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# Diversity in the Pulmonary and Critical Care Medicine Pipeline

## Trends in Gender, Race, and Ethnicity among Applicants and Fellows

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### ABSTRACT

**Background:** The diversity in pulmonary and critical care medicine (PCCM) training programs in the United States has not been systematically evaluated, despite emphasis on workforce diversity and its role in improving gender and racial healthcare disparities.

**Objectives:** We analyzed the diversity of the PCCM pipeline by gender, race, and ethnicity over the last 10 years.

**Methods:** The PCCM pipeline was defined as internal medicine residents, fellowship applicants, and fellows in pulmonary-only, critical care medicine-only, and combined PCCM programs. Data on gender, race, and ethnicity were obtained from 2009 to 2018 graduate medical education census data and the Association of American Medical Colleges Electronic Resident Application Service. We used the Association of American Medical Colleges definition of “underrepresented in medicine” (UIM), which comprises African American/black, Hispanic/Latino, American Indian/Alaska Native, or Native Hawaiian/Pacific Islander physicians.

**Results:** Over the last decade, the percentage of female fellows was unchanged in pulmonary (range, 19.4–37.1%), critical care medicine (range, 17.6–31.9%), and PCCM programs (range, 29.5–35.2%). To capture the current snapshot of data across residents, applicants, and fellows, we analyzed 2018 data and found that there was a drop-off from the percentage of female internal medicine residents (41.9%) to the percentage of female applicants and fellows ( $\leq 33\%$  in all three programs). The percentage of UIM fellows decreased in PCCM programs over the last decade to 10.3%. In 2018, there was a drop-off from the percentage of UIM residents (13.7%) to the percentage of UIM fellows in all three programs ( $< 12.9\%$  in all three programs).

**Conclusions:** Striking disparities remain in gender, race, and ethnicity in the pipeline of trainees in PCCM programs; these have not improved (for gender) or have even worsened (for race and ethnicity) over the last decade.

**Keywords:**

career choice; internal medicine residency; fellowship; gender; race/ethnicity

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Gender disparities in leadership positions, editorial roles, and prestigious awards in the field of pulmonary and critical care medicine (PCCM) have been increasingly described (1). The pipeline of trainees entering the workforce is an important contributor to physician diversity, which ultimately impacts gender and racial disparities in health care. Diversity within PCCM training programs has not been systematically evaluated by gender, race, and ethnicity.

Two prior studies have looked at different components of diversity among PCCM fellows (2, 3). Stone and colleagues examined gender diversity in nine internal medicine (IM) subspecialty fellowships and found the percentage of women in PCCM fellowships increased from 16.2% in 1991 to 32.6% in 2016 (2). Lane-Fall and colleagues examined the demographics of critical care fellows from 2004 to 2014 and found the percentages of female fellows increased from 29.5% to 38.3%, the percentage of black fellows stayed the same, and the percentage of Hispanic fellows increased (3). However, these pooled data included trainees within pediatrics, surgery, anesthesia, and IM. Neither article included fellowship applicants, an often-overlooked part of the trainee pipeline. Because only approximately 70% of applicants to PCCM programs and 25% of applicants to pulmonary-only programs successfully match to fellowships (4), the diversity of the overall applicant pool is an important step in the pipeline.

We examined the gender, racial, and ethnic diversity of the complete continuum of the graduate medical education (GME) pipeline in the field of PCCM, including IM residents, fellowship applicants, and fellows in pulmonary-only, critical care medicine (CCM)-only, and combined PCCM programs. We looked at all three programs to provide a comprehensive analysis of diversity within the field.

## METHODS

Data were examined from 2009 to 2018 for IM residents, fellowship applicants, and fellows in pulmonary-only, CCM-only, and combined PCCM programs. We focused on the IM pipeline specifically, because IM-trained fellows make up the majority of trainees across all PCCM programs. Data on gender, race, and ethnicity were obtained from GME census data for IM residents and fellows (5–14) and from the Association of American Medical Colleges (AAMC) Electronic Resident Application Service (ERAS) for fellowship applicants (15). Data from ERAS on the race and ethnicity of fellowship applicants were included from 2013 onward, owing to a methodological change in how this information was collected by ERAS in 2013 (data were not comparable before and after this change). Both GME census (5–14) and ERAS (15) data include the following race and ethnicity categories: white, black, Asian, Hispanic/Latino, American Indian/Alaskan Native, and Native Hawaiian/Pacific Islander.

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**Author Contributions:** L.S. and J.M.B. formulated the research question, collected the data, analyzed the data, wrote the manuscript, and edited the manuscript.

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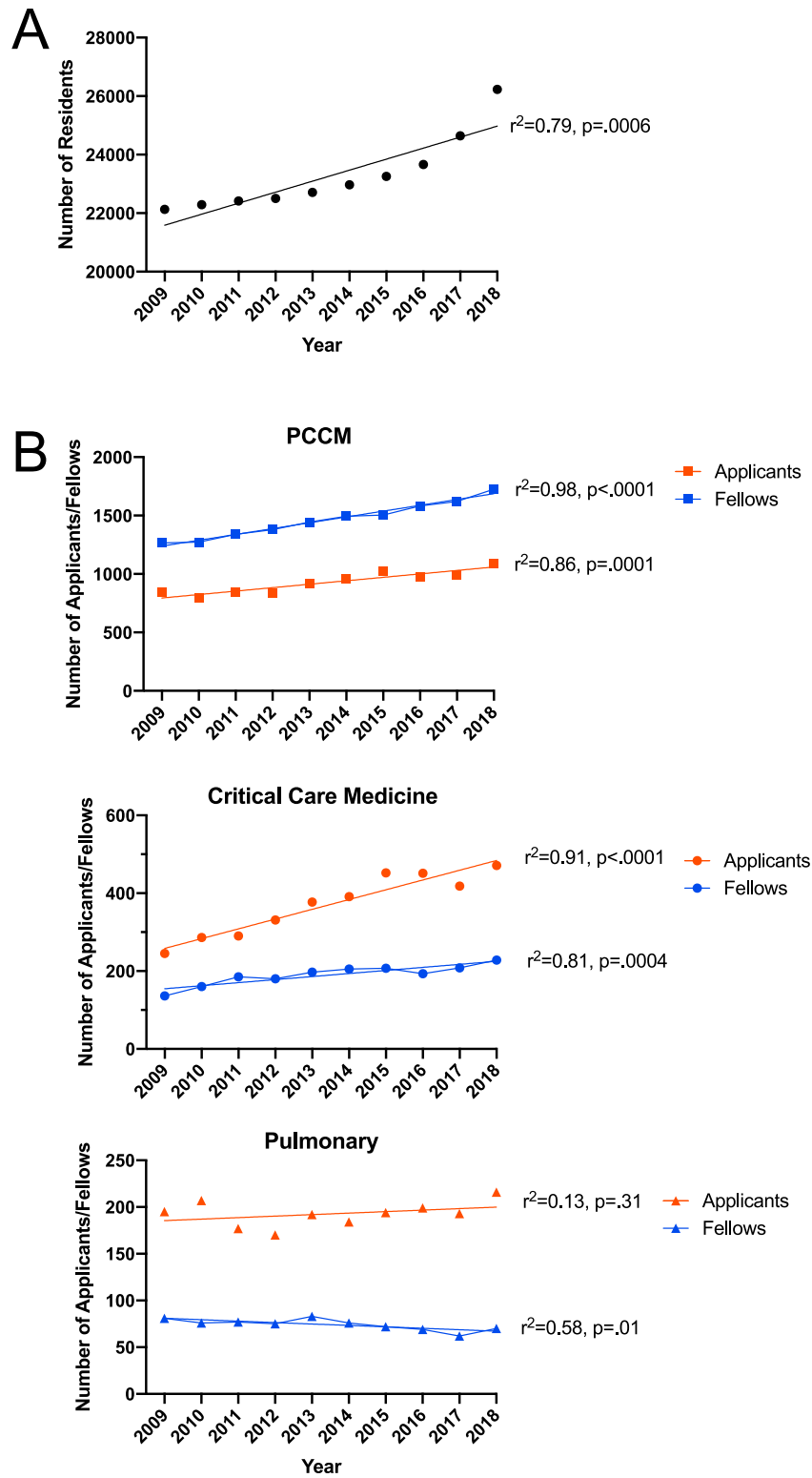
We used the AAMC term “underrepresented in medicine” (UIM), which was introduced in 2004 to accommodate changing demographics and is defined as “racial and ethnic populations that are underrepresented in the medical profession relative to their numbers in the general population” (16). We further defined UIM as described in the AAMC Medical Minority Applicant Registry: African American/black, Hispanic/Latino, American Indian/Alaska Native, or Native Hawaiian/Pacific Islander (17). To evaluate the current pipeline, we used data from 2018 for all groups. Statistical analysis was performed using Prism software (GraphPad Software) for linear regression or chi-square test for trend when appropriate.  $P < 0.05$  was considered statistically significant.

## RESULTS

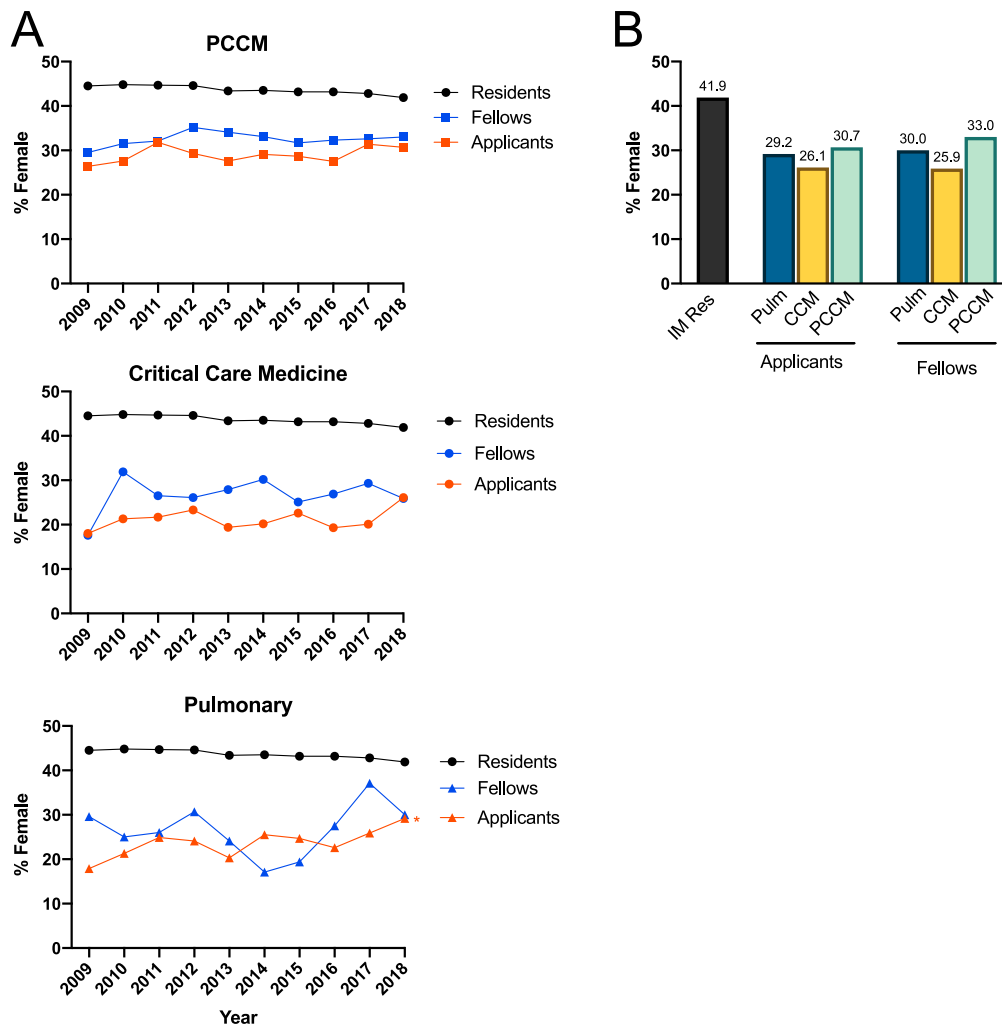
Over the last decade, the number of IM residents, fellowship applicants, and fellows in both CCM and PCCM programs increased significantly (Figure 1). The number of applicants to pulmonary programs remained stable, whereas the number of pulmonary fellows declined slightly. Over this same time frame, the percentage of female IM residents decreased from 44.5% to 41.9% ( $P < 0.0001$ ) (Figure 2A). There was no significant change in the percentage of female applicants to PCCM or CCM programs, whereas pulmonary programs had an increase in the percentage of female applicants (17.9–29.2%;  $P = 0.02$ ). The percentage of female fellows was unchanged in pulmonary (range, 19.4–37.1%), CCM (range, 17.6–31.9%), and PCCM programs (range, 29.5–35.2%). In examining gender across the pipeline of residents, applicants, and fellows in 2018

(Figure 2B), we observed a large drop-off from the percentage of female IM residents (41.9%) to the percentage of female applicants for pulmonary (29.2%), CCM (26.1%), and PCCM (30.7%) fellowships. At the fellow step, there was a slight increase in the percentage of female fellows for PCCM (up to 33.0%) but not for CCM or pulmonary programs.

Over the last 10 years, there was a significant decrease in the percentage of UIM residents from 14.1% to 13.7% ( $P < 0.0001$ ) (Figure 3A). The percentage of UIM PCCM fellows decreased from 12.1% to 10.3% ( $P < 0.0001$ ), but there was no significant change for PCCM applicants. The percentage of UIM applicants and fellows in CCM and pulmonary programs was unchanged. We examined race and ethnicity across the pipeline of residents, applicants, and fellows in 2018 (Figure 3B). For PCCM programs, the main drop-off in percentage of UIM trainees occurred at the applicant step, with only 10.7% of UIM applicants compared with 13.7% of UIM residents. For pulmonary programs, the percentage of UIM applicants (14.6%) was similar to slightly increased compared with residents, but there was then a small decrease in the percentage of UIM fellows (12.9%). For CCM programs, there was actually an increase in the percentage of UIM applicants (16.0%) compared with residents, but then a large drop-off in the percentage of UIM fellows (10.5%). Except for an enrichment in the percentage of African American applicants to CCM programs, the proportion of Latino and African American trainees was relatively stable throughout the pipeline. The percentages of Native Hawaiian/Pacific Islander and American Indian/Alaska Natives were  $\leq 1.5\%$  and  $\leq 0.7\%$ , respectively, for all groups.



**Figure 1.** Trends over the last decade in the number of (A) internal medicine residents and (B) applicants and fellows in PCCM, critical care medicine, and pulmonary fellowships. Linear regression lines and associated  $r^2$  and  $P$  values are shown. PCCM = pulmonary and critical care medicine combined programs.

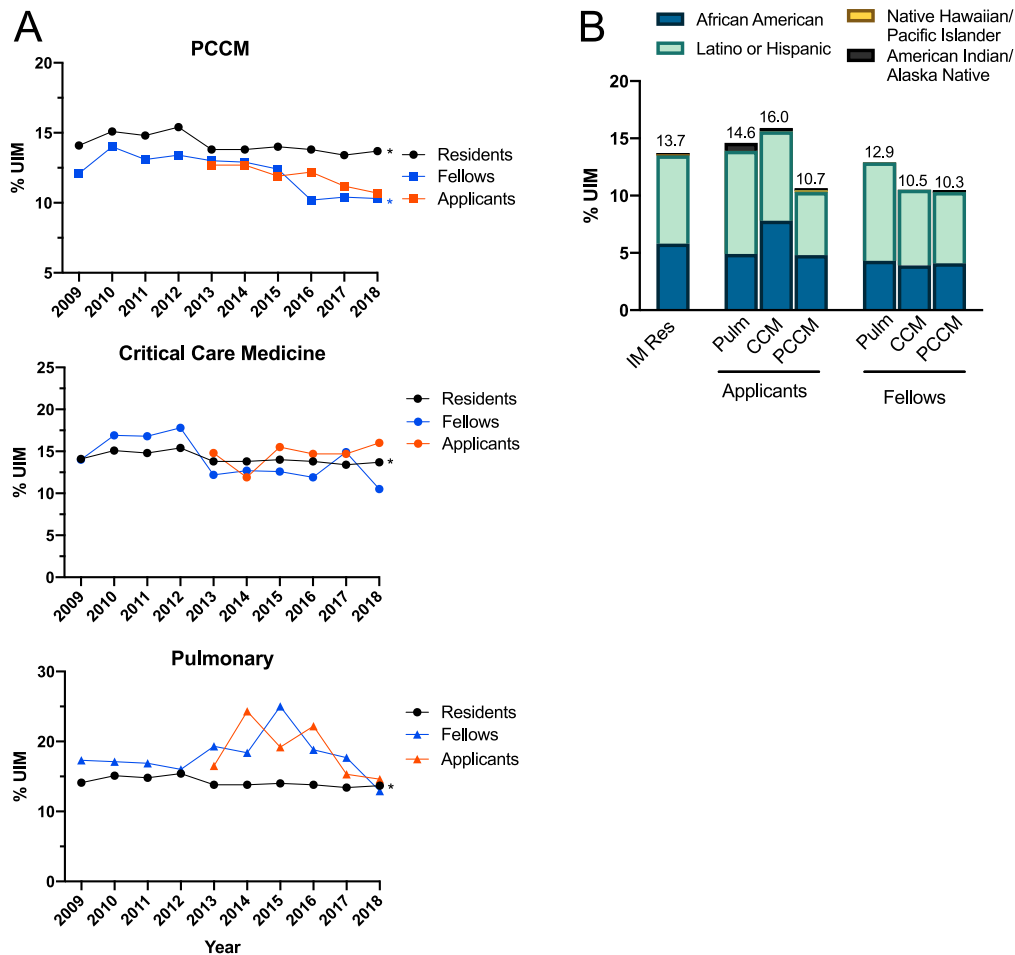


**Figure 2.** (A) Trends over the last decade in the percentage of female IM residents and applicants and fellows in PCCM, CCM, and pulmonary fellowships. (B) Pipeline of female IM residents, applicants (by program), and fellows (by program). An asterisk indicates statistical significance. CCM = critical care medicine; IM = internal medicine; PCCM = pulmonary and critical care medicine combined programs; Pulm = pulmonary.

**DISCUSSION**

Our analysis of diversity in the PCCM pipeline revealed several key points. Despite increased applicants and fellows over the last decade in PCCM and CCM programs, the percentage of female applicants and fellows in these programs was unchanged. In the current 2018 pipeline, the percentage of female applicants and fellows in all three programs was  $\leq 33\%$ , which was substantially lower than the percentage of female IM residents. The percentage of UIM PCCM fellows

decreased over the last decade to now only 10.3% of fellows. In the 2018 pipeline, the percentages of UIM applicants (for PCCM programs) and UIM fellows (for all three programs) were all substantially lower than the percentage of UIM IM residents. Alarming, the pipeline itself is at risk because there have been decreasing percentages, although small, of both women and UIM trainees in IM residency programs. To our knowledge, this is the first comprehensive analysis of trends in gender, race, and ethnicity within the IM pipeline in PCCM.



**Figure 3.** (A) Trends over the last decade in the percentage of UIM IM residents and applicants and fellows in PCCM, CCM, and pulmonary fellowships. (B) Pipeline of UIM trainees among IM residents, applicants (by program), and fellows (by program). The percentages of UIM by race and ethnicity are shown as stacked bars with the total percentage of UIM indicated by the label above the bar. Asterisks indicate statistical significance. CCM = critical care medicine; IM = internal medicine; PCCM = pulmonary and critical care medicine combined programs; Pulm = pulmonary; Res = residents; UIM = underrepresented in medicine.

Although Stone and colleagues heralded an improvement in the percentage of women in combined PCCM programs, showing an increase from 16% in 1991 to 32% in 2016 (2), our analysis showed that the percentage of women PCCM fellows was flat from 2009 to 2018, suggesting that the gains from the 1990s have essentially plateaued. Moreover, the percentage of UIM PCCM fellows has declined over time. When comparing IM residents with PCCM applicants and fellows, there is a pronounced drop-off in the pipeline after residency for both women

and UIM applicants and fellows. Although some data exist on factors impacting resident subspecialty career choice by gender (1, 18, 19), to our knowledge, there are no analogous data for race and ethnicity. Further research is needed to define the factors that influence resident career choice by gender, race, and ethnicity.

### Differences between Pulmonary, CCM, and PCCM Programs

The percentage of female applicants and fellows was highest for PCCM programs

and lowest for CCM programs. Conversely, the percentage of UIM applicants and fellows was highest for pulmonary and CCM programs and lowest for PCCM programs. These gender and race/ethnicity differences between programs may be related to the higher number of international medical graduates in pulmonary-only and CCM-only programs compared with PCCM programs. In 2018, international medical graduates comprised 87% of pulmonary-only programs, 57% of CCM programs, and 40% of PCCM programs (4). Further research is required to better elucidate the reason for these differences.

#### Analyzing the Leaky Pipeline

What can we learn from a close analysis of the pipeline, in particular from the inclusion of fellowship applicants, who are often not considered in pipeline studies? Because the National Resident Matching Program does not report match data by gender, race, or ethnicity, it is not possible to exactly “localize the lesion” and calculate match rates by gender, race, and ethnicity. However, we can infer from the location of the drop-offs where there are “leaks” in the pipeline. For gender, the main drop-off occurs at the application step for all three programs, and there is no substantial change in the percentage of women from applicants to fellows. Efforts to recruit more women to apply to these programs might be helpful. However, for UIM trainees, there are differences between programs: For PCCM, the main drop-off is from residents to applicants. Therefore, efforts should be targeted toward encouraging UIM residents to apply to PCCM programs. For pulmonary and CCM programs, however, the main drop-off occurs from applicants to fellows. This suggests that UIM applicants are matching

to these fellowships at a disproportionately low rate. Fellowships should investigate factors in the interview and ranking process that may contribute to this diversity drop-off.

These data have important implications for workforce diversity in PCCM fields, and the lack of diversity in our trainee pipeline requires urgent action. The findings that across all programs  $\leq 33\%$  of fellows are women and  $<12\%$  of fellows are UIM are striking, especially when considering that the U.S. patient population is 51% women and  $>30\%$  racial and ethnic groups who are UIM (13% African American, 18% Latino, 0.2% Native Hawaiian/Pacific Islander, and 1.3% American Indian/Alaska Native) (20).

#### Steps to Improve Diversity, Equity, and Inclusion across the Pipeline

Given these discouraging data on the presence of women and UIM trainees, how can we move forward and make progress? The AAMC has published a diversity and inclusion strategic planning guide that provides a useful framework to improve the diversity of training programs (21). In addition, some residency and fellowship programs have implemented strategies to improve the diversity of their training programs, with a particular focus on recruitment and mentorship (1, 22–24). Applying these frameworks to the PCCM pipeline, we can strategize how to increase recruitment and retention efforts at each step, moving from residency to fellowship.

First, IM residencies should continue emphasizing recruitment of women and UIM students, because it is concerning that percentages of both women and UIM IM residents are declining. Second, women and UIM residents need exposure to the field of PCCM through mentorship, clinical experiences, and didactics. Third, women



and UIM residents should be encouraged and recruited to apply to PCCM fields. This requires dedicated mentoring and the presence of a diverse faculty so that residents can find role models in their fields of interest. Fourth, during recruitment, interviewers and fellowship selection committee members should be trained in holistic review as well as unconscious bias and its impact on evaluation. Last, recruitment and retention of women and UIM fellows onto the faculty should be prioritized so that they can then serve as mentors to the entire pipeline of trainees. To avoid adding to the “minority tax” women and UIM faculty face, overall faculty capacity should be built to mentor women and UIM trainees.

#### Limitations

These data represent only one component of the complex picture of diversity in the fellowship pipeline. Using secondary data has many attendant problems, including misclassification of data, inability to characterize applicants who apply to multiple fellowships or the reasons underpinning specialty choice, and incomplete information about rank and match lists. Qualitative studies should explore reasons for subspecialty career choice and specific barriers that women and minorities face when considering the field of PCCM. Last, these data are derived from adult programs in the United States

only and thus do not encompass the challenges that international or pediatric programs face.

#### Conclusions

Significant disparities in gender, race, and ethnicity remain in the pipeline of PCCM trainees, and these have not improved (for gender) or have even worsened (for race and ethnicity) over the last decade. Fellowships in pulmonary, CCM, and PCCM programs should continue to emphasize the recruitment of diverse fellows so that trainees can better reflect the diversity of the patient population and so that we as a field can affirm our values of diversity, equity, and inclusion.

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