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Review

Comprehensive Review on HIV: Unravelling Its History, Virology, Epidemiology, Sociobehavioral Dynamics with Focus on Challenges, Impact of Covid-19, Novel Treatments, and Emerging Research Trends and Current Research

Shashank Tiwari[1], Preet Patel[2], Kirti Singh[3], Shreya Verma[4], Kartikay Prakash[*5]

[1]Director (Academic and Research), Department of Pharmacy, Lucknow Model College of Pharmacy and Research, Lucknow, 226008, Uttar Pradesh, Bharat.

[2,3]B. Pharm, Lucknow Model college of Pharmacy and Research, Lucknow, 226008, Uttar Pradesh, Bharat.

*[4,*5]Assistant Professor, Lucknow Model College of Pharmacy and Research, Lucknow, 226008, Uttar Pradesh, Bharat.*

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Corresponding Author: Kartikay Prakash

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Abstract:

This review aims to provide a comprehensive virology and pathogenesis of HIV, the epidemiological landscape, challenges in diagnosis and treatment, Herbal Treatment, FDA approved Novel Drug for the Treatment of HIV and the socio-behavioral aspects affecting prevention and care, and promising directions in research, including vaccine development and potential eradication strategies. By consolidating insights from diverse fields, this review intends to contribute to a deeper understanding of HIV and its multifaceted impacts, aiming to inform future directions for research, policy, and public health interventions.

Keywords: *Human Immunodeficiency Virus, HIV, Virology, Pathogenesis, Current research, FDA approved novel drugs.*

INTRODUCTION

Human Immunodeficiency Virus (HIV) is a complex retrovirus that has garnered global attention due to its profound impact on public health. Discovered in the latter half of the 20th century, HIV has been a significant focal point in medical research and intervention efforts. This virus, primarily transmitted through specific bodily fluids, has caused a pandemic that has affected millions of lives worldwide. Its evolution from an enigmatic and fatal infection to a manageable chronic illness has been attributed to groundbreaking advancements in antiretroviral therapy (ART) and preventive measures. Despite these strides, the ongoing challenges of transmission, prevalence, and the quest for a definitive cure continue to underscore the critical need for sustained research and intervention strategies. The impact of the HIV/AIDS pandemic on people's lives, neighborhoods, and healthcare systems worldwide has been devastating and will continue to pose significant challenges. Thanks to remarkable advancements in antiretroviral therapy (ART) and preventive measures, HIV has transformed from an unknown and often fatal infection into a manageable chronic illness. However, it's important to emphasize that despite these strides, the ongoing transmission, prevalence, and quest for a cure for HIV/AIDS underscore the urgent necessity for further research and intervention. The transmission of the disease from chimpanzees to humans occurred when individuals came into contact with their infected blood during hunting activities for food. The human immunodeficiency virus (HIV) has been documented in the United States since at least the mid to late 1970s, and its gradual global spread initiated in Africa, persisting for decades thereafter. Human contraction of HIV is most likely through direct blood contact while handling or consuming meat from apes infected with SIV. [1].

Similar Immunodeficiency virus

The virus found in chimpanzees is known as the Simian Immunodeficiency Virus (SIV). The earliest confirmed case of HIV infection in a human blood sample dates back to Kinshasa, Congo, around 1959. The identification of the first known patient with HIV and AIDS occurred in the 1960s; this individual was a Scandinavian man who had traveled to West-Central Africa.

Types of HIV Virus

This virus exists in two primary forms: HIV-1 and HIV-2.

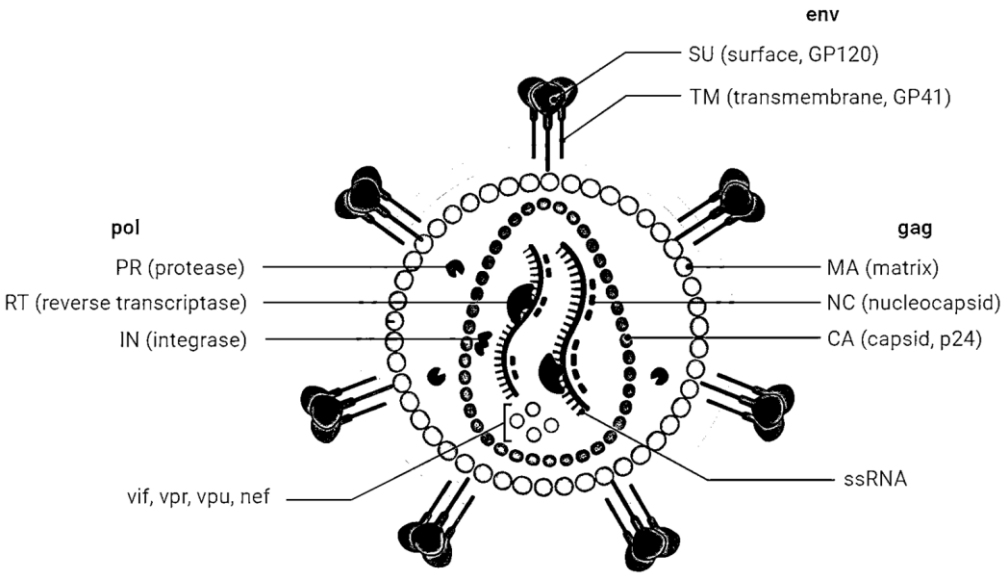

Fig 1: HIV-1 Virion

HIV-1 and HIV-2, although they both compromise the immune system, differ in their progression rates. HIV-2 generally advances at a slower pace and exhibits a lower transmission rate compared to HIV-1. With successful treatment, individuals living with HIV can lead long and healthy lives despite the challenges posed by the virus. [2].

HISTORY OF HIV VIRUS

The narrative of HIV's history is intricate, encompassing scientific breakthroughs, societal responses, and persistent obstacles.

In 1981, the initial cases of an enigmatic illness surfaced among young gay men in the United States, presenting as uncommon pneumonia, Kaposi's sarcoma, and other opportunistic infections. This marked the early recognition of what would later be termed AIDS (Acquired Immuno-deficiency Syndrome).

By 1983, French researchers Luc Montagnier and Françoise Barré-Sinoussi from the Pasteur Institute in Paris isolated a novel retrovirus initially named Lymphadenopathy-Associated Virus (LAV), later renamed Human Immunodeficiency Virus (HIV). Concurrently, American scientist Robert Gallo, working at the National Cancer Institute, identified a similar virus called HTLV-III [3].

In 1984, the U.S. Department of Health and Human Services announced the likely cause of AIDS—a virus that would later be confirmed as HIV. This led to the development of the blood test for detecting HIV antibodies.

By 1985, the FDA licensed the first commercial blood test for HIV, coinciding with actor Rock Hudson publicly disclosing his AIDS diagnosis, which contributed to increased awareness and reduced stigma [4].

The year 1986 saw the official naming of the virus as Human Immunodeficiency Virus (HIV) by the International Committee on the Taxonomy of Viruses, alongside the inaugural International AIDS Conference in Atlanta, Georgia.

In 1987, the FDA approved the first antiretroviral drug, AZT (zidovudine), for treating HIV/AIDS, while the World Health Organization (WHO) established the Global Program on AIDS.

Tragically, in 1991, the death of Freddie Mercury, the lead singer of Queen, due to complications from AIDS-related illness, further spotlighted the disease, raising public awareness.

The turning point arrived in 1996 with the introduction of Highly Active Antiretroviral Therapy (HAART), drastically reducing mortality rates and transforming HIV into a manageable chronic condition for many [5].

By 2000, the United Nations adopted the Millennium Development Goals, targeting the halt and reversal of HIV/AIDS spread by 2015, catalyzing global efforts to enhance treatment, prevention, and support services.

In 2012, the FDA approved pre-exposure prophylaxis (PrEP) for HIV prevention among high-risk populations, significantly reducing transmission risk when consistently taken.

From 2020 to 2023, the COVID-19 pandemic had widespread implications for HIV/AIDS services, treatment, and testing worldwide, emphasizing the challenges in sustaining healthcare delivery amid a global crisis [6-7].

Symptoms of HIV

The symptoms of HIV (Human Immunodeficiency Virus) can vary significantly among individuals and across different stages of the infection. It's important to note that not everyone experiences symptoms immediately after contracting the virus, and some individuals may remain asymptomatic for an extended period [8].

Early-Stage Symptoms (Acute HIV Infection):	Chronic Stage Symptoms (Asymptomatic HIV):	Advanced Stage Symptoms (AIDS):
Fever	Following the acute stage, some individuals may enter a prolonged period without experiencing any symptoms. However, the virus remains active and continues to weaken the immune system.	Skin Issue
Fatigue		Neurological Problems
Rash		Night Sweats and Fever
Sore Throat		Swollen Lymph Nodes
Muscle Pain		Respiratory Problems
Joint Pain		Weight Loss and Fatigue
Headache		Recurrent Infections

Table 1: Symptoms of HIV

COMPREHENSIVE VIROLOGY AND PATHOGENESIS OF HIV

The comprehensive virology and pathogenesis of HIV can be understood through the following key aspects:

1. **Viral Entry:** The process of HIV-1 and HIV-2 entry into cells involves three main stages: binding to the cell, activation, and fusion. The viral envelope interacts with the CD4+ protein present on the cell surface, initiating the infection.
2. **Cell Tropism:** HIV exhibits an affinity for CD4+ cells originating from both lymphocytic and non-lymphocytic sources. This specific targeting of CD4+ cells plays a pivotal role in the progression of HIV infection [9].
3. **Replication Mechanism:** HIV replicates via reverse transcriptase, an enzyme that converts its RNA genome into complementary DNA (cDNA). The integrated cDNA within the host cell's DNA leads to the production of additional viral RNA and proteins.
4. **Disease Progression:** HIV undermines the immune system by infecting and eliminating CD4+ T cells, resulting in immunodeficiency during later disease stages. Additionally, HIV impacts other immune cells like macrophages and dendritic cells [10].
5. **Genetic Variability:** HIV displays significant variability owing to its error-prone reverse transcriptase. This diversity contributes to drug resistance development and influences the course and outcome of HIV-1 infection [11].
6. **Influence of Host Factors:** Various host factors, including genetic predisposition, age, and concurrent infections with other pathogens, can impact the severity and progression of HIV infection.
7. **Treatment Advancements:** The advent of highly active antiretroviral therapy (HAART) has markedly enhanced the management of HIV infection, significantly reducing the risk of disease advancement. [12].

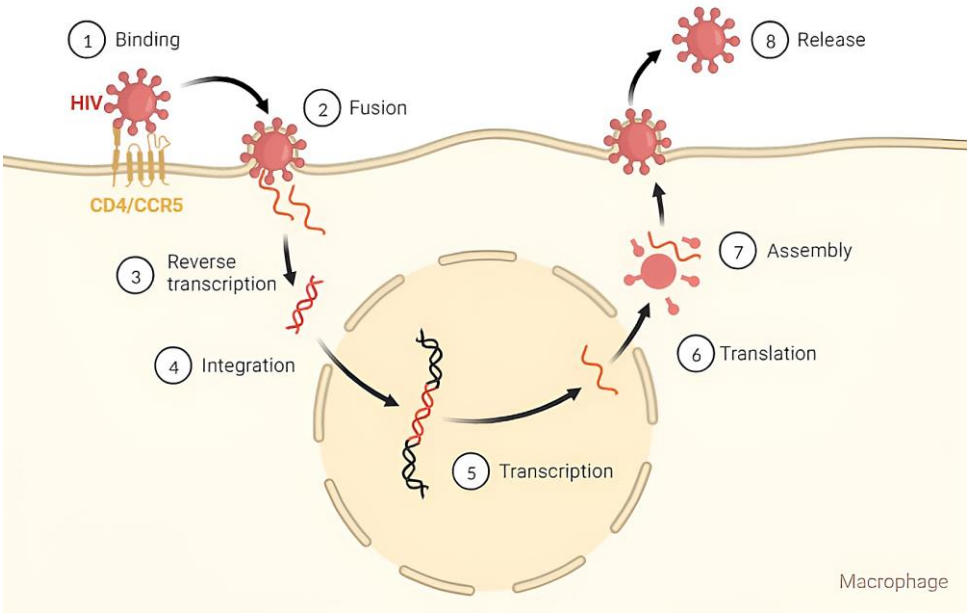

Fig 2: Pathogenesis of HIV

EPIDEMOLOGICAL LANDSCAPE OF HIV

The landscape of HIV epidemiology has undergone significant shifts due to advancements in treatment and prevention. Combined antiretroviral therapy has fundamentally altered how HIV infection is managed by effectively controlling viral replication [13]. There's been a global increase in the proportion of individuals living with HIV (PLWH) who are receiving antiretroviral therapy (ART), leading to changes in the age demographics of those affected, with a rise in older adults living with HIV. HIV weakens the immune system by targeting and depleting CD4+ T cells, causing immunodeficiency in later stages of the disease [14]. Additionally, HIV impacts various immune cells including macrophages and dendritic cells. The process of HIV-1 and HIV-2 entry into cells involves three main stages: binding to the cell, activation, and fusion. The virus's affinity for CD4+ cells from both lymphocytic and non-lymphocytic sources significantly contributes to the development and progression of HIV infection. [15-16].

HIV IN INDIA:

India's HIV epidemic ranks as the world's third-largest, estimating around 2.35 million individuals living with HIV and an adult prevalence of 0.22% in 2019. This issue predominantly affects high-risk groups like female sex workers, men having sex with men, and injecting drug users. The primary drivers behind India's HIV epidemic are unprotected paid sex, unprotected sex between men, and the use of injected drugs. To combat this, India's National AIDS Control Programme (NACP) focuses on targeted interventions and fostering supportive environments [17-18]. Notable progress has been made in curbing the HIV epidemic in India, witnessing a 57% decline in new infections from 2000 to 2011. However, persistent challenges loom, including the emergence of new areas with high HIV prevalence among distinct risk groups like transgender individuals and the potential influence of bridge populations in specific regions. The Indian government has pledged to offer HIV treatment to all in need, and the national AIDS response aligns with UNAIDS-recommended benchmarks for controlling the HIV epidemic. For the latest data, the India HIV Estimation 2021 report furnishes crucial estimates regarding HIV prevalence, individuals affected by HIV, new infections, AIDS-related mortality, and more. Additionally, the National AIDS Control Organization (NACO) regularly updates facts & figures on the HIV landscape in India[19-20].

S No	State/UT	2016	2017	2018	2019	2020	2021
1	Andhra Pradesh	0.90 (0.76-1.05)	0.85 (0.71-0.99)	0.80 (0.67-0.94)	0.75 (0.64-0.88)	0.71 (0.60-0.84)	0.67 (0.56-0.79)
2	Arunachal Pradesh	0.05 (0.03-0.07)	0.05 (0.04-0.07)	0.06 (0.04-0.08)	0.06 (0.04-0.08)	0.06 (0.04-0.09)	0.07 (0.04-0.10)
3	Assam	0.08 (0.08-0.09)	0.08 (0.08-0.09)	0.09 (0.08-0.09)	0.09 (0.08-0.10)	0.09 (0.08-0.10)	0.09 (0.08-0.11)
4	Bihar	0.15 (0.11-0.21)	0.16 (0.11-0.22)	0.16 (0.11-0.22)	0.16 (0.11-0.22)	0.16 (0.11-0.22)	0.16 (0.11-0.22)
5	Chhattisgarh	0.20 (0.17-0.24)	0.19 (0.16-0.23)	0.19 (0.16-0.23)	0.18 (0.15-0.22)	0.18 (0.15-0.22)	0.17 (0.14-0.22)
6	Delhi	0.32 (0.27-0.38)	0.32 (0.27-0.38)	0.32 (0.27-0.38)	0.32 (0.27-0.39)	0.32 (0.26-0.38)	0.31 (0.25-0.39)
7	Goa	0.39 (0.33-0.47)	0.38 (0.32-0.45)	0.36 (0.30-0.44)	0.35 (0.28-0.43)	0.33 (0.26-0.42)	0.31 (0.24-0.41)
8	Gujarat	0.21 (0.18-0.24)	0.21 (0.18-0.24)	0.20 (0.17-0.24)	0.20 (0.17-0.24)	0.19 (0.16-0.24)	0.19 (0.16-0.23)
9	Himachal Pradesh	0.12 (0.09-0.15)	0.12 (0.09-0.15)	0.12 (0.09-0.15)	0.11 (0.09-0.14)	0.11 (0.08-0.14)	0.11 (0.08-0.13)
10	Haryana	0.22 (0.19-0.26)	0.22 (0.19-0.26)	0.22 (0.19-0.26)	0.22 (0.19-0.26)	0.22 (0.18-0.26)	0.22 (0.18-0.26)
11	Jharkhand	0.08 (0.06-0.11)	0.08 (0.06-0.11)	0.08 (0.06-0.11)	0.08 (0.06-0.11)	0.08 (0.06-0.11)	0.08 (0.06-0.11)
12	Jammu & Kashmir	0.06 (0.04-0.09)	0.06 (0.04-0.09)	0.06 (0.04-0.09)	0.06 (0.03-0.09)	0.06 (0.03-0.09)	0.06 (0.03-0.10)
13	Ladakh						
14	Karnataka	0.62 (0.53-0.76)	0.58 (0.50-0.71)	0.55 (0.47-0.66)	0.52 (0.44-0.62)	0.49 (0.42-0.59)	0.46 (0.40-0.56)
15	Kerala	0.07 (0.05-0.10)	0.07 (0.05-0.10)	0.07 (0.05-0.10)	0.07 (0.05-0.09)	0.07 (0.05-0.09)	0.06 (0.04-0.09)
16	Meghalaya	0.24 (0.17-0.36)	0.28 (0.19-0.41)	0.31 (0.21-0.46)	0.34 (0.22-0.52)	0.38 (0.24-0.60)	0.42 (0.25-0.69)
17	Maharashtra	0.44 (0.38-0.53)	0.41 (0.35-0.49)	0.39 (0.33-0.46)	0.37 (0.31-0.44)	0.35 (0.29-0.42)	0.33 (0.28-0.39)
18	Manipur	1.35 (1.19-1.53)	1.27 (1.12-1.44)	1.21 (1.06-1.38)	1.15 (1.01-1.32)	1.10 (0.96-1.27)	1.05 (0.92-1.22)
19	Madhya Pradesh	0.10 (0.09-0.12)	0.09 (0.08-0.11)	0.09 (0.08-0.11)	0.09 (0.08-0.10)	0.09 (0.07-0.10)	0.08 (0.07-0.10)
20	Mizoram	2.32 (2.05-2.69)	2.42 (2.12-2.82)	2.52 (2.19-2.94)	2.61 (2.23-3.07)	2.66 (2.23-3.17)	2.70 (2.24-3.25)
21	Nagaland	1.40 (1.14-1.81)	1.39 (1.14-1.81)	1.38 (1.14-1.82)	1.38 (1.13-1.83)	1.37 (1.12-1.85)	1.36 (1.08-1.85)
22	Odisha	0.15 (0.12-0.19)	0.15 (0.11-0.19)	0.15 (0.11-0.19)	0.15 (0.11-0.19)	0.14 (0.11-0.19)	0.14 (0.10-0.19)
23	Punjab	0.31 (0.26-0.37)	0.31 (0.26-0.36)	0.30 (0.25-0.36)	0.30 (0.24-0.36)	0.29 (0.24-0.36)	0.28 (0.23-0.35)
24	Rajasthan	0.11 (0.10-0.13)	0.11 (0.09-0.13)	0.11 (0.09-0.13)	0.11 (0.09-0.13)	0.11 (0.09-0.13)	0.10 (0.09-0.12)
25	Sikkim	0.07 (0.05-0.10)	0.08 (0.05-0.11)	0.08 (0.05-0.12)	0.08 (0.05-0.13)	0.09 (0.05-0.13)	0.09 (0.05-0.14)
26	Tamil Nadu	0.28 (0.24-0.31)	0.27 (0.23-0.30)	0.25 (0.21-0.28)	0.24 (0.20-0.27)	0.23 (0.19-0.26)	0.22 (0.18-0.24)
27	Tripura	0.06 (0.05-0.08)	0.07 (0.05-0.09)	0.08 (0.06-0.10)	0.09 (0.06-0.12)	0.11 (0.07-0.14)	0.12 (0.08-0.16)
28	Uttarakhand	0.14 (0.12-0.17)	0.14 (0.12-0.16)	0.13 (0.11-0.16)	0.13 (0.11-0.16)	0.13 (0.10-0.16)	0.12 (0.10-0.15)
29	Uttar Pradesh	0.10 (0.08-0.14)	0.10 (0.08-0.13)	0.10 (0.08-0.13)	0.10 (0.08-0.13)	0.10 (0.08-0.14)	0.10 (0.08-0.14)
30	West Bengal	0.09 (0.08-0.10)	0.09 (0.08-0.10)	0.09 (0.08-0.10)	0.08 (0.08-0.09)	0.08 (0.07-0.09)	0.08 (0.07-0.09)
31	A & N Islands	0.16 (0.07-0.31)	0.16 (0.07-0.32)	0.15 (0.07-0.34)	0.15 (0.06-0.35)	0.14 (0.06-0.36)	0.14 (0.06-0.38)
32	Chandigarh	0.21 (0.17-0.26)	0.21 (0.16-0.26)	0.20 (0.15-0.26)	0.20 (0.15-0.26)	0.20 (0.14-0.26)	0.19 (0.13-0.26)
33	DNH&DD	0.18 (0.13-0.24)	0.18 (0.13-0.25)	0.19 (0.13-0.25)	0.19 (0.13-0.25)	0.19 (0.13-0.25)	0.19 (0.13-0.25)
34	Puducherry	0.36 (0.21-0.54)	0.35 (0.21-0.53)	0.34 (0.20-0.50)	0.32 (0.19-0.48)	0.32 (0.19-0.47)	0.31 (0.18-0.46)
35	Telangana	0.59 (0.48-0.73)	0.55 (0.46-0.69)	0.53 (0.43-0.66)	0.51 (0.41-0.64)	0.49 (0.39-0.62)	0.47 (0.37-0.60)
	India	**0.25 (0.20-0.31)**	**0.24 (0.19-0.30)**	**0.30 (0.19-0.29)**	**0.22 (0.18-0.27)**	**0.21 (0.17-0.27)**	**0.21 (0.17-0.25)**

Table 2: State and UT-wise Adult HIV prevalence in India.

CHALLENGES IN DIAGNOSIS AND TREATMENT:

Despite significant progress in the diagnosis and treatment of HIV, there are still challenges that need to be addressed. One of the major challenges in diagnosis is the lack of access to testing and early diagnosis, particularly in low- and middle-income countries. Stigma and discrimination also remain significant barriers to HIV testing and treatment. There is a need for more effective and affordable treatment options, particularly for those who have developed drug resistance or have limited treatment options due to comorbidities. Finally, the COVID-19 pandemic has presented new challenges to the diagnosis and treatment of HIV, including disruptions to healthcare services and supply chains for medications.

Human Immunodeficiency Virus (HIV) continues to pose significant challenges in both diagnosis and treatment, despite remarkable progress in understanding the virus and developing therapeutic interventions. These challenges span various facets of healthcare, encompassing access, accuracy, adherence, and social dynamics [21].

Diagnostic Hurdles

Access to reliable HIV testing remains a considerable challenge globally. In resource-limited regions, socioeconomic barriers, coupled with inadequate healthcare infrastructure, limit the availability of testing facilities. Moreover, societal stigma and discrimination deter individuals from seeking testing, perpetuating undiagnosed cases. Although testing technology has evolved, traditional methods have a window period—delaying accurate diagnosis during the early stages of infection.

Point-of-care testing (POCT) has emerged as a solution to increase accessibility and provide rapid results. However, while offering convenience, some POCTs may compromise sensitivity, leading to potential false-negative results. Balancing speed and accuracy remain a critical challenge in diagnostic strategies.

Treatment Hurdles

Antiretroviral therapy (ART) has revolutionized HIV management, yet several obstacles persist. Adherence to a lifelong therapy regimen poses a significant challenge, impacted by factors such as pill burden, complex dosing schedules, and medication side effects. Non-adherence can lead to treatment failure, drug resistance, and virologic rebound. Moreover, drug resistance is a growing concern. Prolonged or inconsistent adherence to ART fosters the development of drug-resistant HIV strains, limiting treatment options and effectiveness. Access to affordable and effective medications remains a challenge, particularly in low-resource settings and for marginalized populations.

Comprehensive HIV care requires addressing not only medical needs but also the psychosocial aspects. Stigma and discrimination surrounding HIV deter individuals from seeking care, impacting mental health and treatment-seeking behavior. The complex interplay between HIV and comorbidities, including cardiovascular diseases and certain cancers, adds layers of complexity to treatment and management.

Addressing the Challenges

Tackling these challenges necessitates multifaceted approaches. Innovations in diagnostic technologies, including more sensitive and accessible testing methods, are crucial. Simplifying treatment regimens, reducing pill burden, and developing long-acting therapies could enhance adherence. Strategies to combat stigma and discrimination are pivotal, requiring community engagement, education, and policy initiatives.

Furthermore, ensuring equitable access to medications and healthcare services globally is essential. Integrated healthcare models that address both medical and psychosocial needs should be prioritized, encompassing mental health support and addressing stigma within healthcare settings [22].

IMPACT OF COVID-19 ON HIV

The COVID-19 pandemic had a notable impact on HIV treatment and care, presenting various challenges to healthcare systems and individuals living with HIV:

Disruption in Healthcare Services:

Access to Medications: Lockdowns, travel restrictions, and disruptions in supply chains affected access to antiretroviral therapy (ART) and other essential medications for individuals living with HIV, especially in regions heavily affected by COVID-19.

Healthcare Delivery: Overwhelmed healthcare systems diverted resources and attention toward managing COVID-19 cases, leading to disruptions in routine HIV care services, including testing, treatment initiation, and monitoring [23-24].

Impact on Testing and Diagnosis:

Reduced Testing Rates: Fear of contracting COVID-19, restricted movement, and clinic closures led to reduced HIV testing rates, resulting in delayed or missed diagnoses.

Delayed Diagnosis: Individuals with HIV may have experienced delays in diagnosis due to reduced healthcare-seeking behavior during the pandemic, potentially leading to advanced disease progression at the time of diagnosis [25].

Vulnerability of At-Risk Populations:

Marginalized Communities: Communities already facing social and economic disparities, such as LGBTQ+ individuals, sex workers, and marginalized populations, were disproportionately affected by both HIV and COVID-19 due to increased vulnerabilities.

Increased Stigma: The COVID-19 pandemic exacerbated stigma and discrimination, impacting access to healthcare and support for individuals living with HIV.

Challenges in Treatment Adherence:

Disrupted Routines: Lockdowns and social restrictions disrupted daily routines, potentially affecting adherence to ART and clinic visits for HIV management.

Mental Health Impact: The pandemic's psychological impact, including stress, anxiety, and depression, could have affected mental health and, subsequently, adherence to treatment [26].

Resilience and Adaptation:

Telemedicine and Remote Services: Healthcare systems rapidly adopted telemedicine and remote healthcare services to ensure continuity of care, including virtual consultations, medication delivery, and telemonitoring for individuals with HIV.

Community Support: Grassroots organizations and community networks played a crucial role in providing support, information, and resources to individuals living with HIV during the pandemic [27].

SOCIO-BEHAVIORAL ASPECTS AFFECTING PREVENTION & CARE

Stigma and Discrimination: Persistent stigma surrounding HIV/AIDS affects individuals' willingness to seek testing, treatment, and support. Combatting stigma through education and advocacy is crucial in encouraging early diagnosis and treatment adherence [28].

Sexual Behavior and Prevention Strategies: Socio-cultural factors, beliefs, and practices influence sexual behaviors and the uptake of preventive measures like condom use, pre-exposure prophylaxis (PrEP), and harm reduction strategies among at-risk populations.

Gender Dynamics: Gender inequalities and power imbalances impact HIV risk. Women, especially in patriarchal societies, may have limited control over sexual decision-making and access to preventive measures, contributing to higher infection rates [29].

Access to Healthcare and Resources: Socioeconomic disparities, including poverty, lack of education, and limited access to healthcare, hinder HIV prevention and care, particularly among marginalized communities.

Mental Health and Substance Use: Mental health issues and substance use disorders can intersect with HIV prevention and care, affecting treatment adherence and risk behaviors [30-31].

HERBAL TREATMENT OF HIV

There are various herbs which are used to treat HIV [32], are mentioned in the given figure.

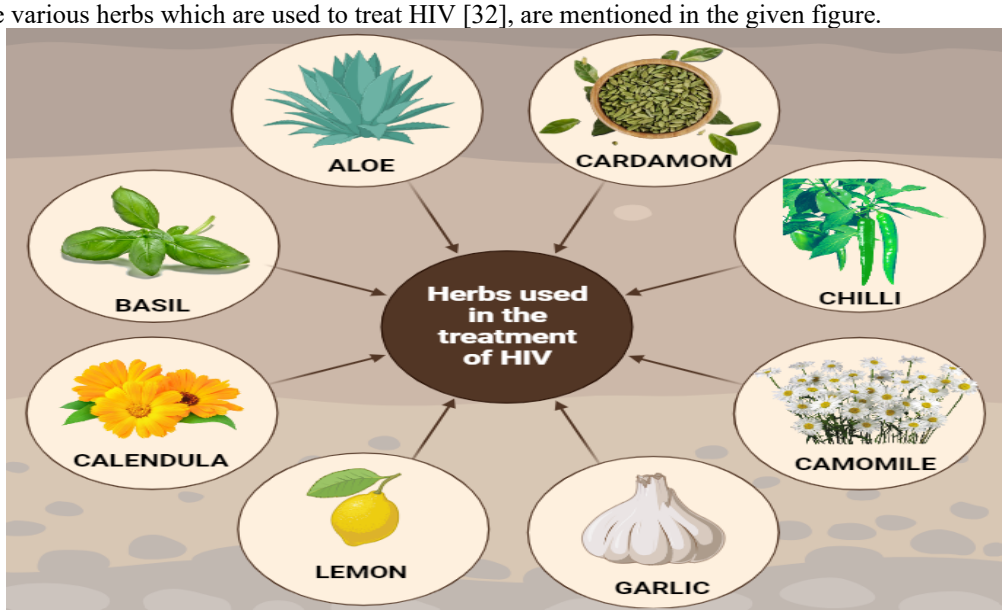

Fig 2: Herbs used in HIV Treatment

NOVEL FDA APPROVED DRUGS FOR THE TREATMENT OF HIV

For the treatment of HIV, first novel FDA approved drugs was approved in 1987, i.e. Retrovir which is a Nucleoside Reverse Transcriptase Inhibitors. The latest approved drug is Sunlenca. All the FDA approved drug [33] are list below.

Brand Name	Generic Name	Drug Class	Mechanism of Action	Approval Year
RETROVIR	Zidovudine	A	A`	1987
EPIVIR	Lamivudine	A	A`	1995
VIRAMUNE	Nevirapine	Non- A	Non-A`	1996
NORVIR	Ritonavir	PA	PA`	1996
COMBIVIR	Lamivudine And Zidovudine	CHM	CHM`	1997
SUSTIVA	Efavirenz	Non- A	Non-A`	1998
ABACAVIR	Ziagen	A	A`	1998
TRIZIVIR	Abacavir, Lamivudine, And Zidovudine	CHM	CHM`	2000
KALETRA	Lopinavir And Ritonavir	CHM	CHM`	2000
VIREAD	Tenofovir, Disoproxil	A	A`	2001
EMTRIVA	Emtricitabine	A	A`	2003
REYATAZ	Atazanavir	PA	PA`	2003
LEXIVA	Fosamprenavir	PA	PA`	2003
FUZEON	Enfuviritide	FI	FI`	2003
EPZICOM	Abacavir And Lamivudine	CHM	CHM`	2004

TRUVADA	Emtricitabine And Tenofovir Disoproxil Fumarate	CHM	CHM`	2004
APTIVUS	Tipranavir	PA	PA`	2005
PREZISTA	Darunavir	PA	PA`	2006
ATRIPLA	Efavirenz, Emtricitabine, And Tenofovir Disoproxil Fumarate	CHM	CHM`	2006
SELZENTRY	Maraviroc	CCR5	CCR5`	2007
ISENTRESS	Raltegravir	INSTI	INSTI`	2007
INTELENCE	Etravirine	Non- A	Non-A`	2008
VIRAMUNE XR (EXTENDED RELEASE)	Nevirapine	Non- A	Non-A`	2011
EDURANT	Rlipivirine	Non- A	Non-A`	2011
COMPLERA	Emtricitabine, Rilpivirine, And Tenofovir Disoproxil Fumarate	CHM	CHM`	2011
STRIBILD	Elvitegravir, Cobicistat, Emtricitabine, And Tenofovir Disoproxil Fumarate	CHM	CHM`	2012
TIVICAY	Dolutegravir	INSTI	INSTI`	2013
TYBOST	Cobicistat	PE	PE`	2014
TRIUMEQ AND TRIUMEQ PD	Abacavir, Dolutegravir, And Lamivudine	CHM	CHM`	2014
EVOTAZ	Atazanavir And Cobicistat	CHM	CHM`	2015
PREZCOBIX	Darunavir And Cobicistat	CHM	CHM`	2015
GENVOYA	Elvitegravir, Cobicistat, Emtricitabine, And Tenofovir Alafenamide	CHM	CHM`	2015
ODEFSEY	Emtricitabine, Rilpivirine, And Tenofovir Alafenamide	CHM	CHM`	2016
DESCOVY	Emtricitabine And Tenofovir Alafenamide	CHM	CHM`	2016
ISENTRESS HD	Raltegravir	INSTI	INSTI`	2017
JULUCA	Dolutegravir And Rilpivirine	CHM	CHM`	2017
PIFELTRO	Doravirinie	Non- A	Non-A`	2018
TROGARZO	Ibalizumab-Uiyk	PAI	PAI`	2018
BIKTARVY	Bictegravir, Emtricitabine, And Tenofovir Alafenamide	CHM	CHM`	2018
SYMTUZA	Darunavir, Cobicistat, Emtricitabine, And Tenofovir Alafenamide	CHM	CHM`	2018
DELSTRIGO	Doravirine, Lamivudine, And Tenofovir Disoproxil Fumarate	CHM	CHM`	2018
SYMFI	Efavirenz, Lamivudine, And Tenofovir Disoproxil Fumarate	CHM	CHM`	2018
SYMFI LO	Efavirenz, Lamivudine, And Tenofovir Disoproxil Fumarate	CHM	CHM`	2018
CIMDUO	Lamivudine And Tenofovir Disoproxil Fumarate	CHM	CHM`	2018
DOVATO	Dolutegravir And Lamivudine	CHM	CHM`	2019
TIVICAY PD	Dolutegravir	INSTI	INSTI`	2020
RUKOBIA	Fostemsavir	AI	AI`	2020
VOCABRIA	Cabotegravir	INSTI	INSTI`	2021
CABENUVA	Cabotegravir And Rilpivirine	CHM	CHM`	2021
SUNLENCA	Lenacapavir	CI	CI`	2022

Where A= Nucleoside Reverse Transciptase Inhibitors (NRTIs), A`= NRTIs prevent HIV replication by inhibiting reverse transcriptase., Non-A= Non-Nucleoside Reverse Transciptase Inhibitors (N-NRTIs), Non-A`= NNRTIs bind to and later alter reverse transcriptase, an enzyme HIV needs to make copies of itself., PA= Protease Inhibitor, PA`= PIs block HIV protease, an enzyme HIV needs to make copies of itself., CHM= Combination HIV Medicine, CHM`= CHMs contain two or more HIV medicines from one or more drug classes., CI= Capsid Inhibitor, CI`= CI`, INSTI= Integrase Strand Transfer Inhibitor (INSTIs), INSTI`= Integrase inhibitors block HIV integrase, an enzyme HIV needs to make copies of itself., AI= Attachment Inhibitor, AI`= AIs bind to the gp120 protein on the outer surface of HIV, preventing HIV from entering CD4 cells. PAI= Post-Attachment Inhibitor, PAI`= PAIs block CD4 receptors on the surface of certain immune cells that HIV needs to enter the cells. PE= Pharmacokinetic Enhancers, PE`= PE are used in HIV treatment to increase the effectiveness of an HIV medicine included in an HIV treatment regimen., CCR5= CCR5 inhibitor, CCR5`= CCR5 antagonists block CCR5 coreceptors on the surface of certain immune cells that HIV needs to enter the cells., FI= Fusion Inhibitor, FI`= Fusion inhibitors block HIV from entering the CD4 T lymphocyte (CD4 cells) of the immune system.

Table 3: List of FDA approved Novel Drug for the treatment of HIV

PROMISING DIRECTIONS IN HIV RESEARCH

Vaccine Development: Continued research into developing an effective HIV vaccine remains a priority. Various vaccine candidates are in different stages of clinical trials, aiming to induce protective immune responses against HIV.

Cure Strategies: Efforts to achieve HIV remission or a functional cure—where the virus remains in check without the need for lifelong antiretroviral therapy—are a focal point. Strategies involve gene editing, immune modulation, and latency reversal.

Long-Acting Therapies: Research focuses on long-acting formulations of antiretroviral drugs, such as injectables or implants, aiming to improve treatment adherence by reducing dosing frequency.

Novel Prevention Approaches: Beyond traditional methods like condoms and PrEP, research explores novel prevention approaches, including microbicides, broadly neutralizing antibodies, and combination prevention strategies tailored to diverse populations.

Implementation Science: Research in implementation science aims to bridge the gap between scientific advancements and effective real-world implementation of HIV prevention and treatment interventions, particularly in resource-limited settings.

Biomedical and Behavioral Interventions: Integrating biomedical and behavioral interventions, such as combining treatment with behavioral support or community-based interventions, shows promise in enhancing prevention and care outcomes.

CURRENT RESEARCH ON HIV

HIV VACCINE (PrEPVacc prevention study)

The HIV vaccine trial, known as the PrEPVacc prevention study, has been halted due to disappointing results. The trial, led by African researchers with support from European scientists, was testing two experimental HIV vaccines alongside a new form of oral pre-exposure prophylaxis (PrEP). The vaccine component of the trial has been stopped due to its ineffectiveness in preventing HIV, although there are no safety concerns about the vaccines. This setback is a significant blow to the medical community, as the development of a working HIV vaccine has been an ongoing challenge for over three decades. The trial, which studied 1,500 volunteer participants in Uganda, Tanzania, and South Africa, reflects the urgent need for new vaccine approaches and technology in the fight against HIV. The failure of the experimental vaccines underscores the continued importance of research and innovation in the quest to develop an effective HIV vaccine.

The disappointing results of the trial highlight the ongoing urgency of the HIV epidemic, with millions of people still living with the infection worldwide, particularly in sub-Saharan Africa, where young women and girls account for a significant proportion of new cases. The trial's halt emphasizes the need for continued efforts and resources to address the HIV/AIDS epidemic, as well as the importance of ongoing research and the development of new vaccine approaches and technologies [34].

MISCONCEPTIONS ABOUT HIV

Some of the most common misconceptions about HIV transmission include:

1. **HIV is a death sentence:** With modern treatment, HIV can be considered a manageable chronic illness, and individuals living with HIV can lead long and healthy lives.
2. **HIV can be transmitted through casual contact:** HIV is not transmitted through casual contact such as hugging, kissing, sharing food, or using the same utensils [35].
3. **HIV can be transmitted by looking at someone:** There is no way to tell if someone has HIV by appearance. People living with HIV who are on treatment may appear healthy, and symptoms vary widely among individuals.
4. **HIV can be transmitted through insect bites:** HIV is not transmitted through insect bites. It is only transmitted through specific bodily fluids such as blood, semen, pre-ejaculate, rectal fluids, vaginal fluids, and breast milk [36].
5. **HIV always leads to AIDS:** While HIV is the infection that causes AIDS, not all HIV-positive individuals will necessarily develop AIDS, especially with proper treatment and care.

It's important to address these misconceptions to combat stigma and ensure accurate understanding of HIV transmission and treatment [37].

MYTHS ABOUT HIV

Some common myths about HIV include:

1. **Transmission through casual contact:** HIV is not spread through touch, tears, sweat, saliva, or urine. It is only transmitted through specific bodily fluids such as blood, semen, pre-ejaculate, rectal fluids, vaginal fluids, and breast milk.
2. **HIV always leads to AIDS:** While HIV is the infection that causes AIDS, not all HIV-positive individuals will necessarily develop AIDS. Proper treatment and care can help maintain a healthy immune system and prevent the advancement to AIDS.
3. **Inevitability of AIDS development:** Starting HIV medication promptly can help protect individuals from advancing to AIDS. In fact, with proper treatment, some individuals may never develop AIDS.

4. **Inability to have children:** With proper medical guidance and treatment, it is possible for individuals with HIV to have children without transmitting the virus.
5. **Avoidance of exercise:** Exercise is actually beneficial for individuals with HIV as it can help prevent fatigue, improve appetite, lower stress, maintain muscles, and protect bones [38-39].

CONCLUSION

After diving into the depths of HIV in this review paper, it's clear how intricate and intertwined its story is. We've journeyed through its history, understanding the tiny but mighty virus, its reach across the globe, including its impact in India, and the challenges it poses in diagnosis and car-e.

COVID-19 threw a curveball, disrupting HIV treatment, but we've also seen the power of human resilience and adaptation. Socio-behavioral factors, like stigma and access barriers, continue to shape the fight against HIV.

But amidst challenges, there's hope. The arrival of new FDA-approved drugs and the promising avenues in research—be it vaccines, long-acting therapies, or exploring herbal remedies—paint a hopeful picture.

This review isn't just about scientific progress; it's about people—how our actions, beliefs, and innovations shape the future of HIV. Together, we're navigating this complex journey, striving for better prevention, care, and treatment for everyone affected by HIV.

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AUTHOR'S INFORMATION: *[*1]Director (Academic and Research), Department of Pharmacology, Lucknow Model college of Pharmacy and Research, Lucknow, 226008, Uttar Pradesh, Bharat.*

[2,3]B. Pharm, Lucknow Model college of Pharmacy and Research, Lucknow, 226008, Uttar Pradesh, Bharat.

[4,5]Assistant Professor, Lucknow Model college of Pharmacy and Research, Lucknow, 226008, Uttar Pradesh, Bharat.

REFERENCES

1. Vivancos, M. J., Martínez-Sanz, J., & Guillén, S. M. (2018, December 11). *HIV infection epidemiology: a change of scenery*. European Geriatric Medicine. https://doi.org/10.1007/s41999-018-0147-y
2. Bachani D, Sogarwal R. National Response to HIV/AIDS in India. Indian J Community Med. 2010 Oct;35(4):469-72. doi: 10.4103/0970-0218.74341. PMID: 21278863; PMCID: PMC3026121.
3. H. (2023, November 15). *A Timeline of HIV and AIDS*. HIV.gov. https://www.hiv.gov/hiv-basics/overview/history/hiv-and-aids-timeline
4. *Global HIV/AIDS Timeline | KFF*. (2019, April 19). KFF. https://www.kff.org/global-health-policy/timeline/global-hivaids-timeline/
5. *Timeline of HIV/AIDS*. (2023, December 15). Wikipedia. https://en.wikipedia.org/wiki/Timeline_of_HIV/AIDS
6. *HIV Facts & Figures | National AIDS Control Organization | MoHFW | GoI*. (n.d.). https://naco.gov.in/hiv-facts-figures
7. *The AIDS Epidemic in the United States, 1981-early 1990s | David J. Sencer CDC Museum | CDC*. (n.d.). https://www.cdc.gov/museum/online/story-of-cdc/aids/index.html
8. Lee KA, Gay C, Portillo CJ, Coggins T, Davis H, Pullinger CR, Aouizerat BE. Symptom experience in HIV-infected adults: a function of demographic and clinical characteristics. J Pain Symptom Manage. 2009 Dec;38(6):882-93. doi: 10.1016/j.jpainsymman.2009.05.013. PMID: 19811886; PMCID: PMC2794949.
9. Fanales-Belasio, E., Raimondo, M., Suligoi, B., & Buttò, S. (2010, January 1). *HIV virology and pathogenetic mechanisms of infection: a brief overview.* DOAJ (DOAJ: Directory of Open Access Journals). https://doi.org/10.4415/ann_10_01_02
10. Naif, H. M. (2013, June 6). Pathogenesis of HIV infection. *Infectious Disease Reports*, *5*(11), e6. https://doi.org/10.4081/idr.2013.s1.e6

11. Rabson, A. B. (1990, June 1). *HIV virology: Implications for the pathogenesis of HIV infection*. Journal of the American Academy of Dermatology. https://doi.org/10.1016/0190-9622(90)70162-b
12. Salgado, M., Garcia-Minambres, A., Dalmau, J., Jiménez-Moyano, E., Viciana, P., Alejos, B., Clotet, B., Prado, J. G., & Martinez-Picado, J. (2018, June 15). Control of HIV-1 Pathogenesis in Viremic Nonprogressors Is Independent of Gag-Specific Cytotoxic T Lymphocyte Responses. *Journal of Virology*, *92*(12). https://doi.org/10.1128/jvi.00346-18
13. National Research Council (US) Panel on Data and Research Priorities for Arresting AIDS in Sub-Saharan Africa; Cohen B, Trussell J, editors. Preventing and Mitigating AIDS in Sub-Saharan Africa: Research and Data Priorities for the Social and Behavioral Sciences. Washington (DC): National Academies Press (US); 1996. 3, Epidemiology of the HIV/AIDS Epidemic. Available from: https://www.ncbi.nlm.nih.gov/books/NBK232813/
14. Pandve HT, Giri PA. HIV/AIDS Prevention and Control in India: Achievements and Future Challenges. N Am J Med Sci. 2015 Dec;7(12):575-6. doi: 10.4103/1947-2714.172853. PMID: 26942136; PMCID: PMC4755085.
15. Kumar P, Das C, Kumar A, Sahu D, Rai SK, Godbole S, Arumugam E, P V M L, Dutta S, Devi HS, Vardhana Rao Mendu V, Kant S, Pandey A, Reddy DCS, Mehendale S, Rajan S. Diversity in HIV epidemic transitions in India: An application of HIV epidemiological metrices and benchmarks. PLoS One. 2022 Jul 18;17(7):e0270886. doi: 10.1371/journal.pone.0270886. PMID: 35849570; PMCID: PMC9292090.
16. Vivancos, M.J., Martínez-Sanz, J. & Moreno, S. HIV infection epidemiology: a change of scenery. *Eur Geriatr Med* **10**, 169–174 (2019). https://doi.org/10.1007/s41999-018-0147-y
17. *India to provide HIV treatment to all who need it*. (n.d.). UNAIDS. https://www.unaids.org/en/resources/presscentre/featurestories/2017/may/20170501_veena
18. https://naco.gov.in/sites/default/files/India%20HIV%20Estimates%202021%20_Fact%20Sheets__Final_Shared_24_08_2022.pdf
19. *ART Treatment | National AIDS Control Organization | MoHFW | GoI*. (n.d.). https://naco.gov.in/treatment
20. *India to provide HIV treatment to all who need it*. (n.d.). UNAIDS. https://www.unaids.org/en/resources/presscentre/featurestories/2017/may/20170501_veena
21. https://naco.gov.in/sites/default/files/NACP_V_Strategy_Booklet.pdf
22. Batra, E. (2023, July 18). *India's pivotal role in the global fight against AIDS: Revolutionising HIV treatment with low-cost antiretrovi*. CNBCTV18. https://www.cnbctv18.com/healthcare/aids-india-pivotal-role-global-fight-hiv-treatment-low-cost-arv-drugs-anti-retroviral-therapy-17247721.html
23. Carbonero-Lechuga P, Castrodeza-Sanz J, Sanz-Muñoz I, Marqués-Sánchez P, Eiros JM, Dueñas-Gutiérrez C, Prada-García C. Impact of COVID-19 on Adherence to Treatment in Patients with HIV. Healthcare (Basel). 2023 May 2;11(9):1299. doi: 10.3390/healthcare11091299. PMID: 37174841; PMCID: PMC10178482.
24. Chenneville T, Gabbidon K, Hanson P, Holyfield C. The Impact of COVID-19 on HIV Treatment and Research: A Call to Action. Int J Environ Res Public Health. 2020 Jun 24;17(12):4548. doi: 10.3390/ijerph17124548. PMID: 32599783; PMCID: PMC7345635.
25. *COVID-19's impact on HIV treatment less severe than feared*. (n.d.). UNAIDS. https://www.unaids.org/en/resources/presscentre/featurestories/2020/october/20201016_covid-impact-on-hiv-treatment-less-severe-than-feared
26. SeyedAlinaghi, S., Mirzapour, P., Pashaei, Z. *et al.* The impacts of COVID-19 pandemic on service delivery and treatment outcomes in people living with HIV: a systematic review. *AIDS Res Ther* **20**, 4 (2023). https://doi.org/10.1186/s12981-022-00496-7
27. H. (2023, October 12). *COVID-19 and People with HIV*. HIV.gov. https://www.hiv.gov/hiv-basics/staying-in-hiv-care/other-related-health-issues/coronavirus-covid-19
28. Klein WM, Bloch M, Hesse BW, McDonald PG, Nebeling L, O'Connell ME, Riley WT, Taplin SH, Tesauro G. Behavioral research in cancer prevention and control: a look to the future. Am J Prev Med. 2014 Mar;46(3):303-11. doi: 10.1016/j.amepre.2013.10.004. PMID: 24512871; PMCID: PMC3921666.
29. https://assets.publishing.service.gov.uk/media/5bb21dd2e5274a3e0d7af9e0/Improving_Peoples_Health_Behavioural_Strategy.pdf
30. Hogben M, Dittus PJ, Leichliter JS, Aral SO. Social and behavioural research prospects for sexually transmissible infection prevention in the era of advances in biomedical approaches. Sex Health. 2020 Apr;17(2):103-113. doi: 10.1071/SH19105. PMID: 32119815; PMCID: PMC7261391.
31. Valente PK, Wu Y, Cohen YZ, Caskey M, Meyers K. Behavioral and social science research to support development of educational materials for clinical trials of broadly neutralizing antibodies for HIV treatment and prevention. Clinical Trials. 2021;18(1):17-27. doi:10.1177/1740774520948042Current Research on HIV

32. Salehi B, Kumar NVA, Şener B, Sharifi-Rad M, Kılıç M, Mahady GB, Vlaisavljevic S, Iriti M, Kobarfard F, Setzer WN, Ayatollahi SA, Ata A, Sharifi-Rad J. Medicinal Plants Used in the Treatment of Human Immunodeficiency Virus. Int J Mol Sci. 2018 May 14;19(5):1459. doi: 10.3390/ijms19051459. PMID: 29757986; PMCID: PMC5983620.
33. https://hivinfo.nih.gov/understanding-hiv/fact-sheets/fda-approved-hiv-medicines.
34. https://edition.cnn.com/2023/12/09/health/hiv-vaccine-trial-halted-intl/index.html
35. *Misconceptions about HIV/AIDS*. (2023, November 7). Wikipedia. https://en.wikipedia.org/wiki/Misconceptions_about_HIV/AIDS
36. *Common Misconceptions about AIDS | Narayana Health*. (2019, December 24). Narayana Health Care. https://www.narayanahealth.org/blog/common-misconceptions-about-aids/amp/
37. *Common Misconceptions About HIV | Ending HIV NSW*. (2023, December 7). Ending HIV. https://endinghiv.org.au/blog/7-common-misconceptions-hiv/
38. Crna, R. N. M. (2023, October 6). *HIV and AIDS: Transmission myths and facts*. https://www.medicalnewstoday.com/articles/323832
39. Schaefer, A. (2020, April 24). *9 Myths About HIV/AIDS*. Healthline. https://www.healthline.com/health/hiv-aids/misconceptions-about-hiv-aids

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