TECHNICAL REPORT

HIV DRUG RESISTANCE REPORT 2021

NOVEMBER 2021

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World Health Organization

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ACRONYMS AND ABBREVIATIONS

3TC	lamivudine
ABC	abacavir
ART	antiretroviral therapy
ARV	antiretroviral drug
ATV/r	atazanavir/ritonavir
BIC	bictegravir
CAB	cabotegravir
CI	confidence interval
DBS	dried blood spots
DPV	dapivirine
DRV/r	darunavir/ritonavir
DTG	dolutegravir
EFV	efavirenz
FTC	emtricitabine
INSTI	integrase strand-transfer inhibitor
NNRTI	non-nucleoside reverse-transcriptase inhibitor
NRTI	nucleoside reverse-transcriptase inhibitor
NVP	nevirapine

PEPFAR	United States President's Emergency Plan for AIDS Relief
PI/r	ritonavir-boosted protease inhibitor
PrEP	pre-exposure prophylaxis
TDF	tenofovir disoproxil fumarate
TLD	TDF in combination with 3TC and DTG as a fixed-dose combination
TLE	TDF in combination with 3TC and EFV as a fixed-dose combination
ZDV	zidovudine

DEFINITIONS

- **ARV drug–naive** applies to people with no history of ARV drug exposure.
- **HIV drug resistance** is caused by one or more changes (mutations) in the genetic structure of HIV that affect the ability of a specific drug or combination of drugs to block replication of HIV. All current ARV drugs, including newer classes, are at risk of becoming partly or fully inactive because of the emergence of drug-resistant virus. For the purpose of this report, HIV drug resistance was assessed using the Stanford HIVdb algorithm version 9.0, with virus predicted to have low-, intermediate- or high-level resistance categorized as resistant (penalty score ≥15). The following are the three main categories of HIV drug resistance.

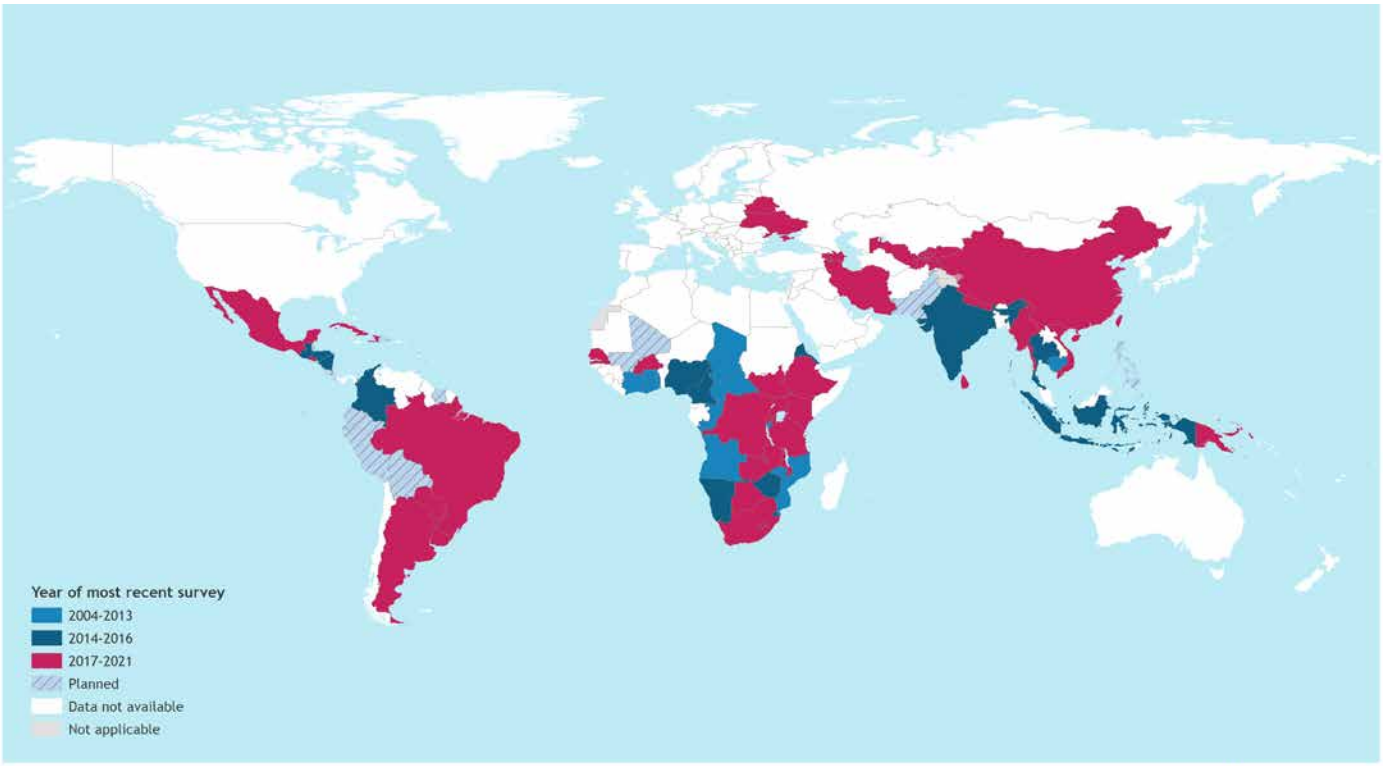
    1. **Acquired HIV drug resistance** develops when HIV mutations emerge because of viral replication among individuals receiving ARV drugs.
    2. **Transmitted HIV drug resistance** occurs when individuals are infected with HIV that has drug resistance mutations.
    3. **Pretreatment HIV drug resistance** refers to drug-resistant virus detected in ARV drug–naive individuals initiating ART or individuals with previous ARV drug exposure initiating or reinitiating first-line ART. Thus, for the purpose of this report, pretreatment HIV drug resistance is either transmitted or acquired resistance or both. Resistant virus may have been transmitted at the time of infection (transmitted HIV drug resistance) or may be selected (acquired HIV drug resistance) through previous ARV drug exposure (such as among women who received ARV drugs for the prevention of mother-to-child transmission of HIV, among people who have received pre-exposure prophylaxis or among individuals reinitiating first-line ART after a period of treatment interruption).

- **NNRTI-based ART regimens** are defined as regimens containing efavirenz or nevirapine for the purpose of this report.
- **PI-based ART regimens** are defined as regimens containing ritonavir-boosted atazanavir, ritonavir-boosted darunavir or ritonavir-boosted lopinavir for the purpose of this report.

EXECUTIVE SUMMARY

Antiretroviral therapy (ART) has been scaled up: at the end of 2020, 27.5 million people were receiving ART globally. However, HIV drug resistance can compromise the effectiveness of antiretroviral (ARV) drugs in reducing HIV incidence and HIV-associated morbidity and mortality. To minimize the emergence and transmission of drug-resistant HIV, WHO recommends that ART and pre-exposure prophylaxis (PrEP) programmes be accompanied by measures to monitor the quality of ART and PrEP delivery and the routine surveillance of HIV drug resistance. Between 2004 and 2021, 66 countries implemented surveys of HIV drug resistance using WHO-recommended methods (**Map 1**). As of late 2021, 34 countries plan to conduct HIV drug resistance surveys during 2022–2024.

MAP 1. Implementation of national HIV drug resistance surveys, 2004–2021



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World Health Organization

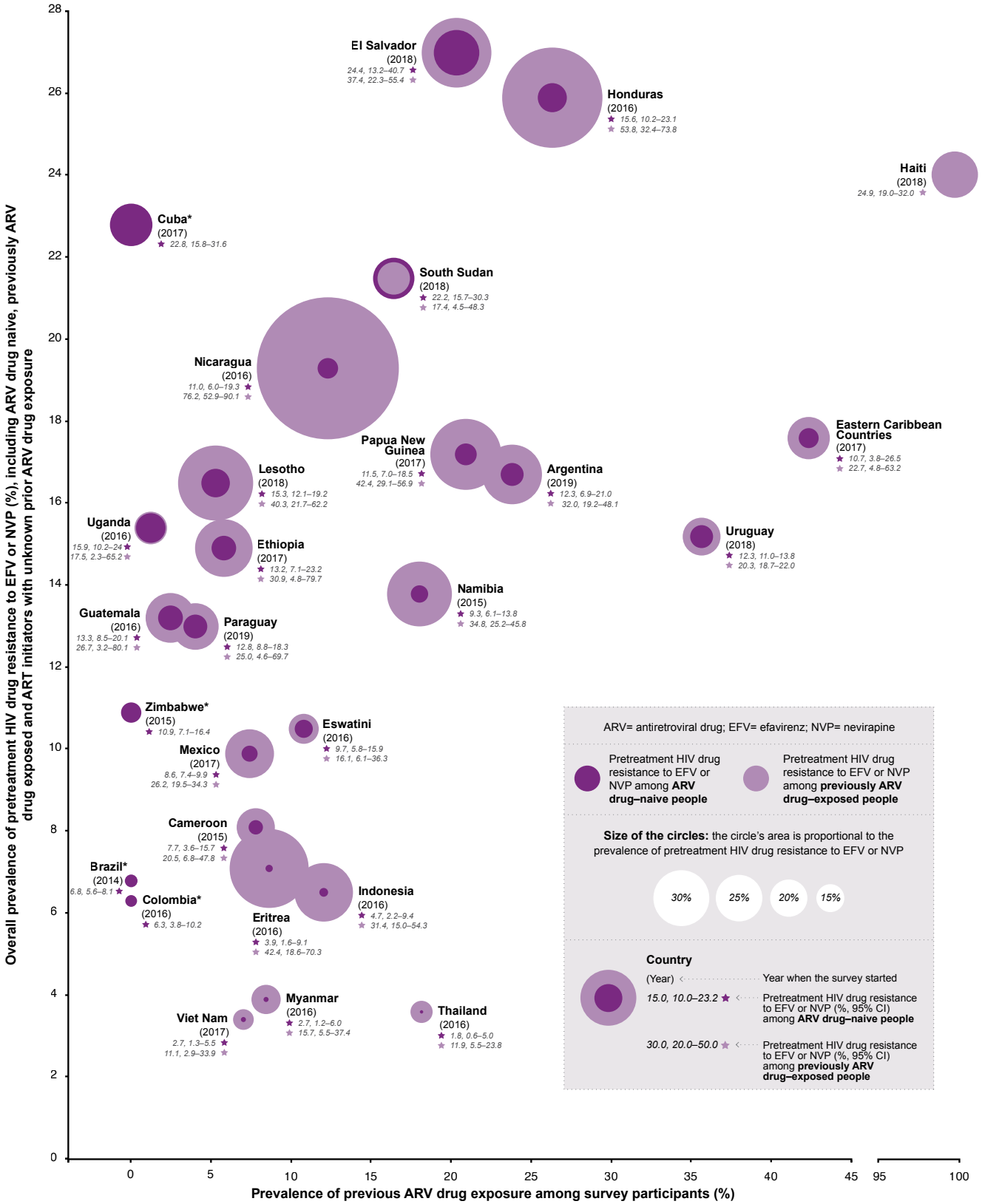
Surveillance of pretreatment HIV drug resistance among adults initiating first-line ART

Nevirapine (NVP) or efavirenz (EFV)-based regimens were the most frequent ART regimens initiated in 16 of 20 countries reporting survey findings to WHO (2014–2020). In 21 of 30 surveys reported, pretreatment drug resistance to NVP or EFV in populations initiating first-line ART exceeded 10%. The prevalence of pretreatment drug resistance to NVP or EFV was higher among ART initiators reporting previous ARV drug exposure than among ARV drug-naive ART initiators (**Fig. 1**). The pooled summary results estimate a prevalence of pretreatment drug resistance to NVP or EFV three times higher among ART initiators reporting previous ARV drug exposure (24%, 95% confidence interval (CI) 18–29%) than among ARV drug-naive ART initiators (7%, 95% CI 4–10%). The high levels of observed pretreatment drug resistance to NVP or EFV emphasize the need to fast-track the transition to the integrase strand-transfer inhibitor dolutegravir (DTG)-based first-line regimens in accordance with WHO recommendations in countries where this transition has not started and to accelerate the phase-out of non-nucleoside reverse-transcriptase inhibitor (NNRTI)-based first-line regimens in countries where DTG has been introduced.

Ten countries assessed pretreatment HIV drug resistance to integrase strand-transfer inhibitors. Among these countries, only South Sudan detected an extremely low prevalence of resistance to DTG (0.2%, 95% CI 0.0–1.2%). This observation is reassuring and suggests high levels of predicted efficacy of DTG-based regimens in achieving population-level viral load suppression, provided sufficient adherence is maintained. As countries scale up the use of DTG-based first-line ART, it remains important for countries to conduct periodic pretreatment drug resistance surveys to document any signals of increases in pretreatment resistance to integrase strand-transfer inhibitors or nucleoside reverse-transcriptase inhibitors (NRTIs) that may affect population-level treatment outcomes.

To the extent that the population enrolled in surveys of pretreatment HIV drug resistance represents the people who are likely to transmit HIV to others, the low prevalence of pretreatment drug resistance to tenofovir disoproxil fumarate (TDF) (pooled summary results: 1.6%, (95% CI 1.1–2.1%) and emtricitabine (FTC) or lamivudine (3TC) (1.7%, 95% CI 1.2–2.2%) provides reassurance for using this drug combination in PrEP; however, since these two drugs are used in combination as PrEP and as a component of first-line ART regimens, routine surveillance is strongly recommended as PrEP programmes scale up.

Fig.1 Prevalence of pretreatment HIV drug resistance to efavirenz or nevirapine by previous ARV drug exposure, 2014–2020



This figure shows the study design–weighted prevalence of pretreatment HIV drug resistance to EFV or NVP among adults initiating ART, with or without previous exposure to ARV drugs, in countries reporting data to WHO between 2014 and 2020. In all countries, pretreatment HIV drug resistance estimates are generated from nationally representative surveys using standard WHO survey methods. The Eastern Caribbean Countries are depicted in aggregate because a multicountry survey was carried out in Antigua and Barbuda, Dominica, Grenada, Saint Kitts and Nevis, Saint Lucia, and Saint Vincent and the Grenadines. HIV drug resistance was defined as the presence of a penalty score ≥15 for EFV or NVP based on the Stanford HIVdb algorithm version 9.0. The size of the circles is proportional to the prevalence of pretreatment HIV drug resistance to EFV or NVP in previously ARV drug exposed (light purple circles) and in ARV drug–naive (dark purple circles) ART initiators. Circles are centred along the y-axis based on the overall prevalence of pretreatment HIV drug resistance to EFV or NVP among all survey participants. *Pretreatment HIV drug resistance surveys included only individuals initiating ART without previous exposure to ARV drugs in 4 countries (Brazil, Colombia, Cuba and Zimbabwe).

Surveillance of pretreatment HIV drug resistance among treatment-naive infants newly diagnosed with HIV

Based on the most recent findings from surveys conducted in 10 countries in sub-Saharan Africa, nearly half of infants newly diagnosed with HIV carry drug-resistant HIV before initiating treatment. The prevalence of pretreatment HIV drug resistance to EFV or NVP was high, with a pooled summary result of 45% (95% CI 42–49%). These findings highlight the need to accelerate the ongoing transition to the WHO-recommended DTG-based HIV treatment for children. The prevalence of pretreatment resistance to abacavir (preferred NRTI for infants and children) was ≥10% in five of the 10 countries, and the prevalence of resistance to 3TC was ≥10% in four of the 10 countries reporting data to WHO. The relatively high levels of pretreatment NRTI resistance in some countries suggest the need for caution when initiating regimens containing drugs with a low-genetic barrier to resistance (e.g., raltegravir in neonates). Moreover, findings highlight the importance of using DTG-containing regimens in young children as early as possible.

Surveillance of HIV drug resistance among individuals using PrEP who are diagnosed with HIV

Pre-exposure prophylaxis (PrEP) is an effective prevention option for HIV-negative individuals at substantial risk of HIV infection as part of combination prevention approaches. PrEP significantly reduces the risk of acquiring HIV when adherence is optimal. Inadequate protection from insufficient doses of PrEP is the most common cause of seroconversion on PrEP.

Although PrEP users have a substantially reduced risk of acquiring HIV, individuals who become infected are at risk of having drug-resistant HIV, which could be transmitted from a partner or acquired by continuing PrEP after breakthrough infection in the window period before seroconversion. Resistance is most likely to occur when PrEP is started in the setting of undiagnosed acute HIV infection. Taking all reasonable steps to exclude acute HIV infection before initiating or reinitiating PrEP is therefore imperative.

There is significant overlap of resistance profiles for next-generation PrEP regimens (such as the intravaginal ring containing the NNRTI dapivirine and the long-acting injectable integrase inhibitor cabotegravir) and WHO-recommended ARV drugs used for first-line ART. Since HIV drug resistance may compromise the effectiveness of first-line ART among PrEP users who acquire HIV, WHO recommends that PrEP scale-up be accompanied by surveillance of HIV drug resistance. Nonetheless, concern over HIV drug resistance must never be a reason to limit the use of PrEP.

Surveillance of acquired HIV drug resistance among adults, children and adolescents receiving ART

The prevalence of viral load suppression among adults receiving ART for 12 ± 3 months was ≥90% in seven of 14 countries and in six of 14 countries among adults receiving ART for ≥48 months, suggesting differences in programme performance between countries. Overall, the quality of HIV care needs to be strengthened trough the identification and implementation of locally sustainable solutions to achieve sustained levels of viral suppression >95% by 2025.

Zambia was the only country reporting viral load survey data from children and adolescents receiving ART. In this country, among children and adolescents receiving first-line ART for ≥36 months, the prevalence of viral load suppression was significantly higher among those receiving a DTG-based regimen (92%, 95% CI 83–97%) than among those receiving PI-based ART (76%, 95% CI 63–86%) or NNRTI-based ART (61%, 95% CI 49–72%); odds ratio: 6.9, 95% CI 2.5–19.3, P = 0.001 for DTG-based versus non-DTG-based ART. This finding supports transition to TLD (tenofovir disoproxil fumarate, lamivudine and dolutegravir) in low- and middle-income countries and attests to the potency and efficacy of DTG-containing regimens.

High levels of both NNRTI and NRTI HIV drug resistance were observed among individuals taking NNRTI-based regimens without viral suppression, emphasizing the need to scale up viral load testing and enhanced adherence counselling and promptly switch individuals with confirmed failure of second-line ART.

Low levels of protease inhibitor (PI) resistance were observed among children and adolescents receiving a PI-based ART regimen in Uganda and Zambia, suggesting that routine viral load monitoring for early detection of suboptimal adherence followed by greatly intensified adherence support may be an optimal initial approach to managing treatment failure in children and adolescents receiving PI-based ART.

At the time these surveys were conducted, few countries had transitioned large number of adults to TLD. As countries scale up the transition to DTG-based ART, surveillance for DTG-resistant virus among people for whom DTG-containing regimens are failing in low- and middle-income countries will be required.

Global Action Plan implementation: progress and challenges

Over the past four years, significant progress has been made in implementing the Global Action Plan on HIV drug resistance 2017–2021. This report summarizes some of the key areas of progress and highlights ongoing challenges and opportunities. Successes include (1) increased uptake of HIV drug resistance surveys from 37 surveys in 23 countries between 2014 and 2016 to 113 surveys in 47 countries between 2017 and 2020; (2) increased response to high levels of pretreatment drug resistance, with all countries that documented high levels of pretreatment HIV drug resistance to NVP and EFV transitioning or in the process of transitioning to recommended regimens; (3) increase in the number of countries achieving high levels of viral suppression (≥90%) from 33% in 2017 to 80% in 2020; (4) designation of an additional five laboratories to support HIV drug resistance genotyping. In addition, 10 of 34 WHO HIVResNet laboratories have validated a genotypic assay for the HIV-1 integrase region, and several others are expected to complete the required validation before the end of 2021; (5) progress by the global research community in addressing critical research gaps related to HIV drug resistance, such as assessing clinical correlates of DTG resistance, especially the impact of TDF resistance among people receiving TLD; (6) increase in the number of countries with a national action plan on HIV drug resistance from 46% (13 of 28) of countries with a high burden of HIV in 2018 to 64% (25 of 39) in 2020; and (7) increased funding support by global donors on HIV drug resistance surveillance and monitoring. Between 2018 and September 2021, the Global Fund funded 42 surveys in 22 countries, and the United States President's Emergency Plan for AIDS Relief (PEPFAR) supported 44 surveys in 18 countries reporting data to WHO.

Despite progress, opportunities to prevent, monitor and respond to HIV drug resistance remain: (1) few countries have attained the recommended targets for programme quality-of-care indicators associated with HIV drug resistance or viral load suppression, which is prevention of HIV drug resistance, and the performance of some indicators has declined or plateaued globally; (2) few countries report annual monitoring of clinic-level quality-of-care indicators associated with HIV drug resistance; and (3) inadequate funding for fully implementing comprehensive national action plans on HIV drug resistance remains a challenge.

As the current Global Action Plan on HIV drug resistance draws to a close, countries have a new opportunity to focus on improving the quality of HIV care delivery across the entire HIV care continuum and achieving the proposed targets. Future global, national and country efforts should identify ongoing opportunities to prevent, monitor and respond to HIV drug resistance and should rapidly adapt to the evolving treatment landscape and new service delivery models.

INTRODUCTION

Antiretroviral therapy (ART) has been scaled up at an unprecedented rate over the past decade: at the end of December 2020, 27.5 million people were receiving ART globally. As efforts to scale up ART and pre-exposure prophylaxis (PrEP) continue, and more individuals receive antiretroviral (ARV) drugs for treating and preventing HIV, a further increase in HIV drug resistance is likely (*1–3*). Drug-resistant HIV is selected when the virus replicates in the presence of subtherapeutic levels of ARV drugs. HIV drug resistance can compromise the effectiveness of HIV treatments, leading to possible increase in HIV incidence and HIV-associated morbidity and mortality (*4,5*).

In 2017, WHO launched a comprehensive global action plan to prevent, monitor and respond to HIV drug resistance at the global and country levels and to protect the ongoing progress towards achieving the global targets for epidemic control by 2030 (*6*). To minimize the emergence and transmission of drug-resistant HIV, WHO recommends that ART and PrEP programmes be accompanied by measures to monitor the quality of ART and PrEP delivery and by routine surveillance of population-level HIV drug resistance (*7*). Routine surveillance of HIV drug resistance provides countries with evidence that informs national HIV treatment guidelines and that can be leveraged to optimize patient and population-level treatment outcomes. WHO recommends implementing the following nationally representative HIV drug resistance surveys:

- surveillance of acquired HIV drug resistance in adults, children and adolescents receiving ART (*8,9*);
- surveillance of pretreatment HIV drug resistance among treatment-naive infants newly diagnosed with HIV (*10*);
- surveillance of pretreatment HIV drug resistance among adults initiating or reinitiating first-line ART (*11*); and
- surveillance of HIV drug resistance among individuals using pre-exposure prophylaxis who are diagnosed with HIV (*12*).

The 2021 HIV drug resistance report summarizes the progress in the implementation and the outcomes of the WHO-recommended surveys (**Sections 1, 2 and 4**). The report includes a literature review on HIV drug resistance among populations receiving PrEP who are diagnosed with HIV, which foreshadows the need for surveillance of resistance among people taking PrEP who test positive for HIV (**Section 3**). Finally, this report summarizes the progress achieved between 2017 and 2020 in implementing the Global Action Plan on HIV drug resistance 2017-2021 and summarizes the remaining challenges, with specific focus on 45 countries accounting for more than 85% of the total burden of HIV infection (**Section 5**).

1. PRETREATMENT HIV DRUG RESISTANCE AMONG ADULTS INITIATING FIRST-LINE ART

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The routine surveillance of pretreatment HIV drug resistance provides valuable evidence to inform the selection of first-line antiretroviral therapy (ART) and regimens used for pre-exposure prophylaxis (PrEP) and post-exposure prophylaxis (*13*). The overall goal of pretreatment HIV drug resistance surveys is to generate nationally representative estimates of (1) the prevalence of pretreatment HIV drug resistance among adults initiating ART, regardless of previous antiretroviral (ARV) drug exposure, (2) the prevalence of pretreatment HIV drug resistance among ARV drug–naive adults initiating ART and (3) the proportion of adult ART initiators reporting previous ARV drug exposure.

1.1 Survey method: pretreatment HIV drug resistance among adults

The WHO concept note for pretreatment HIV drug resistance surveys among adults initiating or reinitiating first-line ART (*13*) describes the sample size estimation, sampling methods, implementation considerations and statistical analysis in detail. Briefly, this cross-sectional clinic-based survey uses a two-stage cluster design. In the first stage, the clinics are sampled from a list of all clinics dispensing ART in the country. In the second stage, a sample of eligible patients is recruited from each of the selected clinics. The specimens collected are genotyped and HIV drug resistance is predicted using the Stanford HIVdb algorithm (*14,15*).

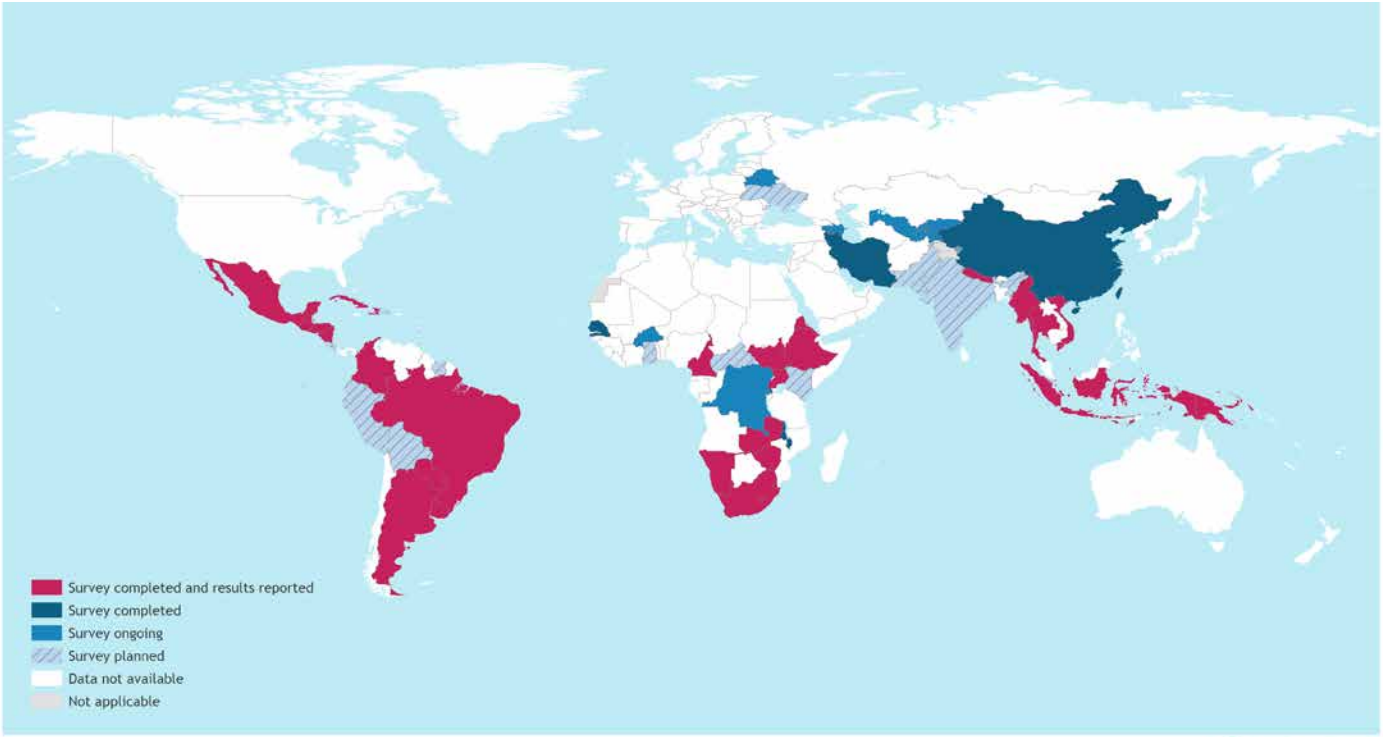
1.2 Progress in implementing the surveys and geographical representation

Between 2014 and 2020, 56 countries implemented surveys of pretreatment HIV drug resistance among adults initiating or reinitiating first-line ART; of these, 46 had finalized the surveys by the time of this report (**Map 2**). Seventeen countries have plans to initiate surveys of pretreatment HIV drug resistance. This report summarizes findings from 35 countries that have completed pretreatment HIV drug resistance surveys and have reported data to WHO: 11 from the African Region,[1] 18 from the Region of the Americas,[2] four from the South-East Asia Region and two from the Western Pacific Region.

1 Including a national household survey from South Africa. Participants in the pretreatment HIV drug resistance analysis were people with no detectable ARV drugs in their blood and either self-reported not taking daily medication or this information was unknown (http://www.croiconference.org/sessions/hiv-drug-resistance-south-africa-results-population-based-household-survey).

2 Including a multicountry survey in the Eastern Caribbean Countries. Due to small sample sizes in each country, a multicountry pretreatment HIV drug resistance survey was performed in six Eastern Caribbean Countries: Antigua and Barbuda, Dominica, Grenada, Saint Kitts and Nevis, Saint Lucia and Saint Vincent and the Grenadines.

MAP 2. Implementation of WHO pretreatment HIV drug resistance national surveys among adults initiating first-line ART, 2014–2021



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Data Source: World Health Organization
Map Production: WHO GIS Centre for Health, DNA/DDI
Map Creation Date: **11 October 2021**

World Health Organization

1.3 Data analysis

HIV drug resistance was defined as the presence of a penalty score ≥15 assigned to an ARV drug using the Stanford HIVdb algorithm version 9.0 (*14,15*). HIV subtype was assigned using the Stanford HIVdb subtyping tool (*14*). Statistical analysis was performed using STATA 15.1 (Stata Statistical Software: release 15.1, 2017, StataCorp LLC) following the WHO-recommended method to generate weighted estimates based on the study's design (*13*). **Annex 2** describes the methods used for pooled analysis.

1.4 Populations

Most ART initiators in countries reporting data from Africa, Nepal and Papua New Guinea were women (ranging from 51% to 73%). Men predominated in countries surveyed in the Americas, Indonesia, Myanmar, Thailand and Viet Nam (ranging from 52% to 88%). Most ART initiators were older than 25 years, except for Argentina (29%), Haiti (33%) and Ethiopia (34%) (**Annex 1: Tables A1.1a– A1.1i**). HIV-1 subtype C was the most frequently observed subtype in the majority of surveyed countries from Africa, Nepal and Papua New Guinea. Most ART initiators in countries reporting data from the Americas were infected with HIV-1 subtype B. In Indonesia, Myanmar, Thailand and Viet Nam, CRF01_AE predominated (**Fig. 1.1 and Annex 1: Table A1.2**).

Twenty-three surveys included both ARV drug–naive ART initiators and ART initiators reporting previous exposure to ARV drugs, including women with previous ARV drug exposure for prevention of mother-to-child transmission of HIV, individuals reinitiating first-line ART after disengagement from care, PrEP or post-exposure prophylaxis. In these 23 surveys, the proportion of ART initiators with previous ARV drug exposure ranged from 1.2% (95% CI 0.4–3.7%) in Uganda to 99.3% (95% CI 95.1–99.9%) in Haiti (**Fig. 1.2**). Previous use of ARV drugs for prevention of mother-to-child transmission of HIV was the most commonly reported type of previous ARV drug exposure in Cameroon, Eswatini and the Eastern Caribbean Countries,[3] whereas previous ART followed by treatment discontinuation and subsequent ART reinitiation was more common in Argentina, El Salvador, Eritrea, Haiti, Honduras, Indonesia, Lesotho, Mexico, Myanmar, Namibia, Papua New Guinea, Paraguay, Thailand, Uganda, Uruguay and Viet Nam (**Annex 1: Tables A1.1a– A1.1i**).

ART regimens based on non-nucleoside reverse-transcriptase inhibitors (NNRTIs) were the most frequently prescribed in 16 of 20 countries for which ART data were reported. Dolutegravir (DTG)-based regimens were prescribed in Zambia (59%), Haiti (54%), Uruguay (29%) and Argentina (29%).

3 Antigua and Barbuda, Dominica, Grenada, Saint Kitts and Nevis, Saint Lucia and Saint Vincent and the Grenadines.

Fig. 1.1 HIV-1 subtype distribution observed among ART initiators from pretreatment drug resistance surveys conducted between 2014 and 2020

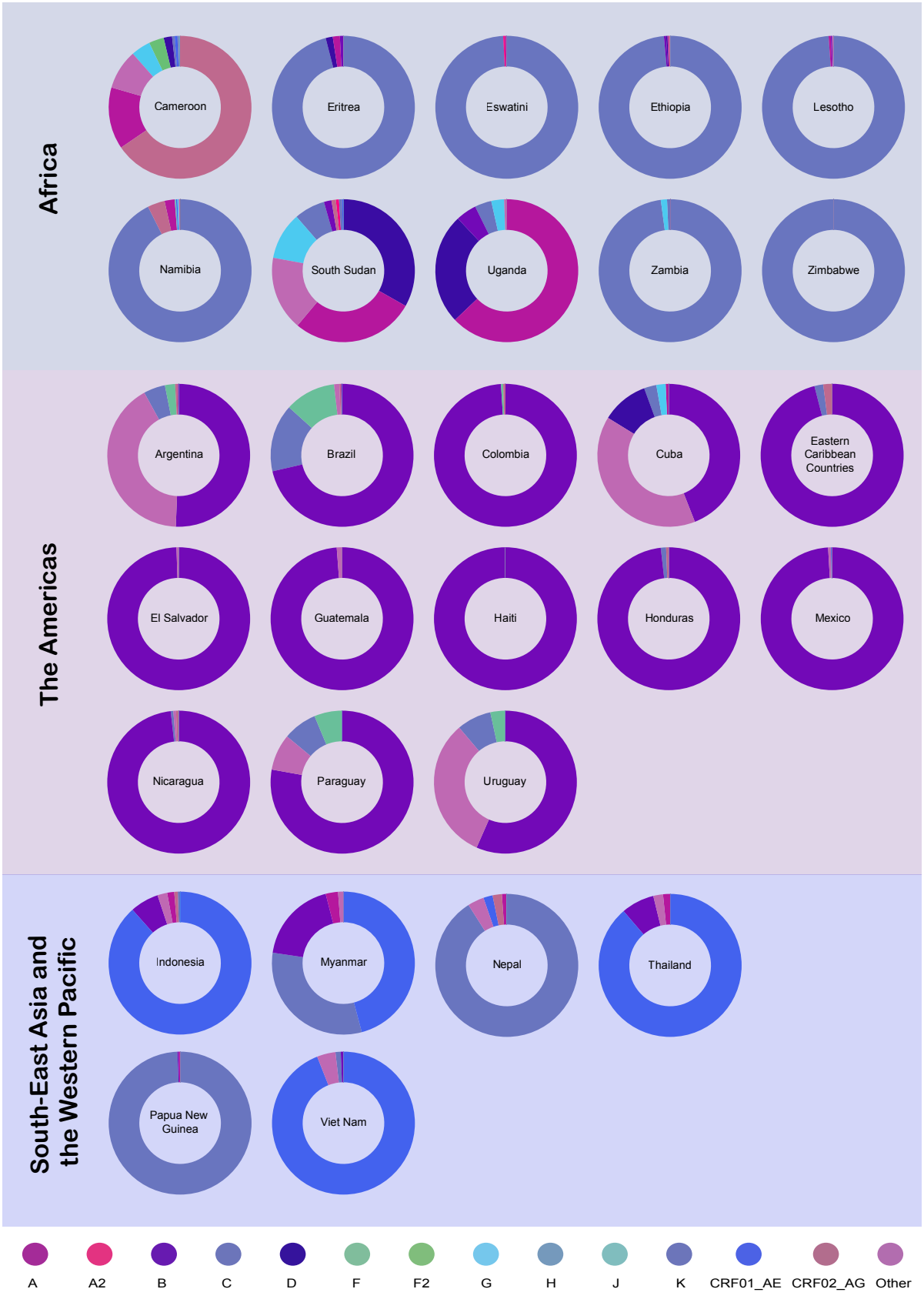

Fig 1.1 is a graphic representation of the distribution of HIV-1 subtypes observed among adults initiating ART in countries reporting data to WHO between 2014 and 2020. HIV-1 subtype C was the most frequently observed subtype in the majority of countries from Africa, Nepal, and Papua New Guinea. Most ART initiators in countries reporting data from the Americas were infected with HIV-1 subtype B. In Indonesia, Myanmar, Thailand, and Viet Nam HIV-1 CRF01_AE predominated. HIV subtype was assigned using the Stanford HIVdb subtyping tool. The Eastern Caribbean Countries are aggregated because a multi-country survey was carried out in Antigua and Barbuda, Dominica, Grenada, Saint Kitts and Nevis, Saint Lucia, and Saint Vincent and the Grenadines. Detailed prevalence figures are presented in the Annexes: Table A1.2.

Fig. 1.2. Proportion of adults initiating ART and reporting previous ARV drug exposure, 2014–2020

Country (year)	Previous ARV drug exposure (%)	Type of previous ARV drug exposure			
		PMTCT (%)	ART (%)	Other (%)	Unknown (%)
Haiti (2018)	99.3	0.6	99.2	0.2	0.0
Eastern Caribbean Countries (2017)	42.3	59.1	4.5	0.0	36.4
Uruguay (2018)	35.6	1.3	79.8	1.3	17.6
Honduras (2016)	26.3	7.9	90.8	0.0	1.3
Argentina (2019)	23.8	8.0	83.6	1.7	6.7
Papua New Guinea (2017)	20.9	0.0	98.7	0.0	1.3
El Salvador (2018)	20.3	1.7	100.0	0.0	0.0
Thailand (2016)	18.1	24.9	75.1	0.0	0.0
Namibia (2015)	18.0	23.2	76.8	0.0	0.0
South Sudan (2018)	16.4	2.3	11.1	0.0	88.9
Nicaragua (2016)	12.3	38.1	9.5	4.8	47.6
Indonesia (2016)	12.0	0.0	99.5	0.5	0.0
Eswatini (2016)	10.7	60.6	16.1	0.0	23.3
Eritrea (2016)	8.6	0.0	100.0	0.0	0.0
Myanmar (2016)	8.4	13.2	76.4	10.1	0.3
Cameroon (2015)	7.8	47.4	24.0	28.6	0.0
Mexico (2017)	7.4	0.0	97.1	2.9	0.0
Viet Nam (2017)	7.0	30.9	69.1	0.0	0.0
Ethiopia (2017)	5.8	30.8	1.6	0.0	67.5
Lesotho (2018)	5.3	24.0	70.0	1.6	4.4
Paraguay (2019)	3.8	0.0	100.0	0.0	0.0
Guatemala (2016)	2.8	12.0	0.0	0.0	88.0
Uganda (2016)	1.2	8.1	59.9	0.0	32.0

Fig 1.2 shows the proportion of adults initiating (reinitiating) ART and reporting previous exposure to antiretroviral drugs, and the proportional distribution of the type of exposure to antiretroviral drugs, in countries reporting data to WHO between 2014 and 2020. The Eastern Caribbean Countries is a multi-country survey carried out in Antigua and Barbuda, Dominica, Grenada, St. Kitts and Nevis, St. Lucia, and St. Vincent and the Grenadines. Four countries (Brazil, Colombia, Cuba, and Zimbabwe) enrolled only individuals initiating antiretroviral therapy without previous exposure to antiretroviral drugs, and therefore are not included in this figure.

ARV: antiretroviral drugs; ART: antiretroviral therapy; PMTCT: prevention of mother-to-child transmission.

1.5 Key findings

In 21 of 30 surveys reported to WHO, pretreatment HIV drug resistance to nevirapine (NVP) or efavirenz (EFV) in populations initiating first-line ART reached levels above 10% (Argentina, Cuba, the Eastern Caribbean Countries, El Salvador, Eswatini, Ethiopia, Guatemala, Haiti, Honduras, Lesotho, Namibia, Nepal, Nicaragua, Papua New Guinea, Paraguay, South Africa, South Sudan, Uganda, Uruguay, Zambia, and Zimbabwe) (**Fig. 1.3 and Annex 1: Tables A1.3a–A1.3r**). The prevalence of pretreatment HIV drug resistance to NVP or EFV was higher among ART initiators reporting previous ARV drug exposure than among ARV drug-naive ART initiators (**Fig. 1.4**). Further, in the pooled summary results, the overall prevalence of pretreatment HIV drug resistance to EFV or NVP was three times higher among people reporting previous exposure to ARV drugs (24%, 95% CI 18–29%) than among ARV drug–naive people (7%, 95% CI 4–10%). This higher prevalence of pretreatment HIV drug resistance to EFV or NVP among people reporting previous exposure to ARV drugs was observed across the regions (**Table 1.1**). The overall pretreatment resistance to second-generation NNRTIs ranged from 0.5% to 13.2% for doravirine, 1.0% to 10.3% for etravirine and 2.4% to 18.7% for rilpivirine (**Annex 1: Tables A1.3a – A1.3r**).

In the pooled summary results, the overall prevalence of pretreatment HIV drug resistance to nucleoside reverse-transcriptase inhibitors (NRTIs) such as tenofovir disoproxil fumarate (TDF) was 1.6% (95% CI 1.1–2.1%) and 1.7% (95% CI 1.2–2.2%) to emtricitabine (FTC) or lamivudine (3TC) (**Fig. 1.5**).

Ten countries assessed pretreatment HIV drug resistance to integrase strand-transfer inhibitors (INSTI): three from Africa (Ethiopia, South Sudan and Zambia) and seven from the Americas (Argentina, El Salvador, Guatemala, Mexico, Nicaragua, Paraguay and Uruguay). Overall, pretreatment HIV drug resistance prevalence to the second-generation INSTIs DTG, bictegravir (BIC) and cabotegravir (CAB) was very low (≤0.4%) (**Annex 1: Tables A1.3a–A1.3n**). Among the surveys reporting data, only South Sudan detected DTG resistance (0.2%, 95% CI 0.0–1.2%), because of the presence of the rare non-polymorphic integrase mutation S153F/Y.

Fig. 1.3. Prevalence of pretreatment HIV drug resistance to efavirenz or nevirapine among adults initiating antiretroviral therapy, 2014–2020

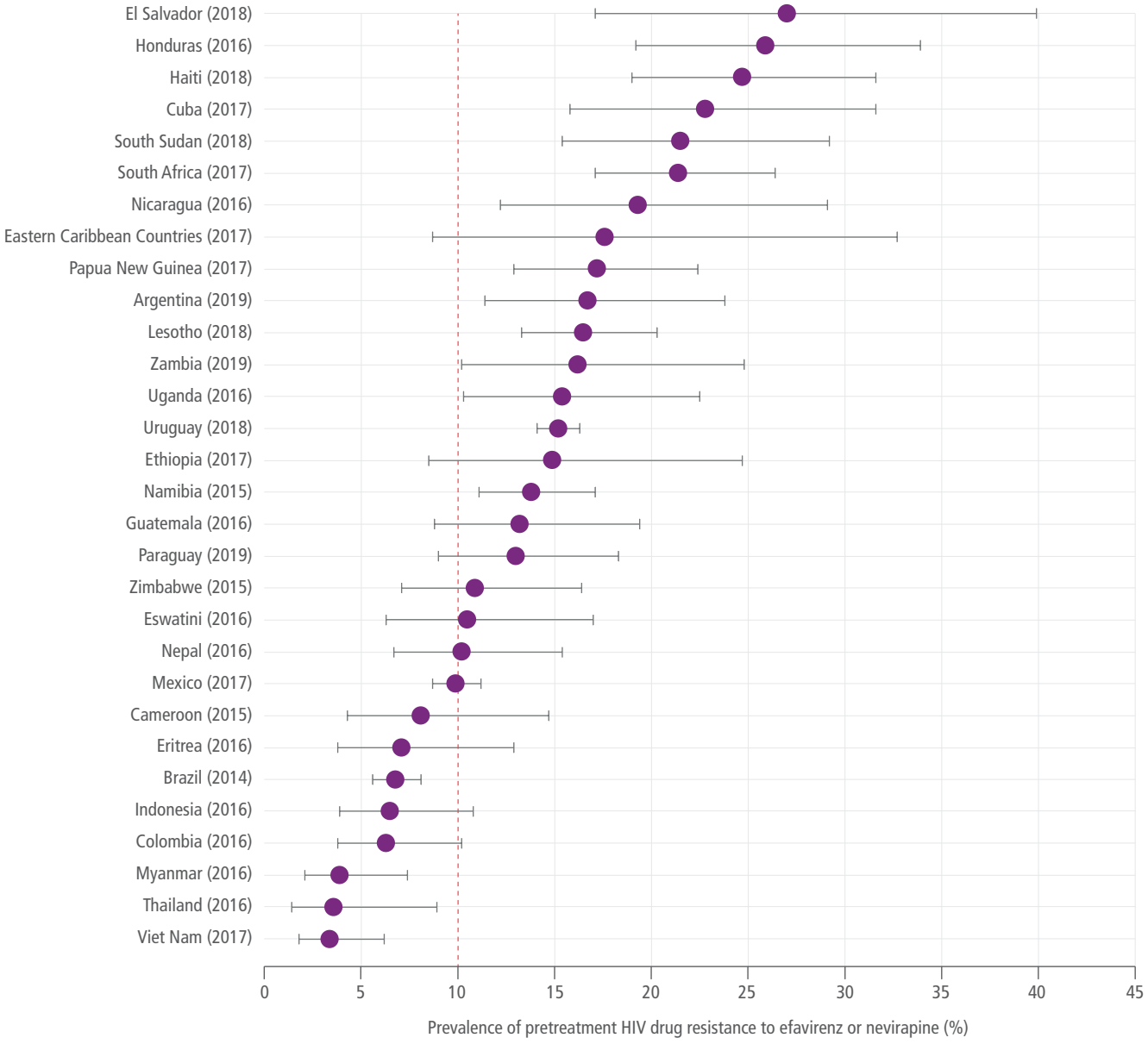

Fig 1.3 shows the study design–weighted prevalence and 95% confidence interval (error bars) of pretreatment HIV drug resistance to efavirenz or nevirapine among adults initiating (or reinitiating) ART in countries reporting data to WHO between 2014 and 2020. In all countries, pretreatment HIV drug resistance estimates are generated from nationally representative surveys using standard WHO survey methods, except in South Africa, where pretreatment HIV drug resistance estimates are generated from a national household survey. The Eastern Caribbean Countries are aggregated because a multi-country survey was carried out in Antigua and Barbuda, Dominica, Grenada, St. Kitts and Nevis, St. Lucia, and St. Vincent and the Grenadines. In 4 countries (Brazil, Colombia, Cuba, and Zimbabwe) only individuals initiating antiretroviral therapy without prior exposure to antiretroviral drugs were included in the pretreatment HIV drug resistance surveys.

HIV drug resistance was defined as the presence of a penalty score ≥15 using the Stanford HIVdb algorithm. The dotted line (10% prevalence) indicates the prevalence above which WHO recommends to fast-track the transition to DTG-based first-line regimens.

Fig. 1.4. Prevalence of pretreatment HIV drug resistance to efavirenz or nevirapine among adults initiating ART, by previous exposure to ARV drugs, 2014–2020

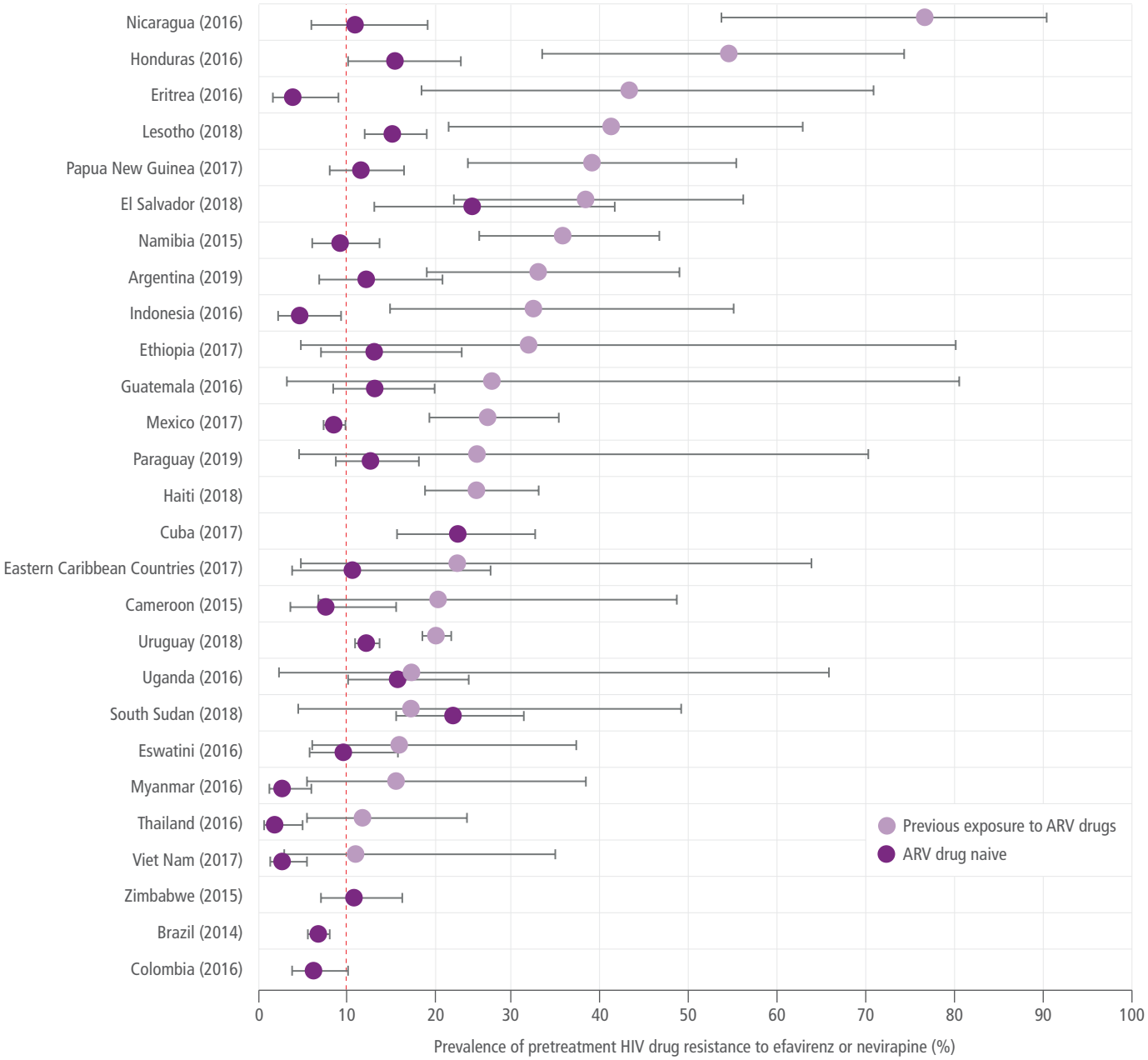

Fig 1.4 shows the study design–weighted prevalence and 95% confidence interval (error bars) of pretreatment HIV drug resistance to efavirenz or nevirapine among adults initiating antiretroviral therapy, with or without prior exposure to antiretroviral drugs, in countries reporting data to WHO between 2014 and 2020. In all countries, pretreatment HIV drug resistance estimates are generated from nationally representative surveys using standard WHO survey methods. The Eastern Caribbean Countries are shown in aggregate because a multi-country survey was carried out in Antigua and Barbuda, Dominica, Grenada, St. Kitts and Nevis, St. Lucia, and St. Vincent and the Grenadines. In 4 countries (Brazil, Colombia, Cuba, and Zimbabwe) only individuals initiating antiretroviral therapy without prior exposure to antiretroviral drugs were included in the pretreatment HIV drug resistance surveys.

HIVDR was defined as the presence of a penalty score ≥15 using the Stanford HIVdb algorithm. The dotted line (10% prevalence) indicates the prevalence above which WHO recommends to fast-track the transition to DTG-based first-line regimens.

Table. 1.1. Prevalence of pretreatment HIV drug resistance among adults initiating ART, 2014–2020

	Africa %, 95% CI[a]	The Americas %, 95% CI[a]	South-East Asia %, 95% CI[a]	Western Pacific %, 95% CI[a]	Overall %, 95% CI[a]
All ART initiators					
NRTI	6.1, 2.7–9.5	6.4, 3.9–9.0	3.1, 1.5–4.6	4.0, 2.9–5.1	5.4, 2.6–8.1
EFV or NVP	15.4, 13.9–17.0	16.7, 10.3–23.2	5.3, 3.3–7.3	6.9, 0.0–14.9	12.9, 9.0–16.9
ATV/r, DRV/r or LPV/r	0.3, 0.0–0.7	0.8, 0.2–1.5	0.4, 0.0–1.0	0.0, 0.0–0.6	0.4, 0.0–0.7
INSTI	0.1, 0.0–0.3	2.7, 0.0–10.2	ND	ND	0.6, 0.0–2.0
Women initiating ART					
NRTI	8.5, 4.9–12.0	5.4, 3.0–7.8	4.3, 3.4–5.2	3.6, 1.7–5.4	7.7, 3.9–11.4
EFV or NVP	14.6, 13.6–15.5	21.3, 16.7–25.9	6.5, 5.7–7.3	9.2, 0.0–25.1	14.2, 12.1–16.2
ATV/r, DRV/r or LPV/r	0.3, 0.0–1.0	0.6, 0.0–1.5	1.2, 0.7–1.6	0.0, 0.0–1.3	0.4, 0.0–1.0
INSTI	0.0, 0.0–0.1	2.9, 0.0–12.2	ND	ND	0.3, 0.0–1.2
Men initiating ART					
NRTI	4.3, 2.6–6.0	6.8, 3.0–10.6	3.9, 3.6–4.3	4.3, 3.3–5.2	4.7, 3.7–5.8
EFV or NVP	16.3, 12.8–19.8	14.8, 7.9–21.8	6.7, 6.4–7.0	5.5, 3.4–7.6	13.1, 7.8–18.4
ATV/r, DRV/r or LPV/r	0.0, 0.0–0.0	0.9, 0.4–1.5	0.6, 0.6–0.7	0.0, 0.0–1.1	0.3, 0.0–0.7
INSTI	0.1, 0.0–0.4	2.7, 0.0–9.8	ND	ND	0.8, 0.0–2.7
ART initiators without previous ARV drug exposure					
NRTI	1.8, 0.4–3.3	4.9, 1.9–7.9	2.6, 0.0–5.5	2.7, 2.7–2.8	2.8, 1.4–4.3
EFV or NVP	11.3, 9.1–13.5	11.4, 7.8–15.0	3.3, 1.3–5.4	4.7, 0.2–9.2	7.2, 4.3–10.2
ATV/r, DRV/r or LPV/r	1.0, 0.6–1.4	0.9, 0.4–1.3	0.6, 0.0–1.4	0.0, 0.0–0.7	0.7, 0.3–1.1
INSTI	0.6, 0.0–2.2	2.2, 0.0–8.1	ND	ND	2.3, 0.0–5.5
ART initiators with previous ARV drug exposure					
NRTI	2.6, 1.5–3.7	9.3, 6.1–12.5	7.5, 7.1–7.9	12.1, 4.4–19.8	7.9, 6.3–9.5
EFV or NVP	20.0, 13.2–26.7	26.7, 23.3–30.1	19.8, 6.1–33.5	28.0, 5.0–51.1	23.6, 17.8–29.4
ATV/r, DRV/r or LPV/r	0.0, 0.0–1.9	0.8, 0.0–2.5	0.0, 0.0–2.9	0.0, 0.0–4.6	0.4, 0.0–1.0
INSTI	0.0, 0.0–6.8	4.0, 0.7–18.7	ND	ND	7.3, 0.0–16.3

a Weighted proportion and 95% CI. Pooled estimates were calculated using countries reporting data to WHO between 2014 and 2020.

HIV drug resistance was defined as the presence of a penalty score ≥15 using the Stanford HIVdb algorithm.

ART: antiretroviral therapy; ATV/r: atazanavir/ritonavir; DRV/r: darunavir/ritonavir; EFV: efavirenz; INSTI: integrase strand transfer inhibitor; LPV/r: lopinavir/ritonavir; ND: no data; NRTI: nucleoside reverse-transcriptase inhibitor; NVP: nevirapine.

Fig. 1.5. Prevalence of pretreatment HIV drug resistance among adults initiating ART, 2014–2020

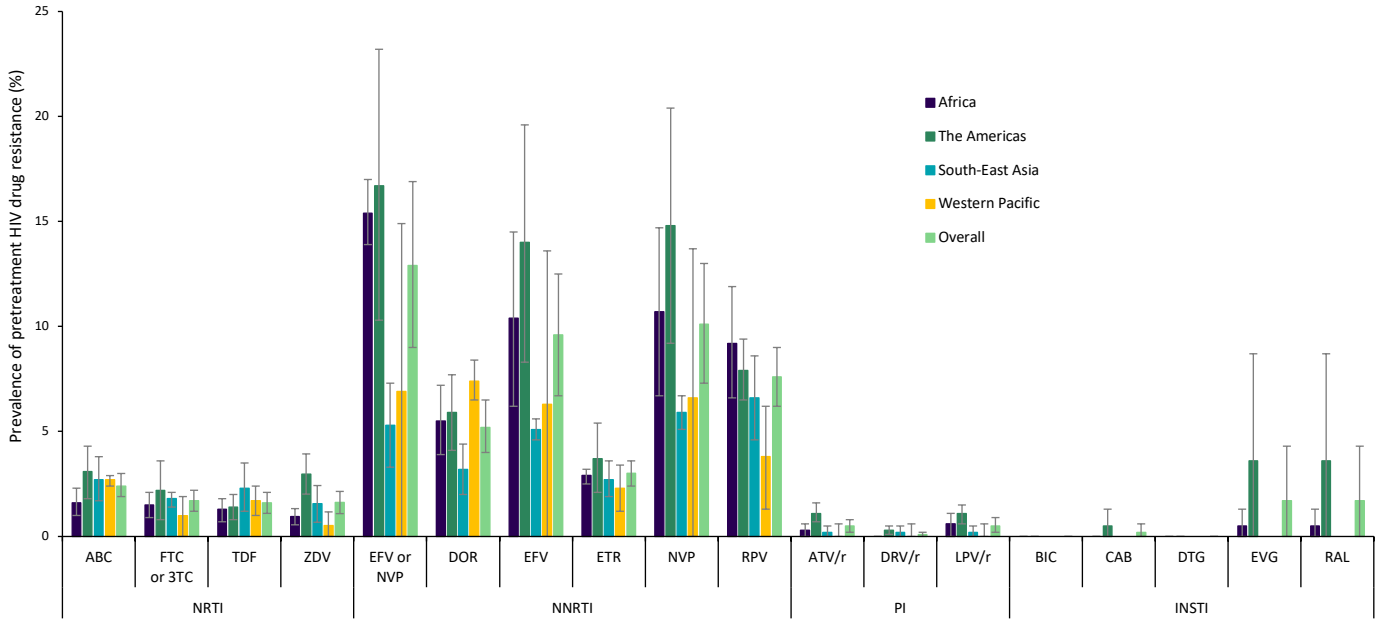

Fig 1.5 shows the study design–weighted prevalence and 95% confidence interval (error bars) of pretreatment HIV drug resistance among adults initiating antiretroviral therapy by region and overall. Pooled regional and overall estimates were calculated using countries reporting data to WHO between 2014 and 2020. South-East Asia and the Western Pacific regions did not contribute with data for the INSTI resistance estimates. HIVDR was defined as the presence of a penalty score ≥15 using the Stanford HIVdb algorithm.

ABC: abacavir; ATV/r: atazanavir/ritonavir; BIC: bictegravir; CAB: cabotegravir; DOR: doravirine; DRV/r: darunavir/ritonavir; DTG: dolutegravir; EFV: efavirenz; ETR: etravirine; EVG: elvitegravir; INSTI: integrase strand transfer inhibitor; LPV/r: lopinavir/ritonavir; NNRTI: non-nucleoside reverse transcriptase inhibitor; NRTI: nucleoside reverse transcriptase inhibitor; NVP: nevirapine; PI: protease inhibitor; RAL: raltegravir; RPV: rilpivirine; TDF: tenofovir; ZDV: zidovudine; 3TC/FTC: lamivudine/emtricitabine.

1.6 Implications of the findings

Historically, high levels of observed pretreatment HIV drug resistance to EFV or NVP (≥10%) were especially concerning, signalling higher than desirable levels of anticipated population-level failure to suppress viral loads and highlighting the need to fast-track the transition to DTG-based first-line regimens for adults and to use protease inhibitor (PI)-based ART when the levels of pretreatment HIV drug resistance are high and the use of DTG is not feasible in accordance with WHO recommendations (*5*).

At the time of survey implementation, only four of 35 countries providing data for this report had introduced TDF in combination with 3TC and DTG as a fixed-dose combination (TLD) for adult treatment initiators. Since this time, transition to TLD has been initiated in all 35 countries reporting survey data. Among the 10 countries reporting integrase inhibitor data to WHO for this report, DTG resistance was virtually non-existent which is highly reassuring and suggests high levels of predicted efficacy of this drug in achieving population-level viral load suppression, provided sufficient adherence is maintained. Survey findings are consistent with other studies indicating low levels of transmission of integrase inhibitor-resistant virus (*16–25*). Despite the anticipated benefits of DTG, it remains important for countries to conduct periodic surveys of pretreatment drug resistance to ensure the long-lasting efficacy of TLD and to be alert to any signal of increased levels of pretreatment resistance to DTG and/or to NRTIs, which may affect population-level treatment outcomes (*8*). In addition, high levels of pretreatment HIV drug resistance among people with previous ARV drug exposure reinforces the need to minimize attrition from care by implementing vigorous retention strategies and also highlights the need to fully adopt lifelong ART in everyone living with HIV, including pregnant women.

Overall estimates of pretreatment TDF resistance were generally low and ranged from 0.0% in Eritrea and Eswatini in 2016 to 8.2% in Zambia in 2019. FTC and 3TC pretreatment resistance estimates ranged from 0.0% in Eritrea and Colombia in 2016 to 8.0% in El Salvador in 2018. Virus with resistance to both TDF and FTC or 3TC was rare and only reached 6.6% (95% CI 2.7–15.1%) in Zambia in 2019. Recent studies suggest that successful treatment outcomes can be achieved among adults with TDF resistance by using TLD (*26,27*). Nevertheless, routine and ongoing analysis of national programmatic outcome data assessing viral load suppression in populations receiving TLD will remain critical, as will routine surveys of acquired HIV drug resistance and maximizing overall HIV treatment delivery to minimize the proportion of the treated population with treatment failure.

Levels of pretreatment INSTI HIV drug resistance were extraordinarily low or absent in countries reporting survey data from Africa. However, in the Americas, in countries

that tested for resistance to INSTIs and where the subtype F was observed, the prevalence of raltegravir or elvitegravir resistance ranged from 3.4% in Paraguay to 14.9% in Uruguay. This finding was due to the G163R/K mutations (**Annex 1: Table A1.4d**), which are polymorphic in HIV-1 subtype F and found among ARV drug–naive people but are otherwise non-polymorphic in other HIV-1 subtypes (*14,15*). The G163K/R mutations are common integrase inhibitor-selected mutations that cause predicted low-level resistance to elvitegravir and raltegravir; they cause no predicted resistance to BIC, CAB or DTG (*28,29*).

Levels of pretreatment resistance to EFV and NVP were high in African, Latin American and Caribbean countries, especially among women (**Fig. 1.6**), suggesting the need to strengthen the health systems, and in particular, to increase women's access to a continuous supply of reliable ARV drugs.

Overall, the low prevalence of TDF and FTC or 3TC resistance provides reassurance for using this drug combination in PrEP; however, since these two drugs are used in combination as PrEP and as a component of ART first-line regimens, routine surveillance is required to provide assurance that these two drugs can be effectively used as both treatment and prophylaxis when PrEP programmes are scaled up in low- and middle-income countries. **Section 3** provides additional information on HIV drug resistance among populations receiving pre-exposure prophylaxis for preventing HIV.

Fig. 1.6. Prevalence of pretreatment HIV drug resistance to efavirenz or nevirapine among adults initiating ART, by gender, 2014–2020

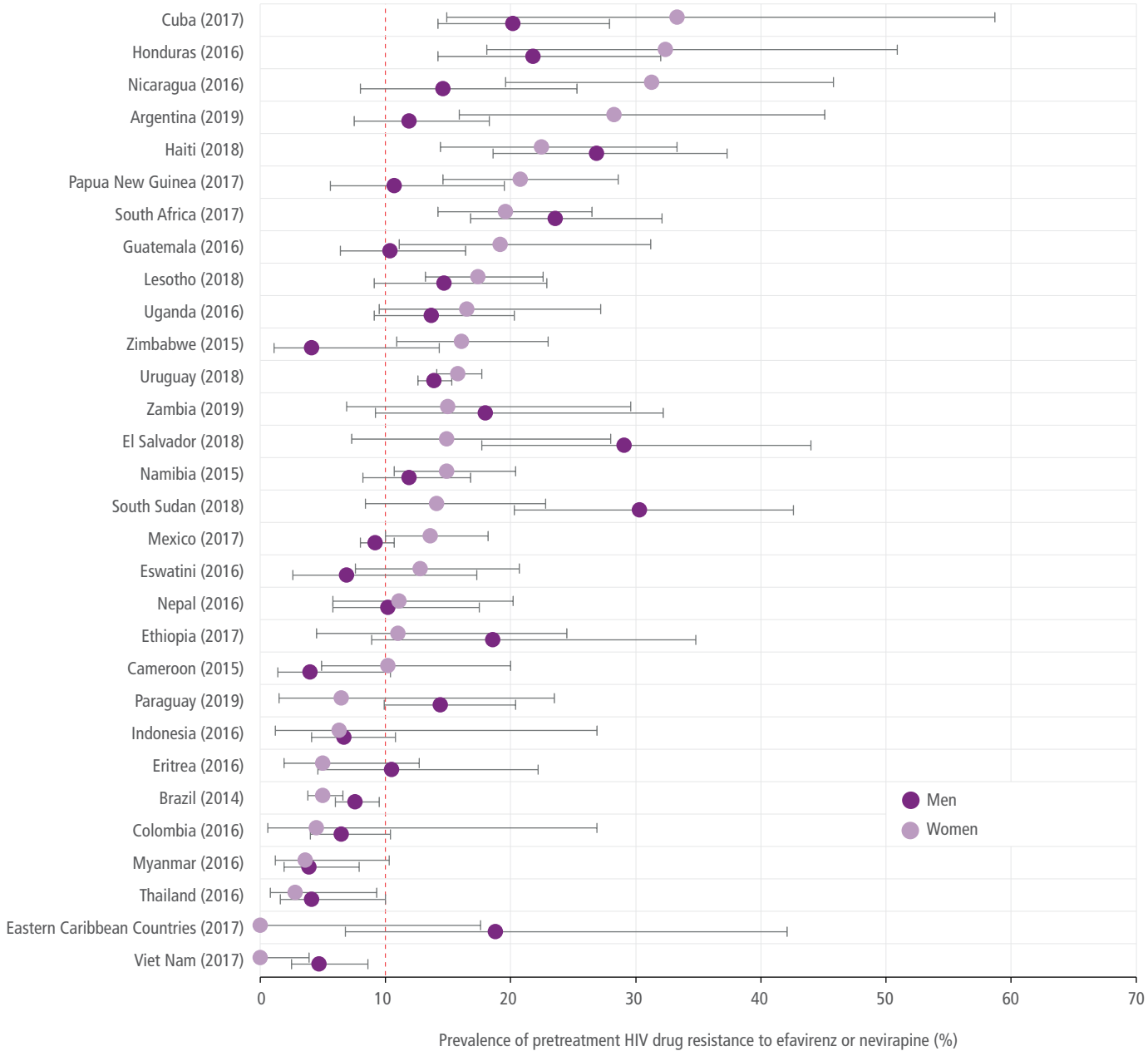

Fig 1.6 shows the prevalence of pretreatment HIV drug resistance to efavirenz or nevirapine among adults starting antiretroviral therapy, by gender, in countries reporting data to WHO between 2014 and 2020. In all countries, pretreatment HIV drug resistance estimates are generated from nationally representative surveys using standard WHO survey methods. The Eastern Caribbean Countries are aggregated because a multi-country survey was carried out in Antigua and Barbuda, Dominica, Grenada, Saint Kitts and Nevis, Saint Lucia, and Saint Vincent and the Grenadines. In 4 countries (Brazil, Colombia, Cuba, and Zimbabwe) only individuals starting antiretroviral therapy without prior exposure to antiretroviral drugs were included in the pretreatment HIV drug resistance surveys.
Error bars correspond to the 95% confidence intervals. The dotted line (10% prevalence) indicates the prevalence above which WHO recommends to fast-track the transition to DTG-based first-line regimens.

2. PRETREATMENT HIV DRUG RESISTANCE AMONG INFANTS NEWLY DIAGNOSED WITH HIV


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The findings of pretreatment HIV drug resistance surveys among infants newly diagnosed with HIV inform the selection of standard first-line ART for children and accelerate the transition from NNRTI- to non-NNRTI-based first-line ART (*10*).

The goals of the survey are to generate nationally representative estimates of (1) pretreatment HIV drug resistance prevalence among treatment-naive infants, regardless of exposure to prophylactic regimens used for preventing the mother-to-child transmission of HIV; (2) pretreatment HIV drug resistance prevalence among treatment-naive infants with known exposure to ARV drugs to prevent mother-to-child transmission (maternal or neonatal portion); (3) pretreatment HIV drug resistance prevalence among treatment-naive infants with no or unknown exposure to ARV drugs to prevent mother-to-child transmission; and (4) proportion of infants newly diagnosed with HIV through early infant diagnosis with exposure to ARV drugs for prevention of mother-to-child transmission.

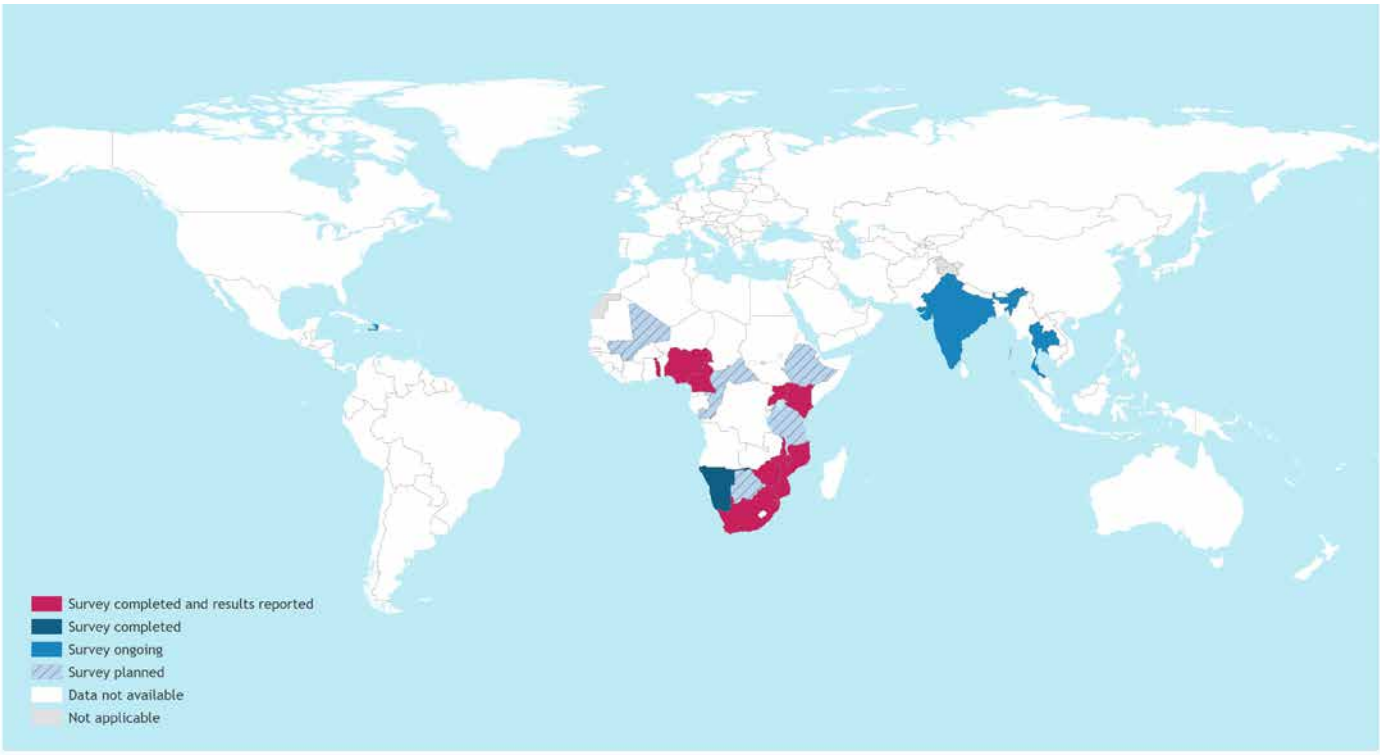
2.1 Survey method: pretreatment HIV drug resistance among infants newly diagnosed with HIV

The WHO concept note for pretreatment HIV drug resistance surveys among children newly diagnosed with HIV by early infant diagnosis (*10*) describes the sample size estimation, sampling methods and statistical analysis in detail. Briefly, HIV drug resistance testing is performed on a random sample of remnant dried blood spots (DBS) collected for early HIV infant diagnosis from treatment-naive infants younger than 18 months newly diagnosed with HIV. Sampling is random and proportional to the number of remnant specimens available for testing during the survey period in each participating laboratory.

2.2 Progress in implementing the surveys and geographical representation

Between 2012 and 2020, 15 countries implemented surveys of pretreatment HIV drug resistance among ART-naive infants younger than 18 months, and 10 have reported the results to WHO (**Map 3**). Seven countries are planning the survey.

Map 3. Implementation of WHO pretreatment HIV drug resistance national surveys among infants newly diagnosed with HIV and treatment naive, 2011–2021



The designations employed and the presentation of the material in this publication do not imply the expression of any opinion whatsoever on the part of WHO concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. Dotted and dashed lines on maps represent approximate border lines for which there may not yet be full agreement.

Data Source: World Health Organization
Map Production: WHO GIS Centre for Health, DNA/DDI
Map Creation Date: **30 September 2021**

World Health Organization

2.3 Data analysis

HIV drug resistance was defined as having mutations with a penalty score ≥15 assigned to an ARV drug using the Stanford HIVdb algorithm version 9.0 (*14,15*). HIV subtype was assigned using the Stanford HIVdb subtyping tool (*14*). Statistical analysis was performed using STATA 15.1 (Stata Statistical Software: release 15.1, 2017, StataCorp LLC) following the WHO-recommended method to generate weighted estimates based on the study's design (*10*). **Annex 2** describes the methods used for pooled analysis.

2.4 Populations

Most of the infants had been exposed to ARV drugs for the infant and/or maternal portion of the regimen for prevention of mother-to-child transmission, ranging from 39% in Cameroon to 89% in Kenya (**Annex 1: Tables A2.1a–A2.1c**). Infants from countries in eastern and southern Africa had higher levels of exposure to ARV drugs for prevention of mother-to-child transmission (range 75% in Eswatini to 89% in Kenya) than did countries in western Africa (39% in Cameroon to 65% in Togo). Many infants, however, had missing information on exposure to ARV drugs for prevention of mother-to-child transmission. Missing information on previous ARV drug exposure reached 28% in Nigeria. Among six countries reporting the type of regimen for prevention of mother-to-child transmission, NVP was the most commonly used neonatal prophylaxis in Cameroon, Nigeria and Uganda (>90%), while dual zidovudine (ZDV) +NVP was the most common prophylaxis in Kenya (94%). Triple ART was the most commonly reported maternal regimen for prevention of mother-to-child transmission in surveys conducted after the 2013 WHO recommendation for lifelong ART (in Kenya, Nigeria and Uganda).

2.5 Key findings

Overall, the prevalence of pretreatment HIV drug resistance to EFV or NVP was high, with a pooled prevalence of 45.5% (95% CI 42–49%), ranging from 34% in Eswatini to 68% in Malawi (**Fig. 2.1 and Annex 1: Tables A2.3a–A2.3c**). The prevalence of pretreatment resistance to abacavir (ABC) and 3TC (the preferred NRTIs for infants) was also high and had exceeded 10% in five and four of the 10 countries reporting data, respectively (**Fig. 2.2**). Specifically, ABC resistance levels ranged from 1.5% in Eswatini in 2011 to 19.8% in Malawi in 2016. Nearly one third (32%) of all specimens with predicted ABC resistance had only the M184I/V mutations, which confer low-level resistance. Thus, the infants from which these specimens were obtained are likely to derive at least partial clinical benefit from ABC (*30*). Pretreatment resistance to second-generation NNRTIs was also high, ranging from about 13–45% for doravirine, 12–49% for etravirine and 23–63% for rilpivirine (**Annex 1: Tables A2.3a–A2.3c**).

Fig. 2.1. Prevalence of pretreatment HIV drug resistance to efavirenz or nevirapine among treatment-naive infants newly diagnosed with HIV, 2012–2020

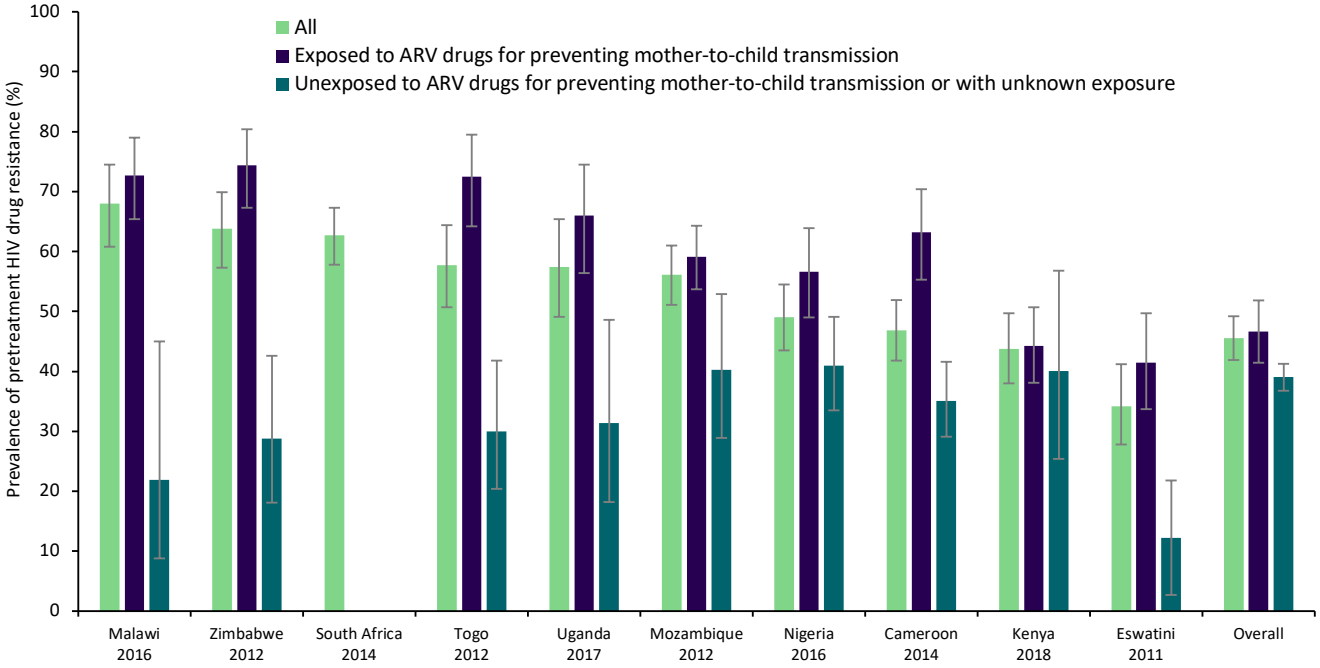


Fig 2.1 shows the study design–weighted prevalence and 95% confidence interval (error bars) of pretreatment HIV drug resistance to efavirenz or nevirapine among infants aged ≤18 months newly diagnosed with HIV and treatment-naive in countries reporting data to WHO between 2012 and 2020. The pooled overall estimate was calculated using countries reporting data to WHO between 2012 and 2020. HIVDR was defined as the presence of a penalty score ≥15 using the Stanford HIVdb algorithm.

Fig. 2.2. Prevalence of pretreatment HIV drug resistance to NRTIs among treatment-naive infants newly diagnosed with HIV, 2012–2020

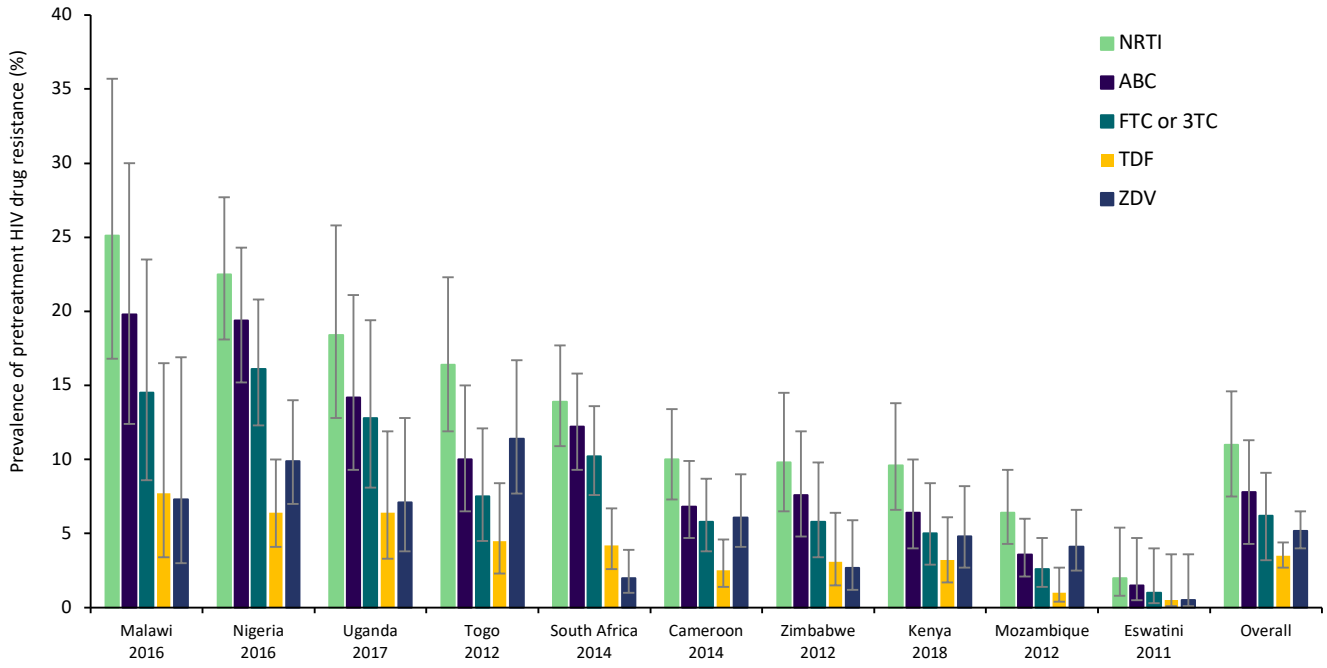


Fig 2.2 shows the study design–weighted prevalence and 95% confidence interval (error bars) of NRTI pretreatment HIV drug resistance among infants aged ≤18 months newly diagnosed with HIV and ART-naïve in countries reporting data to WHO between 2012 and 2020. The pooled overall estimate was calculated using countries reporting data to WHO between 2012 and 2020. HIVDR was defined as the presence of a penalty score ≥15 using the Stanford HIVdb algorithm.

ABC: abacavir; NRTI: nucleoside reverse transcriptase inhibitor; FTC: emtricitabine; TDF: tenofovir; ZDV: zidovudine; 3TC: lamivudine.

2.6 Implications of the findings

The high levels of resistance to EFV or NVP among infants living with HIV are not unexpected and are consistent with previoulsy published data. Recent assessment indicates that most countries are moving away from NNRTI-based ART for infants in accordance with WHO recommendations. Nevertheless, as of 2020 about 28% of infants remained on NVP-based regimens (*31*). Overall, these findings highlight the need to accelerate the ongoing transition to the WHO-recommended HIV treatments for children, which are based on DTG.

The relatively high levels of pretreatment NRTI resistance in some countries suggest caution when initiating regimens containing drugs with a low-genetic barrier to resistance (e.g., raltegravir in neonates), and findings highlight the importance of using DTG-containing regimens in young children as early as possible. The current WHO-recommended first-line regimen for infants younger than one month is raltegravir + ZDV or ABC + 3TC. Only when children reach 3 kg and four weeks of age is DTG + ABC + 3TC recommended (*32*). Thus, observed levels of ABC resistance merit consideration, and studies are needed to characterize the impact of ABC and 3TC or FTC resistance on PI- and DTG-based regimens and the impact of this resistance when used in combination with first-generation integrase inhibitors (such as raltegravir).

Since TDF is not used among young children because of bone toxicity concerns, even as DTG becomes more available for younger children, the possible impact of ABC resistance should be further investigated. Although high levels of viral load suppression have been observed among adults when DTG is used in combination with TDF or FTC in the presence of TDF and/or 3TC or FTC resistance (*26,27*), these findings apply to TDF and cannot be readily extrapolated to ABC as ABC has a different resistance profile. Therefore, a clinical trial assessing the outcomes of infants with predicted ABC resistance when receiving ABC +3TC+DTG should be conducted. Observed levels of ABC resistance also accentuate the need to accelerate access to new ARV drugs in this population, such as tenofovir alafenamide and drugs from new classes such as islatravir or lenacapavir. Unfortunately, no country reporting data from HIV drug resistance surveys genotyped the integrase region of HIV-1, and the levels of integrase inhibitor resistance in this population are thus unknown. However, based on the levels observed in adults, the prevalence of resistance to INSTIs in infants is likely to be vanishingly small unless treated with raltegravir. Overall, the findings underscore a need for greatly enhanced virological monitoring of infants living with HIV and pregnant and breastfeeding women, with prompt switching of regimen when failure to suppress viral load is documented and using DTG-based regimens for young children as early as possible.

3. REVIEW OF HIV DRUG RESISTANCE AMONG POPULATIONS RECEIVING PrEP FOR PREVENTING HIV

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3.1 Summary of the problem

Potent ARV drugs used as part of combination HIV prevention are critical for ending the HIV epidemic (*33*). Oral pre-exposure prophylaxis (PrEP) has been highly successful at protecting individuals from acquiring HIV, and promising new options are in the pipeline, including the dapivirine (DPV) vaginal ring and the long-acting injectable cabotegravir (CAB-LA), both of which are currently undergoing regulatory review. DPV is a second-generation NNRTI, and CAB is a second-generation integrase inhibitor. The DPV vaginal ring received a positive scientific opinion from the European Medicines Agency in July 2020 and was recommended as part of combination prevention by WHO in January 2021. The United States Food and Drug Administration is expected to approve CAB-LA in January 2022 (*34*).

A potential concern is that the same drugs and drug classes are being used for both HIV prevention and treatment, such as TDF and FTC for oral PrEP and for first-line ART. HIV drug resistance from oral PrEP could lead to failure to suppress viral loads on ART, whereas transmitted drug resistance from non-suppressive ART could lead to infection despite oral PrEP. Secondary transmission of resistant HIV can also occur. Continued monitoring for HIV drug resistance from oral PrEP will be important, as will monitoring of HIV drug resistance arising from the rollout of new prevention products (DPV vaginal ring and CAB-LA).

To date, most HIV drug resistance data from the use of ARV drugs for HIV prevention have been reported from clinical trials and case reports. **Box 1** summarizes the current published findings for oral PrEP, DPV vaginal ring and CAB-LA.

Box 1. Key findings: HIV drug resistance among PrEP users diagnosed with HIV

Oral TDF + FTC PrEP

- Inadequate protection from insufficient doses of PrEP is the most common cause of seroconversion on PrEP.
- Breakthrough infection of virus resistant to TDF or FTC is infrequent.
- Resistance to oral PrEP is most likely to occur when it is started in the setting of undiagnosed acute infection.
- Breakthrough of wild-type HIV infection is rare.
- Resistance in rollout settings may differ from what has been observed in trials.

DPV vaginal ring

- The risk of selecting NNRTI resistance with seroconversion on the DPV vaginal ring is low; rates of resistance did not differ between the placebo ring and DPV vaginal ring arms in Phase 3 trials.
- The risk of transmission or selection of high-level NNRTI resistant virus in rollout settings is not yet known.

CAB-LA

- Diagnosis of HIV infection could be delayed for individuals who become HIV positive while taking CAB-LA. There is a risk of CAB resistance selection during undiagnosed infection.
- To date, a small number of individuals have been infected with HIV while receiving CAB-LA as part of a clinical trial; in more than half of these cases, CAB resistance was detected.
- More studies are needed to understand the risk of resistance among individuals who acquire HIV after missing doses or discontinuing CAB-LA.

3.2 HIV drug resistance among people seroconverting on TDF-based PrEP

Of 217 results using the search terms "HIV", "PrEP" and "resistance" in PubMed, 37 studies were identified that reported HIV drug resistance results from individuals who seroconverted after being prescribed oral TDF + FTC for HIV prevention. These included TDF + FTC arms from randomized clinical trials of oral PrEP and other PrEP products, open-label studies, demonstration studies and population-based cohorts.

To date, reports have been published on 348 seroconversions from 20 867 individuals who have been prescribed TDF + FTC PrEP (*35–37*). Thirty-five seroconversions have been reported among individuals who started PrEP during undiagnosed acute infection; of these, 18 of **35** (51%) had HIV-1 with mutations associated with TDF or FTC resistance (K65R and/or M184I or V). A total of **313** individuals became HIV positive after starting PrEP; of these, 19 of 313 (6%) had TDF- and/or FTC-associated mutations (**Table 3.1**).

Twelve case reports of individuals who seroconverted on PrEP despite detectable drug levels have been published (**Table 3.2**). Of these 12, nine had HIV with K65R and/or M184V with or without NNRTI mutations, and three had wild-type HIV.

The Global Evaluation of Microbicide Sensitivity project monitored HIV drug resistance associated with PrEP between December 2017 and July 2021 in South Africa through PrEP implementation partners, and in Eswatini, Kenya and Zimbabwe through a national protocol in which a blood sample was collected from any consenting current PrEP user (defined as having collected an initial supply or resupply of oral PrEP) who was diagnosed as HIV infected in accordance with national HIV testing algorithms (*38*). The PrEP HIV drug resistance monitoring protocols are currently ongoing through the Maximizing Options to Advance Informed Choice for HIV Prevention (MOSAIC) consortium (*39*). Of 118 seroconversions tested for HIV drug resistance to date by Sanger sequencing, 23% had PrEP-associated resistance mutations, with the majority having TDF diphosphate levels associated with four or more doses per week. With PrEP use outside of controlled trials, multiple mechanisms of resistance are possible that need to be investigated and monitored, such as stopping or restarting PrEP without knowing HIV status, starting PrEP during acute infection and continuing PrEP after breakthrough infection.

There are limited data on the use of FTC + tenofovir alafenamide as PrEP. Among 2694 participants receiving FTC + tenofovir alafenamide in the DISCOVER study, eight seroconversions have been reported (*40*). Resistance was not detected among any participant by Sanger sequencing, but for one of the eight participants, sensitive next generation-sequencing detected M184V present at 2% of the viral population (*41*).

Table 3.1. Seroconversions in studies and cohorts of individuals prescribed TDF + FTC PrEP for HIV prevention

Study or cohort	Number in TDF + FTC arm	HIV positive at follow-up	TDF- or FTC-associated mutations (K65R, M184I or V, K70E) at follow-up	HIV positive at enrolment	TDF- or FTC-associated mutations (K65R, M184I or V, K70E) at enrolment
FEM-PrEP (*42,43*)	1025	33	4	1	0
iPrEX (*44,45*)	1226	48	0	2	2
TDF2 (*46,47*)	602	9	0	1	1
Partners PrEP (*48–50*)	1579	21	3	4	2
VOICE (*51–53*)	1 003	61	1	9	2
IPERGAY (*54*)	206	2	0	1	0
IPERGAY OLE (*54*)	336	3	0	1	0
PROUD (*55*)	275	2	0	3	2
HPTN-067 (*56*)	622	9	1	3	2
HPTN-073 (*57*)	165	5	1	–	–
USA DEMO (*58*)	557	2	0	3	1
HPTN-082 (*59*)	451	4	0	–	–
iPrEX OLE (*60*)	1 225	28	1	0	0
ATN 110 (*61*)	200	4	0	–	–
DISCOVER (*40,62*)	2 699	11	0	4[a]	4
SEARCH (*63*)	5 447	25	1[b]	–	–
IAVI-Kenya (*64*)	140	9	0	–	–
VHA (*65*)	825	6	2	–	–
HPTN-083 (*66*)	2 284	39	4	3	2
Princess PrEP (*67*)	1 697	7	1	–	–
Total	**28 867**	**313**	**19 (6%)**	**35**	**18 (51%)**

a Suspected of having started PrEP during acute infection.
b Resistance results available from only 10 of the 25 seroconversions.

Table 3.2. HIV drug resistance among reported cases of seroconversion among people receiving TDF + FTC PrEP

Case location	Resistance mutations[a]	Drug level results	PrEP regimen	Duration
Toronto (*68*)	M41L, D67G, T69D, K70R, M184V, Y215E ; Y181C; L10I; H51Y E92Q	High DBS, plasma	Daily TDF + FTC	24 months
New York City (*69*)	K65R, M184V; K103S, E138Q, Y188L	High DBS, hair	Daily TDF + FTC	5 months
North Carolina (*70*)	K65R, K70T, M184V; K103N	High plasma, hair	Daily TDF + FTC	9 months
Pattaya (*71*)	M184V; A98G, K103N	High plasma, hair	Daily TDF + FTC	8 weeks
San Francisco (*72*)	M184V, L74V; L100I, K103N	High DBS, plasma, hair	Daily TDF + FTC	13 months
San Francisco (*73*)	M184V	Self-reported on-demand dosing	On-demand TDF + FTC	~9 months
Germany (*74*)	K65R	Inferred from hepatitis B virus response	Daily TDF	18 months
Texas (*75*)	M184V, K70N; V179E, P225H	High DBS, hair	Daily TDF + FTC	18 months
KwaZulu-Natal (*76*)	K65R, M184V	High DBS	Daily TDF + FTC	9 months
Amsterdam (*77*)	Wild type	High DBS	Daily TDF + FTC	8 months
London (*78,79*)	Wild type	High plasma	Daily TDF	4 years
London (*78,79*)	Wild type	Inferred from hepatitis B virus response	Daily TDF	3 years

3.3 HIV drug resistance among women using the DPV vaginal ring

A vaginal ring containing the NNRTI DPV was found to be effective for preventing HIV infection in two Phase 3, randomized, placebo-controlled clinical trials: ASPIRE (MTN-020) and the Ring Study (IPM 027).

ASPIRE enrolled 2629 healthy HIV-negative women at 15 sites in Malawi, South Africa, Uganda and Zimbabwe, and the Ring Study enrolled 1959 women in South Africa and Uganda. Both studies randomized participants to a monthly vaginal ring containing 25 mg of DPV or a placebo ring.

Of 71 women from the DPV ring arm who seroconverted in ASPIRE, 8 (10%) had one or more HIV NNRTI resistance mutations; of the 77 women from the DPV ring arm who seroconverted in the Ring Study, 14 (18%) had one or more HIV NNRTI resistance mutations. Similar levels of drug resistance were observed in placebo arms (*80–82*). The open-label studies HOPE and DREAM enrolled participants who remained HIV negative after ASPIRE and the Ring Study closed, and neither study included a placebo ring arm. The frequency of NNRTI resistance in HOPE and DREAM was 7 of 38 seroconversions (18%) and 5 of 18 seroconversions (28%) respectively (**Table 3.3**) (*83,84*).

a Mutations in underline text are associated with the highest levels of reduced susceptibility or virological response to TDF, FTC or 3TC.

Table 3.3. NNRTI resistance from Phase 3 and open-label studies of DPV vaginal ring

Study	DPV vaginal ring arm: number with NNRTI resistance/number seroconverted (%)	Placebo ring arm: number with NNRTI resistance/number seroconverted (%)
MTN-020 (ASPIRE) (*80,81*)	8/71 (11%)	10/96 (10%)
IPM 027 (RING) (*82*)	14/77 (18%)	9/56 (16%)
MTN-025 (HOPE) (*83*)	7/38 (18%)	–
IPM 032 (DREAM) (*84*)	5/18 (28%)	–

3.4 HIV drug resistance among people seroconverting on CAB-LA PrEP

HPTN-083 was a randomized trial of CAB-LA that started with a five-week lead-in phase with 30 mg of oral CAB with oral TDF + FTC daily. Participants were then randomized to 600 mg of intramuscular CAB-LA given at weeks 5 and 9 and every 8 weeks for the duration of the blinded trial portion or daily oral TDF + FTC. The trial ended with open-label TDF + FTC to cover the CAB pharmacokinetic tail. A total of 2283 participants were randomized to the CAB-LA arm, and two were retrospectively found to be HIV infected at study enrolment. Sixteen people acquired HIV in the CAB-LA arm: four before enrolment, five among individuals with no recent CAB-LA dose, three among individuals taking oral CAB during the lead-in period and four among individuals who had on-time CAB injections. **Table 3.4** shows the five participants with INSTI resistance. One case was in an individual with undetected wild-type acute infection at enrolment who then developed HIV-1 with INSTI mutations at week 6. Two participants who seroconverted during the oral lead-in period had INSTI resistance, and two participants who seroconverted on CAB-LA had INSTI resistance (*66,85*).

In HPTN-084, Long-Acting Injectable for the Epidemic (LIFE) study, which evaluated the efficacy of CAB-LA among women in Sub-Saharan Africa, no INSTI mutations were detected in the four seroconversions observed (one baseline infection and three incident infections) (*86*).

Table 3.4. HIV drug resistance from individuals from HPTN 083 who seroconverted on CAB-LA

Case	Visit	NRTI/NNRTI	INSTI
A2	Enrolment	–	Not detected
	Week 6	–	E138K, Q148K
C1 (oral)	Week 9	–	Q148R
	Week 10	–	E138E/K, G140G/S, Q148R
C3 (oral)	Week 9	–	E138, Q148R
D3 (IM)	Week 17	K103N	–
	Week 33	K103N	R263K
D4 (IM)	Week 12	–	G140A, Q148R

3.5 Public health implications of PrEP-associated resistance

PrEP-associated resistance is infrequent overall and should not inhibit PrEP use, but it should be better understood to minimize its occurrence. Counselling on the importance of PrEP adherence prior to initiation and throughout its use may also reduce the risk of infection on PrEP. The resistance identified in seroconversions on PrEP could be due to individuals who started PrEP during acute infection or who had inadequate drug exposure because of insufficient ARV drug levels to prevent infection. Seroconversions on PrEP could also be transmission from a source partner of HIV with resistance to the PrEP agents. Finally, HIV infection despite adequate adherence to PrEP is rare. Avoiding the use of PrEP by infected individuals is critical for minimizing the risk of drug resistance and must be balanced with maintaining easy access to PrEP to protect individuals at substantial risk of acquiring HIV.

The data on ART outcomes in individuals who seroconverted while taking PrEP and have drug-resistant HIV are sparse. Closer monitoring of these individuals after starting ART is warranted, especially in regions where drug resistance testing to guide regimen selection is unavailable.

The various mechanisms by which HIV infection and resistance occur among individuals who seroconvert on PrEP are not always simple to elucidate. Transmitted resistance is challenging to confirm without having the HIV sequence from the source partner, except in cases of infection with multi-class resistance mutations or detection of mutations unrelated to the PrEP agent taken (such as NNRTI resistance only in an individual who seroconverted on oral TDF + FTC PrEP).

Additional considerations are needed with future use of the DPV ring and CAB-LA. PrEP-associated resistance does not appear to be a consequence of DPV ring use, but it will be important to monitor for transmitted NNRTI resistance among women using DPV rings. More data are needed to assess whether DPV will remain active against highly NNRTI-resistant variants or whether there will be preferential selection of NNRTI-resistant variants in seroconversions among women using a DPV ring. CAB-LA may delay the diagnosis of HIV infection by rapid antigen or antibody testing as observed in HPTN-083, but there are logistical challenges with requiring plasma HIV RNA testing before initiating CAB-LA for HIV prevention. Delayed diagnosis of HIV could lead to continued CAB injections that can increase the selection of CAB-resistant HIV. Secondary transmissions of CAB-resistant virus arising from CAB-LA use are possible but have yet to be detected.

Despite the need for ongoing study of PrEP-associated HIV drug resistance and the need for national data on HIV drug resistance among PrEP users testing positive for HIV while taking PrEP, resistance concerns must never be a reason to limit the use of or access to PrEP.

3.6 WHO survey method for countries scaling up PrEP

In October 2020, WHO recommended that PrEP scale-up be accompanied by surveillance of HIV drug resistance and published technical guidance to describe the methods and implementation considerations for monitoring HIV drug resistance among PrEP users who are diagnosed with HIV. The recommended approach is based on national policy. If HIV drug resistance testing is routinely performed on all PrEP users who test positive for HIV, HIV drug resistance genotypic data can be aggregated annually at the national level to estimate the prevalence of HIV drug resistance among PrEP users diagnosed with HIV. If HIV drug resistance testing of all PrEP users who test positive for HIV is not routinely performed, WHO recommends implementing a cross-sectional survey at all sites providing PrEP in a country in which HIV drug resistance testing is performed on all PrEP users who test positive for HIV during a defined survey period, generally one year. If surveys are implemented, it is suggested that they be conducted every 3–5 years (*7*). The concept note (*87*) provides specific details on conducting the survey and analysing survey data. While the current focus of the concept note is on TDF and 3TC and FTC resistance, as new PrEP regimens become available, the outcomes of the survey will be expanded to include the prevalence of resistance by drug and drug class relevant to the drugs included in new PrEP regimens. Although WHO survey methods cannot account for non-reporting or underreporting of HIV incident cases among individuals who have taken PrEP during the survey period, and its passive or cross-sectional design cannot distinguish acquired (PrEP-selected) and transmitted HIV drug resistance to the prescribed PrEP regimen, the results will support the selection of appropriate first-line ART among people who test positive for HIV while taking PrEP and can be correlated with levels of pretreatment HIV drug resistance in a country among those reporting previous ARV drug exposure, specifically exposure to PrEP.

In addition, future consideration may be given to parallel testing of drug levels of PrEP agents among individuals who acquire HIV despite PrEP, since drug levels could help elucidate the mechanism of PrEP failure, including non-adherence, intermittent adherence or infection despite adequate PrEP drug exposure. Future WHO global reports featuring results from surveys of HIV drug resistance among PrEP users are anticipated.

4. ACQUIRED HIV DRUG RESISTANCE AMONG ADULTS AND AMONG CHILDREN AND ADOLESCENTS RECEIVING ART

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Surveys of acquired HIV drug resistance provide critical information to assess the performance of ART programmes in preventing HIV drug resistance (maximizing population-level viral load suppression), with the prevalence and patterns of acquired HIV drug resistance among individuals taking ART without viral load suppression informing the selection of second-line and potentially third-line ART regimens (*11*). The overall goal of WHO-recommended acquired HIV drug resistance surveys is to generate nationally representative estimates of the prevalence of viral load suppression and of acquired HIV drug resistance in populations receiving ART.

4.1 Survey method: acquired HIV drug resistance among adults and children and adolescents receiving ART

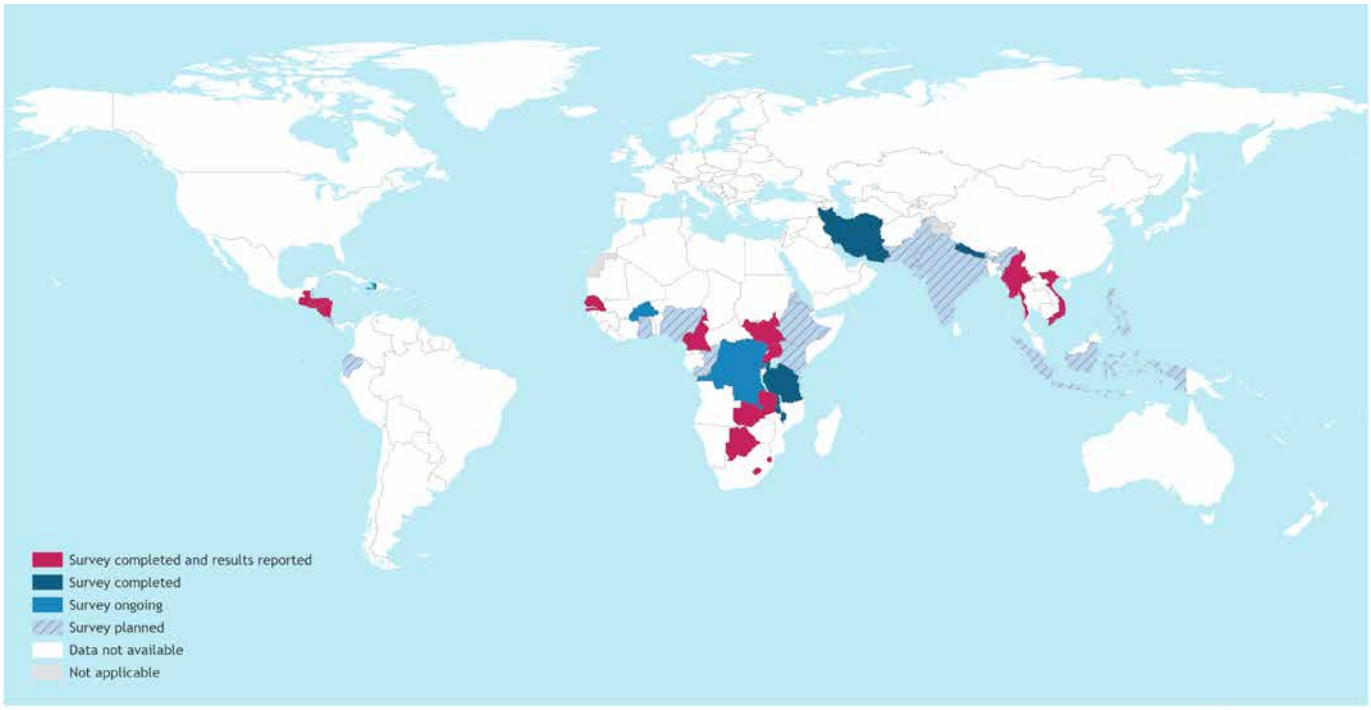
The WHO concept note for acquired HIV drug resistance surveys among individuals receiving ART (*11*) describes the sample size estimation, sampling methods, implementation considerations and statistical analysis in detail. Briefly, the cross-sectional clinic-based survey uses a method known as a two-stage cluster design. In the first stage, the clinics are sampled from a list of all clinics dispensing ART in the country. In the second stage, a sample of eligible people is recruited from each of the selected clinics. The specimens collected with a viral load ≥1000 copies/mL are genotyped, and HIV drug resistance is predicted using the Stanford HIVdb algorithm (*14,15*).

4.2 Progress in implementing the surveys and geographical representation

Between 2014 and 2020, 63 surveys of acquired HIV drug resistance among individuals receiving ART were implemented in 28 countries; of these, 58 surveys are completed and five remain ongoing (**Map 4**). Twenty-two countries plan to conduct acquired HIV drug resistance surveys in the near future. This report summarizes findings from 29 acquired HIV drug resistance surveys among adults conducted in 20 countries and with data reported to WHO: eight countries in the African Region, 10 in the Region of the Americas,[4] one in the South-East Asia Region and one in the Western Pacific Region. In addition, this report includes the results of three acquired HIV drug resistance surveys among children and adolescents conducted in two African countries (Uganda and Zambia).

4 Including a multicountry acquired HIV drug resistance survey in the Eastern Caribbean Countries.

Map 4. Implementation of WHO acquired HIV drug resistance national surveys among adults receiving antiretroviral therapy, 2014–2021



The designations employed and the presentation of the material in this publication do not imply the expression of any opinion whatsoever on the part of WHO concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. Dotted and dashed lines on maps represent approximate border lines for which there may not yet be full agreement.

Data Source: World Health Organization
Map Production: WHO GIS Centre for Health, DNA/DDI
Map Creation Date: 28 September 2021

World Health Organization

4.3 Data analysis

HIV drug resistance was defined as the presence of a penalty score ≥15 assigned to an ARV drug using the Stanford HIVdb algorithm version 9.0 (*14,15*). HIV subtype was assigned using the Stanford HIVdb subtyping tool (*14*). Statistical analysis was performed using STATA 15.1 (Stata Statistical Software: release 15.1, 2017, StataCorp LLC), the WHO-recommended method to generate weighted estimates based on the study's design (*11*). **Annex 2** describes the methods used for pooled analysis.

4.4 Populations

Women receiving ART were predominant in countries in Africa that reported survey findings to WHO (**Annex 1: Tables A4.1a– A4.1d**). Men receiving ART predominated in countries reporting survey data from the Americas and in Myanmar and Viet Nam (**Annex 1: Tables A4.1e–A4.1h**). In all countries, most adults receiving ART were taking a first-line ART regimen (≥70%). The most common first-line regimen used in countries reporting survey data was an NNRTI-based regimen, except for adults receiving ART for 12 ± 3 months in Botswana in 2019, where 86% (95% CI 78–92%) were receiving DTG-based ART. One third of adults receiving ART in Zambia were receiving DTG-based ART. The proportion of adults receiving second-line regimens was low across all surveys, ranging from 0% in Botswana, South Sudan and Uganda (among adults receiving ART for 9–15 months) to 16% in El Salvador (among adults receiving ART for ≥48 months) (**Annex 1: Tables A4.1a–A4.1h**).

Most children and adolescents receiving ART in Zambia were receiving a first-line regimen (86%). In Zambia, the proportion of children and adolescents receiving a DTG-based regimen was 6% (95% CI 3–11%) among those receiving ART for 12 ± 3 months and 11% (95% CI 7–17%) among those receiving ART for ≥36 months (**Annex 1: Tables A4.2**).

4.5 Key findings

The prevalence of viral load suppression, which is the prevention of acquired HIV drug resistance, among adults receiving ART for 12 ± 3 months was ≥90% in seven of 14 surveys and in six of 14 surveys among adults receiving ART for ≥48 months (**Fig. 4.1 and Annex 1: Tables A4.3a–A4.3h**). Prevalence of viral load suppression ≥95% was achieved in two of 14 countries among adults receiving ART for 12 ± 3 months (Botswana and Viet Nam) and in two of 14 countries among adults receiving ART for ≥48 months (Myanmar and Viet Nam). The prevalence of viral load suppression among adults receiving ART for 12 ± 3 months ranged from 63% (95% CI 51–73%) in South Sudan in 2018 to 96% (95% CI 94–98%) in Viet Nam in 2020, and the prevalence of viral load suppression among adults receiving ART for ≥48 months ranged from 68% (95% CI 56–78%) in Cameroon in 2015 to 99% (95% CI 96–99%) in Viet Nam in 2020. Viral load suppression among adults receiving ART for ≥48 months was comparatively lower than the levels among adults receiving ART for 12 ± 3 months (**Fig. 4.1 and Table 4.1**); these differences were significant in two countries: Honduras and Uganda (**Fig. 4.1 and Annex 1: Tables A4.3d and A4.3f**). The prevalence of viral load

suppression among adults receiving ART in the Eastern Caribbean Countries[5] was 84% (95% CI 72–91%).

The pooled results for viral load suppression in Africa were 94% (95% CI 92–96%) among adults receiving first-line ART and 86% (95% CI 82–89%) among adults receiving second-line ART. In the Americas, the pooled results for viral load suppression were 81% (95% CI 75–87%) among adults receiving first-line ART and 69% (95% CI 67–72%) among adults receiving second-line ART (**Table 4.1**).

Among countries reporting data to WHO for this report, only Zambia reported viral load suppression data from children and adolescents receiving ART. **Box 2** highlights these findings.

Fig. 4.1. Prevalence of viral load suppression among adults receiving ART, 2014–2020

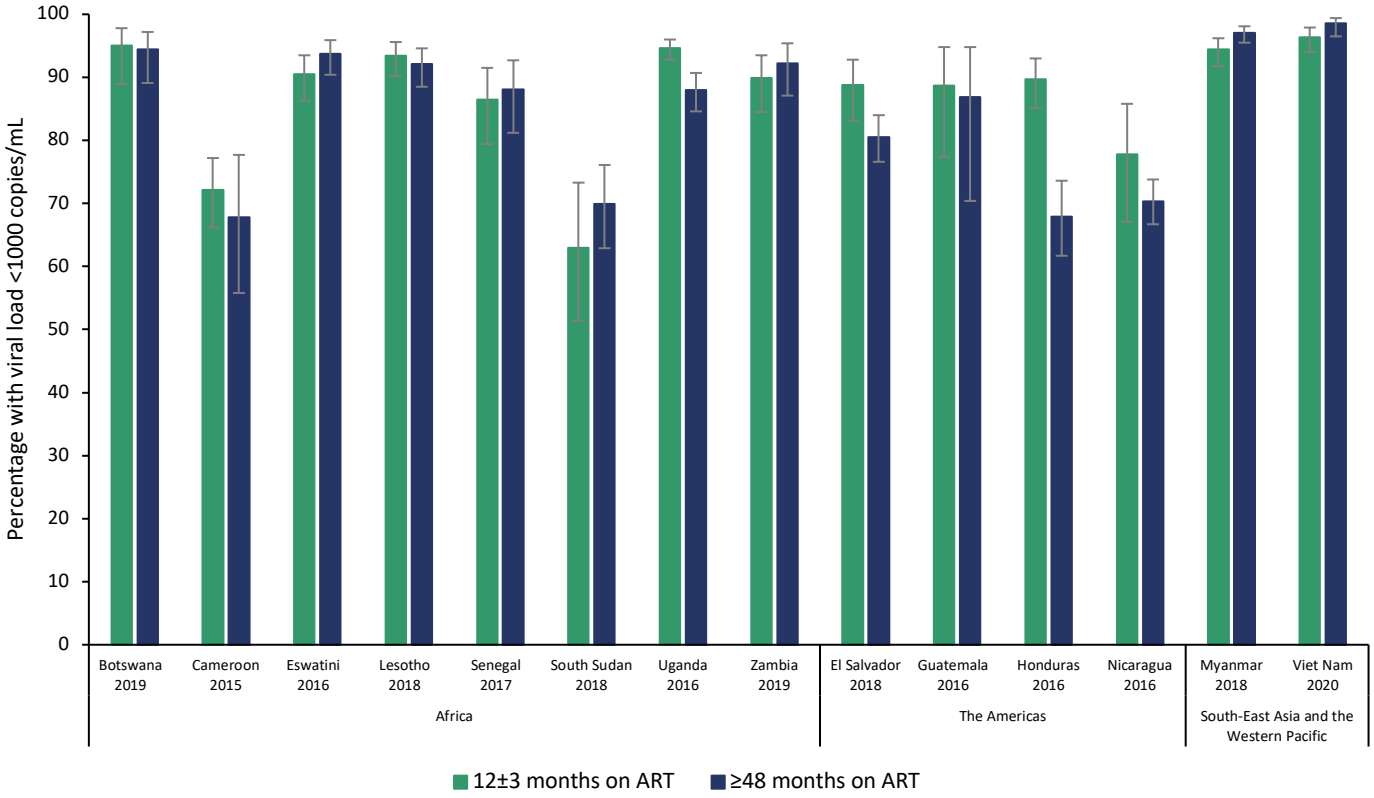


Fig 4.1 shows the study design–weighted prevalence and 95% confidence interval (error bars) of viral load suppression among adults receiving ART for 12±3 months or ≥48 months in countries reporting data to WHO between 2014 and 2020. Viral load suppression was defined as viral load <1000 copies/mL, with the exception of Eswatini where the viral load suppression was defined as viral load ≤2500 copies/mL using DBS (lower limit of detection by the Roche free viral elution platform). The early time point survey (12 months) in Cameroon included participants who had been receiving treatment for 12–24 months; the late time point survey (≥48 months) in Senegal included participants who had been receiving treatment for ≥40 months. In Honduras and Uganda, the prevalence of viral load suppression among adults on ART for ≥48 months was significantly lower than prevalence of viral load suppression among adults on ART for 12±3 months.

5 Antigua and Barbuda, Dominica, Grenada, Saint Kitts and Nevis, Saint Lucia and Saint Vincent and the Grenadines.

Table. 4.1. Prevalence of viral load suppression among adults receiving ART, 2014–2020

	Africa %, 95% CI[c]	The Americas %, 95% CI[c]	Overall[d] %, 95% CI[c]
Adults receiving ART	93.4, 91.2–95.6	79.8, 73.7–85.8	93.5, 91.6–95.5
NNRTI-based ART[a]	93.6, 91.5–95.6	80.5, 74.1–86.9	93.7, 91.9–95.5
PI-based ART[b]	84.0, 78.9–89.1	70.4, 67.6–73.3	86.2, 82.2–90.1
DTG-based ART	92.6, 92.2–93.0	NA	92.7, 92.1–93.3
Adults receiving first-line ART	93.5, 91.5–95.5	81.0, 74.7–87.2	93.7, 91.8–95.5
Adults receiving second-line ART	83.6, 79.4–87.7	69.5, 67.1–72.0	85.6, 82.2–88.9
LPV/r-based ART	78.9, 73.9–83.8	72.1, 67.9–76.2	82.3, 76.1–88.6
ATV/r-based ART	100, 99.9–100.0	66.0, 60.5–71.4	97.8, 93.2–100.0
Adults receiving ART for 12 ± 3 months	94.2, 93.0–95.3	87.5, 83.8–91.1	94.2, 93.0–95.3
Adults receiving ART for ≥48 months	91.0, 88.5–93.6	75.9, 68.2–83.5	91.9, 89.2–94.5

Box 2. Viral load suppression among children and adolescents receiving ART in Zambia

Zambia was the only country reporting viral load suppression outcomes as part of surveys of acquired HIV drug resistance among children and adolescents receiving ART. In Zambia, the prevalence of viral suppression was 69% (95% CI 60–78%) among children and adolescents receiving ART for 12 ± 3 months and 68% (95% CI 59–76%) among those receiving ART for ≥36 months (**Annex 1: Table A4.4**). The prevalence of viral load suppression among children receiving ART for ≥36 months was significantly higher among those receiving a DTG-based regimen (92%, 95% CI: 83%–97%) than among those receiving PI-based ART (76%, 95% CI 63–86%) or NNRTI-based ART (61%, 95% CI 49–72%); odds ratio: 6.9, 95% CI: 2.5–19.3, $P = 0.001$ for DTG-based versus non-DTG-based ART. This finding supports transition to DTG-based regimens in low- and middle-income countries. Moreover, children and adolescents may be at higher risk for less-than-optimal adherence to HIV treatment, and using DTG-based regimens may be more likely to result in sustained viral suppression, even in situations of poorer adherence and treatment interruptions, than regimens based on older drugs (*88*).

a NNRTI-based regimens include EFV or NVP.

b PI-based regimens include ATV/r, DRV/r or LPV/r.

c Weighted proportion and 95% confidence interval. Pooled estimates were calculated using countries reporting data to WHO between 2014 and 2020.
Viral load suppression was defined as viral load <1000 copies/mL except for one country, Eswatini, where viral load suppression was defined as viral load ≤2500 copies/mL using DBS (lower limit of detection by the Roche free viral elution platform).

d The overall estimate incorporates data from all the countries reporting data to WHO between 2014 and 2020 from Africa, the Americas, Myanmar and Viet Nam.

ART: antiretroviral therapy; ATV/r: atazanavir/ritonavir; CI: confidence interval; DRV/r: darunavir/ritonavir; DTG: dolutegravir: EFV: efavirenz; LPV/r: lopinavir/ritonavir; NA: not applicable; NRTI: nucleoside reverse-transcriptase inhibitor; NVP: nevirapine.

Adults receiving NNRTI-based first-line ART for 12 ± 3 months with viral load ≥1000 copies/mL had high levels of predicted EFV or NVP resistance, ranging from 50% (95% CI 31–69%) in Lesotho in 2018 to 97% (95% CI 84–99%) in Uganda in 2016. Among adults receiving NNRTI-based ART for ≥48 months, resistance to EFV or NVP was similar, ranging from 50% (95% CI 33–67%) in Viet Nam in 2020 to 95% (95% CI 72–99%) in El Salvador in 2018. The prevalence of resistance to TDF ranged from 13% (95% CI 7–21%) in South Sudan in 2018 to 84% (95% CI 52–96%) in Uganda in 2016 among adults receiving ART for 12 ± 3 months with unsuppressed viral load and currently receiving NNRTI-based first-line ART (**Fig. 4.2 and 4.3 and Annex 1: Tables A4.5a–A4.5h**). The prevalence of resistance to TDF ranged from 5% (95% CI 0.5–38%) in Botswana in 2019 to 56% (95% CI 43–68%) in Honduras in 2016 among adults on ART for ≥48 months with viral load ≥1000 copies/mL and currently receiving NNRTI-based first-line ART (**Fig. 4.2 and 4.3 and Annex 1: Tables A4.5a–A4.5h**). The pooled summary results estimate resistance to TDF among adults receiving NNRTI + ZDV-based first-line ART with unsuppressed viral load at 39% (95% CI 30–47%) in Africa and 46% (95% CI 26–67%) in the Americas. The pooled summary estimate of predicted resistance to ZDV among adults receiving NNRTI + TDF-based first-line ART with unsuppressed viral load was 11% (95% CI 45–16%) in Africa and 13% (95% CI 5–21%) in the Americas (**Table 4.2**).

Box 3 summarizes viral load suppression and HIV drug resistance prevalence estimates among adults receiving DTG-based ART.

Fig. 4.2. Prevalence of acquired HIV drug resistance among adults receiving ART for 12 ± 3 months with unsuppressed viral load and currently on a first-line NNRTI-based regimen, 2014–2020

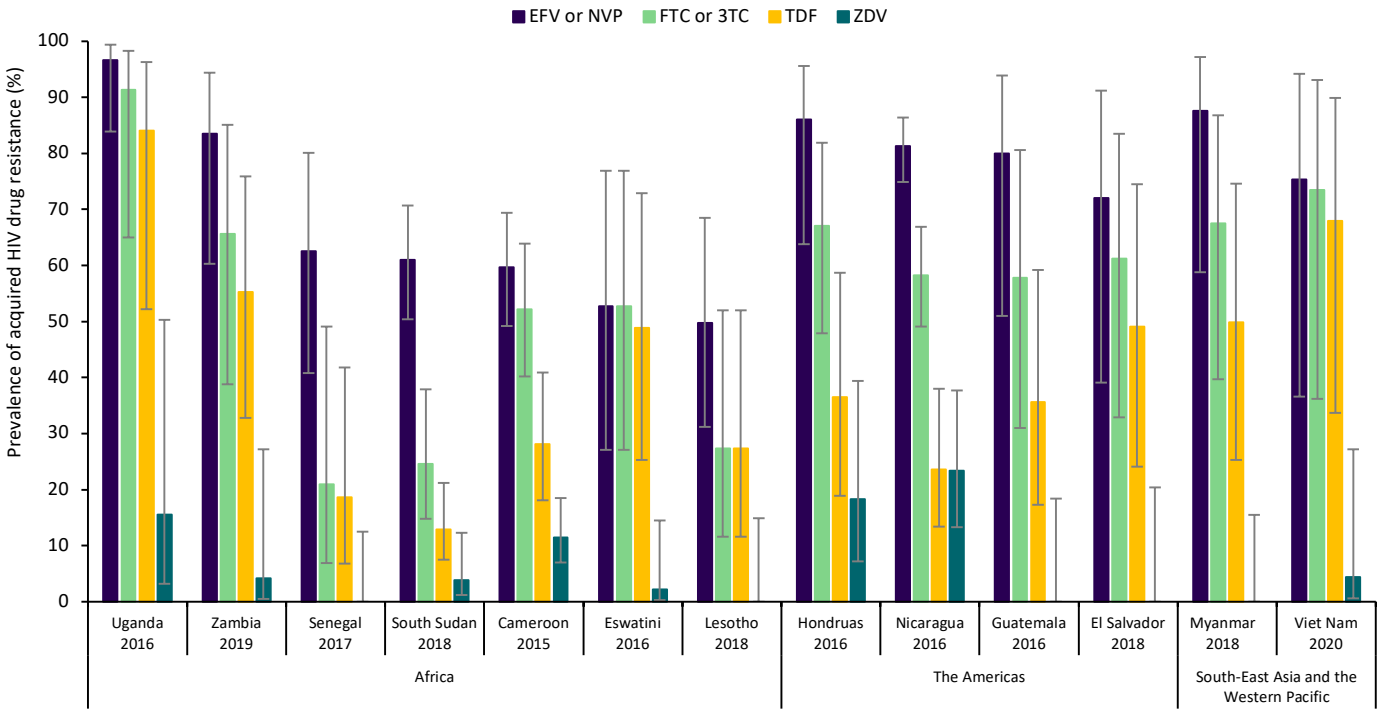


Fig 4.2 shows the study design–weighted prevalence and 95% confidence interval (error bars) of acquired HIV drug resistance among adults receiving antiretroviral therapy for 12±3 months with unsuppressed viral load and currently on first-line NNRTI-based regimen. Unsuppressed viral load was defined as viral load ≥1000 copies/mL, with the exception of Eswatini where unsuppressed viral load was defined as viral load >2500 copies/mL using DBS (lower limit of detection by the Roche free viral elution platform). The survey in Cameroon included participants who had been receiving treatment for 12–24 months.
HIVDR was defined as the presence of a penalty score ≥15 using the Stanford HIVdb algorithm.
EFV: efavirenz; NVP: nevirapine; FTC: emtricitabine; TDF: tenofovir; ZDV: zidovudine; 3TC: lamivudine.

Fig. 4.3. Prevalence of acquired HIV drug resistance among adults receiving ART for ≥48 months with unsuppressed viral load and currently on a first-line NNRTI-based regimen, 2014–2020

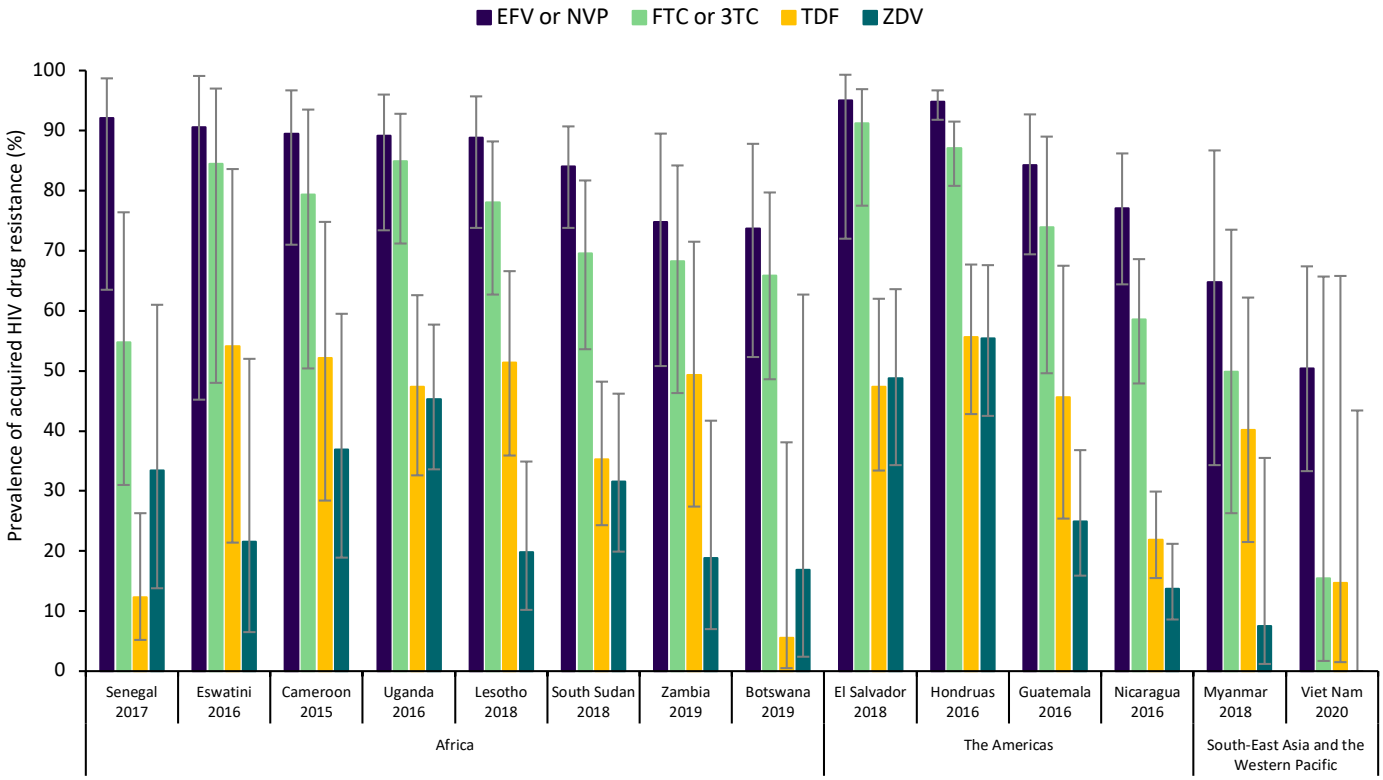


Fig 4.3 shows the study design–weighted prevalence and 95% confidence interval (error bars) of acquired HIV drug resistance among adults receiving antiretroviral therapy for ≥48 months with unsuppressed viral load and currently on first-line NNRTI-based regimen. Unsuppressed viral load was defined as viral load ≥1000 copies/mL, with the exception of Eswatini where unsuppressed viral load was defined as viral load >2500 copies/mL using DBS (lower limit of detection by the Roche free viral elution platform). The survey in Senegal included participants who had been receiving treatment for ≥40 months.
HIVDR was defined as the presence of a penalty score ≥15 using the Stanford HIVdb algorithm.
EFV: efavirenz; NVP: nevirapine; FTC: emtricitabine; TDF: tenofovir; ZDV: zidovudine; 3TC: lamivudine.

Box 3. Viral load suppression and HIV drug resistance prevalence estimates among adults receiving DTG-based ART

The DTG-containing triple drug combination TLD was used for adults receiving ART at the time of the survey enrolment in Botswana, Myanmar, Viet Nam and Zambia. In these countries, the prevalence of viral load suppression was >90% among those receiving DTG-based regimens (**Annex 1: Tables A4.3a–A4.3h**). However, only one country, Zambia, sequenced the HIV-1 integrase region from adults with viral load ≥1000 copies/mL, and no predicted resistance to DTG or other integrase inhibitors was detected. Among those receiving DTG with unsuppressed viral load, data were available for NRTI resistance from Botswana, Viet Nam and Zambia. The prevalence of NRTI resistance ranged from a low of 2% (95% CI 0.2–23%) in Botswana (for people receiving ART for 12 ± 3 months) to 91% (95% CI 47–99%) in Botswana (for people receiving ART for ≥48 months).

The prevalence of resistance to EFV or NVP among children and adolescents receiving NNRTI-based first-line ART and with viral load ≥1000 copies/mL was 97% (95% CI 93–99%) in Uganda, 85% (95% CI 51–97%) in Zambia among those receiving ART for 12 ± 3 months and 84% (95% CI 77–89%) in Zambia among those receiving ART for ≥36 months (**Annex 1: Tables A4.6a–A4.6b**). The prevalence of NRTI resistance ranged from 62% (95% CI 43–79%) in Zambia for children and adolescents receiving ART for 12 ± 3 months to 75% (95% CI 69–80%) in Zambia for children and adolescents receiving ART for ≥36months. In contrast, children and adolescents receiving a PI-based ART regimen and with viral load ≥1000 copies/mL had low levels of PI resistance: in Zambia, 0.7% (95% CI 0.1–5%) among those receiving ART for 12 ± 3 months and 4% (95% CI 0.6–22%) among those receiving ART for ≥36 months; in Uganda the prevalence of PI resistance was 6% (95% CI 12–17%). The prevalence of NRTI resistance ranged from 50% (95% CI 36–65%) in Uganda to 81% (95% CI 61–92%) in Zambia for children and adolescents receiving ART for ≥36months.

The HIV-1 integrase region was sequenced from Zambia's acquired drug resistance survey of children and adolescents, and no predicted resistance to DTG or other integrase inhibitors was detected. Among those receiving DTG, data were available for NRTI resistance from Uganda and Zambia. The prevalence of NRTI resistance ranged from 31% (95% CI 14–56%) in Zambia (for people receiving ART for 12 ± 3 months) to 71% (95% CI 29–94%) in Uganda.

Table 4.2. Prevalence of HIV drug resistance to NRTIs among adults receiving ART and with unsuppressed viral load, 2014–2020

	Africa %, 95% CI[c]	The Americas %, 95% CI[c]	Overall %, 95% CI[c]
HIV drug resistance among adults receiving first-line ART with viral load ≥1000 copies/mL			
NRTI	83.5, 71.0–95.9	75.5, 64.2–86.8	83.1, 70.5–95.7
ABC	83.1, 70.3–95.9	74.1, 61.2–87.0	82.8, 69.8–95.7
FTC or 3TC	83.0, 70.0–96.0	73.5, 60.1–87.0	82.6, 69.5–95.8
TDF	67.5, 41.9–93.1	41.3, 24.1–58.6	67.1, 41.5–92.7
ZDV	16.8, 8.5–25.2	32.2, 13.5–50.9	16.8, 8.6–24.9
HIV drug resistance among adults receiving NNRTI-based[a] ART with viral load ≥1000 copies/mL			
NRTI	84.9, 74.1–95.8	77.7, 68.2–87.3	84.6, 73.5–95.6
ABC	84.6, 73.5–95.7	76.3, 64.7–87.8	84.2, 72.9–95.6
FTC or 3TC	84.5, 73.1–95.9	76.1, 64.5–87.6	84.1, 72.5–95.8
TDF	71.4, 50.8–92.1	43.9, 29.4–58.5	71.0, 50.2–91.8
ZDV	18.3, 9.7–26.9	35.6, 19.7–51.5	18.2, 9.8–26.7
HIV drug resistance among adults receiving PI-based[b] ART with viral load ≥1000 copies/mL			
NRTI	82.8, 54.2–100.0	53.2, 42.9–63.6	81.2, 56.8–100.0
ABC	82.8, 54.1–100.0	50.4, 38.7–62.1	81.1, 56.6–100.0
FTC or 3TC	59.8, 56.1–63.4	45.8, 38.5–53.2	62.1, 49.8–74.5
TDF	70.8, 21.9–100.0	23.5, 13.7–33.2	65.7, 24.6–100.0
ZDV	34.4, 24.5–44.3	25.2, 9.8–40.5	32.9, 24.2–41.6
HIV drug resistance among adults receiving NNRTI + ZDV-based[a] first-line ART with viral load ≥1000 copies/mL			
NRTI	93.5, 91.6–95.4	81.4, 67.8–94.9	93.1, 91.1–95.1
ABC	91.0, 88.5–93.6	80.9, 66.6–95.3	90.7, 88.3–93.1
FTC or 3TC	91.0, 88.5–93.6	80.6, 66.0–95.1	90.7, 88.3–93.1
TDF	38.7, 30.5–46.9	46.2, 25.8–66.6	38.8, 30.8–46.7
ZDV	49.3, 36.9–61.8	54.2, 31.1–77.4	49.3, 37.0–61.5
HIV drug resistance among adults receiving NNRTI + TDF-based[a] first-line ART with viral load ≥1000 copies/mL			
NRTI	64.6, 58.6–70.7	71.9, 66.1–77.6	64.1, 57.8–70.5
ABC	64.6, 58.4–70.7	69.6, 60.2–78.9	64.1, 57.6–70.5
FTC or 3TC	64.0, 58.4–69.7	69.6, 60.2–78.9	63.5, 57.6–69.5
TDF	50.9, 47.4–54.3	42.2, 29.6–54.8	50.6, 47.3–53.8
ZDV	10.7, 4.9–16.4	13.4, 5.3–21.4	10.4, 4.6–16.1

a NNRTI-based regimens include EFV or NVP.

b PI-based regimens include ATV/r, DRV/r or LPV/r.

c Weighted proportion and 95% confidence interval. Pooled estimates were calculated using countries reporting data to WHO between 2014 and 2020.

Unsuppressed viral load was defined as viral load ≥1000 copies/mL, except for Eswatini, where unsuppressed viral load was defined as viral load >2500 copies/mL using DBS (lower limit of detection by the Roche free viral elution platform). HIV drug resistance was defined as the presence of a penalty score ≥15 using the Stanford HIVdb algorithm. The overall estimate incorporates data from all the countries reporting data to WHO between 2014 and 2020 from Africa, the Americas, Myanmar and Viet Nam.

ABC: abacavir; ART: antiretroviral therapy; ATV/r: atazanavir/ritonavir; CI: confidence interval; DRV/r: darunavir/ritonavir; DTG: dolutegravir; EFV: efavirenz; FTC: emtricitabine; LPV/r: lopinavir/ritonavir; NRTI: nucleoside reverse-transcriptase inhibitor; NVP: nevirapine; TDF: tenofovir; ZDV: zidovudine; 3TC: lamivudine.

4.6 Implications of the findings

Viral load suppression prevalence exceeded 90% in 12 surveys from six countries, but only two countries achieved the 2025 UNAIDS global target of >95% viral load suppression. Overall, the quality of HIV care needs to be continually strengthened, including the characterization of national and clinic-level determinants of treatment failure, to identify and operationalize locally sustainable solutions to achieve improved and sustained levels of viral suppression by 2025. In addition, as part of optimizing HIV care and treatment, the use of the undetectable equals untransmissible (U=U) principle (*89*) can be enhanced to promote the empowerment of people living with HIV in preventing transmission of HIV, including preventing the transmission of drug-resistant HIV. Using U=U to promote the prevention of HIV drug resistance by optimizing adherence and other HIV prevention measures has recently been demonstrated in proof of concept (*90*) and may prove to be a powerful tool if locally adapted and expanded.

The high levels of both NNRTI and NRTI HIV drug resistance among individuals with treatment failure emphasize the need to scale up viral load testing and enhanced adherence counselling and promptly switch individuals with treatment failure. The observed high levels of NRTI resistance, including to TDF and 3TC or FTC, suggest an opportunity to optimize the NRTI backbone when switching to second-line ART, especially if switching to a PI. Although some studies have shown that regimens including ritonavir-boosted PIs may remain effective for adults who have resistance to the co-administered NRTIs, especially TDF or ZDV, no such studies have been conducted among children and there are no outcomes data assessing viral suppression outcomes when using an ABC-containing NRTI backbone in combination with boosted PIs in the presence of ABC resistance. Thus, caution is warranted regarding the use of recycled NRTIs when switching to PIs among children. Additional studies assessing the impact of NRTI resistance when used in combination with PIs in this population are needed. Moreover, viral load monitoring to ensure viral suppression after a switch of regimen combined with adherence support should be considered optimal clinical practice.

At the time these surveys were conducted, few countries had begun using DTG-based regimens. Nevertheless, higher levels of viral load suppression among those receiving DTG-containing regimens versus non-DTG-containing regimens in Zambia confirm the potency of these regimens, and the absence of acquired DTG resistance in these integrase inhibitor–naive populations underscores the high genetic barrier to DTG resistance and highlights the anticipated success of achieving high levels of population-level viral load suppression in countries transitioning to DTG-based ART. Among countries not yet transitioning adults to DTG, the data suggest a need to address barriers such as availability and preferential pricing to further support concerted efforts to transition to DTG following WHO's 2021 recommendations on ART (*32*). Among countries not yet transitioning children to DTG-based regimens, reliable procurement and maintaining a continuous supply of drug remains a challenge.

Overall levels of predicted TDF and 3TC resistance among adults for whom NNRTI-based ART is failing were high. Although recent controlled clinical trials have reported successful outcomes among adults with TDF-resistant HIV treated with TLD (*26,27*), continued monitoring of the possible impact of predicted TDF resistance, caused by either K65R/N or multiple thymidine analogue mutations, in the context of TLD roll-out is warranted.

Reassuringly, little DTG resistance has emerged globally to date. Among 15 cases of DTG-resistant HIV among people with treatment failure, 10 had either suboptimal DTG levels or poor adherence, and three had advanced HIV and severe active infections (*91*). Factors such as malabsorption among severely immunosuppressed individuals living with HIV and drug interactions could influence the plasma pharmacokinetics of ARV drugs, including DTG (*91*). This observation suggests that critically ill individuals with AIDS or individuals with poor adherence require close follow-up. In addition, four treatment-naive and five treatment-experienced people had a baseline viral load exceeding 100 000 copies/mL, which has been associated with treatment failure in some studies with INSTI-based regimens (*91*). Although DTG resistance was very rare in clinical trials, observational data from ART programmes are needed to confirm that DTG resistance does not emerge to levels that may limit its utility in achieving viral load suppression when coupled with greatly enhanced adherence counselling among people with treatment failure.

Mutational pathways to DTG resistance may be influenced by polymorphisms in integrase, which can vary according to HIV-1 subtype and may include regions of the virus other than the integrase coding region such as the 3'-polypurine tract (*92*), although their clinical relevance remains unknown and much additional study is needed. Some polymorphisms in integrase, which could lower the genetic barrier to DTG resistance, are more prevalent in certain subtypes of HIV (such as L74M and T97A in CRF02_AG) (*14,93*). Since DTG-based ART is being scaled up in areas where non-B subtypes predominate, continued genotypic and phenotypic analysis is needed to elucidate relationships between viral mutations and DTG susceptibility across non-B subtypes to assess potentially novel resistance mechanisms that contribute to treatment failure. Continued surveillance of drug resistance among people for whom TLD has failed may help to elucidate the relative contribution of these alternative mechanisms of DTG resistance.

The low levels of PI resistance among children and adolescents receiving a PI-based ART regimen in Uganda and Zambia are noteworthy and suggest that most failures to suppress viral loads were not caused by drug-resistant virus but rather by poor adherence, at least to the PI component of the regimen. This observation suggests that greatly intensified adherence

support may be an optimal initial approach to managing treatment failure among children and adolescents receiving PI-based ART. However, the potential for PI resistance to be conferred by mutations outside the protease region (such as in the gag or env genes) has been reported (*94,95*), but more well-designed studies are needed to further elucidate the mechanism of this type of resistance and to conclusively identify the mutations responsible. Nevertheless, the findings support the importance of routine viral load monitoring for early detection of suboptimal adherence, followed by drug resistance testing, if available, for individuals for whom ART has failed, an approach that is likely to minimize premature switching to more complex and costly third-line regimens. Additionally, children and adolescents should be transitioned to DTG-containing regimens as early as possible to maximize viral load suppression, arrest disease progression and minimize the emergence of preventable HIV drug resistance in this vulnerable population.

Globally, the vast majority of people living with HIV will be receiving integrase inhibitor–based ART over the next five years. Despite high levels of reported viral load suppression in countries that have transitioned populations to TLD, ongoing surveillance for DTG-resistant virus among people for whom DTG-containing regimens have failed in low- and middle-income countries will be required. Such surveillance is best accomplished through nationally representative acquired drug resistance surveys, including the recently WHO-recommended viral load laboratory-based survey of acquired drug resistance (*8,9*). However, in the future, initial assessments of DTG-resistance at sentinel ART clinics with sufficient numbers of people for whom DTG-based ART is failing may be cost effective and provide early signals of the emergence of DTG resistance. Such early signals would allow maximal characterization of the determinants of DTG resistance and would complement data generated from recommended nationally representative survey methods.

5. UPDATE ON PROGRESS IN IMPLEMENTING THE 2017–2021 GLOBAL ACTION PLAN ON HIV DRUG RESISTANCE

Increasing prevalence of drug-resistant HIV is of public health concern, and resistant virus has the potential to undermine efforts to achieve epidemic control by 2030. In response to increased levels of HIV drug resistance, especially to NNRTIs, WHO and its partners launched a Global Action Plan on HIV drug resistance in July 2017 (*6*). The Global Action Plan on HIV drug resistance 2017–2021 is a five-year plan outlining key synergistic actions for community, country and global stakeholders to operationalize efforts to prevent, monitor and respond to HIV drug resistance. The Global Action Plan on HIV drug resistance unites stakeholders around five strategic objectives aimed at minimizing the emergence, transmission and impact of drug-resistant HIV:

1. **prevention and response:** implement high-impact interventions to prevent and respond to HIV drug resistance;
2. **monitoring and surveillance:** obtain high-quality data on HIV drug resistance from periodic surveys, while expanding the coverage and quality of routine viral load and HIV drug resistance testing to inform continuous HIV drug resistance surveillance; monitor quality of service delivery and collect and analyse data recorded as part of routine patient care for the purpose of evaluating programme performance to prevent HIV drug resistance;
3. **research and innovation:** encourage relevant and innovative research, leading to interventions that will have the greatest public health impact on minimizing HIV drug resistance and fill existing knowledge gaps on the risk of HIV drug resistance for newer ARV drugs and the impact of service delivery interventions to increase viral load suppression and contain HIV drug resistance;
4. **laboratory capacity:** strengthen laboratory capacity and quality to support and expand the use of viral load monitoring and build capacity to monitor HIV drug resistance in low- and middle-income countries; and
5. **governance and enabling mechanisms:** ensure that governance and enabling mechanisms (advocacy, country ownership, coordinated action and sustainable funding) are in place to support action on HIV drug resistance.

In 2018, WHO published an early progress report that highlighted early successes and opportunities in implementing the Global Action Plan on HIV drug resistance (*96*). This section outlines progress attained during the first four years of the plan (2017–2020), with specific focus on the 45 countries with a high burden of HIV infection accounting for more than 85% of global HIV cases.

5.1 Progress on HIV drug resistance prevention and response (strategic objective 1)

5.1.1 Quality-of-care indicators: early warning indicators of HIV drug resistance

Preventing the emergence and transmission of drug-resistant HIV is critical to the ongoing success of the global response against HIV and is achieved by optimizing the quality of HIV care delivery along the entire diagnosis and treatment cascade. Opportunities for clinics and ART programmes to minimize the possible emergence of HIV drug resistance may be identified through routine monitoring of programme quality indicators associated with treatment failure and or drug resistance. Early warning indicator results provide clinic and programme managers with data about how their clinics perform compared with national means and with international targets aimed at preventing the emergence of HIV drug resistance. These indicators include: HIV viral load testing coverage, viral load suppression, retention on ART, ARV drug stock-outs and adherence to ART (*7,32*). Identifying opportunities to optimize HIV care and treatment to minimize the emergence and transmission of drug-resistant HIV by implementing specific and evidence-informed actions to improve clinic and programme performance are critical. **Table 5.1** and **Box 4** summarize the outcomes of programmatic quality indicators from 45 countries with a high burden of HIV infection between 2017 and 2020.

Box 4. Monitoring of quality-of-care indicators associated with the emergence of HIV drug resistance in 45 countries with a high burden of HIV infection, 2017–2020

Between 2017 and 2020, 44 of 45 WHO focus countries reported data on programme quality indicators through the UNAIDS Global AIDS Monitoring system. Viral load suppression data from PEPFAR population health indicator surveys were used when available. Targets for WHO early warning indicators of HIV drug resistance were used to classify country-level performance for a given indicator. To minimize bias, only information from countries reporting nationally representative data or data from more than 70% of all ART clinics in the country are included in the summary results.

- **Retention on ART 12 months after initiation.** Data on people retained on ART 12 months after initiation were generally scarce or inadequately reported. The proportions of countries with classifiable data were 49% (22 of 45) in 2017 and 56% (25 of 45) in 2018. The proportion of countries meeting the target of ≥85% retained on ART 12 months after ART initiation was 27% (6 of 22) in 2017 and 20% in 2018 (5 of 25). In 2020, the retention indicator was dropped in favour of total attrition on ART, which has been incorporated into WHO's indicator guidance and monitoring tools.
- **Viral load testing coverage.** The proportions of countries reporting levels of viral load testing coverage were 64% (29 of 45) in 2017, 89% (40 of 45) in 2018, 78% (35 of 45) in 2019 and 62% (28 of 45) in 2020. The proportions of countries achieving the target of ≥70% of eligible individuals receiving at least one annual viral load test were 31% (9 of 29) in 2017, 40% (16 of 40) in 2018, 43% (15 of 35) in 2019 and 28.5% (8 of 28) in 2020. The decline in viral load testing coverage in 2020 may be due to the COVID-19 pandemic, as has been highlighted in other reports.
- **Viral load suppression.** Information on viral load suppression is presented only from countries reporting viral load testing coverage ≥70% or from nationally representative estimates. The proportions of reporting countries with data meeting these inclusion criteria were 33% (15 of 45) in 2017, 36% (16 of 45) in 2018, 33% (15 of 45) in 2019 and 22% (10 of 45) in 2020. The proportions of countries reporting ≥90% of people receiving ART achieving viral suppression were 33% (5 of 15) in 2017, 50% (8 of 16) in 2018, 67% (10 of 15) in 2019 and 80% (8 of 10) in 2020.
- **Drug stock-outs.** The proportions of countries reporting information on drug stock-outs were 67% (30 of 45) in 2017 and 2018, 53% (24 of 45) in 2019 and 58% (26 of 45) in 2020. The proportion of countries meeting the target of zero drug stock-outs were 53% (16 of 30) in 2017, 50% in 2018 (15 of 30), 54% in 2019 (13 of 24) and 50% (13 of 26) in 2020.
- **Proportion of people switching to second-line ART.** Switch to second-line ART is a proxy measure of how well a country uses viral load information to identify individuals with treatment failure and switches them in a timely manner to prevent the emergence and accumulation of resistance. The proportions of countries reporting this indicator were 64% (29 of 45) in 2017 and 2018, 62% (28 of 45) in 2019 but declined to 56% (25 of 45) in 2020. The proportions of countries that achieved the target of having at least 5% of people on a second-line regimen were 45% (13 of 29) in 2017, 38% (11 of 29) in 2018, 50% (14 of 28) in 2019 and 56% (14 of 25) in 2020.

Table 5.1. Countries with a high burden of HIV infection meeting targets for the quality-of-care indicators associated with the emergence of HIV drug resistance, 2017–2020

	Retention on ART at 12 months[b]				Viral load testing coverage[c]				Viral load suppression[d]				Drug stock-out				Proportion of people receiving second-line ART			
	2017	2018	2019	2020	2017	2018	2019	2020	2017	2018	2019	2020	2017	2018	2019	2020	2017	2018	2019	2020
Angola																				
Botswana																				
Brazil																				
Cambodia																				
Cameroon[a]																				
Chad																				
China																				
Côte d'Ivoire[a]																				
Democratic Republic of the Congo																				
Dominican Republic																				
Ethiopia																				
Eswatini																				
Ghana																				
Guatemala																				
Haiti																				
India																				
Indonesia																				
Iran (Islamic Republic of)																				
Jamaica																				
Kenya																				
Lesotho[a]																				
Malawi																				
Malaysia																				
Mali																				
Mexico																				
Morocco																				
Mozambique																				
Myanmar																				
Namibia[a]																				
Nigeria																				
Pakistan																				
Papua New Guinea																				
Philippines																				
Russian Federation																				
Somalia																				
South Africa																				
South Sudan																				
Sudan																				
Thailand																				
Uganda																				
Ukraine																				
United Republic of Tanzania																				
Viet Nam																				
Zambia																				
Zimbabwe[a]																				

Data not available

Data reported but not national representative or ≥70% of eligible population

Excellent performance: targets for retention at 12 months (>85%), viral load testing coverage (≥70%), viral load suppression (≥90%), drug stock-outs (0%), proportion of people on second-line ART (≥5%)

Fair performance: targets for retention at 12 months (75-85%), viral load suppression (80 to <90%)

Unsatisfactory performance: retention (<75%), viral load testing coverage (<70%), viral load suppression (<80%), drug stock-outs (>0%), proportion of people on second-line ART (<5%)

Sources: AIDSInfo, UNAIDS/WHO Global AIDS Monitoring tool and WHO AIDS Medicines and Diagnostics Survey on the use of ARV medicines and laboratory technologies and implementation of WHO-related guidelines.

a Viral load suppression data (from 5 countries) were obtained from Population Health Impact Survey supported by PEPFAR.

b Countries' data sets were included if they comprise ≥70% of the people newly initiating ART or <70% but reported to be nationally representative.

c The data originated from countries responding with the proportion of people receiving treatment who received a viral load test in the 12-month period. Countries' data sets were included if data were collected from everyone receiving ART or from a nationally representative data set. However, the results may overestimate viral load testing coverage in countries in which viral load testing coverage is estimated based on the number of tests done and thus may not be able to account for multiple tests per person.

d Countries' data sets were included if viral load testing coverage was ≥70% or <70% and reported to be nationally representative.

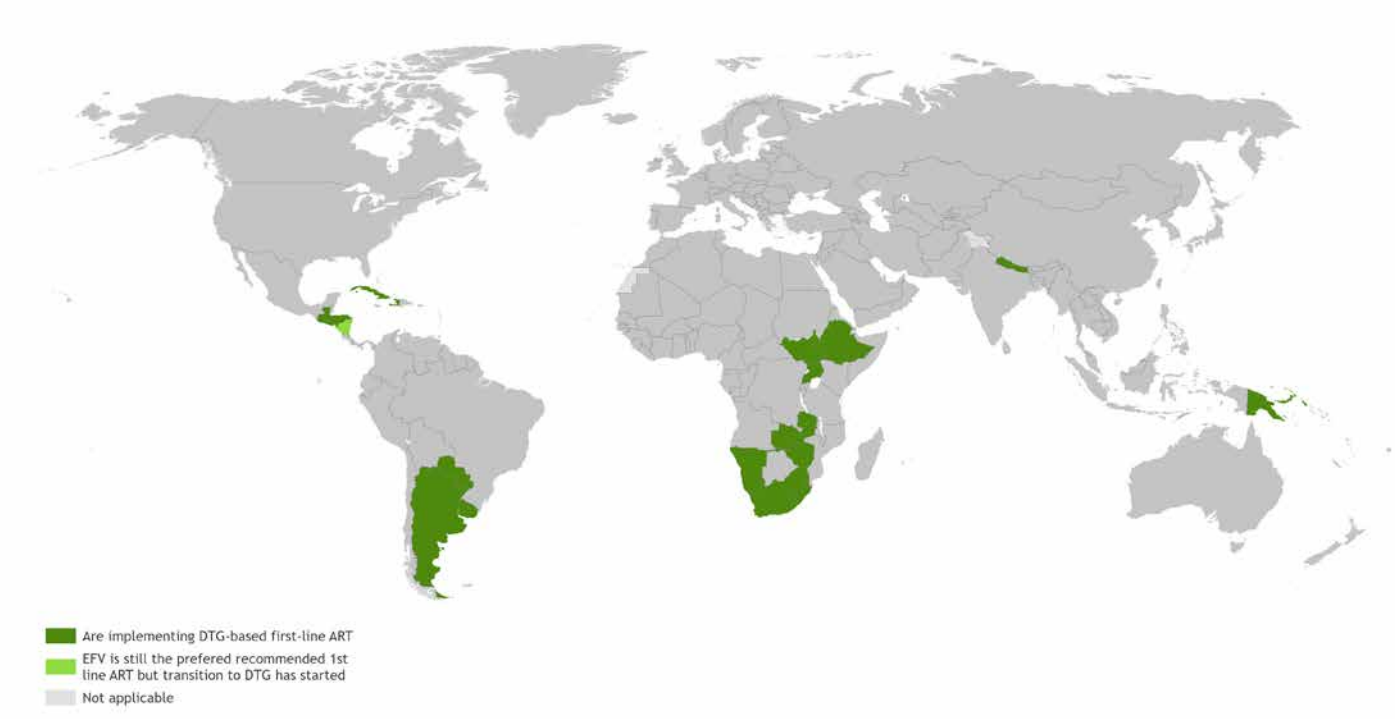
Overall, data reporting is suboptimal in many countries, highlighting an opportunity to strengthen data management and reporting structures. The performance of programme quality indicators remains below desirable levels in many countries reporting data, emphasizing a need to support countries in proactively finding sustainable solutions that are appropriate to local contexts and can involve community members and civil society.

5.1.2 Country responses to high levels of pretreatment HIV drug resistance

Following the 2017 HIV drug resistance report, WHO published guidance to support countries to respond to high levels (≥10%) of pretreatment NNRTI resistance (*5*). This guidance recommended accelerating transition to non-NNRTI-based ART (such as integrase inhibitor–based treatment) and, when transition was not feasible, suggested that individual HIV drug resistance testing be considered, if possible, to guide the selection of optimal regimens for people initiating (or reinitiating) treatment. In 2018, WHO published interim guidelines recommending DTG as a preferred component of first-line treatment (*97*). Between 2014 and 2021, 21 of 30 surveys of pretreatment drug resistance from 26 of 35 countries reported levels of resistance to NVP or EFV exceeding 10%. By 2021, all 26 countries[6] had initiated transition to DTG-based first-line ART, with different levels of implementation (**Map 5**).

Between 2012 and 2020, 10 countries (all in Africa) reported data on drug resistance from ART-naive infants younger than 18 months of age (**Map 3**). Levels of resistance to EFV and NVP were very high and exceeded 50% in most of the countries, meaning that nearly half of all newly diagnosed infants had NNRTI-resistant virus before initiating treatment. All countries reporting data to WHO have now adopted lopinavir/ritonavir as the preferred first-line regimen, and some countries have initiated a shift to using DTG-containing regimens for infants weighing ≥3 kg and ≥4 weeks of age in accordance with the current recommendations (**Map 6**).

Map 5. Country response to levels of pretreatment HIV drug resistance (PDR) to efavirenz/nevirapine (EFV/NVP) at or above 10% among people initiating first-line antiretroviral therapy as of December 2020: uptake of WHO recommendations



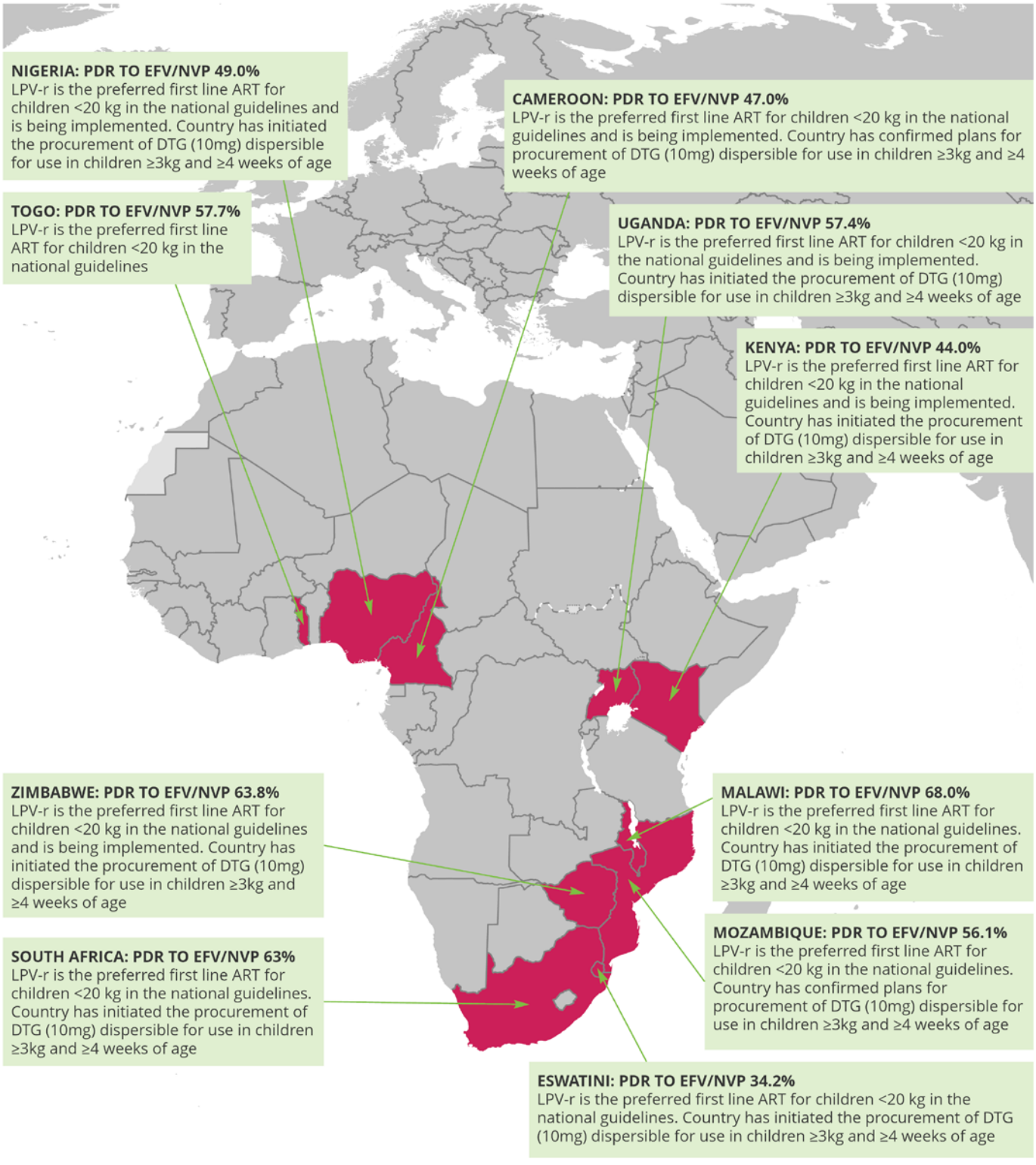
The designations employed and the presentation of the material in this publication do not imply the expression of any opinion whatsoever on the part of WHO concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. Dotted and dashed lines on maps represent approximate border lines for which there may not yet be full agreement.

Data Source: UNAIDS/WHO Global AIDS Monitoring tool and WHO/AIDS Medicines and Diagnostics Survey on the use of ARV medicine and laboratory technologies and implementation of WHO related guidelines
Map Production: WHO GIS Centre for Health, DNA/DDI

World Health Organization

6 The 26 countries includes a multicountry pretreatment HIV drug resistance survey in six Eastern Caribbean countries: Antigua and Barbuda, Dominica, Grenada, Saint Kitts and Nevis, Saint Lucia and Saint Vincent and the Grenadines.

Map 6. Country response to levels of pretreatment HIV drug resistance among infants as of December 2020: uptake of WHO recommendations



Data Source: UNAIDS/WHO Global AIDS Monitoring tool and WHO/AIDS Medicines and Diagnostics Survey on the use of ARV medicine and laboratory technologies and implementation of WHO related guidelines, Clinton Health Access Initiative 2020 HIV Market Report

World Health Organization

5.2 Progress on monitoring and surveillance (strategic objective 2)

WHO recommends that countries implement periodic nationally representative surveys to estimate the prevalence of drug-resistant HIV in various populations (described in Section 1). The results from these surveys support the selection of optimal ART regimens in a country and measure the extent to which programme practices and stalwart ARV drug stewardship minimize the emergence and transmission of drug-resistant virus. In 2021, WHO updated its HIV drug resistance strategy to include new survey methods, as described in **Box 5.**

To assist countries with survey implementation, standardized guidance, operational toolkits and a database to support countries and genotyping laboratories in the quality assurance of epidemiological and sequence data are available (*7*).

Substantial progress in survey implementation has been achieved since 2014, with 56 countries implementing 136 surveys. Between 2017 and 2020, 113 surveys were implemented in 47 countries versus 37 surveys in 23 countries between 2014 and 2016 (**Map 1**). This includes:

- 39 pretreatment drug resistance surveys implemented in 38 countries between 2017 and 2020 versus 17 surveys in 17 countries between 2014 and 2016;
- nine surveys of HIV drug resistance among treatment-naive infants implemented in nine countries between 2017 and 2020 (some recent surveys have not been finalized) versus seven surveys in seven countries between 2014 and 2016; and
- 61 surveys of acquired HIV drug resistance conducted in 30 countries between 2017 and 2020 versus 12 surveys in seven countries between 2014 and 2016.

In addition to the surveillance activities listed above, WHO recommends that ART programmes routinely monitor quality-of-care indicators at the national and clinic levels (*7*). Routine monitoring of quality-of-care indicators and response to suboptimal performance forms the foundation of HIV drug resistance prevention and links the surveillance of HIV drug resistance to programmatic interventions designed to minimize it. Between January 2018 and December 2020, 40% (16 of 40) of the 45 countries with a high burden of HIV infection reported data to Global AIDS Monitoring monitored programme quality indicators associated with HIV drug resistance prevention. The proportion of countries reporting data from early warning indicator surveys declined from 41% (9 of 22) in 2018 to 21% (6 of 28) in 2019 and remained stable at 22% (7 of 32) in 2020. As of 2020, 59% (13 of 22) of countries reporting data have integrated early warning indicators of HIV drug resistance into routine monitoring and evaluation systems in accordance with the WHO recommendations. Therefore, reporting is anticipated to increase in future years. Finally, given the global transition to TLD, there will be an important opportunity to rigorously review and update indicator definitions and targets to ensure that they remain associated with and predictive of HIV drug resistance or treatment failure, with the goal of ensuring that standardized definitions remain grounded in the medical and scientific literature.

Box 5. Summary of updated WHO guidance on HIV drug resistance surveillance as revised in 2021 (*7*)

Updated list of quality-of-care indicators associated with HIV drug resistance or treatment failure: four indicators remain unchanged: (1) viral load testing coverage, (2) ARV medicine stock-out, (3) ART adherence proxy and (4) appropriate switch to second-line ART. Three new indicators were added or revised as below.

- **Total attrition from ART:** this indicator measures the retention of people receiving ART and mitigation of loss from care: that is, ART attrition. The indicator of total attrition from ART replaces the previously used indicator of retention on ART 12 months after initiation.
- **People living with HIV who have suppressed viral load:** this indicator measures the clinical outcomes of people receiving ART regardless of treatment duration and measures how well clinics perform in reaching targets for viral load suppression (UNAIDS target of 90% for 2020 and 95% for 2025). This revised indicator replaces the previously used indicator of viral load suppression 12 months after ART initiation.
- **Appropriate second viral load test:** this indicator measures ART clinic performance in identifying individuals without viral suppression and ensuring that they receive appropriate confirmatory viral load testing. The timely confirmation of treatment failure enables people who have not achieved viral suppression following a first elevated viral load result and adherence counselling to switch to a different regimen, thereby maximizing the likelihood of viral suppression and minimizing the emergence of preventable HIV drug resistance.

Updated methods for surveillance of acquired drug resistance: the methods accommodate the transition to DTG-based first-line ART in most countries with a high burden of HIV infection and recognize that the pace of transition varies by country and respects that transition to DTG-based therapies may not occur in the near future in some countries. Equally, the methods acknowledge that global attention and concern is rightly focused on the emergence of DTG resistance; thus, methods yield robust estimates of acquired DTG resistance to facilitate analysis of trends over time. Survey results inform ART programme guidance with respect to optimal second- and third-line regimens and benchmark performance of ART programmes in achieving viral load suppression targets.

The following are the revised 2021 survey methods for acquired HIV drug resistance.

- **Laboratory-based acquired HIV drug resistance survey method:** this method leverages remnant viral load specimens obtained from routine clinical testing to assess (1) the prevalence of any drug resistance and (2) the prevalence of DTG resistance among adults and children and adolescents with treatment failure (viral load of ≥1000 copies/mL). To minimize bias, this survey is suitable for countries with viral load testing coverage of ≥60%.
- **Clinic-based acquired HIV drug resistance survey method:** for countries with viral load testing coverage <60%, the use of a clinic-based survey that is designed to generate robust prevalence estimates of viral suppression and resistance among all people receiving ART and among those receiving DTG-based treatment is recommended.

New survey method for countries scaling up PrEP: PrEP is one of the WHO-recommended options for HIV-negative individuals at substantial risk of HIV infection as part of combination prevention approaches. Anticipating the widescale use of PrEP, monitoring resistance will be important to minimize the impact of emerging PrEP resistance on ART, since similar drugs are used for both prevention and treatment. Resistance related to PrEP is most likely to occur when PrEP is started in the setting of undiagnosed acute infection. WHO surveys of HIV drug resistance in populations taking PrEP inform the choice of effective first-line ART regimens for PrEP users diagnosed with HIV.

Addition of genotyping of the integrase region in all specimens for all type of surveys: with widescale roll-out of DTG-based ART, assessing the prevalence of DTG resistance in populations for whom treatment is failing as well as the potential impact of polymorphic mutations in integrase on TLD efficacy becomes important. For this reason, WHO recommends genotyping the integrase region in addition to the reverse-transcriptase and protease regions in all specimens collected in surveys of pretreatment or acquired HIV drug resistance.

5.3 Progress on research and innovation (strategic objective 3)

Relevant and innovative research is vital to address knowledge gaps and create interventions that will have the greatest impact on minimizing the emergence and transmission of clinically relevant drug-resistant HIV. In 2017, WHO convened an expert meeting to identify research gaps and areas of innovation for preventing and monitoring HIV drug resistance (*98*) (**Table 5.2**). Priority research topics grouped around three main themes were identified: (1) epidemiological and clinical, (2) virological and (3) innovative technologies. Each theme specifically focused on the global transition to DTG-based regimens.

Table 5.2. Summary of progress in addressing current research gaps related to HIV drug resistance

Epidemiology and clinical aspects	
Effect of pre-existing resistance to the NRTI backbone on the efficacy of DTG-based ART†	✓
Levels of viral suppression and prevalence and pattern of HIV drug resistance mutations among people for whom DTG-based ART is failing in low- and middle-income countries	✓
Cost–effectiveness of individualized HIV drug resistance testing for people for whom a boosted PI or DTG-based regimen is failing to minimize unnecessary switches to subsequent lines	✓
HIV drug resistance emerging in programmes scaling up PrEP	✓
Impact of K65R/M184V mutations on the efficacy of TDF and FTC-based PrEP	✓
Validated local, inexpensive and sustainable corrective actions to minimize the emergence and transmission of preventable drug-resistant HIV	—
Clinical impact of raltegravir-based ART among children infected with NRTI-resistant HIV	✓
Clinical impact of DTG administered twice daily among children for whom raltegravir-based ART is failing	✓
Optimal viral load switching algorithm to minimize the emergence of resistance	✓
Simple algorithm for interpreting HIV drug resistance for use by caregivers	✓
Efficacy of DTG administered twice daily as a strategy to increase the potency of the regimen in individuals with partly active NRTI backbone	✓
Levels of viral suppression and acquired HIV drug resistance among people receiving second-line boosted PIs in low- and middle-income countries, with particular focus on atazanavir/ritonavir	✓
Response of TDF, 3TC and DTG in populations at high risk of suboptimal adherence (such as adolescents) and among people coinfected with TB and HIV	✓
Clinically significant thresholds of low-abundance NNRTI-resistant variants	✓
Cost–effectiveness analysis tools for use in countries for financing and advocacy of optimized treatment	✓
Virological aspects	
Correlation of genotype-phenotype and clinical significance for all mutations	✓
List of transmitted integrase inhibitor mutations†	✓
Minimum set of mutations for PIs, reverse-transcriptase inhibitors and integrase inhibitors for clinical purposes for point-mutation technology	—
Impact of novel drug delivery methods (such as long-acting drug formulations) on the selection of HIV drug resistance	✓
Innovative technologies	
Simple and affordable point-of-care HIV drug resistance assays	✓
Inexpensive, simple, easy-to-interpret tests that combine viral load and HIV drug resistance testing that can be used to minimize unnecessary switches to subsequent regimens	✓
Simple and affordable next-generation sequencing bioinformatics algorithms	✓
Newer collection matrices for HIV drug resistance testing	✓
Affordable, simple and easy-to-use point-of-care tests to measure drug levels to distinguish people for whom treatment is failing because of poor adherence versus resistance†	✓

Methods: rapid assessment of research question implementation among the research community and review of published literature. In the Global Action Plan on HIV drug resistance 2017–2021, research topics considered as the highest priority within the five-year plan were ranked as tier 1. Topics deemed less critical over the next five years were ranked as tier 2.

☐ Tier 1 research question

☐ Tier 2 research question

✓ Research currently undergoing

— No evidence that research is being conducted

† Expounded upon in Sections 5.3.1, 5.3.2 and 5.3.3

5.3.1 Impact of NRTI resistance on the efficacy of DTG-based ART

As the HIV treatment landscape in low- and middle-income countries changes, there is a need to study the long-term efficacy and durability of TLD when susceptibility to co-administered NRTIs is predicted to be reduced. In 2021, two studies were published showing favourable results when DTG is used with predicted partial active or inactive NRTI backbone containing either ZDV or TDF. The Nucleosides and Darunavir/Dolutegravir in Africa (NADIA) study, a two-by-two factorial randomized controlled trial in Kenya, Uganda and Zimbabwe, compared the use of ZDV or TDF with either darunavir or DTG as second-line treatment among people for whom NNRTI-based first-line treatment had failed (27). The study included adults whose HIV was predicted to be partly or fully resistant to TDF and 3TC or FTC who were retained on TDF. Overall, the study showed high levels of viral suppression among people receiving TDF in combination with 3TC or FTC when co-administered with either DTG or darunavir at 48 months, regardless of predicted TDF resistance. This finding supports the reuse of TDF and 3TC or FTC when combined with an anchor drug having a high genetic barrier to selection of resistance. Similarly, the ARTIST study (26), a single-arm trial in South Africa, assessed 24-week outcomes among people who had switched from TLE (TDF in combination with 3TC and EFV as a fixed-dose combination) to TLD and who had genotypic evidence of NRTI resistance before switching. ARTIST reported high levels of viral suppression among those on TLD, even in the presence of TDF and 3TC or FTC resistance-associated mutations. Although these findings are reassuring, long-term outcome data are needed and are expected to be available in late 2021 or early 2022. Other large studies designed to address this same question, such as the D2EFT clinical trial and the ACTG 5381 OBSERVE TLD cohort study, are ongoing, with results expected in 2022–2023.

For infants and young children, WHO recommends that ABC be used in combination with DTG and 3TC for children ≥4 weeks of age and weighing between ≥3 kg and <30 kg. Currently, there is limited evidence addressing the efficacy of DTG when used in combination with ABC among children with predicted ABC and/or FTC resistance. The efficacy of DTG in the presence of TDF and FTC resistance has been attributed to residual activity of the NRTIs, the high genetic barrier of DTG and an antagonistic effect of the M184V mutation, which causes hypersusceptibility of HIV to TDF but, in contrast, increases resistance to ABC (27,99). For this reason, as well as the different resistance profile for ABC versus TDF, caution is warranted when extrapolating results from studies conducted among adults (such as NADIA or ARTIST) to children; studies evaluating treatment outcomes among children receiving ABC in combination with DTG when ABC and/or 3TC resistance is present should be performed to confirm successful short- and long-term virological outcomes.

5.3.2 Mutation list for surveillance of transmitted integrase inhibitor resistance

As INSTI-based regimens become widely available in low- and middle-income countries, transmitted integrase inhibitor resistance will need to be assessed. In 2019, WHO HIVResNet working groups published a standardized list of 24 non-polymorphic INSTI-selected mutations for the surveillance of transmitted INSTI resistance (*100*).

5.3.3 Affordable, simple and easy-to-use point-of-care tests to measure drug levels to identify people for whom treatment is failing because of poor adherence versus resistance

Innovative technologies are needed for optimal ART monitoring. WHO HIVResNet has identified the need for affordable, easy-to-use tests to identify people for whom treatment is failing due to poor adherence and not drug-resistant virus. Several studies are ongoing in this area and include both centralized and point-of-care qualitative and quantitative drug level tests using various sample types, including urine, saliva, blood, plasma and DBS. Emerging data assessing drug level tests in predicting non-adherence appear promising and, although more study is needed, these tests may one day support adherence and may minimize the need for drug resistance testing in populations demonstrating poor adherence (*101,102*). To render drug monitoring feasible in low- and middle-income countries and to integrate their use into the HIV care and treatment cascade as a tool to maximize viral load suppression, questions around the accuracy, clinical utility and cost–effectiveness of drug level monitoring among people receiving DTG-based ART must be resolved. In addition, studies are needed to determine feasibility of implementation, population values and preferences and to identify the most strategic placement of therapeutic drug monitoring within the HIV monitoring cascade.

5.4 Progress on strengthening laboratory capacity (strategic objective 4)

5.4.1 Viral load testing

Since 2013, WHO has recommended routine viral load testing for everyone receiving ART. Expanding access and optimal use of viral load testing is essential for the prevention of HIV drug resistance. Early identification of failure to suppress viral loads reduces the risk of emergence and transmission of drug-resistant virus.

Although viral load testing coverage has increased globally, it remains below the target of 90% in most countries (93%, 26 of 28) (**Map 7**). More than one third (36%) of the countries reported ≤50% viral load testing coverage in 2020. Nearly half the people receiving treatment for HIV in the countries reporting data did not receive a viral load test in 2020. This is a slight increase from 2019, when 31% (14 of 35) of reporting countries had viral load coverage of ≤50%. The decline in viral load testing coverage in 2020

may be attributed to the COVID-19 pandemic and mitigation measures, including restricting access to health-care systems. Despite the COVID-19 pandemic, reported data signal the need for greatly expanding viral load testing and implementing viral load testing catch-up campaigns (*103*).

5.4.2 Laboratory network for HIV drug resistance surveillance

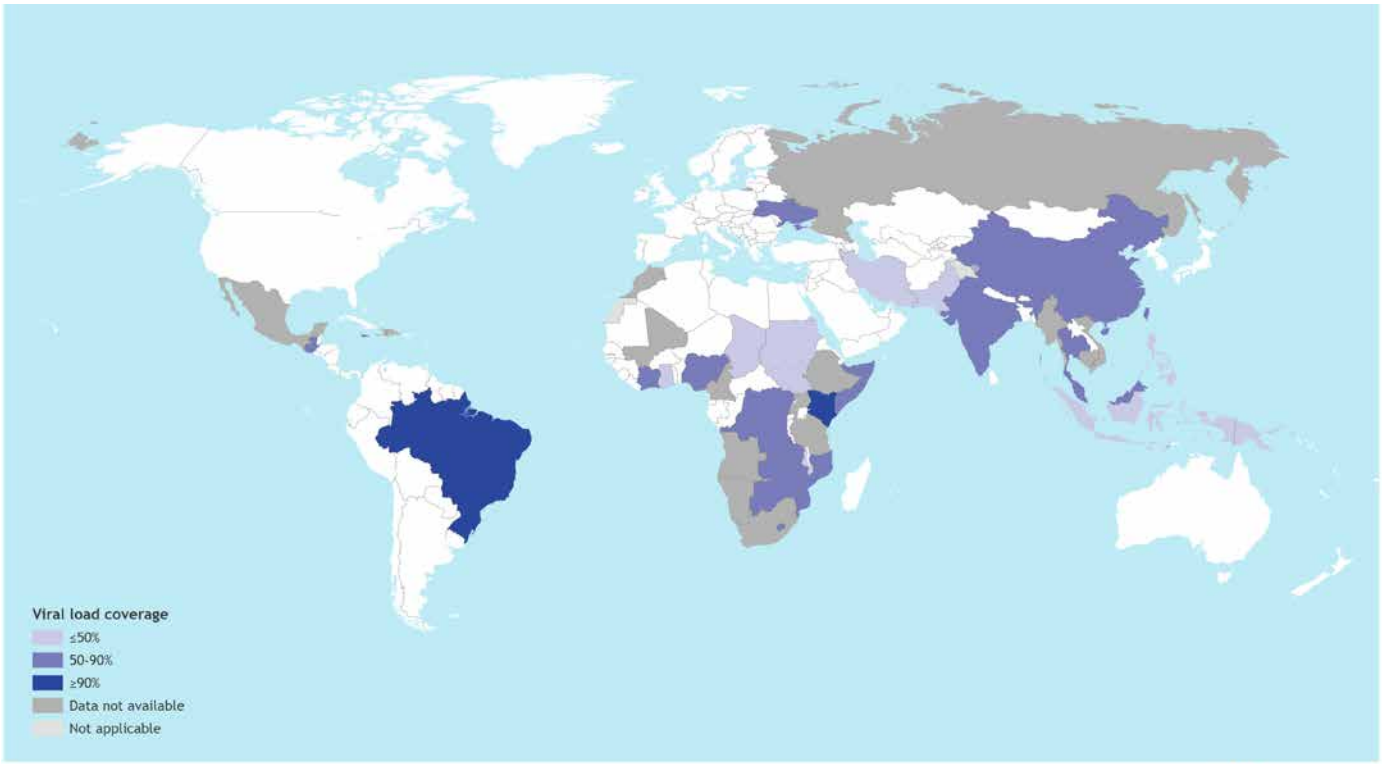
The WHO HIVResNet network of designated laboratories performs drug resistance testing for countries implementing HIV drug resistance surveillance (*104*). For countries without a designated national HIV drug resistance laboratory, specimens are sent to a regional or specialized laboratory in the network, where testing is performed using a validated method with standardized quality control procedures. As of October 2021, the WHO HIVResNet Laboratory Network includes 34 laboratories (**Map 8**). Fifteen of the laboratories have capacity for genotyping from DBS specimens, a field-friendly specimen type most suitable for use in many low- and middle-income countries.

The capacity for integrase inhibitor resistance testing within the WHO HIVResNet Laboratory Network is increasing to support the transition to integrase inhibitor–based regimens. To date, 10 laboratories have validated a genotypic assay for integrase, and several others are expected to complete the validation before the end of 2021. Quality-assured genotypic testing of the integrase region of the HIV-1 pol gene will enable countries conducting HIV drug resistance surveys to monitor resistance to integrase inhibitors, especially among people receiving DTG-based regimens with unsuppressed viral load.

WHO is steering a diagnostic agenda to develop and adapt the use of HIV drug resistance assays, partly in response to the increased use of HIV drug resistance testing for individual patient management in low- and middle-income countries. According to Global AIDS Monitoring 2021, 23 of 34 (68%) countries with a high burden of HIV infection reporting data to WHO have a policy recommending the use of HIV drug resistance testing for individual patient management.

Between July and October 2021, a series of consultations was held to support the development of a target product profile for HIV drug resistance tests to be used for individual patient management in low- and middle-income countries, with a focus on countries in the African Region. The target product profile is expected to be available for public comment by mid-2022.

Map 7. Viral load testing coverage among 45 high burden HIV countries (as of December 2020)

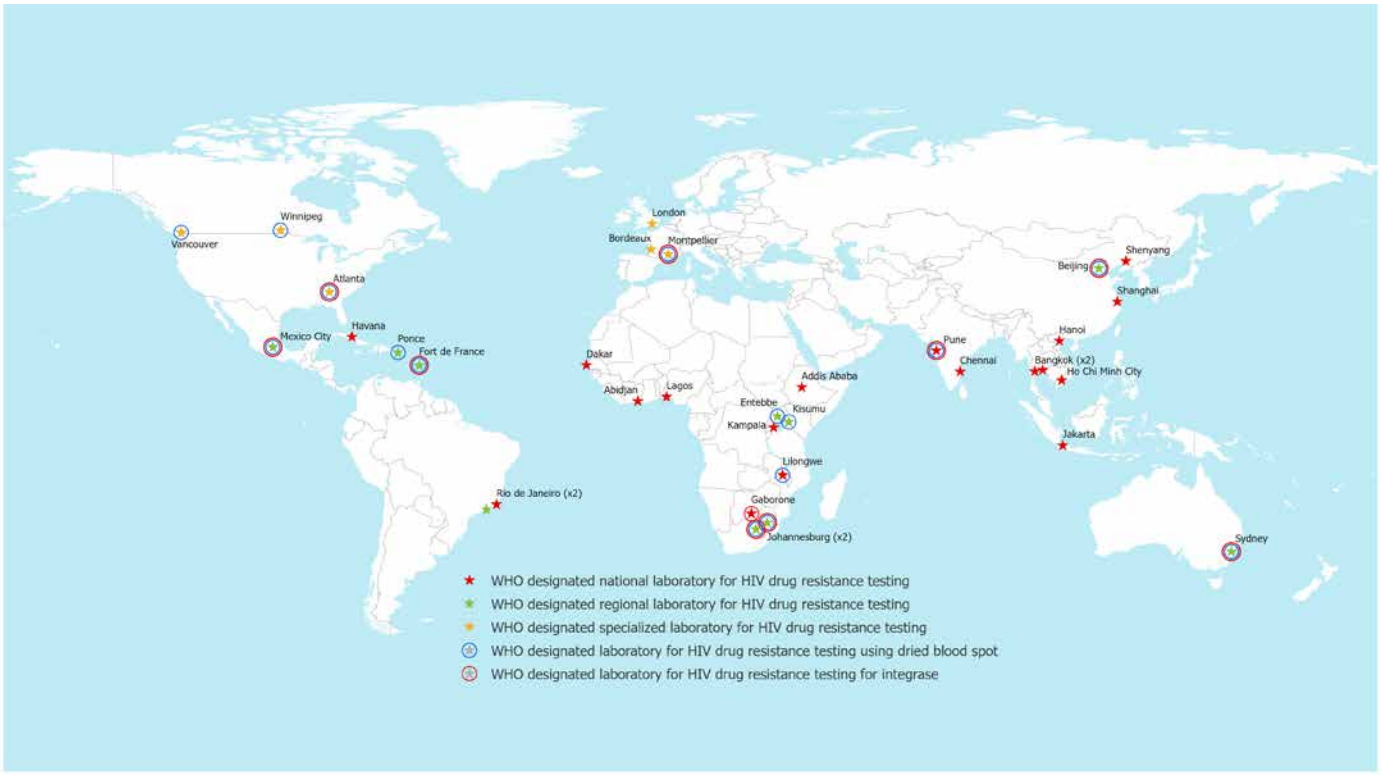


The designations employed and the presentation of the material in this publication do not imply the expression of any opinion whatsoever on the part of WHO concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. Dotted and dashed lines on maps represent approximate border lines for which there may not yet be full agreement.

Data Source: UNAIDS/WHO Global AIDS Monitoring tool and WHO/AIDS Medicines and Diagnostics Survey on the use of ARV medicine and laboratory technologies and implementation of WHO related guidelines
Map Production: WHO GIS Centre for Health, DNA/DDI

World Health Organization

Map 8. WHO HIV drug resistance laboratory network, September 2021



Data Source: World Health Organization
Map Production: WHO GIS Centre for Health, DNA/DDI
Map Creation Date: **12 October 2021**

World Health Organization

5.5 Progress on building sustainable governance and enabling mechanisms (strategic objective 5)

Like the global fight against antimicrobial resistance, efforts to mitigate the unnecessary emergence and transmission of drug-resistant HIV are a collective responsibility of countries, national and international stakeholders, people living with HIV, academic institutions and civil society. Plans to mitigate HIV drug resistance should therefore be situated within the wider context of health policies, and success requires resource mobilization and broad stakeholder engagement.

5.5.1 Funding HIV drug resistance activities

Establishing sustainable funding mechanisms is critical to support HIV drug resistance prevention and monitoring activities in low- and middle-income countries. International partners, in particular the Global Fund to Fight AIDS, Tuberculosis and Malaria and PEPFAR have committed to funding HIV drug resistance surveillance activities in countries and have committed to strengthening health-care systems and building laboratory capacity to achieve universal viral load testing coverage. A review of Global Fund grants between 2015 to 2017 shows that 24 countries received support for HIV drug resistance surveillance totalling about US$ 4.7 million. Most of this support funded HIV drug resistance surveys. Between 2018 and September 2021, the Global Fund supported 42 surveys in 22 countries reported to WHO. Between 2018 and September 2021, PEPFAR supported 44 surveys in 18 countries reporting data to WHO.

Both the Global Fund and PEPFAR have committed to support countries to prevent and monitor the emergence of INSTI resistance as countries transition to DTG-based regimens as a means of ensuring the durability of these newer regimens and as part of global efforts to end the AIDS epidemic as a public health threat by 2030. In this regard, countries should leverage their national action plan implementation frameworks to request funding for activities related to HIV drug resistance.

5.5.2 Country ownership and ARV drug stewardship

Governance and country ownership of HIV drug resistance prevention, monitoring and response is a critical element of a well-functioning ART programme. The proportion of focus countries with HIV drug resistance prevention and response plans increased from 46% (13 of 28) of reporting countries in 2018 to 64% (25 of 39) in 2020, demonstrating in-country commitment and multistakeholder engagement. To facilitate the sustainability of HIV drug resistance prevention, monitoring and response, WHO recommends that countries integrate national HIV drug resistance plans into their broader HIV response, antimicrobial resistance strategies and health sector development plans. Health ministries may consider setting aside a small portion of overall care and treatment budgets for the purposes of preventing, monitoring and responding to HIV drug resistance.

5.5.3 Advocacy and awareness

Advocacy and increased awareness of the burden and impact of HIV drug resistance among policy-makers, health-care workers, communities, patients and civil society are critical to minimize the emergence and spread of HIV drug resistance. As part of the national action plan on HIV drug resistance, national ART programmes should institute strategies to improve HIV drug resistance awareness in-country.

WHO and WHO HIVResNet have convened activities to advocate for HIV drug resistance prevention and control as well as increased awareness. In 2018, WHO, the Joep Lange Institute, AIDS Fond and the Partnership to Inspire, Transform and Connect the HIV response (PITCH) met in The Hague, Netherlands with civil society advocates, community representatives, healthcare practitioners, researchers and policy-makers to define the building blocks of a bold advocacy strategy to promote the implementation of the Global Action Plan (*105*). Overall, the meeting affirmed the critical role of the community and civil rights groups in preventing and monitoring HIV drug resistance and identified ways to engage them, by (1) more strongly emphasizing that HIV drug resistance is a quality-of-care concern that requires community engagement to monitor and address (including digitally); (2) developing quality indicators and a framework to guide community responses; (3) increasing HIV drug resistance awareness by developing simplified, evidence-informed messaging, including coordinated audience-specific messaging at key events and through social media; and (4) visibly benchmarking countries and regions based on their quality-of-care indicators to trigger community engagement in supporting quality improvement processes and stimulating advocacy actions. In 2021, UNAIDS developed a guide for establishing community-led monitoring of HIV services (*106*) that countries can leverage to partly implement the recommendations from the meeting.

In 2021, WHO and Project ECHO, in partnership with the WHO Quality of HIV Care Global Technical Working Group initiated a collaboration to host a webinar series bringing together health policy-makers, national programme managers, health-care providers, donors, partners in interventions on HIV and people living with HIV.[7] An overall goal is to stimulate discussions between various stakeholders and share best practices and lessons learned in an effort to improve the quality of care and life of people living with HIV. Webinars have been held on community-led monitoring and how it can contribute to improved access to medicines, including preventing ARV drug stock-outs and improving the quality of life for people living with HIV. These webinars emphasize the need for high-quality HIV care services along the entire cascade and have featured locally led initiatives to maximize the quality of service delivery, all of which directly or indirectly maximize population-level HIV viral suppression, thereby minimizing the preventable emergence and unnecessary transmission of drug-resistant HIV. In 2021, four seminars have been held and have been attended by 201 individuals from 56 countries,

WHO has also been using avenues such as the World Antimicrobial Awareness Week (WAAW) and the Global Antimicrobial Resistance and Use Surveillance System report (GLASS) for increased HIV drug resistance awareness and advocacy. In addition, WHO has developed infographics and videoclips to simplify HIV drug resistance messaging, which are available at its website.[8]

5.6 Successes and challenges in implementing the Global Action Plan on HIV drug resistance 2017–2021

In 2021, WHO conducted a survey to assess the success and challenges of the implementation of the Global Action Plan on HIV drug resistance and received responses from 18 of 45 countries surveyed. Overall, progress has been made over the past four years in implementing the Global Action Plan at the country and global levels. This progress has occurred because of either direct or inadvertent implementation of strategies in the national action plans on HIV drug resistance.

Progress includes:

- increasing numbers of nationally representative surveys of pretreatment HIV drug resistance followed by a transition from EFV-based regimens to DTG-based regimens for adolescents and adults;
- wide phase out of NNRTI-based regimens and adoption of lopinavir/ritonavir or DTG-based ART for infants, as child-friendly formulations become available;
- adopting differentiated service delivery, including multimonth dispensing, to improve retention and adherence;
- implementing HIV drug resistance surveys to monitor the emergence of acquired HIV drug resistance;
- expanding the WHO HIVResNet laboratory network capacity, including designating five additional laboratories between 2017 and October 2021 (AIDS National Reference Laboratory, Havana, Cuba; Clinical Microbiology Laboratory, Department of Microbiology, Faculty of Medicine, University of Indonesia, Jakarta, Indonesia; Botswana-Harvard HIV Reference Laboratory, Gaborone, Botswana; National HIV Reference Laboratory, Lilongwe, Malawi; Centre for Human Virology & Genomics, Nigerian Institute of Medical Research, Lagos, Nigeria) and capacity building to support genotyping of the integrase region of HIV;
- increase in the proportion of countries achieving the UNAIDS 2020 90% viral load suppression target;
- adopting HIV drug resistance testing in some countries for individual patient management, including the formation of third-line committees to guide the choice of salvage regimens;

7 https://hsc.unm.edu/echo/partner-portal/programs/covid-19-response/international-covid19/who-collaborations/who-hiv-care-services.html

8 https://www.who.int/teams/global-hiv-hepatitis-and-stis-programmes/hiv/treatment/hiv-drug-resistance

- developing national action plans for preventing, monitoring and responding to HIV drug resistance, which are increasingly embedded in national HIV plans and integrated into national antimicrobial resistance prevention strategies; and
- developing a national curriculum for HIV management that includes HIV drug resistance prevention and monitoring for use in training clinicians and medical students in some countries.

Challenges include:

- many countries cite lack of funds as a barrier to implementing elements of their national action plans to prevent, monitor and respond to HIV drug resistance; programmes may need to identify innovative resource mobilization and sustainable funding mechanisms, including further integrating the national action plans within broader health-sector strategies and antimicrobial resistance strategies;
- insufficient local HIV drug resistance testing capacity and long turnaround time when testing is performed abroad for patient management;
- limited human capacity to implement a national action plan and programmatic data gaps to inform its implementation; and
- need for locally adaptable guidance to address gaps in the quality of service delivery identified though routine programme monitoring.

5.7 Conclusions

The launch of the Global Action Plan in 2017 demonstrated increased commitment by the global community to prevent, monitor and respond to the threat posed by increasing levels of HIV drug resistance to ensure the long-term durability and efficacy of available and future ARV drugs. Progress in implementing the Global Action Plan has been made over the first four years; in particular, all countries with high levels of pretreatment NVP and EFV resistance have either transitioned or are in the process of transitioning to DTG-based regimens among children ≥4 weeks and weighing ≥3 kg and among adults. This is expected to lead to improved treatment outcomes, including higher levels of viral suppression (*107,108*). However, elevated levels of ABC resistance among infants merit attention and emphasize the need for additional studies to understand the impact of using DTG in the presence of a compromised ABC backbone in this population as well as accelerated action to enable use of alternative ARVs such as tenofovir alafenamide or new ARV drug classes.

Although tremendous strides have been made and tangible improvements in the quality of care are evident, significant opportunities remain in all 45 countries with a high burden of HIV infection to improve the quality of service delivery. Few countries have attained the recommended targets for programme quality-of-care indicators associated with HIV drug resistance, and the performance of some indicators is declining or stagnating globally. Particular attention should be focused on supporting retention, maximizing adherence, preventing drug stock-outs and increasing access to viral load testing accompanied by prompt clinical response to treatment failure. Frameworks for clinics and programmes to identify the causes of performance gaps are required to support the development of sustainable and locally appropriate solutions.

As the current Global Action Plan on HIV drug resistance draws to a close, many countries continue to need to focus on improving the quality of HIV care delivery across the entire HIV care continuum. Future efforts will need to identify ongoing opportunities to prevent, monitor and respond to HIV drug resistance within a rapidly evolving treatment landscape and new service delivery models and address challenges encountered during the first four years of its implementation. In 2022, WHO plans to conduct a comprehensive review of the impact of the Global Action Plan on HIV drug resistance on broader health sector strategies, national and global HIV treatment plans and national antimicrobial resistance prevention plans. Increased ownership and commitment will be required from all stakeholders to fully attain the targets established in the Global Action Plan on HIV drug resistance and to attain the wider global goals for controlling the HIV epidemic. In addition, increased funding, infrastructure, political will and integration with the broader global antimicrobial agenda are required to sustain and expand global HIV drug resistance prevention surveillance and response efforts.

DTG-based ART promises to revolutionize HIV care and treatment, and its use can lead to very high levels of population viral load suppression and propel us towards an AIDS-free future. However, without the benefit of cumulative standardized HIV drug resistance surveillance data and commitment by international organizations, national governments, ART programmes, funders, implementing partners, civil society and people living with HIV to identify and find local, national and global solutions to programmatic challenges associated with HIV drug resistance, the full promise of DTG-based ART may not be realized over the next decade. Now more than ever, greater funding, infrastructure and political will are required to sustain and expand global HIV drug resistance prevention, monitoring and surveillance efforts.

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ANNEX 1. COUNTRY-LEVEL TABLES

SECTION 1: PRETREATMENT HIV DRUG RESISTANCE AMONG ADULTS INITIATING FIRST-LINE ANTIRETROVIRAL THERAPY

Table A1.1a. Population characteristics of adults initiating first-line ART – Africa

	Cameroon (start year: 2015) *N*=321		Eritrea (start year: 2016) *N*=154		Eswatini (start year: 2016) *N*=398		Ethiopia (start year: 2017) *N*=610	
	n/N	%, 95% CI[d]	*n/N*	%, 95% CI[d]	*n/N*	%, 95% CI[d]	*n/N*	%, 95% CI[d]
Gender								
Women	203/321	65.4, 60.0–70.6	93/154	62.6, 55.2–69.4	279/398	73.3, 63.2–81.5	334/610	56.6, 47.0–65.8
Men	118/321	34.6, 29.4–40.1	61/154	37.4, 30.6–44.8	119/398	26.7, 18.5–36.8	251/610	38.3, 31.0–46.2
Other	0/321	0.0, 0.0–1.2	0/154	0.0, 0.0–2.4	0/398	0.0, 0.0–1.0	0/610	0.0, 0.0–0.6
Unknown	0/321	0.0, 0.0–1.2	0/154	0.0, 0.0–2.4	0/398	0.0, 0.0–1.0	25/610	5.1, 1.9–12.5
Mean age, 95% CI (years)[a]	**37.7, 36.5–38.9**		**39.9, 38.5–41.4**		**34.4, 31.6–37.2**		**20.1, 18.2–22.1**	
≤25 years	33/321	9.5, 6.2–14.4	11/154	7.0, 3.5–13.5	83/398	29.4, 21.1–39.3	368/610	60.9, 53.3–67.9
>25 years	288/321	90.5, 85.6–93.8	142/154	93.0, 86.5–96.5	315/398	70.6, 60.7–78.9	215/610	34.0, 26.7–42.2
Unknown	0/321	0.0, 0.0–1.2	0/154	0.0, 0.0–2.4	0/398	0.0, 0.0–1.0	27/610	5.1, 2.0–12.5
Initiated first-line								
NNRTI-based[b]	320/321	100.0, 99.7–100.0	152/154	99.2, 97.9–99.7	0/398	0.0, 0.0–1.0	0/610	0.0, 0.0–0.6
PI-based[c]	1/321	0.0, 0.0–0.3	1/154	0.4, 0.1–1.7	0/398	0.0, 0.0–1.0	0/610	0.0, 0.0–0.6
DTG-based	0/321	0.0, 0.0–1.2	0/154	0.0, 0.0–2.4	0/398	0.0, 0.0–1.0	0/610	0.0, 0.0–0.6
Other	0/321	0.0, 0.0–1.2	0/154	0.0, 0.0–2.4	0/398	0.0, 0.0–1.0	0/610	0.0, 0.0–0.6
Unknown	0/321	0.0, 0.0–1.2	1/154	0.4, 0.1–1.3	398/398	100.0, 99.0–100.0	610/610	100.0, 99.4–100.0
Previous ARV drug exposure								
Yes	29/321	7.8, 4.2–14.0	14/154	8.6, 5.3–13.7	40/398	10.7, 6.8–16.4	35/610	5.8, 3.2–10.3
No	223/321	80.6, 72.2–86.9	140/154	91.4, 86.3–94.7	358/398	89.3, 83.6–93.2	524/610	87.8, 83.0–91.4
Unknown	69/321	11.6, 6.2–20.9	0/154	0.0, 0.0–2.4	0/398	0.0, 0.0–1.0	51/610	6.4, 3.9–10.1
Previous ARV drug exposure (women)								
Yes	22/203	10.0, 5.1–18.7	7/93	7.4, 3.9–13.6	36/279	14.2, 8.7–22.5	27/334	7.4, 3.5–14.8
No	137/203	77.3, 67.4–84.5	86/93	92.6, 86.4–96.1	243/279	85.8, 77.5–91.4	290/334	89.3, 81.7–93.9
Unknown	44/203	12.7, 6.8–22.6	0/93	0.0, 0.0–4.0	0/279	0.0, 0.0–1.4	17/334	3.4, 1.5–7.6
Previous ARV drug exposure (men)								
Yes	7/118	3.6, 1.1–11.0	7/61	10.8, 5.2–20.9	4/119	0.9, 0.2–3.2	8/251	4.3, 1.7–10.5
No	86/118	86.8, 77.1–92.7	54/61	89.2, 79.1–94.8	115/119	99.1, 96.8–99.8	233/251	93.8, 87.7–97.0
Unknown	25/118	9.6, 4.5–19.3	0/61	0.0, 0.0–5.9	0/119	0.0, 0.0–3.1	10/251	1.8, 0.7–4.9
Type of ARV drug exposure								
PMTCT	14/29	47.4, 17.2–79.7	0/14	0.0, 0.0–21.5	25/40	60.6, 29.7–84.9	8/35	30.8, 8.5–68
ART	9/29	24.0, 5.7–62.4	14/14	100.0, 78.5–100.0	11/40	16.1, 5.4–39.4	2/35	1.6, 0.3–9.2
Other	6/29	28.6, 4.6–76.9	0/14	0.0, 0.0–21.5	0/40	0.0, 0.0–8.8	0/35	0.0, 0.0–9.9
Unknown	0/29	0.0, 0.0–11.7	0/14	0.0, 0.0–21.5	4/40	23.3, 4.5–66.3	25/35	67.5, 31.8–90.3

a Study design–weighted mean and 95% confidence interval.
b NNRTI-based regimens include EFV or NVP.
c PI-based regimens include ATV/r, DRV/r or LPV/r.
d Study design–weighted proportion and 95% confidence interval.
ART: antiretroviral therapy; ATV/r: atazanavir/ritonavir; CI: confidence interval; DRV/r: darunavir/ritonavir; DTG: dolutegravir; EFV: efavirenz; LPV/r: lopinavir/ritonavir; NVP: nevirapine; NNRTI: non-nucleoside reverse-transcriptase inhibitor; PI: protease inhibitor; PMTCT: prevention of mother-to-child transmission.

Table A1.1b. Population characteristics of adults initiating first-line ART – Africa

	Lesotho (start year: 2018) *N*=405		Namibia (start year: 2015) *N*=383		South Sudan (start year: 2018) *N*=377		Uganda (start year: 2016) *N*=342	
	n/N	%, 95% CI[d]	*n/N*	%, 95% CI[d]	*n/N*	%, 95% CI[d]	*n/N*	%, 95% CI[d]
Gender								
Women	261/405	66.3, 60.7–71.6	248/383	64.8, 59.3–69.8	209/377	56.8, 50–63.3	208/342	61.4, 51.8–70.2
Men	144/405	33.7, 28.4–39.3	135/383	35.2, 30.1–40.7	168/377	43.2, 36.7–50	133/342	38.4, 29.7–48.0
Other	0/405	0.0, 0.0–0.9	0/383	0.0, 0.0–1.0	0/377	0.0, 0.0–1.0	0/342	0.0, 0.0–1.1
Unknown	0/405	0.0, 0.0–0.9	0/383	0.0, 0.0–1.0	0/377	0.0, 0.0–1.0	1/342	0.1, 0.0–1.2
Mean age, 95% CI (years)[a]	**34.4, 33.2–35.7**		**35.3, 33.5–37.1**		**33.0, 31.5–34.6**		**34.1, 31.2–37.0**	
≤25 years	60/405	15.7, 12.2–20.1	60/383	15.7, 11.2–21.4	80/377	25.9, 19.7–33.2	72/342	21.6, 15.1–29.9
>25 years	345/405	84.3, 79.9–87.8	317/383	82.8, 77.1–87.2	297/377	74.1, 66.8–80.3	270/342	78.4, 70.1–84.9
Unknown	0/405	0.0, 0.0–0.9	6/383	1.6, 0.6–3.9	0/377	0.0, 0.0–1.0	0/342	0.0, 0.0–1.1
Initiated first-line								
NNRTI-based[b]	0/405	0.0, 0.0–0.9	379/383	99.7, 98.0–100.0	377/377	100.0, 99.0–100.0	321/342	97.3, 91.4–99.2
PI-based[c]	0/405	0.0, 0.0–0.9	0/383	0.0, 0.0–1.0	0/377	0.0, 0.0–1.0	0/342	0.0, 0.0–1.1
DTG-based	0/405	0.0, 0.0–0.9	0/383	0.0, 0.0–1.0	0/377	0.0, 0.0–1.0	0/342	0.0, 0.0–1.1
Other	0/405	0.0, 0.0–0.9	1/383	0.3, 0.0–2.0	0/377	0.0, 0.0–1.0	0/342	0.0, 0.0–1.1
Unknown	405/405	100.0, 99.1–100.0	3/383	0.8, 0.3–2.4	0/377	0.0, 0.0–1.0	21/342	2.7, 0.8–8.6
Previous ARV drug exposure								
Yes	25/405	5.3, 3.7–7.6	69/383	18.0, 13.2–24.0	46/377	16.4, 8.6–29.1	9/342	1.2, 0.4–3.7
No	380/405	94.7, 92.4–96.3	313/383	81.7, 75.6–86.6	330/377	83.3, 70.8–91.2	296/342	88.9, 77.2–95.0
Unknown	0/405	0.0, 0.0–0.9	1/383	0.3, 0.0–2.1	1/377	0.2, 0.0–1.4	37/342	9.9, 4.2–21.2
Previous ARV drug exposure (women)								
Yes	16/261	6.0, 3.8–9.1	48/248	19.4, 14.7–24.5	27/209	16.1, 8.1–29.4	5/208	0.9, 0.2–3.8
No	245/261	94.0, 90.9–96.2	199/248	80.2, 74.6–84.9	182/209	83.9, 70.6–91.9	177/208	89.6, 74.9–96.1
Unknown	0/261	0.0, 0.0–1.5	1/248	0.4, 0.0–3.2	0/209	0.0, 0.0–1.8	26/208	9.5, 3.3–24.8
Previous ARV drug exposure (men)								
Yes	9/144	4.0, 1.8–8.9	21/135	15.6, 10.1–23.1	19/168	16.9, 7.7–33.3	4/133	1.8, 0.5–6.4
No	135/144	96, 91.1–98.2	114/135	84.4, 76.9–89.9	148/168	82.5, 66.5–91.8	118/133	87.8, 76.9–94.0
Unknown	0/144	0.0, 0.0–2.6	0/135	0.0, 0.0–2.8	1/168	0.6, 0.1–3.2	11/133	10.4, 4.9–20.9
Type of ARV drug exposure								
PMTCT	4/25	24.0, 7.6–54.7	16/69	23.2, 13.3–37.1	2/46	2.3, 0.2–21.0	6/9	8.1, 0.3–74.7
ART	19/25	70.0, 40.9–88.7	53/69	76.8, 62.8–86.6	21/46	11.1, 1.3–55.3	1/9	59.9, 7.3–96.6
Other	1/25	1.6, 0.2–13.7	0/69	0.0, 0.0–5.3	0/46	0.0, 0.0–7.7	0/9	0.0, 0.0–29.9
Unknown	1/25	4.4, 0.5–31.7	0/69	0.0, 0.0–5.3	25/46	88.9, 44.7–98.7	2/9	32.0, 2.2–90.7

a Study design–weighted mean and 95% confidence interval.
b NNRTI-based regimens include EFV or NVP.
c PI-based regimens include ATV/r, DRV/r or LPV/r.
d Study design–weighted proportion and 95% confidence interval.
ART: antiretroviral therapy; ATV/r: atazanavir/ritonavir; CI: confidence interval; DRV/r: darunavir/ritonavir; DTG: dolutegravir; EFV: efavirenz; LPV/r: lopinavir/ritonavir; NVP: nevirapine; NNRTI: non-nucleoside reverse-transcriptase inhibitor; PI: protease inhibitor; PMTCT: prevention of mother-to-child transmission.

Table A1.1c. Population characteristics of adults initiating first-line ART – Africa

	Zambia (start year: 2019) *N*=208		Zimbabwe[e] (start year: 2015) *N*=353	
	n/N	%, 95% CI[d]	*n/N*	%, 95% CI[d]
Gender				
Women	122/208	57.8, 47.8–67.2	207/353	56.7, 50.1–63.0
Men	86/208	42.2, 32.8–52.2	145/353	43.3, 36.9–49.8
Other	0/208	0.0, 0.0–1.8	0/353	0.0, 0.0–1.1
Unknown	0/208	0.0, 0.0–1.8	1/353	0.0, 0.0–0.4
Mean age, 95% CI (years)[a]	**33.5, 31.9–35.1**		**34.7, 32.6–36.8**	
≤25 years	48/208	23.1, 16.8–30.8	54/353	18.9, 14.0–25.0
>25 years	160/208	76.9, 69.2–83.2	299/353	81.1, 75.0–86.0
Unknown	0/208	0.0, 0.0–1.8	0/353	0.0, 0.0–1.1
Initiated first-line				
NNRTI-based[b]	30/208	12.7, 7.1–21.6	353/353	100.0, 98.9–100.0
PI-based[c]	0/208	0.0, 0.0–1.8	0/353	0.0, 0.0–1.1
DTG-based	127/208	58.9, 38.4–76.7	0/353	0.0, 0.0–1.1
Other	0/208	0.0, 0.0–1.8	0/353	0.0, 0.0–1.1
Unknown	51/208	28.4, 15.4–46.3	0/353	0.0, 0.0–1.1
Previous ARV drug exposure				
Yes	0/208	0.0, 0.0–1.8	ND	
No	0/208	0.0, 0.0–1.8	ND	
Unknown	208/208	100.0, 98.2–100.0	ND	
Previous ARV drug exposure (women)				
Yes	0/122	0.0, 0.0–3.1	ND	
No	0/122	0.0, 0.0–3.1	ND	
Unknown	122/122	100.0, 96.9–100.0	ND	
Previous ARV drug exposure (men)				
Yes	0/86	0.0, 0.0–4.3	ND	
No	0/86	0.0, 0.0–4.3	ND	
Unknown	86/86	100.0, 95.7–100.0	ND	
Type of ARV drug exposure				
PMTCT	NA		ND	
ART	NA		ND	
Other	NA		ND	
Unknown	NA		ND	

a Study design–weighted mean and 95% confidence interval.
b NNRTI-based regimens include EFV or NVP.
c PI-based regimens include ATV/r, DRV/r or LPV/r.
d Study design–weighted proportion and 95% confidence interval.
e Previously ARV drug–exposed participants were not included in the survey.
ART: antiretroviral therapy; ATV/r: atazanavir/ritonavir; CI: confidence interval; DRV/r: darunavir/ritonavir; DTG: dolutegravir; EFV: efavirenz; LPV/r: lopinavir/ritonavir; NA: not applicable; ND: no data; NVP: nevirapine; NNRTI: non-nucleoside reverse-transcriptase inhibitor; PI: protease inhibitor; PMTCT: prevention of mother-to-child transmission.

Table A1.1d. Population characteristics of adults initiating first-line ART – the Americas

	Argentina[d] (start year: 2019) *N*=435		Brazil[f] (start year: 2014)[g] *N*=1391		Colombia[f] (start year: 2016) *N*=192		Cuba[f] (start year: 2017) *N*=150	
	n/N	%, 95% CI[e]	*n/N*	%, 95% CI[e]	*n/N*	%, 95% CI[e]	*n/N*	%, 95% CI[e]
Gender								
Women	120/435	25.9, 20.1–32.6	380/1391	27.3, 22.9–32.2	22/192	11.5, 8.1–15.9	30/150	20.3, 15.4–26.3
Men	292/435	71.4, 63.6–78.1	874/1391	62.8, 52.7–71.9	170/192	88.5, 84.1–91.9	120/150	79.7, 73.7–84.6
Other	0/435	0.0, 0.0–0.9	0/1391	0.0, 0.0–0.3	0/192	0.0, 0.0–2.0	0/150	0.0, 0.0–2.5
Unknown	23/435	2.7, 1.1–6.4	137/1391	9.8, 2.6–30.6	0/192	0.0, 0.0–2.0	0/150	0.0, 0.0–2.5
Mean age, 95% CI (years)[a]	**19.4, 17.3–21.5**		**35.6, 35.0–36.2**		**31.7, 30.5–32.9**		**35.1, 31.8–38.5**	
≤25 years	272/435	68.1, 61.1–74.4	264/1391	19.0, 15.5–23.0	67/192	34.9, 29.0–41.2	45/150	28.9, 19.1–41.2
>25 years	140/435	29.1, 23.4–35.7	942/1391	67.7, 57.3–76.6	125/192	65.1, 58.8–71.0	105/150	71.1, 58.8–80.9
Unknown	23/435	2.7, 1.1–6.4	185/1391	13.3, 5.1–30.5	0/192	0.0, 0.0–2.0	0/150	0.0, 0.0–2.5
Initiated first-line								
NNRTI-based[b]	49/435	17.1, 9.5–28.7	0/1391	0.0, 0.0–0.3	0/192	0.0, 0.0–2.0	94/150	62.1, 53.2–70.3
PI-based[c]	87/435	23.1, 14.5–34.8	0/1391	0.0, 0.0–0.3	0/192	0.0, 0.0–2.0	54/150	36.9, 29.1–45.5
DTG-based	123/435	28.7, 18.2–42.1	0/1391	0.0, 0.0–0.3	0/192	0.0, 0.0–2.0	2/150	1.0, 0.2–4.1
Other	10/435	3.4, 1.5–7.4	0/1391	0.0, 0.0–0.3	0/192	0.0, 0.0–2.0	0/150	0.0, 0.0–2.5
Unknown	170/435	28.0, 15.3–45.5	1391/1391	100.0, 99.7–100.0	192/192	100.0, 98.0–100.0	0/150	0.0, 0.0–2.5
Previous ARV drug exposure								
Yes	95/435	23.8, 15.9–34.0	ND		ND		ND	
No	317/435	74.0, 64.2–81.9	ND		ND		ND	
Unknown	23/435	2.2, 0.8–5.6	ND		ND		ND	
Previous ARV drug exposure (women)								
Yes	44/120	39.5, 21.8–60.5	ND		ND		ND	
No	74/120	59.5, 38.8–77.4	ND		ND		ND	
Unknown	2/120	1.0, 0.2–4.0	ND		ND		ND	
Previous ARV drug exposure (men)								
Yes	49/292	18.3, 12.0–27.1	ND		ND		ND	
No	242/292	81.6, 72.9–88.0	ND		ND		ND	
Unknown	1/292	0.1, 0.0–0.5	ND		ND		ND	
Type of ARV drug exposure								
PMTCT	3/95	8.0, 3.1–19.4	ND		ND		ND	
ART	80/95	83.6, 72.5–90.8	ND		ND		ND	
Other	2/95	1.7, 0.3–10.7	ND		ND		ND	
Unknown	10/95	6.7, 2.5–16.9	ND		ND		ND	

a Study design–weighted mean and 95% confidence interval.
b NNRTI-based regimens include EFV or NVP.
c PI-based regimens include ATV/r, DRV/r or LPV/r.
d Four participants initiated ART with a DTG + PI-based regimen: DTG + DRV/r.
e Study design–weighted proportion and 95% confidence interval.
f Previously ARV drug–exposed participants were not included in the survey.
g Survey enrolment between 2013 and 2016, with the majority (~80%) of survey participants enrolled in 2014.
ART: antiretroviral therapy; ATV/r: atazanavir/ritonavir; CI: confidence interval; DRV/r: darunavir/ritonavir; DTG: dolutegravir; EFV: efavirenz; LPV/r: lopinavir/ritonavir; ND: no data; NVP: nevirapine; NNRTI: non-nucleoside reverse-transcriptase inhibitor; PI: protease inhibitor; PMTCT: prevention of mother-to-child transmission.

Table A1.1e. Population characteristics of adults initiating first-line ART – the Americas

	Eastern Caribbean Countries[d] (start year: 2017) *N*=52		El Salvador (start year: 2018) *N*=260		Guatemala (start year: 2016) *N*=241	
	n/N	%, 95% CI[e]	*n/N*	%, 95% CI[f]	*n/N*	%, 95% CI[f]
Gender						
Women	18/52	34.6, 22.8–48.7	54/260	23.9, 17.3–32.2	66/241	32.7, 20.1–48.4
Men	33/52	63.5, 50.3–74.9	200/260	72.5, 64–79.7	173/241	66.7, 51.0–79.4
Other	0/52	0.0, 0.0–6.9	6/260	3.5, 1.4–8.7	2/241	0.6, 0.2–2.3
Unknown	1/52	1.9, 0.1–23.2	0/260	0.0, 0.0–1.5	0/241	0.0, 0.0–1.6
Mean age, 95% CI (years)[a]	**37.3, 33–41.7**		**34.9, 33.4–36.5**		**32.9, 31.8–34.1**	
≤25 years	14	26.9, 14.1–45.2	57/260	22.3, 15.9–30.3	191/241	19.9, 14.7–26.3
>25 years	37	71.2, 53.7–84.0	203/260	77.7, 69.7–84.1	50/241	80.1, 73.7–85.3
Unknown	1	1.9, 0.1–23.2	0/260	0.0, 0.0–1.5	0/241	0.0, 0.0–1.6
Initiated first-line						
NNRTI-based[b]	31/52	59.6, 42.2–74.9	256/260	98.9, 97.8–99.4	220/241	89.2, 74.1–96.0
PI-based[c]	2/52	3.8, 0.5–24.3	3/260	0.7, 0.4–1.2	5/241	2.7, 0.9–7.4
DTG-based	0/52	0.0, 0.0–6.9	0/260	0.0, 0.0–1.5	1/241	0.3, 0.0–2.8
Other	0/52	0.0, 0.0–6.9	1/260	0.4, 0.1–1.9	0/241	0.0, 0.0–1.6
Unknown	19/52	36.5, 18.7–59.1	0/260	0.0, 0.0–1.5	15/241	7.8, 2.5–21.9
Previous ARV drug exposure						
Yes	22/52	42.3, 14.7–75.7	55/260	20.3, 15.3–26.4	7/241	2.8, 0.7–11.1
No	29/52	55.8, 23.3–83.9	202/260	79.2, 73.1–84.2	229/241	93.9, 81.9–98.1
Unknown	1/52	1.9, 0.1–23.2	3/260	0.6, 0.6–0.6	5/241	3.3, 0.8–12.9
Previous ARV drug exposure (women)						
Yes	7/18	38.9, 9.3–79.7	16/54	30.7, 18.2–46.8	3/66	5.7, 1.1–9.3
No	11/18	61.1, 20.3–90.7	36/54	67.7, 51.8–80.4	60/66	91.1, 79.3–96.4
Unknown	0/18	0.0, 0.0–17.6	2/54	1.6, 1.2–2.2	3/66	3.3, 1.5–19.5
Previous ARV drug exposure (men)						
Yes	18/33	45.5, 11.9–83.7	37/200	16.7, 11.6–23.5	4/173	2.6, 0.9–6.9
No	15/33	54.5, 16.3–88.1	162/200	83.0, 76.3–88.2	167/173	95.3, 88.9–98.1
Unknown	0/33	0.0, 0.0–10.4	1/200	0.3, 0.2–0.3	2/173	2.1, 0.5–9.4
Type of ARV drug exposure						
PMTCT	13/22	59.1, 25.3–86.0	1/55	1.7, 0.2–13.2	1/7	12.0, 0.1–94.0
ART	1/22	4.5, 0.3–46.0	55/55	100.0, 93.5–100.0	0/7	0.0, 0.0–35.4
Other	0/22	0.0, 0.0–14.9	0/55	0.0, 0.0–6.5	0/7	0.0, 0.0–35.4
Unknown	8/22	36.4, 15.3–64.5	0/55	0.0, 0.0–6.5	6/7	88.0, 6.0–99.9

a Study design–weighted mean and 95% confidence interval.
b NNRTI-based regimens include EFV or NVP.
c PI-based regimens include ATV/r, DRV/r or LPV/r.
d Multicountry pretreatment drug resistance survey: Antigua and Barbuda, Dominica, Grenada, Saint Kitts and Nevis, Saint Lucia and Saint Vincent and the Grenadines.
e Unweighted proportion and 95% confidence interval adjusted for clustering.
f Study design–weighted proportion and 95% confidence interval.
ART: antiretroviral therapy; ATV/r: atazanavir/ritonavir; CI: confidence interval; DRV/r: darunavir/ritonavir; DTG: dolutegravir; EFV: efavirenz; LPV/r: lopinavir/ritonavir; NVP: nevirapine; NNRTI: non-nucleoside reverse-transcriptase inhibitor; PI: protease inhibitor; PMTCT: prevention of mother-to-child transmission.

Table A1.1f. Population characteristics of adults initiating first-line ART – the Americas

	Haiti (start year: 2018) *N*=246		Honduras (start year: 2016) *N*=194		Mexico[e] (start year: 2017) *N*=2006	
	n/N	%, 95% CI[d]	*n/N*	%, 95% CI[d]	*n/N*	%, 95% CI[d]
Gender						
Women	125/246	47.5, 38.9–56.3	61/194	36.1, 27.8–45.4	328/2006	15.2, 13.8–16.7
Men	120/246	52.3, 43.5–60.9	126/194	59.1, 50.5–67.1	1676/2006	84.6, 83.1–86
Other	0/246	0.0, 0.0–1.5	7/194	4.8, 2.1–13	2/2006	0.2, 0.1–0.7
Unknown	1/246	0.2, 0.0–1.6	0/194	0.0, 0.0–1.9	0/2006	0.0, 0.0–0.2
Mean age, 95% CI (years)[a]	**20.3, 18.2–22.3**		**33.5, 31.7–35.2**		**31.9, 31.4–32.3**	
≤25 years	167/246	67.1, 59.5–73.9	45/194	23.0, 16.5–31.1	593/2006	30.8, 28.7–33.1
>25 years	79/246	32.9, 26.1–40.5	149/194	77.0, 68.9–83.5	1413/2006	69.2, 66.9–71.3
Unknown	0/246	0.0, 0.0–1.5	0/194	0.0, 0.0–1.9	0/2006	0.0, 0.0–0.2
Initiated first-line						
NNRTI-based[b]	110/246	41.8, 32.4–51.8	172/194	86.3, 80.4–90.7	415/2006	19.3, 17.7–20.9
PI-based[c]	5/246	1.4, 0.5–4.3	2/194	0.5, 0.2–1.0	64/2006	3.1, 2.4–3.9
DTG-based	124/246	54.5, 43.4–65.1	0/194	0.0, 0.0–1.9	53/2006	2.5, 1.9–3.2
Other	1/246	0.3, 0.0–2.3	1/194	0.2, 0.1–0.7	75/2006	3.6, 2.9–4.5
Unknown	6/246	2.0, 0.8–5.1	19/194	13.0, 8.7–18.9	1400/2006	71.6, 69.7–73.4
Previous ARV drug exposure						
Yes	245/246	99.3, 95.1–99.9	41/194	26.3, 20.1–33.5	158/2006	7.4, 6.3–8.7
No	1/246	0.7, 0.1–4.9	134/194	61.3, 53.3–68.7	1848/2006	92.6, 91.3–93.7
Unknown	0/246	0.0, 0.0–1.5	19/194	12.4, 8.1–18.7	0/2006	0.0, 0.0–0.2
Previous ARV drug exposure (women)						
Yes	125/125	100.0, 97.0–100.0	19/61	36.0, 22.3–52.4	55/328	16.8, 12.9–21.5
No	0/125	0.0, 0.0–3.0	35/61	51.2, 34.1–68.1	273/328	83.2, 78.5–87.1
Unknown	0/125	0.0, 0.0–3.0	7/61	12.8, 5.8–26.1	0/328	0.0, 0.0–1.2
Previous ARV drug exposure (men)						
Yes	119/120	98.7, 91.7–99.8	22/126	22.5, 14.8–32.6	103/1676	5.7, 4.6–7.1
No	1/120	1.3, 0.2–8.3	92/126	64.3, 54.5–73.1	1573/1676	94.3, 92.9–95.4
Unknown	0/120	0.0, 0.0–3.1	12/126	13.2, 7.2–23.0	0/1676	0.0, 0.0–0.2
Type of ARV drug exposure						
PMTCT	243/245	0.6, 0.1–4.3	3/41	7.9, 2.1–25.1	0/158	0.0, 0.0–2.4
ART	1/245	99.2, 96.2–99.8	36/41	90.8, 74.7–97.1	154/158	97.1, 91.6–99.0
Other	1/245	0.2, 0.0–1.6	0/41	0.0, 0.0–8.6	4/158	2.9, 1.0–8.4
Unknown	0/245	0.0, 0.0–1.5	2/41	1.3, 0.3–6.8	0/158	0.0, 0.0–2.4

a Study design–weighted mean and 95% confidence interval.
b NNRTI-based regimens include EFV or NVP.
c PI-based regimens include ATV/r, DRV/r or LPV/r.
d Study design–weighted proportion and 95% confidence interval.
e One participant initiated ART with a DTG + PI-based regimen.
ART: antiretroviral therapy; ATV/r: atazanavir/ritonavir; CI: confidence interval; DRV/r: darunavir/ritonavir; DTG: dolutegravir; EFV: efavirenz; LPV/r: lopinavir/ritonavir; NVP: nevirapine; NNRTI: non-nucleoside reverse-transcriptase inhibitor; PI: protease inhibitor; PMTCT: prevention of mother-to-child transmission.

Table A1.1g. Population characteristics of adults initiating first-line ART – the Americas

	Nicaragua (start year: 2016) *N*=171		Paraguay (start year: 2019) *N*=208		Uruguay (start year: 2018) *N*=206	
	n/N	%, 95% CI[d]	*n/N*	%, 95% CI[d]	*n/N*	%, 95% CI[d]
Gender						
Women	48/171	28.1, 21.5–35.7	31/208	14.9, 10.7–20.5	71/206	34.3, 33.2–35.4
Men	123/171	71.9, 64.3–78.5	174/208	83.7, 78.0–88.1	130/206	63.2, 62.1–64.3
Other	0/171	0.0, 0.0–2.2	3/208	1.4, 0.5–4.4	4/206	2.0, 1.6–2.5
Unknown	0/171	0.0, 0.0–2.2	0/208	0.0, 0.0–1.8	1/206	0.5, 0.5–0.5
Mean age, 95% CI (years)[a]	**34.2, 32.5–35.9**		**34.0, 32.2–35.7**		**36.7, 36.5–36.9**	
≤25 years	42/171	24.6, 20.5–29.1	54/208	26, 20.4–32.4	30/206	14.3, 13.8–14.8
>25 years	129/171	75.4, 70.9–79.5	154/208	74, 67.6–79.6	176/206	85.7, 85.2–86.2
Unknown	0/171	0.0, 0.0–2.2	0/208	0.0, 0.0–1.8	0/206	0.0, 0.0–1.8
Initiated first-line						
NNRTI-based[b]	165/171	96.5, 94.3–97.8	0/208	0.0, 0.0–1.8	113/206	55.1, 54.0–56.1
PI-based[c]	5/171	2.9, 1.6–5.3	0/208	0.0, 0.0–1.8	24/206	11.7, 11.0–12.6
DTG-based	0/171	0.0, 0.0–2.2	0/208	0.0, 0.0–1.8	61/206	29.4, 28.4–30.4
Other	0/171	0.0, 0.0–2.2	0/208	0.0, 0.0–1.8	0/206	0.0, 0.0–1.8
Unknown	1/171	0.6, 0.1–4.8	100/208	100.0, 98.2–100.0	8/206	3.8, 3.6–3.9
Previous ARV drug exposure						
Yes	21/171	12.3, 5.8–24.3	8/208	3.8, 1.9–7.5	73/206	35.6, 34.2–37.0
No	146/171	85.4, 75.4–91.7	195/208	93.8, 89.5–96.3	133/206	64.4, 63.0–65.8
Unknown	4/171	2.3, 1.0–5.4	5/208	2.4, 1.0–5.7	0/206	0.0, 0.0–1.8
Previous ARV drug exposure (women)						
Yes	13/48	27.1, 16.6–40.9	1/31	3.2, 0.4–21	37/71	47.9, 45.7–50.0
No	34/48	70.8, 56.5–82.0	29/31	93.5, 76.5–98.5	34/71	52.1, 50.0–54.3
Unknown	1/48	2.1, 0.2–15.8	1/31	3.2, 0.4–21	0/71	0.0, 0.0–5.1
Previous ARV drug exposure (men)						
Yes	8/123	6.5, 3.0–13.6	6/174	3.4, 1.5–7.5	35/130	27.2, 25.4–29.1
No	112/123	91.2, 83.7–95.3	164/174	94.3, 89.6–96.9	95/130	72.8, 70.9–74.6
Unknown	3/123	2.4, 0.7–7.9	4/174	2.3, 0.9–6	0/130	0.0, 0.0–2.9
Type of ARV drug exposure						
PMTCT	8/21	38.1, 18.3–62.8	0/8	0.0, 0.0–32.4	1/73	1.3, 0.2–10.6
ART	2/21	9.5, 1.2–47.6	8/8	100.0, 67.6–100.0	58/73	79.8, 69.8–87.0
Other	1/21	4.8, 0.3–41.9	0/8	0.0, 0.0–32.4	1/73	1.3, 0.2–10.7
Unknown	10/21	47.6, 34.9–60.6	0/8	0.0, 0.0–32.4	13/73	17.6, 11.3–26.4

a Study design–weighted mean and 95% confidence interval.
b NNRTI-based regimens include EFV or NVP.
c PI-based regimens include ATV/r, DRV/r or LPV/r.
d Study design–weighted proportion and 95% confidence interval.
ART: antiretroviral therapy; ATV/r: atazanavir/ritonavir; CI: confidence interval; DRV/r: darunavir/ritonavir; DTG: dolutegravir; EFV: efavirenz; LPV/r: lopinavir/ritonavir; NVP: nevirapine; NNRTI: non-nucleoside reverse-transcriptase inhibitor; PI: protease inhibitor; PMTCT: prevention of mother-to-child transmission.

Table A1.1h. Population characteristics of adults initiating first-line ART – South-East Asia

	Indonesia (start year: 2016) *N*=408		Myanmar (start year: 2016) *N*=327		Nepal (start year: 2016) *N*=274		Thailand (start year: 2016) *N*=334	
	n/N	%, 95% CI[d]	*n/N*	%, 95% CI[d]	*n/N*	%, 95% CI[d]	*n/N*	%, 95% CI[d]
Gender								
Women	125/408	24.6, 16.1–35.7	115/327	36.2, 29.4–43.5	143/274	50.8, 44.2–57.3	120/334	40.5, 30.7–51.2
Men	282/408	74.9, 63.7–83.5	206/327	62.7, 55.5–69.4	123/274	46.4, 39.9–53.1	214/334	59.5, 48.8–69.3
Other	0/408	0.0, 0.0–0.9	0/327	0.0, 0.0–1.2	1/274	0.2, 0.0–0.6	0/334	0.0, 0.0–1.1
Unknown	1/408	0.5, 0.1–3.7	6/327	1.1, 0.2–5.7	7/274	2.7, 1.6–4.5	0/334	0.0, 0.0–1.1
Mean age, 95% CI (years)[a]	**32.2, 30.0–34.4**		**35.6, 34.1–37.2**		**34.7, 33.6–35.7**		**37.4, 35.8–39.0**	
≤25 years	97/408	26.5, 16.9–39.0	51/327	15.8, 11.5–21.4	42/274	16.5, 12.1–22.1	55/334	13.5, 8.7–20.5
>25 years	311/408	73.5, 61.0–83.1	270/327	83.0, 77.2–87.6	232/274	83.5, 77.9–87.9	279/334	86.5, 79.5–91.3
Unknown	0/408	0.0, 0.0–0.9	6/327	1.1, 0.2–5.7	0/274	0.0, 0.0–1.4	0/334	0.0, 0.0–1.1
Initiated first-line								
NNRTI-based[b]	299/408	61.0, 45.9–74.2	263/327	71.1, 48.1–86.7	0/274	0.0, 0.0–1.4	0/334	0.0, 0.0–1.1
PI-based[c]	5/408	0.6, 0.1–3.2	0/327	0.0, 0.0–1.2	0/274	0.0, 0.0–1.4	0/334	0.0, 0.0–1.1
DTG-based	0/408	0.0, 0.0–0.9	0/327	0.0, 0.0–1.2	0/274	0.0, 0.0–1.4	0/334	0.0, 0.0–1.1
Other	104/408	0.0, 0.0–0.9	0/327	0.0, 0.0–1.2	0/274	0.0, 0.0–1.4	0/334	0.0, 0.0–1.1
Unknown	0/408	38.4, 24.9–53.9	64/327	28.9, 13.3–51.9	274/274	100.0, 98.6–100.0	334/334	100.0, 98.9–100.0
Previous ARV drug exposure								
Yes	55/408	12.0, 6.0–22.4	32/327	8.4, 5.0–13.8	0/274	0.0, 0.0–1.4	54/334	18.1, 9.8–30.9
No	295/408	71.1, 48.4–86.6	287/327	90.0, 83.7–94.0	0/274	0.0, 0.0–1.4	280/334	81.9, 69.1–90.2
Unknown	58/408	17.0, 6.7–36.5	8/327	1.6, 0.5–5.6	274/274	100.0, 98.6–100.0	0/334	0.0, 0.0–1.1
Previous ARV drug exposure (women)								
Yes	20/125	14.9, 5.8–33.2	13/115	7.6, 2.9–18.9	0/143	0.0, 0.0–2.6	30/120	26, 13.3–44.7
No	83/125	60.9, 36.5–80.8	102/115	92.4, 81.1–97.1	0/143	0.0, 0.0–2.6	90/120	74, 55.3–86.7
Unknown	22/125	24.3, 9.1–50.6	0/115	0.0, 0.0–3.2	143/143	100.0, 97.4–100.0	0/120	0.0, 0.0–3.1
Previous ARV drug exposure (men)								
Yes	35/282	11.1, 5.0–22.8	19/206	9.0, 4.8–16.1	0/123	0.0, 0.0–3.0	24/214	12.7, 5.3–27.4
No	212/282	75.0, 51.3–89.5	185/206	90.2, 82.2–94.8	0/123	0.0, 0.0–3.0	190/214	87.3, 72.6–94.7
Unknown	35/282	14.0, 5.2–32.4	2/206	0.8, 0.2–4.4	123/123	100.0, 97.0–100.0	0/214	0.0, 0.0–1.8
Type of ARV drug exposure								
PMTCT	0/55	0.0, 0.0–6.5	4/32	13.2, 2.7–45.5	NA		18/54	24.9, 8.8–53.3
ART	54/55	99.5, 95.4–99.9	24/32	76.4, 41.2–93.7	NA		36/54	75.1, 46.7–91.2
Other	1/55	0.5, 0.1–4.6	3/32	10.1, 2.9–29.7	NA		0/54	0.0, 0.0–6.6
Unknown	0/55	0.0, 0.0–6.5	1/32	0.3, 0.0–3.1	NA		0/54	0.0, 0.0–6.6

a Study design–weighted mean and 95% confidence interval.
b NNRTI-based regimens include EFV or NVP.
c PI-based regimens include ATV/r, DRV/r or LPV/r.
d Study design–weighted proportion and 95% confidence interval.
ART: antiretroviral therapy; ATV/r: atazanavir/ritonavir; CI: confidence interval; DRV/r: darunavir/ritonavir; DTG: dolutegravir; EFV: efavirenz; LPV/r: lopinavir/ritonavir; NA: not applicable; NVP: nevirapine; NNRTI: non-nucleoside reverse-transcriptase inhibitor; PI: protease inhibitor; PMTCT: prevention of mother-to-child transmission.

Table A1.1i. Population characteristics of adults initiating first-line ART – Western Pacific

	Papua New Guinea (start year: 2017) *N*=337		Viet Nam (start year: 2017) *N*=409	
	n/N	%, 95% CI[d]	*n/N*	%, 95% CI[d]
Gender				
Women	207/337	62.5, 57.9–66.8	122/409	29.9, 22.8–38.0
Men	128/337	37.0, 33.0–41.3	287/409	70.1, 62.0–77.2
Other	0/337	0.0, 0.0–1.1	0/409	0.0, 0.0–0.9
Unknown	2/337	0.5, 0.1–2.3	0/409	0.0, 0.0–0.9
Mean age, 95% CI (years)[a]	**31.0, 29.6–32.4**		**34.2, 32.8–35.6**	
≤25 years	106/337	32.3, 24.0–42.0	73/409	16.1, 12.3–20.8
>25 years	227/337	66.7, 57.3–74.9	336/409	83.9, 79.2–87.7
Unknown	4/337	1.0, 0.2–4.8	0/409	0.0, 0.0–0.9
Initiated first-line				
NNRTI-based[b]	312/337	94.4, 87.6–97.6	0/409	0.0, 0.0–0.9
PI-based[c]	0/337	0.0, 0.0–1.1	0/409	0.0, 0.0–0.9
DTG-based	0/337	0.0, 0.0–1.1	0/409	0.0, 0.0–0.9
Other	0/337	0.0, 0.0–1.1	0/409	0.0, 0.0–0.9
Unknown	25/337	5.6, 2.4–12.4	409/409	100.0, 99.1–100.0
Previous ARV drug exposure				
Yes	69/337	20.9, 13.8–30.3	28/409	7.0, 4.1–11.7
No	268/337	79.1, 69.7–86.2	371/409	89.8, 82.7–94.2
Unknown	0/337	0.0, 0.0–1.1	10/409	3.2, 0.8–12.6
Previous ARV drug exposure (women)				
Yes	51/207	25.4, 19.2–32.9	14/122	12.3, 5.6–24.9
No	156/207	74.6, 67.1–80.8	107/122	85.9, 72.9–93.2
Unknown	0/207	0.0, 0.0–1.8	1/122	1.8, 0.2–13.5
Previous ARV drug exposure (men)				
Yes	17/128	12.8, 4.7–30.2	14/287	4.7, 2.3–9.5
No	111/128	87.2, 69.8–95.3	264/287	91.5, 83.2–95.9
Unknown	0/128	0.0, 0.0–2.9	9/287	3.8, 1.0–13.8
Type of ARV drug exposure				
PMTCT	0/69	0.0, 0.0–5.3	7/28	30.9, 9.7–65.1
ART	68/69	98.7, 88.9–99.9	21/28	69.1, 34.9–90.4
Other	0/69	0.0, 0.0–5.3	0/28	0.0, 0.0–12.1
Unknown	1/69	1.3, 0.1–11.1	0/28	0.0, 0.0–12.1

a Study design–weighted mean and 95% confidence interval.
b NNRTI-based regimens include EFV or NVP.
c PI-based regimens include ATV/r, DRV/r or LPV/r.
d Study design–weighted proportion and 95% confidence interval.
ART: antiretroviral therapy; ATV/r: atazanavir/ritonavir; CI: confidence interval; DRV/r: darunavir/ritonavir; DTG: dolutegravir; EFV: efavirenz; LPV/r: lopinavir/ritonavir; NVP: nevirapine; NNRTI: non-nucleoside reverse-transcriptase inhibitor; PI: protease inhibitor; PMTCT: prevention of mother-to-child transmission.

Table A1.2. Distribution of HIV subtype among adults initiating first-line ART

Region	Country	Start year	*N*	Subtype (%)[b]													
				A	A2	B	C	D	F	F2	G	H	J	K	CRF01_AE	CRF02_AG	Other
Africa	Cameroon	2015	321	14.0	0.0	0.0	0.3	1.9	0.0	3.4	4.4	0.3	0.0	0.6	0.6	65.4	9.0
	Eritrea	2016	124	1.6	0.0	0.8	96.0	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Eswatini	2016	266	0.4	0.4	0.0	99.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Ethiopia	2017	384	0.3	0.0	0.5	98.7	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0
	Lesotho	2018	376	0.5	0.0	0.3	98.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3
	Namibia	2015	383	2.3	0.0	0.0	92.7	0.0	0.0	0.0	0.3	0.0	0.3	0.0	0.3	3.9	0.3
	South Sudan	2018	298	27.9	0.7	1.7	7.0	33.2	0.0	0.0	10.7	0.0	0.0	0.7	0.3	1.0	16.8
	Uganda	2016	342	62.9	0.0	4.7	3.8	25.1	0.0	0.0	2.9	0.0	0.0	0.0	0.0	0.0	0.6
	Zambia	2019	146	0.0	0.0	0.0	97.9	0.0	0.0	0.0	1.4	0.0	0.0	0.7	0.0	0.0	0.0
	Zimbabwe	2015	353	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
The Americas	Argentina	2019	385	0.3	0.0	50.6	4.9	0.0	2.3	0.0	0.0	0.0	0.0	0.0	0.0	0.5	41.3
	Brazil	2014	1391	0.2	0.0	71.4	15.3	0.1	11.5	0.0	0.0	0.0	0.0	0.0	0.0	0.3	1.2
	Colombia	2016	192	0.0	0.0	99.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0
	Cuba	2017	141	0.7	0.0	44.0	2.8	10.6	0.0	0.0	2.1	0.0	0.0	0.0	0.0	0.0	39.7
	Eastern Caribbean Countries[a]	2017	51	0.0	0.0	96.1	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0
	El Salvador	2018	215	0.0	0.0	99.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5
	Guatemala	2016	241	0.0	0.0	98.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2
	Haiti	2018	246	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Honduras	2016	161	0.0	0.0	98.1	1.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.0
	Mexico	2017	2006	0.0	0.0	98.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.1	0.6
	Nicaragua	2016	171	0.0	0.0	98.2	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.6
	Paraguay	2019	208	0.0	0.0	77.9	7.7	0.0	6.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.2
	Uruguay	2018	205	0.0	0.0	56.6	7.8	0.0	3.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	32.2
South-East Asia and the Western Pacific	Indonesia	2016	370	1.6	0.0	6.5	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	88.4	0.8	2.2
	Myanmar	2016	327	2.8	0.0	18.7	31.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	45.9	0.0	1.2
	Nepal	2016	190	1.1	0.0	0.0	91.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.1	2.1	3.7
	Papua New Guinea	2017	315	0.3	0.0	0.3	99.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Thailand	2016	320	1.6	0.0	7.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	88.8	0.0	2.2
	Viet Nam	2017	168	0.0	0.0	0.6	1.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	94.0	0.0	4.2

a Eastern Caribbean Countries: Antigua and Barbuda, Dominica, Grenada, Saint Kitts and Nevis, Saint Lucia and Saint Vincent and the Grenadines.
b Unweighted proportions of HIV subtypes. HIV subtype was assigned using the Stanford HIVdb subtyping tool.

Table A1.3a. Prevalence of pretreatment HIV drug resistance among adults – Africa

		Cameroon (start year: 2015)		Eritrea (start year: 2016)		Eswatini (start year: 2016)		Ethiopia (start year: 2017)	
		n/N	%, 95% CI[a]	*n/N*	%, 95% CI[a]	*n/N*	%, 95% CI[a]	*n/N*	%, 95% CI[a]
HIV drug resistance among ART initiators									
NRTI	Any	5/321	2.4, 0.4–12.9	0/124	0.0, 0.0–3.0	4/266	1.0, 0.3–3.3	12/277	3.1, 1.1–8.0
	ABC	4/321	1.3, 0.2–7.5	0/124	0.0, 0.0–3.0	2/266	0.5, 0.1–2.8	8/277	2.5, 0.7–8.0
	3TC or FTC	4/321	1.3, 0.2–7.5	0/124	0.0, 0.0–3.0	2/266	0.5, 0.1–2.8	8/277	2.5, 0.7–8.0
	TDF	2/321	1.2, 0.2–7.9	0/124	0.0, 0.0–3.0	0/266	0.0, 0.0–1.4	6/277	2.3, 0.6–8.0
	ZDV	2/321	2.3, 0.4–13.3	0/124	0.0, 0.0–3.0	1/266	0.4, 0.0–2.6	7/277	0.9, 0.4–2.1
NNRTI	EFV or NVP	23/321	8.1, 4.3–14.7	9/124	7.1, 3.8–12.9	31/266	10.5, 6.3–17.0	30/277	14.9, 8.5–24.7
	DOR	12/321	4.9, 1.9–12.2	3/124	2.3, 0.7–7.2	14/266	4.7, 2.2–9.8	17/277	12.4, 6.3–23.0
	ETR	8/321	2.8, 1.0–7.3	2/124	2.1, 0.5–8.1	10/266	3.5, 1.6–7.4	9/277	4.7, 1.2–16.4
	RPV	21/321	7.6, 3.2–17.0	7/124	5.4, 2.5–11.3	47/266	17.3, 12.3–23.8	22/277	13.8, 7.7–23.4
PI/r	ATV/r, DRV/r or LPV/r	1/321	0.2, 0.0–1.7	0/124	0.0, 0.0–3.0	2/266	0.9, 0.2–4.2	1/277	1.4, 0.2–9.7
	ATV/r	1/321	0.2, 0.0–1.7	0/124	0.0, 0.0–3.0	1/266	0.7, 0.1–4.8	0/277	0.0, 0.0–1.4
	DRV/r	0/321	0.0, 0.0–1.2	0/124	0.0, 0.0–3.0	0/266	0.0, 0.0–1.4	0/277	0.0, 0.0–1.4
	LPV/r	1/321	0.2, 0.0–1.7	0/124	0.0, 0.0–3.0	2/266	0.9, 0.2–4.2	1/277	1.4, 0.2–9.7
INSTI	Any	ND		ND		ND		3/341	0.5, 0.1–1.8
	BIC	ND		ND		ND		0/341	0.0, 0.0–1.1
	CAB	ND		ND		ND		0/341	0.0, 0.0–1.1
	DTG	ND		ND		ND		0/341	0.0, 0.0–1.1
	EVG	ND		ND		ND		3/341	0.5, 0.1–1.8
	RAL	ND		ND		ND		3/341	0.5, 0.1–1.8
HIV drug resistance among women starting ART									
NRTI	Any	4/203	3.6, 0.6–18.7	0/73	0.0, 0.0–5.0	4/173	1.7, 0.5–5.1	5/147	1.3, 0.4–3.7
	ABC	3/203	1.9, 0.3–11.3	0/73	0.0, 0.0–5.0	2/173	0.8, 0.1–4.3	3/147	0.6, 0.1–2.5
	3TC or FTC	3/203	1.9, 0.3–11.3	0/73	0.0, 0.0–5.0	2/173	0.8, 0.1–4.3	3/147	0.6, 0.1–2.5
	TDF	1/203	1.7, 0.2–11.9	0/73	0.0, 0.0–5.0	0/173	0.0, 0.0–2.2	3/147	0.6, 0.1–2.5
	ZDV	2/203	3.5, 0.6–19.1	0/73	0.0, 0.0–5.0	1/173	0.6, 0.1–4.2	3/147	1.1, 0.3–3.4
NNRTI	EFV or NVP	16/203	10.2, 4.9–20.0	4/73	5.0, 1.9–12.7	21/173	12.8, 7.6–20.7	14/147	11.0, 4.5–24.5
	DOR	9/203	6.5, 2.3–17.0	1/73	0.8, 0.2–3.3	11/173	6.6, 3.1–13.4	7/147	8.5, 2.6–24.4
	ETR	4/203	3.1, 0.9–10.5	0/73	0.0, 0.0–5.0	7/173	5, 2.2–11.1	4/147	2.1, 0.6–7.5
	RPV	14/203	10.0, 3.8–23.7	2/73	1.5, 0.6–4.1	28/173	15.4, 9.6–23.8	10/147	9.4, 3.2–24.3
PI/r	ATV/r, DRV/r or LPV/r	1/203	0.3, 0.0–2.6	0/73	0.0, 0.0–5.0	2/173	1.5, 0.3–6.4	1/147	3.0, 0.4–18.4
	ATV/r	1/203	0.3, 0.0–2.6	0/73	0.0, 0.0–5.0	1/173	1.1, 0.2–7.2	0/147	0.0, 0.0–2.5
	DRV/r	0/203	0.0, 0.0–1.9	0/73	0.0, 0.0–5.0	0/173	0.0, 0.0–2.2	0/147	0.0, 0.0–2.5
	LPV/r	1/203	0.3, 0.0–2.6	0/73	0.0, 0.0–5.0	2/173	1.5, 0.3–6.4	1/147	3.0, 0.4–18.4
INSTI	Any	ND		ND		ND		2/187	0.4, 0.1–2.4
	BIC	ND		ND		ND		0/187	0.0, 0.0–2.0
	CAB	ND		ND		ND		0/187	0.0, 0.0–2.0
	DTG	ND		ND		ND		0/187	0.0, 0.0–2.0
	EVG	ND		ND		ND		2/187	0.4, 0.1–2.4
	RAL	ND		ND		ND		2/187	0.4, 0.1–2.4
HIV drug resistance among men starting ART									
NRTI	Any	1/118	0.1, 0.0–0.8	0/51	0.0, 0.0–7.0	0/93	0.0, 0.0–4.0	7/130	4.7, 1.4–15.2
	ABC	1/118	0.1, 0.0–0.8	0/51	0.0, 0.0–7.0	0/93	0.0, 0.0–4.0	5/130	4.3, 1.1–15.4
	3TC or FTC	1/118	0.1, 0.0–0.8	0/51	0.0, 0.0–7.0	0/93	0.0, 0.0–4.0	5/130	4.3, 1.1–15.4
	TDF	1/118	0.1, 0.0–0.8	0/51	0.0, 0.0–7.0	0/93	0.0, 0.0–4.0	3/130	4.0, 0.9–15.7
	ZDV	0/118	0.0, 0.0–3.2	0/51	0.0, 0.0–7.0	0/93	0.0, 0.0–4.0	4/130	0.7, 0.2–2.3
NNRTI	EFV or NVP	7/118	4.0, 1.4–10.4	5/51	10.5, 4.6–22.2	10/93	6.9, 2.6–17.3	16/130	18.6, 8.9–34.8
	DOR	3/118	2.1, 0.4–10.6	2/51	4.7, 1.2–16.8	3/93	1.7, 0.4–6.5	10/130	16.1, 6.9–33.4
	ETR	4/118	2.2, 0.4–10.4	2/51	5.8, 1.6–18.9	3/93	1.0, 0.3–3.7	5/130	7.2, 1.4–29.9
	RPV	7/118	3.2, 1.0–10.0	5/51	11.9, 4.9–26.2	19/93	20.3, 11.3–33.8	12/130	18.0, 8.7–33.6
PI/r	ATV/r, DRV/r or LPV/r	0/118	0.0, 0.0–3.2	0/51	0.0, 0.0–7.0	0/93	0.0, 0.0–4.0	0/130	0.0, 0.0–2.9
	ATV/r	0/118	0.0, 0.0–3.2	0/51	0.0, 0.0–7.0	0/93	0.0, 0.0–4.0	0/130	0.0, 0.0–2.9
	DRV/r	0/118	0.0, 0.0–3.2	0/51	0.0, 0.0–7.0	0/93	0.0, 0.0–4.0	0/130	0.0, 0.0–2.9
	LPV/r	0/118	0.0, 0.0–3.2	0/51	0.0, 0.0–7.0	0/93	0.0, 0.0–4.0	0/130	0.0, 0.0–2.9
INSTI	Any	ND		ND		ND		1/154	0.5, 0.1–3.9
	BIC	ND		ND		ND		0/154	0.0, 0.0–2.4
	CAB	ND		ND		ND		0/154	0.0, 0.0–2.4
	DTG	ND		ND		ND		0/154	0.0, 0.0–2.4
	EVG	ND		ND		ND		1/154	0.5, 0.1–3.9
	RAL	ND		ND		ND		1/154	0.5, 0.1–3.9

a Study design–weighted proportion and 95% confidence interval.

HIV drug resistance was defined as the presence of a penalty score ≥15 using the Stanford HIVdb algorithm.

ABC: abacavir; ATV/r: atazanavir/ritonavir; BIC: bictegravir; CAB: cabotegravir; CI: confidence interval; DOR: doravirine; DRV/r: darunavir/ritonavir; DTG: dolutegravir; EFV: efavirenz; ETR: etravirine; EVG: elvitegravir; INSTI: integrase strand-transfer inhibitor; LPV/r: lopinavir/ritonavir; ND: no data; NNRTI: non-nucleoside reverse-transcriptase inhibitor; NRTI: nucleoside reverse-transcriptase inhibitor; NVP: nevirapine; PI/r: boosted protease inhibitor; RAL: raltegravir; RPV: rilpivirine; TDF: tenofovir disoproxil fumarate; ZDV: zidovudine; 3TC/FTC: lamivudine/emtricitabine.

Table A1.3b. Prevalence of pretreatment HIV drug resistance among adults – Africa

		Cameroon (start year: 2015)		Eritrea (start year: 2016)		Eswatini (start year: 2016)		Ethiopia (start year: 2017)	
		n/N	%, 95% CI[a]	*n/N*	%, 95% CI[a]	*n/N*	%, 95% CI[a]	*n/N*	%, 95% CI[a]
HIV drug resistance among treatment-naive ART initiators									
NRTI	Any	2/223	2.8, 0.4–16.3	0/113	0.0, 0.0–3.3	3/240	0.8, 0.2–3.1	11/251	3.3, 1.2–8.7
	ABC	1/223	1.4, 0.2–10.1	0/113	0.0, 0.0–3.3	2/240	0.5, 0.1–3.2	7/251	2.7, 0.8–8.7
	3TC or FTC	1/223	1.4, 0.2–10.1	0/113	0.0, 0.0–3.3	2/240	0.5, 0.1–3.2	7/251	2.7, 0.8–8.7
	TDF	1/223	1.4, 0.2–10.1	0/113	0.0, 0.0–3.3	0/240	0.0, 0.0–1.6	5/251	2.5, 0.7–8.8
	ZDV	2/223	2.8, 0.4–16.3	0/113	0.0, 0.0–3.3	0/240	0.0, 0.0–1.6	7/251	1.0, 0.4–2.3
NNRTI	EFV or NVP	12/223	7.7, 3.6–15.7	5/113	3.9, 1.6–9.1	26/240	9.7, 5.8–15.9	26/251	13.2, 7.1–23.2
	DOR	3/223	2.3, 0.5–9.0	3/113	2.5, 0.8–7.6	9/240	3.0, 1.2–7.2	15/251	10.8, 5.1–21.7
	ETR	13/223	7.4, 2.5–20.2	2/113	2.3, 0.6–8.6	6/240	2.7, 1.0–7.5	8/251	5.2, 1.4–17.8
	RPV	1/223	0.3, 0.0–2.1	5/113	3.9, 1.6–9.1	39/240	16.6, 11.2–24.0	18/251	11.8, 6.1–21.7
PI/r	ATV/r, DRV/r or LPV/r	1/223	0.3, 0.0–2.1	0/113	0.0, 0.0–3.3	2/240	1.0, 0.2–4.8	1/251	1.6, 0.2–10.5
	ATV/r	4/223	4.1, 1.1–14.2	0/113	0.0, 0.0–3.3	1/240	0.8, 0.1–5.4	0/251	0.0, 0.0–1.5
	DRV/r	0/223	0.0, 0.0–1.7	0/113	0.0, 0.0–3.3	0/240	0.0, 0.0–1.6	0/251	0.0, 0.0–1.5
	LPV/r	1/223	0.3, 0.0–2.1	0/113	0.0, 0.0–3.3	2/240	1.0, 0.2–4.8	1/251	1.6, 0.2–10.5
INSTI	Any	ND		ND		ND		3/312	0.5, 0.1–2.0
	BIC	ND		ND		ND		0/312	0.0, 0.0–1.2
	CAB	ND		ND		ND		0/312	0.0, 0.0–1.2
	DTG	ND		ND		ND		0/312	0.0, 0.0–1.2
	EVG	ND		ND		ND		3/312	0.5, 0.1–2.0
	RAL	ND		ND		ND		3/312	0.5, 0.1–2.0
HIV drug resistance among ART initiators previously exposed to ARV drugs									
NRTI	Any	3/29	1.6, 0.2–9.9	0/11	0.0, 0.0–25.9	1/26	2.8, 0.4–17.3	0/17	0.0, 0.0–18.4
	ABC	3/29	1.6, 0.2–9.9	0/11	0.0, 0.0–25.9	0/26	0.0, 0.0–12.9	0/17	0.0, 0.0–18.4
	3TC or FTC	3/29	1.6, 0.2–9.9	0/11	0.0, 0.0–25.9	0/26	0.0, 0.0–12.9	0/17	0.0, 0.0–18.4
	TDF	1/29	0.5, 0.1–3.7	0/11	0.0, 0.0–25.9	0/26	0.0, 0.0–12.9	0/17	0.0, 0.0–18.4
	ZDV	0/29	0.0, 0.0–11.7	0/11	0.0, 0.0–25.9	1/26	2.8, 0.4–17.3	0/17	0.0, 0.0–18.4
NNRTI	EFV or NVP	8/29	20.5, 6.8–47.8	4/11	42.4, 18.6–70.3	5/26	16.1, 6.1–36.3	2/17	30.9, 4.8–79.7
	DOR	7/29	20, 6.5–47.3	0/11	0.0, 0.0–25.9	5/26	16.1, 6.1–36.3	1/17	30.0, 4.5–79.8
	ETR	5/29	12.5, 3.3–37.2	0/11	0.0, 0.0–25.9	4/26	8.5, 2.9–22.7	0/17	0.0, 0.0–18.4
	RPV	6/29	13.0, 3.6–37.5	2/11	21.7, 5.7–56.2	8/26	21.9, 9.9–41.9	2/17	32.6, 5.7–79.4
PI/r	ATV/r, DRV/r or LPV/r	0/29	0.0, 0.0–11.7	0/11	0.0, 0.0–25.9	0/26	0.0, 0.0–12.9	0/17	0.0, 0.0–18.4
	ATV/r	0/29	0.0, 0.0–11.7	0/11	0.0, 0.0–25.9	0/26	0.0, 0.0–12.9	0/17	0.0, 0.0–18.4
	DRV/r	0/29	0.0, 0.0–11.7	0/11	0.0, 0.0–25.9	0/26	0.0, 0.0–12.9	0/17	0.0, 0.0–18.4
	LPV/r	0/29	0.0, 0.0–11.7	0/11	0.0, 0.0–25.9	0/26	0.0, 0.0–12.9	0/17	0.0, 0.0–18.4
INSTI	Any	ND		ND		ND		0/23	0.0, 0.0–14.3
	BIC	ND		ND		ND		0/23	0.0, 0.0–14.3
	CAB	ND		ND		ND		0/23	0.0, 0.0–14.3
	DTG	ND		ND		ND		0/23	0.0, 0.0–14.3
	EVG	ND		ND		ND		0/23	0.0, 0.0–14.3
	RAL	ND		ND		ND		0/23	0.0, 0.0–14.3

a Study design–weighted proportion and 95% confidence interval.

HIV drug resistance was defined as the presence of a penalty score ≥15 using the Stanford HIVdb algorithm.

ABC: abacavir; ATV/r: atazanavir/ritonavir; BIC: bictegravir; CAB: cabotegravir; CI: confidence interval; DOR: doravirine; DRV/r: darunavir/ritonavir; DTG: dolutegravir; EFV: efavirenz; ETR: etravirine; EVG: elvitegravir; INSTI: integrase strand-transfer inhibitor; LPV/r: lopinavir/ritonavir; ND: no data; NNRTI: non-nucleoside reverse-transcriptase inhibitor; NRTI: nucleoside reverse-transcriptase inhibitor; NVP: nevirapine; PI/r: boosted protease inhibitor; RAL: raltegravir; RPV: rilpivirine; TDF: tenofovir disoproxil fumarate; ZDV: zidovudine; 3TC/FTC: lamivudine/emtricitabine.

Table A1.3c. Prevalence of pretreatment HIV drug resistance among adults – Africa

		Lesotho (start year: 2018)		Namibia[b] (start year: 2015)		South Sudan (start year: 2018)		Uganda (start year: 2016)	
		n/N	%, 95% CI[a]	*n/N*	%, 95% CI[a]	*n/N*	%, 95% CI[a]	*n/N*	%, 95% CI[a]
HIV drug resistance among ART initiators									
NRTI	Any	5/376	1.6, 0.7–3.9	6/383	1.6, 0.6–3.8	30/298	5.2, 2.4–10.9	11/342	5.1, 2.4–10.3
	ABC	3/376	0.9, 0.3–3.1	5/383	1.3, 0.5–3.6	26/298	4.8, 2.2–10.2	9/342	4.2, 1.9–9.0
	3TC or FTC	3/376	0.9, 0.3–3.1	5/383	1.3, 0.5–3.6	23/298	3.8, 1.7–8.1	6/342	3.4, 1.2–9.1
	TDF	3/376	0.9, 0.3–3.1	3/383	0.8, 0.3–2.4	10/298	2.7, 0.9–7.8	7/342	3.3, 1.1–9.2
	ZDV	2/376	0.7, 0.2–2.8	2/383	0.5, 0.1–2.1	12/298	2.6, 0.8–7.7	7/342	3.4, 1.2–9.1
NNRTI	EFV or NVP	59/376	16.5, 13.3–20.3	53/383	13.8, 11.1–17.1	71/298	21.5, 15.4–29.2	43/342	15.4, 10.3–22.5
	DOR	24/376	6.8, 5.1–9.1	22/283	5.7, 3.6–9.1	38/298	11.6, 6.8–19.1	11/342	4.7, 2.4–9.1
	ETR	12/376	3.7, 2.1–6.4	13/383	3.4, 1.8–6.2	22/298	5.4, 3.0–9.7	12/342	5.2, 2.7–9.7
	RPV	42/376	10.2, 7.9–13.1	42/383	11, 8.1–14.7	36/298	9.2, 5.6–14.7	31/342	10.1, 5.3–18.4
PI/r	ATV/r, DRV/r or LPV/r	2/376	0.6, 0.1–2.8	2/383	0.5, 0.1–2.2	3/298	1.2, 0.3–5.2	2/342	1.0, 0.2–4.6
	ATV/r	2/376	0.6, 0.1–2.8	1/383	0.3, 0.0–2.0	2/298	1.2, 0.2–5.3	1/342	0.2, 0.0–1.4
	DRV/r	0/376	0.0, 0.0–1.0	0/383	0.0, 0.0–1.0	1/298	0.1, 0.0–0.6	0/342	0.0, 0.0–1.1
	LPV/r	1/376	0.2, 0.0–1.5	2/383	0.5, 0.1–2.2	3/298	1.2, 0.3–5.2	2/342	1.0, 0.2–4.6
INSTI	Any	ND		ND		3/256	3.8, 0.9–14.4	ND	
	BIC	ND		ND		1/256	0.2, 0.0–1.2	ND	
	CAB	ND		ND		1/256	0.2, 0.0–1.2	ND	
	DTG	ND		ND		1/256	0.2, 0.0–1.2	ND	
	EVG	ND		ND		3/256	3.8, 0.9–14.4	ND	
	RAL	ND		ND		2/256	3.6, 0.8–14.8	ND	
HIV drug resistance among women starting ART									
NRTI	Any	2/241	0.8, 0.2–3.3	4/248	1.6, 0.5–5.3	17/158	3.9, 1.6–9.7	9/208	7.3, 3.3–15.4
	ABC	1/241	0.3, 0.0–2.3	4/248	1.6, 0.5–5.3	14/158	3.4, 1.3–8.6	8/208	6.0, 2.5–13.8
	3TC or FTC	1/241	0.3, 0.0–2.3	4/248	1.6, 0.5–5.3	13/158	3.2, 1.2–8.3	6/208	5.6, 2.1–13.9
	TDF	1/241	0.3, 0.0–2.3	2/248	0.8, 0.2–3.3	5/158	1.0, 0.3–2.8	6/208	4.6, 1.3–15.2
	ZDV	1/241	0.5, 0.1–3.6	1/248	0.4, 0.1–3.0	7/158	1.3, 0.4–4.2	6/208	5.3, 1.9–13.9
NNRTI	EFV or NVP	41/241	17.4, 13.2–22.6	37/248	14.9, 10.7–20.4	37/158	14.1, 8.4–22.8	28/208	16.5, 9.5–27.2
	DOR	15/241	6.6, 4.4–9.8	17/248	6.9, 4.1–11.2	18/158	7.5, 3.7–14.5	9/208	5.3, 3.0–9.0
	ETR	7/241	3.3, 1.5–7.1	7/248	2.8, 1.3–6.1	12/158	5.2, 2.2–12.0	9/208	5.1, 1.6–14.8
	RPV	28/241	9.2, 6.1–13.8	25/248	10.1, 6.7–14.8	18/158	6.3, 3.0–12.8	19/208	8.4, 3.0–21.6
PI/r	ATV/r, DRV/r or LPV/r	2/241	1.0, 0.2–4.1	2/248	0.8, 0.2–3.2	2/158	2.1, 0.4–9.5	1/208	1.3, 0.2–7.5
	ATV/r	2/241	1.0, 0.2–4.1	1/248	0.4, 0.1–3.0	2/158	2.1, 0.4–9.5	0/208	0.0, 0.0–1.8
	DRV/r	0/241	0.0, 0.0–1.6	0/248	0.0, 0.0–1.5	0/158	0.0, 0.0–2.4	0/208	0.0, 0.0–1.8
	LPV/r	1/241	0.3, 0.0–2.3	2/248	0.8, 0.2–3.2	2/158	2.1, 0.4–9.5	1/208	1.3, 0.2–7.5
INSTI	Any	ND		ND		1/134	0.3, 0.0–2.2	ND	
	BIC	ND		ND		1/134	0.3, 0.0–2.2	ND	
	CAB	ND		ND		1/134	0.3, 0.0–2.2	ND	
	DTG	ND		ND		1/134	0.3, 0.0–2.2	ND	
	EVG	ND		ND		1/134	0.3, 0.0–2.2	ND	
	RAL	ND		ND		0/134	0.0, 0.0–2.8	ND	
HIV drug resistance among men starting ART									
NRTI	Any	3/135	3.3, 1.0–10.0	2/135	1.5, 0.3–6.2	13/140	6.7, 2.5–16.7	2/133	1.5, 0.3–7.1
	ABC	2/135	2.2, 0.5–9.0	1/135	0.7, 0.1–6.0	12/140	6.4, 2.3–16.4	1/133	1.2, 0.2–8.1
	3TC or FTC	2/135	2.2, 0.5–9.0	1/135	0.7, 0.1–6.0	10/140	4.5, 1.8–11.2	0/133	0.0, 0.0–2.8
	TDF	2/135	2.2, 0.5–9.0	1/135	0.7, 0.1–6.0	5/140	4.7, 1.3–16.0	1/133	1.2, 0.2–8.1
	ZDV	1/135	1.1, 0.1–8.1	1/135	0.7, 0.1–5.6	5/140	4.1, 0.9–16.0	1/133	0.3, 0.0–2.4
NNRTI	EFV or NVP	18/135	14.7, 9.1–22.9	16/135	11.9, 8.2–16.8	34/140	30.3, 20.3–42.6	15/133	13.7, 9.1–20.3
	DOR	9/135	7.4, 3.7–14.2	5/135	3.7, 1.6–8.3	20/140	16.6, 8.5–29.9	2/133	3.9, 1.0–13.9
	ETR	5/135	4.6, 1.9–10.6	6/135	4.4, 1.7–10.9	10/140	5.7, 2.4–12.8	3/133	5.4, 1.9–14.2
	RPV	14/135	12.2, 7.3–19.6	17/135	12.6, 6.1–24.1	18/140	12.6, 6.7–22.7	12/133	12.7, 7.5–20.7
PI/r	ATV/r, DRV/r or LPV/r	0/135	0.0, 0.0–2.8	0/135	0.0, 0.0–2.8	1/140	0.2, 0.0–1.2	1/133	0.4, 0.0–3.6
	ATV/r	0/135	0.0, 0.0–2.8	0/135	0.0, 0.0–2.8	0/140	0.0, 0.0–2.7	1/133	0.4, 0.0–3.6
	DRV/r	0/135	0.0, 0.0–2.8	0/135	0.0, 0.0–2.8	1/140	0.2, 0.0–1.2	0/133	0.0, 0.0–2.8
	LPV/r	0/135	0.0, 0.0–2.8	0/135	0.0, 0.0–2.8	1/140	0.2, 0.0–1.2	1/133	0.4, 0.0–3.6
INSTI	Any	ND		ND		2/122	7.8, 1.7–30.0	ND	
	BIC	ND		ND		0/122	0.0, 0.0–3.1	ND	
	CAB	ND		ND		0/122	0.0, 0.0–3.1	ND	
	DTG	ND		ND		0/122	0.0, 0.0–3.1	ND	
	EVG	ND		ND		2/122	7.8, 1.7–30.0	ND	
	RAL	ND		ND		2/122	7.8, 1.7–30.0	ND	

a Study design–weighted proportion and 95% confidence interval.

b Unweighted estimates differs from the weighted estimate that has been reported elsewhere (doi: 10.1093/jac/dky278).

HIV drug resistance was defined as the presence of a penalty score ≥15 using the Stanford HIVdb algorithm.

ABC: abacavir; ATV/r: atazanavir/ritonavir; BIC: bictegravir; CAB: cabotegravir; CI: confidence interval; DOR: doravirine; DRV/r: darunavir/ritonavir; DTG: dolutegravir; EFV: efavirenz; ETR: etravirine; EVG: elvitegravir; INSTI: integrase strand-transfer inhibitor; LPV/r: lopinavir/ritonavir; ND: no data; NNRTI: non-nucleoside reverse-transcriptase inhibitor; NRTI: nucleoside reverse-transcriptase inhibitor; NVP: nevirapine; PI/r: boosted protease inhibitor; RAL: raltegravir; RPV: rilpivirine; TDF: tenofovir disoproxil fumarate; ZDV: zidovudine; 3TC/FTC: lamivudine/emtricitabine.

Table A1.3d. Prevalence of pretreatment HIV drug resistance among adults – Africa

		Lesotho (start year: 2018)		Namibia[b] (start year: 2015)		South Sudan (start year: 2018)		Uganda (start year: 2016)	
		n/N	%, 95% CI[a]	*n/N*	%, 95% CI[a]	*n/N*	%, 95% CI[a]	*n/N*	%, 95% CI[a]
HIV drug resistance among treatment-naive ART initiators									
NRTI	Any	5/354	1.7, 0.7–4.0	1/313	0.3, 0.0–2.5	24/264	5.3, 2.5–11.0	11/296	5.7, 2.7–11.5
	ABC	3/354	1.0, 0.3–3.3	1/313	0.3, 0.0–2.5	20/264	4.8, 2.1–10.5	9/296	4.7, 2.2–9.9
	3TC or FTC	3/354	1.0, 0.3–3.3	1/313	0.3, 0.0–2.5	18/264	3.8, 1.7–8.1	6/296	3.8, 1.4–10.0
	TDF	3/354	1.0, 0.3–3.3	1/313	0.3, 0.0–2.5	8/264	2.9, 0.9–8.7	7/296	3.7, 1.3–10.0
	ZDV	2/354	0.7, 0.2–3.0	1/313	0.3, 0.0–2.5	9/264	2.6, 0.8–8.5	7/296	3.8, 1.4–10.0
NNRTI	EFV or NVP	49/354	15.3, 12.1–19.2	29/313	9.3, 6.1–13.8	58/264	22.2, 15.7–30.3	39/296	15.9, 10.2–24
	DOR	21/354	6.6, 4.8–9.0	10/313	3.2, 1.5–6.8	31/264	12.6, 7.0–21.6	11/296	5.3, 2.8–9.9
	ETR	11/354	3.6, 2.1–6.1	6/313	1.9, 0.9–4.0	18/264	5.9, 3.1–10.7	12/296	5.8, 3.2–10.6
	RPV	40/354	10.3, 8.0–13.2	28/313	8.9, 5.9–13.3	31/264	10.1, 6.0–16.5	30/296	11.2, 6.0–19.9
PI/r	ATV/r, DRV/r or LPV/r	2/354	0.7, 0.2–3.0	2/313	0.6, 0.2–2.6	3/264	1.5, 0.3–5.8	2/296	1.1, 0.2–5.4
	ATV/r	2/354	0.7, 0.2–3.0	1/313	0.3, 0.0–2.5	2/264	1.3, 0.3–6.0	1/296	0.2, 0.0–1.6
	DRV/r	0/354	0.0, 0.0–1.1	0/313	0.0, 0.0–1.2	1/264	0.1, 0.0–0.6	0/296	0.0, 0.0–1.3
	LPV/r	1/354	0.2, 0.0–1.6	2/313	0.6, 0.2–2.6	32/264	1.5, 0.3–5.8	2/296	1.1, 0.2–5.4
INSTI	Any	ND		ND		3/225	4.4, 1.0–17.2	ND	
	BIC	ND		ND		1/225	0.2, 0.0–1.4	ND	
	CAB	ND		ND		1/225	0.2, 0.0–1.4	ND	
	DTG	ND		ND		1/225	0.2, 0.0–1.4	ND	
	EVG	ND		ND		3/225	4.4, 1.0–17.2	ND	
	RAL	ND		ND		2/225	4.3, 0.9–17.6	ND	
HIV drug resistance among ART initiators previously exposed to ARV drugs									
NRTI	Any	0/22	0.0, 0.0–14.9	5/69	7.2, 2.7–18.2	6/33	4.6, 1.0–18.8	0/9	0.0, 0.0–29.9
	ABC	0/22	0.0, 0.0–14.9	4/69	5.8, 1.7–17.9	6/33	4.6, 1.0–18.8	0/9	0.0, 0.0–29.9
	3TC or FTC	0/22	0.0, 0.0–14.9	4/69	5.8, 1.7–17.9	5/33	3.9, 0.9–15.9	0/9	0.0, 0.0–29.9
	TDF	0/22	0.0, 0.0–14.9	2/69	2.9, 0.6–12.1	2/33	1.4, 0.2–8.7	0/9	0.0, 0.0–29.9
	ZDV	0/22	0.0, 0.0–14.9	1/69	1.4, 0.2–10.1	3/33	2.1, 0.3–12.0	0/9	0.0, 0.0–29.9
NNRTI	EFV or NVP	10/22	40.3, 21.7–62.2	24/69	34.8, 25.2–45.8	13/33	17.4, 4.5–48.3	2/9	17.5, 2.3–65.2
	DOR	3/22	12.1, 3.3–35.4	12/69	17.4, 9.5–29.7	7/33	5.3, 1.1–21.6	0/9	0.0, 0.0–29.9
	ETR	1/22	6.7, 0.8–37.9	7/69	10.1, 3.9–24.1	4/33	2.8, 0.5–15.3	0/9	0.0, 0.0–29.9
	RPV	2/22	8.6, 1.5–36.3	14/69	20.3, 11.9–32.5	5/33	3.5, 0.6–18.4	1/9	11.2, 2.0–43.5
PI/r	ATV/r, DRV/r or LPV/r	0/22	0.0, 0.0–14.9	0/69	0.0, 0.0–5.3	0/33	0.0, 0.0–10.4	0/9	0.0, 0.0–29.9
	ATV/r	0/22	0.0, 0.0–14.9	0/69	0.0, 0.0–5.3	0/33	0.0, 0.0–10.4	0/9	0.0, 0.0–29.9
	DRV/r	0/22	0.0, 0.0–14.9	0/69	0.0, 0.0–5.3	0/33	0.0, 0.0–10.4	0/9	0.0, 0.0–29.9
	LPV/r	0/22	0.0, 0.0–14.9	0/69	0.0, 0.0–5.3	0/33	0.0, 0.0–10.4	0/9	0.0, 0.0–29.9
INSTI	Any	ND		ND		0/30	0.0, 0.0–11.4	ND	
	BIC	ND		ND		0/30	0.0, 0.0–11.4	ND	
	CAB	ND		ND		0/30	0.0, 0.0–11.4	ND	
	DTG	ND		ND		0/30	0.0, 0.0–11.4	ND	
	EVG	ND		ND		0/30	0.0, 0.0–11.4	ND	
	RAL	ND		ND		0/30	0.0, 0.0–11.4	ND	

a Study design–weighted proportion and 95% confidence interval.

b Unweighted estimates differs from the weighted estimate that has been reported elsewhere (doi: 10.1093/jac/dky278)

HIV drug resistance was defined as the presence of a penalty score ≥15 using the Stanford HIVdb algorithm.

ABC: abacavir; ATV/r: atazanavir/ritonavir; BIC: bictegravir; CAB: cabotegravir; CI: confidence interval; DOR: doravirine; DRV/r: darunavir/ritonavir; DTG: dolutegravir; EFV: efavirenz; ETR: etravirine; EVG: elvitegravir; INSTI: integrase strand-transfer inhibitor; LPV/r: lopinavir/ritonavir; ND: no data; NNRTI: non-nucleoside reverse-transcriptase inhibitor; NRTI: nucleoside reverse-transcriptase inhibitor; NVP: nevirapine; PI/r: boosted protease inhibitor; RAL: raltegravir; RPV: rilpivirine; TDF: tenofovir disoproxil fumarate; ZDV: zidovudine; 3TC/FTC: lamivudine/emtricitabine.

Table A1.3e. Prevalence of pretreatment HIV drug resistance among adults – Africa

		Zambia[a] (start year: 2019)		Zimbabwe[c] (start year: 2015)	
		n/N	%, 95% CI[b]	*n/N*	%, 95% CI[b]
HIV drug resistance among ART initiators					
NRTI	Any	8/146	8.3, 3.8–16.9	3/353	0.8, 0.2–3.3
	ABC	8/146	8.3, 3.8–16.9	2/353	0.4, 0.1–2.5
	3TC or FTC	7/146	6.6, 2.8–15.2	2/353	0.4, 0.1–2.5
	TDF	7/146	8.2, 3.8–16.9	2/353	0.4, 0.1–2.5
	ZDV	3/146	3.9, 1.0–14.4	1/353	0.4, 0.1–3.4
NNRTI	EFV or NVP	21/146	16.2, 10.2–24.8	34/353	10.9, 7.1–16.4
	DOR	14/146	13.2, 7.7–21.6	9/353	2.4, 1.1–5.0
	ETR	10/146	8.0, 3.9–15.8	10/353	2.6, 1.0–6.7
	RPV	25/146	18.7, 11.3–29.2	63/353	14.6, 7.5–26.6
PI/r	ATV/r, DRV/r or LPV/r	0/146	0.0, 0.0–1.8	0/353	0.0, 0.0–1.1
	ATV/r	0/146	0.0, 0.0–1.8	0/353	0.0, 0.0–1.1
	DRV/r	0/146	0.0, 0.0–1.8	0/353	0.0, 0.0–1.1
	LPV/r	0/146	0.0, 0.0–1.8	0/353	0.0, 0.0–1.1
INSTI	Any	0/135	0.0, 0.0–2.8	ND	
	BIC	0/135	0.0, 0.0–2.8	ND	
	CAB	0/135	0.0, 0.0–2.8	ND	
	DTG	0/135	0.0, 0.0–2.8	ND	
	EVG	0/135	0.0, 0.0–2.8	ND	
	RAL	0/135	0.0, 0.0–2.8	ND	
HIV drug resistance among women starting ART					
NRTI	Any	6/88	10.3, 3.6–26.3	3/207	1.4, 0.4–5.6
	ABC	6/88	10.3, 3.6–26.3	2/207	0.7, 0.1–4.2
	3TC or FTC	5/88	7.6, 2.1–24.3	2/207	0.7, 0.1–4.2
	TDF	5/88	10.2, 3.5–26.2	2/207	0.7, 0.1–4.2
	ZDV	3/88	6.6, 1.5–24.5	1/207	0.8, 0.1–6.0
NNRTI	EFV or NVP	12/88	15.0, 6.9–29.6	26/207	16.1, 10.9–23.0
	DOR	9/88	12.9, 5.4–27.6	7/207	2.8, 1.2–6.4
	ETR	6/88	8.7, 2.7–24.4	5/207	2.4, 0.8–6.8
	RPV	15/88	19.8, 9.9–35.6	37/207	15.4, 8.8–25.7
PI/r	ATV/r, DRV/r or LPV/r	0/88	0.0, 0.0–4.2	0/207	0.0, 0.0–1.8
	ATV/r	0/88	0.0, 0.0–4.2	0/207	0.0, 0.0–1.8
	DRV/r	0/88	0.0, 0.0–4.2	0/207	0.0, 0.0–1.8
	LPV/r	0/88	0.0, 0.0–4.2	0/207	0.0, 0.0–1.8
INSTI	Any	0/82	0.0, 0.0–4.5	NA	
	BIC	0/82	0.0, 0.0–4.5	NA	
	CAB	0/82	0.0, 0.0–4.5	NA	
	DTG	0/82	0.0, 0.0–4.5	NA	
	EVG	0/82	0.0, 0.0–4.5	NA	
	RAL	0/82	0.0, 0.0–4.5	NA	
HIV drug resistance among men starting ART					
NRTI	Any	2/58	5.2, 1.4–17.3	0/145	0.0, 0.0–2.6
	ABC	2/58	5.2, 1.4–17.3	0/145	0.0, 0.0–2.6
	3TC or FTC	2/58	5.2, 1.4–17.3	0/145	0.0, 0.0–2.6
	TDF	2/58	5.2, 1.4–17.3	0/145	0.0, 0.0–2.6
	ZDV	0/58	0.0, 0.0–6.2	0/145	0.0, 0.0–2.6
NNRTI	EFV or NVP	9/58	18.0, 9.2–32.2	8/145	4.1, 1.1–14.3
	DOR	5/58	13.5, 5.6–29.3	2/145	1.8, 0.4–8.4
	ETR	4/58	7.1, 2.6–17.7	4/145	2.8, 0.9–8.6
	RPV	10/58	17.0, 7.3–34.9	25/145	13.5, 5.3–30.3
PI/r	ATV/r, DRV/r or LPV/r	0/58	0.0, 0.0–6.2	0/145	0.0, 0.0–2.6
	ATV/r	0/58	0.0, 0.0–6.2	0/145	0.0, 0.0–2.6
	DRV/r	0/58	0.0, 0.0–6.2	0/145	0.0, 0.0–2.6
	LPV/r	0/58	0.0, 0.0–6.2	0/145	0.0, 0.0–2.6
INSTI	Any	0/53	0.0, 0.0–6.8	NA	
	BIC	0/53	0.0, 0.0–6.8	NA	
	CAB	0/53	0.0, 0.0–6.8	NA	
	DTG	0/53	0.0, 0.0–6.8	NA	
	EVG	0/53	0.0, 0.0–6.8	NA	
	RAL	0/53	0.0, 0.0–6.8	NA	

a Prior ARV drug–exposed data were not collected.

b Study design–weighted proportion and 95% confidence interval.

c Previously ARV drug–exposed participants were not included in the survey.

HIV drug resistance was defined as the presence of a penalty score ≥15 using the Stanford HIVdb algorithm.

ABC: abacavir; ATV/r: atazanavir/ritonavir; BIC: bictegravir; CAB: cabotegravir; CI: confidence interval; DOR: doravirine; DRV/r: darunavir/ritonavir; DTG: dolutegravir; EFV: efavirenz; ETR: etravirine; EVG: elvitegravir; INSTI: integrase strand-transfer inhibitor; LPV/r: lopinavir/ritonavir; NA: not applicable; ND: no data; NNRTI: non-nucleoside reverse-transcriptase inhibitor; NRTI: nucleoside reverse-transcriptase inhibitor; NVP: nevirapine; PI/r: boosted protease inhibitor; RAL: raltegravir; RPV: rilpivirine; TDF: tenofovir disoproxil fumarate; ZDV: zidovudine; 3TC/FTC: lamivudine/emtricitabine.

Table A1.3f. Prevalence of pretreatment HIV drug resistance among adults – Africa

		Zimbabwe[a] (start year: 2015)	
		n/N	%, 95% CI[b]
HIV drug resistance among treatment-naive ART initiators			
NRTI	Any	3/353	0.8, 0.2–3.3
	ABC	2/353	0.4, 0.1–2.5
	3TC or FTC	2/353	0.4, 0.1–2.5
	TDF	2/353	0.4, 0.1–2.5
	ZDV	1/353	0.4, 0.1–3.4
NNRTI	EFV or NVP	34/353	10.9, 7.1–16.4
	DOR	9/353	2.4, 1.1–5.0
	ETR	10/353	2.6, 1.0–6.7
	RPV	63/353	14.6, 7.5–26.6
PI/r	ATV/r, DRV/r or LPV/r	0/353	0.0, 0.0–1.1
	ATV/r	0/353	0.0, 0.0–1.1
	DRV/r	0/353	0.0, 0.0–1.1
	LPV/r	0/353	0.0, 0.0–1.1
INSTI	Any	ND	
	BIC	ND	
	CAB	ND	
	DTG	ND	
	EVG	ND	
	RAL	ND	
HIV drug resistance among ART initiators previously exposed to ARV drugs			
NRTI	Any	NA	
	ABC	NA	
	3TC or FTC	NA	
	TDF	NA	
	ZDV	NA	
NNRTI	EFV or NVP	NA	
	DOR	NA	
	ETR	NA	
	RPV	NA	
PI/r	ATV/r, DRV/r or LPV/r	NA	
	ATV/r	NA	
	DRV/r	NA	
	LPV/r	NA	
INSTI	Any	NA	
	BIC	NA	
	CAB	NA	
	DTG	NA	
	EVG	NA	
	RAL	NA	

a Previously ARV drug–exposed participants were not included in the survey.

b Study design–weighted proportion and 95% confidence interval.

HIV drug resistance was defined as the presence of a penalty score ≥15 using the Stanford HIVdb algorithm.

ABC: abacavir; ATV/r: atazanavir/ritonavir; BIC: bictegravir; CAB: cabotegravir; CI: confidence interval; DOR: doravirine; DRV/r: darunavir/ritonavir; DTG: dolutegravir; EFV: efavirenz; ETR: etravirine; EVG: elvitegravir; INSTI: integrase strand-transfer inhibitor; LPV/r: lopinavir/ritonavir; NA: not applicable; ND: no data; NNRTI: non-nucleoside reverse-transcriptase inhibitor; NRTI: nucleoside reverse-transcriptase inhibitor; NVP: nevirapine; PI/r: boosted protease inhibitor; RAL: raltegravir; RPV: rilpivirine; TDF: tenofovir disoproxil fumarate; ZDV: zidovudine; 3TC/FTC: lamivudine/emtricitabine.

Table A1.3g. Prevalence of pretreatment HIV drug resistance among adults – the Americas

		Argentina (start year: 2019)		Brazil[b] (start year: 2014)		Colombia[b] (start year: 2016)		Cuba[b] (start year: 2017)	
		n/N	%, 95% CI[a]	*n/N*	%, 95% CI[a]	*n/N*	%, 95% CI[a]	*n/N*	%, 95% CI[a]
HIV drug resistance among ART initiators									
NRTI	Any	30/373	9.6, 6.1–14.7	50/1391	3.6, 2.8–4.7	7/192	3.6, 1.7–7.6	15/141	9.9, 6.2–15.6
	ABC	10/373	2.7, 0.9–7.6	25/1391	1.8, 1.1–2.8	1/192	0.5, 0.1–4.0	9/141	6.4, 3.4–11.6
	3TC or FTC	6/373	2.1, 0.6–7.1	9/1391	0.6, 0.4–1.1	0/192	0.0, 0.0–2.0	5/141	3.0, 1.3–6.7
	TDF	3/373	0.4, 0.1–1.8	17/1391	1.2, 0.6–2.4	1/192	0.5, 0.1–4.0	5/141	2.9, 1.3–6.5
	ZDV	21/373	6.0, 3.7–9.7	32/1391	2.3, 1.6–3.3	6/192	3.1, 1.6–6.1	11/141	6.4, 3.5–11.6
NNRTI	EFV or NVP	68/373	16.7, 11.4–23.8	94/1391	6.8, 5.6–8.1	12/192	6.3, 3.8–10.2	33/141	22.8, 15.8–31.6
	DOR	26/373	5.2, 2.4–10.7	39/1391	2.8, 2.0–3.9	1/192	0.5, 0.1–4.4	11/141	6.9, 3.7–12.5
	ETR	21/373	4.0, 2.0–7.9	15/1391	1.1, 0.5–2.1	2/192	1.0, 0.3–3.3	15/141	10.3, 6.2–16.5
	RPV	34/373	6.6, 3.5–12.1	97/1391	7.0, 5.7–8.4	8/192	4.2, 2.6–6.7	23/141	15.2, 10.2–22.0
PI/r	ATV/r, DRV/r or LPV/r	5/373	1.2, 0.3–3.8	13/1391	0.9, 0.6–1.5	0/192	0.0, 0.0–2.0	2/141	1.4, 0.3–5.7
	ATV/r	4/373	1.1, 0.3–3.8	12/1391	0.9, 0.5–1.4	0/192	0.0, 0.0–2.0	2/141	1.4, 0.3–5.7
	DRV/r	2/373	0.1, 0.0–0.5	3/1391	0.2, 0.1–0.5	0/192	0.0, 0.0–2.0	1/141	0.8, 0.1–5.9
	LPV/r	5/373	1.2, 0.3–3.8	11/1391	0.8, 0.5–1.3	0/192	0.0, 0.0–2.0	2/141	1.4, 0.3–5.7
INSTI	Any	36/375	9.2, 6.0–13.9	ND		ND		ND	
	BIC	0/375	0.0, 0.0–1.0	ND		ND		ND	
	CAB	1/375	0.4, 0.1–2.9	ND		ND		ND	
	DTG	0/375	0.0, 0.0–1.0	ND		ND		ND	
	EVG	35/375	9.2, 6.0–13.8	ND		ND		ND	
	RAL	36/375	9.2, 6.0–13.9	ND		ND		ND	
HIV drug resistance among women starting ART									
NRTI	Any	7/101	8.7, 2.6–25.3	11/380	2.9, 1.7–4.9	1/22	4.5, 0.5–30.9	5/27	15.4, 5.9–34.6
	ABC	4/101	6.4, 1.4–24.4	6/380	1.6, 0.7–3.4	0/22	0.0, 0.0–14.9	4/27	12.3, 4.4–30.1
	3TC or FTC	4/101	6.4, 1.4–24.4	1/380	0.3, 0.0–2.1	0/22	0.0, 0.0–14.9	3/27	9.2, 2.9–26.0
	TDF	0/101	0.0, 0.0–3.7	5/380	1.3, 0.5–3.3	0/22	0.0, 0.0–14.9	2/27	6.1, 1.4–22.8
	ZDV	3/101	2.4, 0.6–9.5	9/380	2.4, 1.3–4.1	1/22	4.5, 0.5–30.9	2/27	6.1, 1.4–22.8
NNRTI	EFV or NVP	24/101	28.3, 15.9–45.1	19/380	5.0, 3.8–6.6	1/22	4.5, 0.5–30.9	8/27	33.3, 14.9–58.7
	DOR	11/101	11.9, 4.8–26.6	7/380	1.8, 1.0–3.2	0/22	0.0, 0.0–14.9	1/27	4.2, 0.6–23.4
	ETR	8/101	6.1, 2.5–14.0	2/380	0.5, 0.1–1.9	0/22	0.0, 0.0–14.9	4/27	19.9, 7.0–45.2
	RPV	11/101	9.3, 4.7–17.5	20/380	5.3, 3.0–9.1	0/22	0.0, 0.0–14.9	6/27	27.2, 11.5–51.9
PI/r	ATV/r, DRV/r or LPV/r	0/101	0.0, 0.0–3.7	1/380	0.3, 0–2.1	0/22	0.0, 0.0–14.9	1/27	4.2, 0.6–23.4
	ATV/r	0/101	0.0, 0.0–3.7	1/380	0.3, 0–2.1	0/22	0.0, 0.0–14.9	1/27	4.2, 0.6–23.4
	DRV/r	0/101	0.0, 0.0–3.7	1/380	0.3, 0–2.1	0/22	0.0, 0.0–14.9	1/27	4.2, 0.6–23.4
	LPV/r	0/101	0.0, 0.0–3.7	1/380	0.3, 0–2.1	0/22	0.0, 0.0–14.9	1/27	4.2, 0.6–23.4
INSTI	Any	11/105	9.2, 4.5–18.1	ND		NA		ND	
	BIC	0/105	0.0, 0.0–3.5	ND		NA		ND	
	CAB	1/105	1.6, 0.2–9.9	ND		NA		ND	
	DTG	0/105	0.0, 0.0–3.5	ND		NA		ND	
	EVG	11/105	9.2, 4.5–18.1	ND		NA		ND	
	RAL	11/105	9.2, 4.5–18.1	ND		NA		ND	
HIV drug resistance among men starting ART									
NRTI	Any	23/270	10.0, 5.9–16.3	37/874	4.2, 3.2–5.6	6/170	3.5, 1.5–7.9	10/114	8.6, 4.4–16.2
	ABC	6/270	1.5, 0.5–4.3	18/874	2.1, 1.2–3.5	1/170	0.6, 0.1–4.5	5/114	5.0, 1.8–12.8
	3TC or FTC	2/270	0.7, 0.1–4.2	8/874	0.9, 0.5–1.7	0/170	0.0, 0.0–2.2	2/114	1.5, 0.4–6.2
	TDF	3/270	0.5, 0.1–2.5	11/874	1.3, 0.5–3.0	1/170	0.6, 0.1–4.5	3/114	2.1, 0.7–6.4
	ZDV	18/270	7.4, 4.4–12.1	21/874	2.4, 1.3–4.3	5/170	2.9, 1.4–6.0	9/114	6.5, 3.3–12.4
NNRTI	EFV or NVP	42/270	11.9, 7.5–18.3	66/874	7.6, 6.0–9.5	11/170	6.5, 4.1–10.1	25/114	20.2, 14.2–27.9
	DOR	14/270	2.4, 0.9–6.1	28/874	3.2, 2.2–4.7	1/170	0.6, 0.1–5.0	10/114	7.5, 4.1–13.4
	ETR	12/270	2.9, 1.3–6.3	12/874	1.4, 0.7–2.8	2/170	1.2, 0.4–3.7	11/114	7.9, 3.9–15.5
	RPV	22/270	5.3, 2.6–10.7	69/874	7.9, 6.5–9.6	8/170	4.7, 2.9–7.6	17/114	12.3, 6.8–21.1
PI/r	ATV/r, DRV/r or LPV/r	5/270	1.6, 0.4–5.3	11/874	1.3, 0.7–2.3	0/170	0.0, 0.0–2.2	1/114	0.8, 0.1–6.0
	ATV/r	4/270	1.5, 0.4–5.3	10/874	1.1, 0.6–2.1	0/170	0.0, 0.0–2.2	1/114	0.8, 0.1–6.0
	DRV/r	2/270	0.2, 0.0–0.7	2/874	0.2, 0.1–0.6	0/170	0.0, 0.0–2.2	0/114	0.0, 0.0–3.3
	LPV/r	5/270	1.6, 0.4–5.3	9/874	1.0, 0.5–1.9	0/170	0.0, 0.0–2.2	1/114	0.8, 0.1–6.0
INSTI	Any	25/268	9.3, 5.8–14.7	ND		NA		ND	
	BIC	0/268	0.0, 0.0–1.4	ND		NA		ND	
	CAB	0/268	0.0, 0.0–1.4	ND		NA		ND	
	DTG	0/268	0.0, 0.0–1.4	ND		NA		ND	
	EVG	24/268	9.2, 5.7–14.6	ND		NA		ND	
	RAL	25/268	9.3, 5.8–14.7	ND		NA		ND	

a Study design–weighted proportion and 95% confidence interval.

b Previously ARV drug–exposed participants were not included in the survey.

HIV drug resistance was defined as the presence of a penalty score ≥15 using the Stanford HIVdb algorithm.

ABC: abacavir; ATV/r: atazanavir/ritonavir; BIC: bictegravir; CAB: cabotegravir; CI: confidence interval; DOR: doravirine; DRV/r: darunavir/ritonavir; DTG: dolutegravir; EFV: efavirenz; ETR: etravirine; EVG: elvitegravir; INSTI: integrase strand-transfer inhibitor; LPV/r: lopinavir/ritonavir; ND: no data; NNRTI: non-nucleoside reverse-transcriptase inhibitor; NRTI: nucleoside reverse-transcriptase inhibitor; NVP: nevirapine; PI/r: boosted protease inhibitor; RAL: raltegravir; RPV: rilpivirine; TDF: tenofovir disoproxil fumarate; ZDV: zidovudine; 3TC/FTC: lamivudine/emtricitabine.

Table A1.3h. Prevalence of pretreatment HIV drug resistance among adults – the Americas

		Argentina (start year: 2019)		Brazil[b] (start year: 2014)		Colombia[b] (start year: 2016)		Cuba[b] (start year: 2017)	
		n/N	%, 95% CI[a]	*n/N*	%, 95% CI[a]	*n/N*	%, 95% CI[a]	*n/N*	%, 95% CI[a]
HIV drug resistance among treatment-naive ART initiators									
NRTI	Any	19/296	8.0, 4.0–15.5	50/1391	3.6, 2.8–4.7	7/192	3.6, 1.7–7.6	15/141	9.9, 6.2–15.6
	ABC	4/296	1.0, 0.2–4.3	25/1391	1.8, 1.1–2.8	1/192	0.5, 0.1–4.0	9/141	6.4, 3.4–11.6
	3TC or FTC	1/296	0.4, 0.0–2.8	9/1391	0.6, 0.4–1.1	0/192	0.0, 0.0–2.0	5/141	3.0, 1.3–6.7
	TDF	2/296	0.4, 0.1–2.4	17/1391	1.2, 0.6–2.4	1/192	0.5, 0.1–4.0	5/141	2.9, 1.3–6.5
	ZDV	15/296	5.8, 3.1–10.6	32/1391	2.3, 1.6–3.3	6/192	3.1, 1.6–6.1	11/141	6.4, 3.5–11.6
NNRTI	EFV or NVP	42/296	12.3, 6.9–21.0	94/1391	6.8, 5.6–8.1	12/192	6.3, 3.8–10.2	33/141	22.8, 15.8–31.6
	DOR	17/296	3.9, 1.8–8.5	39/1391	2.8, 2.0–3.9	1/192	0.5, 0.1–4.4	11/141	6.9, 3.7–12.5
	ETR	14/296	3.9, 1.8–8.2	15/1391	1.1, 0.5–2.1	2/192	1.0, 0.3–3.3	15/141	10.3, 6.2–16.5
	RPV	23/296	6.1, 3.3–11.1	97/1391	7.0, 5.7–8.4	8/192	4.2, 2.6–6.7	23/141	15.2, 10.2–22.0
PI/r	ATV/r, DRV/r or LPV/r	2/296	0.2, 0.0–1.2	13/1391	0.9, 0.6–1.5	0/192	0.0, 0.0–2.0	2/141	1.4, 0.3–5.7
	ATV/r	1/296	0.1, 0.0–0.7	12/1391	0.9, 0.5–1.4	0/192	0.0, 0.0–2.0	2/141	1.4, 0.3–5.7
	DRV/r	1/296	0.1, 0.0–0.7	3/1391	0.2, 0.1–0.5	0/192	0.0, 0.0–2.0	1/141	0.8, 0.1–5.9
	LPV/r	2/296	0.2, 0.0–1.2	11/1391	0.8, 0.5–1.3	0/192	0.0, 0.0–2.0	2/141	1.4, 0.3–5.7
INSTI	Any	24/294	7.6, 3.6–15.1	ND		ND		ND	
	BIC	0/294	0.0, 0.0–1.3	ND		ND		ND	
	CAB	1/294	0.5, 0.1–3.9	ND		ND		ND	
	DTG	0/294	0.0, 0.0–1.3	ND		ND		ND	
	EVG	23/294	7.5, 3.6–15.0	ND		ND		ND	
	RAL	24/294	7.6, 3.6–15.1	ND		ND		ND	
HIV drug resistance among ART initiators previously exposed to ARV drugs									
NRTI	Any	11/76	15.2, 5.2–36.7	ND		ND		ND	
	ABC	6/76	8.5, 2.0–29.4	ND		ND		ND	
	3TC or FTC	5/76	8.3, 1.9–29.3	ND		ND		ND	
	TDF	1/76	0.3, 0.0–2.3	ND		ND		ND	
	ZDV	6/76	6.9, 2.4–18.3	ND		ND		ND	
NNRTI	EFV or NVP	26/76	32.0, 19.2–48.1	ND		ND		ND	
	DOR	9/76	9.5, 2.5–30.4	ND		ND		ND	
	ETR	7/76	4.5, 1.3–14.9	ND		ND		ND	
	RPV	11/76	8.5, 2.7–23.4	ND		ND		ND	
PI/r	ATV/r, DRV/r or LPV/r	3/76	4.6, 1.2–15.8	ND		ND		ND	
	ATV/r	3/76	4.6, 1.2–15.8	ND		ND		ND	
	DRV/r	1/76	0.3, 0.0–2.3	ND		ND		ND	
	LPV/r	3/76	4.6, 1.2–15.8	ND		ND		ND	
INSTI	Any	12/80	15.3, 8.9–25.0	ND		ND		ND	
	BIC	0/80	0.0, 0.0–4.6	ND		ND		ND	
	CAB	0/80	0.0, 0.0–4.6	ND		ND		ND	
	DTG	0/80	0.0, 0.0–4.6	ND		ND		ND	
	EVG	12/80	15.3, 8.9–25.0	ND		ND		ND	
	RAL	12/80	15.3, 8.9–25.0	ND		ND		ND	

a Study design–weighted proportion and 95% confidence interval.

b Previously ARV drug–exposed participants were not included in the survey.

HIV drug resistance was defined as the presence of a penalty score ≥15 using the Stanford HIVdb algorithm.

ABC: abacavir; ATV/r: atazanavir/ritonavir; BIC: bictegravir; CAB: cabotegravir; CI: confidence interval; DOR: doravirine; DRV/r: darunavir/ritonavir; DTG: dolutegravir; EFV: efavirenz; ETR: etravirine; EVG: elvitegravir; INSTI: integrase strand-transfer inhibitor; LPV/r: lopinavir/ritonavir; ND: no data; NNRTI: non-nucleoside reverse-transcriptase inhibitor; NRTI: nucleoside reverse-transcriptase inhibitor; NVP: nevirapine; PI/r: boosted protease inhibitor; RAL: raltegravir; RPV: rilpivirine; TDF: tenofovir disoproxil fumarate; ZDV: zidovudine; 3TC/FTC: lamivudine/emtricitabine.

Table A1.3i. Prevalence of pretreatment HIV drug resistance among adults – the Americas

		Eastern Caribbean Countries[a] (start year: 2017)		El Salvador (start year: 2018)		Guatemala (start year: 2016)	
		n/N	%, 95% CI[b]	*n/N*	%, 95% CI[c]	*n/N*	%, 95% CI[c]
HIV drug resistance among ART initiators							
NRTI	Any	1/51	2.0, 0.1–21.1	14/209	10.3, 4.1–23.6	9/241	3.2, 1.5–6.8
	ABC	0/51	0.0, 0.0–7.0	9/209	8.0, 3.0–23.0	5/241	1.6, 0.4–6.1
	3TC or FTC	0/51	0.0, 0.0–7.0	9/209	8.0, 3.0–23.0	2/241	0.7, 0.1–6.6
	TDF	0/51	0.0, 0.0–7.0	3/209	3.0, 1.0–11.0	1/241	0.3, 0.0–1.9
	ZDV	1/51	2.0, 0.1–21.1	6/209	2.0, 1.0–4.0	3/241	0.9, 0.1–5.5
NNRTI	EFV or NVP	9/51	17.6, 8.7–32.7	39/209	27.0, 17.1–39.9	29/241	13.2, 8.8–19.4
	DOR	1/51	2.0, 0.1–23.7	23/209	12.0, 7.0–19.0	16/241	7.6, 4.9–11.7
	ETR	2/51	3.9, 1.0–14.6	14/209	10.0, 4.0–23.0	10/241	4.9, 2.2–10.6
	RPV	2/51	3.9, 1.0–14.6	21/209	12.0, 6.0–25.0	13/241	5.9, 3.1–11.2
PI/r	ATV/r, DRV/r or LPV/r	0/51	0.0, 0.0–7.0	4/209	1.2, 0.6–2.4	2/241	0.6, 0.1–3.7
	ATV/r	0/51	0.0, 0.0–7.0	3/209	1.0, 0.0–2.0	2/241	0.6, 0.1–3.7
	DRV/r	0/51	0.0, 0.0–7.0	0/209	0.0, 0.0–2.0	0/241	0.0, 0.0–1.6
	LPV/r	0/51	0.0, 0.0–7.0	2/209	1.0, 0.0–2.0	1/241	0.3, 0.0–1.9
INSTI	Any	ND		2/197	3.5, 2.9–19.5	2/206	1.3, 0.2–6.5
	BIC	ND		0/197	0.0, 0.0–1.9	0/206	0.0, 0.0–1.8
	CAB	ND		0/197	0.0, 0.0–1.9	0/206	0.0, 0.0–1.8
	DTG	ND		0/197	0.0, 0.0–1.9	0/206	0.0, 0.0–1.8
	EVG	ND		1/197	3.0, 0.3–21.5	2/206	1.3, 0.2–6.5
	RAL	ND		1/197	0.5, 0.1–2.6	2/206	1.3, 0.2–6.5
HIV drug resistance among women starting ART							
NRTI	Any	0/18	0.0, 0.0–17.6	4/43	9.1, 3.7–20.9	1/66	1.0, 0.1–9.1
	ABC	0/18	0.0, 0.0–17.6	3/43	7.0, 2.5–18.2	1/66	1.0, 0.1–9.1
	3TC or FTC	0/18	0.0, 0.0–17.6	3/43	7.0, 2.5–18.2	1/66	1.0, 0.1–9.1
	TDF	0/18	0.0, 0.0–17.6	1/43	2.0, 0.4–9.9	0/66	0.0, 0.0–5.5
	ZDV	0/18	0.0, 0.0–17.6	2/43	4.1, 1.2–12.7	0/66	0.0, 0.0–5.5
NNRTI	EFV or NVP	0/18	0.0, 0.0–17.6	7/43	14.9, 7.3–28.0	10/66	19.2, 11.1–31.2
	DOR	0/18	0.0, 0.0–17.6	5/43	10.8, 4.8–22.6	5/66	11.6, 4.3–27.4
	ETR	0/18	0.0, 0.0–17.6	3/43	6.4, 2.4–16.0	3/66	7.1, 1.5–27.2
	RPV	0/18	0.0, 0.0–17.6	3/43	6.4, 2.4–16.0	3/66	7.1, 1.5–27.2
PI/r	ATV/r, DRV/r or LPV/r	0/18	0.0, 0.0–17.6	1/43	1.1, 0.7–1.7	0/66	0.0, 0.0–5.5
	ATV/r	0/18	0.0, 0.0–17.6	0/43	0.0, 0.0–8.2	0/66	0.0, 0.0–5.5
	DRV/r	0/18	0.0, 0.0–17.6	0/43	0.0, 0.0–8.2	0/66	0.0, 0.0–5.5
	LPV/r	0/18	0.0, 0.0–17.6	1/43	1.1, 0.7–1.7	0/66	0.0, 0.0–5.5
INSTI	Any	ND		2/42	14.0, 10.4–52.3	1/54	3.0, 0.3–22.1
	BIC	ND		0/42	0.0, 0.0–8.4	0/54	0.0, 0.0–6.6
	CAB	ND		0/42	0.0, 0.0–8.4	0/54	0.0, 0.0–6.6
	DTG	ND		0/42	0.0, 0.0–8.4	0/54	0.0, 0.0–6.6
	EVG	ND		1/42	12.0, 1.5–54.8	1/54	3.0, 0.3–22.1
	RAL	ND		1/42	2.0, 0.4–9.1	1/54	3.0, 0.3–22.1
HIV drug resistance among men starting ART							
NRTI	Any	1/32	3.1, 0.2–31.2	9/160	10.8, 3.6–28.2	8/173	4.3, 2.1–8.5
	ABC	0/32	0.0, 0.0–10.7	5/160	8.9, 2.4–28.3	4/173	2.0, 0.6–5.9
	3TC or FTC	0/32	0.0, 0.0–10.7	5/160	8.9, 2.4–28.3	1/173	0.5, 0.0–5.4
	TDF	0/32	0.0, 0.0–10.7	2/160	2.8, 0.4–15.8	1/173	0.4, 0.1–2.6
	ZDV	1/32	3.1, 0.2–31.2	4/160	1.9, 0.9–4.3	3/173	1.3, 0.2–7.5
NNRTI	EFV or NVP	6/32	18.8, 6.8–42.1	30/160	29.1, 17.7–44.0	19/173	10.4, 6.4–16.4
	DOR	1/32	3.1, 0.2–34.6	17/160	12.3, 6.6–21.8	11/173	5.8, 3.5–9.2
	ETR	2/32	6.3, 1.3–25.5	11/160	11.6, 4.2–28.4	7/173	3.9, 2.1–7.3
	RPV	2/32	6.3, 1.3–25.5	18/160	14.7, 6.5–29.8	10/173	5.4, 3.1–9.2
PI/r	ATV/r, DRV/r or LPV/r	0/32	0.0, 0.0–10.7	3/160	1.3, 0.5–3.0	2/173	0.9, 0.1–5.1
	ATV/r	0/32	0.0, 0.0–10.7	3/160	1.3, 0.5–3.0	2/173	0.9, 0.1–5.1
	DRV/r	0/32	0.0, 0.0–10.7	0/160	0.0, 0.0–2.3	0/173	0.0, 0.0–2.2
	LPV/r	0/32	0.0, 0.0–10.7	1/160	0.6, 0.1–3.2	1/173	0.4, 0.1–2.6
INSTI	Any	ND		0/149	0.0, 0.0–2.5	1/150	0.5, 0.1–2.7
	BIC	ND		0/149	0.0, 0.0–2.5	0/150	0.0, 0.0–2.5
	CAB	ND		0/149	0.0, 0.0–2.5	0/150	0.0, 0.0–2.5
	DTG	ND		0/149	0.0, 0.0–2.5	0/150	0.0, 0.0–2.5
	EVG	ND		0/149	0.0, 0.0–2.5	1/150	0.5, 0.1–2.7
	RAL	ND		0/149	0.0, 0.0–2.5	1/150	0.5, 0.1–2.7

a Multicountry pretreatment drug resistance survey: Antigua and Barbuda, Dominica, Grenada, Saint Kitts and Nevis, Saint Lucia and Saint Vincent and the Grenadines.

b Unweighted proportion and 95% confidence interval adjusted for clustering.

c Study design–weighted proportion and 95% confidence interval.

HIV drug resistance was defined as the presence of a penalty score ≥15 using the Stanford HIVdb algorithm.

ABC: abacavir; ATV/r: atazanavir/ritonavir; BIC: bictegravir; CAB: cabotegravir; CI: confidence interval; DOR: doravirine; DRV/r: darunavir/ritonavir; DTG: dolutegravir; EFV: efavirenz; ETR: etravirine; EVG: elvitegravir; INSTI: integrase strand-transfer inhibitor; LPV/r: lopinavir/ritonavir; ND: no data; NNRTI: non-nucleoside reverse-transcriptase inhibitor; NRTI: nucleoside reverse-transcriptase inhibitor; NVP: nevirapine; PI/r: boosted protease inhibitor; RAL: raltegravir; RPV: rilpivirine; TDF: tenofovir disoproxil fumarate; ZDV: zidovudine; 3TC/FTC: lamivudine/emtricitabine.

Table A1.3j. Prevalence of pretreatment HIV drug resistance among adults – the Americas

		Eastern Caribbean Countries[a] (start year: 2017)		El Salvador (start year: 2018)		Guatemala (start year: 2016)	
		n/N	%, 95% CI[b]	*n/N*	%, 95% CI[c]	*n/N*	%, 95% CI[c]
HIV drug resistance among treatment-naive ART initiators							
NRTI	Any	0/28	0.0, 0.0–12.1	7/159	9.6, 2.8–28.4	8/229	3.0, 1.5–6.0
	ABC	0/28	0.0, 0.0–12.1	2/159	7.0, 1.0–30.0	4/229	1.4, 0.4–4.2
	3TC or FTC	0/28	0.0, 0.0–12.1	2/159	7.0, 1.0–30.0	1/229	0.4, 0.0–3.7
	TDF	0/28	0.0, 0.0–12.1	1/159	2.0, 0.0–17.0	1/229	0.3, 0.0–1.9
	ZDV	0/28	0.0, 0.0–12.1	5/159	2.0, 1.0–5.0	3/229	0.9, 0.1–5.7
NNRTI	EFV or NVP	3/28	10.7, 3.8–26.5	21/159	24.4, 13.2–40.7	27/229	13.3, 8.5–20.1
	DOR	0/28	0.0, 0.0–12.1	10/159	9.0, 4.0–18.0	15/229	7.7, 4.8–12.2
	ETR	2/28	7.1, 2.3–20.1	6/159	9.0, 2.0–29.0	9/229	4.8, 2.1–10.6
	RPV	2/28	7.1, 2.3–20.1	13/159	12.0, 4.0–29.0	12/229	5.9, 3.0–11.2
PI/r	ATV/r, DRV/r or LPV/r	0/28	0.0, 0.0–12.1	4/159	1.5, 0.7–3.1	2/229	0.6, 0.1–3.8
	ATV/r	0/28	0.0, 0.0–12.1	3/159	1.0, 0.0–3.0	2/229	0.6, 0.1–3.8
	DRV/r	0/28	0.0, 0.0–12.1	0/159	0.0, 0.0–2.0	0/229	0.0, 0.0–1.6
	LPV/r	0/28	0.0, 0.0–12.1	2/159	1.0, 0.0–3.0	1/229	0.3, 0.0–1.9
INSTI	Any	ND		1/149	3.9, 3.8–27.1	2/198	1.3, 0.2–6.8
	BIC	ND		0/149	0.0, 0.0–2.5	0/198	0.0, 0.0–1.9
	CAB	ND		0/149	0.0, 0.0–2.5	0/198	0.0, 0.0–1.9
	DTG	ND		0/149	0.0, 0.0–2.5	0/198	0.0, 0.0–1.9
	EVG	ND		1/149	3.9, 0.4–27.1	2/198	1.3, 0.2–6.8
	RAL	ND		0/149	0.0, 0.0–2.5	2/198	1.3, 0.2–6.8
HIV drug resistance among ART initiators previously exposed to ARV drugs							
NRTI	Any	1/22	4.5, 0.2–58.5	7/47	13.3, 6.9–24.1	1/7	12.0, 1.6–53.8
	ABC	0/22	0.0, 0.0–14.9	7/47	13.0, 7.0–24.0	1/7	12.0, 1.6–53.8
	3TC or FTC	0/22	0.0, 0.0–14.9	7/47	13.0, 7.0–24.0	1/7	12.0, 1.6–53.8
	TDF	0/22	0.0, 0.0–14.9	2/47	3.0, 1.0–9.0	0/7	0.0, 0.0–35.4
	ZDV	1/22	4.5, 0.2–58.5	1/47	2.0, 0.0–9.0	0/7	0.0, 0.0–35.4
NNRTI	EFV or NVP	5/22	22.7, 4.8–63.2	18/47	37.4, 22.3–55.4	2/7	26.7, 3.2–80.1
	DOR	1/22	4.5, 0.2–58.5	13/47	23.0, 14.0–35.0	1/7	13.3, 2.0–54.1
	ETR	0/22	0.0, 0.0–14.9	8/47	14.0, 8.0–23.0	1/7	13.3, 2.0–54.1
	RPV	0/22	0.0, 0.0–14.9	8/47	14.0, 8.0–23.0	1/7	13.3, 2.0–54.1
PI/r	ATV/r, DRV/r or LPV/r	0/22	0.0, 0.0–14.9	0/47	0.0, 0.0–7.6	0/7	0.0, 0.0–35.4
	ATV/r	0/22	0.0, 0.0–14.9	0/47	0.0, 0.0–7.6	0/7	0.0, 0.0–35.4
	DRV/r	0/22	0.0, 0.0–14.9	0/47	0.0, 0.0–7.6	0/7	0.0, 0.0–35.4
	LPV/r	0/22	0.0, 0.0–14.9	0/47	0.0, 0.0–7.6	0/7	0.0, 0.0–35.4
INSTI	Any	ND		1/45	2.1, 1.4–8.7	0/6	0.0, 0.0–39.0
	BIC	ND		0/45	0.0, 0.0–7.9	0/6	0.0, 0.0–39.0
	CAB	ND		0/45	0.0, 0.0–7.9	0/6	0.0, 0.0–39.0
	DTG	ND		0/45	0.0, 0.0–7.9	0/6	0.0, 0.0–39.0
	EVG	ND		0/45	0.0, 0.0–7.9	0/6	0.0, 0.0–39.0
	RAL	ND		1/45	2.1, 1.4–8.7	0/6	0.0, 0.0–39.0

a Multicountry pretreatment drug resistance survey: Antigua and Barbuda, Dominica, Grenada, Saint Kitts and Nevis, Saint Lucia and Saint Vincent and the Grenadines.

b Unweighted proportion and 95% confidence interval adjusted for clustering.

c Study design–weighted proportion and 95% confidence interval.

HIV drug resistance was defined as the presence of a penalty score ≥15 using the Stanford HIVdb algorithm.

ABC: abacavir; ATV/r: atazanavir/ritonavir; BIC: bictegravir; CAB: cabotegravir; CI: confidence interval; DOR: doravirine; DRV/r: darunavir/ritonavir; DTG: dolutegravir; EFV: efavirenz; ETR: etravirine; EVG: elvitegravir; INSTI: integrase strand-transfer inhibitor; LPV/r: lopinavir/ritonavir; ND: no data; NNRTI: non-nucleoside reverse-transcriptase inhibitor; NRTI: nucleoside reverse-transcriptase inhibitor; NVP: nevirapine; PI/r: boosted protease inhibitor; RAL: raltegravir; RPV: rilpivirine; TDF: tenofovir disoproxil fumarate; ZDV: zidovudine; 3TC/FTC: lamivudine/emtricitabine.

Table A1.3k. Prevalence of pretreatment HIV drug resistance among adults – the Americas

		Haiti (start year: 2018)		Honduras (start year: 2016)		Mexico (start year: 2017)	
		n/N	%, 95% CI[a]	*n/N*	%, 95% CI[a]	*n/N*	%, 95% CI[a]
HIV drug resistance among ART initiators							
NRTI	Any	17/246	7.6, 3.7–14.9	15/161	6.9, 4.0–11.7	64/2006	3.2, 2.5–4.1
	ABC	14/246	5.9, 2.9–11.6	14/161	6.5, 3.6–11.3	41/2006	2.1, 1.6–2.8
	3TC or FTC	14/246	5.9, 2.9–11.6	12/161	5.7, 3.0–10.6	25/2006	1.3, 0.9–1.9
	TDF	6/246	3.0, 1.2–7.2	6/161	3.3, 1.2–8.5	19/2006	0.9, 0.6–1.4
	ZDV	3/246	1.7, 0.6–4.8	10/161	5.0, 2.5–10.0	38/2006	1.8, 1.4–2.5
NNRTI	EFV or NVP	65/246	24.7, 19.0–31.6	45/161	25.9, 19.2–33.9	205/2006	9.9, 8.7–11.2
	DOR	22/246	9.3, 5.2–16.1	21/161	9.1, 6.0–13.7	130/2006	6.5, 5.5–7.7
	ETR	13/246	5.0, 2.7–9.2	6/161	2.5, 1.2–5.1	50/2006	2.3, 1.8–3.1
	RPV	20/246	7.6, 4.2–13.5	14/161	7.2, 4.4–11.7	124/2006	6.5, 5.3–7.9
PI/r	ATV/r, DRV/r or LPV/r	0/246	0.0, 0.0–1.5	0/161	0.0, 0.0–2.3	29/2006	1.4, 1.0–2.0
	ATV/r	0/246	0.0, 0.0–1.5	0/161	0.0, 0.0–2.3	29/2006	1.4, 1.0–2.0
	DRV/r	0/246	0.0, 0.0–1.5	0/161	0.0, 0.0–2.3	11/2006	0.7, 0.4–1.2
	LPV/r	0/246	0.0, 0.0–1.5	0/161	0.0, 0.0–2.3	27/2006	1.3, 0.9–1.9
INSTI	Any	ND		ND		10/1855	0.5, 0.3–0.9
	BIC	ND		ND		0/1855	0.0, 0.0–0.2
	CAB	ND		ND		2/1855	0.1, 0–0.4
	DTG	ND		ND		0/1855	0.0, 0.0–0.2
	EVG	ND		ND		10/1855	0.5, 0.3–0.9
	RAL	ND		ND		8/1855	0.4, 0.2–0.8
HIV drug resistance among women starting ART							
NRTI	Any	5/125	3.6, 1.5–8.2	6/50	9.2, 3.1–24.1	16/328	4.7, 2.8–7.9
	ABC	4/125	2.3, 0.9–6.1	6/50	9.2, 3.5–22.0	11/328	3.6, 2.1–6.1
	3TC or FTC	4/125	2.3, 0.9–6.1	5/50	8.1, 2.8–21.5	8/328	2.2, 1.2–4.0
	TDF	0/125	0.0, 0.0–3.0	3/50	5.9, 1.4–21.0	5/328	2.0, 0.9–4.5
	ZDV	1/125	1.3, 0.2–8.8	4/50	6.6, 1.9–20.7	10/328	3.2, 1.8–5.6
NNRTI	EFV or NVP	33/125	22.5, 14.4–33.3	18/50	32.4, 18.1–50.9	43/328	13.6, 10.0–18.2
	DOR	9/125	6.5, 2.8–14.4	6/50	8.7, 3.2–21.6	24/328	7.3, 5.1–10.4
	ETR	7/125	4.3, 1.7–10.3	3/50	2.5, 1.2–5.4	10/328	3.7, 2.0–6.8
	RPV	12/125	7.9, 3.9–15.2	7/50	8.1, 3.8–16.5	23/328	7.4, 5.0–10.9
PI/r	ATV/r, DRV/r or LPV/r	0/125	0.0, 0.0–3.0	0/50	0.0, 0.0–43.4	7/328	2.4, 1.1–5.2
	ATV/r	0/125	0.0, 0.0–3.0	0/50	0.0, 0.0–43.4	7/328	2.4, 1.2–4.7
	DRV/r	0/125	0.0, 0.0–3.0	0/50	0.0, 0.0–43.4	2/328	0.9, 0.2–3.3
	LPV/r	0/125	0.0, 0.0–3.0	0/50	0.0, 0.0–43.4	6/328	2.1, 1–4.5
INSTI	Any	ND		ND		1/303	0.3, 0.1–1.3
	BIC	ND		ND		0/303	0.0, 0.0–1.3
	CAB	ND		ND		0/303	0.0, 0.0–1.3
	DTG	ND		ND		0/303	0.0, 0.0–1.3
	EVG	ND		ND		1/303	0.3, 0.1–1.3
	RAL	ND		ND		1/303	0.3, 0.1–1.3
HIV drug resistance among men starting ART							
NRTI	Any	12/120	11.2, 5.1–22.8	8/105	5.5, 2.8–10.6	48/1676	2.9, 2.2–3.9
	ABC	10/120	9.2, 4.2–18.7	7/105	4.9, 2.5–9.3	30/1676	1.9, 1.3–2.6
	3TC or FTC	10/120	9.2, 4.2–18.7	6/105	4.3, 2.1–8.6	17/1676	1.1, 0.7–1.8
	TDF	6/120	5.7, 2.5–12.5	3/105	2, 0.8–5.1	14/1676	0.8, 0.5–1.2
	ZDV	2/120	2.1, 0.5–7.6	6/105	4.5, 2.2–8.9	28/1676	1.6, 1.1–2.3
NNRTI	EFV or NVP	32/120	26.9, 18.6–37.3	24/105	21.8, 14.2–32	162/1676	9.2, 8.0–10.7
	DOR	13/120	11.9, 5.4–24.0	15/105	10, 6.6–15.1	106/1676	6.4, 5.3–7.6
	ETR	6/120	5.7, 2.4–12.8	3/105	2.7, 1–7.2	40/1676	2.1, 1.6–2.8
	RPV	8/120	7.5, 3.0–17.4	7/105	7.3, 3.6–14.2	101/1676	6.3, 5.0–7.9
PI/r	ATV/r, DRV/r or LPV/r	0/120	0.0, 0.0–3.1	0/105	0.0, 0.0–3.5	22/1676	1.2, 0.8–1.9
	ATV/r	0/120	0.0, 0.0–3.1	0/105	0.0, 0.0–3.5	22/1676	1.2, 0.8–1.8
	DRV/r	0/120	0.0, 0.0–3.1	0/105	0.0, 0.0–3.5	9/1676	0.6, 0.3–1.2
	LPV/r	0/120	0.0, 0.0–3.1	0/105	0.0, 0.0–3.5	21/1676	1.2, 0.8–1.8
INSTI	Any	ND		ND		9/1550	0.5, 0.3–1.0
	BIC	ND		ND		0/1550	0.0, 0.0–0.2
	CAB	ND		ND		2/1550	0.1, 0.0–0.4
	DTG	ND		ND		0/1550	0.0, 0.0–0.2
	EVG	ND		ND		9/1550	0.5, 0.3–1.0
	RAL	ND		ND		7/1550	0.4, 0.2–0.9

a Study design–weighted proportion and 95% confidence interval.

HIV drug resistance was defined as the presence of a penalty score ≥15 using the Stanford HIVdb algorithm.

ABC: abacavir; ATV/r: atazanavir/ritonavir; BIC: bictegravir; CAB: cabotegravir; CI: confidence interval; DOR: doravirine; DRV/r: darunavir/ritonavir; DTG: dolutegravir; EFV: efavirenz; ETR: etravirine; EVG: elvitegravir; INSTI: integrase strand-transfer inhibitor; LPV/r: lopinavir/ritonavir; ND: no data; NNRTI: non-nucleoside reverse-transcriptase inhibitor; NRTI: nucleoside reverse-transcriptase inhibitor; NVP: nevirapine; PI/r: boosted protease inhibitor; RAL: raltegravir; RPV: rilpivirine; TDF: tenofovir disoproxil fumarate; ZDV: zidovudine; 3TC/FTC: lamivudine/emtricitabine.

Table A1.3l. Prevalence of pretreatment HIV drug resistance among adults – the Americas

		Haiti[a] (start year: 2018)		Honduras (start year: 2016)		Mexico (start year: 2017)	
		n/N	%, 95% CI[b]	*n/N*	%, 95% CI[b]	*n/N*	%, 95% CI[b]
HIV drug resistance among treatment-naive ART initiators							
NRTI	Any	NA		10/112	6.4, 3.4–11.6	39/1848	2.3, 1.7–3.1
	ABC	NA		9/112	5.8, 3.2–10.0	20/1848	1.3, 0.8–2.0
	3TC or FTC	NA		7/112	4.5, 2.3–8.5	9/1848	0.7, 0.3–1.2
	TDF	NA		3/112	1.8, 0.7–4.2	9/1848	0.5, 0.3–0.9
	ZDV	NA		7/112	4.6, 2.4–8.8	29/1848	1.5, 1.1–2.1
NNRTI	EFV or NVP	NA		24/112	15.6, 10.2–23.1	161/1848	8.6, 7.4–9.9
	DOR	NA		14/112	8.3, 5.3–12.8	103/1848	5.6, 4.7–6.8
	ETR	NA		4/112	2.9, 1.2–7.0	34/1848	1.7, 1.2–2.3
	RPV	NA		7/112	4.5, 2.3–8.5	97/1848	5.3, 4.2–6.7
PI/r	ATV/r, DRV/r or LPV/r	NA		0/112	0.0, 0.0–3.3	22/1848	1.2, 0.8–1.8
	ATV/r	NA		0/112	0.0, 0.0–3.3	22/1848	1.2, 0.8–1.8
	DRV/r	NA		0/112	0.0, 0.0–3.3	9/1848	0.6, 0.3–1.2
	LPV/r	NA		0/112	0.0, 0.0–3.3	20/1848	1.1, 0.7–1.7
INSTI	Any	NA		ND		8/1701	0.4, 0.2–0.6
	BIC	NA		ND		0/1701	0.0, 0.0–0.2
	CAB	NA		ND		1/1701	0.0, 0.0–0.2
	DTG	NA		ND		0/1701	0.0, 0.0–0.2
	EVG	NA		ND		8/1701	0.4, 0.2–0.6
	RAL	NA		ND		6/1701	0.3, 0.1–0.5
HIV drug resistance among ART initiators previously exposed to ARV drugs							
NRTI	Any	17/245	7.6, 3.7–15.1	4/33	10.6, 2.8–33.3	25/158	15.0, 10.1–21.8
	ABC	14/245	5.9, 2.9–11.8	4/33	10.6, 3.5–28.2	21/158	12.9, 8.9–18.4
	3TC or FTC	14/245	5.9, 2.9–11.8	4/33	10.6, 3.5–28.2	16/158	9.1, 6.0–13.5
	TDF	6/245	3.0, 1.2–7.3	2/33	7.6, 1.7–28.2	10/158	6.7, 3.9–11.5
	ZDV	3/245	1.7, 0.6–4.9	2/33	7.6, 1.7–28.2	9/158	6.0, 3.3–10.6
NNRTI	EFV or NVP	65/245	24.9, 19.0–32.0	17/33	53.8, 32.4–73.8	44/158	26.2, 19.5–34.3
	DOR	22/245	9.3, 5.2–16.3	5/33	13.4, 5.2–30.3	27/158	17.5, 12.5–23.8
	ETR	13/245	5.0, 2.7–9.3	1/33	2.0, 0.3–10.6	16/158	10.9, 7.0–16.5
	RPV	20/245	7.7, 4.2–13.7	4/33	9.5, 3.7–22.3	27/158	21.3, 13.5–32.1
PI/r	ATV/r, DRV/r or LPV/r	0/245	0.0, 0.0–1.5	0/33	0.0, 0.0–10.4	7/158	4.0, 2.0–7.6
	ATV/r	0/245	0.0, 0.0–1.5	0/33	0.0, 0.0–10.4	7/158	4.0, 2.0–7.6
	DRV/r	0/245	0.0, 0.0–1.5	0/33	0.0, 0.0–10.4	2/158	1.1, 0.4–3.6
	LPV/r	0/245	0.0, 0.0–1.5	0/33	0.0, 0.0–10.4	7/158	4.0, 2.0–7.6
INSTI	Any	ND		ND		2/154	2.3, 0.6–8.1
	BIC	ND		ND		0/154	0.0, 0.0–2.4
	CAB	ND		ND		1/154	0.8, 0.1–4.2
	DTG	ND		ND		0/154	0.0, 0.0–2.4
	EVG	ND		ND		2/154	2.3, 0.6–8.1
	RAL	ND		ND		2/154	2.3, 0.6–8.1

a In Haiti, the proportion of ART initiators with previous ARV drug exposure was 99.3% (95% CI 95.1–99.9%).

b Study design–weighted proportion and 95% confidence interval.

HIV drug resistance was defined as the presence of a penalty score ≥15 using the Stanford HIVdb algorithm.

ABC: abacavir; ATV/r: atazanavir/ritonavir; BIC: bictegravir; CAB: cabotegravir; CI: confidence interval; DOR: doravirine; DRV/r: darunavir/ritonavir; DTG: dolutegravir; EFV: efavirenz; ETR: etravirine; EVG: elvitegravir; INSTI: integrase strand-transfer inhibitor; LPV/r: lopinavir/ritonavir; NA: not applicable; ND: no data; NNRTI: non-nucleoside reverse-transcriptase inhibitor; NRTI: nucleoside reverse-transcriptase inhibitor; NVP: nevirapine; PI/r: boosted protease inhibitor; RAL: raltegravir; RPV: rilpivirine; TDF: tenofovir disoproxil fumarate; ZDV: zidovudine; 3TC/FTC: lamivudine/emtricitabine.

Table A1.3m. Prevalence of pretreatment HIV drug resistance among adults – the Americas

		Nicaragua (start year: 2016)		Paraguay (start year: 2019)		Uruguay (start year: 2018)	
		n/N	%, 95% CI[a]	*n/N*	%, 95% CI[a]	*n/N*	%, 95% CI[a]
HIV drug resistance among ART initiators							
NRTI	Any	18/171	10.5, 4.9–21.1	9/208	4.3, 2.3–8.1	21/204	10.3, 9.4–11.2
	ABC	9/171	5.3, 1.9–13.8	3/208	1.4, 0.5–4.4	12/204	5.9, 5.2–6.6
	3TC or FTC	6/171	3.5, 1.1–10.2	3/208	1.4, 0.5–4.4	4/204	1.9, 1.7–2.2
	TDF	5/171	2.9, 0.8–10.4	2/208	1.0, 0.2–3.8	7/204	3.5, 2.9–4.1
	ZDV	12/171	7.0, 3.1–15.2	6/208	2.9, 1.3–6.3	16/204	7.9, 7.0–8.8
NNRTI	EFV or NVP	33/171	19.3, 12.2–29.1	27/208	13.0, 9.0–18.3	31/204	15.2, 14.1–16.3
	DOR	10/171	5.8, 2.2–14.5	7/208	3.4, 1.6–6.9	12/204	5.8, 5.3–6.2
	ETR	3/171	1.8, 0.6–5.2	6/208	2.9, 1.3–6.3	11/204	5.2, 4.9–5.6
	RPV	16/171	9.4, 4.5–18.3	17/208	8.2, 5.1–12.8	28/204	13.8, 12.6–15.2
PI/r	ATV/r, DRV/r or LPV/r	0/171	0.0, 0.0–2.2	0/208	0.0, 0.0–1.8	3/204	1.5, 1.1–2.1
	ATV/r	0/171	0.0, 0.0–2.2	0/208	0.0, 0.0–1.8	3/204	1.5, 1.1–2.1
	DRV/r	0/171	0.0, 0.0–2.2	0/208	0.0, 0.0–1.8	1/204	0.6, 0.2–1.3
	LPV/r	0/171	0.0, 0.0–2.2	0/208	0.0, 0.0–1.8	3/204	1.5, 1.1–2.1
INSTI	Any	1/166	0.1, 0.0–1.0	7/208	3.4, 1.6–6.9	26/205	12.7, 11.7–13.8
	BIC	0/166	0.0, 0.0–2.3	0/208	0.0, 0.0–1.8	0/205	0.0, 0.0–1.8
	CAB	0/166	0.0, 0.0–2.3	0/208	0.0, 0.0–1.8	0/205	0.0, 0.0–1.8
	DTG	0/166	0.0, 0.0–2.3	0/208	0.0, 0.0–1.8	0/205	0.0, 0.0–1.8
	EVG	1/166	0.1, 0.0–1.0	7/208	3.4, 1.6–6.9	26/205	12.7, 11.7–13.8
	RAL	1/166	0.1, 0.0–1.0	7/208	3.4, 1.6–6.9	26/205	12.7, 11.7–13.8
HIV drug resistance among women starting ART							
NRTI	Any	7/48	14.6, 5.0–35.5	2/31	6.5, 1.5–23.5	8/70	11.5, 10.1–13.2
	ABC	4/48	8.3, 2.8–22.4	1/31	3.2, 0.4–21.0	5/70	7.3, 5.9–9
	3TC or FTC	3/48	6.3, 1.9–18.9	1/31	3.2, 0.4–21.0	0/70	0.0, 0.0–5.2
	TDF	3/48	6.3, 1.6–21.6	0/31	0.0, 0.0–11.0	4/70	5.9, 4.6–7.6
	ZDV	5/48	10.4, 3.5–27.4	1/31	3.2, 0.4–21.0	7/70	10.1, 8.7–11.8
NNRTI	EFV or NVP	15/48	31.3, 19.6–45.8	2/31	6.5, 1.5–23.5	11/70	15.8, 14.1–17.7
	DOR	4/48	8.3, 2.4–25.4	1/31	3.2, 0.4–21.0	3/70	4.3, 3.4–5.4
	ETR	2/48	4.2, 1.2–13.6	1/31	3.2, 0.4–21.0	3/70	4.2, 3.9–4.5
	RPV	7/48	14.6, 5.7–32.4	1/31	3.2, 0.4–21.0	8/70	11.5, 10–13.1
PI/r	ATV/r, DRV/r or LPV/r	0/48	0.0, 0.0–7.4	0/31	0.0, 0.0–11.0	1/70	1.7, 0.7–3.9
	ATV/r	0/48	0.0, 0.0–7.4	0/31	0.0, 0.0–11.0	1/70	1.7, 0.7–3.9
	DRV/r	0/48	0.0, 0.0–7.4	0/31	0.0, 0.0–11.0	1/70	1.7, 0.7–3.9
	LPV/r	0/48	0.0, 0.0–7.4	0/31	0.0, 0.0–11.0	1/70	1.7, 0.7–3.9
INSTI	Any	0/47	0.0, 0.0–7.6	0/31	0.0, 0.0–11.0	7/71	9.8, 8.8–10.9
	BIC	0/47	0.0, 0.0–7.6	0/31	0.0, 0.0–11.0	0/71	0.0, 0.0–5.1
	CAB	0/47	0.0, 0.0–7.6	0/31	0.0, 0.0–11.0	0/71	0.0, 0.0–5.1
	DTG	0/47	0.0, 0.0–7.6	0/31	0.0, 0.0–11.0	0/71	0.0, 0.0–5.1
	EVG	0/47	0.0, 0.0–7.6	0/31	0.0, 0.0–11.0	7/71	9.8, 8.8–10.9
	RAL	0/47	0.0, 0.0–7.6	0/31	0.0, 0.0–11.0	7/71	9.8, 8.8–10.9
HIV drug resistance among men starting ART							
NRTI	Any	11/123	8.9, 4.0–18.8	7/174	4.0, 1.9–8.2	12/129	9.3, 8.4–10.2
	ABC	5/123	4.1, 1.3–12.3	2/174	1.1, 0.3–4.5	7/129	5.3, 4.8–6
	3TC or FTC	3/123	2.4, 0.6–9.2	2/174	1.1, 0.3–4.5	4/129	3, 2.6–3.5
	TDF	2/123	1.6, 0.3–8.4	2/174	1.1, 0.3–4.5	3/129	2.3, 1.9–2.7
	ZDV	7/123	5.7, 2.2–13.9	5/174	2.9, 1.2–6.8	8/129	6.2, 5.5–7.1
NNRTI	EFV or NVP	18/123	14.6, 8.0–25.3	25/174	14.4, 9.9–20.4	18/129	13.9, 12.6–15.3
	DOR	6/123	4.9, 1.8–12.5	6/174	3.4, 1.5–7.5	8/129	6, 5.5–6.6
	ETR	1/123	0.8, 0.1–7.5	5/174	2.9, 1.2–6.8	7/129	5.3, 4.8–5.8
	RPV	9/123	7.3, 3.4–15.1	15/174	8.6, 5.2–13.9	19/129	14.9, 13.1–16.9
PI/r	ATV/r, DRV/r or LPV/r	0/123	0.0, 0.0–3.0	0/174	0.0, 0.0–2.2	2/129	1.5, 1.5–1.5
	ATV/r	0/123	0.0, 0.0–3.0	0/174	0.0, 0.0–2.2	2/129	1.5, 1.5–1.5
	DRV/r	0/123	0.0, 0.0–3.0	0/174	0.0, 0.0–2.2	0/129	0.0, 0.0–2.9
	LPV/r	0/123	0.0, 0.0–3.0	0/174	0.0, 0.0–2.2	2/129	1.5, 1.5–1.5
INSTI	Any	1/119	0.2, 0.0–1.8	7/174	4.0, 1.9–8.2	19/129	14.8, 13.3–16.4
	BIC	0/119	0.0, 0.0–3.1	0/174	0.0, 0.0–2.2	0/129	0.0, 0.0–2.9
	CAB	0/119	0.0, 0.0–3.1	0/174	0.0, 0.0–2.2	0/129	0.0, 0.0–2.9
	DTG	0/119	0.0, 0.0–3.1	0/174	0.0, 0.0–2.2	0/129	0.0, 0.0–2.9
	EVG	1/119	0.2, 0.0–1.8	7/174	4.0, 1.9–8.2	19/129	14.8, 13.3–16.4
	RAL	1/119	0.2, 0.0–1.8	7/174	4.0, 1.9–8.2	19/129	14.8, 13.3–16.4

a Study design–weighted proportion and 95% confidence interval.

HIV drug resistance was defined as the presence of a penalty score ≥15 using the Stanford HIVdb algorithm.

ABC: abacavir; ATV/r: atazanavir/ritonavir; BIC: bictegravir; CAB: cabotegravir; CI: confidence interval; DOR: doravirine; DRV/r: darunavir/ritonavir; DTG: dolutegravir; EFV: efavirenz; ETR: etravirine; EVG: elvitegravir; INSTI: integrase strand-transfer inhibitor; LPV/r: lopinavir/ritonavir; NA: not applicable; ND: no data; NNRTI: non-nucleoside reverse-transcriptase inhibitor; NRTI: nucleoside reverse-transcriptase inhibitor; NVP: nevirapine; PI/r: boosted protease inhibitor; RAL: raltegravir; RPV: rilpivirine; TDF: tenofovir disoproxil fumarate; ZDV: zidovudine; 3TC/FTC: lamivudine/emtricitabine.

Table A1.3n. Prevalence of pretreatment HIV drug resistance among adults – the Americas

		Nicaragua (start year: 2016)		Paraguay (start year: 2019)		Uruguay (start year: 2018)	
		n/N	%, 95% CI[a]	*n/N*	%, 95% CI[a]	*n/N*	%, 95% CI[a]
HIV drug resistance among treatment-naive ART initiators							
NRTI	Any	10/146	6.8, 2.7–16.1	8/195	4.1, 2.1–8.0	11/131	8.5, 7.4–9.8
	ABC	2/146	1.4, 0.3–6.4	2/195	1.0, 0.3–4.0	4/131	3.1, 2.4–4.1
	3TC or FTC	2/146	1.4, 0.3–6.4	2/195	1.0, 0.3–4.0	0/131	0.0, 0.0–2.8
	TDF	0/146	0.0, 0.0–2.6	1/195	0.5, 0.1–3.6	4/131	3.1, 2.4–4.1
	ZDV	8/146	5.5, 2–14.1	5/195	2.6, 1.1–6.0	10/131	7.8, 6.6–9.1
NNRTI	EFV or NVP	16/146	11.0, 6.0–19.3	25/195	12.8, 8.8–18.3	16/131	12.3, 11.0–13.8
	DOR	3/146	2.1, 0.5–7.7	6/195	3.1, 1.4–6.7	4/131	2.9, 2.9–3
	ETR	1/146	0.7, 0.1–6.4	5/195	2.6, 1.1–6.0	6/131	4.5, 4.1–4.8
	RPV	10/146	6.8, 3.0–15.1	15/195	7.7, 4.7–12.4	18/131	14.1, 12.4–16.1
PI/r	ATV/r, DRV/r or LPV/r	0/146	0.0, 0.0–2.6	0/195	0.0, 0.0–1.9	3/131	2.4, 1.7–3.2
	ATV/r	0/146	0.0, 0.0–2.6	0/195	0.0, 0.0–1.9	3/131	2.4, 1.7–3.2
	DRV/r	0/146	0.0, 0.0–2.6	0/195	0.0, 0.0–1.9	1/131	0.9, 0.4–2.1
	LPV/r	0/146	0.0, 0.0–2.6	0/195	0.0, 0.0–1.9	3/131	2.4, 1.7–3.2
INSTI	Any	1/141	0.2, 0.0–1.6	7/195	3.6, 1.7–7.4	20/132	14.9, 14.1–15.6
	BIC	0/141	0.0, 0.0–2.7	0/195	0.0, 0.0–1.9	0/132	0.0, 0.0–2.8
	CAB	0/141	0.0, 0.0–2.7	0/195	0.0, 0.0–1.9	0/132	0.0, 0.0–2.8
	DTG	0/141	0.0, 0.0–2.7	0/195	0.0, 0.0–1.9	0/132	0.0, 0.0–2.8
	EVG	1/141	0.2, 0.0–1.6	7/195	3.4, 1.6–6.9	20/132	14.9, 14.1–15.6
	RAL	1/141	0.2, 0.0–1.6	7/195	3.4, 1.6–6.9	20/132	14.9, 14.1–15.6
HIV drug resistance among ART initiators previously exposed to ARV drugs							
NRTI	Any	7/21	33.3, 13.9–60.8	1/8	12.5, 1.1–64.2	10/73	13.4, 12.5–14.4
	ABC	6/21	28.6, 8.5–63.4	1/8	12.5, 1.1–64.2	8/73	10.7, 9.9–11.6
	3TC or FTC	3/21	14.3, 3.2–45.9	1/8	12.5, 1.1–64.2	4/73	5.4, 4.8–6.0
	TDF	4/21	19.0, 4.2–55.7	1/8	12.5, 1.1–64.2	3/73	4.0, 3.5–4.6
	ZDV	3/21	14.3, 3.2–45.9	1/8	12.5, 1.1–64.2	6/73	8.0, 7.3–8.8
NNRTI	EFV or NVP	16/21	76.2, 52.9–90.1	2/8	25.0, 4.6–69.7	15/73	20.3, 18.7–22.0
	DOR	7/21	33.3, 7.8–74.6	1/8	12.5, 1.1–64.2	8/73	10.8, 9.7–12.0
	ETR	2/21	9.5, 2.0–35.2	1/8	12.5, 1.1–64.2	5/73	6.6, 6.1–7.2
	RPV	5/21	23.8, 4.9–65.4	2/8	25.0, 4.6–69.7	10/73	13.3, 12.5–14.2
PI/r	ATV/r, DRV/r or LPV/r	0/21	0.0, 0.0–15.5	0/8	0.0, 0.0–32.4	0/73	0.0, 0.0–5.0
	ATV/r	0/21	0.0, 0.0–15.5	0/8	0.0, 0.0–32.4	0/73	0.0, 0.0–5.0
	DRV/r	0/21	0.0, 0.0–15.5	0/8	0.0, 0.0–32.4	0/73	0.0, 0.0–5.0
	LPV/r	0/21	0.0, 0.0–15.5	0/8	0.0, 0.0–32.4	0/73	0.0, 0.0–5.0
INSTI	Any	0/21	0.0, 0.0–15.5	0/8	0.0, 0.0–32.4	6/73	8.8, 6.6–11.5
	BIC	0/21	0.0, 0.0–15.5	0/8	0.0, 0.0–32.4	0/73	0.0, 0.0–5.0
	CAB	0/21	0.0, 0.0–15.5	0/8	0.0, 0.0–32.4	0/73	0.0, 0.0–5.0
	DTG	0/21	0.0, 0.0–15.5	0/8	0.0, 0.0–32.4	0/73	0.0, 0.0–5.0
	EVG	0/21	0.0, 0.0–15.5	0/8	0.0, 0.0–32.4	6/73	8.8, 6.6–11.5
	RAL	0/21	0.0, 0.0–15.5	0/8	0.0, 0.0–32.4	6/73	8.8, 6.6–11.5

a Study design–weighted proportion and 95% confidence interval.

HIV drug resistance was defined as the presence of a penalty score ≥15 using the Stanford HIVdb algorithm.

ABC: abacavir; ATV/r: atazanavir/ritonavir; BIC: bictegravir; CAB: cabotegravir; CI: confidence interval; DOR: doravirine; DRV/r: darunavir/ritonavir; DTG: dolutegravir; EFV: efavirenz; ETR: etravirine; EVG: elvitegravir; INSTI: integrase strand-transfer inhibitor; LPV/r: lopinavir/ritonavir; NA: not applicable; ND: no data; NNRTI: non-nucleoside reverse-transcriptase inhibitor; NRTI: nucleoside reverse-transcriptase inhibitor; NVP: nevirapine; PI/r: boosted protease inhibitor; RAL: raltegravir; RPV: rilpivirine; TDF: tenofovir disoproxil fumarate; ZDV: zidovudine; 3TC/FTC: lamivudine/emtricitabine.

Table A1.3o. Prevalence of pretreatment HIV drug resistance among adults – South-East Asia

		Indonesia (start year: 2016)		Myanmar (start year: 2016)		Nepal[b] (start year: 2016)		Thailand (start year: 2016)	
		n/N	%, 95% CI[a]	*n/N*	%, 95% CI[a]	*n/N*	%, 95% CI[a]	*n/N*	%, 95% CI[a]
HIV drug resistance among ART initiators									
NRTI	Any	15/370	4.0, 1.8–8.7	5/327	1.4, 0.5–3.7	14/184	7.8, 4.7–12.6	5/320	1.7, 0.6–5.1
	ABC	10/370	3.1, 1.2–7.9	3/327	0.5, 0.1–1.9	13/184	7.3, 4.3–12.1	5/320	1.7, 0.6–5.1
	3TC or FTC	8/370	3.1, 1.2–7.9	2/327	0.3, 0.1–1.2	4/184	2.0, 0.9–4.8	3/320	1.2, 0.3–5.0
	TDF	7/370	3.0, 1.1–7.9	2/327	0.3, 0.1–2.1	3/184	1.5, 0.5–4.3	4/320	1.7, 0.5–5.1
	ZDV	8/370	3.0, 1.2–7.5	3/327	1.1, 0.3–3.5	11/184	6.5, 3.6–11.3	1/320	0.4, 0.1–3.1
NNRTI	EFV or NVP	27/370	6.5, 3.9–10.8	16/327	3.9, 2.1–7.4	21/184	10.2, 6.7–15.4	14/320	3.6, 1.4–8.9
	DOR	20/370	5.2, 2.9–9.4	7/327	1.6, 0.7–3.6	12/184	6.0, 3.3–10.4	4/320	1.2, 0.3–4.7
	ETR	13/370	3.2, 1.3–7.5	7/327	1.8, 0.7–4.8	9/184	3.8, 2.0–7.1	9/320	1.9, 0.6–5.6
	RPV	27/370	6.4, 3.4–11.7	18/327	5.4, 3.1–9.3	21/184	9.8, 6.4–14.7	19/320	5.5, 2.6–11.4
PI/r	ATV/r, DRV/r or LPV/r	2/370	0.8, 0.2–3.3	1/326	0.2, 0.0–1.8	0/182	0.0, 0.0–2.1	0/320	0.0, 0.0–1.2
	ATV/r	2/370	0.8, 0.2–3.3	1/326	0.2, 0.0–1.8	0/182	0.0, 0.0–2.1	0/320	0.0, 0.0–1.2
	DRV/r	2/370	0.8, 0.2–3.3	0/326	0.0, 0.0–1.2	0/182	0.0, 0.0–2.1	0/320	0.0, 0.0–1.2
	LPV/r	2/370	0.8, 0.2–3.3	0/326	0.0, 0.0–1.2	0/182	0.0, 0.0–2.1	0/320	0.0, 0.0–1.2
INSTI	Any	ND		ND		ND		ND	
	BIC	ND		ND		ND		ND	
	CAB	ND		ND		ND		ND	
	DTG	ND		ND		ND		ND	
	EVG	ND		ND		ND		ND	
	RAL	ND		ND		ND		ND	
HIV drug resistance among women starting ART									
NRTI	Any	3/120	4.0, 0.6–22.9	2/115	1.6, 0.3–7.4	7/84	9.4, 4.4–18.8	0/113	0.0, 0.0–3.3
	ABC	3/120	4.0, 0.6–22.9	1/115	0.5, 0.1–3.5	6/84	8.3, 3.7–17.8	0/113	0.0, 0.0–3.3
	3TC or FTC	3/120	4.0, 0.6–22.9	0/115	0.0, 0.0–3.2	1/84	1.2, 0.2–7.2	0/113	0.0, 0.0–3.3
	TDF	3/120	4.0, 0.6–22.9	1/115	0.5, 0.1–3.5	1/84	1.2, 0.2–7.2	0/113	0.0, 0.0–3.3
	ZDV	1/120	1.3, 0.2–8.8	1/115	1.2, 0.2–8.2	7/84	9.4, 4.4–18.8	0/113	0.0, 0.0–3.3
NNRTI	EFV or NVP	9/120	6.3, 1.2–26.9	5/115	3.6, 1.2–10.3	10/84	11.1, 5.8–20.2	5/113	2.8, 0.8–9.3
	DOR	5/120	4.4, 0.8–21.6	2/115	1.3, 0.2–7.9	7/84	8.7, 4.0–17.7	2/113	1.9, 0.4–8.5
	ETR	4/120	2.2, 0.6–7.6	3/115	2.3, 0.6–8.7	6/84	6.0, 2.8–12.4	3/113	1.1, 0.2–6.1
	RPV	10/120	5.6, 1.4–20.0	6/115	4.6, 1.3–14.8	10/84	11.6, 6.2–20.8	6/113	2.9, 0.9–9.3
PI/r	ATV/r, DRV/r or LPV/r	1/120	1.3, 0.2–8.8	0/115	0.0, 0.0–3.2	0/84	0.0, 0.0–4.4	0/113	0.0, 0.0–3.3
	ATV/r	1/120	1.3, 0.2–8.8	0/115	0.0, 0.0–3.2	0/84	0.0, 0.0–4.4	0/113	0.0, 0.0–3.3
	DRV/r	1/120	1.3, 0.2–8.8	0/115	0.0, 0.0–3.2	0/84	0.0, 0.0–4.4	0/113	0.0, 0.0–3.3
	LPV/r	1/120	1.3, 0.2–8.8	0/115	0.0, 0.0–3.2	0/84	0.0, 0.0–4.4	0/113	0.0, 0.0–3.3
INSTI	Any	ND		ND		ND		ND	
	BIC	ND		ND		ND		ND	
	CAB	ND		ND		ND		ND	
	DTG	ND		ND		ND		ND	
	EVG	ND		ND		ND		ND	
	RAL	ND		ND		ND		ND	
HIV drug resistance among men starting ART									
NRTI	Any	12/249	4.0, 1.7–9.4	3/206	1.3, 0.4–4.5	6/94	5.7, 2.7–11.3	5/207	2.9, 1.1–7.8
	ABC	7/249	2.9, 1.0–8.3	2/206	0.5, 0.1–2.0	6/94	5.7, 2.7–11.3	5/207	2.9, 1.1–7.8
	3TC or FTC	5/249	2.8, 0.9–8.3	2/206	0.5, 0.1–2.0	3/94	2.9, 1.0–7.7	3/207	2.0, 0.5–7.8
	TDF	4/249	2.7, 0.8–8.4	1/206	0.3, 0.0–2.1	2/94	1.8, 0.5–6.6	4/207	2.8, 1.0–7.8
	ZDV	7/249	3.7, 1.4–9.4	2/206	1.0, 0.2–4.7	3/94	3.1, 1.1–8.4	1/207	0.7, 0.1–5.0
NNRTI	EFV or NVP	18/249	6.7, 4.1–10.8	10/206	3.9, 1.9–7.9	11/94	10.2, 5.8–17.5	9/207	4.1, 1.6–10.0
	DOR	15/249	5.6, 3.0–10.2	4/206	1.5, 0.5–4.2	5/94	4.1, 1.8–8.7	2/207	0.7, 0.1–3.9
	ETR	9/249	3.6, 1.3–9.4	4/206	1.6, 0.5–5.0	3/94	2.2, 0.9–5.5	6/207	2.4, 0.7–8.4
	RPV	17/249	6.8, 3.3–13.6	12/206	6.0, 3.3–10.5	11/94	8.8, 5.1–14.8	13/207	7.3, 3.6–14.5
PI/r	ATV/r, DRV/r or LPV/r	1/249	0.6, 0.1–4.7	1/205	0.4, 0.0–2.9	0/94	0.0, 0.0–3.9	0/207	0.0, 0.0–1.8
	ATV/r	1/249	0.6, 0.1–4.7	1/205	0.4, 0.0–2.9	0/94	0.0, 0.0–3.9	0/207	0.0, 0.0–1.8
	DRV/r	1/249	0.6, 0.1–4.7	0/205	0.0, 0.0–1.8	0/94	0.0, 0.0–3.9	0/207	0.0, 0.0–1.8
	LPV/r	1/249	0.6, 0.1–4.7	0/205	0.0, 0.0–1.8	0/94	0.0, 0.0–3.9	0/207	0.0, 0.0–1.8
INSTI	Any	ND		ND		ND		ND	
	BIC	ND		ND		ND		ND	
	CAB	ND		ND		ND		ND	
	DTG	ND		ND		ND		ND	
	EVG	ND		ND		ND		ND	
	RAL	ND		ND		ND		ND	

a Study design–weighted proportion and 95% confidence interval.

b Prior ARV drug–exposed data were unknown.

HIV drug resistance was defined as the presence of a penalty score ≥15 using the Stanford HIVdb algorithm.

ABC: abacavir; ATV/r: atazanavir/ritonavir; BIC: bictegravir; CAB: cabotegravir; CI: confidence interval; DOR: doravirine; DRV/r: darunavir/ritonavir; DTG: dolutegravir; EFV: efavirenz; ETR: etravirine; EVG: elvitegravir; INSTI: integrase strand-transfer inhibitor; LPV/r: lopinavir/ritonavir; ND: no data; NNRTI: non-nucleoside reverse-transcriptase inhibitor; NRTI: nucleoside reverse-transcriptase inhibitor; NVP: nevirapine; PI/r: boosted protease inhibitor; RAL: raltegravir; RPV: rilpivirine; TDF: tenofovir disoproxil fumarate; ZDV: zidovudine; 3TC/FTC: lamivudine/emtricitabine.

Table A1.3p. Prevalence of pretreatment HIV drug resistance among adults – South-East Asia

		Indonesia (start year: 2016)		Myanmar (start year: 2016)		Thailand (start year: 2016)	
		n/N	%, 95% CI[a]	*n/N*	%, 95% CI[a]	*n/N*	%, 95% CI[a]
HIV drug resistance among treatment-naive ART initiators							
NRTI	Any	11/275	4.5, 2.1–9.4	5/287	1.5, 0.6–4.2	2/268	0.5, 0.1–3.0
	ABC	7/275	3.4, 1.4–8.2	3/287	0.5, 0.1–2.2	2/268	0.5, 0.1–3.0
	3TC or FTC	6/275	3.3, 1.3–8.3	2/287	0.4, 0.1–1.4	2/268	0.5, 0.1–3.0
	TDF	5/275	3.3, 1.2–8.3	2/287	0.4, 0.1–2.3	1/268	0.4, 0.0–3.4
	ZDV	7/275	4.2, 1.8–9.3	3/287	1.2, 0.4–3.9	0/268	0.0, 0.0–1.4
NNRTI	EFV or NVP	10/275	4.7, 2.2–9.4	9/287	2.7, 1.2–6.0	8/268	1.8, 0.6–5.0
	DOR	10/275	4.7, 2.2–9.4	5/287	1.4, 0.5–3.8	2/268	0.5, 0.1–3.0
	ETR	5/275	3.5, 1.3–9.3	7/287	2.0, 0.8–5.4	7/268	1.8, 0.5–6.7
	RPV	14/275	6.7, 3.4–13.0	17/287	5.9, 3.3–10.4	15/268	4.8, 2.2–10.3
PI/r	ATV/r, DRV/r or LPV/r	2/275	1.1, 0.3–4.6	1/286	0.3, 0.0–2.0	0/268	0.0, 0.0–1.4
	ATV/r	2/275	1.1, 0.3–4.6	1/286	0.3, 0.0–2.0	0/268	0.0, 0.0–1.4
	DRV/r	2/275	1.1, 0.3–4.6	0/286	0.0, 0.0–1.3	0/268	0.0, 0.0–1.4
	LPV/r	2/275	1.1, 0.3–4.6	0/286	0.0, 0.0–1.3	0/268	0.0, 0.0–1.4
INSTI	Any	ND		ND		ND	
	BIC	ND		ND		ND	
	CAB	ND		ND		ND	
	DTG	ND		ND		ND	
	EVG	ND		ND		ND	
	RAL	ND		ND		ND	
HIV drug resistance among ART initiators previously exposed to ARV drugs							
NRTI	Any	4/45	7.7, 1.4–32.7	0/32	0.0, 0.0–10.7	3/52	7.6, 3.3–16.6
	ABC	3/45	7.5, 1.3–33.0	0/32	0.0, 0.0–10.7	3/52	7.6, 3.3–16.6
	3TC or FTC	2/45	7.0, 1.1–34.0	0/32	0.0, 0.0–10.7	1/52	4.4, 0.9–19.4
	TDF	2/45	7.0, 1.1–34.0	0/32	0.0, 0.0–10.7	3/52	7.6, 3.3–16.6
	ZDV	1/45	0.2, 0.0–1.4	0/32	0.0, 0.0–10.7	1/52	2.4, 0.3–15.2
NNRTI	EFV or NVP	15/45	31.4, 15.0–54.3	6/32	15.7, 5.5–37.4	6/52	11.9, 5.5–23.8
	DOR	8/45	18.0, 7.8–36.2	1/32	1.8, 0.3–10.2	2/52	4.2, 1.0–16.3
	ETR	6/45	5.2, 1.5–16.9	0/32	0.0, 0.0–10.7	2/52	2.2, 0.3–13.2
	RPV	9/45	6.1, 2.0–17.1	0/32	0.0, 0.0–10.7	4/52	8.9, 4.2–18.0
PI/r	ATV/r, DRV/r or LPV/r	0/45	0.0, 0.0–7.9	0/32	0.0, 0.0–10.7	0/52	0.0, 0.0–6.9
	ATV/r	0/45	0.0, 0.0–7.9	0/32	0.0, 0.0–10.7	0/52	0.0, 0.0–6.9
	DRV/r	0/45	0.0, 0.0–7.9	0/32	0.0, 0.0–10.7	0/52	0.0, 0.0–6.9
	LPV/r	0/45	0.0, 0.0–7.9	0/32	0.0, 0.0–10.7	0/52	0.0, 0.0–6.9
INSTI	Any	ND		ND		ND	
	BIC	ND		ND		ND	
	CAB	ND		ND		ND	
	DTG	ND		ND		ND	
	EVG	ND		ND		ND	
	RAL	ND		ND		ND	

a Study design–weighted proportion and 95% confidence interval.

HIV drug resistance was defined as the presence of a penalty score ≥15 using the Stanford HIVdb algorithm.

ABC: abacavir; ATV/r: atazanavir/ritonavir; BIC: bictegravir; CAB: cabotegravir; CI: confidence interval; DOR: doravirine; DRV/r: darunavir/ritonavir; DTG: dolutegravir; EFV: efavirenz; ETR: etravirine; EVG: elvitegravir; INSTI: integrase strand-transfer inhibitor; LPV/r: lopinavir/ritonavir; ND: no data; NNRTI: non-nucleoside reverse-transcriptase inhibitor; NRTI: nucleoside reverse-transcriptase inhibitor; NVP: nevirapine; PI/r: boosted protease inhibitor; RAL: raltegravir; RPV: rilpivirine; TDF: tenofovir disoproxil fumarate; ZDV: zidovudine; 3TC/FTC: lamivudine/emtricitabine.

Table A1.3q. Prevalence of pretreatment HIV drug resistance among adults – the Western Pacific

		Papua New Guinea (start year: 2017)		Viet Nam (start year: 2017)	
		n/N	%, 95% CI[a]	*n/N*	%, 95% CI[a]
HIV drug resistance among ART initiators					
NRTI	Any	13/315	5.6, 1.6–17.1	13/340	3.5, 1.8–6.8
	ABC	11/315	4.8, 1.2–17.7	7/340	1.8, 0.8–4.0
	3TC or FTC	8/315	3.9, 0.9–15.3	2/340	0.3, 0.1–1.5
	TDF	10/315	4.5, 1.0–18.1	5/340	1.0, 0.3–2.7
	ZDV	5/315	2.3, 0.7–6.7	2/340	0.2, 0.0–0.7
NNRTI	EFV or NVP	49/315	17.8, 13.6–23.0	15/340	3.4, 1.8–6.2
	DOR	20/315	7.2, 3.9–12.7	30/340	10.5, 5.9–17.8
	ETR	12/315	4.4, 2.0–9.3	8/340	1.8, 0.8–3.9
	RPV	24/315	8.5, 5–14.1	11/340	2.4, 1.3–4.7
PI/r	ATV/r, DRV/r or LPV/r	0/315	0.0, 0.0–1.2	0/333	0.0, 0.0–1.1
	ATV/r	0/315	0.0, 0.0–1.2	0/333	0.0, 0.0–1.1
	DRV/r	0/315	0.0, 0.0–1.2	0/333	0.0, 0.0–1.1
	LPV/r	0/315	0.0, 0.0–1.2	0/333	0.0, 0.0–1.1
INSTI	Any	ND		ND	
	BIC	ND		ND	
	CAB	ND		ND	
	DTG	ND		ND	
	EVG	ND		ND	
	RAL	ND		ND	
HIV drug resistance among women starting ART					
NRTI	Any	7/193	5.0, 1.2–18.3	2/95	2.5, 0.5–11.5
	ABC	6/193	4.7, 1.0–18.7	1/95	2.2, 0.4–12.2
	3TC or FTC	6/193	4.7, 1.0–18.7	0/95	0.0, 0.0–3.9
	TDF	5/193	4.3, 0.8–19.4	0/95	0.0, 0.0–3.9
	ZDV	3/193	2.2, 0.4–10.8	1/95	0.3, 0.0–2.4
NNRTI	EFV or NVP	36/193	21.7, 16.7–27.7	0/95	0.0, 0.0–3.9
	DOR	14/193	8.0, 4.4–14.3	9/95	22.4, 6.8–53.2
	ETR	8/193	4.9, 2.3–10.2	0/95	0.0, 0.0–3.9
	RPV	18/193	10.2, 6.2–16.2	0/95	0.0, 0.0–3.9
PI/r	ATV/r, DRV/r or LPV/r	0/193	0.0, 0.0–2	0/93	0.0, 0.0–4.0
	ATV/r	0/193	0.0, 0.0–2	0/93	0.0, 0.0–4.0
	DRV/r	0/193	0.0, 0.0–2	0/93	0.0, 0.0–4.0
	LPV/r	0/193	0.0, 0.0–2	0/93	0.0, 0.0–4.0
INSTI	Any	ND		ND	
	BIC	ND		ND	
	CAB	ND		ND	
	DTG	ND		ND	
	EVG	ND		ND	
	RAL	ND		ND	
HIV drug resistance among men starting ART					
NRTI	Any	6/120	6.5, 2.1–18.3	11/245	3.9, 1.7–8.5
	ABC	5/120	5.0, 1.2–18.4	6/245	1.7, 0.7–4.0
	3TC or FTC	2/120	2.5, 0.5–11.3	2/245	0.4, 0.1–2.1
	TDF	5/120	5.0, 1.2–18.4	5/245	1.3, 0.5–3.7
	ZDV	2/120	2.4, 0.6–9.1	1/245	0.1, 0.0–0.8
NNRTI	EFV or NVP	12/120	10.5, 4.5–22.6	15/245	4.7, 2.5–8.6
	DOR	5/120	5.1, 2.0–12.4	21/245	5.9, 3.2–10.5
	ETR	4/120	3.6, 1.1–11.2	8/245	2.4, 1.1–5.4
	RPV	5/120	5.1, 2.0–12.4	11/245	3.4, 1.8–6.4
PI/r	ATV/r, DRV/r or LPV/r	0/120	0.0, 0.0–3.1	0/240	0.0, 0.0–1.6
	ATV/r	0/120	0.0, 0.0–3.1	0/240	0.0, 0.0–1.6
	DRV/r	0/120	0.0, 0.0–3.1	0/240	0.0, 0.0–1.6
	LPV/r	0/120	0.0, 0.0–3.1	0/240	0.0, 0.0–1.6
INSTI	Any	ND		ND	
	BIC	ND		ND	
	CAB	ND		ND	
	DTG	ND		ND	
	EVG	ND		ND	
	RAL	ND		ND	

a Study design–weighted proportion and 95% confidence interval.

HIV drug resistance was defined as the presence of a penalty score ≥15 using the Stanford HIVdb algorithm.

ABC: abacavir; ATV/r: atazanavir/ritonavir; BIC: bictegravir; CAB: cabotegravir; CI: confidence interval; DOR: doravirine; DRV/r: darunavir/ritonavir; DTG: dolutegravir; EFV: efavirenz; ETR: etravirine; EVG: elvitegravir; INSTI: integrase strand-transfer inhibitor; LPV/r: lopinavir/ritonavir; ND: no data; NNRTI: non-nucleoside reverse-transcriptase inhibitor; NRTI: nucleoside reverse-transcriptase inhibitor; NVP: nevirapine; PI/r: boosted protease inhibitor; RAL: raltegravir; RPV: rilpivirine; TDF: tenofovir disoproxil fumarate; ZDV: zidovudine; 3TC/FTC: lamivudine/emtricitabine.

Table A1.3r. Prevalence of pretreatment HIV drug resistance among adults – the Western Pacific

		Papua New Guinea (start year: 2017)		Viet Nam (start year: 2017)	
		n/N	%, 95% CI[a]	*n/N*	%, 95% CI[a]
HIV drug resistance among treatment-naive ART initiators					
NRTI	Any	6/254	2.7, 1.0–7.1	10/310	2.7, 1.2–6.1
	ABC	5/254	2.0, 0.6–6.5	6/310	1.7, 0.7–4.2
	3TC or FTC	2/254	0.8, 0.1–5.8	1/310	0.1, 0.0–0.8
	TDF	5/254	2.0, 0.6–6.5	5/310	1.1, 0.4–3.0
	ZDV	2/254	1.1, 0.3–4.6	2/310	0.2, 0.0–0.8
NNRTI	EFV or NVP	28/254	11.5, 7.0–18.5	10/310	2.7, 1.3–5.5
	DOR	11/254	3.8, 1.5–9.1	24/310	10.4, 5.6–18.5
	ETR	7/254	1.8, 0.6–5.5	6/310	1.5, 0.6–3.9
	RPV	15/254	4.9, 2.1–10.9	7/310	1.8, 0.8–4.2
PI/r	ATV/r, DRV/r or LPV/r	0/254	0.0, 0.0–1.5	0/305	0.0, 0.0–1.2
	ATV/r	0/254	0.0, 0.0–1.5	0/305	0.0, 0.0–1.2
	DRV/r	0/254	0.0, 0.0–1.5	0/305	0.0, 0.0–1.2
	LPV/r	0/254	0.0, 0.0–1.5	0/305	0.0, 0.0–1.2
INSTI	Any	ND		ND	
	BIC	ND		ND	
	CAB	ND		ND	
	DTG	ND		ND	
	EVG	ND		ND	
	RAL	ND		ND	
HIV drug resistance among ART initiators previously exposed to ARV drugs					
NRTI	Any	7/61	16.9, 4.1–49.1	2/20	6.5, 1.4–24.7
	ABC	6/61	15.9, 3.5–49.8	1/20	4.0, 0.6–20.9
	3TC or FTC	6/61	15.9, 3.5–49.8	1/20	4.0, 0.6–20.9
	TDF	5/61	14.5, 2.7–51.4	0/20	0.0, 0.0–16.1
	ZDV	3/61	6.8, 1.6–24.6	0/20	0.0, 0.0–16.1
NNRTI	EFV or NVP	21/61	42.4, 29.1–56.9	4/20	11.1, 2.9–33.9
	DOR	9/61	20.4, 8.7–41.1	6/20	18.2, 5.6–45.7
	ETR	5/61	14.6, 5.4–34.1	2/20	6.5, 1.8–21.0
	RPV	9/61	22.8, 10.8–41.8	3/20	8.6, 2.9–22.5
PI/r	ATV/r, DRV/r or LPV/r	0/61	0.0, 0.0–5.9	0/18	0.0, 0.0–17.6
	ATV/r	0/61	0.0, 0.0–5.9	0/18	0.0, 0.0–17.6
	DRV/r	0/61	0.0, 0.0–5.9	0/18	0.0, 0.0–17.6
	LPV/r	0/61	0.0, 0.0–5.9	0/18	0.0, 0.0–17.6
INSTI	Any	ND		ND	
	BIC	ND		ND	
	CAB	ND		ND	
	DTG	ND		ND	
	EVG	ND		ND	
	RAL	ND		ND	

a Study design–weighted proportion and 95% confidence interval.

HIV drug resistance was defined as the presence of a penalty score ≥15 using the Stanford HIVdb algorithm.

ABC: abacavir; ATV/r: atazanavir/ritonavir; BIC: bictegravir; CAB: cabotegravir; CI: confidence interval; DOR: doravirine; DRV/r: darunavir/ritonavir; DTG: dolutegravir; EFV: efavirenz; ETR: etravirine; EVG: elvitegravir; INSTI: integrase strand-transfer inhibitor; LPV/r: lopinavir/ritonavir; ND: no data; NNRTI: non-nucleoside reverse-transcriptase inhibitor; NRTI: nucleoside reverse-transcriptase inhibitor; NVP: nevirapine; PI/r: boosted protease inhibitor; RAL: raltegravir; RPV: rilpivirine; TDF: tenofovir disoproxil fumarate; ZDV: zidovudine; 3TC/FTC: lamivudine/emtricitabine.

Table A1.4a. Prevalence of mutations associated with HIV drug resistance to nucleoside reverse-transcriptase inhibitors among adults

Region	Country	Start year	Number of reverse transcriptase sequences	Mutations associated with HIV drug resistance to nucleoside reverse-transcriptase inhibitors (%)[c]																		
				E40F	M41L	*E44AD*	*A62V*	K65ENR	D67EGHNSTDel	*S68Del*	T69DGDelIns	K70EGNQRST	L74VI	V75AIMST	F77L	Y115F	F116Y	Q151LM	M184VI	L210W	T215ACDEFILNSVY	K219QENRW
Africa	Eritrea	2016	124	0.0	0.0	0.8	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Eswatini	2016	266	0.0	0.0	0.0	0.4	0.0	0.4	0.0	0.4	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.8	0.0	0.0	0.4
	Ethiopia	2017	277	0.0	0.0	0.7	0.7	0.7	0.7	0.0	0.0	2.5	0.0	0.0	0.0	0.0	0.0	0.0	2.9	0.7	0.7	0.7
	Lesotho	2018	376	0.0	0.0	0.0	0.3	0.8	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.5	0.0	0.5	0.8
	Namibia	2015	383	0.0	0.3	0.0	0.3	0.5	0.3	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	1.0	0.0	0.5	0.0
	South Sudan	2018	298	0.0	1.7	0.0	0.7	1.0	1.7	0.0	0.7	2.7	0.7	2.3	0.0	0.3	0.0	0.0	7.7	0.0	2.3	1.3
	Uganda	2016	342	0.0	1.5	1.8	0.0	0.3	0.3	0.0	0.0	1.2	0.0	0.0	0.3	0.0	0.0	0.0	1.5	0.6	1.8	0.6
	Zambia	2019	146	0.0	1.4	0.7	0.7	2.7	0.7	0.0	0.0	0.7	0.0	0.7	0.0	0.7	0.0	0.0	3.4	0.0	2.1	0.7
	Zimbabwe[a]	2015	353	0.0	0.3	0.0	0.0	0.6	0.0	0.0	0.0	0.3	0.0	0.3	0.0	0.0	0.0	0.0	0.3	0.0	0.3	0.3
The Americas	Argentina	2019	373	0.0	2.7	0.0	1.1	0.0	0.0	0.0	0.3	0.5	0.5	0.3	0.0	0.0	0.0	0.0	1.6	0.3	2.9	1.1
	Brazil	2014	1391	0.0	0.9	0.5	0.2	0.1	0.3	0.0	0.3	0.2	0.0	0.6	0.1	0.0	0.0	0.0	0.6	0.4	1.9	0.7
	Colombia[a]	2016	192	0.0	0.5	1.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	3.1	0.0
	Cuba[a]	2017	141	0.0	2.1	1.4	0.0	0.7	3.5	0.0	0.0	3.5	2.1	0.0	0.7	0.0	0.7	0.0	2.8	1.4	2.8	4.3
	Eastern Caribbean Countries[b]	2017	51	0.0	2.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	El Salvador	2018	209	0.0	0.0	0.0	0.0	1.0	1.0	0.0	0.0	1.0	1.0	0.0	0.0	1.0	0.0	0.0	4.3	0.0	2.4	2.4
	Guatemala	2016	241	0.0	0.8	0.0	0.0	0.0	0.0	0.0	0.8	0.0	1.2	0.0	0.0	0.0	0.0	0.0	0.8	0.0	0.8	0.0
	Haiti	2018	246	0.0	0.4	1.2	0.8	1.6	0.4	0.0	0.4	0.4	2.0	0.4	0.0	0.0	0.0	0.0	4.5	0.0	0.8	0.0
	Honduras	2016	161	0.0	3.7	0.0	1.2	0.0	1.2	0.0	0.0	1.2	0.6	0.6	0.0	0.0	0.0	0.0	7.5	1.2	5.0	0.6
	Mexico	2017	2006	0.0	0.6	0.2	0.3	0.2	0.5	0.0	0.2	0.2	0.4	0.3	0.0	0.0	0.0	0.0	1.1	0.2	1.6	0.7
	Nicaragua	2016	171	0.0	4.7	1.2	0.6	0.0	1.8	0.0	0.0	2.3	0.6	0.0	0.0	0.0	0.0	0.0	3.5	1.2	2.3	2.3
	Paraguay	2019	208	0.0	1.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.5	0.5	0.0	0.0	0.0	0.0	1.4	1.4	2.4	0.5
	Uruguay	2018	204	0.0	2.5	0.0	1.5	0.0	1.0	0.0	0.5	0.0	0.5	0.0	0.0	0.0	0.0	0.0	2.0	1.5	6.4	1.5
South-East Asia and the Western Pacific	Indonesia	2016	370	0.0	0.8	0.0	0.5	0.8	0.3	0.0	0.3	0.8	0.3	0.3	0.3	0.0	0.0	0.0	1.6	0.5	1.6	1.1
	Myanmar	2016	327	0.0	0.3	0.0	0.0	0.3	0.3	0.0	0.0	0.3	0.3	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.6	0.0
	Nepal	2016	184	0.0	4.9	2.7	0.0	0.0	1.1	0.0	0.0	1.6	4.3	0.0	0.0	0.0	0.0	0.0	2.2	0.0	1.1	0.0
	Papua New Guinea	2017	315	0.0	0.6	0.3	1.0	1.3	1.0	0.0	0.0	1.9	1.0	0.6	0.0	0.3	0.0	0.0	2.2	0.3	1.0	1.0
	Thailand	2016	320	0.0	0.0	0.0	0.3	0.6	0.3	0.0	0.0	0.6	0.0	0.0	0.0	0.3	0.0	0.0	0.9	0.0	0.3	0.3
	Viet Nam	2017	340	0.0	0.6	0.0	0.0	0.0	0.0	0.0	0.6	0.6	0.6	3.0	0.0	0.0	0.0	0.0	0.6	0.0	0.6	0.0

a Previously ARV drug–exposed participants were not included in the survey.

b Eastern Caribbean Countries: Antigua and Barbuda, Dominica, Grenada, Saint Kitts and Nevis, Saint Lucia and Saint Vincent and the Grenadines.

c Unweighted proportions of sequences that have non-zero penalty scores in the Stanford HIVdb algorithm. Mutations in italics correspond to non-SDRM positions (may include polymorphisms).

Table A1.4b. Prevalence of mutations associated with HIV drug resistance to non-nucleoside reverse-transcriptase inhibitors among adults

Region	Country	Start year	Number of reverse-transcriptase sequences	Mutations associated with HIV drug resistance to non-nucleoside reverse-transcriptase inhibitors (%)[c]																				
				A98G	**L100IV**	**K101EHP**	**K103HNST**	*K103R*	**V106MA**	*V106I*	*V108I*	*E138A*	*E138GKQR*	**V179FL**	*V179DE*	**Y181CFGISV**	**Y188CFHL**	**G190ACEQSTV**	*H221Y*	**P225H**	*F227CILV*	**M230IL**	*L234I*	*P236L*	*K238NT*
Africa	Eritrea	2016	124	0.0	0.0	0.0	3.2	0.8	0.0	0.0	1.6	3.2	0.0	0.0	0.0	0.8	0.0	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Eswatini	2016	266	0.0	0.4	1.9	6.4	2.6	2.3	0.4	0.4	14.7	1.1	0.0	3.8	0.4	0.4	2.6	0.0	0.8	0.4	0.0	0.0	0.0	0.0
	Ethiopia	2017	277	1.4	0.0	1.4	6.5	1.1	1.8	0.0	1.1	2.5	0.0	0.0	0.7	2.5	0.0	1.1	0.4	0.0	0.7	0.0	0.0	0.0	0.0
	Lesotho	2018	376	1.9	0.0	0.5	11.7	1.6	1.9	0.3	0.8	5.9	0.0	0.0	2.1	1.1	0.5	1.6	0.3	0.8	0.3	0.5	0.3	0.0	0.0
	Namibia	2015	383	1.6	0.3	1.6	8.9	1.3	1.0	0.5	0.8	5.7	1.8	0.0	1.8	0.8	0.3	1.3	0.5	0.3	0.0	0.0	0.0	0.0	0.0
	South Sudan	2018	298	2.7	1.3	1.3	18.1	0.7	1.0	2.3	1.0	1.0	1.3	0.0	1.7	3.4	1.7	0.7	0.7	2.0	0.3	0.3	0.0	0.0	0.7
	Uganda	2016	342	1.2	0.3	0.3	9.1	0.6	0.3	0.9	1.2	3.5	1.8	0.6	1.5	2.0	0.6	0.6	1.2	0.3	0.0	0.0	0.0	0.0	0.9
	Zambia	2019	146	2.7	0.7	0.7	4.8	2.7	3.4	0.7	2.1	8.9	0.0	0.0	2.1	3.4	0.7	2.7	2.1	0.0	0.0	0.0	0.0	0.0	0.0
	Zimbabwe[a]	2015	353	1.1	0.0	0.8	7.4	1.7	0.3	0.0	0.3	15.0	0.8	0.0	1.4	0.6	0.0	1.7	0.3	0.0	0.0	0.0	0.0	0.0	0.0
The Americas	Argentina	2019	373	0.5	0.8	0.8	12.6	4.6	0.5	5.1	1.6	1.6	2.1	0.0	2.7	1.9	0.3	4.6	1.6	0.8	0.0	0.0	0.0	0.0	0.5
	Brazil	2014	1391	0.6	0.2	0.2	4.2	1.4	0.1	5.2	0.6	3.8	0.9	0.1	1.9	0.4	0.2	1.4	0.1	0.6	0.0	0.0	0.1	ND	ND
	Colombia[a]	2016	192	0.0	0.0	0.0	4.7	2.1	0.0	3.6	0.5	4.2	0.0	0.0	4.2	0.0	0.0	2.1	0.0	0.0	0.0	0.0	0.0	0.0	0.5
	Cuba[a]	2017	141	0.0	0.7	1.4	14.2	3.5	0.0	1.4	0.7	0.7	1.4	0.0	7.8	4.3	0.0	3.5	3.5	0.0	2.1	2.1	0.0	0.0	1.4
	Eastern Caribbean Countries[b]	2017	51	0.0	0.0	0.0	13.7	0.0	0.0	3.9	2.0	0.0	0.0	0.0	2.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	El Salvador	2018	209	0.0	1.4	1.9	12.9	3.3	0.0	1.9	2.9	2.9	1.0	0.0	6.7	2.4	0.5	3.3	1.9	2.9	0.5	0.0	0.0	0.0	0.0
	Guatemala	2016	241	0.4	0.8	1.2	7.1	6.6	0.0	2.9	2.5	0.8	1.2	0.0	7.1	0.8	0.0	6.6	0.4	0.4	0.0	0.0	0.0	0.0	0.0
	Haiti	2018	246	1.6	1.6	0.4	22.8	1.2	1.2	2.8	1.6	2.4	0.0	0.0	2.8	0.4	0.8	1.2	0.0	4.1	0.4	0.4	0.0	0.0	1.2
	Honduras	2016	161	0.6	0.0	1.2	21.7	10.6	1.2	5.0	4.3	3.1	0.6	0.0	5.6	0.0	2.5	10.6	0.0	2.5	0.0	0.6	0.0	0.0	2.5
	Mexico	2017	2006	0.2	0.3	0.7	6.4	6.2	0.2	3.8	1.1	2.4	0.5	0.0	6.0	0.5	0.5	6.2	0.2	0.6	0.0	0.0	0.0	0.0	0.1
	Nicaragua	2016	171	0.6	1.2	0.0	15.8	1.8	1.8	2.3	1.8	4.7	0.6	0.0	4.1	0.6	0.6	1.8	0.0	2.3	0.0	0.0	0.0	0.0	0.6
	Paraguay	2019	208	0.0	0.0	1.4	9.1	2.4	0.0	11.5	1.9	4.3	0.5	0.0	2.9	1.0	0.0	2.4	0.0	0.0	0.0	0.5	0.0	0.0	0.5
	Uruguay	2018	204	1.0	0.0	2.5	10.3	2.0	0.0	7.4	1.5	6.9	1.5	0.0	4.9	2.0	0.5	2.0	0.5	1.5	0.0	0.0	0.0	0.0	0.5
South-East Asia and the Western Pacific	Indonesia	2016	370	0.0	0.3	0.8	3.8	0.3	0.8	2.7	0.5	2.2	1.1	0.0	4.1	2.4	0.8	0.3	0.8	0.8	0.0	0.0	0.0	0.0	0.0
	Myanmar	2016	327	0.3	0.3	0.3	2.1	3.1	0.6	3.1	0.3	2.8	0.9	0.0	6.1	1.2	0.0	3.1	0.0	0.3	0.0	0.0	0.0	0.0	0.0
	Nepal	2016	184	3.3	0.0	1.1	5.4	3.3	0.5	0.5	1.6	3.8	2.7	0.0	2.7	0.5	0.0	3.3	0.0	0.0	0.0	0.5	0.0	0.0	0.0
	Papua New Guinea	2017	315	1.3	0.6	1.0	11.7	0.3	1.9	0.0	0.3	1.0	0.6	0.0	0.3	2.2	0.3	0.3	0.3	1.3	0.6	0.3	0.0	0.0	0.6
	Thailand	2016	320	0.3	0.0	0.3	1.6	1.3	0.3	7.8	0.0	3.1	0.6	0.0	6.6	1.3	0.3	1.3	0.3	0.0	0.3	0.0	0.0	0.0	0.6
	Viet Nam	2017	340	1.2	0.0	0.6	3.0	0.6	0.0	11.3	0.0	0.0	0.0	0.0	3.0	1.2	0.6	0.6	1.2	0.6	0.0	0.0	0.0	0.0	0.0

a Previously ARV drug–exposed participants were not included in the survey.

b Eastern Caribbean Countries: Antigua and Barbuda, Dominica, Grenada, Saint Kitts and Nevis, Saint Lucia and Saint Vincent and the Grenadines.

c Unweighted proportions of sequences that have non-zero penalty scores in the Stanford HIVdb algorithm. Mutations in italics correspond to non-SDRM positions (may include polymorphisms).

ND: no data

Table A1.4c. Prevalence of mutations associated with HIV drug resistance to protease inhibitors among adults

Region	Country	Start year	Number of protease sequences	Mutations associated with HIV drug resistance to protease inhibitors (%)[c]												
				L10F	*V11IL*	*K20T*	L23I	L24IFM	D30N	V32I	*L33F*	*K43T*	M46ILV	I47VA	G48LMQSTV	I50VL
Africa	Eritrea	2016	124	0.0	0.8	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Eswatini	2016	266	0.0	1.1	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.4	0.0	0.0
	Ethiopia	2017	277	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.4	0.0	0.0
	Lesotho	2018	376	0.0	0.5	0.0	0.0	0.0	0.3	0.0	0.3	0.0	0.3	0.0	0.0	0.0
	Namibia	2015	383	0.0	0.8	0.0	0.0	0.3	0.0	0.0	0.5	0.3	1.6	0.3	0.0	0.0
	South Sudan	2018	298	0.3	2.7	0.0	0.0	0.0	0.3	0.0	1.7	0.7	0.0	0.0	0.0	0.3
	Uganda	2016	342	0.6	0.6	0.0	0.0	0.0	0.0	0.0	1.5	0.6	1.2	0.3	0.0	0.0
	Zambia	2019	146	0.0	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Zimbabwe[a]	2015	353	0.0	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
The Americas	Argentina	2019	373	0.3	0.3	0.0	0.0	0.0	0.3	0.3	0.3	0.3	0.5	0.0	0.0	0.3
	Brazil	2014	1391	0.3	0.4	0.2	0.0	0.0	0.1	0.1	0.4	0.4	0.9	0.0	0.0	0.1
	Colombia[a]	2016	192	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0
	Cuba[a]	2017	141	0.0	1.4	0.0	0.0	0.0	0.7	0.0	0.0	0.0	1.4	0.0	0.0	0.0
	Eastern Caribbean Countries[b]	2017	51	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	El Salvador	2018	209	0.0	0.5	0.0	0.0	0.5	0.0	0.0	2.4	0.0	0.0	0.5	0.0	0.0
	Guatemala	2016	241	0.8	0.4	0.0	0.0	0.4	0.0	0.0	1.2	0.4	0.4	0.0	0.0	0.0
	Haiti	2018	246	0.4	0.4	0.4	0.0	0.0	0.0	0.0	0.8	0.4	0.4	0.0	0.0	0.0
	Honduras	2016	161	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.0	0.0	0.0	0.0
	Mexico	2017	2006	0.3	0.3	0.0	0.0	0.0	0.1	0.1	0.5	0.4	1.0	0.0	0.0	0.0
	Nicaragua	2016	171	0.0	0.6	0.6	0.0	0.0	0.0	0.0	0.6	0.6	0.0	0.0	0.0	0.0
	Paraguay	2019	208	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0
	Uruguay	2018	204	0.0	1.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.5	0.5	0.0	0.0
South-East Asia and the Western Pacific	Indonesia	2016	370	0.0	0.8	0.0	0.0	0.0	0.0	0.3	4.9	0.3	1.1	0.3	0.0	0.0
	Myanmar	2016	327	0.3	0.9	0.6	0.0	0.3	0.0	0.0	4.6	0.0	1.2	0.0	0.0	0.0
	Nepal	2016	182	0.0	1.1	0.5	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0
	Papua New Guinea	2017	315	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Thailand	2016	320	0.0	0.6	0.3	0.0	0.0	0.0	0.0	1.6	0.0	1.3	0.0	0.0	0.0
	Viet Nam	2017	333	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.0	1.2	0.0	0.0	0.0

a Previously ARV drug–exposed participants were not included in the survey.

b Eastern Caribbean Countries: Antigua and Barbuda, Dominica, Grenada, Saint Kitts and Nevis, Saint Lucia and Saint Vincent and the Grenadines.

c Unweighted proportions of sequences that have non-zero penalty scores in the Stanford HIVdb algorithm. Mutations in italics correspond to non-SDRM positions (may include polymorphisms).

Table A1.4c. Continued

Region	Country	Start year	Number of protease sequences	Mutations associated with HIV drug resistance to protease inhibitors (%)[c]												
				F53LY	I54VLMATS	*Q58E*	G73ADCSTV	*T74P*	L76V	V82ATFSCML	N83D	I84VAC	I85V	N88DGST	*L89V*	L90M
Africa	Eritrea	2016	124	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.0	0.0	0.0
	Eswatini	2016	266	0.0	0.0	2.6	0.4	0.0	0.0	0.0	0.4	0.0	0.4	0.0	0.0	0.4
	Ethiopia	2017	277	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.0
	Lesotho	2018	376	0.3	0.3	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.3	0.0	0.0
	Namibia	2015	383	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.3	0.3
	South Sudan	2018	298	0.0	0.0	2.7	0.0	0.0	0.0	0.3	0.0	0.0	5.7	0.0	0.3	0.3
	Uganda	2016	342	0.0	0.0	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.3
	Zambia	2019	146	0.0	0.0	1.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Zimbabwe[a]	2015	353	0.0	0.0	2.3	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.0	0.0
The Americas	Argentina	2019	373	0.0	0.3	0.5	0.3	0.3	0.0	0.8	0.0	0.0	0.5	0.0	0.0	1.1
	Brazil	2014	1391	0.2	0.1	0.6	0.0	0.1	0.0	0.6	0.0	0.1	0.6	0.2	0.1	0.2
	Colombia[a]	2016	192	0.0	0.0	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0
	Cuba[a]	2017	141	0.0	0.0	0.7	0.0	0.7	0.0	0.7	0.0	0.0	0.0	0.0	0.0	0.0
	Eastern Caribbean Countries[b]	2017	51	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.9	0.0	0.0	0.0
	El Salvador	2018	209	0.0	0.5	1.0	0.5	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Guatemala	2016	241	0.0	0.4	0.8	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.4	0.0	0.0
	Haiti	2018	246	0.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.0	0.0	0.0
	Honduras	2016	161	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Mexico	2017	2006	0.2	0.4	1.5	0.0	0.0	0.1	0.4	0.0	0.2	0.0	0.3	0.0	1.0
	Nicaragua	2016	171	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Paraguay	2019	208	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Uruguay	2018	204	0.0	0.5	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.5	0.0	0.0	0.0
South-East Asia and the Western Pacific	Indonesia	2016	370	0.0	0.3	1.1	0.0	0.0	0.3	0.5	0.0	0.0	0.0	0.0	0.0	0.3
	Myanmar	2016	327	0.0	0.0	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.0
	Nepal	2016	182	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0
	Papua New Guinea	2017	315	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0
	Thailand	2016	320	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0
	Viet Nam	2017	333	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

a Previously ARV drug–exposed participants were not included in the survey.

b Eastern Caribbean Countries: Antigua and Barbuda, Dominica, Grenada, Saint Kitts and Nevis, Saint Lucia and Saint Vincent and the Grenadines.

c Unweighted proportions of sequences that have non-zero penalty scores in the Stanford HIVdb algorithm. Mutations in italics correspond to non-SDRM positions (may include polymorphisms).

Table A1.4d. Prevalence of mutations associated with HIV drug resistance to integrase strand-transfer inhibitors among adults

Region	Country	Start year	Number of integrase sequences	Mutations associated with HIV drug resistance to integrase strand-transfer inhibitors (%)[a]										
				H51Y	T66AIK	E92GQV	*Q95K*	*T97A*	G118R	F121CY	E138AKT	G140ACRS	Y143CGHKRS	*P145S*
Africa	Ethiopia	2017	341	0.0	0.0	0.3	0.3	0.6	0.0	0.0	0.0	0.0	0.0	0.0
	South Sudan	2018	256	0.0	0.0	0.0	0.0	4.3	0.0	0.0	0.0	0.0	0.0	0.0
	Zambia	2019	135	0.0	0.0	0.0	0.0	3.7	0.0	0.0	0.0	0.0	0.0	0.0
The Americas	Argentina	2019	375	0.0	0.0	0.0	0.5	2.9	0.0	0.0	0.0	0.3	0.3	0.0
	El Salvador	2018	197	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0
	Guatemala	2016	206	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0
	Mexico	2017	1855	0.0	0.0	0.0	0.2	0.8	0.0	0.0	0.1	0.0	0.0	0.0
	Nicaragua	2016	166	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Paraguay	2019	208	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0
	Uruguay	2018	205	0.0	0.0	0.0	0.5	2.0	0.0	0.0	0.0	0.0	0.0	0.0

Region	Country	Start year	Number of integrase sequences	Mutations associated with HIV drug resistance to integrase strand-transfer inhibitors (%)[a]										
				Q146P	S147G	Q148HKNR	*V151AL*	*S153FY*	N155HST	*E157Q*	*G163KR*	S230R	*D232N*	R263K
Africa	Ethiopia	2017	341	0.0	0.0	0.0	0.0	0.0	0.0	2.9	0.6	0.0	0.0	0.0
	South Sudan	2018	256	0.0	0.0	0.0	0.0	0.4	0.0	3.1	0.4	0.0	0.0	0.0
	Zambia	2019	135	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
The Americas	Argentina	2019	375	0.0	0.0	0.0	0.0	0.0	0.0	0.5	9.1	0.0	0.3	0.0
	El Salvador	2018	197	0.0	0.5	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.5	0.0
	Guatemala	2016	206	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.5	0.0	0.0	0.0
	Mexico	2017	1855	0.0	0.0	0.0	0.0	0.0	0.0	1.2	0.1	0.0	0.2	0.0
	Nicaragua	2016	166	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.6	0.0
	Paraguay	2019	208	0.0	0.0	0.0	0.0	0.0	0.0	0.5	3.4	0.0	0.0	0.0
	Uruguay	2018	205	0.0	0.0	0.0	0.0	0.0	0.0	2.0	12.7	0.0	0.0	0.0

a Unweighted proportions of sequences that have non-zero penalty scores in the Stanford HIVdb algorithm. Mutations in italics correspond to non-SDRM positions (may include polymorphisms).

SECTION 2: PRETREATMENT HIV DRUG RESISTANCE AMONG INFANTS NEWLY DIAGNOSED WITH HIV

Table A2.1a. Population characteristics of infants newly diagnosed with HIV – Africa

	Cameroon[b] (start year: 2014) *N*=411		Eswatini (start year: 2011) *N*=197		Kenya (start year: 2018) *N*=478	
	n/N	%, 95% CI[c]	*n/N*	%, 95% CI[c]	*n/N*	%, 95% CI[c]
Sex						
Female	0/411	0.0, 0.0–0.9	96/197	48.7, 41.7–55.8	209/478	45.3, 40.5–50.2
Male	0/411	0.0, 0.0–0.9	91/197	46.2, 39.2–53.2	269/478	54.7, 49.8–59.5
Unknown	411/411	100.0, 99.1–100.0	10/197	5.1, 2.0–8.2	0/478	0.0, 0.0–0.8
Mean age, 95% CI (years)[a]	**5.8, 5.3–6.3**		**5.9, 5.3–6.5**		**6.4, 5.9–6.9**	
Aged ≤6 months	147/411	38.9, 34.1–44.0	82/197	41.6, 34.7–48.6	210/478	46.3, 41.4–51.2
Aged >6 months	243/411	61.1, 56.0–65.9	115/197	58.4, 51.4–65.3	268/478	53.7, 48.8–58.6
PMTCT exposure						
Yes	167/411	39.3, 34.6–44.2	148/197	75.1, 69.0–81.2	422/478	88.6, 85.2–91.3
No	158/411	40.7, 36.0–45.6	22/197	11.2, 6.7–15.6	54/478	10.8, 8.2–14.1
Unknown	86/411	20.0, 16.4–24.1	27/197	13.7, 8.9–18.6	2/478	0.6, 0.2–2.5
Breastfeeding						
Yes	288/411	70.1, 65.3–74.4	123/197	62.4, 55.6–69.3	421/478	87.8, 84.1–90.7
No	18/411	4.5, 2.8–7.1	66/197	33.5, 26.9–40.2	9/478	2.1, 1.0–4.2
Unknown	105/411	25.4, 21.4–30.0	8/197	4.1, 1.3–6.8	48/478	10.1, 7.5–13.5
Type of PMTCT exposure						
Maternal prophylaxis	109/411	23.9, 20.2–28.0	125/197	63.5, 56.7–70.2	390/478	82.3, 78.4–85.6
Infant prophylaxis	126/411	30.2, 25.9–35.0	128/197	65.0, 58.3–71.7	289/478	58.3, 53.4–63.1
Both maternal ART and infant prophylaxis	68/411	17.5, 14.0–21.7	105/197	53.3, 46.3–60.3	257/478	54.4, 49.4–59.3

a Study design–weighted mean and 95% confidence interval.
b Twenty-one participants had missing data for age.
c Study design–weighted proportion and 95% confidence interval.
ART: antiretroviral therapy; CI: confidence interval; PMTCT: prevention of mother-to-child HIV transmission.

Table A2.1b. Population characteristics of infants newly diagnosed with HIV – Africa

	Malawi[b] (start year: 2016) *N*=405		Mozambique[d] (start year: 2012) *N*=400		Nigeria[e] (start year: 2016) *N*=547	
	n/N	%, 95% CI[c]	*n/N*	%, 95% CI[c]	*n/N*	%, 95% CI[c]
Sex						
Female	176/405	38.2, 32.8–43.8	195/400	48.8, 43.8–53.7	242/547	43.7, 39.0–48.4
Male	167/405	47.2, 41.5–53.0	170/400	42.5, 37.6–47.4	252/547	44.9, 40.1–49.8
Unknown	62/405	14.6, 11.0–19.2	35/400	8.8, 6.0–11.5	53/547	11.4 (8.8–14.8)
Mean age, 95% CI (years)[a]	**5.1, 4.6–5.6**		**4.6, 4.2–4.9**		**6.0, 5.6–6.5**	
Aged ≤6 months	147/405	37.7, 32.0–43.8	97/400	24.3, 20.0–28.5	200/547	40.4, 35.4–45.6
Aged >6 months	252/405	62.3, 56.2–68.0	300/400	75.8, 71.5–80.0	288/547	59.6, 54.4–64.6
PMTCT exposure						
Yes	308/405	77.3, 71.9–81.9	338/400	84.5, 80.9–88.1	259/547	52.1, 47.7–56.5
No	3/405	1.6, 0.5–5.3	16/400	4.0, 2.1–5.9	117/547	20.3, 16.7–24.4
Unknown	94/405	21.1, 16.7–26.3	46/400	11.5, 8.4–14.6	171/547	20.3, 16.7–24.4
Breastfeeding						
Yes	265/405	66.2, 60.2–71.8	0/400	0.0, 0.0–1.0	414/547	79.2, 75.4–82.5
No	140/405	33.8, 28.2–39.8	0/400	0.0, 0.0–1.0	44/547	5.2, 3.8–7.0
Unknown	0/405	0.0, 0.0–0.9	400/400	10.0, 99.0–100.0	89/547	15.7, 12.7–19.2
Type of PMTCT exposure						
Maternal prophylaxis	302/405	76.0, 70.5–80.7	260/400	65.0, 60.3–69.7	209/547	41.2, 36.9–45.6
Infant prophylaxis	141/405	31.5, 26.5–37.0	304/400	76.0, 71.8–80.2	183/547	37.3, 33.1–41.7
Both maternal ART and infant prophylaxis	135/405	30.4, 25.4–35.8	226/400	56.5, 51.6–61.4	133/547	28.3, 24.3–32.6

a Study design–weighted mean and 95% confidence interval.
b Six participants had missing data for age.
c Study design–weighted proportion and 95% confidence interval.
d Three participants had missing data for age.
e Fifty-nine participants had missing data for age.
ART: antiretroviral therapy; CI: confidence interval; PMTCT: prevention of mother-to-child HIV transmission.

Table A2.1c. Population characteristics of infants newly diagnosed with HIV – Africa

	Togo (start year: 2012) *N*=201		Uganda (start year: 2017) *N*=494		Zimbabwe (start year: 2012) *N*=227	
	n/N	%, 95% CI[b]	*n/N*	%, 95% CI[b]	*n/N*	%, 95% CI[b]
Sex						
Female	105/201	52.2, 45.3–59.1	269/494	54.5, 50.0–58.8	116/227	51.1, 44.5–57.7
Male	95/201	47.3, 40.4–54.2	225/494	45.5, 41.2–50.0	105/227	46.3, 39.7–52.8
Unknown	1/201	<0.5	0/494	0.0, 0.0–0.8	6/227	2.6, 0.1–4.8
Mean age, 95% CI (years)[a]	**6.0, 5.4–6.7**		**5.0, 4.6–5.4**		**6.0, 5.4–6.6**	
Aged ≤6 months	81/201	40.3, 33.7–47.3	137/494	27.7, 24.0–31.9	99/227	43.6, 37.1–50.1
Aged >6 months	120/201	59.7, 52.7–66.3	357/494	72.3, 68.1–76.0	128/227	56.4, 49.9–62.9
PMTCT exposure						
Yes	131/201	65.2, 58.3–71.5	417/494	84.4, 80.9–87.4	174/227	76.7, 71.1–82.2
No	46/201	22.9, 17.6–29.3	69/494	14.0, 11.2–17.3	46/227	20.3, 15.0–25.5
Unknown	24/201	11.9, 8.1–17.2	8/494	1.6, 0.8–3.2	7/227	3.1, 0.8–5.3
Breastfeeding						
Yes	156/201	77.6, 71.3–82.9	377/494	76.3, 72.4–79.9	172/227	75.8, 70.2–81.4
No	18/201	9.0, 5.7–13.8	101/494	20.4, 17.1–24.2	35/227	15.4, 10.7–20.2
Unknown	27/201	13.4, 9.3–18.9	16/494	3.2, 2.0–5.2	20/227	8.8, 5.1–12.5
Type of PMTCT exposure						
Maternal prophylaxis	90/201	44.8, 38.0–51.8	412/494	83.4, 79.8–86.4	134/227	60.8, 54.4–67.2
Infant prophylaxis	111/201	55.2, 48.2–62.0	395/494	80.0, 76.2–83.3	151/227	66.5, 60.3–72.7
Both maternal ART and infant prophylaxis	70/201	44.8, 38.0–51.8	390/494	79.8, 75.9–83.1	115/227	50.7, 44.1–57.2

a Study design–weighted mean and 95% confidence interval.
b Study design–weighted proportion and 95% confidence interval.
ART: antiretroviral therapy; CI: confidence interval; PMTCT: prevention of mother-to-child HIV transmission

Table A2.2. Distribution of HIV subtype among infants newly diagnosed with HIV – Africa

Country	Start year	N	Subtype (%)[a]														
			A	B	C	D	F	F2	G	CRF01_AE	CRF02_AG	CRF06_cpx	CRF11_cpx	CRF12_BF	CRF18_cpx	CRF20_BG	URF, other
Cameroon	2014	372	9.9	0.8	0.3	1.6	0.0	2.4	5.9	0.3	70.7	0.0	0.0	0.0	0.0	0.0	8.1
Eswatini	2011	196	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Kenya	2018	320	76.9	3.4	5.9	12.2	0.0	0.0	2.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Malawi	2016	230	0.4	0.0	99.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mozambique	2012	392	1.3	0.3	96.7	1.3	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Nigeria	2016	418	5.3	0.5	0.5	0.5	0.0	0.0	42.1	0.0	45.7	0.0	0.0	0.0	0.0	0.0	5.5
South Africa	2014	402	0.0	0.0	99.8	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Togo	2012	201	6.5	0.5	0.0	0.0	0.0	0.0	12.4	0.0	59.2	0.0	0.0	0.0	0.0	0.0	21.4
Uganda	2017	141	60.3	4.3	5.0	30.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Zimbabwe	2012	224	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

a Unweighted proportions of HIV subtypes. HIV subtype was assigned using the Stanford HIVdb subtyping tool.

Table A2.3a. Prevalence of pretreatment HIV drug resistance among infants newly diagnosed with HIV – Africa

		Cameroon (start year: 2014)		Eswatini (start year: 2011)		Kenya (start year: 2018)		Malawi (start year: 2016)	
		n/N	%, 95% CI[a]	*n/N*	%, 95% CI[a]	*n/N*	%, 95% CI[a]	*n/N*	%, 95% CI[a]
HIV drug resistance among all infants									
NRTI	Any	38/372	10.0, 7.3–13.4	4/196	2.0, 0.8–5.4	28/320	9.6, 6.6–13.8	45/230	25.1, 16.8–35.7
	ABC	26/372	6.8, 4.7–9.9	3/196	1.5, 0.5–4.7	20/320	6.4, 4.0–10.0	37/230	19.8, 12.4–30.0
	3TC or FTC	22/372	5.8, 3.8–8.7	2/196	1.0, 0.3–4.0	14/320	5.0, 2.9–8.4	28/230	14.5, 8.6–23.5
	TDF	10/372	2.5, 1.4–4.6	1/196	0.5, 0.1–3.6	11/320	3.2, 1.7–6.1	14/230	7.7, 3.4–16.5
	ZDV	23/372	6.1, 4.1–9.0	1/196	0.5, 0.1–3.6	13/320	4.8, 2.7–8.2	10/230	7.3, 3.0–16.9
NNRTI	EFV or NVP	178/372	46.8, 41.8–51.9	67/196	34.2, 27.8–41.2	138/320	43.8, 38.0–49.7	143/230	68.0, 60.8–74.5
	DOR	93/372	24.5, 20.4–29.1	27/196	13.8, 9.6–19.4	46/320	14.5, 10.8–19.2	86/230	39.8, 30.3–50.2
	ETR	117/372	30.5, 26.1–35.3	50/196	25.5, 19.9–32.1	40/320	12.3, 8.9–16.8	48/230	17.7, 11.5–26.2
	RPV	142/372	37.1, 32.4–42.0	69/196	35.2, 28.8–42.2	72/320	22.9, 18.3–28.3	77/230	27.8, 20.3–36.8
PI/r	ATV/r, DRV/r or LPV/r	0/372	0.0, 0.0–1.0	ND		2/320	0.9, 0.2–3.5	0/230	0.0, 0.0–1.6
	ATV/r	0/372	0.0, 0.0–1.0	ND		2/320	0.9, 0.2–3.5	0/230	0.0, 0.0–1.6
	DRV/r	0/372	0.0, 0.0–1.0	ND		2/320	0.9, 0.2–3.5	0/230	0.0, 0.0–1.6
	LPV/r	0/372	0.0, 0.0–1.0	ND		0/320	0.0, 0.0–1.2	0/230	0.0, 0.0–1.6
HIV drug resistance among infants exposed to PMTCT									
NRTI	Any	21/158	13.1, 8.7–19.3	4/147	2.7, 1.0–7.1	24/278	9.5, 6.3–14.1	40/197	26.8, 17.7–38.2
	ABC	18/158	11.3, 7.2–17.4	3/147	2.0, 0.7–6.2	16/278	5.8, 3.4–9.6	36/197	21.8, 13.7–32.9
	3TC or FTC	16/158	10.0, 6.2–15.8	2/147	1.4, 0.3–5.3	11/278	4.4, 2.4–7.9	27/197	16.0, 9.5–25.7
	TDF	7/158	4.3, 2.0–8.7	1/147	0.7, 0.1–4.7	8/278	2.6, 1.2–5.6	14/197	8.5, 3.7–18.1
	ZDV	10/158	6.3, 3.4–11.4	1/147	0.7, 0.1–4.7	12/278	5.0, 2.8–8.8	7/197	7.6, 2.9–18.3
NNRTI	EFV or NVP	100/158	63.2, 55.3–70.4	61/147	41.5, 33.7–49.7	123/278	44.3, 38.1–50.7	130/197	72.7, 65.4–79.0
	DOR	52/158	32.8, 25.9–40.6	26/147	17.7, 12.3–24.8	39/278	13.9, 10.0–18.8	80/197	43.4, 33.0–54.5
	ETR	65/158	40.8, 33.3–48.7	43/147	29.3, 22.4–37.2	37/278	12.7, 9.1–17.5	43/197	18.6, 11.9–27.9
	RPV	82/158	51.4, 43.5–59.2	57/147	38.8, 31.2–47.0	64/278	22.9, 18.0–28.7	66/197	28.4, 20.4–38.0
PI/r	ATV/r, DRV/r or LPV/r	0/158	0.0, 0.0–2.4	ND		2/278	1.0, 0.3–4.0	0/197	0.0, 0.0–1.9
	ATV/r	0/158	0.0, 0.0–2.4	ND		2/278	1.0, 0.3–4.0	0/197	0.0, 0.0–1.9
	DRV/r	0/158	0.0, 0.0–2.4	ND		2/278	1.0, 0.3–4.0	0/197	0.0, 0.0–1.9
	LPV/r	0/158	0.0, 0.0–2.4	ND		0/278	0.0, 0.0–1.4	0/197	0.0, 0.0–1.9
HIV drug resistance among infants unexposed to PMTCT or with unknown exposure									
NRTI	Any	17/214	7.7, 4.8–12.1	0/49	0.0, 0.0–7.3	4/42	10.2, 3.6–25.4	5/33	8.7, 2.1–30.1
	ABC	8/214	3.6, 1.8–7.0	0/49	0.0, 0.0–7.3	4/42	10.2, 3.6–25.4	1/33	0.0
	3TC or FTC	6/214	2.7, 1.2–6.0	0/49	0.0, 0.0–7.3	3/42	9.1, 3.0–24.8	1/33	0.0
	TDF	3/214	1.3, 0.4–3.8	0/49	0.0, 0.0–7.3	3/42	7.1, 2.1–21.6	0/33	0.0, 0.0–10.4
	ZDV	13/214	5.9, 3.4–10.0	0/49	0.0, 0.0–7.3	1/42	3.0, 0.4–19.0	3/33	4.5, 0.6–26.5
NNRTI	EFV or NVP	78/214	35.1, 29.1–41.6	6/49	12.2, 2.7–21.8	15/42	40.1, 25.4–56.8	13/33	21.9, 8.8–45.0
	DOR	41/214	18.6, 13.9–24.3	1/49	2.0, 0.3–13.3	7/42	19.1, 9.1–35.8	6/33	4.5, 0.6–26.5
	ETR	52/214	23.2, 18.1–29.2	7/49	14.3, 6.9–27.2	3/42	9.6, 3.1–26.0	5/33	8.9, 2.2–30.3
	RPV	60/214	26.9, 21.5–33.1	12/49	24.5, 14.4–38.5	8/42	22.8, 11.7–39.9	11/33	22.1, 8.9–45.0
PI/r	ATV/r, DRV/r or LPV/r	0/214	0.0, 0.0–1.8	ND		0/42	0.0, 0.0–8.4	0/33	0.0, 0.0–10.4
	ATV/r	0/214	0.0, 0.0–1.8	ND		0/42	0.0, 0.0–8.4	0/33	0.0, 0.0–10.4
	DRV/r	0/214	0.0, 0.0–1.8	ND		0/42	0.0, 0.0–8.4	0/33	0.0, 0.0–10.4
	LPV/r	0/214	0.0, 0.0–1.8	ND		0/42	0.0, 0.0–8.4	0/33	0.0, 0.0–10.4

a Study design–weighted proportion and 95% confidence interval.

HIV drug resistance was defined as the presence of a penalty score ≥15 using the Stanford HIVdb algorithm.

ABC: abacavir; ATV/r: atazanavir/ritonavir; CI: confidence interval; DOR: doravirine; DRV/r: darunavir/ritonavir; EFV: efavirenz; ETR: etravirine; LPV/r: lopinavir/ritonavir; ND: no data; NNRTI: non-nucleoside reverse-transcriptase inhibitor; NRTI: nucleoside reverse-transcriptase inhibitor; NVP: nevirapine; PI/r: boosted protease inhibitor; RPV: rilpivirine; TDF: tenofovir disoproxil fumarate; ZDV: zidovudine; 3TC/FTC: lamivudine/emtricitabine.

Table A2.3b. Prevalence of pretreatment HIV drug resistance among infants newly diagnosed with HIV – Africa

		Mozambique (start year: 2012)		Nigeria (start year: 2016)		South Africa (start year: 2014)		Togo (start year: 2012)	
		n/N	%, 95% CI[a]	*n/N*	%, 95% CI[a]	*n/N*	%, 95% CI[a]	*n/N*	%, 95% CI[a]
HIV drug resistance among all infants									
NRTI	Any	25/392	6.4, 4.3–9.3	90/418	22.5, 18.1–27.7	56/402	13.9, 10.9–17.7	33/201	16.4, 11.9–22.3
	ABC	14/392	3.6, 2.1–6.0	78/418	19.4, 15.2–24.3	49/402	12.2, 9.3–15.8	20/201	10.0, 6.5–15.0
	3TC or FTC	10/392	2.6, 1.4–4.7	66/418	16.1, 12.3–20.8	41/402	10.2, 7.6–13.6	15/201	7.5, 4.5–12.1
	TDF	4/392	1.0, 0.4–2.7	27/418	6.4, 4.1–10.0	17/402	4.2, 2.6–6.7	9/201	4.5, 2.3–8.4
	ZDV	16/392	4.1, 2.5–6.6	40/418	9.9, 7.0–14.0	8/402	2.0, 1.0–3.9	23/201	11.4, 7.7–16.7
NNRTI	EFV or NVP	220/392	56.1, 51.1–61.0	190/418	49.0, 43.5–54.5	252/402	62.7, 57.8–67.3	116/201	57.7, 50.7–64.4
	DOR	65/392	16.6, 13.2–20.6	99/418	25.5, 20.9–30.7	131/402	32.6, 28.2–37.3	67/201	33.3, 27.1–40.2
	ETR	157/392	40.1, 35.3–45.0	84/418	20.2, 16.0–25.1	107/402	26.6, 22.5–31.2	77/201	38.3, 31.8–45.3
	RPV	199/392	50.8, 45.8–55.7	119/418	29.6, 24.7–35.0	153/402	38.1, 33.4–42.9	99/201	49.3, 42.3–56.2
PI/r	ATV/r, DRV/r or LPV/r	ND		0/418	0.0, 0.0–0.9	1/402	0.2, 0.0–1.8	ND	
	ATV/r	ND		0/418	0.0, 0.0–0.9	1/402	0.2, 0.0–1.8	ND	
	DRV/r	ND		0/418	0.0, 0.0–0.9	1/402	0.2, 0.0–1.8	ND	
	LPV/r	ND		0/418	0.0, 0.0–0.9	1/402	0.2, 0.0–1.8	ND	
HIV drug resistance among infants exposed to PMTCT									
NRTI	Any	20/330	6.1, 3.9–9.2	61/192	30.8, 24.1–38.5	ND		21/131	16.0, 10.7–23.4
	ABC	10/330	3.0, 1.6–5.6	52/192	25.6, 19.4–32.9	ND		13/131	9.9, 5.8–16.4
	3TC or FTC	8/330	2.4, 1.2–4.8	45/192	22.3, 16.5–29.4	ND		10/131	7.6, 4.1–13.7
	TDF	3/330	0.9, 0.3–2.8	20/192	9.7, 5.7–15.8	ND		5/131	3.8, 1.6–8.9
	ZDV	14/330	4.2, 2.5–7.0	27/192	14.0, 9.3–20.5	ND		16/131	12.2, 7.6–19.1
NNRTI	EFV or NVP	195/330	59.1, 53.7–64.3	106/192	56.6, 49.0–63.9	ND		95/131	72.5, 64.2–79.5
	DOR	59/330	17.9, 14.1–22.4	61/192	32.2, 25.4–40.0	ND		58/131	44.3, 35.9–52.9
	ETR	140/330	42.4, 37.2–47.8	47/192	22.2, 16.4–29.2	ND		63/131	48.1, 39.6–56.7
	RPV	174/330	52.7, 47.3–58.1	65/192	32.3, 25.4–40.0	ND		83/131	63.4, 54.7–71.2
PI/r	ATV/r, DRV/r or LPV/r	ND		0/192	0.0, 0.0–2.0	ND		ND	
	ATV/r	ND		0/192	0.0, 0.0–2.0	ND		ND	
	DRV/r	ND		0/192	0.0, 0.0–2.0	ND		ND	
	LPV/r	ND		0/192	0.0, 0.0–2.0	ND		ND	
HIV drug resistance among infants unexposed to PMTCT or with unknown exposure									
NRTI	Any	5/62	8.1, 3.4–18.0	29/226	13.8, 8.8–21.0	ND		12/70	17.1, 10.0–27.9
	ABC	4/62	6.5, 2.4–16.0	26/226	12.9, 8.0–20.1	ND		7/70	10.0, 4.8–19.6
	3TC or FTC	2/62	3.2, 0.8–12.1	21/226	9.6, 5.6–15.8	ND		5/70	7.1, 3.0–16.1
	TDF	1/62	1.6, 0.2–10.7	7/226	3.1, 1.2–7.6	ND		4/70	5.7, 2.1–14.4
	ZDV	2/62	3.2, 0.8–12.1	13/226	5.7, 2.9–11.0	ND		7/70	10.0, 4.8–19.6
NNRTI	EFV or NVP	25/62	40.3, 28.9–52.9	84/226	41.0, 33.5–49.1	ND		21/70	30.0, 20.4–41.8
	DOR	6/62	9.7, 4.4–20.0	38/226	18.4, 12.8–25.7	ND		9/70	12.9, 6.8–23.0
	ETR	17/62	27.4, 17.7–39.8	37/226	18.2, 12.6–25.6	ND		14/70	20.0, 12.2–31.1
	RPV	25/62	40.3, 28.9–52.9	54/226	26.7, 19.8–35.0	ND		16/70	22.9, 14.4–34.2
PI/r	ATV/r, DRV/r or LPV/r	ND		0/226	0.0, 0.0–1.7	ND		ND	
	ATV/r	ND		0/226	0.0, 0.0–1.7	ND		ND	
	DRV/r	ND		0/226	0.0, 0.0–1.7	ND		ND	
	LPV/r	ND		0/226	0.0, 0.0–1.7	ND		ND	

a Study design–weighted proportion and 95% confidence interval.

HIV drug resistance was defined as the presence of a penalty score ≥15 using the Stanford HIVdb algorithm.

ABC: abacavir; ATV/r: atazanavir/ritonavir; CI: confidence interval; DOR: doravirine; DRV/r: darunavir/ritonavir; EFV: efavirenz; ETR: etravirine; LPV/r: lopinavir/ritonavir; ND: no data; NNRTI: non-nucleoside reverse-transcriptase inhibitor; NRTI: nucleoside reverse-transcriptase inhibitor; NVP: nevirapine; PI/r: boosted protease inhibitor; RPV: rilpivirine; TDF: tenofovir disoproxil fumarate; ZDV: zidovudine; 3TC/FTC: lamivudine/emtricitabine.

Table A2.3c. Prevalence of pretreatment HIV drug resistance among infants newly diagnosed with HIV – Africa

		Uganda (start year: 2017)		Zimbabwe (start year: 2012)	
		n/N	%, 95% CI[a]	*n/N*	%, 95% CI[a]
HIV drug resistance among all infants					
NRTI	Any	26/141	18.4, 12.8–25.8	22/224	9.8, 6.5–14.5
	ABC	20/141	14.2, 9.3–21.1	17/224	7.6, 4.8–11.9
	3TC or FTC	18/141	12.8, 8.1–19.4	13/224	5.8, 3.4–9.8
	TDF	9/141	6.4, 3.3–11.9	7/224	3.1, 1.5–6.4
	ZDV	10/141	7.1, 3.8–12.8	6/224	2.7, 1.2–5.9
NNRTI	EFV or NVP	81/141	57.4, 49.1–65.4	143/224	63.8, 57.3–69.9
	DOR	35/141	24.8, 18.3–32.7	78/224	34.8, 28.8–41.3
	ETR	37/141	26.2, 19.6–34.2	109/224	48.7, 42.1–55.2
	RPV	55/141	39.0, 31.2–47.4	142/224	63.4, 56.8–69.5
PI/r	ATV/r, DRV/r or LPV/r	0/141	0.0, 0.0–2.7	ND	
	ATV/r	0/141	0.0, 0.0–2.7	ND	
	DRV/r	0/141	0.0, 0.0–2.7	ND	
	LPV/r	0/141	0.0, 0.0–2.7	ND	
HIV drug resistance among infants exposed to PMTCT					
NRTI	Any	23/106	21.7, 14.8–30.7	21/172	12.2, 8.1–18.1
	ABC	19/106	17.9, 11.7–26.5	16/172	9.3, 5.8–14.7
	3TC or FTC	18/106	17.0, 10.9–25.5	13/172	7.6, 4.4–12.6
	TDF	9/106	8.5, 4.4–15.6	7/172	4.1, 1.9–8.3
	ZDV	8/106	7.5, 3.8–14.5	6/172	3.5, 1.6–7.6
NNRTI	EFV or NVP	70/106	66.0, 56.4–74.5	128/172	74.4, 67.3–80.4
	DOR	32/106	30.2, 22.1–39.7	73/172	42.4, 35.2–50.0
	ETR	32/106	30.2, 22.1–39.7	98/172	57.0, 49.4–64.2
	RPV	48/106	45.3, 36.0–54.9	122/172	70.9, 63.7–77.3
PI/r	ATV/r, DRV/r or LPV/r	0/106	0.0, 0.0–3.5	ND	
	ATV/r	0/106	0.0, 0.0–3.5	ND	
	DRV/r	0/106	0.0, 0.0–3.5	ND	
	LPV/r	0/106	0.0, 0.0–3.5	ND	
HIV drug resistance among infants unexposed to PMTCT or with unknown exposure					
NRTI	Any	3/35	8.6, 2.8–23.7	1/52	1.9, 0.3–12.6
	ABC	1/35	2.9, 0.4–18.0	1/52	1.9, 0.3–12.6
	3TC or FTC	0/35	0.0, 0.0–9.9	0/52	0.0, 0.0–6.9
	TDF	0/35	0.0, 0.0–9.9	0/52	0.0, 0.0–6.9
	ZDV	1/35	2.9, 0.4–18.0	0/52	0.0, 0.0–6.9
NNRTI	EFV or NVP	11/35	31.4, 18.2–48.6	15/52	28.8, 18.1–42.6
	DOR	3/35	8.6, 2.8–23.7	5/52	9.6, 4.0–21.2
	ETR	5/35	14.3, 6.0–30.3	11/52	21.2, 12.1–34.4
	RPV	7/35	20.0, 9.8–36.6	20/52	38.5, 26.3–52.3
PI/r	ATV/r, DRV/r or LPV/r	0/35	0.0, 0.0–9.9	ND	
	ATV/r	0/35	0.0, 0.0–9.9	ND	
	DRV/r	0/35	0.0, 0.0–9.9	ND	
	LPV/r	0/35	0.0, 0.0–9.9	ND	

a Study design–weighted proportion and 95% confidence interval.

HIV drug resistance was defined as the presence of a penalty score ≥15 using the Stanford HIVdb algorithm.

ABC: abacavir; ATV/r: atazanavir/ritonavir; CI: confidence interval; DOR: doravirine; DRV/r: darunavir/ritonavir; EFV: efavirenz; ETR: etravirine; LPV/r: lopinavir/ritonavir; ND: no data; NNRTI: non-nucleoside reverse-transcriptase inhibitor; NRTI: nucleoside reverse-transcriptase inhibitor; NVP: nevirapine; PI/r: boosted protease inhibitor; RPV: rilpivirine; TDF: tenofovir disoproxil fumarate; ZDV: zidovudine; 3TC/FTC: lamivudine/emtricitabine.

Table A2.4a. Prevalence of mutations associated with HIV drug resistance to nucleoside reverse-transcriptase inhibitors among infants newly diagnosed with HIV

Country	Start year	Number of reverse-transcriptase sequences	Mutations associated with HIV drug resistance to nucleoside reverse-transcriptase inhibitors (%)[a]																		
			E40F	M41L	*E44AD*	*A62V*	K65ENR	D67EGHNSTDel	*S68Del*	T69DGDelIns	K70EGNQRST	L74VI	V75AIMST	F77L	Y115F	F116Y	Q151LM	M184VI	L210W	T215ACDEFILNSVY	K219QENRW
Cameroon	2014	372	0.0	1.1	0.8	0.3	0.8	1.1	0.0	0.0	2.7	0.8	0.3	0.0	0.0	0.0	0.0	5.6	0.3	3.8	3.5
Eswatini	2011	196	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	1.5
Kenya	2018	320	0.0	0.3	0.6	0.3	0.9	1.9	0.0	0.6	1.9	1.2	0.3	0.0	0.0	0.0	0.0	3.7	0.0	2.2	2.8
Malawi	2016	230	0.0	0.4	0.4	0.4	3.4	4.2	0.0	0.4	1.9	3.0	0.8	0.0	0.0	0.0	0.0	9.9	0.4	0.8	1.1
Mozambique	2012	392	0.0	0.3	0.0	0.0	0.3	1.3	0.0	0.0	0.5	1.0	0.3	0.0	0.0	0.0	0.0	2.3	0.0	2.6	2.0
Nigeria	2016	418	0.0	3.3	0.7	0.2	1.0	3.6	0.0	0.5	2.9	1.7	0.7	0.2	0.0	0.2	0.2	15.8	0.7	6.9	4.1
South Africa	2014	402	0.0	0.0	0.2	0.5	3.5	0.5	0.0	0.2	1.0	3.0	0.5	0.0	0.7	0.0	0.0	9.5	0.0	1.2	1.5
Togo	2012	201	0.0	4.5	0.5	0.0	0.5	4.0	0.0	0.5	4.5	2.5	0.0	0.0	0.0	0.0	0.0	7.5	0.0	6.5	4.5
Uganda	2017	141	0.0	0.0	4.4	0.7	3.5	2.1	0.0	0.0	2.1	2.8	0.7	0.0	0.7	0.0	0.0	11.3	0.0	3.5	2.8
Zimbabwe	2012	224	0.0	0.0	0.4	0.0	3.1	0.9	0.0	0.0	0.9	1.8	0.0	0.0	0.0	0.0	0.0	2.7	0.0	1.3	1.3

Table A2.4b. Prevalence of mutations associated with HIV drug resistance to non-nucleoside reverse-transcriptase inhibitors among infants newly diagnosed with HIV

Country	Start year	Number of reverse-transcriptase sequences	Mutations associated with HIV drug resistance to non-nucleoside reverse-transcriptase inhibitors (%)[a]																				
			A98G	L100IV	K101EHP	K103HNST	*K103R*	V106MA	*V106I*	*V108I*	*E138A*	*E138GKQR*	V179FL	*V179DE*	Y181CFGISV	Y188CFHL	G190ACEQSTV	*H221Y*	P225H	*F227CILV*	M230IL	*L234I*	*P236L*	*K238NT*
Cameroon	2014	372	3.0	0.3	2.4	18.0	0.5	2.4	2.7	3.8	3.8	1.1	0.0	2.7	29.0	3.0	7.0	5.6	1.3	2.2	0.0	0.0	0.0	0.3
Eswatini	2011	196	0.5	0.0	2.0	7.7	0.5	3.1	0.0	1.0	11.2	0.0	0.0	2.0	22.4	2.0	2.0	2.1	0.0	0.5	0.0	0.0	0.0	0.0
Kenya	2018	320	2.2	0.3	2.2	29.4	0.6	1.2	1.2	1.9	3.4	2.8	0.3	0.3	9.3	1.5	7.7	3.1	1.9	0.0	0.0	0.0	0.0	0.3
Malawi	2016	230	1.5	0.8	3.4	38.4	1.5	16.3	1.5	1.9	5.7	1.9	0.4	3.8	14.4	5.3	9.1	1.5	4.6	2.7	0.0	0.0	0.0	0.8
Mozambique	2012	392	0.8	0.3	1.8	13.8	1.0	2.8	0.8	0.8	10.2	0.3	0.3	1.5	37.2	1.5	6.9	2.8	0.3	1.3	0.0	0.0	0.0	0.5
Nigeria	2016	418	5.0	0.2	3.3	27.8	0.5	3.1	2.6	2.4	3.3	1.0	0.0	4.5	14.8	3.8	8.1	4.3	2.6	2.2	0.2	0.0	0.0	0.7
South Africa	2014	402	1.5	0.5	2.7	38.1	2.5	12.9	1.0	2.0	6.0	0.7	0.2	2.7	24.1	3.2	7.5	1.7	1.2	2.5	0.0	0.2	0.0	0.5
Togo	2012	201	2.5	0.0	2.5	18.4	0.0	5.5	2.5	4.5	4.0	3.0	0.0	1.0	34.8	4.5	8.5	5.0	1.0	2.0	0.5	0.0	0.0	0.0
Uganda	2017	141	3.0	2.1	4.3	31.2	0.7	2.8	0.7	3.0	3.7	3.7	0.0	2.1	17.7	4.3	11.3	2.2	2.1	1.5	0.7	0.0	0.0	1.5
Zimbabwe	2012	224	2.2	0.0	3.6	14.7	0.4	8.9	0.0	0.9	11.6	2.2	0.0	0.0	43.8	5.4	10.7	3.6	0.0	0.9	0.0	0.0	0.0	0.0

a Unweighted proportions of sequences that have non-zero penalty scores in the Stanford HIVdb algorithm. Mutations in italics correspond to non-SDRM positions (may include polymorphisms).

Table A2.4c. Prevalence of mutations associated with HIV drug resistance to protease inhibitors among infants newly diagnosed with HIV

Country	Start year	Number of protease sequences	Mutations associated with HIV drug resistance to protease inhibitors (%)[a]												
			L10F	*V11IL*	*K20T*	L23I	L24IFM	D30N	V32I	*L33F*	*K43T*	M46ILV	I47VA	G48LMQSTV	I50VL
Cameroon	2014	372	0.5	3.8	0.3	0.0	0.0	0.3	0.0	0.3	0.0	1.1	0.0	0.0	0.0
Kenya	2018	320	0.3	1.2	0.0	0.0	0.0	0.0	0.0	1.2	0.0	0.3	0.0	0.0	0.0
Malawi	2016	230	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Nigeria	2016	418	ND	ND	2.9	0.0	0.0	0.0	0.0	0.5	0.0	1.2	0.0	0.0	0.0
South Africa	2014	402	0.2	1.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0
Uganda	2017	141	0.0	0.7	0.7	0.0	0.0	0.0	0.0	2.8	1.4	0.7	0.0	0.0	0.0

Country	Start year	Number of protease sequences	Mutations associated with HIV drug resistance to protease inhibitors (%)[a]												
			F53LY	I54VLMATS	*Q58E*	G73ADCSTV	*T74P*	L76V	V82ATFSCML	N83D	I84VAC	I85V	N88DGST	*L89V*	L90M
Cameroon	2014	372	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0
Kenya	2018	320	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.0	0.6
Malawi	2016	230	0.0	0.0	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.0
Nigeria	2016	418	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
South Africa	2014	402	0.0	0.0	0.2	0.0	0.2	0.0	0.0	0.2	0.0	0.5	0.0	0.0	0.0
Uganda	2017	141	0.0	0.0	1.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

a Unweighted proportions of sequences that have non-zero penalty scores in the Stanford HIVdb algorithm. Mutations in italics correspond to non-SDRM positions (may include polymorphisms).
ND: no data

SECTION 4: ACQUIRED HIV DRUG RESISTANCE AMONG ADULTS AND AMONG CHILDREN AND ADOLESCENTS RECEIVING ART

Table A4.1a. Population characteristics of adults receiving ART – Africa

	Botswana (start year: 2019) Time on ART: 12 ± 3 months *N*=332		Botswana (start year: 2019) Time on ART: ≥48 months *N*=611		Cameroon (start year: 2015) Time on ART: 12–24 months *N*=1064		Cameroon (start year: 2015) Time on ART: 48–60 months *N*=388	
	n/N	%, 95% CI[d]	*n/N*	%, 95% CI[d]	*n/N*	%, 95% CI[d]	*n/N*	%, 95% CI[d]
Gender								
Women	189/332	47.2, 33.5–61.4	411/611	71.5, 65.3–77.0	808/1064	77.9, 75.4–80.2	287/388	75.3, 66.6–82.3
Men	143/332	52.8, 38.6–66.5	200/611	28.5, 23.0–34.7	256/1064	22.1, 19.8–24.6	101/388	24.7, 17.7–33.4
Other	0/332	0.0, 0.0–1.1	0/611	0.0, 0.0–0.6	0/1064	0.0, 0.0–0.4	0/388	0.0, 0.0–1.0
Unknown	0/332	0.0, 0.0–1.1	0/611	0.0, 0.0–0.6	0/1064	0.0, 0.0–0.4	0/388	0.0, 0.0–1.0
Mean age, 95% CI (years)[a]	**38.9, 37.2–40.6**		**44.9, 43.2–46.6**		**40.0, 39.4–40.7**		**43.1, 42.0–44.3**	
≤25 years	31/332	6.9, 4.4–10.7	23/611	4.3, 2.5–7.2	43/1064	3.9, 3.0–5.1	5/388	1.2, 0.4–3.8
>25 years	301/332	93.1, 89.3–95.6	588/611	95.7, 92.8–97.5	1021/1064	96.1, 94.9–97	383/388	98.8, 96.2–99.6
Unknown	0/332	0.0, 0.0–1.1	0/611	0.0, 0.0–0.6	0/1064	0.0, 0.0–0.4	0/388	0.0, 0.0–1.0
Current ART								
First-line	331/332	100, 99.6–100	573/611	94.6, 90.7–96.9	1050/1064	99.0, 98.1–99.5	364/388	94.4, 83.9–98.2
NNRTI-based[b]	47/331	12.9, 7.8–20.4	463/573	87.8, 81.6–92.1	1048/1050	99.9, 99.2–100.0	364/364	100.0, 99.0–100.0
PI-based[c]	0/331	0.0, 0.0–1.1	12/573	2.5, 0.9–6.5	2/1050	0.1, 0.0–0.8	0/364	0.0, 0.0–1.0
DTG-based	281/331	86.2, 77.7–91.9	96/573	9.2, 5.2–15.7	0/1050	0.0, 0.0–0.4	0/364	0.0, 0.0–1.0
Other	0/331	0.0, 0.0–1.1	0/573	0.0, 0.0–0.7	0/1050	0.0, 0.0–0.4	0/364	0.0, 0.0–1.0
Unknown	3/331	0.9, 0.2–3.3	2/573	0.5, 0.1–2.3	0/1050	0.0, 0.0–0.4	0/364	0.0, 0.0–1.0
Second-line	1/332	0.0, 0.0–0.4	38/611	5.4, 3.1–9.3	14/1064	1.0, 0.6–1.9	24/388	5.6, 1.8–16.1
PI-based[c]	0/1	0.0, NA	33/38	92.0, 75.4–97.8	14/14	100.0, 78.5–100.0	23/24	96.1, 67.7–99.7
DTG-based	1/1	100.0, NA	5/38	8.0, 2.2–24.6	0/14	0.0, 0.0–21.5	0/24	0.0, 0.0–13.8
Other	0/1	0.0, NA	0/38	0.0, 0.0–9.2	0/14	0.0, 0.0–21.5	1/24	3.9, 0.3–32.3
Unknown	0/1	0.0, NA	0/38	0.0, 0.0–9.2	0/1064	0.0, 0.0–0.4	0/388	0.0, 0.0–1.0
Third-line	0/332	0.0, 0.0–1.1	0/611	0.0, 0.0–0.6	0/1064	0.0, 0.0–0.4	0/388	0.0, 0.0–1.0
Unknown	0/332	0.0, 0.0–1.1	0/611	0.0, 0.0–0.6	0/375	0.0, 0.0–1.0	0/500	0.0, 0.0–0.8

a Study design–weighted mean and 95% confidence interval.
b NNRTI-based regimens include EFV or NVP.
c PI-based regimens include ATV/r, DRV/r or LPV/r.
d Study design–weighted proportion and 95% confidence interval.
ART: antiretroviral therapy; ATV/r: atazanavir/ritonavir; CI: confidence interval; DRV/r: darunavir/ritonavir; DTG: dolutegravir; EFV: efavirenz; LPV/r: lopinavir/ritonavir; NVP: nevirapine; NNRTI: non-nucleoside reverse-transcriptase inhibitor; PI: protease inhibitor; PMTCT: prevention of mother-to-child transmission.

Table A4.1b. Population characteristics of adults receiving ART – Africa

	Eswatini (start year: 2016) Time on ART: 12 ± 3 months *N*=375		Eswatini (start year: 2016) Time on ART: ≥48 months *N*=500		Lesotho (start year: 2018) Time on ART: 12 ± 3 months *N*=385		Lesotho (start year: 2018) Time on ART: ≥48 months *N*=490	
	n/N	%, 95% CI[d]	*n/N*	%, 95% CI[d]	*n/N*	%, 95% CI[d]	*n/N*	%, 95% CI[d]
Gender								
Women	270/375	72.1, 65.4–77.9	359/500	70.3, 65.3–74.7	252/385	66.5, 58.2–73.8	376/490	77.5, 72.6–81.7
Men	105/375	27.9, 22.1–34.6	141/500	29.7, 25.3–34.7	133/385	33.5, 26.2–41.8	114/490	22.5, 18.3–27.4
Other	0/375	0.0, 0.0–1.0	0/500	0.0, 0.0–0.8	0/385	0.0, 0.0–1.0	0/490	0.0, 0.0–0.8
Unknown	0/375	0.0, 0.0–1.0	0/500	0.0, 0.0–0.8	0/385	0.0, 0.0–1.0	0/490	0.0, 0.0–0.8
Mean age, 95% CI (years)[a]	**36.0, 34.5–37.6**		**43.4, 41.3–45.6**		**36.1, 34.4–37.9**		**44.7, 42.7–46.7**	
≤25 years	47/375	13.7, 9.4–19.5	13/500	2.0, 1.0–3.9	67/385	18.3, 14.4–22.9	16/490	4.0, 2.0–8.0
>25 years	328/375	86.3, 80.5–90.6	487/500	98.0, 96.1–99.0	318/385	81.7, 77.1–85.6	474/490	96.0, 92.0–98.0
Unknown	0/375	0.0, 0.0–1.0	0/500	0.0, 0.0–0.8	0/385	0.0, 0.0–1.0	0/490	0.0, 0.0–0.8
Current ART								
First-line	374/375	99.8, 98.8–100.0	468/500	93.6, 90.4–95.8	383/385	99.3, 97.0–99.8	487/490	99.4, 97.6–99.9
NNRTI-based[b]	368/374	98.2, 95.8–99.3	464/468	99.0, 97.4–99.6	383/383	100.0, 99.0–100.0	487/487	100.0, 99.2–100.0
PI-based[c]	0/374	0.0, 0.0–1.0	0/468	0.0, 0.0–0.8	0/383	0.0, 0.0–1.0	0/487	0.0, 0.0–0.8
DTG-based	0/374	0.0, 0.0–1.0	0/468	0.0, 0.0–0.8	0/383	0.0, 0.0–1.0	0/487	0.0, 0.0–0.8
Other	0/374	0.0, 0.0–1.0	0/468	0.0, 0.0–0.8	0/383	0.0, 0.0–1.0	0/487	0.0, 0.0–0.8
Unknown	6/374	1.8, 0.7–4.2	4/468	1.0, 0.4–2.6	0/383	0.0, 0.0–1.0	0/487	0.0, 0.0–0.8
Second-line	1/375	0.2, 0.0–1.2	32/500	6.4, 4.2–9.6	2/385	0.7, 0.2–3.0	3/490	0.6, 0.1–2.4
PI-based[c]	1/1	100.0, NA	25/32	77.9, 54.7–91.2	2/2	100.0, NA	3/3	100.0, NA
DTG-based	0/1	0.0, NA	0/32	0.0, 0.0–10.7	0/2	0.0, NA	0/3	0.0, NA
Other	0/1	0.0, NA	0/32	0.0, 0.0–10.7	0/2	0.0, NA	0/3	0.0, NA
Unknown	0/1	0.0, NA	7/32	22.1, 8.8–45.3	0/2	0.0, NA	0/3	0.0, NA
Third-line	0/375	0.0, 0.0–1.0	0/500	0.0, 0.0–0.8	0/385	0.0, 0.0–1.0	0/490	0.0, 0.0–0.8
Unknown	0/375	0.0, 0.0–1.0	0/500	0.0, 0.0–0.8	0/385	0.0, 0.0–1.0	0/490	0.0, 0.0–0.8

a Study design–weighted mean and 95% confidence interval.
b NNRTI-based regimens include EFV or NVP.
c PI-based regimens include ATV/r, DRV/r or LPV/r.
d Study design–weighted proportion and 95% confidence interval.
ART: antiretroviral therapy; ATV/r: atazanavir/ritonavir; CI: confidence interval; DRV/r: darunavir/ritonavir; DTG: dolutegravir; EFV: efavirenz; LPV/r: lopinavir/ritonavir; NVP: nevirapine; NNRTI: non-nucleoside reverse-transcriptase inhibitor; PI: protease inhibitor; PMTCT: prevention of mother-to-child transmission.

Table A4.1c. Population characteristics of adults receiving ART – Africa

	Senegal (start year: 2017) Time on ART: 12 ± 3 months *N*=255		Senegal (start year: 2017) Time on ART: ≥40 months *N*=315		South Sudan (start year: 2018) Time on ART: 12 ± 3 months *N*=377		South Sudan (start year: 2018) Time on ART: ≥48 months *N*=515	
	n/N	%, 95% CI[d]	*n/N*	%, 95% CI[d]	*n/N*	%, 95% CI[d]	*n/N*	%, 95% CI[d]
Gender								
Women	184/255	72.7, 63.6–80.3	239/315	76.5, 69.2–82.4	237/377	57.2, 49.4–64.7	378/515	74.5, 69.1–79.3
Men	71/255	27.3, 19.7–36.4	76/315	23.5, 17.6–30.8	140/377	42.8, 35.3–50.6	137/515	25.5, 20.7–30.9
Other	0/255	0.0, 0.0–1.5	0/315	0.0, 0.0–1.2	0/377	0.0, 0.0–1.0	0/515	0.0, 0.0–0.7
Unknown	0/255	0.0, 0.0–1.5	0/315	0.0, 0.0–1.2	0/377	0.0, 0.0–1.0	0/515	0.0, 0.0–0.7
Mean age, 95% CI (years)[a]	**42.1, 38.8–45.4**		**43.8, 42.0–45.6**		**35.0, 34.0–36.0**		**39.0, 37.4–40.5**	
≤25 years	17/255	5.0, 2.7–9.2	13/315	2.7, 1.4–4.9	49/377	16.0, 11.7–21.4	33/515	7.4, 4.6–11.6
>25 years	238/255	95.0, 90.8–97.3	302/315	97.3, 95.1–98.6	328/377	84.0, 78.6–88.3	482/515	92.6, 88.4–95.4
Unknown	0/255	0.0, 0.0–1.5	0/315	0.0, 0.0–1.2	0/377	0.0, 0.0–1.0	0/515	0.0, 0.0–0.7
Current ART								
First-line	253/255	99.3, 96.7–99.9	311/315	98.8, 96.4–99.6	376/377	99.8, 98.8–100	480/515	96.7, 92–98.7
NNRTI-based[b]	249/253	96.1, 86.3–99.0	311/311	100.0, 98.8–100.0	376/376	100.0, 99.0–100.0	478/480	99.9, 99.7–100
PI-based[c]	0/253	0.0, 0.0–1.5	0/311	0.0, 0.0–1.2	0/376	0.0, 0.0–1.0	0/480	0.0, 0.0–0.8
DTG-based	0/253	0.0, 0.0–1.5	0/311	0.0, 0.0–1.2	0/376	0.0, 0.0–1.0	0/480	0.0, 0.0–0.8
Other	2/253	2.7, 0.4–15.4	0/311	0.0, 0.0–1.2	0/376	0.0, 0.0–1.0	2/480	0.1, 0.0–0.3
Unknown	2/253	1.2, 0.2–5.5	0/311	0.0, 0.0–1.2	0/376	0.0, 0.0–1.0	0/480	0.0, 0.0–0.8
Second-line	1/255	0.5, 0.1–3.7	3/315	1.1, 0.3–3.6	0/376	0.0, 0.0–1.0	34/515	3.2, 1.3–8.0
PI-based[c]	1/1	100.0, NA	3/3	100.0, NA	NA		34/34	100.0, 89.8–100.0
DTG-based	0/1	0.0, NA	0/3	0.0, NA	NA		0/34	0.0, 0.0–10.2
Other	0/1	0.0, NA	0/3	0.0, NA	NA		0/34	0.0, 0.0–10.2
Unknown	0/255	0.0, 0.0–1.5	1/315	0.1, 0.0–0.7	NA		0/34	0.0, 0.0–10.2
Third-line	1/255	0.2, 0.0–1.0	0/315	0.0, 0.0–1.2	0/377	0.0, 0.0–1.0	0/515	0.0, 0.0–0.7
Unknown	0/375	0.0, 0.0–1.0	0/500	0.0, 0.0–0.8	1/377	0.2, 0.0–1.2	1/515	0.0, 0.0–0.2

a Study design–weighted mean and 95% confidence interval.
b NNRTI-based regimens include EFV or NVP.
c PI-based regimens include ATV/r, DRV/r or LPV/r.
d Study design–weighted proportion and 95% confidence interval.
ART: antiretroviral therapy; ATV/r: atazanavir/ritonavir; CI: confidence interval; DRV/r: darunavir/ritonavir; DTG: dolutegravir; EFV: efavirenz; LPV/r: lopinavir/ritonavir; NVP: nevirapine; NNRTI: non-nucleoside reverse-transcriptase inhibitor; PI: protease inhibitor; PMTCT: prevention of mother-to-child transmission.

Table A4.1d. Population characteristics of adults receiving ART – Africa

	Uganda[d] (start year: 2016) Time on ART: 12 ± 3 months *N*=533		Uganda[d] (start year: 2017) Time on ART: ≥48 months *N*=1062		Zambia (start year: 2019) Time on ART: 12 ± 3 months *N*=462		Zambia (start year: 2019) Time on ART: ≥48 months *N*=764	
	n/N	%, 95% CI[e]	*n/N*	%, 95% CI[e]	*n/N*	%, 95% CI[e]	*n/N*	%, 95% CI[e]
Gender								
Women	351/533	65.9, 59.3–72.0	693/1062	65.6, 62.2–68.9	273/462	56.8, 50.2–63.3	501/764	68.3, 62.6–73.5
Men	182/533	34.1, 28.0–40.7	369/1062	34.4, 31.1–37.8	189/462	43.2, 36.7–49.8	263/764	31.7, 26.5–37.4
Other	0/533	0.0, 0.0–0.7	0/1062	0.0, 0.0–0.4	0/462	0.0, 0.0–0.8	0/764	0.0, 0.0–0.5
Unknown	0/533	0.0, 0.0–0.7	0/1062	0.0, 0.0–0.4	0/462	0.0, 0.0–0.8	0/764	0.0, 0.0–0.5
Mean age, 95% CI (years)[a]	**33.2, 31.1–35.2**		**44.6, 43.7–45.5**		**36.8, 35.9–37.6**		**42.5, 40.7–44.3**	
≤25 years	70/533	18.2, 14.8–22.2	11/1062	1.3, 0.6–2.5	56/462	11.3, 8.4–15.0	45/764	6.7, 4.8–9.4
>25 years	462/533	81.4, 77.5–84.8	1051/1062	98.7, 97.5–99.4	406/462	88.7, 85.0–91.6	719/764	93.3, 90.6–95.2
Unknown	1/533	0.4, 0.0–3.0	0/1062	0.0, 0.0–0.4	0/462	0.0, 0.0–0.8	0/764	0.0, 0.0–0.5
Current ART								
First-line	533/533	100.0, 99.3–100.0	1062/1062	100.0, 99.6–100.0	460/462	99.3, 97.1–99.8	710/764	93.6, 89.7–96.1
NNRTI-based[b]	533/533	100.0, 99.3–100.0	1061/1062	99.9, 99.2–100.0	274/460	61.1, 56.1–66.0	452/710	62.8, 54.1–70.8
PI-based[c]	0/533	0.0, 0.0–0.7	1/1062	0.1, 0.0–0.8	2/460	0.5, 0.1–2.5	2/710	0.2, 0.0–1.5
DTG-based	0/533	0.0, 0.0–0.7	0/1062	0.0, 0.0–0.4	184/460	38.4, 33.6–43.3	256/710	36.9, 29.0–45.7
Other	0/533	0.0, 0.0–0.7	0/1062	0.0, 0.0–0.4	0/460	0.0, 0.0–0.8	0/710	0.0, 0.0–0.5
Unknown	0/533	0.0, 0.0–0.7	0/1062	0.0, 0.0–0.4	0/460	0.0, 0.0–0.8	0/710	0.0, 0.0–0.5
Second-line	0/533	0.0, 0.0–0.7	0/1062	0.0, 0.0–0.4	2/462	0.7, 0.2–2.9	54/764	6.4, 3.9–10.3
PI-based[c]	NA		NA		2/2	100.0, NA	54/54	100.0, 93.4–100.0
DTG-based	NA		NA		0/2	0.0, NA	0/54	0.0, 0.0–6.6
Other	NA		NA		0/2	0.0, NA	0/54	0.0, 0.0–6.6
Unknown	0/533	0.0, 0.0–0.7	0/1062	0.0, 0.0–0.4	0/2	0.0, NA	0/54	0.0, 0.0–6.6
Third-line	0/533	0.0, 0.0–0.7	0/1062	0.0, 0.0–0.4	0/462	0.0, 0.0–0.8	0/764	0.0, 0.0–0.5
Unknown	0/375	0.0, 0.0–1.0	0/500	0.0, 0.0–0.8	0/462	0.0, 0.0–0.8	0/764	0.0, 0.0–0.5

a Study design–weighted mean and 95% confidence interval.
b NNRTI-based regimens include EFV or NVP.
c PI-based regimens include ATV/r, DRV/r or LPV/r.
d Included only participants on first-line ART
e Study design–weighted proportion and 95% confidence interval.
ART: antiretroviral therapy; ATV/r: atazanavir/ritonavir; CI: confidence interval; DRV/r: darunavir/ritonavir; DTG: dolutegravir; EFV: efavirenz; LPV/r: lopinavir/ritonavir; NVP: nevirapine; NNRTI: non-nucleoside reverse-transcriptase inhibitor; PI: protease inhibitor; PMTCT: prevention of mother-to-child transmission.

Table A4.1e. Population characteristics of adults receiving ART – the Americas

	El Salvador (start year: 2018) Time on ART: 12 ± 3 months *N*=230		El Salvador (start year: 2018) Time on ART: ≥48 months *N*=425		Guatemala (start year: 2016) Time on ART: 12 ± 3 months *N*=222		Guatemala (start year: 2016) Time on ART: ≥48 months *N*=377	
	n/N	%, 95% CI[d]	*n/N*	%, 95% CI[d]	*n/N*	%, 95% CI[d]	*n/N*	%, 95% CI[d]
Gender								
Women	62/230	22.6, 17.8–28.2	211/425	47.1, 42.2–52.0	66/222	29.7, 21.1–40.1	161/377	42.7, 35.0–50.7
Men	164/230	75.6, 69.7–80.6	213/425	52.6, 47.6–57.4	156/222	70.3, 59.9–78.9	214/377	56.8, 48.5–64.7
Other	4/230	1.8, 0.6–5.5	1/425	0.4, 0.1–2.3	0/222	0.0, 0.0–1.7	2/377	0.5, 0.1–2.1
Unknown	0/230	0.0, 0.0–1.6	0/425	0.0, 0.0–0.9	0/222	0.0, 0.0–1.7	0/377	0.0, 0.0–0.1
Mean age, 95% CI (years)[a]	**35.8, 32.3–39.3**		**44.8, 43.5–46.0**		**35.7, 33.8–37.6**		**42.7, 41.4–43.9**	
≤25 years	42/230	19.0, 11.3–30.2	13/425	4.2, 2.4–7.3	41/222	18.5, 14.3–23.5	369/377	97.9, 95.9–98.9
>25 years	188/230	81.0, 69.8–88.7	412/425	95.8, 92.7–97.6	181/222	81.5, 76.5–85.7	8/377	2.1, 1.1–4.1
Unknown	0/230	0.0, 0.0–1.6	0/425	0.0, 0.0–0.9	0/222	0.0, 0.0–1.7	0/377	0.0, 0.0–0.1
Current ART								
First-line	229/230	99.7, 98.6–99.9	337/425	83.4, 80.4–86.0	220/222	99.1, 96.4–99.8	350/377	92.9, 81.8–97.4
NNRTI-based[b]	229/229	100.0, 98.4–100.0	331/337	98.5, 96.6–99.4	216/220	98.2, 96.1–99.2	323/350	92.3, 87.8–95.2
PI-based[c]	0/229	0.0, 0.0–1.6	5/337	1.2, 0.5–3.2	4/220	1.8, 0.8–3.9	25/350	7.1, 4.3–11.6
DTG-based	0/229	0.0, 0.0–1.6	0/337	0.0, 0.0–1.1	0/220	0.0, 0.0–1.7	0/350	0.0, 0.0–1.1
Other	0/229	0.0, 0.0–1.6	0/337	0.0, 0.0–1.1	0/220	0.0, 0.0–1.7	2/350	0.6, 0.3–1.3
Unknown	0/229	0.0, 0.0–1.6	0/337	0.0, 0.0–1.1	0/220	0.0, 0.0–1.7	0/350	0.0, 0.0–1.1
Second-line	1/230	0.3, 0.1–1.4	87/425	16.5, 13.8–19.5	2/222	0.9, 0.4–2.1	27/377	7.1, 5.4–9.4
PI-based[c]	1/1	100.0, NA	87/87	100.0, 95.8–100.0	2/2	100.0. NA	27/27	100.0, 87.5–100.
DTG-based	0/1	0.0, NA	0/87	0.0, 0.0–4.2	0/2	0.0, NA	0/27	0.0, 0.0–12.5
Other	0/1	0.0, NA	0/87	0.0, 0.0–4.2	0/2	0.0, NA	0/27	0.0, 0.0–12.5
Unknown	0/1	0.0, NA	0/87	0.0, 0.0–4.2	0/2	0.0, NA	0/27	0.0, 0.0–12.5
Third-line	0/230	0.0, 0.0–1.6	1/425	0.2, 0.0–0.6	0/222	0.0, 0.0–1.7	0/377	0.0, 0.0–0.1
Unknown	0/230	0.0, 0.0–1.6	0/425	0.0, 0.0–0.9	0/222	0.0, 0.0–1.7	0/377	0.0, 0.0–0.1

a Study design–weighted mean and 95% confidence interval.
b NNRTI-based regimens include EFV or NVP.
c PI-based regimens include ATV/r, DRV/r or LPV/r.
d Study design–weighted proportion and 95% confidence interval.
ART: antiretroviral therapy; ATV/r: atazanavir/ritonavir; CI: confidence interval; DRV/r: darunavir/ritonavir; DTG: dolutegravir; EFV: efavirenz; LPV/r: lopinavir/ritonavir; NVP: nevirapine; NNRTI: non-nucleoside reverse-transcriptase inhibitor; PI: protease inhibitor; PMTCT: prevention of mother-to-child transmission.

Table A4.1f. Population characteristics of adults receiving ART – the Americas

	Honduras (start year: 2016) Time on ART: 12 ± 3 months *N*=168		Honduras (start year: 2016) Time on ART: ≥48 months *N*=367		Nicaragua (start year: 2016) Time on ART: 12 ± 3 months *N*=114		Nicaragua (start year: 2016) Time on ART: ≥48 months *N*=353	
	n/N	%, 95% CI[d]	*n/N*	%, 95% CI[d]	*n/N*	%, 95% CI[d]	*n/N*	%, 95% CI[d]
Gender								
Women	61/168	35.0, 28.6–42.1	212/367	58.8, 51.8–65.5	38/114	33.4, 24.3–44.0	134/353	43.0, 35.8–50.5
Men	107/168	65.0, 57.9–71.4	154/367	41.0, 34.3–48.1	76/114	66.6, 56.0–75.7	219/353	57.0, 49.5–64.2
Other	0/168	0.0, 0.0–2.2	1/367	0.1, 0.1–0.1	0/114	0.0, 0.0–3.3	0/353	0.0, 0.0–1.1
Unknown	0/168	0.0, 0.0–2.2	0/367	0.0, 0.0–1.0	0/114	0.0, 0.0–3.3	0/353	0.0, 0.0–1.1
Mean age, 95% CI (years)[a]	**34.9, 34.9–36.3**		**43.4, 41.7–45.0**		**32.3, 30.9–33.8**		**38.7, 37.2–40.2**	
≤25 years	31/168	15.5, 12.1–19.7	18/367	3.1, 2.5–3.9	20/114	21.5, 12.8–33.7	22/353	8.0, 4.8–13.1
>25 years	137/168	84.5, 80.3–87.9	349/367	96.9, 96.1–97.5	94/114	78.5, 66.3–87.2	331/353	92.0, 86.9–95.2
Unknown	0/168	0.0, 0.0–2.2	0/367	0.0, 0.0–1.0	0/114	0.0, 0.0–3.3	0/353	0.0, 0.0–1.1
Current ART								
First-line	167/168	99.1, 95.3–99.8	298/367	86.0, 81.8–89.4	110/114	97.8, 97.7–97.9	303/353	84.8, 79.2–89.1
NNRTI-based[b]	166/167	99.4, 97.2–99.9	290/298	97.9, 96.6–98.7	104/110	90.4, 76.8–96.4	257/303	83.9, 78.5–88.1
PI-based[c]	1/167	0.6, 0.1–2.8	8/298	2.1, 1.3–3.4	6/110	9.6, 3.6–23.2	46/303	16.1, 11.9–21.5
DTG-based	0/167	0.0, 0.0–2.2	0/298	0.0, 0.0–1.3	0/110	0.0, 0.0–3.4	0/303	0.0, 0.0–1.3
Other	0/167	0.0, 0.0–2.2	0/298	0.0, 0.0–1.3	0/110	0.0, 0.0–3.4	0/303	0.0, 0.0–1.3
Unknown	0/167	0.0, 0.0–2.2	0/298	0.0, 0.0–1.3	0/110	0.0, 0.0–3.4	0/303	0.0, 0.0–1.3
Second-line	1/168	0.9, 0.2–4.7	62/367	12.5, 9.3–16.7	4/114	2.2, 2.1–2.3	49/353	14.4, 10.4–19.5
PI-based[c]	0/1	0.0, NA	52/62	82.2, 72–89.2	4/4	100.0, NA	42/49	73.3, 50.0–88.3
DTG-based	0/1	0.0, NA	0/62	0.0, 0.0–5.8	0/4	0.0, NA	0/49	0.0, 0.0–7.3
Other	1/1	100.0, NA	10/62	17.8, 10.8–28	0/4	0.0, NA	7/49	26.7, 11.7–50.0
Unknown	0/1	0.0, NA	0/62	0.0, 0.0–5.8	0/4	0.0, NA	0/49	0.0, 0.0–7.3
Third-line	0/168	0.0, 0.0–2.2	7/62	1.5, 0.8–2.7	0/114	0.0, 0.0–3.3	1/353	0.8, 0.1–5.6
Unknown	0/168	0.0, 0.0–2.2	0/367	0.0, 0.0–1.0	0/114	0.0, 0.0–3.3	0/353	0.0, 0.0–1.1

a Study design–weighted mean and 95% confidence interval.
b NNRTI-based regimens include EFV or NVP.
c PI-based regimens include ATV/r, DRV/r or LPV/r.
d Study design–weighted proportion and 95% confidence interval.
ART: antiretroviral therapy; ATV/r: atazanavir/ritonavir; CI: confidence interval; DRV/r: darunavir/ritonavir; DTG: dolutegravir; EFV: efavirenz; LPV/r: lopinavir/ritonavir; NVP: nevirapine; NNRTI: non-nucleoside reverse-transcriptase inhibitor; PI: protease inhibitor; PMTCT: prevention of mother-to-child transmission.

Table A4.1g. Population characteristics of adults receiving ART – the Americas

	Eastern Caribbean Countries[d] (start year: 2017) Time on ART: any *N*=424	
	n/N	%, 95% CI[e]
Gender		
Women	202/424	47.6, 41.5–53.8
Men	221/424	52.1, 46.1–58.1
Other	0/424	0.0, 0.0–0.9
Unknown	1/424	0.2, 0.0–3.2
Mean age, 95% CI (years)[a]	**44.4, 42.5–46.3**	
≤25 years	33/424	7.8, 5.4–11.1
>25 years	389/424	91.7, 87.9–94.4
Unknown	2/424	0.5, 0.1–2.9
Current ART		
First-line	296/424	69.8, 54.4–81.8
NNRTI-based[b]	281/296	66.5, 50.7–79.3
PI-based[c]	6/296	15.8, 6.5–33.8
DTG-based	0/296	0.0, 0.0–1.3
Other	0/296	0.0, 0.0–1.3
Unknown	9/296	17.7, 3.7–54.8
Second-line	66/424	15.6, 7.5–29.5
PI-based[c]	61/66	92.4, 46.0–99.4
DTG-based	0/66	0.0, 0.0–5.5
Other	0/66	0.0, 0.0–5.5
Unknown	5/66	7.6, 0.6–54.0
Third-line	0/424	0.0, 0.0–0.9
Unknown	62/424	14.6, 3.0–48.9

a Unweighted mean and 95% confidence interval adjusted for clustering.
b NNRTI-based regimens include EFV or NVP.
c PI-based regimens include ATV/r, DRV/r or LPV/r.
d Multi-country acquired drug resistance survey: Antigua and Barbuda, Dominica, Grenada, Saint Kitts and Nevis, Saint Lucia and Saint Vincent and the Grenadines.
e Unweighted proportion and 95% confidence interval adjusted for clustering.
ART: antiretroviral therapy; ATV/r: atazanavir/ritonavir; CI: confidence interval; DRV/r: darunavir/ritonavir; DTG: dolutegravir; EFV: efavirenz; LPV/r: lopinavir/ritonavir; NVP: nevirapine; NNRTI: non-nucleoside reverse-transcriptase inhibitor; PI: protease inhibitor; PMTCT: prevention of mother-to-child transmission.

Table A4.1h. Population characteristics of adults receiving ART – South-East Asia and the Western Pacific

	Myanmar (start year: 2018) Time on ART: 12 ± 3 months *N*=481		Myanmar (start year: 2018) Time on ART: ≥48 months *N*=859		Viet Nam (start year: 2020) Time on ART: 12 ± 3 months *N*=391		Viet Nam (start year: 2020) Time on ART: ≥48 months *N*=690	
	n/N	%, 95% CI[d]	*n/N*	%, 95% CI[d]	*n/N*	%, 95% CI[d]	*n/N*	%, 95% CI[d]
Gender								
Women	223/481	46.3, 38.6–54.2	411/859	49.5, 44.7–54.3	97/391	20.9, 15.1–28.1	262/690	38.1, 32.9–43.6
Men	258/481	53.7, 45.8–61.4	448/859	50.5, 45.7–55.3	294/391	79.1, 71.9–84.9	428/690	61.9, 56.4–67.1
Other	0/481	0.0, 0.0–0.8	0/859	0.0, 0.0–0.4	0/391	0.0, 0.0–1.0	0/690	0.0, 0.0–0.6
Unknown	0/481	0.0, 0.0–0.8	0/859	0.0, 0.0–0.4	0/391	0.0, 0.0–1.0	0/690	0.0, 0.0–0.6
Mean age, 95% CI (years)[a]	**38.3, 36.8–39.7**		**42.7, 41.4–44.1**		**33.0, 30.7–35.2**		**39.8, 39.0–40.7**	
≤25 years	36/481	8.2, 4.5–14.5	31/859	3.4, 1.9–6.1	85/391	25.3, 17.2–35.6	16/690	2.3, 1.3–4.2
>25 years	445/481	91.8, 85.5–95.5	828/859	96.6, 93.9–98.1	306/391	74.7, 64.4–82.8	674/690	97.7, 95.8–98.7
Unknown	0/481	0.0, 0.0–0.8	0/859	0.0, 0.0–0.4	0/391	0.0, 0.0–1.0	0/690	0.0, 0.0–0.6
Current ART								
First-line	475/481	99.4, 97.5–99.9	731/859	85.1, 70.7–93.1	388/391	99.2, 97.6–99.7	631/690	91.1, 85.8–94.6
NNRTI-based[b]	471/475	99.5, 98.1–99.9	719/731	97.8, 96.3–98.7	363/388	94.2, 82.4–98.3	583/631	92.1, 75.7–97.8
PI-based[c]	0/475	0.0, 0.0–0.8	1/731	0.2, 0.0–1.9	3/388	1.8, 0.2–11.5	5/631	0.7, 0.2–2.7
DTG-based	4/475	0.5, 0.1–1.9	1/731	0.3, 0.0–2.4	22/388	4.0, 0.9–15.9	43/631	7.1, 1.8–24.2
Other	0/475	0.0, 0.0–0.8	0/731	0.0, 0.0–0.5	0/388	0.0, 0.0–1.0	0/631	0.0, 0.0–0.6
Unknown	0/475	0.0, 0.0–0.8	10/731	1.7, 0.9–3.2	0/388	0.0, 0.0–1.0	0/631	0.0, 0.0–0.6
Second-line	6/481	0.6, 0.1–2.5	127/859	14.7, 6.8–29.1	3/391	0.8, 0.3–2.4	59/690	8.9, 5.4–14.2
PI-based[c]	6/6	100.0, 61.0–100.0	124/127	98.1, 91.8–99.6	3/3	100.0, NA	58/59	97.8, 84.9–99.7
DTG-based	0/6	0.0, 0.0–39.0	1/127	0.7, 0.1–5.4	0/3	0.0, NA	1/59	2.2, 0.3–15.1
Other	0/6	0.0, 0.0–39.0	2/127	1.2, 0.2–8.3	0/3	0.0, NA	0/59	0.0, 0.0–6.1
Unknown	0/6	0.0, 0.0–39.0	0/127	0.0, 0.0–2.9	0/3	0.0, NA	0/59	0.0, 0.0–6.1
Third-line	0/481	0.0, 0.0–0.8	1/859	0.1, 0.0–1.1	0/391	0.0, 0.0–1.0	0/690	0.0, 0.0–0.6
Unknown	0/481	0.0, 0.0–0.8	0/859	0.0, 0.0–0.4	0/391	0.0, 0.0–1.0	0/690	0.0, 0.0–0.6

a Study design–weighted mean and 95% confidence interval.
b NNRTI-based regimens include EFV or NVP.
c PI-based regimens include ATV/r, DRV/r or LPV/r.
d Study design–weighted proportion and 95% confidence interval.
ART: antiretroviral therapy; ATV/r: atazanavir/ritonavir; CI: confidence interval; DRV/r: darunavir/ritonavir; DTG: dolutegravir; EFV: efavirenz; LPV/r: lopinavir/ritonavir; NVP: nevirapine; NNRTI: non-nucleoside reverse-transcriptase inhibitor; PI: protease inhibitor; PMTCT: prevention of mother-to-child transmission.

Table A4.2. Population characteristics of children and adolescents receiving ART – Africa

	Zambia (start year: 2019) Time on ART: 12 ± 3 months *N*=333		Zambia (start year: 2019) Time on ART: ≥36 months *N*=828		Uganda[e] (start year: 2019) Time on ART: any *N*=687	
	n/N	%, 95% CI[d]	*n/N*	%, 95% CI[d]	*n/N*	%, 95% CI[d]
Sex						
Female	178/333	52.9, 43.8–61.9	400/828	45.1, 40.0–50.2	360/687	53.5, 49.8–57.0
Male	154/333	46.3, 37.4–55.4	427/828	54.7, 49.4–59.9	327/687	46.5, 43.0–50.2
Other	0/333	0.0, 0.0–1.1	0/828	0.0, 0.0–0.5	0/687	0.0, 0.0–0.6
Mean age, 95% CI (years)[a]	**7.7, 6.8–8.5**		**10.5, 10.2–10.8**		**10.2, 9.6–10.8**	
≤25 years	130/333	37.6, 29.0–47.0	56/828	6.9, 4.6–10.2	154/687	23.3, 19.3–27.8
>25 years	91/333	28.9, 20.7–38.8	317/828	38.9, 33.9–44.2	174/687	24.5, 19.8–30.0
Unknown	112/333	33.5, 26.8–41.0	455/828	54.2, 49.8–58.5	359/687	52.2, 46.2–58.2
Current ART						
First-line	329/333	99.0, 95.4–99.8	712/828	86.5, 81.6–90.2	687/687	100.0, 99.4–100.0
NNRTI-based[b]	166/329	50.9, 39.8–61.9	513/712	74.1, 65.7–81.1	441/687	62.5, 54.6–69.9
PI-based[c]	137/329	38.7, 31.2–46.8	103/712	13.4, 9.1–19.3	178/687	25.5, 20.5–31.2
DTG-based	17/329	5.8, 3.0–11.0	81/712	11.1, 7.1–17.0	68/687	12.0, 8.8–16.0
Other	0/329	0.0, 0.0–1.2	0/712	0.0, 0.0–0.5	0/687	0.0, 0.0–0.6
Unknown	9/329	4.7, 1.9–10.7	15/712	1.4, 0.5–3.4	0/687	0.0, 0.0–0.6
Second-line	2/333	0.5, 0.1–2.4	96/828	11.8, 8.1–16.9	NA	
PI-based[c]	1/2	50.0, NA	78/96	80.9, 57.4–93.1	NA	
DTG-based	1/2	50.0, NA	8/96	10.0, 2.1–36.8	NA	
Other	0/2	0.0, NA	1/96	0.4, 0.1–3.2	NA	
Unknown	0/2	0.0, NA	9/96	8.6, 3.1–21.4	NA	
Third-line	0/333	0.0, 0.0–1.1	1/828	0.1, 0.0–1.0	NA	
Unknown	2/333	0.5, 0.1–2.3	19/828	1.6, 0.7–3.7	NA	

a Study design–weighted mean and 95% confidence interval.
b NNRTI-based regimens include EFV or NVP.
c PI-based regimens include ATV/r, DRV/r or LPV/r.
d Study design–weighted proportion and 95% confidence interval.
e Survey population was children and adolescents on first-line ART for at least six months with viral load ≥1000 copies/mL.
ART: antiretroviral therapy; ATV/r: atazanavir/ritonavir; CI: confidence interval; DRV/r: darunavir/ritonavir; DTG: dolutegravir; EFV: efavirenz; LPV/r: lopinavir/ritonavir; NVP: nevirapine; NNRTI: non-nucleoside reverse-transcriptase inhibitor; PI: protease inhibitor; PMTCT: prevention of mother-to-child transmission.

Table A4.3a. National prevalence estimates of viral load suppression among adults on ART – Africa

	Botswana (start year: 2019) Time on ART: 12 ± 3 months		Botswana (start year: 2019) Time on ART: ≥48 months		Cameroon (start year: 2015) Time on ART: 12–24 months		Cameroon (start year: 2015) Time on ART: 48–60 months	
	n/N	%, 95% CI[c]	*n/N*	%, 95% CI[c]	*n/N*	%, 95% CI[c]	*n/N*	%, 95% CI[c]
Adults on ART	315/332	95.0, 88.9–97.8	574/611	94.4, 89.1–97.2	796/1064	72.1, 66.2–77.2	267/388	67.8, 55.8–77.7
Women on ART	179/189	97.4, 93.0–99.0	389/411	95.6, 91.7–97.7	624/808	75.0, 69.4–79.9	202/287	69.4, 57.2–79.3
Men on ART	136/143	92.9, 82.2–97.3	185/200	91.3, 79.5–96.6	172/256	61.6, 51.7–70.6	65/101	62.7, 41.8–79.7
Adults on first-line ART	314/331	95.0, 88.9–97.8	545/573	96.1, 92.8–98.0	786/1050	72.1, 66.5–77.2	255/364	68.7, 56.0–79.1
Adults on first-line NNRTI-based[a] ART	44/47	93.8, 80.9–98.2	446/463	96.7, 92.5–98.6	785/1048	72.1, 66.4–77.2	255/364	68.7, 56.0–79.1
Adults on TDF-based first-line NNRTI-based[a] ART	42/45	93.5, 80.4–98.0	286/296	97.1, 91.5–99.1	668/887	74.9, 70.2–79.1	210/287	70.8, 57.4–81.4
Adults on ZDV-based first-line NNRTI-based[a] ART	NA		150/156	95.8, 89.9–98.4	117/180	60.2, 49.1–70.4	45/77	60.6, 42.7–76.1
Adults on first-line DTG-based ART	267/281	95.1, 88.9–97.9	88/96	93.3, 85.6–97.1	NA		NA	
Adults on PI-based[b] second-line ART	NA		24/33	59.8, 20.4–89.7	10/14	83.7, 50.5–96.3	12/23	53.2, 38.1–67.8
Adults on DTG-based second-line ART	1/1	100.0, NA	5/5	100.0, 56.6–100.0	NA		NA	

a NNRTI-based regimens include EFV or NVP.
b PI-based regimens include ATV/r, DRV/r or LPV/r.
c Study design–weighted proportion and 95% confidence interval.
Viral load suppression was defined as viral load <1000 copies/mL.
ART: antiretroviral therapy; ATV/r: atazanavir/ritonavir; CI: confidence interval; DRV/r: darunavir/ritonavir; DTG: dolutegravir; EFV: efavirenz; LPV/r: lopinavir/ritonavir; NA: not applicable; NVP: nevirapine; NNRTI: non-nucleoside reverse-transcriptase inhibitor; PI: protease inhibitor; PMTCT: prevention of mother-to-child transmission.

Table A4.3b. National prevalence estimates of viral load suppression among adults on ART – Africa

	Eswatini[c] (start year: 2016) Time on ART: 12 ± 3 months		Eswatini[c] (start year: 2016) Time on ART: ≥48 months		Lesotho[e] (start year: 2018) Time on ART: 12 ± 3 months		Lesotho[e] (start year: 2018) Time on ART: ≥48 months	
	n/N	%, 95% CI[d]	*n/N*	%, 95% CI[d]	*n/N*	%, 95% CI[d]	*n/N*	%, 95% CI[d]
Adults on ART	340/375	90.5, 86.3–93.5	468/500	93.7, 90.4–95.9	361/385	93.4, 90.2–95.6	450/490	92.1, 88.5–94.6
Women on ART	249/270	92.0, 88.2–94.7	339/359	94.1, 89.6–96.7	237/252	93.6, 89.1–96.3	344/376	91.9, 88.1–94.6
Men on ART	91/105	86.5, 74.1–93.5	129/141	92.6, 86.9–96.0	124/133	93.0, 86.2–96.6	106 /114	92.7, 85.4–96.5
Adults on first-line ART	340/375	90.6, 86.5–93.6	443/468	94.7, 91.3–96.8	359/383	93.3, 90.2–95.5	447/487	92.0, 88.4–94.6
Adults on first-line NNRTI-based[a] ART	335/368	90.8, 86.6–93.8	441/464	95.1, 91.6–97.2	359/383	93.3, 90.2–95.5	447/487	92.0, 88.4–94.6
Adults on TDF-based first-line NNRTI-based[a] ART	303/334	90.7, 86.4–93.7	164/171	96.0, 90.6–98.3	355/379	93.3, 90.1–95.5	336/357	94.4, 89.8–97.0
Adults on ZDV-based first-line NNRTI-based[a] ART	15/17	85.9, 58.4–96.3	217/228	95.1, 90.6–97.5	1/1	100.0, NA	105/122	86.5, 80.3–91.0
Adults on first-line DTG-based ART	NA		NA		NA		NA	
Adults on PI-based[b] second-line ART	0/1	0.0, NA	18/25	72.8, 54.8–85.5	2/2	100.0, NA	3/3	100.0, NA
Adults on DTG-based second-line ART	NA		NA		NA		NA	

a NNRTI-based regimens include EFV or NVP.

b PI-based regimens include ATV/r, DRV/r or LPV/r.

c Viral load suppression defined as viral load ≤2500 copies/mL using DBS (lower limit of detection by the Roche free viral elution platform).

d Study design–weighted proportion and 95% confidence interval.

e Viral load suppression was defined as viral load <1000 copies/mL.

ART: antiretroviral therapy; ATV/r: atazanavir/ritonavir; DRV/r: darunavir/ritonavir; DTG: dolutegravir; EFV: efavirenz; LPV/r: lopinavir/ritonavir; NA: not applicable; NVP: nevirapine; NNRTI: non-nucleoside reverse-transcriptase inhibitor; PI: protease inhibitor; PMTCT: prevention of mother-to-child transmission.

Table A4.3c. National prevalence estimates of viral load suppression among adults on ART – Africa

	Senegal (start year: 2017) Time on ART: 12 ± 3 months		Senegal (start year: 2017) Time on ART: ≥40 months		South Sudan (start year: 2018) Time on ART: 12 ± 3 months		South Sudan (start year: 2018) Time on ART: ≥48 months	
	n/N	%, 95% CI[c]	*n/N*	%, 95% CI[c]	*n/N*	%, 95% CI[c]	*n/N*	%, 95% CI[c]
Adults on ART	211/255	86.5, 79.4–91.5	270/315	88.1, 81.2–92.7	271/376	63.0, 51.4–73.3	351/513	69.9, 62.9–76.1
Women on ART	154/184	86.8, 78.9–92.0	208/239	89.3, 81.9–93.8	173/236	64.5, 51.8–75.4	264/377	70.2, 63.1–76.5
Men on ART	57/71	85.8, 72.0–93.5	62/76	84.4, 69.7–92.8	98/140	61.1, 48.2–72.6	87/136	69.0, 57.2–78.8
Adults on first-line ART	208/252	86.4, 79.2–91.4	267/311	88.2, 81.2–92.8	271/376	63.0, 51.4–73.3	332/479	70.4, 63.7–76.4
Adults on first-line NNRTI-based[a] ART	206/249	86.0, 78.8–91.0	267/311	88.2, 81.2–92.8	270/375	62.9, 51.3–73.2	330/476	70.4, 63.7–76.4
Adults on TDF-based first-line NNRTI-based[a] ART	196/238	85.4, 78.0–90.6	206/236	88.5, 80.6–93.5	263/366	61.9, 50.3–72.3	195/274	70.5, 62.9–77.0
Adults on ZDV-based first-line NNRTI-based[a] ART	NA		61/75	87.1, 73.6–94.2	NA		135/201	70.5, 60.8–78.6
Adults on first-line DTG-based ART	NA		NA		NA		NA	
Adults on PI-based[b] second-line ART	1/1	100.0, NA	2/3	83.2, 32.4–98.1	NA		19/34	54.6, 30.3–76.9
Adults on DTG-based second-line ART	NA		NA		NA		NA	

a NNRTI-based regimens include EFV or NVP.
b PI-based regimens include ATV/r, DRV/r or LPV/r.
c Study design–weighted proportion and 95% confidence interval.
Viral load suppression was defined as viral load <1000 copies/mL.
ART: antiretroviral therapy; ATV/r: atazanavir/ritonavir; CI: confidence interval; DRV/r: darunavir/ritonavir; DTG: dolutegravir; EFV: efavirenz; LPV/r: lopinavir/ritonavir; NA: not applicable; NVP: nevirapine; NNRTI: non-nucleoside reverse-transcriptase inhibitor; PI: protease inhibitor; PMTCT: prevention of mother-to-child transmission.

Table A4.3d. National prevalence estimates of viral load suppression among adults on ART – Africa

	Uganda (start year: 2016) Time on ART: 12 ± 3 months		Uganda (start year: 2017) Time on ART: ≥48 months		Zambia (start year: 2019) Time on ART: 12 ± 3 months		Zambia (start year: 2019) Time on ART: ≥48 months	
	n/N	%, 95% CI[c]	*n/N*	%, 95% CI[c]	*n/N*	%, 95% CI[c]	*n/N*	%, 95% CI[c]
Adults on ART	493/533	94.6, 92.8–96.0	923/1062	88.0, 84.6–90.7	414/460	89.9, 84.5–93.5	693/756	92.2, 87.1–95.4
Women on ART	324/351	93.1, 91.4–94.5	606/693	88.3, 85.2–90.8	247/272	91.4, 86.2–94.7	457/496	91.8, 84.7–95.8
Men on ART	169/182	97.6, 90.8–99.4	317/369	87.4, 81.6–91.6	167/188	87.9, 78.7–93.5	236/260	93.0, 88.4–95.9
Adults on first-line ART	493/533	94.6, 92.8–96.0	923/1062	88.0, 84.6–90.7	412/458	89.8, 84.4–93.5	646/703	92.7, 87.0–960
Adults on first-line NNRTI-based[a] ART	493/533	94.6, 92.8–96.0	922/1061	88.0, 84.6–90.7	239/272	89.6, 83.5–93.6	405/450	92.4, 87.4–95.5
Adults on TDF-based first-line NNRTI-based[a] ART	493/533	94.6, 92.8–96.0	328/366	90.7, 84.9–94.4	235/267	89.5, 83.4–93.5	374/417	92.3, 87.1–95.5
Adults on ZDV-based first-line NNRTI-based[a] ART	53/58	94.9, 86.9–98.1	591/692	86.6, 82.4–89.9	NA		8/8	100.0, 67.6–100.0
Adults on first-line DTG-based ART	NA		NA		171/184	90.1, 81.0–95.1	240/252	93.2, 75.9–98.3
Adults on PI-based[b] second-line ART	NA		NA		2/2	100, NA	47/53	84.9, 68.9–93.4
Adults on DTG-based second-line ART	NA		NA		NA		NA	

a NNRTI-based regimens include EFV or NVP.
b PI-based regimens include ATV/r, DRV/r or LPV/r.
c Study design–weighted proportion and 95% confidence interval.
Viral load suppression was defined as viral load <1000 copies/mL.
ART: antiretroviral therapy; ATV/r: atazanavir/ritonavir; DRV/r: darunavir/ritonavir; DTG: dolutegravir; EFV: efavirenz; LPV/r: lopinavir/ritonavir; NA: not applicable; NVP: nevirapine; NNRTI: non-nucleoside reverse-transcriptase inhibitor; PI: protease inhibitor; PMTCT: prevention of mother-to-child transmission.

Table A4.3e. National prevalence estimates of viral load suppression among adults on ART – the Americas

	El Salvador (start year: 2018) Time on ART: 12 ± 3 months		El Salvador (start year: 2018) Time on ART: ≥48 months		Guatemala (start year: 2016) Time on ART: 12 ± 3 months		Guatemala (start year: 2016) Time on ART: ≥48 months	
	n/N	%, 95% CI[c]	*n/N*	%, 95% CI[c]	*n/N*	%, 95% CI[c]	*n/N*	%, 95% CI[c]
Adults on ART	206/230	88.8, 83.1–92.8	341/425	80.5, 76.6–84.0	197/222	88.7, 77.4–94.8	328/377	86.9, 70.4–94.8
Women on ART	52/62	81.7, 66.5–90.9	164/211	77.7, 71.6–82.8	56/66	84.8, 73.0–92.0	137/161	85.0, 67.2–94.0
Men on ART	151/164	91.2, 84.8–95.0	176/213	82.9, 77.2–87.4	141/156	90.4, 76.0–96.5	189/214	88.2, 71.8–95.7
Adults on first-line ART	205/229	88.8, 83.0–92.8	278/337	82.6, 78.3–86.3	195/220	88.6, 77.1–94.7	308/350	87.9, 71.5–95.4
Adults on first-line NNRTI-based[a] ART	205/229	88.8, 83.0–92.8	273/331	82.6, 78.2–86.3	193/216	89.3, 79.2–94.9	286/323	88.4, 71.8–95.8
Adults on TDF-based first-line NNRTI-based[a] ART	195/217	88.9, 82.8–93.0	101/123	83.6, 77.2–88.5	181/199	91.0, 81.6–95.8	188/212	88.6, 72.8–95.7
Adults on ZDV-based first-line NNRTI-based[a] ART	6/7	89.9, 58.1–98.3	161/197	81.2, 75.0–86.2	4/6	66.7, 13.8–96.2	72/84	85.5, 59.2–96.0
Adults on first-line DTG-based ART	NA		NA		NA		NA	
Adults on PI-based[b] second-line ART	1/1	100.0, NA	62/87	69.8, 59.2–78.7	2/2	100.0, NA	20/27	74.1, 54.0–87.4
Adults on DTG-based second-line ART	NA		NA		NA		NA	

a NNRTI-based regimens include EFV or NVP.
b PI-based regimens include ATV/r, DRV/r or LPV/r.
c Study design–weighted proportion and 95% confidence interval.
Viral load suppression was defined as viral load <1000 copies/mL.
ART: antiretroviral therapy; ATV/r: atazanavir/ritonavir; CI: confidence interval; DRV/r: darunavir/ritonavir; DTG: dolutegravir; EFV: efavirenz; LPV/r: lopinavir/ritonavir; NA: not applicable; NVP: nevirapine; NNRTI: non-nucleoside reverse-transcriptase inhibitor; PI: protease inhibitor; PMTCT: prevention of mother-to-child transmission.

Table A4.3f. National prevalence estimates of viral load suppression among adults on ART – the Americas

	Honduras (start year: 2016) Time on ART: 12 ± 3 months		**Honduras** (start year: 2016) Time on ART: ≥48 months		**Nicaragua** (start year: 2016) Time on ART: 12 ± 3 months		**Nicaragua** (start year: 2016) Time on ART: ≥48 months	
	n/N	%, 95% CI[c]	*n/N*	%, 95% CI[c]	*n/N*	%, 95% CI[c]	*n/N*	%, 95% CI[c]
Adults on ART	150/168	89.7, 85.1–93.0	246/367	67.9, 61.7–73.6	86/114	77.8, 67.1–85.8	240/353	70.3, 66.7–73.8
Women on ART	52/61	87.0, 77.4–92.9	141/212	69.4, 61.3–76.5	28/38	66.4, 42.7–84.0	92/134	72.5, 65.2–78.8
Men on ART	98/107	91.2, 83.6–95.5	105/154	66.1, 54.9–75.7	58/76	83.5, 73.8–90.2	148/219	68.7, 62.2–74.5
Adults on first-line ART	149/167	89.6, 85.0–93.0	203/298	68.9, 61.7–75.3	82/110	77.3, 66.4–85.5	208/303	70.9, 66.8–74.6
Adults on first-line NNRTI-based[a] ART	148/166	89.6, 84.9–92.9	198/290	69.2, 61.8–75.7	78/104	80.7, 76.1–84.7	182/264	70.3, 65.7–74.4
Adults on TDF-based first-line NNRTI-based[a] ART	142/158	90.4, 85.8–93.6	38/60	64.6, 54.0–73.9	67/91	80.0, 75.9–83.6	77/113	70.4, 64.8–75.6
Adults on ZDV-based first-line NNRTI-based[a] ART	5/7	66.1, 35.0–87.7	161/227	71.9, 63.2–79.2	15/19	68.3, 37.7–88.5	112/159	71.9, 65.8–77.3
Adults on first-line DTG-based ART	NA		NA		NA		NA	
Adults on PI-based[b] second-line ART	1/1	100.0, NA	37/52	74.5, 62.9–83.5	4/4	100.0, NA	26/42	61.8, 48.7–73.3
Adults on DTG-based second-line ART	NA		NA		NA		NA	

a NNRTI-based regimens include EFV or NVP.
b PI-based regimens include ATV/r, DRV/r or LPV/r.
c Study design–weighted proportion and 95% confidence interval.
Viral load suppression was defined as viral load <1000 copies/mL.
ART: antiretroviral therapy; ATV/r: atazanavir/ritonavir; CI: confidence interval; DRV/r: darunavir/ritonavir; DTG: dolutegravir; EFV: efavirenz; LPV/r: lopinavir/ritonavir; NA: not applicable; NVP: nevirapine; NNRTI: non-nucleoside reverse-transcriptase inhibitor; PI: protease inhibitor; PMTCT: prevention of mother-to-child transmission.

Table A4.3g. National prevalence estimates of viral load suppression among adults on ART – the Americas

	Eastern Caribbean Countries[c] (start year: 2017) Time on ART: any	
	n/N	%, 95% CI[d]
Adults on ART	355/424	83.7, 71.9–91.2
Women on ART	169/202	83.7, 66.1–93.1
Men on ART	185/221	83.7, 72.0–91.1
Adults on first-line ART	258/296	87.2, 80.9–91.6
Adults on first-line NNRTI-based[a] ART	247/282	87.6, 82.1–91.5
Adults on TDF-based first-line NNRTI-based[a] ART	157/183	85.8, 81.0–89.6
Adults on ZDV-based first-line NNRTI-based[a] ART	84/92	91.3, 81.3–96.2
Adults on first-line DTG-based ART	NA	
Adults on PI-based[b] second-line ART	51/61	83.6, 64.1–93.6
Adults on DTG-based second-line ART	NA	

a NNRTI-based regimens include EFV or NVP.
b PI-based regimens include ATV/r, DRV/r or LPV/r.
c Eastern Caribbean Countries: Antigua and Barbuda, Dominica, Grenada, Saint Kitts and Nevis, Saint Lucia and Saint Vincent and the Grenadines.
d Unweighted proportion and 95% confidence interval adjusted for clustering.
Viral load suppression was defined as viral load <1000 copies/mL.
ART: antiretroviral therapy; ATV/r: atazanavir/ritonavir; CI: confidence interval; DRV/r: darunavir/ritonavir; DTG: dolutegravir; EFV: efavirenz; LPV/r: lopinavir/ritonavir; NA: not applicable; NVP: nevirapine; NNRTI: non-nucleoside reverse-transcriptase inhibitor; PI: protease inhibitor; PMTCT: prevention of mother-to-child transmission.

Table A4.3h. National prevalence estimates of viral load suppression among adults on ART – South-East Asia and the Western Pacific

	Myanmar (start year: 2018) Time on ART: 12 ± 3 months		Myanmar (start year: 2018) Time on ART: ≥48 months		Viet Nam (start year: 2020) Time on ART: 12 ± 3 months		Viet Nam (start year: 2020) Time on ART: ≥48 months	
	n/N	%, 95% CI[c]	*n/N*	%, 95% CI[c]	*n/N*	%, 95% CI[c]	*n/N*	%, 95% CI[c]
Adults on ART	452/481	94.4, 91.8–96.2	825/859	97.1, 95.5–98.1	373/391	96.4, 94.0–97.9	679/ 690	98.6, 96.5–99.4
Women on ART	212/223	94.1, 88.0–97.2	394/411	96.8, 94.2–98.3	95/97	98.5, 92.5–99.7	254/262	97.2, 92.3–99.0
Men on ART	240/258	94.6, 88.9–97.4	431/448	97.4, 95.4–98.5	278/294	95.8, 92.7–97.7	425/428	99.4, 97.9–99.9
Adults on first-line ART	446/475	94.3, 91.7–96.1	710/731	97.8, 95.2–99.0	370/388	96.4, 93.9–97.8	624/631	99.3, 97.6–99.8
Adults on first-line NNRTI-based[a] ART	442/471	94.3, 91.7–96.1	698/719	97.7, 95.1–99.0	345/363	96.1, 93.6–97.7	578/583	99.4, 97.4–99.9
Adults on TDF-based first-line NNRTI-based[a] ART	425/453	94.5, 91.7–96.4	501/514	98.2, 94.6–99.4	343/361	96.1, 93.5–97.7	534/539	99.4, 97.2–99.9
Adults on ZDV-based first-line NNRTI-based[a] ART	10/11	80.3, 43.9–95.5	171/178	96.1, 90.2–98.5	1/1	100.0, NA	43/43	100.0, NA
Adults on first-line DTG-based ART	4/4	100.0, 51.0–100.0	1/1	100.0, NA	22/22	100.0, NA	42/43	98.8, 90.5–99.9
Adults on PI-based[b] second-line ART	6/6	100.0, 61.0–100.0	112/124	93.2, 81.8–97.6	3/3	100.0, NA	55/58	93.2, 76.9–98.2
Adults on DTG-based second-line ART	NA		1/1	100.0, NA	NA		0/1	0.0, NA

a NNRTI-based regimens include EFV or NVP.
b PI-based regimens include ATV/r, DRV/r or LPV/r.
c Study design–weighted proportion and 95% confidence interval.
Viral load suppression was defined as viral load <1000 copies/mL.
ART: antiretroviral therapy; ATV/r: atazanavir/ritonavir; DRV/r: darunavir/ritonavir; DTG: dolutegravir; EFV: efavirenz; LPV/r: lopinavir/ritonavir; NA: not applicable; NVP: nevirapine; NNRTI: non-nucleoside reverse-transcriptase inhibitor; PI: protease inhibitor; PMTCT: prevention of mother-to-child transmission.

Table A4.4. National prevalence estimates of viral load suppression among children and adolescents on ART – Zambia

	Zambia (start year: 2019) Time on ART: 12 ± 3 months		**Zambia** (start year: 2019) Time on ART: ≥36 months	
	n/N	%, 95% CI[c]	*n/N*	%, 95% CI[c]
Children and adolescents on ART	243/332	69.4, 59.8–77.5	586/824	68.3, 59.1–76.3
Aged ≤10 years old	156/220	69.2, 58.1–78.4	257/372	65.9, 55.9–74.6
Aged >10 years old	87/112	69.7, 54.4–81.7	329/452	70.3, 59.9–79.0
Children and adolescents on first-line ART	239/328	69.1, 59.5–77.2	496/708	67.3, 57.0–76.3
Children and adolescents on first-line NNRTI-based[a] ART	124/166	68.8, 54.2–80.5	333/510	61.5, 49.5–72.3
Children and adolescents on first-line PI-based[b] ART	94/136	65.2, 49.7–78.0	75/103	76.3, 62.8–85.9
Children and adolescents on first-line DTG-based ART	14/17	79.4, 47.9–94.2	74/80	92.5, 82.8–97.0
Children and adolescents on second-line ART	2/2	100.0, NA	75/96	79.7, 71.3–86.2
Children and adolescents on second-line PI-based[b] ART	1/1	100.0, NA	58/78	75.9, 66.7–83.3
Children and adolescents on second-line DTG-based ART	1/1	100.0, NA	8/8	100.0, 67.6–100.0

a NNRTI-based regimens include EFV or NVP.
b PI-based regimens include ATV/r, DRV/r or LPV/r.
c Study design–weighted proportion and 95% confidence interval.
Viral load suppression was defined as viral load <1000 copies/mL.
ART: antiretroviral therapy; ATV/r: atazanavir/ritonavir; CI: confidence interval; DRV/r: darunavir/ritonavir; DTG: dolutegravir; EFV: efavirenz; LPV/r: lopinavir/ritonavir; NA: not applicable; NVP: nevirapine; NNRTI: non-nucleoside reverse-transcriptase inhibitor; PI: protease inhibitor; PMTCT: prevention of mother-to-child transmission.

Table A4.5a. Prevalence of acquired HIV drug resistance among adults on ART – Africa

		Botswana (start year: 2019) Time on ART: 12 ± 3 months		Botswana (start year: 2019) Time on ART: ≥48 months		Cameroon (start year: 2015) Time on ART: 12–24 months		Cameroon (start year: 2015) Time on ART: 48–60 months	
		n/N	%, 95% CI[a]	*n/N*	%, 95% CI[a]	*n/N*	%, 95% CI[a]	*n/N*	%, 95% CI[a]
HIV drug resistance among adults on ART with viral load ≥1000 copies/mL									
NRTI	Any	1/9	2.4, 0.2–22.8	15/25	58.3, 41.7–73.3	97/164	52.6, 41.2–63.7	53/67	77.9, 50.2–92.5
	ABC	1/9	2.4, 0.2–22.8	15/25	58.3, 41.7–73.3	96/164	52.3, 40.3–63.9	52/67	77.2, 50.1–91.9
	3TC or FTC	1/9	2.4, 0.2–22.8	15/25	58.3, 41.7–73.3	96/164	52.3, 40.3–63.9	52/67	77.2, 50.1–91.9
	TDF	1/9	2.4, 0.2–22.8	4/25	16.9, 7.1–35.4	58/164	28.4, 18.4–41.1	33/67	49.9, 26.9–73.0
	ZDV	0/9	0.0, 0.0–29.9	3/25	9.9, 2.3–34.1	23/164	11.7, 7.1–18.6	22/67	36.1, 17.8–59.6
NNRTI	EFV or NVP	1/9	2.4, 0.2–22.8	15/25	51.1, 26.6–75.1	109/164	59.7, 49.3–69.4	59/67	87.7, 67.4–96.1
	DOR	1/9	2.4, 0.2–22.8	11/25	37.0, 20.4–57.4	ND		ND	
	ETR	1/9	2.4, 0.2–22.8	9/25	29.6, 12.7–54.8	65/164	34.9, 24.4–47.1	31/67	47.7, 41.3–54.1
	RPV	2/9	3.9, 0.5–23.8	13/25	49.7, 33.3–66.1	78/164	43.1, 32.1–54.8	41/67	59.5, 52.2–66.3
PI/r	ATV/r, DRV/r or LPV/r	0/9	0.0, 0.0–29.9	1/25	1.0, 0.1–8.2	1/163	1.2, 0.2–8.4	2/70	0.8, 0.1–9.6
	ATV/r	0/9	0.0, 0.0–29.9	1/25	1.0, 0.1–8.2	1/163	1.2, 0.2–8.4	2/70	0.8, 0.1–9.6
	DRV/r	0/9	0.0, 0.0–29.9	0/25	0.0, 0.0–13.3	0/163	0.0, 0.0–2.3	0/70	0.0, 0.0–5.2
	LPV/r	0/9	0.0, 0.0–29.9	1/25	1.0, 0.1–8.2	1/163	1.2, 0.2–8.4	0/70	0.0, 0.0–5.2
INSTI	Any	ND		ND		ND		ND	
	BIC	ND		ND		ND		ND	
	CAB	ND		ND		ND		ND	
	DTG	ND		ND		ND		ND	
	EVG	ND		ND		ND		ND	
	RAL	ND		ND		ND		ND	
HIV drug resistance among adults on first-line ART with viral load ≥1000 copies/mL									
NRTI	Any	1/9	2.4, 0.2–22.8	11/18	65.6, 47.4–80.1	96/162	52.6, 41.2–63.7	51/63	79.3, 50.4–93.5
	ABC	1/9	2.4, 0.2–22.8	11/18	65.6, 47.4–80.1	95/162	52.3, 40.3–64.0	51/63	79.3, 50.4–93.5
	3TC or FTC	1/9	2.4, 0.2–22.8	11/18	65.6, 47.4–80.1	95/162	52.3, 40.3–64.0	51/63	79.3, 50.4–93.5
	TDF	1/9	2.4, 0.2–22.8	2/18	6.0, 1.1–26.2	57/162	28.3, 18.3–41.1	33/63	52.1, 28.4–74.8
	ZDV	0/9	0.0, 0.0–29.9	3/18	19.0, 4.2–55.6	22/162	11.5, 6.9–18.4	21/63	36.9, 18.9–59.5
NNRTI	EFV or NVP	1/9	2.4, 0.2–22.8	13/18	71.5, 49.8–86.4	108/162	59.8, 49.3–69.5	57/63	89.5, 71.0–96.7
	DOR	1/9	2.4, 0.2–22.8	9/18	44.5, 22.8–68.4	ND		ND	
	ETR	1/9	2.4, 0.2–22.8	7/18	30.2, 8.0–68.3	65/162	35.1, 24.5–47.3	31/63	49.8, 44.8–54.7
	RPV	2/9	3.9, 0.5–23.8	10/18	50.9, 28.3–73.1	77/162	43.1, 32.0–54.8	40/63	60.9, 53.8–67.5
PI/r	ATV/r, DRV/r or LPV/r	0/9	0.0, 0.0–29.9	0/18	0.0, 0.0–17.6	1/161	1.2, 0.2–8.4	2/65	0.8, 0.1–10.3
	ATV/r	0/9	0.0, 0.0–29.9	0/18	0.0, 0.0–17.6	1/161	1.2, 0.2–8.4	2/65	0.8, 0.1–10.3
	DRV/r	0/9	0.0, 0.0–29.9	0/18	0.0, 0.0–17.6	0/161	0.0, 0.0–2.3	0/65	0.0, 0.0–5.6
	LPV/r	0/9	0.0, 0.0–29.9	0/18	0.0, 0.0–17.6	1/161	1.2, 0.2–8.4	0/65	0.0, 0.0–5.6
INSTI	Any	ND		ND		ND		ND	
	BIC	ND		ND		ND		ND	
	CAB	ND		ND		ND		ND	
	DTG	ND		ND		ND		ND	
	EVG	ND		ND		ND		ND	
	RAL	ND		ND		ND		ND	
HIV drug resistance among adults on first-line NNRTI-based[b] ART with viral load ≥1000 copies/mL									
NRTI	Any	NA		7/12	65.8, 48.6–79.7	95/161	52.5, 41.1–63.6	51/63	79.3, 50.4–93.5
	ABC	NA		7/12	65.8, 48.6–79.7	94/161	52.2, 40.2–63.9	51/63	79.3, 50.4–93.5
	3TC or FTC	NA		7/12	65.8, 48.6–79.7	94/161	52.2, 40.2–63.9	51/63	79.3, 50.4–93.5
	TDF	NA		1/12	5.5, 0.5–38.1	56/161	28.1, 18.1–40.9	33/63	52.1, 28.4–74.8
	ZDV	NA		2/12	16.9, 2.4–62.7	22/161	11.5, 7–18.5	21/63	36.9, 18.9–59.5
NNRTI	EFV or NVP	NA		9/12	73.7, 52.3–87.8	107/161	59.7, 49.2–69.4	57/63	89.5, 71.0–96.7
	DOR	NA		6/12	43.3, 21.9–67.4	ND		ND	
	ETR	NA		4/12	24.3, 4.4–69.3	64/161	34.9, 24.4–47.2	31/63	49.8, 44.8–54.7
	RPV	NA		6/12	46.3, 25.0–69.1	76/161	42.9, 31.9–54.7	40/63	60.9, 53.8–67.5
PI/r	ATV/r, DRV/r or LPV/r	NA		0/12	0.0, 0.0–24.2	1/160	1.2, 0.2–8.5	2/65	0.8, 0.1–10.3
	ATV/r	NA		0/12	0.0, 0.0–24.2	1/160	1.2, 0.2–8.5	2/65	0.8, 0.1–10.3
	DRV/r	NA		0/12	0.0, 0.0–24.2	0/160	0.0, 0.0–2.3	0/65	0.0, 0.0–5.6
	LPV/r	NA		0/12	0.0, 0.0–24.2	1/160	1.2, 0.2–8.5	0/65	0.0, 0.0–5.6
INSTI	Any	NA		ND		ND		ND	
	BIC	NA		ND		ND		ND	
	CAB	NA		ND		ND		ND	
	DTG	NA		ND		ND		ND	
	EVG	NA		ND		ND		ND	
	RAL	NA		ND		ND		ND	

a Study design–weighted proportion and 95% confidence interval.

b NNRTI-based regimens include EFV or NVP.

HIV drug resistance was defined as the presence of a penalty score ≥15 using the Stanford HIVdb algorithm.

ABC: abacavir; ATV/r: atazanavir/ritonavir; BIC: bictegravir; CAB: cabotegravir; CI: confidence interval; DOR: doravirine; DRV/r: darunavir/ritonavir; DTG: dolutegravir; EFV: efavirenz; ETR: etravirine; EVG: elvitegravir; INSTI: integrase strand-transfer inhibitor; LPV/r: lopinavir/ritonavir; ND: no data; NNRTI: non-nucleoside reverse-transcriptase inhibitor; NRTI: nucleoside reverse-transcriptase inhibitor; NVP: nevirapine; PI/r: boosted protease inhibitor; RAL: raltegravir; RPV: rilpivirine; TDF: tenofovir disoproxil fumarate; ZDV: zidovudine; 3TC/FTC: lamivudine/emtricitabine.

Table A4.5b. Prevalence of acquired HIV drug resistance among adults on ART – Africa

		Eswatini[a,b] (start year: 2016) Time on ART: 12 ± 3 months		Eswatini[b] (start year: 2016) Time on ART: ≥48 months		Lesotho (start year: 2018) Time on ART: 12 ± 3 months		Lesotho (start year: 2018) Time on ART: ≥48 months	
		n/N	%, 95% CI[c]	*n/N*	%, 95% CI[c]	*n/N*	%, 95% CI[c]	*n/N*	%, 95% CI[c]
HIV drug resistance among adults on first-line ART with viral load ≥1000 copies/mL									
NRTI	Any	18/26	51.8, 26.8–76.0	14/20	75.0, 40.2–93.1	6/22	27.3, 11.6–52.0	32/40	80.0, 64.1–89.9
	ABC	18/26	51.8, 26.8–76.0	14/20	75, 42.7–92.4	6/22	27.3, 11.6–52.0	31/40	78.0, 62.7–88.2
	3TC or FTC	18/26	51.8, 26.8–76.0	14/20	75, 42.7–92.4	6/22	27.3, 11.6–52.0	31/40	78.0, 62.7–88.2
	TDF	15/26	46.2, 24.4–69.5	9/20	52.1, 24.3–78.6	6/22	27.3, 11.6–52.0	20/40	51.4, 35.9–66.6
	ZDV	1/26	2.1, 0.3–13.4	7/20	29.1, 10.9–57.8	0/22	0.0, 0.0–14.9	8/40	19.8, 10.2–34.9
NNRTI	EFV or NVP	17/26	49.7, 26.4–73.2	13/20	72.9, 41.6–91.1	10/22	49.8, 31.2–68.5	36/40	88.8, 73.8–95.7
	DOR	17/26	49.7, 26.4–73.2	9/20	39.3, 17.2–66.9	7/22	33.6, 15.3–58.6	30/40	76.7, 60.1–87.8
	ETR	11/26	28.0, 13.6–49.0	8/20	35.2, 14.7–63.2	4/22	16.7, 5.3–41.7	17/40	44.0, 24.6–65.5
	RPV	15/26	40.6, 20.0–65.0	9/20	39.8, 16.6–68.7	5/22	22.3, 8.1–48.1	27/40	68.3, 48.8–83.0
PI/r	ATV/r, DRV/r or LPV/r	0/26	0.0, 0.0–12.9	1/20	2.6, 0.3–20.6	0/22	0.0, 0.0–14.9	0/40	0.0, 0.0–8.8
	ATV/r	0/26	0.0, 0.0–12.9	1/20	2.6, 0.3–20.6	0/22	0.0, 0.0–14.9	0/40	0.0, 0.0–8.8
	DRV/r	0/26	0.0, 0.0–12.9	1/20	2.6, 0.3–20.6	0/22	0.0, 0.0–14.9	0/40	0.0, 0.0–8.8
	LPV/r	0/26	0.0, 0.0–12.9	1/20	2.6, 0.3–20.6	0/22	0.0, 0.0–14.9	0/40	0.0, 0.0–8.8
INSTI	Any	ND		ND		ND		ND	
	BIC	ND		ND		ND		ND	
	CAB	ND		ND		ND		ND	
	DTG	ND		ND		ND		ND	
	EVG	ND		ND		ND		ND	
	RAL	ND		ND		ND		ND	
HIV drug resistance among adults on first-line ART with viral load ≥1000 copies/mL									
NRTI	Any	17/25	50.8, 26.2–75.0	11/13	85.7, 47.8–97.5	6/22	27.3, 11.6–52.0	32/40	80.0, 64.1–89.9
	ABC	17/25	50.8, 26.2–75.0	11/13	85.7, 51.2–97.2	6/22	27.3, 11.6–52.0	31/40	78.0, 62.7–88.2
	3TC or FTC	17/25	50.8, 26.2–75.0	11/13	85.7, 51.2–97.2	6/22	27.3, 11.6–52.0	31/40	78.0, 62.7–88.2
	TDF	15/25	47.1, 24.5–71.0	7/13	57.8, 25.8–84.3	6/22	27.3, 11.6–52.0	20/40	51.4, 35.9–66.6
	ZDV	1/25	2.1, 0.3–14.0	4/13	19.7, 6.0–48.6	0/22	0.0, 0.0–14.9	8/40	19.8, 10.2–34.9
NNRTI	EFV or NVP	17/25	50.8, 26.2–75.0	12/13	91.4, 48.0–99.2	10/22	49.8, 31.2–68.5	36/40	88.8, 73.8–95.7
	DOR	17/25	50.8, 26.2–75.0	8/13	43.1, 16.2–74.8	7/22	33.6, 15.3–58.6	30/40	76.7, 60.1–87.8
	ETR	11/25	28.6, 13.5–50.6	7/13	37.2, 13.3–69.6	4/22	16.7, 5.3–41.7	17/40	44.0, 24.6–65.5
	RPV	14/25	39.3, 19.5–63.3	8/13	43.8, 15.3–77.1	5/22	22.3, 8.1–48.1	27/40	68.3, 48.8–83.0
PI/r	ATV/r, DRV/r or LPV/r	0/25	0.0, 0.0–13.3	0/13	0.0, 0.0–22.8	0/22	0.0, 0.0–14.9	0/40	0.0, 0.0–8.8
	ATV/r	0/25	0.0, 0.0–13.3	0/13	0.0, 0.0–22.8	0/22	0.0, 0.0–14.9	0/40	0.0, 0.0–8.8
	DRV/r	0/25	0.0, 0.0–13.3	0/13	0.0, 0.0–22.8	0/22	0.0, 0.0–14.9	0/40	0.0, 0.0–8.8
	LPV/r	0/25	0.0, 0.0–13.3	0/13	0.0, 0.0–22.8	0/22	0.0, 0.0–14.9	0/40	0.0, 0.0–8.8
INSTI	Any	ND		ND		ND		ND	
	BIC	ND		ND		ND		ND	
	CAB	ND		ND		ND		ND	
	DTG	ND		ND		ND		ND	
	EVG	ND		ND		ND		ND	
	RAL	ND		ND		ND		ND	
HIV drug resistance among adults on first-line NNRTI-based[d] ART with viral load ≥1000 copies/mL									
NRTI	Any	17/24	52.7, 27.1–76.9	10/12	84.5, 44.6–97.4	6/22	27.3, 11.6–52.0	32/40	80.0, 64.1–89.9
	ABC	17/24	52.7, 27.1–76.9	10/12	84.5, 48.0–97.0	6/22	27.3, 11.6–52.0	31/40	78.0, 62.7–88.2
	3TC or FTC	17/24	52.7, 27.1–76.9	10/12	84.5, 48.0–97.0	6/22	27.3, 11.6–52.0	31/40	78.0, 62.7–88.2
	TDF	15/24	48.9, 25.3–72.9	6/12	54.1, 21.4–83.6	6/22	27.3, 11.6–52.0	20/40	51.4, 35.9–66.6
	ZDV	1/24	2.2, 0.3–14.5	4/12	21.5, 6.5–52.0	0/22	0.0, 0.0–14.9	8/40	19.8, 10.2–34.9
NNRTI	EFV or NVP	17/24	52.7, 27.1–76.9	11/12	90.6, 45.2–99.1	10/22	49.8, 31.2–68.5	36/40	88.8, 73.8–95.7
	DOR	17/24	52.7, 27.1–76.9	7/12	38.2, 13.1–71.7	7/22	33.6, 15.3–58.6	30/40	76.7, 60.1–87.8
	ETR	11/24	29.6, 14.0–52.1	6/12	31.7, 10.1–65.9	4/22	16.7, 5.3–41.7	17/40	44.0, 24.6–65.5
	RPV	14/24	40.7, 20.2–65.1	7/12	38.9, 12.0–74.9	5/22	22.3, 8.1–48.1	27/40	68.3, 48.8–83.0
PI/r	ATV/r, DRV/r or LPV/r	0/24	0.0, 0.0–13.8	0/12	0.0, 0.0–24.2	0/22	0.0, 0.0–14.9	0/40	0.0, 0.0–8.8
	ATV/r	0/24	0.0, 0.0–13.8	0/12	0.0, 0.0–24.2	0/22	0.0, 0.0–14.9	0/40	0.0, 0.0–8.8
	DRV/r	0/24	0.0, 0.0–13.8	0/12	0.0, 0.0–24.2	0/22	0.0, 0.0–14.9	0/40	0.0, 0.0–8.8
	LPV/r	0/24	0.0, 0.0–13.8	0/12	0.0, 0.0–24.2	0/22	0.0, 0.0–14.9	0/40	0.0, 0.0–8.8
INSTI	Any	ND		ND		ND		ND	
	BIC	ND		ND		ND		ND	
	CAB	ND		ND		ND		ND	
	DTG	ND		ND		ND		ND	
	EVG	ND		ND		ND		ND	
	RAL	ND		ND		ND		ND	

a Weight trimming approach used to adjust for excessively large sampling variances.

b HIV drug resistance among adults with viral load >2500 copies/mL using DBS (lower limit of detection by the Roche free viral elution platform).

c Study design–weighted proportion and 95% confidence interval.

d NNRTI-based regimens include EFV or NVP.

HIV drug resistance was defined as the presence of a penalty score ≥15 using the Stanford HIVdb algorithm.

ABC: abacavir; ATV/r: atazanavir/ritonavir; BIC: bictegravir; CAB: cabotegravir; CI: confidence interval; DOR: doravirine; DRV/r: darunavir/ritonavir; DTG: dolutegravir; EFV: efavirenz; ETR: etravirine; EVG: elvitegravir; INSTI: integrase strand-transfer inhibitor; LPV/r: lopinavir/ritonavir; ND: no data; NNRTI: non-nucleoside reverse-transcriptase inhibitor; NRTI: nucleoside reverse-transcriptase inhibitor; NVP: nevirapine; PI/r: boosted protease inhibitor; RAL: raltegravir; RPV: rilpivirine; TDF: tenofovir disoproxil fumarate; ZDV: zidovudine; 3TC/FTC: lamivudine/emtricitabine.

Table A4.5c. Prevalence of acquired HIV drug resistance among adults on ART – Africa

		Senegal (start year: 2017) Time on ART: 12 ± 3 months		Senegal (start year: 2017) Time on ART: ≥40 months		South Sudan (start year: 2018) Time on ART: 12 ± 3 months		South Sudan (start year: 2018) Time on ART: ≥48 months	
		n/N	%, 95% CI[a]	*n/N*	%, 95% CI[a]	*n/N*	%, 95% CI[a]	*n/N*	%, 95% CI[a]
HIV drug resistance among adults on first-line ART with viral load ≥1000 copies/mL									
NRTI	Any	8/27	21.0, 6.9–49.1	16/32	56.8, 30.0–80.1	23/69	25.4, 15.4–38.9	85/115	71.0, 55.5–82.8
	ABC	8/27	21.0, 6.9–49.1	15/32	54.7, 31.0–76.4	21/69	24.6, 14.8–37.9	85/115	71.0, 55.5–82.8
	3TC or FTC	8/27	21.0, 6.9–49.1	15/32	54.7, 31.0–76.4	21/69	24.6, 14.8–37.9	85/115	71.0, 55.5–82.8
	TDF	7/27	18.6, 6.8–41.8	5/32	12.3, 5.2–26.3	14/69	12.9, 7.5–21.2	45/115	35.2, 24.7–47.4
	ZDV	0/27	0.0, 0.0–12.5	7/32	33.4, 13.8–61.0	8/69	3.9, 1.2–12.3	44/115	31.6, 20.3–45.7
NNRTI	EFV or NVP	15/27	62.5, 40.8–80.1	28/32	92.1, 63.5–98.7	37/69	61.0, 50.4–70.7	98/115	84.8, 74.9–91.3
	DOR	8/27	21.0, 8.3–44.1	17/32	47.6, 23.1–73.3	23/69	28.7, 17.1–44.1	67/115	61.8, 47.9–74.0
	ETR	5/27	11.1, 3.3–31.6	10/32	24.7, 12.2–43.7	12/69	12.6, 7.1–21.3	46/115	38.3, 25.8–52.6
	RPV	6/27	16.3, 5.4–39.9	16/32	43.1, 18.1–72.1	19/69	20.9, 13.7–30.4	68/115	57.6, 41.7–72.0
PI/r	ATV/r, DRV/r or LPV/r	ND		ND		0/69	0.0, 0.0–5.3	1/115	0.8, 0.1–6.7
	ATV/r	ND		ND		0/69	0.0, 0.0–5.3	1/115	0.8, 0.1–6.7
	DRV/r	ND		ND		0/69	0.0, 0.0–5.3	0/115	0.0, 0.0–3.2
	LPV/r	ND		ND		0/69	0.0, 0.0–5.3	1/115	0.8, 0.1–6.7
INSTI	Any	ND		ND		0/46	0.0, 0.0–7.7	1/87	0.9, 0.1–7.9
	BIC	ND		ND		0/46	0.0, 0.0–7.7	0/87	0.0, 0.0–3.2
	CAB	ND		ND		0/46	0.0, 0.0–7.7	0/87	0.0, 0.0–3.2
	DTG	ND		ND		0/46	0.0, 0.0–7.7	0/87	0.0, 0.0–3.2
	EVG	ND		ND		0/46	0.0, 0.0–7.7	1/87	0.9, 0.1–7.9
	RAL	ND		ND		0/46	0.0, 0.0–7.7	1/87	0.9, 0.1–7.9
HIV drug resistance among adults on first-line ART with viral load ≥1000 copies/mL									
NRTI	Any	8/27	21.0, 6.9–49.1	16/32	56.8, 30.0–80.1	23/69	25.4, 15.4–38.9	75/105	69.5, 53.7–81.8
	ABC	8/27	21.0, 6.9–49.1	15/32	54.7, 31.0–76.4	21/69	24.6, 14.8–37.9	75/105	69.5, 53.7–81.8
	3TC or FTC	8/27	21.0, 6.9–49.1	15/32	54.7, 31.0–76.4	21/69	24.6, 14.8–37.9	75/105	69.5, 53.7–81.8
	TDF	7/27	18.6, 6.8–41.8	5/32	12.3, 5.2–26.3	14/69	12.9, 7.5–21.2	41/105	35.4, 24.4–48.3
	ZDV	0/27	0.0, 0.0–12.5	7/32	33.4, 13.8–61.0	8/69	3.9, 1.2–12.3	40/105	31.7, 20.0–46.3
NNRTI	EFV or NVP	15/27	62.5, 40.8–80.1	28/32	92.1, 63.5–98.7	37/69	61.0, 50.4–70.7	88/105	84.0, 73.8–90.7
	DOR	8/27	21.0, 8.3–44.1	17/32	47.6, 23.1–73.3	23/69	28.7, 17.1–44.1	61/105	61.5, 47.0–74.2
	ETR	5/27	11.1, 3.3–31.6	10/32	24.7, 12.2–43.7	12/69	12.6, 7.1–21.3	41/105	39.5, 26.6–54.0
	RPV	6/27	16.3, 5.4–39.9	16/32	43.1, 18.1–72.1	19/69	20.9, 13.7–30.4	61/105	57.9, 41.1–73.1
PI/r	ATV/r, DRV/r or LPV/r	ND		ND		0/69	0.0, 0.0–5.3	1/105	0.8, 0.1–7.2
	ATV/r	ND		ND		0/69	0.0, 0.0–5.3	1/105	0.8, 0.1–7.2
	DRV/r	ND		ND		0/69	0.0, 0.0–5.3	0/105	0.0, 0.0–3.5
	LPV/r	ND		ND		0/69	0.0, 0.0–5.3	1/105	0.8, 0.1–7.2
INSTI	Any	ND		ND		0/46	0.0, 0.0–7.7	1/80	1.0, 0.1–8.4
	BIC	ND		ND		0/46	0.0, 0.0–7.7	0/80	0.0, 0.0–4.6
	CAB	ND		ND		0/46	0.0, 0.0–7.7	0/80	0.0, 0.0–4.6
	DTG	ND		ND		0/46	0.0, 0.0–7.7	0/80	0.0, 0.0–4.6
	EVG	ND		ND		0/46	0.0, 0.0–7.7	1/80	1.0, 0.1–8.4
	RAL	ND		ND		0/46	0.0, 0.0–7.7	1/80	1.0, 0.1–8.4
HIV drug resistance among adults on first-line NNRTI-based[b] ART with viral load ≥1000 copies/mL									
NRTI	Any	8/27	21.0, 6.9–49.1	16/32	56.8, 30.0–80.1	23/69	25.4, 15.4–38.9	74/104	69.5, 53.6–81.7
	ABC	8/27	21.0, 6.9–49.1	15/32	54.7, 31.0–76.4	21/69	24.6, 14.8–37.9	21/69/104	69.5, 53.6–81.7
	3TC or FTC	8/27	21.0, 6.9–49.1	15/32	54.7, 31.0–76.4	21/69	24.6, 14.8–37.9	21/69/104	69.5, 53.6–81.7
	TDF	7/27	18.6, 6.8–41.8	5/32	12.3, 5.2–26.3	14/69	12.9, 7.5–21.2	14/69/104	35.3, 24.3–48.2
	ZDV	0/27	0.0, 0.0–12.5	7/32	33.4, 13.8–61.0	8/69	3.9, 1.2–12.3	8/69/104	31.6, 19.9–46.2
NNRTI	EFV or NVP	15/27	62.5, 40.8–80.1	28/32	92.1, 63.5–98.7	37/69	61.0, 50.4–70.7	87/104	84.0, 73.8–90.7
	DOR	8/27	21.0, 8.3–44.1	17/32	47.6, 23.1–73.3	23/69	28.7, 17.1–44.1	23/69/104	61.5, 46.9–74.2
	ETR	5/27	11.1, 3.3–31.6	10/32	24.7, 12.2–43.7	12/69	12.6, 7.1–21.3	12/69/104	39.4, 26.5–53.9
	RPV	6/27	16.3, 5.4–39.9	16/32	43.1, 18.1–72.1	19/69	20.9, 13.7–30.4	19/69/104	57.9, 41.0–73.1
PI/r	ATV/r, DRV/r or LPV/r	ND		ND		0/69	0.0, 0.0–5.3	1/104	0.8, 0.1–7.2
	ATV/r	ND		ND		0/69	0.0, 0.0–5.3	1/104	0.8, 0.1–7.2
	DRV/r	ND		ND		0/69	0.0, 0.0–5.3	0/104	0.0, 0.0–3.6
	LPV/r	ND		ND		0/69	0.0, 0.0–5.3	1/104	0.8, 0.1–7.2
INSTI	Any	ND		ND		0/46	0.0, 0.0–7.7	1/79	1.0, 0.1–8.4
	BIC	ND		ND		0/46	0.0, 0.0–7.7	0/79	0.0, 0.0–4.6
	CAB	ND		ND		0/46	0.0, 0.0–7.7	0/79	0.0, 0.0–4.6
	DTG	ND		ND		0/46	0.0, 0.0–7.7	0/79	0.0, 0.0–4.6
	EVG	ND		ND		0/46	0.0, 0.0–7.7	1/79	1.0, 0.1–8.4
	RAL	ND		ND		0/46	0.0, 0.0–7.7	1/79	1.0, 0.1–8.4

a Study design–weighted proportion and 95% confidence interval.

b NNRTI-based regimens include EFV or NVP.

HIV drug resistance was defined as the presence of a penalty score ≥15 using the Stanford HIVdb algorithm.

ABC: abacavir; ATV/r: atazanavir/ritonavir; BIC: bictegravir; CAB: cabotegravir; CI: confidence interval; DOR: doravirine; DRV/r: darunavir/ritonavir; DTG: dolutegravir; EFV: efavirenz; ETR: etravirine; EVG: elvitegravir; INSTI: integrase strand-transfer inhibitor; LPV/r: lopinavir/ritonavir; ND: no data; NNRTI: non-nucleoside reverse-transcriptase inhibitor; NRTI: nucleoside reverse-transcriptase inhibitor; NVP: nevirapine; PI/r: boosted protease inhibitor; RAL: raltegravir; RPV: rilpivirine; TDF: tenofovir disoproxil fumarate; ZDV: zidovudine; 3TC/FTC: lamivudine/emtricitabine.

Table A4.5d. Prevalence of acquired HIV drug resistance among adults on ART – Africa

		Uganda (start year: 2016) Time on ART: 12 ± 3 months		Uganda (start year: 2017) Time on ART: ≥48 months		Zambia (start year: 2019) Time on ART: 12 ± 3 months		Zambia (start year: 2019) Time on ART: ≥48 months	
		n/N	%, 95% CI[a]	*n/N*	%, 95% CI[a]	*n/N*	%, 95% CI[a]	*n/N*	%, 95% CI[a]
HIV drug resistance among adults on first-line ART with viral load ≥1000 copies/mL									
NRTI	Any	23/30	91.3, 65.0–98.3	83/93	87.4, 73.6–94.5	26/37	60.3, 40.3–77.3	33/47	74.8, 53.0–88.7
	ABC	23/30	91.3, 65.0–98.3	82/93	84.9, 71.2–92.8	25/37	57.9, 38.7–74.9	33/47	74.8, 53.0–88.7
	3TC or FTC	23/30	91.3, 65.0–98.3	82/93	84.9, 71.2–92.8	24/37	56.0, 37.2–73.1	32/47	70.3, 47.4–86.1
	TDF	14/30	84.1, 52.2–96.3	42/93	47.4, 32.6–62.6	17/37	39.9, 25.1–56.8	24/47	48.7, 31.1–66.6
	ZDV	8/30	15.5, 3.2–50.3	40/93	45.3, 33.6–57.7	2/37	4.9, 1.1–18.6	7/47	16.0, 5.8–36.7
NNRTI	EFV or NVP	27/30	96.6, 83.9–99.4	85/93	89.1, 73.4–96.0	30/37	70.4, 49.7–85.1	35/47	73.6, 58.0–84.9
	DOR	21/30	90.3, 64.9–97.9	51/93	56.9, 47.8–65.6	25/37	60.3, 39.9–77.7	31/47	64.2, 49.1–76.9
	ETR	16/30	86.4, 58.4–96.7	49/93	54.4, 37.6–70.3	21/37	51.4, 32.0–70.4	24/47	44.2, 31.1–58.2
	RPV	23/30	93.4, 74.4–98.6	64/93	67.8, 51.7–80.6	24/37	56.7, 36.3–75.1	31/47	64.1, 48.7–77.1
PI/r	ATV/r, DRV/r or LPV/r	0/30	0.0, 0.0–11.4	0/93	0.0, 0.0–4.0	0/37	0.0, 0.0–9.4	1/47	4.5, 0.6–29.0
	ATV/r	0/30	0.0, 0.0–11.4	0/93	0.0, 0.0–4.0	0/37	0.0, 0.0–9.4	1/47	4.5, 0.6–29.0
	DRV/r	0/30	0.0, 0.0–11.4	0/93	0.0, 0.0–4.0	0/37	0.0, 0.0–9.4	0/47	0.0, 0.0–7.6
	LPV/r	0/30	0.0, 0.0–11.4	0/93	0.0, 0.0–4.0	0/37	0.0, 0.0–9.4	1/47	4.5, 0.6–29.0
INSTI	Any	ND		ND		0/29	0.0, 0.0–11.7	0/39	0.0, 0.0–9.0
	BIC	ND		ND		0/29	0.0, 0.0–11.7	0/39	0.0, 0.0–9.0
	CAB	ND		ND		0/29	0.0, 0.0–11.7	0/39	0.0, 0.0–9.0
	DTG	ND		ND		0/29	0.0, 0.0–11.7	0/39	0.0, 0.0–9.0
	EVG	ND		ND		0/29	0.0, 0.0–11.7	0/39	0.0, 0.0–9.0
	RAL	ND		ND		0/29	0.0, 0.0–11.7	0/39	0.0, 0.0–9.0
HIV drug resistance among adults on first-line ART with viral load ≥1000 copies/mL									
NRTI	Any	23/30	91.3, 65.0–98.3	83/93	87.4, 73.6–94.5	26/37	60.3, 40.3–77.3	30/44	72.0, 48.3–87.7
	ABC	23/30	91.3, 65.0–98.3	82/93	84.9, 71.2–92.8	25/37	57.9, 38.7–74.9	30/44	72.0, 48.3–87.7
	3TC or FTC	23/30	91.3, 65.0–98.3	82/93	84.9, 71.2–92.8	24/37	56.0, 37.2–73.1	30/44	72.0, 48.3–87.7
	TDF	14/30	84.1, 52.2–96.3	42/93	47.4, 32.6–62.6	17/37	39.9, 25.1–56.8	21/44	42.9, 26.6–61.0
	ZDV	8/30	15.5, 3.2–50.3	40/93	45.3, 33.6–57.7	2/37	4.9, 1.1–18.6	6/44	12.7, 4.2–32.3
NNRTI	EFV or NVP	27/30	96.6, 83.9–99.4	85/93	89.1, 73.4–96.0	30/37	70.4, 49.7–85.1	32/44	70.6, 54.5–82.8
	DOR	21/30	90.3, 64.9–97.9	51/93	56.9, 47.8–65.6	25/37	60.3, 39.9–77.7	28/44	60.2, 44.8–73.9
	ETR	16/30	86.4, 58.4–96.7	49/93	54.4, 37.6–70.3	21/37	51.4, 32.0–70.4	23/44	46.1, 31.9–61.0
	RPV	23/30	93.4, 74.4–98.6	64/93	67.8, 51.7–80.6	24/37	56.7, 36.3–75.1	28/44	60.1, 44.4–74.0
PI/r	ATV/r, DRV/r or LPV/r	0/30	0.0, 0.0–11.4	0/93	0.0, 0.0–4.0	0/37	0.0, 0.0–9.4	0/44	0.0, 0.0–8.0
	ATV/r	0/30	0.0, 0.0–11.4	0/93	0.0, 0.0–4.0	0/37	0.0, 0.0–9.4	0/44	0.0, 0.0–8.0
	DRV/r	0/30	0.0, 0.0–11.4	0/93	0.0, 0.0–4.0	0/37	0.0, 0.0–9.4	0/44	0.0, 0.0–8.0
	LPV/r	0/30	0.0, 0.0–11.4	0/93	0.0, 0.0–4.0	0/37	0.0, 0.0–9.4	0/44	0.0, 0.0–8.0
INSTI	Any	ND		ND		0/29	0.0, 0.0–11.7	0/34	0.0, 0.0–10.2
	BIC	ND		ND		0/29	0.0, 0.0–11.7	0/34	0.0, 0.0–10.2
	CAB	ND		ND		0/29	0.0, 0.0–11.7	0/34	0.0, 0.0–10.2
	DTG	ND		ND		0/29	0.0, 0.0–11.7	0/34	0.0, 0.0–10.2
	EVG	ND		ND		0/29	0.0, 0.0–11.7	0/34	0.0, 0.0–10.2
	RAL	ND		ND		0/29	0.0, 0.0–11.7	0/34	0.0, 0.0–10.2
HIV drug resistance among adults on first-line NNRTI-based[b] ART with viral load ≥1000 copies/mL									
NRTI	Any	23/30	91.3, 65.0–98.3	83/93	87.4, 73.6–94.5	20/27	68.8, 42.4–86.9	26/36	68.2, 46.3–84.2
	ABC	23/30	91.3, 65.0–98.3	82/93	84.9, 71.2–92.8	20/27	68.8, 42.4–86.9	26/36	68.2, 46.3–84.2
	3TC or FTC	23/30	91.3, 65.0–98.3	82/93	84.9, 71.2–92.8	19/27	65.6, 38.8–85.1	26/36	68.2, 46.3–84.2
	TDF	14/30	84.1, 52.2–96.3	42/93	47.4, 32.6–62.6	15/27	55.3, 32.8–75.9	19/36	49.3, 27.4–71.5
	ZDV	8/30	15.5, 3.2–50.3	40/93	45.3, 33.6–57.7	1/27	4.2, 0.5–27.2	6/36	18.8, 7.0–41.7
NNRTI	EFV or NVP	27/30	96.6, 83.9–99.4	85/93	89.1, 73.4–96.0	23/27	83.5, 60.3–94.4	28/36	74.8, 50.8–89.5
	DOR	21/30	90.3, 64.9–97.9	51/93	56.9, 47.8–65.6	20/27	78.7, 58.7–90.5	25/36	62.8, 42.1–79.7
	ETR	16/30	86.4, 58.4–96.7	49/93	54.4, 37.6–70.3	17/27	67.6, 45.5–83.9	21/36	54.0, 36.1–71.0
	RPV	23/30	93.4, 74.4–98.6	64/93	67.8, 51.7–80.6	19/27	72.6, 50.8–87.2	24/36	62.6, 41.4–79.8
PI/r	ATV/r, DRV/r or LPV/r	0/30	0.0, 0.0–11.4	0/93	0.0, 0.0–4.0	0/27	0.0, 0.0–12.5	0/36	0.0, 0.0–9.6
	ATV/r	0/30	0.0, 0.0–11.4	0/93	0.0, 0.0–4.0	0/27	0.0, 0.0–12.5	0/36	0.0, 0.0–9.6
	DRV/r	0/30	0.0, 0.0–11.4	0/93	0.0, 0.0–4.0	0/27	0.0, 0.0–12.5	0/36	0.0, 0.0–9.6
	LPV/r	0/30	0.0, 0.0–11.4	0/93	0.0, 0.0–4.0	0/27	0.0, 0.0–12.5	0/36	0.0, 0.0–9.6
INSTI	Any	ND		ND		0/20	0.0, 0.0–16.1	0/29	0.0, 0.0–11.7
	BIC	ND		ND		0/20	0.0, 0.0–16.1	0/29	0.0, 0.0–11.7
	CAB	ND		ND		0/20	0.0, 0.0–16.1	0/29	0.0, 0.0–11.7
	DTG	ND		ND		0/20	0.0, 0.0–16.1	0/29	0.0, 0.0–11.7
	EVG	ND		ND		0/20	0.0, 0.0–16.1	0/29	0.0, 0.0–11.7
	RAL	ND		ND		0/20	0.0, 0.0–16.1	0/29	0.0, 0.0–11.7

a Study design–weighted proportion and 95% confidence interval.

b NNRTI-based regimens include EFV or NVP.

HIV drug resistance was defined as the presence of a penalty score ≥15 using the Stanford HIVdb algorithm.

ABC: abacavir; ATV/r: atazanavir/ritonavir; BIC: bictegravir; CAB: cabotegravir; CI: confidence interval; DOR: doravirine; DRV/r: darunavir/ritonavir; DTG: dolutegravir; EFV: efavirenz; ETR: etravirine; EVG: elvitegravir; INSTI: integrase strand-transfer inhibitor; LPV/r: lopinavir/ritonavir; ND: no data; NNRTI: non-nucleoside reverse-transcriptase inhibitor; NRTI: nucleoside reverse-transcriptase inhibitor; NVP: nevirapine; PI/r: boosted protease inhibitor; RAL: raltegravir; RPV: rilpivirine; TDF: tenofovir disoproxil fumarate; ZDV: zidovudine; 3TC/FTC: lamivudine/emtricitabine.

Table A4.5e. Prevalence of acquired HIV drug resistance among adults on ART – the Americas

		El Salvador (start year: 2018) Time on ART: 12 ± 3 months		El Salvador (start year: 2018) Time on ART: ≥48 months		Guatemala (start year: 2016) Time on ART: 12 ± 3 months		Guatemala (start year: 2016) Time on ART: ≥48 months	
		n/N	%, 95% CI[a]	*n/N*	%, 95% CI[a]	*n/N*	%, 95% CI[a]	*n/N*	%, 95% CI[a]
HIV drug resistance among adults on first-line ART with viral load ≥1000 copies/mL									
NRTI	Any	9/15	61.2, 32.9–83.5	50/61	83.5, 72.0–90.8	11/19	60.0, 33.5–81.7	25/40	63.0, 43.7–78.9
	ABC	9/15	61.2, 32.9–83.5	50/61	83.5, 72.0–90.8	11/19	60.0, 33.5–81.7	25/40	63.0, 43.7–78.9
	3TC or FTC	9/15	61.2, 32.9–83.5	47/61	77.2, 65.1–86.1	10/19	56.0, 28.7–80.1	24/40	60.7, 42.6–76.2
	TDF	8/15	49.1, 24.1–74.5	28/61	42.4, 30.8–55.0	5/19	32.0, 13.8–58.0	15/40	35.9, 22.3–52.2
	ZDV	0/15	0.0, 0.0–20.4	26/61	45.9, 33.5–58.7	0/19	0.0, 0.0–16.8	8/40	19.6, 13.5–27.5
NNRTI	EFV or NVP	12/15	72.0, 39.1–91.2	53/61	84.8, 71.5–92.5	15/19	76.0, 51.2–90.5	29/40	74.2, 51.8–88.5
	DOR	9/15	62.8, 34.2–84.5	39/61	63.4, 50.7–74.5	10/19	52.0, 32.7–70.7	24/40	59.1, 40.7–75.3
	ETR	6/15	48.1, 23.3–73.9	18/61	29.3, 19.6–41.4	5/19	27.0, 10.2–54.7	13/40	33.4, 24.4–43.8
	RPV	7/15	53.3, 27.3–77.6	28/61	43.5, 32.2–55.6	6/19	31.0, 13.6–56.2	20/40	50.5, 35.6–65.4
PI/r	ATV/r, DRV/r or LPV/r	0/15	0.0, 0.0–20.4	5/61	9.8, 3.7–23.3	0/19	0.0, 0.0–16.8	1/40	2.6, 0.3–21.6
	ATV/r	0/15	0.0, 0.0–20.4	5/61	9.8, 3.7–23.3	0/19	0.0, 0.0–16.8	1/40	2.6, 0.3–21.6
	DRV/r	0/15	0.0, 0.0–20.4	3/61	2.8, 1.3–5.9	0/19	0.0, 0.0–16.8	1/40	2.6, 0.3–21.6
	LPV/r	0/15	0.0, 0.0–20.4	5/61	9.8, 3.7–23.3	0/19	0.0, 0.0–16.8	1/40	2.6, 0.3–21.6
INSTI	Any	0/17	0.0, 0.0–18.4	1/61	5.1, 1.3–18.7	0/16	0.0, 0.0–19.4	0/31	0.0, 0.0–11.0
	BIC	0/17	0.0, 0.0–18.4	1/61	3.6, 0.5–21.4	0/16	0.0, 0.0–19.4	0/31	0.0, 0.0–11.0
	CAB	0/17	0.0, 0.0–18.4	1/61	3.6, 0.5–21.4	0/16	0.0, 0.0–19.4	0/31	0.0, 0.0–11.0
	DTG	0/17	0.0, 0.0–18.4	2/61	3.6, 0.5–21.4	0/16	0.0, 0.0–19.4	0/31	0.0, 0.0–11.0
	EVG	0/17	0.0, 0.0–18.4	2/61	5.1, 1.3–18.7	0/16	0.0, 0.0–19.4	0/31	0.0, 0.0–11.0
	RAL	0/17	0.0, 0.0–18.4	2/61	5.1, 1.3–18.7	0/16	0.0, 0.0–19.4	0/31	0.0, 0.0–11.0
HIV drug resistance among adults on first-line ART with viral load ≥1000 copies/mL									
NRTI	Any	9/15	61.2, 32.9–83.5	39/42	91.2, 77.5–96.9	11/19	60.0, 33.5–81.7	25/35	71.6, 42.4–89.6
	ABC	9/15	61.2, 32.9–83.5	39/42	91.2, 77.5–96.9	11/19	60.0, 33.5–81.7	25/35	71.6, 42.4–89.6
	3TC or FTC	9/15	61.2, 32.9–83.5	39/42	91.2, 77.5–96.9	10/19	56.0, 28.7–80.1	24/35	68.9, 44.3–86.1
	TDF	8/15	49.1, 24.1–74.5	21/42	47.4, 33.4–62.0	5/19	32.0, 13.8–58.0	15/35	40.8, 22.3–62.3
	ZDV	0/15	0.0, 0.0–20.4	19/42	48.8, 34.3–63.6	0/19	0.0, 0.0–16.8	8/35	22.3, 13.6–34.3
NNRTI	EFV or NVP	12/15	72.0, 39.1–91.2	41/42	95.0, 72.0–99.3	15/19	76.0, 51.2–90.5	28/35	81.1, 59.3–92.6
	DOR	9/15	62.8, 34.2–84.5	35/42	80.8, 64.2–90.8	10/19	52.0, 32.7–70.7	23/35	64.0, 41.7–81.5
	ETR	6/15	48.1, 23.3–73.9	16/42	37.7, 24.7–52.8	5/19	27.0, 10.2–54.7	13/35	38.0, 25.9–51.8
	RPV	7/15	53.3, 27.3–77.6	22/42	52.9, 38.1–67.2	6/19	31.0, 13.6–56.2	20/35	57.4, 33.9–78.0
PI/r	ATV/r, DRV/r or LPV/r	0/15	0.0, 0.0–20.4	1/42	1.3, 0.4–4.9	0/19	0.0, 0.0–16.8	1/35	2.9, 0.3–23.4
	ATV/r	0/15	0.0, 0.0–20.4	1/42	1.3, 0.4–4.9	0/19	0.0, 0.0–16.8	1/35	2.9, 0.3–23.4
	DRV/r	0/15	0.0, 0.0–20.4	1/42	1.3, 0.4–4.9	0/19	0.0, 0.0–16.8	1/35	2.9, 0.3–23.4
	LPV/r	0/15	0.0, 0.0–20.4	1/42	1.3, 0.4–4.9	0/19	0.0, 0.0–16.8	1/35	2.9, 0.3–23.4
INSTI	Any	0/17	0.0, 0.0–18.4	1/45	2.1, 0.8–5.4	0/16	0.0, 0.0–19.4	0/27	0.0, 0.0–12.5
	BIC	0/17	0.0, 0.0–18.4	0/45	0.0, 0.0–7.9	0/16	0.0, 0.0–19.4	0/27	0.0, 0.0–12.5
	CAB	0/17	0.0, 0.0–18.4	0/45	0.0, 0.0–7.9	0/16	0.0, 0.0–19.4	0/27	0.0, 0.0–12.5
	DTG	0/17	0.0, 0.0–18.4	0/45	0.0, 0.0–7.9	0/16	0.0, 0.0–19.4	0/27	0.0, 0.0–12.5
	EVG	0/17	0.0, 0.0–18.4	1/45	2.1, 0.8–5.4	0/16	0.0, 0.0–19.4	0/27	0.0, 0.0–12.5
	RAL	0/17	0.0, 0.0–18.4	1/45	2.1, 0.8–5.4	0/16	0.0, 0.0–19.4	0/27	0.0, 0.0–12.5
HIV drug resistance among adults on first-line NNRTI-based[b] ART with viral load ≥1000 copies/mL									
NRTI	Any	9/15	61.2, 32.9–83.5	39/42	91.2, 77.5–96.9	10/17	62.2, 37.5–81.9	24/31	76.9, 47.1–92.5
	ABC	9/15	61.2, 32.9–83.5	39/42	91.2, 77.5–96.9	10/17	62.2, 37.5–81.9	24/31	76.9, 47.1–92.5
	3TC or FTC	9/15	61.2, 32.9–83.5	39/42	91.2, 77.5–96.9	9/17	57.8, 31.0–80.6	23/31	73.9, 49.6–89.0
	TDF	8/15	49.1, 24.1–74.5	21/42	47.4, 33.4–62.0	5/17	35.6, 17.3–59.2	15/31	45.6, 25.4–67.5
	ZDV	0/15	0.0, 0.0–20.4	19/42	48.8, 34.3–63.6	0/17	0.0, 0.0–18.4	8/31	24.9, 15.9–36.8
NNRTI	EFV or NVP	12/15	72.0, 39.1–91.2	41/42	95.0, 72.0–99.3	14/17	80.0, 51.0–93.9	26/31	84.3, 69.4–92.7
	DOR	9/15	62.8, 34.2–84.5	35/42	80.8, 64.2–90.8	10/17	57.8, 41.3–72.7	22/31	68.4, 42.8–86.2
	ETR	6/15	48.1, 23.3–73.9	16/42	37.7, 24.7–52.8	5/17	30.0, 11.9–57.6	12/31	39.4, 23.4–57.9
	RPV	7/15	53.3, 27.3–77.6	22/42	52.9, 38.1–67.2	6/17	34.4, 15.3–60.5	19/31	61.1, 31.7–84.2
PI/r	ATV/r, DRV/r or LPV/r	0/15	0.0, 0.0–20.4	1/42	1.3, 0.4–4.9	0/17	0.0, 0.0–18.4	1/31	3.3, 0.3–26.5
	ATV/r	0/15	0.0, 0.0–20.4	1/42	1.3, 0.4–4.9	0/17	0.0, 0.0–18.4	1/31	3.3, 0.3–26.5
	DRV/r	0/15	0.0, 0.0–20.4	1/42	1.3, 0.4–4.9	0/17	0.0, 0.0–18.4	1/31	3.3, 0.3–26.5
	LPV/r	0/15	0.0, 0.0–20.4	1/42	1.3, 0.4–4.9	0/17	0.0, 0.0–18.4	1/31	3.3, 0.3–26.5
INSTI	Any	0/17	0.0, 0.0–18.4	1/44	2.1, 0.8–5.6	0/14	0.0, 0.0–21.5	0/23	0.0, 0.0–14.3
	BIC	0/17	0.0, 0.0–18.4	0/44	0.0, 0.0–8.0	0/14	0.0, 0.0–21.5	0/23	0.0, 0.0–14.3
	CAB	0/17	0.0, 0.0–18.4	0/44	0.0, 0.0–8.0	0/14	0.0, 0.0–21.5	0/23	0.0, 0.0–14.3
	DTG	0/17	0.0, 0.0–18.4	0/44	0.0, 0.0–8.0	0/14	0.0, 0.0–21.5	0/23	0.0, 0.0–14.3
	EVG	0/17	0.0, 0.0–18.4	1/44	2.1, 0.8–5.6	0/14	0.0, 0.0–21.5	0/23	0.0, 0.0–14.3
	RAL	0/17	0.0, 0.0–18.4	1/44	2.1, 0.8–5.6	0/14	0.0, 0.0–21.5	0/23	0.0, 0.0–14.3

a Study design–weighted proportion and 95% confidence interval.

b NNRTI-based regimens include EFV or NVP.

HIV drug resistance was defined as the presence of a penalty score ≥15 using the Stanford HIVdb algorithm.

ABC: abacavir; ATV/r: atazanavir/ritonavir; BIC: bictegravir; CAB: cabotegravir; CI: confidence interval; DOR: doravirine; DRV/r: darunavir/ritonavir; DTG: dolutegravir; EFV: efavirenz; ETR: etravirine; EVG: elvitegravir; INSTI: integrase strand-transfer inhibitor; LPV/r: lopinavir/ritonavir; ND: no data; NNRTI: non-nucleoside reverse-transcriptase inhibitor; NRTI: nucleoside reverse-transcriptase inhibitor; NVP: nevirapine; PI/r: boosted protease inhibitor; RAL: raltegravir; RPV: rilpivirine; TDF: tenofovir disoproxil fumarate; ZDV: zidovudine; 3TC/FTC: lamivudine/emtricitabine.

Table A4.5f. Prevalence of acquired HIV drug resistance among adults on ART – the Americas

		Honduras (start year: 2016) Time on ART: 12 ± 3 months		Honduras (start year: 2016) Time on ART: ≥48 months		Nicaragua (start year: 2016) Time on ART: 12 ± 3 months		Nicaragua (start year: 2016) Time on ART: ≥48 months	
		n/N	%, 95% CI[a]	*n/N*	%, 95% CI[a]	*n/N*	%, 95% CI[a]	*n/N*	%, 95% CI[a]
HIV drug resistance among adults on first-line ART with viral load ≥1000 copies/mL									
NRTI	Any	10/16	67.1, 47.9–81.9	79/103	84.1, 78.6–88.4	17/27	70.2, 55.1–81.9	68/110	59.4, 50.3–67.9
	ABC	10/16	67.1, 47.9–81.9	77/103	83.0, 77.3–87.5	15/27	64.9, 48.2–78.7	64/110	55.2, 46.5–63.6
	3TC or FTC	10/16	67.1, 47.9–81.9	77/103	83.0, 77.3–87.5	15/27	64.9, 48.2–78.7	63/110	54.5, 45.7–63.1
	TDF	5/16	36.5, 18.9–58.7	43/103	49.6, 38.0–61.3	5/27	17.9, 8.6–33.5	27/110	24.3, 18.4–31.4
	ZDV	3/16	18.3, 7.2–39.4	42/103	49.2, 37.5–61.0	5/27	17.7, 8.5–33.3	19/110	17.9, 12.0–25.7
NNRTI	EFV or NVP	14/16	86.1, 63.8–95.6	86/103	86.0, 75.9–92.3	21/27	82.4, 71.7–89.7	82/110	70.7, 61.2–78.7
	DOR	6/16	47.7, 28.8–67.3	55/103	54.9, 43.2–66.1	13/27	40.6, 24.1–59.7	48/110	42.2, 34.7–50.0
	ETR	6/16	47.7, 28.8–67.3	34/103	36.8, 26.0–49.2	5/27	14.2, 8.4–23.0	29/110	24.8, 18.8–31.9
	RPV	10/16	68.5, 49.8–82.6	50/103	53.3, 41.8–64.5	11/27	31.1, 19.0–46.5	49/110	43.6, 36.0–51.5
PI/r	ATV/r, DRV/r or LPV/r	1/16	3.8, 2.0–7.0	3/103	7.3, 2.1–22.5	0/27	0.0, 0.0–12.5	6/110	4.6, 2.8–7.4
	ATV/r	1/16	3.8, 2.0–7.0	3/103	7.3, 2.1–22.5	0/27	0.0, 0.0–12.5	6/110	4.6, 2.8–7.4
	DRV/r	0/16	0.0, 0.0–19.4	0/103	0.0, 0.0–3.6	0/27	0.0, 0.0–12.5	4/110	3.2, 1.6–6.3
	LPV/r	1/16	3.8, 2.0–7.0	3/103	7.3, 2.1–22.5	0/27	0.0, 0.0–12.5	5/110	3.9, 2.2–6.7
INSTI	Any	ND		ND		0/27	0.0, 0.0–12.5	0/107	0.0, 0.0–3.5
	BIC	ND		ND		0/27	0.0, 0.0–12.5	0/107	0.0, 0.0–3.5
	CAB	ND		ND		0/27	0.0, 0.0–12.5	0/107	0.0, 0.0–3.5
	DTG	ND		ND		0/27	0.0, 0.0–12.5	0/107	0.0, 0.0–3.5
	EVG	ND		ND		0/27	0.0, 0.0–12.5	0/107	0.0, 0.0–3.5
	RAL	ND		ND		0/27	0.0, 0.0–12.5	0/107	0.0, 0.0–3.5
HIV drug resistance among adults on first-line ART with viral load ≥1000 copies/mL									
NRTI	Any	10/16	67.1, 47.9–81.9	67/80	88.0, 81.9–92.2	17/27	70.2, 55.1–81.9	58/93	59.7, 49.9–68.8
	ABC	10/16	67.1, 47.9–81.9	66/80	87.2, 81.0–91.6	15/27	64.9, 48.2–78.7	56/93	56.6, 47.1–65.6
	3TC or FTC	10/16	67.1, 47.9–81.9	66/80	87.2, 81.0–91.6	15/27	64.9, 48.2–78.7	55/93	55.8, 46.2–65.0
	TDF	5/16	36.5, 18.9–58.7	37/80	56.1, 43.5–68.0	5/27	17.9, 8.6–33.5	21/93	21.4, 15.7–28.4
	ZDV	3/16	18.3, 7.2–39.4	36/80	55.9, 43.1–67.9	5/27	17.7, 8.5–33.3	12/93	12.6, 8.2–19.1
NNRTI	EFV or NVP	14/16	86.1, 63.8–95.6	73/80	94.8, 91.9–96.7	21/27	82.4, 71.7–89.7	70/93	71.6, 61.0–80.2
	DOR	6/16	47.7, 28.8–67.3	43/80	56.4, 42.8–69.0	13/27	40.6, 24.1–59.7	42/93	42.8, 34.8–51.2
	ETR	6/16	47.7, 28.8–67.3	28/80	39.9, 27.3–54.0	5/27	14.2, 8.4–23.0	23/93	24.2, 17.5–32.5
	RPV	10/16	68.5, 49.8–82.6	40/80	55.7, 42.3–68.3	11/27	31.1, 19.0–46.5	39/93	41.0, 32.5–50.0
PI/r	ATV/r, DRV/r or LPV/r	1/16	3.8, 2.0–7.0	1/80	0.6, 0.4–0.8	0/27	0.0, 0.0–12.5	2/93	1.8, 0.9–3.5
	ATV/r	1/16	3.8, 2.0–7.0	1/80	0.6, 0.4–0.8	0/27	0.0, 0.0–12.5	2/93	1.8, 0.9–3.5
	DRV/r	0/16	0.0, 0.0–19.4	0/80	0.0, 0.0–4.6	0/27	0.0, 0.0–12.5	1/93	0.9, 0.3–3.3
	LPV/r	1/16	3.8, 2.0–7.0	1/80	0.6, 0.4–0.8	0/27	0.0, 0.0–12.5	2/93	1.8, 0.9–3.5
INSTI	Any	ND		ND		0/27	0.0, 0.0–12.5	0/90	0.0, 0.0–4.1
	BIC	ND		ND		0/27	0.0, 0.0–12.5	0/90	0.0, 0.0–4.1
	CAB	ND		ND		0/27	0.0, 0.0–12.5	0/90	0.0, 0.0–4.1
	DTG	ND		ND		0/27	0.0, 0.0–12.5	0/90	0.0, 0.0–4.1
	EVG	ND		ND		0/27	0.0, 0.0–12.5	0/90	0.0, 0.0–4.1
	RAL	ND		ND		0/27	0.0, 0.0–12.5	0/90	0.0, 0.0–4.1
HIV drug resistance among adults on first-line NNRTI-based[b] ART with viral load ≥1000 copies/mL									
NRTI	Any	10/16	67.1, 47.9–81.9	66/79	87.9, 81.7–92.1	16/25	65.3, 56.5–73.1	51/78	62.2, 51.1–72.2
	ABC	10/16	67.1, 47.9–81.9	65/79	87.1, 80.8–91.5	14/25	58.3, 49.1–66.9	49/78	58.6, 47.9–68.6
	3TC or FTC	10/16	67.1, 47.9–81.9	65/79	87.1, 80.8–91.5	14/25	58.3, 49.1–66.9	49/78	58.6, 47.9–68.6
	TDF	5/16	36.5, 18.9–58.7	36/79	55.6, 42.8–67.7	5/25	23.6, 13.4–38.0	18/78	21.9, 15.5–29.9
	ZDV	3/16	18.3, 7.2–39.4	35/79	55.4, 42.5–67.6	5/25	23.4, 13.3–37.7	11/78	13.7, 8.6–21.2
NNRTI	EFV or NVP	14/16	86.1, 63.8–95.6	72/79	94.8, 91.8–96.7	20/25	81.3, 74.9–86.4	64/78	77.1, 64.4–86.2
	DOR	6/16	47.7, 28.8–67.3	42/79	55.9, 42.2–68.7	13/25	53.6, 43.8–63.1	39/78	46.5, 37.4–55.9
	ETR	6/16	47.7, 28.8–67.3	28/79	40.4, 27.7–54.5	5/25	18.7, 13.5–25.4	20/78	25.1, 17.5–34.6
	RPV	10/16	68.5, 49.8–82.6	40/79	56.4, 42.9–69.0	11/25	41.0, 32.4–50.2	34/78	42.5, 33.0–52.5
PI/r	ATV/r, DRV/r or LPV/r	1/16	3.8, 2.0–7.0	1/79	0.6, 0.4–0.8	0/25	0.0, 0.0–13.3	1/78	1.0, 0.4–2.3
	ATV/r	1/16	3.8, 2.0–7.0	1/79	0.6, 0.4–0.8	0/25	0.0, 0.0–13.3	1/78	1.0, 0.4–2.3
	DRV/r	0/16	0.0, 0.0–19.4	0/79	0.0, 0.0–4.6	0/25	0.0, 0.0–13.3	0/78	0.0, 0.0–4.7
	LPV/r	1/16	3.8, 2.0–7.0	1/79	0.6, 0.4–0.8	0/25	0.0, 0.0–13.3	1/78	1.0, 0.4–2.3
INSTI	Any	ND		ND		0/25	0.0, 0.0–13.3	1/76	0.0, 0.0–4.8
	BIC	ND		ND		0/25	0.0, 0.0–13.3	1/76	0.0, 0.0–4.8
	CAB	ND		ND		0/25	0.0, 0.0–13.3	1/76	0.0, 0.0–4.8
	DTG	ND		ND		0/25	0.0, 0.0–13.3	1/76	0.0, 0.0–4.8
	EVG	ND		ND		0/25	0.0, 0.0–13.3	1/76	0.0, 0.0–4.8
	RAL	ND		ND		0/25	0.0, 0.0–13.3	1/76	0.0, 0.0–4.8

a Study design–weighted proportion and 95% confidence interval.

b NNRTI-based regimens include EFV or NVP.

HIV drug resistance was defined as the presence of a penalty score ≥15 using the Stanford HIVdb algorithm.

ABC: abacavir; ATV/r: atazanavir/ritonavir; BIC: bictegravir; CAB: cabotegravir; CI: confidence interval; DOR: doravirine; DRV/r: darunavir/ritonavir; DTG: dolutegravir; EFV: efavirenz; ETR: etravirine; EVG: elvitegravir; INSTI: integrase strand-transfer inhibitor; LPV/r: lopinavir/ritonavir; ND: no data; NNRTI: non-nucleoside reverse-transcriptase inhibitor; NRTI: nucleoside reverse-transcriptase inhibitor; NVP: nevirapine; PI/r: boosted protease inhibitor; RAL: raltegravir; RPV: rilpivirine; TDF: tenofovir disoproxil fumarate; ZDV: zidovudine; 3TC/FTC: lamivudine/emtricitabine.

Table A4.5g. Prevalence of acquired HIV drug resistance among adults on antiretroviral therapy – the Americas

		Eastern Caribbean Countries[a] (start year: 2017) Time on ART: any	
		n/N	%, 95% CI[b]
HIV drug resistance among adults on first-line ART with viral load ≥1000 copies/mL			
NRTI	Any	31/67	46.3, 27.3–66.4
	ABC	31/67	46.3, 27.3–66.4
	3TC or FTC	29/67	43.3, 26.1–62.3
	TDF	15/67	22.4, 16.1–30.2
	ZDV	12/67	17.9, 11.3–27.1
NNRTI	EFV or NVP	42/67	62.7, 42.5–79.2
	DOR	25/67	37.3, 25.0–51.5
	ETR	18/67	26.9, 18.4–37.4
	RPV	24/67	35.8, 24.5–49.0
PI/r	ATV/r, DRV/r or LPV/r	2/67	3.0, 0.5–15.8
	ATV/r	1/67	1.5, 0.3–8.3
	DRV/r	2/67	3.0, 0.5–15.8
	LPV/r	2/67	3.0, 0.5–15.8
INSTI	Any	ND	
	BIC	ND	
	CAB	ND	
	DTG	ND	
	EVG	ND	
	RAL	ND	
HIV drug resistance among adults on first-line ART with viral load ≥1000 copies/mL			
NRTI	Any	14/38	36.8, 13.7–68.2
	ABC	14/38	36.8, 13.7–68.2
	3TC or FTC	14/38	36.8, 13.7–68.2
	TDF	7/38	18.4, 10.9–29.4
	ZDV	4/38	10.5, 4.4–22.9
NNRTI	EFV/NVP	22/38	57.9, 25.8–84.4
	DOR	14/38	36.8, 16.1–64.0
	ETR	14/38	36.8, 25.9–49.4
	RPV	17/38	44.7, 23.3–68.3
PI/r	ATV/r, DRV/r or LPV/r	0/38	0.0, 0.0–9.2
	ATV/r	0/38	0.0, 0.0–9.2
	DRV/r	0/38	0.0, 0.0–9.2
	LPV/r	0/38	0.0, 0.0–9.2
INSTI	Any	ND	
	BIC	ND	
	CAB	ND	
	DTG	ND	
	EVG	ND	
	RAL	ND	
HIV drug resistance among adults on first-line NNRTI-based[c] ART with viral load ≥1000 copies/mL			
NRTI	Any	14/35	40.0, 16.7–68.9
	ABC	14/35	40.0, 16.7–68.9
	3TC or FTC	14/35	40.0, 16.7–68.9
	TDF	7/35	20.0, 12.4–30.6
	ZDV	4/35	11.4, 5.1–23.8
NNRTI	EFV/NVP	22/35	62.9, 29.8–87.1
	DOR	14/35	40.0, 18.8–65.8
	ETR	14/35	40.0, 29.6–51.4
	RPV	17/35	48.6, 28.1–69.5
PI/r	ATV/r, DRV/r or LPV/r	0/35	0.0, 0.0–9.9
	ATV/r	0/35	0.0, 0.0–9.9
	DRV/r	0/35	0.0, 0.0–9.9
	LPV/r	0/35	0.0, 0.0–9.9
INSTI	Any	ND	
	BIC	ND	
	CAB	ND	
	DTG	ND	
	EVG	ND	
	RAL	ND	

a Eastern Caribbean Countries: Antigua and Barbuda, Dominica, Grenada, Saint Kitts and Nevis, Saint Lucia and Saint Vincent and the Grenadines.

b Unweighted proportion and 95% confidence interval adjusted for clustering.

c NNRTI-based regimens include EFV or NVP.

HIV drug resistance was defined as the presence of a penalty score ≥15 using the Stanford HIVdb algorithm.

ABC: abacavir; ATV/r: atazanavir/ritonavir; BIC: bictegravir; CAB: cabotegravir; CI: confidence interval; DOR: doravirine; DRV/r: darunavir/ritonavir; DTG: dolutegravir; EFV: efavirenz; ETR: etravirine; EVG: elvitegravir; INSTI: integrase strand-transfer inhibitor; LPV/r: lopinavir/ritonavir; ND: no data; NNRTI: non-nucleoside reverse-transcriptase inhibitor; NRTI: nucleoside reverse-transcriptase inhibitor; NVP: nevirapine; PI/r: boosted protease inhibitor; RAL: raltegravir; RPV: rilpivirine; TDF: tenofovir disoproxil fumarate; ZDV: zidovudine; 3TC/FTC: lamivudine/emtricitabine.

Table A4.5h. Prevalence of acquired HIV drug resistance among adults on ART – South-East Asia and the Western Pacific

		Myanmar (start year: 2018) Time on ART: 12 ± 3 months		Myanmar (start year: 2018) Time on ART: ≥48 months		Viet Nam (start year: 2020) Time on ART: 12 ± 3 months		Viet Nam (start year: 2020) Time on ART: ≥48 months	
		n/N	%, 95% CI[a]	*n/N*	%, 95% CI[a]	*n/N*	%, 95% CI[a]	*n/N*	%, 95% CI[a]
HIV drug resistance among adults on first-line ART with viral load ≥1000 copies/mL									
NRTI	Any	13/21	67.8, 39.9–87.0	13/29	45.5, 26.8–65.7	14/18	73.5, 36.2–93.1	6/11	52.1, 19.4–83.1
	ABC	13/21	67.5, 39.7–86.8	13/29	45.0, 26.6–64.9	14/18	73.5, 36.2–93.1	6/11	52.1, 19.4–83.1
	3TC or FTC	13/21	67.5, 39.7–86.8	12/29	39.3, 18.8–64.5	14/18	73.5, 36.2–93.1	6/11	52.1, 19.4–83.1
	TDF	12/21	49.9, 25.3–74.6	10/29	39.3, 23.5–57.7	11/18	68.0, 33.7–89.9	3/11	32.4, 13.7–59.2
	ZDV	0/21	0.0, 0.0–15.5	5/29	14.2, 3.7–41.6	1/18	4.4, 0.6–27.2	1/11	14.0, 2.2–54.5
NNRTI	EFV or NVP	17/21	87.6, 58.8–97.2	20/29	63.5, 41.6–81.0	15/18	75.3, 36.6–94.2	6/11	58.7, 30.2–82.3
	DOR	13/21	75.8, 50.3–90.6	16/29	50.8, 32.5–68.9	15/18	75.3, 36.6–94.2	5/11	46.7, 15.1–81.1
	ETR	9/21	42.9, 18.4–71.4	13/29	45.3, 29.6–61.9	7/18	43.8, 16.8–75.1	4/11	46.4, 14.9–81.0
	RPV	10/21	52.4, 27.4–76.2	15/29	46.6, 30.7–63.2	12/18	64.3, 31.2–87.7	6/11	58.7, 30.2–82.3
PI/r	ATV/r, DRV/r or LPV/r	0/20	0.0, 0.0–15.5	1/28	1.6, 0.2–11.9	0/16	0.0, 0.0–19.4	2/11	19.5, 4.8–53.7
	ATV/r	0/20	0.0, 0.0–15.5	1/28	1.6, 0.2–11.9	0/16	0.0, 0.0–19.4	2/11	19.5, 4.8–53.7
	DRV/r	0/20	0.0, 0.0–15.5	1/28	1.6, 0.2–11.9	0/16	0.0, 0.0–19.4	1/11	14.0, 2.2–54.5
	LPV/r	0/20	0.0, 0.0–15.5	1/28	1.6, 0.2–11.9	0/16	0.0, 0.0–19.4	2/11	19.5, 4.8–53.7
INSTI	Any	ND		ND		ND		ND	
	BIC	ND		ND		ND		ND	
	CAB	ND		ND		ND		ND	
	DTG	ND		ND		ND		ND	
	EVG	ND		ND		ND		ND	
	RAL	ND		ND		ND		ND	
HIV drug resistance among adults on first-line ART with viral load ≥1000 copies/mL									
NRTI	Any	13/21	67.8, 39.9–87.0	9/17	49.9, 26.3–73.5	14/18	73.5, 36.2–93.1	3/7	23.8, 5.2–64.1
	ABC	13/21	67.5, 39.7–86.8	9/17	49.9, 26.3–73.5	14/18	73.5, 36.2–93.1	3/7	23.8, 5.2–64.1
	3TC or FTC	13/21	67.5, 39.7–86.8	9/17	49.9, 26.3–73.5	14/18	73.5, 36.2–93.1	3/7	23.8, 5.2–64.1
	TDF	12/21	49.9, 25.3–74.6	6/17	40.2, 21.5–62.2	11/18	68.0, 33.7–89.9	1/7	11.1, 1.3–54.7
	ZDV	0/21	0.0, 0.0–15.5	2/17	7.5, 1.2–35.5	1/18	4.4, 0.6–27.2	0/7	0.0, 0.0–35.4
NNRTI	EFV or NVP	17/21	87.6, 58.8–97.2	13/17	64.8, 34.3–86.7	15/18	75.3, 36.6–94.2	3/7	38.2, 16.7–65.7
	DOR	13/21	75.8, 50.3–90.6	12/17	57.7, 36.6–76.4	15/18	75.3, 36.6–94.2	2/7	11.7, 1.5–54.2
	ETR	9/21	42.9, 18.4–71.4	9/17	48.4, 31.9–65.3	7/18	43.8, 16.8–75.1	1/7	11.1, 1.3–54.7
	RPV	10/21	52.4, 27.4–76.2	11/17	50.6, 33.8–67.3	12/18	64.3, 31.2–87.7	3/7	38.2, 16.7–65.7
PI/r	ATV/r, DRV/r or LPV/r	0/20	0.0, 0.0–15.5	0/16	0.0, 0.0–19.4	0/16	0.0, 0.0–19.4	1/7	12.1, 1.5–56.0
	ATV/r	0/20	0.0, 0.0–15.5	0/16	0.0, 0.0–19.4	0/16	0.0, 0.0–19.4	1/7	12.1, 1.5–56.0
	DRV/r	0/20	0.0, 0.0–15.5	0/16	0.0, 0.0–19.4	0/16	0.0, 0.0–19.4	0/7	0.0, 0.0–35.4
	LPV/r	0/20	0.0, 0.0–15.5	0/16	0.0, 0.0–19.4	0/16	0.0, 0.0–19.4	1/7	12.1, 1.5–56.0
INSTI	Any	ND		ND		ND		ND	
	BIC	ND		ND		ND		ND	
	CAB	ND		ND		ND		ND	
	DTG	ND		ND		ND		ND	
	EVG	ND		ND		ND		ND	
	RAL	ND		ND		ND		ND	
HIV drug resistance among adults on first-line NNRTI-based[b] ART with viral load ≥1000 copies/mL									
NRTI	Any	13/21	67.8, 39.9–87.0	9/17	49.9, 26.3–73.5	14/18	73.5, 36.2–93.1	2/5	15.5, 1.7–65.7
	ABC	13/21	67.5, 39.7–86.8	9/17	49.9, 26.3–73.5	14/18	73.5, 36.2–93.1	2/5	15.5, 1.7–65.7
	3TC or FTC	13/21	67.5, 39.7–86.8	9/17	49.9, 26.3–73.5	14/18	73.5, 36.2–93.1	2/5	15.5, 1.7–65.7
	TDF	12/21	49.9, 25.3–74.6	6/17	40.2, 21.5–62.2	11/18	68.0, 33.7–89.9	1/5	14.7, 1.5–65.8
	ZDV	0/21	0.0, 0.0–15.5	2/17	7.5, 1.2–35.5	1/18	4.4, 0.6–27.2	0/5	0.0, 0.0–43.4
NNRTI	EFV or NVP	17/21	87.6, 58.8–97.2	13/17	64.8, 34.3–86.7	15/18	75.3, 36.6–94.2	3/5	50.4, 33.3–67.4
	DOR	13/21	75.8, 50.3–90.6	12/17	57.7, 36.6–76.4	15/18	75.3, 36.6–94.2	2/5	15.5, 1.7–65.7
	ETR	9/21	42.9, 18.4–71.4	9/17	48.4, 31.9–65.3	7/18	43.8, 16.8–75.1	1/5	14.7, 1.5–65.8
	RPV	10/21	52.4, 27.4–76.2	11/17	50.6, 33.8–67.3	12/18	64.3, 31.2–87.7	3/5	50.4, 33.3–67.4
PI/r	ATV/r, DRV/r or LPV/r	0/20	0.0, 0.0–15.5	0/16	0.0, 0.0–19.4	0/16	0.0, 0.0–19.4	0/5	0.0, 0.0–43.4
	ATV/r	0/20	0.0, 0.0–15.5	0/16	0.0, 0.0–19.4	0/16	0.0, 0.0–19.4	0/5	0.0, 0.0–43.4
	DRV/r	0/20	0.0, 0.0–15.5	0/16	0.0, 0.0–19.4	0/16	0.0, 0.0–19.4	0/5	0.0, 0.0–43.4
	LPV/r	0/20	0.0, 0.0–15.5	0/16	0.0, 0.0–19.4	0/16	0.0, 0.0–19.4	0/5	0.0, 0.0–43.4
INSTI	Any	ND		ND		ND		ND	
	BIC	ND		ND		ND		ND	
	CAB	ND		ND		ND		ND	
	DTG	ND		ND		ND		ND	
	EVG	ND		ND		ND		ND	
	RAL	ND		ND		ND		ND	

a Study design–weighted proportion and 95% confidence interval.

b NNRTI-based regimens include EFV or NVP.

HIV drug resistance was defined as the presence of a penalty score ≥15 using the Stanford HIVdb algorithm.

ABC: abacavir; ATV/r: atazanavir/ritonavir; BIC: bictegravir; CAB: cabotegravir; CI: confidence interval; DOR: doravirine; DRV/r: darunavir/ritonavir; DTG: dolutegravir; EFV: efavirenz; ETR: etravirine; EVG: elvitegravir; INSTI: integrase strand-transfer inhibitor; LPV/r: lopinavir/ritonavir; ND: no data; NNRTI: non-nucleoside reverse-transcriptase inhibitor; NRTI: nucleoside reverse-transcriptase inhibitor; NVP: nevirapine; PI/r: boosted protease inhibitor; RAL: raltegravir; RPV: rilpivirine; TDF: tenofovir disoproxil fumarate; ZDV: zidovudine; 3TC/FTC: lamivudine/emtricitabine.

Table A4.6a. Prevalence of acquired HIV drug resistance among children and adolescents on ART – Africa

		Zambia (start year: 2019) Time on ART: 12 ± 3 months		Zambia (start year: 2019) Time on ART: ≥36 months		Uganda[c] (start year: 2019) Time on ART: any	
		n/N	%, 95% CI[a]	*n/N*	%, 95% CI[a]	*n/N*	%, 95% CI[a]
HIV drug resistance among children and adolescents on ART with viral load ≥1000 copies/mL							
NRTI	Any	46/69	62.4, 43.1–78.5	145/194	74.2, 68.0–79.6	284/382	70.6, 60.1–79.3
	ABC	45/69	60.7, 42.1–76.7	143/194	72.8, 65.9–78.7	279/382	69.7, 59.5–78.3
	3TC or FTC	45/69	60.7, 42.1–76.7	140/194	71.6, 64.8–77.5	274/382	68.0, 57.0–77.2
	TDF	18/69	10.9, 4.9–22.5	63/194	30.3, 22.6–39.3	83/382	20.3, 16.5–24.9
	ZDV	9/69	8.1, 3.4–18.3	40/194	19.5, 12.0–30.1	97/382	18.4, 11.7–27.8
NNRTI	EFV/NVP	49/69	62.6, 42.7–78.9	158/194	81.5, 75.7–86.2	314/382	78.4, 68.5–85.9
	DOR	37/69	50.3, 32.5–68.0	129/194	66.7, 58.8–73.8	206/382	53.2, 43.6–62.5
	ETR	30/69	33.2, 21.7–47.1	92/194	47.6, 39.0–56.4	154/382	37.8, 30.2–46.1
	RPV	39/69	43.2, 29.0–58.5	122/194	63.1, 53.6–71.7	232/382	57.5, 46.6–67.7
PI/r	ATV/r, DRV/r or LPV/r	1/69	0.3, 0.0–2.0	6/194	3.8, 1.4–9.9	8/382	1.6, 0.5–4.7
	ATV/r	1/69	0.3, 0.0–2.0	5/194	3.4, 1.1–9.9	8/382	1.6, 0.5–4.7
	DRV/r	1/69	0.3, 0.0–2.0	3/194	2.0, 0.5–7.5	3/382	0.8, 0.1–4.4
	LPV/r	1/69	0.3, 0.0–2.0	6/194	3.8, 1.4–9.9	7/382	1.6, 0.5–4.7
INSTI	Any	0/45	0.0, 0.0–7.9	1/154	0.5, 0.1–3.6	ND	
	BIC	0/45	0.0, 0.0–7.9	0/154	0.0, 0.0–2.4	ND	
	CAB	0/45	0.0, 0.0–7.9	0/154	0.0, 0.0–2.4	ND	
	DTG	0/45	0.0, 0.0–7.9	0/154	0.0, 0.0–2.4	ND	
	EVG	0/45	0.0, 0.0–7.9	1/154	0.5, 0.1–3.6	ND	
	RAL	0/45	0.0, 0.0–7.9	1/154	0.5, 0.1–3.6	ND	
HIV drug resistance among children and adolescents on first-line ART with viral load ≥1000 copies/mL							
NRTI	Any	46/69	62.4, 43.1–78.5	128/170	74.8, 68.9–80.0	284/382	70.6, 60.1–79.3
	ABC	45/69	60.7, 42.1–76.7	126/170	73.2, 66.4–79.1	279/382	69.7, 59.5–78.3
	3TC or FTC	45/69	60.7, 42.1–76.7	123/170	71.8, 65.0–77.8	274/382	68.0, 57.0–77.2
	TDF	18/69	10.9, 4.9–22.5	58/170	32.0, 23.8–41.5	83/382	20.3, 16.5–24.9
	ZDV	9/69	8.1, 3.4–18.3	36/170	20.1, 11.9–31.8	97/382	18.4, 11.7–27.8
NNRTI	EFV/NVP	49/69	62.6, 42.7–78.9	140/170	82.5, 76.6–87.1	314/382	78.4, 68.5–85.9
	DOR	37/69	50.3, 32.5–68.0	112/170	66.5, 58.9–73.4	206/382	53.2, 43.6–62.5
	ETR	30/69	33.2, 21.7–47.1	83/170	50.2, 41.4–59.0	154/382	37.8, 30.2–46.1
	RPV	39/69	43.2, 29.0–58.5	111/170	65.7, 57.0–73.4	232/382	57.5, 46.6–67.7
PI/r	ATV/r, DRV/r or LPV/r	1/69	0.3, 0.0–2.0	6/170	4.2, 1.6–10.9	8/382	1.6, 0.5–4.7
	ATV/r	1/69	0.3, 0.0–2.0	5/170	3.9, 1.3–10.9	8/382	1.6, 0.5–4.7
	DRV/r	1/69	0.3, 0.0–2.0	3/170	2.2, 0.6–8.3	3/382	0.8, 0.1–4.4
	LPV/r	1/69	0.3, 0.0–2.0	6/170	4.2, 1.6–10.9	7/382	1.6, 0.5–4.7
INSTI	Any	0/45	0.0, 0.0–7.9	1/134	0.6, 0.1–4.2	ND	
	BIC	0/45	0.0, 0.0–7.9	0/134	0.0, 0.0–2.8	ND	
	CAB	0/45	0.0, 0.0–7.9	0/134	0.0, 0.0–2.8	ND	
	DTG	0/45	0.0, 0.0–7.9	0/134	0.0, 0.0–2.8	ND	
	EVG	0/45	0.0, 0.0–7.9	1/134	0.6, 0.1–4.2	ND	
	RAL	0/45	0.0, 0.0–7.9	1/134	0.6, 0.1–4.2	ND	
HIV drug resistance among children and adolescents on first-line NNRTI-based[b] ART with viral load ≥1000 copies/mL							
NRTI	Any	27/35	72.7, 40.7–91.2	105/141	74.1, 68.0–79.3	223/263	83.7, 77.2–88.7
	ABC	26/35	69.6, 39.3–89.0	103/141	72.2, 65.2–78.3	221/263	83.0, 76.2–88.1
	3TC or FTC	26/35	69.6, 39.3–89.0	100/141	70.7, 63.6–76.9	219/263	81.3, 73.3–87.3
	TDF	11/35	14.4, 5.8–31.8	51/141	33.1, 24.2–43.5	72/263	27.0, 21.1–33.8
	ZDV	5/35	12.4, 5.0–27.6	34/141	21.9, 12.9–34.6	81/263	23.6, 15.0–34.9
NNRTI	EFV/NVP	31/35	85.5, 51.1–97.1	120/141	83.9, 77.5–88.8	255/263	97.1, 93.2–98.8
	DOR	27/35	79.6, 50.2–93.8	94/141	66.5, 58.0–74.1	172/263	69.2, 60.6–76.7
	ETR	21/35	50.4, 28.8–71.9	68/141	51.0, 41.9–60.1	133/263	52.5, 45.4–59.5
	RPV	24/35	61.0, 36.7–80.9	93/141	65.3, 54.8–74.5	191/263	73.0, 65.2–79.5
PI/r	ATV/r, DRV/r or LPV/r	0/35	0.0, 0.0–9.9	5/141	4.4, 1.5–12.4	0/263	0.0, 0.0–1.4
	ATV/r	0/35	0.0, 0.0–9.9	5/141	4.4, 1.5–12.4	0/263	0.0, 0.0–1.4
	DRV/r	0/35	0.0, 0.0–9.9	2/141	2.1, 0.4–9.7	0/263	0.0, 0.0–1.4
	LPV/r	0/35	0.0, 0.0–9.9	5/141	4.4, 1.5–12.4	0/263	0.0, 0.0–1.4
INSTI	Any	0/21	0.0, 0.0–15.5	1/112	0.6, 0.1–4.8	ND	
	BIC	0/21	0.0, 0.0–15.5	0/112	0.0, 0.0–3.3	ND	
	CAB	0/21	0.0, 0.0–15.5	0/112	0.0, 0.0–3.3	ND	
	DTG	0/21	0.0, 0.0–15.5	0/112	0.0, 0.0–3.3	ND	
	EVG	0/21	0.0, 0.0–15.5	1/112	0.6, 0.1–4.8	ND	
	RAL	0/21	0.0, 0.0–15.5	1/112	0.6, 0.1–4.8	ND	

a Study design–weighted proportion and 95% confidence interval.

b NNRTI-based regimens include EFV or NVP.

c Survey population was children and adolescents on first-line ART for at least six months with viral load ≥1000 copies/mL.

HIV drug resistance was defined as the presence of a penalty score ≥15 using the Stanford HIVdb algorithm.

ABC: abacavir; ATV/r: atazanavir/ritonavir; BIC: bictegravir; CAB: cabotegravir; CI: confidence interval; DOR: doravirine; DRV/r: darunavir/ritonavir; DTG: dolutegravir; EFV: efavirenz; ETR: etravirine; EVG: elvitegravir; INSTI: integrase strand-transfer inhibitor; LPV/r: lopinavir/ritonavir; ND: no data; NNRTI: non-nucleoside reverse-transcriptase inhibitor; NRTI: nucleoside reverse-transcriptase inhibitor; NVP: nevirapine; PI/r: boosted protease inhibitor; RAL: raltegravir; RPV: rilpivirine; TDF: tenofovir disoproxil fumarate; ZDV: zidovudine; 3TC/FTC: lamivudine/emtricitabine.

Table A4.6b. Prevalence of acquired HIV drug resistance among children and adolescents on ART – Africa

		Zambia (start year: 2019) Time on ART: 12 ± 3 months		Zambia (start year: 2019) Time on ART: ≥36 months		Uganda[c] (start year: 2019) Time on ART: any	
		n/N	%, 95% CI[a]	*n/N*	%, 95% CI[a]	*n/N*	%, 95% CI[a]
HIV drug resistance among children and adolescents on first-line PI-based[b] ART with viral load ≥1000 copies/mL							
NRTI	Any	18/31	51.7, 20.4–81.7	20/25	81.4, 61.0–92.4	54/99	50.1, 35.7–64.5
	ABC	18/31	51.7, 20.4–81.7	20/25	81.4, 61.0–92.4	52/99	49.2, 35.3–63.2
	3TC or FTC	18/31	51.7, 20.4–81.7	20/25	81.4, 61.0–92.4	49/99	46.8, 33.2–61.0
	TDF	7/31	7.1, 2.2–20.2	6/25	21.3, 10.1–39.6	10/99	9.6, 5.1–17.4
	ZDV	4/31	3.0, 0.8–10.3	2/25	7.7, 1.2–36.8	14/99	10.4, 5.8–18.0
NNRTI	EFV/NVP	17/31	32.6, 14.7–57.5	17/25	70.5, 44.5–87.7	51/99	48.7, 35.6–62.0
	DOR	9/31	9.5, 3.1–25.8	15/25	64.8, 41.5–82.7	30/99	25.7, 14.1–42.1
	ETR	8/31	7.5, 2.2–22.2	13/25	42.4, 23.1–64.4	19/99	12.4, 7.1–20.8
	RPV	14/31	17.9, 6.7–40.0	16/25	71.7, 49.5–86.7	34/99	29.5, 18.0–44.4
PI/r	ATV/r, DRV/r or LPV/r	1/31	0.7, 0.1–5.2	1/25	3.9, 0.6–21.7	8/99	5.7, 1.8–17
	ATV/r	1/31	0.7, 0.1–5.2	0/25	0.0, 0.0–13.3	8/99	5.7, 1.8–17
	DRV/r	1/31	0.7, 0.1–5.2	1/25	3.9, 0.6–21.7	3/99	2.8, 0.5–15.1
	LPV/r	1/31	0.7, 0.1–5.2	1/25	3.9, 0.6–21.7	7/99	5.5, 1.6–16.9
INSTI	Any	0/22	0.0, 0.0–14.9	0/18	0.0, 0.0–17.6	ND	
	BIC	0/22	0.0, 0.0–14.9	0/18	0.0, 0.0–17.6	ND	
	CAB	0/22	0.0, 0.0–14.9	0/18	0.0, 0.0–17.6	ND	
	DTG	0/22	0.0, 0.0–14.9	0/18	0.0, 0.0–17.6	ND	
	EVG	0/22	0.0, 0.0–14.9	0/18	0.0, 0.0–17.6	ND	
	RAL	0/22	0.0, 0.0–14.9	0/18	0.0, 0.0–17.6	ND	
HIV drug resistance among children and adolescents on first-line DTG-based ART with viral load ≥1000 copies/mL							
NRTI	Any	1/2	44.4, NA	2/3	70.8, 28.9–93.5	7/20	31.2, 14.1–55.5
	ABC	1/2	44.4, NA	2/3	70.8, 28.9–93.5	6/20	29.3, 12.7–54.0
	3TC or FTC	1/2	44.4, NA	2/3	70.8, 28.9–93.5	6/20	29.3, 12.7–54.0
	TDF	0/2	0.0, NA	1/3	41.5, 3.9–92.5	1/20	2.1, 0.3–14.5
	ZDV	0/2	0.0, NA	0/3	0.0, 0.0–56.1	2/20	4.1, 0.9–16.7
NNRTI	EFV/NVP	1/2	55.6, NA	2/3	70.8, 28.9–93.5	8/20	24.4, 7.4–56.6
	DOR	1/2	55.6, NA	2/3	70.8, 28.9–93.5	4/20	14.6, 3.1–47.4
	ETR	1/2	55.6, NA	1/3	41.5, 3.9–92.5	2/20	4.6, 1.0–19.5
	RPV	1/2	55.6, NA	1/3	41.5, 3.9–92.5	7/20	27.0, 11.0–52.3
PI/r	ATV/r, DRV/r or LPV/r	0/2	0.0, NA	0/3	0.0, 0.0–56.1	0/20	0.0, 0.0–16.1
	ATV/r	0/2	0.0, NA	0/3	0.0, 0.0–56.1	0/20	0.0, 0.0–16.1
	DRV/r	0/2	0.0, NA	0/3	0.0, 0.0–56.1	0/20	0.0, 0.0–16.1
	LPV/r	0/2	0.0, NA	0/3	0.0, 0.0–56.1	0/20	0.0, 0.0–16.1
INSTI	Any	0/1	0.0, NA	0/3	0.0, 0.0–56.1	ND	
	BIC	0/1	0.0, NA	0/3	0.0, 0.0–56.1	ND	
	CAB	0/1	0.0, NA	0/3	0.0, 0.0–56.1	ND	
	DTG	0/1	0.0, NA	0/3	0.0, 0.0–56.1	ND	
	EVG	0/1	0.0, NA	0/3	0.0, 0.0–56.1	ND	
	RAL	0/1	0.0, NA	0/3	0.0, 0.0–56.1	ND	
HIV drug resistance among children and adolescents on second-line PI-based[b] ART with viral load ≥1000 copies/mL							
NRTI	Any	NA		12/18	57.0, 34.0–77.3	NA	
	ABC	NA		12/18	57.0, 34.0–77.3	NA	
	3TC or FTC	NA		12/18	57.0, 34.0–77.3	NA	
	TDF	NA		3/18	9.7, 1.3–47.0	NA	
	ZDV	NA		2/18	6.1, 1.4–23.2	NA	
NNRTI	EFV/NVP	NA		12/18	57.7, 34.6–77.9	NA	
	DOR	NA		11/18	48.8, 27.7–70.3	NA	
	ETR	NA		7/18	26.0, 8.9–55.7	NA	
	RPV	NA		8/18	30.2, 11.1–60.0	NA	
PI/r	ATV/r, DRV/r or LPV/r	NA		0/18	0.0, 0.0–17.6	NA	
	ATV/r	NA		0/18	0.0, 0.0–17.6	NA	
	DRV/r	NA		0/18	0.0, 0.0–17.6	NA	
	LPV/r	NA		0/18	0.0, 0.0–17.6	NA	
INSTI	Any	NA		0/16	0.0, 0.0–19.4	NA	
	BIC	NA		0/16	0.0, 0.0–19.4	NA	
	CAB	NA		0/16	0.0, 0.0–19.4	NA	
	DTG	NA		0/16	0.0, 0.0–19.4	NA	
	EVG	NA		0/16	0.0, 0.0–19.4	NA	
	RAL	NA		0/16	0.0, 0.0–19.4	NA	

a Study design–weighted proportion and 95% confidence interval.

b PI-based regimens include ATV/r, DRV/r or LPV/r.

c Survey population was children and adolescents on first-line ART for at least six months with viral load ≥1000 copies/mL.

HIV drug resistance was defined as the presence of a penalty score ≥15 using the Stanford HIVdb algorithm.

ABC: abacavir; ATV/r: atazanavir/ritonavir; BIC: bictegravir; CAB: cabotegravir; CI: confidence interval; DOR: doravirine; DRV/r: darunavir/ritonavir; DTG: dolutegravir; EFV: efavirenz; ETR: etravirine; EVG: elvitegravir; INSTI: integrase strand-transfer inhibitor; LPV/r: lopinavir/ritonavir; ND: no data; NNRTI: non-nucleoside reverse-transcriptase inhibitor; NRTI: nucleoside reverse-transcriptase inhibitor; NVP: nevirapine; PI/r: boosted protease inhibitor; RAL: raltegravir; RPV: rilpivirine; TDF: tenofovir disoproxil fumarate; ZDV: zidovudine; 3TC/FTC: lamivudine/emtricitabine.

Table A4.7a. Prevalence of mutations associated with HIV resistance to nucleoside reverse-transcriptase inhibitors among individuals on ART with unsuppressed viral load

Region	Country	Time on ART (months)	Population	Start year	Number of reverse-transcriptase sequences	Mutations associated with HIV resistance to nucleoside reverse-transcriptase inhibitors (%)[a]																		
						E40F	M41L	*E44AD*	*A62V*	K65ENR	D67EGHNSTDel	*S68Del*	T69DGDelIns	K70EGNQRST	L74VI	V75AIMST	F77L	Y115F	F116Y	Q151LM	M184VI	L210W	T215ACDEFILNSVY	K219QENRW
Africa	Botswana	12 ± 3	Adults	2019	9	0.0	0.0	0.0	0.0	11.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.1	0.0	0.0	0.0
	Botswana	≥48	Adults	2019	25	0.0	4.0	0.0	0.0	8.0	4.0	0.0	0.0	8.0	8.0	0.0	0.0	4.0	0.0	0.0	56.0	0.0	12.0	4.0
	Eswatini	12 ± 3	Adults	2016	26	0.0	18.8	6.3	6.3	6.3	12.5	0.0	0.0	12.5	18.8	6.3	0.0	6.3	0.0	0.0	62.5	6.3	18.8	6.3
	Eswatini	≥48	Adults	2016	20	0.0	10.0	5.0	0.0	10.0	25.0	0.0	10.0	20.0	5.0	0.0	0.0	0.0	0.0	0.0	70.0	10.0	25.0	15.0
	Lesotho	12 ± 3	Adults	2018	22	0.0	0.0	0.0	4.5	18.2	0.0	0.0	0.0	13.6	4.5	0.0	0.0	4.5	0.0	0.0	22.7	0.0	0.0	4.5
	Lesotho	≥48	Adults	2018	40	0.0	15.0	5.0	7.5	25.0	10.0	0.0	5.0	22.5	10.0	7.5	0.0	7.5	0.0	0.0	77.5	2.5	17.5	22.5
	Senegal	12 ± 3	Adults	2017	0	0.0	0.0	0.0	0.0	22.2	0.0	0.0	0.0	3.7	0.0	0.0	0.0	11.1	0.0	0.0	18.5	0.0	0.0	0.0
	Senegal	≥40	Adults	2017	0	0.0	6.3	0.0	3.1	0.0	9.4	0.0	0.0	12.5	0.0	0.0	0.0	6.3	0.0	0.0	46.9	3.1	15.6	12.5
	South Sudan	12 ± 3	Adults	2018	69	0.0	7.2	1.4	1.4	15.9	1.4	0.0	1.4	2.9	2.9	8.7	0.0	4.3	0.0	0.0	26.1	2.9	5.8	8.7
	South Sudan	≥48	Adults	2018	115	0.0	20.9	2.6	1.7	10.4	16.5	0.0	3.5	23.5	6.1	13.9	1.7	0.9	0.0	0.0	73.0	4.3	26.1	20.9
	Uganda	12 ± 3	Adults	2016	30	0.0	3.3	0.0	0.0	26.7	16.7	0.0	0.0	23.3	13.3	0.0	0.0	13.3	0.0	0.0	82.1	0.0	21.4	17.9
	Uganda	≥48	Adults	2017	93	0.0	22.6	7.5	0.0	10.8	15.1	0.0	5.4	26.9	3.2	5.4	0.0	0.0	0.0	0.0	87.1	9.7	33.3	19.4
	Uganda	Any	Children	2019	382	0.0	7.6	3.4	0.5	4.2	11.3	0.0	1.8	14.1	12.3	2.6	0.3	7.3	0.0	0.0	70.9	5.2	17.8	13.9
	Zambia	12 ± 3	Adults	2019	37	0.0	2.7	0.0	10.8	35.1	8.1	0.0	0.0	16.2	10.8	5.4	0.0	16.2	0.0	0.0	56.8	0.0	0.0	8.1
	Zambia	≥48	Adults	2019	47	0.0	6.4	0.0	4.3	29.8	10.6	0.0	0.0	27.7	10.6	4.3	0.0	14.9	0.0	0.0	61.7	2.1	12.8	19.1
	Zambia	12 ± 3	Children	2019	69	0.0	1.4	2.9	7.2	14.5	13.0	0.0	2.9	15.9	18.8	2.9	0.0	18.8	0.0	0.0	60.9	1.4	7.2	13.0
	Zambia	≥36	Children	2019	194	0.0	6.7	1.5	2.1	13.4	13.9	0.0	1.0	16.5	21.6	3.1	0.0	19.6	0.5	0.5	69.1	1.5	14.4	15.5
The Americas	Eastern Caribbean Countries[b]	Any	Adults	2018	67	0.0	11.9	1.5	3.0	4.5	7.5	0.0	1.5	9.0	6.0	6.0	0.0	0.0	0.0	0.0	41.8	3.0	17.9	11.9
	El Salvador	12 ± 3	Adults	2018	15	0.0	0.0	0.0	0.0	26.7	13.3	0.0	0.0	26.7	13.3	0.0	0.0	6.7	0.0	0.0	60.0	0.0	0.0	6.7
	El Salvador	≥48	Adults	2018	61	0.0	19.7	8.2	1.6	4.9	13.1	0.0	1.6	19.7	9.8	11.5	0.0	3.3	0.0	0.0	77.0	14.8	37.7	18.0
	Guatemala	12 ± 3	Adults	2016	19	0.0	0.0	0.0	10.5	15.8	10.5	0.0	0.0	15.8	21.1	5.3	0.0	5.3	0.0	0.0	47.4	0.0	0.0	10.5
	Guatemala	≥48	Adults	2016	40	0.0	5.0	0.0	5.0	5.0	17.5	0.0	2.5	35.0	12.5	2.5	0.0	5.0	0.0	0.0	60.0	0.0	7.5	25.0
	Honduras	12 ± 3	Adults	2016	16	0.0	18.8	6.3	6.3	6.3	12.5	0.0	0.0	12.5	18.8	6.3	0.0	6.3	0.0	0.0	62.5	6.3	18.8	6.3
	Honduras	≥48	Adults	2016	103	0.0	19.4	5.8	3.9	5.8	16.5	0.0	1.9	20.4	17.5	5.8	1.0	3.9	0.0	0.0	73.8	12.6	36.9	22.3
	Nicaragua	12 ± 3	Adults	2016	27	0.0	11.1	3.7	3.7	3.7	7.4	0.0	0.0	14.8	22.2	3.7	3.7	7.4	0.0	0.0	55.6	0.0	3.7	7.4
	Nicaragua	≥48	Adults	2016	110	0.0	11.8	2.7	2.7	6.4	10.0	0.0	2.7	13.6	9.1	1.8	0.0	3.6	0.0	0.0	57.3	4.5	13.6	5.5
South-East Asia and the Western Pacific	Myanmar	12 ± 3	Adults	2018	21	0.0	0.0	0.0	9.5	28.6	28.6	0.0	0.0	38.1	9.5	4.8	0.0	9.1	0.0	0.0	54.5	0.0	0.0	9.1
	Myanmar	≥48	Adults	2018	29	0.0	14.3	7.1	3.6	14.3	21.4	0.0	3.6	25.0	10.7	7.1	0.0	0.0	0.0	0.0	41.4	10.3	17.2	20.7
	Viet Nam	12 ± 3	Adults	2020	16	0.0	0.0	0.0	5.6	38.9	11.1	0.0	0.0	22.2	16.7	16.7	0.0	0.0	0.0	0.0	66.7	0.0	5.6	27.8
	Viet Nam	≥48	Adults	2020	11	0.0	9.1	9.1	0.0	18.2	18.2	0.0	0.0	0.0	18.2	9.1	0.0	9.1	0.0	0.0	45.5	9.1	9.1	18.2

a Unweighted proportions of sequences that have non-zero penalty scores in the Stanford HIVdb algorithm. Mutations in italics correspond to non-SDRM positions (may include polymorphisms).
b Eastern Caribbean Countries: Antigua and Barbuda, Dominica, Grenada, Saint Kitts and Nevis, Saint Lucia and Saint Vincent and the Grenadines.

Table A4.7b. Prevalence of mutations associated with HIV resistance to non-nucleoside reverse-transcriptase inhibitors among individuals on ART with unsuppressed viral load

Region	Country	Time on ART (months)	Population	Start year	Number of reverse-transcriptase sequences	Mutations associated with HIV resistance to non-nucleoside reverse-transcriptase inhibitors (%)[a]										
						A98G	L100IV	K101EHP	K103HNST	*K103R*	V106MA	*V106I*	*V108I*	*E138A*	*E138GKQR*	V179FL
Africa	Botswana	12 ± 3	Adults	2019	9	0.0	0.0	11.1	0.0	0.0	0.0	0.0	11.1	11.1	0.0	0.0
	Botswana	≥48	Adults	2019	25	4.0	4.0	8.0	32.0	8.0	20.0	0.0	0.0	8.0	8.0	0.0
	Eswatini	12 ± 3	Adults	2016	26	0.0	12.5	0.0	75.0	12.5	12.5	0.0	12.5	0.0	0.0	0.0
	Eswatini	≥48	Adults	2016	20	15.0	5.0	10.0	45.0	5.0	10.0	5.0	15.0	10.0	0.0	0.0
	Lesotho	12 ± 3	Adults	2018	22	0.0	4.5	0.0	31.8	9.1	18.2	0.0	0.0	4.5	0.0	0.0
	Lesotho	≥48	Adults	2018	40	15.0	7.5	12.5	60.0	7.5	17.5	0.0	17.5	5.0	0.0	0.0
	Senegal	12 ± 3	Adults	2017	0	3.7	7.4	3.7	48.1	0.0	3.7	0.0	3.7	0.0	3.7	0.0
	Senegal	≥40	Adults	2017	0	12.5	0.0	9.4	59.4	0.0	3.1	6.3	12.5	3.1	12.5	0.0
	South Sudan	12 ± 3	Adults	2018	69	2.9	4.3	2.9	42.0	0.0	4.3	1.4	10.1	1.4	1.4	0.0
	South Sudan	≥48	Adults	2018	115	17.4	2.6	11.3	53.0	1.7	5.2	4.3	10.4	1.7	3.5	2.6
	Uganda	12 ± 3	Adults	2016	30	10.0	20.0	3.3	70.0	3.3	3.3	3.3	13.3	10.7	0.0	3.6
	Uganda	≥48	Adults	2017	93	14.0	4.3	8.6	45.2	0.0	2.2	2.2	14.0	1.1	4.3	1.1
	Uganda	Any	Children and adolescents	2019	382	9.9	2.4	10.2	43.5	1.0	3.4	2.6	6.0	6.0	4.7	1.3
	Zambia	12 ± 3	Adults	2019	37	5.4	10.8	8.1	59.5	2.7	24.3	0.0	2.7	10.8	2.7	2.7
	Zambia	≥48	Adults	2019	47	17.0	14.9	23.4	40.4	4.3	14.9	0.0	10.6	12.8	2.1	2.1
	Zambia	12 ± 3	Children and adolescents	2019	69	7.2	4.3	10.1	36.2	4.3	21.7	0.0	8.7	4.3	5.8	1.4
	Zambia	≥36	Children and adolescents	2019	194	12.4	4.6	13.4	44.3	6.2	21.6	0.5	16.0	7.7	4.1	0.5
The Americas	Eastern Caribbean Countries[b]	Any	Adults	2018	67	4.5	4.5	9.0	43.3	0.0	1.5	6.0	6.0	7.5	3.0	0.0
	El Salvador	12 ± 3	Adults	2018	15	0.0	20.0	6.7	73.3	0.0	6.7	0.0	20.0	0.0	0.0	0.0
	El Salvador	≥48	Adults	2018	61	3.3	8.2	3.3	60.7	13.1	1.6	3.3	9.8	4.9	3.3	0.0
	Guatemala	12 ± 3	Adults	2016	19	0.0	15.8	5.3	57.9	5.3	0.0	5.3	21.1	0.0	0.0	0.0
	Guatemala	≥48	Adults	2016	40	2.5	15.0	10.0	42.5	2.5	5.0	7.5	12.5	0.0	2.5	0.0
	Honduras	12 ± 3	Adults	2016	16	0.0	12.5	0.0	75.0	12.5	12.5	0.0	12.5	0.0	0.0	0.0
	Honduras	≥48	Adults	2016	103	5.8	4.9	10.7	59.2	15.5	1.0	4.9	18.4	0.0	1.9	0.0
	Nicaragua	12 ± 3	Adults	2016	27	0.0	7.4	7.4	66.7	3.7	0.0	7.4	11.1	0.0	0.0	0.0
	Nicaragua	≥48	Adults	2016	110	4.5	5.5	3.6	66.4	3.6	3.6	3.6	5.5	5.5	1.8	0.0
South-East Asia and the Western Pacific	Myanmar	12 ± 3	Adults	2018	21	0.0	4.5	4.5	36.4	4.5	18.2	13.6	0.0	4.5	9.1	0.0
	Myanmar	≥48	Adults	2018	29	10.3	3.4	13.8	37.9	3.4	10.3	10.3	10.3	3.4	10.3	3.4
	Viet Nam	12 ± 3	Adults	2020	16	5.6	5.6	0.0	44.4	5.6	11.1	5.6	16.7	0.0	11.1	0.0
	Viet Nam	≥48	Adults	2020	11	9.1	0.0	18.2	18.2	9.1	0.0	27.3	9.1	0.0	0.0	0.0

a Unweighted proportions of sequences that have non-zero penalty scores in the Stanford HIVdb algorithm. Mutations in italics correspond to non-SDRM positions (may include polymorphisms).
b Eastern Caribbean Countries Antigua and Barbuda, Dominica, Grenada, Saint Kitts and Nevis, Saint Lucia and Saint Vincent and the Grenadines.

Table A4.7b. Continued

Region	Country	Time on ART (months)	Population	Start year	Number of reverse-transcriptase sequences	Mutations associated with HIV resistance to non-nucleoside reverse-transcriptase inhibitors (%)[a]										
						179DE	Y181CFGISV	Y188CFHL	G190ACEQSTV	*H221Y*	P225H	*F227CILV*	M230IL	*L234I*	*P236L*	*K238NT*
Africa	Botswana	12 ± 3	Adults	2019	9	0.0	11.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.1
	Botswana	≥48	Adults	2019	25	8.0	12.0	12.0	8.0	0.0	4.0	8.0	0.0	0.0	0.0	0.0
	Eswatini	12 ± 3	Adults	2016	26	12.5	12.5	0.0	12.5	0.0	18.8	6.3	0.0	0.0	0.0	12.5
	Eswatini	≥48	Adults	2016	20	10.0	20.0	5.0	5.0	15.0	5.0	0.0	0.0	0.0	0.0	10.0
	Lesotho	12 ± 3	Adults	2018	22	9.1	4.5	0.0	9.1	4.5	4.5	4.5	4.5	0.0	0.0	0.0
	Lesotho	≥48	Adults	2018	40	7.5	12.5	12.5	7.5	12.5	12.5	7.5	7.5	0.0	0.0	2.5
	Senegal	12 ± 3	Adults	2017	0	11.1	7.4	3.7	0.0	0.0	4.0	0.0	4.5	0.0	0.0	0.0
	Senegal	≥40	Adults	2017	0	15.6	9.4	12.5	0.0	6.5	9.7	3.4	0.0	0.0	0.0	6.3
	South Sudan	12 ± 3	Adults	2018	69	1.4	8.7	1.4	0.0	2.9	14.5	1.4	1.4	0.0	0.0	1.4
	South Sudan	≥48	Adults	2018	115	3.5	13.9	8.7	1.7	10.4	10.4	0.9	1.7	0.9	0.0	7.0
	Uganda	12 ± 3	Adults	2016	30	3.6	21.4	10.7	3.3	10.7	14.3	0.0	3.6	0.0	0.0	7.1
	Uganda	≥48	Adults	2017	93	0.0	31.2	4.3	0.0	14.0	7.5	2.2	4.3	0.0	0.0	2.2
	Uganda	Any	Children and adolescents	2019	382	2.9	19.9	7.3	1.0	11.5	8.1	1.6	1.8	0.0	0.0	2.6
	Zambia	12 ± 3	Adults	2019	37	8.1	32.4	0.0	2.7	16.2	2.7	5.4	0.0	0.0	0.0	0.0
	Zambia	≥48	Adults	2019	47	4.3	25.5	0.0	4.3	14.9	10.6	4.3	0.0	0.0	0.0	4.3
	Zambia	12 ± 3	Children and adolescents	2019	69	7.2	23.2	5.8	4.3	8.7	2.9	2.9	1.4	0.0	0.0	1.4
	Zambia	≥36	Children and adolescents	2019	194	6.7	30.9	6.7	6.2	12.9	6.2	8.2	2.1	0.0	0.0	1.0
The Americas	Eastern Caribbean Countries[b]	Any	Adults	2018	67	1.5	9.0	3.0	0.0	1.5	11.9	1.5	0.0	1.5	0.0	3.0
	El Salvador	12 ± 3	Adults	2018	15	20.0	13.3	6.7	0.0	20.0	13.3	13.3	0.0	0.0	0.0	6.7
	El Salvador	≥48	Adults	2018	61	16.4	6.6	14.8	13.1	4.9	26.2	0.0	1.6	0.0	0.0	3.3
	Guatemala	12 ± 3	Adults	2016	19	5.3	10.5	5.3	5.3	10.5	10.5	0.0	0.0	0.0	0.0	5.3
	Guatemala	≥48	Adults	2016	40	7.5	12.5	10.0	2.5	2.5	15.0	2.5	0.0	0.0	0.0	0.0
	Honduras	12 ± 3	Adults	2016	16	12.5	12.5	0.0	12.5	0.0	18.8	6.3	0.0	0.0	0.0	12.5
	Honduras	≥48	Adults	2016	103	8.7	7.8	8.7	15.5	5.8	25.2	1.0	3.9	1.0	0.0	10.7
	Nicaragua	12 ± 3	Adults	2016	27	3.7	3.7	3.7	3.7	7.4	18.5	0.0	0.0	3.7	0.0	0.0
	Nicaragua	≥48	Adults	2016	110	7.3	3.6	9.1	3.6	0.0	17.3	0.9	1.8	0.0	0.0	7.3
South-East Asia and the Western Pacific	Myanmar	12 ± 3	Adults	2018	21	27.3	9.1	9.1	4.5	4.5	9.1	9.1	9.1	0.0	0.0	0.0
	Myanmar	≥48	Adults	2018	29	6.9	13.8	10.3	3.4	10.3	6.9	10.3	10.3	0.0	0.0	6.9
	Viet Nam	12 ± 3	Adults	2020	16	16.7	11.1	11.1	5.6	5.6	22.2	0.0	11.1	5.6	0.0	0.0
	Viet Nam	≥48	Adults	2020	11	9.1	36.4	0.0	9.1	18.2	9.1	0.0	0.0	0.0	0.0	0.0

a Unweighted proportions of sequences that have non-zero penalty scores in the Stanford HIVdb algorithm. Mutations in italics correspond to non-SDRM positions (may include polymorphisms).
b Eastern Caribbean Countries Antigua and Barbuda, Dominica, Grenada, Saint Kitts and Nevis, Saint Lucia and Saint Vincent and the Grenadines.

Table A4.7c. Prevalence of mutations associated with HIV resistance to protease inhibitors among individuals on ART with unsuppressed viral load

Region	Country	Time on ART (months)	Population	Start year	Number of protease sequences	Mutations associated with HIV resistance to protease inhibitors (%)[a]												
						L10F	*V11IL*	*K20T*	L23I	L24IFM	D30N	V32I	*L33F*	*K43T*	M46ILV	I47VA	G48LMQSTV	I50VL
Africa	Botswana	12 ± 3	Adults	2019	9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Botswana	≥48	Adults	2019	25	4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.0	0.0	0.0	0.0
	Eswatini	12 ± 3	Adults	2016	26	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Eswatini	≥48	Adults	2016	20	10.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0	0.0	0.0	0.0
	Lesotho	12 ± 3	Adults	2018	22	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Lesotho	≥48	Adults	2018	40	0.0	5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	South Sudan	12 ± 3	Adults	2018	69	0.0	4.3	0.0	0.0	0.0	0.0	0.0	2.9	0.0	0.0	0.0	0.0	0.0
	South Sudan	≥48	Adults	2018	115	0.0	2.6	0.9	0.0	0.0	0.0	0.0	0.9	0.0	0.9	0.0	0.0	0.0
	Uganda	12 ± 3	Adults	2016	30	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.3	0.0	0.0	0.0	0.0	0.0
	Uganda	≥48	Adults	2017	93	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Uganda	Any	Children and adolescents	2019	382	1.0	1.0	0.8	0.0	0.3	0.0	0.3	2.4	0.3	2.4	0.8	0.0	0.0
	Zambia	12 ± 3	Adults	2019	37	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Zambia	≥48	Adults	2019	47	2.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Zambia	12 ± 3	Children and adolescents	2019	69	1.4	0.0	0.0	0.0	0.0	0.0	0.0	1.4	0.0	1.4	0.0	0.0	0.0
	Zambia	≥36	Children and adolescents	2019	194	2.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.5	0.0	0.0	0.0
The Americas	Eastern Caribbean Countries[b]	Any	Adults	2018	67	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.5	0.0	3.0	0.0	0.0	0.0
	El Salvador	12 ± 3	Adults	2018	15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	El Salvador	≥48	Adults	2018	61	3.3	0.0	1.6	1.6	0.0	0.0	0.0	3.3	1.6	8.2	1.6	0.0	0.0
	Guatemala	12 ± 3	Adults	2016	19	5.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Guatemala	≥48	Adults	2016	40	0.0	0.0	2.4	0.0	0.0	0.0	0.0	0.0	0.0	2.4	0.0	0.0	0.0
	Honduras	12 ± 3	Adults	2016	16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Honduras	≥48	Adults	2016	103	1.0	0.0	0.0	0.0	0.0	0.0	0.0	1.9	1.0	2.9	1.0	0.0	0.0
	Nicaragua	12 ± 3	Adults	2016	27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Nicaragua	≥48	Adults	2016	110	0.0	0.9	1.8	1.8	0.9	0.0	0.9	2.7	0.0	4.5	0.0	0.0	0.9
South-East Asia and the Western Pacific	Myanmar	12 ± 3	Adults	2018	20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.5	0.0	0.0	0.0	0.0	0.0
	Myanmar	≥48	Adults	2018	28	0.0	0.0	3.4	0.0	0.0	0.0	0.0	3.4	0.0	3.4	3.4	0.0	0.0
	Viet Nam	12 ± 3	Adults	2020	18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Viet Nam	≥48	Adults	2020	11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

a Unweighted proportions of sequences that have non-zero penalty scores in the Stanford HIVdb algorithm. Mutations in italics correspond to non-SDRM positions (may include polymorphisms).
b Eastern Caribbean Countries: Antigua and Barbuda, Dominica, Grenada, Saint Kitts and Nevis, Saint Lucia and Saint Vincent and the Grenadines.

Table A4.7c. Continued

Region	Country	Time on ART (months)	Population	Start year	Number of protease sequences	Mutations associated with HIV resistance to protease inhibitors (%)[a]												
						L10F	*V11IL*	*K20T*	L23I	L24IFM	D30N	V32I	*L33F*	*K43T*	M46ILV	I47VA	G48LMQSTV	I50VL
Africa	Botswana	12 ± 3	Adults	2019	9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Botswana	≥48	Adults	2019	25	0.0	4.0	0.0	0.0	0.0	0.0	4.0	0.0	0.0	0.0	0.0	0.0	0.0
	Eswatini	12 ± 3	Adults	2016	26	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.3
	Eswatini	≥48	Adults	2016	20	0.0	5.0	5.0	0.0	0.0	5.0	5.0	0.0	0.0	0.0	0.0	0.0	0.0
	Lesotho	12 ± 3	Adults	2018	22	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Lesotho	≥48	Adults	2018	40	0.0	0.0	2.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	South Sudan	12 ± 3	Adults	2018	69	0.0	0.0	4.3	0.0	0.0	0.0	1.4	0.0	0.0	4.3	0.0	0.0	0.0
	South Sudan	≥48	Adults	2018	115	0.0	0.0	5.2	0.0	0.0	0.0	0.0	0.0	0.0	9.6	0.0	0.0	0.9
	Uganda	12 ± 3	Adults	2016	30	0.0	0.0	6.7	0.0	0.0	0.0	0.0	0.0	0.0	3.3	0.0	3.3	0.0
	Uganda	≥48	Adults	2017	93	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	0.0
	Uganda	Any	Children and adolescents	2019	382	0.0	0.5	0.8	0.3	0.0	0.3	1.8	0.0	0.0	0.8	0.3	0.3	0.0
	Zambia	12 ± 3	Adults	2019	37	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Zambia	≥48	Adults	2019	47	0.0	2.1	0.0	0.0	0.0	0.0	2.1	0.0	0.0	2.1	0.0	0.0	0.0
	Zambia	12 ± 3	Children and adolescents	2019	69	0.0	1.4	0.0	0.0	0.0	1.4	1.4	0.0	0.0	0.0	0.0	0.0	0.0
	Zambia	≥36	Children and adolescents	2019	194	0.0	1.5	0.0	0.0	0.0	1.0	2.1	0.0	0.5	1.0	0.0	0.0	0.5
The Americas	Eastern Caribbean Countries[b]	Any	Adults	2018	61	0.0	1.5	0.0	0.0	0.0	3.0	1.5	0.0	0.0	0.0	0.0	0.0	0.0
	El Salvador	12 ± 3	Adults	2016	19	0.0	0.0	0.0	0.0	6.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	El Salvador	≥48	Adults	2016	40	1.6	6.6	4.9	1.6	0.0	1.6	6.6	0.0	1.6	0.0	0.0	1.6	1.6
	Guatemala	12 ± 3	Adults	2016	16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Guatemala	≥48	Adults	2016	103	0.0	0.0	0.0	0.0	0.0	2.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Honduras	12 ± 3	Adults	2016	27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.3
	Honduras	≥48	Adults	2016	110	1.0	1.9	1.0	0.0	0.0	0.0	1.9	0.0	0.0	0.0	0.0	0.0	0.0
	Nicaragua	12 ± 3	Adults	2018	20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Nicaragua	≥48	Adults	2018	28	0.9	2.7	2.7	0.0	0.0	1.8	3.6	0.0	0.9	0.0	0.9	0.9	0.0
South-East Asia and the Western Pacific	Myanmar	12 ± 3	Adults	2020	18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Myanmar	≥48	Adults	2020	11	0.0	3.4	3.4	3.4	0.0	0.0	0.0	0.0	3.4	0.0	0.0	0.0	0.0
	Viet Nam	12 ± 3	Adults	2020	16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Viet Nam	≥48	Adults	2020	11	0.0	9.1	9.1	0.0	0.0	9.1	0.0	0.0	9.1	0.0	0.0	0.0	0.0

a Unweighted proportions of sequences that have non-zero penalty scores in the Stanford HIVdb algorithm. Mutations in italics correspond to non-SDRM positions (may include polymorphisms).
b Eastern Caribbean Countries: Antigua and Barbuda, Dominica, Grenada, Saint Kitts and Nevis, Saint Lucia and Saint Vincent and the Grenadines.

Table A4.7d. Prevalence of mutations associated with HIV resistance to integrase strand-transfer inhibitors among individuals on ART with unsuppressed viral load

Region	Country	Time on ART (months)	Population	Start year	Number of Integrase sequences	Mutations associated with HIV resistance to integrase strand-transfer inhibitors (%)[a]									
						H51Y	T66AIK	E92GQV	*Q95K*	*T97A*	G118R	F121CY	E138AKT	G140ACRS	Y143CGHKRS	*P145S*
Africa	South Sudan	12 ± 3	Adults	2018	46	0.0	0.0	0.0	2.2	6.5	0.0	0.0	0.0	0.0	0.0	0.0
	South Sudan	≥48	Adults	2018	87	0.0	0.0	0.0	0.0	3.4	0.0	0.0	0.0	0.0	0.0	0.0
	Zambia	12 ± 3	Adults	2019	29	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Zambia	≥48	Adults	2019	39	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Zambia	12 ± 3	Children and adolescents	2019	45	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Zambia	≥36	Children and adolescents	2019	154	0.0	0.0	0.0	0.0	3.2	0.0	0.0	0.0	0.0	0.0	0.0
The Americas	El Salvador	12 ± 3	Adults	2018	17	0.0	0.0	0.0	5.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	El Salvador	≥48	Adults	2018	61	0.0	0.0	0.0	0.0	1.6	0.0	0.0	1.6	0.0	0.0	0.0
	Guatemala	12 ± 3	Adults	2016	16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Guatemala	≥48	Adults	2016	32	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Nicaragua	12 ± 3	Adults	2016	27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Nicaragua	≥48	Adults	2016	107	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Region	Country	Time on ART (months)	Population	Start year	Number of Integrase sequences	Mutations associated with HIV resistance to integrase strand-transfer inhibitors (%)[a]									
						Q146P	S147G	Q148HKNR	*V151AL*	*S153FY*	N155HST	*E157Q*	*G163KR*	S230R	*D232N*	R263K
Africa	South Sudan	12 ± 3	Adults	2018	46	0.0	0.0	0.0	0.0	0.0	0.0	6.5	0.0	0.0	0.0	0.0
	South Sudan	≥48	Adults	2018	87	0.0	0.0	0.0	0.0	0.0	0.0	3.4	1.1	0.0	0.0	0.0
	Zambia	12 ± 3	Adults	2019	29	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Zambia	≥48	Adults	2019	39	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Zambia	12 ± 3	Children and adolescents	2019	45	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Zambia	≥36	Children and adolescents	2019	154	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.6	0.0	0.0	0.0
The Americas	El Salvador	12 ± 3	Adults	2018	17	0.0	0.0	0.0	0.0	0.0	0.0	5.9	0.0	0.0	0.0	0.0
	El Salvador	≥48	Adults	2018	61	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.6
	Guatemala	12 ± 3	Adults	2016	16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Guatemala	≥48	Adults	2016	32	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Nicaragua	12 ± 3	Adults	2016	27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Nicaragua	≥48	Adults	2016	107	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

a Unweighted proportions of sequences that have non-zero penalty scores in the Stanford HIVdb algorithm. Mutations in italics correspond to non-SDRM positions (may include polymorphisms).

ANNEX 2. METHODOLOGICAL NOTES

The aggregate regional and global HIV drug resistance summary results were estimated using the methods described below.

Three data sets were created to produce global and regional summary results of HIV drug resistance and or viral load suppression. Countries were grouped into regions using WHO categories.

The pretreatment drug resistance estimates are based on an aggregation of 31 surveys completed by 35 countries. For countries with multiple surveys of the same type (Argentina and Mexico), only the most recent survey results were used for regional and global estimates. Estimates of acquired drug resistance are based on an aggregation of 29 surveys from 21 countries. Similar to the pretreatment drug resistance estimates, the most recent data from Viet Nam's and Zambia's 12-month and 48+ month surveys were used in aggregate analysis. Infant HIV drug resistance estimates were produced from an aggregation of 10 surveys from 10 countries.

Complex variance estimates were calculated using the SURVEYFREQ procedure in SAS 9.4 (SAS Institute, Cary, NC, USA). Countries were specified as clusters rather than strata to better adjust for the convenient nature of the sample. Countries were not randomly selected and do not comprise an exhaustive set of countries in each WHO region. Treating the countries as strata would thus underestimate sampling variability and reduce coverage rates for 95% intervals. Although they were not truly cluster samples, treating surveys as clusters produces variance estimates in accordance with the true country-to-country variability in drug-resistant HIV measures. This approach gives confidence intervals of sufficient width to give true 95% confidence in reported estimates.

The estimated proportions of predicted HIV drug resistance are accompanied by 95% Wald intervals where appropriate. No confidence intervals are reported for regions with fewer than two countries represented in the data set.

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