Patient-centered medical home care access among adults with chronic conditions: National Estimates from the medical expenditure panel survey

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Abstract

Background: The Patient-Centered Medical Home (PCMH) model is a coordinated-care model that has served as a means to improve several chronic disease outcomes and reduce management costs. However, access to PCMH has not been explored among adults suffering from chronic conditions in the United States. Therefore, the aim of this study was to describe the changes in receiving PCMH among adults suffering from chronic conditions that occurred from 2010 through 2015 and to identify predisposing, enabling, and need factors associated with receiving a PCMH.

Methods: A cross-sectional analysis was conducted for adults with chronic conditions, using data from the 2010–2015 Medical Expenditure Panel Surveys (MEPS). Most common chronic conditions in the United States were identified by using the most recent data published by the Agency for Healthcare Research and Quality (AHRQ). The definition established by the AHRQ was used as the basis to determine whether respondents had access to PCMH. Multivariate logistic regression analyses were conducted to detect the association between the different variables and access to PCMH care.

Results: A total of 20,403 patients with chronic conditions were identified, representing 213.7 million U.S. lives. Approximately 19.7% of the patients were categorized as the PCMH group at baseline who met all the PCMH criteria defined in this paper. Overall, the percentage of adults with chronic conditions who received a PCMH decreased from 22.3% in 2010 to 17.8% in 2015. The multivariate analyses revealed that several subgroups, including individuals aged 66 and older, separated, insured by public insurance or uninsured, from low-income families, residing in the South or the West, and with poor health, were less likely to have access to PCMH.

Conclusion: Our findings showed strong insufficiencies in access to a PCMH between 2010 and 2015, potentially driven by many factors. Thus, more resources and efforts need to be devoted to reducing the barriers to PCMH care which may improve the overall health of Americans with chronic conditions.

Keywords: PCMH, MEPS, Care access, Chronic conditions

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Background
In the United States (U.S.), chronic conditions are among major causes of disability, mortality, and high medical costs [1–4]. It has been estimated that nearly half (50.9%) of U.S. adults live with at least one chronic condition, while 26% have two or more chronic conditions [5]. These conditions are responsible for 46% of all deaths among the U.S. population annually. Furthermore, the associated costs of these conditions are enormous and compromise the health of the U.S. [6] It was estimated that 86% of U.S. health care expenditures are correlated with the treatment of chronic conditions [7].

With the growing number of chronic conditions [8], the associated costs made by these conditions will continue to threaten the entire federal budget. Over the last three decades, several improvements have been implemented into U.S. law, but they all focused heavily on insurance reforms. These steps will not be adequate unless they are coupled with fundamental health care improvement efforts targeting the primary care practice [9]. To achieve this goal, more attention has been paid to replace the poorly coordinated, acute-focused, episodic primary care practice with a care that is continuous, comprehensive, patient-centered, coordinated, and accessible, and that provides communication and shared decision-making [10].

A recent, successful approach to improve the chronic care management is the patient-centered medical home (PCMH). The PCMH model is an innovative primary care delivery system that has served to improve the quality of care and to reduce medical costs. PCMH rearranges how primary care service is designed and delivered to the patients, with the prime focus on patient needs and preferences [11, 12]. Over the past few years, with the growing numbers of adults with chronic conditions, many healthcare stakeholders in the U.S. have adopted the PCMH to prevent or inhibit the progression of specific chronic conditions [12].

Several studies have demonstrated the ability of PCMH application in improving the primary care quality, safety, and efficiency across the U.S. Some studies, for example, have suggested that receiving PCMH care is associated with a decreased number of hospitalizations and emergency room visits [13–18]. Others have also identified improvements in the quality of health care after implementing PCMH care [17, 19, 20].

Despite growing evidence in the literature that supports the effectiveness of the PCMH in improving health care outcomes and reducing costs, the extent of the PCMH’s adoption in treating Americans with chronic conditions remains unknown. Therefore, the objective of this study is to describe, at the national level, the changes in receiving PCMH among adults suffering from chronic conditions and to identify predisposing, enabling, and need factors associated with accessing PCMH care.

Methods
Data source
We conducted an observational cross-sectional analysis of the 2010–2015 Medical Expenditure Panel Survey (MEPS). MEPS has been conducted by the Agency for Healthcare Research and Quality (AHRQ) since 1996. MEPS is a nationally representative population-based survey of health care utilization and expenditures of the U.S. civilian noninstitutionalized population. The MEPS utilizes an overlapping panel design in which participant data are collected over a series of five rounds of interviews spaced about five months apart. The collected data include patient demographics, access to health care, use of health services, health conditions, health status, and other data as well. Information regarding the data and a description of its survey design have been published previously [21].

Study population
Individuals aged 18 years and older who were diagnosed with at least one of the most common chronic conditions (i.e., hypertension, hyperlipidemia, mood disorders, diabetes, anxiety disorders, upper respiratory conditions, arthritis, asthma, or coronary artery disease) were identified. These conditions were considered to be chronic because they are long-lasting, cause diminished physical and/or mental capacity, or require long-term monitoring and medical interventions [22]. The prevalence of these conditions has been confirmed by the most recent data published by the Agency for Healthcare Research and Quality (AHRQ) [23]. According to MEPS documentation, patients in each year may be used as independent observations since each year in MEPS data is intended to be nationally representative [24].

Primary outcome
The primary outcome of our analysis was determining whether the individual was receiving care consistent with PCMH principles. PCMH care was defined using the provider-related questionnaires in MEPS. AHRQ’s definition classifying PCMH care was used to determine whether respondents had a PCMH [25]. The respondent was considered to be receiving PCMH if the patient received comprehensive, patient-centered, and accessible care. Table 1
shows the survey items used to define PCMH features based on AHRQ’s criteria. Similar questions had been used in high-quality research to detect access to PCMH care using the same data [26–29].

We determined that the care received by an individual was comprehensive care if the provider did all of the following: 1) usually asked about any medications prescribed by other doctors; 2) provided care for new health problems; 3) provided preventive care; 4) offered referrals to other health professionals; and 5) provided care for ongoing health problems. We considered the individual to have received patient-centered care if the provider 1) showed respect for the medical, traditional, and alternative treatments other doctors may give; 2) explained all healthcare options to the individual; and 3) asked the individual to help decide on treatment. We considered care to be accessible if the provider 1) was easy to contact by phone about a health problem during regular office hours; 2) offered night and weekend office hours; and 3) spoke the participant’s language or provided translation services.

### Independent variables

By using the Andersen Behavioral Model [30] in the current analysis, we examined the effects of person-specific predisposing, enabling, and need factors on having a PCMH. Predisposing factors investigated in this study included age, sex, race, marital status, and education years. Enabling factors consisted of health insurance, employment status, family income, and census region. (Appendix A contains a list of states composing each region with demographic data.) [31] Our assessments of health needs were based on self-rated health status variables (good/excellent or poor/fair).

### Data analysis

Descriptive statistics were used to characterize and evaluate changes in annual percentage for individuals who had PCMH over the six-year pooled dataset. The number of those individuals and their weighted percentage were calculated. Rao–Scott chi-square (a design-adjusted Pearson chi-square test) [32] analyses were performed to examine significant subgroup differences across strata for the two groups (having PCMH and having no PCMH). Adjusted multiple logistic regression analyses were then conducted to assess predictors associated with having a PCMH. In all analyses, we control for age, sex, race, marital status, education years, health insurance type, employment status, family income, chronic conditions, and calendar year. The c-statistic was calculated for each model to assess the model’s practical ability for correctly discriminating an individual outcome (PCMH/ No PCMH). A model demonstrates a good discrimination when the c-statistic is > 0.7 and outstanding when > 0.9.

To adjust for the complex multistage survey design and nonresponse, the estimates that are calculated from the data sample were multiplied by person-specific sampling weights provided within the original datasets of MEPS. All analyses were conducted with the use of SAS 9.4 software (SAS, Cary, NC).

### Results

A total of 20,403 patients with chronic conditions were identified, representing 213.7 million U.S. lives between 2010 and 2015. Approximately 19.7% of the patients were categorized as the PCMH group at baseline who met all the PCMH criteria defined in this study. The proportion of adults with chronic conditions who received a PCMH decreased from 22.3% in 2010 to 17.8% in 2015. However, in 2012 there was an increase in the number to 23.31% (Table 2).

Table 3 presents the results of the study population’s descriptive characteristics. Individuals aged between 41 and 65 were most likely to report that they had at least one chronic condition (49.5%). The overall sample was predominantly female (57.1%), white (79.5%), married...
Individuals who were living in a poor or low-income family were about 33% less likely to have a PCMH compared to those living with a family with a high income ($OR = 0.67$; CI: 0.57–0.78). Individuals living in the South and West were the most likely to not have access to PCMH compared to individuals living in the Midwest (South: $OR = 0.64$; CI: 0.52–0.78; West: $OR = 0.76$; CI: 0.61–0.96). The analyses also showed that individuals who reported having fair or poor health were negatively associated with having a PCMH compared to those who reported excellent or good general health ($OR = 0.65$; CI: 0.57–0.76). In this population, individuals with the chronic conditions hyperlipidemia, mood disorders, anxiety disorders, and arthritis were significantly associated with limited access to PCMH. However, individuals diagnosed with upper respiratory conditions were positively associated with having access to a PCMH. The c-statistics associated with these adjusted logistic models ranged between 0.71 and 0.86.

### Discussion

As the first national study to present the extent of access to PCMH among adults with chronic conditions and to identify potential drivers for its trends, this study attempts to address this gap in the literature. In this research, we examined the prevalence of adult patients with chronic conditions who accessed PCMH care over the six-year period in the U.S.

This study found only a small percentage of patients with chronic conditions had access to PCMH care with a decreasing trend during the study period. This may raise concerns as this vulnerable population typically requires comprehensive and continuous care by primary care providers to manage their chronic physical problems, especially when the number and complexity of care needs increase as the number of chronic conditions a patient has increases [33]. In terms of medical services, the average numbers of
Table 3 Baseline characteristics of individuals with chronic conditions, by PCMH access

| Characteristic                  | Total                  | Has a PCMH                | P     |                     |                     |
|--------------------------------|------------------------|---------------------------|-------|---------------------|---------------------|
|                                | N         | Weighted %   | N         | Weighted %   | N         | Weighted %   |
| (N = 20,403; Weighted N = 213,733,954) |           |              | (N = 16,443; Weighted N = 171,600,510) |          | (N = 3960; Weighted N = 42,133,444) |          |
| **Predisposing**               |           |              |           |              |           |              |
| Age (Years)                    |           |              |           |              |           |              |
| 19 to 40                       | 5423      | 26.3         | 4299      | 25.9         | 1124      | 28.3         |
| 41 to 65                       | 10,227    | 49.5         | 8213      | 49.2         | 2014      | 50.5         |
| 66 and older                   | 4753      | 24.1         | 3931      | 24.8         | 822       | 21.2         |
| Sex                            |           |              |           |              |           |              |
| Female                         | 12,196    | 57.1         | 9926      | 57.6         | 2270      | 55.2         |
| Male                           | 8207      | 42.8         | 6517      | 42.4         | 1690      | 44.7         |
| Race                           |           |              |           |              |           |              |
| Non-white                      | 6834      | 20.4         | 5485      | 20.5         | 1349      | 20.3         |
| White                          | 13,569    | 79.5         | 10,958    | 79.5         | 2611      | 79.6         |
| Marital Status                 |           |              |           |              |           |              |
| Married                        | 10,810    | 57.8         | 8508      | 56.7         | 2302      | 62.1         |
| Never Married                  | 4272      | 18.4         | 3465      | 18.5         | 807       | 18.3         |
| Separated                      | 5321      | 23.6         | 4470      | 24.7         | 851       | 19.5         |
| Education Years                |           |              |           |              |           |              |
| < 12 Years                     | 3505      | 14.1         | 2980      | 14.7         | 525       | 11.8         |
| 12 Years                       | 4764      | 26.2         | 3833      | 26.3         | 931       | 25.5         |
| > 12 Years                     | 8876      | 59.6         | 6956      | 58.9         | 1920      | 62.6         |
| Enabling                       |           |              |           |              |           |              |
| Health Insurance               |           |              |           |              |           |              |
| Any Private                    | 12,422    | 70.1         | 9708      | 68.5         | 2714      | 76.6         |
| Public Only                    | 6301      | 23.7         | 5319      | 25.04        | 982       | 18.2         |
| Uninsured                      | 1680      | 6.2          | 1416      | 6.4          | 264       | 5.2          |
| Employment Status              |           |              |           |              |           |              |
| Employed                       | 11,006    | 58.1         | 8656      | 57.01        | 2350      | 62.7         |
| Not employed                   | 9336      | 41.8         | 7734      | 42.9         | 1602      | 37.2         |
| Family Income Categorical      |           |              |           |              |           |              |
| High                           | 6515      | 42.2         | 5001      | 40.8         | 1514      | 47.6         |
| Middle                         | 5913      | 28.4         | 4747      | 28.3         | 1166      | 28.8         |
| Poor/ Low                      | 7975      | 29.4         | 6695      | 30.8         | 1280      | 23.6         |
| Census Region                  |           |              |           |              |           |              |
| Midwest                        | 4073      | 21.8         | 3175      | 20.9         | 898       | 25.5         |
| Northeast                      | 3355      | 17.8         | 2538      | 16.7         | 817       | 21.9         |
| South                          | 7872      | 38.2         | 6583      | 39.8         | 1289      | 31.8         |
| West                           | 5103      | 22.2         | 4147      | 22.5         | 956       | 20.8         |
| Healthcare Need                |           |              |           |              |           |              |
| Self-Reported Health           |           |              |           |              |           |              |
| Excellent/Good                 | 15,144    | 79.7         | 1,1957    | 78.4         | 3187      | 85.03        |
ambulatory and emergency department visits, inpatient stays, and number of prescribed medications were much higher among individuals who suffered from two or more chronic conditions compared to those with no chronic condition [34].

To better understand the characteristics and drivers of that observed trend in this population, we analyzed many factors and found several factors were associated with access to PCMH. A change in one of these factors can cause a change in the PCMH trend. The older adults (66 and older) were less likely than comparable younger adults [19 to 40] to have access to PCMH care. This finding is consistent with what has been reported by prior studies that older patients were less likely to receive PCMH care, although the number was not significant [38]. Our findings showed a positive association between a higher level of education and having access to PCMH care. A possible explanation of this finding is that better-educated individuals typically have a higher impact on changing their economic barriers to have full access to PCMH care [39].

All enabling factors were significantly associated with the probability of having PCMH access. Individuals with private insurance, employed, and living in a high-income family were found to report better access to PCMH. These findings are consistent with the literature in that access to PCMH is limited due to financial barriers [40]. Therefore, policy makers and health care providers should pay special attention to these barriers as they may negatively affect health-related outcomes, and the effect is substantial, especially among individuals with chronic diseases. Our findings suggest that expanding health insurance coverage is not an adequate approach to increase access to such care, but policy makers should also

### Table 3 Baseline characteristics of individuals with chronic conditions, by PCMH access (Continued)

| Characteristic                  | Total                                    | Has a PCMH                                      |  |
|--------------------------------|------------------------------------------|-------------------------------------------------|---|
|                                | N (20,403)                               | Weighted %                                     | P |
|                                | Weighted N (16,443)                      | Weighted %                                     |   |
|                                | Weighted N (3960)                        | Weighted %                                     |   |
|                                | (Weighted N = 213,733,954)               | (Weighted N = 171,600,510)                     |   |
|                                | (Weighted N = 42,133,444)               |                                                 |   |
| Fair/Poor                      | 4872                                    | 20.3                                           |  |
| Chronic Conditions             |                                         |                                                 |   |
| Hypertension                   | 10,207                                  | 47.4                                           | 0.001 |
|                                | 8350                                    | 48.1                                           | 1857 44.4 |
| Hyperlipidemia                 | 7732                                    | 37.8                                           | 0.0001 |
|                                | 6359                                    | 38.6                                           | 1373 34.5 |
| Mood Disorders                 | 3902                                    | 20.4                                           | 0.06 |
|                                | 3259                                    | 21.3                                           | 643 17.0 |
| Diabetes Mellitus              | 4474                                    | 19.1                                           | <.0001 |
|                                | 3673                                    | 19.4                                           | 801 17.9 |
| Anxiety Disorders              | 3589                                    | 19.4                                           | 0.002 |
|                                | 2976                                    | 19.9                                           | 613 17.1 |
| Upper Respiratory Conditions   | 7405                                    | 38.8                                           | 0.0005 |
|                                | 5888                                    | 38.03                                          | 1517 42.1 |
| Arthritis                      | 9250                                    | 44.9                                           | <.0001 |
|                                | 7682                                    | 46.3                                           | 1568 39.3 |
| Asthma                         | 2557                                    | 12.2                                           | 0.4 |
|                                | 2071                                    | 12.3                                           | 486 11.8 |
| Coronary Artery Disease        | 2197                                    | 10.8                                           |   |
|                                | 1787                                    | 11.05                                          | 410 9.8 |
| PCMH indicates Patient-Centered Medical Home
Table 4 Adjusted odds ratios of having access to PCMH care among adults with chronic conditions, 2010–2015

| Independent Variable     | Has a PCMH | OR\(^b\) | 95% CI | P     |
|--------------------------|------------|---------|-------|-------|
|                          | No         | Yes     |       |       |
| **Predisposing**         |            |         |       |       |
| Age (Years)              |            |         |       |       |
| 19 to 40                 | 4299       | 1124    | 1.00  |       |
| 41 to 65                 | 8213       | 2014    | 0.93  | 0.82  | 1.06  | 0.3  |
| 66 and older             | 3931       | 822     | 0.80  | 0.67  | 0.95  | 0.01 |
| **Sex**                  |            |         |       |       |
| Female                   | 9926       | 2270    | 1.00  |       |
| Male                     | 6517       | 1690    | 1.08  | 0.99  | 1.18  | 0.05 |
| **Race**                 |            |         |       |       |
| Non-white                | 5485       | 1349    | 1.00  |       |
| White                    | 10,958     | 2611    | 1.003 | 0.88  | 1.13  | 0.9  |
| **Marital Status**       |            |         |       |       |
| Married                  | 8508       | 2302    | 1.00  |       |
| Never Married            | 3465       | 807     | 0.87  | 0.75  | 1.01  | 0.06 |
| Separated                | 4470       | 851     | 0.78  | 0.67  | 0.91  | 0.001|
| **Education Years**      |            |         |       |       |
| < 12 Years               | 2980       | 525     | 1.00  |       |
| 12 Years                 | 3833       | 931     | 1.17  | 0.99  | 1.37  | 0.05 |
| > 12 Years               | 6956       | 1920    | 1.25  | 1.05  | 1.48  | 0.01 |
| **Enabling**             |            |         |       |       |
| Health Insurance         |            |         |       |       |
| Any Private              | 9708       | 2714    | 1.00  |       |
| Public Only              | 5319       | 982     | 0.71  | 0.63  | 0.81  | <.0001|
| Uninsured                | 1416       | 264     | 0.73  | 0.59  | 0.91  | 0.005|
| Employment Status        |            |         |       |       |
| Employed                 | 8656       | 2350    | 1.00  |       |
| Not employed             | 7734       | 1602    | 0.83  | 0.74  | 0.93  | 0.001|
| Family Income Categorical|            |         |       |       |
| High                     | 5001       | 1514    | 1.00  |       |
| Middle                   | 4747       | 1166    | 0.89  | 0.77  | 1.03  | 0.1  |
| Poor/ Low                | 6695       | 1280    | 0.67  | 0.57  | 0.78  | <.0001|
| Census Region            |            |         |       |       |
| Midwest                  | 3175       | 898     | 1.00  |       |
| Northeast                | 2538       | 817     | 1.11  | 0.89  | 1.39  | 0.3  |
| South                    | 6583       | 1289    | 0.64  | 0.52  | 0.78  | <.0001|
| West                     | 4147       | 956     | 0.76  | 0.61  | 0.96  | 0.02 |
| **Healthcare Need**      |            |         |       |       |
| Self-Reported Health     |            |         |       |       |
| Excellent/Good           | 1,1957     | 3187    | 1.00  |       |
| Fair/Poor                | 4157       | 715     | 0.65  | 0.56  | 0.76  | <.0001|
improve the provided public health insurance coverage for this population to have better access to PCMH care [41].

Clearly, census region is also important. Individuals who resided in the South or the West were less likely to have access to PCMH. This is not surprising because of the considerable difference in socioeconomic status of the majority of people who live in the South or the West compared to those in other regions. For example, a higher proportion of the population in the South and the West are racially Hispanic and Black [42]. There is evidence in many studies that these groups tend to not seek care for their chronic conditions [43–46]. Furthermore, compared to those in other regions, people in the South or the West are more likely to be uninsured, hence, less likely to have access to PCMH [47].

By looking closely at the chronic conditions, we identified a lack of uniform access to PCMH care across chronic conditions. We found that hyperlipidemia, mood disorders, anxiety disorders, and arthritis were significantly associated with limited access to PCMH, yet patients with upper respiratory conditions had better access to the care. A possible explanation is that upper respiratory conditions are minor and very common [48, 49]; thus, patients often seek the primary care provider’s help instead of the emergency department’s help, which results in a lower cost in managing their conditions.

Despite the uniqueness of the information provided by MEPS on individuals’ socioeconomic, access to care, and others in the U.S., there are limitations to the interpretation of the results of this study. First, as noted above, MEPS data provide information on the civilian, noninstitutionalized population, and hence exclude individuals living in institutions, such as individuals in nursing homes and long-term care hospitals who live with broad arrays of chronic conditions. Second, the definition of PCMH used in this study was based on patient responses, which might be subject to recall bias; thus, our estimates may underrepresent actual PCMH use. Despite the limitations, this study provides an important overview of the access to PCMH in a nationally representative general population sample of the U.S.

More effort is needed to facilitate access to PCMH among those with chronic conditions. In the PCMH care model, the primary care health professionals provide labor-intensive work behind the scenes, and it should be compensated accordingly because the total PCMH care fees ultimately demanded by physicians exceed the avoided expense for chronic conditions. This will increase access to PCMH, improve the quality of care, and reduce the overall cost associated with chronic conditions considerably [50, 51].

### Conclusion

Despite general agreement about the importance of PCMH, our findings showed strong deficiencies in access to PCMH between 2010 and 2015 to be potentially driven by many factors. These findings serve as a sign for more general problems with access to appropriate care. Moreover, reduced access to comprehensive and continuous services such as PCMH care may exacerbate chronic conditions, leading to more emergency department visits and hospitalizations that might have been preventable, as was reported in the literature. Thus, more resources and efforts need to be devoted to reduce barriers to PCMH care across the U.S., which may

### Table 4 Adjusted odds ratios of having access to PCMH care among adults with chronic conditions, 2010–2015a (Continued)

| Independent Variable | Has a PCMH | ORb  | 95% CI | P    |
|----------------------|------------|------|--------|------|
| Chronic Conditions (Yes vs No) |            |      |        |      |
| Hypertension         | 8350       | 1857 | 0.90   | 0.80 | 1.01 | 0.09 |
| Hyperlipidemia       | 6359       | 1373 | 0.88   | 0.79 | 0.98 | 0.02 |
| Mood Disorders       | 3259       | 643  | 0.79   | 0.69 | 0.90 | 0.0006 |
| Diabetes Mellitus    | 3673       | 801  | 0.95   | 0.83 | 1.07 | 0.4  |
| Anxiety Disorders    | 2976       | 613  | 0.81   | 0.707| 0.93 | 0.002 |
| Upper Respiratory Conditions | 5888    | 1517 | 1.14   | 1.01 | 1.28 | 0.02 |
| Arthritis            | 7682       | 1568 | 0.78   | 0.70 | 0.87 | <.0001 |
| Asthma               | 2071       | 486  | 0.93   | 0.80 | 1.06 | 0.3  |
| Coronary Artery Disease | 1787     | 410  | 0.96   | 0.82 | 1.11 | 0.5  |

Abbreviations: PCMH indicates Patient-Centered Medical Home; CI, confidence interval

*Sample size (N) is unweighted; Percentage weighted using weights provided with 2010–2015 MEPS

*Adjusted Odds Ratio
## Appendix

### Table 5 Demographic data by state

| 2017 Population | Sex | Male | Female | Race | Hispanic | Black or African American | Asian | Not Hispanic | White | Black or African American | Asian |
|-----------------|-----|------|--------|------|----------|---------------------------|-------|--------------|-------|--------------------------|-------|
| United States   | 325,719,178 | 140,408,119 | 165,311,059 | 53,403,379 | 367,214 | 1,081,490 | 203,948,942 | 43,738,256 | 21,101,628 |
| Northeast Region| 56,470,581 | 27,530,306 | 28,940,275 | 6,670,850 | 1,413,848 | 130,784 | 37,714,017 | 6,915,133 | 4,206,459 |
| Connecticut     | 3,588,184 | 1,751,800 | 1,836,384 | 494,988 | 79,472 | 7401 | 2,459,296 | 399,168 | 190,313 |
| Maine           | 1,335,907 | 654,520 | 681,387 | 19,619 | 1833 | 762 | 1,267,954 | 27,024 | 22,099 |
| Massachusetts   | 6,859,819 | 3,330,365 | 3,529,454 | 663,031 | 5339 | 12,577 | 5,064,022 | 550,067 | 515,303 |
| New Hampshire   | 1,342,795 | 665,009 | 681,387 | 19,619 | 130 | 1011 | 1,235,192 | 24,697 | 43,679 |
| Rhode Island    | 1,059,639 | 514,991 | 544,648 | 129,144 | 2578 | 2578 | 787,314 | 75,632 | 43,896 |
| Vermont         | 623,657 | 308,256 | 315,401 | 10,773 | 1080 | 315 | 590,084 | 11,433 | 14,181 |
| New Jersey      | 9,005,644 | 4,396,574 | 4,609,070 | 1,583,995 | 232,080 | 26,086 | 5,074,996 | 1,231,086 | 952,219 |
| New York        | 19,849,399 | 9,637,462 | 10,211,937 | 2,972,074 | 744,422 | 63,004 | 11,249,519 | 3,080,220 | 1,914,601 |
| Pennsylvania    | 12,805,537 | 6,271,329 | 6,534,208 | 753,540 | 75,567 | 17,140 | 9,985,640 | 1,515,806 | 510,168 |
| Midwest Region  | 68,179,351 | 33,659,324 | 34,520,027 | 4,907,673 | 328,391 | 75,567 | 52,871,947 | 7,828,966 | 2,621,209 |
| Illinois        | 12,802,023 | 6,292,478 | 6,509,545 | 2,059,344 | 92,288 | 26,288 | 8,033,680 | 1,907,543 | 792,728 |
| Indiana         | 6,666,818 | 3,287,095 | 3,379,723 | 424,866 | 31,395 | 6099 | 5,394,727 | 699,635 | 182,314 |
| Michigan        | 9,962,311 | 4,903,752 | 5,058,559 | 448,997 | 45,859 | 7872 | 7,688,615 | 1,490,926 | 373,137 |
| Ohio            | 11,658,609 | 5,713,100 | 5,945,509 | 380,535 | 56,605 | 7623 | 9,443,607 | 1,616,217 | 319,890 |
| Wisconsin       | 5,795,483 | 2,882,738 | 2,912,401 | 10,773 | 1080 | 315 | 4,803,844 | 417,245 | 190,977 |
| Iowa            | 3,145,711 | 1,564,733 | 1,580,978 | 174,674 | 8476 | 2622 | 2,745,459 | 143,876 | 94,566 |
| Kansas          | 2,913,123 | 1,451,956 | 1,461,167 | 320,506 | 169,788 | 4476 | 2,278,889 | 204,687 | 105,079 |
| Minnesota       | 5,576,606 | 2,776,846 | 2,799,760 | 266,704 | 20,460 | 6451 | 4,570,571 | 414,490 | 318,572 |
| Missouri        | 6,113,532 | 3,002,236 | 3,111,296 | 232,440 | 19,122 | 4914 | 4,977,790 | 774,014 | 154,207 |
| Nebraska        | 1920,076 | 958,131 | 961,945 | 189,923 | 8429 | 2832 | 1,549,724 | 109,839 | 58,318 |
| North Dakota    | 755,393 | 387,299 | 368,094 | 23,519 | 1594 | 574 | 652,943 | 27,037 | 15,402 |
| South Dakota    | 869,666 | 438,960 | 430,706 | 25,578 | 1452 | 610 | 732,098 | 23,457 | 16,019 |
| South Region    | 123,658,624 | 60,616,528 | 63,042,096 | 20,466,319 | 1,205,243 | 240,734 | 72,437,426 | 24,796,491 | 5,027,316 |
| Delaware        | 961,939 | 465,514 | 496,425 | 74,221 | 12,839 | 283 | 617,848 | 223,603 | 44,712 |
| District of Columbia | 693,972 | 329,199 | 364,773 | 60,912 | 13,196 | 1737 | 267,319 | 325,427 | 35,717 |

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improve the overall health of Americans with chronic conditions.

**Acknowledgments**

The authors would like to thank the Saudi Association for Scientific Research (SASR) for providing logistical support throughout the duration of the project.

**Funding**

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

**Availability of data and materials**

The datasets generated and/or analyzed during the current study are available in the AHRQ RDC, [https://meps.ahrq.gov/mepsweb/data_stats/onsite_datacenter.jsp](https://meps.ahrq.gov/mepsweb/data_stats/onsite_datacenter.jsp).

**Authors’ contributions**

ZA carried out the literature review, statistical analyses, manuscript drafting, manuscript editing, and manuscript revision. NK and IA carried out the study design, statistical analyses, and manuscript revision. RA and AM participated in data collection, statistical analyses, and manuscript editing. NA and TA participated in manuscript editing and manuscript revision. EA and SA participated in study design and data collection, manuscript editing, manuscript revision, and coordination. All authors read and approved the final manuscript.

**Ethics approval and consent to participate**

Not applicable.

**Consent for publication**

Not applicable.

**Competing interests**

The authors declare that they have no competing interests.

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**Table 5 Demographic data by state (Continued)**

| State     | 2017 Population | Sex | Male | Female | Hispanic | Black or African American | Asian | White | Black or African American | Asian |
|-----------|-----------------|-----|------|--------|----------|---------------------------|------|-------|---------------------------|-------|
| Louisiana | 4,684,333       |     | 2,289,446 | 2,394,887 | 211,356 | 27,336 | 4703 | 2,807,713 | 1,545,237 | 101,469 |
| Oklahoma  | 3,930,864       |     | 1,947,562 | 1,983,302 | 360,519 | 20,791 | 5623 | 2,782,296 | 349,881 | 111,591 |
| Texas     | 28,304,596      |     | 14,061,793 | 14,242,803 | 10,654,967 | 287,901 | 90,702 | 12,255,269 | 3,556,780 | 1,521,035 |
| West Region | 77,410,622 |     | 38,601,961 | 38,808,661 | 21,358,537 | 725,732 | 634,405 | 40,925,552 | 4,197,666 | 9,246,644 |
| Arizona   | 7,016,270       |     | 3,488,301 | 3,527,969 | 2,030,058 | 68,296 | 35,498 | 3,976,031 | 360,278 | 284,344 |
| Colorado  | 5,607,154       |     | 2,822,333 | 2,784,821 | 1,107,360 | 43,409 | 19,603 | 3,944,067 | 273,910 | 230,929 |
| Idaho     | 1,716,943       |     | 860,458 | 856,485 | 198,805 | 4338 | 3542 | 1,441,202 | 19,658 | 37,789 |
| Montana   | 1,050,493       |     | 528,956 | 521,537 | 32,730 | 1333 | 995 | 930,784 | 10,369 | 13,960 |
| Nevada    | 2,988,070       |     | 1,503,749 | 1,494,290 | 791,040 | 38,478 | 24,854 | 1,556,233 | 304,546 | 303,310 |
| New Mexico | 208,080,70     |     | 1,034,144 | 1,053,926 | 952,789 | 20,820 | 9381 | 811,077 | 48,485 | 41,353 |
| Utah      | 3,101,833       |     | 1,561,688 | 1,540,145 | 399,778 | 13,416 | 7644 | 2,494,166 | 50,068 | 103,551 |
| Wyoming   | 579,315         |     | 295,438 | 283,877 | 52,917 | 1579 | 795 | 496,212 | 9466 | 8176 |
| Alaska    | 739,795         |     | 386,792 | 353,003 | 41,519 | 4643 | 2596 | 493,807 | 34,833 | 60,211 |
| California | 39,536,653      |     | 19,647,553 | 19,889,100 | 14,316,549 | 459,987 | 416,190 | 15,638,899 | 2,551,034 | 6,388,282 |
| Hawaii    | 1,427,538       |     | 716,087 | 711,451 | 101,593 | 8043 | 68,273 | 516,294 | 42,935 | 747,347 |
| Oregon    | 4,142,776       |     | 2,052,989 | 2,089,787 | 492,326 | 17,686 | 12,830 | 3,264,775 | 113,156 | 240,501 |
| Washington | 7405,743        |     | 3,703,473 | 3,702,270 | 841,073 | 43,704 | 32,204 | 5,362,005 | 378,928 | 786,891 |

**Publisher’s Note**

Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

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Received: 4 May 2018 Accepted: 21 September 2018

Published online: 27 September 2018

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