

**MAKING THE END OF AIDS REAL:  
CONSENSUS BUILDING AROUND  
WHAT WE MEAN BY  
"EPIDEMIC CONTROL"**

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**A MEETING CONVENED BY  
THE UNAIDS SCIENCE PANEL**

**4-6 OCTOBER, 2017  
GLION, SWITZERLAND**

## 1. INTRODUCTION

In 2014, UNAIDS convened a panel of leading scientists, politicians, implementers, activists and people living with HIV to consider potential long-term goals for the global response to the AIDS epidemic. The panel agreed on “ending AIDS as a public health threat” by 2030 as an ambitious yet feasible goal for policies and strategies. Since then the “ending AIDS” language has seen widespread adoption, including within the UN Agenda for Sustainable Development, the 2016 UNAIDS Fast-Track strategy and the national policies of many countries. The 2016 United Nations General Assembly High-Level Meeting on Ending AIDS adopted a Political Declaration with a set of programme-coverage targets to be achieved by 2020—including 90–90–90 and access to comprehensive HIV prevention by 90% of people in need—to push towards the 2030 goal and ultimately toward the shared vision of getting to zero: zero new HIV infections; zero discrimination; and zero AIDS-related deaths.

It is in within this framework that the UNAIDS Science Panel convened a meeting of experts from various stakeholder groups on 4-6 October 2017 in Glion, Switzerland, to refine the pathway towards ending AIDS as a public health threat by more clearly defining the meaning of “epidemic control”. The particular objectives of the Glion meeting were:

1. To build consensus around an epidemiological definition of “epidemic control” that can be used by implementers, programme staff and policy-makers both to drive and to assess progress in the response to the epidemic in their own jurisdictions within national, sub-national, metropolitan or other strata.
2. To provide mathematical modellers with a clear goal towards which we are moving by 2025, 2030, 2035 and beyond, in order to inform future programmatic targets, estimates of the impact of the response and of resource needs.
3. To ensure that the definition of “epidemic control” is sufficiently nuanced to allow for the heterogeneity of the HIV response by age, sex, geography and key populations.

The meeting sought to include a broad range of expertise, including Science Panel members, national HIV response programme managers, representatives of communities of people living with HIV and key populations and other stakeholders.<sup>1</sup> To ensure frank and open dialogue, the participants agreed that unscripted discussions would be done under the Chatham House Rule, in which participants are free to use the information received, but neither the identity nor the affiliation of the speaker(s), nor that of any other participant, may be revealed. However, pre-prepared presentations and formal background papers were attributable to individual speakers and authors.

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<sup>1</sup> See annex 1 for participants list.

From the outset, concerns were expressed regarding whether using the term “epidemic control” and the epidemiological language around it would be misinterpreted to mean that HIV was no longer a major global concern or to be supportive of punitive or repressive approaches and have negative impacts on evidence-based interventions and communities of key populations and people living with HIV. Participants agreed that any new metric must strike a delicate balance between acknowledging the substantial progress that has been made, while also guarding against complacency and encouraging investment at the levels required to reach the Sustainable Development Goals.

In his opening remarks to the meeting, UNAIDS Executive Director Michel Sidibé stressed the need for a metric or metrics that can be used to galvanize the political and financial support required, and will be useful performance measures for programme managers and decision-makers at national and sub-national levels. Participants agreed that such metrics should be concise, easy to understand, scientifically valid, feasible (can be measured) and applicable to all epidemics and populations.

## 2. CONTEXT

### **Key epidemiological concepts for control, elimination and eradication<sup>2</sup>**

Disease occurrence is typically measured in terms of incidence (all new cases of a disease during a given period of time for a specific population) and prevalence (all existing cases of disease at a given moment in time for a specific population). An epidemic is defined as an increase in cases in a specific population above what is expected. For example, influenza may be present in a population at a baseline level, and then when many additional people are infected over a short period, it may be described as a flu epidemic. If the scope of the disease spread is to other continents and affects a substantial number of people, it may be termed a pandemic. A disease that is regularly found among a particular population or geographic area can be described as endemic. For example, malaria is endemic in many low-altitude, warm-weather rural areas of sub-Saharan Africa and southeast Asia. A disease is considered hyperendemic when the regular presence is at high and continued levels of incidence.

There are various epidemiological definitions that describe what it means for a disease to be controlled, eliminated or eradicated (see box). Disease control is defined as reducing incidence, prevalence, or mortality to a locally acceptable level through effective interventions. Thus, “epidemic control” refers to a change in epidemic dynamics in which specific goals are achieved, but some level of incidence and/or prevalence persists. Elimination refers to the interruption of transmission which may lead to the eventual elimination of disease. As with control, elimination occurs within a defined geographic area

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<sup>2</sup> Summary of the background paper, Epidemic control in the context of HIV: identifying goals and measuring success (Jones J, Sullivan PS, Curran JW), as presented by Jim Curran.

or region. In the context of other infectious diseases, continued prevention efforts, such as vaccination programmes, are often required to maintain elimination because the disease agent is still present in the environment or might return via processes such as mobility, immigration or from nonhuman sources. Eradication is the successful removal of a disease-causing pathogen from the environment, resulting in a complete halting of incidence globally.

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### Definitions of basic epidemiological measures of disease occurrence and control<sup>3</sup>

- Control: Reduction of disease incidence, prevalence, or mortality in a geographically defined area to a locally acceptable level via evidence-based interventions.
- Elimination of transmission: Complete cessation of incidence in a geographically defined area. Because the disease-causing agent persists, elimination requires ongoing intervention to maintain.<sup>4</sup>
- Elimination as a public health problem: Reduction of incidence and morbidity below a specific (globally defined) level.
- Eradication: Complete removal of the disease-causing agent from the natural environment. The disease-causing agent might persist in controlled laboratory environments. Prevention interventions are no longer needed.
- Extinction: Complete removal of the disease-causing agent from all natural and laboratory environments.

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Eradication of HIV remains an ultimate long-term goal that will require a vaccine and cure. Achievement of the goal of elimination is more feasible in the near term for two specific modes of HIV transmission—blood transfusions and vertical (mother-to-child) transmission—where prevention methods are currently available that are very effective, and where the risk of transmission largely occurs within clinical settings, in which interventions can be scaled up universally. It may also be feasible to eliminate AIDS-related morbidity and mortality by preventing the progression of HIV through universal access to antiretroviral therapy, even as some incidence of HIV persists. Given the current state of the epidemic, elimination of HIV transmission through sexual intercourse or the sharing of injecting equipment is a longer-term prospect in most parts of the world. Nonetheless, over the short to medium term, it is possible for countries to dramatically reduce both HIV transmission and AIDS-related morbidity.

Participants agreed that the standard definition of “epidemic control” to bring incidence, prevalence and mortality to “locally acceptable levels” is unsatisfactory as it is both vague and could imply complacency or acceptability for a certain level of AIDS-related mortality. To better define measures of achievement towards the ultimate goal of getting to zero, it is important to explicitly define what “control” means and how it can be measured. A useful

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<sup>3</sup> Definitions summarized from Generic framework for control, elimination and eradication of neglected tropical diseases, World Health Organization, 2016.

<sup>4</sup> “Elimination” is sometimes used in the sense of “elimination as a public health problem”. For example, elimination of syphilis has been defined by the World Health Organization as 50 or fewer cases of congenital syphilis per 100,000 live births.

metric discussed among participants was the basic reproduction number<sup>5</sup>, denoted  $R_0$ . The basic reproduction number of an infection is the number of cases that one case generates on average over the course of its infectious period in an otherwise uninfected population.<sup>6</sup> This metric is useful because it helps determine whether or not an infectious disease will spread through a population. When an  $R_0$  of less than 1 is maintained, the infection will die out in the long run; but if  $R_0$  is greater than 1, the infection will spread in a population. The reproduction number at a given time during an epidemic, when a proportion of the population is already infected, is denoted  $R_t$ .

### **Lessons from other disease control programmes<sup>7</sup>**

Efforts to define and achieve a state of control for the HIV epidemic should be informed by the lessons learned from other global infectious disease control efforts.

#### **Malaria**

In 1955 a Global Malaria Eradication Campaign (GMEP) based in practice on the widespread, regimented use of a residual insecticide such as DDT for indoor spraying and treatment of malaria was adopted by the World Health Assembly. The definition of eradication during this campaign was primarily the “global extinction” of the parasite, although this was at odds with the GMEP decision to exclude much of Africa from the strategy. Investment had focused solely on a campaign which was mainly logistical in operation, and actively denigrated broader control measures and discouraged research.

The GMEP succeeded in giving a final stimulus to ongoing activities to eliminate malaria from Europe, North America, many island states and pushing it back a long way in parts of Asia and South-Central America. However, as malaria eradication reached the ‘consolidation’ phase there was still high expenditure, in an environment of greatly reduced transmission and disease incidence. Increasing resistance of vectors to DDT and of the parasites to chloroquine became a significant challenge. Sustaining political commitment and high levels of financing became increasingly difficult, and in 1969 the goal of eradication was abandoned. There was little attention given to malaria in the following decade, and the 1970s onwards saw a resurgence of the disease, sometimes in epidemic proportions.

The Roll Back Malaria initiative of the late 1990s was the first sign of renewed international interest. It successfully highlighted the significant malaria burden especially in Africa and advocated for malaria control programmes including both prevention and treatment to be delivered through strong health systems. In October 2007, a goal of eradicating malaria was again announced, this time by the Bill & Melinda Gates Foundation with endorsement from WHO. Both accepted that this was a long-term aspiration. There is disagreement among experts on whether eradication in Africa is technically feasible and whether an eradication programme that is not time-limited is sustainable. The most recent strategy for malaria control, built upon a vision for a “malaria-free world”, was adopted in 2015. It advocates a combination of control measures for highly endemic regions, investment in malaria elimination in 35 countries with low malaria incidence and research into developing novel interventions.

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<sup>5</sup> Sometimes called the basic reproductive ratio or the basic reproductive rate. The roots of the basic reproduction concept can be traced through the work of Alfred Lotka, Ronald Ross and others, but its first modern application in epidemiology was by George MacDonald in 1952, who constructed population models of the spread of malaria.

<sup>6</sup> Christophe Fraser; Christl A. Donnelly; Simon Cauchemez; et al. (19 June 2009). “Pandemic Potential of a Strain of Influenza A (H1N1): Early Findings”. *Science*. 324 (5934): 1557–1561.

<sup>7</sup> Summary of the background paper, Setting targets for HIV/AIDS—what lessons can be learned from other disease control programmes (Enoch J, Bhatia T, Khan M, Mathewson S, Heymann D, Hayes R, Dar O), as presented by Richard Hayes.

The lessons from the last 70 years of the malaria response caution against fluctuation in commitment and premature generalizable solutions that are not specifically tailored to the populations and geographies they serve. For example, investment in elimination or shrinking the malaria map should not be undertaken at the cost of malaria control in the countries with highest burden of disease.

### **Leprosy**

The example of leprosy highlights both the benefits and hazards of setting strong, high-level targets. Like HIV, leprosy has a long latency period and can be viewed as a chronic disease rather than an acute infectious disease. Following the advent of multidrug therapy (MDT), which cures the leprosy infection but does not restore damaged tissue, a surge in funding and treatment coverage led to a considerable decrease in disease prevalence by the end of the 1980s. Amid this progress and optimism, the World Health Assembly passed a resolution in 1991 seeking to “eliminate leprosy as a public health problem by 2000”, defining elimination as reduction of prevalence to less than one in 10,000 globally. The 1/10,000 target was set by a small number of individuals with minimal consultation, and was not supported by other evidence, such as modelling. It was hoped that if the level of infection decreased to this level, it would, as in some countries where leprosy had been present, continue to decrease and transmission would be interrupted.

At the global level, the target of a prevalence of 1/10,000 had seemingly been achieved by the end of 2000, and at the country level all but six countries reported having reached this target by 2005. Despite the impressive progress in reducing global disease burden (from about 12 million patients on leprosy registers in 1985 to 0.6 million in 2002), the elimination initiative did not lead to a reduction in the new-case detection rate within countries with a significant disease burden, such as India and Brazil. Continuing high numbers of new cases detected, including among children, indicated that MDT had not had the anticipated effect on the interruption of transmission. Since 2005, declines in both prevalence and incidence rates have largely stalled, and in many countries with a national prevalence below 1/10,000, high incidence rates persist in some areas at the sub-national level. Attaining the global target has thus represented an advance in leprosy control rather than elimination.

There is evidence that pressure to achieve the elimination target at the national level led to less active case-finding, diagnosis and reporting in some programmes. A 2003 independent evaluation recommended an approach to leprosy control focused on avoidance of nerve damage and rehabilitation of cases rather than on elimination. The elimination target of 1/10,000 was officially abandoned in 2007, and newer targets in WHO five-year strategies shifted towards a focus on preventing secondary disability. Disability-based targets and a target of zero countries discriminating on the basis of leprosy are underpinned by a broad agenda of 23 performance indicators, six guiding principles and three pillars, reflecting the complexities of leprosy control. The strategy emphasises the importance of “eliminating leprosy at the subnational level”, and encourages countries with large populations and high leprosy case-detection rates to include a target for elimination at the sub-national level in their country plans.

## **Tuberculosis**

Following the Second World War industrialized countries witnessed rapid declines in tuberculosis (TB) incidence as result of socio-economic development, including reductions in overcrowding and improved living conditions, nutrition and hygiene. Effective TB control was aided by the advent of chemotherapy and universal (free or affordable) access to health care combined with the building of vertical TB programmes ensuring case finding and specialized case management. However, by the early 1960s it was clear that this vertical programme approach was too costly for low-income countries. There was a move to integrate TB service delivery into general health services with the hope of increasing coverage and reducing costs. This approach was not appropriate for TB control since it required more specialist training and supervision. Integration led to the oversimplification of the information system, more passive monitoring and evaluating of case finding and of treatment results, and frequent shortages in critical medicines.

The early 1990s saw a sharp rise in TB notifications due to the growing HIV epidemic, dissolution of the former USSR and its vertical TB control programmes, especially among prison populations, and a collapse in general community health services. In 1993, WHO declared a “global TB emergency”. Global targets were set by the World Health Assembly in 1991, for the turn of the millennium that aimed at reducing TB incidence by 5-10% annually. Targets were based on the assumption that achieving an 85% cure rate and 70% case detection rate would reduce prevalence of active TB cases, thus leading to reduced transmission and the overall burden of illness and death. However, these targets failed to predict the impact the HIV epidemic was having on TB incidence. In addition, the global TB strategy assumed that increasing adherence and cure rates would prevent the spread of multi-drug-resistant TB (MDR-TB) and access to MDR-TB treatment was limited. Nonetheless, by 2015 the Millennium Development Goal to “halt and reverse TB incidence” was achieved on a worldwide basis with TB incidence falling by an average of 1.5% per year since 2000—although this rate of reduction was much lower than the target of 5-10% annually.

In 2014, the World Health Assembly approved the WHO End TB strategy, 2016-2035, which sought to reduce annual incidence to less than one case per million worldwide by 2050. This would mean that of the 9 billion people expected to be alive in 2050, the number of new cases of TB would need to be fewer than 9,000, as compared to the 9 million new TB cases in 2010. To meet this target, the strategy ambitiously calls for the incidence rate to fall at 10% annually between 2015 and 2025 through the optimization of current tools, approaches and significant progress in achieving the Sustainable Development Goals (SDGs), and then declines further at an average of 17% annually with the advent of new technologies including a vaccine, drug treatments for active and latent disease and point of care diagnostics. Modelling studies from 2014 suggest that optimization of existing tools could achieve the strategy’s 2025 targets in some countries, such as South Africa, but not in other countries with high incidence, such as China and India, although there could be substantial health gains.

### Lessons across the three disease responses

- Scientific and technological advancements and an enabling environment to implement the most effective interventions are fundamental to the setting, monitoring and realization of global targets for disease control and achieving eradication.
- “Epidemic control” was a common concept across all three disease responses.
- Strong political, social and economic commitment is necessary at all levels of society to achieving sustained success. Care must be taken to draw on expertise from biomedical sciences, social sciences and economics, stakeholders from national programme delivery, patient/ carer representatives and civil society more broadly. At the global level, the engagement of political stakeholders from the highest burden settings is also crucial.
- An appropriate balance needs to be found between ambitious, aspirational, galvanizing targets, that drive funding and political/ public engagement, and ones that reflect the complexities and local epidemiological variations in disease profile.
- Care should be taken to avoid overly burdensome reporting requirements for individual local programmes and countries, and the potential confusion of too many overlapping and sometimes conflicting targets both within and across vertical disease programmes.
- Achieving coverage targets is important, but the higher objective is to reach an impact target. “Epidemic control” targets should therefore focus on impact rather than process achievement, and they should promote equity.
- Targeting reservoirs of infection is critical to the elimination and eradication of infectious diseases, and must be done in a way that does not stigmatize or infringe upon the rights of people living with a pathogen or at high risk of infection.
- There is a need to ensure the retention of expert healthcare workers’ and other specialists’ technical skills and services while moving towards integrated health systems if effective disease control programmes are to be maintained
- Although not relevant to HIV at this time, eradication campaigns can be motivating, but they can also be dangerous when efforts to achieve eradication in low-incident areas distract from efforts to control the disease in high-incidence areas.
- Although not relevant to HIV without an effective HIV vaccine or cure, sustaining any elimination or eradication strategy in the end phase and achieving success once incidence and prevalence levels are low will require prolonged investment and continuing political buy-in.
- Achieving elimination and/or eradication will only be possible with sufficient investment in: (a) research to develop new prevention tools such as vaccines, novel point of care diagnostics and treatments to counteract the effects of increasing drug resistance; (b) public health infrastructure upgrades that address wider determinants of health; and (c) health and surveillance systems that allow for and ensure equitable delivery and access to services.



### 3. FOUR POTENTIAL METRICS

Four potential metrics or milestones that could complement existing indicators as countries move along the pathway to ending the AIDS epidemic were presented to participants: percentage reductions; an absolute rate; an incidence-mortality ratio; and an incidence-prevalence ratio. The advantages and limitations of each measure were explored, leading to greater shared understanding of both the added value a measure of “epidemic control” could bring to the HIV response and the unintended consequences such a measure could have if it is not carefully presented and explained.

#### Percentage reductions

Modelling exercises conducted in 2014 and 2015 defined “ending AIDS as a public health threat by 2030” as 90% reductions in new HIV infections and AIDS-related deaths compared to a 2010 baseline. The model calculated the levels of service coverage that would be required to achieve this impact, as well as the level of financial resources needed to pay for those services. This modelling work informed the development of a UNAIDS “Fast-Track” strategy that called for front-loaded investment and rapid expansion of HIV prevention, testing and treatment services between 2016 and 2020. Most of these service coverage targets for 2020, such as the 90–90–90 treatment targets, and interim impact targets of 75% reductions in new infections and AIDS-related deaths by 2020, were subsequently agreed by the United Nations General Assembly within its 2016 Political Declaration on Ending AIDS.

Among the advantages of these percentage-reduction targets are their simplicity, their applicability to all countries regardless of the level of a country’s epidemic in 2010, and scalability to regional, national and sub-national levels, as well as the possibility of measuring progress by sex (male/female) and by age group. Data are also readily available: estimates of new HIV infections and AIDS-related deaths are produced annually by countries and published by UNAIDS, meaning that progress towards the targets can also be measured annually.

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#### Percentage reductions in new HIV infections and AIDS-related deaths

$$\frac{[\text{New infections, 2010} - \text{New infections, 2020}]}{\text{New infections, 2010}}$$
$$\frac{[\text{AIDS-related deaths, 2010} - \text{AIDS-related deaths, 2020}]}{\text{New infections, 2010}}$$

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Participants noted that such steep reductions in low-level epidemic settings may be more difficult to achieve than in high prevalence settings. The 2010 baseline also tends to disadvantage countries that made strong gains against their epidemics before 2010, compared to countries that scaled up their HIV responses relatively later.

### **Absolute rate**

Another option proposed was absolute rates of HIV incidence and AIDS-related mortality of less than one per 1,000 adults per year, or less than one per 10,000 adults per year. Public health officials are used to definitions in terms of absolute rates, such as the leprosy target described earlier and the definition currently included within the process to certify the elimination of vertical transmission of HIV. This is also an indicator used to measure progress towards the Sustainable Development Goals (SDG indicator 3.3.1).<sup>8</sup>

How achievement of absolute rates of incidence and mortality would achieve control of the HIV epidemic was illustrated using Malawi as an example. With an adult prevalence of 10%, an incidence of 1/1,000 adults would be more or less balanced by the AIDS-related mortality expected in a good treatment programme (at least 1% per year, which is equivalent to 1/1,000 among the adult population). As other people living with HIV die of natural causes, the overall population of people living with HIV will fall and the epidemic could be described as being controlled.

The advantages of absolute rates are that they are easy for policy-makers and the public to understand, they can be scaled globally, regionally, nationally and sub-nationally, and they can be applied to specific populations, age groups and gender. An interim goal of <1/1000 as a step towards epidemic control could be relevant in higher-incident and higher-prevalence settings. However, many countries with low-level epidemics concentrated among key populations are already below the 1/1,000 threshold, and some are below the 1/10,000 threshold, including countries that most would view as not having an epidemic that is under control. For example, the estimated incidence of HIV in India nationally in 2016 was between 0.8 and 1.4 infections per 10,000 people<sup>9</sup>—an estimate that hides rapidly rising incidence among people who inject drugs and men who have sex with men in some parts of the country<sup>10,11</sup>. The example illustrates that absolute rates may not work well for epidemics that are concentrated among gay men and other men who have sex with men, people who inject drugs, transgender people and sex workers, unless it was possible to determine disaggregated measures for subpopulations, by gender, geographic area or key population.

### **Incidence-mortality ratio**

In its 2017-2020 strategy, the US President's Emergency Plan for AIDS Relief (PEPFAR), the largest provider of funding for HIV responses in low- and middle-income countries, defines "epidemic control" as occurring "when the total number of new HIV infections [per year] falls below the total number of deaths from all causes among HIV-infected individuals [per year]".<sup>12</sup>

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<sup>8</sup> Available at <https://unstats.un.org/sdgs/metadata/>

<sup>9</sup> 2017 UNAIDS estimates.

<sup>10</sup> Lucas GM et al. High HIV burden among people who inject drugs in 15 Indian cities. *AIDS*. 2015 Mar 13;29(5):619-28. doi: 10.1097/QAD.0000000000000592.

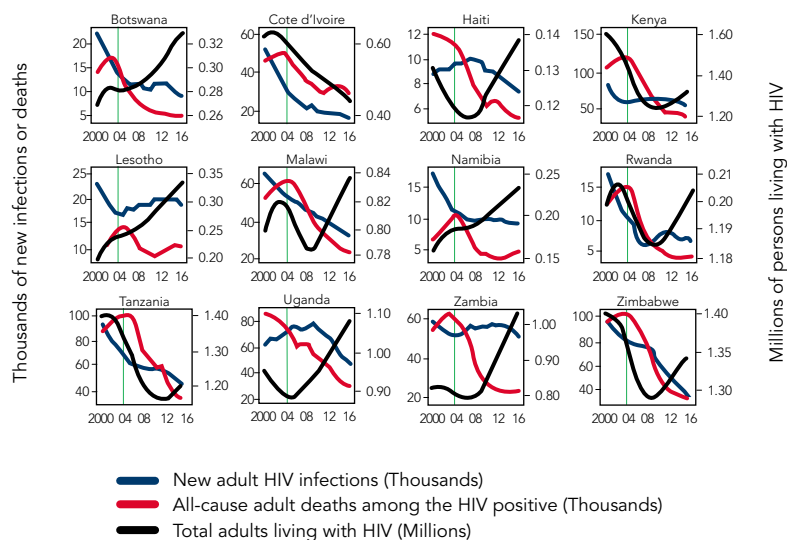
<sup>11</sup> Solomon SS et al. High HIV prevalence and incidence among men who have sex with men (MSM) across 12 cities in India. *AIDS*. 2015 Mar 27; 29(6): 723-731. doi: 10.1097/QAD.0000000000000602.

<sup>12</sup> Strategy for Accelerating HIV/AIDS Epidemic Control (2017-2020), US President's Emergency Plan for AIDS Relief (<https://www.pepfar.gov/documents/organization/274400.pdf>).

Combining HIV incidence and mortality among people living with HIV from all causes in a ratio produces a dynamic measure of the annual change in the number of people living with HIV within a given population that is relevant for both high-level and low-level epidemic settings. When the incidence-mortality ratio is greater than 1 (when there are more new infections than deaths within a year), there will be a net increase in the number of people living with HIV; when the incidence-mortality ratio is less than 1, there will be a net decrease in the number of people living with HIV. From the perspective of a Minister of Finance and international donors, who want to know how current investments in a country's HIV response will impact future resource needs, trends in the number of people living with HIV are important to monitor. In the absence of a cure, people living with HIV require lifelong antiretroviral therapy. As the number of people living with HIV increases, the financial burden on the health system increases. Conversely, as the number of people living with HIV decreases, so does the financial burden.

The incidence-mortality ratio (IMR) is a dynamic measure based on strong foundations within the field of epidemiology. However, use of the incidence-mortality ratio in isolation of other measures can be misleading. Reductions in the number of people living with HIV within a population can be achieved through high AIDS-related mortality, as was the case in many countries before antiretroviral therapy was widely available. Because high mortality is clearly not the objective of national AIDS programmes, PEPFAR has noted that reductions in the incidence-mortality ratio must occur within the context of high treatment coverage (greater than 70%). This is an important caveat, as currently only one of the 13 priority high-burdened countries supported by PEPFAR have an incidence-mortality ratio of less than 1: Côte d'Ivoire, where antiretroviral therapy coverage is 41% [35–47%] (see Figure 1).<sup>13</sup> Under the PEPFAR definition, Côte d'Ivoire is therefore not eligible for the calculation until treatment coverage is greater than 70%. The mortality measurement is all cause mortality and recognizes that people living with HIV on effective antiretroviral therapy will age similarly and have similar causes of death to people not living with HIV.

**Figure 1: Incidence, mortality and total adults living with HIV in 12 PEPFAR-supported countries**



Source: Computations by Over M using AIDSInfo (accessed September 20, 2017) supplemented by all-cause mortality data from Avenir Health's Spectrum model.

<sup>13</sup> Global AIDS Monitoring, 2017.

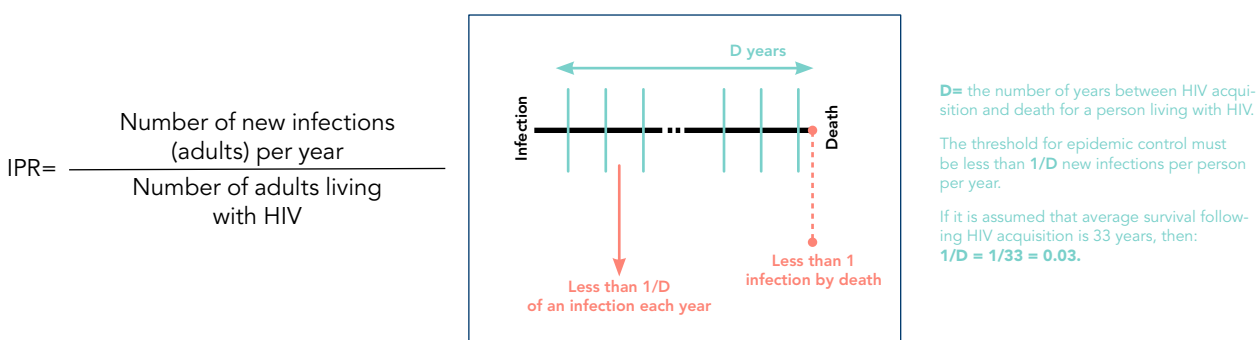
### Incidence-prevalence ratio

A similar dynamic measure under consideration is the incidence-prevalence ratio (IPR). In a stable epidemiological setting, the prevalence and incidence of a condition are directly linked by the average duration of that condition (Incidence \* Duration = Prevalence). When this equation is rearranged into a ratio of HIV incidence to HIV prevalence within a given population, the result is the average duration of time a person lives with the disease being measured (Prevalence/Incidence = Duration).

As well as preventing HIV infections, a primary objective of an HIV response is to ensure that people living with HIV live long and healthy lives. An advantage of the incidence-prevalence ratio is that it can incorporate both objectives by choosing a threshold for “epidemic control” that corresponds to a long life expectancy among people living with HIV. Another advantage of the incidence-prevalence ratio is that one of its two inputs—HIV prevalence—is much easier to measure accurately compared to mortality among people living with HIV.

An illustrative example was provided to participants. If it is assumed that acceptable average survival following HIV acquisition (D) is 33 years, the threshold for “epidemic control” is 1/33 or 0.03, which translates to three infections per 100 people living with HIV per year (Figure 2). If the number of new infections is less than three per 100 per year, then the epidemic is in a state of control and the total population of people living with HIV will gradually fall. However, if the number of new infections is more than three infections per 100 per year, the population of people living with HIV will grow over time and the epidemic is not considered to be in a state of control. If the acceptable survival is assumed to be 50 years, the threshold for “epidemic control” would fall to two new infections per 100 people living with HIV per year. Like IMR, the incidence-prevalence ratio is dynamic. A country could achieve a state of control, but if efforts are later relaxed and infections rise above the threshold, that state of control would be lost.

Figure 2. the incidence-prevalence ratio

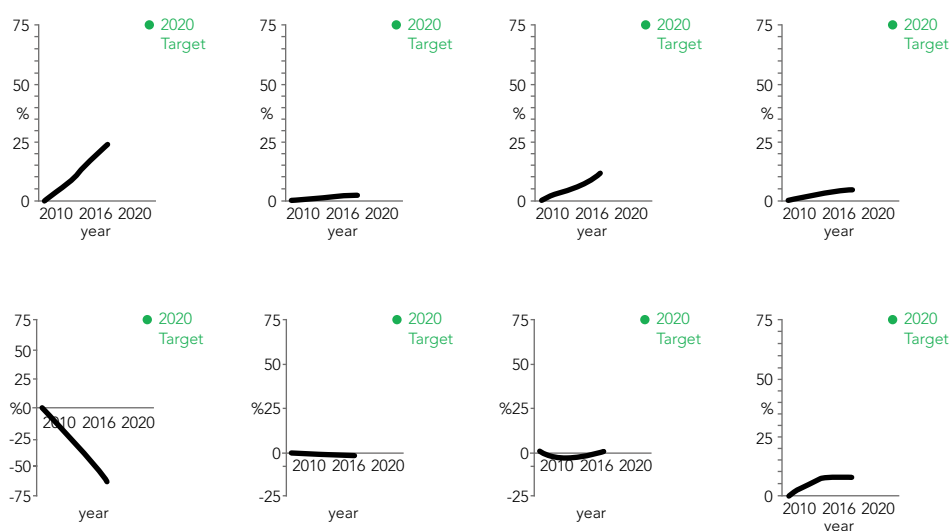


A principal challenge of the incidence-prevalence ratio is its applicability to sub-populations and geographic areas where there is significant migration in and out of the populations. The measure works best when there is a closed population of people living with HIV and people who are susceptible to HIV transmission. However, it is very difficult to apply the measure to a five-year age group (e.g. young people aged 20–24) because each year the population will change by about 20% as people age in and out of the group. It is also difficult to apply the measure to a population such as sex workers where HIV acquisition and transmission is not solely within the index population. Despite this drawback, the measure might still have limited value for key populations as a whole where they collectively comprise a large proportion of the overall epidemic because it gives an indication of whether people living with HIV within the key population are living longer. The incidence-prevalence ratio's ability to measure the duration of time a person lives with a disease is also compromised when an epidemic is rising or falling rapidly.

### Progress against the proposed metrics

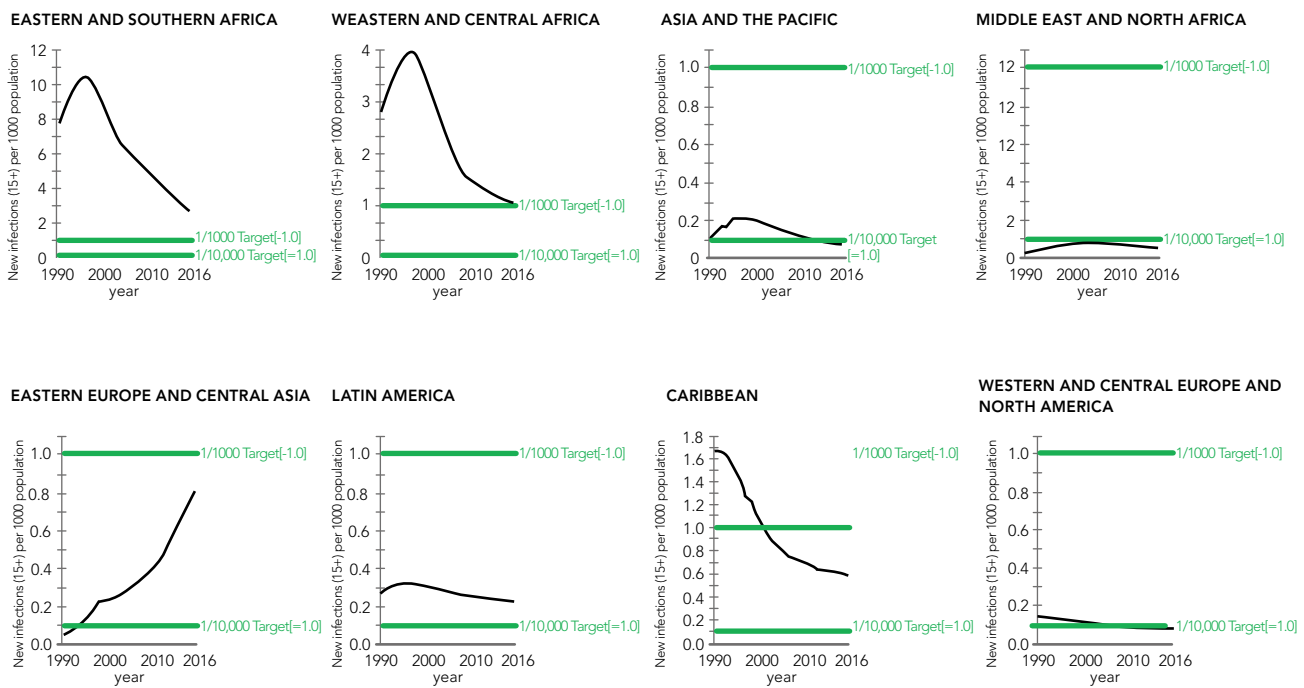
Global, regional and selected country progress against each of the four potential metrics was presented by UNAIDS to give participants a better sense of whether they reflected progress towards ending AIDS as a public health threat. Few regions<sup>14</sup> are on track to reach the existing 75% percentage-reduction targets for 2020, especially for new infections (Figure 3). Most regions are well under 1/1,000 threshold for new infections, and Asia and the Pacific, Middle East and North Africa and western and central Europe and North America have already crossed the 1/10,000 threshold (Figure 4). Several regions reached or nearly reached an incidence-mortality ratio of less than 1 before antiretroviral therapy was widely available, but the ratio steadily climbed above 1 in more recent years when AIDS-related mortality declined much faster than progress in reducing new HIV infections (Figure 5). Incidence-prevalence ratios by region ranged from about 0.03 for western and central Europe and North America to about 0.12 for eastern Europe and central Asia (Figure 6).

**Figure 3. Percentage reduction in new HIV infections among adults (aged 15 and above), by region, 2010–2016**

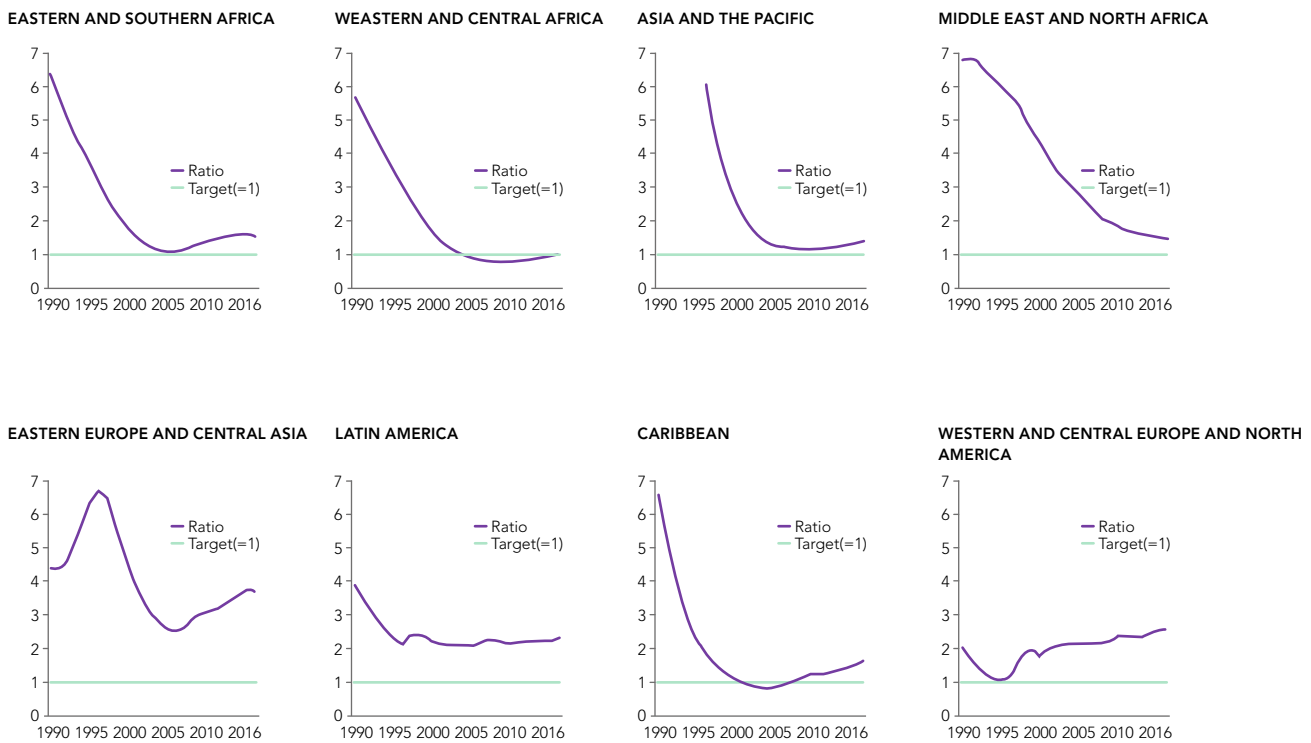


<sup>14</sup> The regions presented are standard UNAIDS groupings. Other organizations may define regions differently.

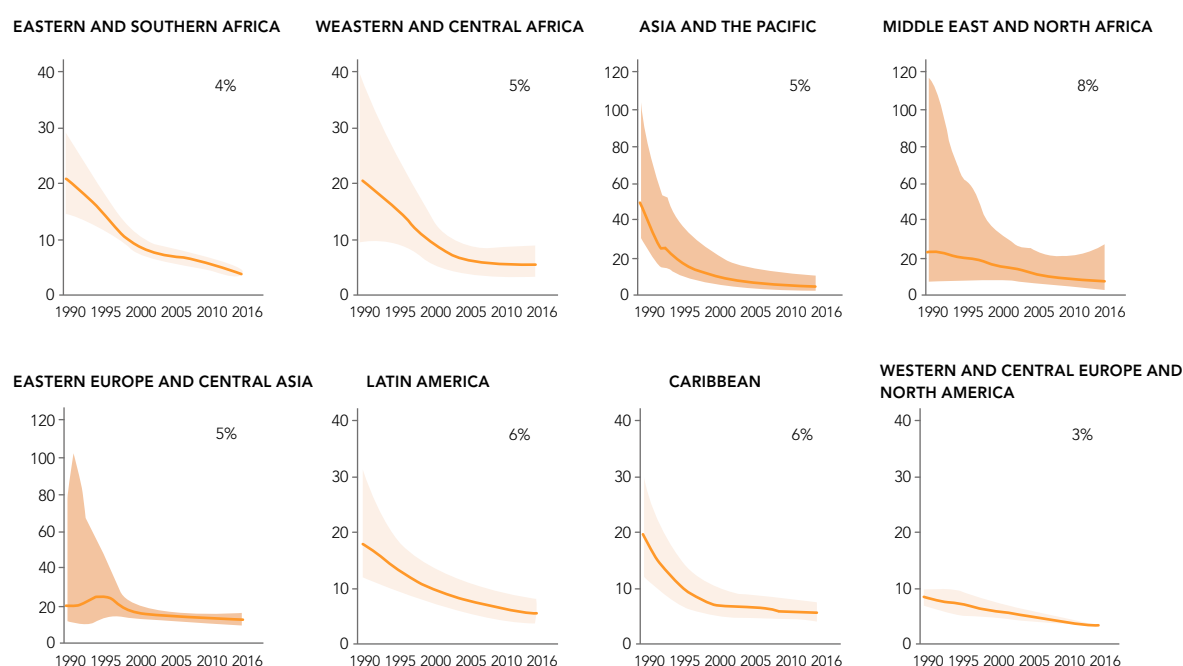
**Figure 4. Number of new HIV infections per 1,000 uninfected adults (aged 15 and above), by region, 2010–2016**



**Figure 5. Incidence-mortality ratio, adults (aged 15 and above), by region, 2010–2016**



**Figure 6. Incidence-prevalence ratio, adults (aged 15 and above), by region, 2010–2016**



#### 4. QUESTIONS AND CONCERNS

##### The term “epidemic control” itself

The concept of “epidemic control” and the four potential measures sparked vigorous debate among participants. There were objections to the term “epidemic control” itself and some of the language used to describe it as stigmatizing and even threatening for key populations and people living with HIV. Controlling the epidemic could in some settings easily become synonymous with punishing and controlling people living with HIV and controlling key populations, as well as promoting traditional “epidemic control” strategies as quarantines, contact tracing and compulsory interventions such as testing and treatment that violate human rights and have been shown to be counterproductive to effective and sustainable HIV responses. Communities particularly affected by the epidemic have spent decades advocating against language that blames them for the epidemic or that describes them as vectors of disease. It was noted specifically that neither people living with HIV nor key populations are drivers of the epidemic, but rather that the social and legal environment surrounding people living with HIV and key populations is what puts them at risk and drives the epidemic. Others argued that “epidemic control” is a standard epidemiological term that should not be exceptionally abandoned by the global HIV response in favour of more ambiguous terms or language.

##### What does “epidemic control” mean, and where does it fit within the current target framework?

At the outset there were different views regarding what “epidemic control” means within the context of other global targets. Participants accepted that

the 2020 Fast-Track targets and the 2030 target to end AIDS as a public health threat have been agreed by the United Nations General Assembly, and that any new measure is not meant to replace these targets. Participants also agreed that adding a new impact metric that measures whether a response is on track towards ending AIDS and getting to zero should not distract from countries' efforts to achieve service coverage targets, such as the 90–90–90 treatment targets or voluntary male circumcision targets by 2020.

There was also some debate about whether “epidemic control” should be interpreted as having reached a goal (i.e. the end of AIDS as public health threat) or rather should be viewed as an active state of being “in control” and heading in the right direction of ending AIDS as a public health threat if strong efforts continue.

Different metaphors were used by individual participants to describe these views. One was an ascent of Mount Everest, where the summit represents getting to zero, while “epidemic control” and “ending AIDS as a public health threat” correspond to critical basecamps along the route (Figure 7). This analogy perhaps lends itself better to a definition of “epidemic control” as a static threshold.

Figure 7. Climbing Mount Everest

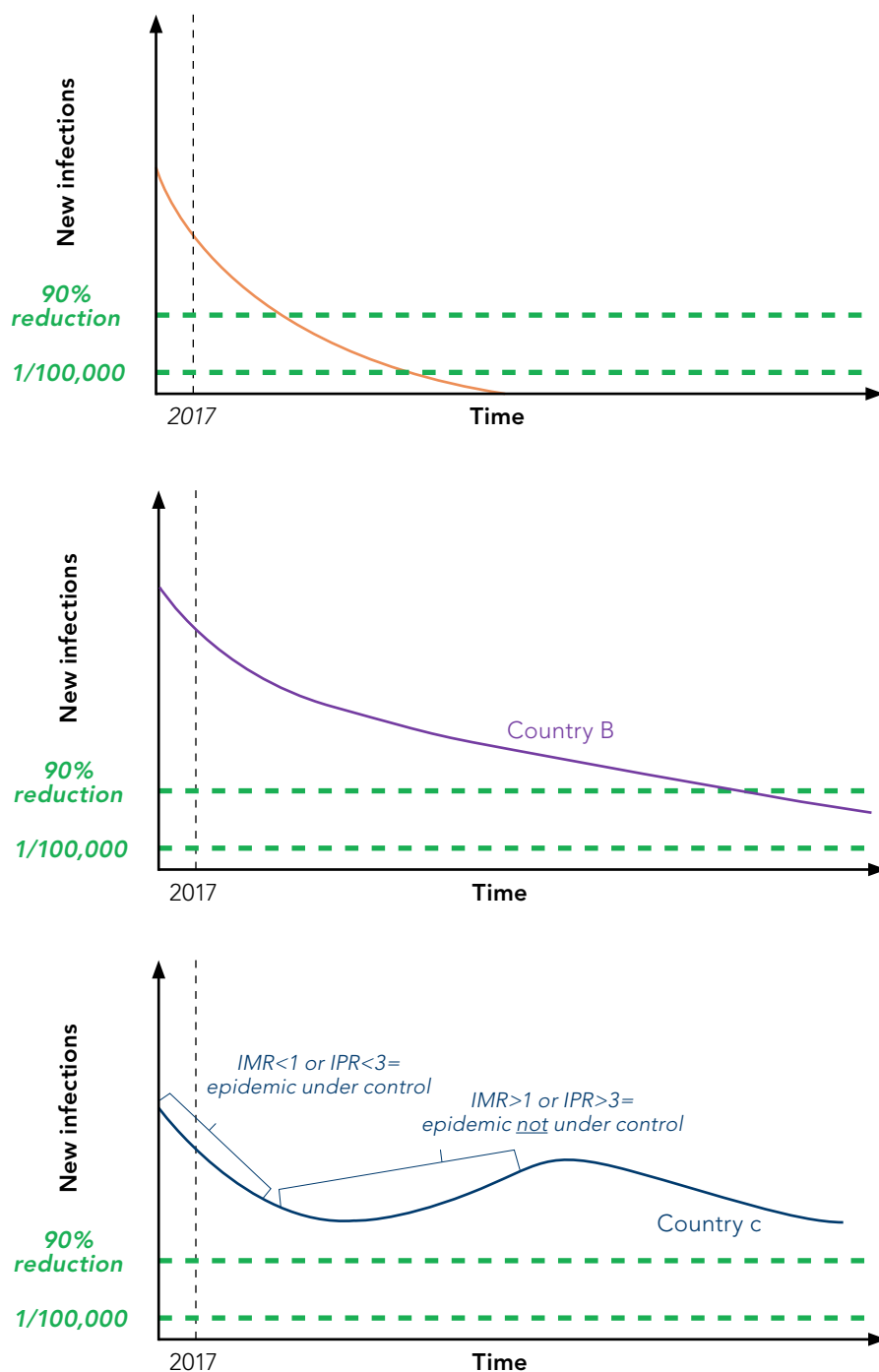


Another metaphor that may fit better with a dynamic measure, such as the two proposed ratios, was the glide path of an airplane on final approach, where “epidemic control” is represented by the mixture of airspeed, lift and pitch required to land at the end of AIDS as a public health threat. If this mixture is lost, the airplane will not land safely. Some countries may quickly



reach and maintain an incidence-mortality ratio below 1 or an incidence-prevalence ratio less than 3, and therefore achieve more rapid and sustained reductions in incidence and mortality (Country A); others may maintain ratios just below the required thresholds, translating to slower sustained gains (Country B); while others may struggle to maintain ratios below the thresholds, leading to uneven patterns of epidemic contraction and expansion (Country C) (Figure 8).

Figure 8. Illustration of a glide path towards zero



### **Scalability and disaggregation**

Participants largely agreed that any metric for “epidemic control” must ideally be applicable to both high-prevalence and low-prevalence settings, and also scalable from global level all the way down to local level. In other words, the measure should be useful for individuals and organizations responsible for tracking progress against the epidemic at all levels, from UNAIDS at global level to Kenya’s National AIDS & STI Control Programme to municipal HIV responses in Kiev, San Francisco or Johannesburg, or a project working with a cluster of rural villages in Mozambique.

Similarly, participants agreed that the measure should not hide progress or a lack of progress towards “epidemic control” in sub-populations, which may be defined by age, by sex or by key populations such as sex workers, people who inject drugs, prisoners, transgender people and gay men and other men who have sex with men. As the world continues on the path towards an end of AIDS, it is likely that an increasing number of countries will have epidemics concentrated among particular populations, so the utility of national-level metrics will diminish over time. All four metrics proposed appeared to have weaknesses in this regard.

### **Effectively reaching target audiences**

As well as being a useful metric for programme management that does not alienate affected communities, a metric for “epidemic control” must generate and sustain political commitment and resource mobilization. It was noted that recent messaging on “ending AIDS” coupled with the falling levels of morbidity and mortality have sometimes been misinterpreted to mean that the epidemic is already over and no longer a concern. Political leaders grappling with competing priorities want to know what the endgame for the HIV response is, and they want reassurance that investing in this endgame will lead to lower future costs, both financially and in terms of human lives. Views were expressed by some participants that the incidence-mortality and incidence-prevalence ratios need careful explanation and messaging, and that absolute numbers of new HIV infections and AIDS-related deaths are more straightforward than incidence and mortality rates.

### **Quality of underlying data**

A major limitation of all four metrics is that their inputs are usually based on modelled estimates, rather than data that are directly measured. The quality of these estimates relies on the strength of their models and the availability and quality of the input data. There are specific challenges in directly measuring HIV incidence due to the relative infrequency of HIV infections and the long latency period between infection and symptoms of disease. Individuals can be asymptomatic for several years. Therefore, most newly infected persons do not immediately seek HIV testing and may be diagnosed many months or years after infection, meaning that new diagnoses are not synonymous with new infections. For these reasons UNAIDS incidence estimates in high-prevalence settings do not use case reporting data.

Participants also noted that in many countries key populations may be unwilling to be tested out of fear that being a notified case of HIV or a registered key population will lead to stigma, discrimination or even incarceration. Anecdotes were shared regarding how efforts to scale up HIV testing often lead to increases in new diagnoses that may be misinterpreted

by politicians and the general public as an increase in new HIV infections. However, as coverage of HIV testing increases and knowledge of status approaches the levels called for in the 90–90–90 targets, the utility of case reporting in the modelling of HIV incidence estimates increases.

Measures of mortality, both AIDS-related and from all causes, are also difficult, especially in countries where death registries are absent or incomplete or where high levels of stigma and discrimination would encourage families to hide an AIDS-related cause of death. In settings with high coverage of antiretroviral therapy, AIDS-related deaths are increasingly not associated with “AIDS-defining causes”, while at the same time HIV increases mortality in other ways, making estimates of AIDS-related deaths even more difficult.

Most estimates have large uncertainty, making it difficult to identify when a particular target is met. Because they are not direct measures, estimates are more likely to be questioned by political leaders and other stakeholders, especially when they do not match a stakeholder’s perception of reality or if they tend to fluctuate from year to year as new information is used to refine the model. These challenges are magnified when data is unavailable or of poor quality, which is often the case for key populations or smaller geographic areas.

### **Static vs dynamic metrics**

The four proposed metrics include two thresholds and two ratios. The percentage reduction and absolute rate are static targets—milestones that would be achieved on the path to an end to AIDS. By comparison, the two ratios are dynamic measures of whether an epidemic is “on track” towards elimination or “not on track” towards elimination (the epidemic is expanding). In the case of the incidence prevalence ratio, its incorporation of long and healthy life among people living with HIV also makes it a measure of whether a response is on track towards ending AIDS as a public health threat. This is also arguably the case for the incidence-mortality ratio when the caveat of high treatment coverage is included. More modelling is required to better understand how well these dynamic models will perform in diverse epidemic settings.

### **Missing aspects of a comprehensive response**

Several participants expressed concerns that the four proposed metrics omit important aspects of the HIV response. All four incorporate HIV incidence and emphasize the importance of reducing new HIV infections. Some participants argued that the phrase “ending AIDS” really emphasizes reductions in AIDS-related morbidity and mortality, reflecting the fact that most people’s primary concern is keeping themselves and their loved ones alive and healthy. Conversely, others felt that several of the proposed metrics appeared to focus exclusively on populations of people living with HIV, and could potentially ignore populations at high risk of HIV acquisition in low-level epidemics. Prevention cascades, policy cascades and indicators to track research and development were also mentioned as missing process-level measures.

Many participants expressed strong concerns that the metrics did not reflect the structural and social determinants that facilitate the spread of HIV, the substantial stigma and discrimination faced by people living with HIV and key populations, and the need to establish an enabling legal and

policy environment to protect these individuals from rights violations in the short term and change attitudes and behaviours of the general population in the long term. Others felt that efforts to eliminate vertical transmission were not reflected in the metrics, nor was the need to ensure that services are high quality and available to all who need them, including migrants and people in conflict settings. An example was presented of the World Health Organization's approach to the elimination of trachoma as a public health problem. Certification of elimination requires countries to prepare a dossier of several indicators related to incidence (at the level of health districts), morbidity and health system strengthening. It was suggested that this approach could be a model that would directly engage countries (and could probe for additional research on key populations or other subpopulations) and collectively certify "epidemic control", as opposed to a single indicator. However, it was noted that a set of globally-agreed process-level indicators and targets is already in place. It was also noted that controlling the epidemic among adults will contribute to efforts to eliminate vertical transmission, and that elimination of vertical transmission and robust service coverage and quality indicators are already included in existing global targets (e.g. the third 90, which calls for 73% of all people living with HIV to be virally suppressed). It was acknowledged that the United Nations General Assembly has made a general commitment to achieving zero discrimination, and that there are several approaches to measuring stigma and discrimination (e.g. the newly revised People Living With HIV Stigma Index, new guidance for bio-behavioural surveys among key populations, a new indicator for use in population-based household surveys) and enabling policy environments (e.g. the National Commitments and Policy Instrument included in UNAIDS Global AIDS Monitoring). However, these elements are often under-represented in national responses, and measurable targets for this aspect of the response are largely missing from global commitments.

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### **Measuring progress towards ending AIDS as an epidemic in New York State by 2020<sup>15</sup>**

New York has been among the US states most affected by HIV and AIDS since the earliest days of the epidemic. A vigorous response saw AIDS deaths peak in 1994 and then plummet rapidly. However, there were years of little or no progress on new HIV infections, especially among the gay community.

As emerging scientific evidence on the preventative effects of antiretroviral therapy made it possible to envision ending AIDS as an epidemic globally, there appeared to be too little ambition for the HIV response nationally. Community-based activist and advocacy groups in New York began working in late 2012 to urge the state and New York City governments to develop a plan with a target to end AIDS as an epidemic in the state by the end of 2020 through increased HIV testing, prevention and treatment. In November 2013 the New York State Medicaid office – which provides health coverage to 50% of the state's people living with HIV – began negotiations with HIV treatment

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<sup>15</sup> Summary of the background paper with the same title, as presented by Mark Harrington (the author).

manufacturers to secure volume-based discounts to bring down the price of pre-exposure prophylaxis and antiretroviral therapy, thus making a state plan to end AIDS more affordable.

On 9 January 2014, New York State Health Commissioner Nirav Shah first publicly announced the state's commitment to end AIDS as an epidemic by the end of the year 2020. The state plan calls for new HIV infections to reduce to 750 by 2020, from 3,400 diagnoses in 2012 and a peak of 15,000 diagnoses in 1993. The plan has three pillars:

(1) identifying persons with HIV who remain undiagnosed and linking them to health care; (2) linking and retaining persons diagnosed with HIV to health care and getting them on anti-HIV therapy to maximize HIV virus suppression so they remain healthy and prevent further transmission; and (3) providing access to pre-exposure prophylaxis (PrEP) for high-risk persons to keep them HIV negative. Nine indicators are used to measure progress: new HIV infections (incidence), new HIV diagnoses; linkage to care; receiving any care; viral suppression among people diagnoses; viral suppression among people receiving any care; HIV status aware; concurrent AIDS diagnosis; time from diagnosis to AIDS. Strengthening of the surveillance system has improved estimates of HIV prevalence and HIV incidence.

New York State has already achieved elimination of vertical transmission, while new infections among injecting drug users are also approaching elimination targets. Slower, but substantial declines in new infections have also occurred among heterosexuals. However, others such as men who have sex with men—particularly young men of colour—and transgender women still experience disproportionately high rates of new diagnoses.



## 5. EMERGING CONSENSUS

Over the course of the three days of the meeting, a shared understanding was achieved that strong measures and targets for HIV service coverage and the impact target for ending AIDS as a public health threat are already in place. There was agreement that a new summary metric that signals countries' progress towards ending AIDS as a public health threat and ultimately zero new HIV infections, zero discrimination and zero AIDS-related deaths would be a useful addition to (a) dispel the notion that AIDS is no longer a problem or that a tipping point of certain success will soon be reached, and (b) to help drive policy-makers and galvanize continued political commitment and financial investment in the HIV response.

There was agreement that each of the proposed metrics are important measures that may form a continuum along the path to ending AIDS as a public health threat. Percentage reductions were acknowledged as the existing global targets; absolute rates were admired for their simplicity; and the incidence-mortality ratio was viewed as being a strong epidemiological measure, but only relevant when treatment coverage is high. The incidence-prevalence ratio, with its ability to include the effect of antiretroviral therapy

and measure efforts to both reduce new HIV infections and extend the lives of people living with HIV, was viewed as an attractive option, but needs further elaboration to understand how it performs in specific populations and epidemics. All four metrics should be tracked and celebrated when achieved, but with the clear caveat that achieving them is not the end goal, as there is no inexorable path to towards zero new HIV infections, zero discrimination and zero AIDS-related deaths once a particular ratio is achieved or a particular threshold is crossed. Indeed, achieving them should encourage decision-makers that their investments have made significant impact, and that intensifying efforts and staying focused can lead to the historic achievement of the end of the epidemic. Conversely, pulling back or remaining steady would likely lead to the resurgence of the epidemic.

**Efforts to refine and finalize the use of summary metrics should be guided by the following criteria:**

- They should be scientifically sound, feasible, acceptable to communities and useful for AIDS programme management.
- They must be relevant for all epidemics (high prevalence and low prevalence), at all levels (global, regional, national, sub-national) and be able to measure progress within sub-populations (defined by age, sex and/or population).
- They should be resistant to “gaming”—intentional skewing of data to overstate programme performance.
- They should include inputs that measure:
  - Trends in new infections.
  - Trends in morbidity and mortality among people living with HIV.
- They should be packaged with improved measures of:
  - Trends in HIV-related stigma and discrimination.
  - A “policy cascade” that measure whether an enabling legal and policy environment is in place for efforts to eliminate of stigma and discrimination.

It was also acknowledged that although the term “epidemic control” is a standard epidemiological term, it has potential negative connotations, and that UNAIDS should consider alternative terms that do not suggest the promotion of punitive approaches or the curtailing of human rights for people living with HIV or people at higher risk of HIV acquisition. It was also agreed that the input measures and language used to describe them should also be acceptable to communities and promote efforts to reduce HIV-related stigma and discrimination.

## 6. WAY FORWARD

Participants agreed to a set of short-term, medium-term and longer-term actions aimed at the finalization and adoption of the new metrics:

### Short-term actions

- The meeting report will be finalized and disseminated along with the background papers for the meeting.

### Medium-term actions

- A small working group will conduct further modelling work to explore the behaviour of the incidence-prevalence ratio for different epidemics and sub-populations, and the robustness of the proposed metric in relation to assumptions about epidemic stability, and the value and meaning of different threshold levels (e.g. 3 infections vs 2 infections per 100 people living with HIV per year).
- All metrics discussed will be analysed to better understand their sensitivity and specificity, to see how they interact with each other, and to consider whether there should be a continuum of metrics along the road to full control of the global pandemic and the multitude of epidemics in key populations.
- Development of an alternative term to “epidemic control”, language that is sensitive to communities, easy-to-understand and does not call into question the robustness of individual measures.
- Work with key stakeholders, especially communities and programme managers, to better measure stigma, discrimination and an enabling legal and policy environment, and the presentation of such information in conjunction with metrics for “epidemic control”.
- Finalization of a plan for uses of the continuum of new metrics, including a communications strategy.

### Longer term actions

- Use of the metrics in the next round of UNAIDS reporting, target-setting, resource needs estimation and impact estimation.
- Advocacy for wider use of the metrics and terminology by countries and institutions.
- Development and implementation of a plan to improve measurements of incidence (case reporting and assay-based) and mortality, including for key populations.

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