

Review Article

ART in HIV and factors affecting adherence to ART among HIV-positive individuals: a review

Hemant Kharkwal^{1*}, Jhuma Samanta¹, Srishti Kharkwal²

¹Department of Public Health, School of Pharmaceutical Science, Jigyasa University, Dehradun, Uttarakhand, India

²Department of Dravyaguna, Patanjali Bhartiya Ayurvedigyan Evam Anusandhan Sansthan, Haridwar, Uttarakhand, India

Received: 12 July 2026

Revised: 08 September 2026

Accepted: 17 September 2026

*Correspondence:

Dr. Hemant Kharkwal,

E-mail: hemant.kharkwal@gmail.com

Copyright: © the author(s), publisher and licensee Medip Academy. This is an open-access article distributed under the terms of the Creative Commons Attribution Non-Commercial License, which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

ABSTRACT

Anti-Retroviral Therapy (ART) has greatly enhanced the quality of life for individuals living with Human Immunodeficiency Virus (HIV) globally. In regions where ART is widely accessible, there has been a noticeable decline in HIV-related illness and death, making Acquired Immune Deficiency Syndrome (AIDS) a manageable chronic condition. For ART to be most effective, patients must maintain a high level of adherence. Consistent adherence is essential to achieve the full benefits of treatment and to prevent the development of drug resistance. Despite this, numerous barriers to adherence exist in both developed and developing countries. This review aims to examine the impact of HIV, evaluate adherence rates, and identify factors that influence adherence to ART among people living with HIV. It highlights the importance of providing intensive adherence counseling before starting therapy. Healthcare providers should also identify potential obstacles to adherence early and implement appropriate strategies to address them.

Keywords: Adherence, ART, Human immunodeficiency virus, Factors, AIDS

INTRODUCTION

HIV stands for “human immunodeficiency virus.” It targets and damages cells in the body’s immune system, weakening their ability to function. As HIV advances, it gradually breaks down the immune system, causing “immune deficiency.” When the immune system is weakened, a person becomes more susceptible to many different infections because the body can no longer defend itself effectively. Illnesses that occur in people with severe immune suppression are called “opportunistic infections,” since they take hold when the immune system is compromised.

AIDS, which stands for “acquired immunodeficiency syndrome,” refers to a group of illnesses and symptoms that occur when the immune system becomes severely

weakened due to HIV infection. Doctors use the number of CD4 cells in the blood, along with the presence of specific infections or cancers, to determine when HIV has advanced to AIDS. CD4 cells are a type of blood cell that play an important role in protecting the body from disease. HIV targets and destroys these cells, and when their numbers drop too low, the body becomes more vulnerable to infections and illness.

Symptoms of HIV infection

Many people who become infected with HIV are unaware of it because the virus usually does not cause symptoms immediately. Some individuals may develop a temporary, flu-like illness—such as fever, rash, joint pain, and swollen lymph nodes—around the time their body forms antibodies to the virus, typically 6 weeks to 3 months

after exposure. Even without early symptoms, a person with HIV can still spread the virus to others. The only reliable way to know if someone has HIV is to take an HIV test.

Testing of HIV

HIV testing involves examining a person's blood or other body fluids to detect antibodies that the body produces in response to HIV infection. Because of the "window period," it can take up to 14 weeks or more after infection for these antibodies to appear in high enough levels to be detected by the test.

An HIV test should always include counselling before and after the test, be carried out only with the person's informed and voluntary consent, and remain confidential, with the results disclosed only to the individual tested.

Transmission of HIV

HIV can spread when infected blood, semen, vaginal fluids, or breast milk enter another person's body. This typically happens during sex without protection or when people share needles for injecting drugs. Any person living with HIV can pass on the virus—even if they look healthy, have not developed AIDS, or are on effective treatment. Pregnant individuals with HIV can also transmit the virus to their babies during pregnancy, childbirth, or breastfeeding.

Unprotected sexual contact

Globally, the most common way HIV is transmitted is through unprotected vaginal or anal sex with an infected partner. Oral sex carries a much lower risk than vaginal or anal intercourse.

Exposure with infected blood

HIV is transmitted most efficiently when infected blood directly enters the bloodstream, such as through a transfusion of contaminated blood. Today, most blood-to-blood transmission happens when people use and share contaminated needles or other injecting equipment. Poorly sterilized medical instruments can also spread HIV. Avoiding contact with another person's blood helps prevent HIV as well as hepatitis and other blood-borne diseases.

Extensive research shows that HIV cannot be spread through shaking hands, coughing or sneezing, visiting hospitals, touching door knobs, sharing food, dishes, or drinks, drinking from fountains, using toilets or showers, mosquito or insect bites, working, living, or spending time with people who have HIV including those who are in prisons.

GLOBAL HIV AND AIDS STATISTICS

Global HIV Statistics

Approximately 40.8 million people globally were living with HIV in 2024, including 39.4 million adults (≥ 15 years) and 1.4 million children (0–14 years). Women and girls accounted for 53% of all people living with HIV. Since the beginning of the epidemic, 91.4 million people have been infected with HIV, and 44.1 million have died from AIDS-related illnesses. In 2024, 1.3 million people were newly infected, while 630,000 people died due to AIDS-related causes.

HIV diagnosis and treatment access

About 87% of people living with HIV knew their HIV status, leaving roughly 5.3 million undiagnosed. 31.6 million people were receiving antiretroviral therapy (ART), up from 7.7 million in 2010, but still below the 34 million targets for 2025. Among those receiving treatment 78% of adults (≥ 15 years) 55% of children (0–14 years), 83% of women and 73% of men had access. Additionally, 84% of pregnant women living with HIV received ART to prevent mother-to-child transmission.

Trends in new infections and mortality

New HIV infections have declined by 61% since 1996 and by 40% since 2010, but remain above the 2025 target of 370,000. Among children, new infections decreased by 62% since 2010, though recent progress has slowed. AIDS-related deaths fell by 70% since 2004 and 54% since 2010. In 2024, around 630,000 deaths occurred globally, including 75,000 children. Mortality reductions: 58% among women and girls and 50% among men and boys since 2010.

Key populations at higher risk included adult HIV prevalence (15–49 years) was 0.7% globally, with higher prevalence among men who have sex with men: 7.6%, sex workers: 2.7%, people who inject drugs: 7.1%, transgender individuals: 8.5% and people in prisons: 1.4%

Women and girls

Women and girls accounted for 45% of new infections globally and 63% in sub-Saharan Africa. Weekly, 4,000 adolescent girls and young women (15–24 years) were newly infected, mostly in sub-Saharan Africa.

Progress toward 95–95–95 targets

Globally, among all people living with HIV, 87% knew their status, 77% were on treatment and 73% were virally suppressed. Among adults, children, and by sex, coverage varied, with notable gaps among men and children.

Investments in HIV Response

In 2024, US\$ 18.7 billion was available for the HIV/AIDS response in low- and middle-income countries, 17% below the estimated need. 52% of funding came from domestic sources, which increased by 2.2% for the first time since the COVID-19 pandemic.

Funding uncertainties, including potential cuts from PEPFAR, could widen the existing 17% financing gap, jeopardizing progress toward the 2030 global targets.

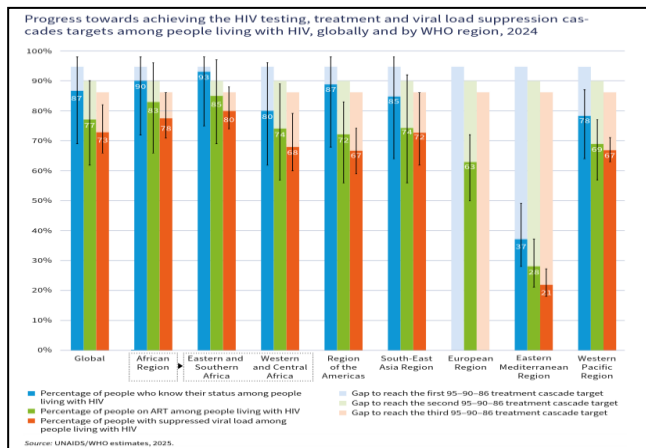


Figure 1: Progress of HIV testing, treatment and viral load suspension cascade targets in HIV patients globally by WHO⁴

STATUS OF HIV/AIDS IN INDIA

prevalence and infections

India has an estimated 2.4–2.6 million people living with HIV (PLHIV). The adult HIV prevalence is approximately 0.20%, indicating a low-level epidemic.

Trends and progress

Since 2010, new HIV infections have declined by 48% and AIDS-related deaths by 82%, significantly exceeding global reductions of 31% and 47%, respectively.

Regional variations

The epidemic is geographically concentrated: Northeastern states (Mizoram, Nagaland, Manipur) show the highest adult HIV prevalence. Southern states (Andhra Pradesh, Maharashtra, Karnataka, Tamil Nadu) account for most HIV infections in absolute numbers.

Vulnerable populations

Unprotected heterosexual sex accounts for the majority of transmissions (87%). Key populations disproportionately affected include female sex workers, men who have sex with men, transgender individuals, and people who inject drugs.

STATUS OF ART

Free and widespread access

The Indian government launched its free ART program on April 1, 2004, managed by the National AIDS Control Organization (NACO). The program is among the largest government-funded HIV treatment initiatives globally, providing lifelong, high-quality ART through over 700 ART centers nationwide.

Treat all policy

Since June 2017, India has implemented a “treat all” policy, initiating ART for all individuals diagnosed with HIV regardless of CD4 count, supporting both individual health and prevention of transmission.

Treatment cascade and targets

The program aligns with the UNAIDS 95-95-95 targets for 2025: About 95% of all people living with HIV know their HIV status. 95% of diagnosed individuals receive sustained ART and 95% of people on ART achieve viral suppression.

Current coverage

As of late 2023 approximately ~82% of PLHIV knew their HIV status, ~72% were on ART, ~68% of those on ART achieved viral suppression. A 2024 update reported 81% identified, 88% on ART, and 97% virally suppressed among those on ART.

Key challenges

Key challenges included ensuring consistent ART supply in remote areas, addressing loss to follow-up, particularly among young people and males, integrating HIV care with other health programs (e.g., TB, non-communicable diseases) and eliminating stigma and discrimination to improve service uptake.

HIV CLINICAL STAGES

Two primary clinical staging systems are used to classify HIV and HIV-related conditions for surveillance, the World Health Organization (WHO) HIV staging system and the Centers for Disease Control and Prevention (CDC) HIV classification system

The WHO first defined AIDS in 1986 and has periodically updated its classification, with the most recent version released in 2007. The WHO system divides HIV infection into four stages. Stage I included asymptomatic infection with CD4+ T cell count above 500 cells/ μ l; may include generalized lymph node enlargement. Stage II was characterized by mild symptoms, such as minor skin or mucous membrane problems and recurrent upper respiratory infections; CD4

count below 500 cells/ μ l. Stage III included Advanced symptoms including chronic unexplained diarrhoea lasting more than a month, severe bacterial infections, and tuberculosis; CD4 count below 350 cells/ μ l and stage IV (AIDS): Severe conditions such as cerebral toxoplasmosis, candidiasis of the oesophagus, trachea, bronchi, or lungs, and Kaposi's sarcoma; CD4 count below 200 cells/ μ l.

The CDC in the U.S. also developed a classification system, last updated in 2008, which categorizes HIV infection into three stages based on CD4 counts and clinical symptoms. Stage 1 showed a CD4 count $\geq$ 500 cells/ μ l, no AIDS-defining illnesses, stage 2 showed CD4 count 200–500 cells/ μ l, no AIDS-defining illnesses, while stage 3 showed CD4 count $\leq$ 200 cells/ μ l or presence of AIDS-defining illnesses.

While the CDC system is commonly used in developed countries, the WHO system is particularly suited to resource-limited settings because it does not require laboratory testing and can guide clinical management. Despite their differences, both systems allow for global statistical comparisons of HIV cases.⁹

TREATMENT OF HIV/AIDS

Anti-HIV drugs are medications that slow down the replication of the HIV virus. Because HIV is a type of retrovirus, these drugs are called antiretrovirals (ARVs). Different classes of ARVs work by targeting specific viral proteins that HIV needs to reproduce.¹

The two primary classes of anti-HIV drugs are the reverse transcriptase inhibitors (RT inhibitors) These block the viral enzyme reverse transcriptase and the second class known as protease inhibitors. These block the viral enzyme protease.

There are several types of drugs that act on different stages of the virus's replication process. Since HIV can quickly mutate and develop resistance to a single medication, patients need to take a combination of drugs to achieve the best viral suppression. This approach is called antiretroviral therapy (ART).

ART significantly slows the progression of HIV, delaying the development of symptoms. Starting therapy before AIDS symptoms appear is ideal, but even people who begin ART after an AIDS diagnosis can gain major and lasting health benefits. Although ART is highly effective, it does not cure HIV.

In addition to treating HIV itself, therapies exist to prevent or manage opportunistic infections associated with the virus. Across both developing and developed countries, ART has been shown to greatly improve the health, well-being, and life expectancy of people living with HIV.

ART

Over the past twenty years, HIV-related illness and death have declined sharply thanks to the expanded availability of affordable, more effective, and less toxic antiretroviral drugs. Antiretroviral therapy (ART) involves using a combination of at least three medications from different drug classes to block HIV replication and lower the viral load to undetectable levels. When viral replication is consistently suppressed, the immune system begins to recover, which is shown by rising CD4 counts. Higher CD4 levels slow disease progression, decrease the incidence of opportunistic infections, enhance quality of life, and extend life expectancy. Because of these achievements, ART has changed the outlook on HIV—from a condition once regarded as a “death sentence” to a chronic, manageable disease. ART was previously referred to as Highly Active Antiretroviral Therapy (HAART) or combination ART (cART).^{3-5,7-14}

GOALS OF ART

With ongoing suppression of the virus, the loss of CD4 lymphocytes slows down, allowing CD4 levels to gradually rise. This is accompanied by a partial recovery of immune responses against specific pathogens. As a result, the occurrence of opportunistic infections decreases, leading to lower morbidity and mortality.¹⁴

Table 1: Goals of ART.

Goals of ART	
Clinical goals	Increased survival and improvement in quality of life
Virological goals	Greatest possible sustained reduction in viral load
Immunological goals	Immune reconstitution, that is, both quantitative and qualitative
Therapeutic goals	Rational sequencing of drugs in manner that achieves clinical, virological and immunological goals while maintaining future treatment options, limiting drug toxicity and facilitating adherence
Preventive goals	Reduction of HIV transmission by suppression of viral load

Principles of antiretroviral therapy

From the earliest stages of HIV infection, the virus replicates at a very high rate, producing at least a billion new viral particles during active replication. Antiretroviral drugs (ARVs) work by interfering with different steps of this replication cycle.¹⁴ Each class of ARVs is named according to the stage at which it acts. Prevent HIV from binding to and entering the target cell (Fusion inhibitors and CCR5 co-receptor blockers), block the cleavage of viral RNA and inhibit reverse

transcriptase (Reverse Transcriptase Inhibitors), inhibit integrase, the enzyme that allows viral DNA to integrate into the host's chromosomes (Integrase Inhibitors), interfere with viral RNA, stopping the production of viral proteins, block the protease enzyme (Protease Inhibitors) and prevent the virus from budding off from infected cells. Among these, the most commonly used ARVs are those that inhibit the enzymes reverse transcriptase (RT), integrase, and protease.

Factors affecting adherence to art

The number of people receiving ART has risen sharply both globally and in India. However, there is limited information on the factors and characteristics influencing ART users within the Indian context. Existing research on ART adherence has mainly examined determinants at two levels: the individual level and the structural level.¹⁴⁻²¹

Individual-level barriers identified in previous studies highlight several issues linked to poor adherence, including lack of support from family or close relationships, mental health challenges such as depression and anxiety, substance or drug misuse and experiences of stigma or discrimination within families, healthcare settings, and communities.¹⁶⁻¹⁹ Supporting these findings, Mills, reported additional factors contributing to non-adherence such as substance abuse, reluctance to disclose HIV status, forgetfulness, limited access to healthcare, distrust of treatment, complex medication regimens, financial hardship, and difficulty balancing work and family obligations²⁰.

Kagee, in their work on structural barriers to ART, categorized these obstacles into the following.²¹

Poverty related factors

Research has identified several poverty-linked challenges that hinder ART adherence. These include, financial resources often need to be allocated to other pressing needs, unemployment limits the ability to consistently afford treatment-related expenses, forced migration disrupts continuity of care, the need for frequent clinic visits becomes difficult for people with limited resources, transportation costs create an additional financial burden, lack of family support further complicates adherence food insecurity is a major obstacle—patients in Botswana and Tanzania reported taking ART only when food was available, and because additional nutrition is often required at the start of treatment, they were unable to meet these needs, leading to poor adherence and childcare responsibilities can also interfere with regular treatment routines.²²⁻²⁴

Institutional related factor

Logistical barriers: Patients often experience long waiting times at clinics, sometimes having to arrive as early as 4 a.m. They may also fear potential dangers such as criminal activity or wild animals while traveling to or waiting outside the clinic.^{24,25}

Inadequate medical services: The rapid increase in the number of people on ART and the demand for comprehensive care have placed a heavy workload on nurses, resulting in high staff turnover and widespread nursing shortages in many countries. Combined with limited health infrastructure, insufficient facilities, and prolonged waiting times, these issues lead to patient dissatisfaction and discourage frequent clinic visits.²⁵

Insufficient training of counsellors. Many counselors lack adequate training, which affects the quality of support provided to patients.

Limited mental health services: The scarcity of mental health facilities and resources further weakens support for ART patients who may need psychological care.

Political and cultural barriers²⁶

Political and cultural factors can influence adherence to antiretroviral therapy (ART) among people living with HIV. Conflicting messages about AIDS care, such as claims that nutrition is superior to ART, may cause confusion among patients. Voluntary or forced migration, particularly among individuals living abroad without legal status, can disrupt access to treatment. Traditional beliefs and cultural practices may affect ART acceptance, while low health literacy can hinder understanding of treatment requirements. Furthermore, HIV-related stigma may discourage individuals from accessing or consistently adhering to treatment, and gender inequalities may limit access to healthcare and negatively affect adherence.

Socio demographic factors and ART adherence

Several studies have attempted to examine how socio-demographic characteristics influence ART adherence, but the evidence remains inconsistent. Research from different regions shows contradictory trends. For example, Levine et al, reported that younger individuals and women were more likely to adhere to ART.²⁷ In contrast, Jones et al. also acknowledged age as a factor but found that older patients and men demonstrated better adherence.²⁸ Atanga et al, presented mixed results, noting that adherence increased with age, was higher among men, highest among those with no formal education, and lowest among widows.²⁹

Gender appears to be a significant predictor of adherence as well. De Fatima et al., found that women often delay starting ART, miss appointments more frequently, report more side effects, and are at increased risk of viral rebound because they metabolize ARVs differently.³⁰ In India, where gender norms influence how men and women encounter HIV, women experience greater stigma, UNIFEM, 2010. This is supported by Kermode et al., who reported that widows of injection drug users (IDUs) in Manipur face substantial socio-economic, health, and discrimination-related challenges.³¹

Some research has also examined socio-economic status. Di Matteo, found a link between higher income and better adherence.³² However, Coetzee et al., suggested that even in resource-limited settings, if patients receive thorough preparation and counselling aligned with ART goals, adherence outcomes similar to those in high-income countries can be achieved.³³

***Health literacy as a factor for ART adherence*^{15,34-39}**

Similar to the mixed evidence surrounding socio-demographic factors, research on the role of health literacy in ART adherence has also produced inconsistent findings. Some studies indicate that even patients with limited formal education can achieve good adherence if they understand the benefits and potential side effects of ART³⁴. However, this contradicts findings by Catz et al., who reported that lower education levels and poor literacy can hinder adherence, while higher literacy supports better adherence.³⁵ Atanga et al, also found that individuals with higher literacy levels tend to adhere more consistently to treatment.³⁶

To explain these varied results, Wagner et al, proposed a framework linking health literacy to health outcomes and the use of health services. Their model consists of four interconnected components: disease knowledge and self-care, preventive care and routine medical visits, health-risk behaviors, and treatment adherence. According to this framework, people with low literacy tend to perform poorly across all these areas. Limited understanding of illness leads to missed warning signs, fewer primary and preventive care visits, and increased reliance on hospitalization and secondary care. Low literacy may also foster misconceptions, such as believing ART can prevent HIV transmission or that ART is harmful.

Supporting this view, Spies, observed that individuals with low health literacy are often less capable of managing their health and may engage in more risk behaviors. She suggests that information should be given in a simple, need-to-know manner, and that healthcare providers should regularly assess patients' understanding so that education can be tailored appropriately. Additional research reinforces these patterns: Hegazi et al., found that more educated patients in The Gambia showed higher adherence, and Wolf et al likewise reported links between low literacy and poor adherence.^{37,38} However,

Karim et al noted that increased education and knowledge alone have not significantly reduced HIV prevalence, indicating that literacy is only one piece of a complex puzzle.³⁹

Social support as a factor for ART adherence

Shumaker et al, define social support as the exchange of resources or services between individuals, where the recipient is the intended beneficiary. Social support has been shown to have significant health benefits.⁴⁰ For example, Cox et al, noted that it acts as a protective factor against stress and positively influences both physical and mental health.⁴¹

Simoni et al. categorized social support into four types: emotional, instrumental, informational, and appraisal support. Emotional support involves expressing empathy, love, trust, and care, while providing opportunities for patients to share feelings and emotions. The instrumental support includes material assistance or services that directly help a person in need, such as housing, transportation, or financial aid, typically provided by friends, colleagues, or neighbors. Informational support refers to giving advice, relevant information, or suggestions to help individuals solve problems or cope with challenges and the appraisal support which involves providing constructive feedback and guidance for self-evaluation, helping individuals assess their attitudes and behaviors.

All four types of social support are critical for patients on ART, as they enhance adherence and overall treatment outcomes.⁴²

MEASUREMENT OF ADHERENCE

It is now widely recognized that HIV has become a manageable chronic condition. However, poor adherence or non-adherence to ART can significantly reduce the effectiveness of treatment, impacting the health and survival of patients.⁴³ There is no universally accepted "gold standard" for measuring ART adherence, and various methods—such as pill counts, pharmacy records, biological markers, or self-reporting—each have their own advantages and limitations.

Directly observed therapy (DOT) or Directly administered ART (DAART)

Directly observed therapy involves healthcare providers, family members, caregivers, and the patient working together to ensure adherence.⁴⁴ This method can be implemented in hospitals or opioid substitution therapy (OST) centers, where clients regularly visit to receive care or collect medication. DOT is often used alone or in combination with other adherence measures.⁴³

Patient self-report method

Self-reported adherence, often combined with pharmacy-based data, is one of the simplest and most cost-effective ways to assess adherence.⁴⁵ While it is easy to administer and feasible in resource-limited settings, it is less sensitive and may be subject to methodological limitations.⁴⁶ Researchers often validate self-reported data by cross-checking with pill counts or conducting exit interviews⁴⁷. Despite its limitations, self-reporting is widely used in both clinical and non-clinical research due to its low cost, ease of use, and reasonable correlation with other methods.⁴⁸

Pill count method

In India, the National AIDS Control Program (NACP) primarily uses the pill count method to monitor adherence. This approach calculates adherence by

comparing the number of pills issued, consumed, and remaining at follow-up visits.⁴⁹ However, pill counts may not accurately reflect actual adherence, as discrepancies can arise between reported and consumed doses, and inconsistencies may occur among patients, doctors, and pharmacists.⁴³

Biological marker method

Biological markers, such as viral load measurements or immunological markers like CD4 and CD8 counts, provide a more objective assessment of adherence and treatment effectiveness.⁵⁰ A decreasing viral load typically indicates good adherence, although in some cases, viral loads may remain high despite proper medication use. Monitoring viral load is highly informative but expensive and may not be feasible for frequent testing in resource-limited settings.⁵¹

Table 2: Classes of ARV drugs.

Nucleoside reverse transcriptase inhibitors (NsRTI)	Non-nucleoside reverse transcriptase inhibitors (NNRTI)	Protease inhibitors (PI)
Zidovudine (AZT)*	Nevirapine (NVP)*	Saquinavir (SQV)
Stavudine (d4T)	Efavirenz (EFV)*	Ritonavir (RTV)*
Lamivudine (3TC)*	Delavirdine (DLV)	Nelfinavir (NFV)
Abacavir (ABC)*	Rilpivirine (RPV)	Amprenavir (APV)
Didanosine (ddl)	Etravirine (ETV)	Indinavir (INV)
Zalcitabine (ddC)	Doravirine (DOR)	Lopinavir (LPV)*
Emtricitabine (FTC)	Integrase Inhibitors	Fosamprenavir (FPV)
Nucleotide reverse transcriptase inhibitors (NtRTI)	Dolutegravir (DTG)*	Atazanavir (ATV)*
	Raltegravir (RGV)*	Tipranavir (TPV)
	Elvitegravir (EVG)	Darunavir (DRV)*
	Bictegravir (BIC)	
Tenofovir Disoproxil Fumarate (TDF)*	Cabotegravir (CAB)	
Tenofovir Alafenamide (TAF)		
Fusion inhibitors (FI)	CCR5 entry inhibitor	Post attachment maturation inhibitor
Enfuvirtide (T-20)	Maraviroc (MVC)	Ibalizumab (IBA)

CLASSES OF ARV DRUGS

Current NACO Guidelines on ART Initiation

According to the latest NACO guidelines, all individuals diagnosed with HIV should be started on ART, regardless of their CD4 count, WHO clinical stage, age, or population subgroup.

Ensuring high levels of adherence is critical for the effectiveness of treatment and for preventing the development of drug resistance. Counseling should begin at the patient's first contact with the clinical team. This includes preparing patients for treatment, providing psychosocial support, and engaging a caregiver, guardian,

or treatment supporter along with broader support networks. Before initiating ART, patients should typically undergo two to three preparedness counseling sessions. The waiting period for investigations and results should be used to provide counseling, initiate cotrimoxazole prophylaxis, start tuberculosis preventive therapy (TPT) for eligible patients, and ensure overall treatment readiness. Efforts should also be made to trace patients who miss appointments or are lost to follow-up, ensuring that ART is initiated for all people living with HIV registered at ART centers. Additionally, each ART center should establish linkages with NGOs and positive networks to provide localized support for patients.

What to start: antiretroviral therapy regimens

Fixed-dose combinations (FDCs) of antiretroviral drugs are preferred because they simplify both prescribing and patient administration, thereby promoting better adherence. High adherence is crucial for people living with HIV, as lifelong therapy is required and poor adherence increases the risk of drug resistance and treatment failure. National experience has demonstrated that regimens using FDCs are generally more acceptable to patients, better tolerated, and associated with higher compliance rates.

Recommended choice of first-line regimen

In alignment with WHO guidelines and the recommendations of the NACO Technical Resource Group, dolutegravir (DTG)-containing regimens have been designated as the preferred first-line treatment for HIV-positive adults, adolescents, and children weighing more than 20 kg (or older than 6 years) under the NACP since July 2020. Dolutegravir offers several advantages. It gives high genetic barrier. DTG is highly potent and has a strong genetic barrier, making it an ideal choice for first-line therapy. It enables rapid reduction of viral load, often lowering HIV RNA to <50 copies/ml within four weeks, which helps reduce transmission risk. Compared to NNRTI-based regimens, DTG regimens are associated with fewer adverse effects, including lower risk of allergic reactions and neuropsychiatric events. DTG has limited interactions with other medications commonly taken by people living with HIV.

Additionally, DTG-based therapy is suitable for individuals infected with HIV-2 or dual HIV-1/HIV-2 infection, replacing the previous need for two NRTIs plus a boosted protease inhibitor. This simplifies treatment and harmonizes care across patient populations. There is no need for regimen substitution in co-infections. DTG-based ART can be safely continued in patients co-infected with TB, HBV, or HCV without requiring modification. The recommended regimens apply to individuals infected with HIV-1, HIV-2, or dual HIV-1 and 2, unless otherwise specified. For treatment-naïve adults and adolescents, the core principle is to use a triple-drug combination from at least two different classes of antiretroviral drugs. The first-line regimen generally consists of a nucleoside reverse transcriptase inhibitor (NRTI) backbone—preferably a non-thymidine combination of tenofovir (TDF) and lamivudine (3TC)—along with an integrase strand transfer inhibitor (INSTI), preferably dolutegravir (DTG).

Based on evidence of greater efficacy and fewer side effects, the preferred first-line regimen for all people living with HIV aged over 10 years and weighing more than 30 kg is: Tenofovir (TDF 300 mg) +Lamivudine (3TC 300 mg) +Dolutegravir (DTG 50 mg)—TLD. Administered as a single fixed-dose combination (FDC) pill once daily at a fixed time convenient for the patient.

This regimen offers several advantages including harmonized treatment across adults, adolescents, pregnant women, those with HIV-1, HIV-2, or dual HIV-1 & 2 infection, women previously exposed to single-dose nevirapine, and patients co-infected with TB or hepatitis. It is simple, potent, and well-tolerated, supports decentralized service delivery and monitoring. Simplifies supply chain management and reduces monitoring requirements.

Monitoring of patients on ART

Regular follow-up and monitoring are crucial for patients receiving ART to assess clinical progress, overall well-being, and to detect any adverse drug reactions or toxicities. ART monitoring involves both clinical and laboratory assessments. Clinical monitoring includes evaluating adherence to ART, checking for side effects, and assessing general health status. Patients should be reviewed monthly for clinical progress, drug-related side effects, and adherence. Laboratory monitoring is performed at specified intervals to track treatment effectiveness and detect potential complications. A combination of clinical and laboratory monitoring should be applied consistently to all people living with HIV after ART initiation to ensure optimal treatment outcomes.

Monitoring and follow-up schedule for patients on ART

Table 3: Monitoring and follow-up schedule for patients on ART.

Monitoring tool	When to monitor
Body weight	Every visit
Height/Length in children	Every visit
Treatment adherence	Every visit
Clinical monitoring and T-staging	Every visit
4-symptom TB screening	Every visit
Screening for common NCD; Hypertension, Diabetes mellitus	Every 6 months or symptom directed
Laboratory evaluation based on ART regimen	Every 6 months or symptom directed
CD4 Count	CD4 must be done every 6 months
Viral load	At 6 months, 12 months and then every 12 months

CONCLUSION

This review highlights key factors influencing ART adherence. Variables such as age, treatment regimen, WHO clinical stage, nutritional status, sex, weight, recent CD4 count, viral load, and daily ART dosage were found to be significant predictors of adherence.

To optimize treatment outcomes, all patients should receive intensive adherence counseling prior to initiating antiretroviral therapy. Healthcare providers must proactively identify potential barriers to adherence and implement appropriate strategies to address them, ensuring sustained viral suppression and improved quality of life for people living with HIV.

preventable disease health education activity for the rural population to be taken for creating awareness about management of dog bite to prevent deaths occurring due to rabies

Funding: No funding sources

Conflict of interest: None declared

Ethical approval: Not required

REFERENCES

1. HIV/AIDS in places of detention: a toolkit for policy makers, managers and staff. UNODC, WHO. Accessed October 26, 2025.
2. Paterson DL, Swindells S, Mohr J, Brester M, Vergis EN, Squier C, et al. Adherence to protease inhibitor therapy and outcomes in patients with HIV infection. *Ann Intern Med*. 2000;133:21–30.
3. National AIDS Control Organisation. National guidelines for HIV care and treatment. Ministry of Health and Family Welfare, Government of India; 2021.
4. World Health Organization. HIV statistics, globally and by WHO region; 2024. Accessed November 17, 2025.
5. National AIDS Control Organisation. National AIDS and STD Control Programme Phase V, 2021–2026. Ministry of Health and Family Welfare, Government of India; 2021.
6. National AIDS Control Organisation. India HIV estimates: technical report. Ministry of Health and Family Welfare, Government of India; 2023.
7. Rivera-Picón C, Benavente-Cuesta MH, Quevedo-Aguado MP, Sánchez-González JL, Rodríguez-Muñoz PM. Factors associated with adherence to treatment in patients with HIV and diabetes mellitus. *J Pers Med*. 2023;13(2):269.
8. Gupta PK, Saxena A. HIV/AIDS: current updates on the disease, treatment, and prevention. *Proc Natl Acad Sci India Sect B Biol Sci*. 2021;91(3):495–510.
9. Centers for Disease Control and Prevention. Guidelines for the use of antiretroviral agents in HIV-1-infected adults and adolescents; 2022.
10. European AIDS Clinical Society. European guidelines for treatment of HIV-infected adults in Europe; 2022.
11. International AIDS Society–USA. Antiretroviral treatment guidelines; 2022.
12. World Health Organization. Antiretroviral treatment working group treatment white paper; 2010.
13. Lakshmi MG. Impact of psychoeducation on stigma and quality of life in people living with HIV/AIDS [dissertation]. University of Mysore, Department of Psychology; 2014.
14. National AIDS Control Organisation. NACO guidelines; 2021. Accessed October 30, 2025.
15. Gangte L, Popli UK. Assessment of drug adherence to antiretroviral therapy among patients in Churachandpur district, Manipur. Department of Social Work, Jamia Millia Islamia University; 2016.
16. Holstad MM, DiIorio C, Kelley ME, Resnicow K, Sharma S. Group motivational interviewing to promote adherence to antiretroviral medications and risk-reduction behaviors in HIV-infected women. *AIDS Behav*. 2010.
17. Kilbourne AM, Reynolds CF, Good CB, Sereika SM, Justice AC, Fine MJ. How does depression influence diabetes medication adherence in older patients? *Am J Geriatr Psychiatry*. 2005;13(3):202–10.
18. Tucker JS, Orlando M, Burnam MA, Sherbourne CD, Kung FY, Gifford AL. Psychosocial mediators of antiretroviral nonadherence in HIV-positive adults with substance use and mental health problems. *Health Psychol*. 2004;23(4):363–70.
19. Coetzee B, Kagee A, Vermeulen N. Structural barriers to adherence to antiretroviral therapy in a resource-constrained setting: the perspectives of health care providers. *AIDS Care*. 2011;23(2):146–51.
20. Mills EJ, Nachega JB, Bangsberg DR, Singh S, Rachlis B, Wu P, et al. Adherence to HAART: a systematic review of developed and developing nation patient-reported barriers and facilitators. *PLoS Med*. 2006;3(11):e438.
21. Kagee A, Remien RH, Berkman A, Hoffman S, Campos L, Swartz L. Structural barriers to ART adherence in Southern Africa: challenges and potential ways forward. *Glob Public Health*. 2011;6(1):83–97.
22. Kagee A, Le Roux M, Dick J. Treatment adherence among primary care patients in a historically disadvantaged community in South Africa: a qualitative study. *J Health Psychol*. 2007;12(3):444–60.
23. Holstad MKM, Pace JC, De AK, Ura DR. Factors associated with adherence to antiretroviral therapy. *J Assoc Nurses AIDS Care*. 2006;17(2):4–15.
24. Hardon AP, Akurut D, Comoro C, Ekezie C, Irunde HF, Gerrits T, et al. Hunger, waiting time and transport costs: time to confront challenges to ART adherence in Africa. *AIDS Care*. 2007;19(5):658–65.
25. Largu MA, Oprea L, Manciu C. Adherence to antiretroviral therapy in HIV/AIDS-infected individuals: reasons for non-adherence in the HIV-positive population of northeastern Romania. *Soc Res Rep*. 2015;27.
26. Nattrass N. AIDS, science and governance: the battle over antiretroviral therapy in post-apartheid

- South Africa. Southern African HIV Clinicians Journal. 2006. Available from: <http://www.aidstruth.org/Rolling-out-HAART-in-SouthAfrica.pdf>, Accessed on 10-Jun-26
27. Levine AJ, Hinkin CH, Castellon SA, Mason KI, Lam MN, Perkins A, et al. Variations in patterns of highly active antiretroviral therapy (HAART) adherence. *AIDS Behav*. 2005;9(3):355–62.
28. Jones D, Cook R, Rodriguez A, Waldrop-Valverde D. Personal HIV knowledge, appointment adherence and HIV outcomes. *AIDS Behav*. 2012;2(2):67–80.
29. Atanga MBS, Akenji JF, Atashili J, Nde FP. Can support group membership enhance knowledge of ART and adherence? Views and quotes from people living with HIV/AIDS in the Fako Division, SWR, Cameroon; 2015.
30. De Fátima Bonolo P, Ceccato MDGB, Rocha GM, de Assis Acúrcio F, Campos LN, Guimarães MDC. Gender differences in nonadherence among Brazilian patients initiating antiretroviral therapy. *Clinics (Sao Paulo)*. 2013;68(5):612–20.
31. Kermode M, Devine A, Chandra P, Dzuvichu B, Gilbert T, Herrman H. Some peace of mind: assessing a pilot intervention to promote mental health among widows of injecting drug users in north-east India. *BMC Public Health*. 2008;8:1.
32. DiMatteo MR. Variations in patients' adherence to medical recommendations: a quantitative review of 50 years of research. *Med Care*. 2004;42(3):200–9.
33. Coetzee B, Kagee A, Vermeulen N. Structural barriers to adherence to antiretroviral therapy in a resource-constrained setting: the perspectives of health care providers. *AIDS Care*. 2011;23(2):146–51.
34. Mathes T, Pieper D, Antoine SL, Eikermann M. Adherence-enhancing interventions for highly active antiretroviral therapy in HIV-infected patients: a systematic review. *HIV Med*. 2013;14(10):583–95.
35. Catz S, Heckman T, Kochman A. Adherence to HAART therapy among older adults living with HIV disease. In: *Fourth International Conference on the Biophysical Aspects of HIV Infection*; Ottawa, Canada; 1999. Poster 18.
36. Atanga MBS, Akenji JF, Atashili J, Nde FP. Can support group membership enhance knowledge of ART and adherence? Views and quotes from people living with HIV/AIDS in the Fako Division, SWR, Cameroon; 2015.
37. Hegazi A, et al. Literacy, education and adherence to antiretroviral therapy in The Gambia. *AIDS Care*. 2010;22(11):1340–5.
38. Wolf MS. Literacy, self-efficacy, and HIV medication adherence. *Patient Educ Couns*. 2007;65(2):253–60.
39. Karim SSA, Churchyard GJ, Karim QA, Lawn SD. HIV infection and tuberculosis in South Africa: an urgent need to escalate the public health response. *Lancet*. 2009;374(9693):921–33.
40. Shumaker SA, Brownell A. Introduction: social support interventions. *J Soc Issues*. 1984;40(1):1–4.
41. Cox LE. Social support, medication compliance and HIV/AIDS. *Soc Work Health Care*. 2002;35(1–2):425–60.
42. Simoni JM, Kurth AE, Pearson CR, Pantalone DW, Merrill JO, Frick PA. Self-report measures of antiretroviral therapy adherence: a review with recommendations for HIV research and clinical management. *AIDS Behav*. 2006;10(3):227–45.
43. Sahay S, Reddy KS, Dhayarkar S. Optimizing adherence to antiretroviral therapy. *Indian J Med Res*. 2011:835–49.
44. Eramova I, Matic S, Munz M. HIV/AIDS treatment and care: clinical protocols for the WHO European Region. Copenhagen: WHO Regional Office for Europe; 2007.
45. Kaboré L, Muntner P, Chamot E, Zinski A, Burkholder G, Mugavero MJ. Self-report measures in the assessment of antiretroviral medication adherence: comparison with medication possession ratio and HIV viral load. *J Int Assoc Provid AIDS Care*. 2014:156–62.
46. Muñoz-Moreno JA, Fumaz CR, Ferrer JM, Tuldra A, Rovira T, Viladrich C, et al. Assessing self-reported adherence to HIV therapy by questionnaire: the SERAD (Self-Reported Adherence) study. *AIDS Res Hum Retroviruses*. 2007;1166–75.
47. Chalker JC, Andualet T, Gitau LN, Ntaganira J, Obua C, Tadege H, et al. Measuring adherence to antiretroviral treatment in resource-poor settings: the feasibility of collecting routine data for key indicators. *BMC Health Serv Res*. 2010.
48. Lu M, Safren AS, Skolnik PR, Rogers WH, Coady W, Hardy H. Optimal recall period and response task for self-reported HIV medication adherence. *AIDS Behav*. 2008:86–94.
49. McKinney O, Pearce D, Banta J, Mataya R, Muula A, Crounse J, et al. Evaluation of pill-count adherence with self-reported adherence in assessing antiretroviral therapy behavior of women living with HIV at a faith-based clinic in Malawi. *HIV Curr Res*. 2017:1–6.
50. Platt MO, Evans D, Keegan PM, McNamara L, Parker IK, Roberts LM, et al. Low-cost method to monitor patient adherence to HIV antiretroviral therapy using multiplex cathepsin zymography. *Mol Biotechnol*. 2017:56–64.
51. Population Council. Adherence to antiretroviral therapy in adults: a guide for trainers. Nairobi, Kenya: Population Council; 2004.

Cite this article as: Kharkwal H, Samanta J, Kharkwal S. ART in HIV and factors affecting adherence to ART among HIV-positive individuals. *Int J Community Med Public Health* 2026;13:6953-62.