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Estimating the population need for preexposure prophylaxis for HIV in the United States[★]

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Abstract

Preexposure prophylaxis (PrEP) is highly effective in preventing HIV infections and is recommended for people without HIV who are at ongoing risk of HIV acquisition. In 2019, the U.S. launched the “Ending the HIV Epidemic in the U.S.” initiative, which aims to reduce by 90 % the number of annual new HIV infections. To monitor progress towards this goal, several national indicators have been established, one of which is PrEP coverage. Several ways to monitor PrEP use have been developed, each with its own advantages and disadvantages. We developed a method to estimate PrEP “need” in the U.S. that could be used as a denominator to estimate PrEP coverage. The “population need for PrEP” (PPN) is estimated based on the number of people needed to treat (NNT) with PrEP to prevent an additional HIV infection in subpopulations whose annual HIV incidence is ≥ 1 %. This is done in three steps: 1) calculating NNT for each transmission group using 1 % incidence threshold and clinical trial-and cohort-generated evidence of the degree of PrEP effectiveness in each transmission group, 2) estimating the proportion of new HIV infections in subpopulations with incidence at least 1 % from epidemiologic data, 3) multiplying estimates from steps 1 and 2 with the number of new HIV infections for each transmission group from Surveillance. The estimates for each transmission group are then added together, and the number of current PrEP users is finally added to this estimate to produce PPN.

[★]The views expressed in this paper are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

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This method is relatively easy to calculate and can provide public health authorities at the national, state, or local level with pragmatic estimates of PrEP “need” among different demographic or transmission groups, which can help with planning, resource allocation, and monitoring progress.

Keywords

Hiv; PrEP; Need; United States; Method

Preexposure prophylaxis (PrEP) is highly efficacious in preventing new HIV infections [1] and its scale-up is expected to make a substantial contribution to preventing HIV in the United States [2]. In 2019, the U.S. government launched the “Ending the HIV Epidemic” in the U.S. (EHE) initiative, which aims to achieve a 90 % reduction in new HIV infections [3]. The U.S. Department of Health and Human Services monitors progress towards the EHE goals by use of a number of metrics, one of which is PrEP coverage [4].

To calculate a PrEP coverage indicator, a denominator estimate is required to quantify the population who would be eligible for PrEP for HIV prevention. The PrEP indicator was reported by CDC until 2023 as a proportion: Its numerator was the number of people who have received at least one prescription for PrEP in a given year, derived from a validated algorithm that classifies persons prescribed PrEP using a national pharmacy claims database [4]. The denominator represented the number of people who could benefit from PrEP in that year by estimating the number of people “with indications for PrEP” [5]. This approach for deriving the number of people who would benefit from PrEP involved estimation of the number of gay, bisexual and other men who have sex with men (MSM) in the U.S. using the American Community Survey and U.S. Census data; and subsequently, calculating the proportion of MSM who have clinical or behavioral indications for PrEP [1]. This information was obtained using clinical indications for PrEP in sexually active persons together with self-reported behavioral data from the National Health and Nutrition Examination Survey (NHANES) data. The relative ratios of new HIV diagnoses in MSM vs people who have heterosexual sex (PHET) and people who inject drugs (PWID) were then used as proxies for HIV acquisition risk estimates, to estimate the number of PHET and of PWID who may be eligible for PrEP relative to the corresponding number of MSM with indications for PrEP [5]. The numbers of people who were eligible for PrEP from each transmission category (MSM, PHET, PWID) were then added to derive the overall estimate for the denominator of the PrEP indicator.

This estimate of PrEP ‘need’ makes good use of multiple nationwide data sources, however it has several limitations: i). It uses clinical and behavioral indications for MSM but not for PHET or PWID; instead, the PrEP indication estimation for these groups is based on the number of HIV diagnoses proportionate to that among MSM, which relies on assuming similar testing rates and similar HIV acquisition risk across these groups; ii). The method is complex and depends on multiple data sources with different schedules of data release, making it difficult to update in real time; iii). representation of self-reported behaviors that relate to clinical indications for PrEP (number of sex partners, condom use, previous sexually transmitted infection) in behavioral surveys may not be accurate

due to social desirability, recall, or other biases, and such misreporting of behaviors may vary across different transmission, age, race/ethnicity, or socioeconomic groups [6]. In addition, a particular type of clinical indication for PrEP may incur different level of HIV acquisition probability depending on geographic and temporal changes in HIV prevalence in particular locales/networks. Thus, estimating risk based on reported individual behavior may not accurately reflect the associated HIV acquisition risk. Some researchers have voiced concerns that the current NHANES-based estimate of proportion of MSM with indications for PrEP may underestimate the number of some groups of MSM such as young Black and Hispanic/Latino MSM who would benefit from PrEP [6–8]. Concerns have also been raised about whether the current PrEP indications for women can reliably identify women who may benefit from PrEP [9]. Alternative, less complex, and potentially more accurate, methods for estimating PrEP “need” would be desirable for health care resource allocation and monitoring of public health goals.

Some researchers have used a rate of PrEP users over the total U.S. population; others have proposed a “PrEP use-to-need ratio” [10,11], a ratio of the number of PrEP prescriptions in a year over the number of new HIV diagnoses in the previous year. While they can be used to compare different populations, these approaches cannot be translated into denominator estimates of number of people who “need PrEP”. Such an estimate could be useful on its own for program and resource allocation purposes, not just as a “denominator” of coverage.

“Need” for PrEP can be defined in different ways, each of which are oriented towards a desired public health prevention goal (e.g., preventing all or a proportion of new HIV infections in the U.S.). One approach, as mentioned above, focuses on estimating the number of persons with the presence of clinical or behavioral indications. Another pragmatic way can relate the need for PrEP to a threshold for the rate of HIV acquisition above which the benefits of using PrEP outweigh any risks. Such a threshold would only apply to the segments of a population that are at substantial risk, and it can be context- and goal-specific, and could thus vary geographically or temporally. We use an annual HIV incidence of 1 % as the threshold for sub-populations to prioritize for PrEP.

HIV incidence estimates in the U.S. among subpopulations at risk

Up-to-date evidence on HIV incidence for different populations at various levels of risk is not always easily obtainable. In particular, the populations under consideration would be the people who would benefit from PrEP, i.e. subpopulations at increased probability of HIV acquisition, and not the total U.S. population. Several sources of evidence indicate that utilizing an incidence threshold of 1 % for U.S. subpopulations who would benefit from PrEP is reasonable. A recently published systematic review of global HIV incidence found studies reporting HIV incidence as high as > 2 per 100 PY for groups of PWID and > 4 per 100 PY for groups of MSM in the U.S.; however no data were found for heterosexual women and men who may need PrEP in the U.S. [13].

For MSM, relevant clinical trial data could be from the U.S. component of the HPTN 083 clinical trial [14]. This randomized clinical trial was performed between 2016 and 2020 in multiple settings, including the U.S., and demonstrated superiority of injectable CAB

LA, compared with oral daily tenofovir/emtricitabine (TDF/FTC) as PrEP, in preventing HIV. The U.S. HIV incidence for MSM in HPTN 083 was 1.33 per 100 PY in the TDF/FTC arm and 0.26 per 100 PY in the CAB LA arm. These rates are consistent with a baseline incidence without PrEP greater than 1.33 per 100 PY in the U.S. among MSM with indications for PrEP; some studies have estimated an annual HIV incidence as high as 2–7 % among particular subgroups, such as Black MSM or Hispanic/Latino MSM in jurisdictions with high HIV prevalence [13,15–19]. Several large cohort studies and clinical trials of MSM in the U.S. have documented an annual HIV incidence of 1 % or greater for MSM with characteristics that constitute clinical/behavioral indications for PrEP [14,20–22].

There is no recent clinical trial that tested PrEP efficacy among women in the U.S., where the HIV incidence among women is generally much lower than in some international settings. A recently published pooled analysis of PrEP efficacy from 11 post-approval studies of TDF/FTC conducted across many settings provides an estimated HIV incidence for women with no or consistently low adherence to PrEP, which can approximate incidence among women with indications for PrEP but not receiving PrEP. This incidence was 1.27 per 100 PY, compared with 0–0.13 per 100 PY among women with consistently high or consistently daily adherence to PrEP (90 % effectiveness). There was very little U.S. representation among the studies included in this pooled analysis, however [23]. Groups of women with estimated annual incidence ranging from 0.32 % to 1 % per year have been described among a few U.S. cohorts with clinical or behavioral characteristics that confer indications for PrEP, however one study was published over 20 years ago [21,24]. Race and ethnicity, as well as geography, are other factors associated with elevated HIV annual incidence [30,36]. As of November 2024, among 2556 U.S. women who used an HIV self-test obtained through CDC’s ongoing “Together Take me Home” project and who responded to a follow-up survey, 1.3 % reported a new positive HIV self-test result (personal communication, CAPT. R. MacGowan).

The Bangkok Tenofovir trial was, to our knowledge, the only trial of PrEP efficacy in preventing HIV among PWID; it was conducted between 2005 and 2010 in Thailand [25]. The HIV incidence without PrEP among PWID in this study was 0.68 per 100 PY vs. 0.35 per 100 PY in the PrEP arm (49 % efficacy); for those with detectable levels of tenofovir efficacy was 74 %. Estimates by Evans et al [26] indicate high incidence of HIV (9.3 per 1000 PY) among groups of PWID in U.S. settings.

The “number needed to treat” for each transmission group

A method to estimate the “need for PrEP” in the U.S. could be based on the concept of the “number needed to treat”, a metric estimating the number of people who need to receive a health intervention to gain benefit over a period of time e.g., prevent an illness or death, in this case PrEP for preventing new HIV infections [4]. The number needed to treat (NNT) is typically derived from clinical trials or other rigorously designed studies that evaluated a particular intervention in a given setting. When a study outcome is expressed as a percent risk reduction, the number needed to treat is the inverse of the absolute risk reduction. Similarly, when a study outcome is based on time of exposure (patient-years, PY), the number needed to treat is calculated based on cumulative event proportions and

reflects additional person-years needed to treat. NNT is a relatively simple metric and has the advantages of being easy to understand and applicable to public health efforts. However, it is dependent on the population studied, and will be lower for groups at higher baseline risk and higher for groups at lower baseline risk [12]. Additionally, different PrEP modalities will have different NNT, based on the effectiveness of the intervention (which depends on adherence); injectable long-acting cabotegravir (CAB LA) and lenacapavir will likely be associated with a somewhat lower NNT, compared with oral daily or event-driven PrEP, given the same HIV incidence, due to their higher effectiveness [13].

The NNT can be defined as follows:

$$NNT = \frac{1}{IR_U - IR_T} = \frac{1}{IR_U \times Efficacy_{PrEP}}$$
, rounded up to the nearest whole number, where IR_T is the HIV Incidence Rate in persons who received PrEP and IR_U is the HIV Incidence Rate in persons who did not receive PrEP (or, in this case, the baseline HIV Incidence in those who would benefit from PrEP).

Based on a baseline HIV incidence of 1 % per year and assumed PrEP effectiveness in preventing HIV acquisition due to sexual exposures of 90 % with high adherence, as shown in multiple reports [27–32], the NNT with PrEP to prevent one additional HIV infection in that population would be $\frac{1}{IR_U \times Efficacy_{PrEP}} = \frac{1}{0.01 \times 0.9} = 112$. As mentioned, NNT varies by level of incidence within a population, and it will vary by particular transmission groups, sexual networks, age, and other factors. [12,13,16]. NNT will also vary by PrEP modality, however, given that the great majority of current PrEP use in the U.S. is of oral PrEP, and CAB LA use is currently less than 2 % [33], we based the NNT calculations on oral PrEP effectiveness.

For PWID, assuming an incidence of 1 % per year as a threshold for the PWID subpopulation who may need PrEP and with an assumed PrEP effectiveness for PWID of 70 %, the NNT with PrEP to prevent one additional HIV infection would be 143.

Method of calculating “population need for PrEP” (PPN)

Population-level “need for PrEP” (PPN) can be estimated by applying the number needed to treat (NNT) to the most recent and locally granular available data of new HIV infections obtained by HIV surveillance [34]. Therefore, PPN would be calculated as: $PPN = NNT \times N$, where N denotes the number of new HIV infections in a year, observed within a population whose baseline HIV Incidence Rate corresponds to the IR_U used to calculate the NNT.

This calculation assumes that all new HIV infections occurred among people in subpopulations with annual incidence of HIV of 1 % or greater, an assumption that may not be true. For any population, there is a distribution of people at risk for HIV, some with higher underlying risk (greater than 1 %) and some lower. If only a proportion of people with new HIV infections are in subpopulations with a baseline annual incidence of 1 % or higher, then we need to remove the proportion of new HIV infections occurring within

the subpopulations corresponding to a baseline annual incidence below 1 % from the PPN calculation. Therefore, the formula for PPN is modified as follows:

If p denotes the proportion of new HIV infections that occur among persons within subpopulations with annual incidence of 1 % or higher, then the PPN would be calculated as:

$$PPN = NNT \times N \times p.$$

Proportion p of HIV incident infections in the U.S. that correspond to subpopulations with annual incidence ≥ 1 %

Several cohort studies in the US have demonstrated that people with epidemiologic, clinical or behavioral factors that confer a higher probability for HIV acquisition have annual HIV incidence of around 1 % or higher [20–22,24,35–39]. Some of these studies, as well as findings from CDC’s National HIV Behavioral Surveillance (NHBS) have also examined the prevalence of such factors among people with new HIV diagnoses. For example, condomless anal sex with 2 + partners has been found in approximately 70–80 % of MSM with a new HIV diagnosis, whereas rectal gonorrhea or chlamydia (GC/CT) infection has been found in a wider range of proportions (26–68 %) in different cohorts of MSM with a new HIV diagnosis [20–22,38,40]. Condomless anal sex (CAS) increases the rate of HIV acquisition 2–3 fold [21,22,38]; given an overall annual incidence rate among MSM of about 0.58 %, CAS may then correspond to an annual incidence of ≥ 1 %. The prevalence of CAS with two or more partners among MSM with a new HIV diagnosis from published studies mentioned above as well as from NHBS data (Dr C. Wejnert, personal communication) can aid in determining that the proportion of new infections acquired by MSM at ≥ 1 % annual probability of HIV acquisition could be about 0.7; while about 30 % of new HIV infections stem from MSM subpopulations with a lower than 1 % per year risk of acquiring HIV.

For heterosexual women in the US, the factors most predictive of higher HIV incidence in different cohorts included substance use and demographic characteristics such as race and geographic location; injecting drugs and crack cocaine use was associated with elevated HIV incidence rates up to 30-fold [35], whereas sexual behavioral factors alone did not confer annual HIV incidence rates of 1 % or higher [21,24,35,39,41]. The prevalence of substance use varied between studies of women with recent HIV infection from 14 % to 60 %; data were based on small numbers of women with new HIV diagnosis [24,35,39]. A reasonable approximation of the proportion of new HIV infections that came from a subpopulation of women with a 1 % or higher HIV incidence rate may be 0.3, near the midpoint of the estimates of the studies mentioned.

As there were no relevant data we could find for heterosexual men in the U.S., we selected 0.2 as the proportion of new HIV infections that come from a subpopulation of heterosexual men with an underlying HIV incidence rate of 1 % or higher. These proportions set for both heterosexual women and men were somewhat arbitrary selections and could likely vary.

Sharing syringes and condomless sex in the past 12 months were associated with elevated proportions of recent HIV infections by 1.7–2.8 fold, respectively, in a study among PWID [37], where the overall incidence of recent HIV infections was 0.6 %. Among the 50 people with new HIV infections, 42 % shared syringes and 70 % reported condomless sex in the past 12 months. Therefore, we opted to use 0.5 as the proportion of new infections coming from a subpopulation at ≥ 1 % risk for PWID.

Refining the PPN calculation by incorporating multiple subgroups with varying levels of baseline HIV incidence and corresponding number needed to treat

A large proportion of new HIV infections (approximately 70 %) among MSM are attributed to a subpopulation with ≥ 1 % annual HIV incidence, so calculations using the NNT of 112 corresponding to an underlying incidence of exactly 1 % will overestimate the NNT because the incidence among this group is likely higher than 1 %. To improve upon this calculation, we can use available epidemiologic information to identify different subgroups of MSM corresponding to different levels of underlying annual incidence ≥ 1 %.

For PPN calculations, the proportion p can be divided into n subgroups, each with a different incidence rate and NNT:

$p_1, p_2, p_3, \dots, p_n$ = proportion of new HIV infections in each subgroup, where $\sum_{i=1}^n p_i = p$

$IR_1, IR_2, IR_3, \dots, IR_n$ = HIV incidence rate in each subgroup

$NNT_1, NNT_2, NNT_3, \dots, NNT_n$ = NNT for each subgroup, where

$$NNT_i = \frac{1}{IR_i \times Efficacy_{PrEP}}$$

$$PPN = \sum_{i=1}^n NNT_i \times N \times p_i$$

Rectal GC/CT is associated with an increase in the rates of HIV acquisition 3–4 fold, which may place the annual HIV incidence at 2 % or higher for those with rectal GC/CT [20,40,42,43]. Several studies indicate that rectal GC/CT are associated with approximately 15 % (and up to 30 %) of all incident HIV infections in the U.S. [40,44]. Based on this, we assumed that approximately 20 % of incident HIV infections correspond to subpopulations of MSM with annual HIV incidence of ≥ 2 %.

Given this epidemiologic evidence, for MSM we can create two subgroups: Subgroup 1 with high incidence (1 %) and subgroup 2 with very high incidence (2 %, estimated as those with rectal STI, representing 20 % of all infections). Based on these two groups, the adjusted NNT for subgroup 1 will remain 112 corresponding to an underlying incidence rate of 1

%, while the NNT for subgroup 2 will be 56 corresponding to an underlying incidence rate of 2 %, given the same PrEP effectiveness of 90 % in both subgroups. These estimated NNTs are supported by modeling studies. Compartmental models of the HIV epidemic at both the national level and focusing on a Southern state estimate the NNT for MSM to be roughly 100 and 50, respectively (C. Lyles, personal communication). Another modeling study of the U.S. HIV epidemic among MSM that included social network dynamics in various MSM populations and incorporated risk behavior, sexual partnerships, and other HIV transmission factors, also supports these estimated NNTs [16]. It should be noted that HIV incidence varies by race/ethnicity as well as age, with Black and younger MSM having higher incidence [34]; thus such groups of MSM may differ in the distribution of proportions at “high” vs “very high” incidence, and the corresponding incident cutoffs may differ as well.

For heterosexual men and women and for PWID there is no additional evidence we could find to help differentiate subgroups at higher levels of HIV incidence. Thus, the PPN is calculated based on an underlying incidence of 1 % and the corresponding NNT and p for each transmission groups, as discussed earlier.

Putting it all together: calculating population need for PrEP (PPN)

Based on above formulas and assumed parameter values, and utilizing the estimated number of new HIV infections in 2022 from the latest HIV surveillance report [34], the estimates of the magnitude of the Population Need for for PrEP (NNP) in 2023 in the U.S. are (Table 1):

PPN among MSM:

$$(NNT_{1, \text{MSM}} \times N_{\text{MSM}} \times p_{1, \text{MSM}}) + (NNT_{2, \text{MSM}} \times N_{\text{MSM}} \times p_{2, \text{MSM}}) = (112 \times 22,500 \times 0.5) + (56 \times 22,500 \times 0.2) = 1512,000$$

$$\text{PPN among PWID: } NNT_{\text{PWID}} \times N_{\text{PWID}} \times p_{\text{PWID}} = 143 \times 2300 \times 0.5 = 164,450$$

PPN among heterosexual women:

$$NNT_{\text{Het-women}} \times N_{\text{Het-women}} \times p_{\text{Het-women}} = 112 \times 4900 \times 0.3 = 164,640$$

PPN among heterosexual men:

$$NNT_{\text{Het-men}} \times N_{\text{Het-men}} \times p_{\text{Het-men}} = 112 \times 2100 \times 0.2 = 47,040$$

By adding these PPN estimates across the different transmission groups, the approximate total number of additional people who need to receive PrEP in the U.S. to prevent the new HIV infections that occurred in 2022 in the subpopulations with underlying annual incidence of 1 % or higher would be estimated as 1888,130.

Table 1 provides a range of PPN estimates for a range of PrEP effectiveness (50 %–90 %) [13–18]).

As the number needed to treat calculates the number of additional people needed to be treated in a year to prevent one infection, we need to also take into account the number of people who were already using PrEP for our total PPN estimate. Given that 366,359 people received PrEP prescription in the U.S. in 2021 [4], and assuming they corresponded to an

underlying HIV incidence of $\geq 1\%$ per year, this number can be added to the PPN estimate above, so that the total PPN estimate becomes $PPN = 2254,489$.

These calculations can also be made for discrete jurisdictions for which there are available HIV incidence data (states, counties) and for different sex, age, and race/ethnicity groups. Jurisdictions can then estimate the number needed to receive PrEP to achieve their prevention goals. This can be very useful from a programmatic perspective, and for monitoring progress towards achieving public health goals. Table 2 provides 2023 PrEP estimates based on this method for each U.S. state, using the same assumptions as described above. The method can also be applied to distinct demographic groups for which there are data on new HIV infections (or, for jurisdictions for which this number is not available, the number of diagnoses could be used as a proxy).

Discussion

The method we have developed for estimating the Population Need for PrEP (PPN) can be used with different levels of HIV incidence as thresholds; thresholds could also vary for different transmission groups or localities. Based on an annual HIV incidence rate of 1% as our defined threshold for PrEP ‘need’, our method estimated the number who need to be prioritized for PrEP in the U.S. as 2254,489 people in 2023. It is thus higher than the estimate of the currently used PrEP coverage indicator (which estimated approximately 1.2 M people with indications for PrEP in the U.S. in 2015). Advantages of the PPN method are its relative simplicity, and the fact that it can provide PrEP need estimates per jurisdiction and per any demographic or transmission group for which HIV incidence data are available; such data are broadly available and frequently updated in National HIV Surveillance. Through the possible inclusion of multiple subgroups within any group, the method can also accommodate information on these subgroups at different levels of HIV incidence which account for differing proportions of new HIV infections (population attributable fractions) when data are available. Local policy makers can use the estimates we used in this paper to define the size of subgroups at different levels of HIV incidence, or they can utilize local data that may be tailored to specific demographic or transmission groups. The PPN estimate can function as the denominator for a PrEP indicator and its findings would be valid as long as they represent a reasonably accurate reflection of the current state of the epidemic in the particular locality. Our estimates focus on preventing the portion of new infections that occur among those subpopulations with higher underlying annual HIV incidence ($\geq 1\%$). To be successful in preventing these infections, programs should prioritize PrEP for these communities or subpopulations with a 1% or higher risk of HIV acquisition. Limitations of the method include: i) It is difficult to accurately estimate HIV incidence in the different transmission groups in the U.S., as well as the proportions of new HIV infections that correspond to subpopulations with differing levels of incidence $\geq 1\%$. ii) We applied measures of PrEP effectiveness based on relatively high adherence. Effectiveness in practice may be lower, which would increase the PPN. Given that PPN represents the number who need to be on PrEP for a given time period, in this instance a year, this limitation could be overcome if use of PrEP (the numerator of a PrEP indicator) incorporates a measure of PrEP consistency and persistence, such as time covered by a PrEP prescription. iii) This method of estimating PrEP “need” does not provide information about

a particular individual's need for PrEP; clinical evaluation is necessary to guide individual recommendations; iv. We could be overestimating PrEP "need" if the proportion of new infections that occur among people with annual incidence of $\geq 1\%$ is lower than what we estimated based on clinical and epidemiologic evidence. This would mostly apply to heterosexual or PWID groups, for which incidence data are limited. We could also be overestimating among subpopulations of MSM, if the HIV incidence rates among those subgroups were higher than what we estimated above based on the 1% and 2% underlying HIV incidence rate thresholds we assumed. Finally, HIV incidence is estimated in National Surveillance and as such it has a range of uncertainty.

In summary, we have provided initial estimates of U.S. PrEP "need" based on an alternative method using NNTs for different transmission groups. This method could be further modified using different thresholds for HIV incidence to define PrEP "need". It could also be further refined for specific population groups and jurisdictions, based on additional information of PrEP use patterns as well as parameters of the HIV epidemic locally.

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Table 1

Range of “Population PrEP Need” in the U.S. in 2023 based on estimation of the additional Number of people who need to start PrEP among different transmission groups and a range of PrEP effectiveness.

Transmission group and HIV risk cutoffs used in calculations	Lower range of PrEP effectiveness *	Higher range of PrEP effectiveness **	Number Needed to Treat, higher estimation (NNT) *	Number Needed to Treat, lower estimation (NNT) **	Number of HIV incident infections in 2022 (N)	Proportion of new HIV infections that occur in subgroup with ≥ 1 % annual incidence	Population Need for PrEP (PPN) %&	Population Need for PrEP (PPN) **&
MSM (high incidence/very high incidence)								
1 %/2 %	50 %	90 %	200/100	112/56	22,500	.50/.20	2700,000	1512,000
Heterosexual Women								
1 %	50 %	90 %	200	112	4900	.30	294,000	164,640
Heterosexual Men								
1 %	50 %	90 %	200	112	2100	.20	84,000	47,040
PWID								
1 %	40 %	70 %	250	143	2300	.50	287,500	164,450
Total U.S. ***								1888,130

MSM: Men who have sex with men; PWID: People who inject drugs; PHET: People with heterosexual sex; NNT: number needed to treat

$$\left(NNT = \frac{1}{IR_U - IR_T} = \frac{1}{IR_U * Efficacy_{PrEP}} \right); IR_T = HIV \text{ Incidence Rate in persons treated with PrEP}; IR_U = HIV \text{ Incidence Rate in persons not treated with PrEP}$$

* Based on lower estimate of PrEP effectiveness;

** Based on higher estimate of PrEP effectiveness.

Estimates of the “total U.S. PrEP need” are based on focusing on subgroups with a threshold of 1 % HIV incidence within each of the transmission groups (MSM, PHET, PWID), 90 % PrEP efficacy for MSM and PHET, and 70 % efficacy for PWID and estimation of the proportion of new HIV infections (p) occurring among people with annual HIV incidence ≥ 1 % as 0.7 for MSM, 0.5 for PWID, 0.3 for heterosexual women and 0.2 for heterosexual men.

Adding the 366,359 persons prescribed PrEP in 2021, the total number of Population Need for PrEP in the U.S. is 2254,489 people in 2022.

& PPN = NNT × N × p. Bolded cells represent the estimates that were added to contribute to the total estimate on final row.

Table 2
Population Need for HIV PrEP (PPN) in the U.S. in 2023 by State and by transmission group.

State	Population Need for PrEP (PPN)*				PWID	Total
	MSM	Heterosexual Women	Heterosexual Men			
Alabama	34,317	5261	844		2867	43,287
Alaska**	2256	125	61		239	2681
Arizona	43,582	3257	596		3794	51,227
Arkansas	19,565	2906	614		1493	24,576
California	262,803	18,657	3496		23,949	308,903
Colorado	31,102	2101	597		1947	35,745
Connecticut	10,612	1972	956		1280	14,818
Delaware**	5064	814	662		997	7536
District of Columbia	11,220	2303	624		929	15,074
Florida	160,301	26,530	18,340		11,285	216,453
Georgia	105,343	15,760	5611		4636	131,347
Hawaii**	4736	289	148		946	6118
Idaho**	2659	166	88		558	3469
Illinois	60,435	8793	3301		4124	76,651
Indiana	25,136	3976	704		4868	34,682
Iowa**	7637	791	230		787	9443
Kansas**	8438	561	97		649	9743
Kentucky	18,197	1390	397		4971	24,953
Louisiana	32,613	5412	1357		5493	44,874
Maine**	1965	724	90		375	3152
Maryland	25,410	5206	2698		2044	35,357
Massachusetts	20,533	5000	1418		6373	33,322
Michigan	36,314	3591	540		2516	42,958
Minnesota	14,282	1880	491		2080	18,731
Mississippi	21,908	2720	757		1577	26,961
Missouri	22,983	3675	1453		3681	31,791

State	Population Need for PrEP (PPN)*				
	MSM	Heterosexual Women	Heterosexual Men	PWID	Total
Montana**	926	0	0	215	1140
Nebraska**	4765	624	201	824	6412
Nevada	28,855	2971	422	2280	34,527
New Hampshire**	1550	254	105	506	2413
New Jersey	38,902	5224	3127	4999	52,250
New Mexico**	5991	559	120	710	7378
New York	106,879	15,436	5099	12,667	140,078
North Carolina	55,299	6639	1577	4284	67,798
North Dakota**	1838	320	87	234	2477
Ohio	45,235	6351	1597	7779	60,961
Oklahoma	19,132	2343	454	3567	25,494
Oregon**	15,213	1624	289	3160	20,283
Pennsylvania	39,367	5941	2594	8637	56,537
Puerto Rico	10,059	1340	852	1333	13,582
Rhode Island**	4300	505	224	564	5591
South Carolina	35,214	4689	931	3028	43,860
South Dakota**	1524	234	139	692	2587
Tennessee	34,921	4336	1000	6443	46,698
Texas	238,590	25,958	5799	18,430	288,775
Utah**	11,221	877	132	742	12,970
Vermont**	490	130	0	168	788
Virginia	35,551	3885	1325	2611	43,370
Washington	29,956	4454	619	3104	38,130
West Virginia**	2028	234	276	7056	9592
Wisconsin	13,507	1464	511	1248	16,727
Wyoming**	855	0	34	83	970

* Based on an annual threshold HIV Incidence of 1 % for each of the transmission groups (MSM, Heterosexual Women, Heterosexual Men, and PWID), and PrEP Efficacy of 90 % for MSM, Heterosexual Women, and Heterosexual Men and 70 % for PWID; Proportion of new HIV infections occurring among those with underlying annual incidence ≥ 1 % estimated as 0.7 for MSM; 0.5 for PWID, 0.3 for

heterosexual women and 0.2 for heterosexual men. Estimates take into account the number of people already using PrEP by adding those who received a PrEP prescription in 2021 per transmission group according to the distribution of new HIV infections.

* * Number of diagnoses, rather than incident infections, were used for calculations in the indicated states when data on incident cases are not available at the state level.

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