

EVALUATING THE USE OF 90-90-90 FOR HIV POLICY IN THE ASIAN CONTEXT

Abstract

UNAIDS recommends the 90-90-90 policy for controlling HIV infection (identify 90% of HIV cases, provide care for 90% of these, and have 90% of the treated achieve viral suppression). 90-90-90 requires an accurate measurement of HIV prevalence, which is impossible to achieve. Prevalence must be estimated. Customarily, 90-90-90 prevalence estimates are based on point estimates at the midpoint of a credible range of high and low estimates. This paper examines the effect of the high and low estimates on 90-90-90. We examined the impact on policy goal based on 90% of the point estimate, if the true prevalence were the credible range's high or low estimate. This was calculated for 14 Asian Countries (Afghanistan, Cambodia, Indonesia, Iran, Kazakhstan, Laos Malaysia, Myanmar, Nepal, Pakistan, Philippines Thailand, Uzbekistan, Viet Nam) that UNAIDS estimated point prevalence of prevalence greater than 10,000 persons. If the low estimate for the 14 countries was the true prevalence, 11 of the countries could not achieve 90% of the point estimate because the low prevalence was less than 90% of the point estimate. The other three countries, would have to identify 97.5% to 99.0% of infected persons to achieve 90% of the point prevalence. If the true prevalence is the high estimate, twelve of the countries

would have identified only 76.8% to 84.9 of the true prevalence. Afghanistan (26.0%) and Iran (40.8%) would have identified far fewer persons than the point estimate goal. Therefore 90-90-90 should be considered to be non-evaluable and should not be used for policy making.

Key words: 90-90-90; HIV prevalence; Evaluation, Asia, Policy

UNDER PEER REVIEW

## Introduction

The United Nations' organization for dealing with HIV infection, UNAIDS, has adopted a policy known as the 90-90-90 concept as a goal for controlling HIV infection. The organization defined this as: "90% of all people living with HIV will know their HIV status; 90% of all people with diagnosed HIV infection will receive sustained antiretroviral therapy (ART); and 90% of all people receiving antiretroviral therapy will have viral suppression" (a level of circulating virus below the range of detectability with conventional laboratory assays). (UNAIDS . 90-90-90, 2017) Achieving the 90-90-90 policy would result in 72.9% ( $.9 \times .9 \times .9$ ) of HIV infected persons having a level of virus that would make them 95% less likely to transmit the virus to others. (Cohen et al., 2011)

Achieving these policy goals has been seen as approaching feasibility in the European context. Gourlay et al. examined 90-90-90 data from 11 European countries (Austria, Belgium, Denmark, France, Germany, Greece, Italy, the Netherlands, Spain, Sweden, and the United Kingdom). They summed the data from these countries and determined that the group had diagnosed 84% of Persons living with HIV; 84% of the diagnosed were on ART; and 85% of those were virally suppressed. This would equate to 60% ( $.84 \times .84 \times .85$ ) of individuals living with HIV being virally suppressed. (Gourlay et al., 2017) It should be noted that all of these countries were highly developed European countries with good public health infrastructures.

In a follow up study, a research group obtained data from 44 European countries and found that only Sweden and the United Kingdom had reached the 72.9% level indicating a 90-90-90

accomplishment. Forty-four countries provided data for at least one of the elements of 90-90-90. Only 37 countries provided estimates of prevalence and the percent of these that had been diagnosed which ranged from 38% to 98%. 37 countries reported the percent of diagnosed cases that were on antiretroviral therapy that ranged from 27% to 96%. 31 countries estimated the percent (32% to 97%) of those on therapy who were suppressed. (Porter et al., 2018)

Levi et al. demonstrated the difficulty of extrapolating those European results to the rest of the world. They examined available data from 196 countries and found that only 69 countries had estimates of the percent diagnosed, treatment coverage or percent suppressed. Only 32 countries had data on all three elements and another 37 countries had data on some of the three elements. The estimated range of HIV detection in 55 countries ranged from 11% to 87%. The percent of the estimated number of HIV infected person in 66 countries who were receiving ART ranged from 3% to 71%. In the 44 countries that had estimated the level of viral suppression, the range was from 7% to 68% of those receiving ART. (Levi et al., 2016)

In 2018, only 60 countries the world had data on the percent of HIV positive persons, number of HIV positive individuals on antiretroviral therapy and percent of those who were virally suppressed. Of these, 79% (67–92%) knew their HIV status; 78% (69–82%) were receiving treatment and 86% (72–92%) of people receiving had suppressed viral loads. Of these countries 15 were said to have achieved 90-90-90. (Marshall et al., 2019)

Using the 90-90-90 concept as policy also has been examined from the perspective of availability of financial resources to implement 90-90-90 throughout the world when considering medication costs, personnel necessary to administer the program and the needed facilities. (Grimes and Grimes, 2018; Dutta et al., 2015; Bain et al., 2017) The UNAIDS policy also has been questioned on the basis of continuing stigma associated with HIV infection in many areas.

Stigma will make testing infeasible at the 90% level and contribute to the lack of infrastructure for linking to care and retaining HIV infected persons in care. (Bain et al., 2017) There also have been questions about the capacity of the supply chain that is necessary to assure that medications reach HIV infected persons.<sup>9</sup> (Jamieson and Kellerman, 2016) Two systematic reviews have shown that attempts to improve the elements of 90-90-90 have been found to be difficult to achieve. (Dave et al., 2019; Mbuagbaw et al., 2019)

In spite of these caveats, the 90-90-90 policy has been adopted by multiple countries and over 150 cities throughout the world have adopted 90-90-90 as their HIV control policy. (fast track cities 2020) Adopting 90-90-90 requires a government to commit significant resources to accomplish these goals. Good stewardship of funds obligates the organizations allocating the funds to evaluate progress toward accomplishment of the elements of 90-90-90.

Evaluating progress toward the 90-90-90 policy rests entirely on the ability to accurately determine the number of persons infected with HIV (the prevalence) because the other two calculations depend on it. Prevalence of HIV is extraordinarily difficult to determine. As UNAIDS says “it is impossible to count the exact number of people living with HIV, people who are newly infected with HIV or people who have died from AIDS related illness in any country: doing so would require regularly testing every person for HIV and investigating all deaths, which is logistically impossible and ethically problematic.” (UNAIDS, Annex on Methods, 2020)

Determining prevalence requires knowledge of the unduplicated laboratory results of individuals who been tested and the unachievable knowledge of the infected status of those who have not been tested. The latter group includes some who are unlikely to be tested due to a positive result revealing their engagement in illegal and/or stigmatized behaviors. The degree of illegality or stigmatization varies in different populations and sub-populations thereby making it impossible

to determine the point estimate that is required to calculate 90-90-90. It has also been difficult to identify in older populations. (Rohr, 2020)

Nonetheless countries and cities base their 90-90-90 calculations on a point estimates of HIV prevalence. This is in spite of the fact that their point estimates are surrounded by a range that includes a high and low estimate of the prevalence. This is sometimes termed the credible interval and should not be considered as the tails of a normal distribution. Rather these are numbers that suggest that the true prevalence is somewhere between the high and low estimates. UNAIDS describes the range that is calculated by their method, “The software calculates uncertainty bounds around each estimate that define the range within which the true value (if it could be measured) lies.” (UNAIDS data and estimates, 2020) Once one recognizes that there is an interval around the point estimate, the difficulty of evaluating the success or failure of achieving the 90-90-90 aspiration becomes evident. If the true prevalence is less than 10% of the point estimate it is impossible for any location to be successful at identifying the 90% of the point estimate. Similarly, if the true prevalence is the high estimate, then achieving 90% of the point estimate means that the result is less than 90% of the true prevalence. For example, consider a hypothetical jurisdiction that had a point estimate of 1000 HIV infected persons with a credible interval of 850 to 1150. If the goal is to achieve 90% of the point estimate or 900 persons, then it cannot be achieved if the true prevalence is the low end of the credible interval or 850. If the true prevalence is 1150, identifying 90% of the point estimate means that the actual accomplishment is only 78% ( $900 \div 1150$ ).

The purpose of this paper to demonstrate how the uncertainty around the point estimate of prevalence of HIV impacts the calculations used to evaluate the success of reaching 90-90-90 in Asian countries.

## Methodology

The usual method for calculating 90-90-90 is to use 90% of the point estimate of prevalence as the goal and to multiply it by the percent of accomplishment of treatment and viral suppression. Given that it was the policy goal, we calculated the degree of error that would occur in meeting that goal if the true prevalence was either the high or low end of the credible interval. This was calculated for 14 Asian countries for which UNAIDS had provided an estimated point prevalence of over 10,000 HIV infected persons and a credible range around that estimate. (UNAIDS HIV data and estimates), 2020) The countries were Afghanistan, Cambodia, Indonesia, Iran, Kazakhstan, Laos, Malaysia, Myanmar, Nepal, Pakistan, Philippines Thailand, Uzbekistan and Viet Nam

The authors calculated low and high ends of the range as a percent of the point estimate. If the low estimate was the true prevalence and was less than 90% of point prevalence a country would have established as a policy goal of identifying more HIV positive persons than there were in the country. If the low estimate was above 90% of the point estimate, the authors calculated the percent of HIV positive persons that would have to identified in order to reach 90% of the point estimate. The high estimates were divided into 90% of the point estimate to determine what the actual percent of HIV infected persons that would have been identified if the high prevalence was the true prevalence.

## Results

Table 1 shows that, if the low estimate of the credible range for the 14 countries was the true prevalence, 11 of the countries could not achieve a goal that was based on 90% of point estimate as the true prevalence was less than 90% of the point estimate. The other three countries, would

have to identify 97.5% to 99.0% of the true prevalence in order to reach 90% of point prevalence. If the true prevalence is the high estimate, twelve of the countries would have identified only 76.8% to 84.9 of the true prevalence. Afghanistan (26.0%) and Iran (40.8%) would have identified far fewer persons than 90% of the point estimate.

## Discussion

The data presented in the table show the potential effects of uncertain estimates of prevalence. While they show the extremes, they indicate that variations from the point prevalence in either direction lead to false or unattainable results in determining whether 90-90-90 has been accomplished. Given that the provision of resources is usually dependent on achieving stated goals, variations in actual prevalence may greatly affect resource allocations. If the true prevalence is less than 90% of the point estimate, then either more resources will be devoted to trying to achieve the impossible or decision makers will declare a successful program to be a failure and withdraw resources. Conversely, if the high prevalence is the true estimate, programs that claim to have achieved the 72.9% goal based on the point estimate will have achieved lower outcomes even if 90% of the point estimate are identified, 90% of those are on antiretroviral medications and 90% of those are virally suppressed.

One must also be cautious about assigning truth to either the point estimate, the high estimate or the low estimate. The methods annex for the UNAIDS (UNAIDS, 2020) discusses the methods used for making prevalence estimates. These include monitoring positivity rates from antenatal clinics and cohort studies. The data from the antenatal clinics are the most comprehensive data on prevalence. Obviously, they exclude males but one can make assumptions about the ratio of HIV infected males for each HIV positive antenatal clinic attender. However, these assumptions can be complicated by the degree of polyandry, polygamy and short-term sexual relationships in

a population. In addition, these data do not reflect HIV rates in non-pregnant women or in men who have sex with men. Cohort studies are not random samples of the population so they may or may not reflect the actual prevalence. In addition, in countries where there are no cohort studies, UNAIDS uses cohort data from neighboring countries. So, while UNAIDS works diligently at estimating prevalence for many countries, it is greatly hampered by lack of sound data on which it can base its estimates. As result, even the best estimates of credible intervals of prevalence may be wrong.

If achieving 90-90-90 becomes the basis on which resources are allocated it will be easy for receivers of the resources to downgrade the point estimate to the level that indicates a false success. This could indicate that using 90-90-90 as the basis for resource allocations may result in poor estimates of prevalence making good HIV planning efforts less likely. Finally, one must recognize that obtaining a precise estimate of prevalence is impossible. As a result, it is equally impossible to accurately evaluate whether the 90-90-90 policy is being achieved. Therefore, while 90-90-90 is conceptually elegant, it should be recognized as a non-evaluable approach toward HIV control and should not be used for HIV policy.

## References

Bain LE, Nkoke C, Noubiap JJN. UNAIDS 90–90–90 targets to end the AIDS epidemic by 2020 are not realistic: comment on “Can the UNAIDS 90–90–90 target be achieved? A systematic analysis of national HIV treatment cascades”. *BMJ Global Health* 2017;2:e000227. doi:10.1136/bmjgh-2016-000227.

Cohen MS, Chen YQ, McCauley M. Prevention of HIV-1 Infection with Early Antiretroviral Therapy. *N Engl J Med*. 2011;365(6):4.

Dave S, Peter T, Fogarty C, Karatzas N, Belinsky N, Pai NP. Which community based HIV initiatives are effective in achieving UNAIDS 90-90-90 targets? A systematic review and meta-analysis of evidence. (2007-2018). *PLoS ONE* 14(7): e0219826. <https://doi.org/10.1371/journal.pone.0219826>

Dutta A, Barker C, Kallarakal A. The HIV Treatment Gap: Estimates of the Financial Resources Needed versus Available for Scale-Up of Antiretroviral Therapy in 97 Countries from 2015 to 2020. *PLoS Med* 12(11): e1001907.

Fast Track Cities. About fast track Cities. <https://www.fast-trackcities.org/about>. Accessed Oct 23, 2020

Grimes RM, Grimes DE. Medication costs associated with early initiation of antiretroviral therapy. *AIDS Care*. 2018;30(12):1512-15.

Gourlay A; Noori T; Pharris A; Axelsson M; Costagliola D; Cowan S et al. The human immunodeficiency virus continuum of care in European Union countries in 2013: data and challenges. *Clin Infect Dis*, 64:1644-56,2017.93-505.

Jamieson D, Kellerman SE. The 90 90 90 strategy to end the HIV Pandemic by 2030: Can the supply chain handle it? *J Int AIDS Soc.* 2016;19(1):20917.

Levi J, Raymond A, Pozniak A, Vernazza P, Kohler P, Hill A. Can the UNAIDS 90-90-90 target be achieved? A systematic analysis of national HIV treatment cascades. *BMJ Global Health* 2016;1:e000010. doi:10.1136/bmjgh-2015-000010

Marsha K, Eaton JW, Mahya M, Sabina K, Autenrieth CS, Wanyekia I, et al. Global, regional and country-level 90–90–90 estimates for 2018: assessing progress towards the 2020 target. *AIDS* 2019, 33 (Suppl 3):S213–S226.

Mbuagbaw L, Hajizadeh A, Wang A, Mertz D, Lawson DO, Smieja M et al. Overview of systematic reviews on strategies to improve treatment initiation, adherence to antiretroviral therapy and retention in care for people living with HIV: part 1. *BMJ Open* 2020;10:e034793. doi:10.1136/bmjopen-2019-034793

Porter K, Gourlay A, Attawell K et al. Substantial Heterogeneity in Progress Toward Reaching the 90-90-90 HIV Target in the WHO European Region. *J Acquir Immune Defic Syndr* 2018;79:28–37.

Rohr JK, Manne-Goehler J, Gómez-Olivé FX, Wagner RG, Rosenberg M, Geldsetzer P et al. HIV treatment cascade for older adults in rural South Africa. *Sex Transm Infect.* 2020;96(4):271–276.

UNAIDS. 90-90-90. An ambitious treatment target to help end the AIDS epidemic.

<http://www.unaids.org/en/resources/909090>. Accessed Nov 30, 2020.

UNAIDS. Annex on Methods. Available at:

[http://aidsinfo.unaids.org/documents/estimates\\_methods\\_2018.pdf](http://aidsinfo.unaids.org/documents/estimates_methods_2018.pdf) Accessed November 30,

2020

UNAIDS HIV data and estimates. Available at UNAIDS. DATA 2020.

<https://www.unaids.org/en/resources/documents/2020/unaid-data>. Accessed November 30,

2020.

UNDER PEER REVIEW

Table 1. Effect of High and Low Prevalence Estimates in 2019 on 90-90-90 for 14 Asian Countries with a Point Prevalence Estimate of over 10,000 persons

Country	A Low Estimate	B Point Prevalence Estimate	C High Estimate	D Policy goal is 90% of Point Prevalence	E % to be Identified if column A is True prevalence (D÷A)	F % Actually identified if column C is True prevalence (D÷C)
Afghanistan	4,300	11,000	38,000	9,900	230%*	26.0%
Cambodia	63000	73,000	84,000	65,700	104%*	78.2%
Indonesia	550,000	640,000	750,000	576,000	104.7%*	76.8%
Iran	33,000	59,000	130,000	53,100	161.0%*	40.8%
Kazakhstan	30,000	33,000	38,000	29,700	99.0%	78.1%
Laos	12,000	13,000	15,000	11,700	97.5%	78.0%
Malaysia	78,000	88,000	98,000	79,200	101.5%*	80.8%
Myanmar	210,000	240,000	270,000	216,000	102.8%*	80.8%
Nepal	26,000	30,000	34,000	27,000	103.8%*	79.4%
Pakistan	160,000	190,000	210,000	171,000	106.9%*	81.4%
Philippines	81,000	97,000	110,000	87,300	107.7%*	79.3%
Thailand	410,000	470,000	540,000	423,000	103.2%*	78.3%
Uzbekistan	46,000	50,000	53,000	45,000	97.8%	84.9%
Viet Nam	200,000	230,000	260,000	207,000	103.5%*	79.6%

\* Impossible to accomplish because the policy goal is greater than Column A.