National Study of the Emergency Physician Workforce, 2020

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Study objective: We describe the current US emergency physician workforce.

Methods: We analyzed the 2020 American Medical Association Physician Masterfile data set. All physicians who designated emergency medicine as their primary or secondary specialty were included; nonactive physicians, residents, primarily research or teaching faculty, or those primarily involved in administration or nonclinical work were excluded. We calculated emergency physician population density, using 2018 Census Bureau estimates of the US population; urban-rural assignments were based on Urban Influence Codes. We compared 2020 results with our previous analysis of the 2008 emergency physician workforce. Again, we were unable to account for American Osteopathic Board of Emergency Medicine certification.

Results: There were 48,835 clinically active emergency physicians in 2020. The median age was 50 years (interquartile range [IQR] 41 to 62 years) and 28% were women. Overall density of emergency physicians per 100,000 population was 14.9. Most emergency physicians were in urban areas (92%), whereas 2,730 (6%) were in large rural areas and 1,197 (2%) in small rural areas. Urban emergency physicians were younger (median age 50 years; IQR 41 to 61 years) than those in large rural areas (median age 58 years; IQR 47 to 67 years) or small rural areas (median age 62 years; IQR 51 to 68 years), and more likely to be women (29%, 20%, and 19%, respectively). Most emergency physicians in small rural areas (71%) completed their medical training more than 20 years ago. Compared with 2008, the total number of clinically active emergency physicians has increased by 9,774, but, per 100,000 US population in 2020, emergency physician density decreased in both large rural (−0.4) and small rural (−3.7) areas.

Conclusion: Urban emergency physicians in 2020 remain substantially younger than rural emergency physicians, with many rural ones near the US retirement age. We did not observe a continued increase in the percentage of female physicians among emergency physicians. Given the ongoing demand for physicians in all US emergency departments, this analysis provides essential information for understanding the current emergency physician workforce and the challenges ahead. [Ann Emerg Med. 2020;■:1-14.]

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INTRODUCTION

Background

The American College of Emergency Physicians (ACEP) affirms that there is a "significant shortage of physicians appropriately trained and certified in emergency medicine."[1] In 2008,[2] we performed a national study of the US emergency physician workforce and found that a sizable number of emergency departments (EDs) are staffed by physicians who are neither emergency medicine trained nor emergency medicine board certified; these nonemergency medicine–trained and nonemergency medicine board-certified physicians were older, were men, and disproportionately worked in rural EDs. We also found low densities of emergency physicians in rural areas of the United States; given this finding and that only 1% of recent emergency medicine graduates at that time were practicing in rural areas, we predicted that the emergency physician shortage in rural areas would likely worsen.[2] Our findings[2] demonstrated that many physicians who are neither emergency medicine trained nor emergency medicine board certified continue to provide ED care nationwide. Further support for this finding was a recent analysis of a 2014 Medicare data set, which reached similar conclusions.[3] Both studies provide strong evidence for ACEP's affirmation.[1]

Editor's Capsule Summary

What is already known on this topic

The emergency physician workforce affects emergency care capabilities.

What question this study addressed

What does the current US emergency physician workforce look like and has this changed since 2008?

What this study adds to our knowledge

Analysis of the American Medical Association 2020 Physician Masterfile showed that of the current 48,835 self-declared clinically active emergency physicians, the mean age was 50 years, with mostly men (72%) or practice in an urban setting (92%). The workforce increased by 9,774 since 2008 but shrank relative to population in rural areas.

How this is relevant to clinical practice

Planning for future emergency care should integrate the opportunities noted in this current description.

Indeed, the 2014 ACEP report card on America's emergency care environment gave a D– grade for access to emergency care, which was without any interval improvement from the 2009 grade of D–[4,5]; these low scores were concurrent with an overall national grade of D+ that was lower than the 2009 report card's score of C–. This downgrade was predominately driven by poor access to emergency care providers and centers[5] and is in the context of previous work by our group predicting a long-term inability to staff all US EDs with emergency medicine board-certified physicians.[6] Despite increasing ED volumes, emergency physicians are tasked with serving an ever-aging society with increasingly complex medical comorbidities who are visiting EDs at twice the rate of the US population growth.[5]

Importance

Several previous reports have focused on the national emergency medicine workforce.[2,7–9] There is also an ongoing ACEP task force focused on defining the future state of the workforce[10] and recent legislation by the Centers for Medicare & Medicaid Services aimed at addressing rural and underserved areas by removing barriers to training residents in these areas.[11] Given the exponential increase of emergency medicine residency programs,[12] increased presence of physician assistants and nurse practitioners working in US EDs,[13] emergence of telemedicine,[14,15] ongoing challenges with workforce diversity,[16,17] and a population of older emergency physicians who will soon leave the emergency medicine workforce,[2,3,18] there is a need for an updated emergency physician workforce study. Findings from such a study would help guide future emergency medicine workforce policies.

Goals of This Investigation

The goal of this study was to determine the current state of the US emergency physician workforce and to expand on our previous workforce analysis.[2] To achieve this, we used the 2020 American Medical Association (AMA) Physician Masterfile, a database inclusive of every physician with a medical license.[19] The primary objective was to describe the demographic characteristics, training, board certification, and geographic distribution of all clinically active emergency physicians in the United States today. Secondary goals were to investigate overall changes in the rural emergency physician workforce, to identify overall trends in the proportion of emergency physicians who identify as women, and to explore other changes between the 2020 versus 2008 data. Our hypotheses were that we would identify a decreased number of rural emergency physicians, and that there would be ongoing increases in the percentage of female emergency physicians.

MATERIALS AND METHODS

Study Design

We performed a cross-sectional analysis of the 2020 AMA Physician Masterfile database[19] and then compared these results with those from our previous analysis of the 2008 Masterfile database.[2] The Masterfile was initially developed as a record-keeping device by the AMA; it includes data on virtually all allopathic and osteopathic physicians.[19] The Masterfile includes current and historical data on more than 1.4 million physicians, residents, and medical students; AMA membership is not required nor involved. Physician data are entered during initial medical license application and updated during subsequent renewals. The database is updated weekly and subjected to continuous verification efforts by the AMA Division of Health Solutions Data Management. We obtained a commercially available copy of this database from Medical Marketing Service, Inc (Schaumburg, IL), the only AMA Masterfile-licensed vendor for workforce analyses. Data were obtained on March 11, 2020. This work was deemed an exempt protocol by the Partners Institutional Review Board (Boston, MA).

Selection of Participants

Within the 2020 AMA Masterfile, there were 67,357 physicians who self-identified as having a primary or

secondary specialty of emergency medicine, emergency medicine/pediatrics, internal medicine/emergency medicine, family medicine/emergency medicine, pediatric emergency medicine/emergency medicine, or pediatric emergency medicine alone. To reflect a population of clinically active physicians who designated emergency medicine as their primary or secondary specialty, we excluded residents (n=7,038); physicians who were primarily in administration (n=934), teaching (n=615), or research roles (n=164); those who indicated they were primarily nonclinical (n=143); those either retired (n=5,384) or semiretired (n=696); those temporarily not in practice (n=153) or not active for other reasons (n=521); and those without classification (n=2,874). There were 48,835 emergency physicians who met criteria and were the focus of our analysis (Figure E1, available online at http://www.annemergmed.com).

Methods of Measurement

As previously described,[2] variables were defined by self-report at state medical license application or renewal, demographics did not include race/ethnicity, and international medical graduates were defined as physicians who graduated from medical school outside the United States and Canada. Most emergency physicians (n=34,202; 70%) provided home location, and we again assumed, for the purposes of this analysis, that physicians lived and worked in the same county; 29% provided professional location. The remainder (≈1%) of addresses were unknown. Location was classified into the same 9 US Census divisions as in our previous study[2]; these were New England (Connecticut, Massachusetts, Maine, New Hampshire, Rhode Island, and Vermont), Mid Atlantic (New Jersey, New York, and Pennsylvania), East North Central (Illinois, Indiana, Michigan, Ohio, and Wisconsin), West North Central (Iowa, Kansas, Minnesota, Missouri, North Dakota, Nebraska, and South Dakota), South Atlantic (Washington, DC; Delaware; Florida; Georgia; Maryland; North Carolina; South Carolina; Virginia; and West Virginia), East South Central (Alabama, Kentucky, Mississippi, and Tennessee), West South Central (Arkansas, Louisiana, Oklahoma, and Texas), Mountain (Arizona, Colorado, Idaho, Montana, New Mexico, Nevada, Utah, and Wyoming), and Pacific (Alaska, California, Hawaii, Oregon, and Washington). We also used the same approach for classifying population size of the metropolitan statistical area population categories according to US Office of Management and Budget groups (less than 100,000; 100,000 to 249,999; 250,000 to 999,999; and greater than or equal to 1,000,000 people). Likewise, we used the same approach to apply US Department of Agriculture Urban Influence Codes[20] for each emergency physician's county to categorize locations as urban (n=44,743), large rural (n=2,730), or small rural (n=1,197)[2]; the most recent 2013 version was used. As previously reported,[2] Urban Influence Codes are an established approach based on commuting and economic centers of influence (in addition to area population sizes) to measure urbanization or rurality of an area as a means of capturing difference in economic opportunities among counties. In the same fashion documented in our previous report, urban areas were those that contained all counties designated within metropolitan areas. This was defined as counties with 1 or more cities with population greater than or equal to 50,000 and adjacent outlying counties that are economically tied to the core by greater than or equal to 25% commuting to the central county (categories 1 and 2); large rural areas contained counties with designated micropolitan classification, designed to distinguish rural counties with an urban cluster of at least 10,000 people and economically tied adjacent counties (categories 3, 5, and 8). Small rural areas were all counties, defined as nonmetropolitan and nonmicropolitan areas (categories 4, 6, 7, 9, 10, 11, and 12). According to 2010 US Census data, 85% of the US population lived in urban counties, 9% lived in large rural counties, and 6% in small rural counties.

We used completion of an Accreditation Council for Graduate Medical Education (ACGME)–accredited program in emergency medicine, internal medicine/emergency medicine, or family medicine/emergency medicine, or a pediatric emergency medicine fellowship, to classify residency and fellowship training. For nonemergency medicine–trained physicians, we classified training as family medicine, internal medicine, pediatrics, surgery, and other. As in our previous study,[2] we classified physicians who subspecialized through fellowship training by their original residency training. Likewise, we separately listed transitional or preliminary internship; individuals who completed only an internship were classified as internship only. Years since training was based on the graduation year from the most recently completed ACGME-accredited program. Again, we were able to include only board certification information from the American Board of Medical Specialties (ABMS).[2] Missing data fields were not imputed; we analyzed the available data.

Primary Data Analysis

Stata (version 14.2; StataCorp, College Station, TX) was used for statistical analysis. Values were summarized with

descriptive statistics, including medians with interquartile range (IQR) and proportions. As in our previous study,[2] we did not report confidence intervals, given that the AMA Physician Masterfile is an inclusive resource representing the total population of emergency physicians. US Census Bureau resident population estimates for 2018 were used to calculate physician density (defined as number of emergency physicians per 100,000 population). Emergency physician population density maps by county were created with ArcMap (version 10.6.1; ESRI, Redlands, CA). To test our hypothesis regarding changes between 2020 and 2008, we compared differences between the 2 years, with a focus on the rural emergency medicine workforce and female emergency physicians.

RESULTS

Characteristics of Study Subjects

We identified 48,835 clinically active emergency physicians in the United States in 2020. Table 1 shows the characteristics of these physicians by training and ABMS board certification. Of these emergency physicians, 81% were emergency medicine trained or emergency medicine board certified; the remaining 19% were neither emergency medicine trained nor emergency medicine board certified. Of the overall population, 69% were emergency medicine board certified. The most common alternate training pathways used by emergency physicians who were neither emergency medicine trained nor emergency medicine board certified were family medicine (33%), internal medicine (24%), or surgery (12%). With regard to the emergency care of children, pediatric emergency medicine was designated for 2,300 emergency physicians (5.0%), 103 (0.2%) reported both pediatric emergency medicine and general emergency medicine, and 46,432 (95%) reported general emergency medicine only.

Physicians who were neither emergency medicine trained nor emergency medicine board certified, compared with those who were emergency medicine trained or emergency medicine board certified, were more likely to be men (83% versus 70%, respectively) and international medical graduates (20% versus 6%). They also were older (median age 64 years [IQR 58 to 69 years] versus 47 years [IQR 40 to 57 years]) and more likely to be located in a rural area (18% versus 5%). Among these physicians without emergency medicine training or emergency medicine board certification, 54% reported their primary specialty as emergency medicine.

Compared with urban emergency physicians, with a median age of 50 years (IQR 41 to 61 years), rural emergency physicians were older (those in large rural areas 58 years [IQR 47 to 67 years]; those in small rural areas 62 years [IQR 51 to 68 years]) and more likely to be men (71%, 80%, and 81%, respectively). Table 2 shows the 2020 comparison of emergency physicians in urban versus rural (large rural and small rural) areas. Compared with urban emergency physicians, rural ones were more likely to be located in New England, West North Central, East South Central, and Mountain US Census divisions. Rural emergency physicians, particularly those from small rural areas, were also much less likely than urban emergency physicians to have emergency medicine training (urban 74%, large rural 52%, and small rural 37%) or to be emergency medicine board certified (urban 70%, large rural 56%, and small rural 40%); many emergency physicians from small rural areas (29%) reported family medicine as their residency training. Rural emergency physicians were less likely to have graduated from training in the past 5 years compared with urban emergency physicians; most of the rural workforce graduated from training at least 20 years before 2020 (large rural 61% and small rural 71%).

Table 3 presents characteristics of emergency physicians by years since residency or fellowship graduation. We did not observe a continued increase in the percentage of female emergency physicians. Although this percentage has been increasing for many years (19% for individuals $\geq$20 years since residency or fellowship graduation, then 33% for those 10 to 19 years out, and then 38% for those 5 to 9 years out), only 36% of those graduating within the last 0 to 4 years were women. There also remains a trend among newer emergency medicine–trained graduates to be in more urban areas (96% of those 3 years out to 93% of those 30 years out) (Figure E2, available online at http://www.annemergmed.com) and more likely to be emergency medicine board certified (92% of those 5 to 9 years since residency fellowship were emergency medicine board certified). As demonstrated previously,[2] the proportion of emergency medicine–trained or emergency medicine board-certified emergency physicians currently practicing in rural areas increased with time since graduation (Figure E2, available online at http://www.annemergmed.com).

There remains notable variation in density of emergency physicians by geographic area; this, along with changes since 2008, is demonstrated in Table 4. Per 100,000 US population in 2020, there were 10.2 emergency medicine board-certified, 12.1 emergency medicine–trained or emergency medicine board-certified, and 14.9 total emergency physicians; all of these overall density values are higher than in 2008. On the other hand, and despite an increase in density among all emergency physicians in urban areas (1.4), we found decreases in both large rural (–0.4) and small rural (–3.7) areas. These decreases are due,

Table 1. Comparison of emergency physicians by emergency medicine training and emergency medicine board certification status.

	Emergency Medicine Trained or ABMS Emergency Medicine Board Certified, n=39,736		Not Emergency Medicine Trained or ABMS Emergency Medicine Board Certified, n=9,099		All Emergency Physicians, n=48,835	
Characteristics	**No.**	**%**	**No.**	**%**	**No.**	**%**
Demographics						
Median age (IQR), y	39,697	47 (40–57)	9,069	64 (58–69)	48,766	50 (41–62)
Age categories, y						
25–44	16,120	41	383	4	16,503	34
45–64	18,032	45	4,502	50	22,534	46
≥65	5,545	14	4,184	46	9,729	20
Female sex	12,095	30	1,533	17	13,628	28
International medical graduate	2,389	6	1,862	20	4,251	9
Geography						
US Census division						
New England	2,356	6	406	5	2,762	6
Mid Atlantic	4,891	12	1,040	12	5,931	12
East North Central	5,887	15	1,365	15	7,252	15
West North Central	2,080	5	692	8	2,772	6
South Atlantic	7,889	20	1,786	20	9,675	20
East South Central	1,586	4	815	9	2,401	5
West South Central	4,116	10	1,203	13	5,319	11
Mountain	3,509	9	644	7	4,153	9
Pacific	7,192	18	1,021	11	8,213	17
MSA population size						
≥1,000,000	27,088	68	4,489	49	31,577	65
250,000–999,999	6,396	16	1,701	19	8,097	17
100,000–249,999	2,677	7	770	8	3,447	7
<100,000	277	0.7	101	0.1	378	0.8
Unknown	3,298	8	2,038	22	5,336	11
Urban influence						
Urban	37,321	94	7,422	82	44,743	92
Large rural	1,739	4	991	11	2,730	6
Small rural	547	1	650	7	1,197	2
Training						
Residency						
Emergency medicine	35,236	89	N/A	N/A	35,236	72
Family medicine	678	2	2,968	33	3,646	7
Internal medicine	1,260	3	2,207	24	3,467	7
Pediatrics	608	2	457	5	1,065	2
Surgery	665	2	1,102	12	1,767	4
Internship only	491	1	325	4	816	2
Other residency	260	0.7	280	3	540	1
None	538	1	1,760	19	2,298	5

in large part, to a population density decrease for nonemergency medicine–trained, nonemergency medicine board-certified physicians. More specifically, this group of emergency physicians experienced decreases in density across urban (–1.6) and large rural (–1.5) areas, with an especially large decrease in small rural areas (–4.1).

The highest emergency physician densities were found in New England and Mountain divisions; lowest density

Table 1. Continued.

Characteristics	Emergency Medicine Trained or ABMS Emergency Medicine Board Certified, n=39,736		Not Emergency Medicine Trained or ABMS Emergency Medicine Board Certified, n=9,099		All Emergency Physicians, n=48,835	
	No.	%	No.	%	No.	%
Years since medical training completed						
<5	5,774	15	34	0.5	5,808	12
5–9	6,868	18	92	1	6,960	15
10–19	12,516	32	615	8	13,131	28
≥20	14,039	36	6,598	90	20,637	44
Primary specialty of emergency medicine	38,696	97	4,957	54	43,653	89

MSA, Metropolitan statistical area.

was found in the East South Central division. Emergency physician density per 100,000 population by county is presented in Figure 1*A* (all emergency physicians) and Figure 1*B* (emergency medicine–trained or emergency medicine board-certified emergency physicians only). Changes in emergency physician density in 2008 versus 2020 are presented in Figure 2*A* (all emergency physicians) and Figure 2*B* (emergency medicine–trained or emergency medicine board-certified emergency physicians only). Combined, these figures demonstrate a band of underserved states (from North Dakota down to Texas) (Figure E3, available online at http://www.annemergmed.com) with many underserved counties and, compared with 2008 data, worse rural emergency physician shortages.

LIMITATIONS

Like our previous analysis using the 2008 AMA Masterfile, the current study has several potential limitations.[2] Although the AMA strives to maintain accuracy of the Masterfile with frequent surveys and updates—and has an internal division, the Division of Health Solutions Data Management, dedicated to this quality assurance—we cannot be certain how often each of the requested individual data elements obtained in our aggregate sample was updated by respondents. Physicians can also request "do not release" restrictions on their Masterfile record. We do not know whether this is a restriction any emergency physicians may have requested[19] and, if so, to what extent it may have affected our findings. Furthermore, much of the data are self-reported, including classification as an emergency physician. Also, as noted previously,[2] the AMA allows reporting of either home or work address. In line with our 2008 study, our analysis is based on the assumption that emergency physicians lived and worked in the same county, although locum emergency physicians often do not live in the area in which they work; we were unable to account for this possible confounder or the possible confounder of emergency physicians living near county lines and practicing in nearby counties. However, our analyses did identify a "band" (Figure E3, available online at http://www.annemergmed.com) with low emergency physician densities involving entire states. These data argue against an explanation that counties with low emergency physician densities are low only because that county's emergency physician(s) was on the other side of the county line. As we previously reported, though,[2] our use of Urban Influence Codes accounted for commuting and economic centers of influence. This limits potential misclassification of rurality. Although the extent of assumption and possible misclassification is unknown, we believe that the AMA Masterfile data are the most accurate and most complete data available. Moreover, the use of consistent methods in both the 2008 analysis[2] and current analysis permits helpful comparisons over time. We were also unable to account for the effect rural hospital closures have had on rural emergency physician density.

Finally, data are linked only to ACGME-associated training programs and ABMS. Despite multiple requests, and similar to our previous study,[2] we were unable to obtain identifiable data on board certification from the American Osteopathic Association. We know from other sources that there were 1,746 American Osteopathic Association diplomates with active certification in 2008 versus 3,530 diplomates in 2017.[21] We acknowledge that both the 2008 and 2020 results underestimate board certification statistics for osteopathic emergency physicians certified through the American Osteopathic Board of Emergency Medicine.[22]

Table 2. Comparison of emergency physicians in urban versus rural areas.

Characteristics	Urban, n=44,743, No. (%)	Large Rural, n=2,730, No. (%)	Small Rural, n=1,197, No. (%)
Demographics			
Median age (IQR), y	50 (41–61)	58 (47–67)	62 (51–68)
Age categories, y			
25–44	15,753 (35)	558 (20)	158 (13)
45–64	20,618 (46)	1,300 (48)	534 (45)
≥65	8,308 (19)	869 (32)	503 (42)
Female sex	12,819 (29)	551 (20)	223 (19)
International medical graduate	3,940 (9)	203 (7)	93 (8)
Geography			
US Census division			
New England	2,389 (5)	241 (9)	132 (11)
Mid Atlantic	5,710 (13)	172 (6)	49 (4)
East North Central	6,609 (15)	459 (17)	184 (15)
West North Central	2,397 (5)	250 (9)	125 (10)
South Atlantic	9,131 (21)	356 (13)	187 (16)
East South Central	2,014 (5)	244 (9)	143 (12)
West South Central	4,997 (11)	204 (7)	118 (10)
Mountain	3,519 (8)	466 (17)	168 (14)
Pacific	7,784 (17)	337 (12)	91 (8)
MSA population size			
≥1,000,000	31,467 (70)	109 (4)	1 (0.1)
250,000–999,999	8,047 (18)	49 (2)	1 (0.1)
100,000–249,999	3,400 (8)	47 (2)	0
<100,000	364 (0.8)	6 (0.2)	8 (0.7)
Unknown	1,465 (3)	2,519 (92)	1,187 (99)
Training			
Residency			
Emergency medicine	33,281 (74)	1431 (52)	440 (37)
Family medicine	2,800 (6)	489 (18)	343 (29)
Internal medicine	3,065 (7)	272 (10)	124 (10)
Pediatrics	995 (2)	50 (2)	18 (2)
Surgery	1,555 (3)	132 (5)	76 (6)
Internship only	669 (2)	97 (4)	44 (4)
Other residency	479 (1)	39 (1)	20 (2)
None	1,899 (4)	220 (8)	132 (11)
Years since medical training completed			
<5	5,577 (13)	173 (7)	50 (5)
5–9	6,600 (15)	262 (10)	81 (8)
10–19	12,370 (29)	551 (22)	173 (16)
≥20	18,296 (43)	1,524 (61)	761 (71)
ABMS board certification			
Emergency medicine	31,402 (70)	1,539 (56)	473 (40)
Other specialty	4,957 (11)	637 (23)	396 (33)
None	8,384 (19)	554 (20)	328 (27)
Primary specialty of emergency medicine	40,380 (90)	2,249 (82)	876 (73)

Table 3. Characteristics of emergency physicians by years since residency or fellowship graduation.

	Years Since Residency or Fellowship Graduation							
	0–4, n=5,808		5–9, n=6,960		10–19, n=13,131		≥20, n=20,637	
Characteristics	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**
Demographics								
Median age (IQR), y	5,808	34 (33–36)	6,954	39 (37–41)	13,103	46 (44–50)	20,632	63 (57–68)
Age categories, y								
25–44	5,684	98	6,300	91	4,244	32	0	
45–64	123	2	648	9	8,776	67	11,849	57
≥65	1	0.0	6	0.1	83	0.6	8,783	43
Female sex	2,102	36	2,668	38	4,361	33	3,992	19
International medical graduate	369	6	569	8	824	6	2,287	11
Geography								
US Census division								
New England	326	6	409	6	801	6	1,138	6
Mid Atlantic	786	14	819	12	1,611	12	2,427	12
East North Central	1,026	18	952	14	1,741	13	3,028	15
West North Central	349	6	405	6	744	6	1,112	5
South Atlantic	1,028	18	1,377	20	2,605	20	4,294	21
East South Central	250	4	300	4	583	4	1,161	6
West South Central	706	12	897	13	1,445	11	1,980	10
Mountain	470	8	646	9	1,094	8	1,776	9
Pacific	849	15	1,123	16	2,445	19	3,591	18
MSA population size								
≥1,000,000	4,096	71	4,799	69	9,123	69	12,317	60
250,000–999,999	1,038	18	1,127	16	1,978	15	3,566	17
100,000–249,999	350	6	480	7	866	7	1,570	8
<100,000	32	0.6	61	0.9	84	0.6	186	0.9
Unknown	292	5	493	7	1,080	8	2,998	15
Urban influence								
Urban	5,577	96	6,600	95	12,370	94	18,296	89
Large rural	173	3	262	4	551	4	1,524	7
Small rural	50	0.9	81	1	173	1	761	4
Training								
Residency								
Emergency medicine	5,774	99	6,867	99	12,476	95	10,118	49
Family medicine	18	0.3	52	0.8	375	3	3,201	16
Internal medicine	9	0.2	11	0.2	125	1	3,322	16
Pediatrics	6	0.1	24	0.3	88	0.7	947	5
Surgery	1	0.0	6	0.1	38	0.3	1,722	8
Internship only	0		0		12	0.1	804	4
Other residency	0		0		17	0.1	523	3
ABMS board certification								
Emergency medicine	1,338	23	6,374	92	11,815	90	13,461	65
Other specialty	338	6	121	2	570	4	4,840	23
None	4,132	71	465	7	746	6	2,336	11
Primary specialty of emergency medicine	5,795	99.8	6,915	99	12,759	97	16,254	79

The table excludes 2,299 (5%) individuals because of no previous residency training (n=2,298) or no listed graduation year (n=1).

Table 4. Number of emergency medicine–trained or emergency medicine board-certified emergency physicians per 100,000 population.

	2020, n=48,835			2008,* n=39,061			Change (2020 Minus 2008), n=9,774		
	No. Emergency Physicians per 100,000			No. Emergency Physicians per 100,000			No. Emergency Physicians per 100,000		
	Emergency Medicine Board Certified	Emergency Medicine Trained or Emergency Medicine Board Certified	All Emergency Physicians	Emergency Medicine Board Certified	Emergency Medicine Trained or Emergency Medicine Board Certified	All Emergency Physicians	Emergency Medicine Board Certified	Emergency Medicine Trained or Emergency Medicine Board Certified	All Emergency Physicians
Total	10.2	12.1	14.9	7.3	8.8	12.8	2.9	3.3	2.1
US Census division									
New England	13.8	15.9	18.6	9.7	11.6	16	4.1	4.3	2.6
Mid Atlantic	9.8	11.9	14.4	7.0	9.0	12.9	2.8	2.9	1.5
East North Central	10.2	12.5	15.5	7.6	9.3	13.4	2.6	3.2	2.1
West North Central	8.1	9.7	13.0	5.6	6.8	10.8	2.5	2.9	2.2
South Atlantic	10.3	12.1	14.8	7.7	9.2	13.2	2.6	2.9	1.6
East South Central	6.9	8.3	12.6	5.2	6.2	11.2	1.7	2.1	1.4
West South Central	8.4	10.2	13.2	5.5	6.6	10.2	2.9	3.6	3.0
Mountain	12.3	14.3	16.9	8.4	9.8	13.8	3.9	4.5	3.1
Pacific	11.8	13.5	15.4	8.6	9.9	13.5	3.2	3.6	1.9
Urban influence									
Urban	11.2	13.3	15.9	8.5	10.3	14.5	2.7	3.0	1.4
Large rural	5.6	6.4	10.0	4.7	5.3	10.4	0.9	1.1	–0.4
Small rural	2.5	2.9	6.4	2.3	2.5	10.1	0.2	0.4	–3.7

*From our earlier study of the 2008 US emergency physician workforce.[2]

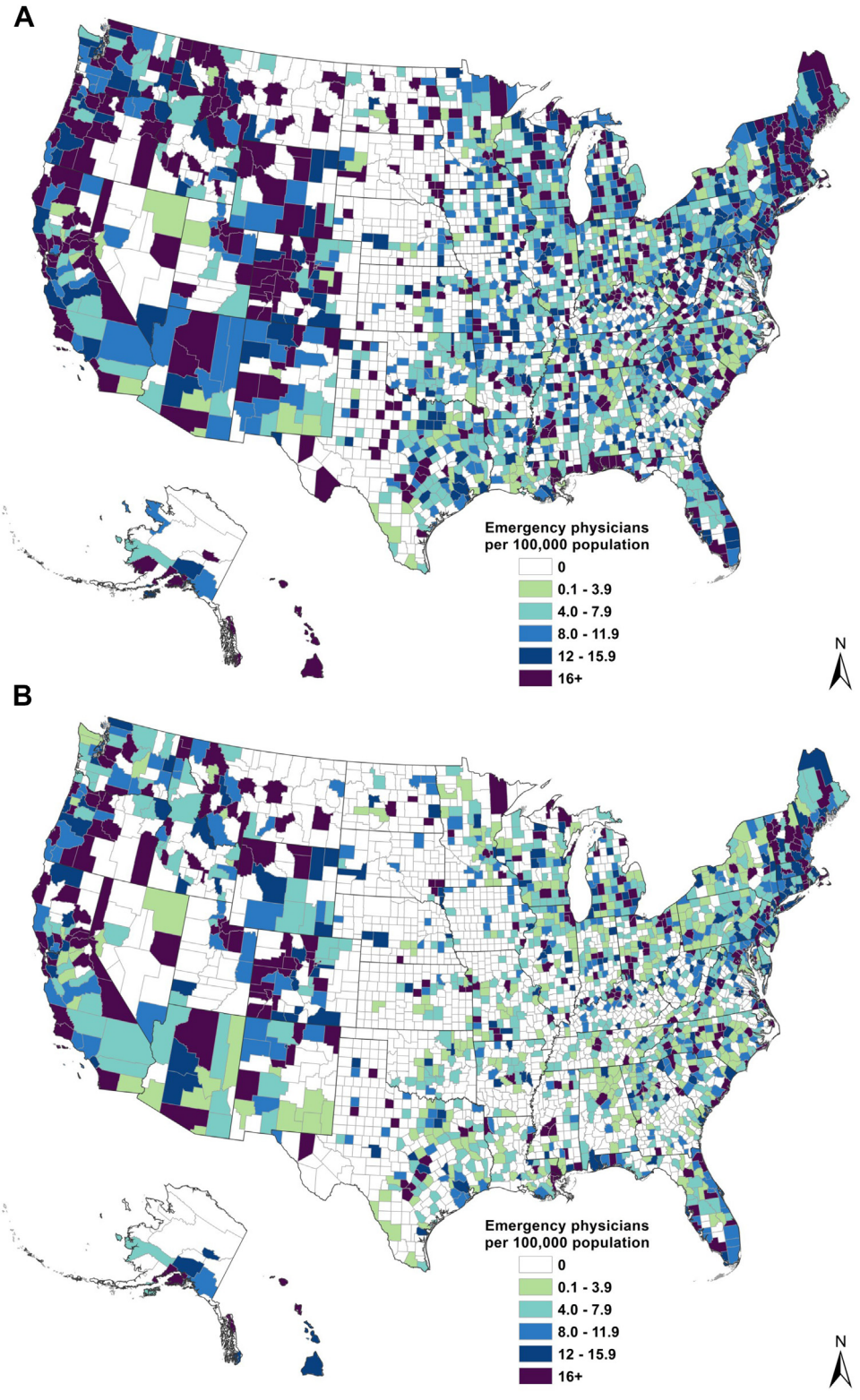

Figure 1. Emergency physician density per 100,000 population by county. *A,* All emergency physicians. *B,* Emergency medicine–trained or emergency medicine board-certified emergency physicians. Three hundred fifty-eight emergency physicians (1%) had missing county-level population data and could not be classified.

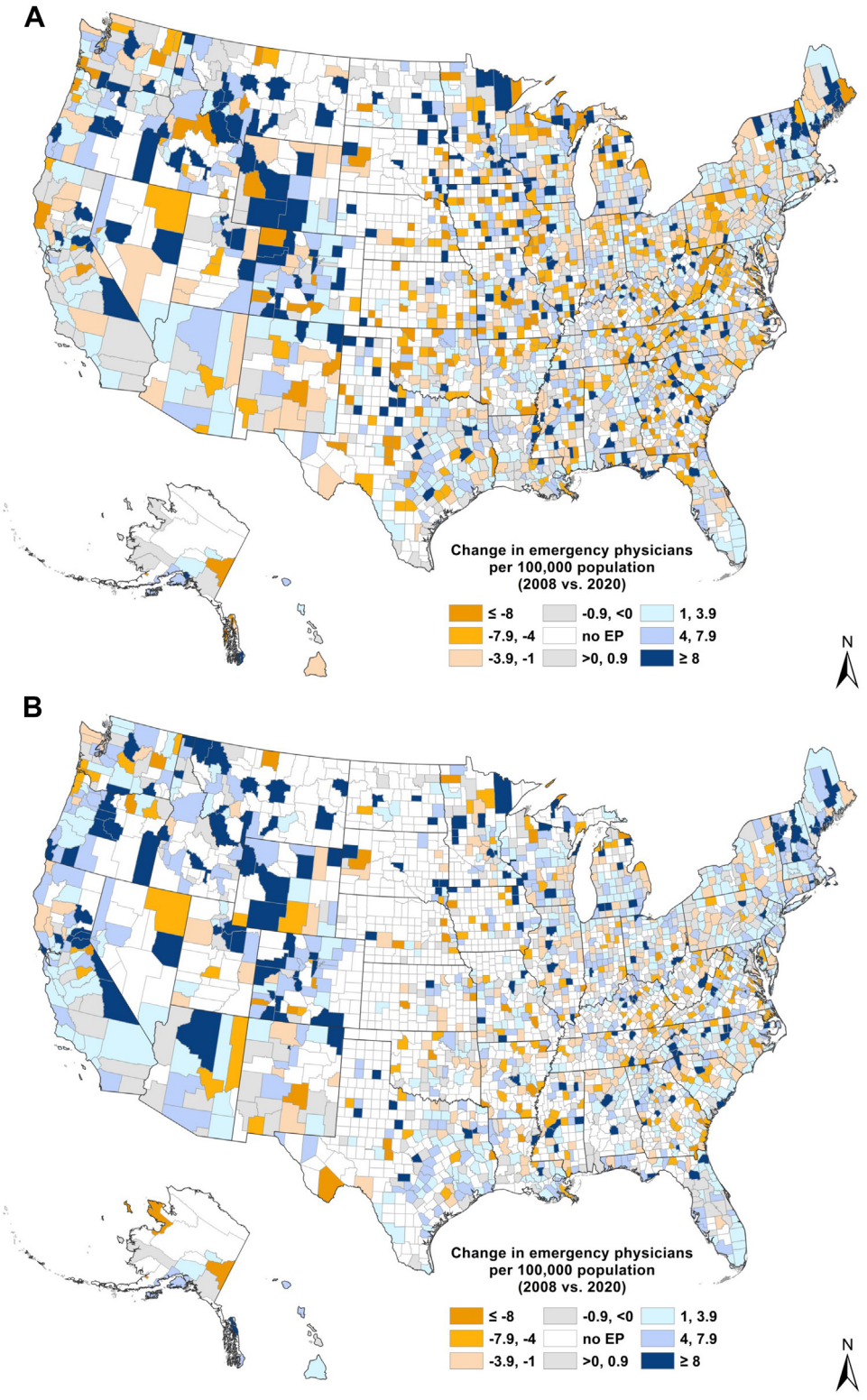

Figure 2. Change in emergency physician density per 100,000 population by county between 2008 and 2020. Orange denotes decreases over time, blue denotes increases over time, gray denotes minor changes (an increase or decrease of less than 1 per 100,000), and white denotes zero emergency physicians in either year. *A,* All emergency physicians. *B,* Emergency medicine–trained or emergency medicine board-certified emergency physicians.

DISCUSSION

By analyzing the AMA Physician Masterfile, the most complete available database on US physicians,[19] we report a population of 48,835 clinically active emergency physicians in 2020. This represents an overall increase of 9,774 physicians since our 2008 analysis, in which we reported 39,061 clinically active emergency physicians. These clinically active emergency physicians work in the context of recent statistics from the 2017 National Emergency Department Inventory–USA.[23] Specifically, emergency physicians are responsible for staffing 5,455 EDs with a median visit volume of 20,805 (IQR 8,000 to 43,689) and an annual ED visit volume of more than 159 million.

We found that most clinically active emergency physicians were emergency medicine trained or ABMS emergency medicine board certified, and that this has increased since our 2008 report. Specifically, the percentage of US emergency physicians who were neither emergency medicine trained nor ABMS emergency medicine board certified was 31% in 2008[2] and has decreased to 19% in 2020. Although a clear improvement from among the emergency physician population analyzed here, almost 1 in 5 emergency physicians today lacks emergency medicine training or ABMS emergency medicine board certification. These results are consistent with concerns raised by the National Academy of Medicine[24] and supported by our previous prediction modeling (based on 2005 data) that posited that the supply (and distribution) of emergency medicine board-certified physicians would not meet ED staffing demands for decades.[6] Ongoing concerns about our specialty's ability to ensure that "patients seeking emergency care are treated by board certified emergency physicians"[25] and the field's desire to more effectively deliver care in rural and underserved areas have prompted a renewed focus on this topic (eg, through the current national emergency medicine workforce study being conducted by ACEP).[10]

In the setting of an ongoing need for more emergency physicians, the ACGME reported 7,940 emergency medicine residents in a total of 247 programs in 2018 to 2019, of which 63 had initial accreditation.[26] In 2007 to 2008, there were 4,565 residents in 145 programs.[27] Emergency medicine has experienced the third largest 5-year change in accredited programs (after family medicine and internal medicine).[26] The increase was due in part to continued transition to a single accreditation system and incorporation of previously American Osteopathic Association–approved programs[26] but is also in the setting of new residencies supported by national contract management groups. This expansion of residencies has unclear long-term implications, although it does parallel an ongoing, demonstrated need for additional emergency medicine–trained physicians. Future efforts by our group will be directed toward better understanding the emergency medicine resident population.

Consistent with our primary hypothesis, we identified a decrease in emergency physicians in rural areas since our 2008 report.[2] Per 100,000 US population in 2020, we found a decline for both large rural (–0.4) and small rural (–3.7) emergency physician densities. In 2008, we reported that 7.6% and 3.3% of emergency physicians practice in large and small rural areas, respectively; in 2020, the corresponding values were 5.6% and 2.5%. We also found that, compared with their urban counterparts, physicians in large and small rural EDs are older (median age 58 and 62 years, respectively) and nearing the US retirement age. This finding is more pronounced than what we reported about in 2008, in which the median age was 54 and 56 years, respectively.[2] These emergency physicians are also far less likely to be ABMS emergency medicine board certified. The population density of emergency physicians in rural areas, especially those who are emergency medicine trained or ABMS emergency medicine board certified, is much lower than in urban areas. Taken together, these findings suggest a population of emergency physicians who are poised to leave the workforce. As this older cadre of emergency physicians retires, and as newly trained emergency physicians predominate in more urban practice environments, large expanses of rural areas in the United States, which already are understaffed, will likely experience further critical shortages and be forced to find alternative models of staffing. This supports our previous prediction modeling suggesting an ongoing, unmet demand for emergency medicine residency–trained, emergency medicine board-certified physicians.[6] Future efforts by our group will be directed toward the creation of updated prediction models of the emergency physician workforce.

Given previous trends, we anticipate these rural emergency physician shortages will accelerate use of physician assistants and nurse practitioners, both in comanagement with physicians and in autonomous patient care,[13,28] and may encourage further uptake of either telemedicine[14,15] or urgent care centers for lower-acuity conditions[29] as EDs attempt to meet demand for emergency care in rural practice environments. The influence of recent legislation[11] that allows Medicare to reimburse residency training programs for time resident physicians spend at

designed critical access hospitals is not yet clear, but it will presumably increase the presence of emergency medicine trainees in rural areas, which may help. Previous work demonstrates an interest in rural emergency electives among many emergency medicine residents,[30,31] which could increase recruitment of emergency medicine–trained physicians to rural areas. We anticipate that addressing the rural emergency physician shortage will require a multipronged approach and will likely need to include financial incentive such as student loan repayment[32] or increased salaries for emergency physicians working in rural areas.

With regard to our second hypothesis, we found that only 28% of all US emergency physicians were women. Although this reflects a modest increase from 22% in 2008,[2] the 2020 result was lower than we had anticipated. However, the finding does coincide with a recently noted decline in the percentage of women among emergency medicine residency graduates.[33] Compared with their urban counterparts, emergency physicians in typically rural areas were also less likely to be women, even more so than we had previously reported. The 2020 proportion of women aligns with a recent study demonstrating that only 28% of academic emergency medicine faculty are women[16] and occurs despite many previous calls for increased equity, inclusion, and diversity within the emergency physician workforce.[17,34] Thus, female physicians remain grossly underrepresented in emergency medicine and current efforts aimed at promoting sex representation are insufficient. The topic merits further research both on the scope of the problem and on the effectiveness of currently proposed solutions.

In summary, we analyzed the most comprehensive available resource to better understand all clinically active emergency physicians in the United States. We report a population of predominantly male emergency physicians (given the less than anticipated increase in female emergency physicians since 2008) who are more likely to be emergency medicine trained and ABMS emergency medicine board certified, but concurrently are less likely to practice in rural areas that are already understaffed. Looking ahead, as the current population of rural emergency physicians leaves the workforce, we expect more profound "emergency physician deserts" in many underserved parts of the country. These deserts are likely to be increasingly staffed through alternative models, possibly by increased use of physician assistants and nurse practitioners or telemedicine. Given the current US emergency physician workforce and observed trends during the past decade, the implications for our specialty and our patients are profound.

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REFERENCES

1. American College of Emergency Physicians. Policy statement on emergency medicine workforce. Available at: https://www.acep.org/globalassets/new-pdfs/policy-statements/emergency.medicine.workforce.pdf. Accessed November 4, 2019.
2. Ginde AA, Sullivan AF, Camargo CA. National study of the emergency physician workforce, 2008. *Ann Emerg Med*. 2009;54:349-359.
3. Hall MK, Burns K, Carius M, et al. State of the national emergency department workforce: who provides care where? *Ann Emerg Med*. 2018;72:302-307.
4. Epstein SK, Burstein JL, Case RB, et al. The national report card on the state of emergency medicine: evaluating the emergency care environment state by state 2009 edition. *Ann Emerg Med*. 2009;53:4-148.
5. Hirshon JM, Alson RL, Blunk D, et al. America's emergency care environment, a state-by-state report card: 2014 edition. *Ann Emerg Med*. 2014;63:97-242.
6. Camargo CA Jr, Ginde AA, Singer AH, et al. Assessment of emergency physician workforce needs in the United States, 2005. *Acad Emerg Med*. 2008;15:1317-1320.

7. Moorhead JC, Gallery ME, Mannie T, et al. A study of workforce in emergency medicine. *Ann Emerg Med*. 1998;31:595-607.
8. Moorhead JC, Gallery ME, Hirshkoren C, et al. A study of the workforce in emergency medicine: 1999. *Ann Emerg Med*. 2002;40:3-15.
9. Counselman FL, Marco CA, Patrick VC, et al. A study of the workforce in emergency medicine: 2007. *Am J Emerg Med*. 2009;27:691-700.
10. American College of Emergency Physicians. Emergency Medicine Workforce Taskforce, 2019. Available at: https://www.acep.org/how-we-serve/committee/task-forces/emergency-medicine-workforce-task-force/. Accessed November 4, 2019.
11. Centers for Medicare & Medicaid Services. HHS. Final ruling on Medical Program CMS-1716-F; 84 FR 42044 effective October 1, 2019. Available at: https://www.federalregister.gov/d/2019-16762. Accessed November 4, 2019.
12. Nelson LS, Keim SM, Beeson MS, et al. American Board of Emergency Medicine report on residency and fellowship training information (2018-2019). *Ann Emerg Med*. 2019;73:524-541.
13. Brown DF, Sullivan AF, Espinola JA, et al. Continued rise in the use of mid-level providers in US emergency departments, 1993-2009. *Int J Emerg Med*. 2012;21:1-5.
14. Zachrison KS, Boggs KM, Hayden E, et al. A national survey of telemedicine use by US emergency departments. *J Telemed Telecare*. 2020;26:278-284.
15. Zachrison KS, Boggs KM, Hayden E, et al. Understanding barriers to telemedicine implementation in rural emergency departments. *Ann Emerg Med*. 2020;75:392-399.
16. Bennett CL, Raja A, Kapoor N, et al. Sex differences in faculty rank among academic emergency physicians in the United States. *Acad Emerg Med*. 2019;26:281-285.
17. Madsen TE, Linden JA, Rounds K, et al. Current status of gender and racial/ethnic disparities among academic emergency medicine physicians. *Acad Emerg Med*. 2017;24:1182-1192.
18. Ginde AA, Sullivan AF, Camargo CA. Attrition from emergency medicine clinical practice in the United States. *Ann Emerg Med*. 2010;56:166-171.
19. American Medical Association. AMA Physician Masterfile. Available at: https://www.ama-assn.org/practice-management/masterfile/ama-physician-masterfile. Accessed November 4, 2019.
20. US Department of Agriculture. Urban Influence Codes, 2013. Available at: https://www.ers.usda.gov/data-products/urban-influence-codes.aspx. Accessed November 4, 2019.
21. Wieting JM, Williams DG, Kelly KA, et al. Appendix 2: American Osteopathic Association specialty board certification. *J Am Osteopath Assoc*. 2018;118:275-279.
22. American Osteopathic Board of Emergency Medicine. Available at: https://certification.osteopathic.org/emergency-medicine/. Accessed November 1, 2019.
23. Emergency Medicine Network. 2016 National Emergency Department Inventory–USA. Available at: http://www.emnet-usa.org/research/studies/nedi/nedi2017/usa/. Accessed November 4, 2019.
24. Institute of Medicine Committee on the Future of Emergency Care in the US Health System. *Hospital-Based Emergency Care: At the Breaking Point*. Washington, DC: National Academies Press; 2006.
25. American College of Emergency Physicians. Mission, vision, and values. https://www.acep.org/what-we-believe/mission-vision–values/. Accessed November 4, 2019.
26. Accreditation Council on Graduate Medical Education. ACGME Data Book, 2018-2019. Available at: https://www.acgme.org/About-Us/Publications-and-Resources/Graduate-Medical-Education-Data-Resource-Book. Accessed November 4, 2019.
27. Accreditation Council on Graduate Medical Education. ACGME Data Book, 2007-2008. Available at: https://www.acgme.org/About-Us/Publications-and-Resources/Graduate-Medical-Education-Data-Resource-Book. Accessed November 4, 2019.
28. Sawyer BT, Ginde AA. Scope of practice and autonomy of physician assistants in rural versus urban emergency departments. *Acad Emerg Med*. 2014;21:520-525.
29. Carlson LC, Raja AS, Dworkis DA, et al. Impact of urgent care openings on emergency department visits to two academic medical centers within an integrated health care system. *Ann Emerg Med*. 2020;75:382-391.
30. Helland LC, Westfall JM, Camargo CA, et al. Motivations and barriers for recruitment of new emergency medicine residency graduates to rural emergency departments. *Ann Emerg Med*. 2010;65:668-673.
31. Talley BE, Ann Moore S, Camargo CA, et al. Availability and potential effect of rural rotations in emergency medicine residency programs. *Acad Emerg Med*. 2011;18:279-300.
32. Renner DM, Westfall JM, Wilroy LA, et al. The influence of loan repayment on rural healthcare provider recruitment and retention in Colorado. *Rural Remote Health*. 2010;10:1605.
33. Bennett CL, McDonald DA, Hurwitz S, et al. Changes in sex, race, and ethnic origin of American emergency medicine resident physicians from 2007-2017. *Acad Emerg Med*. 2019;26:331-334.
34. Choo EK, Kass D, Westergaard M, et al. The development of best practice recommendations to support the hiring, recruitment, and advancement of women physicians in emergency medicine. *Acad Emerg Med*. 2016;23:1203-1209.