS: The authors identified 658 pathway programs: 153 (23%) listed on AAMC website and 505 (77%) identified from medical school websites. Only 88 (13%) programs listed outcomes and 143 (22%) had adequate website information. URiM-focused programs (48%) were independently associated with AAMC website listing (adjusted odds ratio [aOR] = 2.62, P = .001), no fees requirement (aOR = 3.33, P = .001), oversight by diversity departments (aOR = 2.05, P = .012), Medical College Admission Test preparations (aOR = 2.70, P = .001), research opportunities (aOR = 1.51, P = .022), and mentoring (aOR = 2.58., P < .001). Programs targeting K1-12 were less likely to offer mentoring, shadowing or research or include URiM students. Programs with outcomes were more likely to be college programs with longer durations and offer research, while programs listed on AAMC website provided more resources.

CONCLUSION: Although pathway programs are available for URiM students, accessibility issues due to inadequate websites information and early exposure are barriers. Most programs have insufficient data on their website, including a lack of outcome data which is detrimental in today's virtual climate. Medical schools should update their websites to ensure that students requiring support to matriculate into medical school have adequate and relevant information to make informed decisions regarding participation.

KEYWORDS: pathway program, AAMC website, underrepresented in medicine, diversity, medical school

Introduction

Based on the 2020 census, the racial and ethnic diversity of the United States has increased since 2010. Although the most prevalent racial group for the United States is still non-Hispanic White, this population decreased from 63.7% in 2010 to 57.8% in the 2020 census.[1] However, minoritized racial groups, including those who identify as African American and Hispanic, continue to be underrepresented in the physician workforce.[2] People who identify as African American and Hispanic ethnicity comprised only 5.7% and 6.9% of the active physician workforce in 2022 compared to their representations of 13.6% and 18.9% in the US 2022 census, respectively.[1,3] For this study, we used the Association of American Medical Colleges (AAMC) definition for underrepresented in medicine (URiM) which states those racial and ethnic populations that are underrepresented in the medical profession relative to their numbers in the general population.[4] Evidence indicates that patients with race concordant physicians report improved access to healthcare,[5] better communication, higher Press Ganey patient satisfaction scores, greater patient acceptance of invasive procedures during preventative visits and improved show rates for longitudinal care visits.[5–8] Additionally, Whitla et al[9] demonstrated that diversity in medical school enhances the educational experience due to interactions with diverse peers.

Although the number of URiM students matriculating to US medical schools is increasing, 2018-2019 AAMC data

revealed that only 7.1% of matriculants identify as Hispanic, 6.2% as African American, and 0.2% as American Indian/Alaska native, in contrast to 49.9% who identified as non-Hispanic White and 22.1% as Asians.[10] Thus, increasing the racial and ethnic diversity of students entering medical school can help eliminate health disparities since physicians from minoritized groups are more likely to opt to care for minoritized patients in medically underserved areas.[11,12] Furthermore, patients from minoritized groups are more likely to trust and be understood by race-concordant physicians.[12,13]

Pathway programs in medicine focus on intervening in the educational pathway to enhance opportunities for racial/ethnic minoritized and disadvantaged students to be able to matriculate into medical school. Strategies usually incorporate a combination of mentoring, academic support, professional opportunities, research experiences to expose students to biological areas of interest, and financial support in the form of stipends or scholarships to individual students.[12] However, there is limited published research on pathway programs and even less investigating program effectiveness.[2] Furthermore, a literature review revealed multiple studies on individual pathway programs; however, to date, there is no combined study or systematic review on a national assessment of Liaison Committee on Medical Education (LCME) accredited US medical schools' pathway programs.[14–16] Therefore, our objectives were to (1) describe the status and associations of pathway programs in US medical schools and (2) assess characteristics of pathway programs focused on URiM students. We hypothesized that pathway programs would share more information on their websites to ensure that they attract highly motivated students and that URiM-focused pathway programs will offer specific academic strategies such as examination preparation and financial support that would increase the likelihood of the students matriculating into medical school.

Methods
For this study we defined pathway programs by the following 3 parameters: (1) educational program in an LCME accredited US medical school, (2) an educational program dedicated to K-12, undergraduate students, and/or recent graduates/post-baccalaureate students, and (3) a program focused on health science-related curricula. We further categorized the pathway programs into URiM-focused pathways if the program reported targeting only URiM students and non-URiM-focused pathways if the program targeted all students. We set an arbitrary definition for a short program as one that lasted <20 weeks and a long program as one that lasted more than 20 weeks. Our pedagogical concept was that short programs were mostly summer programs generally <20 weeks or a semester in duration while longitudinal programs would last longer and cover more than 1 semester. In May 2021, we accessed and downloaded the data on the AAMC Summer Enrichment and Pipeline Programs database.[17] The AAMC database had information concerning state, fee, stipend available, focus, education level and eligibility. For each program in the database, we used either the link provided by AAMC (if functional) or an internet search to find the program to check the accuracy of the listed information from the AAMC database, and if the program was still functioning. To expand the database, we retrieved the following data from the medical school website: school department with oversight over the pathway program, program length, program funding, Grade Point Average (GPA) requirements, year started, if program was active and in what form, number of students accepted each year, student demographics, goals of the program, types of activities offered, whether research was offered, who implemented the program, program outcomes, and administrator title, email, and phone number. For each pathway, we counted the number of categories for which information was available (out of the 27 assessed) then ranked programs in terms of that number (Table 1). The 27-item checklist was established based on the maximum number of different items that was extracted from any of the medical school websites. A website was defined as having adequate information if it achieved the 75th percentile or higher in that ranking across pathways (Table 1).

As a second step of the study, we sought and added programs that met our pathway criteria that were not listed on the AAMC website. To find these programs, a list of 155 accredited US medical schools was obtained from the LCME website. From May to July 2021, we reviewed the website for each of the 155 schools and added programs that met the specified criteria along with all the available program information.

As a third step, to obtain further or missing information, we performed Google searches to find additional information on the programs. We then used the listed phone numbers and made calls to each program between June to July 2021. For programs that had phone numbers listed that did not answer, voicemails were left. We called each school at least once with a log kept on the date of the call and the information discussed if a conversation was obtained. We added any information obtained from these calls that were not found on the website.

Statistical analysis was performed using SPSS 21.0 (IBM Corp, Armonk, New York). Because of multiple comparisons performed due to the likelihood that some significant correlations are just due to chance, for the univariate analyses, we made a priori decision to accept a two-sided P value of < .01 and an odds ratio of at least 1.5 or 0.8 as significant. We used chi-square test to analyze the data and determine significant associations of the following: programs with URiM-focused pathways versus programs with non-URiM-focused pathways, programs listed on the AAMC website versus programs not listed on the AAMC website, programs that reported outcomes versus programs that did not report outcomes as a measure of program efficacy, programs targeting K1-12 versus those targeting college students and programs with adequate website information versus those without adequate website information. We

Table 1. Twenty-seven item checklist to evaluate programs.

No.	Checklist item
1	School department
2	AMMC website listed
3	Program focus
4	Program length
5	Funding
6	State
7	Fee
8	Program
9	Stipend
10	Educational level
11	Combination programs
12	GPA
13	Year started
14	Currently active
15	Number of students
16	URiM focused
17	Goals listed
18	Program
19	Shadowing
20	MCAT prep admissions
21	Research
22	Mentoring
23	Health coursework
24	Networking
25	Implemented by
26	Outcomes
27	Adequate website information

Abbreviations: AAMC, Association of American Medical Colleges; GPA, Grade Point Average; MCAT, Medical College Admission Test; URiM, underrepresented in medicine.

also performed a regression analysis to determine independent associations of pathway programs focused on URiM pathway students. Arrowhead Reginal Medical Center Institutional Review Board (IRB) reviewed protocol#22-57 and waived the requirement for informed consent and also provided exempt ethics approval given the nature of the study.

Results

We identified 658 pathway programs, of which 153 (23%) were listed on the AAMC website and 505 (77%) were identified from a review of medical school websites (Table 2). The geographical distribution of programs were South US = 245 (37%), Northeast = 186 (28%), West = 117 (18%), and Midwest = 108 (16%).[14] We found that 306 (60%) of programs were active and in-person, 127 (25%) of programs were active and virtual, 32 (6%) of programs were inactive secondary to the COVID-19 pandemic, and 44 (9%) of programs appeared inactive for unknown reasons; 385 (84%) of programs were short (<20 weeks in duration) while 16% were long (20 weeks or more) and 11% classified as longitudinal (48 weeks or more in length). The targets of the pathway programs were K1-8 (10%), high schools (38%), colleges (44%), and postgraduate (8%). URiM students as the only focus occurred in 48%. In 70% of programs, students were tutored by faculty only, and in 14% of programs, students were tutored by faculty in combination with students or other healthcare professionals. The activities offered include shadowing (20%), Medical Colleges Admission Test (MCAT) and admissions preparations (9%), research (42%), mentoring (55%), health coursework (49%), and networking (20%). Only 88 (13%) of programs reported outcomes which included: awards, or college credits (6%), publications (19%), college admissions (15%), and medical school admissions (60%). Website information was adequate in about 21% of programs. Inadequate website information was highest for outcomes (87%), year program started (74%), funding source (63%), program length (30%), stipend availability (28%), and medical school department with oversight of the program (25%) (Table 2). Supplemental Appendix 1 provides the programs' pathway data that we compiled from our review of medical school websites.

Programs focused on recruiting URiM students into their pathway programs were more likely to have a GPA requirement (OR = 2.0, P = .002), offer stipends (OR = 1.7, P = .005), mentoring (OR = 2.4, P < .001), MCAT prep/admissions (OR = 3.4, P < .001), but less likely to charge a fee (OR = 0.2, P < .001). The URiM-focused pathway programs were also more likely to be implemented by diversity departments in the medical school (OR = 2.0, P < .001), focus on undergraduate students (OR = 1.9, P < .001), and was active during the COVID-19 pandemic (OR = 2.2, P = .003) (Table 3).

Programs with adequate website information compared to those with inadequate website information were more likely to focus on recruiting undergraduate students (OR = 1.8, P = .002), give stipends (OR = 2.6, P < .001), provide research opportunities (OR = 1.9, P = .001), have program outcome data (OR = 5.3, P < .001), and be listed on the AAMC website (OR = 6.6, P < .001) but were less likely to be supervised by diversity departments (OR = 0.4, P < .001) (Table 4).

Programs focused on colleges versus those targeting K-12 were more likely to recruit URiM students (OR = 1.9, P < .001), offer stipends (OR = 14.1, P < .001), mentoring (OR = 1.8, P < .001), shadowing (OR = 2.8, P < .001), research (OR = 3.2, P < .001), and also require fees (OR = 2.5, P < .001).

Table 2. Frequency of information characteristics of 658 pathway programs listed on medical school websites from May to July 2021[a].

Characteristic	Yes (n)	Yes (%)	Missing (n)	Missing (%)
Program				
AAMC website listed	153	23.3	0	
Website with adequate information (75th percentile or more)[b]	143	21.7	0	
Multiple programs in the same institution	72	10.9	0	
Program length listed	462	70.2	0	
Year program started listed	170	25.7	0	
Administrator email listed	550	83.6	0	
Currently active				
Currently active—both virtual and in person	433	85.1	149	22.6
Currently active—no, no reason given/only old dates	44	8.6	149	22.6
Currently active—yes active in person	306	60.1	149	22.6
Currently active—no due to COVID	32	6.3	149	22.6
Currently active—yes, virtual	127	25	149	22.6
Demographic focus				
Demographic focus—all, no preference	244	39	33	5
Demographic focus—all, but preference to URiM	82	13.1	33	5
Demographic focus—URiM only	299	47.8	33	5
Education level target				
Education level target—elementary school	67	10.2	0	
Education level target—high school	252	38.4	0	
Education level target—undergraduate	287	43.7	0	
Education level target—postbachelors/recent grads	51	7.8	0	
Eligibility/cost				
Goals of program listed	614	93.3	44	6.7
Eligibility—International students F1 visa accepted	13	3.4	275	41.8
Eligibility—citizen/permanent resident requirement	129	33.7	275	41.8
Eligibility—state/school requirement	241	62.9	275	41.8
Fee required	79	20.7	276	41.9
GPA/ACT requirement	101	15.3	0	
Stipend available	244	51.8	187	28.4
Focus/program type				
Focus/program type—general	449	68.2	0	
Focus/program type—research	184	28	0	
Focus/program type—true pipeline/admissions link	19	2.9	0	
Focus/program type—postbachelors/masters	4	0.6	0	
Focus/program type—BA/MD program	2	0.3	0	
Funding				

Table 2. Continued.

Characteristic	Yes (n)	Yes (%)	Missing (n)	Missing (%)
Funding	247	37.5	411	62.5
Funding—grant funded	134	54.3	411	62.5
Funding—university and grant funded	62	25.1	411	62.5
Funding—university funded	51	20.6	411	62.5
Implemented by				
Implemented by-faculty	452	68.7	0	
Implemented by-faculty and students	85	12.9	0	
Implemented by-faculty and healthcare professionals	11	1.7	0	
Implemented by-healthcare professionals	4	0.6	0	
Implemented by-students	39	5.9	0	
Experiences offered				
MCAT prep/admissions offered	61	9.4	12	1.8
Mentoring offered	358	55.4	12	1.8
Research offered	269	41.6	11	1.7
Shadowing offered	130	20.1	12	1.8
Health coursework offered	318	49.2	12	1.8
Networking offered	127	19.7	12	1.8
Outcomes				
Outcomes any	88	13.4	570	86.6
Outcomes—pipeline into college/postgraduate education	13	14.8	570	86.6
Outcomes—pipeline opportunity into medical school	53	60.2	570	86.6
Outcomes—program awards, receive college credit, other	5	5.7	570	86.6
Outcomes—publication and/or poster presentation	17	19.3	570	86.6
Region[c]				
Region—Midwest	108	16.4	0	
Region—Northeast	186	28.3	0	
Region—Puerto Rico	2	0.3	0	
Region—South	245	37.2	0	
Region—West	117	17.8	0	
Department				
Department diversity inclusion and equity	265	53.6	164	24.9
Department community outreach	25	5.1	164	24.9
Department medical school administration	39	7.9	164	24.9
Department graduate school	30	6.1	164	24.9

Table 2. Continued.

Characteristic	Yes (n)	Yes (%)	Missing (n)	Missing (%)
Department research office	16	3.2	164	24.9
Department other	119	24.1	164	24.9

Percentages: percentages of valid cases and the missing cases are excluded from the denominator.

[a] The cross-sectional data from the AAMC website was obtained from May 14 to 25, 2021. The data on medical school websites were extracted from June 29 to July 16, 2021. Medical schools were called from June 29 to July 16, 2021. A total of 658 pathway programs were reviewed. Please note values may not add to 658 due to missing values.

[b] Website with adequate information (75th percentile or more) was achieving 20 or more of the following categories: Website information categories included: (1) stipend available, (2) focus of program, (3) education level targeted, (4) eligibility requirements, (5) school department with oversight over the pathway program, (6) program length, (7) program funding, (8) fee requirements, (9) GPA requirements, (10) year started, (11) if program was active, (12) if program was virtual or in-person, (13) number of students, (14) demographics of students, (15) goals of the program, (16) mentoring offered, (17) health coursework offered, (18) research offered, (19) networking offered, (20) shadowing offered, (21) MCAT preparation offered, (22) program teachers/instructors categories, (23) outcomes of the program, (24) program location, (25) administrator title, (26) contact email, and (27) contact phone number.

[c] Region—Northeast: Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont, New Jersey, New York, and Pennsylvania.

Region—Midwest: Indiana, Illinois, Michigan, Ohio, Wisconsin, Iowa, Nebraska, Kansas, North Dakota, South Dakota, Minnesota, and Missouri.

Region—South: Delaware, District of Columbia, Florida, Georgia, Maryland, North Carolina, South Carolina, Virginia, West Virginia, Alabama, Kentucky, Mississippi, Tennessee, Arkansas, Louisiana, Oklahoma, and Texas.

Region—West: Alaska, California, Hawaii, Oregon, Washington, Arizona, Colorado, Idaho, New Mexico, Montana, Utah, Nevada, and Wyoming.[18]

Abbreviations: AAMC, Association of American Medical Colleges; BA/MD, Baccalaureate/Doctor of Medicine; GPA/ACT, Grade Point Average/American College Test; MCAT, Medical College Admission Test; URiM, underrepresented in medicine (as defined by each program).

Table 3. Significant findings of the comparison of URiM-focused pathway programs versus non-URiM-focused pathway programs obtained from May to July 2021[a] using chi-square test.

Variable	URiM—no n! (%)	URiM—yes n (%)	*P* value	Odds ratio (CI)
Adequate website information[b]	61/326 (18.7)	80/299 (26.8)	.017*	1.6 (1.1-2.3)
GPA requirement	38/326 (11.7)	62/299 (20.7)	.002	2.0 (1.3-3.1)
Fee required	59/188 (31.4)	18/183 (9.8)	<.001	0.2 (0.1–0.4)
Medical school outcomes	17/37 (45.9)	36/50 (72)	.016*	3.0 (1.2-7.4)
MCAT prep/admissions offered	16/326 (4.9)	45/299 (15.1)	<.001	3.4 (1.9-6.2)
Mentoring offered	147/326 (45.1)	199/299 (66.6)	<.001	2.4 (1.8-3.4)
Oversight by diversity department	106/236 (44.9)	145/232 (62.5)	<.001	2.0 (1.4-3.0)
Currently active	204/252 (81)	215/238 (91)	.003	2.2 (1.3-3.7)
AAMC website listed	54/326 (16.6)	95/298 (31.9)	<.001	2.4 (1.6-3.4)
Stipend available	106/228 (46.5)	135/226 (59.7)	.005	1.7 (1.2-2.5)
Undergraduate pathway programs	149/326 (45.7)	183/298 (61.4)	<.001	1.9 (1.4-2.6)

! In each row the numerator is the number of programs positive for the variable and the denominator is the total number of programs reporting the variable.

*The *P* value or odds ratio did not meet the a priori decision of *P* value of < .01 and an odds ratio of at least 1.5 or 0.8 as significant.

[a] The cross-sectional data from the AAMC website was obtained from May 14 to 25, 2021. The data on medical school websites was extracted from June 29 to July 16, 2021. Medical schools were called from June 29 to July 16, 2021. A total of 658 pathway programs were reviewed. Please note many values do not add up to 658 due to missing values.

[b] Adequate website information (75th percentile or more) was achieving 20 or more of the following categories: Website information categories included: (1) stipend available, (2) focus of program, (3) education level targeted, (4) eligibility requirements, (5) school department with oversight over the pathway program, (6) program length, (7) program funding, (8) fee requirements, (9) GPA requirements, (10) year started, (11) if program was active, (12) if program was virtual or in-person, (13) number of students, (14) demographics of students, (15) goals of the program, (16) mentoring offered, (17) health coursework offered, (18) research offered, (19) networking offered, (20) shadowing offered, (21) MCAT preparation offered, (22) program teachers/instructors categories, (23) outcomes of the program, (24) program location, (25) administrator title, (26) contact email, and (27) contact phone number.

Abbreviations: AAMC, Association of American Medical Colleges; CI, 95% confidence interval; GPA, Grade Point Average; MCAT, Medical College Admission test; URiM, Underrepresented in Medicine (as defined by each program).

K1-12 programs were less likely to have larger student-sized programs (OR = 0.2, *P* < .001), provide healthcare coursework (OR = 0.4, *P* < .001), and were less likely to have a GPA requirement (OR = 0.6, *P* = .009) (Table 5).

Pathway programs that provided outcome data compared to those that did not provide outcomes were more likely to have programs longer than 20 weeks in duration (OR = 2.1, *P* = .01), recruit undergraduate students (OR = 2.8, *P* < .001),

Table 4. Significant findings of the comparison of pathway programs with adequate website information versus pathway programs with inadequate website information using chi-square test, May to July 2021[a].

Variable	Inadequate website information n! (%)	Adequate website information[b] n (%)	P value	Odds ratio (CI)
GPA requirement	63/515 (12.2)	38/143 (26.6)	<.001*	1.2 (1.1-1.3)
Research offered	193/515 (37.5)	76/143 (51.1)	.001	1.9 (1.3-2.8)
Oversight by diversity department	215/364 (59.1)	50/130 (38.5)	<.001	0.4 (0.3-0.7)
Stipend available	150/333 (45)	94/138 (68.1)	<.001	2.6 (1.7-4.0)
Undergraduate pathway programs	248/514 (48.2)	90/143 (62.9)	.002	1.8 (1.2-2.7)
Outcome listed	42/515 (8.2)	46/143 (32.2)	<.001	5.3 (3.3-8.6)
URiM focused	219/484 (45.2)	80/141 (56.7)	.02*	1.6 (1.1–2.3)
AAMC website listed—yes	77/515 (15)	76/142 (53.5)	<.001	6.6 (4.4–9.9)

! In each row the numerator is the number of programs positive for the variable and the denominator is the total number of programs reporting the variable.
*The P value or odds ratio did not meet the a priori decision of P value of < .01 and an odds ratio of at least 1.5 or 0.8 as significant.
[a]The cross-sectional data from the AAMC website was obtained from May 14 to 25, 2021. The data on medical school websites was extracted from June 29 to July 16, 2021. Medical schools were called from June 29 to July 16, 2021. A total of 658 pathway programs were reviewed. Please note values may not add to 658 due to missing values.
[b]Adequate website information (75th percentile or more) was achieving 20 or more of the following categories: Website information categories included: (1) stipend available, (2) focus of program, (3) education level targeted, (4) eligibility requirements, (5) school department with oversight over the pathway program, (6) program length, (7) program funding, (8) fee requirements, (9) GPA requirements, (10) year started, (11) if program was active, (12) if program was virtual or in-person, (13) number of students, (14) demographics of students, (15) goals of the program, (16) mentoring offered, (17) health coursework offered, (18) research offered, (19) networking offered, (20) shadowing offered, (21) MCAT preparation offered, (22) program teachers/instructors categories, (23) outcomes of the program, (24) program location, (25) administrator title, (26) contact email, and (27) contact phone number.
Abbreviations: AAMC, Association of American Medical Colleges; CI, 95% confidence interval; GPA, Grade Point Average; MCAT, Medical College Admission test; URiM, Underrepresented in Medicine (as defined by each program).

Table 5. Significant findings of the comparison of K1-12 programs versus college/postbaccalaureate-focused pathway programs using chi-square test from May to July 2021[a].

Variable	K1-12 n! (%)	College/postbaccalaureate, n (%)	P value	Odds ratio (CI)
URiM focused	115/292 (39.4)	183/332 (55.1)	<.001	1.9 (1.4-2.6)
Healthcare coursework	196/319 (61.4)	122/338 (36.1)	<.001	0.4 (0.3-0.5)
Research offered	86/319 (27)	182/338 (53.8)	<.001	3.2 (2.3–4.4)
Medical school outcomes	10/24 (41.7)	43/63 (68.3)	.029*	3.0 (1.1-7.9)
Adequate website Information[b]	53/319 (16.6)	90/338 (26.6)	.002	1.8 (1.2-2.7)
Mentoring offered	151/319 (47.3)	207/338 (61.2)	<.001	1.8 (1.3-2.4)
GPA requirement	282/319 (88.4)	274/338 (81.1)	.009	0.6 (0.4-0.9)
Fee required	128/179 (71.5)	174/202 (86.1)	.001	2.5 (1.5-4.1)
South US region	106/319 (33.2)	139/338 (31.9)	.04*	1.4 (1.0-1.9)
Stipend available	37/200 (18.5)	206/270 (76.3)	<.001	14.1 (9.0-22.3)
Shadowing offered	38/319 (11.9)	92/338 (27.2)	<.001	2.8 (1.8-4.2)
Large student-size program	55/123 (44.7)	19/153 (12.4)	<.001	0.2 (0.1–0.3)

! In each row the numerator is the number of programs positive for the variable and the denominator is the total number of programs reporting the variable.
*The P value or odds ratio did not meet the a priori decision of P value of < .01 and an odds ratio of at least 1.5 or 0.8 as significant.
[a] The cross-sectional data from the AAMC website was obtained from May 14 to 25, 2021. The data on medical school websites was extracted from June 29 to July 16, 2021. Medical schools were called from June 29 to July 16, 2021. A total of 658 pathway programs were reviewed. Please note values may not add to 658 due to missing values.
[b] Adequate website information (75th percentile or more) was achieving 20 or more of the following categories: Website information categories included: (1) stipend available, (2) focus of program, (3) education level targeted, (4) eligibility requirements, (5) school department with oversight over the pathway program, (6) program length, (7) program funding, (8) fee requirements, (9) GPA requirements, (10) year started, (11) if program was active, (12) if program was virtual or in-person, (13) number of students, (14) demographics of students, (15) goals of the program, (16) mentoring offered, (17) health coursework offered, (18) research offered, (19) networking offered, (20) shadowing offered, (21) MCAT preparation offered, (22) program teachers/instructors categories, (23) outcomes of the program, (24) program location, (25) administrator title, (26) contact email, and (27) contact phone number.
Abbreviations: AAMC, Association of American Medical Colleges; CI, 95% confidence interval; GPA, Grade Point Average; MCAT, Medical College Admission test; URiM, Underrepresented in Medicine (as defined by each program).

Table 6. Significant findings of the comparison of pathway with outcomes versus pathway programs without outcomes using chi-square test from May to July 2021[a].

Variable	With outcomes n! (%)	Without outcomes n (%)	*P* value	Odds ratio (CI)
Long program length[b]	19/71 (26.8)	56/389 (14.4)	0.01	2.1 (1.2-3.9)
Healthcare coursework	28/88 (31.8)	290/570 (50.9)	.001	0.5 (0.3-0.7)
Research offered	47/88 (53.4)	222/570 (38.9)	.01	1.8 (1.1-2.8)
Undergraduate pathway programs	63/87 (72.4)	275/570 (48.2)	<.001	2.8 (1.7-4.6)
Adequate website information[c]	46/88 (52.3)	97/570 (26.6)	<.001	5.3 (3.3-8.6)
West US region	8/88 (9.1)	109/570 (19.1)	.02*	0.4 (0.2-0.9)
Stipend available	45/71 (63.4)	199/400 (49.8)	.04*	1.8 (1.0-2.9)

! In each row the numerator is the number of programs positive for the variable and the denominator is the total number of programs reporting the variable.
*The *P* value or odds ratio did not meet the a priori decision of *P* value of < .01 and an odds ratio of at least 1.5 or 0.8 as significant.
[a] The cross-sectional data from the AAMC website was obtained from May 14 to 25, 2021. The data on medical school websites was extracted from June 29 to July 16, 2021. Medical schools were called from June 29 to July 16, 2021. A total of 658 pathway programs were reviewed. Please note values may not add to 658 due to missing values.
[b] Program length >20 weeks.
[c] Adequate website information (75th percentile or more) was achieving 20 or more of the following categories: Website information categories included: (1) stipend available, (2) focus of program, (3) education level targeted, (4) eligibility requirements, (5) school department with oversight over the pathway program, (6) program length, (7) program funding, (8) fee requirements, (9) GPA requirements, (10) year started, (11) if program was active, (12) if program was virtual or in-person, (13) number of students, (14) demographics of students, (15) goals of the program, (16) mentoring offered, (17) health coursework offered, (18) research offered, (19) networking offered, (20) shadowing offered, (21) MCAT preparation offered, (22) program teachers/instructors categories, (23) outcomes of the program, (24) program location, (25) administrator title, (26) contact email, and (27) contact phone number.
Abbreviations: AAMC, Association of American Medical Colleges; CI, 95% confidence interval; GPA, Grade Point Average; MCAT, Medical College Admission test; URiM, Underrepresented in Medicine (as defined by each program).

offer research (OR = 1.8, *P* = .01), and healthcare course work (OR = 0.5, *P* = .001) (Table 6).

Programs listed on the AAMC website compared to those found only on the medical school website were more likely to be focused on URiM students (OR = 2.4, *P* < .001), provide more adequate website information (OR = 6.6, *P* < .001), offer a stipend to students in the program (OR = 3.1, *P* < .001), have a GPA requirement to be admitted into the program (OR = 6.5, *P* < .001), offer research opportunities (OR = 2.3, *P* < .001), and be <20 weeks in duration (OR = 0.28, *P* < .001) (Table 7).

Logistic regression analysis showed that URiM-focused programs were independently associated with being listed on the AAMC website (adjusted odds ratio [aOR] = 2.62, *P* = .001), having no fee requirements (aOR = 3.33, *P* = .001), and managed by diversity departments in the medical schools (aOR = 2.05, *P* = .012). URiM-focused programs were also independently associated as more likely to provide MCAT preparation (aOR = 2.70, *P* = .001), offer research opportunities (aOR = 1.51, *P* = .022), and provide mentoring to pathway students (aOR = 2.58., *P* < .001) (Table 8).

Discussion

We found that approximately half of the pathway programs had URiM students as their main focus. However, studies suggest that even though many medical schools do offer academic enrichment programs designed to reach "disadvantaged" students, many of these pathway programs are limited by financial cutbacks and sustainability.[15] A program that has risen to the challenge is the Summer Health Professions Education Program. This program was funded by The Robert Wood Johnson Foundation in 1989 as a free summer enrichment program at 12 universities across the nation and is focused on improving access to information and resources for URiM college students.[11,16,19]

The pathway programs varied in their curriculum, though the majority involved mentorship with other activities such as health coursework, research, networking, and shadowing. As outlined in the 2-part discussion by Smith et al, successful pathway programs are those that achieve an increase in URiM representation in health professional schools.[12] Components of successful pathway programs include academic enrichment (especially in science and mathematics), admissions preparation, mentoring, financial support, psychosocial support, and professional opportunities.[11] The programs listed on AAMC's website were more likely to focus on URiM students and have adequate information on their website. For example, the Stanford Medical Youth Science Program is a free, residential program focused on low-income California high school students that offers research projects, health coursework, college/career advising, exposure to college life, interactions with role models, and long-term support. Since its inception in 1988, 405 students who have completed the program have been followed for up to 18 years with 81% graduating from a 4-year college of which 52% have graduated from medical or graduate school. However, even though this program sought to diversify health professions, only 59% of

Table 7. Significant findings of the comparison of AAMC website listed pathway programs versus non-AAMC website listed pathway programs using chi-square test, May to July 2021[a].

Variables	AAMC website listed— no n! (%)	AAMC website listed— yes n (%)	*P* value	Odds ratio (CI)
URiM focused	203/475 (42.8)	95/149 (63.8)	<.001	2.4 (1.6-3.4)
Stipend available	143/328 (43.6)	100/142 (70.4)	<.001	3.1 (2.0-4.7)
GPA requirement	43/504 (8.5)	58/153 (37.9)	<.001	6.5 (4.2–10.3)
Shadowing offered	90/504 (17.9)	40/153 (26.1)	.03*	1.6 (1.1-2.5)
MCAT prep/admissions offered	39/504 (8)	22/153 (14.5)	.02*	2.0 (1.1-3.5)
Research offered	182/504 (36.1)	86/153 (56.2)	<.001	2.3 (1.6-3.3)
Long program length[b]	65/313 (20.8)	10/146 (6.8)	<.001	0.28 (0.1-0.6)
Adequate website information[c]	66/504 (13.1)	76/153 (49.7)	<.001	6.6 (4.4–9.9)
Undergraduate pathway programs	243/503 (48.3)	94/153 (61.4)	.005	1.7 (1.2-2.5)

! In each row the numerator is the number of programs positive for the variable and the denominator is the total number of programs reporting the variable.
*The *P* value or odds ratio did not meet the a priori decision of *P* value of < .01 and an odds ratio of at least 1.5 or 0.8 as significant.
[a] The cross-sectional data from the AAMC website was obtained from May 14 to 25, 2021. The data on medical school websites was extracted from June 29 to July 16, 2021. Medical schools were called from June 29 to July 16, 2021. A total of 658 pathway programs were reviewed. Please note values may not add to 658 due to missing values.
[b] Program length >20 weeks.
[c] Adequate website information (75th percentile or more) was achieving 20 or more of the following categories: Website information categories included: (1) stipend available, (2) focus of program, (3) education level targeted, (4) eligibility requirements, (5) school department with oversight over the pathway program, (6) program length, (7) program funding, (8) fee requirements, (9) GPA requirements, (10) year started, (11) if program was active, (12) if program was virtual or in-person, (13) number of students, (14) demographics of students, (15) goals of the program, (16) mentoring offered, (17) health coursework offered, (18) research offered, (19) networking offered, (20) shadowing offered, (21) MCAT preparation offered, (22) program teachers/instructors categories, (23) outcomes of the program, (24) program location, (25) administrator title, (26) contact email, and (27) contact phone number.
Abbreviations: AAMC, Association of American Medical Colleges; CI, 95% confidence interval; GPA, Grade Point Average; MCAT, Medical College Admission test; URiM, Underrepresented in Medicine (as defined by each program).

Table 8. Significant findings of logistic regression analysis[a] to determine independent correlates of pathway programs focused on URiM students, May to July 2021[b].

Risk factor	Coefficient[c]	*P* value	Odds ratio	95% CI
Model 1: Administrative factors[d]				
AAMC website listing	0.99	.001	2.62	1.45-4.74
No fees	1.20	.001	3.33	1.62-6.85
Oversight by diversity department	0.73	.012	2.05	1.17-3.58
Model 2: Program factors[e]				
MCAT prep offered	0.99	.001	2.70	1.47-5.0
Research offered	0.41	.022	1.51	1.06-2.16
Mentoring offered	0.95	<.001	2.58	1.84-3.61

[a] Logistic regression analysis calculates adjusted odds ratio in the presence of more than one explanatory variable. The result is the impact of each variable on the odds ratio of the observed event of interest. The main advantage is the avoidance of confounding effects by analyzing the association of all variables together.
[b] The cross-sectional data from the AAMC website was obtained from May 14 to 25, 2021. The data on medical school websites was extracted from June 29 to July 16, 2021. Medical schools were called from June 29 to July 16, 2021. A total of 658 pathway programs were reviewed. Please note values may not add to 658 due to missing values.
[c] The coefficient is the estimated amount of increase (or decrease, if the sign of the coefficient is negative) in the predicted log odds of dependent variable that would be predicted by the change (increase or decrease) between the yes and no categories of the dichotomous predictor, holding all other predictors constant.
[d] For model 1, administrative risk factor variables entered into the model included AAMC website listing; no fees and oversight by diversity department; adequate website information, undergraduate pathway programs, and stipend available.
[e] For model 2, programs variables entered into models were shadowing offered, research offered, health course work offered, networking offered, mentoring offered, research offered, and MCAT preparation offered.
Abbreviations: AAMC, Association of American Medical Colleges; CI, 95% confidence interval; MCAT, Medical College Admission test; URiM, Underrepresented in Medicine (as defined by each program).

Table 9. Sample outcome metrics for pathway programs[a].

Outcome measurement	Definition/example
Student assessment of pathway program effectiveness	Postprogram survey of students' perception of how effective the program was in each domain (ie, mentorship, academic enhancement, health science lectures)
Preprogram and postprogram mindset ratings	Postprogram Likert scale questions about students' sense of belonging in the health professions, confidence in doing well in science courses, interest in becoming a health professional, connection to mentors
Objective learning evaluations	Measurement of the increase in knowledge or intellectual capability from before to after the learning experience (ie, immediate postprogram and 4-month postprogram SAT scores)
Program academic outcomes	Measurement of improvement in students GPA, college admissions, awards, or college credits, graduation from college, matriculation into medical school, publications

[a]Adapted from Tables 1–3 in Hill et al and Donald Kirkpatrick's model for evaluating an educational intervention.[2,19]
Abbreviation: GPA, Grade Point Average.

the pathway students were URiM.[20] Another example of a successful pathway program is the Travelers Summer Research Program at Cornell, wherein 25 URiM undergraduate students are invited to reside at Weill Cornell Medical College to learn about medicine and the medical profession. In an outcome paper from 2016, archival data showed that 83% (N = 945) of all participants matriculated into medical school and 90% (N = 850) graduated.[21]

Less-efficient pathways previously labeled as "leaky pipelines," defined as the departure of students from the path to a medical career who had previously declared this intention, is an important factor in decreasing the pool of URiM applicants for medical school. The primary cause of these inefficient pathways are the systemic and institutional racism, endemic poverty and other structural barriers leading to an inequitable deficient educational system for Black and brown students. Freeman et al noted that perceived challenges of URiM students include inadequate institutional support and resources, limited personal resources and social/family conflicts, inadequate guidance and mentoring to assist with key career decisions, and societal barriers.[22] In addition to utilizing strategies such as mentoring, enrichment, and resources to stem this less-efficient pathways; involving families in the "pathway" early on to support a student's progression and improved dissemination and resources is important. In affirmation, a focus group of educators, students, and parents revealed that parents have a significant impact on their children's career, but often lack knowledge about the academic requirements

and resources available to help their children succeed in healthcare professions.[23] Our study finding that URiM-focused pathway programs were significantly more likely to offer mentoring, MCAT preparations, and stipends, is confirmatory that current pathway programs are adopting these strategies. More effort is required for family inclusion in pathway programs.

Currently, there is a scarcity of published literature on pathway programs and their effectiveness.[14,16] This is in confirmation with our study in which only 13% of the pathway programs reported any outcomes. In addition to programs[11,15] that published long-term outcomes, Hill et al from the University of Pennsylvania's Provost's Summer Mentorship Program posited that since long-term outcomes of enrollment in medical school is costly and takes many years to track; programs should select short-term meaningful outcomes that programs can more easily collect.[2] Using mindset changes and test scores, they showed that their program effectively increased SAT scores, increased students' sense of belonging in the medical field and their connections to physician mentors, which are 2 common barriers for URiM students who are interested in medicine.[2] Consequently, pathway programs should focus on developing short-term and long-term success measures in order to implement highly effective pathway programs that will facilitate the recruitment of the physician workforce best able to deliver high-quality, culturally sensitive care to all patients, regardless of demographic factors.[2] Table 9 lists sample metrics that could be utilized by pathway programs to measure outcomes.

In our review, we found that 10% of pathway programs targeted elementary school, while 38% targeted high school. Studies show that especially for URiM students, interest in science and achievement decline during middle and high school,[11,15] but interventions have been shown to increase this interest.[20] Hence, academic preparation programs must start early, be intensive, and persist throughout schooling.[11,24,25] However, in contrast, our review showed that K1-12 targeted programs were less likely to involve URiM students or offer mentoring, shadowing or research suggesting that more work needs to be done to optimize K1-12 pathway programs. This difficult task of including URiM in pathway programs especially in K1-12 programs is exemplified by the University of Louisville's medical school pathway programs initiated in 1981, which originally targeted high school students and began targeting elementary school students in 1996. They reported that they were able to increase the percentage of URiM students from 2% to 3% before 1993 to almost 10% by 1998 as a result of many years of developing and implementing a continuum of preparation and retention programs.[25]

In addition, our review showed a paucity of longitudinal programs with only 12% classified as longitudinal (duration of 48 weeks or more). Longitudinal programs support retention of students and increase the potential for successful matriculation of the students into college and medical school. Acosta et al

demonstrated that increasing retention in pathway programs for native American students required a proactive network of academic support services that included tutoring, study skills and time management; identification of marginally performing students earlier in the process so that tutorial assistance can be provided before they fail, providing financial assistance, a structured mentoring system that provides social, emotional, and possibly academic support, group sessions, one-on-one introductory meeting with a counselor during orientation and connection to traditional culture and practices.[26]

Although we found out that approximately 50% of programs offered a stipend, about 20% of programs charged a fee for participation. The gap in educational equality correlates with the fact that URiM families are more likely to live in poverty than their white counterparts. More than half of those who identify as American Indian/Alaska native, African American, and Hispanic are poor in contrast to 26% of whites.[11] Studies have shown that cost is a strong deterrent for URiM students achieving higher education because of the lower parental income. Financial barriers can considerably widen the privilege gap, resulting in a socially stratified higher education system.[27] Our study findings are reassuring since they demonstrated that URiM-focused programs were significantly less likely to charge a fee and more likely to offer a stipend.

Our review showed that only a minority of medical schools (21%) had adequate website information regarding their pathway programs on their website. An important factor is to determine the accessibility and functionality of information and the user-friendly status of the websites. Pollack et al evaluated 192 medical schools for the presence of 39 items relevant to medical school applicants and their findings revealed a lack of online information for medical school applicants.[28] Websites with adequate and relevant information are useful in enabling applicants to make informed decisions. The COVID pandemic with limits on personal interactions and the move to virtual interviews, highlights the need for medical schools to develop their website content and functionality, in order to adequately inform applicants and increase recruitment. A recent study used an explicit nondiscrimination and welcoming statement on the admissions website that was associated with the increased diversity of the sexual orientation of recruited students.[29] Consequently, medical schools should focus on providing pertinent and useful information on their websites regarding their pathway programs that will attract, motivate, and invite students, especially the disadvantaged and marginalized, to connect and participate.

The limitations to our study included the process of analyzing medical school websites since there is no standard process. However, we developed a method of data collection that should potentially capture all the relevant information on pathway programs.[28] It is possible that there is other information on the medical schools' websites that may be useful to prospective pathway students, that we did not retrieve. We also used a convenient sample of available websites of medical schools and did not do a sample size calculation. Furthermore, since we did not have access to the detailed data and internal records of the programs; our report cannot address the accuracy or quality of information contained on websites. However, this is the major theme of our study since the public data on the school's website is usually the only information available to these students who already are marginalized by limited access and networking opportunities. Additionally, our study was limited to programs affiliated with medical schools and thus we did not study pathway programs administered by health system or health sciences campus wide programs, governmental or public agencies, private institutions, and nonprofit organizations.[22] Nonetheless, our study may even be more relevant since it was conducted during the pandemic and enables us to assess the impact of the pandemic current inactivity and the emerging role of virtual format in pathway programs. Notwithstanding these limitations, we believe our analysis provides valuable insight for medical school directors, website developers, and potential pathway students. Future studies should evaluate how website quality affects recruitment of URiM students into pathway programs. Furthermore, a careful study of outcomes data should be performed to determine the most effective interventions.

Conclusion

In conclusion, we found that most medical school pathway programs had insufficient data on their website to assist prospective pathway students in making informed choices regarding pathway program selections, and in addition, only a minority of programs provides outcome data. Programs listed on the AAMC website were more likely to target URiM students and have adequate information about their pathway programs on their websites. URiM-focused programs were independently and significantly more likely to be managed by diversity departments, have no fee requirement, provide MCAT preparation, offer research opportunities, and offer mentoring to pathway students. Programs focused on K1-12 were less likely to recruit URiM students, offer stipends, mentoring, nor shadowing and research. We recommend that medical schools be aware of the following: (1) URiM-focused pathway programs are required to provide physician workforce equity and to help mitigate health disparities; (2) pathway programs outcomes should be published and posted on medical school websites; and (3) a focus on the K-12 pathway is fundamental and can truly improve the diversity of the physician workforce for decades to come.

Authors' Contributions

DO developed the protocol, obtained AAMC website data, wrote the manuscript, and provided oversight for medical students. CW, ME, PP, and SagA obtained the data from medical school websites, developed the database, and organized

the tables. SS obtained the data from medical school websites, developed the database, organized the tables, and reviewed the manuscript. AT reviewed the data, organized the tables, and helped with manuscript development and revision. NR, MG, TL, and SarA were involved in hypothesis generation, protocol review, and manuscript development.

ORCID iD

Mason Eghbali https://orcid.org/0000-0003-3509-8661

Supplemental Material

Supplemental material for this article is available online.

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