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Nanoeduparemiological perspectives on HIV-AIDS management

Abstract

Each day brings more devastating news about the spread of HIV/AIDS. HIV survives in latent cellular and anatomical reservoirs, rendering current treatments useless. Currently, the most cutting-edge antiretrovirals (ARVs) cocktail are used in HIV/AIDS treatment. The only thing ARVs can do is keep the virus under control and stop it from spreading. Because of this, those living with HIV and those at risk can coexist peacefully and normally. Nanomedicine and nanotechnology as a strategy to defeat HIV/AIDS is desperately needed. From the vantage point of Nanoeduparemiology, one can take a holistic view of potential solutions. This holistic strategy incorporates nanomedicine, education, and paremiology, all of which are rooted in many religious and spiritual traditions. Teachers and lecturers can transmit eduparemiology tactics (education through proverbs and local knowledge) to parents, students, and the society at large.

Keywords: HIV/AIDS, nanoeduparemiology, perspectives, management

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Abbreviations: RDT, rapid diagnostic tests; AIDS acquired immunodeficiency syndrome; HR, hadits riwayat

Introduction

Current HIV medications are ineffective because the virus persists in dormant cellular and anatomical reservoirs.[1] Macrophages serve as a key cellular reservoir and a host for viral genetic recombination, both of which contribute to the development of evasive mutant viral genotypes.[2] Secondary lymphoid tissue, testicles, liver, kidney, lungs, intestines, and the brain are all examples of latent reservoirs in the body. Patients must take drugs for the rest of their lives since current therapy regimens do not completely eliminate the virus from these reservoirs.[3] Taking medicines on a daily basis is a requirement of current treatment, and this might cause adherence issues. Additionally, some persons may acquire resistance to the virus' sensitivity to the medications, and everyone reacts differently to the drugs.[4]

This document was written with the intention of giving readers a multi-faceted understanding of HIV/AIDS care and management comprehensively. The urgency arises from the fact that different strategies for combating HIV/AIDS often overlook the proverbial gems and conventional wisdom of individual nations.

The first AIDS case was detected in 1981. It was in 1983 that scientists recognized HIV as the cause of the disease. WHO stated that at the end of 2016 there were 36.7million people living with HIV and about 1.8million new cases of infection worldwide.[5]

In Indonesia, the cumulative number of persons existing with HIV from 1987 to September 2014 reached 150,296 people. While the cumulative total of AIDS cases reached 55,799 people (Health Ministry of Indonesia, 2014). There were around 640 thousand people living with HIV in Indonesia in 2018.[6]

HIV focuses on the immune system and declines a human's armament system against cancers and infections. Immune function was measured by CD4 cell count.[7]

HIV infection is often diagnosed through rapid diagnostic tests (RDTs), which detect the presence of HIV antibodies. The advanced stage of HIV infection is Acquired Immunodeficiency Syndrome (AIDS), which can develop for 2-15years depending on the individual's immunity.[8]

World AIDS Day is commemorated every December1 to increase knowledge, combat prejudice, stigma, and discrimination, as well as improve education so that the understanding of the public, netizens, relevant agencies or institutions, together with the government on HIV-AIDS prevention and control increases from knowledge into real action.[9] One simple strategy to support people living with HIV-AIDS on World AIDS Day is to wear a red ribbon. It is a symbol of international support for HIV.[10]

Not only that, this form of caring can be realized at any time through education, counseling, advocacy, socialization, fundraising, storytelling, creating games that contain moral teachings and character as a preventive measure, strengthening the role of the family as the first and main pillar in HIV/AIDS prevention.[11] Synergize and cooperate with ulemas (spiritual or religious leaders), leaders, traditional leaders to strengthen the values of religiosity-spirituality and the values of local wisdom as the foundation for eradicating HIV-AIDS.[12]

Management

Current management of HIV-AIDS uses the latest combination of antiretrovirals, such as atazanavir, efavirenz, emtricitabine, lopinavir, raltegravir, ritonavir, and tenofovir.[13,14]

Antiretroviral drugs (ARVs) cannot eliminate or eradicate but only control the virus and avoid transmission. Therefore, persons with HIV and those at high risk can live in harmony and balance.[15] The availability of various combinations of antiretroviral therapy, which has the characteristic of being able to suppress viral loads to undetectable levels for years, does not appear to be able to overcome the HIV virus (Figure 1).[16]

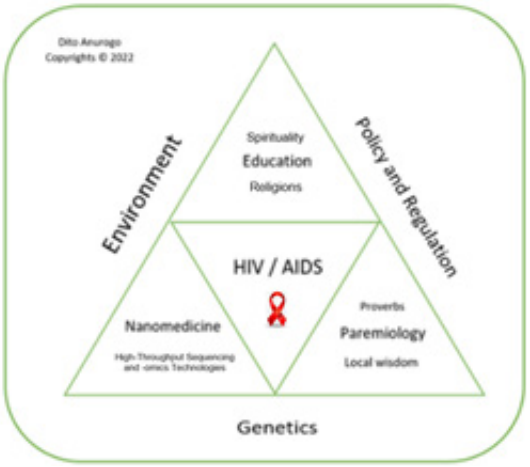

Figure 1 Triangle of HIV-AIDS management.

HIV-1 integrase is a realistic target for chemotherapy interference. It is a viral enzyme that needs replication.[17] As a first HIV-integrase inhibitor, Raltegravir enters phase III clinical trials for management of HIV-1 infection.[18] Optimal administration of antiretroviral therapy (ARV) has not been able to reduce viral reservoirs, especially in the intestinal mucosa, where low levels of viral replication residues can persistently activate the immune system, resulting in AIDS and eventually death.[19]

HIV produces cells in the reservoir that are not eliminated by ARV drugs and are therefore susceptible to immune clearance, but combination antiretroviral therapy reduces the range of HIV-specific T-cell responses.[20]

Nanomedicine

The nanomedicine-nanotechnology strategy is urgently needed to conquer HIV-AIDS. To improve bioavailability, the nanomedicine formulation efavirenz was incorporated with linear core and branched polypropylene oxide and polyethylene oxide micellar block copolymers. Aptamer surfaces used in efavirenz-loaded micelles to target CD4 cells were produced as an oral solution for pediatrics.[21]

The challenges of HIV therapy are twofold. Firstly, a single drug regimen that is effective, safe, well tolerated, replaces conventional drugs. Secondly, the development of innovative immunotherapy-based nanomaterials, synergized with optogenetics and omics technology to stop the disease and cure HIV-AIDS.[22]

The development of nanomedicine provides hope and opens up great opportunities for the availability of an effective vaccine to eradicate HIV-AIDS.[21]

There are new ways in which nanotechnology can help with HIV/AIDS care and prevention. Using nanotechnology platforms for delivery of antiretroviral medications may improve treatment choices.[23] If patients are more likely to stick to their medication schedules, treatment outcomes would likely increase. Macrophages are key HIV viral reservoirs, and they have been targeted with nanoparticles using ligands such mannose, galactose, tuftsin, and fMLF peptides.[24] One potential future advancement in treating viral reservoirs is the targeted co-delivery of two or more antiviral medicines in a nanoparticle system. Hydrophobic and hydrophilic medications or genes may be co-delivered using nanoparticles created by our lab and others; this could increase the flexibility of antiviral drug codelivery.[25] Nanomaterials have been proven to have the ability to limit viral replication on their own, in addition to their use in the delivery of antiviral medicines. Antiviral effects can be produced by fullerenes, dendrimers, and inorganic nanoparticles like silver, or they can be enhanced by other molecules, like in the case of gold nanoparticles.[26]

Nanotechnology has the potential to improve the efficacy of cutting-edge medical techniques like gene therapy and immunotherapy.[27] The study of how to transport siRNA outside of viruses is one of the most active research fields in nanotechnology. Despite the proven success of siRNA delivery to HIV-specific cells, the development of safe and effective nanotechnology for RNAi has yet to be used to HIV/AIDS.[28] Nanotechnology has the potential to play a pivotal role in immunotherapy as well. Nanoimmunotherapy is progressing into Phase II trials, suggesting it may be the first nanotechnology-based treatment for HIV/AIDS.[29]

Additionally, preliminary research on HIV/AIDS vaccinations based on nanotechnology has shown encouraging results. Nanoparticles are a wonderful alternative to viral vectors because of their capacity to target specific cells and release antigens in a regulated and sustained manner. Animal studies have demonstrated that nanoparticles made of lipids and polymers can stimulate the production of antibodies and cell-mediated immune responses against HIV.[30]

Despite the advances made, more preclinical research into the processes involved in nanoparticle induction of robust humoral and cellular immunity is needed. Research into the production of microbicides is still vital, in addition to ongoing vaccine development efforts. By facilitating the design of novel ways for nanoparticle-based delivery of therapeutic chemicals or RNAi, nanotechnology has the potential to play a pivotal role in microbicide development.[31]

Nanomedicine has promising potential in the treatment of HIV/AIDS, but many obstacles must first be overcome. Toxicological concerns, physiological stability, and mass production viability are just a few.[32] All fields of nanomedicine face these issues, and many different approaches are being taken to solve them. Most nanotechnology-based HIV/AIDS studies to date are still in the preclinical stages of research.[33] This suggests that a lot of obstacles must be overcome before these technologies can be widely used in the clinic. Preliminary in vitro and in vivo experiments have been completed, but additional work is needed with specific therapeutic end points to determine whether or not nanotechnology-based systems are effective. A lack of an appropriate animal model is one of the main obstacles to animal studies for HIV/AIDS treatment.[34] Use of the HIV relative SIV in nonhuman monkey models shows parallels but ultimately differs from human HIV pathogenesis. Human T cells may now be studied in vivo thanks to the advent of humanized mice, or animals with a human immune compartment that can sustain HIV infection.[35] This has made in vivo investigation and manipulation of HIV's interaction with human T cells possible. Using humanized mice, researchers in a study looking at the targeted delivery of siRNA to T-cells were able to successfully reduce viremia in HIV-infected mice, restore CD4+ T cell numbers, and decrease endogenous viral replication. To speed up translational research, humanized mice can be used to do experiments on human cells in a more natural setting.[36]

The route of administration is also a crucial factor to think about when using nanotechnology-based delivery systems for HIV/AIDS treatment and prevention. Studies depicted thus far mostly involved parenteral delivery of the formulations.[37] Needle-free delivery modalities, such as oral, transdermal, nasal, and pulmonary administration, have received a lot of attention as an alternative

to injection administration. The convenience and friendliness of nonparenteral routes may make them the best option for HIV/AIDS medicine delivery (e.g., oral vaccine delivery).[38] Advantages include increased patient compliance with treatment plans.[39] However, there are restrictions on the efficacy and bioavailability of nonparenteral methods, and their use over the long term may cause side effects (e.g., potential irritation by transdermal or pulmonary route).[40] Research of extremely effective nanoparticle delivery technologies as an alternative to injection/infusion of HIV/AIDS treatments is needed to overcome these challenges.[41]

Nanomaterials have been shown to have therapeutic benefits independent of their employment as delivery agents. Drugs designed using HIV's three-dimensional structure could target the virus's capsid, according to a number of studies.[42] Compounds that may prevent HIV capsid assembly have so been found through computational and experimental research.[43] It has been hypothesized that the structural interference with viral assembly is at the root of the effects seen when using various nanomaterials to limit viral replication in vitro.[44]

In vitro studies have revealed that a number of different fullerene (C-60)-based structures, dendrimers, and inorganic nanoparticles (such as gold and silver) have anti-HIV activity.[45] Despite the fact that these efforts have not advanced beyond in vitro investigations, they do show the promise of therapeutic nanomaterials in blocking HIV replication.[46]

The economic impact of exploring nanotechnology-based systems for HIV/AIDS is also crucial, given the hardest hit and most vulnerable populations live in underdeveloped and economically impoverished nations.[47] Nanotherapeutics may increase the total cost of antiretroviral therapy, decreasing its value. Nanotherapeutics may be more expensive, but their potential benefits could outweigh the price tag if they do what's hoped for and reduce the number of times a patient needs to take a dose while still providing the same level of protection.[48] If compared to other potential solutions, the employment of nanotheraepeutics in the context of emerging therapeutic modalities like gene therapy and immunotherapy may even lower their overall cost. Despite the lack of evidence, it seems reasonable to expect that nanotherapeutics, when compared to viral or ex vivo DC-based gene therapy or immunotherapy, would have advantages for large-scale productions.[49] Nanotherapeutics for preventative approaches shouldn't be more expensive than current treatments, either.[50] Developing nanotechnology-enabled vaccinations would be one of the most cost-effective ways to combat the HIV/AIDS pandemic around the world because vaccines are extensively distributed through government organizations.[51] For efficient dissemination to economically challenged countries, nanotechnology-enabled microbicides may also require backing from governmental or nongovernmental organizations.[23]

The rate of scientific discovery is picking up, and it is an exciting time to be involved in nanotechnology studies. The medical field and HIV/AIDS research are two areas where it is generally agreed that nanotechnology will make significant contributions in the years to come if it is given the funding and resources.[52]

Eduparemiology

Eduparemiology strategies (education through proverbs and local wisdom) can be disseminated from teachers/lecturers to parents, students, and community. Some of the following proverbs need to be taught as values and guidelines for preventing free sex.[53]

In Manado, there are several relevant proverbs, such as

a) "'Baru batona' so kase vorskot" means pregnant before marriage,

b) "Lebe dulu de pe pajeko kong de pe sapi" is a figure of speech for women who are already "full" before marriage,

c) "Hot deng seti cuma bakubirman", the expression that heat and high sex drive are only neighbors,

d) "Muka bole fororo mar cinta tatap jo manyala" literally means "face may wrinkle but love continues" as a form of depiction of true love is not just physical love, but spiritual love that is always eternal.

In Makassar, there is a term for "naughty" women, namely "baine jaddalak". There is also a woman who prostitutes herself is termed "nabalukang lammoroki kalenna".

There is also the term "bunga rosina pakrasanganga" which means village flower. The expressions "niebaraki kamma bayao", "bayao bottokmo" are often used for girls who have been deprived of their honor.

For men who like to hang out with prostitutes, aka male flirts/female players, it is termed "burakne pakarena baine". The proverb "sipanjariangi gauk siagang anjo bainea" means committing immoral acts with women.

The young man who had sex with a woman who had not yet become his wife was quipped through the proverb "kamma pakeang tanapayapi na napakemo". The right advice from parents and traditional elders for youth is contained in the proverb "teako akmata karanjengi", which means don't be masher or pervert.[54]

From a religious-spiritual perspective, Allah in QS. Al Israa (32) has made a will that humans stay away from adultery, including being alone in a quiet place, dating, revealing aurat, and all behaviors that cause lust.[55]

Furthermore, Hadits Riwayat (HR) Bukhari 6243 and HR Muslim 2657 (21) advised to stay away from adultery of the eyes, ears, mouth, hands, feet, heart, and farji (genitalia organs).

Conclusion

[56]The perspective of nanoeduparemiology, which combines spirituality, religions, proverbs, local wisdom, high-throughput and single-cell T cell receptor sequencing technologies, -omics technologies, genetics, environment, policy and regulation are expected to prevent increasement of HIV/AIDS. Therefore, multi-sector collaboration and synergy is a must to create this harmony towards meaningful life.

Conflicts of interest

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