

ON NATURAL SCIENCES

HIV/AIDS AS A DEVELOPMENTAL PROBLEM IN CAMEROON: *ISSUES, IMPACTS & WAY FORWARD*

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ABSTRACT

Since the discovery of the HIV, our knowledge and understanding of the immunopathogenesis of HIV-1 infection, AIDS viral life cycle and the host response to infection have increased significantly. As a result, virus specific interventions have been developed that are highly active and that can contain viral replication. The damaged immune system can then be at least partially immune reconstituted, and even individuals presenting with late-stage infection now have an expectation of long-term survival if they have access to antiretrovirals and expert healthcare providers. The extraordinary effort of scientists to understand and contain HIV-1 infection has led to new knowledge discoveries in areas such as virology, immunology, and oncology. Despite the advances in HIV treatment, there continues to be considerable variation in HIV disease progression. In addition to biological mechanisms, we need to consider behavioral and psychosocial factors such as depression, stress and coping that may affect adherence to medications as well as the immunology and virology of the disease. Moreover, efforts need to be sustained and increased globally in order to eliminate the incidence of HIV/AIDS infections around the world, and particularly in Africa to the barest minimum. While the prevalence of HIV/AIDS infection is very high in Africa, its high incidence in Cameroun makes it very alarming coupled with the fact that it tends to affect vulnerable groups such as women and children. Although the Cameroonian government in its effort to curb the HIV and AIDS pandemic has made significant achievements barely midway into the implementation of the second national strategic plan, there is still much to be done if the incidence of HIV/AIDS is to be completely dealt with.

Key words: HIV, AIDS, disease, virology, immunology, antiretrovirals, oncology, infection.

1.1 Introduction and Background

Acquired immune deficiency syndrome (AIDS) is the direct result of chronic infection with the human immunodeficiency virus (HIV). The official commencement of this lethal epidemic occurred in the summer of 1981 when the US Centers for Disease Control and Prevention (CDC) reported on a cluster of *Pneumocystis carinii* pneumonia (PCP) in five homosexual men (CDC, 1981). However, there is enough evidence that supports the belief that HIV first crossed the simian-human species barrier much earlier, possibly in Cameroon in West Africa (Keele, Van Heuverswyn, Li, Bailes, Takehisa, Santiago, Bibollet-Ruche, Chen, Wain, Liegeois, Loul, Ngole, Bienvenue, Delaporte, Brookfield, Sharp, Shaw, Peeters & Hahn, 2006). There is also evidence that HIV found its way to the Caribbean before the 1980s (DeMedina, Fletcher, Valledor, Ashman, Gordon, & Schiff, 1987). From 1981, approximately 1.7 million people have been infected with HIV in the United States, more than 550,000 have subsequently died, and 1.2 million, as at 2007 alone, were living with HIV/AIDS (Henry Kaiser Foundation, 2007). Despite improved HIV medications and lower morbidity and death rates in the past decade, there is still great variability in HIV disease progression (Nilsson, Kinloch-de-Loes, Granath, Soñnerborg, Goh & Andersson, 2007).

Although HIV/AIDS is a major issue globally, it is much exacerbated in developing countries especially of Sub-Saharan Africa (SSA), where 67% of the world's infection is harboured. The incidence and prevalence of HIV has been aggravated by plethora of factors which may be either socio-economic, cultural and/or religious, including taboos and war. Moreover, children have also been seriously affected, with 420,000 new infections in children under 15 years of age in 2007 alone, and 330,000 deaths in the same period, much of which was in SSA (UNAIDS/WHO, 2007) with an estimated 25 million orphans projected by 2010.

Previous researches have resulted in the identification, classification and description of two subfamilies of the HIV, namely; HIV-1 and HIV-2. HIV-1, based on phylogenetic analysis is at the moment classified into three distinct categories: M (Major), O (Outlier) and N (Non-M, non-O). HIV-1 group M is most the prevalent worldwide and has several subtypes (A-D, F-H, J-L) and two subsubtypes (A1 and A2; F1 and F2). Of these, subtypes A,B,C,D,F,G,H,J,K,L are reported to be present in Cameroon, with Subtype A being most prevalent (Fonjungo, Mpoudi, Torimiro, Alemnji, Eno, Lyonga, Nkengasong, Lal, Rayfield, Kalish, Folks & Pieniazek, 2002; Ndembi, Takehisa, Zekeng, Kobayashi, Ngansop, Songok, Kageyama, Takemura, Ido, Hayami, Kaptue, Ichimura, 2004; Ndongmo, Pieniazek, Holberg-Petersen, Holm-Hansen, Zekeng, Jeansson, Kaptue, Kalish, 2006).

As at 2008, not less than 34 circulating recombinant forms (CRF) of HIV have also been described, and in Cameroon, the CRF 02_AG is predominant (Koizumi, Ndembi, Miyashita, Lwembe, Kageyama, Mbanya, Kaptue, Numazaki, Fujiyama, Ichimura, 2006; Ndembi, Abraha, Pilch, Ichimura, Mbanya, Kaptue, Salata, 2008).

The O subtype which seems to be absent in West and East African countries is most divergent and was first described in 1990 from a Cameroonian patient (Vanden Haesevelde, Decourt, De Leys, Vanderborght, van der Groen, van Heuverswijn, Saman, 1994). The prevalence of the O

subtype in Cameroon has been reported to be around 5% (Nkengasong, Peeters, vanden Haesevelde, Musi, Willems, Ndumbe, Delaporte, Perret, Piot, van den Groen, 1993).

1.2 Objectives

The study seeks to;

- i. Provide a comprehensive overview of the incidence of the HIV pandemic, the basic biology and immunology of the virus (e.g., genetic diversity of HIV and the viral life cycle), the phases of disease progression, modes of HIV transmission, HIV testing, immune response to the infection, and current therapeutic strategies.
- ii. Review the current status of HIV/AIDS in Cameroon
- iii. Analyze the impacts of HIV/AIDS on socio-economic development in Cameroon and
- iv. Recommend policy strategies to help minimize the incidence of HIV/AIDS and facilitate socio-economic development in Cameroon.

1.3 Brief Profile of Cameroon

Cameroon is situated in Central West Africa, north of the Equator. Cameroon is bounded on the North by Chad, on the South by Gabon and Congo, on the West by Nigeria and on the East by the Central African Republic [See Figure 1]. Cameroon has a surface area of about 475,000 km² and a population of about 16 million people and an annual growth rate of about 2.8%. Cameroon is undergoing a demographic transition and about 50% of the population now lives in urban areas. Administratively, the country is divided into 10 provinces headed by governors. Each province is divided into divisions, divisions into subdivisions and subdivisions into districts. Yaoundé is the administrative capital of Cameroon and is in the Central Province of the country. Its economic capital is situated in Douala and the average income per capita over the last five years ranges from US\$ 600-650 (Mbanya, Sama & Tchounwou, 2008).

The Ministry of Public Health co-ordinates all health services in the country. According to a Ministry of Health report in 2002, the health system is organized at three levels: central, intermediate and peripheral. The Central level has three reference health institutions of Category I and three of Category II institutions. Of the Intermediary level are nine provincial hospitals and affiliated health structures. Peripheral institutions are health districts. In Cameroon, in 2002, there were 150 such health districts and 1,388 health centers. Currently there is an estimated 174 health districts in Cameroon. Among the rest, some are under the auspices of private institutions and religious missions. There is a national public health emphasis on preventive medicine and preventive health services are available throughout the country to complete this national health structure. The national social insurance scheme in Cameroon does not cover the health service; patients have to pay for every aspect of services rendered (Mbanya, Sama & Tchounwou, 2008).

Figure 1: Geographical Location of Cameroun on the African Map



Source: www. Wikipedia.com. Retrieved March, 2017.

1.4 Literature Review

This section presents a review of biological, genetic, immunological, epidemiological, socio-economic and government interventions related to HIV/AIDS in Cameroun.

1.4.1 Basic biology and immunology of the HIV

The biology and immunology of the HIV involves learning to understand the human immune system, the structure of the HIV virus and how the virus affects the immune system once it infects it.

1.4.2 The Human Immune System

An appreciation of the various components of the immune system and the complex signaling that takes place between immune cells is a key to understanding the HIV. Both non-specific and specific lines of defense help thwart the invasion of pathogens. Non-specific defenses act quickly and indiscriminately to exclude microbes from the body or actively kill intruders. Mechanical barriers — such as the mucus, hairs, and cilia in the respiratory tract, and the flow of urine through the urinary tract — are among these non-specific defenses. Skin oils and chemicals in perspiration and gastric juices also serve as non-specific barriers (Coffin, 1999).

Mechanisms involving complex chemical signals such as fever and inflammation also act against a wide variety of pathogens. One nonspecific defense involves phagocytes, a particular type of leukocyte (white blood cell), which acts as cellular “Pac-Men,” engulfing and digesting microbes or other irritants like dust and pollen. If invaders have breached the non-specific defenses, the immune system will use a variety of leukocytes to mount directed defenses against specific invaders. Lymphocytes bind and respond to specific foreign molecules (**antigens**). One subset of lymphocytes, the B cells, matures into antibody-secreting cells. Another subset of lymphocytes, the T cells, includes immune cells that directly kill cancerous or virally infected cells. Some subtypes of T cells serve a regulatory function, releasing chemical signals that can stimulate or suppress a variety of immune functions. Because HIV preferentially infects one of these regulatory T cells, the so-called helper T (TH) cell, it can subvert and decimate the immune system, leading to AIDS (Coffin, 1999; Amborzia & Levy, 1998).

Table 1: Types of Leukocytes (*white blood cells*)

Respond Non-Specifically	
Granulocytes Basophils (contain cytoplasmic granules)	Basophils -Important in inflammation and allergic responses
	Neutrophils -Phagocytic; during inflammation they squeeze through capillaries to destroy microbes in tissue
	Eosinophils Phagocytic; elevated in allergy and in parasite infections
Monocytes and macrophages	Monocytes that leave the circulation then mature into highly phagocytic macrophages in tissue. “Fixed” macrophages stay in certain places, such as the lymph nodes or the lung.
Interact with specific antigens	
Lymphocytes	B cells Cells that provide immunity to antigens circulating in the blood, such as bacteria, toxins, and circulating viruses. B cells mature from stem cells in the bone marrow. Once they encounter antigen, B cells mature into plasma cells that secrete antibodies
	T cells* Cells that provide cellular immunity to antigens inside or associated with cells, such as cancer cells or cells infected with a virus. They also help clear infections caused by fungi and worms, and contribute to transplant rejection. They mature from stem cells in the thymus. Types of T cells include:

- **TC** - cytotoxic T cells; lyse cells expressing foreign antigens
- **TH** - helper cells; secrete chemicals that enhance TC and B cell responses
- **TS** - suppressor cells; reduce TC and B cell responses
- **TD** - delayed hypersensitivity cells involved in certain allergic-like responses

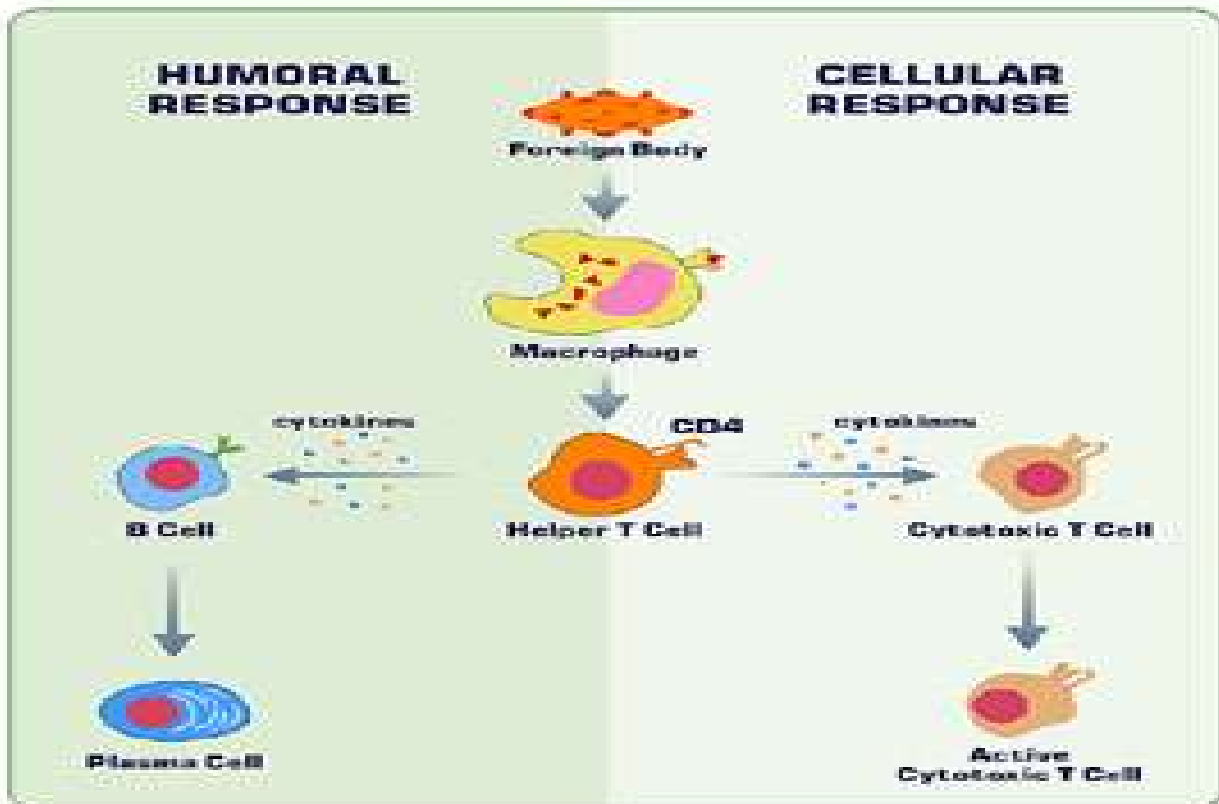
* *T cells can be differentiated, in part, based on certain proteins on their surfaces. Helper T cells, which are often called T4 cells, express the CD4 protein. Cytotoxic T cells and suppressor T cells express CD8. Because HIV infects helper T cells, the ratio of CD4 to CD8 cells is valuable for monitoring the course of infection.*

Source: Coffin, J. M. 1999. *Molecular biology of HIV*. In *The Evolution of HIV*, ed. K. A. Crandall, 3–40. Baltimore: Johns Hopkins University Press.

Helper T (TH) cells are critical to coordinating the activity of the immune response. The chemical messages they secrete (**cytokines**) stimulate the non-specific immune response to continue, and strengthen and boost appropriate specific responses. Helper T cells have sometimes been called the “conductors” of the immune system because they coordinate activity like the conductor of a symphony. They have also been called the “generals” of the immune system because they call up troops of B cells, cytotoxic T cells, and other helper T cells to go into battle against invading pathogens (**Fig. 2**).

Macrophages alert helper T cells to the presence of pathogens. These phagocytic macrophages engulf bacteria and viruses and can display foreign antigens — the identifying proteins of the bacteria or viruses— on the surface of their cell membrane. Embedded within the macrophage cell membrane is a molecule produced by the human leukocyte antigen (HLA) complex. (See the *Human Evolution* unit.) The helper T cells bind simultaneously to the foreign antigen and the HLA molecule. Only TH cells with receptors that match those of the foreign antigen on the activated macrophage are able to bind and respond to the call to action. Once bound, the helper T cell proliferates to form a clone of cells, each capable of recognizing the same antigen. The members of the helper T clone, the generals, generate the chemical signals that call up the troops.

Figure 2: Humoral and Cellular Immune Responses



A specialized macrophage ingests foreign antigens and displays antigen fragments along with MHC (self) molecules on its surface. A helper T cell (TH) with the appropriate receptor binds and responds by producing cytokines that stimulate antigen specific B cells, as well as specific cytotoxic T cells.

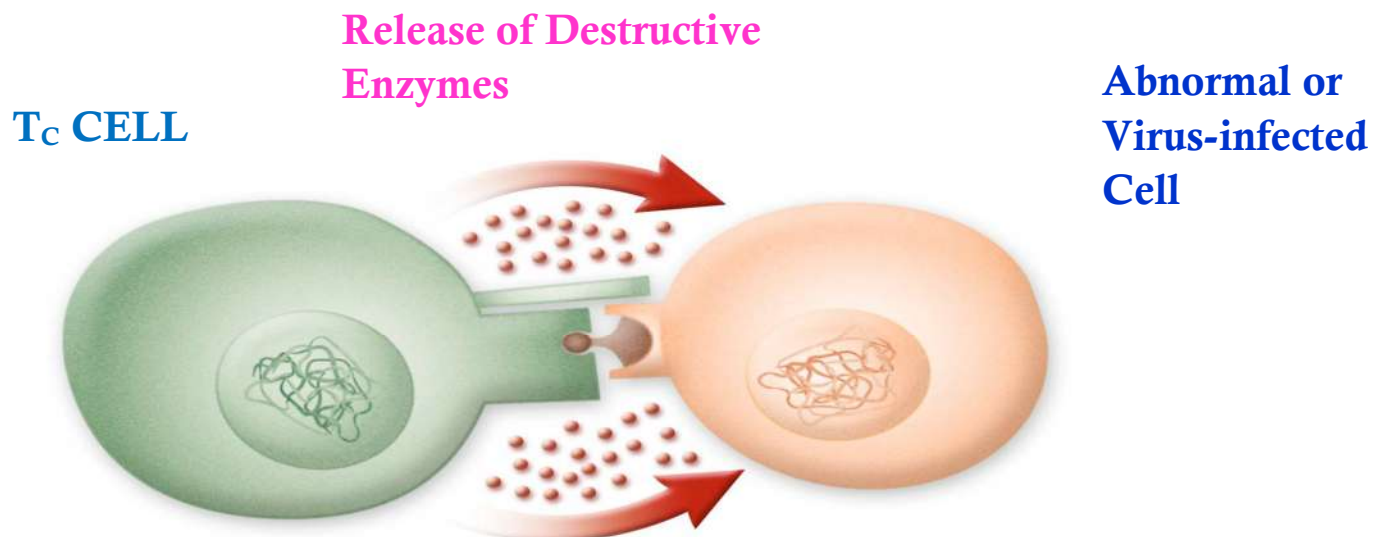
Some signals sent by helper T cells stimulate cytotoxic T cells (TC). Cytotoxic T cells (also known as killer T cells) bind cells that have been altered, such as by viral infection; they avoid healthy cells. Surface antigens on the altered cell perform the binding. These antigens are specific to the offending agent, and match receptors in the membrane of the specific TC cell. In addition, the TC cell simultaneously binds an MHC molecule on the surface of the infected cell. Once bound by both the foreign antigen and the HLA molecule, the cytotoxic T cell secretes a chemical called "perforin," which destroys the offending cell (**Fig. 3**).

Helper T cells also stimulate the production of antibodies. Chemical signals from helper T cells stimulate the production of B cells specific to an infecting pathogen, and then stimulate the B cells to differentiate into plasma cells. The plasma cells are factories for the production of antibodies, which are specific to given pathogens circulating in blood or lymph. Antibodies work by blocking the receptors that allow pathogens to attach to target cells, or by creating clumps of bacteria. Clumping makes the job of phagocytes easier, as they will more readily engulf bacteria

in clumps. Bound antibodies sometimes serve as tags, called **opsonins**, enhancing phagocytosis. Antibody binding can also initiate a cascade of biochemical reactions, activating a set of chemicals known as complement. Activated complement components can form holes in bacterial membranes and enhance inflammation.

Helper T cells are clearly critical to the operation of the immune system. If they are destroyed because of an HIV infection, the whole system is crippled. The immune system is described as having two "arms": the **cellular** arm, which depends on T cells to mediate attacks on virally infected or cancerous cells; and the **humoral** arm, which depends on antibodies to clear antigens circulating in blood and lymph. As an HIV infection progresses, destroying helper T cells, both arms of immunity are impaired.

Figure 3. Binding by both the antigen and an MHC molecule initiates the secretion of lytic enzymes by the cytotoxic T cell (T_c).



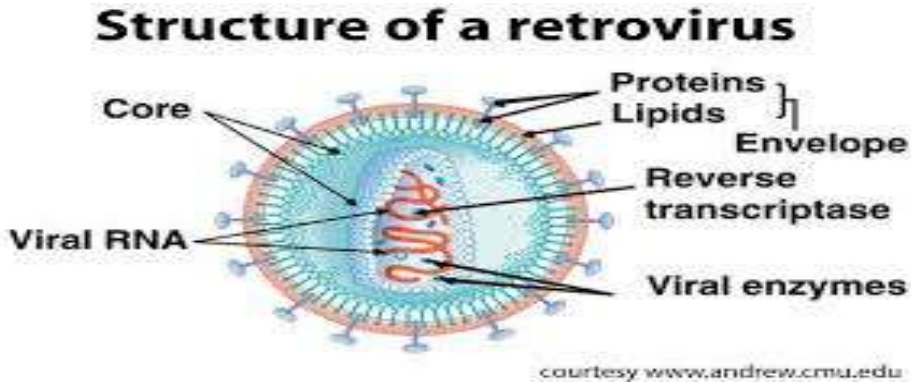
1.4.3 Human Immunodeficiency Virus (HIV)

HIV belongs to a class of viruses called retroviruses ¹[**Figure 4**] and a subgroup of retroviruses known as lentiviruses or "slow" viruses (Chiu, Yaniv, Dahlberg, Gazit, Skuntz, Tronick, Aaronson, 1985). The course of infection with these viruses is characterized by a long interval between initial infection and the onset of serious symptoms. Like all viruses, HIV can replicate only inside cells, commandeering the cell's machinery to reproduce. Retroviruses have genes composed of

¹ Retroviruses typically consist of a viral enzyme, and RNA bearing reverse transcriptase both bounded by a core. The cytoplasm of the cell is enveloped by proteins and lipid bi-layers.

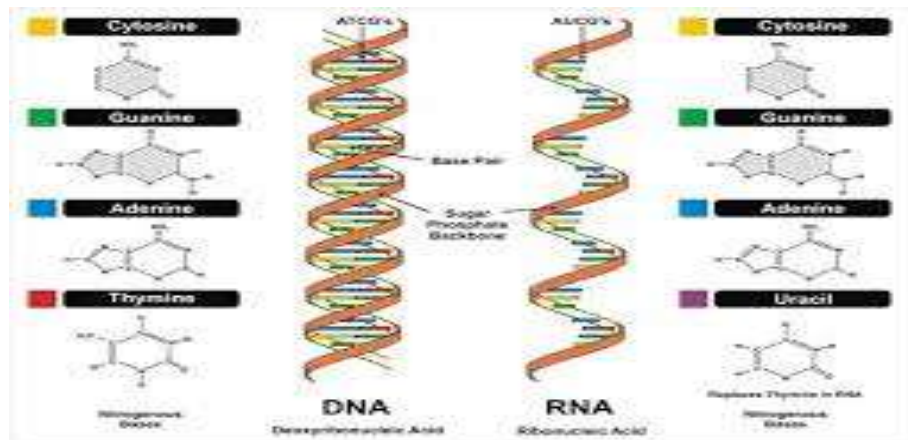
ribonucleic acid (RNA)² molecules whereas the genes of humans and most other organisms are made of a related molecule, deoxyribonucleic acid (DNA)³ [See **Figures 4 & 5**]. However, once inside the cell, HIV and other retroviruses use the enzyme reverse transcriptase to convert their RNA into DNA, which can be incorporated into the human cell's genes (Smith & Daniel, 2006).

Figure 4: Generalized Structure of a Retrovirus



Source: www. Wikipedia.com. Retrieved March, 2017.

Figure 5: Structure of RNA and DNA



Source: www. Wikipedia.com. Retrieved March, 2017.

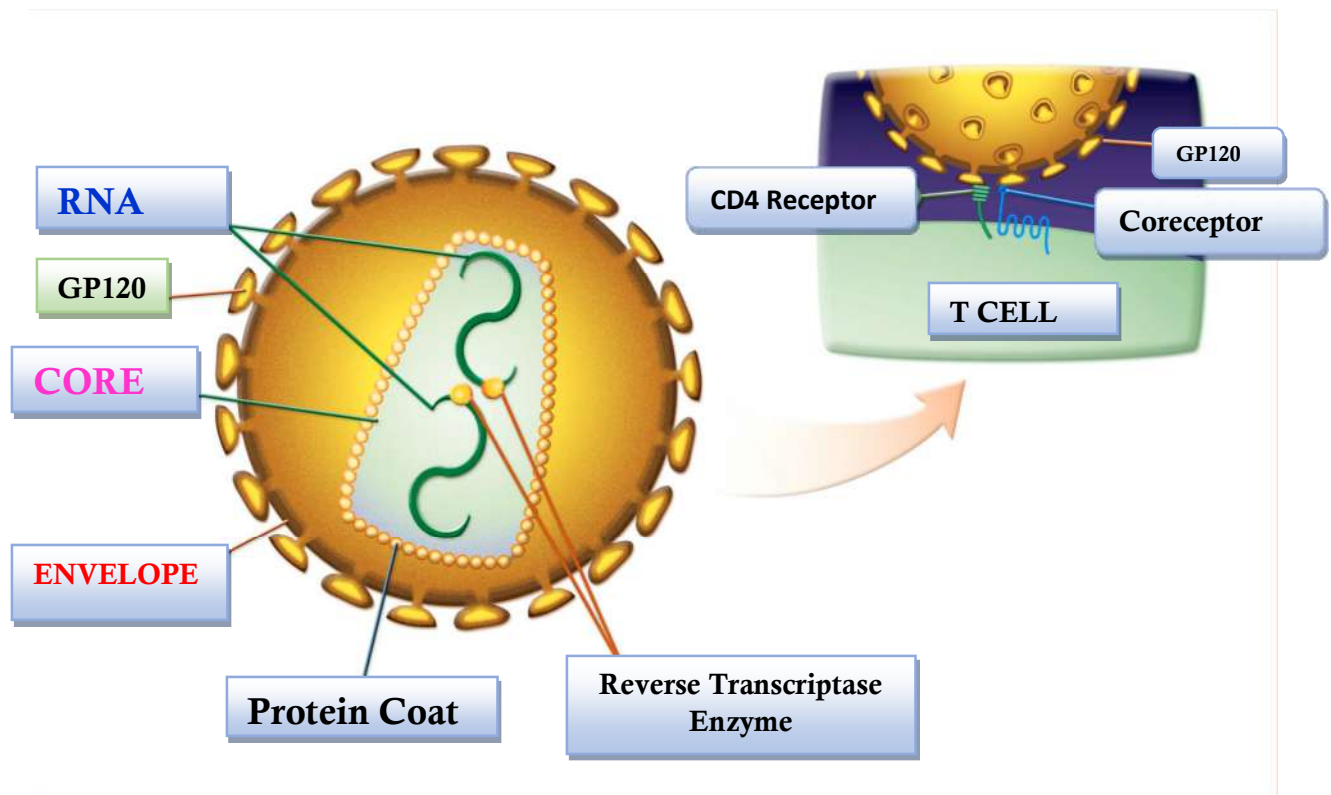
² RNA is a single stranded nucleic acid that contains ribose sugar, and the nitrogenous bases of cytosine, adenine, guanine and uracil.

³ DNA is a double stranded, helix-shaped nucleic acid molecule containing de-oxyribose sugar, and nitrogenous bases of cytosine, adenine, guanine and thymine.

1.4.4 The Structure and Life Cycle of HIV

HIV is an enveloped RNA virus. As HIV buds out of the host cell during replication, it acquires a phospholipid envelope. Protruding from the envelope are peg-like structures that the viral RNA encodes. Each peg consists of three or four gp41 glycoproteins (the stem), capped with three or four **gp120** glycoproteins. Inside the envelope the bulletshaped nucleocapsid of the virus is composed of protein and surrounds two single strands of RNA. Three enzymes important to the virus's life cycle — **reverse transcriptase**, **integrase**, and **protease** — are also within the nucleocapsid (**Fig. 6**).

Figure 6: Shows the binding of HIV to a host cell. GP120 on the virus binds CD4 receptors on the host.



A second coreceptor molecule on the host is also required for binding. Although helper T cells seem to be the main target for HIV, other cells can become infected as well. These include monocytes and macrophages, which can hold large numbers of viruses within themselves without being killed. Some T cells harbor similar reservoirs of the virus. Entry of HIV into the host cell requires the binding of one or more gp120 molecules on the virus to CD4 molecules on the host cell's surface. Binding to a second receptor is also required. Ed Berger helped identify this

coreceptor. As he compared his results with those of other researchers, it became clear that two different coreceptors are involved in the binding. One, CCR5, a **chemokine receptor**, serves as a coreceptor early in an infection. Another chemokine receptor (CXCR4) later serves as a coreceptor. That two coreceptors are involved is consistent with previous observations. Viruses isolated from individuals early in an infection, during the asymptomatic phase, will typically infect macrophages in the laboratory, but not T cells (the viruses are M-tropic). Virus isolated from patients later in the infection, in the symptomatic phase, will infect T cells (the viruses are T-tropic). It seems that a shift takes place in the viral population during the progression of the infection so that new cellular receptors are used and different cells become infected.

HIV is a member of the group of viruses known as retroviruses, which share a unique life cycle (**Fig. 7**). Once HIV binds to a host cell, the viral envelope fuses with the cell membrane, and the virus's RNA and enzymes enter the cytoplasm. HIV, like other retroviruses, contains an enzyme called reverse transcriptase. This allows the single-stranded RNA of the virus to be copied and **double-stranded DNA (dsDNA)** to be generated. The enzyme integrase then facilitates the integration of this viral DNA into the cellular chromosome. **Provirus** (HIV DNA) is replicated along with the chromosome when the cell divides. The integration of provirus into the host DNA provides the latency that enables the virus to evade host responses so effectively.

Production of viral proteins and RNA takes place when the provirus is transcribed. Viral proteins are then assembled using the host cell's protein-making machinery. The virus's protease enzyme allows for the processing of newly translated polypeptides into the proteins, which are then ultimately assembled into viral particles. The virus eventually buds out of the cell. A cell infected with a retrovirus does not necessarily lyse the cell when viral replication takes place; rather, many viral particles can bud out of a cell over the course of time [Fig. 7].

The major steps in the HIV replication cycle are summarized as follows (See Figure 7 below) :

- ❖ *Fusion of the HIV cell to the host cell surface.*
- ❖ *HIV RNA, reverse transcriptase, integrase, and other viral proteins enter the host cell.*
- ❖ *Viral DNA is formed by reverse transcription.*
- ❖ *Viral DNA is transported across the nucleus and integrates into the host DNA.*
- ❖ *New viral RNA is used as genomic RNA and to make viral proteins.*
- ❖ *New viral RNA and proteins move to cell surface and a new, immature, HIV virus forms.*
- ❖ *The virus matures by protease releasing individual HIV proteins.*

Figure 7. HIV replication cycle

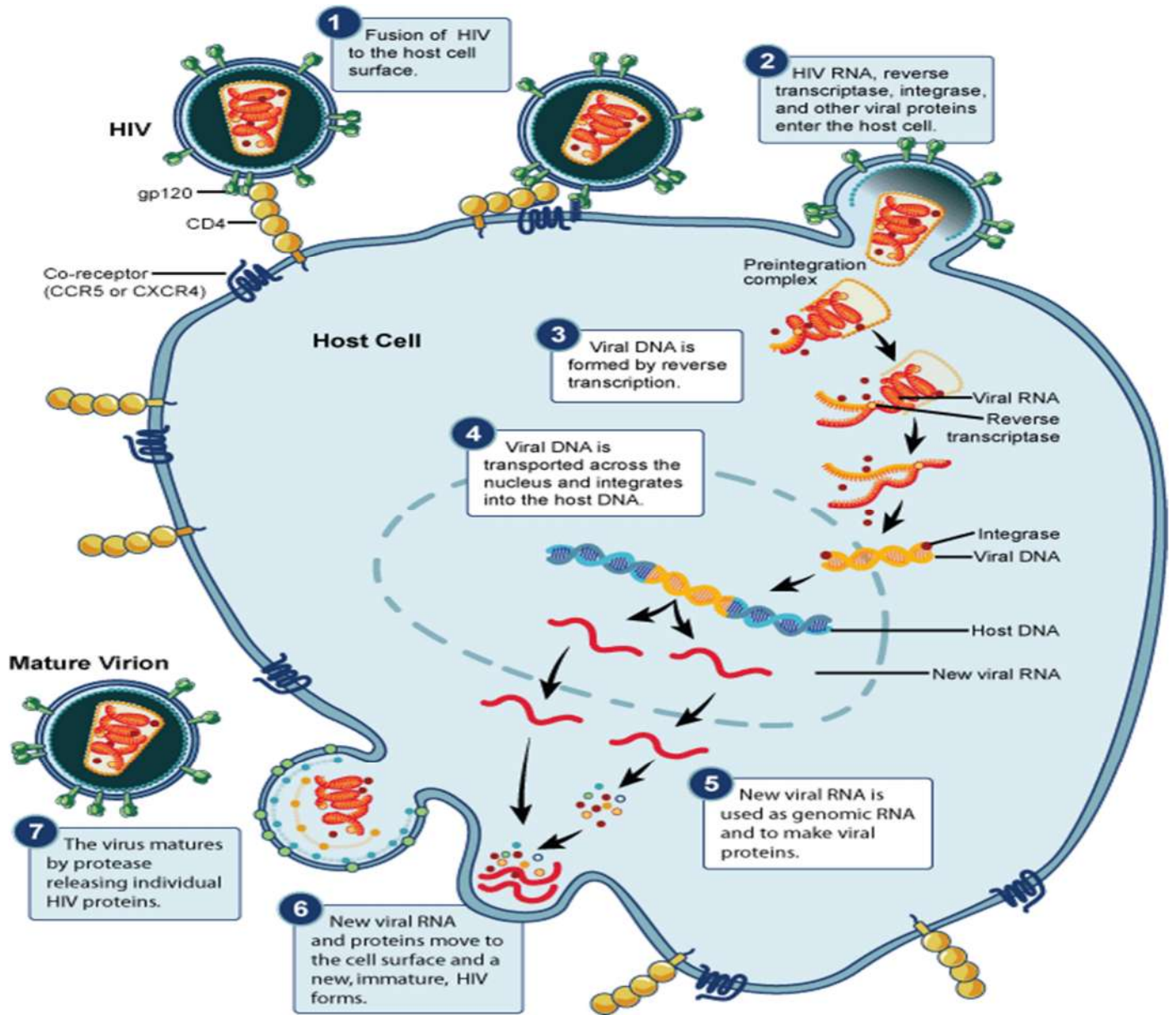


Image source: NIAID. Retrieved from: http://www.daviddarling.info/encyclopedia/A/acquired_immune_deficiency_syndrome.html, March, 29, 2017 at 8:09PM GMT.

1.4.5 Genetic Diversity of HIV

Two genetically distinct viral types of HIV have been identified (Butler, Pandrea, Marx, Apetrel & 2007). HIV-1 is the type associated with disease in the United States, Europe, central Africa, and most other parts of the world. HIV-2 has been found mainly in infected individuals in western Africa and is very similar to HIV-1 in that it has the same tropism for cells of the immune system and causes illness that results from immune deficiency. All HIV types and subtypes are thought to be derived from zoonotic introductions from nonhuman primates (Tebit, Nankya, Arts & Gao, 2007). HIV-1 variants are classified into three major groups: group M (main), group O (outlier), and group N (non-M/non-O). Group M, which is responsible for the majority of infections in the worldwide HIV-1 epidemic, can be further subdivided into 10 subtypes, or clades (A to K). Sub-subtypes and circulating recombinant forms (CRFs) have emerged over the past few decades (Buonaguro, Tornesello & Buonaguro, 2007).

Genetic variation for HIV-1 is especially high, with rapid turnover of HIV-1 virions. Over 20 different CRFs have been defined within group M alone. The HIV-1 subtypes C and A account for the majority of HIV cases in the pandemic, but the other viral forms circulate globally. HIV-1 subtype B is predominant in North America, Western Europe, and Australia (21). Information garnered from the study of the biophysical, biochemical, and in vitro studies of the HIV-1 subtype B was used to develop the antiretroviral drugs we currently have available. However, subtype B only accounts for only a small portion of the virus subtypes comprising the HIV pandemic (Buonaguro, Tornesello, Buonaguro, 2007; Kantor , Katzenstein, Efron, Carvalho, Wynhoven, Cane ,Clarke, Sirivichayakul , Soares , Snoeck , Pillay, Rudich ,Rodrigues, Holguin , Ariyoshi, Bouzas , Cahn , Sugiura ,Soriano, Brigido, Grossman , Morris , Vandamme , Tanuri, Phanuphak, Weber, Pillay, Harrigan , Camacho , Schapiro, Shafer, 2006). The proliferation of these various viral forms has serious implications for the feasibility of vaccine development and will have a major impact on diagnostic testing, monitoring, and treatment.

1.4.6 Phases of disease progression from HIV to AIDS

During the first few weeks of infection, the patient often suffers from a flu-like illness and a rash, an illness termed acute HIV-1 infection syndrome (Levy, 2006). This initial phase of HIV infection is followed by a gradual deterioration of the immune function. HIV has the ability to infect CD4+lymphocytes and a variety of other cells in the body, including monocytes and thymocytes (Nilsson et al., 2007; Ho Tsong Fang, Colantonio, Uittenbogaart, 2008). The virus enters target cells via cell surface molecules, including CD4 and chemokine coreceptors (CXCR4, CCR5) (8). CD4+ cells, also called "T-helper cells," play a central role in the immune response, signaling other cells such as the cytotoxic T cell and the B cells to perform their functions (Fahey, Taylor, Detels, Hofmann, Melmed, Nishanian & Giorgi, 1990). Normally, a healthy person has a CD4+ count of 800 to 1200 CD4+ T cells per cubic millimeter (mm³) of blood. As CD4+ cells are destroyed by HIV and as these cells decrease in number, holes develop in the immune repertoire (Nilsson et al., 2007). Once the CD4+ count falls to <500 mm³, half of the immune reserve has been destroyed and minor infections including cold sores (herpes simplex), condyloma (warts) and fungal infections, thrush and vaginal candidiasis, may occur (Table 2, Category B). These infections are troublesome but not life threatening. However, as the CD4+count falls to< 200 cells/mm³, the patient becomes particularly vulnerable to the serious opportunistic infections and

cancers that typify AIDS, the end stage of HIV disease. As shown in the shaded parts of Table 1, AIDS is defined as a CD4+count of <200 cells/mm³ (Category 3), or the presence of a serious infection, such as PCP, toxoplasmosis, cytomegalovirus infections of the eye or intestine, as well as debilitating weight loss, diarrhea, HIV dementia and cancers, Kaposi's sarcoma and lymphomas (Category C) (CDC, 1993).

TABLE 2. CDC Classification System for HIV-Infected Adults and Adolescents			
CD4 Cell Categories	Clinical Categories		
	A	B	C
Conditions	Asymptomatic, Acute HIV, or PGL ^a	Symptomatic Conditions, Not A or C	AIDS-Indicator
≥500 cells/mm ³	A1	B1	C1
200 to 499 cells/mm ³	A2	B2	C2
<200 cells/mm ³	A3	B3	C3
From the Centers for Disease Control and Prevention (10). Available at http://www.cdc.gov/mmwr/preview/mmwrhtml/00018871.htm . PGL ^a = persistent generalized lymphadenopathy.			

1.4.7 Modes of HIV transmission

Known routes of HIV transmission include:

- *Sexual contact (homosexual, bisexual or heterosexual)*
- *Contaminated needles - used for intravenous drug injection, or for general medical purposes in countries where disposable needles or sterilising equipment may be scarce*
- *Vertical transmission from mother to child*
- *Blood transfusions, blood products and organ/tissue transplants*
- *Injuries in healthcare settings, e.g. people working with blood products, needlestick injuries* (Negishi, 1993). However, there is no significant evidence to support claims that HIV may be transmitted by the following:
 - *Insects, e.g. mosquitoes, which penetrate the skin and blood supply*
 - *Saliva, e.g. kissing, sharing food and eating/drinking utensils*
 - *Sneezing or coughing*
 - *Shared use of facilities and equipment, e.g. toilets, swimming pools, towels, etc*
 - *Casual social contact, e.g. shaking hands, hugging, etc.* (Negishi, 1993)

1.4.8 HIV testing

In 1987, the United States Public Health Service issued guidelines which made HIV testing and counseling a primary prevention strategy for patients who were identified as practicing high-risk behaviors. Based on the 2006 HIV testing recommendations from the CDC, all patients in healthcare settings (regardless of risk factors) should be notified and then screened for HIV unless they decline testing (Branson, Handsfield, Lampe, Janssen, Taylor, Lyss & Clark, 2006). This approach to HIV testing is referred to as "opt-out screening." Routine screening for HIV is a crucial public health tool needed to identify the virus so that treatment can be offered before symptom development and also to reduce the likelihood of continued virus transmission.

The US Food and Drug Administration (FDA) has approved enzyme-linked immunoassay screening blood tests to be used by blood banks to detect antibody to both HIV-1 and HIV-2. A recent study was done to determine the ability of several FDA-licensed assays to detect anti-HIV in 240 human plasma specimens collected from two urban blood centers in Cameroon, where HIV genetic diversity and recombinant HIV strains are highly prevalent. The results indicated that the assays had high sensitivity for detection of emerging genetic variants (Lee , Wood , Tang , Hu , Machuca , Kerby , Awazi , Vockley & Hewlett , 2007). There are currently four rapid HIV tests that have been approved by the FDA. Two of these rapid HIV tests (OraQuick and Multispot) are able to screen for both HIV-1 and HIV-2, whereas the other two tests (Reveal and Uni-Gold Recombigen) only screen for HIV-1 (Greenwald, Burstein & Pincus, 2006). Currently, none of the rapid tests are available over-the-counter.

1.4.9 Antiretroviral Therapies (ART)

There are currently 20 antiretroviral drugs that have been approved for use in the treatment of HIV ((Panel on Antiretroviral Guidelines, 2008). There are presently six classes of ART available that interrupt viral replication: a) nucleoside/nucleotide reverse transcriptase inhibitors, b) nonnucleoside reverse transcriptase inhibitors, c) protease inhibitors, d) fusion inhibitors, e) CCR5 antagonists, and f) integrase inhibitors (Panel on Antiretroviral Guidelines, 2008).). Each of these classes of drugs affects the HIV virus at a different stage in its life cycle.

Current treatment consists of highly active antiretroviral therapy (HAART), that is, at least three drugs belonging to two classes of antiretroviral agents. According to current recommendations from the Panel on Antiretroviral Guidelines for Adults and Adolescents from the Department of Health and Human Services, patients who have not previously been treated (naive patients) may be treated if their CD4+ count falls <350 cells/mm³ (Panel on Antiretroviral Guidelines , 2008).). Patients should be treated if they present with an AIDS-defining illness, or if the CD4+ count is <200/mm³ because they are at a greater risk of developing complications due to HIV infection.

Treatment should be started with pregnant women, people with HIV-associated nephropathy, and with individuals coinfecting with hepatitis B regardless of their CD4+ count. In the US, it is now standard care to ask every pregnant woman to be HIV tested early in the pregnancy (Panel on Antiretroviral Guidelines, 2008). Adherence is a key issue as multidrug resistance is a very real challenge. Psychosocial factors, which may create a barrier to patient adherence, should be

addressed before the initiation of treatment (McPherson-Baker, Jones, Duran, Klimas, Schneiderman, 2005).

1.4.10 Immune Reconstitution Post HAART

Adoption of treatment strategies recommended by the current National Institutes of Health guidelines has resulted in substantial reductions in HIV-related morbidity and mortality (Panel on Antiretroviral Guidelines, 2008). The principles of therapy of HIV infection are based on our understanding of the immunologic damage caused by ongoing viral mutation from early in the infection process through late stages of the disease. Because the virus is highly mutable, every effort should be made to shut down viral replication completely. The goals of treatment are to suppress plasma viremia for as long as possible, to delay the selection of drug resistance mutations, and to preserve immune function.

Studies show that HAART protects from death, and the data suggest that this occurs by increasing immune subset counts and decreasing viral load. Although HAART “maintains” immunocompetence, this may occur in conjunction with viral suppression itself having a direct beneficial effect on adaptive and innate parameters (Stebbing , Bower, Mandalia , Nelson. Gazzard, 2006). The degree of improvement of the total CD4 count is, in part, a function of the initial degree of immune destruction. High baseline CD4+ T-cell counts predicted a better virological outcome of HAART (Paredes R, Mocroft, Kirk, Lazzarin, Barton, van Lunzen, Katzenstein, Antunes, Lundgren & Clotet, 2000).

1.4.11 Drug Resistance

Effective sustained treatment with HAART is complicated by the prevalence of drug resistance. The highly mutable nature of HIV has led to a number of virus mutations that have decreased or negated the efficacy of some antiretroviral drugs. The primary cause of drug resistance is the lack of regimen adherence of patients who are on HAART. Genotypic assays are available to detect drug resistance mutations when present in HIV genes (Patarca, Isava , Campo , Rodriguez , Nunez , Alter , Marchette , Sanabia , Mitchell , Rivera , Scott , Jayaweera , Moreo , Boulanger , Kolber , Mask , Sierra , Vallejo , Page , Klimas, Fletcher, 2003(a) ; Patarca et al., 2003(b)). Results can be reported within 1 to 2 weeks of sample collection.

The International AIDS Society- USA maintains a list of significant resistance-associated mutations in the reverse transcriptase, protease, and envelope genes (The International AIDS Society-USA (IAS-USA, n.d.). Phenotypic assays measure the ability of a virus to grow in different concentrations of antiretroviral drugs. Phenotypic assays cost more to perform than genotypic assays. In addition, interpretation of phenotypic assay results is more complicated (Panel on Antiretroviral Guidelines, 2008). Drug resistance testing is not advised for persons with viral load of <1000 copies/ml because amplification of the virus is unreliable (Panel on Antiretroviral Guidelines, 2008). Resistance testing in a person with acute HIV infection is recommended. Performing drug resistance testing before initiation of ART in patients with chronic HIV infection

is less straightforward. No prospective trial has addressed whether drug resistance testing before initiation of therapy confers benefit in this population. However, a cost-effectiveness analysis of early genotypic resistance testing suggests that baseline testing in this population should be performed (Sax, Islam, Walensky, Losina, Weinstein, Goldie, Sadownik & Friedberg, 2005).

Resistance to some drugs may confer cross-resistance to other types of antiretrovirals, further complicating the selection of appropriate drug regimens. Resistant strains of HIV can be transferred from people who have been treated with antiretrovirals to treatment naive individuals, so concerns about drug resistance are salient not only for the treatment exposed but also for the newly infected and for those who are new to drug therapy. The emergence of drug resistance in treated populations and the transmission of drug-resistant strains to newly infected individuals are important public health concerns in the prevention and control of HIV (Wu, Yan, Archibald, 2007). The influence of a number of psychosocial and behavioral factors has become a critical issue in relationship to drug resistance. A patient's mood, stressful life events, and socioeconomic status can influence adherence to the very successful, though sometimes complex, three- and four-drug regimens. A highly motivated patient can dramatically influence his or her outcome, with regimens that require 95% adherence levels to prevent drug resistance. A missed weekend of medications can result in drug resistance. Unfortunately, adherence to these regimens is poor (Klimas, 1998; Maher, Klimas, Fletcher, Cohen, Maggio, Triplett, Valenzuela, Dickinson, 1999), and poor adherence translates into multiple drug-resistant strains of HIV and rapid progression (Klimas, 1998). Even more recent once a day and twice a day regimens with low pill burdens have poor rates of adherence, with a recent Veterans Administration study showing a 76% refill rate to prescribed regimens (Braithwaite, Kozal, Chang, Roberts, Fultz, Goetz, Gibert, Rodriguez-Barradas, Mole & Justice, 2007).

1.4.12 Vaccine Development

The development of an HIV vaccine has taken place rather slowly, due to the tremendous capacity of this virus to escape immune pressure as well as the number of strain variations. Nonetheless, with an improved understanding of effective host response to the infection and the ability to deliver viral antigens to the immune system in novel ways, vaccine development is being pursued vigorously (Gallo, 2005). A June 2005 study estimated that \$682 million has been spent on AIDS vaccine research annually (Tracking funding for preventive HIV, 2000–2005). A number of vaccine concepts are being pursued including live attenuated vaccines, subunit vaccines, and live recombinant vaccines. This essential research effort recently suffered a baffling setback. The first trial of a vaccine designed to elicit strong cellular immunity has shown no protection against infection. More alarmingly, the vaccine seemed to increase the rate of HIV infection in individuals with prior immunity against the adenovirus vector used in the vaccine (Sekaly, 2008). The field is still a long way from a testable vaccine that will induce neutralizing antibody responses. The degree of difficulty in developing an effective AIDS vaccine rivals that of sending humans to Mars and back to Earth again.

1.5 Current status of HIV/AIDS in Cameroon

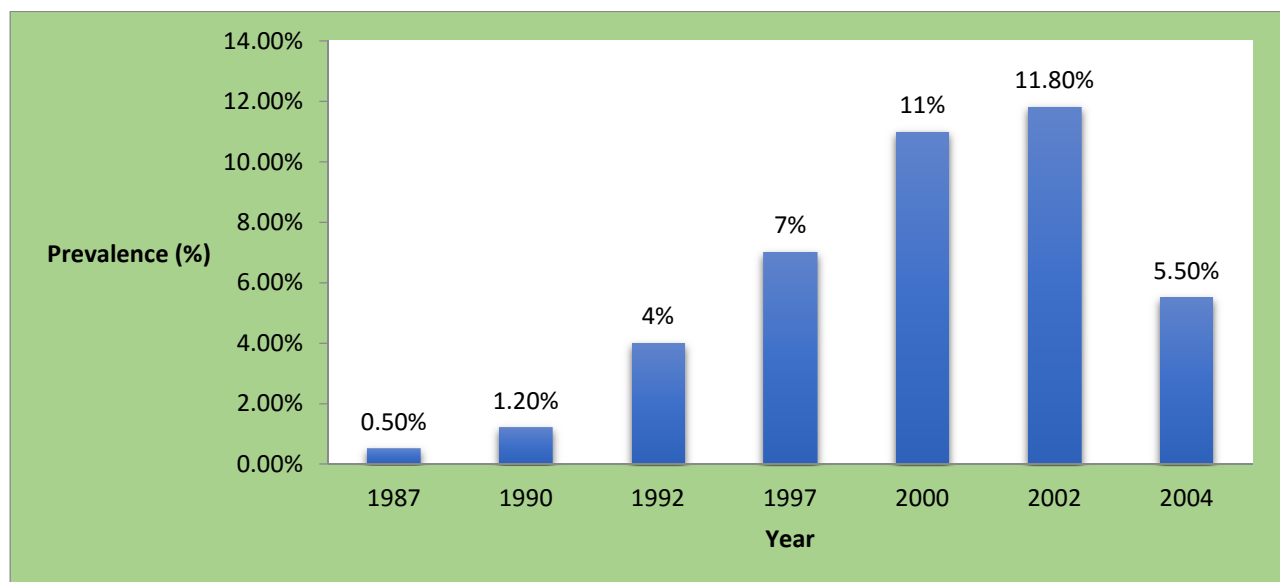
According to Mbanya, Sama and Tchounwou (2008):

“The first AIDS cases were reported in Cameroon in 1985 and ten years later, in 1995, an official total of 2766 had been notified with a cumulative number of 8,141.

The prevalence of the HIV infection in Cameroon has progressively risen from 0.5% in 1987 to 1.2% in 1990 (Garcia-Calleja et al., 1992 and from 4% in 1992 (Garcia-Calleja & Abbenyi, 1993) to about 7% in 1997, to 11% in 2000 and 11.8% in 2002 (Sentinel Surveillance, 2000). It however decreased to 5.5% in 2004 based on a Demographic and Health Survey carried out in 2004 (Institut National de la Statistique, 2008), –” (p.379).

Figure 8 below shows a steady rise in the HIV prevalence from 0.5% in 1987 to 11.8% in 2002. In 2004, there is a huge drop observed, to 5.5%. This is explained by the fact that the data from 1987 to 2002 was obtained from sentinel surveillance in antenatal clinics throughout the nation, whereas in 2004 it was a demographic and health survey of various strata of the general population, including university students, commercial sex workers, long distance drivers and others. Transmission is mainly heterosexual (90%) with the blood and vertical routes being 5% respectively

Figure 8: Prevalence of HIV from 1987 to 2004



Source: Mbanya, Sama & Tchounwou (2008), p.379.

They further observe (Mbanya et al., 2008, p. 379):

“In the earlier years, more than 70% of the infected people were aged between 20 and 39 years (Garcia-Calleja et al., 1992), the work force of the country. Today, youths are still the most infected and those in

the 15-24 year age group are hard hit, with the girls infected constituting 10-15%, compared to 4-6.5% of boys of the same age. There is no doubt that the socio-economic impact on this society is profound with growing numbers of sectors being affected, and high hospital bed occupancy rampant, resulting in an overstretched medical personnel and an extra burden to the health system. School teachers are reported to be unproductive on several counts and morbidity is high from opportunistic such as tuberculosis. Furthermore, there is a rising number of orphans from the HIV pandemic, with 122,670 cases reported in 2005" (National AIDS Control, 2005).

1.6 Trends in General Population

Gender

Concerning the gender distribution of HIV/AIDS in Cameroun, Mbanya et al., 2008 (p. 380) report:

"..the Cameroonian woman is more infected than the man, constituting about 55% of cases. According to the DHS in 2004 (Institut National de la Statistique , 2008), HIV infection was detected in 6.8% females, compared to 4.1% males. This trend in women is also observed when other variables are examined including marital and educational status. Several factors contribute to the Cameroonian woman and the African woman on the whole, being more vulnerable to the infection. These may include socio-cultural factors and gender-related norms, poor educational and healthcare access, especially for treatment of sexually transmitted infections (STI) as well as the lack of reproductive and sexual rights, with women being mostly economically dependent on men, and hence with little negotiating power. In fact, it has been suggested that gender may be a single most important determinant of the HIV and AIDS epidemic. There is no data published in Cameroon on men having sex with men, but anecdotal evidence suggests that the practice is now existent in Cameroon".

Children

When it comes to distribution of HIV/AIDS among children, Mbanya et al., 2008 (p. 380) further indicate:

"There were about 45,000 children reported to be living with HIV and AIDS in Cameroon in 2001, and a drop was noted in 2005 to 35,000 children. The numbers of AIDS orphans was 122,670 in 2005. Most children are believed to acquire the infection during pregnancy and breastfeeding. Indeed several studies have confirmed that mother-to-child transmission of HIV is a primary route of infection in SSA, accounting for up to 90-95% transmissions. An estimated 1,600 children are infected daily by their mothers and without any intervention, 30- 40% of breastfeeding mothers transmit to their babies (Iloff, Piwoz, Tavengwa, Zunguza, Marinda, Nathoo, Moulton, Ward, Humphrey, 2005). This can be explained by the high rate of infection in the women and the efficiency of mother-to-child transmission of the infection. In a study in Cameroon by *Kouam et al. (2006)*, mother-to-child transmission was estimated at 11.1% in mothers who had been put on the recommended single dose of Nevirapine at the onset of labour, as well as for their neonates within 72 hours of delivery. Transmission in these children may also occur through the sexual route, mainly through sexual abuse, rampant amongst orphans and through the blood route (unsterile injections, unsafe transfusions and scarifications)".

Risk Groups

With regards to groups at risk of infection with HIV/AIDS, Mbanaya et al., 2008 (p. 380) note :
“The trends of the infection have also been reported in various target groups of the population including commercial sex workers, long distance lorry drivers, uniformed officers and tuberculosis patients. In some of these groups, the HIV prevalence has been as high as 40-50%. In one study looking at HIV infection in specific subpopulations of Cameroon (Musoko, Macauley, Zoungkanyi, Assumpta, Koulla-Shiro, 2007), a prevalence of 26.4%, 19.9% and 16.3% was respectively observed in female commercial sex workers, residents along the Chad-petroleum pipeline and long distance truck drivers. In the same analysis, lower prevalences were noted in health care personnel (5.2%) and university students (3.8%). These findings confirm the need for expanded prevention and care programmes for high risk groups of the community”.

1.7 Impacts of HIV/AIDS on socio-economic development in Cameroun

The impacts of HIV/AIDS on socio-economic development in Africa have been studied by Stover and Bollinger (1999). The impacts could be analyzed under micro- and macro-economic impacts.

1.7.1 Microeconomic impacts

Micro-Economic Impact of AIDS on Households

According to Stover and Bollinger (1999) the household impacts (particularly in Cameroun and other parts of sub-Saharan Africa) begin as soon as a member of the household starts to suffer from HIV-related illnesses and it includes:

- *Loss of income of the patient (who is frequently the main breadwinner*
- *Household expenditures for medical expenses may increase substantially*
- *Other members of the household, usually daughters and wives, may miss school or work less in order to care for the sick person*
- *Death results in: a permanent loss of income, from less labor on the farm or from lower remittances; funeral and mourning costs; and the removal of children from school in order to save on educational expenses and increase household labor, resulting in a severe loss of future earning potential.*

Micro-Economic Impact of AIDS on Agriculture

Agriculture is the largest sector in most African economies accounting for a large portion of production and a majority of employment. Studies done in Tanzania and other countries (Cameroun, Ivory Coast, and Tanzania) have shown that AIDS will have adverse effects on agriculture, including loss of labor supply and remittance income. The loss of a few workers at the crucial periods of planting and harvesting can significantly reduce the size of the harvest. In countries where food security has been a continuous issue because of drought, any declines in household production can have serious consequences. Additionally, a loss of agricultural labor is likely to cause farmers to switch to less-labor-intensive crops. In many cases this may mean

switching from export crops to food crops. Thus, AIDS could affect the production of cash crops as well as food crops (Stover & Bollinger, 1999).

Micro-Economic Impact of AIDS on Firms

AIDS may have a significant impact on some firms. AIDS-related illnesses and deaths to employees affect a firm by both increasing expenditures and reducing revenues. Expenditures are increased for health care costs, burial fees and training and recruitment of replacement employees. Revenues may be decreased because of absenteeism due to illness or attendance at funerals and time spent on training. Labor turnover can lead to a less experienced labor force that is less productive (Stover & Bollinger, 1999).

1.7.2 Micro-economic Impacts on Other Economic Sectors

AIDS will also have significant effects in other key sectors. Among them are health, transport, mining, education and water.

- ❖ ***Health.*** AIDS will affect the health sector for two reasons: (1) it will increase the number of people seeking services and (2) health care for AIDS patients is more expensive than for most other conditions. The number of AIDS patients seeking care is already overwhelming health care systems. In many hospitals in Africa, half of hospital beds are now occupied by AIDS patients. AIDS is also an expensive disease. On average, treating an AIDS patient for one year is about as expensive as educating ten primary school students for one year. Governments will face trade-offs along at least three dimensions: treating AIDS versus preventing HIV infection; treating AIDS versus treating other illnesses; and spending for health versus spending for other objectives. Maintaining a healthy population is an important goal in its own right and is crucial to the development of a productive workforce essential for economic development (Stover & Bollinger, 1999).

- ❖ ***Transport.*** The transport sector is especially vulnerable to AIDS and important to AIDS prevention. Building and maintaining transport infrastructure often involves sending teams of men away from their families for extended periods of time, increasing the likelihood of multiple sexual partners. The people who operate transport services (truck drivers, train crews, sailors) spend many days and nights away from their families. A survey of bus and truck drivers in Cameroon found that they spent an average of 14 days away from home on each trip and that 68 percent had sex during the most recent trip and 25 percent had sex every night they were away. Most transport managers are highly trained professionals who are hard to replace if they die. Governments face the dilemma of improving transport as an essential element of national development while protecting the health of the workers and their families (Stover & Bollinger, 1999).

- ❖ ***Mining.*** The mining sector is a key source of foreign exchange for many countries. Most mining is conducted at sites far from population centers forcing workers to live apart from their families for extended periods of time. They often resort to commercial sex. Many become infected with HIV and spread that infection to their spouses and communities when they return home. Highly trained mining engineers can be very difficult to replace.

As a result, a severe AIDS epidemic can seriously threaten mine production (Stover & Bollinger, 1999).

- ❖ **Education.** AIDS affects the education sector in at least three ways: the supply of experienced teachers will be reduced by AIDS-related illness and death; children may be kept out of school if they are needed at home to care for sick family members or to work in the fields; and children may drop out of school if their families cannot afford school fees due to reduced household income as a result of an AIDS death. Another problem is that teenage children are especially susceptible to HIV infection. Therefore, the education system also faces a special challenge to educate students about AIDS and equip them to protect themselves (Stover & Bollinger, 1999).
- ❖ **Water.** Developing water resources in arid areas and controlling excess water during rainy periods requires highly skilled water engineers and constant maintenance of wells, dams, embankments, etc. The loss of even a small number of highly trained engineers can place entire water systems and significant investment at risk. These engineers may be especially susceptible to HIV because of the need to spend many nights away from their families (Stover & Bollinger, 1999).

1.7.3 Macro-economic Impact of AIDS

The macroeconomic impact of AIDS is difficult to assess. Most studies have found that estimates of the macroeconomic impacts are sensitive to assumptions about how AIDS affects savings and investment rates and whether AIDS affects the best-educated employees more than others. Few studies have been able to incorporate the impacts at the household and firm level in macroeconomic projections. Some studies have found that the impacts may be small, especially if there is a plentiful supply of excess labor and worker benefits are small. Other studies have found significant macroeconomic impacts. Studies in Tanzania, Cameroon, Zambia, Swaziland, Kenya and other sub-Saharan African countries have found that the rate of economic growth could be reduced by as much as 25 percent over a 20-year period. There are several mechanisms by which AIDS affects macroeconomic performance.

- Firstly, AIDS deaths lead directly to a reduction in the number of workers available. These deaths occur to workers in their most productive years. As younger, less experienced workers replace these experienced workers, worker productivity is reduced. Secondly, shortage of workers leads to higher wages, which leads to higher domestic production costs. Higher production costs lead to a loss of international competitiveness which can cause foreign exchange shortages.
- Thirdly, lower government revenues and reduced private savings (because of greater health care expenditures and a loss of worker income) can cause a significant drop in savings and capital accumulation. This leads to slower employment creation in the formal sector, which is particularly capital intensive.
- Fourthly, reduced worker productivity and investment leads to fewer jobs in the formal sector. As a result some workers will be pushed from high paying jobs in the formal sector to lower paying jobs in the informal sector.

In effect, the overall impact of AIDS on the macro-economy is small at first but increases significantly over time. Several studies have found that these effects could be large in some African countries. A simulation model of the economy of Cameroon concluded that the annual growth rate of GDP could have been reduced by as much as 2 percentage points during the 1987-1991 period because of AIDS (Gerard, Deverajan & Over, 1992).

1.8 Current HIV policy plan in Cameroon

The political commitment in the fight against HIV/AIDS in Cameroon translates into the development of a national strategic plan. The first short term national AIDS plan was designed in 1987, followed by two national plans for 1988 to 1992 and 1993 to 1999 (UNAIDS/WHO Epidemiological Fact, 2004). The fight against HIV/AIDS in Cameroon during the period from 1987 to 1999 had several barriers including: ignorance and indifference, leading to lack of general mobilization, insufficient coordination of programs, failure to adopt a multi-sectorial approach and limited allocation of resources for the various HIV/AIDS programs. As a result, the HIV/AIDS situation worsened considerably and the HIV prevalence rate in Cameroon increased from 0.5% in 1987 to 7.73% in 2000 [29, 30]. In response to the limitations of the two short term national AIDS plan of 1988 to 1992 and 1993 to 1999, and the growing social and economic threat of the HIV/AIDS epidemic to the population, the Prime Minister launched the Plan Strategique National de Lutte Contre le SIDA, 2000-2005 later extended to 2006 (UNAIDS/WHO Epidemiological Fact, 2004). According to this plan, HIV/AIDS is the priority number one of the national health development plan and it proposes strategies and programs in 20 different areas to address the epidemic. Some examples of those activities are programs that focus on illiteracy, gender issues, human rights, substance abuse, and mother-to-child transmission of HIV/AIDS (UNAIDS/WHO Epidemiological Fact, 2004).

The HIV/AIDS plan for the country is to preserve the health of children, women, and men in different settings such as the home, at work, at leisure and in hospital (Memfih, 2005). This is to be achieved through a series of measures: minimizing the risk of contamination with HIV/AIDS among children aged five to fourteen by promoting a healthy lifestyle and the development of responsible sexual behaviour. Develop information mechanisms aimed at bringing about changes in the behaviour of the sexually active population, reduce the risk of transmission of HIV from mother to child, minimize the risk of infection through blood transfusion and develop a national mechanism for solidarity with persons living with HIV/AIDS (UNAIDS/WHO Epidemiological Fact, 2004).

1.9 Effectiveness of Current Strategic Plan

Universal Access to HIV prevention

The strategies employed to promote access to prevention for all included the increase in the number of fixed & mobile voluntary counseling and testing (VCT) units, prevention and treatment of STI and the promotion of the use of both male and female condoms. With reference to the increasing numbers of people being tested for HIV infection, it is of interest to note that there is also a high percentage of those returning to collect their results in all the provinces where testing

has occurred, with an overall rate of those not returning of about 4.2%. In addition the prevention of mother-to-child transmission of HIV, the promotion of blood safety as well as of youth programmes, has also all been employed (Mbanya et al., 2008).

Universal Access to Treatment and Care

One useful strategy implemented by the Cameroonian government has been the decentralisation of HIV and AIDS management units through the creation of certified treatment centers (CTC) throughout the national territory. In 2005 40 CTC existed, covering 14 of the 174 existing health districts, and by 2007 there were 113 CTC, covering 82 districts, thus enhancing access to care for the population (Mbanya et al., 2008).

The access to treatment and care has been mostly supported by the Cameroon Government, Global Funds for AIDS, Tuberculosis and Malaria (GFATM) and to some extent by other agencies. According to the Report by the National AIDS Control Committee in 2008, the GFATM has supported this since 1st January 2005, renewed in February, 2007 for a period of three years. The Clinton Foundation also supports second line ARV for adults and first and second line ARV for children. The National AIDS Control Committee also estimates that 510,000 people are currently living with HIV and AIDS in Cameroon, of which 91,453 are said to be eligible for treatment with antiretroviral (ARV) drugs. In December 2006, there were 28,403 patients on ARV and by December 2007 the number effectively on treatment had reached 45,605 (49.9%), an increase by 61%. About 6.2% had been lost either through death (2.2%) or totally lost to follow up (4.0%). A similar trend has also been observed in paediatric cases with 1001 on ARV in December 2006 and 1700 by December 2007, an increase by approximately 70% (Mbanya et al., 2008).

Opportunistic Infections

Concerning opportunistic infections there has been a steady rise in the numbers with access to free cotrimoxazole (16,534 in 2006 compared to 57,550 in 2007) and in those on free treatment for Cryptococcus and cerebral toxoplasmosis (119 in 2006 and 454 in 2007). In order to ease patient monitoring and treatment, there has been marked capacity building and recruitment of psychosocial staff (184 in 2005 and total of 508 by 2007); subsidized laboratory testing packages (for CD4 counts, full blood counts, fasting blood sugar and liver enzymes is one package that costs 3000Frs CFA - approximately \$7 USD) and health systems reinforcement through the provision of equipment to the health institutions (spectrophotometers, flow cytometres, electronic counters *etc.*). Furthermore, in 2007, a nutritional support programme was implemented for which 120 personnel has already been trained (Mbanya et al., 2008).

Protection and Support to OVC

In 2006, taking into consideration all categories of OVC, there were 183, 523 identified for assistance by the NACC, of which assistance was provided to 25,643 (14%). In 2007, assistance was given to 43,505 of them, an increase by 69.6%. However, when AIDS orphans were

examined, 12,776 and 28,319 (121.7% rise) were respectively catered for in 2006 and 2007 (Mbanya et al., 2008).

Involvement of all Stakeholders

The program has involved various categories of stakeholders, assisting them technically and financially in anti-AIDS activities. For example, in 2006, 130 associations of PLWHA were sponsored and in 2007 there were 101 sponsored. Religious organizations, believed to promote moral education also received financial support in 2007. Opinion leaders including political leaders, traditional chiefs, administrative authorities have been implicated, and the public sector (Government and private structures, firms, NGOs, International partners including WHO, UNICEF, UNAIDS, World Bank, CDC, French Cooperation, UNESCO, UNDP, CARE, GTZ, PLAN International etc.) have all collaborated in the achievement of success in the implementation of this plan. The role of the media cannot be overemphasized (Mbanya et al., 2008).

Epidemiological Surveillance and Research Promotion

Epidemiological surveillance has mainly consisted in the notification of new cases. For example, in 2006 there were 8,569 new cases notified, compared to 10,625 new cases in 2007. The major research projects have covered: virological studies including resistance studies; mother- to-child transmission of HIV; clinical & epidemiological research; Social science aspects as well as public health research. Some of the major institutions involved in the various arms of research include the National AIDS Control Committee, the Faculty of Medicine and Biomedical Sciences and other Faculties of Cameroonian Universities, the Institute Pasteur in Cameroon, the French National Agency for AIDS Research, CRESAR, CDC Atlanta, the Chantal Biya International Research Centre, and others. A lot of data is being generated & disseminated in various ways both nationally and internationally, some of which has been used to implement policy. For example, in studies demonstrating that there was no correlation between total lymphocyte counts and CD4 counts in HIV infected persons in our community, equipment for CD4 counts have been made available in most major health institutions of the country. The results of several studies on the genetic diversity of HIV in Cameroon as well as on primary and secondary drug resistance to ARV have all contributed significantly to policies and access to second line therapy in the country. Furthermore, several HIV prevention and care programmes have targeted specific groups based on the high prevalence of the infection reported from research and surveillance carried out in such groups (Mbanya et al., 2008).

1.9 Conclusions

There have been outstanding advances in our knowledge of the immunopathogenesis of HIV-1 infection and AIDS since the discovery of the virus. Our understanding of the viral life cycle and the host response to infection is comprehensive. As a result, virus specific interventions have been developed that are highly active and that can contain viral replication. The damaged immune system can then be at least partially immune reconstituted, and even individuals presenting with late-stage infection now have an expectation of long-term survival if they have access to antiretrovirals and expert healthcare providers.

There has never before been a comparable increase in our scientific understanding of any disease process in so short a time. This extraordinary effort to understand and contain HIV-1 infection has enabled scientists to gain important new knowledge in virology, immunology, and oncology. The promise of these effective therapies rest, however, almost entirely on an individual's ability to adhere to sometimes complicated and often toxic regimens. Even with once a day pill regimens, adherence is often poor. Despite the advances in HIV treatment, there continues to be considerable variation in HIV disease progression. In addition to biological mechanisms, we need to consider behavioral and psychosocial factors such as depression, stress and coping that may affect adherence to medications as well as the immunology and virology of the disease. Moreover, efforts need to be sustained and increased globally in order to eliminate the incidence of HIV/AIDS infections around the world, and particularly in Africa to the barest minimum.

While the prevalence of HIV/AIDS infection is very high in Africa, its high incidence in Cameroun makes it very alarming coupled with the fact that it tends to affect vulnerable groups such as women and children.

And while the Cameroonian government in its effort to curb the HIV and AIDS pandemic has achieved a lot barely midway into the implementation of the second national strategic plan, there is still much to be done if the incidence of HIV/AIDS is to be completely dealt with.

1.10 Recommendations for Improvement in policy strategies

The following strategies are recommended to help minimize the incidence of HIV/AIDS and facilitate socio-economic development in Cameroun.

- 1. Prevent new infections.** The most effective response will be to support programs to reduce the number of new infections in the future. After more than a decade of research and pilot programs, we now know how to prevent most new infections. An effective national response should include information, education and communications; voluntary counseling and testing; condom promotion and availability; expanded and improved services to prevent and treat sexually transmitted diseases; and efforts to protect human rights and reduce stigma and discrimination. Governments, NGOs and the commercial sector, working together in a multi-sectoral effort can make a difference. Workplace-based programs can prevent new infections among experienced workers.
- 2. Design major development projects appropriately.** Some major development activities may inadvertently facilitate the spread of HIV. Major construction projects often require large numbers of male workers to live apart from their families for extended periods of time, leading to increased opportunities for commercial sex. A World Bank-funded pipeline construction project in Cameroon was redesigned to avoid this problem by creating special villages where workers could live with their families. Special prevention programs can be put in place from the very beginning in projects such as mines or new ports where commercial sex might be expected to flourish.

- 3. Programs to address specific problems.** Special programs can mitigate the impact of AIDS by addressing some of the most severe problems. Reduced school fees can help children from poor families and AIDS orphans stay in school longer and avoid deterioration in the education level of the workforce. Tax benefits or other incentives for training can encourage firms to maintain worker productivity in spite of the loss of experienced workers.
- 4. Mitigate the effects of AIDS on poverty.** The impacts of AIDS on households can be reduced to some extent by publicly funded programs to address the most severe problems. Such programs have included home care for people with HIV/AIDS, support for the basic needs of the households coping with AIDS, foster care for AIDS orphans, food programs for children and support for educational expenses. Such programs can help families and particularly children survive some of the consequences of an adult AIDS death that occur when families are poor or become poor as a result of the costs of AIDS. The costs of these programs can vary widely.
- 5. Much Stronger Government Commitment and Political Will.** A much strong political commitment to the fight against AIDS is crucial. Countries that have shown the most success, such as Uganda, Thailand and Senegal, all have strong support from the top political leaders. This support is critical for several reasons. First, it sets the stage for an open approach to AIDS that helps to reduce the stigma and discrimination that often hamper prevention efforts. Second, it facilitates a multi-sectoral approach by making it clear that the fight against AIDS is a national priority. Third, it signals to individuals and community organizations involved in the AIDS programs that their efforts are appreciated and valued. Finally, it ensures that the program will receive an appropriate share of national and international donor resources to fund important programs. Perhaps the most important role for the government in the fight against AIDS is to ensure an open and supportive environment for effective programs. Governments need to make AIDS a national priority, not a problem to be avoided. By stimulating and supporting a broad multi-sectoral approach that includes all segments of society, governments can create the conditions in which prevention, care and mitigation programs can succeed and protect the country's future development prospects.
- 6. Improve Livelihoods of Women and Children.** Government must strengthen social protection polices to help not only to protect women and children from sexual abuse but also to improve their levels of livelihoods.

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