

Current Demographic Status of Cardiologists in the United States

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IMPORTANCE Increasing cardiology workforce diversity will expand the talent of the applicant pool and may reduce health care disparities.

OBJECTIVE To assess US cardiology physician workforce demographics by sex and race/ethnicity in the context of the US population and the available pipelines of trainees.

DESIGN, SETTING, AND PARTICIPANTS This cross-sectional study used data from the Association of American Medical Colleges, the American Medical Association, and the American Board of Internal Medicine to stratify medical students, resident physicians, fellows, and cardiologists by sex and race/ethnicity. Additionally, proportional changes from 2006 through 2016 were assessed for adult and pediatric cardiology. Data analysis took place from August 2018 to January 2019.

MAIN OUTCOMES AND MEASURES Percentage of cardiologists and trainees by sex and race/ethnicity in 2016, as well as changes in proportions between 2006 and 2016.

RESULTS Despite a high percentage of female internal medicine resident physicians (10 765 of 25 252 [42.6%]), female physicians were underrepresented in adult general cardiology fellowships (584 of 2720 [21.5%]) and procedural subspecialty fellowships (interventional cardiology, 30 of 305 [9.8%]; electrophysiology, 24 of 175 [13.7%]). The percentage of female adult cardiologists slightly increased from 2006 through 2016 (from 8.9% to 12.6%; slope, 0.36; $P < .001$) but remained low. Female physicians made up a disproportionately higher number of pediatric residency positions (6439 of 8832 [72.9%]). Trends showed an increase in female pediatric cardiology fellows (from 40.4% to 50.5%; slope, 1.25; $P < .001$), which resulted in an increase in the percentage of female pediatric cardiologists (from 27.1% to 34.0%; slope, 0.64; $P < .001$). The percentages of members of underrepresented minority groups in adult and pediatric cardiology fellowships (from 11.1% to 12.4%; slope, 0.15; $P = .01$; and from 7.7% to 9.9%; slope, 0.29; $P = .009$; respectively) were low and increased only slightly over time. Additionally, members of underrepresented minorities made up less than 8% of practicing adult and pediatric cardiologists. Although Asian individuals are 5.2% of the US general population, they are not considered underrepresented because they are 22.1% of US medical school graduates ($n = 4202$ of 18 999), 38.1% of internal medicine resident physicians ($n = 9618$ of 25 252), 40.4% of adult cardiology fellows ($n = 1098$ of 2720), 19.9% of adult cardiologists ($n = 5973$ of 30 016), 22.6% of pediatric resident physicians ($n = 1998$ of 8832), 28.0% of pediatric cardiology fellows ($n = 122$ of 436), and 20.1% of pediatric cardiologists ($n = 574$ of 2860).

CONCLUSIONS AND RELEVANCE Female physicians remain underrepresented in adult cardiology, despite a robust pipeline of female medical students and internal medicine resident physicians. Women in pediatric cardiology are underrepresented but increasing in number. Members of several racial/ethnic minority groups remain underrepresented in adult and pediatric cardiology, and the percentages of trainees and medical students from these groups were also low. Different strategies are needed to address the continuing lack of diversity in cardiology for underrepresented minority individuals and women.

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Despite increasing racial/ethnic diversity within the US general population, diversification among physicians is lagging.¹ Sex and racial/ethnic diversity in medicine provides opportunities for diverse mentorship along all stages of career pathway and stimulates research on diversity and health inequities. However, there is a dearth of demographic data characterizing the current cardiology workforce.² The purpose of this study is to examine diversity within US cardiology training programs and the cardiology workforce.

Methods

Demographic data, including self-reported race/ethnicity, were collected from the American Medical Association Physician Masterfile and various Association of American Medical Colleges (AAMC) sources. Population data for the United States were obtained from the American Community Survey Public Use microdata files. American Board of Internal Medicine data identified cardiologists with active board certifications. Members of underrepresented minorities (URMs) were defined as individuals who self-reported being black or African American; Hispanic, Latino, or of Spanish origin; American Indian or Alaska Native; or Native Hawaiian or Pacific Islander, either alone or

Key Points

Question What are the current sex and race/and ethnicity demographics within the cardiology physician workforce, and how have they changed in recent years?

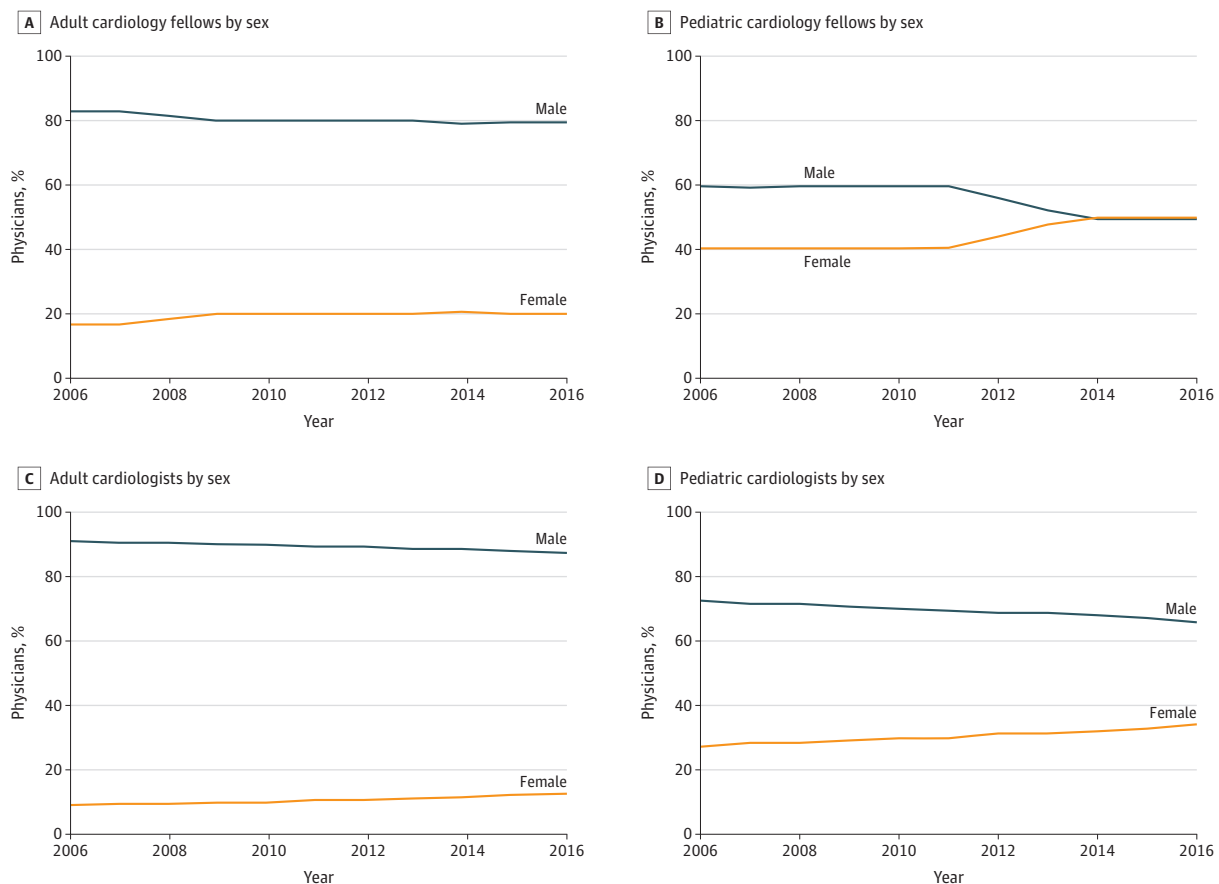
Findings The proportion of adult female cardiologists increased slightly from 2006 through 2016 but remained low, and despite a greater proportional increase in female pediatric cardiologists, they still lagged relative to the US population. There was a modest increase in members of underrepresented minorities, but representation remained low in adult and pediatric cardiology.

Meaning The cardiology physician workforce is not diverse; the slow pace of diversification suggests that focused efforts to address diversity among trainees are needed for improvement.

in combination with any other race. Reliable race and ethnicity data only became available in the mid-1970s, and therefore race/ethnicity information is missing for many older physicians. Additionally, there are missing race/ethnicity data in subspecialty cardiology fellowship data sets.

This study was approved by the American Institutes for Research’s institutional review board. It was also granted a waiver of approval from obtaining informed consent from study

Figure 1. Proportions of Cardiology Fellow Physicians and Cardiologists From 2006 Through 2016, Stratified by Sex



Data source: GME Track, 2006-2016 (December 31, 2016, snapshot).

Table. Sex and Race/Ethnicity Data of Trainees, Cardiologists, and American Board of Internal Medicine Board-Certified Cardiologists^a

Characteristic	Individuals, No. (%)				
	Sex		Race/Ethnicity ^b		
	Men	Women	White	Asian	Under-represented Minority Groups ^c
US population					
All	156 759 567 (49.2)	161 798 595 (50.8)	197 374 343 (62.0)	16 438 078 (5.2)	101 665 114 (31.9)
Age					
25-35 y	24 021 125 (50.4)	23 618 815 (49.6)	27 131 505 (57.0)	3 069 562 (6.4)	16 935 869 (35.5)
35-70 y	69 363 476 (48.8)	72 664 625 (51.2)	94 915 538 (66.8)	7 579 030 (5.3)	38 669 181 (27.2)
US medical school graduates ^d	10 174 (53.6)	8825 (46.4)	10 965 (57.7)	4202 (22.1)	2969 (15.6)
Internal medicine resident physicians	14 465 (57.3)	10 765 (42.6)	10 397 (41.2)	9618 (38.1)	3500 (13.9)
Adult cardiology fellows					
General cardiology	2128 (78.2)	584 (21.5)	1102 (40.5)	1098 (40.4)	347 (12.8)
Interventional	274 (89.8)	30 (9.8)	120 (39.3)	135 (44.3)	28 (9.2)
Electrophysiology	150 (85.7)	24 (13.7)	64 (36.6)	74 (42.3)	18 (10.3)
Heart failure	64 (71.9)	24 (27.0)	41 (46.1)	30 (33.7)	14 (15.7)
Adult cardiologists					
Practicing cardiologists	26 215 (87.3)	3768 (12.6)	15 361 (51.2)	5973 (19.9)	2248 (7.5)
Full-time faculty members	3818 (81.7)	847 (18.1)	3054 (65.4)	1083 (23.2)	403 (8.6)
Pediatric resident physicians	2391 (27.1)	6439 (72.9)	4962 (56.2)	1998 (22.6)	1413 (16.0)
Pediatric cardiology fellows	216 (49.5)	220 (50.5)	246 (56.4)	122 (28.0)	43 (9.9)
Pediatric cardiologists					
Practicing cardiologists	1884 (65.9)	972 (34.0)	1781 (62.3)	574 (20.1)	224 (7.8)
Full-time faculty members	874 (66.0)	449 (33.9)	938 (70.8)	258 (19.5)	96 (7.2)
ABIM board certification					
Clinical cardiology	20 888 (87.4)	2996 (12.5)	12 781 (53.5)	5217 (21.8)	1789 (7.5)
Interventional	6088 (95.0)	316 (4.9)	3315 (51.7)	1791 (27.9)	497 (7.8)
Electrophysiology	2283 (91.2)	215 (8.6)	1405 (56.2)	746 (29.8)	205 (8.2)
Heart failure	700 (74.5)	239 (25.5)	516 (55.0)	271 (28.9)	91 (9.7)

Abbreviation: ABIM, American Board of Internal Medicine.

^a Data sources: 2016 American Community Survey 5-year Estimates for 50 states, Washington, DC, and Puerto Rico; 2016-2017 academic year data from Association of American Medical Colleges (AAMC) Student Records System; GME Track, December 31, 2016, snapshot; American Medical Association Physician Masterfile, December 31, 2016, snapshot; the AAMC Faculty Roster, December 31, 2016, snapshot; and the 2016 American Board of Internal Medicine administrative data, December 31, 2016.

^b Reliable race and ethnicity data only became available in the mid-1970s, and thus race/ethnicity information was missing for many older physicians. Additionally, there are missing race/ethnicity data in current subspecialty cardiology fellowship data sets. For this reason, percentages in the race/ethnicity categories do not add up to 100%.

^c Members of underrepresented minorities were defined as individuals who self-reported being black or African American; Hispanic, Latino, or of Spanish origin; American Indian or Alaska Native; or Native Hawaiian or Pacific Islander, either alone or in combination with any other race.

^d With doctor of medicine (MD) degrees.

participants, because the research project was of minimal risk and all data were anonymous. The *t* test and the χ^2 test were used when appropriate. Trends over time (2006 to 2016) in demographic characteristics (in GME Track Database [AAMC], this was coded as cardiology fellows; in the American Medical Association Physician Masterfile, as active cardiologists) were assessed using the slope and associated *P* value of a simple linear regression model, with the year as the independent variable. All *P* < .05 were considered significant. Statistical analyses were conducted with SAS version 9.4 (SAS Institute) from August 2018 to January 2019.

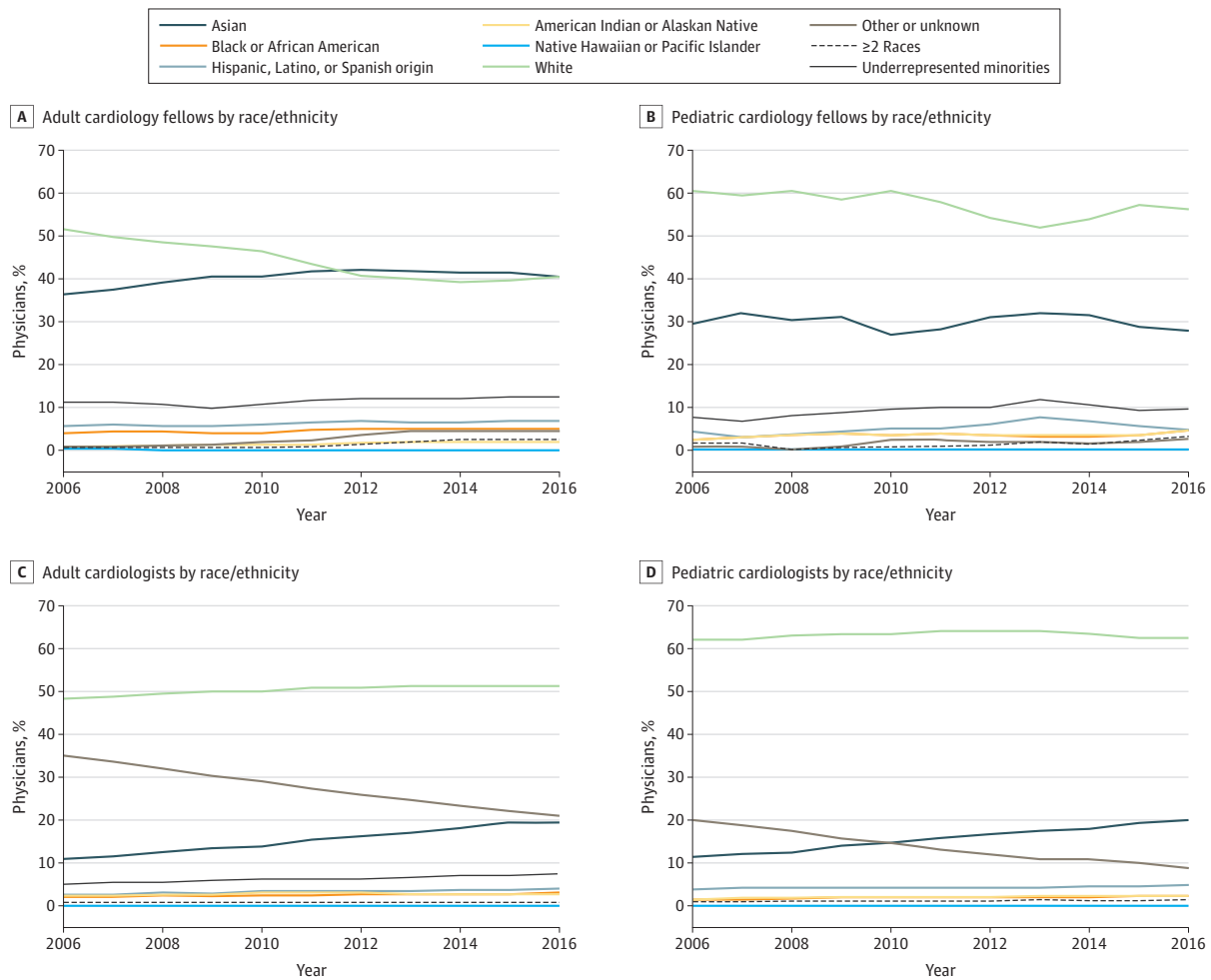
Results

In 2016, 42.6% of internal medicine resident physicians (*n* = 10 765 of 25 252 physicians) and 21.5% of adult clinical cardiology fellows (584 of 2720) were women; procedural subspecialty fellowships had lower percentages (interventional

fellowship, 30 of 305 [9.8%]; electrophysiology fellowship, 24 of 175 [13.7%]). Percentages of female adult cardiology fellows (from 16.7% [456 of 2727] to 20.2% [666 of 3300]; slope, 0.33; *P* < .001) and adult cardiologists (from 8.9% [2365 of 26 469] to 12.6% [3768 of 30 016]; slope, 0.36; *P* < .001) increased from 2006 to 2016, but both remained low (**Figure 1**). Percentages of board-certified women adult clinical cardiologists and practicing cardiologists were similar (**Table**). Although 72.9% of pediatric resident physicians (6439 of 8832) were women, only 50.5% of pediatric cardiology fellows (220 of 436) were women. From 2006 to 2016, percentages of women pediatric cardiology fellows (from 40.4% [126 of 312] to 50.5% [220 of 436]; slope, 1.25; *P* < .001) and pediatric cardiologists (from 27.1% [569 of 2096] to 34.0% [972 of 2860]; slope, 0.64; *P* < .001) increased.

Individuals in URMs made up 13.9% of internal medicine resident physicians (3500 of 25 252) and 12.8% of adult cardiology fellows (347 of 2720). From 2006 through 2016, the percentage of URM adult cardiology fellows increased mini-

Figure 2. Proportions of Cardiology Fellows and Cardiologists From 2006 Through 2016, Stratified by Race/Ethnicity



Data source: GME Track, 2006-2016 (December 31, 2016, snapshot).

mally (from 11.1% [302 of 2728] to 12.4% [409 of 3300]; slope, 0.15; $P = .01$). Only 8.6% of medical school faculty members teaching adult cardiology (403 of 4672) were URM members. The percentage of URM adult cardiologists has slightly increased (from 5.3% [1404 of 26 469] to 7.5% [2248 of 30 016]; 0.22; $P < .001$) from 2006 through 2016 (Figure 2). The percentage of URM pediatric resident physicians was low (1413 of 8832 [16.0%]), and the percentage of URM pediatric cardiology fellows slightly increased (from 7.7% [24 of 312] to 9.9% [43 of 436]; slope, 0.29; $P = .009$) over the same period. Approximately 7.8% of pediatric cardiologists (224 of 2860) were from URM groups. The percentage of URM pediatric cardiologists increased from 5.9% (124 of 2096) to 7.8% (224 of 2860; slope, 0.17; $P < .001$) over time.

In 2016, 38.1% of internal medicine resident physicians (9618 of 25 252) were Asian, and 40.4% of adult cardiology fellows (1098 of 2720) were Asian (Table). There were more Asian physicians than white physicians in procedural subspecialty fellowships (adult interventional cardiology fellows: Asian, 135 of 305 [44.3%]; white, 120 of 305 [39.3%]; adult electrophysiology fellows: Asian, 74 of 175 [42.3%]; white, 64 of

175 [36.6%]). The percentages of Asians among adult cardiology fellows (from 36.4% [994 of 2728] to 40.4% [1098 of 2720]) and adult cardiologists (from 10.9% [2880 of 26 469] to 19.9% [5973 of 30 016]) increased from 2006 to 2016 (Figure 2). Almost a quarter of adult cardiologists with medical school faculty appointments were Asian (1083 of 4672 [23.2%]). Additionally, 20.1% of pediatric cardiologists (574 of 2860) were Asian, as well as 19.9% of adult cardiologists (5973 of 30 016), 22.6% of pediatric resident physicians (1998 of 8832), and 28.0% of pediatric cardiology fellows (122 of 436).

Discussion

This survey of selected demographic characteristics of adult and pediatric cardiologists in training and practice provides important data regarding sex and race/ethnicity in the cardiology workforce. Women in adult cardiology remain underrepresented, despite a robust pipeline; however, trends show improvement in women in pediatric cardiology fellowships. Members of URM remain underrepresented in cardiology.

Trainees' perceptions of a negative culture and job description within cardiology³ are barriers that need to be addressed to improve female representation within adult cardiology fellowships. The perceived attractiveness of other professionally demanding fields (eg, surgery, obstetrics) may lend insights as to how the culture within cardiology may successfully accommodate trainees (men and women) who may highly value work-life balance and desire more flexibility throughout the span of their careers.

Despite extensive efforts to increase URM representation, the slow rate of change suggests tactics beyond the current methods are needed. Holistic review of medical school applicants may increase the number of URM matriculants; however, efforts targeted to each group within the collective URM category are necessary. Also, programs aimed at reaching children during early education are crucial to establish a deep pipeline of future medical students and cardiologists.

Asian individuals are minority members within the general US population who have had substantial representation within medicine and contributed to diversity in medicine. Additionally, the Asian population is the largest worldwide, and perhaps further differentiating Asian groups into regions (eg, East, South, and Southeast Asian) may be more representative and shed light on gaps within these communities. The Asian population as a whole has higher mean educational achievement and wages than other minority groups.^{4,5} As the cardiology field works toward greater URM diversity, the overall success of Asian individuals should not penalize or delegitimize diversity initiatives for Asian physicians. Despite Asian individuals constituting a nonunderrepresented minority group, they remain a minority in leadership within medicine.⁶⁻⁸

Currently, the American College of Cardiology's Task Force on Diversity and Inclusion has a multipronged approach that

includes efforts to engage and leverage diverse talent via strategies affecting the deep pipeline, recruitment, retention, and leadership, to help create a culture of inclusion within the field of cardiology. Efforts to improve the culture, increase mentorship, and promote work-life balance may help attract a more diverse group of individuals to pursue training in cardiology. Further research is needed regarding potential solutions that may be effective in reducing barriers to diversity and improving the climate for diversity in the cardiology workforce.

Limitations

Because the AAMC only began collecting reliable race/ethnicity data in the mid-1970s, this information was missing for many older physicians; also, sex data were missing for some physicians. Furthermore, there are missing race/ethnicity data in subspecialty cardiology fellowship data sets, and board certification and subspecialty fellowship data were not available for pediatric cardiology.

Conclusions

Women in adult cardiology remain underrepresented, despite an available pipeline of female medical students and internal medicine resident physicians, whereas women in pediatric cardiology are underrepresented, but trends show improvement. Members of underrepresented minorities remain underrepresented in adult and pediatric cardiology, but the percentages of trainees and medical students in these groups are also low. Asian individuals make up much of the racial diversity seen within the cardiology workforce. Given these findings, improving cardiology workforce diversity will require different strategies for members of URMs and women.

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Concept and design: Mehta, Lipner, Mitchell, Acosta, Oetgen, Douglas.

Acquisition, analysis, or interpretation of data: Mehta, Fisher, Rzeszut, Lipner, Mitchell, Dill, Douglas.

Drafting of the manuscript: Mehta, Mitchell.

Critical revision of the manuscript for important intellectual content: Mehta, Fisher, Rzeszut, Lipner, Dill, Acosta, Oetgen, Douglas.

Statistical analysis: Mehta, Fisher.

Administrative, technical, or material support: Fisher, Rzeszut, Lipner, Mitchell, Dill, Acosta, Oetgen, Douglas.

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