Original Article

Nanotechnology And the Therapeutic Interventions of HIV

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Abstract

The primary concept of the paper is linked with identifying the prospects of nanotechnology in medical science with special attention to human immunodeficiency virus (HIV). The term nano represents extremely small, similarly, the study of nanoscience and nanotechnology is inherently associated with the evaluation of exceptionally small items. These items however are studied within a controlled environment since this helps one to manipulate the phenomena and change their innate properties. Moreover, HIV is ascertained to be a terminal illness which is incurable and higher probability of it leading to AIDS. In compliance with this notion, nanotechnology is deemed vital in altering the dimensions of HIV-affected cells which in turn has a better chance of increased life expectancy. Thereby, this paper attempts to showcase an inherent linkage between the usages of nanotechnology which acts as a therapeutic intervention for HIV.

Keywords: nanotechnology, emergence of HIV, diagnosis and treatment of HIV, nanoscale

I. INTRODUCTION

Sincere developments in the science, technology and engineering fields are witnessed wherein super inventions have shaped the dynamics of the healthcare sector. Concerning this, the rise of nanotechnology is noted to be of critical importance to help overcome untreatable diseases. Speaking from the scientific aspect, the concept of nanotechnology is observed to be a residue of the amalgamation between science, engineering and technology [1]. In other words, the application of nanotechnology is involved with its execution on the nanoscale which is exactly within 1 to 100 nanometres. Scientists have changed the dimensions of society with the introduction of nanoscience as well as nanotechnology which considers the study of exceptionally small items and it has large-scale utility across other fields, namely; physics, chemistry, biology, and many more. In present times, there is a strong association between the implementation of nanotechnology and HIV treatment. In compliance with the human immunodeficiency virus (HIV), it is mainly traced as a virus that is responsible for attacking the immune system of the human body [3].

Evidence from previous studies has implied that traces of HIV dates back to the era of the 1800s. The primary belief of HIV puts forward the notion that initially chimpanzees had been convicted of this deadly virus which later on jumped to humans. Moreover, in cases of HIV not being remedied, it ultimately escalates to the disease; acquired immunodeficiency syndrome or more commonly called AIDS. Hence, in the last few decades, a series of medical inventions have been formulated for understanding their implication for reducing the propensity of HIV.

II. OBJECTIVES

- To explain the grounds of nanotechnology
- To show traces of nanotechnology in the modern healthcare sector
- To highlight the fundamentals of HIV
- To critically analyse the diagnosis of HIV and treatment aspects
- To measure the influence of external and internal factors aggravating the growth and spread of HIV
- To shed light on the connectivity between nanotechnology and remedies for HIV

III. METHODOLOGY

With respect to the introduction of nanoscience, there has been tremendous development in society wherein treatment for severe ailment is obtained such as cancer, HIV, and others. The arguments for nanotechnology show that it typically associates with studying several phenomena within a controlled environment that has a length scale below 100 nanometres [2]. In response to the technological field, the application of nanotechnology is obtained through manipulation of the molecular structure of the chosen phenomena which further proceeds by altering their inherent properties. This process of manipulation and alteration of the properties of the molecules enables one to attain life-changing applications. One of the most challenging issues of HIV is its nature of being incurable, that is an individual contracting HIV suffers through terminal illness [6]. Following this notion, branches of medical science have shed light on the variable uses of nanotechnology. Therefore, it can be ascertained that with accurate development in nanotechnology, consistent treatment can be achieved for HIV.

The emergence of nanotechnology in the medical branch has rendered positive outcomes for several diseases since this metamorphic development can help in unblocking the arteries as well as cells can be specifically attacked to diminish any particular ailment [8]. This ability of nanotechnology in the selective attack of body cells has extensive advantages in reducing the growth of damaged cells.

IV. EVALUATING THE INCEPTION OF NANOTECHNOLOGY AND ITS APPLICATION IN THE HEALTHCARE SECTORS

In relation to healthcare, one of the driving forces of this sector is linked with super inventions through the development of technology and scientific branches. The prospect to receive healthcare facilities is ascertained to be a fundamental human right which guarantees adequate treatment and medical services. However, it is witnessed that there are certain specific ailments and diseases that remain undetectable for a long span which leads to delays in gaining appropriate medical attention [4]. In association with this, it can be said that innovative technological development has paved the pathway for upgrading the medical science society and relieving humanity from deadly diseases. This statement has a direct impact on the inception of nanotechnology which gave rise to a variety of treatment programs, thereby; changing the dynamics of healthcare. In other words, the inception of nanotechnology has been first observed in the lectures of the renowned physicist Richard Feynman in 1959, however, the term has been coined by Norio Taniguichi in the year 1974.

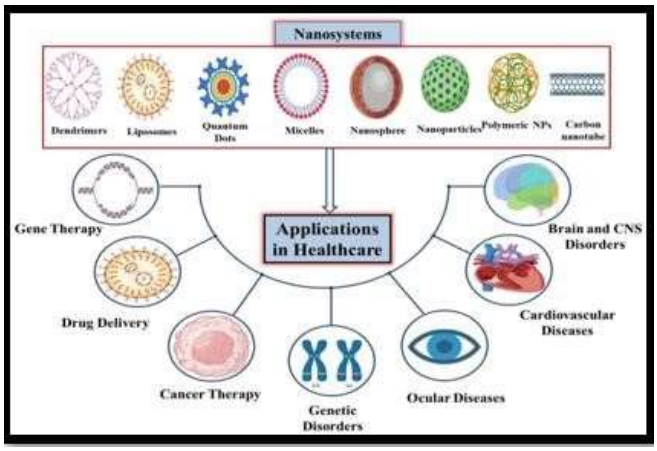

Figure 1: Range of utilities of nanosystems in healthcare
(**Source:** Influenced by 16)

The assumption of nanotechnology has been based on the ability to witness isolated atoms and molecules [5]. Furthermore, through nanotechnology, these atoms and molecules are controlled and manipulated according to the requirements. The assumption of nanotechnology has been based on the ability to witness isolated atoms and molecules [5]. Furthermore, through nanotechnology, these atoms and molecules are controlled and manipulated according to the requirements. It is duly the innovative capabilities of nanoscience that have given rise to a whole new aspect of nanostructures that have significant implications in healthcare, engineering, and many more. In terms of this innovation, nanotechnology is ascertained to have distinct criteria and properties which in turn are responsible for their widespread utilities. The medical world has thoroughly benefitted from the inception of nanotechnology wherein the introduction of its counterparts such as nanocarriers and nanosystems has strengthened the opportunities to detect diseases and develop treatment facilities [7]. The term nanocarriers are often known as nanomedicine, a diverse field in itself which has aggravated the possibilities of early identification, increased the rate of disease prevention and several others.

V. CRITICALLY MEASURING THE EMERGENCE OF HIV

Information related to HIV hints at the discovery made in the US which recorded a high rate of pneumonia and cancer that had rare phenomena. Following the investigation of HIV, it has been witnessed that the dire and direct consequences it is related to AIDS [15]. Both these diseases are proven to be highly damaging since they are not curable, hence, an

individual suffers lifelong implications. On the other hand, in the last few decades, certain treatments and medication facilities have come to the forefront which has given an alternative to battle the deadly sickness; HIV [16]. Studies have highlighted that HIV is an infection that is transmitted in two ways such as sexual transmission and blood transfusion. From the previous discussion, it has been observed that the treatment of both HIV and AIDS is largely unavailable, however, the medical society has innovated the usage of nanotechnology; a comprehensive multidisciplinary which has major abilities in revolutionising and creating medicines and therapeutic interventions in treating intense sickness [10].

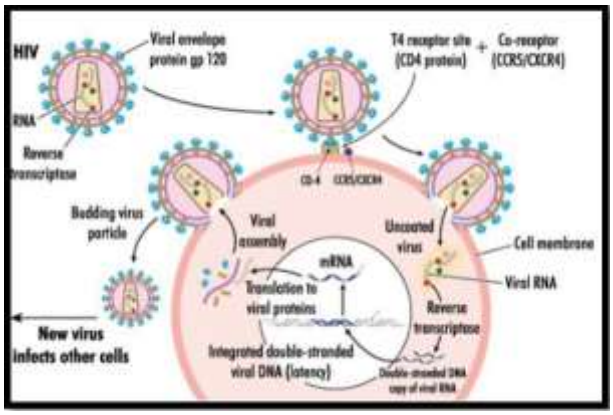

Figure 2: Lifecycle of HIV infected cells
(**Source:** Influenced by 13)

VI. FACTORS ASSOCIATED WITH THE DIAGNOSIS OF HIV AND SHOWCASING ITS TREATMENT DEVELOPMENT IN RECENT YEARS

In light of enabling one to gain immediate medical attention, it is foremost vital to identify the diseases. Oftentimes it has been seen that an absence of early identification leads to an increased risk rate of deteriorating health conditions [17]. Since HIV is a viral infection that has no accurate cure, therefore, adequate diagnosis is one of the top priorities of patients suffering from HIV. Based on this, it has been seen that doctors prescribe three major tests such as an antigen, antibody and nucleic acid tests detect the traces of HIV and to investigate further body complications, tests related to liver damage, cervical cancer, UTI and others are conducted [13]. Furthermore, the treatment and resources of HIV are quite limited despite its emergence since the 1800s [20]. Therefore, there is one major treatment for HIV which is antiretroviral therapy along with a series of anti-HIV medicines.

Diagnosis of HIV	Tests for Body Complications	Treatment and Resources
Antigen tests	Tuberculosis, Liver damage	Based on the stage of HIV detection, treatment is suggested such as antiretroviral therapy (ART) along with HIV medicines
Antibody tests	Hepatitis B, C, STIs	ART treatment is recommended for HIV patients and anti-HIV drugs
Nucleic acid test (NAT)	Cervical cancer, anal cancer, urinary tract infection (UTI)	Anti-HIV drugs such as Sustiva, edurant and others as well as ART

Table 1: Several Diagnosis tests and Treatment of HIV

VII. ASSOCIATION BETWEEN THE MODERN APPLICATION OF NANOTECHNOLOGY AND HIV

There is tremendous importance of nanotechnology in the healthcare sector and especially helpful in dealing with HIV. This particular innovation has enabled one to utilise a variety of tools that delineates the developmental aspects of diseases to a higher extent [18]. In response to nanotechnology, the rise of nanoparticles (NPs), nanocarriers, and nanosystems has been observed. The initiation of nanoparticles in terms of metal, semiconductor, oxides, and other types of NPs are utilised within the length dimension of the nanoscale and thereby attempt to manipulate and control this phenomenon. Furthermore, it has been witnessed that the majority of nanoparticles are highly accessible given their production abilities, factors of cost-effectiveness, low level of toxicity and others [14]. Therefore, the connectivity between nanotechnology and modern healthcare society is ascertained to be highly valuable in modifying the structures of certain diseases [18].

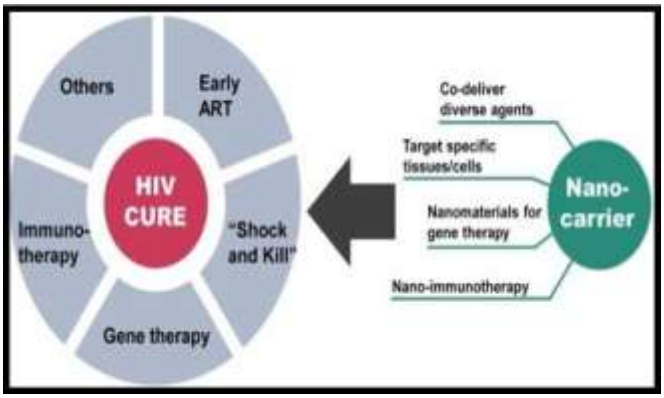

Figure 3: Various treatment interventions for HIV based on the application of nanotechnology (**Source:** Influenced by 18)

Benefits of Nanotechnology	Challenges of Nanotechnology
It has extended utilities in the field of electronics	It has tremendous environmental impacts which are formulated as a result of toxic materials and pollutants.
It is extensively vital in producing powerful medications	Nanotechnology has inherently reduced job markets in other fields.
Application of nanotechnology helps in selective attack of the defected cells, has immense utility in repairing damaged genes	The use of nanotechnology is linked with microscopic recording equipment, therefore, probability to detect diseases is observed

Table 2: Benefits and drawbacks of utilising nanotechnology

X. PROBLEM STATEMENT

The precedent argument puts forward the notion of usages of nanoscience and nanotechnology. Although the emergence of nanotechnology produces significant benefits it is seen that one of the most effective drawback is linked with environmental concerns [11]; [12]. In other words, the deployment of nanotechnology is correlated with use of toxic materials and pollutants wherein this aggravates environmental degradation. Furthermore, the application of microscopic recording instrument has intensified the risk of undetected diseases [19]. As witnessed from previous argument, HIV is a sickness that goes undetected for a longer period this in turn increases the risk aspects of attaining proper medical treatment. Therefore, it is of utmost importance to conduct appropriate diagnosis and leverage the prospects of HIV [9]. The issues with high cost is equally responsible since this technological advancement requires huge financial assistance, therefore, these mentioned problems occur quite often.

CONCLUSION

The implementation of nanotechnology has been a boon to mankind especially in the world of medical science. Following the evaluation of the study, it can be concluded that nanotechnology has higher chances to leverage the treatment benefits of HIV diseases. Considering its usability in studying nano materials and manipulate their molecular structure according to the needs, therefore, it has rendered immense growth in the healthcare sector. HIV diseases and AIDS have lifelong health implications which cause further damages such as tuberculosis, kidney failure, liver issues, cervical cancer and many more. Therefore, through extensive implementation of nanotechnology, therapeutic interventions in HIV are obtained.

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