


however, would increase consumer confidence in supplements in general, helping all legitimate companies, and would preserve incentives for research into highly concentrated CBD and other chemicals with botanical origins.

 An audio interview with Dr. Cohen is available at [NEJM.org](https://www.nejm.org)

While not perfect, such a compromise would have something to offer farmers, manufacturers, consumers, cannabis enthusiasts, and health care professionals. Whatever its health benefits turn out to be, CBD could well prove to have

beneficial effects for the safety of all supplements and foods in the United States.

Disclosure forms provided by the authors are available at [NEJM.org](https://www.nejm.org).

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1. Food and Drug Administration. FDA regulation of cannabis and cannabis-derived products: questions and answers. 2019 (<https://www.fda.gov/news-events/public-health-focus/fda-regulation-cannabis-and-cannabis-derived-products-questions-and-answers>).

- Devinsky O, Patel AD, Cross JH, et al. Effect of cannabidiol on drop seizures in the Lennox–Gastaut syndrome. *N Engl J Med* 2018;378:1888–97.
- Dietary Supplement Health and Education Act of 1994. Pub. L. No. 103-417, 1994. 103rd Congress, 2nd sess., S784.
- Chatham-Stephens K, Taylor E, Chang A, et al. Hepatotoxicity associated with weight loss or sports dietary supplements, including OxyELITE Pro — United States, 2013. *Drug Test Anal* 2017;9:68–74.
- Neltner TG, Alger HM, O'Reilly JT, Krinsky S, Bero LA, Maffini MV. Conflicts of interest in approvals of additives to food determined to be generally recognized as safe: out of balance. *JAMA Intern Med* 2013;173:2032–6.

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Implications of an Aging Rural Physician Workforce

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Rural areas in the United States suffer disproportionately from inadequate access to health care. In 2018, according to the Health Resources and Services Administration (HRSA), 66% of Health Professional Shortage Areas for primary care and 62% of those for mental health were located in rural or partially rural areas of the country. Although there is disagreement about the adequacy of the overall physician supply, there is little disagreement that the uneven distribution of physicians presents serious access problems in many rural areas. Limited access to physicians can reduce access to preventive care and exacerbate unmet health needs, leading to costly hospitalizations and poor health status.

Despite concerns about the number of physicians practicing in rural areas who are nearing retirement age, very little is known about the implications of an ag-

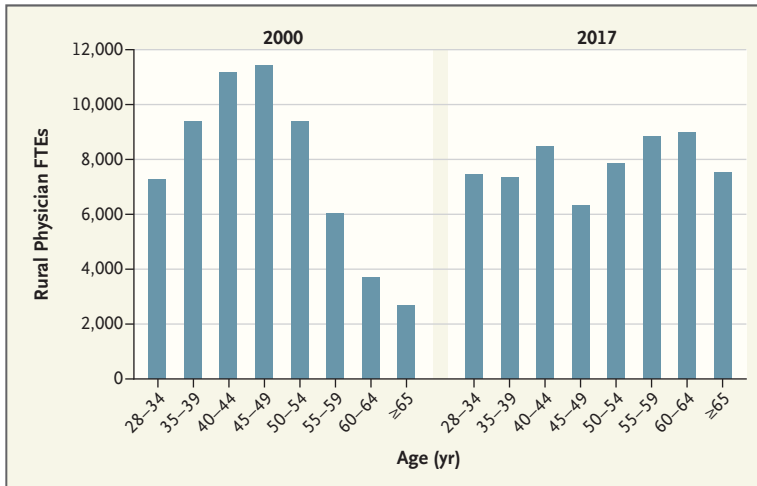
ing rural physician workforce for future physician supply in these areas. Maintaining physician supply in rural areas has important equity implications, given that, as compared with more urban populations, rural residents are likely to be older and poorer, are more commonly uninsured, and have lower life expectancy.

We used data on physician age and location from the U.S. Census to establish recent trends in the age distribution of rural physicians and used this information to forecast workforce growth through 2030. Our primary data originate from the American Community Survey (ACS) Public Use Microdata Sample (PUMS) conducted by the U.S. Bureau of the Census, which collects information on respondents' occupation, hours worked, age, and location of residence.¹ We used data on all physicians 28 to 74 years of age from the 2005 to 2017 ACS surveys and similar information

from the 2000 Census 5% sample (n=153,822) and converted these counts to full-time equivalents (FTEs).

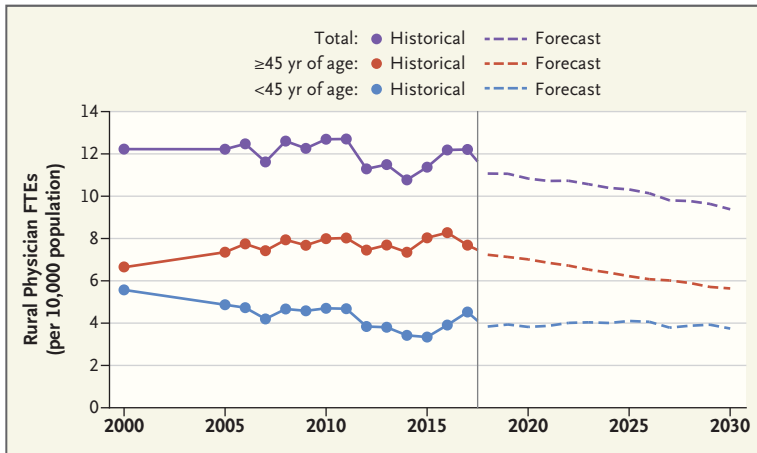
We used the HRSA approach to identify rural residence,² assigning physicians rural status (n=14,076) if their household was in a Public Use Microdata Area (PUMA) in which the majority of the population lives in a nonmetropolitan area. U.S. population size was calculated using Census data stratified into rural and urban areas, and estimates of the rural population after 2017 were based on a United Nations growth forecast. We projected the number of physicians through 2030 using our forecast model (described by Buerhaus et al.³), which takes into account life-cycle workforce-participation patterns associated with age (age effects) and differences among birth cohorts in entry into the profession (cohort effects).

From 2000 to 2017, the age distribution of rural physicians shift-



Age Distribution of Rural Physicians in the United States, 2000 and 2017.

Estimates are based on data from the U.S. Census Bureau.



Number of Physicians per 10,000 Population in U.S. Rural Areas, in Total and by Physician Age.

Historical estimates are based on data from the U.S. Census Bureau. Forecasts are based on our cohort supply model.

ed dramatically (see bar graph). While the total number of rural physicians grew only 3% (from about 61,000 in 2000 to 62,700 in 2017), the number of physicians under 50 years of age living in rural areas decreased by 25% (from 39,200 in 2000 to 29,600 in 2017). As the number of younger physicians entering rural practice has declined, the rural physician

workforce has grayed. By 2017, more than half of rural physicians were at least 50 years old, and more than a quarter were at least 60. In contrast, the number of urban physicians under 50 grew 12% from 2000 to 2017, and in 2017 only 39% of urban physicians were 50 years of age or older and only 18% were at least 60.

These demographic shifts have

important implications for the future. We used our model, which accounts for these cohort and aging trends, to forecast the number of rural physician FTEs per 10,000 population through 2030. As a benchmark, the number of FTE physicians nationally has remained around 27 per 10,000 population for the past decade. The line graph shows actual FTEs per 10,000 population in rural areas from 2000 to 2017 and our forecast for 2018 to 2030, both overall and by age (<45 years and ≥45 years).

The size of the workforce held relatively steady at about 12 physicians per 10,000 population in rural areas from 2000 to 2017, but it is forecast to decrease by 23% by 2030 (from 12.2 physicians per 10,000 in 2017 to 9.4 per 10,000 in 2030). Nearly all the forecasted decline comes from a reduction in the number of rural physicians 45 years of age or older, since a large proportion of this group will retire by 2030 and be replaced by the smaller cohorts currently in their 30s. In contrast, we forecast a fairly stable supply of younger physicians under 45 years of age.

The supply of nonrural physicians is projected to remain steady at 29.6 per 10,000 population by 2030, just below the rate of 30.7 in 2017. Thus, we project that the large existing disparities in physician supply between rural and nonrural areas will widen through 2030.

Because HRSA's method of identifying rural physicians in the Census may misclassify some urban physicians as having a rural residence, we reproduced our analysis using an alternative definition based on physicians living

in PUMAs that contained no metropolitan areas. The forecasted decline in rural physicians is somewhat larger when we use this more restrictive definition.

Despite decades of private- and public-sector initiatives aimed at increasing physician supply in rural areas, these projections of the rural physician supply are troubling. In 2030, residents of rural areas will have access to one third as many physicians per capita as their suburban and urban counterparts will. Yet rural residents are likely to be older, poorer, and in worse health than city dwellers, with a lower life expectancy, and they are more likely to be uninsured.⁴

This confluence of the growing health care needs of rural populations and the dwindling of the rural physician workforce suggests that policy actions should be taken as soon as possible rather than after the inevitable crisis occurs. Although physician loan repayment, expansion of the national health service corps, medical school grants for recruiting and providing focused training and experiences to students who are likely to practice in underserved rural communities, and funding of rural teaching clinics are all helpful, in their current incarnations such efforts are unlikely to narrow care delivery gaps. Though these initiatives may have resulted in a slower decline in rural physician supply than would otherwise have occurred, they do not appear to have yielded even a

stabilization of that supply. Furthermore, the greater the shortfall in the rural physician workforce, the harder it may be to attract new physicians to assume the greater patient workload.

Breaking this potential vicious cycle requires additional strategies, including expansion of graduate medical education programs in rural hospitals and higher payments for physicians in rural areas to account for the higher average cost of providing care in low-volume areas, which could influence some physicians, who might otherwise avoid these areas, to practice in them. Access to care could be improved by expanding the use of mobile health vans equipped with diagnostic and treatment technology and by policymakers acting with greater urgency to overcome barriers that have slowed adoption of telehealth services.

Policymakers can also explore the possibilities offered by the rapidly growing nurse practitioner (NP) workforce. Not only are the percentages of NPs training in primary care and practicing in rural areas higher than those of physicians, but a growing body of studies confirms the high quality and cost-effectiveness of care provided by NPs and their greater propensity to serve vulnerable populations.⁵ Medical schools, graduate medical education programs, teaching hospitals, clinics, and other sites training primary care clinicians, particularly those located near rural populations,

could work with NP education programs to explicitly capitalize on the greater likelihood of NPs practicing in rural areas, to create NP residency programs in rural health, and to develop programs that make it easy for rural NPs to consult with physicians and rural health specialists. Innovative strategies such as these will be needed to forestall the growing disparities in access to health care that we project are on the horizon for the rural population.

Disclosure forms provided by the authors are available at NEJM.org.

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1. Staiger DO, Auerbach DI, Buerhaus PI. Comparison of physician workforce estimates and supply projections. *JAMA* 2009; 302:1674-80.
2. National Center for Health Workforce Analysis. Distribution of U.S. health care providers residing in rural and urban areas. Rockville, MD: Health Resources and Services Administration, 2014 (<https://bhwh.hrsa.gov/sites/default/files/bhwh/nchw/nchwafactsheet.pdf>).
3. Buerhaus PI, Staiger DO, Auerbach DI. Implications of an aging registered nurse workforce. *JAMA* 2000;283:2948-54.
4. Meit M, Knudson A, Gilbert T, et al. The 2014 update of the rural-urban chartbook. Bethesda, MD: Rural Health Reform Policy Research Center, October 2014 (<http://workforce.org/sites/default/files/2014-rural-urban-chartbook.pdf>).
5. Barnes H, Richards MR, McHugh MD, Martsolf G. Rural and nonrural primary care physician practices increasingly rely on nurse practitioners. *Health Aff (Millwood)* 2018;37:908-14.

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