Annals of Epidemiology 28 (2018) 858–864

Contents lists available at ScienceDirect

Annals of Epidemiology

journal homepage: www.annalsofepidemiology.org

Original article

Location location location: an exploration of disparities in access to publicly listed pre-exposure prophylaxis clinics in the United States

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ARTICLE INFO

Article history:
Received 10 November 2017
Accepted 19 May 2018
Available online 26 May 2018

Keywords:
Pre-exposure prophylaxis
HIV
Primary prevention

ABSTRACT

Purpose: HIV pre-exposure prophylaxis (PrEP) is highly effective in preventing HIV transmission. Finding a PrEP provider, however, can be a barrier to accessing care. This study explores the distribution of publicly listed PrEP-providing clinics in the United States.

Methods: Data regarding 2094 PrEP-providing clinics come from PrEP Locator, a national database of PrEP-providing clinics. We compared the distribution of these PrEP clinics to the distribution of new HIV diagnoses within various geographical areas and by key populations.

Results: Most (43/50) states had less than one PrEP-providing clinic per 100,000 population. Among states, the median was two clinics per 1000 PrEP-eligible men who have sex with men. Differences between disease burden and service provision were seen for counties with higher proportions of their residents living in poverty, lacking health insurance, identifying as African American, or identifying as Hispanic/Latino. The Southern region accounted for over half of all new HIV diagnoses but only one-quarter of PrEP-providing clinics.

Conclusions: The current number of PrEP-providing clinics is not sufficient to meet needs. In addition, PrEP-providing clinics are unevenly distributed compared to disease burden, with poor coverage in the Southern divisions and areas with higher poverty, uninsured, and larger minority populations. PrEP services should be expanded and targeted to address disparities.

Introduction

Pre-exposure prophylaxis (PrEP) is highly effective in preventing HIV transmission [1]. PrEP is indicated by the U.S. Centers for Disease Control and Prevention (CDC) for men who have sex with men (MSM), heterosexual men and women, and people who inject drugs [2]. PrEP is effective in preventing HIV across different populations, with a meta-analysis finding a 70% reduction in HIV infection risk among groups with high (>70%) PrEP adherence [3]. Individuals in an integrated health care system who had initiated and remained on PrEP had no HIV seroconversions in 850 person-years of accumulated follow-up time; however, two seroconversions occurred among individuals who had discontinued PrEP [4].

PrEP initiations have grown rapidly in the United States. From 2012 to 2015, there was a 6.9-fold increase in individuals initiating PrEP regimens [5]. In the 2015 National HIV/AIDS Strategy, the states of New York and Washington were highlighted for their "End AIDS" programs, both of which facilitate access to PrEP [6]. Currently, dozens of other states and cities have projects, specified clinics, and programs that are dedicated to providing PrEP [7]. Despite these efforts, PrEP uptake remains low compared to estimated need. CDC estimates that one-quarter of all MSM are eligible for PrEP [2], yet survey data indicate that uptake is around 4% [8].

One barrier to PrEP uptake is the need to find an appropriate provider. All providers who meet standard prescriptive authority rules can prescribe PrEP but not all providers are willing. A qualitative exploration found rationales of providers for not prescribing PrEP to include concerns regarding poor adherence, toxicity, and the potential for generation of drug resistance [9]. Other providers may be unaware of PrEP [10,11] or have concerns regarding cost [12]. Providers who have experience treating patients living with HIV, have previously prescribed postexposure prophylaxis, or are part of a larger practice group were more willing to prescribe PrEP

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https://doi.org/10.1016/j.annepidem.2018.05.006

[10,13]. These attributes may increase the likelihood of a physician prescribing PrEP due to increased familiarity with prescribing antiretroviral medication. Similarly, the PrEP "purview paradox'" notes that primary care physicians view PrEP antiretroviral regimens and adherence issues as the domain of HIV care specialists, and HIV care specialists are less likely to see the HIV-negative patients who would be eligible for PrEP [14].

In the short time that tenofovir disoproxil fumarate has been indicated for PrEP by the U.S. Food and Drug Administration (FDA), racial disparities in PrEP uptake have developed. For instance, 44% of new HIV diagnoses in 2014 were among African Americans, yet only 10% of individuals initiating PrEP that year were African American [15]. Twenty-three percent of new HIV diagnoses in 2014 were among Hispanic Americans, yet only 12% of individuals initiating PrEP were Hispanic. Reasons for disparities are likely multifactorial, with diverse contributors such as social stigma, medical mistrust, financial barriers, and awareness [16,17]. Medical students in one study were more likely to expect sexual risk compensation in African American patients than white patients; these beliefs indirectly reduced willingness to prescribe PrEP to African American patients [18].

Given hesitancy or unwillingness to prescribe PrEP by some clinicians, and in light of racial disparities in PrEP use, it is critical to minimize known barriers to accessing PrEP. Minorities and individuals with lower incomes are more likely to face geographic barriers to accessing health care [19]. Geographic availability has been shown to impact access to HIV care and may also be critical to PrEP access [20]. Proximity of providers may be particularly important because individuals on PrEP are recommended by CDC to have four clinician visits each year [21]. Using data from PrEP Locator, a national database of publicly listed clinics that prescribe PrEP, we describe the geographic distribution of PrEP clinics in the United States. This county-level analysis explores how the density of PrEP-providing clinics aligns with race, income, insurance status, and urbanicity in comparison to the overall population, to estimated numbers of MSM eligible for PrEP, and to new HIV diagnoses.

Methods

Data regarding PrEP-providing clinics come from PrEP Locator, a national and publicly available database of clinics developed by the authors [22,23]. The PrEP Locator database was developed from over 50 different data sources, including all available state health department directories, local health department directories, nongovernmental organization directories, and HIV-related medical organization member surveys. To be eligible for inclusion, all clinics in the database were determined to have a working phone number, have personnel at that phone number confirm that the clinic prescribes PrEP, and have a clinician with appropriate licensure to prescribe PrEP determined by state licensure databases. Clinic eligibility was assessed through phone calls by Emory staff. Nonresponsive clinics, having not responded to a minimum of three calls, were excluded from the database. Updates to the database occurred through opt-in suggestions to add or update provider information through a public Web form or through collaborations with state and local directories to update database information on a regular basis. Proposed updates to the database are placed in a holding pen, which is then vetted by Emory staff before release. Further documentation regarding the development and procedures of PrEP Locator are available [22]. Data for the present analysis were extracted from the Locator database in February 2018.

County- and state-level data for age, gender, the proportion of residents living in poverty, and the proportion of residents uninsured were obtained from the U.S. Census Bureau. Poverty is defined as three times the cost of a minimum food diet [24] and uninsured is defined as individuals not covered by any type of private or government insurance for any part of the previous year [25]. Geographic regions were categorized into nine divisions according to standard U.S. Census Bureau divisions. To explore possible racial disparities in the distribution of PrEP clinics, we used race/ethnicity estimates: for state-level data, we used the year 2016 American Community Survey (ACS) of the U.S. Census Bureau, and for county-specific data, we used the four year 2012–2016 ACS. We ranked counties by the proportion within each county that identified as African American race or Hispanic ethnicity (inclusive of all races) and categorized the data as <5%, 5 to <10%, 10 to <20%, and ≥20% of each race/ethnicity. Counties were also ranked based on the proportion of residents living in poverty and the proportion of residents uninsured into categories of <10%, 10 to <15%, 15 to <20%, and ≥20%. These cut points were chosen to provide meaningful intervals, guided by histograms of each variable's distribution. Urbanicity classification was based on the National Center for Health Statistics Urban-Rural Classification Scheme.

New HIV diagnoses and prevalent HIV cases from 2016 are from the AIDSVu database [26], which uses data from the CDC National HIV Surveillance System for county-level data. The National HIV Surveillance System is a database of HIV/AIDS diagnosis surveillance conducted by state or territory health departments according to uniform surveillance case definitions and case report forms, with data then provided to CDC. In the AIDSVu data set, geographic areas with either small numerator (HIV diagnosis or prevalent case numbers <5) or small denominator (number of people in a particular population <100) data are suppressed to protect identity. We estimated values for counties with suppressed data by subtracting, for each state, all known county-level values of HIV diagnoses from the state total. The remainder (the total from unknown counties) was distributed evenly to counties with missing data. To assess HIV diagnoses in urban areas, we included county-level diagnosis data for 33 cities in the AIDSVu database. AIDSVu obtains these data directly from state and local health departments. City limits for this analysis were defined by core-based statistical areas. We estimated the number of PrEP-eligible MSM in each state and city using small-area population estimates for MSM multiplied by the CDC-estimated proportion of MSM indicated for PrEP (24.7%) [2]. MSM population estimates were calculated based on previously published methods, here replicated based on current 2016 U.S. Census data [27,28]. In brief, this estimation method uses the National Health and Nutrition Examination Survey and urbanicity-stratified weights derived from ACS to estimate population counts for the number of MSM in each county in the United States.

We calculated the number, and percent of national total, of PrEP-providing clinics in U.S. Census Divisions (excluding Puerto Rico). The numbers of PrEP clinics are also displayed for groups of counties ranked by urbanicity, proportion of residents living in poverty or uninsured, and concentration of the population African American or Hispanic (Table 1). Ratios of PrEP clinics divided by new HIV diagnoses were calculated at the county level and are shown in Table 1 to explore the distribution of PrEP clinics relative to epidemic need. Tables 2 and 3 provide state- and city-level data on the number of PrEP clinics in geographic areas. We calculated clinic prevalence (clinics per 100,000 population over 13 years of age), ratios of clinics per 1000 PrEP-eligible MSM, and ratios of clinics per 1000 new HIV diagnoses for each area. Clinic prevalence is calculated to allow for assessment of the number of clinics relative to the population size for each geographic area. Ratios of clinics per PrEP-eligible MSM are used to compare the number of clinics relative to the number of individuals indicated for the service. Ratios of clinics to new HIV diagnoses are used to compare the number of clinics to epidemic need. The data set may not contain all publicly listed PrEP clinics. It is, however, the only nationally

Table 1
Distribution of 2094 PrEP-providing clinics and new HIV diagnoses in the United States

Area classification	PrEP-providing clinics, 2018		PrEP-eligible MSM, 2016			PrEP need*: New diagnoses, 2016		
	n	% Of national total	*n*	% Of national total	Clinics per 1000	*n*	% Of national total	Clinics per 1000
Census Division								
East North Central	260	12	115,444	14	2.3	3807	10	68.3
East South Central	67	3	37,396	4	1.8	1991	5	33.7
Middle Atlantic	365	17	87,396	10	4.2	5168	13	70.6
Mountain	197	9	66,586	8	3.0	2067	5	95.3
New England	148	7	27,824	3	5.3	1131	3	130.9
Pacific	485	23	179,799	21	2.7	5733	14	84.6
South Atlantic	333	16	186,289	22	1.8	12,303	31	27.1
West North Central	100	5	38,928	5	2.6	1232	3	81.2
West South Central	139	7	110,508	13	1.3	6222	16	22.3
Urbanicity† (by county)								
Large central metro	1062	51	447,717	53	2.4	20,344	51	52.2
Large fringe metro	381	18	205,695	24	1.9	7832	20	48.6
Medium metro	370	18	101,172	12	3.7	6544	17	56.5
Small metro	143	7	39,911	5	3.6	2072	5	69.0
Micropolitan	88	4	35,431	4	2.5	1354	3	65.0
Noncore	50	2	20,232	2	2.5	1506	4	33.2
Poverty (by county)								
Less than 10% poverty	273	13	126,253	15	2.2	3878	10	70.4
10% to <15% poverty	677	32	249,405	29	2.7	9698	24	69.8
15% to <20% poverty	855	41	379,932	45	2.3	18,864	48	45.3
20% or more poverty	289	14	94,580	11	3.1	7215	18	40.1
Percent Uninsured (by county)								
Less than 10% uninsured	922	44	297,035	35	3.1	9484	24	97.2
10% to <15% uninsured	793	38	332,874	39	2.4	16,644	42	47.6
15% to <20% uninsured	299	14	157,017	18	1.9	9232	23	32.4
20% or more uninsured	80	4	63,244	7	1.3	4294	11	18.6
African American Concentration (by county)								
Less than 5% African American	555	27	207,048	24	2.7	5906	15	94.0
5% to <10% African American	496	24	209,107	25	2.4	7909	20	62.7
10% to <20% African American	474	23	198,946	23	2.4	10,260	26	46.2
20% or more African American	569	27	235,068	28	2.4	15,579	39	36.5
Hispanic Concentration (by county)								
Less than 5% Hispanic	370	18	132,241	16	2.8	6549	17	56.5
5% to <10% Hispanic	487	23	192,599	23	2.5	8450	21	57.6
10% to <20% Hispanic	411	20	160,620	19	2.6	7248	18	56.7
20% or more Hispanic	826	39	364,709	43	2.3	17,408	44	47.4

* New HIV diagnoses are considered as an ecological proxy for PrEP need per geographic area.
† Large central metro: greater than 1,000,000 population, central. Large fringe metro: greater than 1,000,000 population, fringe. Medium metro: between 250,000 and 999,999 population. Small metro: between 250,000 and 50,000 population. Micropolitan: between 10,000 and 49,999 population. Noncore: less than 10,000 population.

available method to find PrEP-providing clinics, and it includes data from all other major listings of PrEP clinics such as health departments and medical organizations. Therefore, we believe the data approximate a census of clinics that an individual seeking PrEP would be able to easily access, so we do not use inferential statistics to generalize to a broader population of clinics, such as statistical significance testing.

Figure 1, A and B geographically present state-level data. Figure 1A displays clinic prevalence for each state, with states grouped by quintile (groups of 10 states) from least to greatest PrEP clinic prevalence. Figure 1B displays the ratio of clinics per 1000 new HIV diagnosis in each state, with states grouped by quintile from least to greatest values.

Results

There were 2094 publicly listed, PrEP-providing clinics in the United States (Table 1). Relative to need, estimated through concentration of new HIV diagnoses, Southern census divisions had fewer than expected PrEP clinics. Southern census divisions of the United States had lower ratios of PrEP-providing clinics to new HIV diagnoses than census divisions in other regions. For instance, the South Atlantic Division had 15.9% of all publicly listed PrEP clinics and 31.0% of all new HIV diagnoses. The Southern region, comprising all Southern census divisions (East South Central, West South Central, and South Atlantic) accounted for 51.7% of all new HIV diagnoses but only 25.7% of PrEP-providing clinics. Analysis of counties, grouped by demographic characteristics, revealed disparities in the proportion of clinics relative to the number of new HIV diagnoses. Counties with ≥20% of the population living in poverty had 13.8% of PrEP-providing clinics, and 18.2% of new HIV diagnoses. Counties with ≥20% of the population lacking health insurance had 3.8% of clinics and 10.8% of new HIV diagnoses. Counties with ≥20% identifying as African American had 27.2% of PrEP-providing clinics and 39.3% of new HIV diagnoses.

PrEP-providing clinic prevalence (clinics per overall population), ratios of clinics per PrEP-eligible MSM, and ratios of clinics per new HIV diagnoses were low across states (Table 2). Forty-three of 50 states had less than one PrEP-providing clinic per 100,000 population, 1/50 states had less than one clinic per 1000 PrEP-eligible MSM, and 35/50 states had less than 100 clinics per 1000 new HIV diagnoses. No state had more than three PrEP-providing clinics per 100,000 population or more than 14 clinics per 1000 PrEP-eligible MSM.

There was substantial variation in the availability of PrEP across states. The median ratio of PrEP clinics per 100,000 overall population was 0.6 among all states, with a range that spanned over an order of magnitude (0.2 to 2.8). The median ratio of PrEP clinics per

Table 2
State-level distribution of PrEP-providing clinics by total population, PrEP-eligible MSM, and new HIV diagnoses

State	PrEP-providing clinics						
	n per state	Population*	*n* per 100,000 population	PrEP-eligible MSM population	*n* per 1000 PrEP-eligible MSM	New HIV diagnoses†	*n* per 1000 new HIV diagnoses
Alabama	10	4,082,821	0.2	7928	1.3	533	18.8
Alaska	8	605,097	1.3	1637	4.9	37	216.2
Arizona	47	5,761,526	0.8	20,500	2.3	778	60.4
Arkansas	7	2,479,841	0.3	3653	1.9	314	22.3
California	322	32,715,033	1.0	134,968	2.4	4961	64.9
Colorado	89	4,632,086	1.9	20,685	4.3	423	210.4
Connecticut	43	3,056,129	1.4	5891	7.3	251	171.3
Delaware	8	806,543	1.0	2449	3.3	117	68.4
Florida	139	17,661,830	0.8	77,093	1.8	4940	28.1
Georgia	33	8,521,448	0.4	26,781	1.2	2709	12.2
Hawaii	7	1,201,433	0.6	3958	1.8	82	85.4
Idaho	7	1,369,530	0.5	3058	2.3	44	159.1
Illinois	90	10,726,317	0.8	40,942	2.2	1384	65.0
Indiana	33	5,506,076	0.6	13,537	2.4	483	68.3
Iowa	10	2,611,034	0.4	2985	3.4	133	75.2
Kansas	17	2,389,068	0.7	3577	4.8	141	120.6
Kentucky	17	3,714,599	0.5	9486	1.8	319	53.3
Louisiana	33	3,878,595	0.9	9404	3.5	1151	28.7
Maine	25	1,151,311	2.2	2371	10.5	50	500.0
Maryland	37	5,052,126	0.7	16,133	2.3	1097	33.7
Massachusetts	54	5,845,108	0.9	13,198	4.1	710	76.1
Michigan	47	8,385,984	0.6	21,417	2.2	747	62.9
Minnesota	29	4,588,522	0.6	15,342	1.9	286	101.4
Mississippi	10	2,471,502	0.4	3434	2.9	424	23.6
Missouri	31	5,101,456	0.6	13,653	2.3	511	60.7
Montana	6	878,537	0.7	2106	2.9	17	352.9
Nebraska	5	1,562,564	0.3	1857	2.7	76	65.8
Nevada	21	2,452,586	0.9	8260	2.5	525	40.0
New Hampshire	9	1,152,702	0.8	2011	4.5	42	214.3
New Jersey	44	7,537,589	0.6	15,496	2.8	1143	38.5
New Mexico	17	1,733,137	1.0	5317	3.2	125	136.0
New York	255	16,745,354	1.5	49,896	5.1	2875	88.7
North Carolina	52	8,513,324	0.6	22,582	2.3	1404	37.0
North Dakota	5	626,443	0.8	765	6.5	46	108.7
Ohio	69	9,765,669	0.7	29,147	2.4	969	71.2
Oklahoma	8	3,225,510	0.3	7894	1.0	293	27.3
Oregon	22	3,471,843	0.6	14,124	1.6	221	99.6
Pennsylvania	66	10,888,756	0.6	22,004	3.0	1150	57.4
Rhode Island	2	912,171	0.2	3239	0.6	70	28.6
South Carolina	13	4,172,373	0.3	6781	1.9	757	17.2
South Dakota	2	707,973	0.3	749	2.7	39	51.3
Tennessee	30	5,576,555	0.5	16,548	1.8	715	42.0
Texas	91	22,593,541	0.4	89,558	1.0	4464	20.4
Utah	10	2,377,712	0.4	5670	1.8	135	74.1
Vermont	15	540,664	2.8	1113	13.5	8	1875.0
Virginia	24	7,070,310	0.3	23,152	1.0	893	26.9
Washington	126	6,106,317	2.1	25,111	5.0	432	291.7
West Virginia	9	1,562,558	0.6	2665	3.4	66	136.4
Wisconsin	20	4,865,079	0.4	10,400	1.9	224	89.3
Wyoming	2	481,302	0.4	989	2.0	20	100.0

* Population counts include only persons at least 13 years of age.
† New HIV diagnoses are considered as an ecological proxy for PrEP need per geographic area.

1000 PrEP-eligible MSM was 2.4 (range, 0.6 to 13.5). The median was ratio of PrEP clinics per new 1000 new HIV diagnoses was 67.1, with a range that spanned over two orders of magnitude (12.2 to 1875.0).

State-level geographic distributions of PrEP-providing clinics are displayed using a denominator of population in Figure 1A and a denominator of new HIV diagnoses in Figure 1B. The different denominators allow for a view of the level of PrEP-providing clinics per population (Fig. 1A) and per epidemic need (Fig. 1B). PrEP-providing clinic ratios per PrEP-eligible MSM and per new 1000 HIV diagnoses were higher in the New England, Middle Atlantic, and Mountain districts of the United States and lower in the West South Central, East South Central, and South Atlantic districts (Fig. 1). Analysis of city-level data reveals similar trends (Table 3). PrEP availability is lower in the Southern cities of Birmingham (19.0 clinics/1000 new diagnoses), Atlanta (14.5/1000), and Jacksonville (17.8/1000) than in the Northeast cities of Philadelphia (58.8/1000) and New York (58.8/1000) or than in the Northwest cities of San Francisco (111.0/1000) and Seattle (261.1/1000).

Discussion

This study of publicly listed PrEP-providing clinics in the United States provides a geographic depiction of the availability of PrEP. PrEP-providing clinics were rare, with more than half of states having less than three PrEP-providing clinics per 1000 PrEP-eligible MSM. For even a moderate proportion of MSM eligible for PrEP to be able to initiate care, the availability of PrEP-providing clinics will need to increase. To have optimal impact, PrEP coverage will need to be high; modeling indicates that 40% PrEP coverage among

Table 3
Distribution of 996 PrEP-providing clinics in cities in the United States, by total population, eligible MSM, and new diagnoses

City*	PrEP-providing clinics						
	n per city	Population†	*n* per 100,000 population	PrEP-eligible MSM population	*n* per 1000 PrEP-eligible MSM	New HIV diagnoses‡	*n* per 1000 new HIV diagnoses
Atlanta, Georgia	25	4,592,379	0.5	21,588	1.2	1722	14.5
Austin, Texas	9	1,596,561	0.6	11,167	0.8	308	29.2
Baltimore, Maryland	26	2,336,010	1.1	9054	2.9	531	49.0
Baton Rouge, Louisiana	5	682,542	0.7	1076	4.6	250	20.0
Birmingham, Alabama	2	950,171	0.2	3717	0.5	106	19.0
Bridgeport area§, Connecticut	13	786,439	1.7	1142	11.4	72	180.6
Charlotte, North Carolina	16	1,960,643	0.8	8777	1.8	399	40.1
Chicago, Illinois	80	7,913,514	1.0	37,347	2.1	1255	63.8
Columbia, South Carolina	5	671,446	0.7	1191	4.2	178	28.1
Dallas, Texas	27	5,607,813	0.5	32,245	0.8	1341	20.1
Denver, Colorado	48	2,275,974	2.1	16,145	3.0	302	159.1
Detroit, Michigan	25	3,605,463	0.7	12,684	2.0	504	49.6
Hartford, Connecticut	13	1,036,214	1.3	2806	4.6	72	181.8
Houston, Texas	45	5,203,917	0.9	26,238	1.7	1467	30.7
Jackson, Mississippi	1	134,485	0.7	183	5.5	11	90.9
Jacksonville, Florida	6	1,190,311	0.5	5162	1.2	337	17.8
Las Vegas, Nevada	19	1,712,020	1.1	6767	2.8	470	40.4
Memphis, Tennessee	13	1,096,682	1.2	5647	2.3	303	42.9
Miami Area‖, Florida	59	5,050,905	1.2	29,762	2.0	2342	25.2
Milwaukee, Wisconsin	9	1,304,605	0.7	5533	1.6	117	76.9
Nashville, Tennessee	6	1,484,647	0.4	6793	0.9	187	32.1
New Haven Area¶, Connecticut	10	734,856	1.4	1099	9.1	81	123.5
New Orleans, Louisiana	21	1,045,421	2.0	5055	4.2	422	49.8
New York City Area#, New York	200	16,859,126	1.2	50,878	3.9	3401	58.8
Norfolk Area**, Virginia	5	1,433,906	0.3	5421	0.9	298	16.8
Orlando, Florida	35	1,957,263	1.8	12,226	2.9	664	52.7
Philadelphia, Pennsylvania	46	5,086,489	0.9	11,700	3.9	793	58.0
Raleigh, North Carolina	11	1,019,379	1.1	4942	2.2	189	58.3
Richmond, Virginia	6	1,058,667	0.6	3888	1.5	181	33.1
San Francisco Area††, California	82	3,897,873	2.1	29,413	2.8	739	111.0
Seattle, Washington	82	3,080,373	2.7	16,941	4.8	314	261.1
Tampa, Florida	13	2,500,138	0.5	17,143	0.8	559	23.3
Washington, D.C.‡‡	33	4,990,502	0.7	25,579	1.3	1110	29.7

* Defined by core-based statistical areas.
† Population counts include only persons at least 13 years of age.
‡ New HIV diagnoses are considered as an ecological proxy for PrEP need per geographic area.
§ Bridgeport-Stamford-Norwalk core-based statistical area (CBSA).
‖ Miami-Fort Lauderdale–West Palm Beach CBSA.
¶ New Haven–Milford CBSA.
# New York City-Newark CBSA.
** Norfolk–Virginia Beach–Hampton Roads CBSA.
†† San Francisco-Oakland-Alameda CBSA.
‡‡ Washington-Arlington-Alexandria, CBSA.

eligible MSM could prevent 33% of new HIV infections, with diminishing impact at lower coverage levels [29]. To achieve such levels of PrEP scale-up, new strategies are needed to increase access to PrEP.

Within the United States, several disparities in PrEP access emerge in this county-level analysis, including different numbers of clinics compared to region, income, ethnicity, and insurance status. The direction of the disparities contradicts need, with population groups with higher levels of HIV transmission having less access to PrEP services. Southern states, areas of lower income, areas with higher African American and Hispanic populations, and areas with less insurance coverage all represent areas disproportionately impacted by new HIV diagnoses [30] and are conversely underrepresented in PrEP clinic density. If not addressed, PrEP geographic and other access disparities may be sufficient to exacerbate existing disparities in the overall HIV epidemic in the United States. Therefore, there is a need to develop new strategies to make PrEP accessible not only more broadly but also to those groups most at risk who currently experience lower levels of access to health services.

PrEP is a new HIV intervention approved by the U.S. FDA in 2012, and the existence of 2094 publicly listed PrEP-providing clinics in the United States is a noteworthy public health accomplishment. In our data set, it is clear that local investments in PrEP have an impact in terms of access. Public health authorities in cities such as Seattle [31] and New York [32] have made concerted efforts to increase the number of publicly listed PrEP-providing clinics, and the success of these efforts can be seen in the geographic distribution of clinics. Similarly, public health officials and groups in North Carolina have made successful outreach efforts to increase the number of local PrEP-providing clinics [33], resulting in the state being an outlier to the trend of Southern states housing fewer PrEP providers. Localities also have the potential to alleviate disparities in PrEP provision due to income or insurance coverage by funding PrEP drug assistance and navigation programs that can facilitate increased PrEP access. These public health investments in PrEP yield clear benefits and should be continued and expanded.

This study has a number of limitations. Clinics included in the data set, coming from PrEP Locator, do not comprise all clinicians prescribing PrEP in the United States. Instead, clinics are those that were publicly listed and identified through an extensive search and vetting process. This results in underestimating the availability of PrEP-providing clinics. Yet, a substantial proportion

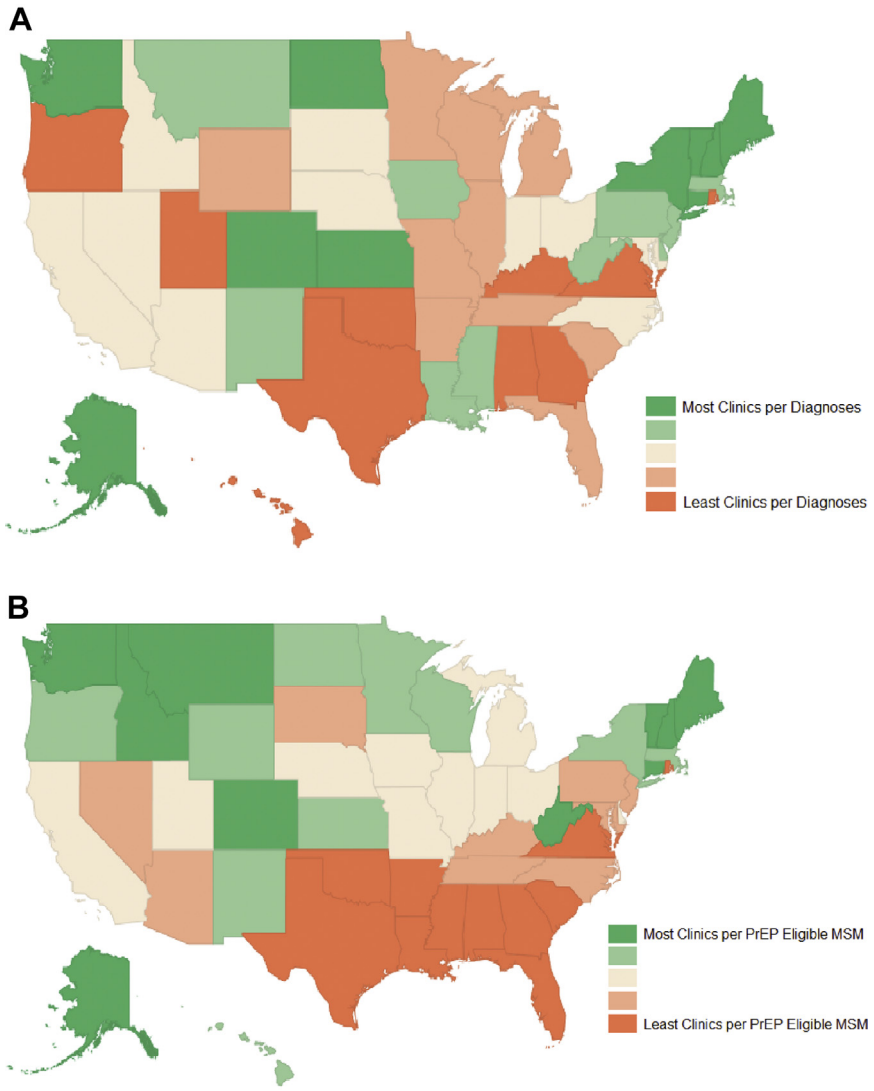

Fig. 1. (A) The proportion of PrEP-providing clinics per PrEP-eligible MSM by state, ranked by quintile 2018. (B) The proportion of PrEP-providing clinics per new HIV diagnoses by state, ranked by quintile, 2018. (For interpretation of the references to color in this figure legend, the reader is referred to the Web version of this article.)

(72% in one study) [34] of primary care providers had low familiarity with prescribing PrEP, so many patients seeking PrEP will be limited to publicly listed PrEP clinics such as those in this study's data set. Using new HIV diagnoses from 2016, compared to PrEP clinic data from 2018, might introduce misclassification of characteristics of states, counties, or cities. Notably, CDC has recently indicated that new diagnoses decreased from 2008 to 2013 in the United States [35]. Ratios of PrEP-providing clinics to new HIV diagnoses may therefore be underestimated, although relative comparisons are likely still valid. Another limitation is that this analysis does not take into account the clinic size. However, having fewer PrEP clinics overall, even if some may be larger or smaller, still likely serves as a barrier to seeking care. Finally, access to a PrEP provider is not the sole barrier to PrEP use. An adequate distribution of PrEP-providing clinics would still not be sufficient to overcome other racial and economic disparities in PrEP access [36,37].

In the 6 years since the indication of emtricitabine/tenofovir disoproxil fumarate for PrEP by FDA, over 2000 clinics have publicly listed themselves as providing PrEP. Despite this success, there is insufficient PrEP clinic availability, and local availability is in contradiction of need. Alternative models of PrEP provision may facilitate access, including provision of PrEP at pharmacies, federally qualified health care centers, and through telemedicine [38,39]. Interventions to address disparities should also include structural interventions, such as Florida's use of county-health clinics to provide PrEP at no cost [40]. Such innovative programs and policies have the promise to decrease disparities in PrEP access and to support continuation of the overall expansion of PrEP as a highly effective HIV prevention strategy.

Acknowledgments

Support for development of the PrEP Locator was provided by the MAC AIDS Fund. The study was facilitated by the Emory Center for AIDS Research P30AI050409 and by R01MH114692. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health.

All authors have participated in conception and design or analysis and interpretation of the data, drafting the article or revising it critically for important intellectual content, and approval of the final version.

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