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Evaluating the Use of 90-90-90 for HIV Policy in the Asian Context

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Authors' contributions

This work was carried out in collaboration between both authors. Author RMG performed the calculations that were used in this paper. Authors RMG and DEG jointly wrote the paper. Both authors read and approved the final manuscript.

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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

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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.

Keywords: 90-90-90; HIV prevalence; evaluation; Asia; policy.

1. 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 conventual laboratory assays [1]. Achieving the 90-90-90 policy would result in 72.9% (.9 X .9 X .9) of HIV infected persons having a level of virus that would make them 95% less likely to transmit the virus to others [2].

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 x .84 x .85) of individuals living with HIV being virally suppressed [3]. 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 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 [4].

Levi et al. [5] 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 counties 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.

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 [6].

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 [7,8,9]. 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 [9]. There also have been questions about the capacity of the supply chain that is necessary to assure that medications reach HIV infected persons [10]. Two systematic

reviews have shown that attempts to improve the elements of 90-90-90 have been found to be difficult to achieve [11,12].

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 [13]. 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" [14]. 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 [15].

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" [16]. 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÷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.

2. 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 [16]. 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.

The effect of having the high and low estimates as the true prevalence on the accomplishment of 90-90-90 calculation based on the point estimate can be determined by the formulae:

1. The goal for 90% of point prevalence is: PE X .9 = G: Where PE = point estimate; G = goal;
2. The actual accomplishment if the high estimate is the true estimate is: G ÷ HE = accomplishment: Where HE = high estimate;
3. The necessary percent to be identified if the low estimate is the true prevalence: G ÷ LE = needed accomplishment: Where LE = low estimate (if > 100%, it was considered impossible to achieve).

3. RESULTS

Table 1 shows that, if the low estimate of the credible range for the 14 countries was the true prevalence, Afghanistan, Cambodia, Indonesia, Iran, Malaysia, Myanmar, Nepal, Pakistan, Philippines, Thailand and Vietnam could not achieve a goal of 90% of point estimate. This would be impossible because the true prevalence is less than 90% of the point estimate. Kazakhstan, (99%) Laos (97.5%) and Uzbekistan (97.5%) would have to identify almost all of the true prevalence in order to reach 90% of point prevalence. If the true prevalence is the high estimate, The countries would only achieve these results: Afghanistan (26%), Cambodia (78.2%), Indonesia (76.8%), Iran (40.8%), Kazakhstan (78.1%), Laos 78.0%), Malaysia (80.8%), Myanmar (80.8%), Nepal (79.4%), Pakistan (81.4%), Philippines (79.3%), Thailand (78.3%), Uzbekistan (84.9%) and Viet Nam (79.6%), This is the case because 90% of the point estimate is not equal to 90% of the true prevalence.

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*

4. 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 discusses the methods used for making prevalence estimates [4]. 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 [14]. 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.

5. CONCLUSION

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.

CONSENT

It is not applicable.

ETHICAL APPROVAL

It is not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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