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Recent advances in HIV research and the global response

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Abstract
Despite remarkable scientific progress, HIV remains a significant global health challenge. By 2024, approximately 40.8 million people were living with HIV, and major gaps persisted in treatment access, prevention, and equity. However, recent scientific breakthroughs — including a 2025 study demonstrating successful activation of early immune responses using an HIV vaccine candidate — have renewed hope for ending the epidemic. This paper summarizes recent global data, prevention strategies, and new vaccine research with potential for future impact.

Keywords: HIV, PrEP, PEP

Introduction

Recent Advances in HIV Research and the Global Response

Four decades into the HIV epidemic, global efforts have dramatically transformed prevention, treatment, and care. Antiretroviral therapy (ART), prevention tools such as PrEP and PEP, and global initiatives (e.g., UNAIDS 95-95-95) have significantly reduced HIV-related mortality. They mean that by 2030, 95% of people living with HIV should know their status, 95% of those diagnosed should receive antiretroviral therapy (ART), and 95% of those on ART should have viral suppression

World AIDS Day 2025, under the theme "Overcoming disruption, transforming the AIDS response," emphasizes resilience, innovation, and human-rights-based approaches to achieve the goal of ending AIDS by 2030. Despite progress, disruptions in services and social inequalities continue to heighten vulnerability in many communities. Recent scientific advances, particularly in vaccine development, offer promising pathways forward.

Epidemiological Overview

- 40.8 million People living with HIV globally (2024).
- 1.3 million New HIV infections in 2024.
- 630,000 HIV-related deaths reported in 2024.
- 77% of people living with HIV were receiving ART.
- 73% of those on treatment achieved viral suppression.

These statistics highlight both significant achievements and persistent inequities, especially among children, adolescents, and marginalized populations.

Major Milestones in HIV History

- **1930s:** HIV is believed to have originated from a chimpanzee virus in West Africa and passed to humans through blood exposure during hunting.
- **Early 1980s:** Doctors begin observing unusual pneumonia, cancers, and infections in young gay men in the U.S. — the earliest identified AIDS cases.
- 1981:
- The illness is initially termed GRID (Gay-Related Immune Deficiency).
- Similar cases are found among injection drug users.
- Canada reports its first confirmed AIDS case.
- 1982-1983:

- The disease is officially named AIDS (Acquired Immune Deficiency Syndrome).
- Evidence shows HIV spreads through sex, blood transfusions, and injection drug use.

1986
- First International Conference on AIDS held in Georgia, USA.
- First Canadian Conference on AIDS held in Montreal.
- HIV is found to be transmissible through breastfeeding.

1987
AZT, the first antiretroviral drug, is approved by the U.S. FDA.

1988
World AIDS Day is observed for the first time on December 1.

1991
The red ribbon becomes the global symbol of AIDS awareness.

1990s
- Canadian researcher Dr. Mark Wainberg, supported by CANFAR, helps develop 3TC, a key antiretroviral used in combination therapy.
- Combination therapy produces a 60-80% reduction in AIDS-related deaths.

1999
- WHO reports AIDS as the 4th leading cause of death globally and the leading cause of death in Africa.
- An estimated 33 million people are living with HIV; 14 million deaths since the epidemic began.

2000s
- The UN Millennium Development Goals (MDGs) include targets to halt and reverse HIV, malaria, and TB.
- UNAIDS partners with five pharmaceutical companies to reduce drug costs for developing countries.
- WHO launches the "3 by 5" initiative to provide treatment to 3 million people by 2005.

2010
CANFAR researcher Dr. Kelly McDonald announces a new HIV vaccine candidate showing promising effects in reducing HIV progression.

2011
Timothy Ray Brown (the Berlin Patient) becomes the first person cured of HIV.

2012
The FDA approves PrEP (Pre-Exposure Prophylaxis) for HIV prevention in high-risk individuals.

2016: The United Nations sets a global target to end the AIDS epidemic by 2030, emphasizing expanded prevention, testing, and treatment efforts.

2017-2022: Early research shows that long-acting injectable antiretroviral therapies and simplified treatment regimens significantly improve adherence to ART.

2021: The FDA approves Apretude (cabotegravir), the first long-acting injectable PrEP option for HIV prevention. Clinical trials confirm that it is more effective than daily oral PrEP in reducing HIV acquisition risk.

2024: Approximately 630,000 global deaths occur from HIV/AIDS-related illnesses, continuing the declining trend seen since the mid-2000s. However, major inequalities in access to diagnosis, treatment, and prevention remain, especially in sub-Saharan Africa.

Advances in HIV Prevention
PrEP (Pre-Exposure Prophylaxis)
PrEP remains one of the most effective HIV prevention methods:
- Reduces HIV risk from sexual exposure by about 99% when taken daily as prescribed.
- Reduces risk from injection drug use by at least 74%.
- Effectiveness declines sharply when adherence is inconsistent.

PrEP scale-up has been a major contributor to reductions in new HIV infections in many regions.

PEP (Post-Exposure Prophylaxis)
- **Exposure To Hiv Is A Medical Emergency:** initiation of PEP should be immediately within 2 hours of an exposure but no later than 72 hours after an exposure—because the effectiveness of PEP decreases over time after 2 hours.
- Assessment of exposure, HIV and other baseline testing, and other related activities can proceed after the first dose of PEP is administered.
- Intended only for emergency situations, not regular prevention.

PEP remains a crucial intervention in occupational exposures, sexual assault cases, and unplanned high-risk encounters.

How PEP Works
- After percutaneous or mucosal exposure to HIV, the virus begins replicating locally in tissue macrophages and dendritic cells.
- If the body cannot contain the virus, HIV spreads to regional lymph nodes within 48-72 hours of exposure.
- Systemic viremia (virus entering the bloodstream) typically occurs within 72-120 hours (3-5 days) after exposure.
- Because HIV starts replicating and spreading quickly, post-exposure prophylaxis (PEP) must begin as soon as possible.
- The most effective PEP regimens are those that:

1. act rapidly,
2. target multiple stages of the viral life cycle, and
3. have high antiviral potency.

Early initiation of PEP can block viral replication before the virus becomes established in lymph nodes or the bloodstream. EP must be taken exactly as instructed and for

28 days.

- Do not skip a dose or fail to complete the full month as this makes it less likely to work.
- Do not double a dose if you miss one.
- If you do miss a dose and you remember in less than 24 hours, take the next one as soon as you remember.
- If you miss more than 48 hours of PEP it will be discontinued.

The medication now used for PEP is a single tablet of tenofovir disoproxil/emtricitabine (also known as Truvada) and two tablets of raltegravir.
Side effects from PEP are likely to be mild ones in the first few days, such as nausea, headaches or tiredness.
Antacids (containing aluminium, magnesium or calcium), multivitamins and iron supplements should be avoided while on raltegravir once daily.
Pregnant or breastfeeding can still take PEP.

Major Research in HIV Vaccine

A major scientific milestone was achieved in May 2025, when researchers from IAVI and Scripps Research published findings from two Phase-1 clinical trials in Science.

Key features of the Study

- Nearly 80 participants from North America and Africa were enrolled.
- The vaccine strategy successfully activated early immune responses critical for developing broadly neutralizing antibodies (bnAbs).
- One trial used a stepwise (heterologous) vaccination approach, showing enhanced immune maturation.
- Both trials confirmed the safety and feasibility of initiating bnAb-precursor responses in diverse human populations.
- The platform utilized mRNA technology, allowing rapid development similar to COVID-19 vaccines.

This is one of the strongest proofs of concept to date showing that humans can be primed toward bnAb development — one of the greatest hurdles in HIV vaccine science. It lays essential groundwork for later-phase trials and represents a concrete step toward a globally effective HIV vaccine.

Discussion

The global HIV response stands at a crossroads. Service disruptions, socioeconomic inequalities, and stigma remain major barriers to progress. At the same time, innovations in prevention (PrEP/PEP), expansions in ART access, and scientific breakthroughs — such as the promising 2025 vaccine findings — demonstrate powerful momentum.
To meet the goal of ending AIDS by 2030, health systems must prioritize:

- Sustained political leadership,
- Human-rights-centred approaches,
- Community-led innovation and engagement,
- Equitable access to prevention, care, and treatment.

Conclusion

Recent years have demonstrated both the challenges and the transformative potential of global HIV efforts. Despite ongoing vulnerabilities, the resilience of communities and rapid scientific advancement, especially the 2025 vaccine trial results, offer renewed hope. Achieving an HIV-free future will depend on maintaining strong political commitments, eliminating inequities, and supporting ground-breaking research that brings the world closer to an effective HIV vaccine.

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