

ORIGINAL RESEARCH

Emergency Medical Services

Trends in demographic and employment characteristics of US emergency medical technicians and paramedics, 2011–2019

Rebecca E. Cash PhD^{1,2} | Jonathan R. Powell MPA^{3,4} | Gregory A. Peters MD^{1,2,5} |
Scott A. Goldberg MD, MPH^{2,5} | Ashish R. Panchal MD, PhD^{3,4,6} |
Carlos A. Camargo Jr. MD, DrPH^{1,2}

¹Department of Emergency Medicine, Massachusetts General Hospital, Boston, Massachusetts, USA

²Harvard Medical School, Boston, Massachusetts, USA

³National Registry of Emergency Medical Technicians, Columbus, Ohio, USA

⁴Division of Epidemiology, The Ohio State University College of Public Health, Columbus, Ohio, USA

⁵Department of Emergency Medicine, Brigham & Women's Hospital, Boston, Massachusetts, USA

⁶Department of Emergency Medicine, The Ohio State University Wexner Medical Center, Columbus, Ohio, USA

Correspondence

Rebecca E. Cash, PhD, Department of
Emergency Medicine, Massachusetts General
Hospital, 125 Nashua Street, Suite 920,
Boston, MA 02114, USA.
Email: rcash@mgh.harvard.edu

Prior Presentations: An abstract of this work
was presented at the 2022 National
Association of EMS Physicians Annual Meeting
(San Diego, CA; January 12–15, 2022).

Twitter Handles: @CashRebeccaE, @jreadyd,
@EMS_Boston, @AshPanchalMD

Funding information

Massachusetts General Hospital Department
of Emergency Medicine Fellowship

Abstract

Background: Describing the US emergency medical services workforce is important to understand gaps in recruitment and retention and inform efforts to improve diversity. Our objective was to describe the characteristics and temporal trends of emergency medical technicians (EMTs) and paramedics in the United States.

Methods: We performed a repeated cross-sectional evaluation of US Census Bureau's American Community Survey 1-year Public Use Microdata Sample data sets from 2011–2019. We included respondents working as an EMT or paramedic. Survey-weighted descriptive statistics of demographic and employment characteristics were calculated. Trend analysis was conducted using joinpoint regression to estimate slope and annual percent change (APC).

Results: The total estimated number of EMTs and paramedics in the United States increased from 216,310 (95%CI 204,957–227,663) in 2011 to 289,830 (95%CI 276,918–302,743) in 2019 (APC 3.0%; 95%CI 1.4%, 4.7%). There was a slight increase in the proportion of females (2011, 31%; 2019, 35%). There was a significant decrease in proportion of non-Hispanic whites (2011, 80%; 2019, 72%; APC –1.5%; 95%CI –2.0%, –0.9%) with concurrent increases in other racial/ethnic groups (e.g., Hispanics, 2011, 10%; 2019, 13%). About half worked >40 hours per week, with little change over time. Between 15% and 18% lived and worked in different states, and about 40% traveled ≥30 minutes to their workplace.

Supervising Editor: Elizabeth Donnelly, PhD, MPH.

This is an open access article under the terms of the [Creative Commons Attribution-NonCommercial-NoDerivs](https://creativecommons.org/licenses/by-nc-nd/4.0/) License, which permits use and distribution in any medium, provided the original work is properly cited, the use is non-commercial and no modifications or adaptations are made.

© 2022 The Authors. *JACEP Open* published by Wiley Periodicals LLC on behalf of American College of Emergency Physicians.

Conclusions: The number of EMTs and paramedics actively working in EMS as their primary paid occupation has increased over time. However, there have been only modest changes in their demographic diversity.

KEYWORDS

diversity, emergency medical services, emergency medical technician, health equity, paramedic

1 | INTRODUCTION

1.1 | Background

Emergency medical services (EMS) personnel are a critical component of the overall emergency medical care system, providing lifesaving pre-hospital care and medical transportation for ill and injured people. Annually in the United States, EMS personnel respond to more than 27 million requests for 9-1-1 services each year.¹ Despite their importance, defining and measuring the EMS workforce providing this care has been challenging. Unlike many other health care occupations, there is no single, national database of all active EMS personnel. This lack of a national database of the EMS workforce continues despite calls for such a system in the 2011 *Emergency Medical Services Workforce Agenda for the Future*.² National certification, through the National Registry of Emergency Medical Technicians, serves as the most comprehensive proxy of the national workforce available today.^{3,4} However, only a handful of states require continued national certification to maintain state licensure or certification, and the workforce of active EMS personnel may not be accurately reflected in the National Registry's database.

1.2 | Importance

Understanding the magnitude and characteristics of the EMS workforce is critical for ensuring operational needs can be met and to improve workforce diversity. For many years EMS agencies have faced shortages of personnel, especially paramedics, and the COVID-19 pandemic has exacerbated these shortages.⁵⁻⁷ Prior descriptions of the magnitude of the EMS workforce have focused on single states,^{8,9} the nationally certified population,^{3,10-13} or have used surveys and state rosters^{14,15} with potential duplication of personnel. Estimates vary widely, with the workforce size ranging from approximately 261,000–855,000 people.^{15,16} Additionally, efforts to improve demographic diversity and strengthen the resilience of this occupational group have been hampered by the lack of information on EMS personnel. Prior research has suggested that there is an association between a diverse workplace and improved organizational resilience,¹⁷ as well as superior patient outcomes associated with more diverse teams of health care clinicians.¹⁸ Language discordance between EMS personnel and patients is also frequently cited as a barrier to providing high-quality prehospital care.^{19,20} Existing studies on the demographic diversity of

the EMS workforce are dated, incomplete, or focus on newly certified personnel.^{12,14,15}

1.3 | Goals of this investigation

Our objective was to describe the characteristics and temporal trends of United States. Emergency medical technicians (EMTs) and paramedics currently working in EMS as their primary paid occupation (ie, career EMTs and paramedics) in a nationally representative sample. We focused on trends in the overall number of EMTs and paramedics, sex and racial/ethnic diversity, and employment characteristics to determine temporal changes that would present opportunities to strengthen the EMS workforce.

2 | METHODS

2.1 | Study design, setting, and participants

This was a repeated, cross-sectional analysis of data from the American Community Survey (ACS) Public Use Microdata Sample (PUMS) files provided by the US Census Bureau.²¹ The ACS is a nationally representative, probability-based survey of approximately 3.5 million United States households each year with response rates ranging from 86% to 97% per year.^{22,23} The PUMS 1-year and 5-year files include individual record-level responses to the ACS that are used to calculate nationally representative estimates of the US population. Approximately 1% of the US population is surveyed and included in each 1-year PUMS file, with survey weights provided to reflect the complex survey sampling design. In this analysis, we used the 1-year files from 2011 to 2019.

In the primary analysis, we included all responses where the respondent indicated they were currently working as an EMT or paramedic. These 2 certification levels comprise the majority of the EMS workforce in the United States.^{3,15} We did not include emergency medical responders (EMRs) because the EMR level is not recognized as an EMS certification level by many states. EMRs often serve in roles such as firefighter, police officer, industrial safety team, or lifeguard.²⁴ The Massachusetts General Brigham institutional review board reviewed this study and deemed it non-human subjects research because of the de-identified nature of the publicly available data.

2.2 | Measurements

In the ACS, the respondent's primary paid occupation is categorized using the Census Occupation Code based on the Bureau of Labor Statistics Standard Occupational Classification (SOC) system. Respondents can select only 1 occupation. From 2011–2017, a single SOC code was used for both EMTs and paramedics (SOC code 29–2040).²⁵ Beginning in 2018, the SOC was revised to distinguish between those working as an EMT (SOC code 29–2042) and paramedic (SOC code 29–2043).²⁵ We assumed other state-specific EMS certification levels or advanced EMTs would self-identify as an EMT or paramedic.

We examined demographic and employment characteristics of respondents. Demographic characteristics included age, sex, race/ethnicity, educational attainment, language spoken at home (English only, Spanish, any other language), and location of residence. Employment characteristics included annual personal earnings, usual hours worked per week over the past 12 months, commuting time, and location of workplace. We inflation adjusted annual earnings to 2019 dollars. Usual hours worked was dichotomized in 2 ways to reflect common EMS shift schedules: ≤ 40 hours or > 40 hours, and ≤ 48 hours or > 48 hours. Commuting time was defined as the average time to commute one-way to the respondent's primary workplace. Finally, we examined both the state of residence and state of workplace to determine if the respondent lived and worked in different states.

2.3 | Analysis

In accordance with guidelines published by the US Census Bureau,²² all analyses used the provided weighting variables to calculate nationally representative estimates. We used replicate person weights with the successive difference replication method (ie, direct method) to calculate standard errors. We calculated descriptive statistics for demographic and employment characteristics of the EMS workforce and conducted a trend analysis using joinpoint regression.²⁶ Weighted least-squares regression models were fit to the aggregate, yearly data.²⁷ Based on established analytic guidelines for the minimum number of observations per joinpoint, we allowed for up to 1 inflection point using a Monte Carlo permutation method with Bonferroni adjustment to determine if there was a statistically significant change in slope at the $P < 0.05$ level.²⁶ For trends that were determined to be linear, we used log-linear models to estimate annual percent change (APC). For non-linear trends, we used a weighted average of the slope coefficients of the log-linear models to calculate a summary estimate, the average APC.²⁸

As a sensitivity analysis, we also included those respondents who reported their occupation as a firefighter (SOC code 33–2011) as an extended definition of the EMS workforce, acknowledging that many firefighters also have EMS certification and provide EMS care. Finally, using data from 2019, we compared the characteristics of EMTs and paramedics. Owing to the large, weighted sample size and likelihood of finding statistically significant results with little relevant differences, we chose to calculate the difference in means or

The Bottom Line

Characterizing the US emergency medical services workforce is important for system level planning. Using US Census data, the authors found that between 2011 and 2020, the number of persons reporting a primary profession as emergency medical technician or paramedic increased from 216,310 to 289,830. However, only modest changes in the demographic profile of the workforce were observed.

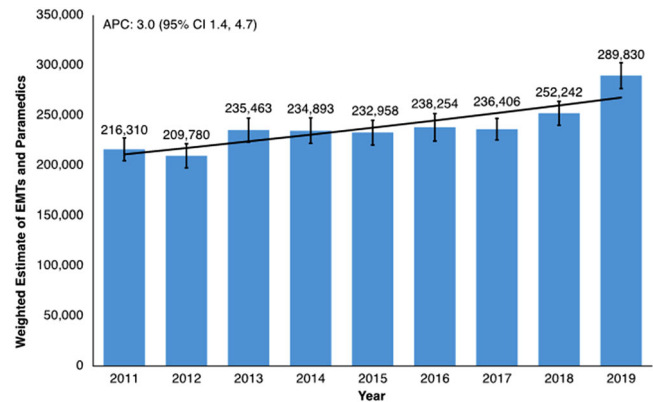


FIGURE 1 Estimated (weighted) number of careers EMTs and paramedics (blue) in the United States from 2011–2019 with modeled trend line (black). APC, annual percent change; CI, confidence interval; EMT, emergency medical technician

proportions and 95% confidence intervals (CI) for the difference, rather than conducting formal statistical testing. All analyses were conducted using Stata SE version 15.1 (StataCorp, LLC, College Station, Texas, USA) and the Joinpoint Regression Program, version 4.9.0 (Statistical Research and Applications Branch, National Cancer Institute).

3 | RESULTS

3.1 | Estimated number of EMTs and paramedics

In 2011, an unweighted total of 2085 respondents reported a primary paid occupation as an EMT or paramedic, representing a weighted estimate of 216,310 people (95%CI 204,957–227,663; Figure 1). In 2019, this increased to an unweighted frequency of 2841 respondents, representing an estimated 289,830 people (95% CI 276,918–302,743). There was an annual percent increase in the total number of EMTs and paramedics of 3.0% (95% CI 1.4%, 4.7%).

In a sensitivity analysis of the size of the EMS workforce that included firefighters, there was an unweighted total of 5242 respondents in 2011, representing a weighted estimate of 540,711 people (95% CI 520,098–561,324; Table S1). In 2019, this increased to an

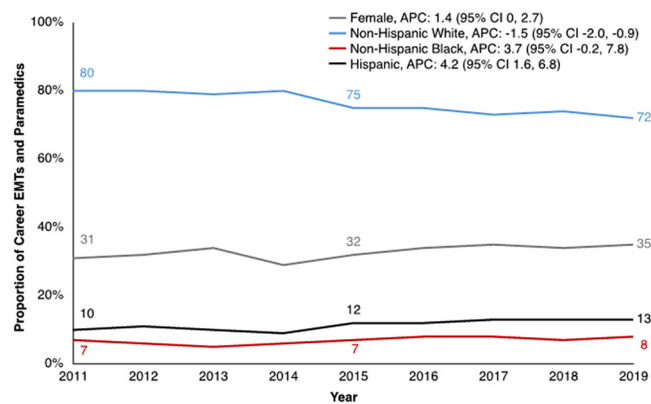


FIGURE 2 Change in sex and racial/ethnic diversity of career EMTs and paramedics in the United States from 2011–2019. APC, annual percent change; CI, confidence interval; EMT, emergency medical technician

unweighted frequency of 6620, representing a workforce size of 664,877 people (95% CI 644,437–685,318). There was a non-linear trend detected, with a change in trend in 2017. The average annual percent increase for the EMS workforce including firefighters was 2.4% (95% CI 0.3%, 4.5%).

3.2 | Demographic characteristics of EMTs and paramedics

There was minimal change in age of career EMTs and paramedics over time; in 2011, the mean age was 36 years versus 35 years in 2019 (Table 1). The proportion of females increased from a low of 29% in 2014 to a high of 35% in 2019 (APC 1.4%; 95% CI 0%, 2.7%; Table 1 and Figure 2). The majority of the EMS workforce was non-Hispanic White, though there was a statistically significant decrease over time from 80% in 2011 to 72% in 2019, with an annual percent decrease of 1.5% (95% CI -2.0%, -0.9%). There was a concurrent increase in the proportion of the EMTs and paramedics who identified as Hispanic (10% in 2011 to 13% in 2019) but little change in those identifying as non-Hispanic Black (from 7% in 2011 to 8% in 2019). When stratified by sex, there was a higher proportion of non-Hispanic White females in 2011 (82%) compared to males (79%; Table S1 and Figure S1). However, diversity increased more rapidly in females than in males over time. In 2019, 74% of males were non-Hispanic White (annual percent decrease of 1.1%) whereas 70% of females were non-Hispanic White (annual percent decrease of 2.0%). Similarly, there was a significant decrease in the proportion of EMS personnel who spoke only English at home (from 90% in 2011 to 87% in 2019; APC -0.4%; 95% CI -0.6%, -0.2%). Spanish was the most prevalent language other than English spoken at home with little change over time (approximately 6%–8% per year).

There was an increase in educational attainment for EMTs and paramedics over time (Table 1). In 2011, about half of EMS personnel reported having completed some college without obtaining a degree

and 18% had a high school diploma or less. By 2019, 2- and 4-year degrees increased from 16% to 21% (APC 2.1%; 95% CI 0.2%, 4.0%) and 14% to 18% (APC 3.1%; 95% CI 1.1%, 5.2%), respectively. Similarly, graduate degrees remained rare but doubled from 2% to 4%.

3.3 | Employment characteristics of EMTs and paramedics

There was a slight overall change in the annual personal earnings inflation adjusted to 2019 dollars (Table 1). In 2011, the mean earnings reported was \$45,261 which increased in 2019 to \$46,233 (APC 2.8%; 95% CI 1.2%, 4.4%). About half of EMTs and paramedics usually worked more than 40 hours per week and about 30% worked more than 48 hours per week, with no significant change over time. Most had a one-way commute to their primary workplace of less than 30 minutes, but this decreased from 61% in 2011 to 55% in 2019 (APC -1.1%; 95% CI -1.8%, -0.3%). Between 15% and 18% of EMTs and paramedics each year reported a primary work place in a different state than they lived.

3.4 | Comparison of EMTs and paramedics

In 2019, there were 1476 respondents reporting their primary occupation as an EMT, representing 152,758 people (95% CI 142,812–162,704; Table 2). There was 1365 paramedics, representing 137,072 people (95% CI 129,167–144,977). EMTs were younger than paramedics, with a mean age of 34 compared to 37 years. EMTs also had greater sex and racial/ethnic diversity than paramedics. Females represented 39% of EMTs compared to 30% of paramedics (difference 9%; 95% CI 5%, 13%) and 68% of EMTs were non-Hispanic White compared to 77% of paramedics (difference -9%; 95% CI -14%, -5%). Fewer EMTs spoke only English at home. Paramedics had higher levels of educational attainment, though having attended some college without obtaining a degree was most common for both groups (44% of EMTs, 40% of paramedics).

EMTs had significantly lower annual personal earnings compared to paramedics (mean difference -\$24,594; 95% CI -\$30,016 to -\$19,172). Working hours also differed, with 34% of EMTs usually working more than 40 hours per week compared to 61% of paramedics. Commutes were generally similar, though more EMTs worked in a different state from which they lived (18% of EMTs vs 12% of paramedics; difference 6%; 95% CI 2%, 10%).

4 | LIMITATIONS

There is no current enumerated list, database, or registry of all active EMS personnel in the United States. Although the ACS is considered a nationally representative survey, the estimate of the career EMS workforce from this data source is much lower than that provided by the National Registry of EMTs (approximately 400,000 EMS personnel)⁴

TABLE 1 Characteristics of sample by year, PUMS 2011–2019

Variable ^a	2011	2012	2013	2014	2015	2016	2017	2018	2019	APC (95% CI)
Unweighted n (95% CI)	2085	2040	2314	2262	2262	2292	2280	2430	2841	
Age (years), mean (95% CI)	36 (35, 36)	36 (35, 36)	35 (35, 36)	36 (35, 36)	36 (35, 37)	36 (35, 36)	37 (36, 37)	35 (35, 36)	35 (35, 36)	
Sex, % (95% CI)										
Male	69 (66, 72)	68 (66, 70)	66 (64, 69)	71 (68, 73)	68 (66, 71)	66 (63, 68)	65 (63, 68)	66 (64, 69)	65 (63, 67)	-0.7 (-1.4, 0)
Female	31 (28, 34)	32 (30, 34)	34 (31, 36)	29 (27, 32)	32 (29, 34)	34 (32, 37)	35 (32, 37)	34 (31, 36)	35 (33, 37)	1.4 (0, 2.7)
Race/ethnicity, % (95% CI)										
Non-Hispanic White	80 (78, 83)	80 (78, 83)	79 (77, 82)	80 (78, 82)	75 (73, 78)	75 (73, 77)	73 (71, 76)	74 (71, 76)	72 (70, 75)	-1.5 (-2.0, -0.9)
Non-Hispanic Black	7 (5, 8)	6 (4, 7)	5 (4, 7)	6 (5, 8)	7 (6, 9)	8 (6, 9)	8 (6, 10)	7 (5, 8)	8 (6, 9)	3.7 (-0.2, 7.8)
Hispanic	10 (9, 12)	11 (9, 12)	10 (9, 12)	9 (7, 10)	12 (10, 14)	12 (11, 14)	13 (11, 15)	13 (11, 14)	13 (11, 14)	4.2 (1.6, 6.8)
Non-Hispanic other ^b	2 (1, 2)	2 (1, 3)	3 (2, 4)	3 (2, 4)	3 (2, 4)	3 (2, 4)	4 (3, 4)	4 (3, 5)	5 (4, 6)	1.2 (8.0, 14.5)
Multiracial	1 (1, 2)	2 (1, 2)	2 (1, 3)	2 (1, 3)	2 (1, 3)	2 (1, 3)	2 (1, 3)	3 (2, 3)	2 (2, 3)	4.9 (-1.5, 11.6)
Education level, % (95% CI)										
High school or less	18 (16, 21)	15 (13, 17)	16 (14, 18)	16 (14, 17)	15 (13, 17)	15 (13, 17)	16 (14, 18)	16 (14, 18)	14 (12, 16)	-1.4 (-3.3, 0.4)
Some college	49 (47, 52)	49 (46, 52)	48 (45, 50)	45 (43, 48)	45 (43, 48)	44 (41, 47)	45 (42, 48)	44 (41, 47)	42 (40, 45)	-1.8 (-2.5, -1.2)
2-year degree	16 (14, 18)	19 (17, 21)	20 (19, 22)	20 (18, 22)	21 (18, 23)	20 (18, 22)	22 (20, 24)	20 (18, 22)	21 (19, 23)	2.1 (0.2, 4.0)
4-year degree	14 (12, 16)	14 (13, 16)	14 (12, 16)	16 (14, 19)	16 (14, 18)	18 (16, 20)	15 (13, 17)	17 (15, 18)	18 (16, 20)	3.1 (1.1, 5.2)
Graduate degree	2 (1, 3)	2 (1, 3)	2 (1, 2)	2 (1, 3)	3 (2, 4)	3 (2, 3)	3 (2, 4)	3 (2, 4)	4 (4, 5)	9.5 (5.6, 13.6)
Language spoken at home, % (95% CI)										
English only	90 (89-92)	90 (88-91)	89 (87-90)	89 (87-90)	88 (86-90)	89 (87-90)	89 (87-90)	87 (86-89)	87 (86-89)	-0.4 (-0.6, -0.2)
Spanish	6 (5-8)	6 (5-8)	7 (6-9)	6 (5-8)	8 (6-9)	8 (6-9)	7 (6-9)	8 (7-10)	7 (6-9)	3.8 (1.1, 6.6)
Any other language	3 (2-4)	4 (3-5)	4 (3-5)	4 (3-5)	4 (3-5)	4 (3-4)	4 (3-5)	4 (4-5)	5 (4-6)	3.6 (0.8, 6.6)
Annual personal earnings (\$US) ^c , mean (95% CI)	\$45,261 (43,132, 47,390)	\$41,197 (39,298, 43,097)	\$40,790 (39,179, 42,401)	\$44,082 (41,512, 46,652)	\$41,955 (39,499, 44,411)	\$42,858 (40,835, 44,881)	\$42,146 (40,237, 44,054)	\$42,653 (40,495, 44,810)	\$46,233 (43,580, 48,886)	2.8 (1.2, 4.4)
Usual work week > 40 hours, % (95% CI)	49 (45, 52)	49 (46, 51)	46 (44, 49)	48 (45, 50)	49 (46, 52)	50 (47, 53)	49 (47, 51)	51 (49, 53)	47 (44, 49)	0.4 (-0.7, 1.4)
Usual work week > 48 hours, % (95% CI)	32 (29, 35)	29 (26, 32)	28 (26, 31)	28 (26, 31)	31 (28, 34)	32 (29, 35)	29 (26, 32)	32 (30, 34)	28 (25, 30)	0.1 (-1.9, 2.2)
Commuting time (1 way), % (95% CI)										
0–29 minutes	61 (58, 63)	58 (55, 61)	56 (53, 59)	59 (56, 61)	56 (53, 59)	58 (56, 61)	55 (52, 59)	55 (52, 57)	55 (53, 58)	-1.1 (-1.8, -0.3)
30–59 minutes	30 (27, 32)	31 (29, 34)	33 (31, 36)	32 (29, 35)	32 (30, 35)	31 (28, 33)	33 (30, 36)	33 (31, 36)	33 (31, 36)	0.9 (0, 1.7)
60 or more minutes	10 (8, 12)	11 (9, 13)	11 (9, 12)	10 (8, 11)	11 (10, 13)	11 (9, 13)	12 (10, 13)	12 (10, 14)	11 (9, 13)	1.5 (-0.2, 3.3)
Live/work in different state	16 (14, 18)	16 (14, 19)	18 (16, 20)	16 (14, 19)	18 (16, 20)	15 (14, 17)	16 (14, 17)	18 (15, 20)	15 (13, 17)	-0.4 (-2.9, 2.1)

Abbreviations: APC, annual percent change; CI, confidence interval; PUMS, Public Use Microdata Sample.

^a% (95% CI) presented unless otherwise specified. All estimates are weighted unless specified.^bOther race/ethnicity includes non-Hispanic American Indian or Alaskan Native, Asian, and Native Hawaiian or Pacific Islander.^cInflation adjusted to 2019 dollars.

TABLE 2 Comparison of career EMT and paramedic characteristics, PUMS 2019

Variable ^a	EMT	Paramedic	Difference (95% CI)
Unweighted n	1476	1365	
Weighted n (95% CI)	152,758 (142,812, 162,704)	137,072 (129,167, 144,977)	15,686 (3192, 28,180)
Age (years), mean (95% CI)	34 (33, 34)	37 (37, 38)	-4 (-5, -3)
Female sex, % (95% CI)	39 (36, 42)	30 (27, 33)	9 (5, 13)
Race/ethnicity, % (95% CI)			
Non-Hispanic White	68 (65, 71)	77 (74, 81)	-9 (-14, -5)
Non-Hispanic Black	11 (8, 13)	5 (3, 6)	6 (3, 9)
Hispanic	13 (11, 16)	12 (9, 14)	2 (-2, 5)
Non-Hispanic other ^b	5 (4, 7)	4 (3, 5)	1 (-0.9, 3)
Multiracial	3 (2, 4)	2 (1, 3)	0.8 (-0.5, 2)
Education level, % (95% CI)			
High school or less	17 (15, 20)	10 (8, 13)	7 (4, 10)
Some college	44 (41, 48)	40 (37, 44)	4 (-0.5, 8)
2-year degree	17 (15, 20)	26 (23, 29)	-8 (-12, -5)
4-year degree	18 (16, 20)	18 (16, 21)	-0.3 (-4, 3)
Graduate degree	4 (2, 5)	6 (4, 7)	-2 (-4, -0.3)
Languages spoken at home, % (95% CI)			
English only	85 (83, 87)	90 (87, 92)	-4 (-8, -1)
Spanish	9 (7, 11)	6 (5, 8)	2 (-0.2, 5)
Any other language	6 (5, 7)	4 (3, 5)	2 (0.2, 4)
Annual personal earnings (\$US), mean (95% CI)	\$34,601 (\$32,104, \$54,320)	\$59,196 (\$37,099, \$64,071)	-\$24,594 (-\$30,016, -\$19,172)
Usual work week > 40 hours, % (95% CI)	34 (30, 37)	61 (57, 65)	-27 (-32, -22)
Usual work week > 48 hours, % (95% CI)	20 (17, 23)	36 (33, 39)	-16 (-21, -12)
Commuting time (1 way), % (95% CI)			
0-29 minutes	54 (50, 58)	56 (52, 60)	-2 (-8, 4)
30-59 minutes	35 (31, 38)	32 (29, 36)	2 (-2, 7)
60 or more minutes	11 (9, 14)	11 (9, 14)	0.1 (-4, 3)
Live/work in different state, % (95% CI)	18 (15, 21)	12 (10, 14)	6 (2, 10)

Abbreviations: CI, confidence interval; EMT, emergency medical technician; PUMS, Public Use Microdata Sample.

^a% (95% CI) presented unless otherwise specified. All estimates are weighted unless specified.

^bNon-Hispanic other race/ethnicity includes non-Hispanic American Indian or Alaskan Native, Asian, and Native Hawaiian or Pacific Islander.

or the National Association of State EMS Officials (approximately 855,000 EMS personnel),¹⁵ but it is similar to estimates from the US Bureau of Labor Statistics (approximately 261,000 EMS personnel).¹⁶ Therefore, we (and US Bureau of Labor Statistics) have likely undercounted the true number of people working as EMTs or paramedics. EMS personnel who hold a different primary occupation may not be included in these estimates. For example, those volunteering to do EMS work, working at level other than EMT or paramedic, firefighters who also provide EMS care, and those for whom their EMS job is a second job would not have been classified as an EMT or paramedic in ACS. To address this limitation, we extended the definition of the career EMS workforce in a sensitivity analysis to include firefighters, demonstrating that the magnitude of the estimated workforce was larger but the relative change in the workforce size was similar.

Estimates for specific characteristics may also be biased—for example, if the predominantly male occupation of firefighters were included in our primary analysis, the proportion of females EMTs and paramedics may have been even lower. Inclusion of firefighters in the definition of the EMS workforce is also problematic, as not all firefighters are required to hold an EMS certification or provide EMS care. We are likely underestimating the proportion of EMTs and paramedics who speak multiple languages, as language spoken at home may not indicate all languages in which an individual could communicate. We were also unable to account for EMTs and paramedics working for more than 1 EMS agency when examining characteristics such as commute time or work location. Ongoing efforts to define and measure the EMS workforce merit support so that future work to quantify and describe those providing EMS care are less biased.

5 | DISCUSSION

According to the ACS PUMS data, we found that the estimated number of career EMTs and paramedics have increased by about 3% per year, from 216,310 people in 2011 to 289,830 people 2019. Extending the definition to include firefighters resulted in a similar average annual increase (2.4% per year) but a more than doubling of the workforce size to 664,877 people in 2019. Among EMTs and paramedics, there have been modest increases in the proportion of females and those of diverse racial/ethnic backgrounds, though EMTs and paramedics remain predominantly non-Hispanic White and male. There were significant differences in the diversity of EMTs and paramedics, with greater sex and racial/ethnic disparities in the higher trained paramedics. Finally, the finding that more than one quarter of career EMTs and paramedics in 2019 reported working over 48 hours per week speaks to the pervasiveness of overtime and risk of burnout in EMS,^{29–31} raising concerns of the resilience of the workforce.

Previous estimates of the EMS workforce have used proxies of the national workforce or convenience samples. However, many of the reported characteristics of the workforce are reflected in the nationally representative estimates we have derived from US Census data. The 2020 *National EMS Assessment* from the National Association of State EMS Officials¹⁵ reported that the mean proportion of females across the 30 states with available data was 27.0% (range 1.0%–70.0%). In an analysis of currently working, nationally certified EMS personnel providing patient care from 2017–2019,³ about 24% were female. These estimates are similar but slightly lower than our estimate of 35% in 2019. In a sample of newly nationally certified EMS personnel in 2017, about 35% of EMTs and 23% of paramedics were female,¹² compared to our estimates of 39% and 30%, respectively, in 2019.

The lack of racial and ethnic diversity in the EMS workforce has also been previously reported. In the 18 states that reported race in the 2020 *National EMS Assessment*, the proportion of EMS personnel identifying as White ranged from 2.0% to 91.4% (mean 50.7%).¹⁵ About 85% of nationally certified EMS personnel providing patient care, 73% of newly nationally certified EMTs, and 81% of newly nationally certified paramedics were non-Hispanic White.^{3,12} These consistent findings demonstrate that the magnitude of disparities might differ depending on data source, but there is a continued need to improve the diversity and support efforts for inclusion of females and racial/ethnic minorities in the EMS workforce.

There has been recent controversy regarding required education for EMS personnel, such as a minimum requirement of an associate degree to become licensed or certified as a paramedic.^{24,32,33} Regardless, paramedic education has largely transitioned to higher education settings (eg, community colleges) since the requirement for program accreditation began in 2013, and more than half of paramedic programs culminate in a 2- or 4-year degree.³⁴ Many barriers to degree requirements persist, but educational attainment has been steadily increasing in EMTs and paramedics. If such degree requirements were instituted, about half of paramedics are estimated to have already obtained a 2-year degree or higher, and an additional 40% have completed some college-level coursework without earning a degree.

The COVID-19 pandemic has demonstrated the need for ensuring a robust and resilient EMS workforce; however, there is no agreed upon method to counting the EMS workforce.^{2,4,15} Basing workforce estimates on state or agency rosters may potentially overcount the many EMS personnel who hold multiple state certifications or work for multiple EMS agencies.²⁹ Our approach focusing on those with a primary paid occupation of EMT or paramedic likely fails to capture the estimated 13% of the workforce that holds only an unpaid, volunteer job in EMS.¹³ Thus, these estimates represent an imperfect description of the active EMS workforce despite using the most nationally representative data that are currently available.

In summary, the number of career EMTs and paramedics in the United States has increased about 3% per year from 2011 to 2019. Diversity of the workforce has slightly improved over time, but there remain opportunities to continue to diversify the predominately non-Hispanic White male occupation. Funding research to better define and describe the EMS workforce on a state and national level is necessary to promote a robust and resilient EMS workforce in the United States.

ACKNOWLEDGMENTS

This work was supported by the Massachusetts General Hospital Department of Emergency Medicine Fellowship.

CONFLICTS OF INTEREST

None.

AUTHOR CONTRIBUTIONS

Rebecca E. Cash and Carlos A. Camargo conceived the study and obtained research funding. Rebecca E. Cash acquired and analyzed the data. Rebecca E. Cash, Jonathan R. Powell, Gregory A. Peters, Scott A. Goldberg, Ashish R. Panchal, and Carlos A. Camargo provided interpretation of the data. Rebecca E. Cash drafted the manuscript, and all authors contributed substantially to its revision. Rebecca E. Cash takes responsibility for the paper as a whole.

REFERENCES

1. National EMS Information System (NEMSIS) NHTSA Office of EMS Department of Transportation. 2019 National EMS Data Report; 2020. Accessed June 4, 2021. <https://nemsis.org/wp-content/uploads/2021/09/NEMSIS-Annual-Public-Data-Report-2019.pdf>
2. National Highway Traffic Safety Administration. *The Emergency Medical Services Workforce Agenda for the Future*. National Highway Traffic Safety Administration; 2011.
3. Rivard MK, Cash RE, Mercer CB, et al. Demography of the national emergency medical services workforce: a description of those providing patient care in the prehospital setting. *Prehosp Emerg Care*. 2021;25:213–220.
4. The National Registry of Emergency Medical Technicians. *2019 Annual Report*. National Registry of Emergency Medical Technicians; 2020.
5. American Ambulance Association. Congressional Letter on the EMS Workforce Shortage; 2021. Accessed January 31, 2022. <https://ambulance.org/2021/10/04/workforceshortage/>
6. Weixel N, Ambulance, EMT first responders face 'crippling workforce shortage'; 2021. Accessed January 31, 2022. <https://thehill.com/regulation/labor/577879-ambulance-emt-first-responders-face-crippling-workforce-shortage>

7. Snyder K, Ambulance services face national paramedic shortage; 2019. Accessed January 31, 2022. <https://www.ems1.com/paramedic-jobs-and-careers/articles/ambulance-services-face-national-paramedic-shortage-QAINB7yNEngfu5ID/>
8. Chng CL, Collins J, Eaddy S. A comparison of rural and urban emergency medical system (EMS) personnel: a Texas study. *Prehosp Disaster Med.* 2001;16:159-165.
9. Van Gelder CM, Frantz R, Bogucki S. Emergency medical services in Connecticut. *Prehosp Emerg Care.* 2005;9:219-226.
10. Bentley MA, Shoben A, Levine R. The demographics and education of emergency medical services (EMS) professionals: a national longitudinal investigation. *Prehosp Disaster Med.* 2016;31:S18-S29.
11. Crowe RP, Levine R, Eggerichs JJ, et al. A longitudinal description of emergency medical services professionals by race/ethnicity. *Prehosp Disaster Med.* 2016;31:S30-S69.
12. Crowe RP, Krebs W, Cash RE, et al. Females and minority racial/ethnic groups remain underrepresented in emergency medical services: a ten-year assessment, 2008–2017. *Prehosp Emerg Care.* 2020;24:180-187.
13. Cash RE, Rivard MK, Chrzan K, et al. Comparison of volunteer and paid EMS professionals in the United States. *Prehosp Emerg Care.* 2021;25:205-212.
14. Federal Interagency Committee on Emergency Medical Services. 2011 National EMS Assessment. U.S. Department of Transportation, National Highway Traffic Safety Administration; 2011.
15. National Association of State EMS Officials. 2020 National Emergency Medical Services Assessment; 2020. Accessed September 3, 2020. <https://nasemso.org/nasemso-document/2020-national-ems-assessment/>
16. Bureau of Labor Statistics US Department of Labor. Occupational Outlook Handbook, EMTs and Paramedics; 2021. Accessed December 24, 2021. <https://www.bls.gov/ooh/healthcare/emts-and-paramedics.htm>
17. Duchek S, Raetze S, Scheuch I. The role of diversity in organizational resilience: a theoretical framework. *Bus Res.* 2020;13:387-423.
18. Gomez LE, Bernet P. Diversity improves performance and outcomes. *J Natl Med Assoc.* 2019;111:383-392.
19. Tate RC. The need for more prehospital research on language barriers: a narrative review. *West J Emerg Med.* 2015;16:1094-1105.
20. Gutman CK, Lion KC, Fisher CL, et al. Breaking through barriers: the need for effective research to promote language-concordant communication as a facilitator of equitable emergency care. *J Am Coll Emerg Physicians Open.* 2022;3:e12639-e12639.
21. US Census Bureau. 2011–2019 American Community Survey 1-year Public Use Microdata Samples; 2020. Accessed July 2, 2021. [https://www2.census.gov/programs-surveys/acs/data/pums/](https://www2.census.gov/programs-surveys/acs/data/pums/www2.census.gov/programs-surveys/acs/data/pums/)
22. US Census Bureau. *Understanding and using the American Community Survey Public Use Microdata Sample files: what data users need to know.* U.S. Government Printing Office; 2020.
23. US Census Bureau. Response Rates; n.d. Accessed March 18, 2022. <https://www.census.gov/acs/www/methodology/sample-size-and-data-quality/response-rates/>
24. National Association of State EMS Officials. National EMS Scope of Practice Model 2019. National Highway Traffic Safety Administration, US Department of Transportation; 2019.
25. US Department of Labor. Standard Occupational Classification Manual. US Office of Management and Budget; 2018.
26. Kim HJ, Fay MP, Feuer EJ, et al. Permutation tests for joinpoint regression with applications to cancer rates. *Stat Med.* 2000;19:335-351.
27. Ingram DD, Malec DJ, Makuc DM, et al. National Center for Health Statistics guidelines for analysis of trends. *Vital Health Stat 2.* 2018;179:1-71.
28. Clegg LX, Hankey BF, Tiwari R, et al. Estimating average annual percent change in trend analysis. *Stat Med.* 2009;28:3670-3682.
29. Rivard MK, Cash RE, Chrzan K, et al. The impact of working overtime or multiple jobs in emergency medical services. *Prehosp Emerg Care.* 2019;24:1-8.
30. Crowe RP, Bower JK, Cash RE, et al. Association of burnout with workforce-reducing factors among EMS professionals. *Prehosp Emerg Care.* 2018;22:229-236.
31. Crowe R. *An assessment of burnout among emergency medical services professionals.* The Ohio State University; 2018.
32. Caffrey SM, Barnes LC, Olvera DJ. Joint position statement on degree requirements for paramedics. *Prehosp Emerg Care.* 2019;23:434-437.
33. Becker D. Is a Degree for EMS Providers Needed to Advance the Profession?; 2018. Accessed December 28, 2021. <https://www.iafc.org/iCHIEFS/iCHIEFS-article/is-a-degree-for-ems-providers-needed-to-advance-the-profession>
34. Cash RE, Clay CE, Leggio WJ, et al. Geographic distribution of accredited paramedic education programs in the United States. *Prehosp Emerg Care.* 2021;1-9. <https://doi.org/10.1080/10903127.2020.1856984>

AUTHOR BIOGRAPHY



Rebecca E. Cash, PhD, MPH, is an epidemiologist/biostatistician and faculty investigator at the Emergency Medicine Network (EMNet) at Massachusetts General Hospital and Assistant Professor of Emergency Medicine at Harvard Medical School in Boston, Massachusetts.

SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

How to cite this article: Cash RE, Powell JR, Peters GA, Goldberg SA, Panchal AR, Camargo CA. Trends in demographic and employment characteristics of US emergency medical technicians and paramedics, 2011–2019. *JACEP Open.* 2022;3:e12776. <https://doi.org/10.1002/emp2.12776>