The Prevalence of Hepatitis B and C among HIV Positive Patients in Some Hospitals in Rivers State

M. A. Erasmus¹, N. P. Akani², L. O. Amadi²* and J. O. Williams²

¹Rivers State University Teaching Hospital P.M.B 5064, Port Harcourt, Nigeria.
²Department of Microbiology, Faculty of Science, Rivers State University Nkpou Orowurukwo P.M.B 5080, Port Harcourt, Nigeria.

ABSTRACT

Human Immunodeficiency Virus (HIV), Hepatitis B Virus (HBV), and Hepatitis C Virus (HCV) are all blood borne pathogens that are still global health challenges and were known to be endemic in Nigeria. Little work had been done on Hepatitis-B and C co-infection among HIV positive patients in the three Senatorial Districts of Rivers State. A case- control, hospital- based study was conducted among subjects from Rivers state University Teaching Hospital (RSUTH), Zonal Hospital, Bori and Zonal Hospital, Ahoada to determine the prevalence of Hepatitis B and C co-infection in these areas. Three hundred and seventy-five subjects of (10-69 years) and both sexes were included in the study. A structured questionnaire was administered to obtain demographic parameters of the participants. The samples collected were screened and confirmed for hepatitis-B and C using standard techniques. The overall prevalence rates of HBV, HCV and HBV/HCV in this study are 4.5%, 2.1% and 0.8% respectively while the prevalence among HIV positive participants were; 4.6%, 2.8% and 1.1% respectively. Bori had the highest prevalence of HBV and HCV, (5.3% and 4.2%) while Ahoada had the highest prevalence of triple infection (2.1%). The prevalence of HIV/HBV, HIV/HCV and HIV/HBV/HCV infection was more among subjects within age range of 30-39 years (7.0%, 5.6% and 4.2%) and lowest within the age range of 20-29 years (2.3%, 0% and 0%). Conclusively, the research findings show that the prevalence of hepatitis B

*Corresponding author: E-mail: amakirimartha@gmail.com, lawrence.amadi1@ust.edu.ng;
and C co-infection among HIV patients in these hospitals are high. Thus, every HIV positive patient should be screened and educated on the danger of co-infection for better management of the patient.

Keywords: Human immunodeficiency virus; hepatitis B; hepatitis C and Co-infection.

1. INTRODUCTION

Human immunodeficiency virus (HIV), Hepatitis B and C viral infections are all endemic in the sub-Saharan Africa (Nigeria inclusive) and are threats to the global health [1]. HIV, HBV and HCV are all blood borne pathogens that shared the similar route of transmission [2]. Although the introduction of antiretroviral therapy (ART) has reduced HIV/AIDS-related illness and death, a number of them are still dying from non-AIDS-related illnesses including; co-infections which could be bacterial, fungal, parasitic or viral [3]. Presently, there is increase in morbidity and mortality resulting from viral infections among people living with HIV (PLHIV) which according to researchers could either be due to co-infection with HBV and or HCV or other non-infectious agents [4].

Hepatitis is the inflammation of the liver and is now a major global health problem in developing countries especially Sub-Saharan Africa including Nigeria [5].

According to [4], HBV and HCV share a similar preference of replication in hepatocytes but their life cycles are entirely different. HBV is a DNA virus that replicates in the nucleus of hepatocytes, while HCV is an RNA virus that replicates mainly in the cytoplasm of hepatocytes. However, they both have RNA replicative intermediates and can interact in co-infected cells, leading to varying viral expression and serologic patterns.

Co-infection of HIV with HBV or HCV is more complex than mono-infection with HIV, HBV or HCV. Co-infection can be defined as the presence of two or more organisms replicating in the same host. Co-infection of HIV with viral hepatitis (HBV and/or HCV) usually occurs as a result of these viruses sharing a similar mode of transmission [2]. HBV and HCV both have an affinity for the liver cells and are responsible for approximately 96% of all hepatitis mortality. They cause severe morbidity including cirrhosis and hepatocellular carcinoma (HCC) due to intrahepatic apoptosis and mortality particularly among HIV-infected individuals [3,6,7]. Another similarity among these viruses is the use of reverse transcriptase enzyme for replication and the possibility of developing chronic infections and the ability for mutation in their genomes. The tendency of mutation gives rise to some strains which are resistant to the commonly available antiviral agents, [1,8].

Studies have shown that the progression of HIV in those co-infected with either HBV or HCV is faster. It should be noted that most of the infected individuals (50% of HCV infected persons), 15-30% of HIV infected persons and about 75% of HBV infected persons are unaware of their infection status hence, the need for screening of every HIV positive patient.

In Nigeria, HIV/AIDS Indicator and Impact Survey report showed a prevalence of 8.1% and 1.1% for HIV/HBV and HIV/HCV for the country. Rivers state was also reported to have a prevalence of 4.7% for HIV/HBV [8]. Very little work has been done on Hepatitis-B and C co-infection among HIV patients in Rivers state. Proper management of patients will involve identifying possible cause of complications so as to effect the necessary actions and improve healthcare delivery.

The aim of this study was to determine the prevalence of Hepatitis B and C co-infection among HIV patients from the three senatorial zones of Rivers State.

2. MATERIALS AND METHODS

2.1 Study Area and Design

This study was carried out in Rivers State University Teaching Hospital (RSUTH) of Port-Harcourt, Zonal Hospital Bori and Zonal Hospital Ahoada. Some of the patients who visited the HIV clinic and out-patient department (OPD) during the study period formed the source population.

2.2 Inclusion and Exclusion Criteria

Both HIV positive and negative individuals of both sexes and within the age bracket of (10-69) years were included in this study.
2.3 Calculation of Sample Size

The minimum sample size required for this study was calculated using the formula by [9,10] at 95% confidence level and a report prevalence of 3.8% (0.038) [9].

Using the formula:

\[ N = \frac{Z^2pq}{d^2} \]

Where

- \( N \) = sample size
- \( Z \) = statistic corresponding to level of 95% confidence level 1.96
- \( P \) = expected prevalence = 3.8% (0.038)
- \( d \) = is the level of significance (allowable error) = 5%, 0.05
- \( q \) = 1 - \( p \)

\[ N = \frac{(1.96)^2 \times 0.038 \times (1-0.038))}{(0.05)^2} \]
\[ = \frac{(3.8416 \times 0.038 \times 0.962)}{0.0025} \]
\[ = 56.2 \text{ (minimum sample size).} \]

A total number of 375 patients were recruited in the study.

2.4 Blood Sample Collection

Total of 10mls of blood was collected from each subject using vein puncture technique [11]. Soft tubing tourniquet was tied around the upper arm of the subject to enable the index finger fill a suitable vein. The puncture site was then cleansed with methylated spirit and venipuncture made with the aid of a sized needle attached to a 10mls syringe. The tourniquet was released and the needle removed immediately after collecting sufficient blood. The sample was transferred into plain and EDTA bottles for screening and confirmation respectively after separation [12] and compared with control.

2.5 Screening for HBV, HCV and HIV

The screening was done using DiaSpot, a commercially available test kits for the detection of HBsAg or anti – HCV antibody from each patient’s serum. The HBV or HCV Rapid Test strip is a qualitative, membrane based immunoassay for the detection of antibody to HBV or HCV in serum or plasma.

The test device was removed from the pouch and was dipped into fresh serum specimen for 3 seconds with the arrow end pointing down. The device was later laid on a clean, dry, nonabsorbent surface on the work-top bench. The result was read in ten minutes [13]. The National algorithm for HIV screening which involves the use of three test kits was employed. Two for parallel testing and one for a tie-breaker, was be adopted. The three kits were Determine-HIV ½ (Abbott Japan Co. Ltd. Germany), Uni-Gold- HIV ½ (Trinity Biotec, France) and Stat-pek Dipstick (Chembio Diagnostic System Inc. The Manufactures’ Standard Operating Procedures (SOP) were followed. HIV sero-positivity was defined as a reactive result on two of the test kits. Non-reactive subjects were considered sero-negative.

2.6 Confirmatory Test for HBV, HCV and HIV

The presence of the viruses was confirmed by running the patient’s plasma sample on COBAS® AmpliPrep/ COBAS® TaqMan® 96 Analyser.

2.7 Principle and Procedure for Quantification of HIV in Human Plasma

This is an in-vitro test based on the amplification of nucleic acid for the quantitation of Human Immunodeficiency Virus in human plasma using an automated machine for both the preparation and detection. The three major processes include; the isolation of HIV-1 RNA, reverse transcription of the target RNA to generate complimentary DNA and finally, the simultaneous PCR amplification of the target complimentary DNA and detection of cleaved double-labeled oligonucleotide probe specific for the target. The machine was logged on and the daily maintenance performed. Reagents were removed from storage and loaded immediately. The samples which were stored were also removed from storage and allowed to thaw at room temperature before pipetting. Consumables were also loaded, order for viral load created, worksheets prepared and barcode clips attached to the sample racks. Sample tubes were placed in the sample racks and labeled. Control samples and test samples were pipetted into the respective tubes (1100 µl). The instrument status was checked and ‘start run’ button pressed. Prepared samples were removed from COBAS® AmpliPrep to the COBAS® TagMan® Analyzer.
automatically because it is docked. Finally, results were reviewed and printed.

2.8 Statistical Analysis

Data generated from this study was analysed using the Statistical Package for Social Sciences (SPSS vs 22).

3. RESULTS

Among the 375 samples collected, 151 (40.3%) males and 224 (59.7%) females were obtained as represented in Table 1. From the table, it was observed that about 103 (27.5%) of the participants had only one sexual partner each while 272 (72.5%) had multiple sexual partners.

Table 2 shows the prevalence of Hepatitis B and C among the recruited subjects with ART-naïve having the highest prevalence of HBV and HBV/HCV (1.9% and 0.5%) respectively, followed by those on ART (1.6%). The highest prevalence of HCV is observed among subjects on ART (1.3%) while control has the least prevalence for both HBV and HCV (1.1% and 0.0%) respectively.

Table 3. Shows a total number of 285 HIV positive samples that were collected with a prevalence of HBV, HCV and HBV/HCV as; 4.6%, 2.8% and 1.1% respectively. Bori had the highest prevalence of HBV and HCV, 5.3% and 4.2% respectively.

Table 4 shows the highest prevalence of HIV/HBV, HIV/HCV and HIV/HBV/HCV infection among the age range of 30-39 years as; 7.0%, 5.6% and 4.2%, respectively while the lowest values were seen in 20-29 years (2.3%) for HIV/HBV and 40-49 years (1.8%) for HIV/HCV.

Table 1. Demographic characteristics of the participants

| Location | Male | Female | One partner | Multiple partners |
|----------|------|--------|-------------|-------------------|
| ART      | 19   | 31     | 13          | 37                |
| BORI     | 20   | 30     | 8           | 42                |
| AHOADA   | 19   | 31     | 14          | 36                |
| ART-NAIVE| 20   | 25     | 12          | 33                |
| RSUTH    | 19   | 26     | 11          | 34                |
| BORI     | 20   | 25     | 8           | 37                |
| AHOADA   | 34   | 56     | 37          | 53                |
| CONTROL  | 46   | 101    | 84          | 17                |
| TOTAL    | 151  | 224    | 103(27.5%)  | 272 (72.5%)       |

Table 2. Prevalence of Co-infection among HIV Positive and negative control

| Group      | No Tested | HBV (%) | HCV (%) | HBV/HCV (%) |
|------------|-----------|---------|---------|-------------|
| ART        | 150       | 6 (1.6) | 5 (1.3) | 1 (0.3)     |
| ART-Naive  | 135       | 7 (1.9) | 3 (0.8) | 2 (0.5)     |
| Control    | 90        | 4 (1.1) | 0 (0.0) | 0 (0.0)     |
| Total      | 375       | 17 (4.5)| 8 (2.1) | 3 (0.8)     |
| p-value    | 0.05      | 0.03    | 0.21    |
| $\chi^2$   | 1.009     | 1.006   | 1.91    |

Table 3. Prevalence of Co-infections among the HIV positive participants according to location

| Location | No. Examined | HIV/HBV (%) | HIV/HCV (%) | HIV/HBV/HCV (%) |
|----------|--------------|-------------|-------------|-----------------|
| RSUTH    | 95           | 4(4.2)      | 2(2.1)      | 1(1.1)          |
| BORI     | 95           | 5(5.3)      | 4(4.2)      | 0(0)            |
| AHOADA   | 95           | 4(4.2)      | 2(2.1)      | 2(2.1)          |
| TOTAL    | 285          | 13(4.6)     | 8(2.8)      | 3(1.1)          |
| p-value  | 0.08         | 0.12        | 0.22        |
| $\chi^2$ | 1.003        | 0.981       | 2.21        |

Human Immuno-deficiency Virus (HIV), Hepatitis B Virus (HBV), Hepatitis C Virus (HCV), Rivers State University Teaching Hospital (RSUTH), Antiretroviral Therapy ART
4. DISCUSSION

This study investigated the sero-prevalence of HBV and HCV among HIV positive using HIV negative subjects as control. An overall prevalence of 4.5%, 2.1% and 0% for HBV, HCV and HBV/HCV was observed among the HIV positive and negative subjects and is in agreement with the findings from other parts of Nigeria [5,11]. A prevalence of 1.1%, for HBV and 0% for HCV was observed among the negative control. For the HIV positive subjects, a prevalence of 4.6%, 2.8% and 1.1% for HIV/HBV and HIV/HCV and HIV/HBV/HCV respectively was observed among the participants.

The prevalence of 4.6% in this study for HIV-HBV co-infection rate is comparable with prevalence of HBsAg of 4.1%, 4.8%, 5.6%, 6.67%, 9.7%, 6.7% reported by [5,13-17] in Port Harcourt and other parts of Nigeria.

Higher prevalence of 56.7% by [18], 51.9% by [19] and 70.5% by [20] were also observed.

Generally, as several studies reported and anticipated in different parts of the world, such co-infection differences could be due to differences in geographic regions, types of risk groups and the means of exposures involved [21,22]. The sero-prevalence rates of HIV-HCV co-infection in this study was 2.8% which is similar to other studies from different parts of the country with prevalence ranging from 2-6% [23-26]. Co-infection rates of HIV-HCV ranging from 3.6-13.3% were also reported from different studies in Ethiopia [7]. Lower prevalence of HIV/HCV had also been reported in other countries like Chile, (1.1%), Colombia (0.8%), Venezuela (0.7%) and Nigeria 0.8% [7,27].

Higher prevalence of HIV/HCV had been reported with prevalence rates ranging from 5.0% to 13.86% in Nigeria and Ethiopia [18,28]. The sero-prevalence of HIV-HBV-HCV triple infection in this study was 1.1%, which is similar to studies from Ethiopia (1.1%) other parts of Nigeria (0.7%, 0.9%) and is more or less comparable to reports from Senegal (0.5%), Kenya (0.26%) and Egypt (0.44%) [26,27,28]. However, higher prevalence of HCV-HBV-HIV triple co-infection was reported in Argentina (9.5%) and Iran (9.2%) [28]. The prevalence of 1.1% for the triple infection in this study reflects what has been reported earlier in Nigeria and in other West African countries [23,27,29]. For such variations, risk factors which accounts for HBV and HIV prevalence difference might also work for the triple infection. A higher prevalence of co-infection was observed at Bori (5.3% and 4.2) for HBV and HCV respectively while, Ahoada had the highest prevalence for triple infection (2.1%). This is not surprising since Khana local government is topping the list of HIV prevalence in the Rivers State [30].

The result from this work also showed highest prevalence of HIV/HBV, HIV/HCV and HIV/BHV/HCV infection in age range of 30-39 years as; 7.0%, 5.6% and 4.2%, respectively while the lowest values were seen in 20-29 years (2.3%) for HIV/HBV, 40-49 years (1.8%) for HIV/HCV as shown on Table 4.

5. CONCLUSION

The overall prevalence of HIV/ HBV (4.6%), HIV/HCV (2.8%) and HIV/HBV/HCV (1.1%) had been established in this study. It was also

Table 4. Age - Related prevalence of Co-infection among the HIV positive participants

| AGE      | NO. TESTED | HIV/HBV (%) | HIV/HCV (%) | HIV/HBV/HCV (%) |
|----------|------------|-------------|-------------|-----------------|
| 10-19    | 19         | 1 (5.7)     | 1 (5.7)     | 0 (0.0)         |
| 20-29    | 87         | 2 (2.3)     | 0 (0.0)     | 0 (0.0)         |
| 30-39    | 71         | 5 (7.0)     | 4 (5.6)     | 3 (4.2)         |
| 40-49    | 56         | 3 (5.4)     | 1 (1.8)     | 0 (0.0)         |
| 50-59    | 43         | 2 (4.7)     | 2 (4.7)     | 0 (0.0)         |
| 60-69    | 9          | 0 (0.0)     | 0 (0.0)     | 0 (0.0)         |
| TOTAL    | 285        | 13 (4.6)    | 8 (2.8)     | 3 (1.1)         |

Human Immuno-deficiency Virus (HIV), Hepatitis B Virus (HBV), Hepatitis C Virus (HCV)
observed that Bori apart from having the highest HIV burden in the state, has the highest prevalence of co-infection of HBV and HCV among HIV patients. Having known the complication that accompany co-infection in the management of HIV infection, every HIV positive patient should undergo screening for HBV and HCV.

**DISCLAIMER**

The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

**CONSENT AND ETHICAL APPROVAL**

An ethical approval for this work was obtained from the office of the Permanent Secretary, Rivers State Ministry of Health, Port Harcourt. Each participant filled a consent form and questionnaires were issued to obtain their demographic data.

**COMPETING INTERESTS**

Authors have declared that no competing interests exist.

**REFERENCES**

1. Romano L, Velati C, Cambie G, Fomiatti, Galli C, Zanetti AR. Hepatitis B Virus Infection Among the Blood Donors in Italy: Prevalence and Correlates Between Serologica Patterns and Occult Infection. Blood Transfusion. 2013;11(2): 281-288.
2. Bello RH, Olabode HOK. Human immunodeficiency virus (HIV) and hepatitis B virus (HBV) co-infection amongst patients in Biu, Borno state- Nigeria. International Research Journal of Microbiology. 2011;2:507-509.
3. Otegbayo JA, Taiwo BO, Akingbola TS, Odaibo GN, Adedapo KS, Penugonda S. Prevalence of hepatitis B and C seropositivity in a Nigerian cohort of HIV-infected patients. Annual Journal of Hepatology. 2008;7(2):152–156.
4. Onwusoanya UE, Ihongbe JC, Obeaga EI, Ifeanyichukwu MO, Nwachukwu PE, Ocheabuto OM. Evaluation of Some Immunological and Haematological Indices of Hepatitis B Infection Subjects in Nnamdi Azikiwe University Teaching Hospital, Nnewi, Anambra State. Nigeria Journal of Biomedical Sciences. 2017; 6(3):1-7.
5. Lawal MA, Adeniyi OF, Akintan PE, Omotosho OS, Temiye EO. Prevalence and risk factor for hepatitis B and C viral co-infections in HIV infected children in Lagos, Nigeria. Procedure Library of Science One. 2020;4:412-420.
6. Diop-Ndialle H, Toure-Kane C, Etard JF, Lo G, Diaw P, Ngom-Gueye NF. Hepatitis B, C seroprevalence and delta viruses in HIV-1 Senegalese patients at HAART initiation (retrospective study) Journal of Medical Virology. 2008; 80(8):1332–1336.
7. Weitzel T, Rodriguez F, Noriega LM, Marcott A, Duran L, Palavecino C. Hepatitis B and C virus infection among HIV patients within the public and private healthcare systems in Chile: A cross-sectional serosurvey. Procedure Library of Science One, 2020;15(1), 325-334.
8. World Health Organization. Global Hepatitis B Report; Fact Sheet; 2018. Available: www.who.int/mediacentre/facts
9. Thrushfield M. Veterinary Epidemiology. (3rd Edition) UK: Oxford Black Well Science; 2005.
10. Tremeau-Bravard A, Ogbukagu IC, Abubakar JJ. Seroprevalence of hepatitis B and C infection among the HIV-positive population in Abuja, Nigeria. African Health Science. 2015;12(3):312-317.
11. Malu AO, Achinge GI, Utoo PM, Kur JT, Obekpa SA. Prevalence of Hepatitis B Surface Antigen and Antibodies to Hepatitis C in the General Population of Benue State, Central Nigeria. American Journal of Tropical Medicine and Hygiene. 2020;102(5):995-1000.
12. Chen JH, Wong KH, Li PC, Chan KK, Lee MP, To SW. In-house human immunodeficiency virus-1 genotype resistance testing to determine highly
active antiretroviral therapy resistance mutations in Hong Kong. Hong Kong Medical Journal. 2012;18:20–24.

13. Inyang-Etoh PC, Obi OA, Udohkong MI. Prevalence of hepatitis B, C and D among patients on highly active antiretroviral drug therapy (HAART) in Calabar metropolis, Nigeria. Journal of Medical and Allied Science. 2018;8(1):17-22.

14. Ayodele MBO, Frank PN. Sero prevalence of Hepatitis B virus infection HIV co-infected patients in Port-Harcourt, Nigeria. New York Science Journal. 2016;9(5):39-43.

15. Nwolisa E, Mbanefo F, Ezeogu J, Amadi P. Prevalence of hepatitis B co-infection among HIV infected children attending a care and treatment centre in Owerri, South-eastern Nigeria. Pan African Medical Journal. 2013;14:89-97.

16. Chakraborty A, Singh M, Misra V. Assessment of Liver Function Test in HIV-HBV Co-infected Patients at Art Prayagraj, Northern India. Indian Journal of Applied Research. 2019;9:31-37.

17. Okoroiwu UH, Okafor MI, Asemota AE, kpokam CD. Seroprevalence of Transfusion Transmissible Infections (HBV, HCV, Syphilis and HIV) among prospective blood donors in Tertiary Health Care Facility in Calabar, Nigeria: An Eleven years evaluation. BioMed Central Journal of Public Health. 2018;18:645-649.

18. Odjimogho S, Agofure O, Oghenenioborue RA, Okandeji-Barry IZL. Prevalence of Hepatitis B and C among HIV/AIDS patients attending Bingham University Teaching Hospital Jos, Plateau State Nigeria: A retrospective study. Journal of public health and Epidemiology. 2018;10(6):198-204.

19. Okonkwo UC, Okpara H, Out A, Ameh S, Ogarekpe Y, Osim H, Inyam M. Prevalence of hepatitis B, hepatitis C and human immunodeficiency viruses, an evaluation of the risk factors for transmission: Report of the population screening in Nigeria. South African Medical Journal. 2017;4:421-430.

20. Nyirenda M, Beadsworth M, Stephany P, Hart C, Hart I, Munthali C. Prevalence of infection with hepatitis B and C virus and co-infection with HIV in medical inpatients in Malawi, Journal of Infectious Diseases. 2008;57:72–77.

21. Alter MJ. Epidemiology of viral hepatitis and co-infection. Journal of Hepatology. 2005;44(1):6-9.

22. Okonko IO, Horsefall SJ, Okentugba PO, Frank-Peterside N. HBV and HIV coinfections among intending donor in Port Harcourt, Nigeria. Journal of Immunoassay and Immunochemistry. 2015;36(4):359-367.

23. Adewole OO, Anteyi E, Ajwun Z, Wada I. Hepatitis B and C virus co-infection in Nigerian patients with HIV infection. Journal of Infections in Developing Countries. 2009;3(5):369-375.

24. Iwalokun BA, Hodonu SO, Olakye BM, Olabisi OA. Seroprevalence and biochemical features of hepatitis B surface antigenemia in patients with HIV-1 infection in Lagos, Nigeria. African Journal Medical Sciences. 2006;35:337–343.

25. Musa BM, Bussell S, Borodo MM. Prevalence of hepatitis B virus infection in Nigeria, 2000-2013: A systematic review and meta-analysis. Nigeria Journal of Clinical Practice. 2015; 18(2):163-172.

26. Okocha EC, Oguegiofor OC, Odimgbo CU, Okonkwo CU, Asomugha L. Prevalence of hepatitis B surface antigen seropositivity among infected and non-infected individuals in Nnewi Nigeria. Nigerian Medical Journal. 2018;53(4):249-253.

27. Oladeinde BH., Omoregie R, Oladeinde OB. Prevalence of HIV, HBV infections among pregnant women receiving antenatal care in a traditional birth home in Benin City, Nigeria. Saudi Journal Of Health Science. 2013;2(1):113-117.

28. Ya’aba Y, Izebe KS, Mohammed SB, Chukwu A, Abdulmumin AR, Abarike MC. Sero-Prevalence of Hepatitis B and C Co-Infection among HIV Patients attending Lapai General Hospital, Niger State, Nigeria. Dutse Journal of Pure and Applied Sciences. 2020;8:104-115.

29. Pappoe F, Hagan CK, O Obiri-Yeboah D. Sero-prevalence of Hepatitis B and C virus infections in Ghanaian HIV positive Cohort; a consideration for health care. BioMed Central
Journal of Infectious Diseases. 2019; 19:380-389.

30. Nwokedi EE, Emokpae MA, Dutse AI. Human immunodeficiency virus and hepatitis B virus co-infection among patients in Kano Nigeria. Nigerian Journal of Medicine. 2006;15:227-229.

© 2021 Erasmus et al.; This is an Open Access article distributed under the terms of the Creative Commons Attribution License (http://creativecommons.org/licenses/by/4.0), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Peer-review history:
The peer review history for this paper can be accessed here: https://www.sdiarticle4.com/review-history/72047