

Mini Review

Optimizing Lifelong Care: Advances and Challenges in Antiretroviral Therapy for People Living with HIV

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Citation: Bobosha R (2025). Optimizing Lifelong Care: Advances and Challenges in Antiretroviral Therapy for People Living with HIV V1(2)

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Received date: December 09 2025; **Accepted date:** December 23, 2025; **Published date:** December 30,2025

Keywords: HIV, Antiretroviral Therapy, ART, AIDS, Viral Suppression, Integrase Inhibitors, HIV Drug Resistance, Long-Acting Injectable Therapy, CD4 Cells, HIV Management

Abstract

The introduction of antiretroviral therapy (ART) has transformed Human Immunodeficiency Virus (HIV) infection from a life-threatening disease into a manageable chronic condition. Continuous improvements in ART regimens have significantly reduced HIV-related morbidity, mortality, and transmission while improving the quality of life for millions of individuals worldwide. Despite remarkable progress, challenges such as medication adherence, drug resistance, long-term toxicities, healthcare disparities, and access to treatment continue to affect optimal patient outcomes. Recent developments, including long-acting injectable therapies, personalized medicine, and simplified treatment regimens, have further enhanced HIV management. This article reviews the principles of ART, current treatment strategies, mechanisms of action, clinical benefits, adverse effects, challenges, and future directions in HIV care. Understanding these evolving therapeutic approaches is essential for healthcare professionals to provide evidence-based, patient-centered care and support global efforts toward ending the HIV epidemic.

Introduction

Human Immunodeficiency Virus (HIV) remains one of the most significant global public health challenges. Since its discovery in the early 1980s, HIV has infected millions of individuals worldwide. The virus primarily targets CD4+ T lymphocytes, progressively weakening the immune system and increasing susceptibility to opportunistic infections and malignancies.

The development of antiretroviral therapy (ART) has revolutionized HIV treatment. Rather than curing the infection, ART effectively suppresses viral replication, preserves immune function, prevents disease progression, and dramatically reduces HIV transmission. Modern ART enables individuals living with HIV to achieve life expectancies approaching those of the general population

when treatment is initiated early and maintained consistently.

Understanding HIV Infection

HIV is a retrovirus that attacks the body's immune system, specifically CD4+ T cells. If untreated, HIV gradually destroys immune defenses, eventually leading to acquired immunodeficiency syndrome (AIDS).

Stages of HIV Infection

1. Acute HIV infection
2. Chronic HIV infection (clinical latency)
3. AIDS

Without treatment, progression from HIV infection to AIDS generally occurs over several years, although the timeline varies among individuals.

Classes of Antiretroviral Drugs

1. Nucleoside/Nucleotide Reverse Transcriptase Inhibitors (NRTIs)

These drugs block reverse transcriptase by acting as defective nucleotides, terminating viral DNA synthesis.

Examples:

- Tenofovir
- Emtricitabine
- Lamivudine
- Abacavir

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Non-Nucleoside Reverse Transcriptase Inhibitors (NNRTIs)

NNRTIs bind directly to reverse transcriptase and inhibit its activity.

Examples:

- Efavirenz
- Doravirine
- Rilpivirine

Protease Inhibitors (PIs)

Protease inhibitors prevent viral maturation by inhibiting the HIV protease enzyme.

Examples:

- Darunavir
- Atazanavir

Integrase Strand Transfer Inhibitors (INSTIs)

These drugs prevent integration of viral DNA into the host genome.

Examples:

- Dolutegravir
- Bictegravir
- Raltegravir

INSTIs are currently recommended as first-line therapy in many treatment guidelines due to their excellent efficacy and tolerability.

Recommended Initial ART Regimens

Current treatment guidelines recommend initiating ART immediately after HIV diagnosis whenever possible.

Common first-line regimens include:

- Bictegravir + Tenofovir + Emtricitabine
- Dolutegravir + Lamivudine
- Dolutegravir + Tenofovir + Lamivudine

Selection depends on:

- Drug resistance testing
- Pregnancy status
- Kidney function
- Hepatitis B coinfection
- Drug interactions
- Patient preference

Benefits of Early ART

Early initiation provides numerous clinical advantages:

- Rapid viral suppression
- Preservation of CD4 cell count
- Reduced opportunistic infections
- Lower cardiovascular complications
- Decreased chronic inflammation
- Reduced HIV transmission
- Improved long-term survival

Long-Acting Antiretroviral Therapy

Recent advances include long-acting injectable medications administered monthly or every two months.

Advantages include:

- Improved adherence
- Reduced pill burden
- Greater patient satisfaction
- Consistent drug exposure

These therapies represent an important innovation in HIV management.

Future Directions

Emerging areas of HIV research include:

- Broadly neutralizing antibodies
- HIV therapeutic vaccines
- Gene-editing technologies
- Long-acting implants
- Novel capsid inhibitors
- Personalized ART
- Functional HIV cure strategies

While a definitive cure remains elusive, scientific advances continue to improve long-term outcomes.

Conclusion

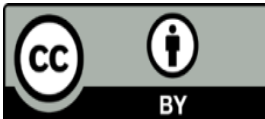
Antiretroviral therapy has fundamentally changed the landscape of HIV treatment by enabling sustained viral suppression, preserving immune function, and improving survival. Early diagnosis, prompt initiation of ART, and lifelong adherence remain the cornerstones of effective HIV management. The emergence of long-acting therapies, innovative drug classes, and personalized treatment approaches offers new opportunities to optimize patient care. Continued investment in research, equitable healthcare access, patient education, and stigma reduction will be essential to achieving global HIV control and improving the lives of people living with HIV.

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DOI:10/JCRRT/2025/010

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