Global Scientific JOURNALS

GSJ: Volume 8, Issue 5, May 2020, Online: ISSN 2320-9186
www.globalscientificjournal.com

THE IMPACT OF HIV INFECTION ON SURGERY IN SUB-SAHARAN AFRICA: A CLINICAL REVIEW

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1.0 ABSTRACT

1.1 BACKGROUND: The human immunodeficiency virus (HIV) infection remains a significant concern to Clinicians in sub-Saharan Africa to date. Interestingly, there is paucity of published data on the impact of the pandemic on surgical outcomes in the literature worldwide. The study aimed to critically review existing literature to determine the current level of impact of HIV infection on surgical disease burden in sub-Saharan Africa and to propose the way forward in alleviating the burden.

1.2 METHODS: Published articles discussing HIV and Surgical Diseases Burden up to April 2020 were obtained for review using a manual library search (PubMed), Medline, Embase, Cochrane Library, and Google. Ultimately, 28 most pertinent articles were selected and critically reviewed in the final analysis.

1.3 DISCUSSION: The existing works of literature point out that HIV infection throughout the last two decades has highly increased the number of African common surgical disease burden, mainly in Sub-African countries. This burden is on all categories of surgical diseases: injuries, congenital abnormalities, tumors, surgical inflammations, and infections. These prevalence levels have affected four critical areas of surgical practice, namely patient care, the clinical practice, pathologies, the clinician, and, lately, prevention. Our surgical patients in Africa, in general, are more likely to be HIV positive than elsewhere in the world. Therefore, HIV has affected the surgical disease pattern by altering disease presentation, diagnosis, management, and outcomes.

1.4 CONCLUSION: Surgery for HIV patients can be safely conducted with a low complication rate for the diagnostic and other entities that comprise the vast majority of surgery in HIV/AIDS patients. Medical

treatment for patients with HIV/AIDS has developed dramatically over the last two decades. Besides, it resulted in a massive and varied workload for general surgeons, who invariably had to deal with the challenging spectrum of this disease.

1.5 KEYWORDS: Antiretroviral therapy, Biomedical interventions, HIV pandemic, HIV prevention, Sub-Saharan Africa.

2.0 INTRODUCTION

Globally, in most clinical settings, medical ethics demand that surgery and especially emergency operation has no preference for any individuals. Therefore, we treat equally both HIV positive and negative patients without knowing their status [1]. "Interestingly, the surgical treatment of HIV positive patients is necessary for problems both related and unrelated to HIV infection. HIV weakens the immune system and thus negatively influences one's ability to fight infections; besides, it does this by infecting CD4 T Helper cells" [1]. Meanwhile, "the reduced immunity puts HIV positive patients at an increased risk of developing diseases. Due to the adverse effect (weakening) on the immune system of HIV positive patients by the virus, it is assumed that they may have an increased risk of surgical complications, especially infections," [1]. One literature report suggests that "the specific risk factors influencing operative morbidity in HIV positive patients, especially infections related to wound-healing, include an absolute CD4 count of <200 cells/mm3 or a viral load of >10,000 copies/mL" [1].

Besides, there is paucity of published data on the impact of the pandemic on surgical outcomes in the literature in SSA. Also, in the global front, there is currently limited and controversial scientific data on the outcome of surgery in general among HIV patients. Moreover, it is still not clear whether an HIV positive patient's CD4 cell count, WHO staging and or viral load influences their risk of postoperative surgical infections and outcomes in general [2, 3]. "CD4 cell counts between 600 and 1,200 cells per microliter of blood have been recorded in healthy individuals with no immunosuppressing ailments. The lower the CD4 count, the weaker the patient's immune system" [2, 3]. Nonetheless, some studies have found no correlation between low CD4 cell counts and surgical complications [2, 3]. In the meantime, "evidence from existing research confirmed that there is an increased rate of operative complications associated with lower CD4 counts" [4, 5]. Further research is needed to elucidate a firm conclusion on this presumption in the long run.

"HIV infection results in a syndrome, otherwise known as Acquired Immune Deficiency Syndrome (AIDS). Despite the numerous advances made in antiretroviral therapies such as nucleoside analogs, protease inhibitors, fusion inhibitors and integrase inhibitors that reduce the viral load in the host serum and restore the numbers of host CD4 cells there is still no cure for HIV infection nor is there a vaccine more than

25years since the virus was first identified" [6, 7]. The study aimed to critically review existing literature to determine the current level of impact of HIV infection on surgical disease burden in sub-Saharan Africa and to suggest novel approach in alleviating the burden.

3.0 METHODS

We identified relevant articles to date using a manual library search (PubMed), Embase Medline, and Cochrane Library as well as ClinicalTrials.gov for current trials on Surgery in HIV-AIDS patients from sub-Saharan Africa. The google search was done in the English language for up to April 30th, 2020. Interestingly, the search was conducted using the words "HIV Surgery," "HIV AIDS," "HIV Surgeons," "AIDS Surgery," "AIDS Surgeon," and "HIV and Surgical Diseases Burden" with attendant six billion hits at the initial period. Thereafter, the search was narrow to HIV- Surgery research themes and relevant references were collected, analyzed, producing the subsequent 204 articles. Consequentially, the study team read through them, and a final selection of the most pertinent twenty-eight research articles was then critically reviewed in the final analysis. Consequently, information relating to historical background, epidemiology, pathophysiology, investigations, management, and prevention was extracted from the materials.

4.0 DISCUSSION

4.1 HISTORICAL BACKGROUND

"HIV, an acronym that stands for Human Immunodeficiency Virus associated with pneumocystis jiroveci pneumonia and Kaposi's sarcoma, was first recognized in 1981 in the United States of America among gay men and identified in 1983 by Barre-Sinoussi *et al.* at the Pasteur's Institute in Paris" [6, 7]. "HIV is a retrovirus that encodes its genome in RNA and transcribes genome copies in DNA using the enzyme reverse transcriptase within host cells such as the human CD4 (T helper) lymphocyte; Also, HIV infection is marked by a fall in the CD4 cell count with an associated decrease in immunity, particularly humoral immunity" [6-10].

4.2 EPIDEMIOLOGY

HIV infection culminates in Acquired Immune Deficiency Syndrome (AIDS) as an end-stage spectrum. It infects the T-helper (CD4+) lymphocytes primarily, thereby causing immune depression and exposing the victim to secondary opportunistic infections and cancers. It also affects monocytes/macrophage, glial cells, and some gut cells. The virus is found in most body fluids, especially blood, semen, and vaginal secretions [11].

4.2.1 DISEASE TRANSMISSION AND PREVALENCE

The virus is spread principally by the following methods 1) Sexual intercourse (heterosexual and homosexual); 2) Transfusion of blood or blood products; 3) The use of contaminated needles and syringes especially by drug addicts, meanwhile, health workers may also be infected in this way; 4) Transmission

from an infected mother to the fetus. The incidence of the virus is high among homosexuals, drug addicts, prostitutes, and their clients and sexually transmitted disease patients [9-11].

Similarly, "the frequency of occurrence of HIV infection among blood donors varies from place to place and ranges between 0.001% and 18%. Paid donors are more likely to be positive for the virus than voluntary donors," [9-11]. The risk of infection is highest in pooled products like Factor VIII concentrate (1 in 200) and lowest in single donation like packed red blood cells (1 in 100,000). Screening of donor blood has reduced the incidence of transfusion-associated infection by 95% [9-11]. "This screening implies that 5% of donors who test negative by current screening methods are infective. Studies of recipients of blood transfusion who developed AIDS show a long interval between exposure to the virus and the period of onset; besides, the average intervals of 12 months in children and 29 months in adults have been noted," [9-11]. However, estimates based on mathematical models suggest even more extended incubation periods in adults with a median time of 5 to 10 years. Factors that affect disease progression include viral phenotype and load, rate of decline of CD4 cells, and HIV receptors expression in the host [9-11]. The emergence of syncytia- forming phenotype of the virus in a patient predicts clinical decline, and a viral concentration greater than 30,000 copies/ mm2 is the number associated with rapid progression to AIDS, On the other hand, a viral load less than 5,000 copies/mm2 is associated with an indolent course [9-11]. "The quicker the decline in the CD4 count, the more rapid the progression to AIDS, and the Center for Disease Control (CDC) at the moment recommends that a CD4 count less than 200cells/mm3 should be taken as an AIDS indicator. Elevated levels of beta-chemokine expression have been found to control HIV load and replication and therefore show the progression of the infection to AIDS," [9-11].

4.2.2 ABRIDGED CLINICAL STAGING

The clinical expressions of HIV Infection in order of severity are:

4.2.2.1 Stage 1- Asymptomatic antibody negative (seronegative) virus-positive: These individuals are infective but not detected by current antibody screening methods. In some patients, the acute viral infection is characterized by a flu-like or glandular fever-like illness, and this expression occurs at the time of seroconversion [9-11].

4.2.2.2 Stage 2- Asymptomatic antibody positive: Seroconversion takes about six weeks to 6 months after infection to occur. The virus systematically destroys the T-helper lymphocytes leading to a breakdown of cellular immunity [9-11].

4.2.2.3 Stage 3- Persistent Generalized Lymphadenopathy (PGL): PGL is defined as the presence of lymph nodes of 1 cm or higher for at least three months in a minimum of two anatomically distinct sites other than the inguinal nodes; which is often symmetrical. The mean duration of lymphadenopathy is 18 months and ranges from 3 months to 4 years. There may be constitutional symptoms like unexplained

fatigue, fever, night sweats, weight loss, and diarrhea. Ten percent of these patients develop full-blown AIDS in 5 years [9-11].

4.2.2.4 Stage 4- AIDS-Related Complex (ARC): The symptoms and signs of this stage of HIV infection are: a) Severe malaise and lethargy. b) Weight loss of more than 10% of body weight. c) Unexplained diarrhea of more than a month duration. d) Night sweats for a month or more. e) Unexplained fever of long-standing. f) Oral thrush. g) Oral leucoplakia (white patches on tongue or cheek). h) Persistent generalized lymphadenopathy. i) Splenomegaly. j) Skin rashes. About 25 % of these patients develop full-blown AIDS within 5 years [9-11].

4.2.2.5 Stage 5- Full-Blown AIDS: This is the most severe consequence of infection with HIV and is invariably fatal. Clinically, the patient should have the features of ARC plus the features of invasive opportunistic infections such as pneumocystis carinii, toxoplasma, cytomegalovirus, candida, mycobacterium, varicella, and Cryptococcus [9-11]. The three major organs affected by opportunistic infections are the lungs, gastrointestinal tract, and brain. Other clinical manifestations of AIDS include Kaposi sarcoma, extra-nodal high- grade B-cell lymphomas, cervical cancer, peripheral neuropathy, and dementia [9-11]. "In contrast to endemic Kaposi sarcoma, the HIV associated Kaposi sarcoma is centripetal in distribution with symmetrical facial plaques and edema and pulmonary infiltrates. Human herpesvirus type 8 (HHV-8) is now considered the causative agent for all forms of Kaposi sarcoma, and HHV- 6 is associated with cervical cancer carrier" [9-11]. "Their oncogenic potential is accelerated in the presence of the immune paresis that accompanies HIV infection. The incidence of more well- known tumors such as cancer of the liver, colon, or bronchus has not changed. Enlargement of the salivary glands due to infiltration by CD8+ lymphocytes is seen in both adult and pediatric HIV patients; besides, such patients seem to experience a slower progression of the infection" [9-11].

4.2.3 REVISED WHO CLINICAL STAGING OF HIV/AIDS (FOR ADULTS AND ADOLESCENTS)

The revised WHO Clinical Staging System mentioned here is otherwise remarked as the Interim African Region version for persons aged 15 years or more with positive HIV antibody test or other laboratory evidence of HIV infection [9-13]. Clinical and immunological staging systems and criteria have been developed to facilitate the proper categorization of patients for quality management. The revised WHO Clinical Staging System narrated below in Table 1, essentially formulated for HIV infected individuals which groups' individuals into four stages according to clinical features [9-13].

TABLE 1: WHO STAGING FOR HIV INFECTION AND DISEASE [12, 13]

WHO Stage	*Characterized by*	*Examples*
1	Acute primary HIV Infection or latent asymptomatic or persistent generalized lymphadenopathy	Acute seroconversion illness in some patients
2	Cutaneous manifestations	Herpes Zoster, Seborrheic dermatitis, Recurrent URI, < 10% weight loss
3		Pulmonary TB < 1year ago, severe bacterial infection, weight loss > 10%, Chronic diarrhea > 1 month
4	AIDS defining illness	Pneumocystis Carinii Pneumonia, Toxoplasmosis, Cryptosporidiosis, CMV retinitis

From the Table 1 above, the authors observed impaired immune defense to common surgical pathogens and delayed wound healing. These immunity impairments are causes for concern about the outcome of surgical procedures on the HIV-positive patient. HIV- positive patients are at higher risk of peri-operative infections, complications, impaired wound healing, and mortality [9-13].

TABLE 2: CD4 LEVELS IN RELATION TO THE SEVERITY OF IMMUNOSUPPRESSION [12, 13]

Not significant immunosuppression -	>500/mm3
Mild immunosuppression-	350–499/mm3
Advanced immunosuppression-	200–349/mm3
Severe immunosuppression-	<200/mm3

4.2.4 THE BURDEN OF HIV IN SUB-SAHARAN AFRICA

In 2013 the population of people was living with HIV worldwide is estimated at 35.0 (33.2-37.2) million. There are about 12% of the global population in Sub-Saharan Africa alone, yet accounts for 71% of the worldwide estimate of HIV infection [14]. "There are ten countries, mostly in Southern and Eastern Africa, account for almost 80% of all people living with HIV. They include the following South Africa -25%, Nigeria -13%, Mozambique -6%, Uganda -6%, Tanzania - 6%, Zambia -4%, Zimbabwe -6%, Kenya -6%, Malawi -4% and Ethiopia -3%" [14]. "The scale-up and widespread coverage of highly active antiretroviral therapy (HAART) is producing a substantial decrease in new HIV infections. For instance, HIV uninfected individuals living in a community with high HAART coverage (30 to 40% of all HIV-infected individuals on

HAART) were 38% less likely to acquire HIV than those living in communities where HAART coverage was low (<10% of all HIV infected individuals on HAART)" [15]. Notwithstanding these outcomes, "HIV incidence rates remain unacceptably high, with the most significant number of new infections coming from these sub-Saharan African countries including South Africa (23%), Nigeria (15%), Uganda (10%), Mozambique (8%) and Kenya (7%)" [14].

Interestingly, "HIV is a pandemic, with some areas more afflicted than others. We are experiencing a decline in the epidemics in Botswana, Namibia, and Zambia, while the situations in Lesotho, Mozambique, and Swaziland seem to be reaching a plateau" [14]. "The available reports suggested that in sub-Saharan Africa, women are disproportionately much affected, constituting 58% of the total number of people living with HIV, with the highest number of children living with HIV, and the highest number of AIDS-related deaths" [14]. Interestingly, "with increasing access to HAART, the number of AIDS-related deaths has declined progressively, and in sub-Saharan Africa, by about 39% between 2005 and 2013. Also, in South Africa alone, the reduction was 51%, whereas, in Ethiopia, the figure was 37%, and in Kenya, it was about 32%," [14]. Several reports from "South Africa, Uganda, Tanzania, Rwanda, and Malawi have demonstrated that the impact of modest HAART coverage at CD4 cell counts ranging from <200 to 500 cell per µl is equally producing a significant decline in mortality with life expectancy increasing by an additional ten years; These works of literature provide evidence in support of the benefits of early HAART initiation to HIV positive individuals" [16, 17].

4.3 PATHOPHYSIOLOGY OF IMMUNITY IMPAIRMENT IN HIV/AIDS

HIV primarily targets the CD4 lymphocytes, which are responsible for cellular immunity and indirectly impairs B lymphocyte differentiation (humoral immunity) [18]. "Monocyte macrophage cell lines and production of interferon-gamma and lymphokines – products of antigenically stimulated lymphocytes are also affected. Absolute polymorphonuclear leucocytes count drops as the disease progresses, to a level that impairs phagocytosis" [19].

"CD4 Lymphocytes and lymphokines play an essential role in wound healing, and the migration of CD4 lymphocytes subsets into a healing wound body region has been documented" [20, 21].

"Platelet deficiency, also seen in HIV infected patients, may lead to excessive bleeding during surgery. Also, this platelet deficiency is initially treated with corticosteroids and if persistent with splenectomy. Corticosteroids further reduce host resistance to infection, and splenectomy is associated with an increased risk of septicemia" [22, 23].

"Neutrophil bactericidal capacity in HIV positive patients has been studied by several groups of researchers. One such study conducted by Murphy *et al."* [24] using cultures of *Staphylococcus aureus* as the target organism, compared ninety-minute bacterial survival in washed neutrophils from nineteen AIDS patients,

who had no active infections and were receiving no drugs, with that in washed neutrophils from seventeen healthy control subjects. Bacterial survival in AIDS patients was significantly higher, at 32.5% vs. 13.8% in the healthy control group [24]. Another study by Ellis *et al.* [19] in patients with AIDS and Kaposi's sarcoma demonstrated reduced bacterial killing against *Staphylococcus aureus.* These two studies demonstrated impairment of all three leukocytes bactericidal functions, i.e., chemotaxis, phagocytosis, and secretion of microbicides - in patients with AIDS.

Due to the complex immune system impairment, patients with advanced HIV infection have a high susceptibility to both common pathogens and opportunistic infections. Krumholz *et al.* reported "forty-four episodes of community-acquired bacteremia in 38 AIDS patients at San Francisco General Hospital. Most of these pathogens include those commonly involved in musculoskeletal infections" [25]. "The most frequently encountered infecting organisms were *Staphylococcus aureus, Streptococcus pneumoniae*, and *Escherichia coli*. Only 57% of the patients were febrile, which is typical of AIDS patients with a bacterial infection, such as septic arthritis or another orthopedic infection," [25]. These patients often present with a minimal inflammatory response, which appears deceptively benign but can progress to sepsis and septicemia, which can be fatal. It has been shown that carriage rate for *Staphylococcus aureus* in the nose, throat, and perineum in asymptomatic HIV-positive subjects was double that in HIV-negative control subjects (49% vs. 27%) [26].

Malnutrition, which may be a consequence of both the disease process or the administration of therapeutic medication, causes hypoalbuminemia, which leads to further impairment of lymphocyte function and phagocytosis hence increased propensity to bacterial infections and delayed wound healing [27, 28].

4.4 HIV/AIDS AND SURGICAL SEPSIS

"In a series from Kigali, Rwanda, Hoekman *et al.* compared the rate of postoperative infection after open reduction and internal fixation of fractures in 171 HIV-negative patients, 26 asymptomatic HIV-positive patients, and 17 symptomatic HIV-positive patients. Meanwhile, none of these patients had hemophilia," [29]. Interestingly, "the surgeons did not know the patients' HIV status, and no prophylactic antibiotics were used. The infection rates were 5% in the HIV-negative group, 0% in the asymptomatic HIV-positive group, and 23% in the symptomatic HIV-positive group," [29]. The infecting organisms were common surgical pathogens: *Staphylococcus aureus* in eight cases, group A *streptococci* in two, *Escherichia coli* in one, and *Pseudomonas aeruginosa* in one. All infections resolved with antibiotic management, and there were no deaths [29]. The rate of infection in the symptomatic HIV-positive patients in this study was substantially higher than that in the survey by Ragni *et al.* [30] of high-risk patients with CD4 lymphocyte counts below 200/mm3. The lack of prophylactic antibiotic therapy and other factors related to the patient population and location may have made a critical difference. The authors did not give the CD4 lym-

phocyte counts of the symptomatic patients, which would have allowed a better correlation of the rate of infection with the degree of immune impairment [30]. Remarkably, the rate of infection in the HIV-negative and asymptomatic HIV-positive patients, who did not receive prophylactic antibiotic therapy, was similar to that in a reported series of open fracture repair in the general population [31]. Based on other studies cited in that report, it appears likely that the symptomatic HIV-positive patients harbored more pathogens and had more severe immunity impairment, which would have made the absence of prophylactic antibiotic administration more critical [31].

"In another related study of 44 HIV positive patients who were clinically staged (WHO) supplemented with an absolute lymphocyte count in Lusaka, Zambia Jellis [32] reported that closed fractures healed if treated conservatively." Still, "if internally fixed, 33% suffered infections, open fractures fared worse with a 72% infection rate and 28% with non-unions. He concluded that major orthopedic surgery in HIV positive patients had increased risk of sepsis, which rises steeply in those with physical signs of HIV disease" [32].

Other studies demonstrating contrary results, such as conducted by Diettrich *et al.* [28] reported the data on a series of 120 HIV-positive patients, 56 (47%) of whom had AIDS, who underwent elective or emergency procedures between 1986 and 1990. They found that the 30-day mortality after emergency procedures was 23% for patients with AIDS, compared with 0% for those who did not have AIDS [28]. For elective procedures, it was 4% for AIDS patients, compared with 0% for non-AIDS patients. Of the seven surviving patients with postoperative complications, one had a wound infection, and one experienced a delay in healing; contrary to what might be expected, neither patient had AIDS [28]. The risk of morbidity or mortality was higher if the patient had a history of opportunistic infection and a serum albumin level below 25 g/L. The study concluded that the results in the HIV-positive patients without AIDS were 0% mortality, and 4% postoperative complications are roughly comparable to those in the HIV-negative population [28].

"Experience, particularly in Eastern and Central Africa, indicates that HIV infection predisposes patients to acquire surgical infections, and, in high incidence areas; Therefore, it may be a more frequent association than diabetes" [10, 11]. Interestingly, "the common sites are the female genital tract (pelvic inflammatory disease), pleural cavity (empyema), large joints (septic arthritis of a single joint like the knee joint), bone (adult hematogenous osteomyelitis) and the anorectal area (sepsis with fistulae)" [10, 11]. HIV-positive patients undergoing surgery are predisposed to an unacceptably high level of wound sepsis, especially after implant surgery [10, 11]. "Even old prostheses do not escape septic complications in subsequent HIV infection. Surgeons in practice in East and Central Africa have observed a significant upsurge in the incidence of surgical tuberculosis, notably of the spine, bone, joints, and lymph nodes, but not of the

peritoneal cavity or the urogenital tract" [10, 11]. "This development is happening in the context of a marked and continuing increase in the incidence of pulmonary tuberculosis in the countries most severely affected by the HIV epidemic, i.e., a clear association between TB and HIV infections" [10, 11]. "Defective healing, skin lesions, and ulcers are other characteristic features of HIV infections; very few HIV- infected persons have flawless skin. Herpes zoster has increased over 20-fold in some populations" [10, 11]. "Dryness, scaling, variable pigmentation, darkening of facial skin, folliculitis, seborrhoeic dermatitis, molluscum contagiosum, and extensive tinea versicolor are other non-specific but suggestive signs of HIV infection" [10, 11]. "Many patients develop an itchy rash early in the course of the disease, and this recurs at intervals. There is some difference of opinion on the healing capabilities of HIV infected patients and the frequency of breakdown of the healing wound; the emerging consensus is that healing is subnormal" [10, 11]. Skin ulcers may develop on the extremities for which no arterial, venous, metabolic, neuropathic, or factitious cause can be established; this is further evidence of impaired healing [10, 11]. "The critical question that needs to be answered now is the extent to which HIV infection influences surgical treatment or vice versa. Many surgeons have experiences of sick persons who have surprisingly made an uneventful recovery from major surgery for desperate pathology," [10, 11]. Equally, "many surgeons have seen patients in whom HN-related pathology was not suspected at admission but who suffered a rapid decline in health following necessary surgery and did not leave the hospital alive" [10, 11].

4.5 LABORATORY FINDINGS

The common findings in immuno-compromised patients with HIV infection include anemia, leucopenia, lymphopenia, thrombocytopenia, raised ESR, or CRP; reduced T: T-ratio (< 1), reduced CD4 count, raised IgA, reduced interferon and cutaneous anergy occur [10, 11].

The liver enzymes and biochemical parameters may become deranged in advanced disease. Serum beta-2-microglobulin and neopterin levels are increased and reflect the immune activation and high macrophage turnover seen in the condition [10, 11].

4.6 THE PRINCIPLES OF MANAGEMENT

The principles of management include counseling of patients and relatives, treatment of opportunistic infection and neoplasia, and specific antiviral therapy with a combination of nucleoside analogs and protease inhibitors [10, 11]. Counseling includes advice on keeping healthy through exercise and nutritious diet and prevention of the spread of the infection to partners and relatives. Diarrhea may be treated empirically with albendazole 800mg twice daily for two weeks. Candida infections are treated with fluconazole 200-400mg per day for 14 days [10, 11]. Pneumocystis pneumonia is treated with cotrimoxazole (trimethoprim 200mg/kg/day and sulfamethoxazole 100mg/kg/day) or pentamidine 4mg/kg/ day for 21 days. Standard treatment for toxoplasmosis is sulphadiazine 65g per day, pyrimethamine 75mg per day

plus folinic acid supplement for 4-8 weeks [10, 11]. Moreover, clindamycin may be used in place of sulphadiazine in patients who cannot tolerate the sulphonamide. Acyclovir 400mg qid for five days may be given for herpes infections and ganciclovir 5mg/kg 12 hourly for 14-21 days, given as a constant IV infusion over one hour is recommended for cytomegalovirus (CMV) infection. Current specific therapy for the HIV virus consists of triple therapy with two nucleosides plus a protease inhibitor. Zidovudine (AZT) 200mg tid., lamivudine (3TC) 150mg bid, and indenavir 800mg tid form one of the favored triple regimens currently in use [10, 11].

The commonest neoplastic disorder seen in HIV infection is Kaposi sarcoma, and the management depends on the stage of the disease. It is classified as stage 0 or reasonable risk when the tumor is confined to the skin, lymph nodes, or palate, together with absent systemic symptoms, a Karnofsky performance score > 70, and a CD4 count > 200 [10, 11]. The tumor is considered stage 1 or poor-risk when any of the following is present: tumor-associated edema or ulceration, extensive oral involvement, gastrointestinal or other visceral involvement, CD4 count < 200, history of opportunistic infection, fever, night sweats, weight loss of more than 10%, chronic diarrhea, Karnofsky performance score < 70 or any other HIV related illness like peripheral neuropathy or dementia. The range of therapeutic options is broad and ranges from observation to systemic chemotherapy. Patients with stage 1 disease generally require surgery [10, 11]. The chemotherapeutic regimens include alpha-interferon 18-36 mega units per day for eight weeks and then three times weekly. The median time of response is ten weeks, and no benefit is seen in patients with very low CD4counts. Adriamycin, bleomycin, and vincristine are given IV every three weeks at a dose of 20mg/m2. Fifteen units/ m2 and 2mg respectively are also beneficial. Because chemotherapy is palliative, antiretroviral therapy is of higher priority in the management of poor-risk patients [10, 11].

4.7 HIV AND THE SURGEON

“Surgical personnel risk infection with HIV from percutaneous injuries caused by needles, sharp instruments, and other sharp objects that have been contaminated with a patient's blood. Patients also risk infection from health workers who may contaminate them with blood during surgical or dental procedures,” [10, 11]. Current estimates of the risk of transmission through a needle stick injury from an HIV infected person are about 1 in 300. A study conducted by the CDC showed that during surgery, percutaneous injuries occurred most often on thy distal forefinger of the non-dominant hand, and vaginal hysterectomy and gastrectomy were showed that holding tissues with fingers, rather than an instrument, at surgery, was associated with higher injury risk [10, 11]. “An unexpected finding in this study was that the surgeon's perception of the patient's HIV status had no significant demonstrable influence on the injury rate. Approaches to injury prevention include changes in surgical technique and equipment and development of improved barriers, such as puncture-resistant gloves,” [10, 11]. Precautions recommended by the

CDC for health workers include i) wearing latex gloves for performing any procedure that might lead to exposure to body fluids ii) wearing masks and goggles when using endoscopes, dental or bone drills, and saws and also during wound irrigation to prevent contamination with effluents and aerosols [10, 11]. "An important ethical question is whether prospective patients for surgery should be routinely tested for HIV antibody status. Since a negative test does not entirely rule out the risk of infection, the value of routine testing of surgical candidates seems doubtful," [10, 11]. Interestingly, the patient should also have a right to how the HIV-status of his surgeon. Routine HIV testing is not practicable in the prevailing circumstances in most developing countries. It is more pragmatic to assume that the risk is significant in all surgical procedures and rake maximal precautions [10, 11].

4.8 POST-EXPOSURE PROPHYLAXIS FOR HEALTHCARE WORKERS

Healthcare workers, especially nurses and laboratory technicians, run the risk of occupationally acquiring HIV infection [10, 11]. The significant risk factors are 1) Deep injury or puncture, 2) Visible blood on the injuring device. 3) Placement of needle, especially a large-bore hollow one, in a vessel, and 4) A patient with late-stage HIV who most probably has a high viral load. Contact with intact skin is not normally considered a risk for HIV transmission unless the area exposed is extensive, and the contaminating fluid is a large volume of blood [10, 11].

4.9 MANAGEMENT OF ACCIDENTAL EXPOSURE

Prophylactic treatment, which should be instituted immediately and indeed within 4h for any worthwhile benefit, mostly based on an assessment of the risk of infection, especially the severity of the exposure and the infectiousness of the body fluid to which the worker is exposed [10, 11]. Measures to be taken include the following: 1) The skin is cleansed, usually using soap and water; the mucosal membrane is flushed with water. 2) The contaminating source is tested for HIV. 3) Preventive treatment with azidothymidine (AZT), also called zidovudine nucleoside reverse transcriptase inhibitors (NRTIs) and Lamivudine (3TC) is started and continued for at least one month. Indenavir, a protease inhibitor, is added if the risk is considered high. 4) The HIV serological test of the worker should be done at six weeks, three months, six months, and one year. It has been shown that AZT prophylaxis reduces the risk of HIV infection with contaminated blood by 79% after percutaneous exposure of health workers [10, 11].

4.10 THE PRACTICE OF SURGERY

"In several works of literature, it's evident that the advent of HIV has influenced surgical practice across the continent; which is mostly covering 1) Diagnosis, 2) Management and 3) Outcomes" [33-35]. HIV infection has changed the surgical practice by altering the presentation of surgical diseases [33, 34]. "The alteration has created challenges in the early diagnosis of diseases and has seen uncommon diseases being seen commonly, or standard conditions presenting in extraordinary ways" [33-35].

Furthermore, “the most critical change is that there has been a progressive increase in surgical sepsis covering body regions like the female genital tract, the pleura, the large joints, and the anorectal area” [33, 36]. “Other surgical complications include pyomyositis, deep-seated abscesses, and perianal inflammatory pathologies, and another author submitted that up to 44% of patients with gynecological diseases were HIV positive,” [33, 36]. Besides, vascular diseases like aneurysms and peripheral vascular disease have also seen an upsurge in the surgeon's practice [33, 37]. “In the surgical subspecialties, there have been newly discovered pathological entities such as cytomegalovirus (CMV) cystitis, CMV retinitis, HPV papillomas of the larynx, nasopharyngeal carcinoma, osteomyelitis, cancers of the cervix and anus and Fournier's gangrene” [33, 37 - 39].

Moreover, “in the early days of the epidemic, the surgeon faced many challenges in the insertion of implants, especially in fields like orthopedics. There have been reports of rejection of metal implants for internal fixation in many patients in stages 3 and 4 of HIV disease with fractures” [33, 38 - 41]. Subsequently, “we see significant result outcomes with prosthesis since the release of HAART treatment. Similar findings have been recorded with organ transplantation even-though this is uncommon in Africa” [33, 38 - 41]. “The general policy is to avoid organ transplants in such HIV positive patients. In HIV associated malignancies such as Kaposi's sarcoma (KS) patients, initial reports are in favor of focused therapy on chemotherapy with significantly high mortalities” [33, 38 - 41]. However, “in the face of HAART, there is a reversal role of chemotherapeutic agents in the treatment of KS. We are also experiencing a restoration of better immune function in earlier treatment with HAART for HIV-related sepsis rather than the first approach of admission into intensive care and the use of multiple antibiotics regimen” [33, 38 - 41]. For postoperative patients, the initial experience was that of an increase in postoperative morbidity and a high rate of surgical site infection (SSI).

Notwithstanding, “there is an overall improvement in medical management, SSI prevalence among HIV patients is similar to seronegative patients. The management of HIV patients in emergency settings, particularly in trauma, has posed a unique burden. Studies have shown that now, with the stabilization of the HIV pandemic, results from emergency care settings showed outcomes that are not significantly different between the two groups” [33, 42 - 44].

4.11 THE PRACTITIONER

“With the current level of evidence, the HIV burden has placed enormous stress on an already overstretched surgical workforce. Several strategies are innovatively being adopted to address this challenge, including task shifting, task sharing, and increased training of surgical specialists” [33, 45-47]. “Many Surgeons and clinicians practicing surgery in Africa have been significantly affected by HIV. This situation is compounded by a high rate of HIV in such a population where they work” [33, 48]. Consequently, “we

are observing a high percentage of HIV patients seeking surgical services. In another African report, the prevalence of HIV in surgical patients was found to range between 15-40%. The WHO places the occupational risk of HIV at 0.3%; this is significantly higher in Africa" [33, 48]. According to a report from Zambia, comparing the risk of HIV acquisition among surgeons in developed countries to those in developing countries, surgeons practicing in Africa have a 15 fold increased occupation risk of HIV. The study showed that the uncertainty in Europe was 0.1% over five years, while that in Zambia 1.5% [33, 49, 50]. In Tanzania, one author submitted that the risk per annum was 0.27% for all clinicians, but for surgeons at 0.7%. "Another study in the South Africa study showed an increased risk of splashing of blood in the eyes due to the reluctance of surgeons to wear eye protection glasses" [33, 51, 52]. "The uptake of post-exposure prophylaxis (PEP) after occupational exposure is also low among health care workers (HCW) in Africa," [33, 53]. "Another study done in Kenya showed the risk for HIV to be 4% compared to 88% for hepatitis B. This is because HCW workers are reluctant to undergo HIV testing, which is required before PEP can be administered" [33, 53].

4.12 SURGERY AND HIV PREVENTION

From the account of Bowa K et al. (2016) who reported that "by the year 2001, about two decades after the HIV pandemic hit Africa, the WHO added male circumcision as an additional HIV prevention strategy" [33]. The findings of some African literature based on three randomized control trials showed that male circumcision, in the long run, significantly impact HIV by as much as 60% [33, 54]. In March 2007, WHO/UNAIDS issued recommendations that male circumcision was an effective HIV prevention strategy and should be rolled out in countries where there are high rates HIV and low male circumcision prevalence especially in communities where there are a generalized epidemic and a heterosexual transmission pattern [33, 55, 56].

In a related development, Odimba BFK (2010) suggested that "the essential priority is to quantify the HIV disease-burden by establishing the disease control modalities in our African settings" [33, 55, 56]. "Such an initiative as the Fogarty International Center of the US National Institutes of Health, the WHO, and the World Bank in 2001 in a project called the Disease Control Priorities Project (DCPP)" [33, 55, 56]. "DCPP provides for the following i) to identifying policy changes and ii) interventions strategies for health problems of our Low-income and middle-income countries (LIMICs)" [33, 55, 56]. After establishing these priorities, "the project then focuses on the assessment of the cost-effectiveness of health-improving strategies (or interventions) for the conditions responsible for the most considerable burden of disease" [33, 55, 56]. Also, "examining cross-cutting issues that are of paramount importance for the effective delivery of quality health services, including the organization, financial support, and capacity building for our ailing health systems" [33, 55, 56].

4.13 FOCUSSED PREVENTIVE APPROACH

"Working under the Ptolemy Research Project, Massey Beveridge et al. [57-59] have identified and summarized the priorities as follow in order to reduce the burden of surgical disease in East Africa by 2010 in the following ways:" 1) improve opportunities for continuing medical education (CME) for practicing surgeons; 2) introduce more surgical skills workshops for medical students and clinical officers; 3) involve regional health bodies like the College of Surgeons of East, Central and Southern Africa (COSECSA), West African College of Surgeons (WACS), etc., in surgical training as well as curriculum development and certification of surgeons; 4) provide a feedback system by which medical students and surgical trainees may evaluate their teachers; 5) recruit and train more nurses and anesthetists. 6) provide free HIV counseling and post-exposure prophylaxis for healthcare workers with occupational exposure; 7) improve surgical resources in local hospitals so they can perform primary surgery; 7) provide or increase service and maintenance for current hospital equipment.; 8) attract funding for medical research into common diseases; develop protocols and treatment logarithms for common conditions [57-59].

The additional preventive approach according to other authors include the following "Four types of activities may be undertaken by mainly surgeons A) efforts of getting funds by available means, B) research on the burden on the surgery, C) organizations of training programs, D) outreach and continuous education to rural areas" [57-59].

Interestingly, funds are needed to practice training programs, outreach programs, and continuous educations as well as research. The search for funds shall be a permanent concern, especially from the International donors' community, partnerships, private and public funds. Ozgediz and Riviello [57, 60] equally suggested successful approaches to research on neglected tropical disease and proposing modalities that improve the delivery of surgical care in Africa, including donation programs and public-private partnerships [57, 60].

4.15 COMPREHENSIVE HIV PREVENTION STRATEGIES

"Comprehensive and effective public health strategies include programming for behavior change, condom use, HIV testing and knowledge of HIV status, harm reduction efforts for injecting substance use, male medical circumcision, and provision of post-exposure prophylaxis" [61-63]. Interestingly, "the combination of these HIV prevention packages has the tendency of preventing over 90% of HIV transmission during vaginal and anal sexual intercourse; Besides, their use is mainly influenced by relationship type and heavily influenced by the form of partnerships" [61-63].

Hattori MK reported that "condom use is most common among commercial sex workers and lower but inconsistent in other categories like the non-commercial and regular partnerships" [61, 64]. Another research reported that "most women find it difficult to negotiate consistent male or female condom use. In

the majority of the cases, the decision on condom use is largely dependent on male partner co-operation. Although increases in male condom distribution and use played a key role in declining HIV incidence during the period 2000-2008" [61, 65], "the major challenge has been sustaining consistent condom use; Therefore, men can protect themselves and their partners" [61, 66].

"Rapid evolutions have been reported for HIV counseling and testing (HCT), which has been tested through several models" [61, 67 - 71]. "HCT objectives include i) Promotion of knowledge of HIV status, ii) Encouragement of HIV prevention, and treatment programs, and iii) Advocating for reduction of stigma and discrimination in association with HIV" [61, 67 - 71]. "Even-though these innovative approaches and expansion of services have been fundamental in promoting knowledge of HIV status to access treatment and promoting preventing onward transmission, knowledge of HIV status remains low" [61, 67 - 71].

"Results from three randomized controlled trials (RCTs) and modeling data have paved the way for large scale rollout of voluntary medical male circumcision (VMMC) as an important intervention by engaging men and reducing heterosexually acquired HIV" [61, 72-75]. In Lesotho, Malawi, Namibia, Rwanda, and Zimbabwe, where VMMC is stated to be a priority, coverage of adult VMMC is less than 10% [61, 76]. "These data suggest that for any benefit of VMMC to be realized, coverage must be scaled up. Improving surgical procedures and using novel approaches for recruitment for the safe delivery of high-quality VMMC services would contribute to rapidly achieving targets for public health benefit" [61, 77 - 80].

Several RCTs of the cervical barrier, diaphragm, and non-antiretroviral (ARV) based microbicides when applied vaginally have failed to show any significant benefit in preventing HIV acquisition [61, 81 - 87]. However, "recent breakthroughs have been testing ARV based vaginal microbicides, oral pre-exposure prophylaxis (PrEP), and early HAART initiation have transformed the HIV prevention agenda and provide hope in reducing the risk of acquiring HIV" [61, 81 - 87]. "The effectiveness of peri coital tenofovir gel in the CAPRISA 004 trial showed that women inserting one dose of gel vaginally within 12 hours before sex and a second dose as soon as possible within 12 hours after sex and not using more than two doses of gel in 24 hours, reducing the risk of HIV acquisition by 39%" [61, 88]. However, "the effectiveness of the daily or peri-coital vaginal application of tenofovir gel in the VOICE (Vaginal and Oral interventions to Curb the Epidemic)" [61, 89] and "the Follow-on African Consortium for Tenofovir Studies (FACTS) 001 trial respectively failed to demonstrate a protective effect" [61, 90]. Similarly, "the FEM PrEP trial tested a daily single oral dose of Truvada®, which contains two ARV drugs: tenofovir disoproxilfumarate (TDF-300 mg) and emtricitabine (FTC-200 mg) also failed to demonstrate the effectiveness of Truvada in preventing HIV acquisition" [61, 91].

4.16 ACHIEVING UNIVERSAL ACCESS TO ANTIRETROVIRAL THERAPY PROGRAMS

Marston M et al. submitted that "effective HAART, since the first introduction in 1996 had led to dramatic

reductions in morbidity and mortality" [61, 92]. "The number of pregnant women receiving HAART for the prevention of mother to child transmission of HIV has increased significantly, and more women and children are collecting HAART" [61, 93]. Available body of data showed that "in sub-Saharan Africa, AIDS-related deaths overall have declined by 39% in the period 2005 to 2013 with dramatic declines in Rwanda (76%), Eritrea (67%), Ethiopia (63%), Kenya (60%), Botswana (58%), Burkina Faso (58%), Zimbabwe (57%), Malawi (51%), South Africa (48%) and Tanzania (44%) attributable to the rapid increase in the number of people on HAART" [61, 93].

Interestingly, "most countries have progressed with scaling-up HAART provision and with a commitment to increase the numbers over the next several years," [61, 94]. Similarly, "Botswana, Namibia, and Rwanda have made remarkable progress with more than 80% coverage of eligible individuals on HAART based on WHO 2010 guidelines, whilst several other countries like Zambia and Swaziland are steadily increasing HAART initiation" [61, 94]. "Approximately 75% of all people receiving HAART live in sub-Saharan Africa, yet many more are in need of and are eligible for HAART; and as such promising results from the INSIGHT START trial [61, 94] of initiating HAART in the early asymptomatic stage at CD4 cell counts of >500 and the TEMPRANO ANRS trial" [61, 95] of early HAART and including isoniazid preventive therapy offer significant benefits in further reducing AIDS-related severe illness including death. Notwithstanding the success of the region as a whole in scaling up HAART, this masks significant in-country variability with some countries, e.g., Botswana, South Africa, Zambia, Zimbabwe and Malawi are providing better treatment access compared to countries such as Nigeria and Central Africa Republic where less than 25% of the adult population has access to treatment [61, 76]. "The variability in treatment access remains a challenge and may potentially reverse the gains made thus far. The significant milestones of HAART provision aiming for maximum coverage through early or universal HAART are rapidly advancing in many countries" [61, 96]. "As we embark on improving our healthcare delivery systems, reducing costs, improving, and simplifying treatment are more likely to improve adherence to drug regimens with better chances for long term survival; Also, new HAART formulations can also help address some of the current challenges, including funding constraints" [61, 96, 97]. Table 3 and Table 4 are out Spectrum and Outcome of previous Surgical Studies on HIV and AIDS.

5. 0 PANEL KEY MESSAGES

1. Sub Sub-Saharan Africa is responsible for the highest-burden of HIV infection globally.
2. Even though little success has been achieved in a growing number of countries, the continued high burden of new HIV infections in Sub-Saharan Africa contributes to new diseases globally.
3. We advocate new and innovative models of delivery, and education on HIV counseling and testing

(HCT), male and female condoms, and voluntary medical male circumcision (VMMC), as well as cost-effective interventions.

4. A well-articulated knowledge of the molecular biology of the HIV, and behavioral factors, including the chains of transmission, could significantly impact the HIV prevention efforts.

5. There remains the potential for ARV based vaginal microbicides, PrEP, and passive immunity to offer hope for young women.

6. We still have a massive population of persons who do not know their HIV status and therefore are yet to be effectively linked to care and treatment programs.

7. Prevention benefits of treatment will require large amounts of men to be tested and initiated on medication, especially men who are not typical users of health services and less likely to begin treatment.

6.0 CONCLUSION

HIV pandemic has become an enigma in the sub-Saharan Africa characterized by the presence of many HIV patients present first to surgical services with their HIV status unknown. Relatively, an average of 30% to 40% of these patients eventually is tested positive with HIV. Interestingly, the surgical patients, pathology, and practice have been heavily impacted by the HIV pandemic in our settings, and with a high incidence of co-infection with Hepatitis B and C.

In addition, the surgical patients are typical, young, mostly female, and have a low CD4 count. The profile of clinical lesion commonly seen include opportunistic infections, inflammations, and malignancies in various body systems. Most importantly, there is an increased episode of deep-seated abscesses, especially in atypical sites such as the chest cavity, the brain, the pelvis, and the perineum.

In recent times, surgical forms of extrapulmonary tuberculosis have emerged, such as TB of the spine, kidney, abdomen, and testis, among others. Other opportunistic infections, such as cytomegalovirus (CMV), have been associated with retinitis and cystitis. Mucosal cancers have increased remarkably under the influence of human papillomavirus. These include cancer of the penis, anus, larynx, and cervix. Other viruses such as Herpes 8 virus have been associated with Kaposi's sarcoma. These pathologies have affected specialized surgical treatments such as the insertion of the prosthesis, implants, and organ transplantation. Notwithstanding the old concerns that HIV would significantly affect surgical outcomes, but, it is much clearer that with HAART treatment, there is no significant difference.

7.0 DECLARATIONS

ACKNOWLEDGEMENTS: Not Applicable

FUNDING: No record of funding for this Study declared

AVAILABILITY OF DATA AND MATERIALS: All data generated or analyzed during this study are included

in this published article

DISCLOSURES: Not Applicable

AUTHORS' CONTRIBUTIONS: The Authors conceived of the study and participated in its design and co-ordination as well as helped to draft the manuscript; the authors also read and approved the final manuscript

ETHICS APPROVAL: Not Applicable

COMPETING INTERESTS: The Authors declare that they have no competing interests

8.0 REFERENCE

1. Davison SP, Reisman NR, Pellegrino ED, Larson EE, Dermody M, Hutchison PJ. Perioperative guidelines for elective surgery in the human immunodeficiency virus-positive patient. Plastic Reconstruction Surg. 2008; 121:1831-1840.

2. Bates J, Mkandawire N, Harrison WJ. The incidence and consequences of early wound infection after internal fixation for trauma in HIV-positive patients. J Bone Joint Surg Br. 2012 Sep; 94(9):1265-1270.

3. Drapeau CM, Pan A, Bellacosa C, Cassola G, Crisalli MP, De Gennaro M et al. Surgical site infections in HIV-infected patients: results from an Italian prospective multicenter observational study. Infection. 2009 Oct;37(5):455-460.

4. Habermann B, Eberhardt C, Kurth AA. Total joint replacement in HIV positive patients. J Infect 2008; 57(1):41-46.

5. Zhang L, Liu BC, Zhang, XY Lei Li, Xia XJ, Guo RZ. Prevention and treatment of surgical site infection in HIV-infected patients. BMC Infectious Diseases 2012; volume 12, Article number: 115.

6. Barré-Sinoussi F, Chermann JC, Rey F, Nugeyre MT, Chamaret S, Gruest J et al. Isolation of a T-lymphotropic retrovirus from a patient at risk for acquired immune deficiency syndrome (AIDS). Science 1983; 220(4599):868-871.

7. Adler MW. ABC of AIDS. Fifth ed. London: BMJ Books, 2001.

8. UNAIDS. 'UNAIDS report on the global AIDS epidemic.'2010.

9. Grant IH, Armstrong D. Management of infectious complications in acquired immunodeficiency syndrome. Am J Med 1986; 81(supplementary 1A):59-72.

10. Fry DE. Surgical problems in the immunosuppressed patient. In: Townsend CM, Beauchamp RD, Evers BM, Mattox KL, eds. Sabiston Textbook of Surgery: The Biological Basis of Modern Surgical Practice.17th ed. Philadelphia, Pa: Elsevier Saunders; 2004:285-286

11. Badoe EA, Archampong EQ, da Rocha-Afodu JT. Principles and Practice of Surgery 4th Edition; Ghana. Publisher: UGMS, 2010

12. WHO annual report. Global HIV/AIDS overview. Geneva, Switzerland: WHO 2005.

13. Loefler IJ. The HIV pandemic and surgery. East Afr Med J 2001; 78(8): 393-394.

15. Joint United Nations Programme on HIV/AIDS (UNAIDS). The Gap Report ISBN: 978-92-9253-062-4. 2014 [Accessed on 30 Jan. 2020];

16. Tanser F, Bärnighausen T, Grapsa E, Zaidi J, Newell ML. High coverage of ART associated with decline in risk of HIV acquisition in rural KwaZulu-Natal, South Africa. Science 2013; 339(6122): 966-971.

17. Herbst AJ, Cooke GS, Bärnighausen T, KanyKany A, Tanser F, Newell ML. Adult mortality and antiretroviral treatment roll out in rural KwaZulu-Natal, South Africa. Bull World Health Organ 2009; 87(10): 754-762.

18. Reniers G, Slaymaker E, Nakiyingi-Miiro J et al. Mortality trends in the era of antiretroviral therapy: evidence from the network for analyzing longitudinal population based HIV/AIDS data on Africa (ALPHA). AIDS 2014; 28(Suppl. 4): S533-42.

19. Grant IH, Armstrong D. Management of infectious complications in acquired immunodeficiency syndrome. Am J Med 1986; 81(supplementary 1A):59-72.

20. Ellis M, Gupta S, Galant S, Hakim S, VandeVen C, Toy C et al. Impaired neutrophil function in patients with AIDS or AIDS-related complex: a comprehensive evaluation. J Infect Dis. 1988; 158(6):1268-1276.

21. Barbul A, Damewood RB, Wasserkrug HL, Penberthy LT, Efron G. Fluid and mononuclear cells from healing wounds inhibit thymocyte immune responsiveness. J Surg Res 1983; 34:505- 509.

22. Fishel RS, Barbul A, Beschorner WE, Wasserkrug HL, Efron G. Lymphocyte participation in wound healing. Morphologic assessment using monoclonal antibodies. Ann Surg. 1987 Jul; 206(1):25-29.

23. Schneider PA, Abrams DI, Rayner AA, Hohn DC. Immunodeficiency-associated thrombocytopenic purpura (IDTP). Response to splenectomy. Arch Surg. 1987 Oct; 122(10):1175-1178.

24. Ravikumar TS, Allen JD, Bothe A Jr, Steele G Jr. Splenectomy. The treatment of choice for human immunodeficiency virus-related immune thrombocytopenia? Arch Surg. 1989 May; 124(5):625-628.

25. Murphy PM, Lane HC, Fauci AS, Gallin JI. Impairment of neutrophil bactericidal capacity in patients with AIDS. J Infect Dis. 1988 Sep; 158(3):627-630.

26. Krumholz HM, Sande MA, Lo B: Community-acquired bacteremia in patients with acquired immunodeficiency syndrome: Clinical presentation, bacteriology, and outcome. Am J. Med 1989; 86:776-779.

27. Holbrook KA, Klein RS, Hartel D, Elliott DA, Barsky TB, Rothschild LH et al. Staphylococcus aureus Nasal Colonization in HIV-Seropositive and HIV-Seronegative Drug [Epidemiology]. Journal of Acquired Immune Deficiency Syndromes 1997; 16(4): 301-306

28. Burack JH, Mandel MS, Bizer LS. Emergency abdominal operations in the patient with acquired immunodeficiency syndrome. Arch Surg 1989; 124: 285-286.

29. Diettrich NA, Cacioppo JC, Kaplan G, Cohen SM. A growing spectrum of surgical disease in patients with human immunodeficiency virus/acquired immunodeficiency syndrome. Experience with 120 major cases. Arch Surg. 1991 Jul;126(7):860-865

30. Hoekman P, van de Perre P, Nelissen J et al. Increased frequency of infection after open reduction of fractures in patients who are sero-positive for human immunodeficiency virus. J Bone Joint Surg Am 1991; 73:675-679.

31. Ragni MV, Crossett LS, Herndon JH. Postoperative infection following orthopaedic surgery in human immunodeficiency virus-infected hemophiliacs with CD4 counts ≤ 200/mm3. J Arthroplasty 1995; 10:716-721.

32. Gustilo RB, Merkow RL, Templeman D. The management of open fractures .J Bone Joint Surg Am 1990; 72:299-304.

33. Guest Speaker to Amsterdam 1996. Orthopaedic Surgery and HIV disease in Africa; J.E. Jellis. School of Medicine, The University of Zambia P. O. Box 50110 Lusaka, Zambia.

34. Bowa K, Kawimbe B, Mugala D, Musowoya D, Makupe A, Njobvu M et al. Review of HIV and Surgery in Africa. The Open AIDS Journal, 2016, 10, 16-23

35. Loefler I. The contest between a clever virus and a facultatively clever host. J R Soc Med 2002; 95(10): 516-517.

36. Bayley AC. Surgical pathology of HIV infection: lessons from Africa. Br J Surg 1990; 77(8): 863-868.

37. Watters DAK. Severe peritoneal sepsis. In: Surgery in the tropics. London, United Kingdom: Bailliere Tindall 1988; 3: pp. 275-300.

38. Jellis JE. Orthopaedic surgery and HIV disease in Africa. Int Orthop 1996; 20(4): 253-256.

39. Elem B, Ranjan P. Impact of immunodeficiency virus (HIV) on Fournier's gangrene: observations in Zambia. Ann R Coll Surg Engl 1995; 77(4): 283-286.

40. Patil P, Elem B, Zumla A. Pattern of adult malignancies in Zambia (1980-1989) in light of the human immunodeficiency virus type 1 epidemic. J Trop Med Hyg 1995; 98(4): 281-284.

41. Elem B, Patil PS. Renal tuberculosis in Zambia: observation on 900 consecutive autopsies. Med J Zambia 1984; 18(1): 5-7.

42. Aird J, Noor S, Lavy C, Rollinson P. The effect of HIV on early wound healing in open fractures treated with internal and external fixation. J Bone Joint Surg Br 2011; 93(5): 678-83.

43. Saltzman DJ, Williams RA, Gelfand DV, Wilson SE. The surgeon and AIDS: twenty years later. Arch Surg 2005; 140(10): 961-967.

44. Cacala SR, Mafana E, Thomson SR, Smith A. Prevalence of HIV status and CD4 counts in a surgical cohort: their relationship to clinical outcome. Ann R Coll Surg Engl 2006; 88(1): 46-51.

45. Crabtree KL, Wojcicki JM, Minhas V et al. Risk factors for early childhood infection of human herpesvirus-8 in Zambian children: the role of early childhood feeding practices. Cancer Epidemiol Biomarkers Prev 2014; 23(2): 300-308.

46. Lavy C, Tindall A, Steinlechner C, Mkandawire N, Chimangeni S. Surgery in Malawi - a national survey of activity in rural and urban hospitals. Ann R Coll Surg Engl 2007; 89(7): 722-724.

47. Mkandawire N, Ngulube C, Lavy C. Orthopaedic clinical officer program in Malawi: a model for providing orthopaedic care. Clin Orthop Relat Res 2008; 466(10): 2385-2391.

48. Chalya PL, Ssentongo R, Kakande I. HIV seroprevalence and its effect on outcome of moderate to severe burn injuries: A Ugandan experience. J Trauma Manag Outcomes 2011; 5(1): 8.

49. Ford N, Mayer KH. World Health Organization- Post-exposure Prophylaxis Guideline Development Group. World Health Organization Guidelines on Post-exposure Prophylaxis for HIV: Recommendations for a Public Health Approach. WHO. GENEVA. 2014

50. Consten EC, van Lanschot JJ, Henny PC, Tinnemans JG, van der Meer JT. A prospective study on the risk of exposure to HIV during surgery in Zambia. AIDS 1995; 9(6): 585-588.

51. Gumodoka B, Favot I, Berege ZA, Dolmans WM. Occupational exposure to the risk of HIV infection among health care workers in Mwanza Region, United Republic of Tanzania. WHO Bull OMS 1997; 75(2): 133-140.

52. Labib M. Scalpel-free surgery could reduce surgeons' risk of HIV and hepatitis. Med J Zambia 2010; 37(2): 99-103.

53. Szabo CP, Dhai A, Veller M. HIV-positive status among surgeons - an ethical dilemma. SAfr Med J 2006; 96(10): 1072-1075.

54. Taegtmeyer M, Suckling RM, Nguku PM, Meredith C, Kibaru J, Chakaya JM et al. Working with risk: occupational safety issues among healthcare workers in Kenya. AIDS Care. 2008 Mar; 20(3):304-310.

55. Fink AJ. A possible explanation for heterosexual male infection with AIDS. N Engl J Med 1986; 315(18): 1167.

56. Bailey RC, Moses S, Parker CB, Agot K, Maclean I, Krieger JN et al. Male circumcision for HIV prevention in young men in Kisumu, Kenya: a randomized controlled trial. Lancet. 2007 Feb 24; 369(9562):643-56.

57. Donoval BA, Landay AL, Moses S, Agot K, Ndinya-Achola JO, Nyagaya EA et al. HIV-1 target cells in foreskins of African men with varying histories of sexually transmitted infections. Am J Clin Pathol. 2006 Mar;125(3):386-391.

58. Odimba BFK. The Impact of HIV Infection on the Surgical Disease Burden in Africa. East and Central African Journal of Surgery March/April 2010; 15 (1): 3-8

59. Beveridge M. Research Capacity Building Partnerships: Ptolemy and the EASI- Delphi Project , Office of International Surgery, University of Toronto, Ptolemy Project research/ Beveridge M, Burton K, Lett R, Barradas R. Priorities for Surgical Development in East Africa: Results of the East African Surgical initiative (EASI Ptolemy Project research).

60. Ozgediz D, Riviello R- The "Other" Neglected Diseases in Global Public Health: Surgical Conditions in Sub-Saharan Africa. PLoS Med 5(6): e121 doi:10.1371/journal.pmed.0050121, Published: June 3, 2008

61. Kharsany ABM, Karim QA. HIV Infection and AIDS in Sub-Saharan Africa: Current Status, Challenges and Opportunities. The Open AIDS Journal 2016; 10: 34-48

62. Chirinda W, Peltzer K. Correlates of inconsistent condom use among youth aged 18-24 years in South Africa. J Child Adolesc Ment Health 2014; 26(1): 75-82.

63. Smith J, Nyamukapa C, Gregson S, Lewis J, Magutshwa S, Schumacher C et al. The Distribution of Sex Acts and Condom Use within Partnerships in a Rural Sub-Saharan African Population. PLoS ONE 2014 9(2): e88378. https://doi.org/10.1371/journal.pone.0088378

64. Hattori MK. Trust and condom use among young adults in relationships in Dar es Salaam, Tanzania. J Biosoc Sci 2014; 46(5): 651-668.

65. Johnson LF, Hallett TB, Rehle TM, Dorrington RE. The effect of changes in condom usage and antiretroviral treatment coverage on human immunodeficiency virus incidence in South Africa: a model-based analysis. J R Soc Interface 2012; 9(72): 1544-1554.

66. Garnett GP, White PJ, Ward H. Fewer partners or more condoms? Modelling the effectiveness of STI prevention interventions. Sex Transm Infect 2008; 84(Suppl. 2): ii4-ii11.

67. Bock NN, Nadol P, Rogers M, Fenley MA, Moore J, Miller B. Provider-initiated HIV testing and counseling in TB clinical settings: tools for program implementation. Int J Tuberc Lung Dis 2008; 12(3)(Suppl. 1): 69-72.

68. Kharsany AB, Karim QA, Karim SS. Uptake of provider initiated HIV testing and counseling among women attending an urban sexually transmitted disease clinic in South Africa missed opportunities for early diagnosis of HIV infection. AIDS Care 2010; 22(5): 533-537.

69. Leon NH, Colvin CJ, Lewin S, Mathews C, Jennings K. Provider-initiated testing and counselling for HIV - from debate to implementation. S Afr Med J 2010; 100(4): 220-221.

70. van Rooyen H, McGrath N, Chirowodza A et al. Mobile VCT: Reaching Men and Young People in Urban and Rural South African Pilot Studies (NIMH Project Accept, HPTN 043). AIDS Behav 2013; 17(9): 2946-2953.

71. Khumalo-Sakutukwa G, Morin SF, Fritz K et al. Project Accept (HPTN 043): a community-based intervention to reduce HIV incidence in populations at risk for HIV in sub-Saharan Africa and Thailand. J Acquir Immune Defic Syndr 2008; 49(4): 422-431.

72. Auvert B, Taljaard D, Lagarde E, Sobngwi-Tambekou J, Sitta R, Puren A. Randomized, controlled intervention trial of male circumcision for reduction of HIV infection risk: the ANRS 1265 Trial. PLoS Med 2005; 2(11): e298.

73. Ashengo TA, Hatzold K, Mahler H, Rock A, Kanagat N, Magalona S et al. Voluntary Medical Male Circumcision (VMMC) in Tanzania and Zimbabwe: Service Delivery Intensity and Modality and Their Influence on the Age of Clients. PLoS ONE 2014; 9(5): e83642.

74. Gray RH, Kigozi G, Serwadda D, Makumbi F, Watya S, Nalugoda F et al. Male circumcision for HIV prevention in men in Rakai, Uganda: a randomized trial. Lancet. 2007 Feb 24; 369(9562):657-666.

75. Williams BG, Lloyd-Smith JO, Gouws E, Hankins C, Getz WM, Hargrove J et al. (2006) The Potential Impact of Male Circumcision on HIV in Sub-Saharan Africa. PLoS Med 3(7): e262. https://doi.org/10.1371/journal.pmed.0030262

76. Joint United Nations Programme on HIV/AIDS (UNAIDS). The Gap Report ISBN: 978-92-9253-062-4. 2014 [Accessed on 2 Feb. 2020];

77. Montague C, Ngcobo N, Mahlase G, Frohlich J, Pillay C, Yende-Zuma N, et al. Implementation of Adolescent-Friendly Voluntary Medical Male Circumcision Using a School Based Recruitment Program in Rural KwaZulu-Natal, South Africa. PLoS ONE 2014; 9(5): e96468. https://doi.org/10.1371/journal.pone.0096468

78. Silumbe M, Labib M, Bowa K. A review of HIV in Urology. Uro Today Int J 2013; 6(1) 6. [http://dx.doi.org/10.3834/uij.1944-5784.2013.02.06]

79. Mwandi Z, Murphy A, Reed J, Chesang K, Njeuhmeli E, Agot K et al. Voluntary Medical Male Circumcision: Translating Research into the Rapid Expansion of Services in Kenya, 2008–2011. PLoS Med 2011; 8(11): e1001130. https://doi.org/10.1371/journal.pmed.1001130

80. Curran K, Njeuhmeli E, Mirelman A, Dickson K, Adamu T, Cherutich P et al. Voluntary Medical Male Circumcision: Strategies for Meeting the Human Resource Needs of Scale-Up in Southern and Eastern Africa. PLoS Med 2011; 8(11): e1001129.

81. Ramjee G. Microbicide research: current and future directions. Curr Opin HIV AIDS 2010; 5(4): 316-321.

82. Padian NS, van der Straten A, Ramjee G, Chipato T, de Bruyn G, Blanchard K et al. Diaphragm and lubricant gel for prevention of HIV acquisition in southern African women: a randomized controlled trial. Lancet. 2007 Jul 21; 370(9583):251-261.

83. McCormack S, Ramjee G, Kamali A, Rees H, Crook AM, Gafos M et al. PRO2000 vaginal gel for prevention of HIV-1 infection (Microbicides Development Programme 301): a phase 3, randomized, double-blind, parallel-group trial. Lancet. 2010 Oct 16; 376(9749):1329-1337.

84. Guffey MB, Richardson B, Husnik M, Makanani B, Chilongozi D, Yu E et al. HIV Prevention Trials Network (HPTN) 035 Study Team. HPTN 035 phase II/IIb randomized safety and effectiveness study of the vaginal microbicides BufferGel and 0.5% PRO 2000 for the prevention of sexually transmitted infections in women. Sex Transm Infect. 2014 Aug; 90(5):363-369.

85. Abdool Karim SS, Richardson BA, Ramjee G, Hoffman IF, Chirenje ZM et al. (2011) Safety and effectiveness of BufferGel and 0.5% PRO2000 gel for the prevention of HIV infection in women. AIDS 25: 957–966.

86. Skoler-Karpoff S, Ramjee G, Ahmed K, Altini L, Plagianos MG, Friedland B et al. Efficacy of Carraguard for prevention of HIV infection in women in South Africa: a randomized, double-blind, placebo-controlled trial. Lancet. 2008 Dec 6; 372(9654):1977-1987.

87. Van Damme L, Govinden R, Mirembe FM, Guédou F, Solomon S, Becker ML et al.- CS Study Group. Lack of effectiveness of cellulose sulfate gel for the prevention of vaginal HIV transmission. N Engl J Med. 2008 Jul 31; 359(5):463-472.

88. Abdool Karim Q, Abdool Karim SS, Frohlich JA, Grobler AC, Baxter C, Mansoor LE et al.; CAPRISA 004 Trial Group. Effectiveness and safety of tenofovir gel, an antiretroviral microbicide, for the prevention of HIV infection in women. Science. 2010 Sep 3; 329(5996):1168-74.]

89. Marrazzo JM, Ramjee G, Richardson BA, Gomez K, Mgodi N, Nair G et al., -for the VOICE Study Team. Tenofovir-based pre-exposure prophylaxis for HIV infection among African women. N Engl J Med 2015; 372(6): 509-518.

90. Rees H, Delany-Moretlwe SA, Lombard C, Baron D, Panchia R, Myer L. FACTS 001 Phase III Trial of Pericoital Tenofovir 1% Gel for HIV Prevention in Women Conference on Retroviruses and Opportunistic Infections (CROI). February 23-26; Seattle, Washington. 2015. Abstract Number: 26LB

91. Van Damme L, Corneli A, Ahmed K, Agot K, Lombaard J, Kapiga S et al.,- for the FEM-PrEP Study Group. Pre-exposure prophylaxis for HIV infection among African women. N Engl J Med 2012; 367(5): 411-422.

92. Marston M, Michael D, Wringe A, Isingo R, Clark BD, Jonas A et al. The impact of antiretroviral therapy on adult mortality in rural Tanzania. Trop Med Int Health. 2012 Aug;17(8):e58-65

93. World Health Organization. Antiretroviral drugs for treating pregnant women and preventing HIV infections in infants: recommendations for a public health approach 2010 [Accessed 30 Jan. 2020]

94. Lundgren JD, Babiker AG, Gordin F, Emery S, Grund B, Sharma S et al., - INSIGHT START Study Group. Initiation of antiretroviral therapy in early asymptomatic HIV infection. N Engl J Med 2015; 373(9): 795-807.

95. Danel C, Moh R, Gabillard D Badje A, Le Carrou J, Ouassa T et al.,- TEMPRANO ANRS 12136 Study Group. A trial of early antiretrovirals and isoniazid preventive therapy in Africa. N Engl J Med 2015; 373(9): 808-822.

96. National Department of Health South Africa. National Consolidated Guidelines for the Prevention of Mother-to-Child Transmission of HIV (PMTCT) and the management of HIV in Children, Adolescents and Adults http://www.sahivsoc.org/upload/documents/ART%20 Guidelines%2015052015.pdf 2015 [Accessed 20 Jan 2020]

97. MacCarthy S, Hoffmann M, Ferguson L, Nunn A, Irvin R, Bangsberg D et al. The HIV care cascade: models, measures and moving forward. Int AIDS Soc. 2015 Mar 2; 18:193-195.

98. Robinson G, Wilson SE, Williams RA. Surgery in patients with acquired immunodeficiency syndrome. Arch Surg 1987; 122: 170–175.

99. Wilson SE, Robinson G, Williams RA, Stabile BE, Cone L, Sarfeh IJ et al. Acquired immune deficiency syndrome (AIDS). Indications for abdominal surgery, pathology, and outcome. Ann Surg 1989; 210: 428–433.

100. Diettrich NA, Cacioppo JC, Kaplan G, Cohen SM. A growing spectrum of surgical disease in patients with human immunodeficiency virus/acquired immunodeficiency syndrome. Experience with 120 major cases. Arch Surg 1991; 126: 860–865.

101. Whitney TM, Macho JR, Russell TR, Bossart KJ, Heer FW, Schecter WP. Appendicitis in acquired immunodeficiency syndrome. Am J Surg 1992; 164: 467–470.

102. Ayers J, Howton MJ, Layon AJ. Postoperative complications in patients with human immunodeficiency virus disease. Clinical data and a literature review. Chest 1993; 103: 1800–1807.

103. Hewitt WR, Sokol TP, Fleshner PR. Should HIV status alter indications for hemorrhoidectomy? Dis Colon Rectum 1996; 39: 615–618.

104. Tran HS, Moncure M, Tarnoff M, Goodman M, Puc MM, Kroon D et al. Predictors of operative outcome in patients with human immunodeficiency virus infection and acquired immunodeficiency syndrome. Am J Surg 2000; 180: 228–233.

105. Yii MK, Saunder A, Scott DF. Abdominal surgery in HIV/AIDS patients: indications, operative management, pathology and outcome. Aust NZ J Surg 1995; 65: 320–6.

106. Consten EC, Slors FJ, Noten HJ, Oosting H, Danner SA, van Lanschot JJ. Anorectal surgery in human immunodeficiency virus-infected patients. Clinical outcome in relation to immune status. Dis Colon Rectum 1995; 38: 1169–1175.

107. Savioz D, Lironi A, Zurbuchen P, Leissing C, Kaiser L, Morel P. Acute right iliac fossa pain in acquired immunodeficiency: a comparison between patients with and without acquired immune deficiency syndrome. Br J Surg 1996; 83: 644–646.

108. Wakeman R, Johnson CD, Wastell C. Surgical procedures in patients at risk of human immunodeficiency virus infection. J R Soc Med 1990; 83: 315–318.

109. Davidson T, Allen-Mersh TG, Miles AJ, Gazzard B, Wastell C, Vipond M et al. Emergency laparotomy in patients with AIDS. Br J Surg 1991; 78: 924–926.

110. Davis PA, Corless DJ, Aspinall R, Wastell C. Effect of CD4(+) and CD8(+) cell depletion on wound healing. Br J Surg 2001; 88: 298–304.

111. Lewis DK, Callaghan M, Phiri K, Chipwete J, Kublin JG, Borgstein E et al. Prevalence and indicators of HIV and AIDS among adults admitted to medical and surgical wards in Blantyre, Malawi. Trans R Soc Trop Med Hygiene 2003; 97: 91–96.

112. Kalima P, Luo NP, Bem C, Watters DA. The prevalence of HIV seropositivity and impact of HIV infection in Zambian surgical patients. Int Conf AIDS 1990; 6:443.

113. Bhagwanjee S, Muckart DJ, Jeena PM, Moodley P. Does HIV status influence the outcome of patients admitted to a surgical intensive care unit? A prospective double blind study. BMJ 1997; 314: 1077–1081.

114. Wiersma R. HIV-positive African children with rectal fistulae. J Pediatr Surg 2003; 38: 62–64.

115. Cacala SR, Mafana E, Thomson SR, Smith A. Prevalence of HIV Status and CD4 Counts in a Surgical Cohort: Their Relationship to Clinical Outcome. Ann R Coll Surg Engl 2006; 88: 46–51

116. Horberg MA, Hurley LB, Klein DB, Stephen E, Follansbee SE, Quesenberry C et al. Surgical Outcomes in Human Immunodeficiency Virus–Infected Patients in the Era of Highly Active Antiretroviral Therapy. Arch Surg. 2006; 141:1238-1245

TABLE 3: Spectrum and Outcome of Surgical Studies on HIV and AIDS [115]

First author (year)	Country	No	Duration (years)	Pathology	HIV+	AIDS	Mortality Early	Mortality Late	Morbidity	Transmission Predominance
Robinson 98 (1986)	USA	21	4	Mixed	All	All	48%	NS	NS	Homosexual
Wilson 99 (1989)	USA	35	5	Mixed	All	All	9%	46%	14%	Homosexual
Diettrich100 (1991)	USA	88	NS	Surgery	All	48%	19%a 9% b	36%	18%	Homosexual
Whitney101 (1992)	USA	28	7	Appendicitis	All	25%	0	NS	18%	Homosexual
Ayers102 (1993)	USA	343	10	Mixed	All	8%	17%	61%	38%	Homosexual
Hewitt103 (1996)	USA	57	2	Hemorrhoids	27	NS	0	NS	3 Bled	Homosexual
Tran104 (2000)	USA	55	1	Mixed	All	40%	11%	NS	24%	Drugs
Yii105 (1995)	Australia	45	9	Mixed	All	67%	12%	35%	7%(HIV) 61%(AIDS)	Homosexual
Consten106 (1995)	The Netherlands	83	10	Mixed anal conditions	All	68%	NS	63%	WoundC healing	Homosexual
Savioz 107 (1996)	Switzerland	17	7	Appendicitis	All	35%	NS	NS	9%(HIV) 50%(AIDS	Drug
Wakeman108 (1990)	UK	112	1	Mixed	40 (35%)	6	0	NS	6%	Homosexual
Davidson109 (1991)	UK	28	3	Emergency laparotomy	All	All	11%	52%	NS	Homosexual
Davis110 (1999)	UK	106	10	Mixed	53(50%)	92%	NS	NS	WoundC healing	Homosexual

Lewis111 (2003)	Mala-wi	486	2 wee ks	All surgical admissions	175 (36%)	8%	5%	NS	NS	Heterosexual
Kalima112 (1990)	Zam-bia	171	3 mon ths	All surgical admissions	23 (14%)	13%	NS	NS	12%	Heterosexual
Bhagwan-jee113 (1997)	South Africa	402	1	All ICU Admissions	52 (13%)	0	24% d 29% e	NS	Organ failure higher in HIV+	Heterosexual
Wiersma114 (2003)	South Africa	39	6	Rectal fistu-lae	All	NS	NS	NS	83%	Vertical MTC
Cacala115 (2006)	South Africa	350	3mo nths	All surgical admissions	137 (39%)	23%	4%	NS	15% HIV+ 20% (AIDS)	Heterosexual
Horberg116 (2006)	USA	332	5	All surgical admissions	37 (11%)	NS	NS	1%	48%	Heterosexual

a Emergency surgery; b elective surgery; c impaired in AIDS patients; d HIV–; e HIV+.

TABLE 4: Outcome Measures in HIV-Infected–HIV Noninfected Patients [116] Matched Surgical Pairs*

Outcome	**HIV-Infected Pairs**	**HIV-Noninfected Pairs**	**P Value†**
Bacterial infection at surgery	37 (11.1) [7.8-14.5]	23 (6.9) [4.2-9.6]	0.03
Postoperative complication			
Any	37 (11.1) [7.8-14.5]	34 (10.2) [7.0-13.5]	0.79
≥ 1	5 (1.5) [0.2-2.8]	3 (0.9) [0-1.9]	0.45
Type of surgery, by pairs			
Abdominal (n = 264)	32 (11.7) [7.9-15.5]	26 (9.5) [6.0-13.0]	0.47
Gynecologic and Breast (n = 13)	2 (15.4) [0-35.0]	2 (15.4) [0-35.0]	0.99
Orthopedic (n = 36)	2 (5.6) [0-13.0]	1 (2.8) [0-8.1]	0.56
Cardiothoracic (n = 19)	1 (5.3) [0-15.3]	5 (26.3) [6.5-46.1]	0.10
Wound infection	13 (3.9) [1.8-6.0]	16 (4.8) [2.5-7.1]	0.70
Surgical site infection within 12 mo	10 (3.0) [1.2-4.9]	8 (2.4) [0.8-4.1]	0.81
Dehiscence	4 (1.2) [.03-2.4]	3 (0.9) [0-1.9]	0.99
Pneumonia, non–*Pneumocystis carinii*	8 (2.4) [0.8-4.1]	1 (0.3) [0-0.9]	0.04
Additional operations to treat surgical complications	10 (3.0) [1.2-4.9]	8 (2.4) [0.8-4.1]	0.80
Length of stay, d			
Mean (median)	2.7 (1.0)	2.4 (1.0)	0.20‡

Range	1-31	1-47	
Mean (median)	1.5 (1.0)	1.5 (1.0)	0.48‡
Range	0-13	0-9	
Dead at 12 months	10 (3.0) [1.2-4.9]	2 (0.6) [0-1.4]	0.04

*Data are given as number (percentage) [95% confidence interval] unless otherwise indicated.
†McNemar test unless otherwise indicated.
‡ Paired *t* test.