



Guidelines for the Use of Antiretroviral Agents in Adults and Adolescents Living with HIV

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What to Start: Initial Combination Regimens for the Antiretroviral-Naive Patient (Last updated October 25, 2018; last reviewed October 25, 2018)

Panel's Recommendations

- An antiretroviral (ARV) regimen for a treatment-naive patient generally consists of two nucleoside reverse transcriptase inhibitors (NRTIs) administered in combination with a third active ARV drug from one of three drug classes: an integrase strand transfer inhibitor (INSTI), a non-nucleoside reverse transcriptase inhibitor (NNRTI), or a protease inhibitor (PI) with a pharmacokinetic (PK) enhancer (also known as a booster; the two drugs used for this purpose are cobicistat and ritonavir).
- A pregnancy test should be performed for those of childbearing potential prior to the initiation of antiretroviral therapy (AIII).
- The Panel on Antiretroviral Guidelines for Adults and Adolescents (the Panel) classifies the following regimens as Recommended Initial Regimens for Most People with HIV (in alphabetical order):
 - Bictegravir/tenofovir alafenamide/emtricitabine (AI)
 - Dolutegravir/abacavir/lamivudine^a—only for patients who are HLA-B*5701 negative (AI)
 - Dolutegravir (DTG) plus tenofovir^b/emtricitabine^a (AI)
 - Raltegravir plus tenofovir^b/emtricitabine^a (BI for tenofovir disoproxil fumarate, BII for tenofovir alafenamide)
 - Preliminary data have raised concerns about an increased risk of neural tube defects in infants born to people who were receiving DTG at the time of conception. Before prescribing DTG or another INSTI, please refer to Table 6b for specific recommendations on initiating these drugs as part of initial therapy.
- To address individual patient characteristics and needs, the Panel also provides a list of Recommended Initial Regimens in Certain Clinical Situations (Table 6a).
- Given the many excellent options for initial therapy, selection of a regimen for a particular patient should be guided by factors such as virologic efficacy, toxicity, pill burden, dosing frequency, drug-drug interaction potential, resistance test results, comorbid conditions, access, and cost. Table 7 provides guidance on choosing an ARV regimen based on selected clinical case scenarios. Table 9 highlights the advantages and disadvantages of different components in a regimen.

Rating of Recommendations: A = Strong; B = Moderate; C = Optional

Rating of Evidence: I = Data from randomized controlled trials; II = Data from well-designed nonrandomized trials, observational cohort studies with long-term clinical outcomes, relative bioavailability/bioequivalence studies, or regimen comparisons from randomized switch studies; III = Expert opinion

^a Lamivudine may substitute for emtricitabine or vice versa.

^b Tenofovir alafenamide (TAF) and tenofovir disoproxil fumarate (TDF) are two forms of tenofovir that are approved by the Food and Drug Administration. TAF has fewer bone and kidney toxicities than TDF, while TDF is associated with lower lipid levels. Safety, cost, and access are among the factors to consider when choosing between these drugs.

Introduction

More than 30 antiretroviral (ARV) drugs in seven mechanistic classes are Food and Drug Administration (FDA)-approved for treatment of HIV infection. These seven classes include the nucleoside/nucleotide reverse transcriptase inhibitors (NRTIs), non-nucleoside reverse transcriptase inhibitors (NNRTIs), protease inhibitors (PIs), integrase strand transfer inhibitors (INSTIs), a fusion inhibitor, a CCR5 antagonist, and a CD4 post-attachment inhibitor. In addition, two drugs, ritonavir (RTV or r) and cobicistat (COBI or c) are used as pharmacokinetic (PK) enhancers (or boosters) to improve the PK profiles of some ARV drugs (e.g., PIs and the INSTI elvitegravir [EVG]).

The initial ARV regimen for a treatment-naive patient generally consists of two NRTIs, usually abacavir/lamivudine (ABC/3TC) or either tenofovir alafenamide/emtricitabine (TAF/FTC) or tenofovir disoproxil fumarate (TDF)/FTC, plus a drug from one of three drug classes: an INSTI, an NNRTI, or a boosted PI. As shown in clinical trials and by retrospective evaluation of cohorts of patients in clinical care, this strategy for initial treatment has resulted in suppression of HIV replication and CD4 T lymphocyte (CD4) cell count increases in most persons with HIV.¹⁻³ Emerging data support the use of two-drug regimens, such as

dolutegravir (DTG) plus 3TC, when ABC, TDF, and TAF cannot be used or are not optimal (see the section below titled *Other Antiretroviral Regimens for Initial Therapy When Abacavir, Tenofovir Alafenamide, and Tenofovir Disoproxil Fumarate Cannot Be Used or Are Not Optimal*).

Supporting Evidence and Rationale Used for the Panel's Recommendations

The Panel on Antiretroviral Guidelines for Adults and Adolescents (the Panel)'s recommendations are primarily based on clinical trial data published in peer-reviewed journals and data prepared by manufacturers for FDA review. In select cases, the Panel considers data from abstracts presented at major scientific meetings. The Panel considers published information from a randomized, prospective clinical trial with an adequate sample size that demonstrates that an ARV regimen produces high rates of viral suppression, increases CD4 count, and has a favorable safety profile to be the strongest evidence on which to base recommendations. Comparative clinical trials of initial treatments generally show no significant differences in HIV-related clinical endpoints or survival. Thus, assessment of regimen efficacy and safety are primarily based on surrogate marker endpoints (especially rates of HIV RNA suppression) and the incidence and severity of adverse events.

In some instances, the Panel recommends regimens that include medications approved by the FDA based on bioequivalence or relative bioavailability studies demonstrating that the exposure of the drug(s) in the new formulation or combination is comparable to the exposure of a reference drug(s) that has demonstrated safety and efficacy in randomized clinical trials. When developing recommendations, the Panel may also consider data from randomized switch studies, in which a new medication replaces an existing medication from the same class in patients who have achieved virologic suppression on an initial regimen. Switch trials do not evaluate the ability of a drug or regimen to induce viral suppression; they only examine the drug or regimen's ability to maintain suppression. Therefore, results from switch trials may not be directly applicable to the selection of an initial regimen and should be considered in conjunction with other data, including data from trials conducted in treatment-naïve patients and bioequivalence/bioavailability studies. In this section of the guidelines, the definition of an evidence rating of **II** is expanded to include supporting data from bioavailability/bioequivalence studies or randomized switch studies.

When developing recommendations, the Panel also considers tolerability and toxicity profiles, pill burden and dosing frequency, drug interaction potential, **cost and access**, post-marketing safety data, observational cohort data published in peer-reviewed publications, and the experience of clinicians and community members who are actively engaged in patient care.

The Panel reviewed the available data to arrive at two regimen classifications for ARV-naïve patients: (1) Recommended Initial Regimens for Most People with HIV and (2) Recommended Initial Regimens in Certain Clinical Situations (Table 6a). Recommended Initial Regimens for Most People with HIV are those regimens with demonstrated durable virologic efficacy, favorable tolerability and toxicity profiles, and ease of use. The Panel also recognizes that, in certain clinical situations, other regimens may be preferred; these options are included in Table 6a in the category of Recommended Initial Regimens in Certain Clinical Situations. Examples of clinical scenarios in which certain drugs in these regimens may be particularly advantageous are outlined in Table 7.

There are many other ARV regimens that are effective for initial therapy but have disadvantages when compared with the regimens listed in Table 6a. These disadvantages include greater toxicity, higher pill burden, less supporting data from large comparative clinical trials, or limitations for use in certain patient populations. These other regimens are no longer included in Table 6a. **A person with HIV who is virologically suppressed and who is not experiencing any adverse effects on a regimen that is not listed in Table 6a need not necessarily change to a regimen that is in that table.** Clinicians should refer to [Optimizing Antiretroviral Therapy in the Setting of Viral Suppression](#) for further guidance if switching to a new regimen is desired.

Regimens and medications listed in Table 10 are not recommended as initial ARV. In most instances, a clinician is urged to consider switching a patient who is on one of the regimens listed in Table 10 to a recommended regimen.

In addition to these tables, several tables presented below and at the end of these guidelines provide clinicians with guidance on selecting and prescribing an optimal regimen for an individual patient. Table 9 lists the potential advantages and disadvantages of the different ARV drug components. Appendix B, [Tables 1–7](#) list characteristics of individual ARV agents (e.g., formulations, dosing recommendations, PKs, common adverse effects). [Appendix B, Table 8](#) provides ARV dosing recommendations for patients who have renal or hepatic insufficiency.

Changes Since the Last Revision of the Guidelines

Since the last revision of the Adult and Adolescent Guidelines, there have been several important changes in the Panel’s recommendations for initial therapy in people with HIV. Among these changes, the following deserve particular emphasis:

INSTI-Based Regimens as Initial Antiretroviral Therapy:

- Bictegravir (BIC)/TAF/FTC has been added to the category of Recommended Initial Regimens for Most People with HIV (**AI**). This regimen was added based on data from randomized Phase 3 clinical trials that demonstrated that its efficacy, safety, and tolerability are similar to other regimens that are recommended for most people with HIV—namely, dolutegravir (DTG)/ABC/3TC and DTG plus TAF/FTC.^{4,5}
- EVG/c/TDF/FTC and EVG/c/TAF/FTC (**BI**) have been moved from the category of Recommended Initial Regimens for Most People with HIV to the category of Recommended Initial Regimens in Certain Clinical Situations. This change was made because these combinations include COBI, a pharmacoenhancer that inhibits cytochrome P (CYP) 3A4 and increases the likelihood of drug-drug interactions. EVG also has a lower barrier to resistance than DTG and BIC.
- Clinicians should review Table 6b before prescribing an INSTI to a person of childbearing potential, as preliminary data suggest that there is an increased risk of neural tube defects (NTDs) in infants born to people who were receiving DTG at the time of conception.^{6,7} Until more information is available:
 - A negative pregnancy test result should be documented prior to initiating DTG in antiretroviral therapy (ART)-naïve individuals of childbearing potential.
 - DTG is **not recommended** for those who are pregnant and within 12 weeks post-conception.
 - DTG is **also not recommended** for those of childbearing potential who are planning to become pregnant or who are sexually active and not using effective contraception.
 - For those who are using effective contraception, use of a DTG-based regimen can be considered after discussing the risks and benefits of this drug with the patient.
 - It is not yet known whether other INSTIs pose a similar risk of NTDs (i.e., a class effect). The chemical structure of BIC is similar to that of DTG. As there are no safety data for BIC use around the time of conception, similar considerations should be discussed with those of childbearing potential before using this drug.

NNRTI-Based Regimens as Initial Antiretroviral Therapy:

- The regimen of doravirine (DOR) plus TDF/3TC or TAF/FTC has been added to the category of Recommended Initial Regimens in Certain Clinical Situations. DOR is a new NNRTI that was recently approved for use in ART-naïve individuals when administered with two NRTIs. DOR/TDF/3TC is coformulated as a single-tablet regimen (STR). Clinical trial data have shown that this regimen is noninferior to efavirenz (EFV)- and darunavir/ritonavir (DRV/r)-based regimens.^{8,9} DOR compares

favorably to EFV and DRV/r in terms of side effects. DOR-based therapy has not been directly compared to INSTI-containing combinations for initial therapy. In patients starting their first ART regimen, treatment-emergent resistance to DOR has been observed.

- EFV 400 mg/TDF/3TC and EFV 600 mg/TDF/FTC are now available as generic STRs. In a randomized trial (ENCORE-1), EFV 400 mg/TDF/3TC and EFV 600 mg/TDF/3TC had similar virologic efficacy, though EFV 400 mg/TDF/3TC had fewer side effects. There are insufficient data regarding the use of EFV 400 mg/TDF/3TC in pregnancy or in people receiving rifampin to recommend its use in these situations. See the NNRTI section below for considerations regarding the use of these two single-pill regimens.

Protease Inhibitor-Based Regimens as Initial Antiretroviral Therapy:

- Boosted atazanavir (ATV/c or ATV/r) plus ABC/3TC is no longer included in the list of Recommended Initial Regimens in Certain Clinical Situations because it has disadvantages when compared with other regimens in this category. In a randomized trial, ATV/r plus ABC/3TC was less potent than ATV/r plus TDF/FTC in people with HIV RNA >100,000 copies/mL.¹⁰ In a separate randomized trial, ATV/r was less well tolerated than DRV/r.¹¹

Other Regimens When Abacavir, Tenofovir Alafenamide, or Tenofovir Disoproxil Fumarate Cannot be Used or Are Not Optimal:

- DTG plus 3TC is now recommended by the Panel when ABC, TAF, or TDF cannot be used or are not optimal. This is based on the results of two large Phase 3 randomized clinical trials: DTG plus 3TC was noninferior to DTG plus TDF/FTC in terms of virologic efficacy, and no drug resistance was seen in either treatment group.¹² Longer-term data are needed before this new two-drug regimen is recommended for most people with HIV.
- Other regimens that can be considered are DRV/r plus raltegravir (RAL), as long as a patient's plasma HIV RNA is <100,000 copies/mL and CD4 cell count is >200/mm³, or DRV/r plus 3TC, although the data for this regimen are not as extensive as for other combinations.
- Lopinavir/ritonavir (LPV/r) plus 3TC is no longer recommended because of pill burden and poor tolerability.

Generic Antiretroviral Drugs:

- A growing number of generic ARV medications have been approved by the FDA since the last revision of these guidelines. In some situations, cost and access are among the factors to consider when choosing an ARV regimen (see [Cost Considerations and Antiretroviral Therapy](#)).

Table 6a. Recommended Antiretroviral Regimens for Initial Therapy (page 1 of 2)

Selection of a regimen should be individualized based on virologic efficacy, potential adverse effects, childbearing potential and use of effective contraception, pill burden, dosing frequency, drug-drug interaction potential, comorbid conditions, cost, access, and resistance test results. Drug classes and regimens within each class are arranged first by evidence rating, and, when ratings are equal, in alphabetical order. Table 7 provides ARV recommendations based on specific clinical scenarios.

Recommended Initial Regimens for Most People with HIV
Recommended regimens are those with demonstrated durable virologic efficacy, favorable tolerability and toxicity profiles, and ease of use.
<u>INSTI plus 2 NRTIs:</u> Note: For individuals of childbearing potential, see Table 6b before prescribing one of these regimens. • BIC/TAF/FTC (AI) • DTG/ABC/3TC ^a (AI)—if HLA-B*5701 negative • DTG plus tenofovir ^b /FTC ^a (AI for both TAF/FTC and TDF/FTC) • RAL ^c plus tenofovir ^b /FTC ^a (BI for TDF/FTC, BII for TAF/FTC)
Recommended Initial Regimens in Certain Clinical Situations
These regimens are effective and tolerable but have some disadvantages when compared with the regimens listed above or have less supporting data from randomized clinical trials. However, in certain clinical situations, one of these regimens may be preferred (see Table 7 for examples).
<u>INSTI plus 2 NRTIs:</u> Note: For individuals of childbearing potential, see Table 6b before prescribing one of these regimens. • EVG/c/tenofovir^b/FTC (BI for both TAF/FTC and TDF/FTC) • RAL ^c plus ABC/3TC ^a (CII)—if HLA-B*5701 negative and HIV RNA <100,000 copies/mL
<u>Boosted PI plus 2 NRTIs:</u> (In general, boosted DRV is preferred over boosted ATV) • (DRV/c or DRV/r) plus tenofovir ^b /FTC ^a (AI) • (ATV/c or ATV/r) plus tenofovir ^b /FTC ^a (BI) • (DRV/c or DRV/r) plus ABC/3TC ^a —if HLA-B*5701 negative (BII)
<u>NNRTI plus 2 NRTIs:</u> • DOR/TDF^b/3TC (BI) or DOR plus TAF^b/FTC (BIII) • EFV plus TDF ^b /FTC ^a (BI for EFV 600 mg/TDF/FTC or EFV 600 mg/TDF/3TC, BII for EFV 600 mg plus TAF/FTC) • RPV/tenofovir ^b /FTC ^a (BI)—if HIV RNA <100,000 copies/mL and CD4 cell count >200 cells/mm ³
<u>Regimens to Consider when ABC, TAF, and TDF Cannot be Used or Are Not Optimal:</u> • DTG plus 3TC (BI) • DRV/r plus RAL BID (CI)—if HIV RNA <100,000 copies/mL and CD4 cell count >200 cells/mm ³ • DRV/r once daily plus 3TC^a (CI)
Rating of Recommendations: A = Strong; B = Moderate; C = Optional Rating of Evidence: I = Data from randomized controlled trials; II = Data from well-designed nonrandomized trials, observational cohort studies with long-term clinical outcomes, relative bioavailability/bioequivalence studies, or regimen comparisons from randomized switch studies; III = Expert opinion

Note: The following are available as coformulated drugs: ABC/3TC, ATV/c, **BIC/TAF/FTC, DOR/TDF/3TC, DRV/c, DRV/c/TAF/FTC, DTG/ABC/3TC, EFV 600 mg/TDF/3TC, EFV/TDF/FTC, EVG/c/TAF/FTC, EVG/c/TDF/FTC, RPV/TAF/FTC, RPV/TDF/FTC, TAF/FTC, TDF/3TC, and TDF/FTC.**

^a 3TC may be substituted for FTC, or vice versa. **ABC/3TC, TDF/3TC, TDF/FTC, and TAF/FTC are available as coformulated, two-NRTI tablets, and they are also available as part of various STRs. Cost, access, and availability of STR formulations are among the factors to consider when choosing between 3TC and FTC.**

^b TAF and TDF are two forms of tenofovir approved by the FDA. TAF has fewer bone and kidney toxicities than TDF, while TDF is associated with lower lipid levels. Safety, cost, and access are among the factors to consider when choosing between these drugs.

^c RAL can be given as RAL 400 mg BID or RAL 1200 mg (two, 600-mg tablets) once daily.

Table 6a. Recommended Antiretroviral Regimens for Initial Therapy (page 2 of 2)

Key to Acronyms: 3TC = lamivudine; ABC = abacavir; ART = antiretroviral therapy; ARV = antiretroviral; ATV = atazanavir; ATV/c = atazanavir/cobicistat; ATV/r = atazanavir/ritonavir; **BIC = bictegravir**; BID = twice daily; CD4 = CD4 T lymphocyte; **DOR = doravirine**; DRV = darunavir; DRV/c = darunavir/cobicistat; DRV/r = darunavir/ritonavir; DTG = dolutegravir; EFV = efavirenz; EVG = elvitegravir; EVG/c = elvitegravir/cobicistat; FDA = Food and Drug Administration; FTC = emtricitabine; HLA = human leukocyte antigen; INSTI = integrase strand transfer inhibitor; NNRTI = non-nucleoside reverse transcriptase inhibitor; NRTI = nucleoside reverse transcriptase inhibitor; PI = protease inhibitor; RAL = raltegravir; RPV = rilpivirine; **STR = single-tablet regimen**; TAF = tenofovir alafenamide; TDF = tenofovir disoproxil fumarate

Table 6b. Considerations Before Initiating Dolutegravir and Other Integrase Strand Transfer Inhibitors as Initial Therapy

Pregnancy testing should be performed in those of childbearing potential prior to initiation of ART (**AIII**). Preliminary data suggest that there is an increased risk of NTDs in infants born to women who were receiving DTG at the time of conception.^{6,7}

Before Initiating DTG:

- Providers and people of childbearing potential should discuss the benefits and risks of using DTG, including the possible risk of NTDs; appropriate counseling should be provided so that the individual can make an informed decision about the use of this drug (**AIII**).
- DTG should not be prescribed for individuals:
 - Who are pregnant and within 12 weeks post-conception (**AII**); or
 - Who are of childbearing potential and planning to become pregnant (**AII**); or
 - Who are of childbearing potential, sexually active, and not using effective contraception (**AIII**).
- For those who are using effective contraception, a DTG-based regimen can be considered after weighing the risks and benefits of DTG use with the individual (**BIII**).
- It is not yet known whether other INSTIs pose a similar risk of NTDs (i.e., a class effect).
- The chemical structure of BIC is similar to DTG. There are no safety data on the use of BIC around the time of conception. For those who are of childbearing potential, but who are not pregnant, an approach similar to that outlined for DTG should be discussed before considering the use of BIC-containing ART (**AIII**).
- In a person who is pregnant, BIC is **not recommended** because of insufficient safety data (**AIII**).
- In a person who is pregnant, EVG/c is **also not recommended** because low EVG concentrations have been reported when this drug is given during the second and third trimesters (**AII**).¹³
- Among those who received RAL during pregnancy, the rate of fetal malformations is within the expected range for pregnancy outcomes in the United States; however, data on RAL use during the first trimester is limited to fewer than 300 deliveries. As it is currently not known whether the association between DTG and NTDs represents a class effect, this potential risk should be discussed with people of childbearing potential who prefer an INSTI-containing regimen.

Rating of Recommendations: A = Strong; B = Moderate; C = Optional

Rating of Evidence: I = Data from randomized controlled trials; II = Data from well-designed nonrandomized trials, observational cohort studies with long-term clinical outcomes, relative bioavailability/bioequivalence studies, or regimen comparisons from randomized switch studies; III = Expert opinion

Key to Acronyms: ART = antiretroviral therapy; BIC = bictegravir; DTG = dolutegravir; EVG/c = elvitegravir/cobicistat; INSTI = integrase strand transfer inhibitor; NTD = neural tube defect; RAL = raltegravir

Selecting an Initial Antiretroviral Regimen

For most patients, initial therapy should be with two NRTIs combined with an INSTI; in some individuals, a combination of an NNRTI or RTV- or COBI-boosted PI should be considered (see below).

Choosing Between an INSTI-, PI-, or NNRTI-Based Regimen

The choice between an INSTI, PI, or NNRTI as the third drug in an initial ARV regimen should be guided by the regimen's efficacy, barrier to resistance, adverse effects profile, convenience, comorbidities, concomitant

medications, and the potential for drug-drug interactions (see Tables 7 and 9 for guidance). The Panel's Recommended Initial Regimens for Most People with HIV as listed in Table 6a include **one of three INSTIs (BIC, DTG, or RAL)** plus two NRTIs. For most patients, these INSTI-containing regimens will be highly effective and have relatively infrequent adverse effects and few drug interactions. In several head-to-head comparisons between boosted PI-containing regimens and INSTI-containing regimens, the INSTI was better tolerated and caused fewer treatment discontinuations.^{11,14,15}

Among the INSTI-based regimens, RAL-containing regimens have the longest clinical experience, and they have been shown to have durable virologic efficacy. However, these regimens have a higher pill burden than BIC- and DTG-containing regimens. RAL also has a lower barrier to resistance than BIC and DTG. In clinical trials of ART-naïve patients who were receiving BIC- or DTG-based therapy, resistance has not been seen in patients experiencing virologic failure, and transmitted resistance is rare. Because of its high barrier to resistance, DTG may be considered for patients who must start ART before resistance test results are available (e.g., during acute HIV infection, and in the setting of certain opportunistic infections). **BIC may also be effective in this setting, but there is less clinical experience with it than with DTG. BIC-based regimens have been shown to be noninferior to DTG-based regimens in clinical trials.^{4,5} DTG is not recommended as initial therapy in those who are pregnant and within 12 weeks post-conception, or in those of childbearing potential who are planning to become pregnant or who are sexually active and not using effective contraception. The safety of BIC use in individuals of childbearing potential who desire pregnancy is unknown.**

In the category of Recommended Initial Regimens in Certain Clinical Situations, EVG-based regimens have the advantage of being available as STRs. However, these regimens have the potential disadvantages of a lower barrier to resistance than DTG or BIC and, importantly, a greater potential for drug interactions because EVG is combined with COBI, a strong CYP3A4 inhibitor. PK-enhanced, PI-based regimens are also effective in ART-naïve patients, but, like EVG/c-based regimens, they also carry the same disadvantage of increased drug interaction potential. For those individuals in whom ART needs to begin urgently before resistance test results are available, boosted DRV may be an appropriate choice, as there is a low rate of transmitted PI resistance, it has a high barrier to resistance, and there is a low rate of treatment-emergent resistance. **DRV/c/TAF/FTC is now available as an STR.** Boosted atazanavir has relatively few metabolic adverse effects in comparison to other boosted-PI regimens; however, in a randomized clinical trial, ATV/r had a higher rate of adverse effect-associated drug discontinuation than DRV/r or RAL.¹¹ In a substudy of this trial, and in a separate cohort study, ATV/r use was associated with slower progression of atherosclerosis, as measured by carotid artery intima medial thickness.^{16,17} Large observational cohorts found an association between some PIs (DRV/r, fosamprenavir [FPV], indinavir [IDV], and lopinavir/ritonavir [LPV/r]) and an increased risk of cardiovascular events, while this association was not seen with ATV.¹⁸⁻²³ Further study is needed.

NNRTI-based regimens (which include **DOR**, EFV, or rilpivirine [RPV]) may be optimal choices for some patients, although these drugs, especially EFV and RPV, have low barriers to resistance. **The emergence of resistance at the time of virologic failure has been reported with DOR.** EFV has a long track record of widespread use and is considered safe in persons of childbearing potential, and its minimal PK interaction with rifamycins makes it an attractive option for patients who require concomitant treatment for tuberculosis (TB). Most EFV-based regimens have excellent virologic efficacy, including in patients with high HIV RNA (except when EFV is used with ABC/3TC); however, the relatively high rate of central nervous system (CNS)-related side effects reduces the tolerability of EFV-based regimens. RPV has fewer adverse effects than EFV, is available as one of the smallest tablet sizes among STRs, and has a favorable lipid profile. However, RPV has lower virologic efficacy in patients with high baseline HIV RNA levels (>100,000 copies/mL) and low CD4 counts (<200 cells/mm³). **DOR is now approved for use in ART-naïve individuals with HIV. It is available both as a single-drug pill to be used with two NRTIs and as part of an STR that also includes TDF/3TC. Both formulations are taken once daily without regard to food. In randomized trials, DOR was noninferior to both EFV and to DRV/r when either of these drugs were taken in combination with two NRTIs. DOR has CNS tolerability advantages over EFV and favorable lipid effects when compared**

with both DRV/r and EFV. It also has fewer potential drug interactions than EFV or RPV, and, unlike RPV, virologic effects are not compromised in those with high HIV RNA levels and low CD4 cell counts.

In those patients who cannot safely be prescribed a combination regimen that contains two NRTIs, there are now several two-drug treatment options. DTG plus 3TC is an option when ABC, TAF, and TDF cannot be used or are not optimal. Two randomized trials that collectively enrolled >1,400 participants with baseline HIV RNA levels <500,000 copies/mL compared DTG plus 3TC to a three-drug regimen of DTG plus TDF/FTC. At week 48, DTG plus 3TC was noninferior to DTG plus TDF/FTC in terms of virologic efficacy. No treatment-emergent resistance was seen in either group.¹² Another option that can be considered is the combination of DRV/r (once daily) plus RAL (twice daily), but this combination can only be used in those with baseline CD4 cell counts >200 cells/mm³ and HIV RNA levels <100,000 copies/mL.²⁴ A small, randomized trial indicated that once-daily DRV/r plus 3TC had similar efficacy to DRV/r plus TDF/3TC, although this study has yet to be published.²⁵

Factors to Consider When Selecting an Initial Regimen

When selecting a regimen for an individual person with HIV, a number of patient- and regimen-specific characteristics should be considered. The goal is to provide a potent, safe, tolerable, and easy-to-adhere-to regimen for the patient in order to achieve sustained virologic control. Some of the factors to consider during regimen selection can be grouped into the categories listed below. Table 7 includes recommendations for regimens to use in specific clinical scenarios.

Initial Characteristics to Consider in All Persons with HIV:

- Pretreatment HIV RNA level (viral load)
- Pretreatment CD4 count
- HIV genotypic drug resistance test results. Based on current rates of transmitted drug resistance to different ARV medications, standard genotypic drug-resistance testing in ARV-naïve persons should focus on testing for mutations in the reverse transcriptase (RT) and protease (PR) genes. If transmitted INSTI resistance is a concern, providers should consider also testing for resistance mutations to this class of drugs.
- HLA-B*5701 status. Those who are positive should not receive ABC.
- Individual preferences
- Anticipated adherence to the regimen

Specific Comorbidities or Other Conditions:

- Cardiovascular disease, hyperlipidemia, renal disease, liver disease, osteopenia/osteoporosis or conditions associated with bone mineral density (BMD) loss, psychiatric illness, neurologic disease, drug abuse or dependency requiring narcotic replacement therapy
- Pregnancy or those with the potential to become pregnant. Clinicians should refer to [Table 6b and the latest Perinatal Guidelines](#) for more detailed recommendations on the safety and effectiveness of ARV drugs during [conception and](#) throughout pregnancy.
- Coinfections: hepatitis B virus (HBV), hepatitis C virus (HCV), TB

Regimen-Specific Considerations:

- Regimen's barrier to resistance
- Potential adverse effects
- Known or potential drug interactions with other medications (see [Drug-Drug Interactions](#))
- Convenience (e.g., pill burden, dosing frequency, availability of fixed-dose combination (FDC) formulations, food requirements)
- Cost [and access](#) (see [Cost Considerations and Antiretroviral Therapy](#))

Table 7. Antiretroviral Regimen Considerations for Initial Therapy Based on Specific Clinical Scenarios
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This table provides guidance to clinicians in choosing an initial ARV regimen according to various patient and regimen characteristics and specific clinical scenarios. When more than one scenario applies to a person with HIV, clinicians should review considerations for each relevant scenario and use their clinical judgment to select the most appropriate regimen. This table is intended to guide the initial choice of regimen. However, if a person is doing well on a particular regimen, it is not necessary to switch to another regimen based on the scenarios outlined in this table. Please see Table 9 for additional information regarding the advantages and disadvantages of particular ARV medications.

Note: Preliminary data suggest that there may be an increased risk of NTDs in infants born to those who were receiving DTG at the time of conception.^{6,7} Until more information is available, clinicians should review Table 6b for further guidance before prescribing an INSTI to a person of childbearing potential.

Patient or Regimen Characteristics	Clinical Scenario	Consideration(s)	Rationale/Comments
Pre-ART Characteristics	CD4 cell count <200 cells/mm ³	Do Not Use the Following Regimens: • RPV-based regimens • DRV/r plus RAL	A higher rate of virologic failure has been observed in those with low pretreatment CD4 cell counts.
	HIV RNA >100,000 copies/mL	Do Not Use the Following Regimens: • RPV-based regimens • ABC/3TC with EFV or ATV/r • DRV/r plus RAL	Higher rates of virologic failure have been observed in those with high pretreatment HIV RNA levels.
	HLA-B*5701 positive or result unknown	Do not use ABC-containing regimens.	ABC hypersensitivity, a potentially fatal reaction, is highly associated with the presence of the HLA-B*5701 allele.
	ARV should be started before HIV drug resistance results are available (e.g., in a person with acute HIV) or when rapid initiation of ART is warranted	Avoid NNRTI-based regimens. Avoid ABC. <u>Recommended ART Regimens:</u> • (DRV/r or DRV/c) plus tenofovir ^a /FTC • DTG plus tenofovir ^a /FTC	Transmitted mutations conferring NNRTI resistance are more likely than mutations associated with PI or INSTI resistance. HLA-B*5701 results may not be available rapidly. Transmitted resistance to DRV and DTG is rare, and these drugs have high barriers to resistance. Refer to Table 6b for further guidance before initiating DTG in persons of childbearing potential.
ART-Specific Characteristics	A 1-pill, once-daily regimen is desired	<u>STR Options as Initial ART Include:</u> • BIC/TAF/FTC • DOR/TDF/3TC • DRV/c/TAF/FTC • DTG/ABC/3TC • EFV/TDF/FTC • EFV/TDF/3TC • EVG/c/TAF/FTC • EVG/c/TDF/FTC • RPV/TAF/FTC • RPV/TDF/FTC	Do not use RPV-based regimens if HIV RNA is >100,000 copies/mL and CD4 cell count is <200/mm ³ . Do not use DTG/ABC/3TC if patient is HLA-B*5701 positive. Refer to Table 6b for further guidance before initiating an INSTI in persons of childbearing potential. See Appendix B, Table 8 for ARV dose recommendations in the setting of renal impairment.
	Food effects	<u>Regimens that Can be Taken Without Regard to Food:</u> • BIC- , DOR- , DTG-, or RAL-based regimens	Oral bioavailability of these regimens is not significantly affected by food. Refer to Table 6b for further guidance before initiating an INSTI in persons of childbearing potential.

Table 7. Antiretroviral Regimen Considerations for Initial Therapy Based on Specific Clinical Scenarios (page 2 of 4)

Patient or Regimen Characteristics	Clinical Scenario	Consideration(s)	Rationale/Comments
ART-Specific Characteristics, continued	Food effects, continued	<u>Regimens that Should be Taken with Food:</u> <ul style="list-style-type: none"> • ATV/r- or ATV/c-based regimens • DRV/r- or DRV/c-based regimens • EVG/c/TAF/FTC^a • EVG/c/TDF/FTC^a • RPV-based regimens 	Food improves absorption of these regimens. RPV-containing regimens should be taken with at least 390 calories of food.
		<u>Regimens that Should be Taken on an Empty Stomach:</u> <ul style="list-style-type: none"> • EFV-based regimens 	Food increases EFV absorption and may increase CNS side effects.
Presence of Other Conditions	Chronic kidney disease (defined as CrCl <60 mL/min)	<p>Avoid TDF unless the patient has ESRD. Use ABC or TAF.</p> <p>ABC may be used if patient is HLA-B*5701 negative. If HIV RNA >100,000 copies/mL, do not use ABC/3TC plus (EFV or ATV/r).</p> <p>TAF may be used if CrCl >30 mL/min.</p> <p>Consider avoiding ATV.</p> <p><u>ART Options When ABC, TAF or TDF Cannot be Used:</u></p> <ul style="list-style-type: none"> • DTG plus 3TC • DRV/r plus 3TC • DRV/r plus RAL (if CD4 cell count >200 cells/mm³ and HIV RNA <100,000 copies/mL) 	<p>TDF has been associated with proximal renal tubulopathy. Higher rates of renal dysfunction have been reported in patients using TDF in conjunction with RTV-containing regimens.</p> <p>An adjusted dose of TDF can be used in patients with ESRD or in those who are on hemodialysis. Refer to Appendix B, Table 8 for specific dosing recommendations.</p> <p>TAF has less impact on renal function and lower rates of proteinuria than TDF.</p> <p>ATV has been associated with chronic kidney disease in some observational studies.</p> <p>ABC has not been associated with renal dysfunction.</p> <p>Refer to Table 6b for further guidance before initiating an INSTI in persons of childbearing potential.</p>
	Liver disease with cirrhosis	Some ARVs are contraindicated or may require dosage modification in patients with Child-Pugh class B or C disease.	<p>Refer to Appendix B, Table 8 for specific dosing recommendations.</p> <p>Patients with cirrhosis should be carefully evaluated by an expert in advanced liver disease.</p>
	Osteoporosis	<p>Avoid TDF.</p> <p>Use ABC or TAF.</p> <p>ABC may be used if patient is HLA-B*5701 negative. If HIV RNA >100,000 copies/mL, do not use ABC/3TC plus (EFV or ATV/r).</p>	TDF is associated with decreases in BMD along with renal tubulopathy, urine phosphate wasting, and resultant osteomalacia. TAF and ABC are associated with smaller declines in BMD than TDF.
	Psychiatric illnesses	<p>Consider avoiding EFV- and RPV-based regimens.</p> <p>Patients on INSTI-based regimens who have pre-existing psychiatric conditions should be closely monitored.</p> <p>Some ARVs are contraindicated and some psychiatric medications need dose adjustments when coadministered with certain ARVs.</p>	<p>EFV and RPV can exacerbate psychiatric symptoms and may be associated with suicidality.</p> <p>INSTIs have been associated with adverse neuropsychiatric effects in some retrospective cohort studies and case series.</p> <p>See the drug-drug interaction tables (Tables 19a, 19b, and 19d) for dosing recommendations when drugs used for psychiatric illnesses are used with certain ARVs.</p>

Table 7. Antiretroviral Regimen Considerations for Initial Therapy Based on Specific Clinical Scenarios (page 3 of 4)

Patient or Regimen Characteristics	Clinical Scenario	Consideration(s)	Rationale/Comments
Presence of Other Conditions, continued	HAD	<p>Avoid EFV-based regimens if possible.</p> <p>Favor DTG- or DRV-based regimens.</p>	<p>EFV-related neuropsychiatric effects may confound assessment of ART's beneficial effects on improvement of HAD-related symptoms.</p> <p>There is a theoretical CNS penetration advantage of DTG- or DRV-based regimens.</p>
	Medication-assisted treatment for opioid dependence	<p>Opioid withdrawal may occur when EFV is initiated in patients who are on a stable dose of methadone.</p> <p>Clinical monitoring is recommended, as medications used to treat opioid dependence may need to be adjusted in some patients.</p>	<p>EFV reduces methadone concentrations and may lead to withdrawal symptoms.</p> <p>See the drug-drug interaction tables (Tables 19a, 19b, and 19d) for dosing recommendations.</p>
	High cardiac risk	<p>Consider avoiding ABC- and LPV/r -based regimens.</p> <p>If a boosted PI is the desired option, an ATV-based regimen may have advantages over a DRV-based regimen.</p> <p>BIC-, DOR-, DTG-, RAL-, or RPV-based regimens may be considered for those with high cardiac risk.</p>	<p>An increased CV risk with ABC has been observed in some studies.</p> <p>Observational cohort studies reported an association between some PIs (DRV, IDV, FPV, and LPV/r) and an increased risk of CV events; this risk has not been seen with ATV (see text). Further study is needed.</p> <p>BIC-, DOR-, DTG-, RAL- or RPV-based regimens have more favorable lipid profiles than other regimens, although evidence on whether this improves CV outcomes is lacking.</p> <p>Refer to Table 6b for further guidance before initiating an INSTI in persons of childbearing potential.</p>
	Cardiac QTc interval prolongation	<p>Consider avoiding EFV- or RPV-based regimens if patient is taking other medications with known risk of Torsades de Pointes, or in patients at higher risk of Torsades de Pointes.</p>	<p>High EFV or RPV concentrations may cause QT prolongation.</p>
	Hyperlipidemia	<p><u>The Following ARV Drugs Have Been Associated with Dyslipidemia:</u></p> <ul style="list-style-type: none"> • PI/r or PI/c • EFV • EVG/c <p>BIC, DOR, DTG, RAL, and RPV have fewer lipid effects.</p>	<p>TDF has been associated with lower lipid levels than ABC or TAF.</p> <p>Refer to Table 6b for further guidance before initiating an INSTI in persons of childbearing potential.</p>
	Patients with history of poor adherence to non-ARV medications or inconsistent engagement in care	<p>Consider using regimens with a boosted PI or DTG.</p> <p>BIC also has a high barrier to resistance, but there is currently no data on its efficacy in this population.</p>	<p>These regimens have a high genetic barrier to resistance.</p> <p>Refer to Table 6b for further guidance before initiating an INSTI in persons of childbearing potential.</p>

Table 7. Antiretroviral Regimen Considerations for Initial Therapy Based on Specific Clinical Scenarios (page 4 of 4)

Patient or Regimen Characteristics	Clinical Scenario	Consideration(s)	Rationale/Comments
Presence of Other Conditions, continued	Pregnancy	<p>Until more information is available, do not initiate a DTG-based regimen for those who are pregnant and within 12 weeks post-conception, because preliminary data suggest that there is an increased risk of NTDs in infants born to those who were receiving DTG at the time of conception.^{6,7}</p> <p>Refer to Table 6b and the Perinatal Guidelines for further guidance on ARV use during pregnancy.</p>	
	Patients of childbearing potential who are planning to become pregnant or who are sexually active and not using effective contraception	<p>Until more information is available, do not initiate a DTG-based regimen in these patients, because preliminary data suggest that there is an increased risk of NTDs in infants born to those who were receiving DTG at the time of conception.^{6,7}</p> <p>Refer to Table 6b for further guidance before initiating an INSTI.</p>	
Presence of Coinfections	HBV infection	<p>Use TDF or TAF, with FTC or 3TC, whenever possible.</p> <p>If TDF and TAF Are Contraindicated:</p> <ul style="list-style-type: none"> For treatment of HBV, use FTC or 3TC with entecavir and a suppressive ART regimen (see HBV/HIV Coinfection). 	TDF, TAF, FTC, and 3TC are active against both HIV and HBV. 3TC- or FTC-associated HBV mutations can emerge rapidly when these drugs are used without another drug that is active against HBV.
	HCV treatment required	Refer to recommendations in HCV/HIV Coinfection , with special attention to potential interactions between ARV drugs and HCV drugs.	
	Treating TB disease with rifamycins	<p>TAF and BIC are not recommended with any rifamycin-containing regimen.</p> <p>If Rifampin is Used:</p> <ul style="list-style-type: none"> The following are not recommended: PI/c or PI/r, BIC, EVG, DOR, RPV, or TAF. EFV can be used without dose adjustment. If RAL is used, increase RAL dose to 800 mg BID. Do not use once-daily RAL. Use DTG at 50 mg BID dose only in patients without selected INSTI mutations (refer to product label). 	<p>Rifamycins may significantly reduce TAF and BIC exposures.</p> <p>Rifampin is a strong inducer of CYP3A4 and UGT1A1 enzymes, causing significant decreases in concentrations of PIs, INSTIs, DOR, and RPV.</p> <p>Rifampin has a less significant effect on EFV concentration than on the concentrations of other NNRTIs, PIs, and INSTIs.</p> <p>Refer to Table 6b for further guidance before initiating an INSTI in persons of childbearing potential.</p> <p>See the drug-drug interaction tables (Tables 19a, 19b, 19c, 19d and 19e) and TB/HIV Coinfection for information on ARV use with rifamycins.</p>

^a TAF and TDF are two approved forms of tenofovir. TAF has fewer bone and kidney toxicities than TDF, whereas TDF is associated with lower lipid levels. Safety, cost, and access are among the factors to consider when choosing between these drugs.

Key to Acronyms: 3TC = lamivudine; ABC = abacavir; ART = antiretroviral therapy; ARV = antiretroviral; ATV = atazanavir; ATV/c = atazanavir/cobicistat; ATV/r = atazanavir/ritonavir; **BIC= bictegravir**; BID = twice daily; BMD = bone mineral density; COBI = cobicistat; CD4 = CD4 T lymphocyte; CNS = central nervous system; CrCl = creatinine clearance; CV = cardiovascular; CYP = cytochrome P; **DOR = doravirine**; DRV = darunavir; DRV/c = darunavir/cobicistat; DRV/r = darunavir/ritonavir; DTG = dolutegravir; EFV = efavirenz; ESRD = end stage renal disease; EVG = elvitegravir; EVG/c = elvitegravir/cobicistat; FPV = fosamprenavir; FTC = emtricitabine; HAD = HIV-associated dementia; HBV = hepatitis B virus; HCV = hepatitis C virus; HLA = human leukocyte antigen; IDV = indinavir; INSTI = integrase strand transfer inhibitor; LPV = lopinavir; LPV/r = lopinavir/ritonavir; NNRTI = non-nucleoside reverse transcriptase inhibitor; **NTD = neural tube defect**; PI = protease inhibitor; PI/c = cobicistat-boosted protease inhibitor; PI/r = ritonavir-boosted protease inhibitor RAL = raltegravir; RPV = rilpivirine; RTV = ritonavir; STR = single-tablet regimen; TAF = tenofovir alafenamide; TB = tuberculosis; TDF = tenofovir disoproxil fumarate; UGT = uridine diphosphate glucuronosyltransferase

Characteristics of Antiretroviral Drugs Recommended for Initial Therapy

The following sections provide detailed information regarding the characteristics, clinical trial results, adverse effects profile, and the Panel's recommendations for ARV drugs that are recommended as initial therapy for persons with HIV.

Dual-Nucleoside Reverse Transcriptase Inhibitor Options as Part of Initial Combination Therapy

Table 8a. Characteristics of Dual-Nucleoside Reverse Transcriptase Inhibitor Options Recommended for Antiretroviral Therapy-Naïve Patients

	ABC/3TC	TAF/FTC	TDF/FTC	TDF/3TC
Dosing Frequency	Once daily	Once daily	Once daily	Once daily
Available Coformulations for ART-Naïve Patients	<ul style="list-style-type: none"> • ABC/3TC • DTG/ABC/3TC 	<ul style="list-style-type: none"> • TAF 25 mg/FTC • BIC/TAF 25 mg/FTC • DRV/c/TAF 10 mg/FTC • EVG/c/TAF 10 mg/FTC • RPV/TAF 25 mg/FTC 	<ul style="list-style-type: none"> • TDF/FTC • EFV/TDF/FTC • EVG/c/TDF/FTC • RPV/TDF/FTC 	<ul style="list-style-type: none"> • TDF/3TC • DOR/TDF/3TC • EFV 600 mg/TDF/3TC • EFV 400 mg/TDF/3TC
Adverse Effects	<p><u>ABC:</u></p> <ul style="list-style-type: none"> • HSR to ABC is associated with the presence of HLA-B*5701 allele • Increase in CV events is associated with ABC use in some, but not all, cohort studies 	<p><u>TAF:</u></p> <ul style="list-style-type: none"> • Renal insufficiency, proximal renal tubulopathy (less frequent than with TDF) • Decrease in BMD (less than with TDF; similar to ABC) 	<p><u>TDF:</u></p> <ul style="list-style-type: none"> • Renal insufficiency, proximal renal tubulopathy • Decrease in BMD • Renal and bone toxicity are exacerbated by pharmacologic boosters 	<p><u>TDF:</u></p> <ul style="list-style-type: none"> • Renal insufficiency, proximal renal tubulopathy • Decrease in BMD • Renal and bone toxicity are exacerbated by pharmacologic boosters
		<u>FTC:</u> Nail pigmentation		<u>3TC:</u> No significant adverse effects
Other Considerations	<ul style="list-style-type: none"> • Perform HLA-B*5701 testing before initiating ABC; if result is positive, do not start ABC and add ABC to allergy list • If HIV RNA >100,000 copies/mL, use only with DTG 	<p>Also used for HBV treatment. Discontinuation may precipitate flare of HBV.</p> <p>See Appendix B, Table 8 for dose recommendations in patients with renal insufficiency.</p>		

Key to Acronyms: 3TC = lamivudine; ABC = abacavir; ART = antiretroviral therapy; BIC= bictegravir; BMD = bone mineral density; CV = cardiovascular; DOR = doravirine; DRV = darunavir; DRV/c = darunavir/cobicistat; DTG = dolutegravir; EFV = efavirenz; EVG = elvitegravir; EVG/c = elvitegravir/cobicistat; FTC = emtricitabine; HBV = hepatitis B virus; HLA = human leukocyte antigen; HSR = hypersensitivity reaction; NRTI = nucleoside reverse transcriptase inhibitor; PI = protease inhibitor; RPV = rilpivirine; STR = single-tablet regimen; TAF = tenofovir alafenamide; TDF = tenofovir disoproxil fumarate

Summary

FDA-approved NRTIs include zidovudine (ZDV), stavudine (d4T), didanosine (ddI), ABC, TDF, TAF, 3TC, and FTC. Older NRTIs (ZDV, d4T, ddI) are no longer recommended for use in clinical practice in the United States due to high rates of serious toxicities, including bone marrow suppression from ZDV use. Other toxicities that mainly occur due to mitochondrial toxicity may lead to myopathy, peripheral neuropathy, hepatic steatosis, lactic acidosis, and lipoatrophy. The incidence of these complications is much lower with 3TC, FTC, ABC, TDF, and TAF than with older NRTIs.^{26,27}

ABC/3TC, TAF/FTC, TDF/3TC, and TDF/FTC are NRTI combinations that are recommended for use as components of initial therapy. Table 6a provides recommendations and ratings for the individual regimens. These recommendations are based on the virologic potency and durability, short- and long-term toxicity, and dosing convenience of these drugs. TAF and TDF are two approved forms of tenofovir. TDF has been associated with bone and kidney toxicities, especially when used with a pharmacologic booster.²⁸ TAF is less likely to cause kidney and bone toxicities than TDF. TDF is associated with lower lipid levels than TAF. Safety, cost, and access are among the factors to consider when choosing between these drugs. ABC/3TC and TDF/3TC are available as generic formulations.

Clinical Trials Comparing Nucleoside Reverse Transcriptase Inhibitors

Abacavir/Lamivudine Compared to Tenofovir Disoproxil Fumarate/Emtricitabine

Several randomized controlled trials in ART-naive participants compared ABC/3TC to TDF/FTC, each administered in combination with a third ARV drug^{10,29,30} (see also the discussion in the DTG section).³¹

- The ACTG 5202 study, a randomized controlled trial in >1,800 participants, evaluated the efficacy and safety of ABC/3TC and TDF/FTC when each was used in combination with either EFV or ATV/r. In patients with baseline HIV RNA $\geq 100,000$ copies/mL, there was a significantly shorter time to virologic failure with ABC/3TC than with TDF/FTC regardless of whether the third active drug was EFV or ATV/r.¹⁰ In the HEAT study, 688 participants received ABC/3TC or TDF/FTC in combination with once-daily LPV/r. Virologic efficacy was similar in the two study arms, including in a subgroup with HIV RNA $\geq 100,000$ copies/mL.³⁰
- The ASSERT study compared open-label ABC/3TC with TDF/FTC in 385 HLA-B*5701–negative, ART-naive patients; all participants also received EFV. The primary study endpoint was renal safety of the regimens. At week 48, the proportion of participants with HIV RNA < 50 copies/mL was lower among ABC/3TC-treated participants than among TDF/FTC-treated participants.²⁹

Tenofovir Alafenamide Compared to Tenofovir Disoproxil Fumarate

- Two randomized double-blind Phase 3 clinical trials compared the safety and efficacy of EVG/c/TDF/FTC and EVG/c/TAF/FTC in 1,733 ART-naive adults with estimated glomerular filtration rate (eGFR) ≥ 50 mL/min.
 - TAF/FTC was virologically noninferior to TDF/FTC at week 48 (92% vs. 90% of participants achieved plasma HIV RNA < 50 copies/mL, respectively),³² but TAF/FTC was superior to TDF/FTC at week 144 (84.2% vs. 80%), largely driven by a higher rate of treatment discontinuation in the TDF arm.³³
 - Participants in the TAF arm had significantly smaller reductions in BMD at the spine and hip than those in the TDF arm through 144 weeks.³³ They also had less pronounced changes in eGFR and renal biomarkers and fewer clinically significant renal events through week 96.³⁴ Conversely, levels of fasting low-density lipoprotein (LDL) cholesterol, high-density lipoprotein (HDL) cholesterol, and triglycerides increased more in the TAF group than in the TDF group at 96 weeks, with no change in total cholesterol to HDL ratio.³⁵

- Two randomized studies have compared the safety and efficacy of TAF/FTC to TDF/FTC each administered in combination with boosted DRV in ART-naive subjects:
 - A Phase 2 study of coformulated DRV/c plus TAF/FTC versus DRV/c plus TDF/FTC demonstrated similar virologic suppression rates in both arms (75% vs. 74%) in treatment-naive patients.³⁶ In the TAF arm, fewer participants developed proteinuria. Changes in BMD were also less pronounced among these participants.
 - The AMBER study randomized ART-naive participants to receive either coformulated DRV/c/TAF/FTC or DRV/c plus TDF/FTC. At 48 weeks, HIV RNA <50 copies/mL was achieved in 91% of the DRV/c/TAF/FTC participants versus 88% of the DRV/c plus TDF/FTC participants. Participants in the TAF/FTC arm showed less decline in hip and spine BMD and eGFR than participants in the TDF/FTC arm.³⁷
 - One analysis evaluated data from 11 randomized trials that compared the virologic efficacy, frequency of renal events, and bone density changes associated with the use of TDF or TAF when either drug was taken with or without PK boosters (RTV or COBI). There were no significant differences between unboosted TDF and TAF in terms of virologic efficacy or in the number of participants who discontinued treatment due to renal or bone adverse events or fractures. However, bone- and renal-related toxicities were more pronounced when TDF was used in combination with RTV or COBI.²⁸
- To assess the ability of TAF to maintain HIV and HBV suppression, 72 patients with HIV/HBV coinfection who had HIV RNA <50 copies/mL and HBV DNA <9 log₁₀ IU/mL on a stable regimen were switched to EVG/c/TAF/FTC.³⁸ In this study, 96% of participants were on a TDF/FTC-containing regimen prior to the switch. Key results of the study showed that:
 - Those who switched to EVG/c/TAF/FTC maintained HIV suppression: 94.4% and 91.7% of participants at 24 and 48 weeks, respectively. At 24 and 48 weeks, 86.1% and 91.7% of participants had HBV DNA <29 log₁₀ IU/mL.
 - Decreases in markers of proximal tubular proteinuria and biomarkers of bone turnover were seen in those who switched to EVG/c/TAF/FTC.³⁸

Dual-Nucleoside Reverse Transcriptase Inhibitor Choices (In alphabetical order)

Abacavir/Lamivudine (ABC/3TC)

ABC plus 3TC has been studied in combination with EFV, several PIs, and DTG in ART-naive patients.^{31,39-41}

Adverse Effects

Hypersensitivity Reactions:

- Clinically suspected hypersensitivity reactions (HSRs) were observed in 5% to 8% of individuals who started ABC in clinical trials conducted before the use of HLA-B*5701 testing. The risk of HSRs is highly associated with the presence of the HLA-B*5701 allele; approximately 50% of HLA-B*5701-positive patients will have an ABC-related HSR if given this drug.^{42,43} HLA-B*5701 testing should be done if the use of ABC is being considered. In a patient who tests positive for HLA-B*5701, ABC should not be given and ABC hypersensitivity should be noted on the allergy list. Patients who are HLA-B*5701 negative are far less likely to experience an HSR, but they should be counseled about the symptoms of the reaction. Patients who discontinue ABC because of a suspected HSR should never be rechallenged, regardless of their HLA-B*5701 status.

Cardiovascular Risk:

- An association between ABC use and myocardial infarction (MI) was first reported in the D:A:D study. This large, multinational, observational study group found that recent (i.e., within 6 months) or current use of ABC was associated with an increased risk of MI, particularly in participants with pre-existing cardiac risk factors.^{19,44}

- Since the D:A:D report, several studies have evaluated the relationship between ABC therapy and cardiovascular events. Some studies have found an association⁴⁵⁻⁵¹ Others, including an FDA meta-analysis of 26 randomized clinical trials that evaluated ABC, have not.^{18,52-55}
- An analysis of data from NA-ACCORD found that use of ABC in the previous 6 months was associated with an increased risk of both type 1 and type 2 MIs after adjusting for cardiovascular disease risk factors.⁵⁶
- No consensus has been reached on the association between ABC use and MI risk or the mechanism for such an association.

Other Factors and Considerations:

- ABC/3TC is available as a coformulated tablet and as a coformulated STR with DTG.
- ABC and 3TC are available separately and as a coformulated tablet in generic tablet formulations.
- ABC does not cause renal dysfunction and can be used instead of TDF in patients with underlying renal dysfunction or in those who are at high risk for renal effects. No dose adjustment is required in patients with renal dysfunction.

The Panel's Recommendations:

- ABC should only be prescribed for patients who are HLA-B*5701 negative.
- On the basis of clinical trial safety and efficacy data, experience in clinical practice, and the availability of DTG/ABC/3TC as an FDC, the Panel classifies DTG/ABC/3TC as a Recommended Initial Regimen for Most People with HIV (**AI**) (see the discussion of DTG in this section regarding the clinical efficacy data for ABC/3TC plus DTG).
- ABC/3TC use with EFV, ATV/r, ATV/c, DRV/c, DRV/r, or RAL is only recommended for patients with pretreatment HIV RNA levels <100,000 copies/mL. See Table 6a for more detailed recommendations on the use of ABC/3TC with these drugs.
- ABC should be used with caution or avoided in patients with known high cardiovascular risk.

Tenofovir Alafenamide/Emtricitabine (TAF/FTC)

TAF, an oral prodrug of tenofovir (TFV), is hydrolyzed to TFV in plasma and then converted to TFV-diphosphate (TFV-DP) intracellularly, where it exerts its activity as an NRTI. Unlike TDF, which readily converts to TFV in plasma after oral absorption, TAF remains relatively stable in plasma, resulting in lower plasma and higher intracellular TFV concentrations. After oral administration, TAF 25 mg resulted in plasma TFV concentrations that were 90% lower than those seen with TDF 300 mg. Intracellular TFV-DP concentrations, however, were substantially higher with TAF.

Adverse Effects

Renal and Bone Effects:

- The potential for adverse kidney and bone effects is lower with TAF than with TDF. In randomized controlled trials that compared TAF and TDF in treatment-naïve or virologically suppressed patients, TAF had more favorable effects on renal biomarkers and bone density than TDF (described below).

Lipid Effects:

- In randomized controlled trials in ART-naïve patients, as well as in switch studies (described below), levels of LDL and HDL cholesterol and triglycerides were higher in patients receiving TAF than in patients receiving TDF. However, total cholesterol to HDL ratios did not differ between patients receiving TAF and TDF. The clinical significance of this finding is not clear.^{32,57,58}

Other Factors and Considerations:

- TAF/FTC is available in FDCs with DRV/c, EVG/c or RPV, allowing the regimens to be administered as a single pill taken once daily with food.
- In Phase 3 randomized trials, BIC/TAF/FTC was comparable to DTG/ABC/3TC and to DTG plus TAF/FTC (see the INSTI section below).
- TAF-containing regimens are approved for patients with eGFR ≥ 30 mL/min. Renal function, urine glucose, and urine protein should be assessed before initiating treatment with TAF, and these assessments should be repeated periodically during treatment. EVG/c/FTC/TAF was safe and effective in a single-arm switch study that was conducted in patients on hemodialysis with eGFRs < 15 mL/min.⁵⁹
- Both TAF and FTC are active against HBV. In patients with HIV/HBV coinfection, TAF/FTC may be used as the NRTI pair in an ART regimen because these drugs have activity against both viruses (see [HBV/HIV Coinfection](#)).³⁸

The Panel's Recommendation:

- On the basis of clinical trial safety and efficacy data, supportive bioequivalence data,⁶⁰ and its availability as a component of various FDCs, the Panel considers TAF/FTC a recommended NRTI combination for initial ART in most persons with HIV when prescribed with BIC, DTG, and RAL.

Tenofovir Disoproxil Fumarate/Emtricitabine (TDF/FTC) and Tenofovir Disoproxil Fumarate/Lamivudine (TDF/3TC)

TDF, with either 3TC or FTC, has been studied in combination with DOR, EFV, RPV, several boosted PIs, EVG/c, RAL, and DTG in randomized clinical trials.^{61,62-70} In a 10-day, open-label, randomized monotherapy trial that was not powered to find a difference between the arms, FTC 200 mg once daily demonstrated a viral load reduction of $1.7 \log_{10}$ from baseline, compared with a reduction of $1.5 \log_{10}$ from baseline for 3TC 150 mg twice daily.⁷¹ In a meta-analysis of 12 trials, no significant difference in treatment success was found between 3TC and FTC.⁷² In the ATHENA cohort, virologic efficacy of TDF/FTC was compared to TDF/3TC when either was combined with an NNRTI (EFV or NVP)⁷³ or with a boosted PI.⁷⁴ TDF/3TC was associated with higher rates of virologic failure than TDF/FTC in the NNRTI analysis; however, it is worth noting that the people in this cohort who were taking 3TC generally had higher viral loads, lower CD4 cell counts, and were more likely to be using injection drugs at the start of the study than people who were taking FTC.⁷³ There was no difference in the rates of virologic failure in people who were taking TDF/FTC and people who were taking TDF/3TC when these drug combinations were used with a boosted PI.⁷⁴ A retrospective analysis of an Italian national database found that viral resistance was more common with TDF/3TC than with TDF/FTC, but this was not observed in clinical trials.⁷⁵

Adverse Effects

Renal Effects:

- New onset or worsening renal impairment has been associated with TDF use.^{76,77} Risk factors may include advanced HIV disease, longer treatment history, low body weight (especially in females)⁷⁸ and pre-existing renal impairment.⁷⁹ Concomitant use of a PK-enhanced regimen (with a PI or EVG) can increase TDF concentrations; studies have suggested that there is a greater risk of renal dysfunction when TDF is used in these regimens. As previously noted, adverse effects on renal biomarkers such as proteinuria, especially tubular proteinuria, were more frequent with TDF than with TAF.^{77,79-83}
- Adverse renal outcomes are more likely when TDF/FTC is coadministered with PK boosters (RTV or COBI). A meta-analysis of randomized trials found that discontinuation due to renal adverse events is more frequent in people who take TDF/FTC with PK boosting.²⁸

Bone Effects:

- While initiation of all NRTI-containing regimens has been associated with a decrease in BMD, the loss of BMD is greater with TDF-containing regimens. For example, in two randomized studies that compared TDF/FTC with ABC/3TC, participants who received TDF/FTC experienced a significantly greater decline in BMD than ABC/3TC-treated participants.^{84,85} BMD generally stabilizes following an early decline after ART initiation. Loss of BMD with TDF is also greater than with TAF (see above).
- Cases of osteomalacia associated with proximal renal tubulopathy have been reported with the use of TDF.⁸⁶
- Adverse bone outcomes are more likely when TDF/FTC is coadministered with PK boosters (RTV or COBI). A meta-analysis of randomized trials found that fractures and discontinuation due to bone adverse events occur more frequently among patients who take TDF/FTC with PK boosting.²⁸

Other Factors and Considerations:

- TDF/FTC is available in FDCs with EFV, EVG/c, and RPV, allowing the regimens to be administered as a single pill taken once daily.
- TDF/3TC is available in FDCs with DOR 100 mg, EFV 600 mg, and EFV 400 mg.
- Renal function, urine glucose, and urine protein should be assessed before initiating treatment with TDF and periodically during treatment (see [Laboratory Testing for Initial Assessment and Monitoring](#)). In patients who have pre-existing renal insufficiency (creatinine clearance [CrCl] <60 mL/min),⁸⁷ use of TDF should generally be avoided. If TDF is used, a dose adjustment is required if the patient's CrCl falls below 50 mL/min (see [Appendix B, Table 8](#) for dose recommendations).
- TDF, FTC, and 3TC are active against HBV. In patients with HIV/HBV coinfection, TDF/FTC or TDF/3TC may be used as the NRTI pair of the ART regimen because these drugs have activity against both viruses (see [HBV/HIV Coinfection](#)).

The Panel's Recommendations:

- On the basis of clinical trial safety and efficacy data, long-term experience in clinical practice, and the combination's availability as a component of FDC drugs, the Panel considers TDF/FTC and TDF/3TC as recommended NRTI combinations for initial ART in most persons with HIV when combined with DTG or RAL. See Table 6a for recommendations regarding use of TDF/FTC with other drugs.
- TDF should be used with caution or avoided in patients with renal disease and osteoporosis.
- Specific attention should be given to renal and bone safety monitoring when TDF is used, especially with PK boosters. Boosters should be avoided when possible in patients taking TDF.

Integrase Strand Transfer Inhibitor–Based Regimens

Table 8b. Characteristics of Integrase Strand Transfer Inhibitors That Are Recommended for Antiretroviral Therapy–Naive Patients

Note: Preliminary data suggest that there may be an increased risk of NTDs in infants born to those who were receiving DTG at the time of conception.^{6,7} Until more information is available:

- Pregnancy testing should be performed for those of childbearing potential prior to initiation of ART.
- DTG is **not recommended** for ART-naive individuals:
 - Who are pregnant and within 12 weeks post-conception, *or*
 - Who are of childbearing potential and who are planning to become pregnant or who are sexually active and not using effective contraception.

Clinicians should refer to Table 6b for further guidance before initiating an INSTI.

	BIC	DTG	EVG	RAL
Dosing Frequency	Once daily	<u>Once Daily:</u> • In ART-naive or INSTI-naive persons <u>Twice Daily:</u> • If used with certain CYP3A4 and UGT1A1 inducers; <i>or</i> • In INSTI-experienced persons with certain INSTI DRMs	Once daily; requires boosting with COBI	• 400 mg BID, <i>or</i> • 1200 mg (two 600-mg tablets) once daily
STR Available for ART-Naive Patients	BIC/TAF/FTC	DTG/ABC/3TC	• EVG/c/TAF/FTC • EVG/c/TDF/FTC	No
Available as a Single-Drug Tablet	No	Yes	No	Yes
Approved for ART-Experienced Patients	No	Yes, with BID dosing for patients with some INSTI DRMs	No	Yes, for patients with DRM to PI/r or NNRTIs, but no DRM to INSTIs
Virologic Efficacy Against EVG- or RAL-Resistant HIV	<i>In vitro</i> data indicate activity, but no clinical trial data are available	Yes, for some isolates; effective with 50 mg BID dose	No	No
Adverse Effects	Nausea, diarrhea (GI disturbance greater with EVG/c), headache, insomnia. Depression and suicidality are rare, occurring primarily in patients with pre-existing psychiatric conditions.			
	↑ CPK (4%)	Hypersensitivity, hepatotoxicity, ↑ CPK, myositis	↑ TG, ↑ LDL	↑ CPK, myopathy, hypersensitivity, SJS/TEN
CYP3A4 Drug-Drug Interactions	CYP3A4 substrate	CYP3A4 substrate (minor)	EVG is a CYP3A4 substrate; COBI is a CYP3A4 inhibitor	No
Chelation with Poly-valent Cation Supplements and Antacids	Oral absorption of all INSTIs may be reduced by polyvalent cations. See Table 19d for recommendations regarding dosing separation of INSTIs and these drugs.			
Other Key Potential Drug Interactions	UGT1A1 substrate, OCT2 and MATE1 inhibitor	p-gp substrate, UGT1A1 substrate	EVG is a UGT1A1 substrate; COBI is a p-gp inhibitor	UGT1A1 substrate

Key to Acronyms: 3TC = lamivudine; ABC = abacavir; ART = antiretroviral therapy; BIC = bicitegravir; BID = twice daily; COBI = cobicistat; CPK = creatine phosphokinase; CYP = cytochrome P; DRM = drug resistance mutation; DTG = dolutegravir; EVG = elvitegravir; EVG/c = elvitegravir/cobicistat; FTC = emtricitabine; GI = gastrointestinal; INSTI = integrase strand transfer inhibitor; LDL = low density lipoprotein; MATE = multidrug and toxic compound extrusion; NNRTI = non-nucleoside reverse transcriptase inhibitor; NTD = neural tube defect; OAT = organic anionic transporter; p-gp = p-glycoprotein; PI = protease inhibitor; PI/r = ritonavir-boosted protease inhibitor; RAL = raltegravir; SJS/TEN = Stevens Johnson Syndrome/toxic epidermal necrolysis; STR = single-tablet regimen; TAF = tenofovir alafenamide; TDF = tenofovir disoproxil fumarate; TG = triglyceride; UGT = uridine diphosphate glucuronosyltransferase

Summary

Four INSTIs—BIC, DTG, EVG, and RAL—are approved for use in ART-naive patients with HIV. All INSTIs are generally well tolerated, though there are reports of insomnia in some patients. Depression and suicidal ideation, primarily in patients with a history of psychiatric illnesses, have rarely been reported in patients receiving INSTI-based regimens. BIC, DTG, and EVG are available as components of STRs—BIC is coformulated with TAF/FTC, DTG is coformulated with ABC/3TC, and EVG is coformulated with a PK enhancer (COBI) and either TAF/FTC or TDF/FTC. The Panel classifies the three unboosted INSTI-based regimens (BIC, DTG, and RAL) as Recommended Initial Regimens for Most People with HIV. Among the INSTI-based regimens, RAL-containing regimens have the longest clinical experience, and they have been shown to have durable virologic efficacy; however, they have a higher pill burden than BIC- and DTG-containing regimens. EVG and RAL have lower barriers to resistance than BIC and DTG. In clinical trials of ART-naive patients who received BIC or DTG plus two NRTIs, resistance was not seen at virologic failure. Because of its high barrier to resistance, DTG may be considered for patients who must start ART before resistance test results are available (e.g., during acute HIV infection and in the setting of certain opportunistic infections). EVG-based regimens are now considered Recommended Initial Regimens in Certain Clinical Situations, because they require boosting with COBI, which results in a greater potential for interaction with concomitant medications.

Preliminary data from an observational study in Botswana suggest that there may be an increased risk of NTDs in infants born to those who were receiving DTG at the time of conception.^{6,7} Until more information is available, DTG-based regimens are not recommended for use in ART-naive patients who are pregnant and within 12 weeks post-conception. These regimens also should not be used in those of childbearing potential who are sexually active and not using effective contraception or who are planning to become pregnant.

It is unclear whether DTG is the only INSTI with the potential to cause NTDs, or if other INSTIs also carry this risk (i.e., a class effect). Table 6b provides recommendations on the use of INSTIs in those who are pregnant or of childbearing potential.

Integrase Strand Transfer Inhibitors Recommended as Part of an Initial Regimen for Most People with HIV

Bictegravir (BIC)

BIC is an INSTI that is approved by the FDA for initial therapy in adults with HIV as a component of a single-tablet, once-daily regimen with TAF and FTC.

Efficacy in Clinical Trials:

- The efficacy of BIC in ART-naive adults has been evaluated in two large Phase 3 randomized double-blind clinical trials that compared BIC to DTG administered in combination with two NRTIs. The primary efficacy endpoint was the proportion of participants with plasma HIV RNA <50 copies/mL at week 48.
 - The GS-US-380-1490 trial randomized participants 1:1 to receive either BIC/TAF/FTC or DTG with coformulated TAF/FTC. Both regimens were given once daily. At week 48, 89% of participants in the BIC arm and 93% of those in the DTG arm achieved HIV RNA <50 copies/mL ($P = 0.12$).³¹
 - The GS-US-380-1489 trial randomized participants 1:1 to receive BIC/TAF/FTC or coformulated DTG/ABC/3TC once daily. At week 48, 92.4% of participants in the BIC/TAF/FTC arm and 93% of those in the DTG/ABC/3TC arm achieved HIV RNA <50 copies/mL ($P = 0.78$).³

Adverse Effects:

- BIC is generally well tolerated. In clinical trials, the most commonly reported adverse reactions of all grades with an incidence $\geq 5\%$ included diarrhea, nausea, and headache.

Other Factors and Considerations:

- BIC is a CYP3A4 substrate and a UGT1A1 substrate, and its metabolism may be affected by concomitant use of CYP3A4 and UGT1A1 inducers or inhibitors. Rifampin or other rifamycins may decrease BIC or TAF concentrations, which may result in a loss of therapeutic effect. For patients who require rifamycins, BIC/FTC/TAF should not be used. Use of certain anticonvulsants and St. John's wort should also be avoided.⁸⁸
- BIC is an inhibitor of the drug transporters OCT2 and MATE1, which may lead to increased concentrations of drugs that are substrates of these transporters. For this reason, dofetilide is **contraindicated** with BIC/TAF/FTC.
- BIC is not a CYP3A4 inducer or inhibitor; thus, unlike EVG/c, it is unlikely to affect the metabolism of medications that are CYP3A4 substrates.
- Like other INSTIs, oral absorption of BIC may be reduced when BIC is coadministered with polyvalent cations (e.g., aluminum-, magnesium-, or calcium-containing antacids, or calcium or iron supplements). See [Table 19d](#) for dosing recommendations when using BIC with these products.
- BIC decreases tubular secretion of creatinine without affecting glomerular function. Increases in serum creatinine are typically observed within the first 4 weeks (with a median increase of 0.10 mg/dL after 48 weeks). This effect on creatinine secretion is similar to that seen with other medications used in people with HIV, including DTG and COBI.
- Treatment-emergent mutations that confer BIC resistance have not yet been reported in people receiving BIC for initial therapy. BIC has not been studied in people with prior INSTI failure or INSTI-related resistance mutations, and BIC should not be used in these individuals until more data are available.
- BIC and DTG share a similar chemical structure. It is unclear whether DTG is the only INSTI with the potential to cause NTDs or if other INSTIs also carry this risk.

The Panel's Recommendation:

- On the basis of clinical trial data, the Panel categorizes the combination of BIC/TAF/FTC administered once daily as a Recommended Initial Regimen for Most People with HIV (**AI**).
- Because there are no safety data for the use of BIC around the time of conception to guide evidence-based recommendations, a similar approach to the one outlined for DTG should be discussed before considering the use of BIC-containing ART in those of childbearing potential. The use of BIC-containing ART is not recommended during pregnancy.

Dolutegravir (DTG)

DTG is an INSTI with a higher barrier to resistance than EVG or RAL. In ART-naive patients, DTG plus two NRTIs demonstrated high efficacy in achieving HIV suppression. It is given once daily, with or without food. Preliminary data from Botswana suggest that there may be an increased risk of NTDs in infants born to women who were receiving DTG at the time of conception.^{6,7} More detailed discussions of this potential risk and recommendations for the use of this drug are found below and in [Table 6b](#).

Efficacy in Clinical Trials

The efficacy of DTG in ART-naive patients has been evaluated in several fully powered randomized controlled clinical trials. In these five trials, DTG-based regimens were noninferior or superior to a comparator INSTI-, NNRTI-, or PI-based regimen. The primary efficacy endpoint in these clinical trials was the proportion of participants with plasma HIV RNA <50 copies/mL.

DTG plus Two NRTIs versus Other INSTIs plus Two NRTIs:

- DTG-based regimens (with TAF/FTC or ABC/3TC) have been compared to BIC/TAF/FTC in two randomized controlled trials. These regimens have shown virologic efficacy that is similar to BIC/TAF/FTC (see the discussion in the BIC section above).^{4,5}
- The SPRING-2 trial compared DTG 50 mg once daily to RAL 400 mg twice daily. Each drug was administered in combination with an investigator-selected, two-NRTI regimen (either ABC/3TC or TDF/FTC) to 822 participants. At week 96, DTG was noninferior to RAL.⁷⁰

DTG/ABC/3TC versus EFV/TDF/FTC:

- The SINGLE trial compared the use of DTG 50 mg once daily plus ABC/3TC to EFV/TDF/FTC in 833 participants. At week 48, DTG was superior to EFV, primarily because the study treatment discontinuation rate was higher in the EFV arm than in the DTG arm.³¹ At week 144, DTG plus ABC/3TC remained superior to EFV/TDF/FTC.⁸⁹

DTG plus Two NRTIs versus PI/r plus Two NRTIs:

- The FLAMINGO study, a randomized open-label clinical trial, compared DTG 50 mg once daily to DRV/r 800 mg/100 mg once daily, each administered in combination with investigator-selected ABC/3TC or TDF/FTC. At week 48, DTG was superior to DRV/r because of the higher rate of discontinuation in the DRV/r arm.⁹⁰ The difference in efficacy between the DTG and DRV/r regimens was more pronounced in patients with pretreatment HIV RNA levels >100,000 copies/mL. At week 96, DTG remained superior to DRV/r.⁹¹
- The ARIA trial, an open-label, Phase 3b randomized controlled trial, compared the efficacy and safety of DTG/ABC/3TC to ATV/r plus TDF/FTC in ART-naive, nonpregnant women. At week 48, 82% of participants in the DTG group achieved HIV RNA viral loads <50 copies/mL compared with 71% in the ATV group ($P = 0.005$). The difference was driven by a lower rate of virologic nonresponse and fewer withdrawals due to adverse events in the DTG group.⁹²

DTG plus Two NRTIs versus DTG plus 3TC:

- Data are emerging that support the use of two-drug therapy with DTG plus 3TC. The results of a large randomized controlled trial that compared DTG plus TDF/FTC with DTG plus 3TC are discussed in the Other Antiretroviral Regimens for Initial Therapy When Abacavir, Tenofovir Alafenamide, and Tenofovir Disoproxil Fumarate Cannot Be Used section below.

Adverse Effects:

- DTG is generally well tolerated. The most commonly reported adverse reactions of moderate-to-severe intensity were insomnia and headache.
- Case series of neuropsychiatric adverse events (sleep disturbances, depression, anxiety, suicidal ideation) associated with the initiation of DTG and RAL have been reported.^{93,94} Two observational cohort studies reported a higher frequency of neuropsychiatric adverse events leading to treatment discontinuation in patients receiving DTG than in patients receiving other INSTIs.^{95,96} However, analyses of data from large randomized controlled trials as well as a health care database demonstrated similar rates of neuropsychiatric adverse events between DTG-based regimens and other ARV regimens,⁹⁷ with neuropsychiatric events rarely leading to DTG discontinuation. Another report from the World Health Organization international pharmacovigilance database reported neuropsychiatric events with all approved INSTIs,⁹⁸ not just DTG. Further studies will be needed to clarify the true incidence and implications of these neuropsychiatric events. A pathophysiologic mechanism for these neuropsychiatric

adverse events has not been defined.

- Preliminary data from an observational surveillance study of birth outcomes among pregnant women on ART in Botswana identified NTDs in four infants born to 596 women (0.67%) who initiated a DTG-based regimen prior to pregnancy, and who were still receiving it at the time of conception. The incidence of NTDs among infants born to women who were receiving other ARV drugs at the time of conception was 0.1%.⁶ This study is ongoing, and more data from births among women who were using a DTG-based regimen around the time of conception are expected. See Table 6b for recommendations on prescribing INSTIs as part of initial therapy.

Other Factors and Considerations:

- DTG, like BIC, decreases tubular secretion of creatinine without affecting glomerular function, with increases in serum creatinine observed within the first 4 weeks of treatment (mean increase in serum creatinine was 0.11 mg/dL after 48 weeks).
- DTG has fewer drug interactions than EVG/c. See [Drug-Drug Interactions](#) for specific drug-drug interactions that require dosage adjustment.
- DTG absorption, like absorption for other INSTIs, may be reduced when the ARV is coadministered with polyvalent cations (see [Drug-Drug Interactions](#)). DTG should be taken at least 2 hours before or 6 hours after cation-containing antacids or laxatives. Alternatively, DTG and supplements containing calcium or iron can be taken simultaneously with food.
- Treatment-emergent mutations that confer DTG resistance have not been reported in patients receiving DTG as part of a three-drug regimen for initial therapy, which suggests that DTG, like BIC, has a higher barrier to resistance than EVG or RAL.

The Panel's Recommendations:

- On the basis of clinical trial data, the Panel categorizes DTG in combination with ABC/3TC (AI), TAF/FTC (AI), or TDF/FTC (AI) as a Recommended Initial Regimen for Most People with HIV.
- A pregnancy test should be performed for those of childbearing potential prior to initiation of DTG (AIII).
- For those of childbearing potential who are using effective contraception, a DTG-based regimen can be considered after weighing the risks and benefits of DTG with the individual (BIII).
- Until more information is available, DTG should not be prescribed for individuals:
 - Who are pregnant and within 12 weeks post-conception (AII), or
 - Who are of childbearing potential and who are planning to become pregnant (AII) or who are sexually active and not using effective contraception (AIII).

Raltegravir (RAL)

RAL was the first INSTI approved for use in both ARV-naive and ARV-experienced patients.

Efficacy in Clinical Trials

RAL 400 mg Twice Daily plus Two NRTIs versus Comparator Drug plus Two NRTIs:

- The efficacy of RAL at a dose of 400 mg twice daily (with either TDF/FTC or ABC/3TC) as initial therapy was evaluated in two randomized, double-blind, controlled clinical trials and a third open-label, randomized trial.
 - STARTMRK compared RAL 400 mg twice daily to EFV 600 mg once daily, each administered in

combination with TDF/FTC. RAL was noninferior to EFV at 48 weeks.⁶⁶ RAL was superior to EFV at 4 and 5 years,^{69,99} in part because of more frequent discontinuations due to adverse events in the EFV group than in the RAL group.

- The SPRING-2 trial compared DTG 50 mg once daily to RAL 400 mg twice daily, each administered in combination with investigator-selected ABC/3TC or TDF/FTC. At week 96, DTG was noninferior to RAL.
- The SPRING-2 trial also provided nonrandomized data on the efficacy of RAL plus ABC/3TC. In this trial, 164 participants (39 participants with baseline viral loads $\geq 100,000$ copies/mL and 125 participants with baseline viral loads $< 100,000$ copies/mL) received RAL in combination with ABC/3TC. After 96 weeks, there was no difference in virologic response between the ABC/3TC and TDF/FTC groups when RAL was given as the third drug.⁷⁰
- ACTG A5257, a large randomized open-label trial, compared three NNRTI-sparing regimens that contained RAL, ATV/r, or DRV/r, each given with TDF/FTC. At week 96, all three regimens had similar virologic efficacy, but RAL was superior to both ATV/r and DRV/r for the combined endpoints of virologic efficacy and tolerability. Participants had greater increases in lipid levels in the PI/r arms than in the RAL arm, and BMD decreased to a greater extent in participants in the PI/r arms than in participants in the RAL arm.¹¹

RAL 1,200 mg Once Daily plus TDF/FTC versus RAL 400 mg Twice Daily plus TDF/FTC:

- In a Phase 3, randomized, double-blind, active comparator-controlled trial (the ONCEMRK trial), the efficacy of once-daily RAL 1,200 mg (formulated as two 600-mg tablets) was compared to RAL 400 mg twice daily, each administered with TDF/FTC. At 96 weeks, a similar proportion of participants in both groups achieved HIV RNA suppression (81.5% in the once-daily arm vs. 80.1% in the twice-daily arm). The responses were similar regardless of baseline HIV RNA or CD4 cell count.¹⁰⁰

Adverse Effects:

- RAL use has been associated with creatine kinase elevations. Myositis and rhabdomyolysis have been reported.
- Rare cases of severe skin reactions and systemic HSRs in patients who received RAL have been reported during post-marketing surveillance.¹⁰¹
- Neuropsychiatric adverse events (e.g., insomnia, headache, depression, and suicidal ideation) have been reported in people receiving INSTIs (see the discussion under DTG).^{97,102}

Other Factors and Considerations:

- RAL can be administered as 1,200 mg (two 600-mg tablets) once daily or as 400 mg twice daily with or without food in ART-naive patients.
- Coadministration of RAL as either 400 mg twice daily or 1,200 mg once daily with aluminum-containing and/or magnesium-containing antacids **is not recommended**. Calcium carbonate-containing antacids may be coadministered with RAL 400 mg twice daily, but not with RAL 1,200 mg once daily. Polyvalent cation-containing supplements may also reduce absorption of RAL. See [Table 19d](#) for dosing recommendations.
- RAL has a lower barrier to resistance than RTV-boosted PIs, **BIC**, and DTG.

The Panel's Recommendations:

- On the basis of these clinical trial data, the Panel considers RAL given as 1,200 mg (two 600-mg tablets)

once daily or as 400 mg twice daily plus TDF/FTC (**BI**) or TAF/FTC (**BII**) as a Recommended Initial Regimen for Most People with HIV.

- Because fewer patients have received RAL plus ABC/3TC in clinical trials or practice and there has not been a randomized trial comparing ABC/3TC plus RAL to TDF/FTC plus RAL, the Panel categorizes RAL plus ABC/3TC as a Recommended Initial Regimen in Certain Clinical Situations (**BII**).

Integrase Strand Transfer Inhibitors Recommended as Part of an Initial Regimen in Certain Clinical Situations

Elvitegravir (EVG)

EVG is available as a component of two STRs: EVG/c/TDF/FTC and EVG/c/TAF/FTC. COBI is a specific, potent CYP3A inhibitor that has no activity against HIV. It acts as a PK enhancer of EVG, which allows for once-daily dosing of the combination but increases the likelihood of significant drug interactions.

Efficacy in Clinical Trials:

- The efficacy of EVG/c/TDF/FTC in ART-naive participants has been evaluated in two randomized, double-blind active-controlled trials.
 - At 144 weeks, EVG/c/TDF/FTC was noninferior to fixed-dose EFV/TDF/FTC.¹⁰³
 - EVG/c/TDF/FTC was also found to be noninferior to ATV/r plus TDF/FTC.¹⁰⁴
 - In a randomized, blinded trial performed in women with HIV, EVG/c/TDF/FTC had superior efficacy when compared to ATV/r plus TDF/FTC, in part because of a lower rate of treatment discontinuation.¹⁵
- The efficacy of EVG/c/TAF/FTC in ART-naive participants has been evaluated in two randomized, double-blind controlled trials in adults with eGFR ≥ 50 mL/min.^{32,35}
 - At 48 and 96 weeks, TAF was noninferior to TDF when both drugs were combined with EVG/c/FTC; at 144 weeks, EVG/c/TAF/FTC was superior to EVG/c/TDF/FTC.³³

Adverse Effects:

- The most common adverse events reported with EVG/c/TDF/FTC were diarrhea, nausea, upper respiratory infection, and headache.^{103,104}
- The most common adverse events reported with EVG/c/TAF/FTC were nausea, diarrhea, headache, and fatigue.¹⁰⁵
- Neuropsychiatric adverse events have been reported in people receiving INSTIs (see the discussion under DTG).

Other Factors and Considerations:

- EVG is metabolized primarily by CYP3A enzymes; as a result, CYP3A inducers or inhibitors may alter EVG concentrations.
- Because COBI inhibits CYP3A, it interacts with a number of medications that are metabolized by this enzyme (see [Drug-Drug Interactions](#)).¹⁰⁶
- Administering EVG simultaneously with polyvalent cation-containing antacids or supplements lowers EVG plasma concentrations (see [Drug-Drug Interactions](#)). Separate EVG/c/TDF/FTC or EVG/c/TAF/FTC and polyvalent antacid administration by at least 2 hours; administer polyvalent cation-containing supplements at least 2 hours before or 6 hours after EVG dosing.

- COBI inhibits active tubular secretion of creatinine, resulting in increases in serum creatinine and a reduction in estimated CrCl without reducing glomerular function.¹⁰⁷ Patients with a confirmed increase in serum creatinine >0.4 mg/dL from baseline while taking EVG/c/TDF/FTC should be closely monitored and evaluated for evidence of TDF-related proximal renal tubulopathy.⁸³
- EVG/c/TDF/FTC **is not recommended** for patients with pretreatment estimated CrCl <70 mL/min.⁸³
- EVG/c/TAF/FTC **is not recommended** for patients with pretreatment estimated CrCl <30 mL/min.
- At the time of virologic failure, INSTI-associated mutations were detected in some EVG/c/TDF/FTC-treated patients whose therapy failed.^{103,104} These mutations conferred cross-resistance to RAL, with most patients retaining susceptibility to DTG.

The Panel's Recommendation:

- On the basis of the above considerations, the Panel classifies EVG/c/TAF/FTC and EVG/c/TDF/FTC as **Recommended Initial Regimens in Certain Clinical Situations (BI)**. EVG/c/TAF/FTC should only be used in people with estimated CrCl ≥30 mL/min; EVG/c/TDF/FTC should only be used in people with estimated CrCl ≥70 mL/min.

Non-Nucleoside Reverse Transcriptase Inhibitor-Based Regimens

Table 8c. Characteristics of Non-Nucleoside Reverse Transcriptase Inhibitors that are Recommended for Antiretroviral Therapy-Naive Patients

	DOR	EFV	RPV
Dosing Frequency	Once daily	Once daily	Once daily
Food Requirement	With or without food	On an empty stomach	With a meal
STR Available for ART-Naive Patients	• DOR/TDF/3TC	• EFV 600 mg/TDF/FTC • EFV 600 mg/TDF/3TC • EFV 400 mg/TDF/3TC	• RPV/TAF/FTC • RPV/TDF/FTC
Available as a Single-Drug Tablet	Yes	Yes	Yes
Adverse Effects	Generally well tolerated	• CNS side effects, including dizziness, abnormal dreams, headache, depression, suicidality, somnolence, and insomnia • Skin rash	• Depression, headache • Skin rash • QT prolongation
CYP3A4 Drug-Drug Interactions	CYP3A4 substrate	CYP3A4 substrate, mixed inducer/inhibitor	CYP3A4 substrate
Other Significant Drug Interactions	None	CYP2B6 and 2C19 inducer	RPV oral absorption is reduced with increased gastric pH. Use of RPV with PPIs is not recommended; see Drug-Drug Interactions for dosing recommendations when RPV is coadministered with H2 blocker or antacids.

Key to Acronyms: 3TC = lamivudine; CNS = central nervous system; CYP = cytochrome P; DOR = doravirine; EFV = efavirenz; FTC = emtricitabine; H2 = histamine 2; PPI = proton pump inhibitor; RPV = rilpivirine; STR = single-tablet regimen; TAF = tenofovir alafenamide; TDF = tenofovir disoproxil fumarate

Summary

Five NNRTIs (delavirdine [DLV], **DOR**, EFV, etravirine [ETR], nevirapine [NVP], and RPV) are currently approved by the FDA for the treatment of HIV when used in combination with other ARV drugs.

NNRTI-based regimens have demonstrated virologic potency and durability. The major disadvantages of currently available NNRTIs (especially EFV and RPV) are the prevalence of NNRTI-resistant viral strains in ART-naive patients¹⁰⁸ and the drugs' low barrier for the development of resistance. Resistance testing should be performed to guide therapy selection for ART-naive patients (see [Drug-Resistance Testing](#)). High-level resistance to all NNRTIs (except ETR or **DOR**) may occur with a single mutation. In RPV-treated patients, the presence of RPV resistance mutations at virologic failure may confer cross-resistance to other NNRTIs, including ETR.^{109,110} **DOR**-, EFV-, and RPV-based regimens are now categorized as Recommended Initial Regimens in Certain Clinical Situations for ART-naive patients.

Doravirine (DOR)

Efficacy in Clinical Trials

The efficacy of DOR-based therapy for treatment of HIV in ART-naive individuals was demonstrated in two randomized, double-blind, placebo-controlled trials.

DOR-Based Regimen versus EFV-Based Regimen:

- In DRIVE-AHEAD, 734 participants received either DOR/TDF/3TC or EFV/TDF/FTC, both as STRs.⁹
 - At 48 weeks, DOR/TDF/3TC was found to be noninferior to EFV/TDF/FTC, with 84.3% of participants who received DOR/TDF/3TC and 80.8% of those who received EFV/TDF/FTC achieving HIV RNA <50 copies/mL. Virologic responses overall were lower in participants with pre-ART HIV RNA >100,000 copies/mL, but there was no difference between the DOR and EFV groups.
 - A greater proportion of participants in the EFV arm discontinued their assigned ART due to adverse events than in the DOR arm (6.3% vs. 2.7%). Neuropsychiatric side effects were more common in the EFV arm.
 - Genotype resistance results were reported for 13 participants with virologic failure in the DOR arm and 10 participants in the EFV arm. For the DOR arm, seven out of 13 participants had NNRTI resistance and five out of 13 had NRTI resistance; for EFV, nine out of 10 participants had NNRTI resistance and five out of 10 had NRTI resistance.
 - The DOR group had no change in LDL cholesterol and non-HDL cholesterol among participants, whereas both LDL and non-HDL cholesterol increased with EFV use.
 - At 96 weeks, 77.5% and 73.6% of participants in the DOR arm and the EFV arm had maintained HIV RNA <50 copies/mL, respectively.¹¹¹

DOR-Based Regimen versus DRV/r-Based Regimen:

- In DRIVE-FORWARD, 769 participants received DOR or DRV/r once daily along with two investigator-selected NRTIs, either ABC/3TC or TDF/FTC.⁸
- At 48 weeks, DOR was found to be noninferior to DRV/r when these drugs were administered with two NRTIs. Eighty-four percent of study participants receiving DOR achieved HIV RNA <50 copies/mL at 48 weeks, compared to 80% of participants receiving DRV/r.
- Participants who received DOR plus ABC/3TC (n = 48) and those who received DOR plus TDF/FTC (n = 316) had similar virologic responses.
- At week 96, DOR was superior to DRV/r in terms of virologic suppression;¹¹² there was a higher rate of discontinuation in the DRV/r group.

- Genotype resistance results were reported for seven and eight participants with virologic failure in the DOR and DRV/r arms, respectively. No drug resistance mutations were detected in either group.
- Treatment-related diarrhea was more frequently reported in the DRV/r arm, and greater increases in fasting LDL cholesterol and triglycerides were seen in the participants who received DRV/r than in those who received DOR.

Other Factors and Considerations:

- DOR is available as a single-drug, 100-mg tablet¹¹³ and as part of an STR that contains DOR/TDF/FTC 100 mg/300 mg/300 mg¹¹⁴ and is dosed once daily, with or without food.
- DOR is primarily metabolized by the CYP3A4 enzyme and should not be coadministered with strong CYP3A4 inducers. DOR concentration may increase in the presence of a CYP3A4 inhibitor (see Table 19b).
- DOR is not a CYP3A4 inducer or inhibitor, so it is not expected to affect the concentrations of concomitant CYP3A4 substrates.
- Treatment-emergent resistance mutations to DOR may confer cross-resistance to certain other NNRTIs. Most isolates with DOR mutations remain susceptible to ETR.¹¹⁵
- DOR-based regimens have not been directly compared to INSTI-based regimens in clinical trials.
- There are currently no data on the safety of DOR use during pregnancy.

The Panel's Recommendations:

- On the basis of the clinical trial data discussed above, the Panel classifies DOR/TDF/3TC (**BI**) and DOR plus two NRTIs (**BI** for TDF/FTC and **BIII** for TAF/FTC) as Recommended Initial Regimens in Certain Clinical Situations.
- Because the number of participants who received DOR plus ABC/3TC is much lower than the number who received TDF/FTC plus DOR, the Panel considers ABC/3TC plus DOR to be an option for initial therapy, but the Panel has less confidence in this regimen than in the other DOR-containing regimens listed above (**CI**).

Efavirenz (EFV)

Efficacy in Clinical Trials:

- Large randomized controlled trials and cohort studies in ART-naive patients have demonstrated potent and durable viral suppression in patients treated with EFV plus two NRTIs. In clinical trials, EFV-based regimens have demonstrated superiority or noninferiority to several comparator regimens in ART-naive patients.
- In ACTG 5202, EFV was comparable to ATV/r when each was given with either TDF/FTC or ABC/3TC.¹¹⁶
- In the ECHO and THRIVE studies, EFV was noninferior to RPV, with less virologic failure. However, EFV caused more discontinuations due to adverse events. The virologic advantage of EFV was most notable in participants with pre-ART viral loads >100,000 copies/mL, and NRTI and NNRTI resistance occurred more frequently in patients who experienced failure on a regimen that included RPV.¹¹⁷
- In the GS 102 study, EFV/TDF/FTC was noninferior to EVG/c/TDF/FTC.¹⁰³
- The DRIVE-AHEAD study compared EFV/TDF/FTC to DOR/TDF/3TC in ART-naive patients. At 48

weeks, DOR/TDF/3TC was found to be noninferior to EFV/TDF/FTC, as discussed in the DOR section. Neuropsychiatric side effects were more common in the EFV arm.

Some regimens have demonstrated superiority to EFV, based primarily on fewer discontinuations because of adverse events:

- In the SINGLE trial, a DTG-based regimen was superior to EFV at the primary endpoint of viral suppression at week 48.³¹
- In the STARTMRK trial, RAL was noninferior to EFV at 48 weeks,⁶⁶ but RAL was superior to EFV at 4 and 5 years,^{69,99} in part because of more frequent discontinuations due to adverse events in the EFV group than in the RAL group.
- In the open-label STaR trial, participants with baseline viral loads $\leq 100,000$ copies/mL had higher rates of treatment success on RPV than on EFV.¹¹⁸

ENCORE 1 (a multinational, randomized, placebo-controlled trial) compared two once-daily doses of EFV (combined with TDF/FTC): EFV 600 mg (standard dose) versus EFV 400 mg (reduced dose). At 96 weeks, EFV 400 mg was noninferior to EFV 600 mg for rate of viral suppression.¹¹⁹ While the frequency of overall adverse events was not different between groups, EFV-related adverse events occurred less frequently in the EFV 400 mg group than in the EFV 600 mg group. Although there were fewer self-reported CNS events in the 400 mg group, the groups had similar rates of psychiatric events. The 400-mg dose of EFV is now approved in the United States for initial treatment of HIV infection and is coformulated with TDF and 3TC in an FDC tablet. However, long-term experience and clinical efficacy data regarding its use during pregnancy and in patients with TB/HIV coinfection are lacking.

Adverse Effects:

- EFV can cause CNS side effects (e.g., abnormal dreams, dizziness, headache, and depression) that resolve over a period of days to weeks in most patients. However, subtler, long-term neuropsychiatric effects can occur.
- EFV use has also been associated with suicidality; however, various large studies have provided different results. An analysis of four ACTG comparative trials showed a higher rate of suicidality (i.e., reported suicidal ideation or attempted or completed suicide) among EFV-treated patients than among patients taking comparator regimens (LPV/r, ATV, ATV/r, or ABC-based regimens).¹²⁰ Similarly, a subgroup analysis of the START trial revealed higher risk of suicidal or self-injurious behavior among participants in the immediate ART group who took EFV than among ART-naïve controls; the risk increased for those with previous psychiatric diagnoses.¹²¹ This association, however, was not found in analyses of three large observational cohorts,^{122,123} or in a retrospective cohort study that used U.S. administrative pharmacy claims data.¹²⁴ A prospective observational cohort study among people with HIV in Uganda revealed no evidence that EFV carried an increased risk of suicidal ideation or depression compared to NVP.¹²⁵
- EFV may cause elevation in LDL cholesterol and triglycerides.
- QTc interval prolongation has been observed with EFV use.^{126,127} Consider an alternative therapy to EFV in patients taking medications known to increase the risk of Torsades de Pointes, or in patients at higher risk of Torsades de Pointes.

Other Factors and Considerations:

- EFV is formulated both as a single-drug, 600-mg tablet and in an FDC tablet of EFV/TDF/FTC that allows for once-daily dosing.

- EFV is also available as a generic single-drug, 600-mg tablet and as a generic once-daily STR tablet that uses 3TC, TDF, and either 600 mg or 400 mg of EFV; the lower-dose EFV/TDF/3TC tablet is approved for treating adults and children who weigh ≥ 35 kg.^{128,129}
- EFV is a substrate of CYP3A4 and an inducer of CYP3A4 and 2D6; therefore, it may potentially interact with other drugs that use the same pathways (see Tables [19b](#), [20a](#), and [20b](#)).
- EFV has been associated with CNS birth defects in nonhuman primates, and cases of NTDs have been reported after first-trimester exposure in humans.¹³⁰ A link between EFV and birth defects in humans has not been supported in meta-analyses (see the [Perinatal Guidelines](#)).¹³¹
- Screening for depression and suicidality is recommended for people with HIV who are taking a regimen that includes EFV.

The Panel's Recommendations:

- Given the availability of regimens with fewer treatment-limiting adverse events and also with noninferior or superior efficacy, the Panel classifies EFV/TDF/FTC or EFV/TDF/3TC (**BI**) or EFV plus TAF/FTC (**BII**) as Recommended Initial Regimens in Certain Clinical Situations.
- Randomized clinical trial data have demonstrated the efficacy of lower-dose (400 mg) EFV,¹¹⁹ but this dose has not been studied in a U.S. population, in pregnant women, or in patients with TB/HIV coinfection. The Panel therefore classifies the use of reduced-dose EFV as a Recommended Initial Regimen in Certain Clinical Situations (**CI**).

Rilpivirine (RPV)

RPV is an NNRTI that is approved for use in combination with NRTIs for ART-naive patients with pretreatment viral loads $< 100,000$ copies/mL.

Efficacy in Clinical Trials:

- Two Phase 3 randomized, double-blind clinical trials—ECHO and THRIVE—compared RPV and EFV, each combined with two NRTIs.¹¹⁷ At 96 weeks, the following findings were reported:
 - RPV was noninferior to EFV overall.
 - Among participants with pre-ART viral loads $> 100,000$ copies/mL, more RPV-treated participants than EFV-treated participants experienced virologic failure. Moreover, in this subgroup of participants with virologic failure, NNRTI and NRTI resistance was more frequently identified in those treated with RPV.
 - Among the RPV-treated participants, the rate of virologic failure was greater in those with pretreatment CD4 cell counts < 200 cells/mm³ than in those with CD4 cell counts ≥ 200 cells/mm³.
- STaR, a Phase 3b, open-label study, compared the FDC of RPV/TDF/FTC and EFV/TDF/FTC in 786 treatment-naive patients. The results at 96 weeks¹³² were similar to the findings reported at 48 weeks.¹¹⁸
 - RPV was noninferior to EFV overall.
 - RPV was superior to EFV in patients with pre-ART viral loads $\leq 100,000$ copies/mL and noninferior in those with pre-ART viral loads $> 100,000$ copies/mL. Among patients with pre-ART viral loads $> 500,000$ copies/mL, virologic failure was more common in RPV-treated patients than in EFV-treated patients.
 - There were more participants with emergent resistance in the RPV/FTC/TDF arm than in the EFV/FTC/TDF arm (4% vs. 1%, respectively).
- The FDC tablet of RPV/TAF/FTC was approved by the FDA based on results from a bioequivalence

study. In this study, participants taking the coformulated drug had plasma concentrations of RPV, FTC, and TAF 25 mg that were similar to concentrations seen in participants who received RPV as the single-drug tablet and TAF/FTC when given as part of the FDC of EVG/c/TAF 10 mg/FTC.⁶⁰

Adverse Effects:

- RPV is generally well tolerated. In the ECHO, THRIVE, and STaR trials, fewer instances of CNS adverse events (e.g., abnormal dreams, dizziness, psychiatric side effects), skin rash, and dyslipidemia were reported in the RPV arms than in the EFV arms, and fewer patients in the RPV arms discontinued therapy due to adverse events. However, up to 9% of clinical trial participants experienced depressive disorders, including approximately 1% of participants who had suicidal thoughts or who attempted suicide. Patients with severe depressive symptoms should be evaluated to assess whether symptoms may be due to RPV and if the risks of continuing the same regimen outweigh the benefits.

Other Factors and Considerations:

- RPV is formulated both as a single-drug tablet and in STRs with TAF/FTC and with TDF/FTC. Among available STRs, RPV/TAF/FTC is the smallest tablet.
- RPV/TAF/FTC and RPV/TDF/FTC are given once daily and must be administered with a meal (containing at least 390 kcal).
- RPV is also coformulated as a once-daily FDC tablet with DTG that is used as continuation therapy for persons with HIV who have achieved viral suppression.¹³³ However, this combination has not been studied in ART-naive individuals, and it is **not recommended** for initial therapy (see [Optimizing Antiretroviral Therapy in the Setting of Viral Suppression](#)).
- The oral drug absorption of RPV can be significantly reduced in the presence of acid-lowering agents. RPV is **contraindicated** in patients who are receiving proton pump inhibitors (PPIs), and should be used with caution in those receiving H2 antagonists or antacids (see [Drug-Drug Interactions](#) for dosing recommendations).
- RPV is primarily metabolized in the liver by the CYP3A enzyme; its plasma concentration may be affected in the presence of CYP3A inhibitors or inducers (see [Drug-Drug Interactions](#)).
- At doses above the approved dose of 25 mg, RPV may cause QTc interval prolongation. RPV should be used with caution when coadministered with a drug known to increase the risk of Torsades de Pointes.

The Panel's Recommendations:

- Given the availability of other effective regimens that do not have virologic and immunologic prerequisites to initiate treatment, the Panel recommends RPV/TDF/FTC and RPV/TAF/FTC as Recommended Initial Regimens in Certain Clinical Situations.
- Use of RPV with TAF/FTC (**BII**) or TDF/FTC (**BI**) should be limited to ART-naive patients with pretreatment viral loads <100,000 copies/mL and CD4 cell counts >200 cells/mm³.
- Data on RPV plus ABC/3TC are insufficient to consider recommending this regimen.

Protease Inhibitor-Based Regimens

Table 8d. Characteristics of Protease Inhibitor Options that are Recommended for Antiretroviral Therapy-Naive Patients

	ATV	DRV
Dosing Frequency	Once daily	<ul style="list-style-type: none"> Once daily for PI-naive patients Twice daily for PI-experienced patients with certain PI mutations
PK Boosting	PK-boosting with RTV or COBI is generally recommended. Unboosted ATV is also FDA-approved for ART-naive patients.	DRV should only be used with a PK booster (i.e., RTV or COBI).
Fixed-Dose Formulation	<ul style="list-style-type: none"> ATV/c 	<ul style="list-style-type: none"> DRV/c DRV/c/TAF/FTC
Available as a Single-Drug Tablet	Yes	Yes
Adverse Effects	<ul style="list-style-type: none"> Jaundice Indirect hyperbilirubinemia Cholelithiasis Nephrolithiasis PR prolongation 	<ul style="list-style-type: none"> Skin rash Increase in serum transaminases Hyperlipidemia A higher cardiovascular risk was reported in participants taking DRV-based regimens than in those taking ATV-based regimens in an observational cohort study.
CYP3A4 Drug-Drug Interactions	CYP3A4 substrate, inhibitor	CYP3A4 substrate, inhibitor
Other Significant Drug Interactions	ATV absorption is reduced when ATV is given with acid-lowering therapies. See Table 19a for ATV dosing recommendations when the drug is coadministered with acid-lowering agents.	N/A

Key to Acronyms: ART = antiretroviral therapy; ATV = atazanavir; ATV/c = atazanavir/cobicistat; COBI = cobicistat; CYP = cytochrome P; DRV = darunavir; DRV/c = darunavir/cobicistat; FDA = Food and Drug Administration; FTC = emtricitabine; PI = protease inhibitor; PK = pharmacokinetic; RTV = ritonavir; TAF = tenofovir alafenamide

Summary

FDA-approved PIs include ATV, ATV/c, DRV, DRV/c, fosamprenavir (FPV), indinavir (IDV), LPV/r, nelfinavir (NFV), RTV, saquinavir (SQV), and tipranavir (TPV). PI-based regimens with PK enhancement (also called boosting) have demonstrated virologic potency, durability in treatment-naive patients, and a high barrier to resistance. Because transmitted PI resistance is uncommon, PI-based regimens are generally recommended if early ART initiation is necessary, before resistance test results are available. Few or no PI mutations are detected when a patient's first PI-based regimen fails, which is not the case with NNRTI-based regimens and some INSTI-based regimens.^{134,135} For this reason, PI-based regimens may be useful for patients at risk for intermittent therapy due to poor adherence. All PIs (boosted by either RTV or COBI) inhibit the CYP3A4 isoenzyme, which may lead to significant drug-drug interactions (see [Drug-Drug Interactions](#)). Each PI has specific characteristics related to its virologic potency, adverse effects profile, and PK properties. The characteristics of recommended PIs are listed in Table 9 and [Appendix B, Table 3](#).

PIs that are recommended for use in ART-naive patients should have proven virologic efficacy, once-daily dosing, a lower pill count than older PI-based regimens, and good tolerability. On the basis of these criteria, the Panel considers once-daily DRV/r, DRV/c, ATV/c, or ATV/r together with two NRTIs as PI-based regimen options in the category of Recommended Initial Regimens in Certain Clinical Situations. **DRV/c/TAF/FTC is now available as an STR.** In a large, randomized controlled trial comparing DRV/r, ATV/r,

and RAL, each administered in combination with TDF/FTC, all three regimens achieved similar virologic suppression rates; however, the proportion of patients who discontinued their assigned treatment because of adverse effects, mainly hyperbilirubinemia, was greater in the ATV/r arm than in the other two arms.¹¹

Several metabolic abnormalities, including dyslipidemia and insulin resistance, have been associated with PI use. The currently available PIs differ in their propensity to cause these metabolic complications, which also depends on the dose of RTV used as a PK-enhancing agent. Large observational cohort studies found an association between some PIs (i.e., DRV/r, FPV, IDV, and LPV/r) and an increased risk of cardiovascular events; this risk was not seen with ATV.^{18-20,23} Another observational cohort study of predominantly male participants found a lower rate of cardiovascular events in those receiving ATV-containing regimens compared to those receiving other regimens.²² Further study is needed.

Compared to other PIs, **LPV/r**, FPV/r, unboosted ATV, and SQV/r have disadvantages such as greater pill burden, lower efficacy, or increased toxicity, and thus are no longer included as options for initial therapy.

Darunavir/Ritonavir (DRV/r)

Efficacy in Clinical Trials:

- The ARTEMIS study compared DRV/r (800 mg/100 mg once daily) with LPV/r (800 mg/200 mg once daily or 400 mg/100 mg twice daily), both administered in combination with TDF/FTC, in a randomized, open-label, noninferiority trial. DRV/r was noninferior to LPV/r at week 48,⁶⁴ and superior at week 192.¹³⁶ Among participants with baseline HIV RNA levels >100,000 copies/mL, virologic response rates were lower in the LPV/r arm than in the DRV/r arm.
- The FLAMINGO study compared DRV/r with DTG, each administered in combination with two NRTIs, in 488 ART-naive participants. The rate of virologic suppression at week 96 was significantly greater among those who received DTG than in those who received DRV/r. The excess failure observed in the DRV/r group was primarily related to a higher rate of virologic failure among those with a viral loads >100,000 copies/mL and secondarily due to more drug discontinuations in the DRV/r group.¹⁴
- ACTG A5257, a large randomized open-label trial, compared ATV/r with DRV/r or RAL, each given with TDF/FTC. The trial showed similar virologic efficacy for DRV/r, ATV/r, and RAL, but more participants in the ATV/r group discontinued randomized treatment because of adverse events.¹¹
- **The DRIVE-FORWARD study compared DRV/r to DOR, both administered with two investigator-selected NRTIs, in ART-naive participants. At 48 weeks, DOR was found to be noninferior to DRV/r, with 80% of participants who received DOR achieving HIV RNA levels <50 copies/mL compared with 84% of participants who received DRV/r.**

Adverse Effects:

- Patients taking DRV/r may develop a skin rash, which is usually mild-to-moderate in severity and self-limited. Treatment discontinuation is necessary on rare occasions when severe rash with fever or elevated transaminases occur.
- ACTG A5257 showed similar lipid changes in participants in the ATV/r and DRV/r arms. BMD decreased to a greater extent in participants in the ATV/r and DRV/r arms than in participants in the RAL arm.¹¹ The likelihood of developing metabolic syndrome was equivalent between the three arms, although a larger increase in waist circumference was observed at 96 weeks in participants assigned to the RAL arm than in those assigned to the DRV/r arm ($P \leq 0.02$).¹³⁷
- An observational cohort study suggested that DRV/r is associated with increased rates of cardiovascular disease.²³

Other Factors and Considerations:

- DRV/r is administered once daily with food in treatment-naïve patients.
- DRV has a sulfonamide moiety and should be used with caution in patients with severe sulfonamide allergies. In clinical trials, the incidence and severity of rash were similar in participants who did or did not have a history of sulfonamide allergy. Most patients with sulfonamide allergy are able to tolerate DRV.
- DRV/r is a potent CYP3A4 inhibitor, and this may lead to significant interactions with other medications metabolized through this same pathway (see [Drug-Drug Interactions](#)).

The Panel's Recommendations:

- On the basis of efficacy and safety data from clinical trials and clinical experience, the Panel classifies DRV/r with TDF/FTC (**AI**), with TAF/FTC (**AII**), or with ABC/3TC (**BII**) as Recommended Initial Regimens in Certain Clinical Situations.

Darunavir/Cobicistat (DRV/c)

A combination of DRV 800 mg with COBI 150 mg is bioequivalent to DRV 800 mg with RTV 100 mg in healthy volunteers, based on the maximum concentration and area under the concentration time curve for DRV.¹³⁸ Because the minimum concentration (C_{\min}) of DRV combined with COBI was 31% lower than that of DRV combined with RTV, bioequivalence for the C_{\min} was not achieved.¹³⁹

Efficacy in Clinical Trials:

- The AMBER trial enrolled 725 ART-naïve participants in a Phase 3 randomized controlled trial that compared the STR DRV/c/TAF/FTC and DRV/c plus TDF/FTC. At 48 weeks, similar virologic suppression rates among participants were achieved in both arms of the study (91% and 88%, respectively). No treatment-emergent mutations associated with DRV or TAF/TDF resistance were observed in either group. In the DRV plus TAF/FTC arm, fewer participants developed proteinuria. Changes in BMD were also less pronounced among these participants.³⁷
- In a single-arm trial in which most of the patients were treatment-naïve (94%), the coformulated DRV/c 800 mg/150 mg tablet was evaluated in combination with two investigator-selected NRTIs (99% of participants were given TDF/FTC). At week 48, 83% of treatment-naïve participants achieved HIV RNA <50 copies/mL; 5% of participants discontinued treatment because of adverse events.¹⁴⁰

Adverse Effects:

- The most common drug-related adverse events were diarrhea, nausea, fatigue, flatulence, rash, and headache.

Other Factors:

- DRV/c 800 mg/150 mg is available as a coformulated boosted PI or as an STR with TAF/FTC 10 mg/200 mg.

The Panel's Recommendations:

- The Panel recommends DRV/c plus TAF/FTC or TDF/FTC (**AI**) and DRV/c plus ABC/3TC (**BII**) as Recommended Initial Regimens in Certain Clinical Situations.
- DRV/c plus TDF/FTC **is not recommended** for patients with CrCl <70 mL/min, whereas DRV/c plus TAF/FTC **is not recommended** for patients with CrCl <30 mL/min.

Atazanavir/Ritonavir (ATV/r) or Atazanavir/Cobicistat (ATV/c)

Efficacy in Clinical Trials:

ATV/r plus Two NRTIs versus LPV/r plus Two NRTIs

- The CASTLE study compared once-daily ATV/r (300 mg/100 mg) with twice-daily LPV/r (400 mg/100 mg), each administered in combination with TDF/FTC. In this open-label, noninferiority study, the two regimens showed similar virologic and CD4 responses at 96 weeks.¹⁴¹

ATV/r plus Two NRTIs versus EFV plus Two NRTIs

- The ACTG A5202 study compared open-label ATV/r and EFV, each given in combination with placebo-controlled TDF/FTC or ABC/3TC. Efficacy was similar in the ATV/r and EFV groups.¹¹⁶ In a separate analysis, women assigned to receive ATV/r were found to have a higher risk of virologic failure than women assigned to receive EFV or men assigned to receive ATV/r.¹⁴²

ATV/r plus Two NRTIs versus INSTI plus Two NRTIs

- In a study that compared ATV/r plus TDF/FTC to EVG/c/TDF/FTC, virologic suppression rates through 144 weeks were similar among participants in the two groups.¹⁰⁴ A Phase 3 clinical trial of 575 women evaluated EVG/c plus FTC/TDF versus ATV/r plus FTC/TDF.¹⁵ At week 48, the virologic suppression rate in the EVG/c arm was superior to that in the ATV/r arm. Nineteen women in the PI arm discontinued therapy because of adverse events, compared to five women in the INSTI arm.
- In a Phase 3 trial, 499 ART-naïve women were randomized to receive either ATV/r plus TDF/FTC or DTG/ABC/3TC. At 48 weeks, DTG was found to have a rate of virologic suppression (<50 copies/mL) that was noninferior to the rate seen in the ATV/r arm, and fewer drug-related adverse events occurred in the DTG arm.⁹²

ATV/r plus Two NRTIs versus DRV/r plus Two NRTIs versus RAL plus Two NRTIs

- In ACTG A5257, a significantly higher proportion of patients in the ATV/r arm discontinued randomized treatment because of adverse events, mostly for elevated indirect bilirubin/jaundice or gastrointestinal toxicities. Lipid changes in participants in the ATV/r and DRV/r arms were similar. BMD decreased to a greater extent in participants in the ATV/r and DRV/r arms than in participants in the RAL arm.¹¹

ATV/c versus ATV/r plus Two NRTIs

- In the Gilead Study 114, all patients received TDF/FTC and ATV and were randomized to receive either RTV or COBI as PK enhancers. Both RTV and COBI were given as a separate tablet with matching placebos.¹⁴³ Through 144 weeks, the percentage of patients who achieved virologic suppression was similar in both study arms. The percentage of adverse events that caused patients to discontinue treatment and changes in serum creatinine and indirect bilirubin levels were comparable.¹⁴⁴

Adverse Effects:

- The main adverse effect associated with ATV/c or ATV/r is reversible indirect hyperbilirubinemia, with or without jaundice or scleral icterus, but without concomitant hepatic transaminase elevations. The risk for treatment-limiting indirect hyperbilirubinemia is greatest for patients who carry two UGT1A1 decreased-function alleles.¹⁴⁵
- Nephrolithiasis,¹⁴⁶⁻¹⁴⁸ nephrotoxicity,²¹ and cholelithiasis¹⁴⁹ have also been reported in patients who received ATV.
- Both ATV/c and ATV/r can cause gastrointestinal side effects, including diarrhea.

Other Factors and Considerations:

- ATV/c and ATV/r are dosed once daily and with food.
- ATV requires acidic gastric pH for dissolution. As a result, concomitant use of drugs that raise gastric pH (e.g., antacids, H₂ antagonists, and particularly PPIs) may impair absorption of ATV. [Table 19a](#) provides

recommendations for use of ATV/c or ATV/r with these agents.

- ATV/c and ATV/r are potent CYP3A4 inhibitors and may have significant interactions with other medications that are metabolized through this same pathway (see [Drug-Drug Interactions](#)).
- Large observational cohort studies found an association between some PIs (DRV/r, FPV, IDV, and LPV/r) and an increased risk of cardiovascular events; this risk was not seen with ATV.^{18-20,23} Another study of an observational cohort of predominantly male participants found a lower rate of cardiovascular events in participants receiving ATV-containing regimens compared with participants receiving other regimens.²² Further study is needed.

The Panel's Recommendations:

- On the basis of clinical trial safety and efficacy data, the Panel classifies ATV/r and ATV/c plus TAF/FTC (**BII**) or TDF/FTC (**BI**) as Recommended Initial Regimens in Certain Clinical Situations.
- **ATV/c or ATV/r plus ABC/3TC is no longer included in the list of Recommended Initial Regimens in Certain Clinical Situations, because it has disadvantages when compared with other regimens in this category. In a randomized trial, when combined with ATV/r, ABC/3TC was less potent than TDF/FTC in people with HIV RNA >100,000 copies/mL.¹⁰**
- **ATV/c plus TDF/FTC is not recommended** for patients with CrCl <70 mL/min, whereas ATV/c plus TAF/FTC **is not recommended** for patients with CrCl <30 mL/min.

Other Antiretroviral Regimens for Initial Therapy When Abacavir, Tenofovir Alafenamide, and Tenofovir Disoproxil Fumarate Cannot Be Used or Are Not Optimal

All currently recommended ARV regimens consist of two NRTIs plus a third active drug. This strategy, however, may not be possible or optimal in all patients. In some situations, it may be necessary to avoid ABC, TAF, and TDF, such as in patients who are HLA-B*5701 positive or at high risk of cardiovascular disease and with significant renal impairment. To address these concerns, several clinical studies have evaluated strategies using initial regimens that avoid the use of two NRTIs or the NRTI drug class altogether. Clinicians should refer to [HBV/HIV Coinfection](#) for guidance on treatment of patients with HBV infection when TAF or TDF cannot be used as part of the ARV regimen.

Strategies Supported by Evidence from Clinical Trials

Dolutegravir plus Lamivudine (DTG plus 3TC)

- **In the GEMINI-1 and -2 trials, a total of 1,433 ART-naive participants with baseline HIV RNA <500,000 copies/mL were randomized to receive DTG plus 3TC or DTG plus TDF/FTC. At week 48, DTG plus 3TC was noninferior to DTG plus TDF/FTC with respect to the proportion of participants with viral loads <50 copies/mL (91% and 93%, respectively).¹² Virologic nonresponse was uncommon, occurring in 3% of participants who received DTG plus 3TC and 2% of participants who received DTG plus TDF/FTC. No instances of treatment-emergent NRTI or INSTI resistance occurred in either treatment group. Longer term follow up is ongoing.**
- The PADDLE trial was a small, single-arm study of DTG plus 3TC in 20 ART-naive adults with baseline HIV RNA <100,000 copies/mL. At 48 weeks, 18 out of 20 subjects (90%) achieved HIV RNA <50 copies/mL.¹⁵⁰ Fifteen of these 18 participants completed 96 weeks of treatment and maintained HIV RNA <50 copies/mL.¹⁵¹
- The ACTG A5353 trial evaluated this same regimen in a single-arm trial that included ART-naive participants with a baseline HIV RNA of up to 500,000 copies/mL and no genotypic NRTI, INSTI, or PI resistance. The trial enrolled 120 participants; 37 participants (30.8%) had a baseline HIV RNA >100,000

copies/mL. At week 24, 90% of participants had HIV RNA <50 copies/mL; there were similar response rates in participants with baseline HIV RNA >100,000 copies/mL and ≤100,000 copies/mL (89% and 90%, respectively). Three participants experienced virologic failure, all of whom had suboptimal adherence; **one participant developed an NRTI resistance mutation (M184V) and an INSTI resistance mutation (R263K).**¹⁵²

The Panel's Recommendation:

- On the basis of these study results, the Panel recommends the use of DTG plus 3TC in ART-naive adults with baseline HIV RNA <500,000 copies/mL in instances where ABC, TAF, or TDF cannot be used or are not optimal **(BI)**.
- Preliminary data from an observational study in Botswana suggest that there may be an increased risk of NTDs in infants born to those who were receiving DTG at the time of conception.^{6,7} Clinicians should refer to Table 6b prior to initiation of DTG in those who are pregnant or those who are of childbearing potential.

Darunavir/Ritonavir plus Lamivudine (DRV/r plus 3TC)

- In the ANDES trial, 145 participants were randomized 1:1 to receive open-label, once-daily dual therapy with DRV/r plus 3TC or triple therapy with DRV/r plus TDF/3TC. **This study was conducted in Argentina, and the researchers used an FDC of DRV/r 800 mg/100 mg that is available in that country.** The median baseline HIV RNA was 4.5 log₁₀ copies, and 24% of participants had HIV RNA >100,000 copies/mL. **At week 48, 93% of the participants in the dual-therapy group and 94% of the participants in the triple-therapy group achieved an HIV RNA <50 copies/mL; dual therapy was noninferior to triple therapy.**²⁵ **The dual- and triple-therapy groups had similar rates of virologic suppression among study participants who had pre-therapy HIV RNA levels >100,000 copies/mL (91% and 92%, respectively).**

The Panel's Recommendation:

- On the basis of results from a small study with a relatively short follow-up period, DRV/r plus 3TC can be considered for use in people who cannot take ABC, TAF, or TDF **(CI)**. Although the ANDES trial supports the use of DRV/r plus 3TC, it is smaller than other trials of NRTI-limiting regimens, and larger studies are warranted.

Darunavir/Ritonavir plus Raltegravir (DRV/r plus RAL)

- In the NEAT/ANRS 143 study, 805 treatment-naive participants were randomized to receive twice-daily RAL or once-daily TDF/FTC, each with DRV/r (800 mg/100 mg once daily). At week 96, DRV/r plus RAL was noninferior to DRV/r plus TDF/FTC based on the primary endpoint of proportion of patients with virologic or clinical failure. Among those with baseline CD4 cell counts <200 cells/mm³, however, there were more failures in the two-drug arm; a trend towards more failure was also observed for those with pretreatment HIV RNA ≥100,000 copies/mL.²⁴ High rates of virologic failure in patients with HIV RNA >100,000 copies/mL were also seen in two smaller studies of DRV/r plus RAL.^{153,154}

The Panel's Recommendation:

- On the basis of these study results, the Panel recommends that DRV/r plus RAL be considered for use only in patients with HIV RNA <100,000 copies/mL and CD4 cell counts >200 cells/mm³, and only in those patients who cannot take ABC, TAF, or TDF **(CI)**.

A Nucleoside-Limiting Regimen that is Efficacious but has Disadvantages

Lopinavir/Ritonavir plus Lamivudine (LPV/r plus 3TC)

- In the GARDEL study, 426 ART-naive patients were randomized to receive twice-daily LPV/r plus either

open-label 3TC (twice daily) or two NRTIs selected by the study investigators. At 48 weeks, a similar proportion of patients in each arm had HIV RNA <50 copies/mL (88.3% vs. 83.7%), meeting the study's noninferiority criteria. The LPV/r plus 3TC regimen was better tolerated than the LPV/r plus two NRTI regimen.¹⁵⁵

- This regimen is used infrequently due to the requirement of twice-daily dosing, the relatively high pill burden (a total of 5–6 tablets per day), and the adverse effect profile of LPV/r. In view of these substantial limitations, the Panel recommends that LPV/r plus 3TC be considered for use only in patients who cannot take ABC, TAF, or TDF and in whom the other alternatives listed above cannot be used (**CI**).

Table 9. Advantages and Disadvantages of Antiretroviral Components Recommended as Initial Antiretroviral Therapy (page 1 of 5)

Note: All drugs within an ARV class are listed in alphabetical order.

ARV Class	ARV Agent(s)	Advantage(s)	Disadvantage(s)
Dual-NRTI	ABC/3TC	<ul style="list-style-type: none"> • Coformulated with DTG • Generic formulations are available for ABC/3TC, ABC, and 3TC. 	<ul style="list-style-type: none"> • May cause life-threatening HSRs in patients who test positive for the HLA-B*5701 allele. As a result, HLA-B*5701 testing is required before use. • In the ACTG 5202 study, patients with baseline HIV RNA ≥100,000 copies/mL showed inferior virologic responses when ABC/3TC was given with EFV or ATV/r as opposed to TDF/FTC. This difference was not seen when ABC/3TC was used in combination with DTG. • ABC use has been associated with CV disease and cardiac events in some, but not all, observational studies.
	TAF/FTC	<ul style="list-style-type: none"> • Coformulated with BIC, DRV/c, EVG/c, or RPV • Active against HBV; a recommended dual-NRTI option for patients with HIV/HBV coinfection • Smaller decline in renal function, less proteinuria, and smaller reductions in BMD than TDF/FTC • Approved for patients with eGFR ≥30 mL/min 	<ul style="list-style-type: none"> • TDF is associated with lower lipid levels than TAF, perhaps because TDF results in higher plasma levels of tenofovir, which lowers lipids.
	TDF/3TC	<ul style="list-style-type: none"> • Coformulated with DOR and EFV • Available as the following generic formulations: <ul style="list-style-type: none"> • TDF • 3TC • TDF/3TC • EFV/TDF/3TC • Long-term clinical experience • Active against HBV 	<ul style="list-style-type: none"> • Renal toxicity, including proximal tubulopathy and acute or chronic renal insufficiency, especially when combined with pharmacologic boosters. • Osteomalacia has been reported as a consequence of proximal tubulopathy. • Decreased BMD has been associated with use of TDF, especially when combined with pharmacologic boosters.
	TDF/FTC	<ul style="list-style-type: none"> • Coformulated with EFV, EVG/c, and RPV as STRs • Active against HBV; a recommended dual-NRTI option for patients with HIV/HBV coinfection • Better virologic responses than ABC/3TC in patients with baseline viral loads ≥100,000 copies/mL when combined with ATV/r or EFV • Associated with lower lipid levels than ABC or TAF 	<ul style="list-style-type: none"> • Renal toxicity, including proximal tubulopathy and acute or chronic renal insufficiency, especially when combined with pharmacologic boosters. • Osteomalacia has been reported as a consequence of proximal tubulopathy. • Decreased BMD has been associated with use of TDF, especially when combined with pharmacologic boosters.

Table 9. Advantages and Disadvantages of Antiretroviral Components Recommended as Initial Antiretroviral Therapy (page 2 of 5)

ARV Class	ARV Agent(s)	Advantage(s)	Disadvantage(s)
INSTI	BIC	<ul style="list-style-type: none"> • Coformulated with TAF/FTC • In trials in ART-naive participants, BIC resistance was not detected • No food requirement 	<ul style="list-style-type: none"> • Compared to other INSTIs, BIC has the shortest post-marketing experience. • Oral absorption of BIC can be reduced by simultaneous administration with drugs or supplements containing polyvalent cations (e.g., Al-, Ca-, or Mg-containing antacids or supplements, or multivitamin tablets with minerals). See dosing recommendations in Table 19d. • Inhibits tubular secretion of creatinine without affecting glomerular function. • CYP3A4 and UGT1A1 substrate (but not a CYP3A4 inducer or inhibitor); potential for drug interactions.
	DTG	<ul style="list-style-type: none"> • Higher barrier to resistance than EVG or RAL • Coformulated with ABC and 3TC • No food requirement • No CYP3A4 interactions • Favorable lipid profile 	<ul style="list-style-type: none"> • Preliminary data suggests that DTG use before pregnancy and through conception may be associated with an increased risk of NTDs in the infant. See text and Table 6b for recommendations. • Oral absorption of DTG can be reduced by simultaneous administration with drugs containing polyvalent cations (e.g., Al-, Ca-, or Mg-containing antacids or supplements, or multivitamin tablets with minerals). See dosing recommendations in Table 19d. • Inhibits renal tubular secretion of Cr and can increase serum Cr without affecting glomerular function. • UGT1A1 substrate; potential for drug interactions (see Table 19d). • Depression and suicidal ideation (rare; usually in patients with pre-existing psychiatric conditions).
	EVG/c	<ul style="list-style-type: none"> • Coformulated with TDF/FTC or TAF/FTC • Compared with ATV/r, causes smaller increases in total and LDL cholesterol 	<ul style="list-style-type: none"> • EVG/c/TDF/FTC is only recommended for patients with baseline CrCl ≥ 70 mL/min; this regimen should be discontinued if CrCl decreases to < 50 mL/min. • COBI is a potent CYP3A4 inhibitor, which can result in significant interactions with CYP3A substrates. • Oral absorption of EVG can be reduced by simultaneous administration with drugs containing polyvalent cations (e.g., Al-, Ca-, or Mg-containing antacids or supplements, or multivitamin tablets with minerals). See dosing recommendations in Table 19d. • COBI inhibits active tubular secretion of Cr and can increase serum Cr without affecting renal glomerular function. • Has a lower barrier to resistance than boosted PI-, BIC, or DTG-based regimens. • Food requirement. • Depression and suicidal ideation (rare; usually in patients with pre-existing psychiatric conditions).

Table 9. Advantages and Disadvantages of Antiretroviral Components Recommended as Initial Antiretroviral Therapy (page 3 of 5)

ARV Class	ARV Agent(s)	Advantage(s)	Disadvantage(s)
INSTI, continued	RAL	<ul style="list-style-type: none"> • Compared to other INSTIs, has longest post-marketing experience • No food requirement • No CYP3A4 interactions • Favorable lipid profile 	<ul style="list-style-type: none"> • Has a lower barrier to resistance than boosted PI-, BIC-, or DTG-based regimens. • Increases in creatine kinase, myopathy, and rhabdomyolysis have been reported. • Rare cases of severe HSRs (including SJS and TEN) have been reported. • Higher pill burden than other INSTI-based regimens. • No STR formulation. • Oral absorption of RAL can be reduced by simultaneous administration with drugs containing polyvalent cations (e.g., Al-, Ca-, or Mg-containing antacids or supplements, or multivitamin tablets with minerals). See dosing recommendations in Table 19d. • UGT1A1 substrate; potential for drug interactions (see Table 19d). • Depression and suicidal ideation (rare; usually in patients with pre-existing psychiatric conditions).
NNRTI	DOR	<ul style="list-style-type: none"> • Coformulated with TDF/3TC • Compared to EFV, CNS side effects are less frequent • No food requirement • Favorable lipid profile 	<ul style="list-style-type: none"> • Shorter-term clinical experience than with EFV and RPV. • Potential for CYP450 drug interactions (see Tables 19b, 20a and 20b). • Treatment-emergent DOR resistance mutations may confer resistance to certain NNRTIs.
	EFV	<ul style="list-style-type: none"> • EFV 600 mg is coformulated with TDF/FTC and TDF/3TC • EFV 400 mg is coformulated with TDF/3TC • EFV 600-mg dose has long-term clinical experience and EFV-based regimens (except for EFV plus ABC/3TC) have well-documented efficacy in patients with high HIV RNA 	<ul style="list-style-type: none"> • Short- and long-term neuropsychiatric (CNS) side effects, including depression and, in some studies, suicidality and catatonia. Screening for depression and suicidality is recommended in people with HIV who are taking a regimen that includes EFV. • Teratogenic in nonhuman primates, although no rate increase has been seen in humans. • Dyslipidemia • Rash • QTc interval prolongation; consider using an alternative to EFV in patients taking medications with known risk of causing Torsades de Pointes or in those at higher risk of Torsades de Pointes. • Transmitted resistance is more common than with PIs and INSTIs. • Greater risk of resistance at the time of treatment failure than with PIs. • Potential for CYP450 drug interactions (see Tables 19b and 20a). • Should be taken on an empty stomach (food increases drug absorption and CNS toxicities).

Table 9. Advantages and Disadvantages of Antiretroviral Components Recommended as Initial Antiretroviral Therapy (page 4 of 5)

ARV Class	ARV Agent(s)	Advantage(s)	Disadvantage(s)
NNRTI, continued	RPV	<ul style="list-style-type: none"> • Coformulated with TDF/FTC and TAF/FTC • RPV/TDF/FTC and RPV/TAF/FTC have smaller pill sizes than other coformulated ARV drugs • Compared with EFV: <ul style="list-style-type: none"> • Fewer CNS adverse effects • Fewer lipid effects • Fewer rashes 	<ul style="list-style-type: none"> • Not recommended in patients with pre-ART HIV RNA >100,000 copies/mL or CD4 cell counts <200 cells/mm³ because of higher rate of virologic failure in these patients. • Depression and suicidality • QTc interval prolongation; consider using an alternative to RPV in patients taking medications with known risk of causing Torsades de Pointes or in those at higher risk of Torsades de Pointes. • Rash • Transmitted resistance is more common than with PIs and INSTIs. • More NNRTI-, TDF-, and 3TC-associated mutations at virologic failure than with regimens that contain EFV and 2 NRTIs. • Potential for CYP450 drug interactions (see Tables 19b and 20a). • Meal requirement (>390 kcal) • Requires acid for adequate absorption. <ul style="list-style-type: none"> • Contraindicated with PPIs. • Use with H2 antagonists or antacids with caution (see Table 19a for detailed dosing information).
PIs	ATV/c or ATV/r	<ul style="list-style-type: none"> • Higher barrier to resistance than NNRTIs, EVG, and RAL • PI resistance at the time of treatment failure is uncommon with PK-enhanced PIs • ATV/c and ATV/r have similar virologic activity and toxicity profiles • Observational cohort studies have found an association between some PIs (DRV, LPV/r, FPV, IDV) and an increased risk of CV events; this risk has not been seen with ATV. Further study is needed. See text for discussion. • Individual ATV and RTV components available as generics 	<ul style="list-style-type: none"> • Commonly causes indirect hyperbilirubinemia, which may manifest as scleral icterus or jaundice. • Food requirement • Absorption depends on food and low gastric pH (see Table 19a for interactions with H2 antagonists, antacids, and PPIs). • Nephrolithiasis, cholelithiasis, nephrotoxicity • GI adverse effects • CYP3A4 inhibitors and substrates: potential for drug interactions (see Table 19a).
	ATV/c (Specific considerations)	<ul style="list-style-type: none"> • Coformulated tablet 	<ul style="list-style-type: none"> • COBI inhibits active tubular secretion of Cr and can increase serum Cr without affecting renal glomerular function. • Coadministration with TDF is not recommended in patients with CrCl <70 mL/min. • COBI (like RTV) is a potent CYP3A4 inhibitor, which can result in significant interactions with CYP3A substrates.
	DRV/c or DRV/r	<ul style="list-style-type: none"> • Higher barrier to resistance than NNRTIs, EVG, and RAL • PI resistance at the time of treatment failure is uncommon with PK-enhanced PIs 	<ul style="list-style-type: none"> • Skin rash • Food requirement • GI adverse effects • CYP3A4 inhibitors and substrates: potential for drug interactions (see Table 19a). • Increased CV risk reported in one observational cohort study.

Table 9. Advantages and Disadvantages of Antiretroviral Components Recommended as Initial Antiretroviral Therapy (page 5 of 5)

ARV Class	ARV Agent(s)	Advantage(s)	Disadvantage(s)
PIs, continued	DRV/c (Specific considerations)	<ul style="list-style-type: none"> • Coformulated as DRV/c and DRV/c/TAF/FTC 	<ul style="list-style-type: none"> • COBI inhibits active tubular secretion of Cr and can increase serum Cr without affecting renal glomerular function. • Coadministration with TDF is not recommended in patients with CrCl <70 mL/min. • COBI (like RTV) is a potent CYP3A4 inhibitor, which can result in significant interactions with CYP3A substrates.
	LPV/r	<ul style="list-style-type: none"> • Only RTV-coformulated PI • No food requirement 	<ul style="list-style-type: none"> • Requires RTV 200 mg per day. • Possible higher risk of MI associated with cumulative use of LPV/r. • PR and QT interval prolongation have been reported. Use with caution in patients at risk of cardiac conduction abnormalities or in patients receiving other drugs with similar effects. • Possible nephrotoxicity • CYP3A4 inhibitors and substrates: potential for drug interactions (see Table 19a).

Key to Acronyms: 3TC = lamivudine; ABC = abacavir; Al = aluminum; ART = antiretroviral therapy; ARV = antiretroviral; ATV = atazanavir; ATV/c = atazanavir/cobicistat; ATV/r = atazanavir/ritonavir; **BIC= bictegravir**; BMD = bone mineral density; Ca = calcium; CD4 = CD4 T lymphocyte; CNS = central nervous system; COBI = cobicistat; Cr = creatinine; CrCl = creatinine clearance; CV = cardiovascular; CYP = cytochrome P; **DOR = doravirine**; DRV = darunavir; DRV/c = darunavir/cobicistat; DRV/r = darunavir/ritonavir; DTG = dolutegravir; eGFR = estimated glomerular filtration rate; EFV = efavirenz; EVG = elvitegravir; EVG/c = elvitegravir/cobicistat; FDC = fixed-dose combination; FPV = fosamprenavir; FTC = emtricitabine; GI = gastrointestinal; HBV = hepatitis B virus; HLA = human leukocyte antigen; HSR = hypersensitivity reaction; IDV = indinavir; INSTI = integrase strand transfer inhibitor; LDL = low-density lipoprotein; LPV = lopinavir; LPV/r = lopinavir/ritonavir; Mg = magnesium; MI = myocardial infarction; NNRTI = non-nucleoside reverse transcriptase inhibitor; NRTI = nucleoside reverse transcriptase inhibitor; **NTD = neural tube defect**; PI = protease inhibitor; PK = pharmacokinetic; PPI = proton pump inhibitor; RAL = raltegravir; RPV = rilpivirine; RTV = ritonavir; SJS = Stevens-Johnson syndrome; STR = single-tablet regimen; TAF = tenofovir alafenamide; TDF = tenofovir disoproxil fumarate; TEN = toxic epidermal necrosis; UGT = uridine diphosphate glucuronosyltransferase

Table 10. Antiretroviral Components or Regimens Not Recommended as Initial Therapy (page 1 of 3)

ARV Components or Regimens	Reasons for Not Recommending as Initial Therapy
NRTIs	
ABC/3TC/ZDV (Coformulated) As triple-NRTI combination regimen	<ul style="list-style-type: none"> • Inferior virologic efficacy
ABC/3TC/ZDV plus TDF As quadruple-NRTI combination regimen	<ul style="list-style-type: none"> • Inferior virologic efficacy
d4T plus 3TC	<ul style="list-style-type: none"> • Significant toxicities (including lipoatrophy, peripheral neuropathy) and hyperlactatemia (including symptomatic and life-threatening lactic acidosis, hepatic steatosis, and pancreatitis)
ddl plus 3TC (or FTC)	<ul style="list-style-type: none"> • Inferior virologic efficacy • Limited clinical trial experience in ART-naive patients • ddl toxicities, such as pancreatitis and peripheral neuropathy
ddl plus TDF	<ul style="list-style-type: none"> • High rate of early virologic failure • Rapid selection of resistance mutations • Potential for immunologic nonresponse/CD4 cell decline • Increased ddl drug exposure and toxicities

Table 10. Antiretroviral Components or Regimens Not Recommended as Initial Therapy (page 2 of 3)

ARV Components or Regimens	Reasons for Not Recommending as Initial Therapy
NRTIs, continued	
ZDV/3TC	<ul style="list-style-type: none"> • Greater toxicities (including bone marrow suppression, GI toxicities, skeletal muscle myopathy, cardiomyopathy, and mitochondrial toxicities such as lipoatrophy, lactic acidosis, and hepatic steatosis) than recommended NRTIs
NNRTIs	
DLV	<ul style="list-style-type: none"> • Inferior virologic efficacy • Inconvenient (three times daily) dosing
ETR	<ul style="list-style-type: none"> • Insufficient data in ART-naive patients
NVP	<ul style="list-style-type: none"> • Associated with serious and potentially fatal toxicity (hepatic events and severe rash, including SJS and TEN) • When compared to EFV, NVP did not meet noninferiority criteria
PIs	
ATV (Unboosted)	<ul style="list-style-type: none"> • Less potent than boosted ATV
DRV (Unboosted)	<ul style="list-style-type: none"> • Use without RTV or COBI has not been studied
FPV (Unboosted) or FPV/r	<ul style="list-style-type: none"> • Virologic failure with unboosted FPV-based regimen may result in selection of mutations that confer resistance to FPV and DRV • Less clinical trial data for FPV/r than for other RTV-boosted PIs
IDV (Unboosted)	<ul style="list-style-type: none"> • Inconvenient dosing (3 times daily with meal restrictions) • Fluid requirement • IDV toxicities, such as nephrolithiasis and crystalluria
IDV/r	<ul style="list-style-type: none"> • Fluid requirement • IDV toxicities, such as nephrolithiasis and crystalluria
LPV/r	<ul style="list-style-type: none"> • Higher pill burden than other PI-based regimens • Higher RTV dose than other PI-based regimens • GI intolerance
NFV	<ul style="list-style-type: none"> • Inferior virologic efficacy • Diarrhea
RTV as sole PI	<ul style="list-style-type: none"> • High pill burden • GI intolerance • Metabolic toxicity
SQV (Unboosted)	<ul style="list-style-type: none"> • Inadequate bioavailability • Inferior virologic efficacy
SQV/r	<ul style="list-style-type: none"> • High pill burden • Can cause QT and PR prolongation; requires pretreatment and follow-up ECG
TPV/r	<ul style="list-style-type: none"> • Inferior virologic efficacy • Higher rate of adverse events than other RTV-boosted PIs • Higher dose of RTV required for boosting than other RTV-boosted PIs
Entry Inhibitors	
T-20 Fusion Inhibitor	<ul style="list-style-type: none"> • Only studied in patients with virologic failure • Twice-daily subcutaneous injections • High rate of injection site reactions
IBA CD4 Post-Attachment Inhibitor	<ul style="list-style-type: none"> • Only studied in a very small number of patients with virologic failure • Requires IV therapy • High cost

Table 10. Antiretroviral Components or Regimens Not Recommended as Initial Therapy (page 3 of 3)

ARV Components or Regimens	Reasons for <u>Not</u> Recommending as Initial Therapy
Entry Inhibitors , continued	
MVC CCR5 Antagonist	<ul style="list-style-type: none"> • Requires testing for CCR5 tropism before initiation of therapy • No virologic benefit when compared with other recommended regimens • Requires twice-daily dosing

Key to Acronyms: 3TC = lamivudine; ABC = abacavir; ART = antiretroviral therapy; ARV = antiretroviral; ATV = atazanavir; CD4 = CD4 T lymphocyte; COBI = cobicistat; d4T = stavudine; ddl = didanosine; DLV = delavirdine; DRV = darunavir; ECG = electrocardiogram; EFV = efavirenz; ETR = etravirine; FPV = fosamprenavir; FPV/r = fosamprenavir/ritonavir; FTC = emtricitabine; GI = gastrointestinal; **IBA = ibalizumab**; IDV = indinavir; IDV/r = indinavir/ritonavir; IV = intravenous; LPV = lopinavir; LPV/r = lopinavir/ritonavir; MVC = maraviroc; NFV = nelfinavir; NNRTI = non-nucleoside reverse transcriptase inhibitor; NRTI = nucleoside reverse transcriptase inhibitor; NVP = nevirapine; PI = protease inhibitor; RTV = ritonavir; SJS = Stevens Johnson Syndrome; SQV = saquinavir; SQV/r = saquinavir/ritonavir; **T-20 = enfuvirtide**; TDF = tenofovir disoproxil fumarate; TEN = toxic epidermal necrolysis; TPV = tipranavir; TPV/r = tipranavir/ritonavir; ZDV = zidovudine

References

1. Moore RD, Bartlett JG. Dramatic decline in the HIV-1 RNA level over calendar time in a large urban HIV practice. *Clin Infect Dis*. 2011;53(6):600-604. Available at: <http://www.ncbi.nlm.nih.gov/pubmed/21844006>.
2. Gill VS, Lima VD, Zhang W, et al. Improved virological outcomes in British Columbia concomitant with decreasing incidence of HIV type 1 drug resistance detection. *Clin Infect Dis*. 2010;50(1):98-105. Available at: <http://www.ncbi.nlm.nih.gov/pubmed/19951169>.
3. Lee FJ, Amin J, Carr A. Efficacy of initial antiretroviral therapy for HIV-1 infection in adults: a systematic review and meta-analysis of 114 studies with up to 144 weeks' follow-up. *PLoS One*. 2014;9(5):e97482. Available at: <http://www.ncbi.nlm.nih.gov/pubmed/24830290>.
4. Sax PE, Pozniak A, Montes ML, et al. Coformulated bictegravir, emtricitabine, and tenofovir alafenamide versus dolutegravir with emtricitabine and tenofovir alafenamide, for initial treatment of HIV-1 infection (GS-US-380-1490): a randomised, double-blind, multicentre, phase 3, non-inferiority trial. *Lancet*. 2017;390(10107):2073-2082. Available at: <http://www.ncbi.nlm.nih.gov/pubmed/28867499>.
5. Gallant J, Lazzarin A, Mills A, et al. Bictegravir, emtricitabine, and tenofovir alafenamide versus dolutegravir, abacavir, and lamivudine for initial treatment of HIV-1 infection (GS-US-380-1489): a double-blind, multicentre, phase 3, randomised controlled non-inferiority trial. *Lancet*. 2017;390(10107):2063-2072. Available at: <http://www.ncbi.nlm.nih.gov/pubmed/28867497>.
6. Zash R, Holmes L, Makhema J, et al. Surveillance for neural tube defects following antiretroviral exposure from conception. Presented at: 22nd International AIDS Conference. 2018. Amsterdam.
7. Zash R, Makhema J, Shapiro RL. Neural-tube defects with dolutegravir treatment from the time of conception. *N Engl J Med*. 2018;379(10):979-981. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/30037297>.
8. Molina JM, Squires K, Sax PE, et al. Doravirine versus ritonavir-boosted darunavir in antiretroviral-naïve adults with HIV-1 (DRIVE-FORWARD): 48-week results of a randomised, double-blind, phase 3, non-inferiority trial. *Lancet HIV*. 2018;5(5):e211-e220. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/29592840>.
9. Orkin C, Squires KE, Molina JM, et al. Doravirine/lamivudine/tenofovir disoproxil fumarate is non-inferior to efavirenz/emtricitabine/tenofovir disoproxil fumarate in treatment-naïve adults with human immunodeficiency virus-1 infection: Week 48 results of the DRIVE-AHEAD Trial. *Clin Infect Dis*. 2018. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/30184165>.
10. Sax PE, Tierney C, Collier AC, et al. Abacavir-lamivudine versus tenofovir-emtricitabine for initial HIV-1 therapy. *N Engl J Med*. 2009;361(23):2230-2240. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/19952143>.
11. Lennox JL, Landovitz RJ, Ribaud HJ, et al. Efficacy and tolerability of 3 nonnucleoside reverse transcriptase inhibitor-sparing antiretroviral regimens for treatment-naïve volunteers infected with HIV-1: a randomized, controlled equivalence trial. *Ann Intern Med*. 2014;161(7):461-471. Available at: <http://www.ncbi.nlm.nih.gov/pubmed/25285539>.
12. Cahn P, Madero JS, Arribas J, et al. Non-inferior efficacy of dolutegravir (DTG) plus lamivudine (3TC) versus DTG plus tenofovir/emtricitabine (TDF/FTC) fixed-dose combination in antiretroviral treatment-naïve adults with HIV-1 infection - 48-week results from the GEMINI studies. Presented at: 22nd International AIDS Conference (AIDS 2018). 2018. Amsterdam, Netherlands. Available at: <http://programme.aids2018.org/Abstract/Abstract/13210>.

13. Momper JD, Best BM, Wang J, et al. Elvitegravir/cobicistat pharmacokinetics in pregnant and postpartum women with HIV. *AIDS*. 2018. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/30134297>.
14. Molina JM, Clotet B, van Lunzen J, et al. Once-daily dolutegravir versus darunavir plus ritonavir for treatment-naive adults with HIV-1 infection (FLAMINGO): 96-week results from a randomised, open-label, phase 3b study. *Lancet HIV*. 2015;2(4):e127-136. Available at: <http://www.ncbi.nlm.nih.gov/pubmed/26424673>.
15. Squires K, Kityo C, Hodder S, et al. Integrase inhibitor versus protease inhibitor-based regimen for HIV-1 infected women (WAVES): a randomised, controlled, double-blind, phase 3 study. *Lancet HIV*. 2016;3(9):e410-e420. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/27562742>.
16. Stein JH, Ribaud H, Hodis HN, et al. A prospective, randomized clinical trial of antiretroviral therapies on carotid wall thickness. *AIDS*. 2015;29(14):1775-1783. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/26372383>.
17. de Saint-Martin L, Bressollette L, Perfezou P, et al. Impact of atazanavir-based HAART regimen on the carotid intima-media thickness of HIV-infected persons: a comparative prospective cohort. *AIDS*. 2010;24(18):2797-2801. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/21063175>.
18. Lang S, Mary-Krause M, Cotte L, et al. Impact of individual antiretroviral drugs on the risk of myocardial infarction in human immunodeficiency virus-infected patients: a case-control study nested within the French Hospital Database on HIV ANRS cohort CO4. *Arch Intern Med*. 2010;170(14):1228-1238. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/20660842>.
19. Worm SW, Sabin C, Weber R, et al. Risk of myocardial infarction in patients with HIV infection exposed to specific individual antiretroviral drugs from the 3 major drug classes: the data collection on adverse events of anti-HIV drugs (D:A:D) study. *J Infect Dis*. 2010;201(3):318-330. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/20039804>.
20. Monforte AD, Reiss P, Ryom L, et al. Atazanavir is not associated with an increased risk of cardio or cerebrovascular disease events. *AIDS*. 2013;27(3):407-415. Available at: <http://www.ncbi.nlm.nih.gov/pubmed/23291539>.
21. Ryom L, Mocroft A, Kirk O, et al. Association between antiretroviral exposure and renal impairment among HIV-positive persons with normal baseline renal function: the D:A:D study. *J Infect Dis*. 2013;207(9):1359-1369. Available at: <http://www.ncbi.nlm.nih.gov/pubmed/23382571>.
22. LaFleur J, Bress AP, Rosenblatt L, et al. Cardiovascular outcomes among HIV-infected veterans receiving atazanavir. *AIDS*. 2017;31(15):2095-2106. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/28692532>.
23. Ryom L, Lundgren JD, El-Sadr W, et al. Cardiovascular disease and use of contemporary protease inhibitors: the D:A:D international prospective multicohort study. *Lancet HIV*. 2018;5(6):e291-e300. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/29731407>.
24. Raffi F, Babiker AG, Richert L, et al. Ritonavir-boosted darunavir combined with raltegravir or tenofovir-emtricitabine in antiretroviral-naive adults infected with HIV-1: 96 week results from the NEAT001/ANRS143 randomised non-inferiority trial. *Lancet*. 2014;384(9958):1942-1951. Available at: <http://www.ncbi.nlm.nih.gov/pubmed/25103176>.
25. Figueroa MI, Sued OG, Gun AM, et al. DRV/R/3TC FDC for HIV-1 treatment naive patients: week 48 results of the ANDES study. Presented at: Conference on Retroviruses and Opportunistic Infections. 2018. Boston, MA.
26. Birkus G, Hitchcock MJ, Cihlar T. Assessment of mitochondrial toxicity in human cells treated with tenofovir: comparison with other nucleoside reverse transcriptase inhibitors. *Antimicrob Agents Chemother*. 2002;46(3):716-723. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/11850253>.
27. Johnson AA, Ray AS, Hanes J, et al. Toxicity of antiviral nucleoside analogs and the human mitochondrial DNA polymerase. *J Biol Chem*. 2001;276(44):40847-40857. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/11526116>.
28. Hill A, Hughes SL, Gotham D, Pozniak AL. Tenofovir alafenamide versus tenofovir disoproxil fumarate: is there a true difference in efficacy and safety? *J Virus Erad*. 2018;4(2):72-79. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/29682298>.
29. Post FA, Moyle GJ, Stellbrink HJ, et al. Randomized comparison of renal effects, efficacy, and safety with once-daily abacavir/lamivudine versus tenofovir/emtricitabine, administered with efavirenz, in antiretroviral-naive, HIV-1-infected adults: 48-week results from the ASSERT study. *J Acquir Immune Defic Syndr*. 2010;55(1):49-57. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/20431394>.
30. Smith KY, Patel P, Fine D, et al. Randomized, double-blind, placebo-matched, multicenter trial of abacavir/lamivudine or tenofovir/emtricitabine with lopinavir/ritonavir for initial HIV treatment. *AIDS*. 2009;23(12):1547-1556. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/19542866>.
31. Walmsley SL, Antela A, Clumeck N, et al. Dolutegravir plus abacavir-lamivudine for the treatment of HIV-1 infection. *N*

Engl J Med. 2013;369(19):1807-1818. Available at: <http://www.ncbi.nlm.nih.gov/pubmed/24195548>.

32. Sax PE, Wohl D, Yin MT, et al. Tenofovir alafenamide versus tenofovir disoproxil fumarate, coformulated with elvitegravir, cobicistat, and emtricitabine, for initial treatment of HIV-1 infection: two randomised, double-blind, phase 3, non-inferiority trials. *Lancet.* 2015;385(9987):2606-2615. Available at: <http://www.ncbi.nlm.nih.gov/pubmed/25890673>.
33. Arribas JR, Thompson M, Sax PE, et al. Brief report: randomized, double-blind comparison of tenofovir alafenamide (TAF) vs tenofovir disoproxil fumarate (TDF), each coformulated with elvitegravir, cobicistat, and emtricitabine (E/C/F) for initial HIV-1 treatment: week 144 results. *J Acquir Immune Defic Syndr.* 2017;75(2):211-218. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/28282300>.
34. Rijnders BJ, Post FA, Rieger A, et al. Longer-term renal safety of tenofovir alafenamide vs tenofovir disoproxil fumarate. Presented at: Conference on Retroviruses and Opportunistic Infections. 2016. Boston, MA. Available at: <http://www.croiconference.org/sessions/longer-term-renal-safety-tenofovir-alafenamide-vs-tenofovir-disoproxil-fumarate>.
35. Wohl D, Oka S, Clumeck N, et al. Brief report: a randomized, double-blind comparison of tenofovir alafenamide versus tenofovir disoproxil fumarate, each coformulated with elvitegravir, cobicistat, and emtricitabine for initial HIV-1 treatment: week 96 results. *J Acquir Immune Defic Syndr.* 2016;72(1):58-64. Available at: <http://www.ncbi.nlm.nih.gov/pubmed/26829661>.
36. Mills A, Crofoot GJ, McDonald C, et al. Tenofovir alafenamide versus tenofovir disoproxil fumarate in the first protease inhibitor-based single-tablet regimen for initial HIV-1 therapy: a randomized phase 2 study. *J Acquir Immune Defic Syndr.* 2015;69(4):439-445. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/25867913>.
37. Eron JJ, Orkin C, Gallant J, et al. A week-48 randomized phase-3 trial of darunavir/cobicistat/emtricitabine/tenofovir alafenamide in treatment-naïve HIV-1 patients. *AIDS.* 2018;32(11):1431-1442. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/29683855>.
38. Gallant J, Brunetta J, Crofoot G, et al. Efficacy and safety of switching to a single-tablet regimen of elvitegravir/cobicistat/emtricitabine/tenofovir alafenamide (E/C/F/TAF) in HIV-1/hepatitis B coinfecting adults. *J Acquir Immune Defic Syndr.* 2016. Available at: <http://www.ncbi.nlm.nih.gov/pubmed/27171740>.
39. DeJesus E, Herrera G, Teofilo E, et al. Abacavir versus zidovudine combined with lamivudine and efavirenz, for the treatment of antiretroviral-naïve HIV-1-infected adults. *Clin Infect Dis.* 2004;39(7):1038-1046. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/15472858>.
40. Rodriguez-French A, Boghossian J, Gray GE, et al. The NEAT study: a 48-week open-label study to compare the antiviral efficacy and safety of GW433908 versus nelfinavir in antiretroviral therapy-naïve HIV-1-infected patients. *J Acquir Immune Defic Syndr.* 2004;35(1):22-32. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/14707788>.
41. Gathe JC, Jr., Ive P, Wood R, et al. SOLO: 48-week efficacy and safety comparison of once-daily fosamprenavir / ritonavir versus twice-daily nelfinavir in naïve HIV-1-infected patients. *AIDS.* 2004;18(11):1529-1537. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/15238771>.
42. Saag M, Balu R, Phillips E, et al. High sensitivity of human leukocyte antigen-b*5701 as a marker for immunologically confirmed abacavir hypersensitivity in white and black patients. *Clin Infect Dis.* 2008;46(7):1111-1118. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/18444831>.
43. Mallal S, Phillips E, Carosi G, et al. HLA-B*5701 screening for hypersensitivity to abacavir. *N Engl J Med.* 2008;358(6):568-579. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/18256392>.
44. Sabin CA, Worm SW, Weber R, et al. Use of nucleoside reverse transcriptase inhibitors and risk of myocardial infarction in HIV-infected patients enrolled in the D:A:D study: a multi-cohort collaboration. *Lancet.* 2008;371(9622):1417-1426. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/18387667>.
45. The SMART/INSIGHT and the D:A:D Study Groups. Use of nucleoside reverse transcriptase inhibitors and risk of myocardial infarction in HIV-infected patients. *AIDS.* 2008;22(14):F17-24. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/18753925>.
46. Obel N, Farkas DK, Kronborg G, et al. Abacavir and risk of myocardial infarction in HIV-infected patients on highly active antiretroviral therapy: a population-based nationwide cohort study. *HIV Med.* 2010;11(2):130-136. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/19682101>.
47. Choi AI, Vittinghoff E, Deeks SG, Weekley CC, Li Y, Shlipak MG. Cardiovascular risks associated with abacavir and tenofovir exposure in HIV-infected persons. *AIDS.* 2011;25(10):1289-1298. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/21516027>.
48. Durand M, Sheehy O, Baril JG, Leloir J, Tremblay CL. Association between HIV infection, antiretroviral therapy, and risk of acute myocardial infarction: a cohort and nested case-control study using Quebec's public health

insurance database. *J Acquir Immune Defic Syndr*. 2011;57(3):245-253. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/21499115>.

49. Young J, Xiao Y, Moodie EE, et al. Effect of cumulating exposure to abacavir on the risk of cardiovascular disease events in patients from the Swiss HIV Cohort Study. *J Acquir Immune Defic Syndr*. 2015;69(4):413-421. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/25932884>.
50. Marcus JL, Neugebauer RS, Leyden WA, et al. Use of abacavir and risk of cardiovascular disease among HIV-infected individuals. *J Acquir Immune Defic Syndr*. 2016;71(4):413-419. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/26536316>.
51. Sabin CA, Reiss P, Ryom L, et al. Is there continued evidence for an association between abacavir usage and myocardial infarction risk in individuals with HIV? A cohort collaboration. *BMC Med*. 2016;14:61. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/27036962>.
52. Brothers CH, Hernandez JE, Cutrell AG, et al. Risk of myocardial infarction and abacavir therapy: no increased risk across 52 GlaxoSmithKline-sponsored clinical trials in adult subjects. *J Acquir Immune Defic Syndr*. 2009;51(1):20-28. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/19282778>.
53. Bedimo RJ, Westfall AO, Drechsler H, Vidiella G, Tebas P. Abacavir use and risk of acute myocardial infarction and cerebrovascular events in the highly active antiretroviral therapy era. *Clin Infect Dis*. 2011;53(1):84-91. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/21653308>.
54. Ribaldo HJ, Benson CA, Zheng Y, et al. No risk of myocardial infarction associated with initial antiretroviral treatment containing abacavir: short and long-term results from ACTG A5001/ALLRT. *Clin Infect Dis*. 2011;52(7):929-940. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/21427402>.
55. Ding X, Andraca-Carrera E, Cooper C, et al. No association of abacavir use with myocardial infarction: findings of an FDA meta-analysis. *J Acquir Immune Defic Syndr*. 2012;61(4):441-447. Available at: <http://www.ncbi.nlm.nih.gov/pubmed/22932321>.
56. Elion RA, Althoff KN, Zhang J, et al. Recent abacavir use increases risk of Type 1 and Type 2 myocardial infarctions among adults with HIV. *J Acquir Immune Defic Syndr*. 2018;78(1):62-72. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/29419568>.
57. Gallant JE, Daar ES, Raffi F, et al. Efficacy and safety of tenofovir alafenamide versus tenofovir disoproxil fumarate given as fixed-dose combinations containing emtricitabine as backbones for treatment of HIV-1 infection in virologically suppressed adults: a randomised, double-blind, active-controlled phase 3 trial. *Lancet HIV*. 2016;3(4):e158-165. Available at: <http://www.ncbi.nlm.nih.gov/pubmed/27036991>.
58. Wohl D, Thalme A, Finlayson R, et al. Renal safety of tenofovir alafenamide in patients at high risk of kidney disease. Presented at: Conference on Retroviruses and Opportunistic Infections; 2016; Boston, MA. Available at: <http://www.croiconference.org/sessions/renal-safety-tenofovir-alafenamide-patients-high-risk-kidney-disease>.
59. Eron JJ, Lelievre JD, Kalayjian R, et al. Safety and efficacy of E/C/F/TAF in HIV-infected adults on chronic hemodialysis. Presented at: Conference on Retroviruses and Opportunistic Infections; 2018; Boston, MA.
60. Zack J, Chuck S, Chu H, et al. Bioequivalence of the rilpivirine/emtricitabine/tenofovir alafenamide single-tablet regimen. *J Bioequiv Availab*. 2016;8(2):49-54. Available at: <http://www.omicsonline.org/open-access/bioequivalence-of-the-rilpivirineemtricitabine-tenofovir-alafenamide-single-tablet-regimen-jbb-1000266.pdf>.
61. Cassetti I, Madruga JV, Suleiman JM, et al. The safety and efficacy of tenofovir DF in combination with lamivudine and efavirenz through 6 years in antiretroviral-naive HIV-1-infected patients. *HIV Clin Trials*. 2007;8(3):164-172. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/17621463>.
62. Molina JM, Podsadecki TJ, Johnson MA, et al. A lopinavir/ritonavir-based once-daily regimen results in better compliance and is non-inferior to a twice-daily regimen through 96 weeks. *AIDS Res Hum Retroviruses*. 2007;23(12):1505-1514. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/18160008>.
63. Molina JM, Andrade-Villanueva J, Echevarria J, et al. Once-daily atazanavir/ritonavir versus twice-daily lopinavir/ritonavir, each in combination with tenofovir and emtricitabine, for management of antiretroviral-naive HIV-1-infected patients: 48 week efficacy and safety results of the CASTLE study. *Lancet*. 2008;372(9639):646-655. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/18722869>.
64. Ortiz R, Dejesus E, Khanlou H, et al. Efficacy and safety of once-daily darunavir/ritonavir versus lopinavir/ritonavir in treatment-naive HIV-1-infected patients at week 48. *AIDS*. 2008;22(12):1389-1397. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/18614861>.
65. Smith KY, Weinberg WG, Dejesus E, et al. Fosamprenavir or atazanavir once daily boosted with ritonavir 100 mg, plus

- tenofovir/emtricitabine, for the initial treatment of HIV infection: 48-week results of ALERT. *AIDS Res Ther.* 2008;5:5. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/18373851>.
66. Lennox JL, DeJesus E, Lazzarin A, et al. Safety and efficacy of raltegravir-based versus efavirenz-based combination therapy in treatment-naive patients with HIV-1 infection: a multicentre, double-blind randomised controlled trial. *Lancet.* 2009;374(9692):796-806. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/19647866>.
 67. DeJesus E, Rockstroh JK, Henry K, et al. Co-formulated elvitegravir, cobicistat, emtricitabine, and tenofovir disoproxil fumarate versus ritonavir-boosted atazanavir plus co-formulated emtricitabine and tenofovir disoproxil fumarate for initial treatment of HIV-1 infection: a randomised, double-blind, phase 3, non-inferiority trial. *Lancet.* 2012;379(9835):2429-2438. Available at: <http://www.ncbi.nlm.nih.gov/pubmed/22748590>.
 68. Sax PE, DeJesus E, Mills A, et al. Co-formulated elvitegravir, cobicistat, emtricitabine, and tenofovir versus co-formulated efavirenz, emtricitabine, and tenofovir for initial treatment of HIV-1 infection: a randomised, double-blind, phase 3 trial, analysis of results after 48 weeks. *Lancet.* 2012;379(9835):2439-2448. Available at: <http://www.ncbi.nlm.nih.gov/pubmed/22748591>.
 69. DeJesus E, Rockstroh JK, Lennox JL, et al. Efficacy of raltegravir versus efavirenz when combined with tenofovir/emtricitabine in treatment-naive HIV-1-infected patients: week-192 overall and subgroup analyses from STARTMRK. *HIV Clin Trials.* 2012;13(4):228-232. Available at: <http://www.ncbi.nlm.nih.gov/pubmed/22849964>.
 70. Raffi F, Jaeger H, Quiros-Roldan E, et al. Once-daily dolutegravir versus twice-daily raltegravir in antiretroviral-naive adults with HIV-1 infection (SPRING-2 study): 96 week results from a randomised, double-blind, non-inferiority trial. *Lancet Infect Dis.* 2013;13(11):927-935. Available at: <http://www.ncbi.nlm.nih.gov/pubmed/24074642>.
 71. Rousseau FS, Wakeford C, Mommeja-Marin H, et al. Prospective randomized trial of emtricitabine versus lamivudine short-term monotherapy in human immunodeficiency virus-infected patients. *J Infect Dis.* 2003;188(11):1652-1658. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/14639535>.
 72. Ford N, Shubber Z, Hill A, et al. Comparative efficacy of Lamivudine and emtricitabine: a systematic review and meta-analysis of randomized trials. *PLoS One.* 2013;8(11):e79981. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/24244586>.
 73. Rokx C, Fibriani A, van de Vijver DA, et al. Increased virological failure in naive HIV-1-infected patients taking lamivudine compared with emtricitabine in combination with tenofovir and efavirenz or nevirapine in the Dutch nationwide ATHENA cohort. *Clin Infect Dis.* 2015;60(1):143-153. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/25273080>.
 74. Rokx C, Gras L, van de Vijver D, Verbon A, Rijnders B, Study ANOC. Virological responses to lamivudine or emtricitabine when combined with tenofovir and a protease inhibitor in treatment-naive HIV-1-infected patients in the Dutch AIDS Therapy Evaluation in the Netherlands (ATHENA) cohort. *HIV Med.* 2016;17(8):571-580. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/26842457>.
 75. Maserati R, De Silvestri A, Uglietti A, et al. Emerging mutations at virological failure of HAART combinations containing tenofovir and lamivudine or emtricitabine. *AIDS.* 2010;24(7):1013-1018. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/20124969>.
 76. Karras A, Lafaurie M, Furco A, et al. Tenofovir-related nephrotoxicity in human immunodeficiency virus-infected patients: three cases of renal failure, Fanconi syndrome, and nephrogenic diabetes insipidus. *Clin Infect Dis.* 2003;36(8):1070-1073. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/12684922>.
 77. Zimmermann AE, Pizzoferrato T, Bedford J, Morris A, Hoffman R, Braden G. Tenofovir-associated acute and chronic kidney disease: a case of multiple drug interactions. *Clin Infect Dis.* 2006;42(2):283-290. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/16355343>.
 78. Gervasoni C, Meraviglia P, Landonio S, et al. Low body weight in females is a risk factor for increased tenofovir exposure and drug-related adverse events. *PLoS One.* 2013;8(12):e80242. Available at: <http://www.ncbi.nlm.nih.gov/pubmed/24312465>.
 79. Gallant JE, Moore RD. Renal function with use of a tenofovir-containing initial antiretroviral regimen. *AIDS.* 2009;23(15):1971-1975. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/19696652>.
 80. Kearney BP, Mathias A, Mittan A, Sayre J, Ebrahimi R, Cheng AK. Pharmacokinetics and safety of tenofovir disoproxil fumarate on coadministration with lopinavir/ritonavir. *J Acquir Immune Defic Syndr.* 2006;43(3):278-283. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/17079992>.
 81. Goicoechea M, Liu S, Best B, et al. Greater tenofovir-associated renal function decline with protease inhibitor-based versus nonnucleoside reverse-transcriptase inhibitor-based therapy. *J Infect Dis.* 2008;197(1):102-108. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/18171292>.

82. Kiser JJ, Carten ML, Aquilante CL, et al. The effect of lopinavir/ritonavir on the renal clearance of tenofovir in HIV-infected patients. *Clin Pharmacol Ther.* 2008;83(2):265-272. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/17597712>.
83. Gilead. Stribild package insert. 2017. Available at: http://www.gilead.com/~media/Files/pdfs/medicines/hiv/stribild/stribild_pi.pdf. Accessed: Sep 20, 2017.
84. Stellbrink HJ, Orkin C, Arribas JR, et al. Comparison of changes in bone density and turnover with abacavir-lamivudine versus tenofovir-emtricitabine in HIV-infected adults: 48-week results from the ASSERT study. *Clin Infect Dis.* 2010;51(8):963-972. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/20828304>.
85. McComsey GA, Kitch D, Daar ES, et al. Bone mineral density and fractures in antiretroviral-naive persons randomized to receive abacavir-lamivudine or tenofovir disoproxil fumarate-emtricitabine along with efavirenz or atazanavir-ritonavir: Aids Clinical Trials Group A5224s, a substudy of ACTG A5202. *J Infect Dis.* 2011;203(12):1791-1801. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/21606537>.
86. Perrot S, Aslangul E, Szwebel T, Caillat-Vigueron N, Le Jeune C. Bone pain due to fractures revealing osteomalacia related to tenofovir-induced proximal renal tubular dysfunction in a human immunodeficiency virus-infected patient. *J Clin Rheumatol.* 2009;15(2):72-74. Available at: <http://www.ncbi.nlm.nih.gov/pubmed/19265350>.
87. Lucas GM, Ross MJ, Stock PG, et al. Clinical practice guideline for the management of chronic kidney disease in patients infected with HIV: 2014 update by the HIV Medicine Association of the Infectious Diseases Society of America. *Clin Infect Dis.* 2014;59(9):e96-138. Available at: <http://www.ncbi.nlm.nih.gov/pubmed/25234519>.
88. Bictgravir/emtricitabine/tenofovir alafenamide (Biktarvy) [package insert]. Gilead Sciences.. 2018. Available at: http://www.gilead.com/~media/files/pdfs/medicines/hiv/biktarvy/biktarvy_pi.pdf.
89. Walmsley S, Baumgarten A, Berenguer J, et al. Brief report: dolutegravir plus abacavir/lamivudine for the treatment of HIV-1 infection in antiretroviral therapy-naive patients: week 96 and week 144 results from the SINGLE randomized clinical trial. *J Acquir Immune Defic Syndr.* 2015;70(5):515-519. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/26262777>.
90. Clotet B, Feinberg J, van Lunzen J, et al. Once-daily dolutegravir versus darunavir plus ritonavir in antiretroviral-naive adults with HIV-1 infection (FLAMINGO): 48-week results from the randomised open-label phase 3b study. *Lancet.* 2014. Available at: <http://www.ncbi.nlm.nih.gov/pubmed/24698485>.
91. Molina JM, Clotet B, van Lunzen J, et al. Once-daily dolutegravir is superior to once-daily darunavir/ritonavir in treatment-naive HIV-1-positive individuals: 96-week results from FLAMINGO. *J Int AIDS Soc.* 2014;17(4 Suppl 3):19490. Available at: <http://www.ncbi.nlm.nih.gov/pubmed/25393999>.
92. Orrell C, Hagins DP, Belonosova E, et al. Fixed-dose combination dolutegravir, abacavir, and lamivudine versus ritonavir-boosted atazanavir plus tenofovir disoproxil fumarate and emtricitabine in previously untreated women with HIV-1 infection (ARIA): week 48 results from a randomised, open-label, non-inferiority, phase 3b study. *Lancet HIV.* 2017. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/28729158>.
93. Kheloufi F, Allemand J, Mokhtari S, Default A. Psychiatric disorders after starting dolutegravir: report of four cases. *AIDS.* 2015;29(13):1723-1725. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/26372287>.
94. Harris M, Larsen G, Montaner JS. Exacerbation of depression associated with starting raltegravir: a report of four cases. *AIDS.* 2008;22(14):1890-1892. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/18753871>.
95. Penafiel J, de Lazzari E, Padilla M, et al. Tolerability of integrase inhibitors in a real-life setting. *J Antimicrob Chemother.* 2017;72(6):1752-1759. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/28333231>.
96. Hoffmann C, Welz T, Sabranski M, et al. Higher rates of neuropsychiatric adverse events leading to dolutegravir discontinuation in women and older patients. *HIV Med.* 2017;18(1):56-63. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/27860104>.
97. Fettiplace A, Stainsby C, Winston A, et al. Psychiatric symptoms in patients receiving dolutegravir. *J Acquir Immune Defic Syndr.* 2017;74(4):423-431. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/27984559>.
98. Kheloufi F, Boucherie Q, Blin O, Micallef J. Neuropsychiatric events and dolutegravir in HIV patients: a worldwide issue involving a class effect. *AIDS.* 2017;31(12):1775-1777. Available at: <http://www.ncbi.nlm.nih.gov/pubmed/28700395>.
99. Rockstroh JK, DeJesus E, Lennox JL, et al. Durable efficacy and safety of raltegravir versus efavirenz when combined with tenofovir/emtricitabine in treatment-naive HIV-1-infected patients: final 5-year results from STARTMRK. *J Acquir Immune Defic Syndr.* 2013;63(1):77-85. Available at: <http://www.ncbi.nlm.nih.gov/pubmed/23412015>.

100. Cahn P, Kaplan R, Sax PE, et al. Raltegravir 1200 mg once daily versus raltegravir 400 mg twice daily, with tenofovir disoproxil fumarate and emtricitabine, for previously untreated HIV-1 infection: a randomised, double-blind, parallel-group, phase 3, non-inferiority trial. *Lancet HIV*. 2017. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/28918877>.
101. Raltegravir [package insert]. Merck Sharp & Dohme Corp. 2017. Available at: http://www.merck.com/product/usa/pi_circulars/i/isentress/isentress_pi.pdf.
102. Gray J, Young B. Acute onset insomnia associated with the initiation of raltegravir: a report of two cases and literature review. *AIDS Patient Care STDS*. 2009;23(9):689-690. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/19663717>.
103. Wohl DA, Cohen C, Gallant JE, et al. A randomized, double-blind comparison of single-tablet regimen elvitegravir/cobicistat/emtricitabine/tenofovir DF versus single-tablet regimen efavirenz/emtricitabine/tenofovir DF for initial treatment of HIV-1 infection: analysis of week 144 results. *J Acquir Immune Defic Syndr*. 2014;65(3):e118-120. Available at: <http://www.ncbi.nlm.nih.gov/pubmed/24256630>.
104. Clumeck N, Molina JM, Henry K, et al. A randomized, double-blind comparison of single-tablet regimen elvitegravir/cobicistat/emtricitabine/tenofovir DF vs ritonavir-boosted atazanavir plus emtricitabine/tenofovir DF for initial treatment of HIV-1 infection: analysis of week 144 results. *J Acquir Immune Defic Syndr*. 2014;65(3):e121-124. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/24346640>.
105. Elvitegravir/cobicistat/emtricitabine/tenofovir alafenamide (Genvoya) [package insert]. 2017. Available at: http://www.gilead.com/~media/files/pdfs/medicines/hiv/genvoya/genvoya_pi.pdf.
106. Mathias AA, West S, Hui J, Kearney BP. Dose-response of ritonavir on hepatic CYP3A activity and elvitegravir oral exposure. *Clin Pharmacol Ther*. 2009;85(1):64-70. Available at: <http://www.ncbi.nlm.nih.gov/pubmed/18815591>.
107. German P, Liu HC, Szwarcberg J, et al. Effect of cobicistat on glomerular filtration rate in subjects with normal and impaired renal function. *J Acquir Immune Defic Syndr*. 2012;61(1):32-40. Available at: <http://www.ncbi.nlm.nih.gov/pubmed/22732469>.
108. Snedecor SJ, Khachatryan A, Nedrow K, et al. The prevalence of transmitted resistance to first-generation non-nucleoside reverse transcriptase inhibitors and its potential economic impact in HIV-infected patients. *PLoS One*. 2013;8(8):e72784. Available at: <http://www.ncbi.nlm.nih.gov/pubmed/23991151>.
109. Cohen CJ, Molina JM, Cahn P, et al. Efficacy and safety of rilpivirine (TMC278) versus efavirenz at 48 weeks in treatment-naïve HIV-1-infected patients: pooled results from the phase 3 double-blind randomized ECHO and THRIVE Trials. *J Acquir Immune Defic Syndr*. 2012;60(1):33-42. Available at: <http://www.ncbi.nlm.nih.gov/pubmed/22343174>.
110. Rilpivirine [package insert]. Janssen Therapeutics. 2017. Available at: <http://www.edurant.com/shared/prescribing-information-edurant.pdf>.
111. Orkin C, Squires K, Molina JM, et al. Doravirine/lamivudine/tenofovir DF continues to be non-inferior to efavirenz/emtricitabine/tenofovir DF in treatment-naïve adults with HIV-1 infection: week 96 results of the DRIVE-AHEAD trial. Presented at: ID Week. 2018. San Francisco, CA.
112. Molina JM, Squires K, Sax P, et al. Doravirine (DOR) versus ritonavir-boosted darunavir (DRV+r): 96-week results of the randomized, double-blind, phase 3 DRIVE-FORWARD Noninferiority trial Presented at: 22nd International AIDS Conference. 2018. Amsterdam, Netherlands.
113. Doravirine [package insert]. Food and Drug Administration. 2018. Available at: https://www.accessdata.fda.gov/drugsatfda_docs/label/2018/210806s000lbl.pdf.
114. Doravirine/lamivudine/tenofovir disoproxil fumarate [package insert]. Food and Drug Administration. 2018. Available at: https://www.accessdata.fda.gov/drugsatfda_docs/label/2018/210807s000lbl.pdf.
115. Lai MT, Xu M, Ngo W, et al. Characterization of doravirine-selected resistance patterns from participants in treatment-naïve Phase 3 clinical trials. Presented at: 22nd International AIDS Conference. 2018. Amsterdam, Netherlands.
116. Daar ES, Tierney C, Fischl MA, et al. Atazanavir plus ritonavir or efavirenz as part of a 3-drug regimen for initial treatment of HIV-1. *Ann Intern Med*. 2011;154(7):445-456. Available at: <http://www.ncbi.nlm.nih.gov/pubmed/21320923>.
117. Cohen CJ, Molina JM, Casetti I, et al. Week 96 efficacy and safety of rilpivirine in treatment-naïve, HIV-1 patients in two Phase III randomized trials. *AIDS*. 2013;27(6):939-950. Available at: <http://www.ncbi.nlm.nih.gov/pubmed/23211772>.
118. Cohen C, Wohl D, Arribas JR, et al. Week 48 results from a randomized clinical trial of rilpivirine/emtricitabine/tenofovir disoproxil fumarate vs. efavirenz/emtricitabine/tenofovir disoproxil fumarate in treatment-naïve HIV-1-infected adults. *AIDS*. 2014;28(7):989-997. Available at: <http://www.ncbi.nlm.nih.gov/pubmed/24508782>.

119. Group ES. Efficacy of 400 mg efavirenz versus standard 600 mg dose in HIV-infected, antiretroviral-naive adults (ENCORE1): a randomised, double-blind, placebo-controlled, non-inferiority trial. *Lancet*. 2014. Available at: <http://www.ncbi.nlm.nih.gov/pubmed/24522178>.
120. Mollan KR, Smurzynski M, Eron JJ, et al. Association between efavirenz as initial therapy for HIV-1 infection and increased risk for suicidal ideation or attempted or completed suicide: an analysis of trial data. *Ann Intern Med*. 2014;161(1):1-10. Available at: <http://www.ncbi.nlm.nih.gov/pubmed/24979445>.
121. Arenas-Pinto A, Grund B, Sharma S, et al. Risk of suicidal behavior with use of efavirenz: results from the strategic timing of antiretroviral treatment trial. *Clin Infect Dis*. 2018;67(3):420-429. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/29538636>.
122. Smith C, Ryom L, Monforte A, et al. Lack of association between use of efavirenz and death from suicide: evidence from the D:A:D study. *J Int AIDS Soc*. 2014;17(4 Suppl 3):19512. Available at: <http://www.ncbi.nlm.nih.gov/pubmed/25394021>.
123. Napoli AA, Wood JJ, Coumbis JJ, Soitkar AM, Seekins DW, Tilson HH. No evident association between efavirenz use and suicidality was identified from a disproportionality analysis using the FAERS database. *J Int AIDS Soc*. 2014;17:19214. Available at: <http://www.ncbi.nlm.nih.gov/pubmed/25192857>.
124. Nkhoma ET, Coumbis J, Farr AM, et al. No evidence of an association between efavirenz exposure and suicidality among HIV patients initiating antiretroviral therapy in a retrospective cohort study of real world data. *Medicine (Baltimore)*. 2016;95(3):e2480. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/26817882>.
125. Chang JL, Tsai AC, Musinguzi N, et al. Depression and suicidal ideation among HIV-infected adults receiving efavirenz versus nevirapine in Uganda: a prospective cohort study. *Ann Intern Med*. 2018;169(3):146-155. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/29946683>.
126. Efavirenz [package insert]. Bristol-Myers Squibb. 2016. Available at: https://www.accessdata.fda.gov/drugsatfda_docs/label/2016/020972s049-021360s0381bl.pdf.
127. Abdelhady AM, Shugg T, Thong N, et al. Efavirenz inhibits the human ether-a-go-go related current (hERG) and induces QT interval prolongation in CYP2B6*6*6 allele carriers. *J Cardiovasc Electrophysiol*. 2016;27(10):1206-1213. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/27333947>.
128. Efavirenz (600)/lamivudine/tenofovir disoproxil fumarate (Symfi) [package insert]. Food and Drug Administration. 2018. Available at: https://www.accessdata.fda.gov/drugsatfda_docs/label/2018/022142s0001bl.pdf.
129. Efavirenz (400)/lamivudine/tenofovir disoproxil fumarate (Symfi Lo) [package insert]. Available at: https://www.accessdata.fda.gov/drugsatfda_docs/label/2018/208255s0001bl.pdf.
130. Fundaro C, Genovese O, Rendeli C, Tamburrini E, Salvaggio E. Myelomeningocele in a child with intrauterine exposure to efavirenz. *AIDS*. 2002;16(2):299-300. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/11807320>.
131. Ford N, Calmy A, Mofenson L. Safety of efavirenz in the first trimester of pregnancy: an updated systematic review and meta-analysis. *AIDS*. 2011;25(18):2301-2304. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/21918421>.
132. van Lunzen J, Antinori A, Cohen CJ, et al. Rilpivirine vs. efavirenz-based single-tablet regimens in treatment-naive adults: week 96 efficacy and safety from a randomized phase 3b study. *AIDS*. 2016;30(2):251-259. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/26684822>.
133. Dolutegravir/Rilpivirine (Jaluca) [package insert]. ViiV Healthcare. 2017. Available at: https://www.gsksource.com/pharma/content/dam/GlaxoSmithKline/US/en/Prescribing_Information/Juluca/pdf/JULUCA-PI-PIL.PDF.
134. Lathouwers E, De Meyer S, Dierynck I, et al. Virological characterization of patients failing darunavir/ritonavir or lopinavir/ritonavir treatment in the ARTEMIS study: 96-week analysis. *Antivir Ther*. 2011;16(1):99-108. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/21311113>.
135. Soriano V, Arasteh K, Migrone H, et al. Nevirapine versus atazanavir/ritonavir, each combined with tenofovir disoproxil fumarate/emtricitabine, in antiretroviral-naive HIV-1 patients: the ARTEN Trial. *Antivir Ther*. 2011;16(3):339-348. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/21555816>.
136. Orkin C, Dejesus E, Khanlou H, et al. Final 192-week efficacy and safety of once-daily darunavir/ritonavir compared with lopinavir/ritonavir in HIV-1-infected treatment-naive patients in the ARTEMIS trial. *HIV Med*. 2013;14(1):49-59. Available at: <http://www.ncbi.nlm.nih.gov/pubmed/23088336>.
137. Ofotokun I, Na LH, Landovitz RJ, et al. Comparison of the metabolic effects of ritonavir-boosted darunavir or atazanavir versus raltegravir, and the impact of ritonavir plasma exposure: ACTG 5257. *Clin Infect Dis*. 2015;60(12):1842-1851. Available at: <http://www.ncbi.nlm.nih.gov/pubmed/25767256>.
138. Cobicistat [package insert]. Gilead. 2017. Available at: [http://www.gilead.com/~media/Files/pdfs/medicines/hiv/tybost/Guidelines for the Use of Antiretroviral Agents in Adults and Adolescents Living with HIV](http://www.gilead.com/~media/Files/pdfs/medicines/hiv/tybost/Guidelines%20for%20the%20Use%20of%20Antiretroviral%20Agents%20in%20Adults%20and%20Adolescents%20Living%20with%20HIV.pdf)

139. Darunavir/cobicistat (Prezcobix) [package insert]. Janssen Therapeutics. 2017. Available at: <https://www.prezcobix.com/sites/www.prezcobix.com/files/prescribing-information-prezcobix.pdf>.
140. Tashima K, Crofoot G, Tomaka FL, et al. Cobicistat-boosted darunavir in HIV-1-infected adults: week 48 results of a Phase IIIb, open-label single-arm trial. *AIDS Res Ther*. 2014;11:39. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/25926858>.
141. Molina JM, Andrade-Villanueva J, Echevarria J, et al. Once-daily atazanavir/ritonavir compared with twice-daily lopinavir/ritonavir, each in combination with tenofovir and emtricitabine, for management of antiretroviral-naive HIV-1-infected patients: 96-week efficacy and safety results of the CASTLE study. *J Acquir Immune Defic Syndr*. 2010;53(3):323-332. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/20032785>.
142. Smith KY, Tierney C, Mollan K, et al. Outcomes by sex following treatment initiation with atazanavir plus ritonavir or efavirenz with abacavir/lamivudine or tenofovir/emtricitabine. *Clin Infect Dis*. 2014;58(4):555-563. Available at: <http://www.ncbi.nlm.nih.gov/pubmed/24253247>.
143. Gallant JE, Koenig E, Andrade-Villanueva J, et al. Cobicistat versus ritonavir as a pharmacoenhancer of atazanavir plus emtricitabine/tenofovir disoproxil fumarate in treatment-naive HIV type 1-infected patients: week 48 results. *J Infect Dis*. 2013;208(1):32-39. Available at: <http://www.ncbi.nlm.nih.gov/pubmed/23532097>.
144. Gallant JE, Koenig E, Andrade-Villanueva JF, et al. Brief report: cobicistat compared with ritonavir as a pharmacoenhancer for atazanavir in combination with emtricitabine/tenofovir disoproxil fumarate: week 144 results. *J Acquir Immune Defic Syndr*. 2015;69(3):338-340. Available at: <http://www.ncbi.nlm.nih.gov/pubmed/26181707>.
145. Gammal RS, Court MH, Haidar CE, et al. Clinical Pharmacogenetics Implementation Consortium (CPIC) Guideline for UGT1A1 and atazanavir prescribing. *Clin Pharmacol Ther*. 2016;99(4):363-369. Available at: <http://www.ncbi.nlm.nih.gov/pubmed/26417955>.
146. Chan-Tack KM, Truffa MM, Struble KA, Birnkrant DB. Atazanavir-associated nephrolithiasis: cases from the US Food and Drug Administration's Adverse Event Reporting System. *AIDS*. 2007;21(9):1215-1218. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/17502736>.
147. Rockwood N, Mandalia S, Bower M, Gazzard B, Nelson M. Ritonavir-boosted atazanavir exposure is associated with an increased rate of renal stones compared with efavirenz, ritonavir-boosted lopinavir and ritonavir-boosted darunavir. *AIDS*. 2011;25(13):1671-1673. Available at: <http://www.ncbi.nlm.nih.gov/pubmed/21716074>.
148. Hamada Y, Nishijima T, Watanabe K, et al. High incidence of renal stones among HIV-infected patients on ritonavir-boosted atazanavir than in those receiving other protease inhibitor-containing antiretroviral therapy. *Clin Infect Dis*. 2012;55(9):1262-1269. Available at: <http://www.ncbi.nlm.nih.gov/pubmed/22820542>.
149. Rakotondravelo S, Poinson Y, Borsa-Lebas F, et al. Complicated atazanavir-associated cholelithiasis: a report of 14 cases. *Clin Infect Dis*. 2012;55(9):1270-1272. Available at: <http://www.ncbi.nlm.nih.gov/pubmed/22820540>.
150. Cahn P, Rolon MJ, Figueroa MI, Gun A, Patterson P, Sued O. Dolutegravir-lamivudine as initial therapy in HIV-1 infected, ARV-naive patients, 48-week results of the PADDLE (Pilot Antiretroviral Design with Dolutegravir LamivudinE) study. *J Int AIDS Soc*. 2017;20(1):1-7. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/28537061>.
151. Figueroa MI, Rolón MJ, Patterson P, Gun A, Cahn P, Sued O. Dolutegravir-lamivudine as initial therapy in HIV-infected, ARV naive patients: 96-week results of the PADDLE trial. Presented at: IAS Conference on HIV Science; 2017; Paris, France. Available at: http://www.ias2017.org/Portals/1/Files/IAS2017_LO.compressed.pdf?ver=2017-07-27-211231-197.
152. Taiwo BO, Zheng L, Stefanescu A, et al. ACTG A5353: A pilot study of dolutegravir plus lamivudine for initial treatment of Human Immunodeficiency Virus-1 (HIV-1)-infected participants with HIV-1 RNA <500000 copies/mL. *Clin Infect Dis*. 2018;66(11):1689-1697. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/29253097>.
153. Taiwo B, Zheng L, Gallien S, et al. Efficacy of a nucleoside-sparing regimen of darunavir/ritonavir plus raltegravir in treatment-naive HIV-1-infected patients (ACTG A5262). *AIDS*. 2011;25(17):2113-2122. Available at: <http://www.ncbi.nlm.nih.gov/pubmed/21857490>.
154. Bedimo RJ, Drechsler H, Jain M, et al. The RADAR study: week 48 safety and efficacy of RAltegravir combined with boosted DARunavir compared to tenofovir/emtricitabine combined with boosted darunavir in antiretroviral-naive patients. Impact on bone health. *PLoS One*. 2014;9(8):e106221. Available at: <http://www.ncbi.nlm.nih.gov/pubmed/25170938>.
155. Cahn P, Andrade-Villanueva J, Arribas JR, et al. Dual therapy with lopinavir and ritonavir plus lamivudine versus triple therapy with lopinavir and ritonavir plus two nucleoside reverse transcriptase inhibitors in antiretroviral-therapy-naive adults with HIV-1 infection: 48-week results of the randomised, open label, non-inferiority GARDEL trial. *Lancet Infect Dis*. 2014;14(7):572-580. Available at: <http://www.ncbi.nlm.nih.gov/pubmed/24783988>.