HYGIENE FACTORS INFLUENCING OPPORTUNISTIC INFECTIONS AMONG PEOPLE LIVING WITH HUMAN IMMUNODEFICIENCY VIRUS AND ACQUIRED IMMUNE DEFICIENCY SYNDROME IN ABUJA, NIGERIA

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CERTIFICATION

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DEDICATION

This work is dedicated to the Almighty God for His infinite Love and protection throughout the duration of my study and also to all the People Living with HIV/AIDS (PLWHA) that consented to environmental assessment of their houses, I wish you all long life.

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Thank you Jesus.

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ABSTRACT

Acquired Immune Deficiency Syndrome (AIDS) is one of the most devastating global health pandemics. The immune suppression of infected persons predisposes them to opportunistic infections resulting in high morbidity and mortality. Factors influencing HIV/AIDS in Nigeria are known; however, the influences of physical environmental factors on People Living with HIV and AIDS (PLWHAs) in Nigeria have not been fully explored. This study was therefore designed to investigate the association between these factors and the occurrence of Opportunistic Infections (OIs) among PLWHAs in Abuja.

A case control study was conducted. PLWHAs in Abuja Municipal Area Council (AMAC) were randomly selected from the six area councils in FCT. Two health facilities were randomly selected by balloting from the nine that provides special services to PLWHAs in AMAC. Systematic random sampling was used to recruit 66 cases and 68 controls from the facilities. Cases were defined as HIV positive clients with OIs while controls were defined as confirmed HIV positive clients not manifesting OIs. Opportunistic Infections considered were Tuberculosis (TB), persistent diarrhea, oral thrush and herpes. The controls were matched by sex, age and residential area. Respondents' demographic characteristics, level of knowledge and hygiene practices were assessed using a validated questionnaire. The level of knowledge of Environmental Influence on Health (EIH) was determined using 40 point scale. Observational checklist was used to assess the prevailing environmental conditions in households. Bacteriological examination of drinking water sources of 25.0% of cases and controls was conducted using standard methods as described by the American Public Health Association. Descriptive statistics, Chi-square and t-test were used for data analysis.

Respondents' mean age was 35.9 ± 6.7years for cases and 34.4 ± 7.0years for controls. About 48.6% and 51.4% of cases and controls respectively were females. The OIs manifested by cases were TB (56.6%), oral thrush (77.4%), persistent diarrhea (69.8%) and herpes (11.3%). The mean knowledge scores on EIH of cases and controls were 31.7 ± 8.9 and 29.0± 13.1 with no significant different. Majority of the cases (75.8%) and control (70.6%) washed their hands with soap after toilet use. Also 66.7% of cases and controls (68.7%) used water closets for excreta disposal. About twenty four percent of cases as against nine percent of controls obtained

drinking water from contaminated sources (OR: 3.25; 95%CI: 1.09 – 10.14). Bacteriological analysis of client drinking water sources indicated that 76.0% of samples for cases and 64.3% for controls contained total coliform, while E.coli was detected in 21.4%, and 15.4% of samples for cases and controls respectively.

The occurrence of water borne opportunistic infections among the cases may be attributable to contaminated drinking water sources. Provision of water especially potable water supply and continuing health education on hygiene practices are highly advocated.

Key words: Hygiene practices, HIV/AIDS, Opportunistic infection, People Living with HIV and AIDS (PLWHA)

Word count: 450

GLOSSARY OF TERMS

AFRH	Association for Family and Reproductive Health
AHI	Action Health Incorporated
AIDS	Acquired Immune Deficiency Syndrome
AMAC	Abuja Municipal Area Council
ANC	Antenatal Clinic
APHA	American Public Health Association
ART	Antiretroviral Therapy
ARV	Antiretrovirals
AZT	Zidovudine Retrovir
BCG	Bacille Calmette Guerin
CACA	Catholic Action Committee on AIDS
CDC	Center for Disease Control and Prevention
CM	Cryptococcal Meningitis
CSO	Civil Society Organisation
DNA	De-oxyribonucleic Acid
E. Coli	Escherichia Coli
ELISA	Enzyme Link Immuno Sorbent Assay
FCT	Federal Capital Territory
FMOH	Federal Ministry of Health
GFTAM	Global Funds for HIV/AIDS, Tuberculosis and Malaria
GP	Glycoprotein
GRID	Gay Related Immune Deficiency
HAART	Highly Active Antiretroviral Therapy

HEAP	HIV/AIDS Emergency Action Plan
HIV	Human Immunodeficiency Virus
HLTV	Human T-Cell Lymphotropic Virus
HSV	Herpes Simplex Virus
ILO	International Labour Organisation
JAAIDS	Journalist Against AIDS
JMPWSS	Joint Monitoring Programs for Water Supply and Sanitation
KS	Kaposi's Sarcoma
LACA	Local Government Action Committee on AIDS
LAV	Lymphodenopathy Associated Virus
MAC	Mycobacterium Avium Complex
MMWR	Morbidity and Mortality Weekly Report
mRNA	Messenger Ribonucleic Acid
NACA	National Action Committee on AIDS
NARHS	National AIDS and Reproductive Health Survey
NASCP	National AIDS and STIs Control Program
NDHS	Nigeria Demographic Health Survey
NHA	National Hospital Abuja
NIAID	National Institute for Allergy and Infectious Disease
NNRIM	Nigeria National Response Information System
NNRTI	Non-Nucleoside Reverse Transcriptase Inhibitors
NTBLCP	National TB and Leprosy Control Program
OI	Opportunistic Infections
PCP	Pneumocystis Carinii Pneumonia
PEPFAR	Presidential Emergency Plan For AIDS Relief

PLWHA	People Living with HIV and AIDS
PMTCT	Prevention of Mother-to-Child Transmission
RNA	Ribonucleic Acid
RT	Reverse Transcriptase
RTI	Reverse Transcriptase Inhibitors
SACA	State Action Committee on AIDS
SFH	Society for Family Health
SON	Standard Organisation of Nigeria
STC	Special Treatment Center
STI	Sexually Transmitted Infection
SWAAN	Society for Women Against AIDS in Nigeria
TB	Tuberculosis
TDS	Total Dissolve Solid
UNAIDS	United Nations Agency for International Development
UNGAS	United Nation General Assembly Special Session
UNICE	United Nations Children Fund
VCT	Voluntary Counseling and Testing
WHO	World Health Organisation

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INTRODUCTION

1.1 ~~1.1~~ Background to the study

Human Immunodeficiency Virus (HIV), the causative agent of Acquired Immune Deficiency Syndrome (AIDS) was first reported in 1981, in San Francisco, USA, among previously well individuals with impaired immune function. It is evidenced by depletion of CD4 T helper lymphocyte, and has emerged as one of the most significant infectious pathogen that is advancing relentlessly into the current century (UNAIDS, 2002).

The first recognized case of AIDS was among homosexuals in USA who developed rare opportunistic infections (Pneumocystic Carinii Pneumonia) and cancer (Kaposi's Sarcoma). The cause of AIDS was not known until 1983, when a virus –HIV, was suspected to be the pathogenic agent of the disease. The fast spread of the virus beyond the primary cases to various other groups led to the suggestion that the infectious agent~~s~~ is~~are~~ sexually transmitted.

HIV has been isolated from many body fluids of infected persons. However, only blood, semen, vaginal fluid and breast milk has been implicated in transmission of the infection. Detailed epidemiological studies throughout the world have documented three major modes of transmission: sexual transmission, transfusion of infected blood and blood products (parenteral) and mother –to –child transmission (prenatal) (Kanki and Adeyi ~~et al~~, 2006).

HIV infection with its consequent degradation of the host immune system results in a defective cell-mediated immune response and makes the individual more vulnerable to a range of secondary infections called opportunistic infections which may be of viral, fungal, mycobacterial or parasitic origin (UNAIDS/WHO, 2002 and Colebunders et al, 2002).

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Opportunistic infections (O.I) are the major causes of morbidity and mortality among People Living with HIV and AIDS (PLWHAs). Some of these opportunistic infections like diarrhea, TB, malaria among others known to form lethal partnership with HIV and AIDS, currently are on the increase among these groups. The opportunistic pathogens are wide spread in the environment and can be contracted from soil, water, air, food and from animal/human excrements. Adequate provision and maintenance of these factors in man environment is paramount to good health. However, overwhelming evidence indicates that these environmental risk factors are inadequately handled and managed the world over; the case is worst in developing countries.

In many countries of the world, HIV/AIDS is manifesting as an epidemic of unprecedented magnitude (Karim, 2000; Piot, 2003). A plethora of epidemiological indicators point to the current and rising impact of the epidemic on individuals, families and societies (UNAIDS, 2003). Global aggregates of HIV/AIDS occurrence show that over 140 million people have lived with HIV/AIDS since the beginning of the epidemic; over 25 million of these have already died from AIDS (UNAIDS/WHO 2006a). In the year 2005 alone, an estimated 3.1 million persons died from AIDS, 4.1 million were newly infected with the virus, thus HIV and AIDS is rated the fourth leading cause of death in the world. The world estimate for 2007 shows that 2.1 million deaths has occurred, 33.2 million adults and 2.5 million children continue to live with the virus (UNAIDS/WHO, 2008).

When disaggregated geographically, the HIV/AIDS pandemic shows widespread but uneven distribution in countries world-wide. Countries of sub-Saharan Africa with just 10% of the world population are known to be most severely affected being host to 26.6 million infections: more than 75% of all people living with HIV (UNAIDS/WHO 2006a). In 2005, an estimated 3.2 million [2.8 million–3.9 million] people in the region became newly infected, while 2.4 million [2.1 million–2.7 million] adults and children died of AIDS. Among young people aged 15–24 years, an estimated 4.6% [4.2–5.5%] of women and 1.7% [1.3–2.2%] of men were living with HIV in 2005. In 2006 alone an estimated 2.3 million children were living with HIV and up to 530,000 were newly infected worldwide, Sub-

Saharan Africa accounting for 90% of both of these figures (FMoH, 2007c). In 2007, 1.6 million people died and 22.5 million individuals are currently living with HIV and AIDS.

Nigeria with an estimated population of 144.4 million people (Census, 2007 mid year release), has 3.4 million (between 3.2 – 3.6 million) people already infected with HIV. The Federal Ministry of Health surveillance report 2005 put the prevalence of HIV and AIDS in the country at 4.4% (FMOH technical Report, 2005). The current HIV prevalence rate obtained in the 2007 survey was 4.6% (NDHS, 2008). It was higher among females (4.0%) than males (3.2%).

The impact of HIV and AIDS permeates all boundaries of the country. The epidemic is described as generalized in that all states including the Federal Capital Territory (FCT) has a bite of the epidemic in varying proportions. The interaction of HIV and AIDS with other infectious diseases is an increasing public health concern in that it causes high morbidity and mortality among the infected due to the incidence of secondary infections otherwise known as opportunistic infections, as well as propagates communicable infections even among the uninfected. However in many countries of the world with high HIV and AIDS prevalence, environmental risk factors such as potable water supply, improved sanitation and hygiene services and good housing conditions are extremely poor. The dwelling conditions of certain groups of people especially in developing nations put them at special health risk, leaving them especially vulnerable to multiple health hazards. Burden of disease analysis suggest that lack of access to safe water supply, sanitation and hygiene is the third most significant risk factor for poor health in developing countries (Lopez et al, 2006). Schaefer, (1987) stated that communicable disease can be reduced if housing provides for safe water supply, sanitary excreta and garbage disposal, adequate drainage of surface water and necessary facilities for domestic hygiene and food storage and preparation.

The intricate web of relationship existing between these factors and HIV and AIDS cannot be underestimated. Indeed some of the easily discernable consequences of HIV and AIDS are long term implications for effective management and provision of such environmental factors like adequate housing, potable water, adequate sanitation and hygiene. These services, when

adequately provided may prevent the transmission of diseases causing pathogens like diarrhea: one of the hallmarks of HIV and AIDS. Janoff and Smith, (1998) reported that about 90% of all HIV and AIDS clients in Africa suffer from chronic diarrhea, tuberculosis: an AIDS defining opportunistic infection and cause of a third of all AIDS death, and malaria amongst others.

The dismal provision of these factors, irrespective of their significance to health and well being is of immense concern and consideration. In Nigeria, in particular, only 10.6% (18.5 urban and 6.2 rural dwellers) of the population have access to safe water supply, obtained from pipes into their dwellings/yards or from public taps, 14.6% have sanitary facility (flush toilet), 42.4% households lives in dwellings with cemented floor and the number of persons per sleeping room (household room density) is 3.3 persons on the average, with disparity between the rural and urban dwellers (NDHS 2003). The impact of these environmental factors fuel the occurrence of OIs among PLWHA~~s~~ thereby decreasing the incubation period of HIV to 2 – 5 years and increasing AIDS morbidity and mortality in the country.

1.2 Statement of the Problem~~s~~:

The pandemic nature of Human Immunodeficiency Virus (HIV) infection and Acquired Immune Deficiency Syndrome (AIDS) makes it a health problem of extraordinary scale and complexity. It presents a variety of social, ethical, legal and technical problems. The immune suppression in infected persons resulted in life threatening infections characterized by high morbidity and mortality. The interaction of HIV and AIDS with other infectious diseases is an increasing public health concern. However, as the pandemic enters it 3rd decade, it most devastating effect is felt on the nations of the third world with poor environmental factors such as unimproved water supply, inadequate sanitation and hygiene services, inadequate solid waste management techniques as well as poor housing conditions. Burden of disease analysis suggested that lack of access to safe water supply, sanitation and hygiene is the 3rd most significant risk factor for poor health in developing countries (Lopez et al, 2006). Salvator (1992) also stated that slum dwellers and those in substandard housing have eight times higher communicable disease infection rate than those in standard housing conditions.

Though water is vital to development and potable water remains a fundamental incentive for socio-economic development of communities, UNICEF/WHO (2005) in their Joint Monitoring Program for Water Supply and Sanitation (JMPWSS) noted that in the year 2000, 1.1 billion people globally lacked access to improved water supply (amounting to 2 out of 10 persons), with 290 million people living in Africa. Also 2.4 billion people lack access to improved sanitation (i.e. 4 out of 10 persons) and at least 1 billion people live in slums. Africa has the lowest water supply of any region; the continent contains 28% of the world population without access to improved water supply and 13% of people without access to improved sanitation.

In Nigeria, according to NDHS (2003), living conditions across the country are mixed, with majority of Nigerians (89.4%) having no access to potable water supply. It is notable that in rural areas, approximately one-fifth obtain drinking water from open public wells and 27% from river or stream. Only 15% households have a flush toilet while the majority (57%) use traditional pit toilets and one-quarter have no facility at all. Overcrowding can impact negatively on health as well as the quality of life. However the average number of persons per sleeping room is 3.3. The sources of water supply, sanitary facilities and hygiene practices and living conditions are important determinants of health status. These essential environmental factors are related to health in various ways. Some of the easily discernable consequences of HIV and AIDS are the long term implications of environmental resource management. PLWHAs are at the highest risk, often bearing the double burden of physical environmental hazards coupled with health problems.

1.3 Rationale for the Study

Studies have shown that Immune system of HIV positive persons are prone to wider range of common diseases and infections (0.ls) than individuals whose immune systems are not compromised by HIV and AIDS. The hallmarks of HIV and AIDS include diarrhea, TB and malaria, and about 90% of PLWHAs in Africa suffer from chronic diarrhea (Janoff and Smith, 1998), and WHO estimates that TB accounts for up to a third of AIDS deaths worldwide (UNAIDS/WHO, 2002).

The causative agents of these lethal partners to HIV are wide spread in the environment. People with compromised immune systems are prone to these diseases and without adequate provision and proper management/handling of these essential environmental health factors infection and re-infection with these pathogens will continue to spread. HIV individuals therefore have increased need for improved environmental health conditions than un-infected individuals (Ashton and Ramashs, ~~,~~ 2002~~0~~). The most affected are the poor, who represent the fastest growing sector of HIV/AIDS afflicted and are very likely to suffer from diarrheal diseases, caused by consumption of unsafe water, inadequate sanitation and hygiene as well as improper disposal of solid waste, and TB due to overcrowding.

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While it is true that inadequate environmental health factors are profoundly detrimental to life, health and welfare of individuals and communities, there is evidence that providing a decent residential environment including all necessary services, facilities, and devices will have a positive impact on physical health and social well-being of individuals especially those infected with or affected by HIV and AIDS. Communicable disease including opportunistic infections will reduce if housing provides for safe water supply, sanitary excreta and garbage disposal and necessary facilities for personal and domestic hygiene and food storage and preparation (Schaefer, 1987). Improving water quality in particular will also lead to a decline in water borne and water related diseases in people living with HIV and AIDS (WHO, 2004b).

Though much has been done to create awareness on the modes of transmission and prevention of HIV, care and support and treatment, the interaction between HIV and AIDS and the physical environmental health factors has received dismal or no attention at all in our country as compared to the social and behavioral issues put in place by the entire society including the government. The increasing number of people living with HIV and AIDS makes it necessary to focus on increasing their longevity and quality of life through improved environmental health factors as much as possible.

This study hopes to establish that access to adequate environmental health factors like safe water supply, adequate sanitation & hygiene practices and good housing condition is a fundamental requirement in reducing the occurrence of opportunistic infections among PLWHAs thereby improving their quality of life and increasing their longevity.

1.4 OBJECTIVES OF THE STUDY

1.4.1 Broad Objective

The broad objective of this study was to determine the hygiene conditions/environmental factors influencing opportunistic infections among PLWHAs in Abuja so as to recommend ways of minimizing this health risk.

1.4.2 Specific Objectives

The specific objectives of this study were to:

1. identify common opportunistic infections prevalent among PLWHAs in Abuja.
2. assess knowledge level of PLWHAs on the effect of environmental risk factors on the occurrence of opportunistic infections.
3. identify the practices that increase the vulnerability of PLWHAs to OIs
4. determine the quality of water used among the cases and controls
5. assess housing characteristics among the cases and controls.
6. determine the association between the occurrence of opportunistic infections among the study groups and the observed environmental risk factors.

1.5 HYPOTHESIS

NULL: Hygiene conditions/environmental factorss does not influence the occurrence of opportunistic infections

aamong PLWHAs

ALTERNATIVE: Hygiene conditions/environmental factors can influence the occurrence of opportunistic

infectionsinfections among people living with HIV and AIDS

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1. 6 Limitations of the study

***** Consent: Recruitment of respondent to the study was a big challenge and time consuming. Most clients declined consent to the study because they have not dealt with the barrier of self discrimination and partial withdrawal. Others complained of being used for personal interest in the past without benevolence hence, not willing to be part of any study.

* Environmental observation: To some of the respondents visiting their residence was seen as intrusion to their privacy. Some decline consent to this aspect of the study on the grounds that visits to their house will raise suspicion to the neighbours –(inability to overcome self stigmatization).

CHAPTER TWO

LITERATURE REVIEW

2.1– Origin and Historical Background of HIV and AIDS

AIDS was first clinically identified and described in 1981 among patients presenting with symptoms of severe immuno-suppression in the United State (Gottlieb et al 1981; Seigal et al, 1981). These initial cases were homosexual men in Los Angeles, USA, who presented with a rare benign cancer known as kaposi's sarcoma (Morbidity and Mortality weekly Report - MMWR, 1981a). At about the same time there was an increased number of cases of a rare lungs infection called Pneumocystic Carinii Pneumonia (PCP) among the same group of people (five gay men) without identifiable cause in USA (MMWR, 1981b). These reports might be more accurately tagged the beginning of the general awareness of AIDS in USA. However, studies of the HIV subtypes of some of the earliest known instances of HIV infection can help to provide clues about the time it first appeared in human and it subsequent evolution (Kanabus and Allen, 2005). The three earliest known instances of HIV infection are as follows:

- the plasma sample taken in 1959 from an adult male living in what is now known as the Democratic Republic of Congo,

- HIV found in tissue samples from an American teenager who died in St Louis in 1966, ~~and~~
- HIV found in tissue samples from a Norwegian sailor who died around 1976 (Zhu et al, 1995~~8~~).

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Scientist and researchers developed a number of theories about the possible cause of these opportunistic infections and cancers characterized by severe immune abnormalities resulting from destruction of CD4+ T-lymphocytes. The knowledge about the disease was changing so quickly but the disease still did not have a name with different groups referring to it in different ways: the CDC generally referred to it by reference to the conditions that were occurring; in contrast some still link it to its initial occurrence in gay men – e.g. gay compromise syndrome (Brennan and Durack 1981), gay related immune deficiency (GRID), gay cancer, among others (Altman, 1982). The term Acquired Immune Deficiency Syndrome (AIDS) was coined by CDC in 1982 to properly describe the disease (MMWR, 1982, McKeown, 1982, and Herman, 1982). Connor and Kingman (1988) noted the general acceptance of AIDS as an appropriate name by doctors because:

- people acquired the condition rather than inherited it
- it resulted in a deficiency within the immune system and
- it was a syndrome, with a number of manifestations rather than a single disease.

The cause of AIDS was not known until 1983 when a new virus suspected to be the pathogenic agent of the disease was isolated by researchers in Institute Pasteur in France and a sample of the virus was sent to CDC (Barre-Sinoussi et al 1983; Connor and Kingman, 1988). The origin of the virus remained a puzzle to scientist world-over till date. The fast spread of the disease beyond the primary cases to various other groups including injecting drug users, transfusion recipients (MMWR, 1982a), women with no other known risk factors (MMWR, 1982b), and locations like Southern California, Haiti, Uganda and even European countries led to suggestions that the infectious agent can be transmitted sexually (CDC, 1982).

Kanabus and Allen (2005) reported that HIV belongs to the subfamily or group of viruses called the Lentivirinea, which is also a part of a larger group called the retrovirus. Typically, lentiviruses causes a slow progressive disease with prolong clinical infection (Kanki et al, 1997). They are also characterized by long incubation period, suppression of immune system, and they are host specific. Lentiviruses other than HIV have been found in a wide range of animals like sheep, cat, cattle and non-human primates. However, lentiviruse incriminated in the investigation into the origin of HIV is the Simian Immunodeficiency Virus (SIV) that affects monkeys. It is therefore generally accepted that HIV is a descendant of the simian immunodeficiency viruses. This is because SIV bear a very close resemblance to the two known types of HIV: HIV 1 and HIV 2. HIV 2 corresponds to SIVsm strain found in the sooty mangabey also known as green monkey, which is indigenous to West Africa (Diop and Gueye, 2002).

The more virulent strain of HIV that is HIV type 1 was until recently more difficult to place. In 1999, a group of researchers studied a frozen sample taken from a chimpanzee and found that the simian virus it carries was almost identical to HIV-1. The researchers therefore claimed that chimpanzee (*pan trogdytes troglodytes- P. t. troglodytes)*, which were once common in West-central Africa were the source of HIV-1 and that the virus had at some point crossed the spices from chimps to humans (Gao et al, 1999). However, it was not very clear that chimps are the original reservoir of HIV-1 rather they can serve as a "mixing vessel" that obtained SIV from two other species of ape. It has been known for a long time that certain viruses can be transferred between animals and human by a process known as zoonosis. Researchers concluded that HIV could have crossed over from chimps as a result of human butchering and consuming monkey and ape meat. Some other theories have contended that HIV was transferred iatrogenically i.e. via medical experiments. One of such is the testing of the oral polio-vaccine called chat, which was grown in chimp kidney cells in the Congo (Kanabus and Allen, 2005, Moore, 2004). This could have resulted in the contamination of the vaccine with chimps SIV.

The origin of HIV 2 virus also remain relatively unexplored, though it is thought to come from the sooty mangabeys rather than chimpanzees, but the cross over to human is believed

to have happened in a similar way to HIV 1. HIV type 2 is far rare, significantly less infectious and progresses more slowly to AIDS than HIV 1, thus it infects far fewer people and it mainly confined to a few countries in West Africa. It is likely that we will never know how, when and where AIDS actually originated, but the spread of HIV and AIDs could quite conceivably have been induced by a combination of many different events.

2.23 Global Epidemiology of HIV and AIDS

In countries the world over, HIV and AIDS is manifesting as an epidemic of unprecedented magnitude (Karim, 2000 and Piot, 2003). A plethora of epidemiological indicators points to the current and rising impact of the epidemic on individuals, families and societies (UNAIDS, 2003). Since the first cases of AIDS were reported in 1981, infection with the virus HIV has grown to pandemic proportions. Global aggregate of HIV and AIDS occurrence shows that over 40 million people have lived with the virus and over 25 million deaths has also occurred (UNAIDS/WHO, 2006a), and more than 90% of these people live in developing countries (http://www.intelhealth.com).

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The annual AIDS epidemic update reports on the latest development in the global HIV epidemic as illustrated in table 1 reveals that in the 2005 alone, an estimated 38.6 million people were living with HIV in the world, 36.3 million of these were adults aged 15 to 49 years of which 17.3 millions are women and 2.3 million were children under 15 years of age. By the end of 2006, the FMoH (2007c) reported that AIDS and AIDS related illnesses have killed more than 25 million people and an estimated 39.5 million people were living with HIV, out of which 17.7 and 2.3million were women and children respectively.

When disaggregated geographically, the HIV pandemic shows widespread but uneven distribution in countries all over the world. In the United State, as at the end of the same year, 2005, more than 998,000 cases of AIDS were reported, with over 530,000 deaths, including over 6,000 children. HIV rate are increasing more rapidly among the minority populations. The infection occurs six times as often in African-Americans and three times as often in Hispanics compared with whites (NIAID, 2006) Despite recent improved access to antiretroviral therapy and care in many regions of the world, the AIDS pandemic claims 3.1

million lives; more than half a million (570,000) were children and 4.1 million new infection also occurred in the year 2007 (UNAIDS/WHO, 2008).

Africa, with just 10% of the world's population carries well over 75% of the burden of this epidemic (UNAIDS, 2004) and is termed "home" to people living with AIDS (UNAIDS/WHO, 2005). An estimated 24.5 million adults and children were living with the virus in the region at the end of 2005, of which 13.2 million are women and 2 million people died from AIDS and about 12 million African children are orphaned by the epidemic. The UNAIDS/WHO (2006) report stipulated that more than 95% of these people live in low and middle income countries. The continent shows tremendous diversity in the level and trends of HIV infection. Prevalence rates in East Africa and Southern Africa includes some of the highest in the world (Eldis, 2003). UNAIDS, (2003) reported that Southern Africa is home to about 30% of people living with AIDS world wide. However, Rosling (2009) stated that the global HIV epidemic has reached a "steady state" with 1% of the adult world population infected and that there are huge differences in HIV occurrence between and within African countries. According to him, many African countries have the same relatively low HIV level as can be found in most of the world, whereas 50% of the worlds HIV infected persons live in a few countries in Eastern and Southern Africa (with 4% of the world population). For instance the prevalence rates in Botswana and Swaziland exceeded 35% while Uganda was at 18% (Kibuka, 2003 and Uganda Aids Commission (http://www.aidsuganda.org). Nasidi and Harry in Adeyi et al, (2006) stated that the rates have remained lower in West Africa, with no country having a rate above 10% and most having a rate between 1% and 5%.

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Table 2.1: Global summary of HIV/AIDS epidemic 2005

Number of people living with HIV & AIDS 2005	
Total	40.3 million (36.7 – 45.3million)
Adults	38.0 million (34.5 – 42.6million)
Women	17.5 million (16.2 – 19.3million)
Children <15years	2.3million (2.1 – 2.8 million)

People newly infected with HIV in 2005

Total	4.9 million (4.3 – 6.6million)
Adults	4.2 million (3.6 – 5.8million)
Children <15years	700,000 (630,000 – 820,000)

AIDS deaths in 2005

Total	3.1 million (2.8 – 3.6million)
Adults	2.6 million (2.3 – 2.9million)
Children < 15 years	570,000 (510,000 – 670,000)

Source: *WHO and UNAIDS report 2005*

Table 2.2: **Estimated number of adults and children living with HIV and AIDS in Nigeria 2007**

Total (adults and children)	**2.6million (2.0 – 3.2 million)**
Adults (15+)	2.4 million (1.6 – 2.9 million)
Children (0 – 14)	220,000 (170,000 – 370,000)
Women (15+)	1.4 million (980,000 – 1.7 million)
Adult rate (15 – 49)	3.1 million (2.3 – 3.8 million)
AIDS orphans (0 -17)	1.2 million (640,000 – 4.1 million)
AIDS death	170,000 (130,000 – 270,000)

Source: UNAIDS/WHO, 2008.

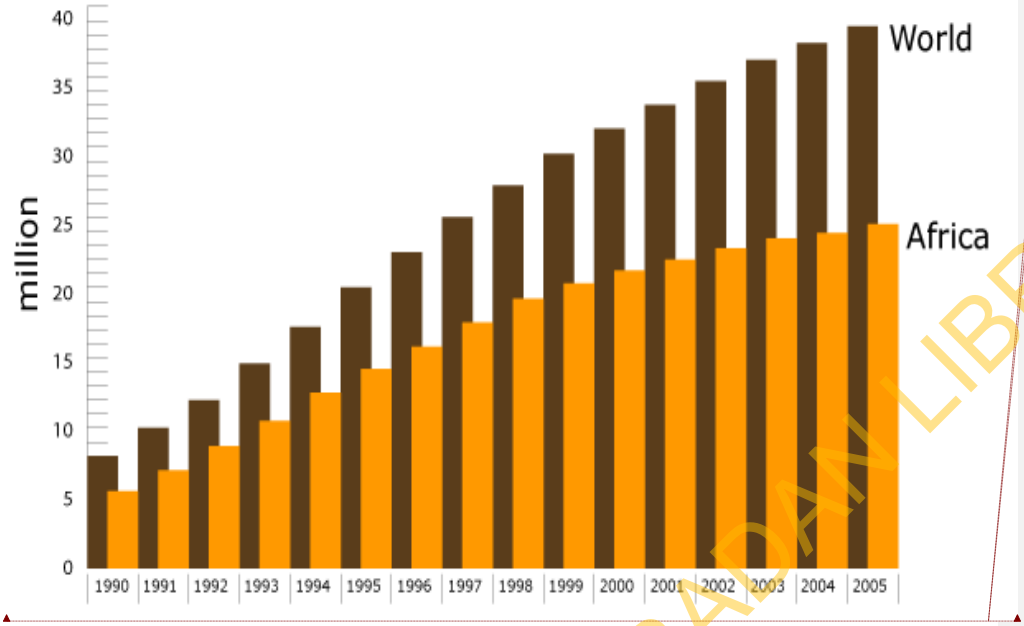

Fig 2.1: The Global Trend of HIV/AIDS

Source: UNAIDS/WHO 2006 report on the global HIV/AIDS Epidemic

2.2.1 Epidemiology of HIV and AIDS in Nigeria

The first case of AIDS in Nigeria was identified in a 13 year old girl in the 1980s, (precisely 1986) as was in neighbouring West African nations. However, the origin and the factors responsible for its early and rapid spread in the country remain unknown. The epidemic has already devastated Nigeria with over a million people dead and more than two million children orphaned; AIDS is now the leading cause of death in the country (Kanki and Adeyi, 2006)~~, Adeyi et al, 2006)~~. The National Intelligent ~~Council,~~Council predicted that Nigeria and Ethiopia would be hard hit with the number of people living with HIV & AIDS. They further projected that the epidemic would balloon to ten to fifteen million by 2010 or as much as 26% of the adult population will be infected (World Fact ~~b~~Book, 2002).

To respond to this epidemic, the Federal Government of Nigeria put various programmes aimed at controlling and mitigating its impacts. One of these intervention programs is the continuous monitoring of the HIV epidemic through a biennial sentinel survey among

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pregnant women attending antenatal clinics in Nigeria. The Federal Ministry of Health (FMoH) in 1991 began a countrywide sentinel survey of HIV infection using pregnant women as representative population. The result of the survey shows consistence increase in HIV prevalence from 1.8% in 1991 to 4.5% in 1996, and 5.8% in 2001. In the 2003 and 2005 sentinel surveys, the national HIV prevalence dropped to 5% and 4.4% respectively (FMoH, 2005 and NACA, 2005). Also the NDHS (2008) report indicated a further increase in the national prevalence in the year 2008 to 4.6%. The 2003 survey estimated that there were 3.3 million adults living with HIV and AIDS in the country and 1.9 million (57%) were women. The UNAIDS/WHO (2006) report stated that based on the Nigeria's population at the end of 2005, there were an estimated 2.9 million people living with HIV & AIDS. This is the largest number in the world after India and South Africa.

The epidemic in Nigeria is classified as generalized, with all the States affected. However, there is a definite trend indicated by a high prevalence band that traverses from the North Central through the South. The 2005 sentinel survey indicated the states with the highest prevalence rate as Benue 10.0%, Akwa Ibom 8.0%, Nassarawa 6.7%, Enugu 6.5% and FCT 6.3%. While those with lowest rates include Oyo (1.0%), Ekiti (1.6%), Jigawa (1.8%), Osun (2.0%) and Kwara (2.0%) (NASCP, 2005). Furthermore, the pattern of distribution of the infection shows a higher prevalence of 4.9% among young people age 25 to 29 year's age group and more women are infected than men. On regional basis, the North West and the South West had the lowest rates of 3.5% and 2.6% respectively while the North Central zone with a 6.1% rate was the highest.

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The UNAIDS/WHO (2008) estimated that 2.6 million Nigerian (adults and children) are living with HIV in 2007. As usual the prevalence was higher among females (4.0%) than males (3.2%); slightly higher in the urban area (3.8%) compared with the rural area (3.5%). As was the case in the previous surveys, the North Central zone still experienced a higher prevalence rate (5.7%), on the contrary the South East zone recorded the lowest rate (2.6%). HIV prevalence was higher among the 30 – 39 years age group (5.4%) and lowest among the 15 – 19 years age group (1.7%). In both urban and rural areas, prevalence of HIV was higher

among females (3.6% and 4.7% respectively) as compared with males (3.3% and 3.0% respectively), (NARHS, 2007).

All these have serious consequences on the economic and social development of the nation and without effective prevention, care, support and treatment on a large scale, Nigeria will experience not only the tragedy of countless lives forever altered by the virus but also untold social and economic effects (Kanki and Adeyi ~~et al~~,2006).

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2.3 Etiology of HIV and AIDS

In 1983 and 1984 respectively, US and French researchers isolated and described the causative agent of AIDS, with each group calling the virus a different name via T-cell lymphotropic virus 111 (HLTV 111) or lymphadenopathy associated virus (LAV) (WHO, 1987; Gallo and Montagnier, 2003). Ultimately, the International Taxonomic Association resolved this issue by naming the causative agent human immunodeficiency virus (HIV) (Kanki and Adeyi~~(Mohammed and Nasidi, 2006; In Adeyi et al 2006~~). Hence, AIDS is caused by a virus called the Human Immunodeficiency Virus (HIV) (Barre-Sinoussi et al, 1983; Cornnor and Kingman, 1988).Viruses are submicroscopic, intracellular parasites that can only grow and reproduce inside a living cell. The nucleic acid polymer (genome) of an infected virus is either double stranded or single stranded DNA or RNA. Mature viruses do not grow or undergo division but they multiply by a process called replication of their genetic material (Olaleye et al., 2006).

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HIV is considered among the virus family *retroviridae* which has three subfamilies: *oncovirinae*, *lentivirinae* and *spumavirinea* (Coffin, 1990, Essex and Mboup, 2002). One unique feature of retroviruses is that they carry their genetic material in the form of a single stranded RNA and posses an enzyme called reverse transcriptase (RT) which function by transcribing the single stranded RNA into a double stranded DNA (also called proviral DNA or provirus). According to WHO (1993) and Jet et al, (2000), the provirus is employed during replication by integrating itself into the chromosome of the host cell (Coffin, 1990). The subfamily *lentiviruses* which HIV belongs, typically causes a slowly progressive disease with prolong sub clinical infection (Levy, 1994). Other characteristics include long incubation period, suppression of immune system, malignancies, wasting associated with autoimmunity

and arthritis and sustainable viremia in the absence of any obvious clinical disease, besides they are host specific. The development of assay sensitive enough to detect the presence of the enzyme RT was crucial to the identification of a retrovirus as the causative agent of AIDS.

2.4 Morphology of HIV Virion

The mature HIV virion is an icosahedral particle, roughly spherical in shape with a diameter of approximately 1/10,000 of a millimeter (110nm). The basic structure consist of an outer lipid bi-layer, studded with 72 copies (on average) of a complex HIV protein (frequently called "spikes"), and glycoprotein; and an inner core. The sticking-out portion of each spike is the major surface glycoprotein of molecular weight 120 kilodalton (gp 120), while the stem of the spike is the transmembrane glycoprotein with molecular weight 41 kilodalton (gp 41), (Poignard et al, 2000). These structural elements shown in figure 2, plays important role in infectivity and disease progression. The central core contains two single stranded RNA genome bounded together by p24 protein (Jossinet et al, 1999; Theilleux-Delande et al, 2002), four viral protein: the capsid protein p24, the matrix proteins – p17, p9 and p7 (Lama and Trono, 1998; NIAID, 2003), and three viral enzymes – reverse transcriptase, integrase and protease, essential for replication), two copies of the HIV RNA genome to which the enzymes are bounded (Jossinet et al, 1999; Theilleux – Delande et al, 2000).

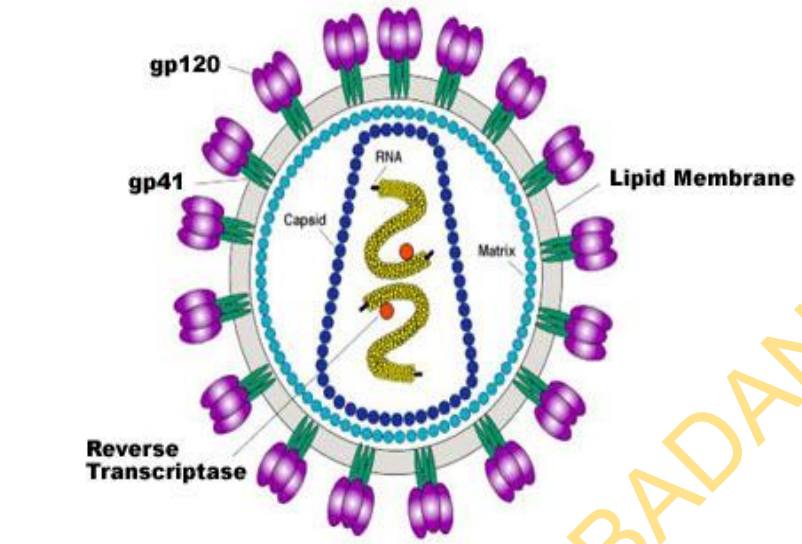

Fig.2.2. Simplified diagram of HIV Virion

Source: NIAIDS (National institute of Allergy and infectious disease) http://www.niaid.nih.gov/.

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2.5 Life Cycle of HIV

The HIV like other viruses is a parasite, it needs an intact host cells to play out its life cycle and reproduce by commandeering the cell's machinery. The life cycle of HIV can be divided into six stages:

(1) Fusion or Binding:

Viruses often have a specific cell in the host that they target. The main target cells for the HIV infection are cells which carry a molecule known as CD4 on their surfaces namely T-helper cells or T-lymphocytes and macrophages (Marodon et al, 1999 and Barkl et al, 2001), which forms part of the body immune system. The CD+ 4 on the surface of these cells serves as a high affinity receptor for HIV. An infection is initiated by binding of the virion envelop

to the CD4 receptor on the host cell with the help of the gp 120 protein on it envelop (Piognard et al, 2001). Consequent upon binding of the viral envelop protein to the CD4, the viral envelop undergoes conformational changes that triggers the entry of the HIV virion into the host cell. A partial encoding of the nucleocapside (material that surround the RNA) dissolved resulting in the release of viral RNA into the cytoplasm of the host cell (Cullen, 2001).

(2) **Reverse Transcriptase:**

Conversion of the viral genetic material (RNA) so released into DNA is catalysed by the viral enzyme – reverse transcriptase (RT). RT reads the sequence of viral RNA that enters the host cell and transcribes into a complementary DNA sequence, which can then use the cellular mechinary to make viral proteins and additional copies of viral RNA (Shih et al, 1991 and Gomez and Hope, 2005).

(3) **Integration:**

The double stranded DNA copy of the viral form (provirus) is transported to the nucleus of the host cell and integrates into the host genetic code (Bouyac-Bertola et al, 2001) and through a series of steps manufactures new viruses which are released to the exterior of the cell by a process known as budding (WHO, 1993). These daughter viruses infects other CD4 cells in the host body and undergo similar processes thus the circle continues.

The integrated provirus may be transcriptionally inactive and behave like any other silent cellular gene. When the host cell divides, the proviral gene is transmitted to daughter cells as part of the host cell chromosome. The ability of HIV, like the other retrovirus, to exist in two forms, both as RNA containing virus particles and as host cellular gene, enable them to persist in cells of an infected individual (Olaleye et al, 2006).

(4) **Transcription:**

When the host cell is activated or when the provirus become transcriptionally active, the host cellular enzyme – RNA polymerase, carry out transcription of the integrated provirus DNA template into messenger RNA (mRNA) (Barkl et al, 2001).

(5) **Translation:**

The mRNA is then translated into viral proteins that undergo extensive post transcriptional modifications. The viral RNA becomes the genetic material for the next generation of viruses.

(6) **Viral Assembly:**

The viral enzyme protease helps to assemble the viral protein and viral RNA to form new HIV particles. The virus subsequently disseminates heamatogeneously and vigorous replication occurs in the brain, spleen, and gut lymphoid tissue. During this initial phase, the virus is present in the plasma at markedly high levels. Between 10.3 billion new viruses are produced per day in people not on antiretroviral therapy (Rosenburg et al, 2000; Olaleye et al, 1993).

2.6 Signs and Symptoms of HIV and AIDS

AIDS is the last stage in the spectrum of events in HIV infection. One is considered to have AIDS if at least two or more of the major signs are present in combination with at least one of the minor signs listed below, and if these signs are not known to be due to conditions unrelated to HIV infection (WHO, 1994)

Major signs:

- Unintentional weight loss of 10% or more of body weight
- Chronic diarrhea for over one month
- Prolonged fever over one month (constant or intermittent).

Minor signs:

- Persistent cough for more than one month

- Generalized pruritic dermatitis
- Recurrent herpes zoster (shringles)
- Oro- pharyngeal candidiasis (oral thrush)
- Chronic, progressive and disseminated herpes simplex infection (generally as painful genital ulceration for over a month)
- Generalized lymphadenopathy (swollen glands of over 1cm diameter in at least two non-contagious and non-inguinal sites.

The presence of either generalized kaposi's sarcoma or cryptococcal meningitis is sufficient for the diagnosis of AIDS for surveillance purposes (WHO, 1994)

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2.7 Stages of HIV Infection

HIV can cause a wide range of symptoms and clinical conditions that reflects varying levels of immunological damage. Certain conditions tend to occur sometimes in association with each other and at specific CD4+ levels. According to WHO (2007), the course of HIV infection can generally be divided into four stages, viz:

- Clinical stage 1 - Primary infection stage
- Clinical stage 2 - Clinically asymptomatic stage
- Clinical stage 3 - Symptomatic HIV infection and
- Clinical stage 4 - Progression from HIV to AIDS (Avert .org, 2002, WHO 2007)

An HIV staging system is of particular significance and usefulness. It is adopted for clinical evaluation, planning a therapeutic intervention, determining the individual level of infirmity and providing prognostic information. Clinical staging is used once HIV infection has been confirmed. The clinical events used in describing the spectrum of HIV symptomatology include asymptomatic, mild symptoms, advanced symptoms and severe symptoms.

2.7.1 STAGE 1 – Primary HIV infection or asymptomatic phase

Following infection with HIV, the disease often present as an acute febrile illness or flu like infection termed viremia two to six weeks post exposure. About half of the new infections experience flu like illness, fever, vomiting and nausea, diarrhea; fatigue, swollen lymph's nodes, muscles and joints aches & pains, while others are without any symptom. Where it

occurs, these symptoms clear up within a few weeks and most people enter symptom free phage. This is often referred to as seroconversion (window period). In about 20% of the people these symptoms are serious enough to consult a doctor but the diagnosis is frequently missed (Soogoor and Daar, 2005, Kassuto and Rosenberg, 2004). WHO (2007) refers to this phase as asymptomatic infection characterized by generalized lymphodenopathy, acute retroviral syndrome and a performance scale level which the patient can perform normal activities.

2.7.2 Stage 2 – Clinically Asymptomatic phase

This is also known as the latent period. It starts at the time of sero conversion (i.e. production and detection of the HIV antibodies in the blood) and ends when symptoms of AIDS manifest. However, though the individual may not present with any symptom, there may be swollen glands, the conditions are transient symptomatic illness that can be identified in 40 – 90% of new infections. The level of HIV in the peripheral blood is relatively low and the CD4+ cells are still within normal range (600 – 1200counts per mm^3 of blood but the client remains infected and infectious (WHO, 2007). This stage can last for 2 – 10 years (Fauci, 1998), though the duration is a function of a number of factors like the strength of the persons immune system, the mode of infection, the amount of viruses transmitted during infection, the persons age. The clinical events used by WHO, (2007), to describe this stage includes:

- moderate unexplained weight loss (<10% body weight)
- recurrent upper respiratory tract infection (URTI)
- minor mucocutenous manifestation
- recurrent oral ulceration
- papular pruritic eruptions,
- seborrhoeic dermatitis fungal nail infection

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2.7.3 Stage 3 – Symptomatic phase

Overtime, the immune system could no longer contain the rate of replication of the virus, such that the viruses are no longer retained in the lymph nodes, thus the circulating level of free virus increase while the CD4 T cell level falls and opportunistic infections sets in.

According to Plantier et al (2003), CD4 cell count is a less technical measure of HIV progression. The clinical manifestations during this phase include the advanced symptoms of the infection such as:

- severe weight loss (>10% body weight),
- unexplained diarrhea for longer than one month,
- Prolonged intermittent or unexplained persistent fever,
- persistent oral candidiasis
- oral hairy leukoplakia,
- pulmonary tuberculosis,
- Several bacterial infections (e.g. pneumonia)
- Vulvovaginal candidiasis that is chronic and does not respond to therapy

This marked the early stage of progression from HIV infection to AIDS also a performance scale level at which the patient remains in bed less than 50% of the day time but more than normal (WHO, 2007).

2.7.4 Stage 4 – Progression from HIV to AIDS

During the advance stage of HIV infection, the CD4 count declines below 200cells/mm^3, a level at which the infected individual is said to have developed full blown AIDS. At this stage otherwise known as severe disease phase, additional life threatening opportunistic infections may occur with increasing frequency. These may include:

- HIV wasting syndrome; defined as unexplained weight loss occasioned by chronic diarrhea, chronic weakness and unexplained fever
- chronic herpes simplex,
- pneumocystis jiroveci pneumonia (formerly Pneumocystis Carinii Pneumonia -PCP)
- cryptosporidiosis with diarrhea lasting longer than one month
- toxoplasmosis of the brain
- isosporiasis with diarrhea lasting for more than one month
- cytomegalovirus disease affecting organs other than the brain
- extra pulmonary TB
- candidiasis of the oesophagus, trachea, bronchi and lung

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- recurrent severe bacteria pneumonia,
- kaposi's sarcoma

This is a performance scale at which patients remain in bed for more than 50% of the day ~~amongst others may occur with increasing frequency (WHO, 2007,~~(Akinsete et al, 1998; Kanki and Adeyi ~~et al~~, 2006 and WHO, 2007~~Akinsete et al 1998~~).

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2.8 Transmission of HIV and AIDS

Detailed epidemiological studies throughout the world documented three principal modes of transmission: sexual transmission, transfusion of infected blood and blood products and mother to child transmission (perinatal contacts). These routes include the four bodily fluids responsible for all HIV transmission – semen, vaginal fluid, and blood and breast milk (Olaleye et al, 2006). The exchange of these fluids from infected to uninfected persons will result in potential transmission. The risk of infection within each route of transmission varies based on factors such as circulating viral concentration and stages of illness in the index case, viral strain, presence of coexisting genital ulcer disease, specific type of contact and immune state of the exposed person (O'Brien et al, 1994).

2.8.1 Sexual transmission

HIV can be transmitted by vaginal, anal and or oral sexual intercourse. Like other sexually transmitted infections, the likelihood of infection with HIV is related to the number of sexual partners, the infectiousness of the infected person (e.g. people with higher viral load) and the duration of infection. According to WHO (2001), sexual intercourse has been proven to be the commonest route of transmission due to some sexual behaviours that put people at risk like homosexuality involving oral and anal sex, heterosexuality with ~~a~~an infected partner. Globally about 90% of all HIV infection is acquired sexually. Padian et al, (1991) stated that in North America and Western Europe, homosexual anal intercourse was initially the major route of HIV transmission, however, heterosexual routes has since become the major modes of transmission in nearly all countries. Kanki and Adeyi~~Nasidi and Harry~~ (2006) reported that heterosexual transmission accounts for up to 80% of all HIV infection in Africa. In Nigeria, these route accounts for up to 82% of all transmission (FMOH, 2007c).

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Based on gender specific anatomical and physiological characteristics, women are more prone to HIV due to a large surface area (vagina, cervix, anus) being exposed, also semen contains higher concentration of HIV than vaginal and cervical fluid, thus efficiency of male – to – female transmission is higher than female –to – male transmission (O' Brien et al., 1994; WHO, 2001). Homosexual intercourse does not appear to contribute significantly to HIV epidemic in Nigeria (Nasidi and Harry, 2006). According to them these practices are not common in the country.

2.8.2 Blood and blood products

Transfusion of infected blood and blood clothing factors is another major route of HIV transmission. Far back in 1994 the WHO stated that the risk of contracting HIV from the transfusion of a unit of infected blood is over 95%. In Africa about 2.5% of all infection is acquired through this route, and 10% of all HIV infection in Nigeria is through blood transfusion (Nasidi and Harry, 2006). Intact skin is an effective barrier against the virus. When pierced with injection needles, tattooing equipment and other invasive instrument that has been contaminated with infected blood, infection can take place if dose of the virus is large enough or with repeated infection like in intravenous drug users. Olaleye et al (20061993) reported that injection drug use account for 2.8% of HIV infection in Africa. This practice is uncommon in Nigeria as it is in other African countries, hence not considered a major route of HIV transmission in the country as compared to other practices like group circumcision, tribal and medicinal scarification and tattooing (Morfeldt-Manson and Lindquist, 1984
Adesoji and Moronkola, 2003).

2.8.3 Mother to child transmission (Vertical transmission)

An infected mother can transmit HIV to her baby in- utero (across the placenta) during delivery (through exposure to infected genital tract secretion) and/or through breast feeding. Nearly all cases of HIV infection in infants both in developed and developing countries occurs as a result of mother –to-child transmission. In Africa, this route accounts for 2.88% of all HIV infection. Kanki and AdeyiAdeyi et al, (2006) stated that in most of the

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developing countries, HIV infection in pregnant women contributes greatly to spread of epidemic through mother-to-child transmission. In Africa this route accounts for 2.8% of all HIV infection. In the year 2004 alone, more than 75,000 infants were born with HIV in Nigeria (FMoH, 2003). Mofenson (2003) reported that most infection is thought to occur at the time of delivery (60 – 70%) followed by transmission through breast feeding (20 – 30%), then transmission in utero (less than 10%). Most children less than 15 years living with HIV acquired the infection through mother to child transmission (MTCT) and this route account for 10% of HIV infection and almost 90% of all infection in children. The risk of such transmission is 15 – 30% in non –breast feeding infected mothers (FMoH, 2007c).

Kanki and Adeyi ~~et al~~, (2006) pointed out that the employment of safe breast milk substitute to prevent transmission through breast milk is further compounded by the fact that many HIV infected mothers lack access to clean water and sanitation. Hence the infant foods so prepared are exposed to various bacterial contaminations through water, inadequate sanitation and hygiene thereby compounding the problem.

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2.9 Diagnosis of HIV Infection

The effectiveness of HIV control measures and the success of treatment depend largely on the establishment and provision of accurate diagnosis. The tests widely used for HIV screening checks for the presence of anti-bodies produced by the body in response to HIV infection, and not the virus itself. The most commonly used serologic assay for diagnosing HIV infection is the enzyme link immunosorbent assay (ELISA) (Hirsch and Curran, 1990). Generally the test is classified into two categories: screening test including ELISA- rapid and simple, and supplemental or confirmatory test, including Western blot, culture, antigen detection and immunoflorescence assay. The standard specimen for detection of HIV antibodies are serum, plasma or whole blood as well as oral fluid like saliva. People at primary stage of infection do record a negative test result due to the time it takes for the antibodies to be produced – window period

2.10 Management of HIV and AIDS

There is no cure for HIV and AIDS, also there is no evidence that vaccine against HIV is available (UNAIDS/WHO, 2006b). Treatment and care remains the only option and it consist of a number of elements including voluntary counseling and testing (VCT), nutritional care and support, support for the prevention of onward transmission of HIV, legal protection from stigma and discrimination, spiritual support, provision of anti – retroviral (ARV) drugs, treatment of STIs and prevention and treatment of STIs (Kanki and Adeyi ~~et al~~, 2006). Successful clinical management centers on early diagnosis, ART, treatment of OIs and malignancies (Kanabus and Allen, 2005). The importance of adequate environmental factors like potable water supply, adequate sanitation and hygiene amongst others cannot be over emphasized in the proper management of HIV and AIDS.

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2.10.1 Anti-Retroviral Therapy (ART)

ART are medications administered to PLWHAs to boast their immunity and reduce viral replication and subsequent progression of HIV infection to AIDS. The recommended treatment for HIV is a combination drug treatment regimen called highly active antiretroviral therapy (HAART). This regimen usually combines several (three or more) drugs simultaneously – often called a drug cocktail (WHO, 2006c). The essence of this combination is to increase the effectiveness of AIDS treatment by attacking HIV at multiple points. ART has significantly reduced morbidity and mortality, prolonged life expectancy and improved quality of life of people living with HIV and AIDS (Kanabus and Allen, 2005). Since 1995, when HAART became available, the number of deaths from AIDS has decreased by over 80% in the United States. The rate of AIDS hospitalizations and complications has also substantially declined (http://www.cdcnpin.org). Effective ART became available much later after the HIV and AIDS occurrence. But unlike developed countries, resource poor countries of Africa could not, and most still cannot afford to procure or regularly supply the drugs to PLWHAs to prolong their lives.

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Though it is not possible to completely clear the virus from the body, the goal of HAART is to suppress the virus so that it cannot be detected in the blood, to increase the CD4 count and to strengthen the weakened immune system. The four types of antiretroviral medications used for HIV and AIDS treatment includes:

1. Reverse transcriptase inhibitors (RTIs) comprising of sub-groups like nucleoside and non-nucleoside inhibitors (NRTIs & NNRTIs respectively), such as zidovudine (Retrovir, AZT), didanosine (Videx, ddI), stavudine (Zerit, d4T), abacavir (ABC), and lamivudine (Epivir, 3TC) (WHO, 2007)
2. Protease inhibitor such as saquinavir (Invirase, Fortovase), ritonavir (Norvir), indinavir (Crixivan), nelfinavir (Viracept).
3. Nucleoside analogs, such as nevirapine (Viramune) and efavirenz (Sustiva)
4. Fusion inhibitors, such as enfuvirtide (Fuzeon) (http://www.intelhealth.com)

These medications function by inhibiting the growth and replication of the virus at various stages of it life cycle; NRTIs interrupts the early stage of the viral replication process thereby slows the spread of the virus in the blood and delay the onset of opportunistic infections. NNRTIs keep the enzyme – reverse transcriptase from catalyzing the replication of the virus. Nucleotide analogs prevent the viral cells from producing viruses and thus decrease the amount of HIV in the body. Fusion inhibitors bind to HIV and prevent the virus from infecting healthy cells in the body.

Many of these drugs have side effects, such as nausea and diarrhea. In addition, some have severe drug interactions with commonly used medications. Fusion inhibitors are reserved for patients who are infected with a drug-resistant HIV strain (www.intelhealth.com).

2.10.2 HAART Provision in Nigeria

For many years, effective ARVs were unavailable, and when they became available, it was difficult to make decision about their use in Nigeria as was the case in much sub Saharan Africa. In 2001, the government showed commitment to providing highly subsidized ART program in the country. This was in line with the Abuja 2001 declaration by the heads of states and representatives of government at the United Nations General Assembly Special session (UNGASS) dedicated to HIV and AIDS (WHO, 2007 and UNAIDS/UNICEF/WHO, 2008). In 2002 the Nigerian government created the ambitious national antiretroviral (ARV) treatment program with the purchase of ARV for 10,000 adults and 5,000 children. This activity needed a significant scale up as even more than one million Nigerians were considered eligible to receive the treatment (Odutola, 2004). Mohammed and Nasidi~~Adeyi et~~

al, (2006) reported that the fewer than 50,000 eligible patients treated by the end of 2005 represent only a fraction of those in need of ART. At the end of 2006, WHO, (2007b) reported that of the 550,000 people estimated to require ARV therapy, only 81,000 (15%) received the drugs. Although this is twice as many as were on treatment the previous year, Nigeria's coverage rate is still only half of average for sub Saharan Africa (WHO, 2006d). Mohammed and Nasidi (2006) stated that these drugs have progressively become available largely on account of reduced costs brought about by allowing developing countries manufacture generic formulations. Nutrition is another essential part of any HIV care package particularly during the asymptomatic phase. However, good nutrition coupled with adequate sanitation and hygiene may help prolong the incubation period of HIV (Kanabus and Allen, 2005 in http://www.avert.org).

Table 2.3: **Estimated number of antiretroviral therapy requirement/provision in Nigeria (2005-2007)**

	2005	2006	2007
Sites providing ART	71	-	215
Estimated number of people receiving ART	41,000 ((37,000-45,000)	95,000 (90,000 – 100,000)	198,000 (144,000-252,000)
Estimated number of people needing ART	670,000 (460,000 – 1,300,000)	710,000 (510,000- 1.2m)	50,000 (550,000 – 1.1m)
Children >15 receiving ART	-	-	15,345
Pregnant women needing ART for PMTCT	190,000 (150,000 – 230,000)	190,000 (130,000 – 230,000)	190,000 (130,000 – 240,000)
Pregnant women with HIV who receive ART for PMTCT	532	6,168	12,278

Source: UNAIDS/UNICEF/WHO, 2008.

2.11 Prevention of HIV and AIDS

Prevention is the only available cure for AIDS at present. According to WHO (1994), prevention and control has three main objectives:

1. To prevent infection
2. to reduce the personal and social impact of HIV
3. To mobilize and unify national and international efforts against AIDS.

Prevention is the main stay of HIV and AIDS control and assumes paramount importance in the world's effort to curb the disease. The main thrust of HIV prevention in Nigeria is based on information, education and communication; condom promotion and behaviour change (Kanki and Adeyi~~Adeyi et al~~, 2006).

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2.11.1 Prevention of sexual transmission

This is difficult, complex and requires accurate informed decisions by the individual and the partner as well as many changes in behaviour/lifestyle. Abstinence is the only full-proof method of preventing sexual transmission. However, the following options should be adopted to decrease the risk of becoming infected; mutual faithful relationship with one sexual partner, proper and consistent use of condom for all penetrative sex (anal, oral, vaginal), restriction of sexual contact to activities that do not involve the exchange of semen, vaginal and cervical secretions or blood.

2.11.2 Prevention of transmission via blood

The safety of blood and blood products however is an area where total control can be achieved by routine and mandatory screening of all blood samples for HIV. Prevention at the health care setting rest on careful attention to infection control procedures including proper sterilization of equipments, proper adherence to procedures based on universal precautions including proper disposal of healthcare waste – sharps. The universally accepted recommendations for minimizing transmission via this route are:

- avoidance of blood transfusion as much as possible but if inevitable the blood must be screened prior to transfusion

- avoid sharing body piercing equipments like needles, syringes and razor blades.

2.11.3 Prevention of mother to child transmission (PMTCT)

One of the goals of the United Nations general assembly special session on HIV and AIDS (UNGASS) is to reduce the proportion of infants infected with HIV by 20% by 2005 and 50% by 2010. The Nigerian national goal for PMTCT as contained in the 2003 AIDS policy is to reduce the transmission of the HIV through MTCT by 50% by the year 2010 and to increase access to quality counseling and testing services. To achieve this goal, a comprehensive four pronged strategy to prevent HIV infection among infants and young children has been developed. These strategies are: primary prevention of HIV infection in women of reproductive age and their partners, prevention of unintended pregnancies among HIV infected women, prevention of HIV transmission from mothers to their children and care and support for infected mothers, their infants and family member (FMoH, 2007c).

According to WHO (1994) the best strategy of preventing mother-to-child transmission is to prevent infection of women of reproductive age. Specific intervention measures available to mothers includes voluntary counseling and testing (VCT), anti-retroviral therapy, safe delivery practices, universal precautions, safe infant feeding practices (FMOH, 2002). Kanki and Adeyi ~~et al~~, (2006), further stresses that the key entry point to PMTCT programs is the VCT offered to pregnant women, and the success of the program depends on the proportion of women who agree to be tested and return to obtain their test result and also accept the ARV prophylaxis.

2.12 Responses to HIV and AIDS

According to the joint ILO/WHO guidelines on health services and HIV/AIDS (2005), UNAIDS is the main advocates for global action on the epidemic. It establishment in 1996 by the United Nations was solely to lead, strengthen and support an expanded response aimed at preventing transmission of HIV, providing care and support, reducing the vulnerability of individuals and communities to HIV/AIDS and alleviating the impact of the epidemic. The

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programme is a joint venture that brings together the efforts and resources of other organizations to help the world prevent new HIV infections, care for those already infected and mitigate the impact of the epidemic. As a co-sponsor of UNAIDS, WHO leads the health sector response to the epidemic. It action is guided by the global health sector strategies (GHSS) for HIV and AIDS 2003 – 2007, endorsed by the World Health Assembly in 2003.

In the year 2003, the global response to HIV and AIDS shifted focus from the more ambitious goal of universal access to prevention, treatment and care to a more proactive approach of expanding access of ART to three million people living with HIV and AIDS in developing countries by the end of 2005. This program was/is referred to as the "3 by 5" initiative. This initiative was a timely response to the finding that by the year 2003, approximately 7% of the six million people in need of ART in developing countries were receiving it, with the biggest gap in Africa (Schwartland et al., 2001). An unprecedented level of political will to deal with epidemic was becoming evident as new institutions such as the Global fund to fight AIDS, TB and Malaria (GFATM), and the ambitious bilateral program including the United State Presidential emergency plan for AIDS relief (PERFAR) were launches. These strategies were designed to provide framework for partnership and action, and to scale up treatment and care within a coordinated and comprehensive response to HIV and AIDS (WHO, 2004).

2.12.1 National Responses to HIV and AIDS

Historically, the response to HIV and AIDS has run a parallel course from one country to another. Nigeria like many other countries around the world initially responded to the epidemic with a long period of denial and little action (Barnet and Whiteside, 2002; Kanki and Adeyi ~~et al~~, 2006). Official denial meant neither the federal government nor the state government committed the needed human and financial resource to prevention and control of HIV infection. The worst period was from 1990 to 1999. But throughout this period, some international organizations and emerging civil society organizations (CSOs) were able to mount responses to the epidemic, particularly in the area of information, education and communication, community mobilization and capacity building for programming (Kanki and Adeyi ~~et al~~, 2006).

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The public sector response to the epidemic commence in 1987 with the establishment of the National Expert Committee on AIDS. The committee was saddled with the responsibility of advising the Federal Government on how best to respond to the epidemic (Peterson and Obileye, 2002). A year later, the Federal Ministry of Health (FMoH) under the auspices of the National AIDS and STI control Program (NASCP) took the responsibility of coordinating the National response. The approach employed was purely biomedical laced with health education and policy formulation. Yet the response remained tepid except for the effort of the CSOs.

The advent of democratic rule in 1999 brought about a dramatic change in the attitude of government to the epidemic as well as the response to it (Ajakaiye, 2002). Under this regime, the HIV/AIDS emergency action plan (HEAP) was drawn up as guide to the national response and was coordinated by National Action Committee on AIDS (NACA), which was formerly established in 2001. This approach resulted in a critical shift from a health sector led response to a truly multi – sectoral response coordinated by newly created presidential committee, (composed of ministers of the various lined – ministries and technical experts) and NACA at the federal level. This effort was/is stepped down to the states and local government areas with the formation of the state and local government action committees (SACA & LACA) respectively (FMoH, 2005).

The HIV/AIDS emergency action plan (HEAP) focused on three major areas via removal of socio-cultural information and systemic barriers to community responses, preventive interventions focused on high risk groups and the general population as well as care and support for people infected with and affected by HIV (FMoH, 2001). The implementation of HEAP increased HIV related activities in the country. For the first time the country began direct services to mitigate the impact of HIV on the affected and infected including prevention of mother to child transmission (PMTCT), provision of antiretroviral therapy (ART), care and support in the communities and of orphans and other vulnerable children. The Government also convened the African head of states summit on HIV/AIDS, STIs Malaria, Tuberculosis and other infectious diseases. The declaration of this summit known as

the Abuja 2001 declaration paved way for the setting up of the global fund to fight AIDS, malaria and TB (GFATM) by the United Nations (UN). One key outcome and benefit of the summit to the country was the government decision to subsidized ART program at a time no government in Africa was doing that (NACA, 2005). The national response received the largest resource base in history both internally and internationally.

However, the review of the framework in 2005 reveals a weak central coordination, limited access to PMTCT and ART. Consequently, a newer plan: the national HIV/AIDS strategic framework 2005 – 2009 was developed. This plan addressed more pressing issues relating to stigmatization, discrimination, impact mitigation and monitoring and evaluation (NACA, 2004).

2.12.2 Civil Society Response (CSOs)

Nigeria CSOs have been active in an organized and informed way in the HIV response since the mid 1980s. In 1985, for instance, the society for Family health (SFH), a national CSO based in Abuja, took the first step in what is now an internationally acclaimed nationwide HIV prevention program focused primarily on the social marketing of condoms (SFH, 1997, PSI, 2005). Similarly, following early research findings about the groups most at risk of HIV infection, STOP AIDS, a Lagos based CSO, launched an HIV prevention education and counseling intervention among long-distance truck drivers that later covered motor parks in different regions of the country (Nwabuko, 1997). Most of the active CSOs in the country are community based and faith based organizations preoccupied mainly with small scale care and welfare services (Action Aid/Nigeria, 2001; Ahanihu, 2005; Touray, 2005).

The leadership of Nigeria health and development CSOs in promoting HIV prevention initiatives among adolescents and youths in Nigeria has been well documented since 1980s. Some of the leading CSOs are Action Health Incorporated (AHI), based in Lagos and founded in 1989 (AHI, 2002; Peterson and Obileye, 2002; and Bryant, 2004) and adolescent health information project (AHIP), Kano – founded 1989 (Brocato, 2005). Other Youth-serving CSOs includes the association for family and reproductive health (AFRH), Ibadan, founded 1989 (Brieger et al 2001 and Mba, 2004); the community life project, Lagos

founded 1992 (Peterson and Obileye, 2002 and Iwere and Kohl, 2005), as well as the Nigeria Youth AIDS Programme (NYAP) located in the University of Calabar, established 1992 (Obot, et al 1996). An increasing number of CSOs spread across Nigeria are providing peer to peer HIV education to thousands of young people in and out of school and are disseminating HIV messages through distribution of information materials, community out reach and the mass media (Mba, 2004, Bryant, 2004 and Brecato, 2005).

CSOs provides most of the available youth friendly reproductive health clinic services, including HIV counseling, referrals and syndromic management of STIs for the in and out of school youths in Nigeria. Howbeit, these CSOs are concentrated in the urban areas and depend heavily on external funding agencies (Ahanihu, 2005).

2.13 National Policies on HIV and AIDS

The overall goal of the HIV policy is to control the spread of the virus in the country, provide equitable care and support for those infected and to mitigate its impacts to the point where HIV is no longer of public health, social and economic concern, such that all Nigerians will be able to achieve socially and economically productive life free of the disease and its effect (FMoH, 2007). Leadership of the policy sector has displayed strength in the development of national policies. Although, up to date Nigeria has not yet determined the right mix of policies and programmatic approaches for tackling HIV and AIDS crises, the country has been muddling through by basically following the trend in approaches recommended or detected by UN agencies – WHO and UNAIDS, (Kanki and Adeyi, et al,2006). However, since 2000, the country under NACA leadership has witnessed a deluge of policy documents and strategic plans for reducing HIV spread and mitigating it impacts (Abantu, 2004).

On the whole, the policy environment for HIV and AIDS control in Nigeria is positive. The implementation of HIV and AIDS measures in the country is guided by a number of instruments including the HIV emergency action plan (HEAP) (Agar, 2003, FMoH, 2007b), the national policy on HIV (FMoH, 2002), and the national HIV strategic framework – launched in 2005 (FMoH, 2007b and NACA, 2004). These frameworks/documents recognized the need to prioritize targeted interventions for vulnerable and high risk groups.

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One stated objective of HEAP was to promote behaviour change in both low and high risk population, hence at the framework and action plan level, the list includes the national strategic framework, the national HIV and AIDS behaviour change communication strategy and the Nigeria national response information management system (NNRIMS) (Abantu, 2004 and NACA, 2004b). Sector specific policies has also been developed by the respective ministries e.g. HIV workplace policy, but the associated strategic and annual implementation plan for translating them into programs and services are yet to be instituted.

2.14 Opportunistic Infections (OI)

Park (2005) defines OIs as infections by organisms that take opportunity provided by a defect in the host immune system to infect the host and hence cause disease. HIV attacks and destroys the helper T cell (known as CD4+cells) that help to keep infections at bay, thereby weakened the immune system. When the immune system is undamaged and working properly, these microbes are prevented from growing and spreading within the body and causing disease. However, if the immune system is damage by HIV (or other sources of immune suppression such as post transplant treatment drugs), the micro organisms are able to reactivate and grow (Training manual, 2005). People with advanced HIV infection are vulnerable to life threatening infections and malignancies than uninfected individual (Kanabus and Allen 2005 in http://www.avert.org). The depletion of CD4 cells leads to the growth and dissemination of various types of OIs. The study of OIs in PLWHAs can be categorized either according to the organs or system in the body that they affect or by the biological grouping or etiological causes.

2.14.1 Categorisation of OIs by etiological agents:

HIV related OIs can be caused by a wide variety of disease causing microorganisms (pathogens) that are common and may have lived in the body for many years. These pathogens which includes:

- Bacterial disease e.g. tuberculosis, bacterial pneumonia, septicemia and mycobacterium avium complex (MAC).

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- Protozoal disease e.g. pneumocystis carinii pneumonia (PCP), toxoplasmosis, microspiridiosis, leishmaniasis and cryptosporidiosis – intestinal infection responsible for severe diarrhea.
- Fungal disease e.g. candidiasis (also known as thrush or candida albican), PCP, cryptococosis and penicilliosis.
- Viral disease such as those caused by cytomegalovirus, herpes simplex and herpes zoster viruses
- HIV associated malignancies like kaposi's sarcoma, lymphoma squamous cell carcinoma (Kanabus and Allen, 2005 in http://www.avert.org)

2.14.2 Categorisation of OIs by organs or system they affect

Almost any organ or system of the body can be affected by the different OIs. According to UNAIDS (2002) those most commonly seen within the different organs and systems are:

- The brain and its meninges which usually affected by cryptococcosis, toxoplasmosis, tuberculosis
- The eye and its appendages: cytomegalovirus herpes zoster
- The mouth, throat and easophagus: candidiasis, oral hairy leukoplakia, kaposi's sarcoma, aphthous ulcers
- The lungs and pleural covering: pneumocystis jiroveci pneumonia (formerly known as PCP), histoplasmosis, kaposis's sarcoma.
- The cuts and liver: cytomegalovirus, crytospodidiosis, mycobacterium avium complex, hepatitis virus, candidiasis
- Genito-urinary system: candidiasis, Human papiloma virus, cervical cancer, syphilis,
- Genital herpes
- The skin: Herpes simplex, herpes zoster.

Opportunistic pathogens can be contracted from almost anywhere in the environment including soil, water, unwashed raw foods, and animal feces and in some cases from other people. Some opportunistic pathogens are benign to the body but get reactivated and cause

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infections when the immune system fails. During the early stage of the epidemic, OIs were the main cause of mortality among PLWHAs rather than HIV itself (Kanabus and Allen, 2005 in http://www.Avert.org).

2.14.3 Prevention of OIs

Prevention and treatment of OIs will not only help clients to live longer, healthier lives but will also prevent transmissible OIs like TB from spreading to others.

The three key ways of preventing OIs are:

- Prevention from being exposed to the pathogen
- Preventing the disease from developing if exposure has occurred and
- Preventing the reoccurrence of the disease, if one had already had an episode.

When possible, prevention of exposure to the pathogen that causes OIs remains the best way to prevent disease. However, many of the pathogens are wide spread in the environment that there is no practical way to avoid contact. Prevention and treatment of OIs will not only help clients to live longer, healthier lives but will also prevent transmissible OIs like TB from spreading to others (CDC, 2009).

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2.14.4 Common OIs in PLWHA

(A) Tuberculosis (TB)

TB is a bacterial infection caused by Mycobacterium tuberculosis often affecting the lung (pulmonary tuberculosis) and other part of the body (extra pulmonary tuberculosis). TB bacteria are very common in many resource poor countries. Infection with the bacteria can be active i.e. symptomatic & infectious or inactive (latent). The common symptoms of TB infection includes bad cough that lasts longer than two weeks, pains in the chest, coughing up of blood stained sputum, weight loss among others. TB is a contagious disease that kills around 2 million people each year. One third of the world population is currently infected with TB and someone is newly infected every second (WHO, 2006).

Park (2005) describes TB as a social disease with medical aspect. The social factors include poor quality of life, poor housing, overcrowding and population explosion. These environmental determinants contribute to the spread of the infection. TB is an air borne infection. Transmission is mainly by droplet infection and droplet nuclei. When a person with active TB coughs, sneezes, spits or even talk, the germs are release into the environment and the people nearby will breath in the bacteria and become infected. This bacteria thrives in damp and dark environment where ventilation is poor, thus transmission is common among people in overcrowded areas, slums and those living in poor housing conditions (JAAIDS, 2006).

TB is the leading HIV-associated opportunistic disease in developing countries and the major cause of death among HIV infected persons. WHO estimates that TB account for up to a third of all AIDS death world wide (NIAID, 2002, WHO 2006). HIV has contributed to a global resurgence of TB such that many high burden countries have seen stable or rising TB case notifications due to HIV-associated TB. HIV infected persons have a 50% lifetime risk of progressing from latent TB infection to TB disease, compared with 5 – 10% of HIV uninfected persons (kanabus et al, 2008). Report from CDC (2005) stated that people who are co-infected with both HIV and latent TB have an up to 800 times greater risk of developing active TB disease and becoming infectious compared to people not infected with TB.

TB is an HIV related O.I. At least one in every three patients with HIV develops TB (French and Gilks, 1999; Gorkom, 2002; Kamminga and Wegelin, 2003). A person that has both HIV and active TB has an AIDS defining illness. TB is a serious health problem in its own right but it is also the most likely cause of death for PLWHAs. Like HIV, TB has an uneven impact around the world. In some part of the world especially in Africa increase prevalence of TB is mainly due to HIV epidemic. Between 1990 and 2005, TB incidence rate tripled in African countries. In 2003, the continent accounted for 81% of estimated 741,000 cases of TB. The estimated incidence per capita in sub Saharan Africa is put at 356 cases per 100,000 populations in 2004. In recent times more than eight (8) million people living with HIV in Africa are co-infected with TB (CDC, 2005).

TB is a major public health problem in Nigeria. The WHO Global report (2007) rank Nigeria fourth (4th) out of the 22 high TB burden countries in the world, also an estimated 373,628 new TB cases occur annually in the country, while about 105,000 people die every year as a result of TB. With the HIV prevalence of 4.4% in Nigeria (FMoH, 2005), the HIV/TB co-infection rate was about 27%, translating to about 800,000 adult suffering from TB/HIV infection.

TB is preventable and curable. The widely used vaccine against TB is called BCG – (Bacille Calmette Guerin). It is used to protect infants and young children from all forms of TB. The protection it provides last for fifteen (15) years, thus not effective in adolescents. Active TB can be cured with a combination of anti-TB drugs. Effective treatment makes the person with TB non contagious and therefore prevent further spread of the disease (Kanabus et al, 2008).

(B) Diarrhoea

Diarrhoea is the passage of three or more loose, watery stools. A person with diarrhoea typically passes stool more than three times a day or more frequently than is normal for the individual. People with diarrhea may pass more than a quart of stool a day. Acute diarrhoea is a common problem that usually lasts 1 or 2 days and goes away on its own without special treatment. Prolonged diarrhoea persisting for more than 2 days may be a sign of a more serious problem and poses the risk of dehydration. Chronic diarrhoea may be a feature of a chronic disease (www.digestive.niddk.nih.gov).

In medicine, diarrhea is characterized by frequent loose or liquid bowel movement. The loss of fluid which occurs along with dangerous amount of important salts, electrolytes and other nutrients through diarrhoea usually result in severe dehydration which is one cause of death in diarrhea sufferers. Diarrhoea commonly results from gastroenteritis caused by viral infections, parasites or bacterial toxins (Wilson, 2005). Acute diarrhoea is usually related to a bacterial, viral, or parasitic infection. Chronic diarrhoea is usually related to functional disorders such as irritable bowel syndrome or inflammatory bowel disease. A few of the more common causes of diarrhoea include the following:

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Bacterial infections. Several types of bacteria consumed through contaminated food or water can cause diarrhoea. Common culprits include *Campylobacter*, *Salmonella*, *Shigella*, *and Escherichia coli (E. coli)*.

- **Viral infections.** Many viruses cause diarrhoea, including rotavirus, Norwalk virus, cytomegalovirus, herpes simplex virus, and viral hepatitis.
- **Food intolerances.** Some people are unable to digest food components such as artificial sweeteners and lactose—the sugar found in milk.
- **Parasites.** Parasites can enter the body through food or water and settle in the digestive system. Parasites that cause diarrhoea include *Giardia lamblia*, *Entamoeba histolytica*, and *Cryptosporidium*.
- **Reaction to medicines.** Antibiotics, blood pressure medications, cancer drugs, and antacids containing magnesium can all cause diarrhoea.
- **Intestinal diseases.** Inflammatory bowel disease, colitis, Crohn's disease, and celiac disease often lead to diarrhoea.
- **Functional bowel disorders.** Diarrhoea can be a symptom of irritable bowel syndrome.

Source; http://digestive.niddk.nih.gov/ddiseases/pubs/diarrhoea/

Ashbolt, (2004) stated that contaminated water sources are vehicles for the transmission of water-borne diseases including diarrhoea. According to Obi et al (2002), several enteropathogens of bacterial, viral and parasitic origins are usually isolated from contaminated water sources. These pathogens variously incriminated in cases of diarrhoea which account for a substantial degree of mortality and morbidity in different age groups worldwide. The WHO estimates that about 1.1 billion people globally drink unsafe water and the vast majority of diarrhoea disease in the world (88%) are attributable to unsafe water, sanitation and hygiene. WHO/UNICEF (2004) reported that more than 2.2 million people mostly in developing countries die each year from disease associated with poor water and sanitation conditions.

Inadequate and unsafe water, poor sanitation and unsafe hygiene practices are the main causes of diarrhoea which results in at least 1.9 million under-five child deaths annually. Acute diarrhoea is the common cause of death in developing countries and the second most common cause of infant mortality worldwide (Wilson, 2005). Infectious diarrhoea which

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includes cholera, salmonellosis, shigellosis, amoebiasis and other protozoal and viral intestinal infections are transmitted by water, person-to-person contact, animal to human contact and food-borne, droplet and aerosol routes. Children in developing countries average four to five debilitating bout of diarrhoea per year.

One of the hallmarks of HIV/AIDS is diarrhea (Prasad et al, 2000) and about 90% of HIV/AIDS patients in Africa suffer from chronic diarrhoea (Janoff and Smith, 1998). The substantial degree of morbidity and mortality due to diarrhoeal diseases in developing countries is thus compounded by the HIV/AIDS epidemic (Obi and Bessong, 2002; Sande and Volberding, 1997). Diarrhoea in HIV/AIDS patients is commonly infective in origin. Classical Diarrhoeagenic enteropathogens in HIV/AIDS include *cryptosporidia*, *Isospora belli*, *Microsporidia*, *Mycobacterium avium complex (MAC)* and bacteria such as *Campylobacter*, *Salmonella*, *Shigella*, *Vibrio*, *Escherichia coli*, *Aeromonas* and *Plesiomonas* (Obi et al., 2003). However, Kartalija and Merle, (1999) opined that non-infective causes of diarrhoea in PLWHA should be considered in differential diagnosis.

Diarrhoeagenic pathogens are water-borne and their association with HIV/AIDS typifies a link, which implicates water quality in some clinical manifestations of HIV/AIDS. *Campylobacter*-associated diarrhoea and bacteraemia occur world-wide in HIV/AIDS patients (Quin, 1997; Lastovica et al., 2001). The incidence of clinical manifestations of campylobacteriosis is higher in HIV-positive than in HIV-negative patients, with substantial mortality and morbidity. In addition, high infection burdens of diarrhoeagenic bacteria have been reported in developing countries especially in communities with high HIV and AIDS prevalence, poor sanitation and inadequate water treatment (Clark, 1999). Children and adults living with HIV/AIDS, because of their weakened immune system are especially susceptible to the debilitating effects of persistent diarrhoea.

Several studies (UNICEF, 2006) in the past few years have indicated that hand washing lead to significant reduction in the transmission of diarrhoea. The Ghana scenario reported by Sridhar (2007) highlighted that diarrhoea is responsible for 18% of under five mortality and lives of over 14,000 children could be saved by simple preventive steps of hand washing at

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critical points. He further stated that among environmental interventions, hand washing and point of use water treatment were shown to reduce diarrhoea.

Several links therefore exist between HIV/AIDS and water quality: In fact providing safe water to people living with HIV/AIDS reduces AIDS related mortality (Lule et al., 2005). However, it should be noted that the mere provision of safe water and sanitation may not guarantee improvement of health except if it is complemented with hygiene promotion and appropriate hygiene behaviour (IRC, 2004). Improved water handling and sanitation practices, personal hygiene and proper disposal of solid waste and drainage are necessary adjuncts for the reduction of water-borne diseases and these factors are even more important for people living with HIV and AIDS and family members of HIV positive people. Hygiene education should therefore focus on care-givers and volunteers involved in home-based care but this is not as yet commonly practiced.

C) Pneumocystis Carinii pneumonia (PCP)

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Pneumocystis carinii pneumonia (PCP) also known as *Pneumocystis jiroveci* pneumonia (Cushion, 1998a & b); or pneumocystosis is a form of pneumonia caused by a yeast-like fungus *Pneumocystis jirovecii*. This pathogen is specific to humans. The older name *Pneumocystis carinii* is, although incorrect for the human variant, still in common usage. The causal agent can be addressed as *P. jiroveci* or *P. jirovecii* (Cushion, 2004).

Pneumonia - infection and inflammation of the lungs in which parts of the lungs may be filled with fluid - can be caused by a wide variety of organisms, including bacteria, viruses and fungi. Whatever the cause, pneumonia can be debilitating and often deadly. Until the 1980s pneumonia caused by Pneumocystis carinii was extremely rare: only about 50 cases were reported in 1970 (Mirken, 1996). Although the organism -long regarded as a protozoan, but now understood to be more like a fungus- is quite common, it is harmless in individuals with healthy immune systems. Simple molecular detection of the organism in lung fluid does not mean that a person has pneumonia or infected with HIV.

The current epidemiology of PJP stated that the causative organism is distributed world wide and Moris et al, (2004) documented that PJP has been described in all continents except in

Antarctica. Before AIDS, the few instances of PJP disease occurred in people whose immune systems had been seriously weakened. It was originally described as a rare cause of pneumonia in neonates. Cases were reported in malnourished World War II orphans and, more recently, in organ transplant recipients receiving immunosuppressive anti-rejection therapy and in people with cancer undergoing chemotherapy (Ryan and Ray, 2004). When PJP began appearing in 1980 and 1981 in young gay men with none of the usual risk factors, alarms went off at the Centers for Disease Control (CDC) (MMWR, 1981b; and CDC, 1995).

Pneumocystis carinii pneumonia (PCP) was one of the first identified manifestations of AIDS and a common OI. Although improved strategies for prevention and treatment of PCP have greatly reduced the number of cases and deaths, PCP and other pneumonias remain a major cause of illness and death among people with AIDS, and account for roughly one-third of AIDS deaths (Rubin, 1994 and Mirken, 1996). Since the start of AIDS epidemic, PCP has been closely associated with AIDS, the relationship hinges on the fact that HIV destroys the CD4+ cell. For many years PCP remained the number one killer of PLWHAs before the advent of treatment. In a study reported in the New England Journal of Medicine, Hirschtick et al, (1995), stated that "the incidence of bacterial pneumonia was about 10-fold higher among HIV-infected people than it was in uninfected individuals". The risk of pneumonia due to Pneumocystis jirovecii increases when CD4 positive cell levels are less than 200 cells/ mm^3. In these immunosuppressed individuals the manifestations of the infection are highly variable (Rubin, 1994; Meo and Hardy, 1994, Hughes, 1996).

A constellation of symptoms, including fever, non-productive cough, shortness of breath weight loss, and fatigue, can signal the onset of pneumonia. Some or all of these symptoms may be present. A classic PCP cough is dry, with little or no sputum; any sputum that is produced is likely to be clear. Chest X-rays are often used to make a diagnosis because different illnesses produce characteristically different patterns. The diagnosis can be definitively confirmed by histological identification of the causative organism in sputum. (Baker and Kapusik-Uner, 1993).

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PJP prevention has been one of the areas of greatest progress in HIV care over the years. Much of the incidence of PJP has been reduced by instituting a standard practice of using oral co-trimoxazole to prevent the disease in people with CD4+ counts less than 200/mm³. PJP prophylaxis is also recommended for anyone, regardless of CD4 count, who is experiencing a sharp decline in CD4 counts or persistent, unexplained fevers or thrush. The CDC has also developed specific PCP prophylaxis guidelines for infants and children. The agency recommends prophylaxis for all infants born to HIV-infected mothers starting at age 4-6 weeks, to be discontinued if HIV antibody testing after 4 months of age indicates that the child is HIV-uninfected. For HIV-infected children aged 1-5 years, prophylaxis is recommended for those with CD4 counts fewer than 500 cells/mm^3 or a CD4 percentage less than 15%. Today, use of prophylactic treatment to prevent PCP in persons with CD4 count fewer than 200 cells/mm^3 is universally regarded as one of the most effective medical interventions available (Baker and Kapusik-Uner, 1993; Meo and Hardy, 1994).

(D) Candidiasis

Candida is a fungus infection caused by *candida albican*. There are two main types of candidiasis: localised disease (involving the mucous membranes of the mouth and throat or of the vagina) and systemic disease (of the oesophagus, and disseminated disease (The AIDS Infonet; (http://www.aids.org/factsheet/501). The mouth and throat variant (commonly known as thrush or oropharyngeal candida - OPC) is believed to occur at least once in the lifetime of all HIV-infected patients. Occurrence of the vaginal variant is common among healthy women and is unrelated to HIV status. While OPC is not a cause of death, it can cause oral pain and make swallowing difficult. The main symptom is creamy white legions in the mouth (white humps) that can be scraped away, dry mouth, difficulty swallowing, and an altered sense of taste. Oesophageal (gullet) candidiasis is a more serious condition which can cause pain in the chest that increases with swallowing. Disseminated candidiasis causes fever and symptoms in the organs affected by the disease (for example, blindness when it affects the eyes), and can be life threatening (Kanabus et al., 2009 in www.avert.org).

Candidiasis is the most common and least serious HIV-related fungus infection. It can occur at any CD4+ count, but those with counts less than 200/mm^3 are in more danger. The US

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Centers for Disease Control says these are category B AIDS defining condition (CDC, 2009 in www.avert.org). It can affect the mouth, throat, skin, stomach, and vagina. Oral thrush looks like white or red patches. It can cause sore throat, pain when swallowing, and nausea. It can also make the person not want to eat, make eating painful, and make food taste different.

US PHS (2002) and WHO (2006) stated that treatments for oral thrush include mouthwash and tablets called troches. Some people try baking soda or hydrogen peroxide mixed with water to rinse the mouth. A recent regimen reported by Kanabus et al, (2009) stated that treatments for thrush include clotrimazole, fluconazole, and ketoconazole.

Vaginal candidiasis is a common yeast infection of the vagina. Symptoms include severe itching, burning, and a thick discharge, often white in color. Nystatin tablets are used for treatment. Clotrimazole ointment is another treatment.

Fig 2.3 Diagrammatic representation of oral thrush infection

Source: http://www.aegis.com/topics/oi/oi-candidiasis.html

Fig 2.4: Pictourial Presentation of herpes simplex infection
Source**:** http://www.aegis.com/pubs/bala/1995/ba950411.html

(E) Herpes

Herpes is a viral infection that infects skin and nerve tissues. There are two kinds of herpes simplex virus:

- Herpes Simplex Virus -1 (HSV - 1)
- Herpes Simplex Virus -2 (HSV – 2)

These herpes viruses fall into the subfamilies of Alphaherpesvirinae of herpesviridae (Ryan and Ray, 2004). HSV -1 affects the area around the mouth (oral herpes, also known as cold sores) while HSV – 2 affects the area around the genitals (genital herpes). The herpes simplex virus-1 (HSV-1) causes oral herpes; both HSV-1 and herpes simplex virus-2 (HSV-2) cause genital herpes. Herpes cannot be cured. Once someone is infected with either virus, it cannot be cleared from the human body. Both HSV-1 and HSV-2 live in nerve cells, usually under the skin. They often remain silent or inactive in these cells, sometimes for many years or even a lifetime. This is called "latency. The viruses can become active and cause symptoms. The symptoms are painful blisters (sores) around the mouth or near the genitals. These symptoms can come and go in what is known as outbreaks, or "flare-ups. During a flare-up, the virus becomes active and causes a chain of events leading to a cluster of small bumps to form. This is called reactivation. The bumps may rupture, heal, and then disappear for an indefinite period of time. Anyone infected with either virus, regardless of

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their HIV status, can experience oral or genital herpes flare-ups. Approximately 70% of all adults living in the United States are infected with one or both viruses (US PHS, 2002).

The symptoms of herpes depend on the site of disease:

Oral herpes (cold sores): Sores around the mouth and nostrils. They may itch or be painful. They might look like the sore in Figure 4a.

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Genital herpes: Sores on the penis in males or near or in the vagina in women. Genital herpes can also cause sores near the anus, including the area between the anus and the genitals (the perianum). Sometimes, genital herpes can cause pain when urinating or defecation. They might look like the sores presented in fig 2.6

HSV-1 is spread via direct contact with an infected area, usually during a flare-up of the disease. Kissing and oral-genital sex can spread HSV-1. More serious sexual activity, including penile-vaginal or penile-anal intercourse, is the main route by which HSV-2 is spread. Both types of HSV can actively reproduce without causing symptoms, this is known as viral "shedding." A person with HSV can infect another person when they are shedding, even if they do not currently have any sores (WHO, 2006; Kanabus et al, 2009).

Oral and genital herpes are well-known diseases. However confirmatory diagnosis can be carried out by testing a small sample of the sore in the lab for the present of the virus (Kanabus et al 2009). The US Centers for Disease Control considers herpes simplex as an AIDS defining condition (CDC, 2009 in http://www.aegis.com/topics/cdc93009. html**).** In people with compromised immune systems, including people with HIV and AIDS, the herpes sores can last longer than a month. HSV infection in AIDS patients with advance HIV disease is often insidious in onset and chronic in duration though skin and mucosal lesions are absent in the majority of patients. Severe herpes flare-ups can be incredibly painful. In a very small number of cases, herpes can spread to other organs, including the eyes, the throat, the lungs, and the brain **(**www.intelhealth.com).

(F) Herpes Zoster Virus (Zonal herpes or Shingles)

Shingles is a viral infection caused by the Varicella zoster virus – the chicken pox virus. Shingles or zonal herpes is a sudden reactivation of the virus (US PHS, 2002; Training

manual, 2005). The first sign of shingles is often fever, chills, fatigue, headache, and an upset stomach. These symptoms are often followed by sensations of numbness, tingling or pain on one side of the body or face. After several days of these symptoms, a belt-like rash that extends from the midline of the body outward will develop. The rash will be made up of grape-like clusters of small, clear, fluid-filled blisters on reddened skin (See Figure 2.7). Within three days after the rash appears, the fluid-filled blisters will turn yellow, dry up, and crust over.

In about 10 to 25% of cases, shingles can occur in the eye, which is known as "ophthalmicus" shingles. The symptoms range from pain and redness of the eye to impaired vision and chronic twitching of the eyelid. Sometimes, shingles can do long-lasting damage to a nerve, which may result in pain, numbness, or tingling for months or years after the rash

Fig 2.5: Pictorial illustration of Oral Herpes simplex infection
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Fig 2.6: Pictorial illustration of genital herpes simplex infection on the penis

Source**:** http://www.medscape.com

Has healed completely (this is called "post-herpetic neuralgia"). Shingles is relatively easy to diagnose, as the rash is fairly unique. In turn if in doubt a small sample of the rash can be taken and send to a lab for the varicella-zoster virus identification. The US center for Disease Control considers shingles a category B ARC defining condition when it involves at least 2 distinct episodes or more than one dermatome (CDC, 2009). Anyone with HIV can get shingles regardless of CD4+ count. Shingles rash can sometimes take longer to crust over in HIV-positive people with severely suppressed immune systems.

Fig 2.7: Pictorial illustration of herpes zoster blisters
Source: http://www.medscape.com

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(G) **Cytomegalovirus**

Cytomegalovirus (from the greek *cyto-*, "cell", and *–megalo-*, "large") is a viral infection caused by the herpes viral genus of the herpesviruses group. It belongs to the *betaherpesvirinae* subfamily of *herpesviridae* (Ryan and Ray, 2004). These viruses which affect both man and animals are host specific, the variant in human is commonly known as Human herpesvirus (HCMV or HHV 5). Like other viruses in this group, it has the characteristics of long latent period within the body. HCMV infections are frequently associated with salivary gland; commonly resulting in sore throat, though they may be found throughout the body. HCMV infection can also be life threatening for patients who are immuno-compromised (*e.g.* patients with HIV, organ transplant recipients, or neonates) (Ryan and Ray, 2004).

HCMV is found throughout all geographic locations and socioeconomic groups, and infects between 50% and 80% of adults in the United States (40% worldwide (Offermanns and Rosenthal, 2008) as indicated by the presence of antibody in much of the general population (Ryan and Ray, 2004). Sero-prevalence is age-dependent: 58.9% of individuals aged 6 and older are infected while 90.8% of individuals aged 80 and older are positive for HCMV. HCMV is most frequently transmitted to a developing fetus. HCMV infection is more

widespread in developing countries and in communities with lower socioeconomic status and represents the most significant viral cause of birth defects in industrialized countries.

After infection, the virus remains latent in the body for the rest of the person's life. Overt disease rarely occurs unless immunity is suppressed either by drugs, infection or old-age. Infectious CMV may be shed in the bodily fluids of any infected person, and can be found in urine, saliva, blood, tears, semen, and breast milk. The shedding of virus can occur intermittently, without any detectable signs or symptoms (Ryan and Ray, 2004). Transmission of HCMV occurs from person to person through bodily fluids. Infection requires close, intimate contact with a person excreting the virus in their saliva, urine, or other bodily fluids. CMV can be sexually transmitted and can also be transmitted via breast milk, transplanted organs, and rarely from blood transfusions. Transmission of the virus is often preventable because it is most often transmitted through infected bodily fluids that come in contact with hands and then are absorbed through the nose or mouth of a susceptible person. Simple hand washing with soap and water is effective in removing the virus from the hands. CMV infection can be demonstrated microscopically by the detection of intranuclear inclusion bodies. The inclusion bodies stain dark pink by H & E staining, and are called "Owl's Eye" inclusion bodies (Griffiths and Walter, 2005).

In HIV infected persons, HCMV is considered an AIDS defining infection, indicating that the T-cell count has dropped to low levels. Primary CMV infection in patients with weakened immune systems can lead to serious disease. However, a more common problem is reactivation of the latent virus, hence almost everyone with HIV tests positive for cytomegalovirus. But it is very rare for CMV disease to develop unless the CD4 cell count drops below 50, a sign of serious damage to the immune system (The AIDS Infonet in http://aids.org/factSheet/999-the AIDS-infonet.html**).** Infection with CMV is a major cause of disease and death in immuno compromised patients including PLWHAs (Ryan and Ray, 2004; www.intelhealth.com). Kanabus et al, 2009 and CDC, 2009) recommended *ganciclovir*, *valganciclovir* and forscarnet drugs for the treatment of CMV infection.

(H) Kaposi 's Sarcoma

Kaposi's sarcoma (KS) is a tumor caused by Human herpesvirus 8 (HHV8), also known as Kaposi's sarcoma-associated herpesvirus (KSHV). It was originally described by Moritz Kaposi, a Hungarian dermatologist practicing at the University of Vienna in 1872 It became more widely known as one of the AIDS defining illnesses in the 1980s. Although KS is now well-established to be a viral infection, there was widespread lack of awareness of this even among persons at risk of the infection (Phillips et al., 2008). HHV-8 is responsible for all varieties of KS which includes:

***Classic KS*:** originally described as a relatively indolent disease affecting elderly men from the Mediterranean region, or of Eastern European descent. Countries bordering the Mediterranean basin have higher rates of KSHV/HHV-8 infection than the remainder of Europe (Fenig, 1998).

Endemic KS was described later in young African people, mainly from sub-Saharan Africa, as a more aggressive disease which infiltrated the skin extensively, especially on the lower limbs. The high rate of KS in sub-Saharan countries is due to the high rates of HHV 8 infection in their general populations, frequently greater than 50% (Olsen, 1998).

Transplant Related KS had been described among transplant patients in the 1980s when its incidence grew rapidly. The tumor arises either when an HHV 8-infected organ is transplanted into someone who has not been exposed to the virus or when the transplant recipient already harbors pre-existing HHV 8 infection (Qunbi, 1998). ***Epidemic KS*** was described during the 1980s as an aggressive disease in AIDS patients. It is over 300 times more common in AIDS patients than in renal transplant recipients. In this case, HHV 8 is sexually transmitted among people who are also at risk for sexually transmitted HIV infection (Beral et al, 1990).

The presentation is highly characteristic, with multiple nodules and blotches that may be red, purple, brown or black and are usually papular (i.e. palpable or raised). They are typically found on the skin, but spread elsewhere is common, especially the mouth, gastrointestinal tract and respiratory tract and is associated with significant mortality and morbidity (Dezube, 1996). Commonly affected areas include the lower limbs, back, face, mouth and genitalia. The virus is sexually transmitted among men having sex with men (Fenig, 1998) and can be

transmitted through organ donation (Cook-Mozaffari, 1998). KSHV infection is thought to be life-long so that persons infected with KSHV may develop KS years later if they develop AIDS or other immunosuppression.

In AIDS patients, Kaposi's sarcoma is considered an OI. Unfortunately, by the time KS lesions appear, it is likely that the immune system has already been severely weakened. AIDS-associated Kaposi sarcoma presents with cutaneous lesions that begin as one or several red to purple-red macules, rapidly progressing to papules, nodules, and plaques (James et al, 2005 in http://en.wikipedia.org/wiki/AIDS-associated_kaposi_sarcoma**)**.

In KS associated with immuno-suppression, treating the cause of the immune system dysfunction can slow or stop the progression of KS. In 40% or more of patients with AIDS-associated Kaposi's sarcoma, the Kaposi lesions will shrink upon first starting antiretroviral therapy.

(I) Toxoplasmosis (Toxo)

Toxo is a protozoan infection caused by a germ called *Toxo plasma gondii*. Incidence varies from region to region reflecting variation in exposure to the parasite. It is estimated that 28% of PLWHAs with antibodies to Toxo will develop the toxoplasma encephalitis (http://www.hivinsite.ucsf.edu). T. gondii like other opportunistic pathogens causes assymptomatic or mild symptomatic infections in normal host, but rapidly progressive, fatal disease in immunosupressed patients (Porter and Sand, 1992; Grant et al., 1990). Toxoplasmosis is a zoonosis with infection reservoirs encompassing all animals. As the definitive host, the domestic cat and dogs appear to be the major culprit in transmission to other animals. Excretion of the oocyst has been documented in approximately 1% of cats. Invertebrates like cockroaches and flies can also serve as transport hosts to oocysts.

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Transmission to human usually occurs by eating poorly cooked meat containing tissue cysts and/or eating food contaminated with soil containing oocyst as well as vertical transmission (from mother to fetus) during an acute infection, among others. The AIDS Infonet stated that the risk factor involved in getting Toxo include CD4+ cell count less than 100/$mm^{3.}$ The Toxo microbe is known to infect the brain and cause headache, confusion, motor weakness

and fever (www.intelhealth.com). Hence, 50% of Toxo patients present with dull or constant headache, while 40 – 50% of cases have fever.

Among all HIV related OIs, Toxo is the most common cause of seizure (Berker et al., (1997; Dismukes, 1998). Lumba puncture is valuable diagnostic technique Known. This is because it excludes other OIs with similar signs and symptoms. Computer scanning and magnetic resonance imaging of the head are key methods for identifying lesions suggestive of CNS Toxo (Chuks and Sandel, 1989). Prevention of Toxo in HIV infected persons who are sero-negative for toxo should include avoidance of situations and practices that put them at risk, such as: avoid contact with long standing cat feces, cook meat thoroughly before being eaten, wash hands after each contact with soil that may be contaminated with cat feces, avoid sharing living apartment with pets e.g. cats.

(J) **Cryptococcal Meningitis (CM)**

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CM is a fungal infection that affects the central Nervous system including the brain. CM is caused by a yeast-like fungus – *cryptococcus neoformans*, commonly found in the soil contaminated by birds' droppings. The fungus usually enters the body through the lungs. It does not appear to spread from person to person. It most often appears as meningitis and occasionally as pulmonary or disseminated disease. CM infection often leads to cryptococcaemia and any organ can be infected. CM infection makes up 50% of all cases of meningitis seen among PLWHAs. The risk factor is a CD4+ cell count less than 50 cells/mm^3. Approximately one in every ten PLAs gets infected with CM (www.intelhealth). A Previous episode means a 60% probability of reoccurrence. The clinical features includes headache with fever, seizures, lethargy, coma irritability and neck-stiffness which can be found in up to 25% cases. Chest symptoms such as chest pain and cough are also common. CM is one of the late OIs in the progression of HIV disease and sometimes co-exists with bacterial or TB meningitis (Godphoh et al. 2001). Cryptococcosis is relatively easy to diagnose, it involve the examination of cerebrospinal fluid (CSF) obtained at lumbar puncture. Untreated CM is fatal within two weeks of diagnosis. Treatment of CM is divided into acute, consolidated and maintenance phases.

2.14.5 Opportunistic Infections in Nigeria

All over the world, OIs are the major cause of morbidity and mortality among people living with AIDS. Nigeria is not speared from these ~~menaces~~menaces. People living with HIV in Nigerian are exposed to a number of OIs of various pathogenic origins. Sequel to poor living conditions in the country like lack of potable water supply, inadequate sanitation and hygiene, improper waste management and slum dwelling amongst other poses a threat to living standard of the citizenry. PLWHAs suffer a double score of the problem due to their impaired immune system. Studies in various part of the country have revealed the occurrence of different types of OIs among PLWHAs. A study on the prevalence and types of opportunistic fungal infections conducted in Nigeria among PLWHAs in Lagos State indicated that the most common fungal infection prevalent among this clients was oropharyngeal candidiasis (oral thrush), other infections includes pulmonary and *vulvovaginal candidiasis*, cryptococcal meningitis and histoplasmosis (Ekong et al, 2000). Abel et al (2007) also reported an increasing prevalence of kaposi's sarcoma among PLWHAs in Nigeria. Enteric opportunistic pathogens like cryptosporidium, isospora and micro sporidium were isolated from HIV and AIDS clients (cases) in Lagos state, while such were not found among the controls (HIV negative clients) (Thomas, 2000).

Some of these pathogens are spread through contaminated water and food or by direct contact with an infected person. Both Crypto and isosporiasis causes recurrent and persistence diarrhoeal diseases and stomach cramps: a major threat to PLWHAs (CDC, 2004). A study in Benin City, Edo state reveals that most of the TB patients are co-infected with HIV, as it is the case in other poor resource nations. According to WHO Global Report (2005), over 50% of PLWHAs in the country are co-infected with TB. The National TB and Leprosy control program (NTBLCP) also stated that in Nigeria more than half of HIV infected persons develop TB in their life time.

OIs of all pathogenic origin abound in Nigeria and it is the leading cause of morbidity and mortality among clients than AIDS itself. Most of these OIs are associated with inadequate environmental conditions, but little or no attention has so far been given to the link between HIV and the environment as a way of reducing the effect/impact of the pandemic.

2.15 Environmental Health Factors

Literally, Environment refers to all the external factors (living and non living) surrounding man. These factors span beyond air, water, soil, housing, climate, debris and noise with which man is in constant interaction to include social and economic conditions that we live in. The total environment of man is basically divided into three key components via:

- Social – culture, custom, habit, occupation, religion among others
- Biological – plants and animal life including microorganisms
- Physical – water, air, soil, waste, housing etc.

That the environment dictates the basic differentials in the incidence and prevalence of specific disease or morbidity and therefore death at global, state, local, town and even household level is not in any doubt. The relationship between environment and health is derived from the fact that differentials in the human health problems are dictated by certain environmental conditions that precipitate the excessive presence or relative lack of certain disease pathogens (Verhasset, 1985).

Park (2005) stated that the key to health lies largely in the environment, and a deviation of any of the factor in the environment result in ill health. Interestingly, most defects in the environment are caused by man himself, hence creating for himself a host of health problems such as air pollution, water pollution, and noise pollution among others. Though the impact of the social and biological environments on HIV has been elucidated, the physical environment remains untouched irrespective of its relevance to health. Therefore, this study is focusing on the impact of the physical environmental health factors on HIV and AIDS.

Bamgboye (2006) defines risk factor as a condition or characteristics that increases the chances of a healthy individual to become sick when the factor is present. Risk factors for Opportunistic infections are therefore factors that do not seem to be a direct cause of the disease, but seem to be associated in some way or a predisposing factor to the disease. Having a risk factor for Opportunistic infections makes the chances of getting a condition higher but may not always lead to Opportunistic infections. Also, the absence of any risk factors or having a protective factor does not necessarily guard against the Opportunistic

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infections (www.aids-info.ch). In this light, environmental health factors are those features in the surrounding which are present in insufficient or inadequate quantity from the normal. Nevertheless, improvement in man's health depends largely on his ability to control these factors in the environment. These factors include amongst others, adequate potable water supply, excreta and sewage management (sanitation), solid waste disposal, standard housing condition, indoor and out-door air quality and pest & vector control (Federal Ministry of Environment, 2005).

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2.15.1 Physical Environment

The physical environment may affect health via air quality, noise pollution or inadequate housing condition. In many densely populated, relatively small cities, issues of inadequate housing are paramount. According to Frumkim (2005), the features in the environment and their potential health implications are as tabulated in Table 2.4~~:~~

2.15.1.1 Air quality

According to Park (2005), Air is a mechanical mixture of gases. The normal composition of air is N (78.1%), O (20.93%), CO_2 (0.03%) among other gases in trace quantity. The immediate environment of man comprises air on which ~~depends~~depend all forms of life. Under normal conditions the composition of outdoor air is constant remarkably following certain self cleansing mechanisms like sunlight, rain, wind, and plant life. On the other hand air can be rendered impure by respiration, combustion and decomposition of organic matters as well as trade, traffic, and manufacturing processes which give off dust, fumes, vapour and gases.

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The presence in the ambient (surrounding) atmosphere of substances generated by man activities in concentrations that interfere with human health, safety, comfort or injurious to vegetations and animal and other environmental media is termed air pollution (Park, 2005). The main sources of air pollution are automobiles, industries, and domestic sources like combustion of coals, wood, and other minor sources. More than hundreds of substances have been identified to pollute the air and these include gases, mixture of gases and particulate matters.

(A) Indoor Air Quality

One of the four most critical global environmental problems is indoor air pollution. It exposes more people worldwide to important pollutants than does the outdoor air. According to Salvator (1992) a decent home in a suitable living environment require among other essential factors clean air devoid of excessive noise and odour. The Human occupancy and activity vitiate air in occupied rooms and give a sense of discomfort to the occupants. The most important changes that occur due to human occupancy are the physical changes like rise in temperature due to emanation of body heat, increase in relative humility due to moisture evaporation from the skin and lung (expiration), decreased of air movement due to overcrowding and poor ventilation. Improved building construction and insulation, including weather stripping and storm and thermopane windows reduces infiltration and air exchange which results in less air dilution and can increase the concentration of indoor air pollution. Unless the vitiated air is replaced by fresh air it may adversely affect the comfort, health and efficiency of the occupants (Park, 2005). It is a known fact that a feeling of suffocation and discomfort is experienced by occupants in insufficient ventilated rooms. There is also the risk of droplet infections and lowered resistance to disease. In less developed countries, air pollution has been estimated to be responsible for millions of annual cases of chronic respiratory diseases especially in young children and immuno compromised individuals (WHO, 2003).

2.156.1.2 Water Supply

Water is used for a wide range of domestic purposes; drinking, food preparation laundry, and the maintenance of personal and environmental hygiene (Enabor, 1998). Water is vital to development; potable water supply remains a fundamental requirement for socio-economic development of communities. The significance of safe water supply to populations is endorsed as one of the eight principal components of Primary Health Care (WHO, 1978). UNDP (2005) noted that the Global Millennium Development Goal of connecting all households to a reliable source of water that is reasonably protected from contamination will be an important step towards improving health and reducing the time spent collecting water. Access to improved water supply is not only a fundamental need and human right, it as well

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possesses considerable health and economic benefits, and inadequate access to water supply limits opportunities to escape poverty and exacerbates the problems of vulnerable groups, especially those affected by HIV/AIDS and other diseases (WHO, 2004).

Access to safe water services in Africa varies considerably and is influenced by the level of urbanisation. Africa has the lowest total water supply coverage of any region, with only 62% of the population having access to improved water supply. The situation is much worse in rural areas, where coverage is only 47%, compared with 85% coverage in urban areas. In global terms, the continent contains 28% of the world's population without access to improved water supply (WHO, 2004b).

The source of drinking water is an indicator of whether it is suitable for drinking. Sources that are likely to provide water suitable for drinking are identified as improved sources (see Table2.7), they include piped source within the dwelling or plot, public tap, tube well or borehole, and protected well or spring. Lack of ready access to water may limit the quantity of suitable drinking water that is available to a household, even if the water is obtained from an improved source. Water that is fetched from source that is not immediately accessible to the household may be contaminated during transportation or storage (NDHS, 2008). Nevertheless, home treatment can be effective in improving the quality of household drinking water.

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2.15.1.3 Housing conditions

The WHO expert committee on public health aspect of housing define's housing -otherwise referred to as residential environment as the physical structure that man uses for shelter and the environs of that structure including all necessary services, facilities, equipment and devices needed or desired for the physical and mental health and social well – being of the family and individual (WHO, 1961). Every family and individual has a basic right to decent home and a suitable living environment. However, large segments of the population in urban and rural areas throughout the world do not enjoy one or both of these fundamental needs. In most developing countries today, the urban landscape is characterized by precarious housing

conditions, poverty, overcrowding, crime, deplorable sanitation, inadequate water supply and low health status (Verhasselt, 1985).

The approved standard which is lower in rural than urban areas includes at least two living rooms, ample verandah, built up area of one to third of total area, provision of sanitary latrine, window area of at least 10% of floor area, sources of potable water, adequate arrangement for disposal of waste water, refuse and garbage (UN, 1997 and WHO, 1975). Practically, all urban and rural areas contain substandard slums and blighted areas. According to the American Public Health Association – APHA, (1949), a substandard housing is said to exist when there are 1.51 or more persons per room in a dwelling unit, when the dwelling unit has no private bath and toilet, or is dilapidated or when the dwelling unit has no running water.

~~2.16.1.3~~ (A) Housing and Health

It has long been established that environmental hazards impinges on the health of the people (Haines, 1990). The interrelationship of housing and health is complex. It is difficult however to demonstrate the specific cause and effect relationship because housing embraces so many factors of the environment. According to the British Medical Association (2003), there are a number of aspects of housing that are understood to have a direct impact on health: the structure of housing; internal conditions such as damp, cold, and indoor contamination; and the behaviour of the occupants.

Table 2.4: **Features of the physical environment and their Health Implications**

Features of the Physical Environment	**Potential Health and Social Problem**
Inadequate water and sanitation	Infectious disease e.g. malaria, TB
Crowding or overcrowding	Infectious diseases, stress, mental health problem etc
Inadequate garbage disposal	Infectious diseases, pest infestation,

	demoralization
Inadequate housing	Infectious disease, homelessness
Air Pollution	Respiratory and cardiovascular diseases, early mortality
Noise pollution	Hearing problem, stress

Source: www.josseybass.com

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Table 2.5: Basic Deficiency of Dwelling

ITEMS	**Conditions Constituting Basic Deficiency**
Facilities	Source of water supply, means of sewage disposal, toilet shares by other dwelling unit or of disapproved type, install bath lacking or shared with other dwelling unit, water supply outside dwelling unit, absent of outside window in any room unit and lack of electricity installation in unit
Occupancy	Room crowding; over 1.5 persons/room Room crowding; number of occupants equals or exceed two (2) times the number of sleeping rooms plus 2 Area crowding; less than $40ft^2$ of sleeping area/person

Source: (Salvato, 1992)

Although a real association is perceived to exist between poor health and substandard housing, it has not been possible to definitely incriminate housing as the cause of a specific illness (Ranson, 1987). Studies have shown that as a matter of practical facts many factors associated with substandard housing are profoundly detrimental to the life, health and welfare of a community. However, the index of differential living conditions such as crowding has long been known to increase the risk of infectious diseases, like meningoccocal disease, (Baker et al, 2000), tuberculosis, (Coetzee, 1988) and hepatitis B, but it also has an

impact on mental health (Howden-Chapman, 1999). Principles of health needs in relation to housing as itemized by Schafer (1987) and WHO 1989) stated amongst others that communicable disease can be reduced if housing provides for safe water supply, sanitary excreta and garbage disposal, adequate drainage of surface waters, and necessary facilities for domestic hygiene and food storage and preparation.

2.156.1.4 Solid Waste

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According to Sridhar (1998) wastes may be regarded as any unavoidable materials resulting from domestic activities and industrial operations for which there are no economic demand and which must be disposed of. All aspects of human endeavors are associated with waste generation (Adesida and Igbuku, 1998). Tchobanoglous (1993) classified wastes into (1) Residential wastes (2) Commercial Wastes (3) Municipal wastes which is a combination of Residential and Commercial wastes; (4) Industrial wastes and (5) Agricultural waste. Solid Wastes may be hazardous or non- hazardous. Non-Hazardous wastes have little or no potential to produce harmful consequence or toxic leachates when stored, while hazardous wastes pose immediate and/or latent hazards to plant, animal and ecological environment. Hazardous wastes produce toxic leachates and harmful fall-out when stored or disposed in the environment (Peavy et al, 1985).

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A) Impacts of Solid Waste

i) Environmental Impacts

Environmental impacts can be grouped into six categories: global warming, photochemical oxidant creation, abiotic resource depletion, acidification, eutrophication, and ecotoxicity to water (Seo, 2004). The decomposition of waste into constituent chemicals is a common source of local environmental pollution. This problem is especially acute in developing nations; very few existing landfills in the world's poorest countries would meet environmental standards accepted in industrialized nations. A major environmental concern is the release of gases (methane and cabondioxide) by decomposing garbage. These gasses in high concentration contribute to the greenhouse gasses (GHGs) which are implicated for global warming (Johannessen, 1999).

(ii) Ecotoxicity to Water

Leachate poses a threat to local surface and ground water systems, and is carefully managed in developed nations. The use of dense clay deposits at the bottom of waste pits, coupled with plastic sheeting-type liners to prevent infiltration into the surrounding soil, is generally regarded as the optimum strategy to contain excess liquid. In this way, waste is encouraged to evaporate rather than infiltrate. Current practices in the developing world range from absolutely no leachate management to direct discharge into surface water systems (rivers), multi-pond aeration and settlement systems, chemical treatment facilities, and recirculation systems (Johannessen, 1999).

(iii) Human Health Risks

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There are some human health risks associated with solid waste handling and disposal in all countries to some degree, but certain problems are more acute and widespread in developing nations. Cointreau-Levine (1986) has classified these into four main categories: 1) presence of human faecal matter, 2) presence of potentially hazardous industrial waste, 3) the decomposition of solids into constituent chemicals which contaminate air and water systems, and 4) the air pollution caused by consistently burning dumps and methane release.

Human faecal matter is commonly found in municipal waste. Insect and rodent vectors are attracted to the waste and can spread diseases such as cholera and dengue fever. Using water polluted by solid waste for bathing, food irrigation, and drinking water can also expose individuals to disease organisms and other contaminants. The U.S. Public Health Service identified 22 human diseases that are linked to improper solid waste management (Hanks, 1967. cited in Tchobanoglous et al, 1993). This presents a potential health problem not only to waste management workers, but also to scavengers, other users of the same municipal drop-off point, and even small children who like to play in or around waste containers. The usual disease pathways include placing contaminated hands in the mouth or eating food, through pest or vector insects such as cockroaches or mosquitoes, or by directly inhaling airborne dust particles contaminated with pollutants.

(iv) Socio-Economic Impacts

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The unsightly scene of illegal disposal sites, the reduced road space due to wastes dumpsites and the possibility of fire outbreaks in nearby communities negatively impact the environment in their vicinity. The environments of illegal dumpsites are generally filthy and dirty. Another common occurrence is that of people scavenging on waste dumps for items which can either be reused or recycled, this singular acts though a social problem constitute a health hazard (UNCHS/UNEP, 1997)

(B) Solid Waste Management

Solid Waste Management may be defined as that discipline associated with the control of generation, storage, collection, transfer and transport, processing, and disposal of solid wastes in a manner that is in accordance with the best principles of public health, economics, engineering, conservation, aesthetics, and other environmental considerations, and that is also responsive to public attitudes (Tchobanoglous, 1993).

The objectives of solid waste management are to collect, transport, treat and finally dispose of the waste in a hygienic and authentically acceptable manner at the lowest possible cost. It is also to reduce the quantity of solid waste disposed off on land by recovery of materials and energy. The necessity for proper solid waste collection and disposal stems from the concern that improperly stored or treated waste can harbour disease bearing pests that endanger public health (Flintoff, 1984). The components of Solid Waste Management Systems involves a number of interrelated activities which are; Storage of waste in household or communal containers, method of collection of the waste from the storage containers, frequency of collection of the waste, transfer of waste from smaller containers to larger ones, haulage of waste to a disposal site, and location and management of the disposal site (Flintoff, 1984). The various disposal methods of waste as indicated in Table 2.6 include uncontrolled dumping, sanitary landfill, composting and incineration.

~~**(C) Solid Waste Management in Nigeria**~~

~~Nigeria is a nation that exemplifies chronic solid waste management problems in conjunction with population growth. It is estimated that nearly ten percent of the population (21 million people) live below the national poverty line (World Bank, 1996).~~

~~The Federal Environmental Protection Agency (FEPA) was established in 1988 to control the growing problems of waste management and pollution in Nigeria (Onibokun and Kumuyi, 2003). In regard to solid waste management, FEPA's goal was to "achieve not less than 80 percent effective management of the volume of municipal solid waste generated at all levels and ensure environmentally sound management" (Vision 2010 Committee, 2003). Strategies to achieve this goal include education and awareness programs, developing collaborative approaches to integrative management of MSW, strengthening existing laws and ensuring compliance, and encouraging local and private sector participation.~~

Table 2.6: Summary of Waste Disposal Methods

Disposal Option	***Description***	***Comment***
Uncontrolled dumping	Waste is dumped at a designated site without any environmental control measures	This is not a 'disposal' option; it has high risks, causes serious environmental problems and is mentioned only because it is so frequently occurring.
Sanitary Landfilling	Controlled application of waste on land	Low cost and low technology solution when land is available. The most common and effective method of disposal for most developed countries, although it presents some risks in certain circumstances.
Composting	Biological decomposition of organic matter in waste under controlled conditions	Not a complete disposal system; needs the correct proportion of bio-degradable materials in the waste. By- products have value as compost, but need to disposed or used. Not appropriate if there is no market for compost. Large centralized schemes have not been successful.

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Incineration	Waste is burned under controlled conditions in purpose built furnaces (incinerators	Success depends on how much combustible material there is in the waste. An expensive high technology solution which needs careful control. Residues need to be disposed of; there is some environmental concern over the nature of the gases emitted.

Source: Flintoff, 1984

(C) Solid Waste Management in Nigeria

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In Nigeria, although local governments are intended to fund solid waste disposal, it seems as though no organization is willing to take responsibility for regulation of waste management. In Abuja, with the population of over a million people and the unchecked influx of more people, management of solid waste is far above what the agency responsible can handle with ease especially in the satellite towns where most dwellers are found. This is compounded

with inaccessible road networks. The result of this has been heaps of refuse and over flowing waste bin along the roads, near residential houses, a treat to human health and environment.

2.15.6.1.56 Sanitation and Environmental Impacts

Sridhar (2006) defines sanitation as the principle and practice of effecting healthful and hygienic conditions in the environment to promote public health and ensure sustainable development. Its deals with a range of interventions designed to improve the management of excreta, sullage, drainage and solid waste. Sanitation therefore is a process of erecting barriers to prevent the transmission of disease agents (UNICEF, 1999). Like water, sanitation and hygiene are key factors to improved health. Globally, 2.4 billion people are without access to improved sanitation (WHO/UNICEF, 2004), and about 2 billion of these people live in rural areas. Barely more than one third of the population uses adequate sanitation facilities in West/Central Africa (36 per cent), South Asia (37 per cent) and Eastern/Southern Africa (38 per cent). In developing countries rural communities have less than half the sanitation coverage (37%) of urban areas (81%) (WHO/–UNICEF, –2004). However, the percentage of people worldwide who have access to improved sanitation facilities has risen from 49% in 1990 to 59% in 2004 (WHO /UNICEF 2004). Currently, only 60% of the total population in Africa has access to basic sanitation coverage, with coverage varying from 84% in urban areas to 45% in rural areas (Global Water supply and sanitation Assessment report, 2000).

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Poor sanitation has negative impact on the environment. It is well known that poor human and animal excreta disposal leads to contamination of drinking water sources and supplies especially surface and ground water sources, a threat to human health (Sridhar 2006). According to UNICEF (1999), one gram of human excreta contains 10, 000, 000 viruses, 1, 000, 000 bacteria, 1, 000 parasite cysts, and 100 parasite eggs. These pathogens are easily transmitted through improper sanitation and poor hygiene practices. More than 2.2 million

people, mostly in developing countries, die each year from diseases associated with poor water and sanitary conditions. Inadequate and unsafe water, poor sanitation, and unsafe hygiene practices are the main causes of diarrhea, malaria and other water related diseases. Children and adults living with HIV and AIDS because of their weakened immune systems, are especially susceptible to the debilitating effects of persistent bout of diarrhea (WHO/UNICEF, 2004).

One of the ancient methods of excreta disposal was sending it back to soil as fertilizer. .Indiscriminate defecation practices were common in most Asian, African and South American regions. 'Improved' sanitation facilities are those that reduce the chances of people coming into contact with human excreta and are likely to be more sanitary than unimproved facilities (see Table 2.7) (WHO/UNICEF, 2004). Some of these facilities require water (wet system), while others do not even for hygiene purposes (dry system).

Operation, costs, construction, water requirements and urban adaptability are the considerations in the selection of sanitation technologies in developing countries. However, the *Global Water Supply and Sanitation Assessment 2000 Report* (WHO/UNICEF, 2000) determined that the following technologies are acceptable:

- Sewerage systems;
- Septic tanks with drainage beds;
- Pour-flush latrines; and
- Pit latrines (Sanplat in some areas particularly in Nigeria)

~~**2.16.7 Potential health impact of improved sanitation**~~

~~There is agreement that improved sanitation has an impact on health and reduces morbidity (WHO, 2004). Sanitation facilities interrupt the transmission of faecal/oral disease at its most critical point, i.e. the prevention of human faecal contamination of water and food. Studies suggest that adequate sanitation is at least as effective in preventing disease as improved water supply. Indiscriminate defecation around the living areas is known to increase the occurrence of infections like diarrhoea; this is the situation in most of the rural areas where most infected persons resides.~~

Table 2.7 Classification of Water and Sanitation Technologies

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Drinking-Water Sources	**Sanitation Facilities**
Improved	Improved
Pipe water into dwelling, plot or yard	Flush/pour flush to:
Public tap/standpipe	-piped sewer system
Tube well/borehole	-septic tank
Protected dug well	-pit latrine
Protected spring	Ventilated improved (VIP) latrine
Rainwater collection	Pit latrine with slab
	Composting toilet
Unimproved	Unimproved
Unprotected dug well	Flush/pour flush to elsewhere
Unprotected spring	Pit latrine without slab/open pit
Cart with small tank/drum	Bucket
Tanker truck	Hanging toilet/hanging latrine
Surface water(river, dam, lake, pond, stream, canal, irrigation channel)	No facilities or bush/field
Bottled waters	

***Bottled water is considered to be improved only when the household uses water from an improved source for cooking and personal hygiene; 2- Only private facilities are considered to be improved; 3 -Excreta are flushed to the street, yard or plot, open sewer, ditch, drainage way, channel, river or stream.*

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2.15.1.76 Hygiene

Hygiene is an old concept of practices and conditions conducive to maintaining health and preventing diseases. According to Wikipedia, hygiene refers to a set of practices associated with the preservation of health and healthy living. The underlying microbiological principle involved breaking the chain of infection transmission by identifying the routes of

- the spread of the pathogen and applying hygienic procedures at critical points at appropriate time to break the chain of infection – "targeted hygiene" (Bloomfield et al, 2007). The main sources of infection in the home are people, food (particularly raw food), water and domestic animals. The main highway for the spread of pathogens in the home is the hands, hand and food, contact surfaces, clothings and household linens.

Hand hygiene; defined as washing hands with soap and water (CCOHS, 2006), is central to preventing the spread of infectious diseases in homes and everyday life setting (Bloomfield et al 2007). The most critical situations where hand washing is needed are after using the toilet or disposing of human or animal faeces, after wiping or blowing the nose or sneezing into the hands, after changing baby's nappy, before preparing or handling cooked/ready to eat foods, before feeding children and after contact with contaminated surfaces. Research shows that, if widely practiced, hand washing with soap could reduce diarrhea by almost 50% (Aiello et al, 2008; Curtis and Cairncross, 2003), and respiratory infections by nearly 25% (WELL fact sheet, 2006).

The improvement of hygiene practices through key behaviours such as hand washing with soap, safer water handling and storage and safe disposal of children faeces are effective means of reducing global burden of diarrhea diseases (Curtis and Cairncross, 2003). However, in spite of the significant scope for improving hygiene practices at homes to prevent infection and cross infection, personal and domestic hygiene practices cannot be improved without basic amenities such as water supply, sanitation and solid waste management (Nath, 2003).

2.168 Water, sanitation, hygiene and health

Poor water quality and lack of access to improved sanitation continue to pose a major threat to human health. Burden of disease analysis suggests that lack of access to safe water supply, sanitation and hygiene is the third most significant risk factor for poor health in developing

countries with high mortality rates (WHO, 2002). Diarrhoea is one of the diseases associated with unsafe water supply, sanitation and hygiene and is a major cause of morbidity and mortality among PLWHAs in sub-Saharan Africa. According to the WHO/UNICEF (2002), diarrheal diseases caused approximately, 6,000 deaths/day, mostly among children, and a good proportion of these deaths due to diarrheal diseases could be attributed to the water, sanitation and hygiene risk factor.

In recognition of the critical role of water and sanitation in the quality of life of human populations, there is concerted effort, globally and locally to put in place various programmes to eradicate the backlog of people without access to safe water and sanitation. The Millennium Development Goal's 10th target is the halving by 2015 of the proportion of people without sustainable access to safe drinking water and sanitation. In spite of the collaborative efforts marked inaccessibility still exists in most developing countries. The UNICEF/WHO (2005) noted in their Joint Monitoring Program for Water Supply and Sanitation (JMPWSS) that in the year 2000, 1.1 billion people globally were without access to an improved water supply (amounting to 2 out of 10 persons) with nearly 290 million in Africa. The JMPWSS noted further that 2.4 billion people were without access to improved sanitation, i.e. 4 out of 10 persons. (http://www.wrc.org.za). In order to achieve the global and local targets, the *UN World Water Development Report* (UNICEF/WHO, 2004) noted that an additional 1.5 billion people will require access to some form of improved water supply by 2015 that is an additional 100 million people each year until 2015.

2.179 Water and sanitation Profile in Nigeria

Access to safe water and sanitation in the country as is the case in other African countries varies considerably and is influenced by the level of urbanisation. According to the National Population Commission (1998), approximately one third of Nigerians live in urban areas. NDHS (2003) supported this fact by stating categorically that 33.6% of the population lives in urban areas while 66.33% live in the rural areas. However, disparities in the provision of safe water and sanitation in the urban and rural areas of Nigeria is so glaring. The urban dwellers are more advantaged overall in terms of household characteristics than their counterparts in the rural settings. 18.5% of urban dwellers compared to 6.2% of rural

households have access to public tap water. Regional access is also varies with the highest in SW with 18.8%, and the lowest of 4.6% SS, the average is given as 10.6% of the population (NDHS, 2003). It is noteworthy that in the rural areas approximately one-fifth obtained drinking water from open public wells and 27% from rivers or stream; sources prone to easy contamination. The NDHS (2008) shows that 79.7% of the urban and 43.8% rural dwellers fetched their drinking water from improve sources (as indicated in table 5 above). Also only 13.2% urban and 9.6% rural population employed appropriate treatment to the water before drinking.

The lack of availability of sanitary facilities poses a serious public health problem, but regretably only 15% of household have access to a flush toilet while majority (57%) use traditional pit toilet and one quarter have no facility at all. There are differences in the type of toilet facilities by both residence and region. Urban households are more than four times as likely to have a modern flush toilet as rural areas (29% and 7% respectively). Households in the North East are the least likely to have a flush toilet. A greater number of households in the North Central (38.0%) which includes Abuja, uses bush/open field to defecate (NDHS 2003). The 2008 report by NDHS indicated an improvement from the 2003 figure (15%).

2.1820 Linkages between HIV/AIDS and water, sanitation and hygiene

The HIV/AIDS epidemic has caused substantial morbidity and mortality in different age groups world-wide. Water-borne diseases are responsible for a vast array of debilitation and death world-wide particularly in rural communities. At a superficial level, issues around HIV/AIDS and water, hygiene and& sanitation may appear not to be connected because HIV is transmitted sexually, whereas water is a renewable natural resource. On a careful analysis, the relationships existing between factors in the physical environment like water and HIV/AIDS cannot be underestimated. Indeed some of the easily discernable consequences of HIV/AIDS are the long-term implications for effective environmental resource management and the provision of descent housing that will provide for safe water, adequate sanitation, and hygiene to communities (Ashton, 2002). Consequently, an exploration of the linkages and perspectives between HIV/AIDS, housing conditions, water, sanitation, hygiene and waste management will enhance development of integrated approaches.

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Despite ~~and inspite of~~ the consequences of the physical environmental factors of housing, water supply, sanitation, hygiene, waste management and vector control on HIV/AIDS, research/studies on this subject is very scanty. The developed nations are not spared this deficiency though. In Nigeria various researches had been conducted to elucidate the impact of the social and biological/clinical environment on HIV as well as its impact on the affected and infected but the physical environment had suffered severe negligence. South Africa had redeemed the continent: there is a study ~~on the effect of water on PLWHA in Kwa Zulu Natal province conducted by Magaret (2009; conference abstract)…… and another~~ titled the interesting cross path of HIV/AIDS and water in South Africa (Obi et al, 2006 in http://www.wrc.org.za)

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CHAPTER THREE

~~MATERIALS AND~~ METHODOLOGY~~S~~

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3.1 Study Design

The study was case control in design. People living with AIDS (PLWAs) manifesting opportunistic infections were selected as cases and people living with HIV ~~-~~without Ols were selected as controls. ~~Both cases and controls were selected such that their exposures to hygiene/environmental factors were very similar.~~

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3.~~2~~1 Study Area:

This study was carried out in Abuja; the Federal Capital Territory (FCT) of Nigeria. The Federal Republic of Nigeria is made of six geo-political zones: North East, North West,

North Central, South -South, South West, and South East. For even development the country is segmented into 36 states and the Federal Capital Territory – Abuja.

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Abuja, the Political nerve center (Federal Capital) of the Federal Republic of Nigeria, is strategically located at the center of the nation; it is situated in the North central zone of the country. The historical evolution of FCT could be traced back to February 1976, with the promulgation of degree number six (6) (AMAC development update, 2008). Abuja covers a land area of 8,000 square kilometers, with the Federal capital city having 250Km^2. It is bounded in the North by Kaduna State, in the West by Niger State, in the East and South by Nassarawa and Kogi States respectively. Geographically, the FCT lies within latitude 9^{0}20' North and longitude 7^{0}39' East.

The FCT is a multi ethnic and cultural society with population estimated at about 1,406,239 residents, with the male proportion of 52.14% (733,172) while that of the female is 47.9% (673,067) according to the 2006 census. The city has six area councils Viz: Kuje, Kwali, Bwari, Abaji, Gwagwalada and Abuja Municipal Area Council (AMAC). The Nations centre of unity accommodates people from all ethnic groups and languages. It also experiences an ever-increasing population density due to unchecked immigration of both men and women in search of greener pasture. The principal inhabitants of the city are civil servants who work in the various Federal ministries and parastatals. Also available are several business merchants, and farmers who are mainly the indigenes. The common spoken language is "pidgin" English, besides all the Nigerian languages (AMAC, 2008).

With the National HIV prevalence of 4.4%, Abuja has a prevalence of 6.3% which exceeds 5% epidemic threshold, with a higher urban prevalence of 6.7% to 5.0% in rural areas; the city is ranked the fifth highest AIDS endemic area in the country (NACA, 2005). It is evident that there are large numbers of HIV infected people in the FCT. Surrounded by Benue and Nassarawa States with higher prevalence of 10% and 6.7% respectively, the burden of AIDS in the FCT will continue to increase due to entry of already infected persons from these States and beyond coupled with new infections.

In tackling the scourge, the FCT has adopted a multifaceted and integrated strategy, which includes clinical prevention and treatment (e.g. ART), information dissemination towards behavioural change as well as care and support for the affected and infected. To achieve these, the tertiary health facilities (Gwagwalada specialist Hospital and National Hospital) and most of the secondary facilities were equipped/strengthened to provide specialized services to these vulnerable groups and also served as outlet for ART. Also available are numerous support groups like the FCT Action Committee on AIDS (FACA), Catholic Action Committee on AIDS (CACA) amongst others, whose programmes and activities are overseen by the Network of people living with HIV and AIDS in Nigeria (NEPWAN). FCT is equally engulfed in the trend of mixed living condition existing in the country, some parts of the urban areas are provided with the necessary facilities like potable water supply, sanitation facilities while the semi-urban and the rural dwellers cannot boast of these facilities.

3.~~3~~2 Study Site

The Abuja Municipal Area Council (AMAC) was created in October 1,1984, located at the east wing of the FCT with a land mass of 1,200 Square Km. It is bounded on the east by Nasarawa State, on the west by Kuje area council, North – West by Gwagwalada and on the North by Bwari area council. The last demographic report by the National Population Commission (2006) indicated that the population of the area council stood at 776,298 with 415,951 (53.58%) males and 360,347 (46.42%) females. The area council has several ethnic groups like the Gbayi's, Koro, Gade, and other Nigerians spread across other ethnic groups. In all it is made up of 49 communities each presided over by a village head. The area council has twelve (12) political wards namely: city center, Wuse, Gwarinpa, Garki, Kabusa, Jiwa, Gwagwa, Karshi, Orozo, Karu and Nyanya. AMAC has several public, private and social amenities like schools, markets, hospitals, amongst others. Besides the numerous Primary Health Care Centers and comprehensive health centers & clinics spread across the area council are seven (7) secondary facilities and one tertiary facility: the National Hospital, Abuja. This study was carried out in the tertiary facility and one secondary facility – Wuse General Hospital, both located at AMAC and offering special services including ART to PLWHAs in Abuja and beyond.

3.32.1 The National Hospital Abuja (NHA)

The National Hospital Abuja established by decree 36 of 1999 with the corporate objective of providing a friendly atmosphere for the care of all discerning patients in the country and beyond without discrimination. Though the hospital was originally designed to attend to the health needs of women and children, this design was however changed as a result of the pressing need to render health care services to the entire Nigerian populace. NHA which is strategically located at the central district of the city is a major reference hospital in the territory. The hospital which was planned to be constructed in phases has the 1st phase already completed and utilised bed capacity of 218, with facilities for future expansion into 500 bed capacity. Among the various Departments is the family medicine Department with the special treatment center (STC) as one of its clinics. The STC as the name implies provide special services to PLWHA in the area of counseling, anti-retrovirals therapy including prevention of mother to child transmission. An average of 176 clients accesses these services on daily basis. The clinic work in collaboration with other departments within the hospital as well as attend to referral cases from other facilities within and outside Abuja (Information Service Unit, NHA -2004).

3.32.2 Wuse General Hospital

Wuse General Hospital was established and officially commissioned in 1990 by the Federal Capital Territory Administration. The need for this facility arises as a result of influx of patients to the only existing hospital that provided both primary and secondary health care services to the FCT residents and its environs in order to reduce the burden on the hospital and also improve the health care services delivery to the people. Presently the hospital has a staff strength of 397 staffers which includes doctors, nurses, pharmacist, lab scientist, and medical ~~reco~~recordde staff, among others.

3.43 Study population

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The study population includes people aged between 15-49 years who have been confirmed HIV positive and are registered and are receiving care/services in one of the selected health facilities.

(i) Cases

After the review of the medical records, the respondents that were classified into the WHO staging 3 and 4 (symptomatic phase and Advanced HIV infection or AIDS respectively) were recruited as cases.

(ii) Controls

Following the above mentioned recruitment procedure and the medical records review, those respondents that fall into the WHO staging~~STAGING~~ 1 &2 (the primary infection and asymptomatic phase respectively) were selected as controls. The controls were carefully matched with cases on demographic characteristics vis age, sex and residential areas.

3.4.~~3.~~1 Inclusion criteria:

1. Respondent should either be a male or female aged between 15 and 49 years.
2. He or she must be a registered client in one of the selected health facilities.
3. Must be residing in FCT
4. Respondent must be willing to participate in the study and comply with the study requirements.

3.4~~3~~.2 Exclusion criteria:

The following categories of persons were not recruited for the study:

1. Persons below age 15years and those above age 49 years.
2. Non clients and clients who are not registered with the selected health facilities.
3. Persons (clients) who are not residing in the FCT.
4. Clients who refuse to consent to the study and those whose spouses or guardians refuse their participation in the study.

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~~3.4 Study Design~~

~~The study was case control in design. People living with AIDS (PLWAs) manifesting opportunistic infections were selected as cases and people living with HIV; without OIs were selected as controls. Both cases and controls were selected such that their exposure to environmental factors were very similar.~~

3.~~5~~6 Sample size Estimation

The sample size for this study was estimated based on the proportion of Nigerians with access to public tap (potable water supply), one of the environmental determinants of health. Thus:

P_i is given as proportion of controls with access to public tap: assumes equal to proportion of Nigerians with access to public tap which is given as 10.6% (NDHS, 2003)

P_2 is the proportion of cases with access to public tap, which is anticipated to be 6% units less than that proportion of controls. (i.e. 4.6%)

The sample size was calculated such that the result within 5% point of the true value with 95% confidence interval

$$\mathbf{n} = \left[Z_{1-\alpha/2} \frac{\sqrt{2P_1(1-p_1) - z_1 - \beta\sqrt{p_1(1-p_1) + p_2(1-p_2)}}}{p_1 - p_2} \right]^2$$

where;

$Z_{1-\alpha/2} = 1.96$ and $Z_{1-\beta} = 1.03$

P_1 = 0.106 (10.6% i.e. proportion of Nigerians with access to tap water)

P_2 = 0.046 (i.e. ~~Type equation here~~. proportion of cases with public tap water anticipated 6.6 units less than controls)

n = 61

Adjusting for non responses and~~&~~ drop-out by 10%

$$N = n \times \frac{1}{1-0.1}$$

N = 68

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Therefore, this study sample comprised 68 cases and 68 controls, totaling 136 respondents.

3.66 Sampling Procedure

A multistage sampling method was used to select the study area while a systematicimple random sampling method was used for the recruitment of respondents – cases and controls, from the selected health facilities.

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3.66.1 1 Selection of Health Facilities:

The Abuja Municipal Area Council (AMAC) was randomly selected by balloting from the six (6) existing area councils. The National Hospital and Wuse General Hospital were randomly selected from the list of those that provide special services to PLWHA through balloting.

3.66.2 Recruitment of Participants

People living positively (PL+, also referred to as clients) and receiving services at the selected health facilities were recruited as respondents (cases and controls) for the study.

A systematicimple random sampling method based on the daily attendance list of clients to the clinic was used for the selection. The study requirement: objective, environmental observation, sample collection and analysis, review of medical records and questionnaire, were carefully applied to all the clients (study populations) on individual basis. This was followed by personal reading of the informed consent form and/or reading and interpreting of the form as the case may be. Those clients that voluntarily agreed to be part of the research signed the consent form. They also provided their hospital numbers, phone numbers and residential areas. For confidentiality purposes, names were not required; the researcher assigned identity (ID) numbers to respective respondents.

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3.77 Survey InstrumentsMethods

3.77.1

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-A 55 item semi structured, self administered questionnaire was designed. The instrument was divided into the following five sections:

- Socio-demographic features
- Knowledge on the effect of environmental factors on health
- Practices on environmental factors
- Environmental characteristics and
- Health information/ conditions.

The questions had multiple answers from which the respondents were required to pick a correct option. Eight questions on knowledge of environmental influences on health were asked and each correct response was awarded 5 points, a 40 point scale was therefore used to assess knowledge of cases and controls after which the mean knowledge score of the cases and controls were determined.

An onsite observation checklist was also designed to assess environmental indicators in respondents' houses. The checklist was structured into four sections via: types of sanitary facility, sources of drinking water, solid waste disposal methods, housing condition via ventilation and vector control measures in the structure as well as number of occupants per sleeping room.

3.7.1 Validity and Reliability of Instruments

To ensure validity and reliability of the study instruments for data collection, a number of steps were taken as listed in the following sections

3.~~7~~7.2~~1~~1.1 Review of Instruments by Experts

The data collection tools (questionnaire and observational checklist) were subjected to review by experts – supervisors and other lecturers. The reviewed comments were used to standardize the instruments.

3.~~7~~7.3~~1~~1.2 Pre-testing of Instruments

A one month pilot study was conducted among PLWHAs who reside outside Abuja but attend clinic at the NHA. A total of 45 draft questionnaires were pretested on PLWHA at the

NHA. The results obtained was used to modify the tool after due consultations, the information gathered also aided in setting up the inclusion and exclusion criteria for the study.

3.87.2 Data Collection

3.87.2.1 Review of Medical Records

Based on the hospital numbers provided by the respondents, medical records (case notes) of the participants were reviewed using a proforma. The information gathered included demographic, health/medical history, common disease/infections (which may or may not be an OI) affecting the clients as well as "WHO Staging" for HIV infection of the client as assessed and documented by the physician based on the WHO recommendations /criteria.

3.87.2.2 Questionnaire

~~A 55 item semi structured, self administered questionnaires were administered to 134 respondents comprising 66 cases and 68 controls. The instrument was divided into the following four sections:~~

- ~~Socio-demographic features~~
- ~~Knowledge and practices of hygiene~~
- ~~Environmental characteristics and~~
- ~~Health information/ conditions.~~

~~The questions were multiple choice questions. The respondents were required to pick an option each. Eight questions on knowledge of environmental influences on health were asked and each correct response was awarded 5 points, a 40 point scale was therefore used to assess knowledge of cases and controls after which the mean knowledge score of the cases and controls were determined.~~ Respondents filled the questionnaires during subsequent appointments to the facility after consenting to the research. Those that consented to environmental observation and sample collection responded to the questionnaire during visit to their houses for the exercise. ~~All~~ Participation in the study was strictly voluntary and optimum confidentiality was ensured and sincerely adhered to. For respondents who could

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not read/write English, the assistance of an interpreter (a staff of the clinic) was sought for interpretation.

3.98 Field Methods

3.98.1 On-site Environmental ~~Assessment~~

Observation

An observational checklist was used to validate the respondents' claim of facilities in their homes. The checklist was used to collect information on type and condition of sanitary facility present, sources of drinking water, solid waste management method, housing condition –(via ventilation and vector control measures) and number of occupants per sleeping room in the house. Thirty-four (34; about a quarter of the sample size) were surveyed. On a scheduled date and time, the researcher visited the respondents' home. The respondents conducted the researcher round the house to observe and collect information accordingly. Sanitary survey of water sources were thoroughly carried out to assess potential risk of contamination after which water sample was collected at source.

~~**3.8.2 Samples Collection;**~~

~~Thirty four (34) respondents were randomly selected from those that consented to environmental assessment and sample collection. Water sources were surveyed and water sample collected from the drinking water source using the recommended standard methods described by APHA (1998).~~

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Plate 3.1 Researcher collecting tap water sample in a participant's home

Plate 3.2 Typical well Source from study participant's home

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3.9.2 Samples Collection;

Thirty four (34) respondents were randomly selected from those that consented to environmental assessment and sample collection. Water sources were surveyed and water sample collected from the drinking water source using the recommended standard methods described by APHA (1998).

3.9.2.1 Procedure for Sample Collection

(A) Samples for Physico-chemical Parameters

Plastic bottles of 1.5 liter capacity were used for the collection of samples for physico-chemical analysis (plate 3.1). The bottles were pre-washed with detergents and rinsed with distilled water. At the point of collection, the bottles were rinsed with the sample before collection. The samples were labeled accordingly indicating the respondents' ID-number, date/time of collection, location and source of the sample and then transported to laboratory for analysis.

(i) Well: Samples were collected using the regular fetching apparatus (locally called *buga* or *ifami*) (plate 3.2). The sample bottles were rinsed with the sample before filling the bottle. Temperature and pH were taken in-situ with the help of mercury in glass thermometer.
(ii) Boreholds/Taps: Samples collected after rinsing the sample bottle with the sample.

~~**3.8.2.1 Procedure for Sample Collection**~~

~~**(A) Samples for Physico-chemical Parameters**~~

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~~(ii) Boreholds/Taps: Samples collected after rinsing the sample bottle with the sample.~~

(B) Samples for Bacteriological Parameters

Sample bottles for bacteriological samples were washed and sterilized in the laboratory. The samples were collected during the early hours of the day and transported in an iced packed container (cooler) to maintain the temperature to the lab (usually within six hours from the time of collection) for analysis.

(i) Well: samples for bacteriological analysis were collected by carefully lowering the sample bottle with the help of a rope tied to the base of the bottle together with a weight (stone) and extended to the neck of the bottle. When the sample was filled the bottle was carefully withdrawn and covered immediately. The sample was stored in an ice packed container and transported to the laboratory within six hours.

(ii) Boreholds/Taps: The mouth of the tap was sterilized (by flaming) before and after with the help of a lighter. The tap was turned on and the water was allowed to waste for about two minutes, the sterile bottle was filled with the sample and corked immediately.

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3.109 Laboratory Methods

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3.109.1 Determination of Physico-chemical parameters of Water samples

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Physical parameters include pH, temperature, Total Dissolved Solids (TDS) and electrical conductivity. A conductivity meter model CO 150, manufactured by HACH UK, was used for the measurements. Methods of sample analysis and handling are summarized in Table 3. Nitrate, Chlorides ion, Hardness and Alkalinity, were carried out according to standard methods described by the American Public Health Association 1998.

3.109.12.1 Determination of pH Value

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The pH measurement or estimation serves as a convenient way to compare the relative acidity or alkalinity of a solution at a given temperature. A pH of seven (7) describes a neutral solution because the activities of H^+ and OH^- are equal. When the pH is below 7, the solution is described as acidic because the activity of H^+ is greater than that of OH^-. A solution is more acidic as the H^+ activity increases hence, the pH decreases. Conversely, as the OH^- activity increases, the solution becomes more alkaline, also referred to as basic, and the pH will increase.

In practice, pH electrode measurements are made, by comparing readings in a sample with readings in standards where the pH has been defined – "buffer"-. These measurements are relative rather than exact thermodynamic determinants of either H^+ or OH^- activity. The pH electrode measurements can be used to detect a titration end point, which will give the acidity or alkalinity in terms of total concentration rather than activity. A pH meter, (HACK model CO 150 made in UK), standardized with phosphate buffer at pH 4 and 9.2 was employed to read off the pH values of the water samples. This was done within 6 hours of their collection. All readings were carried out at room temperature. In between readings, the electrodes of the pH meter were rinsed with distilled water to avoid contamination

Table 3.1 Sample-handling requirement, technique and method of analysis

Parameter	Container	Storage/preservation	Analytical method	Reference/remark
Temperature	Plastic	Analyse immediately	Mercury-in-glass thermometer	Manufacturer manual Hacks chemical Co.
pH	Plastic	Analyse same day within 6hours	Electrometric method(Hack conductivity metre)	Manufacturer manual

TDS	Plastic	Analyse same day, store in dark for up to 24hours	Electrometric method (Hacks TDS metre)	Manufacturer manual
Electrical conductivity	Plastic	Analyse same day,	Electrometric method (Hacks conductivity metre)	Manufacturer manual
Total Alkalinity	Plastic	Analyse same day	Titrimetric method (pH 4.8)	APHA et al., (1998)
Chloride	Plastic	Analyse same day or refrigerate 24-72hours	Titrimetric method (Argentometric)	-do-
Hardness	Plastic	Analyse same day	Titrimetric method (EDTA)	-do-
Nitrate	Plastic	Analysed same day or refrigerate 24- 72 hours	Cadmium reduction Method	-do-

3.910.21.2 Total dissolved solids (TDS)

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Total Dissolved Solids (TDS) in water comprises inorganic salts plus small amounts of organic matter. Principal ions contributing to the TDS of any water samples are Carbonates (CO_3^{2-}), Bicarbonates (HCO_3^-), Sulphates (SO_4^{2-}), Nitrates (NO_3^-), Sodium (Na^+), Potassium (K^+), Calcium (Ca^{2+}) and Magnesium (Mg^{2+}). TDS can also affect other qualities of drinking water such as taste, colour, corrosion properties and tendency to incrustation (WHO, 1984).

TDS in water may originate from natural sources, sewage effluent discharges, urban run-off or industrial waste discharges. Its levels in water depend to a large extent on the nature of the soil materials it comes in contact with. Water in contact with granite, siliceous sand, well-leached soils or other relatively insoluble material have TDS values of less than 30mg/l, while waters in pre-cambium shield areas generally have TDS values less than 65mg/l. water in areas of Paleozoic and Mesozoic sedimentary rocks have higher TDS values ranging from as little as 195 to 110mg/l, CO_3^{2-}, Cl^-, Ca^{2+}, Mg^{2+} and SO_4^{2-}, being the principal ions present (WHO, 1984). In addition to these natural TDS sources, leaching process, sewage and industrial wastes may also lead to further increase.

There is no evidence of deleterious physiological reaction occurring in persons consuming drinking water supplies that have high TDS levels in excess of 1000mg/l. Results of certain epidemiological studies would appear to suggest that TDS in drinking water may even have beneficial health effects (WHO, 1984). While not having serious effects, TDS may alter mildly electrolytic balance in the body, affect taste and may cause gastrointestinal irritation. Values of between 100mg/l are not recommended (WHO, 1991). Gravimetric method of estimating Total Dissolved Solids using the conductivity meter (HACK model CO 150 UK) was employed. All samples were analysed within 6 hours of their collection. Samples were mixed for consistency before all readings and the meter electrodes were rinsed in distilled water between sample measurements.

~~3.9.2.3 Determination of Electrical conductivity~~

~~Electrical Conductivity (EC) is an inherent property of most materials and ranges from extremely conductive materials such as metals to very non-conductive materials like plastics or glass. About halfway between the two extremes in conductivity are aqueous solution such as water (especially seawater) and plating baths. In metals, electrons carry the electric current, while in water; it is carried by charged ions. In both cases, the number of charges carried, how fast they move and how much charge each ion carries determines the conductivity. Hence, for most waters, the higher the concentration of dissolved salts, which lead to more ions, the higher the conductivity. This effect continues until the solution gets "too crowded" restricting the freedom of the ions to move, and the conductivity may actually decrease with increasing concentration.~~

~~Gravimetric method of estimating Electrical Conductivity using the conductivity meter (Hack model C) 150 UK) was employed. All samples were analysed within 6 hours of their collection. Samples were mixed for consistency before all readings and the conductivity meter electrodes were rinsed in distilled water between sample measurements.~~

3.109.21.43 Alkalinity measurement

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Alkalinity is a measure of the basic constituents of water (APHA, 1998); it is an index of the buffering capacity of water (WHO, 1984). When the alkalinity of water is due to the presence of carbonates or bicarbonates, the alkalinity is usually closely linked to its hardness value (APHA, 1998). In natural waters, it is usually present as a carbonate or bicarbonate salt of calcium, magnesium, sodium and potassium. Within reasonable limits, alkalinity has no sanitary significance, but it is very important in connection with coagulation, softening and corrosion prevention (Cox, 1973).

Principle

Hydroxyl ions in a water sample as a result of the dissociation or hydrolysis of solutes are neutralized by titration against a strong acid (0.02N H_2SO_4). The alkalinity arrived at thus depends on the end point pH used.

Procedure

To a 50ml water sample in a conical flask placed over a white tile – is added 0.5ml mixed Bromocresol indicator. This mixture turned brilliant green. The mixture was titrated against standard acid (0.02N H_2SO_4) until the brilliant green colour turned pink. This titre value was recorded.

Calculation

Total Alkalinity as

Mg/l $CaCO_3$ at pH 4.8= $\frac{A*N*5000}{\text{Volume of sample (ml)}}$

Where:

A= Volume of standard acid (0.02N H_2SO_4) used

N= Titre of standard acid used

* = Multiplication

3.~~10~~9.~~21~~.~~45~~ Chloride measurement (Argentometric method)

Chloride in the form of its ion (Cl^-) is one of the major inorganic anions in water. In potable water, the salty taste produced by Cl^- concentration varies and is independent on the chemical composition of the water. Some waters containing 250mg/l Cl^- may have a detectable salty taste if sodium (Na^+) is the cation, while the typical salt taste maybe absent in water containing as much as 1000mg/l Cl^- when the predominant cations are calcium (Ca^{2+}) and magnesium (Mg^{2+}). High Cl^- content in water harms metallic pipes and structures as well as agricultural plants (APHA, 1998). Tests for Cl^- in water serve different purposes. Firstly, salt is present in sewage from urine in the range of about 50 – 200mg/l and higher yet in countries with low water consumption per capita, so the content of Cl^- in polluted water is a rough estimate of the degree of pollution of water. This is especially the case with well waters, in which seepage from cesspools into the groundwater tributary of a well may be disclosed. Secondly, the Cl^- content of groundwater is used in the study of salt-water intrusion along seacoast, which destroys the usefulness of wells so affected. Local deposits of rock salt naturally lead to high chloride content in groundwater i.e. salty water not related to pollution of seawater intrusion and hence without sanitary significance. Water has a salty

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taste to some people when the content of chlorides exceeds about 150 – 200mg/l, which is the maximum desirable content.

Principle

Silver Nitrate ($AgNO_3$) first reacts selectively with the chloride ions (Cl^- present in the water. This reaction produces white insoluble silver chloride (AgCl). When all the chloride ions (Cl^-) have been precipitated, the remaining $AgNO_3$ then reacts with the indicator, potassium chromate (K_2CrO_4) to form an orange silver chromate (Ag_2CrO_4) precipitate. This marks the end-point of the silver nitrate titration method for estimating chloride in water (APHA, 1998).

Procedure

50ml of the water samples was taken for analysis. The pH of the sample was adjusted with Sodium Hydroxide (NaOH) or Tetraoxosulphate (VI) acid (H_2SO_4) to a pH of about 7 – 10. The sample was then titrated against 0.0141m $AgNO_3$ solution to a pinkish – yellow end point using K_2CrO_4 as indicator. Blank titration was also carried out.

Calculation

$$\text{mg/l chloride} = \frac{A - B*M*35450}{\text{Volume of sample (ml)}}$$

Where:

A= Volume of $AgNO_3$ used for titration

B= volume of $AgNO_3$ used for blank titration

M = molarity of $AgNO_3$ solution used

* = multiplication

(Note: mg/l NaCl = mg/l Cl*1.650

~~**3.9.2.6 Determination of Total hardness**~~

~~Water is a universal solvent and dissolves varying amounts of different mineral salts. Those producing hardness do not affect the sanitary condition of water, but are important in the domestic use of water particularly for laundry and boiler purposes. Hardness is defined as a~~

characteristic of water that represents the total concentration of calcium (Ca^{2+}) and magnesium (Mg^{2+}) ions expressed as calcium carbonate ($CaCO_3$) (APHA, 19894. Ca^{2+} and Mg^{2+} salts, the principal mineral constituents consume soap and precipitate as insoluble compounds or soap curds. Until all the Ca^{2+} and Mg^{2+} are precipitated, no latter or washing action is obtained from the soap. The soap consuming power of water is therefore a measure of its hardness. Calcium and magnesium generally are dissolved as soluble bicarbonate (HCO_3^-), but may change owing to heating, to the less soluble carbonate (CO_3^{2-}) which precipitates and is one of the sources of scales in distributing systems and hot water heaters. Hard water is generally less corrosive than soft waters (Egbedeyi and Akinfemiwa), 1980).

Hardness could be "carbonate" or "non carbonate" in nature. This depends on the numerical strength of the concentration of the contributing ions. When the hardness is numerically greater than the total of the carbonate and bicarbonate alkalinities, the amount in excess is referred to as "non carbonate hardness". It is carbonate hardness when all the alkalinity (both carbonate and bicarbonate) is equal to the hardness (APHA, 1998). The Ethylene Diamine Tetra-Acetic (EDTA) titration method was employed in estimating the hardness levels of the water samples.

Principle

Titration method depends on the ability of EDTA ($C_{10}H_{18}O_8N_2$) or its sodium salts to form stable unionized complexes with calcium (Ca^{2+}) and magnesium (Mg^{2+}) ions. On the addition of the dye, Erichrome Black – T (Sodium salt of 1 (1 hydroxyl – 2 naphthanylazo) 5 nitro – 2 naphthol 4 sulfonic acid) (EBT) to the solution containing Ca^{2+} or Mg^{2+} at a pH of 10 + 0.1 (APHA, 1998), a wine red complex is formed. When this solution is titrated against standard EDTA solution (a chelator, which removes Ca^{2+} and Mg^{2+} ions from the dye), the solution changes back to the original colour of the dye. In this way, EBT is used to indicate the end product of the titration of Ca^{2+} and Mg^{2+} ions together (total hardness).

Procedure

To a 50ml water sample was added 1ml of ammonium buffer solution to give a pH of 10.0 – 10.1. A few drops of EBT were added, and the sample titrated against standard EDTA

~~solution until the last reddish tinge disappeared. The colour at the end point of the titration is usually blue. The titre value was recorded.~~

~~**Calculation**~~

~~Hardness as Mg/l $CaCO_3$ = A*N*50,000 / Volume of sample~~

~~Where:~~

~~A= volume of the titrant EDTA used for the water sample~~

~~N= mg $CaCO_3$ equivalent to 1ml EDTA titrant~~

~~* = multiplication sign~~

3.~~10~~9.~~2~~1.~~56~~ ~~7~~ **Nitrate determination (**Cadmium Reduction Method)

The method of analysis used in the high range test is a modification of the cadmium reduction method using gentisic acid in place of 1-naphthlamine. The test assesses both nitrates and nitrites present in the water sample and eliminate~~s~~ the need for dilutions by operating in the most useful range. The Nitraver 5 Nitrate reagent Accuvac Ampuls was used.

This method involves filling a sample cell with 10ml of the sample, adding the contents of one Nitraver 5 nitrate reagent powder pillow to the sample cell. A one-minute reaction was observed, as the timer beeps, another 5min reaction period began, during this period; another cell is filled with 10ml of blank. The blank was used to zero the instrument after which the concentration of the sample was read in mg/l NO_3^-N on DR/820 Dataloging colorimeter. Each pillow contains cadmium and sulphanilic acid.

3.1~~0~~ Collection and pre-treatment of samples for bacteriological Analysis

Samples for bacterial analysis were collected first to avoid the risk of contamination of the sampling point. The major trust here is “sterility”, containers with leak proof lids used for sample collection were previously autoclaved to make them sterile. 0.1ml 0f 3% sodium thiosulphate solution was added to the containers for treated water samples before sterilisation in order to neutralize residual chlorine. They were not opened until at the point

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of sample collection. Collection of sample from raw water sources involved the tying of a rope round the neck of the container and gradually lowering into water body to fill. Sampling from tap involved allowing the tap to run for two minutes and subsequent sterilization. Extreme care was taken to avoid spillage.

3.110.1 Coliform organisms

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The most widely spread hazard associated with drinking water is direct or indirect contamination by sewage or human or animal excrements. Such contamination can be detected by the presence of indicator organisms such as *Eschericia coli* (E. coli), *streptococci*, *Clostridium perfringens* among others (collectively referred to as coliforms. The presence of E.coli is an indication of early contamination while the presence of *Cl perferinges* ova indicates contamination at a later period. Coliform organisms have long been recognized as a suitable microbial indicator of drinking-water quality, largely because they are easy to detect and enumerate in water. The term "coliform organisms (total coliforms)" refers to Gram-negative, rod-shaped bacteria capable of growth in the presence of bile salts or other surface-active agents with similar growth-inhibiting properties, and able to ferment lactose at 35-37 °C with the production of acid, gas, and aldehyde within 24-48 hours. They are also oxidase-negative and non-spore-forming. These definitions have recently been extended by the development of rapid and direct enzymatic methods for enumerating and confirming members of the coliform group. By definition, coliform bacteria display galactosidase activity. Traditionally, coliform bacteria were regarded as belonging to the genera *Escherichia*, *Citrobacter*, *Enterobacter*, and *Klebsiella*. However, the group of coliform bacteria, as defined by modern taxonomical methods, is heterogeneous and includes lactose-fermenting bacteria which can be found in both faeces and the environment, namely in nutrient-rich waters, soil, decaying vegetation and drinking-water containing relatively high levels of nutrients.

3.110.2 Escherichia coli

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Escherichia coli are abundant in human and animal faeces, where numbers may attain 109 per gram of fresh faeces. It is found in sewage, treated effluents, and all natural waters and soils subject to recent faecal contamination, whether from humans, farm animals, or wild

animals and birds. The presence of *E.coli* in water always indicates potentially dangerous contamination requiring immediate attention. Complete identification of *E.coli* is too complicated for routine use; hence certain tests have been evolved for identifying this organism rapidly with a high degree of certainty. Some of them are the subject of international and national standards and have been accepted for routine use, whereas others are still being developed or evaluated. Detection of *E. coli* on complex media entails incubation at the restrictive temperature of 44-45 °C in combination with demonstration of the production of acid and gas from lactose and of specific biochemical reactions such as indole production and glucuronidase activity, and the absence of urease activity.

3.110.3 Determination of Total coliform (multiple fermentation tube method)

Principle

Coliform bacteria when cultured in appropriate media produce gas, acid and turbidity in inverted fermentation tube at 35 or 37^0C after 24 – 48 hours of incubation.

Procedure

5ml (single strength) and 10ml (double strength) of makconkey broth were pipetted into 10 and 5 screw capped pre sterilized bottles containing inverted Durham tubes respectively. A serial dilution of 0.1m of Sample was equally prepared. 1ml of sample and diluted sample were each pipetted into 5 bottles containing the single strength medium respectively. 10ml of sample was equally pipetted into the 5 bottles containing the double strength medium. Bottles were labeled and incubated at 37^0C for 24 – 48 hours. Tubes were examined for gas acid production plus turbidity and color change signifying positive results. Confirmatory test was carried out with brilliant green lactose-bile broth for total coliform.

3.110.4 ~~-~~Determination of ~~total viable count and~~ E.coli. (Pour plate method)

~~This was used in the enumeration of total viable bacterial count and E.coli.~~

Sterile Petri dishes, three per dilution were set out and labeled. 1ml each of dilution was discharged into the centre of the appropriate Petri-dish using a sterile dry pipette. 10ml of ~~molten agar (nutrient agar for total viable count and~~ eosin methylene blue agar for E.coli~~)~~

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was poured into each of the Petri dish already inoculated and carefully mixed by a combination of to and fro and circular movement. The plates were allowed to set; inverted and incubated at 37^0C and 45^0 C for 24hours. A colony counter was used to enumerate the number of colonies per plate.

3.121 Data Processing:

~~**3.11.1 Data Analysis:**~~

Processing of data involved the following

(i) Sifting and sorting of questionnaires – this was to identify and remove incompletely filled or incorrectly filled questionnaires

(ii) Coding of Questionnaire – responses from the questionnaire were coded manually by the researcher using a guide developed by the researcher

(iii) Data entry – data codes were entered into the computer through, the statistical package for social sciences (SPSS) software version 15 and analysed

3.121.12 Data Analysis

All completed questionnaires were collected and screened for completeness manually by the investigator. The data wereas analyzed using SPSS computer software version 15 at 5% level of significance. Descriptive statistics with the use of proportions, means, standard deviations and bar chartgraphs was also employed. Chi square (X^2) analysis ~~and logistic regression~~ waserewas used to test for association between variables of interest. Logistic regression ~~analysis were~~analysis was used to explain association between occurrence of opportunistic infections and environmental factors while student T-test was used to compare means.

3.132 Ethical Approval

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Approval was sought and obtained from the selected health facilities as well as the FCT ethical committee on Biomedical Research. The protocol, consent form and questionnaires were approved by the ethical committee of NHA and the FCT ethical committee on Bio-medical research before administration. Approval was on condition that the study will not inflict any harm to the participants (non maleficience). Participation of all respondents in the study was strictly voluntary. Measures were taken to ensure dignity, respect and freedom of expression in the study. Informed consent (copy attached – appendix 3) was obtained from each respondent by reading and signing a short text that summarized the study and the role of the respondent and ensured confidentiality. After signing the consent form, the researcher coded the forms accordingly while the respondent provided his/her hospital number for medical records review and phone number (for those that accepted the on-site environmental assessment and sample collection).

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CHAPTER FOUR

RESULTS

The first section of this chapter presents the socio – demographic characteristics of the respondents: cases and controls. This is followed by the common OIs occurring among PLWHAs and the level of knowledge of respondents on the effect of ~~environmental risk~~ hygiene factors on the occurrence of OI. Next on the presentation are the practices that enhance the occurrence of these infections following exposure to risk factors, the prevailing environmental conditions (risk factors) that may promote the occurrence of infections (OIs) among the respondents. Finally the association between the occurrences of OIs and the prevailing ~~environmental risk~~ hygiene factors are also presented.

4.1 Review of Medical Records

4.1.1 Clinical staging of HIV Infection

Sixty six (66) clients who were manifesting opportunistic infections were recruited as cases and Sixty eight (68) others confirmed HIV+ without OIs were recruited as controls and matched accordingly by age, sex, and residential areas.

4.1.2 Common Diseases/Infections found Among Respondents

Table 4.1 shows the common diseases/infections suffered by the clients. The most frequently occurring ailment among PLWHAs: cases and controls were fever/malaria 43(81.1%), 47(79.7%); cough 28(52.8%), 29(47.5%); lymphadenopathy 13(24.5%), 25(42.4%); TB 30 (56.6%); oral thrush 41(77.4%); weight loss (> 10% body weight) 52(98.1%); persistent diarrhea 37(69.8%), dementia 2(3.8%), herpes zoster 6(11.3%), upper respiratory track infection (URTI) 17(32.1%), 7(11.9%); among others. Some of these conditions like TB, oral thrush, herpes, persistent diarrhea and dementia were AIDS defining conditions hence occurred only among the cases.

Table 4.1 Common Infections that occurred among PLWHAs between 2007- 2008

Diseases/Infections	Frequency of Occurrence: F (%)	**Total (%)**

	Cases (N53)		Controls (N59)		112	
	Present	Absent	Present	Absent	Present	Absent
Fever/Malaria	43(81.1)	10(18.9)	47(79.7)	12(20.3)	90 (80.4)	22 (19.6)
Tuberculosis	30(56.6)	0(0.0)	0 (0.0)	0 (0.0)	30 (26.8)	82(73.2)
~~Persistent~~ Diarrhea	37(69.8)	16(30.2)	0 (0.0)	0 (0.0)	37 (33.0)	75 (67.0)
Cough	28(52.8)	25(47.2)	29(49.2)	30(50.8)	57 (50.9)	55(49.1)
Oral Candidiasis (thrush)	41(77.4)	12(22.6)	0 (0.0)	0 (0.0)	41 (36.6)	71 (63.4)
Herpes Zoster	6 (11.3)	47(88.8)	0 (0.0)	0 (0.0)	6 (5.4)	106 (94.6)
Herpes Simplex	2 (3.8)	51(96.2)	0 (0.0)	0 (0.0)	2 (1.8)	110 (98.2)
Weight loss (>10% body weight)	52(98.1)	1 (1.9)	0 (0.0)	0 (0.0)	52 (46.4)	60 (53.6)
Minor Mucocutaneous Manifestation (MMM)	17(32.1)	36(67.9)	4 (6.8)	55(93.2)	21 (18.6)	91 (81.3)
Upper Respiratory tract Infection	17(32.1)	36(67.9)	7 (11.9)	52(88.1)	24(21.4)	88(78.6)
Rashes	11(20.7)	42(79.3)	21(35.6)	38(64.4)	32 (28.6)	80 (71.4)
Lymphodenopathy	13(24.5)	40(75.5)	25(42.4)	34(57.6)	38 (33.9)	74 (66.1)
Oral Hairy leukoplakia	7 (13.2)	46(86.7)	3 (5.1)	56(94.5)	10 (8.9)	102(91.1)
Dementia	2 (3.2)	51(96.2)	0 (0.0)	0 (0.0)	2 (1.8)	110(98.2)

Source: Field survey, 2009

4.2 Questionnaire Data

4.2.1 Socio-Demographic Characteristics of Respondents

A total of 134 PLWHAs (study participants) 66 (49.3%) cases and 68 (50.7%) controls responded to the questionnaire. The mean ages of the respondents were 35.9 ±6.7 years for cases and 34.35 ± 7.0 for controls, with no significant difference. About 49.2% males and 50.7% females were in the study. Within groups, there were equal numbers of males and females (50% each) among the cases, while 48.5% females and 51.5% males constitute the control. The marital status of the respondent varied from 61.2% married, 29.1% singles, 2.2% separated and 7.5% widows. More married people (69.1%) were found among the controls than cases (53.0%). Majority of the respondents had acquired tertiary education 73 (54.5%), and secondary 54(40.3%) while 7 (52%) had no formal education. These trend also applies within groups; among the cases 37(56.1%), 25 (37.9%) and 4 (6.1) and controls 36 (52.9%), 29 (42.6%) and 3 (4.4%) respectively. More Christians 105 (78.4%) consented to the study than Muslims 29 (21.6%). Majority of the respondents were civil servants 47 (35.1%) and business merchants 31 (23.1%). Among the cases 26(39.4%) and controls 21(30.9%) were civil servants while 14(21.2%) cases and 17(25.0%) controls were businessmen/women respectively. The median income per month for the clients was N22, 500 for cases and 20,000 for controls. Other characteristics are shown on Table 4.2.

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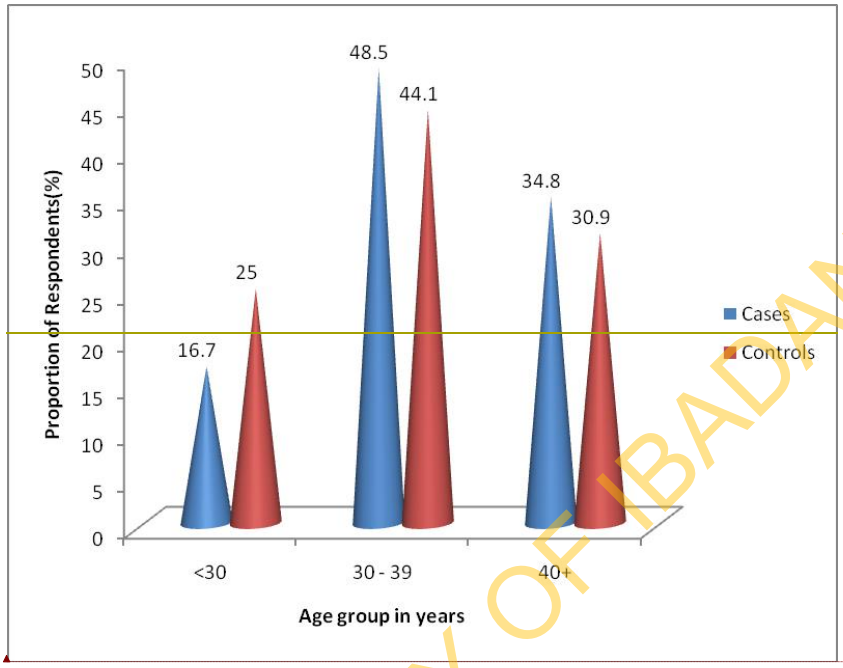
Table 4.2 Socio-Demographic Characteristics of Respondents

Variables	**Cases (%)**	**Controls (%)**	**Totals (%)**
Count	66 (49.3)	68 (50.7)	134
Mean Age	35.9 ± 6.7	34.35± 7.0	
Sex			
Male	33 (50.0)	33 (48.5)	66 (49.2)
Female	33 (50.0)	35 (51.5)	68 (50.7)
Marital Status			
Single	24 (36.4)	15 (22.1)	39 (29.1)
Married	35 (53.0)	47 (69.1)	82 (61.2)
Separated	2 (3.0)	1 (1.5)	3 (2.2)
Widowed	5 (7.6)	5 (7.6)	10 (7.5)
Educational Status			
No formal education	4 (6.1)	3 (4.4)	7 (5.2)
Secondary education	25 (37.9)	29 (42.6)	54 (40.3)
Tertiary education	37 (56.1)	36 (52.9)	73 (54.5)
Religion			
Christianity	53 (80.3)	52 (76.5)	105 (78.4)
Islam	13 (19.7)	16 (23.5)	29 (21.6)
Ethnicity			
Hausa	29 (43.9)	28 (41.2)	57 (42.5)
Igbo	30 (45.5)	34 (50.0)	64 (47.8)
Yoruba	7 (10.6)	6 (8.8)	13 (9.7)
Occupation			
Civil Servant	26 (39.4)	21 (30.9)	47 (35.1)
Business	14 (21.2)	17 (25.0)	31 (23.1)
Trader	12 (18.2)	9 (13.2)	21 (15.7)
Student	5 (7.6)	7 (10.3)	12 (9.0)
Artisan	4 (6.1)	10 (14.7)	10 (14.7)
Apprentice	5 (7.6)	4 (5.9)	9 (6.7)

Duration of Residence in Abuja (yrs)	8.4±4.8	8.8±4.7



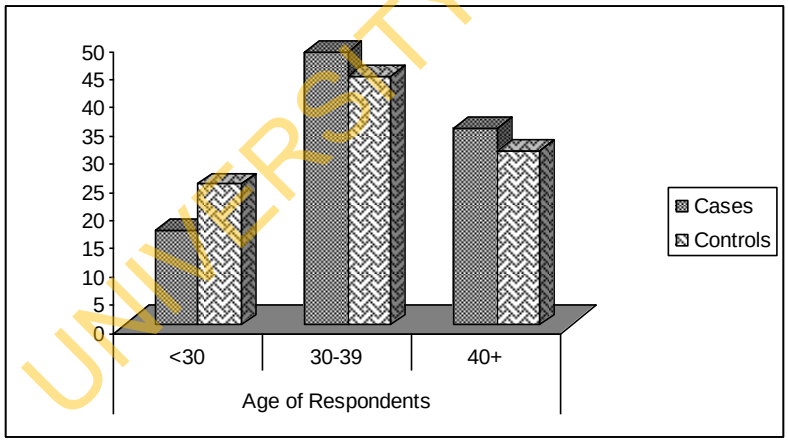


Fig 4.1: Age of Respondents

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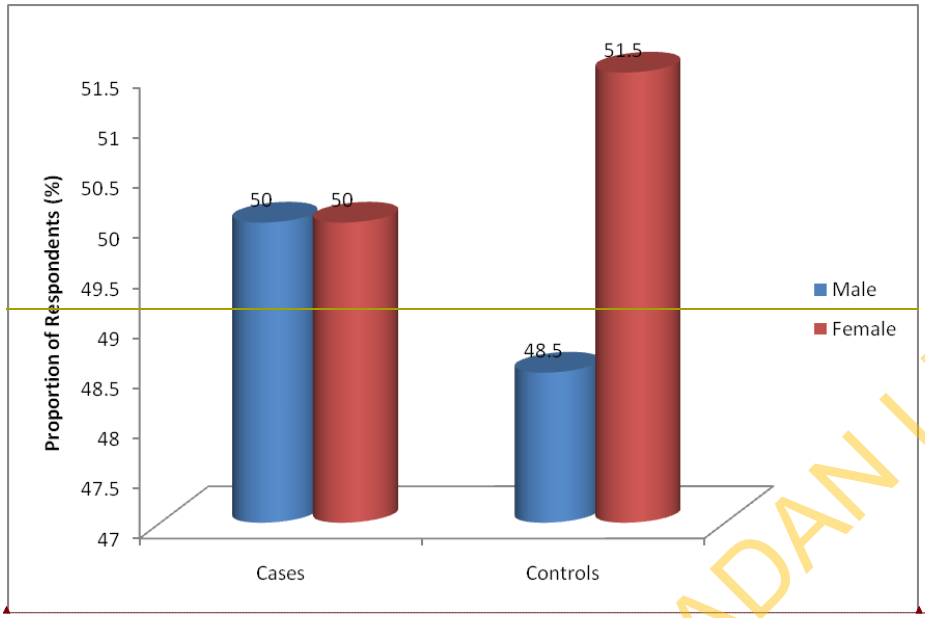

Fig 4.2: Sex of Respondents

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4.2.2 Respondents knowledge on the Environmental Influences on Health

Table 4.3 below shows the level of knowledge of the cases and control on the effect of environmental risk factors on the occurrence of OIs. The knowledge score of the respondents on environmental influences on health was assessed based on a 40 point scale. Scores between 020 –315 were rated as "good", while score >s between 5 –15 was rated as goodwere "poor".

Among all the questions asked, the responses to the question "Good hygiene practices is not a weapon in reducing infection" were significantly different between the cases and the controls ($p<0.05$). The cases demonstrated betterbetter knowledge of environmental risk factors on the occurrence of OIs as more respondents among the cases (65.2%) disagreed with the fact that "Good hygiene practices was not a weapon in reducing infection" than among the controls (63.2%). However a good number of respondents; cases 58 (87.9 %) and controls 56 (82.4%) indicated goodhigh level of knowledge on the effect of poor environmental condition on their health status ($p>0.05$).

Almost equal number of cases 59 (86.8%) and controls 55 (80.9%) agreed to the fact that consumption of unwholesome water can lead to the occurrence of some OIs among infected persons ($p>0.05$). Similar proportion of cases and controlsA fair ; 49 (74.2%) and 43 (63.2%) respectively had good knowledge on the effect of overcrowding of people in a sleeping room as a source of cross infection among sick persons was also displayed; 49 (74.2%) cases and 43 (63.2%) controls agreed to this fact (p>0.05), while 14 (21.2%) cases and 14 (20.6%) controls disagreed. MajoriMajority of the respondents 58 (87.8%) cases versus 54 (79.4%) controls were in agreement with the fact that living in an unclean environment will increase the chances of coming down with some OIs ($p>0.05$). Majority (120 respondents) comprising 63 (95.5%) cases and 57 (83.8%) controls agreed strongly that dumping of refuse around the house can be a source of infection while only one person (a control) disagreed with this fact, the remaining were indifferent about the assertion.

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Table 4.4 summarizes the mean knowledge score of the cases and the controls as 31.7±8.9 and 29.0±13.1 respectively, indicating good knowledge. ~~The overall knowledge score of the respondents was 30.3±11.2 out of a total possible score of 40.~~ The t-test statistic therefore~~however~~ shows that there was no significant difference (p>0.05) between the knowledge score of the cases and the controls.

`Table 4.3 Respondents' knowledge on Environmental influences on health

	Cases	Control			
	Correct knowledge N (%)	Correct knowledge N (%)	Total	Chi-square	p-valu
Poor environmental condition would bring down your health status	58(87.9)	56(82.4)	114(85.1)	0.429	0.5
Drinking of unwholesome water can influence the occurrence of some infections among PLWHAs	59(89.4)	55(80.9)	(114(85.1	1.299	0.2
Good hygiene practice is not a weapon in reducing infection	43(65.2)	43(63.2)	86(64.2)	0.003	0.9
Sleeping with many people (≥2) in a room can lead to cross infection	49(74.2)	43(63.2)	92(68.7)	1.409	0.2

among ill people					
Living in an unclean environment may increase the occurrence of some OIs	58(87.9)	56(82.4)	114(85.1)	1.187	0.2
Ahealthy environment cannot suppress the occurrence of some OIs	29(43.9)	19(27.9)	48(35.8)	0.038	0.8
Unwholesome environment promotes vector breeding (e.g. mosquitoes)	60(90.9)	56(82.4)	116(86.6)	1.437	0.2
Dumping of refuse within the vicinity of the house can be a source of infection	63(95.5)	57(83.8)	120(89.5)	3.679	0.0

~~**Table** 4.3 **Respondents' knowledge on Environmental Influences on Health**~~

	~~Cases~~	~~Controls~~	~~Total~~	~~Chi-square~~	~~p-value~~
	~~N (%)~~	~~N (%)~~	~~N (%)~~		
~~Poor environmental condition would bring down your health status~~					
~~Agreed~~	~~58(87.9)~~	~~56(82.4)~~	~~114(85.1)~~	~~5.06~~	~~0.0796~~
~~Disagreed~~	~~5(7.6)~~	~~2(2.9)~~	~~7(5.2)~~		
~~Indifference~~	~~3(4.5)~~	~~10(14.7)~~	~~13(9.7)~~		

Total	66	68	134		
Drinking of unwholesome water can influence the occurrence of some infections among PLWHAs					
Agreed	59(89.4)	55(80.9)	114(85.1)	4.02	0.1338
Disagreed	4(6.1)	3(4.4)	7(5.2)		
Indifference	3(4.6)	10(14.7)	13(9.7)		
Total	66	68	134		
Good hygiene practices is not a weapon in reducing infection					
Agreed	18 (27.2)	10 (14.7)	28(20.9)	12.85	0.0016
Disagreed	43 (65.2)	43 (63.2)	86(64.2)		
Indifference	5 (7.6)	15 (22.1)	20(14.9)		
Total	66 (100.0)	68 (100.0)	134		
Sleeping with many people (2 and above) in a room can lead to cross infection among ill people					
Agreed	49(74.2)	43(63.2)	92(68.7)	4.93	0.0848
Disagreed	14(21.2)	14(20.6)	28(20.9)		
Indifference	3(4.5)	11(16.2)	14(10.4)		
Total	66	68	134		

Table 4.3 Continued

Living in an unclean environment may increase the occurrence of some OIs					
Agreed	58(87.9)	54(79.4)	112(83.6)	2.36	0.3067
Disagreed	3(4.5)	3(4.4)	6(4.5)		
Indifference	5(7.6)	11(16.2)	16(11.9)		
Total	66	68	134		

A healthy environment cannot suppress the occurrence of some OIs					
Agreed	29(43.9)	19(27.9)	48(35.8)	5.21	0.074
Disagreed	28(42.4)	31(45.6)	59(44.0)		
Indifference	9(13.6)	18(26.5)	27(20.2)		
Total	66	68	134		

Table 4.3 Continued

Unwholesome environment promotes vector breeding (e.g. mosquitoes)					
Agreed	60(90.9)	56(82.4)	116(86.6)	3.71	0.1565
Disagreed	2(3.0)	1(1.5)	3(2.2)		
Indifference	4(6.1)	11(16.2)	15(11.2)		
Total	66	68	134		
Dumping of refuse within the vicinity of the house can be a source of infection					
Agreed	63(95.5)	57(83.8)	120(89.5)	5.04	0.080
Disagreed	0(0.0)	1(1.5)	1(7.5)		
Indifference	3(4.5)	10(14.7)	13(9.7)		
Total	66	68	134		

Source: Field survey, 2009

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Table 4.4 Summary of knowledge scores of the cases and the control

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	Cases	Control	Total		
	Mean ± SD	Mean ± SD	Mean ± SD	t-test	p-value
Knowledge score	31.7 ± 8.9	29.0±13.1	30.3±11.2	1.36	0.176

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4.3 **Practices that May ~~Expose~~ increase Respondents vulnerability to different ~~environmental Risk Factors~~ Health hazards**

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The result of the survey on the practices that may likely enhance the occurrence of OIs among the respondents is presented under the following subheads: hygiene practices, solid waste management practices, water safety practices, sanitary practices, and housing conditions.

4.3.1 Hygiene Practices

As indicated in Table 4.5, the odds ratio at 95% Confidence intervals of the estimates of the hygiene practices of the cases and the controls in terms of the frequency of daily bath taking, hand washing with soap after toilet use and sweeping of living apartment depict that the hygiene practices were similar between the cases and the controls ($p>0.05$). The results reveals that majority 53 (80.3%) cases and 62 (91.2%) controls do take their bath twice daily. 13 (19.47%) cases and 6 (8.8%) controls took their bath once a day. Most of the respondents 50 (75.8%) cases and 48 (70.6%) controls reported washing their hands with soap after using the toilet.

4.3.2 Solid Waste Management Practices

The various methods reported by the respondents include, use of refuse bin, open dumping in the bush and/or roadsides (plate 4.2 and plate 4.3), pit dumping, collection by the Abuja Environmental protection board (plate 4.1) and open burning. Table 4.6 showed the proportion of cases and controls practicing each method. However the odds ratio estimates in Table 4.7 showed that the practices of solid waste disposal in terms of the frequency of waste disposal from generation point (OR: 1.11; 95% CI: 0.46-2.68) and the means of refuse disposal (OR: 0.99; 95%CI: 0.47-2.09) were not significantly different between the cases and the controls ($p>0.05$).

Table 4.5 Hygiene Practices of Cases and Controls

	Cases	Controls	Total	Odds	95% CI of

				ratio	odds ratio
	N (%)	N (%)	N (%)		
No. of times you take bath daily					
Once	13(19.7)	6 (8.8)	19(14.2)	2.53	0.82-8.11
Twice	53(80.3)	62(91.2)	115(85.8		
Total	66	68	134		
Washing of hands with soap after toilet use					
No	16(24.2)	20(29.4)	36(26.9)	0.77	0.33-1.77
Yes	50(75.8)	48(70.6)	98(73.1)		
Total	66	68			
Frequency of sweeping living apartment					
Once	18(27.3)	18(26.5)	36(26.9)	0.96	0.42-2.21
More than once	48(72.7)	50(73.5)	98(73.1)		
Total	66	68	134		

Source: Field Survey, 2009

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Table 4.6 Solid Waste Disposal Practices

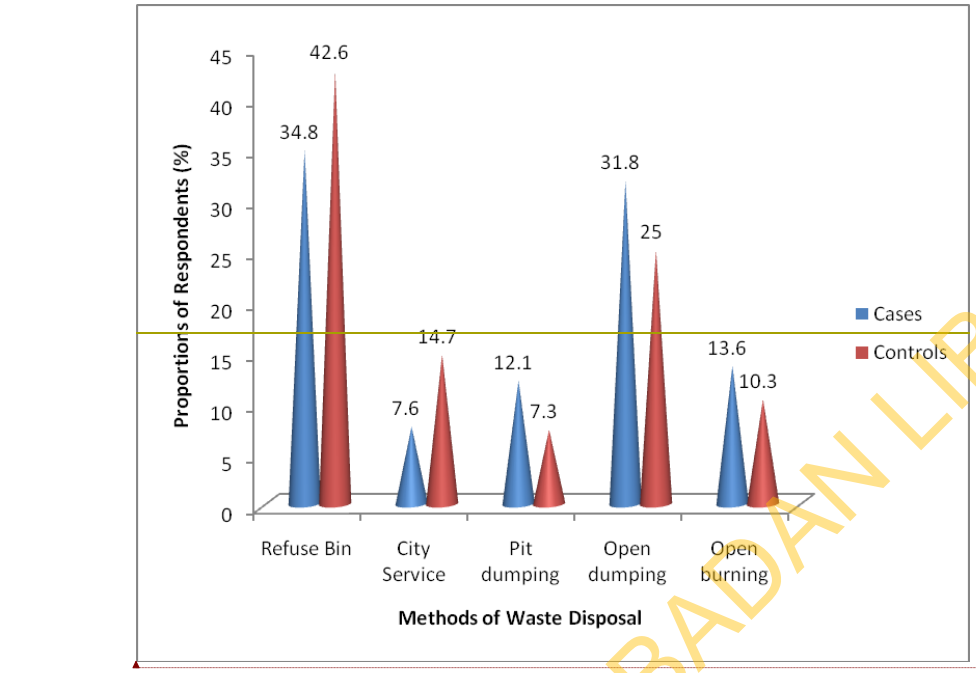
Variables	Cases (%)	Controls (%)	Total (%)
How often do you dispose of your waste from point of generation?			
Daily	29(44.6)	34(51.5)	63(48.1)
Once in two days	20(30.8)	17(25.8)	37(28.2)
Weekly	10(15.4)	10(15.2)	21(16.0)
Twice weekly	6(9.2)	7(10.6)	13(9.9)
Total	65	66	131
How do you dispose off your waste?			
Refuse bin	23(34.8)	29(42.6)	52(38.8)
Pit dumping	8(12.1)	5(7.3)	13(9.7)
Open dumping	21(31.8)	17(25.0)	38(28.4)
City Service (AEPB)	5(7.6)	10(14.7)	15(11.1)
Open burning	9(13.6)	7(10.3)	16(11.9)
Total	66	68	134

Source: Field Survey, 2009

Table 4.7 Summary of Solid waste disposal practices

	Cases	Controls	Total	Odds ratio	95% CI of odds ratio
	N (%)	N (%)	N (%)		
Frequency of waste disposal from generation point					
Weekly /twice weekly	16(24.6)	15(22.7)	31(23.7)	1.11	0.46-2.68
Daily/ once in 2 days	49(73.4)	51 (77.3)	100(76.3)		
Total	65	66	131		
Means of refuse disposal					
Pit & open dumping/Open burning	27(40.9)	28(41.2)	55(41.0)	0.99	0.47-2.09
Refuse bin/City service	39(59.1)	40(58.8)	79(59.0)		
Total	66	68	134		

Source: Field Survey, 2009



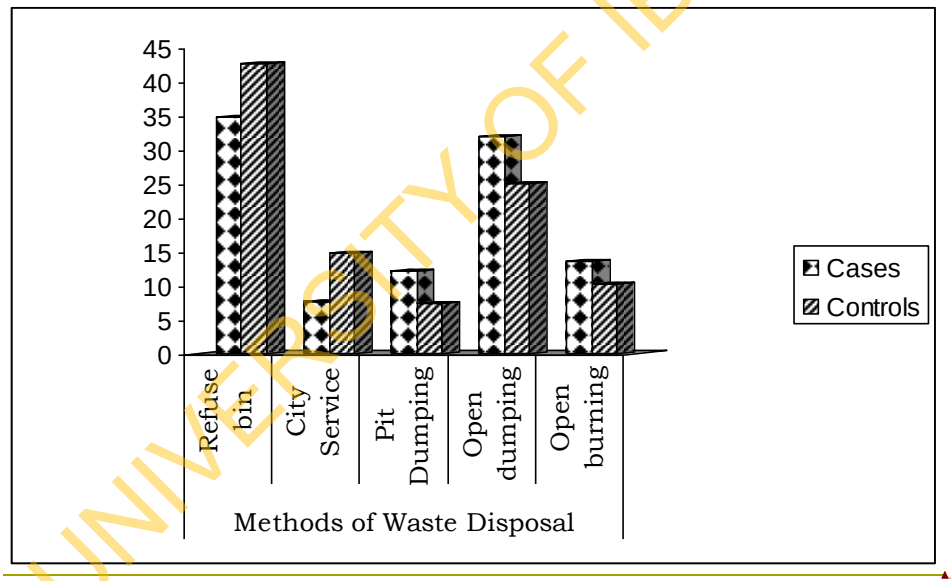


Fig. 4.3 Solid Waste Disposal Methods

Plate 4. 1 AMAC Refuse bin for community waste Collection~~management~~

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Plate 4.2 Heap of refuse within residential area (open dumpsite)

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Plate 4.3 Heap of refuse along the road

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4.3.3 Sanitary Practices

Majority of controls 47 (70.1%) reported using water closet facility (plate 4.5) in their houses as compared to 26 (39.4%) cases. 18 (27.3%), 19 (28.8%) case used bush system and pit latrine (plate 4.4) respectively as compared to 6 (8.9%), 14 (20.9%) controls (table 4.10). In summary two-third of the cases (66.7%) and the controls (68.7%) used water closets for excreta disposal. The odds ratio estimate of 1.10 (95%CI: 0.50-2.41) shows that the sanitary facilities used by the cases and the controls were not significantly different (p>0.05) (table 4.11).

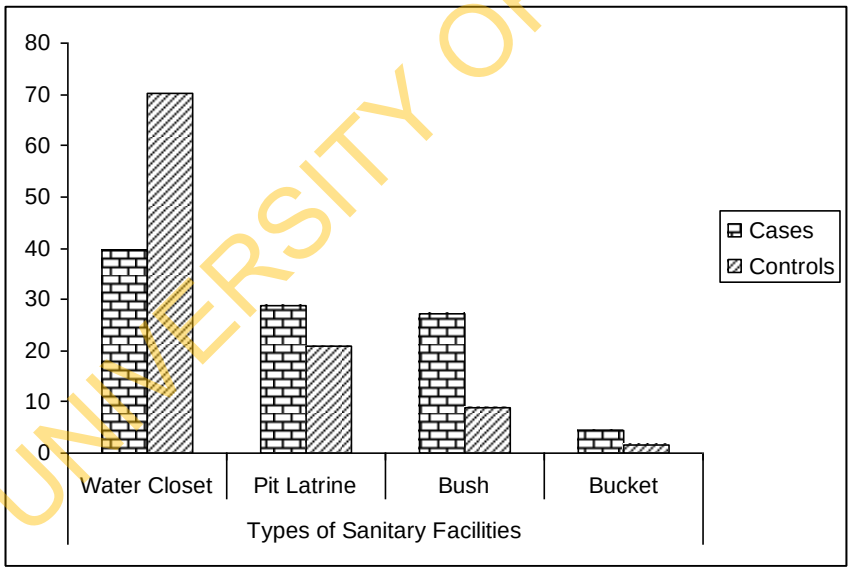

Fig 4.4 Sanitary Facilities

Table 4.8 Status of Sanitary Practices

Type of Facility	Cases (%)	Controls (%)	Total (%)
Water closet (WC)	26(39.4)	47(70.1)	73(54.9)
Bush(Open Ground)	18(27.3)	6(8.9)	24(18.1)
Pit Latrine	19(28.8)	14(20.9)	33(24.8)
Bucket	3(4.5)	1(1.5)	4(3.0)
Total	66	67	132

Table 4.9 Summary of Sanitation practices

Type of toilet used	Cases	Controls	Total	Odds ratio	95% CI of odds ratio
	N (%)	N (%)	N (%)		
Pit latrine/Bush/Bucket system	22 (33.3)	21(31.3)	43(32.3)	1.10	0.50-2.41
Water closet	44 (66.7)	46 (68.7)	90(67.7)		
Total	66 (100.0)	67 (100.0)	133		

Plate 4.4 A typical Pit latrine in a respondent's home

Plate 4.5 A typical water closet facility in a respondent's home

Table 4.108 Safety Practices on drinking water

Variables	Cases (%)	Controls (%)	Total (%)
What is the source of your drinking water?			
Tap	12(18.2)	17(25.0)	29(21.6)
Borehole	30(45.5)	41(60.3)	71(58.0)
Well	6(9.1)	4(5.9)	10(7.5)
Sachet (pure)water	8(12.1)	3(3.5)	11(8.2)
Water vendor (*mai ruwa*)	10(15.2)	2(2.9)	12(8.9)
What type of treatment do you give to your water before consumption?			
Boiling	13(19.7)	24(35.3)	37(27.6)
Filtering	10(15.2)	5(7.4)	15(11.2)
Addition of alum	7(10.6)	2(2.9)	9(6.7)
Water guard (chlorine solution)	23(34.9)	33(48.5)	56(41.8)
No treatment	13(19.7)	4(5.9)	17(12.7)
What type of container do you used in fetching water from the source?			
Jerry can	28(42.4)	36(52.9)	64(47.8)
Plastic bucket with lid	17(25.8)	26(38.2)	43(32.1)

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Plastic bucket without lid	17(25.8)	6(8.8)	23(17.2)
Metal bucket with lid	3(4.5)	0	3(2.2)
Metal bucket without lid	1(1.5)	0	1(0.8)
What type of container do you use in storing water in the house?			
Jerry can	29(43.9)	26(38.2)	55(41.0)
Plastic bucket with lid	21(31.8)	13(19.1)	34(25.4)
Rubber drum	14(21.2)	23(33.8)	37(27.6)
Refrigerator	2(3.0)	4(5.9)	6(4.5)
Dispenser	0	2(2.9)	2(1.5)

Source: Field Survey 2009

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4.3.~~3.1~~ Safety Practices on drinking water

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Majority of the cases 30 (45.5%) and controls 41 (60.3%) get their drinking water from boreholes. 12 (18.2%) cases and 17 (25.0%) controls have public tap as their source of water. More cases 4 (9.1%) than controls 4 (5.9%) fetch their drinking water from well, also 8 (12.1%) and 3 (4.5%) of the same group drink sachet (pure) water, while 10 (15.2%) cases and 2 (2.9%) control purchase their drinking water from water vendors locally known in Hausa dialect as *mai ruwa*.

4.3.~~4.1~~3.2 Water Treatment Practices

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The treatment administered on water before consumption by the respondents ranges from boiling, filtering, addition of alum and use of water guard. The measure mostly employed by the respondents is the addition of water guard (chlorine solution). More controls 33 (48.5%) than cases 23 (34.9%) made use of this method. Also, the proportion of controls 24 (35.3%) that reported boiling their water was more than cases 13 (19.7%). There was no significant difference in the proportion of cases and controls that claim to filtered their water before drinking. However, irrespective of the source of water more cases 13 (19.7%) than controls 4 (5.9%) administered no form of treatment on their water before consumption.

4.3.4.23.3 Containers for Fetching Water from Source

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The survey report showed that the container used by the respondents in fetching water from the sources varied. Majority of the controls36 (52.9%) than cases28 (42.4%) reported using jerry can to fetch water from the source while 17 (25.8%) cases and 26 (38.2%) used plastic bucket with lid.. Others 17 (25.8%) cases and 6 (8.8%) controls used plastic buckets without lid and 4 (6.1%) of cases reported using metal bucket with/without lid.

4.3.4.33.4 Water storage Facilities

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Majority of the respondents 29 (43.9%) cases and 26 (38.2%) controls reported storing their water in plastic buckets with lid. Others 21 (31.8%) cases and 13 (19.1%) controls reported using jerry can while 14 (21.2%) cases and 23 (33.8%) controls used rubber drums and 2 (3.0%) cases and 4 (5.9%) controls used refrigerator while only two controls (2.9%) reported using water dispenser.

Table 4.9 shows the summary of the practices of the cases and the controls in relation to drinking potable water. Twenty four percent of the cases indulged in the practice of unsafe drinking water (i.e. use non potable sources of water for drinking like well water and vendor) unlike the 9.0% who practiced it among the controls. The level of unsafe drinking water source was about three times (OR: 3.25; 95%CI: 1.09-10.14) higher among the cases than among the controls. The water treatment practices of the cases were not significantly different from that of the control ($p>0.05$). The types of containers used for fetching water from the source varied significantly between the cases and the control. The cases (31.8%) had significantly ($p<0.05$) higher proportion of persons indulging in unwholesome practices of fetching water using containers without lids than had the control (8.8%).

4.3.4 Sanitary Practices

Majority of controls 47 (70.1%) reported using water closet facility (plate 4.5) in their houses as compared to 26 (39.4%) cases. 18 (27.3%), 19 (28.8%) case used bush system and pit latrine (plate 4.4) respectively as compared to 6 (8.9%), 14 (20.9%) controls (table 4.10). In summary two third of the cases (66.7%) and the controls (68.7%) used water closets for excreta disposal. The odds ratio estimate of 1.10 (95%CI: 0.50-2.41) shows that the sanitary

~~facilities used by the cases and the controls were not significantly different (p>0.05)~~ ~~(table 4.11).~~

Table 4.11~~9~~: Summary ~~of~~ Safety Practices on Drinking Water Sources

	Cases	Controls	Total	Odds ratio	95% CI odds ratio
	N (%)	N (%)	N (%)		
Sources of drinking water					
WellWater,/vendor	16 (24.2)	6 (9.0)	22(16.5)	3.25	1.09-10.14

(inadequate)					
Tap/Sachet/Borehole (adequate)	50 (75.8)	61 (91.0)	111(83.5)		
Total	66 (100.0)	67 (100.0)	133		
Type of water treatment used before drinking of water					
Addition of Alum/filtering/No treatment	29(43.9)	22(32.4)	51(38.1)	1.64	0.77-3.52
Boiling/Water guard (chlorine solution)	37(56.1)	46(67.6	83(61.9)		
Total	66	68	134		
Type of container used for fetching water from the source					
Plastic bucket without lid/metal bucket with lid/metal bucket without lid	21 (31.8)	6 (8.8)	27(20.1)	4.82	1.66-14.63
Jerry can/Plastic bucket with lid	45 (68.2)	62 (91.2)	107(79.8)		
Total	66 (100.0)	68	134		

Source: Field Survey, 2009

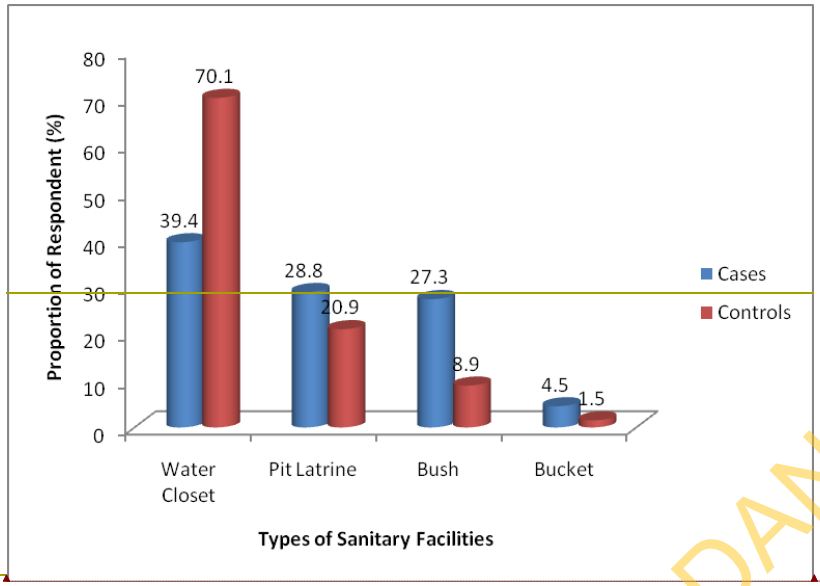

Fig 4.4 Sanitary Facilities

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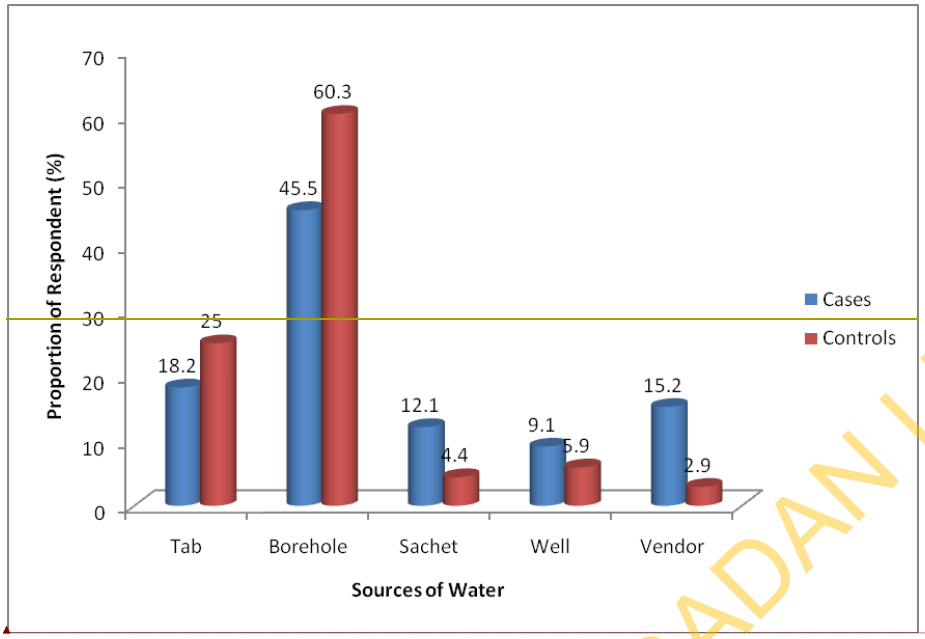

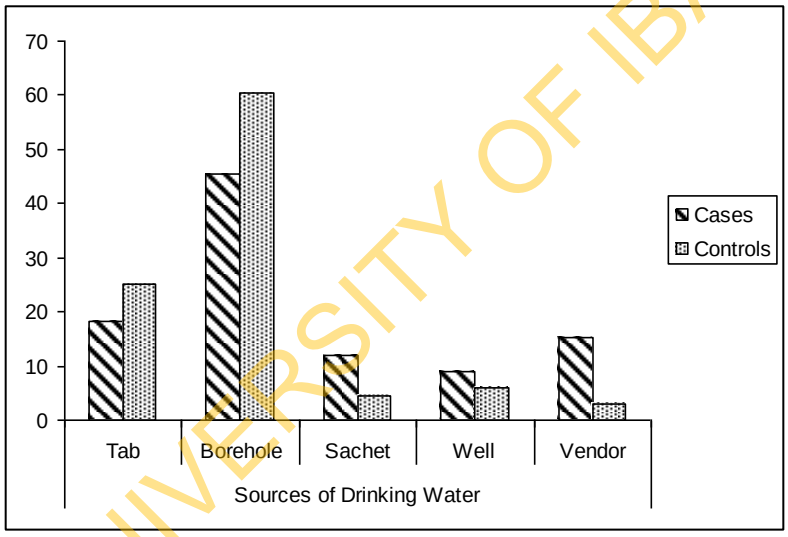

Fig 4.5 Sources of Drinking Water

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~~Table 4.10 – Status of Sanitary Practices~~

~~Type of Facility~~	~~Cases (%)~~	~~Controls (%)~~	~~Total (%)~~
~~Water closet (WC)~~	~~26(39.4)~~	~~47(70.1)~~	~~73(54.9)~~
~~Bush~~	~~18(27.3)~~	~~6(8.9)~~	~~24(18.1)~~
~~Pit Latrine~~	~~19(28.8)~~	~~14(20.9)~~	~~33(24.8)~~
~~Bucket~~	~~3(4.5)~~	~~1(1.5)~~	~~4(3.0)~~
~~Total~~	~~66~~	~~67~~	~~132~~

Table 4.11 Summary of Sanitation practices

Type of toilet used	Cases	Controls	Total	Odds ratio	95% CI of odds ratio
	N (%)	N (%)	N (%)		
Pit latrine/Bush/Bucket system	22 (33.3)	21(31.3)	43(32.3)	1.10	0.50-2.41
Water closet	44 (66.7)	46 (68.7)	90(67.7)		
Total	66 (100.0)	67 (100.0)	133		

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Fig 4.4 A typical Pit latrine in a respondent's home

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Fig 4.2 A typical water closet facility in a respondent's home

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4.3.6 Housing Conditions

The type of house occupied by the respondent ranges from duplex/flats with 36 (53.0%) controls and 25 (37.9%) cases claiming residence in such apartments. 18 (27.3%) cases and 15 (22.1%) controls resided in low cost housing whereas majority cases 23 (34.8%) and controls 17 (25%) find their abode in single room apartment (commonly known as face me, I face you). The number of occupants per sleeping room was also assessed and the result obtained indicated 56.1% cases and 64.7% controls had the ideal number of persons (1 – 2) sleeping in their room, while 29 (43.9%) cases and 24 (35.3%) controls share their sleeping room with two others or above. Table 4.128 summarizes the number of persons sharing a sleeping room by the cases and the controls. The odds ratio estimate of 1.44 (95%CI: 0.68-3.06) signifies that the odds of inadequate sleeping condition (>3 persons) among the cases was not significantly different from that of the control.

4.4 Onsite Environmental Observation

The result of the onsite observation of respondents' residence showed that equal number of cases and controls (35.3%) each fetched their drinking water from borehole. Slightly more controls (23.5%) than cases (17.6%) drink from tap. On the other hand more cases (17.6%) than controls (11.8%) drink from well sources. Other sources observed include sachet (pure) water and Vendors. Water samples were collected from all the sources for analysis and the result is as presented in tables 4.140a& – 4.180b. Also observed was the types and condition

of sanitary conveniences used by the cases and controls which ranges from water closet 52.9% versus 58.8%, , pit latrine 29.4% versus 35.3% and bush system(i.e. no facility) 17.6% versus 5.9%. 5.9%cases and 11.2% controls had their waste water connected to the central sewerage while 52.9% and 47.1% of the same group made use of soak away pit. It was interesting to observed that 44.4% versus 37.5% of the soak away pit used by the cases and controls respectively were just present but not functional. The level of non functionality ranges from broken/blocked chambers to over flown pits. Another feature observed was the complete absent of sanitary facility which subjected 17.6% cases and 5.9% controls to the unsightly practices of defecating in the bush (Table 4.13).

Equal proportion of cases and controls; 29.4%, 17.6%, 17.6% and 11.2% were found to dispose their solid waste by open dumping (Plate 4.2 and 4.3), pit dumping, refuse bin and open burning respectively. A higher proportion of the cases (23.5%) and controls (29.4%) have their waste collected and disposed by the AEPB (city service) (Plate 4.1). Vector control measure in terms of net on the window and doors was also checked. The result indicated the presence of net on 64.7% cases and 70.1% controls, but the available nets on half of these proportion windows were not functional. Fewer proportion of cases (29.4%) than controls (47.1%) used bed net (ITN) but above 50% in each case were not in good functional state (Plate 4.6).

Table 4.12: Number of persons sharing a sleeping room

No. of people sharing the same sleeping room	Cases	Controls	Total	Odds ratio	95% CI of odds ratio
	N (%)	N (%)	N (%)		
≥3 persons	29 (43.9)	24 (35.3)	53(39.6)	1.44	0.68-3.06
1-2 persons	37 (56.1)	44 (64.7)	81(60.4)		
Total	66 (100.0)	68 (100.0)	134		

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Table 4.13 Report of Observational Checklist

Environmental Indicators	Casescontrols	Present(%) Rank Controls
Housing:		
Type – duplex/flat	++	++
Low cost	++	++
Ventilation	+	+
Water:		
Source Tap	3(17.6)	4(23.5)
Borehole	6(35.3)	6(35.3)

Well	3(17.6)	2(11.2)
Sachet	2(11.2)	2(11.2)
Vendor	3(17.6)	3(17.6)++
	++	+++
	+++	++
	++	++
	++	++
	++	
Solid waste management		
Refuse bin	3(17.6)	3(17.6)
Open burning	2(11.2)	2(11.2)
Open dumping	5(29.4)	5(29.4)
Pit dumping	3(17.6)	3(17.6)
City Service (AEPB)	4(23.5)++	5(29.4)++
	++	++
	+++	+++
	++	++
	++	++
Sanitary Convenience		
Water closet	9(52.9)	10(58.8)
Pit latrine	5(29.4)	6(35.3)
Bush	3(17.6)+++	1(5.9)+++
	++	++
	++	++
Vector Control Measures		
Netted Window		12 (70.6)
Netted doors	++	9(52.9)
Bed net (ITN)	++	8(47.1)++
	++11(64.7)	++
	7(41.2)	++
	5(29.4)	
Waste water Management		
Central sewer		2(11.2)
Soak away pit	++	8(47.1)++
	++	++
	1(5.9)	
	9(52.9)	

Source: *Field Survey, 2009*

Key:

+++ = Highly present and functional

++ = Moderately present and moderately functional

+ = present but not functional

= absent

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Fig. 4.6 Insecticide treated net on a respondent's bed

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4.3.4.45 Physico-chemical Characteristics of Water Samples

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Twenty-five percent of samples (comprising 17 for cases and 17 for controls) were collected from sources via: tap, borehole, well, sachet and vendor. The samples were analysed for physico-chemical parameters like pH, Temperature, conductivity, total dissolved solids (TDS), Nitrate, chloride ion, and alkalinity; using the recommended standard methods described by the American Public Health Association (APHA, 1998). The results of the analysis are as shown in Tables 4.14& 4.15. The mean values of the parameters in ~~replicate~~ duplicate were found to be within the guidelines limits recommended by WHO and Standard organization of Nigeria (SON) for drinking water.

The mean value for pH, Temperature and TDS obtained from tap, borehole, well, sachet and vendor ranges from 7.00 ± 0.00 versus 6.96 ±0.14 – 7.00 ± 0.00, 21.4^{o}C ±0.00 – 25.0^{o}C ± 0.00 versus 22.47^{0}C ± 0.01 – 25.17^{0}C ± 0.01 and 37.00Mg/L ± 0.01 – 152Mg/L versus 29.33Mg/L ± 0.01 – 147 ± 0.02Mg/L among the cases and controls. The mean value for nitrate ranges from 0.33 ±0.01 – 1.30±0.00Mg/L versus 0.28 ± 0.5Mg/L – 1.2 ± 0.01Mg/L for tap sources, 0.36 ±0.01 to 9.23 ±0.03 Mg/L for borehole, 0.33 ±0.01 to 1.90 ±0.02Mg/L for well and 0.26 ±0.01 to 3.40 ±0.01Mg/L for vendor samples. These values corro~~lla~~borate with the WHO and SON limit of 50Mg/L.

The values for chloride ion and alkalinity also compares favourably with the recommended standard limits of 250Mg/L and 100Mg/L by WHO and SON respectively. The ranges obtained for the parameters from the various sources were 14.67 ± 0.03Mg/L - 38.47 ± 0.09Mg/L and 34.67 ± 0.01Mg/L – 98.67 ± 0.01Mg/L respectively.

4.3.4.56 Bacteriological Characteristics of water samples

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The presence of coliform organism in water is an indication of direct or indirect contamination by sewage or human/animal excrements. 76% of samples used by cases

indicated the presence of coliform organisms as compared to 64% of controls ($p>0.05$). Samples from well (17.6% cases versus 11.8% controls); vendor (17.6% cases versus 17.6% controls) and borehole 6.3% cases versus 0% controls) were found to be thus contaminated. Samples from tap and sachet were not indicative.

E.coli in water indicates feacal contamination in recent times. 21.4% of sources used by cases and 15.5% of samples for controls were contaminated with E.coli. Disaggregation by source showed that 17.6% sample for cases and 11.8% for controls from well and 5.9% for cases and 11.8% controls from vendors were thus contaminated. The adequacy of sources for consumption has a direct relationship with the presence or absence of Ecoli in the water.

Table 4.124a Mean Physico-chemical and Bacteriological characteristics of Tap water samples for Cases

Parameters	R1	R2	R3
pHPh	7.00±0.00[a]	7.00±0.00[a]	7.00±0.00[a]
Temperature(^{0}C)	25.0±0.00[a]	25.0±0.00[a]	25.0±0.00[a]
TDS (Mg/L)	39.67±0.01[a]	152.0±0.01[b]	42.33±0.02[a]
Nitrate(Mg/L)	1.30±0.00[a]	1.13±0.01[a]	0.33±0.01[b]
Cl- (Mg/L)	28.43±0.01[a]	14.26±0.00[b]	31.58±0.01[c]
Alkalinity (Mg/L)	93.67±0.01[a]	98.33±0.01[b]	58.00±0.02[c]
Coliform	Nil	Nil	Nil
E.coli	Nil	Nil	Nil

Source: Field Survey, 2009

*R1, R2, R3 = Sample Locations -(Mean value of triplicatereplicate analysis for each location)
** Duncan Multiple Range Test (DMRT)[abc,] Difference is significant at pMeans with the same superscripts are not significantly different along the same row (specific parameter) at p>0.05

Table 4.1245ba Mean Physico-chemical and Bacteriological characteristics of Tap water samples- for controls

Parameters	R1	R2	R3	R4
pHPh	7.00±0.009[a]	7.00±0.05[a]	6.96±0.14[a]	7.00±0.09[a]
Temp (^{0}C)	25.0±0.04[a]	25.0±0.02[a]	25.66±0.05[a]	25.0-±.08[a]
TDS (Mg/L)	80.67±0.01[a]	43.0±0.71[b]	80.0±0.71[a]	65.33±0.07[c]
Nitrate (Mg/L)	0.28±0.51[a]	1.2±0.01[b]	0.47±0.01[a]	0.37±0.01[a]
Cl- (Mg/L)	32.95±0.01[a]	31.48±0.00[a]	35.40±0.01[b]	38.47±0.09[c]
Alkalinity(Mg/L)	48.0±0.00[a]	45.0 ±0.01[b]	63.33 ±0.03[c]	62.66±0.01[c]
Coliform	Nil	Nil	Nil	Nil

E.coli	Nil	Nil	Nil	Nil

Source: Field Survey, 2009

*R1-R4 = Locations of sample (Mean value of triplicate~~replicate~~ analysis for each location)
** Duncan Multiple Range Test (DMRT)[abc,] Difference is significant at p>0.05

~~Means with the same superscripts are not significantly different along the same row (specific parameter) at p>0.05~~

Table 4.1~~3~~5a~~4b~~ Mean Physico-chemical and Bacteriological characteristics of Borehole samples for Cases

Parameters	R1	R2	R3	R4	R5	R6
~~Ph~~pH	6.93±0.01[a]	7.00±0.00[a]	6.87±0.01[a]	6.93±0.01[a]	7.00±0.01[a]	6.80±0.01[a]
Temperature(^{0}C)	25.0±0.00[a]	25.17±0.00[a]	23.83±0.02[a]	25.0±0.00[a]	25.0±0.00[a]	23.33±0.02[a]
TDS (Mg/L)	67.67±0.03[a]	70.33±0.01[a]	50.33±0.01[b]	131±0.02[c]	110.0±0.01[c]	71.33±0.01[a]
Nitrate (Mg/L)	0.57±0.01[a]	1.13±0.01[b]	1.17±0.01[b]	1.23±0.01[b]	1.26±0.01[b]	0.70±0.01[a]
Cl- (Mg/L)	23.77±0.01[a]	20.03±0.01[b]	18.02±0.01[bc]	24.77±0.01[a]	30.4±0.01[d]	17.03±0.01[c]
Alkalinity(Mg/L)	106±0.01[a]	98.67±0.0[1b]	99.33±0.01[b]	67.67±0.01[c]	67.47±0.02[c]	73.33±5.25[d]
Coliform	7.00±0.00[a]	4.66±0.01[b]	9.00±0.00[c]	7.00±0.01[a]	6.00±0.00d	6.00±0.01[d]
E.coli	0 (Nil)	0 (Nil)	0 .33±1.41	0 (Nil)	0 (Nil)	0 (Nil)

Source: Field Survey, 2009

*R1 - R6 = Sample locations (Mean value of replicate analysis for each location)
** ** Duncan Multiple Range Test (DMRT)[abcd,] Difference is significant at p>0.05

~~Means with the same superscripts are not significantly different along the same row (specific parameter) at p>0.05~~

Table 4.1~~3~~5b Mean Physico-chemical and Bacteriological characteristics of Borehole samples for controls

Parameters	R1	R2	R3	R4	R5	R6
pH	6.93±0.01[a]	6.67±0.00[a]	6.87±0.01[a]	6.87±0.01[a]	6.92±0.01[a]	7.01±0.00[a]
Temp (^{0}C)	22.47±0.01[a]	25.0±0.00[b]	25.67±0.03[c]	25.00±0.00[b]	25.17+0.01[b]	25.00±0.02[b]
TDS (Mg/L)	142±0.05[a]	147±0.02[b]	140±0.01[a]	64.67±0.01[c]	41±0.01[d]	39±0.02[d]
Nitrate ~~e~~(Mg/L)	0.36±0.01[a]	9.23±0.03[b]	3.53±0.02[c]	0.37±0.01[a]	1.23±0.02[d]	0.33±0.01[a]

Alkalinity(Mg/L)	43.33±0.01[a]	58.15±0.01[b]	34.67±0.01[b]	60.67±0.02[c]	63.67±0.01[c]	60.33±0.01[c]
Coliform	5.67±0.01[a]	6.67±0.01[ab]	6.67±0.01[b]	4.33±0.01a[b]	7.00±0.01[c]	9.33±0.03[d]
E.coli	0.00	0.00	0.00	0.00	0.00	1.00±0.01[b]

Source: Field Survey, 2009

*R1, R2, R3 = Locations of sample (Mean value of replicate analysis for each location)
** ~~Means with the same superscripts are not significantly different along the same row (sp~~** Duncan Multiple Range Test (DMRT)[abcd,] Difference is significant at p>0.05

~~ecific parameter) at p>0.05~~

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Table 4.1~~6~~a~~4c~~ Mean Physico-chemical and Bacteriological characteristics of Well samples

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for Cases

Parameters	R1	R2	R3
~~PH~~pH	6.47±0.01[a]	6.37±0.01[a]	6.87±0.01[b]
Temperature(^{0}C)	22.83±0.01[a]	23.80±0.01[a]	24.00±0.01[b]
TDS (Mg/L)	124.0±0.01[a]	127.33±0.01[a]	120.0±0.03[b]
Nitrate (Mg/L)	1.30±0.01[a]	1.30±0.01[a]	1.90±0.02[b]
Cl- (Mg/L)	46.86±0.02[a]	52.91±0.04[b]	51.41±0.02[b]
Alkalinity (Mg/L)	81.33±0.03[a]	87.33±0.01[b]	75.67±0.01[c]
Coliform	9.67±0.01[a]	15.00±0.02[b]	8.33±0.01[c]
E.coli	3.33±0.01[a]	3.00±0.00[a]	2.33±0.01[b]

Source: Field Survey, 2009

*R1, R2, R3 = Sample locations (Mean value of replicate analysis for each location)
** Duncan Multiple Range Test (DMRT)[abc,] Difference is significant at p>0.05
~~Means with the same superscripts are not significantly different along the same row (specific parameter) at p>0.05~~

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Table 4.146b5cd Mean Physico-chemical and Bacteriological characteristics of Well samples for controls

	R1	R2
pH	6.4±0.00[a]	6.4±0.01[a]
Temp (^{0}C)	21.5±0.00[a]	21.46±0.00[a]
TDS (Mg/L)	171.67±0.01[a]	167.00±0.02[a]
Nitrate (Mg/L)	016±0.03[a]	0.63±0.01[b]
Cl- (Mg/L)	36.20±0.01[a]	34.53±0.04[a]
Alkalinity (Mg/L)	44.67±0.71[a]	44.33±0.01[a]
Coliform	13.67±0.76[a]	5.67±0.01[b]
E.coli	3.33±0.01[a]	1.33±0.01[b]

Source: Field Survey, 2009

*R1& R2 = Sample lLocations ~~for sample collection~~ (Mean value of ~~replicate~~ triplicate analysis for each location)

** Duncan Multiple Range Test (DMRT)[ab,] Difference is significant at p>0.05

~~Means with the same superscripts are not significantly different along the same row (specific parameter) at p>0.05~~

Table 4.175a4d Mean Physico-chemical and Bacteriological characteristics of Sachet samples for Cases

Parameters	R1	R2
pH~~Ph~~	7.27±0.01[a]	6.93±0.01[a]
Temperature (^{0}C)	25.00±0.00[a]	25.17±0.01[a]
TDS (Mg/L)	43.67±0.01[a]	37.00±0.01[b]
Nitrate (Mg/L)	0.40±0.02[a]	0.36±0.05[a]
Cl- (Mg/L)	19.76±0.01[a]	25.53±0.03[b]
Alkalinity (Mg/L)	57.67±0.02[a]	55.33±0.03[b]
Coliform	1.00±0.00[a]	0.00±0.01[b]
E.coli	Nil	Nil

Source: Field Survey, 2009

*R1 & R2 Sample locations (Mean value of replicate analysis for each location)

** ** Duncan Multiple Range Test (DMRT)[ab,] Difference is significant at p>0.05

~~Means with the same superscripts are not significantly different along the same row (specific parameter) at p>0.05~~

Table 4.157~~b5d~~c Mean Physico-chemical and Bacteriological characteristics of Sachet samples for controls

Parameters	R1	R2
pH	7.00±0.00[a]	6.93±0.01[a]
Temp (^{0}C)	25.0±0.00[a]	25.00±0.00[a]
TDS (Mg/L)	29.33±0.01[a]	43.67±0.01[a]
Nitrate (Mg/L)	0.33±0.01[a]	0.33±0.01[a]
Cl- (Mg/L)	17.64±0.02[a]	14.67±0.03[b]
Alkalinity (Mg/L)	64.33±0.01[a]	60.67±0.02[b]
Coliform	0.66±0.01[a]	1.00±0.01[b]
E.coli	0	0

Source: Field Survey, 2009

*R1, R2, R3 = Sample l~~L~~ocations ~~for sample collection~~ (Mean value of ~~replicate~~triplicate analysis for each location)

** ~~Means with the same superscripts are not significantly different along the same row (sp~~ Duncan Multiple Range Test (DMRT)[abc,] Difference is significant at p>0.05

~~ecific parameter) at p>0.05~~

Table 4.168~~a4e~~ Mean Physico-chemical and Bacteriological characteristics of Vendor samples for Cases

Parameters	R1	R2	R3
pH~~Ph~~	6.83±0.01[a]	6.93±0.01[a]	6.83±0.02[a]
Temp (^{0}C)	25.00±0.00[a]	24.12±0.01[a]	25.00±0.00[a]
TDS (Mg/L)	115.33±0.01[a]	96.33±0.03[b]	48.67±0.01[c]
Nitrate(Mg/L)	0.26±0.01[a]	0.70±0.02[b]	0.53±0.04[c]
Cl- (Mg/L)	29.60±0.01[a]	33.67±0.01[b]	19.91V0.01[c]
Alkalinity (Mg/L)	102.67±0.01[a]	59.67±0.03[b]	99.33±0.01[a]

Coliform	7.66±0.01[a]	5.67±0.01[b]	6.00±0.01[b]
E.coli	1.67±0.02[a]	1.33±0.01[ab]	1.00±0.01 [b]

Source: Field Survey, 2009

*R1, R2, R3 = Sample locations (Mean value of triplicate~~replicate~~ analysis for each location)
** Duncan Multiple Range Test (DMRT)[abc,] Difference is significant at p>0.05

~~Means with the same superscripts are not significantly different along the same row (specific parameter) at p>0.05~~

Table 4.16~~8~~b Mean Physico-chemical and Bacteriological characteristics of Vendor samples for controls

	R1	R2	R3
pH	6.93±0.01[a]	6.86±0.01[a]	6.87±0.01[a]
Temp (^{0}C)	25.67±0.01[a]	25.0±0.00[a]	25.0±0.00[a]
TDS (Mg/L)	158.67±0.01[a]	131±0.03[b]	149.33±0.02[c]
Nitrate (Mg/L)	1.06±0.01[a]	0.16±0.01[b]	3.40±0.01[c]
Cl- (Mg/L)	33.22±0.02[a]	28.86±0.01[b]	68.89±0.01[c]
Alkalinity (Mg/L)	46.67±0.01[a]	98.00±0.01[b]	98.67±0.01[b]
Coliform	6.67±0.02[a]	7.33±0.01[b]	3.67±0.01[c]
E.coli	2.00±0.01[a]	1.67±0.01[b]	0.00

Source: Field Survey, 2009

*R1, R2, R3 = Sample locations (Mean value of triplicate analysis for each location)
** ** Duncan Multiple Range Test (DMRT)[abc,] Difference is significant at p>0.05

~~Means with the same superscripts are not significantly different along the same row (specific parameter) at p>0.05~~

~~Table 4.15a Mean Physico-chemical and Bacteriological characteristics of Tap samples for controls~~

~~Parameters~~	~~R1~~	~~R2~~	~~R3~~	~~R4~~
~~Ph~~	~~7.00±0.009[a]~~	~~7.00±0.05[a]~~	~~6.96±0.14[a]~~	~~7.00±0.09[a]~~
~~Temp (^{0}C)~~	~~25.0±0.04[a]~~	~~25.0±0.02[a]~~	~~25.66±0.05[a]~~	~~25.0 ±.08[a]~~
~~(Mg/L)~~	~~80.67±0.01[a]~~	~~43.0±0.71[b]~~	~~80.0±0.71[a]~~	~~65.33±0.07[c]~~
~~Nitrate (Mg/L)~~	~~0.28±0.51[a]~~	~~1.2±0.01[b]~~	~~0.47±0.01[a]~~	~~0.37±0.01[a]~~

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Cl- (Mg/L)	32.95±0.01[a]	31.48±0.00[a]	35.40±0.01[b]	38.47±0.09[c]
Alkalinity(Mg/L)	48.0±0.00[a]	45.0 ±0.01[b]	63.33 ±0.03[c]	62.66±0.01[c]
Coliform	Nil	Nil	Nil	Nil
E.coli	Nil	Nil	Nil	Nil

Source: Field Survey, 2009

*R1-R4 = Locations of sample (Mean value of replicate analysis for each location)
** Means with the same superscripts are not significantly different along the same row (specific parameter) at p>0.05

Table 4.15b Mean Physico-chemical and Bacteriological characteristics of Borehole samples for controls

Parameters	R1	R2	R3	R4	R5	R6
pH	6.93±0.01[a]	6.67±0.00[a]	6.87±0.01[a]	6.87±0.01[a]	6.92±0.01[a]	7.01±0.00[a]
Temp (^{0}C)	22.47±0.01[a]	25.0±0.00[b]	25.67±0.03[c]	25.00±0.00[b]	25.17+0.01[b]	25.00±0.02[b]
TDS (Mg/L)	142±0.05[a]	147±0.02[b]	140±0.01[a]	64.67±0.01[c]	41±0.01[d]	39±0.02[d]
Nitrate (Mg/L)	0.36±0.01[a]	9.23±0.03[b]	3.53±0.02[c]	0.37±0.01[a]	1.23±0.02[d]	0.33±0.01[a]
Alkalinity(Mg/L)	43.33±0.01[a]	58.15±0.01[b]	34.67±0.01[b]	60.67±0.02[c]	63.67±0.01[c]	60.33±0.01[c]
Coliform	5.67±0.01[a]	6.67±0.01[ab]	6.67±0.01[b]	4.33±0.01a[b]	7.00±0.01[c]	9.33±0.03[d]
E.coli	0.00	0.00	0.00	0.00	0.00	1.00±0.01[b]

Source: Field Survey, 2009

*R1, R2, R3 = Locations of sample (Mean value of replicate analysis for each location)
** Means with the same superscripts are not significantly different along the same row (specific parameter) at p>0.05

Table 4.15c Mean Physico-chemical and Bacteriological characteristics of Sachet samples for controls

Parameters	R1	R2
pH	7.00±0.00[a]	6.93±0.01[a]
Temp (^{0}C)	25.0±0.00[a]	25.00±0.00[a]
TDS (Mg/L)	29.33±0.01[a]	43.67±0.01[a]
Nitrate (Mg/L)	0.33±0.01[a]	0.33±0.01[a]

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Cl- (Mg/L)	17.64±0.02[a]	14.67±0.03[b]
Alkalinity (Mg/L)	64.33±0.01[a]	60.67±0.02[b]
Coliform	0.66±0.01[a]	1.00±0.01[b]
E.coli	0	0

Source: Field Survey, 2009

*R1, R2, R3 = Location for sample collection (Mean value of replicate analysis for each location)
** Means with the same superscripts are not significantly different along the same row (specific parameter) at p>0.05

Table 4.15d Mean Physico-chemical and Bacteriological characteristics of Well samples for controls

	R1	R2
pH	6.4±0.00[a]	6.4±0.01a
Temp (^{0}C)	21.5±0.00[a]	21.46±0.00[a]
Mg/L)	171.67±0.01[a]	167.00±0.02[a]
Nitrate (Mg/L)	016±0.03[a]	0.63±0.01[b]
Cl- (Mg/L)	36.20±0.01[a]	34.53±0.04[a]
Alkalinity (Mg/L)	44.67±0.71[a]	44.33±0.01[a]
Coliform	13.67±0.76[a]	5.67±0.01[b]
E.coli	3.33±0.01[a]	1.33±0.01[b]

Source: Field Survey, 2009

*R1& R2 = Location for sample collection (Mean value of replicate analysis for each location)
** Means with the same superscripts are not significantly different along the same row (specific parameter) at p>0.05

Table 4.15e Mean Physico-chemical and Bacteriological characteristics of Vendor samples for controls

	R1	R2	R3
pH	6.93±0.01[a]	6.86±0.01[a]	6.87±0.01[a]
Temp (^{0}C)	25.67±0.01[a]	25.0±0.00[a]	25.0±0.00[a]
TDS (Mg/L)	158.67±0.01[a]	131±0.03[b]	149.33±0.02[c]

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Nitrate (Mg/L)	1.06±0.01[a]	0.16±0.01[b]	3.40±0.01[c]
Cl (Mg/L)	33.22±0.02[a]	28.86±0.01[b]	68.89±0.01[c]
Alkalinity (Mg/L)	46.67±0.01[a]	98.00±0.01[b]	98.67±0.01[b]
Coliform	6.67±0.02[a]	7.33±0.01[b]	3.67±0.01[c]
E.coli	2.00±0.01[a]	1.67±0.01[b]	0.00

4.3.5 Housing Conditions

The type of house occupied by the respondent ranges from duplex/flats with 36 (53.0%) controls and 25 (37.9%) cases claiming residence in such apartments. 18 (27.3%) cases and 15 (22.1%) controls resided in low cost housing whereas majority cases 23 (34.8%) and controls 17 (25%) find their abode in single room apartment (commonly known as face me, I face you). The number of occupants per sleeping room was also assessed and the result obtained indicated 56.1% cases and 64.7% controls had the ideal number of persons (1 – 2) sleeping in their room, while 29 (43.9%) cases and 24 (35.3%) controls share their sleeping room with two others or above. Table 4.12 summarizes the number of persons sharing a sleeping room by the cases and the controls. The odds ratio estimate of 1.44 (95%CI: 0.68-3.06) signifies that the odds of inadequate sleeping condition (>3 persons) among the cases was not significantly different from that of the control.

4.4 Onsite Environmental Observation

The result of the onsite observation of respondents' residence showed that equal number of cases and controls (35.3%) each fetched their drinking water from borehole. Slightly more controls (23.5%) than cases (17.6%) drink from tap. On the other hand more cases (17.6%) than controls (11.8%) drink from well sources. Other sources observed include sachet (pure) water and Vendors. Water samples were collected from all the sources for analysis and the result is as presented in tables 4.14 - 4.18. Also observed was the types and condition of sanitary conveniences used by the cases and controls which ranges from water closet 52.9% versus 58.8%, , pit latrine 29.4% versus 35.3% and bush system(i.e. no facility) 17.6% versus 5.9%. 5.9%cases and 11.2% controls had their waste water connected to the central sewerage while 52.9% and 47.1% of the same group made use of soak away pit. It was interesting to observed that 44.4% versus 37.5% of the soak away pit used by the cases and controls respectively were just present but not functional. The level of non functionality ranges from broken/blocked chambers to over flown pits. Another feature observed was the complete

absent of sanitary facility which subjected 17.6% cases and 5.9% controls to the unsightly practices of defecating in the bush (Table 4.13).

Equal proportion of cases and controls; 29.4%, 17.6%, 17.6% and 11.2% were found to disposed their solid waste by open dumping (Plate 4.2 and 4.3), pit dumping, refuse bin and open burning respectively. A higher proportion of the cases (23.5%) and controls (29.4%) have their waste collected and disposed by the AEPB (city service) (Plate 4.1). Vector control measure in terms of net on the window and doors was also checked. The result indicated the presence of net on 64.7% cases and 70.1% controls, but the available nets on half of these proportion windows were not functional. Fewer proportion of cases (29.4%) than controls (47.1%) used bed net (ITN) but above 50% in each case were not in good functional state (Plate 4.6).

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Table 4.17: Number of persons sharing a sleeping room

No. of people sharing the same sleeping room	Cases	Controls	Total	Odds ratio	95% CI of odds ratio
	N (%)	N (%)	N (%)		
≥3 persons	29 (43.9)	24 (35.3)	53(39.6)	1.44	0.68-3.06
1-2 persons	37 (56.1)	44 (64.7)	81(60.4)		
Total	66 (100.0)	68 (100.0)	134		

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Table 4.18 Report of Observational Checklist

Environmental Indicators	Cases	Controls
Housing:		
Type – duplex/flat	++	++
Low cost	++	++
Ventilation	+	+
Water:		
Source – Tap	++	++
Borehole	+++	+++
Well	++	++
Sachet	++	++
Vendor	++	++
Solid waste management		
Refuse bin	++	++
Open burning	++	++
Open dumping	+++	+++
Pit dumping	++	++
City Service (AEPB)	++	++
Sanitary Convenience		
Water closet	+++	+++
Pit latrine	++	++
Bush	++	++
Vector Control Measures		
Netted Window	++	++
Netted doors	++	++
Bed net (ITN)	++	++
Waste water Management		
Central sewer	++	++
Soak away pit	++	++

Source: *Field Survey, 2009*

Key:
+++ = Highly present and functional
++ = Moderately present and functional
+ = present but not functional
- = absent

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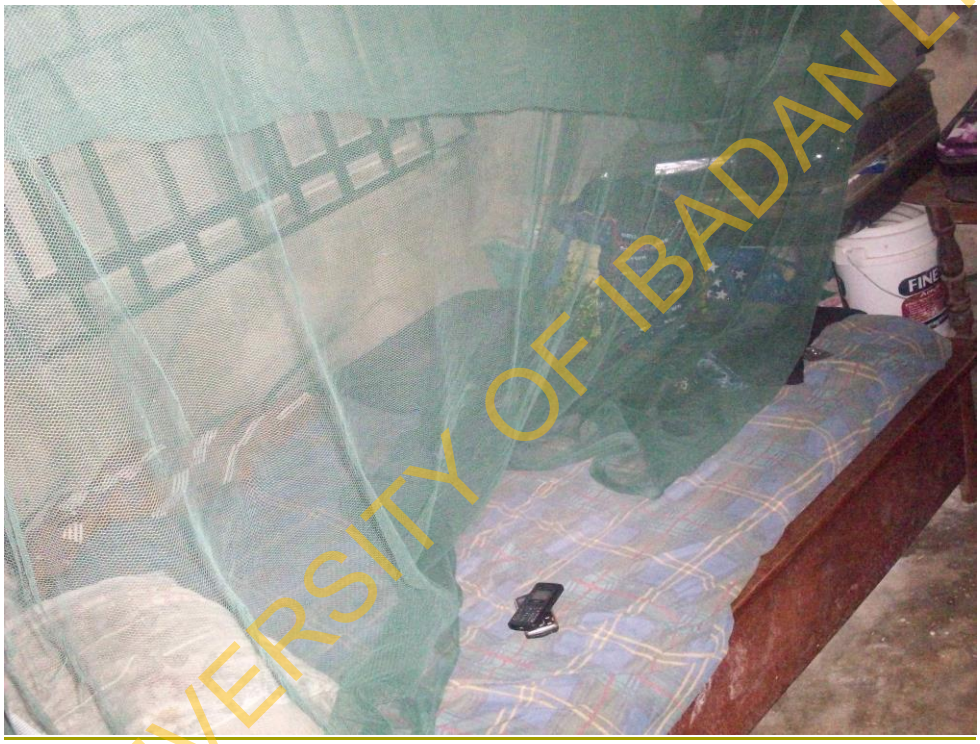

Plate. 4.6 Insecticide treated net on a respondent's bed

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4.5 Hygiene factors influencing opportunistic infection among people living with HIV/AIDS in Abuja.

As shown in Table 4.19, after adjusting for the effect of group, the PLWHAs using sanitary facilities other than Water Closet (WC) were more (AOR=2.79) likely to have OI.

Table 4.19 Influence of sanitary facility on OI

Hygiene factors	Adjusted OR (95%CI)
Sanitary facility (type of toilet facilities used)	
Water Closet system*	1.00
Others* (pit latrine, bucket system, bush)	2.79(1.01, 7.69)
Group	
Control *	1.00
Case	15.37(4.22, 55.98)

Reference category

Table 4.20 shows that hand washing after toilet use had no significant association with having OI among the PLWHAs.

Table 4.20 Influence of hand washing after toilet use on OI

Hygiene factors	AdjustedOR 95%CI)
Do wash hands with soap immediately after toilet use	
Yes*	1.00
No	1.66(0.60, 4.62)
Group	
Control *	1.00
Case	14.77(4.15, 52.54)

Reference category

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Table 4.21 shows that the type of solid waste disposal used by PLWHAs had no significant association with having OI.

Table 4.21 Influence of solid waste disposal on OI

Hygiene factors	Adjuste OR (95%CI)
Solid waste disposal (method of disposal)	
Use of waste bin*	1.00
Dumping into pit	0.96(0.32, 2.88)
Others	1.11(0.37, 3.35)
Group	
Control *	1.00
Case	14.16(4.02,49.92)

Reference category

Table 4.22 shows that the water sources of PLWHAs during rainy season had no significant association with having OI.

Table 4.22 Influence of water source during rainy season on OI

	AdjustedOR 95%CI)
Drinking water source (rainy season)	
Tap water	1.00
Borehole	2.43(0.81, 7.30)
Others	1.72(0.48, 6.11)
Group	
Control *	1.00
Case	15.29(4.27, 54.73)

Reference category

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Table 4.23 shows that the water sources of PLWHA during dry season had no significant association with having OI.

Table 4.23 Influence of water source during dry season on OI

	AdjustedOR(95%CI)
Drinking water source (dry season)	
Tap water	1.00
Borehole	1.24(0.42, 3.69)
Others	1.68(0.44, 6.34)
Group	
Control *	1.00
Case	13.61(3.85, 48.07)

Reference category

Source: Field Survey, 2009

*R1, R2, R3 = LSample locations for sample collection (Mean value of replicatetriplicate analysis for each location)

** Means with the same superscripts are not significantly different along the same row (specific parameter) at p>0.05

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CHAPTER FIVE

DISCUSSION

This chapter focuses on the implications of the findings of the study. It starts by considering the socio-demographic characteristics of the respondents, followed by the section on common infections/diseases including OIs presented by the respondents: cases and controls. The third section highlights the respondents' knowledge on the environmental influences on health. The fourth section addresses the practices ises the practices on relation to the environmenttal factors and how these may influence infections. This is followed by the prevailing/existing factors in the respondents' residents as captured by the onsite observations and finally the quality of the water samples collected from different sources at the respondents' residents.

5.1 Socio Demographic Characteristics of Respondents

There were no significant differences in the sex and age of respondents though slight disparities occur within groups. The mean age of respondents was cases 35.9± 6.7 and

controls 34.4 ± 7.0 years. Majority of cases and controls fell within the 30 – 39 years age bracket. This confirmed the fact that this age group has the highest HIV/AIDS prevalence in the country (NDHS, 2008; FMoH/NASCP, 2007). The next highest category were those >40 years who were found predominantly among the cases. Globally more females are infected with HIV and AIDS than males (WHO/UNAIDS, 2006; FMoH, 2007c). Similarly, more females consented to this study than males. This disparity can also be attributed to the fact that females of reproductive age discover their status during antenatal clinics- a general clinic attendance prerequisite in the country and also an entry point to prevention of mother to child transmission of HIV infection – PMTCT (Kanki and Adeyi~~Adeyi et al~~, 2006); while their spouses may not agree to be tested. On the contrary the males get tested during the later phase of the infection which may be as a result of persistent illness or one compulsory condition or the other hence more males among the cases.

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Most of the cases and controls were married persons; this was followed by the unmarried. A good fraction of the respondents were widows/widowers. According to them, they lost their partner to AIDS complications: a situation that led to the discovery of their HIV status. This report affirms the increase AIDS mortality as well as children made orphaned and vulnerable to the epidemic (UNAIDS/WHO, 2006). The highest proportion of the cases and controls had attended tertiary education, followed by those that had secondary education. These levels coincided with the high proportion of civil servants and business merchants who constitute the cases and controls and are the predominant inhabitants of the territory (AMAC Development update, 2008). Furthermore, this people are the employees in the Federal ministries and parastatals. The three major tribes in the country were duely represented in the research, none the less majority of the cases and controls were Igbos followed by Hausas. Chri~~sa~~tian respondents were more than the Muslims who were less among the controls than cases.

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5.2 Common infections/Diseases Presented by the Respondents

The result of the survey revealed different infections/diseases presented by the respondents in the past two years before the study. Majority of the respondents: cases and controls had presented with at least 2 – 3 episodes of malaria/fever. The cases came down more frequently

with this condition than the controls. This is because cases were clienteles at the symptomatic and advanced stage of HIV infections characterized by low CD4+ cells count (WHO, 2007), resulting from increased circulating free viruses in the system (Plantier et al, 2003). The compromised immune system therefore paves way for these conditions. Besides these conditions may be an indication for a more serious illness. Poor environmental conditions like refuse dumping round the house, un-cleared bushes, stagnant water around the dwellings fuels the propagation of malaria vector in the surrounding. More interestingly, most clients do not use vector control measures like nets on windows and doors, no fumigation of their surroundings. Coupled with their compromised immunity malaria continues to remain the hall mark of HIV and AIDS not only in Nigeria but also in other developing nations of the world.

As one of the AIDS defining conditions (WHO, 2007), Oral thrush; a fungal infection was also found among the respondents, predominantly among the cases. Ekong et al (2000) in their studies stated that the most common fungal infection prevalent among PLWHAs in Nigeria was oropharyngeal candidiasis (oral thrush). Another AIDS defining OI presented by the cases was TB. The proportion of respondents co-infected with TB was the same with FMoH (2005) reported cases of HIV/TB co-infection. Other infections suffered by the cases include herpes, dementia, diarrhea, extreme weight loss (>10% body weight) and upper respiratory tract infection.

5.3 Knowledge on Effect of Environmental Influence on Health

A greater percentage of cases and controls knew that poor environmental conditions have adverse effect on health status and a double score on persons with compromised immune system. This is in line with Park (2005) assertion that the key to health lies largely on the environment and a deviation of any factor in the environment result in ill health. Also the relationship between environment and health are dictated by certain environmental conditions that precipitate the excessive presence or relative lack of certain disease pathogens (Verhasset, 1986). Majority of the cases and controls agreed to the fact that drinking of contaminated water can influence the occurrence of some OIs among PL+. Poor water quality is a threat to human health as such water usually contaminated with vast array of

disease agents. Diarrhea being one of the major treat to PLWHAs all over the world especially in developing countries is associated with unsafe water and most of the respondents reported a bout of diarrhea at one time or the other.

Suffice to say that the knowledge of respondents on effect of environmental risk factors on health was not commensurate with practices. The survey indicated that most of the respondents – cases and controls fetched their drinking water from sources found to be contaminated. This trend is due to what is available in their locality. However, though awareness and education has been provided on the importance of drinking potable water in the health facilities, practices on water handling and treatment was still low among the respondents. The introduction and provision of water guard (Cl solution) free to PLWHA in Abuja has been of considerable advantage though some respondents still reported non-use once the free stock was exhausted while others resent the taste of the disinfectant in water. The cases and controls also expressed good knowledge on the effect of overcrowding as a source of cross infection among sick people which is supported by the study reported by Coetzee (1988) that overcrowding increases the risk of infectious disease. However, the high cost of renting an apartment in the FCT and the economic status of most respondents to this study hinders the expression of this knowledge. The unchecked immigration of people into the FCT in search of greener pastures (job) further compounded the issue by increasing the number of squatters in an apartment.

5.4 **Hygiene Practices**

The attitude and behavior of individuals concerning things affecting their health are formed at an early stage in life. Knowledge and understanding of health may reinforce already established attitude and practices while new knowledge may cause people to develop new attitudes. Among issues directly related to hygiene, the survey reveals that hygiene practices in terms of frequency of bath taking and hand washing with soap after toilet use between cases and controls were similar. Majority of the cases 65.1% and controls 63.2% reported hand washing with soap after toilet use. This practice corroborates the high level of knowledge of the cases and controls to the fact that "good hygiene is a weapon in reducing infection". Moreso, one of the key components of the on-going counseling for the clients in

the two facilities studied is positive living with special emphasis on hygiene practices. Since the main highway for the spread of pathogens are the hands and hand & food contact, hand washing at critical times as stated by Bloomfield (2007) is central to breaking the chain of infection transmission. According to UNICEF (2006), hand washing in the past few years had led to significant reduction in diarrhoea transmission: one of the hallmarks of HIV/AIDS that results in substantial degree of morbidity and mortality. PLWHA due to their weakened immune system are more susceptible to diarrhea infection. Diarrhoeagenic pathogens in HIV/AIDS are highly infectious and about 90% of these people in Africa suffer from chronic diarrhea hence improvement of hygiene practices are effective means of reducing global burden of diarrhea disease.

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5.5 Sanitatryion Practices

Sanitation facilities at the respondents' disposal as elucidated by the survey includes water closet considered as adequate, and unhygienic/inadequate types like bush, pit latrine and bucket system. Two-third of the cases (66.7%) versus controls (63.7%) use the water closet with no significant difference at 95% confidence interval. This proportion agrees with the percentage of people (59%) worldwide having access to improved sanitation facilities in 2004 as well as 60% of total populations of Africans with basic sanitary facilities (WHO/UNICEF, 2006). The survey further revealed that major part of Abuja metropolis is connected to central sewerage while the adjoining residential areas make use of septic tank system. Nevertheless, some pockets of houses still exist mostly in the rural areas without any form of facility hence the use of bushes. This practice can lead to contamination of surface and ground water sources as well as increased occurrence of infections like diarrhoea. Also the unsightly nature of this method renders the surrounding untidy and odour prone.

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5.6 Solid Waste Management Practices

The solid waste management practices in terms of frequency of waste disposal from point of generation and the method(s) of disposal were not significantly different between the cases and controls. Varying proportions of cases 65.1% and controls 77.3% disposed of their waste

daily or twice daily from point of generation also 59.1% cases and 58.8% controls make use of refuse bin or city services as a means of waste disposal. This result contradicts the survey conducted by UNICEF/FOS (1997) which stated that only 13% of Nigerians disposed their waste through Government or personal bins. The practice of inadequate waste disposal as observed by 40.9% of cases and 41.2% of controls could be adduced to the fact that city service truck does not reach their localities on regular intervals or not at all. These lapses has given rise to refuses hips on the roads and/or over flown bins by the roadsides thereby constituting environmental nuisance and a serious health threat. However the result of this study showed that method of solid waste disposal used by respondents: cases and controls had no significant association with having OI.

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5.7 ~~Practices on~~ **Housing** Related Practices

The result of this survey indicated a significant difference in the number of occupants per sleeping room among the cases and the controls. Majority of the controls (64.7%) reported having an ideal number (i.e. 2 persons/sleeping room) as compared to the cases. This practice is in accordance with the recommended persons per sleeping room by Salvato, (1992). On the other hand more cases reported sleeping with up to 3 or more persons per room; one of the indications of substandard dwelling as reported by the American Public health Association (1949) that the approve number of persons per sleeping room is 1.51 (≅ 2 persons) per room in a dwelling unit. This number constitutes overcrowding in the sleeping room. Over crowding is a serious health hazard. Barker et al (2000) stated that "crowding has long been known to increase the risk of infectious disease" like Tuberculosis (Coetzee 1988), and hepathitis B; a typical condition prevalent among this group. However, this practice was not in consonant with the high level of knowledge displayed by these groups on the effect of crowding and cross infection especially of communicable diseases. Nevertheless, living standard in terms of number of occupant and type of housing is a function of economic status. The median income of cases and controls alike is ~~meagre~~meager as compared to the cost of renting an apartment that will provide for enough space for their family members

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besides other necessary expenses. Furthermore~~Besides~~, some of the junior cadre staff of the Federal government ~~were~~was allocated just a room per person irrespective of family size.

5.8 Practices Associated with Drinking Water

The survey reveals that twenty-four percent of cases obtained their drinking water from inadequate sources as compared to 9% of controls. Furthermore, the cases had significantly higher proportion of persons (25.8%) indulging in unwholesome practices of fetching water with containers without lid irrespective of the distance as opposed to controls (8.8%). However water treatment practices of the cases and controls were not significantly different. Though the respondents: cases and controls had good knowledge on the importance of safe water to health, their knowledge was not in consonance with practices. The sources of water utilized by the cases and controls were solely dependent on availability. This is in collaboration with the NDHS (2003) report that sources of water varies considerably by place of residence and fewer households with disparities in rural and urban areas can draw tap water into their yard (6.6%), and only 24.0% used protected well. However, the sources of water used by the cases and controls had no significant association with the occurrence of OIs. Never the less, water handling including ~~C~~containers used in fetching water from source can impinge directly or indirectly on water quality; pathogens in the air can easily find their way into the water thereby posing additional challenge to the water quality and eventually the health of the consumer. Contaminated water sources are vehicles for the transmission of water-borne diseases including diarrhoea and 88% of diarrhoea cases in the world are attributable to unsafe water. These pathogens have been identified as causes of diarrhoea in HIV/AIDS persons hence the implication of water quality in some clinical manifestations. This is in line with the report of Clark (1999) that high burden of diarrhoea among PLWHA is common in developing countries especially in communities with inadequate water supply. Diarrhoea is the major cause of hospital admission among PLWHA and persistence diarrhoea is one of the AIDS defining conditions (OI) responsible for high mortality in this group (Janoff and Smith, 1998; Prasad et al, 2000 and Obi and Bessong, 2002).

5.9 Physico-chemical Characteristics of Water Samples

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The results of the survey showed that there was no significant difference in the mean values obtained for pH, Temperature, conductivity, TDS, Nitrate, chloride ion and alkalinity from tap, borehole, well, sachet and vendor among the cases and controls. The concentration of these parameters was within the recommended guideline limits recommended by WHO and/or SON. However the mean pH obtained from tap, borehole, and vendor for both cases and controls describes a neutral solution, while that of well samples was slightly alkaline. Though no health effect can be attributable to the consumption of this water but it can reduce the lathering potential of soap during washing and bathing. The mean TDS concentration for well samples was higher than that of other sources, according to WHO (1984). This may be the reason for turbid colour. Also high TDS concentration in water may not have serious health effect, it can alter the electrolytic balance in the body as well as gastrointestinal irritation, hence values above 100mg/l are not recommended (WHO 1991). For chloride ion (Cl^-), although the concentrations observed were within the acceptable limits, the value for well samples for both cases and controls and that of vendor for controls were slightly high. According to APHA (1984), high Cl^- content of water is an indication of sewage contamination. Also the content of Cl^- in polluted water is a rough estimate of the degree of pollution of such water especially the case with well waters. Sewage contamination of water sources is as a result of poor animal and human excreta disposal (Sridhar, 2000)., cConsequently loading the water with diverse pathogenic organisms. Obviously, consumption of such water is a major exposure route for water borne infections like diarrhea.

5.10 Bacteriological Characteristics of Water samples

Based on the results of the bacteriological analysis of water samples, the presence of coliform organism varies with sources of water. It was observed that coliform organisms were not indicated in all water samples from tap and sachet water for both cases and controls. Since coliform organisms have long been recognized as a suitable indication for drinking-water quality, these sources may be said to be adequate or potable. Forthwith the WHO guideline and SON recommended standard for drinking water certifies sources without these organisms potable hence suitable for human consumption. One may then want to ask "how many households in our country are making use of such: surprisingly only 10.6% of Nigeria population can boast of tap water in their premises (NDHS, 2003). Almost like the afore

mentioned sources, there was no indication of coliforms in samples from boreholes source except for one source utilized by a case. The result further reveals that majority of cases and controls drink from borehole. Almost all the sample from well indicated the presence of coliform organism. This is in concert with the earlier report in this study which shows presence of Cl^- in well samples; an indication of sewage contamination of that source. All samples from water vendor for both cases and controls indicated the presence of indicator organisms. The source of the contamination is most likely due to handling and the sanitary conditions of the containers used in fetching water. From personal observation, most of the vendors themselves are quite unkempt and the containers constitute an eye-saw. However, direct or indirect contamination of water by sewage or human and/or animal excrements is the wide spread danger associated with drinking water. Most pathogenic contaminants from sewage are diarrhoeagenic., ~~, and~~ ~~i~~Inadequate and unsafe water, poor sanitation and unsafe hygiene practices remain a veritable vehicle of transmission (Wilson, 2005).

5.10.1 E.coli in Water Samples

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The findings of this study reveal that, E.coli was not present in the samples from tap, borehole and sachet water for both cases and controls. This means that there was no fecal contamination of the sources in recent times. This further strengthen the consideration of water from these sources suitable for drinking, granted that hygienic handling of the water will be strictly adhered to. The present of E.coli was detected in samples from well and vendors for both cases and controls. E.coli is abundant in human and animal feces and its detection in water indicates a recent fecal contamination of that water. These organisms can be consumed through water or food, either way it is incriminated in most diarrhea cases. E.coli is one of the causes of infective diarrhea among PLWHA (Obi et al, 2003).

CHAPTER SIX

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CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

The study assessed the influence of the physical environmental factors on the occurrences of opportunistic infections among people living with HIV and AIDS: cases and controls in Abuja. Though the respondents; cases and controls displayed good knowledge on the

environmental influences on health, their knowledge in some instances were not commensurate with practices.

The finding of this study showed that practices on drinking water in terms of sources and treatment administered to the water before consumption differs significantly between cases and controls.

Majority of the controls fetched their drinking water from sources found not to be contaminated unlike their counterpart in the other group – cases. The controls were also found to be treating their water before consumption.

The consumption of water from contaminated sources by most cases led to ingestion of different disease pathogens. Some of these agents which include E.coli are the causative agent for diarrhea which results in high morbidity and mortality. Hence there is an association between the occurrence of water related opportunistic infections and the consumption of unwholesome water.

The cases were also found to have higher number of persons per sleeping room; an indication of crowded space in the living apartment. The inadequate practices on housing are incriminated in cross infection with communicable disease like tuberculosis, one of the major OIs threatening PLWHA in Nigeria and other respiratory track infections.

Inadequate disposal of solid waste: open dumping near residence and along road-sides was found to be a common practice among the cases and controls. This is another major factor of cross infection through flies and rodents. It can as well serve as a breeding ground for malaria vector. Malaria though not an OI is a major threats to PLWHA, infection with and being vulnerable to such further deplete compromises the immune system and pave way for other opportunistic infections

6.2 **Recommendations**

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1. Water is essential to life and access to safe water is a fundamental need. Therefore potable water sources should be provided for the people especially those with compromised immune system.

2. The world bank project on provision of potable water to all – an effort towards achieving the MDG on water supply should be earnestly revisited and completed.
People living with HIV and AIDS and their care givers should improve on their safe practices on drinking water. This effort should be extended to rural communities who are most deficient.

3. Behavior change is a function of knowledge; PLWHA should be enlightened on the importance of safe water to their health. Emphasis on this should be on water treatment, sources of water deemed to be potable for consumption, proper storage and hygienic ways of handling drinking water from source to the point of consumption.

4. Furthermore, since the lowly placed constitute the fastest growing sector of HIV and AIDS, are the most affected, water treatment with locally available materials (like the Moringa plant) should be advertised and encourage.

5. Further research on this subject across States, Goe-political zones in the country is highly advocated. Such studies should be expanded to cover pathological differentials of organisms in water samples, indoor air quality among other environmental health factor.

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APPENDIX I

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QUESTIONNAIRE

Dear respondent,

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I am a Post Graduate Student in the Dept. of Epidemiology, Med. Statistics, & Environmental Health, University of Ibadan. I am carrying out a research on the Environmental risk factors that may influence Opportunistic Infections among PLWHAs in Abuja.I hereby request your voluntary participation in the research by providing appropriate

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response to the questions below. Information given by you will not be disclosed in any way, since absolute confidentiality would be maintained.

Findings from this research would also be useful in future as a guide towards developing adequate intervention strategies to those environmental factors thereby improving health and longevity of PLWHAs.

Thanks in anticipation of your cooperation.

SERIAL NUMBER_____

SECTION A: SOCIO – DEMOGRAPHIC INFORMATION

1. Age of respondent (last birthday) _____
2. Sex: 1 Male 2. Female
3. Marital Status: 1. Single 2. Married 3. Separated 4. Divorced 5. Widowed 4. Educational Level: 1. No formal education 2.Junior secondary 3. Senior secondary 4. Tertiary institution 5. others (specify)……
5. Religion: 1. Christianity 2. Islam 3.Others (specify)……
6. Ethnicity: 1. Hausa 2. Igbo 3. Yoruba 4. Others (specify) …….
7. Occupation: _____
8. Income Level (per month in Naira) _____
9. Residential _____
10. How long have you been living in Abuja? ……

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SECTION B: KNOWLEDGE & PRACTICE OF HYGIENE

(a). Knowledge:

(SD =Strongly Disagreed, D =Disagreed, A =Agreed, SA = Strongly Agreed)

S/n		SD	D	A	SA
11.	Poor environmental conditions would bring down your health status				

12	Hygiene practices is not weapon in reducing infection				
13	Consumption of unclean water can influence the occurrence of some infections among PLWHAs				
14.	Sleeping with many people (3 and above) in a room can lead to cross infection				
15.	Living in an unclean environment may increase the occurrences of some opportunistic infections				
16.	A healthy environment cannot suppress the occurrence of opportunistic infection				
17	Unwholesome environment promotes vector breading.				
18.	Dumping of refuse round the house can be a source of infection				

(b) **Practices:**

19. How many times do you take your bath in a day? (i) once (ii) twice (iii) none (iv) others (specify).....

20. How often do you sweep your living apartment? .....

21. Do you wash your hands with soap immediately after using the toilet?
1. Yes 2. No

22. Do you fumigate your surrounding? 1. Yes 2. No

23. If Yes in question 22 above, how often do you fumigate the surrounding?
(specify).....

24. How often do you eat outside your house? .....

~~24.~~

25. ~~25.~~ Do you treat your water before consumption? 1. Yes 2. No

26. If yes in Q. 25,How do you treat the water .....

27. If no in Q. 25 above, why not? .....

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SECTION C ENVIRONMENTAL FEATURES

(a) Housing

28. What type of house do you live in? _____

1.Duplex 2 .Flat 3. Low cost 4. others (specify.....

29. _____How many persons sleep with you in a room?_____

30. Are the windows of your house having nets? 1. Yes 2. No

31. Are the doors of your house having nets? 1. Yes 2. No

(b) **Waste Management**:

32. What type of wastes do you generate from your house? 1. Paper 2. Plastic 3. Glass 4. Left over foods 5. Others (specify) (*You can pick more than one option*)

33. How often do you dispose off your domestic waste from the point of generation?

1. Daily 2. once in 2days 3. weekly 4. twice weekly 5. Others (specify) .....

34. How do you dispose off these wastes? 1.Use dust bin 2. Dump into pit

3. Burn 4. Bury 5. Reuse 6. Others (specify) _____

35. If in a waste dump, how far is the dumpsite from your house? 1.< 5 mins walk

2) 5 mins walk 3) > 5 mins walk

36. What type of toilet do you use? 1. Bucket system 2. Bush 3. Water system

4 (Ventilated) Pit latrine 5. Others (specify) _____

37. If pit latrine, what is the distance from your house?

1. < 5 mins walk 2. 5 mins walk 3. > 5 mins walk

38. How far is the toilet from your source of drinking water? _____

c) **Water**:

39. What is your source of drinking water during **rainy season**?

1. Tap water 2. Well 3. Borehole 4. Stream 5. Others (specify) .....

(*you can pick more than one option*)

40. What is your source of water during the **dry season**?

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1. Tap water 2. Well 3. Borehole 4. Stream 5. Others (specify) .....

(*you can pick more than one option*

41. . What type of treatment do you give to the collected water before usage?

1. Filtration 2. Boiling 3. Addition of Alum 4. Others (specify) .....

42. If not tap water, how often do you treat this water source?

1. always

2. occasionally 3. none

43. How far is this water source from your house?

1. < 5 mins walk 2. 5 mins walk 3. > 5 mins walk

44. Do you drink water outside your home? 1. Yes 2. No

45. If yes, what is/are the source(s) of the water? .....

46. How often do you take water from this source(s)? ....

47. What type of container do you use in collecting water from the source?

1. Plastic bucket without lid 2. Plastic bucket with lid 3. Jerry can

4. Metal Bucket without lid 4. Metal bucket with lid

48. What type of material do you use for storing water within the house? .....

SECTION C: HEALTH STATUS/CONDITION

49. When were you diagnosed to be HIV positive? _____

50. Why did you take the HIV screening?: 1. Go for a voluntary test 2. Fall sick before being tested 3.blood donation 4. antenatal clinic 5. about to marry 6. about to travel 7. went for surgery 8. new job 9. others (specify).....

51. Are you on anti-retro viral drugs? 1. Yes 2. No

52. If yes in Q. 51, when did you commence the ARV treatment? Month/year

53. What were the commonest disease(s) you always come down with before you were diagnosed HIV positive? .....

54. How many times do you and other members of your family present with the following diseases in the past 4 months?

(*Please indicate the number of times this ailment occurred during the said period in the box below.)*

	Diarrhea	Oral Thrust	Candidiasis	TB	Dysentery	Skin infection (kaposi's sarcoma)	Malaria	Herpes
Respondent								
Spouse								
<5 children								
>5 children								
Parent								
Brother								
Sister								
Neighbours								

APPENDIX II

Observational checklist for assessing~~on~~ Environmental Health Indicators in selected PLWHAs' houses in Abuja.

Serial No ……. Date of visit ……

Type of House ……..

Location ……

No of Residents ……

Average number of inhabitants in each room. ……..

	YES	NO
Have a functional toilet at home	☐	☐
Shared toilet with others……	☐	☐
Faecal matter on floor of toilet…….	☐	☐
Toilet gives unsightly and unpleasant odour	☐	☐
Over flowing septic tank/soak away pit	☐	☐
Open drains nearby the house	☐	☐
Functional sewers or drains	☐	☐
House made with bricks (cement)	☐	☐
Floor of living room/house cemented	☐	☐
Share house with animals/birds	☐	☐
Mosquito proofing of windows	☐	☐
Adequate ventilation	☐	☐

Sanitary survey of water source facilities:

Type of facility ……..

Water sample taken: Y ( ) N ( ) Sample No. …….

Specific diagnostic information for assessment:

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i)	latrine within 10m of source	_____Y N
ii)	latrine uphill than source	_____Y N
iii)	other source of pollution within 10m (e.g. rubbish, animal excreta, surface water)	Y N
iv)	drainage channel available	Y N
v)	floor permanent to water (i.e cemented)	Y N
vi)	cement floor less than 1m radius	Y N
vii)	stagnant water within 2m round the source	Y N
viii)	any ponding on the cement floor	Y N
ix)	source within compound	Y N
x)	well with parapet	Y N
xi)	well has cover	Y N
xii)	well has fixed vessel for fetching water	Y N

Solid waste management facility	**Absent**	**Present and functional**	**Present and non functional**	**Remarks**
Refuse bin				
Open burning				
Pit dumping				
Composting				
Sanitary landfill				

Sanitary conveniences	**Absent**	**Present and functional**	**Present and non functional**	**Remarks**
Pit Latrine				
Septic tank				
Aqua privy				

Bush				
Bucket system				

Waste water management facility	**Absent**	**Present and Functional**	**Present and Non functional**	**Remarks**
Ordinary				
Land treatment				
Sewer				
Soak away pit				

Vector control facility	**Absent**	**Present and Functional**	**Present and Non functional**	**Remarks**
Insecticide				
Rodenticide				
Netted windows				
bednet				

APPENDIX III

INFORMED CONSENT FORM

My name is **OBOT, Esther, a** Master of Public Health (Environmental Health) student in the Faculty of Public Health, College of Medicine, University of Ibadan. We are presently carrying out a research in Abuja to find out environmental factors that influences opportunistic infections among people living with HIV/AIDS. I will need to ask you some questions contained in a structured questionnaire, which may be translated into your local language so that you can have a better understanding of the content. You may find some questions difficult to answer but please note that your answers will be kept strictly confidential.

You will be assigned a number and your name will not be written on the form so that your name will never be used in connection with any information you disclose. The information you and others provide will be used to suggest to policy makers and the Government that provision of some essential environmental factors/ conditions will significantly mitigate some impacts of HIV/AIDS and improve the quality of life of those living with the virus.

During the exercise your medical records will be checked to ascertain your health history. I will also have to follow you to your house to assess the prevailing environmental factors in your house. Your water sample would be collected and analyzed.

You are free to refuse to take part in this research. You also have the right to withdraw at any given time if you want to. However, we will greatly appreciate your help in responding to the survey and taking part in the study to the fullest.

Consent: Now that the study has been well explained to me and I fully understand the content of the study process. I am or will be willing to take part in the programme.

…….. ……..
Signature/Thumbprint of participant/Date Signature of Interviewer / Date

……
Signature/Thumbprint of Witness/ Date (If required)