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Immunological Consequences of Blood Transfusion in Pediatric Severe Malaria Patients Living with HIV: A Narrative Review

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Abstract

Pediatric severe malaria, often exacerbated by coexisting HIV infection, presents a formidable health challenge, necessitating blood transfusion as a life-saving intervention. This review explores the intricate immunological consequences of blood transfusion in children grappling with the dual burden of severe malaria and HIV. The immunopathogenesis of severe malaria, compounded by the immunosuppressive nature of HIV, sets the stage for complex interactions that impact the immune response to transfused blood. We delve into the immunological alterations induced by severe malaria and HIV individually, elucidating the potential synergistic effects when coexisting. Further, the review scrutinizes the implications of blood transfusion on the immune system of pediatric patients, examining donor-related factors and the immunomodulatory properties of stored blood. The inherent challenge lies in balancing the imperative need for transfusion with the potential risks of exacerbating immune dysregulation. Strategies for clinical management are discussed, emphasizing the importance of personalized approaches to optimize therapeutic outcomes.

Keywords: Immunology; Blood Transfusion; Pediatric Severe Malaria; HIV; Immune Response; Co-Infection

Abbreviations: HIV: Human Immunodeficiency Viruses, TLRs: Toll-Like Receptors, ART: Antiretroviral Therapy.

Introduction

Pediatric severe malaria, caused primarily by Plasmodium falciparum, remains a critical health concern, particularly in regions where malaria and HIV coexist. The co-occurrence of these two burdens places a substantial strain on the healthcare infrastructure, requiring a nuanced understanding of their interactions for effective clinical management. Blood transfusion, a common therapeutic intervention for severe malaria-induced anemia, becomes a pivotal aspect of care for pediatric patients. However, the immunological consequences of blood transfusion in the context of coexisting HIV infection are not well-defined; necessitating comprehensive exploration [1-15]. Severe malaria is characterized by a dysregulated immune response, involving cytokine imbalances, immune cell dysfunction, and increased susceptibility to secondary infections. In children, the severity of the disease often manifests as life-threatening anemia, prompting the need for blood transfusion as a vital therapeutic measure [16-21].

The coexistence of HIV introduces an additional layer of complexity. HIV, specifically targeting CD4+ T cells, leads to immunosuppression, impairing both innate and adaptive immunity. The compromised immune status of children

living with HIV may exacerbate the immune dysregulation observed in severe malaria, creating a milieu where the effects of blood transfusion need careful consideration [22-31]. Blood transfusion is a cornerstone in the management of severe malaria-associated anemia. However, the implications of transfusion on the immune response of pediatric patients, especially those living with HIV, are not fully elucidated. Donor-related factors, such as the presence of HIV antibodies, and the immunomodulatory effects of stored blood, warrant investigation to comprehend the holistic impact on the recipient's immune system [32-36].

This paper aims to bridge the knowledge gap surrounding the immunological consequences of blood transfusion in pediatric severe malaria patients living with HIV. By synthesizing existing literature and highlighting gaps in understanding, we seek to inform future research directions and guide clinicians in optimizing therapeutic strategies for this vulnerable population.

Immunological Impact of Severe Malaria

The immunological impact of severe malaria is a complex interplay of host responses and the evasion strategies employed by the Plasmodium parasites, predominantly P. falciparum, during infection [37-41]. Severe malaria triggers a dysregulated innate immune response characterized by the activation of various cells, including monocytes, macrophages, and dendritic cells. Toll-like receptors (TLRs) recognize malaria-associated molecular patterns, leading to the release of pro-inflammatory cytokines such as TNF-α and IL-1β. However, excessive activation can contribute to immunopathology, causing tissue damage and organ dysfunction [42-46]. The adaptive immune response in severe malaria involves the activation of T cells and B cells. CD4+ T cells play a crucial role in coordinating immune responses, but their depletion due to HIV co-infection can compromise the adaptive arm of immunity. Additionally, impaired antigen presentation and T-cell dysfunction contribute to the inadequate control of parasitemia [47-54].

Severe malaria induces a cytokine storm, with elevated levels of pro-inflammatory cytokines (e.g., IFN-γ, TNF-α, IL-6) and anti-inflammatory cytokines (e.g., IL-10). This imbalance contributes to systemic inflammation, vascular dysfunction, and the sequestration of infected erythrocytes in vital organs. In HIV co-infection, the existing immune dysregulation may further amplify these cytokine imbalances [55-64]. Plasmodium parasites employ sophisticated immune evasion strategies, including antigenic variation, sequestration in deep tissues, and modulation of host immune responses. These mechanisms contribute to the persistence of the infection and may impact the efficacy of transfused blood, potentially altering the recipient's immune landscape. Tregs play a crucial role in maintaining immune homeostasis and preventing excessive inflammation. In severe malaria, an expansion of Tregs is observed, potentially contributing to immune suppression and parasite persistence. The influence of HIV on Treg dynamics adds another layer of complexity to the immunological landscape [65-71]. Severe malaria can disrupt hematopoiesis, affecting the production and function of immune cells. The resulting immunosuppression may compromise the host's ability to mount an effective immune response, raising concerns about the potential consequences of blood transfusion in the context of an already compromised immune system.

HIV and Immune Dysfunction

HIV infection is characterized by a progressive impairment of the immune system, primarily targeting CD4+ T cells, leading to widespread immunodeficiency. The intricate immunological consequences of HIV contribute to a weakened defense against opportunistic infections and complications. Understanding the mechanisms of immune dysfunction in HIV is crucial for evaluating the impact of blood transfusion in pediatric severe malaria patients co-infected with HIV [72-79]. HIV primarily infects CD4+ T cells, which play a central role in coordinating immune responses. The virus utilizes the CD4 receptor to enter target cells, resulting in their depletion over time. The loss of CD4+ T cells compromises both the humoral and cellular arms of the immune system, leaving the host susceptible to a range of infections and impairing the overall immune response [80-82]. Persistent immune activation is a hallmark of chronic HIV infection. The virus induces chronic inflammation, leading to the release of pro-inflammatory cytokines, such as TNF-α and IL-6. This sustained activation contributes to immune exhaustion, dysfunction, and the depletion of immune effector cells [83-86].

HIV infection affects antigen-presenting cells, including dendritic cells and macrophages. Impaired antigen presentation compromises the initiation of effective immune responses, further undermining the ability to control infections. This dysregulation may have implications for the recognition and response to antigens introduced through blood transfusion in co-infected individuals [76,87]. HIV-specific CD8+ T cells play a crucial role in controlling viral replication. However, the continuous exposure to high viral loads and the emergence of viral escape mutations can lead to functional exhaustion and reduced cytotoxic capacity of these cells. This compromised CD8+ T cell function contributes to the persistence of HIV infection. HIV-mediated immune dysfunction extends to B cells, impacting the production of antibodies. Hypergammaglobulinemia, a characteristic feature of HIV infection, reflects B cell activation and polyclonal antibody production. However,

the quality of HIV-specific and non-HIV-specific antibody responses may be impaired, affecting the ability to mount effective humoral immune responses. HIV alters the balance between Th17 cells, important for mucosal immunity, and regulatory T cells (Tregs), crucial for immune homeostasis. This imbalance contributes to mucosal barrier dysfunction, increased susceptibility to infections, and chronic immune activation, which may affect the overall response to pathogens introduced through blood transfusion. HIV infection can result in hematological abnormalities, including anemia and thrombocytopenia. These complications may be exacerbated by severe malaria-induced anemia, raising concerns about the impact of blood transfusion on hematopoiesis and overall immune competence.

Blood Transfusion in Pediatric Severe Malaria

Blood transfusion is a critical therapeutic intervention in the management of pediatric severe malaria, particularly when complicated by severe anemia. However, the implications of blood transfusion extend beyond replenishing red blood cells, raising concerns about the potential immunological consequences in the context of coexisting HIV infection. Severe malaria often leads to life-threatening anemia, necessitating blood transfusion to restore oxygen-carrying capacity [88]. The decision to transfuse is guided by clinical and laboratory parameters, including hemoglobin levels, clinical symptoms, and the presence of complications such as impaired consciousness or respiratory distress. Transfused blood has been shown to have immunomodulatory effects, particularly related to the storage duration. Prolonged storage is associated with alterations in cytokine profiles, increased inflammatory responses, and potential immunosuppression. Understanding how these changes may impact the already dysregulated immune system in severe malaria patients is crucial.

The selection of blood donors is paramount, especially in regions with a high prevalence of HIV [89]. Donor screening for infectious diseases, including HIV, is standard practice. However, the potential presence of HIV antibodies or other undetected infections may influence the immunological milieu of the transfused blood, affecting the recipient's immune response. While stringent screening measures aim to minimize the risk of transfusion-transmitted infections, the potential for undetected infections remains. HIV, being a bloodborne pathogen, adds an extra layer of complexity. Coexisting severe malaria and HIV may interact synergistically, affecting the susceptibility to transfusion-transmitted infections and altering the course of both diseases. Blood transfusion may introduce antigens and immunomodulatory factors that influence the recipient's immune response to malaria. The transfused blood may contain Plasmodium antigens or factors that affect the recipient's ability to mount an effective immune response against the parasite. Understanding these interactions is crucial for optimizing therapeutic strategies. The presence of HIV antibodies in transfused blood may have implications for coinfected individuals. While routine screening aims to prevent the transfusion of blood from HIV-positive donors, the potential influence of HIV antibodies on the immune response in pediatric patients living with HIV warrants careful consideration.

Challenges in Clinical Management

The clinical management of pediatric severe malaria patients living with HIV is fraught with challenges, requiring a delicate balance between addressing immediate life-threatening complications and mitigating potential long-term immunological consequences. Determining the optimal timing for blood transfusion is challenging. Balancing the urgency to address severe anemia with the potential immunomodulatory effects of transfused blood requires careful consideration. Establishing clear guidelines for transfusion thresholds, taking into account the degree of anemia, clinical symptoms, and the risk of complications, is crucial. The immunomodulatory effects of blood transfusion, including alterations in cytokine profiles and potential impacts on the recipient's immune response, pose significant challenges [90]. Understanding the nuances of these consequences, especially in the context of coexisting severe malaria and HIV, is essential for informed decision-making and optimizing long-term outcomes.

Ensuring the safety of transfused blood is paramount, with rigorous donor screening for infectious diseases, including HIV. However, challenges may arise due to the potential window period for infection, the sensitivity of screening tests, and the prevalence of undetected infections. Strategies to enhance blood safety and minimize the risk of transfusion-transmitted infections are critical. Pediatric patients coinfected with severe malaria and HIV may be on antiretroviral therapy (ART) [91]. Drug interactions between antimalarial medications and ART can complicate treatment strategies. Understanding these interactions and adjusting drug regimens to ensure both diseases are effectively managed without compromising the efficacy of either therapy is a challenging aspect of clinical care. Severe malaria-induced anemia, compounded by potential HIV-related hematological complications, requires a nuanced approach. Managing coagulopathies, thrombocytopenia, and other hematological abnormalities necessitates close monitoring and tailored interventions to address both diseases simultaneously. Malnutrition is often prevalent in malaria-endemic regions, further compromising the immune response in coinfected children. Providing adequate nutritional support while considering potential interactions with antimalarial and

antiretroviral medications is a multifaceted challenge in the clinical management of these patients.

The heterogeneity in disease presentation and immune status among pediatric severe malaria patients living with HIV underscores the need for individualized treatment strategies. Tailoring interventions based on the specific immunological profile, clinical severity, and treatment history enhances the likelihood of positive therapeutic outcomes. The consequences of coexisting severe malaria and HIV extend beyond the acute phase [92]. Long-term follow-up and monitoring are essential to assess the sustained impact of treatment interventions, evaluate immune recovery, and manage potential complications arising from either disease or their interaction.

Conclusion

The clinical management of pediatric severe malaria patients living with HIV presents a complex and multifaceted challenge, requiring a nuanced understanding of the intricate interactions between these two formidable diseases. The therapeutic landscape is further complicated by the necessity of blood transfusion, which, while essential for addressing severe anemia, introduces potential immunological consequences that demand careful consideration. The immunological impact of severe malaria, characterized by dysregulated innate and adaptive responses, is compounded by the immunosuppressive nature of HIV. These diseases, when coexisting, create a unique immunological milieu that may be further influenced by blood transfusion. The challenges in clinical management encompass a spectrum of considerations, from the timing and indications for blood transfusion to the potential immunomodulatory effects of stored blood, donor-related factors, and the risk of transfusion-transmitted infections.

References

1. Obeagu EI, Okwuanaso CB, Edoho SH, Obeagu GU (2022) Under Nutrition among HIV exposed Uninfected Children a Review of African Perspective. Madonna University journal of Medicine and Health Sciences 2(3): 120-127.

2. Obeagu EI, Alum EU, Obeagu GU (2023) Factors Associated with Prevalence of HIV among Youths: A Review of Africa Perspective. Madonna University journal of Medicine and Health Sciences 3(1): 13-18.

3. Obeagu EI (2023) A Review of Challenges and Coping Strategies Faced by HIV/AIDS Discordant Couples. Madonna University journal of Medicine and Health Sciences 3(1): 7-12.

4. Obeagu EI, Obeagu GU (2023) An Update on Premalignant Cervical Lesions and Cervical Cancer Screening Services among HIV Positive Women. Journal of Public Health and Nutrition 6(2): 141.

5. Ezeoru VC, Enweani IB, Ochiabuto O, Nwachukwu AC, Ogbonna US, et al. (2021) Prevalence of Malaria with Anaemia and HIV Status in Women of Reproductive Age in Onitsha, Nigeria. Journal of Pharmaceutical Research International 33(4): 10-19.

6. Omo Emmanuel UK, Chinedum OK, Obeagu EI (2017) Evaluation of Laboratory Logistics Management Information System in HIV/AIDS Comprehensive Health Facilities in Bayelsa State Nigeria. Int J Curr Res Med Sci 3(1): 21-38.

7. Obeagu EI, Obeagu GU, Musiimenta E, Bot YS, Hassan AO (2023) Factors Contributing to Low Utilization of HIV Counseling and Testing Services. Int J Curr Res Med Sci 9(2): 1-5.

8. Obeagu EI, Obeagu GU (2022) An Update on Survival of People Living with HIV in Nigeria. Journal of Public Health and Nutrition 5(6): 129.

9. Offie DC, Obeagu EI, Akueshi C, Njab JE, Ekanem EE, et al. (2021) Facilitators and Barriers to Retention in HIV Care among HIV Infected MSM Attending Community Health Center Yaba Lagos Nigeria. Journal of Pharmaceutical Research International 33(52B): 10-19.

10. Obeagu EI, Obeagu GU, Chukwueze CM, Ikpenwa JN, Ramos GF (2022) Evaluation of Protein C Protein S and Fibrinogen of Pregnant Women with Malaria in Owerri Metropolis. Madonna University journal of Medicine and Health Sciences 2(2): 1-9.

11. Obeagu EI, Ibeh NC, Nwobodo HA, Ochei KC, Iwegbulam CP (2017) Haematological Indices of Malaria Patients Coinfected with HIV in Umuahia. Int J Curr Res Med Sci 3(5): 100-104.

12. Opeyemi AA, Obeagu EI (2023) Regulations of Malaria in Children with Human Immunodeficiency Virus Infection: A Review. Medicine (Baltimore) 102(46): e36166.

13. Obeagu EI, Chijioke UO, Ekelozie IS (2018) Malaria Rapid Diagnostic Test (RDTs). Ann Clin Lab Res 6(4): 275.

14. Obeagu EI, Alum EU, Ugwu OP (2023) Hepcidin the Gatekeeper of Iron in Malaria Resistance. Newport International Journal of Research in Medical Sciences 4(2): 1-8.

15. Ogomaka IA, Obeagu EI (2019) Methods of Breast Feeding as Determinants of Malaria Infections among Babies in IMO Nigeria. International Journal of Medical

Science and Dental Research 2(1): 17-24.

16. Obeagu EI, Obeagu GU, Egba SI, Emeka Obi OR (2023) Combatting Anemia in Pediatric Malaria Effective Management Strategies. Int J Curr Res Med Sci 9(11): 1-7.

17. Hassan AO, Oso OV, Obeagu EI, Adeyemo AT (2022) Malaria Vaccine Prospects and Challenges. Madonna University journal of Medicine and Health Sciences 2(2): 22-40.

18. Obeagu EI, Busari AI, Uduchi IO, Ogomaka IA, Ibekwe AM, et al. (2021) Age Related Haematological Variations in Patients with Asymptomatic Malaria in Akure. Journal of Pharmaceutical Research International 33(42B): 218-224.

19. Ogomaka IA, Obeagu EI (2021) Malaria in Pregnancy Amidst Possession of Insecticide Treated Bed Nets (ITNs) in Orlu LGA of Imo State Nigeria. Journal of Pharmaceutical Research International 33(41B): 380-386.

20. Ogbonna CO, Obeagu EI, Ufelle SA, Ogbonna LN (2021) Evaluation of haematological alterations in children infected by Plasmodium falciparum Species in Enugu Enugu State Nigeria. Journal of Pharmaceutical Research International 33(2): 38-45.

21. Okorie HM, Obeagu EI, Obarezi HC, Anyiam AF (2019) Assessment of some inflammatory cytokines in malaria infected pregnant women in Imo State Nigeria. International Journal of Medical Science and Dental Research 2(1): 25-36.

22. Odo M, Ochei KC, Obeagu EI, Barinaadaa A, Eteng UE, et al. (2020) TB Infection Control in TB/HIV Settings in Cross River State Nigeria Policy Vs Practice. Journal of Pharmaceutical Research International 32(22): 101-109.

23. Obeagu EI, Eze VU, Alaeboh EA, Ochei KC (2016) Determination of Haematocrit Level and Iron Profile study among Persons Living with HIV in Umuahia Abia State Nigeria. J Bio Innov 5(4): 464-471.

24. Ifeanyi OE, Obeagu GU (2015) The Values of Prothrombin Time among HIV Positive Patients in FMC Owerri. Int J Curr Microbiol App Sci 4(4): 911-916.

25. Izuchukwu IF, Ozims SJ, Agu GC, Obeagu EI, Onu I, et al. (2016) Knowledge of Preventive Measures and Management of HIV/AIDS Victims among Parents in Umuna Orlu Community of Imo state Nigeria. Int J Adv Res Biol Sci 3(10): 55-65.

26. Chinedu K, Takim AE, Obeagu EI, Chinazor UD, Eloghosa O, et al. (2017) HIV and TB Co infection among Patients who used Directly Observed Treatment Short course Centres in Yenagoa Nigeria. IOSR J Pharm Biol Sci 12(4): 70-75.

27. Oloro OH, Oke TO, Obeagu EI (2022) Evaluation of Coagulation Profile Patients with Pulmonary Tuberculosis and Human Immunodeficiency Virus in Owo Ondo State Nigeria. Madonna University journal of Medicine and Health Sciences 2(3): 110-119.

28. Nwosu DC, Obeagu EI, Nkwocha BC, Nwanna CA, Nwanjo HU, et al. (2016) Change in Lipid Peroxidation Marker (MDA) and Non enzymatic Antioxidants (VIT C & E) in HIV Seropositive Children in an Urban Community of Abia State Nigeria. J Bio Innov 5(1): 24-30.

29. Igwe CM, Obeagu IE, Ogbuabor OA (2022) Clinical Characteristics of People Living with HIV/AIDS on ART in 2014 at Tertiary Health Institutions in Enugu Nigeria. Journal of Public Health and Nutrition 5(6): 130.

30. Ifeanyi OE, Obeagu GU, Ijeoma FO, Chioma UI (2015) The Values of Activated Partial Thromboplastin Time (APTT) among HIV Positive Patients in FMC Owerri. Int J Curr Res Aca Rev 3(4): 139-144.

31. Obiomah CF, Obeagu EI, Ochei KC, Swem CA, Amachukwu BO (2018) Hematological Indices o HIV Seropositive Subjects in Nnamdi Azikiwe University Teaching Hospital (NAUTH), Nnewi. Ann Clin Lab Res 6(1): 221.

32. Omo-Emmanuel UK, Ochei KC, Osuala EO, Obeagu EI, Onwuasoanya UF (2017) Impact of Prevention of Mother to Child Transmission (PMTCT) of HIV on Positivity Rate in Kafanchan Nigeria. Int J Curr Res Med Sci 3(2): 28-34.

33. Aizaz M, Abbas FA, Abbas A, Tabassum S, Obeagu EI (2023) Alarming Rise in HIV Cases in Pakistan: Challenges and Future Recommendations at Hand. Health Sci Rep 6(8): e1450.

34. Obeagu EI, Amekpor F, Scott GY (2023) An Update of Human Immunodeficiency Virus Infection Bleeding Disorders. J Pub Health Nutri 6(1): 139.

35. Obeagu EI, Scott GY, Amekpor F, Ofodile AC, Edoho SH, et al. (2022) Prevention of New Cases of Human Immunodeficiency Virus Pragmatic Approaches of Saving Life in Developing Countries. Madonna University journal of Medicine and Health Sciences 2(3): 128-134.

36. Walter O, Anaebo QB, Obeagu EI, Okoroiwu IL (2022) Evaluation of Activated Partial Thromboplastin Time and Prothrombin Time in HIV and TB Patients in

Owerri Metropolis. Journal of Pharmaceutical Research International 34(3A): 29-34.

37. Okorie HM, Obeagu EI, Eze EN, Jeremiah ZA (2018) Assessment of Some Haematological Parameters in Malaria Infected Pregnant Women in Imo State Nigeria. Int J Curr Res Biol Med 3(9): 1-4.

38. Nwosu DC, Obeagu EI, Ezenwuba C, Agu GC, Amah H, et al. (2016) Antioxidant Status of Children with Plasmodium Falciparum Malaria in Owerri Municipal Council of Imo State. Int J Curr Res Chem Pharm Sci 3(8): 40-46.

39. Okamgba OC, Nwosu DC, Nwobodo EI, Agu GC, Ozims SJ, ey al. (2017) Iron Status of Pregnant and Post-Partum Women with Malaria Parasitaemia in Aba Abia State, Nigeria. Annals of Clinical and Laboratory Research 5(4): 206.

40. Anyiam AF, Arinze Anyiam OC, Omosigho PO, Ibrahim M, Irondi EA, et al. (2022) Blood Group Genotype Malaria Blood Pressure and Blood Glucose Screening Among Selected Adults of a Community in Kwara State Implications to Public Health. Asian Hematology Research Journal 6(3): 9-17.

41. Obeagu EI, Nimo OM, Bunu UO, Ugwu OP, Alum EU (2023) Anaemia in Children Under Five Years African Perspectives. Int J Curr Res Biol Med 8(1): 1-7.

42. Madekwe CC, Madekwe CC, Obeagu EI (2022) Inequality of Monitoring in Human Immunodeficiency Virus, Tuberculosis and Malaria A Review Madonna University Journal of Medicine and Health Sciences 2(3): 6-15.

43. Offie DC, Ibekwe AM, Agu CC, Esimai BN, Okpala PU, et al. (2021) Fibrinogen and C Reactive Protein Significance in Children Infected by Plasmodium Falciparum Species in Enugu Enugu State, Nigeria. Journal of Pharmaceutical Research International 33(15): 1-8.

44. Okorie HM, Obeagu EI, Eze EN, Jeremiah ZA (2018) Assessment of Coagulation Parameters in Malaria Infected Pregnant Women in Imo state Nigeria. International Journal of Current Research in Medical Sciences 4(9): 41-49.

45. Ogbonna LN, Ezeoru VC, Ofodile AC, Ochiabuto OM, Obi Ezeani CN, et al. (2021) Gender Based Variations of Haematological Parameters of Patients with Asymptomatic Malaria in Akure Ondo State Nigeria. Journal of Pharmaceutical Research International 33(8): 75-80.

46. Eberendu IF, Ozims SJ, Agu GC, Amah HC, Obasi CC, et al. (2017) Impact of Human Activities on the Breeding of Mosquitoes of Human Disease in Owerri Metropolis Imo State. Int J Adv Res Biol Sci 4(12): 98-106.

47. Odo M, Ochei KC, Obeagu EI, Barinaadaa A, Eteng EU, et al. (2020) Cascade Variabilities in TB Case finding among people living with HIV and the use of IPT Assessment in three levels of care in cross River State Nigeria. Journal of Pharmaceutical Research International 32(24): 9-18.

48. Jakheng SP, Obeagu EI (2022) Seroprevalence of Human Immunodeficiency Virus based on Demographic and Risk Factors among Pregnant Women Attending Clinics in Zaria Metropolis Nigeria. J Pub Health Nutri 5(6): 127.

49. Obeagu EI, Obeagu GU (2023) A Review of knowledge attitudes and socio demographic factors associated with non adherence to antiretroviral therapy among people living with HIV/AIDS. Int J Adv Res Biol Sci 10(9): 135-142.

50. Obeagu EI, Onuoha EC (2023) Tuberculosis among HIV Patients A Review of Prevalence and Associated Factors. Int J Adv Res Biol Sci 10(9): 128-134.

51. Jakheng SP, Obeagu EI, Abdullahi IO, Jakheng EW, Chukwueze CM, et al. (2022) Distribution Rate of Chlamydial Infection According to Demographic Factors among Pregnant Women Attending Clinics in Zaria Metropolis Kaduna State Nigeria. South Asian Journal of Research in Microbiology 13(2): 26-31.

52. Viola N, Kimono E, Nuruh N, Obeagu EI (2023) Factors Hindering Elimination of Mother to Child Transmission of HIV Service Uptake among HIV Positive Women at Comboni Hospital Kyamuhunga Bushenyi District. Asian Journal of Dental and Health Sciences 3(2): 7-14.

53. Okorie HM, Obeagu Emmanuel I, Okpoli Henry CH, Chukwu Stella N (2020) Comparative Study of Enzyme Linked Immunosorbent Assay (Elisa) and Rapid Test Screening Methods on HIV Hbsag Hcv and Syphilis among Voluntary Donors in Owerri Nigeria. J Clin Commun Med 2(3): 180-183.

54. Ezugwu UM, Onyenekwe CC, Ukibe NR, Ahaneku JE, Onah CE, et al. (2021) Use of ATP GTP ADP and AMP as an Index of Energy Utilization and Storage in HIV Infected Individuals at NAUTH Nigeria A Longitudinal Prospective Case Controlled Study. Journal of Pharmaceutical Research International 33(47A): 78-84.

55. Obeagu EI, Ofodile AC, Okwuanaso CB (2023) A Review on Socio Economic and Behavioural Aspects of Malaria and its Control among Children Under 5 years of Age in Africa. J Pub Health Nutri 6(1): 136.

56. Emannuel G, Martin O, Peter OS, Obeagu EI, Daniel K (2023) Factors Influencing Early Neonatal Adverse Outcomes among Women with HIV with Post Dated Pregnancies Delivering at Kampala International University Teaching Hospital, Uganda. Asian Journal of Pregnancy and Childbirth 6(1): 203-211.

57. Igwe MC, Obeagu EI, Ogbuabor AO, Eze GC, Ikpenwa JN, et al. (2022) Socio Demographic Variables of People Living with HIV/AIDS Initiated on ART in 2014 at Tertiary Health Institution in Enugu State. Asian Journal of Research in Infectious Diseases 10(4): 1-7.

58. Vincent CC, Obeagu EI, Agu IS, Ukeagu NC, Onyekachi Chigbu AC (2021) Adherence to Antiretroviral Therapy among HIV/AIDS in Federal Medical Centre Owerri. Journal of Pharmaceutical Research International 33(57A): 360-368.

59. Igwe MC, Obeagu EI, Ogbuabor AO (2022) Analysis of the Factors and Predictors of Adherence to Healthcare of People Living With Hiv/Aids in Tertiary Health Institutions in Enugu State. Madonna University Journal of Medicine and Health Sciences 2(3): 42-57.

60. Echendu GE, Vincent CC, Ibebuike J, Asodike M, Naze N, et al. (2023) Weights of Infants Born to Hiv Infected Mothers A Prospective Cohort Study in Federal Medical Centre Owerri Imo State. European Journal of Pharmaceutical and Medical Research 10(8): 564-568.

61. Nwosu DC, Nwanjo HU, Okolie NJ, Ikeh K, Ajero CM, et al. (2015) Biochemical Alterations in Adult Hiv Patients on Antiretrqviral Therapy. World Journal of Pharmacy and Pharmaceutical Sciences 4(3): 153-160.

62. Obeagu EI, Obeagu GU (2015) Effect of CD4 Counts on Coagulation Parameters among HIV Positive Patients in Federal Medical Centre Owerri Nigeria. Int J Curr Res Biosci Plant Biol 2(4): 45-49.

63. Obeagu EI, Nwosu DC (2019) Adverse Drug Reactions in HIV/AIDS Patients on Highly Active Antiretro Viral Therapy A Review of Prevalence. Int J Curr Res Chem Pharm Sci 6(12): 45-48.

64. Obeagu EI, Scott GY, Amekpor F, Obeagu GU (2023) Implications of CD4/CD8 Ratios in Human Immunodeficiency Virus Infections. Int J Curr Res Med Sci 9(2): 6-13.

65. Obeagu EI, Ochei KC, Okeke EI, Anode AC (2016) Assessment of the Level of Haemoglobin and Erythropoietin in Persons Living with HIV in Umuahia. International Journal of Medicine Research 1(2): 28-30.

66. Ifeanyi OE, Obeagu GU (2015) The Values of CD4 Count among HIV Positive Patients in FMC Owerri. Int J Curr Microbiol App Sci 4(4): 906-910.

67. Obeagu EI, Okeke EI, Anonde Andrew C (2016) Evaluation of Haemoglobin and Iron Profile Study among Persons Living with HIV in Umuahia Abia state Nigeria. Int J Curr Res Biol Med 1(2): 1-5.

68. Alum EU, Ugwu OP, Obeagu EI, Okon MB (2023) Curtailing HIV/AIDS Spread Impact of Religious Leaders. Newport International Journal of Research in Medical Sciences 3(2): 28-31.

69. Obeagu EI, Obeagu GU, Paul-Chima UO (2023) Stigma Associated With HIV AIDS A Review Newport International Journal of Public Health and Pharmacy 3(2): 64-67.

70. Alum EU, Obeagu EI, Ugwu OP, Aja PM, Okon MB (2023) HIV Infection and Cardiovascular diseases The obnoxious Duos Newport. International Journal of Research in Medical Sciences 3(2): 95-99.

71. Ibebuike JE, Nwokike GI, Nwosu DC, Obeagu EI (2018) A Retrospective Study on Human Immune Deficiency Virus among Pregnant Women Attending Antenatal Clinic in Imo State University Teaching Hospital. International Journal of Medical Science and Dental Research 1(2): 8-14.

72. Obeagu EI, Obarezi TN, Omeh YN, Okoro NK, Eze OB (2014) Assessment of Some Haematological and Biochemical Parametrs in HIV Patients before Receiving Treatment in Aba Abia State Nigeria. Res J Pharma Biol Chem Sci 5: 825-830.

73. Obeagu EI, Obarezi TN, Ogbuabor BN, Anaebo QB, Eze GC (2014) Pattern of Total White Blood Cell and Differential Count Values in HIV Positive Patients Receiving Treatment in Federal Teaching Hospital Abakaliki, Ebonyi State Nigeria. International Journal of Life Science Biotechnology and Pharama Research 3(1): 186-189.

74. Oloro OH, Obeagu EI (2022) A Systematic Review on Some Coagulation Profile in HIV Infection. International Journal of Innovative and Applied Research 10(5): 1-11.

75. Nwosu DC, Obeagu EI, Nkwuocha BC, Nwanna CA, Nwanjo HU, et al. (2015) Alterations in Superoxide Dismutiase Vitamins C and E in HIV Infected Children in Umuahia Abia state. International Journal of Advanced Research in Biological Sciences 2(11): 268-271.

76. Obeagu EI, Malot S, Obeagu GU, Ugwu OP (2023) HIV

Resistance in Patients with Sickle Cell Anaemia. Newport International Journal of Scientific and Experimental Sciences (NIJSES) 3(2): 56-59.

77. Ifeanyi OE, Uzoma OG, Stella EI, Chinedum OK, Abum SC (2018) Vitamin D and Insulin Resistance in HIV Sero Positive Individuals in Umudike. Int J Curr Res Med Sci 4(2): 104-108.

78. Ifeanyi OE, Leticia OI, Nwosu D, Chinedum OK (2018) A Review on Blood Borne Viral Infections Universal Precautions. Int J Adv Res Biol Sci 5(6): 60-66.

79. Nwovu AI, Ifeanyi OE, Uzoma OG, Nwebonyi NS (2018) Occurrence of Some Blood Borne Viral Infection and Adherence to Universal Precautions among Laboratory Staff in Federal Teaching Hospital Abakaliki Ebonyi State. Arch Blood Transfus Disord 1(2).

80. Obeagu EI, Obeagu GU, Ede MO, Odo EO, Buhari HA (2023) Translation of HIV/AIDS Knowledge into Behavior Change among Secondary School Adolescents in Uganda: A Review. Medicine (Baltimore) 102(49): e36599.

81. Anyiam AF, Arinze-Anyiam OC, Irondi EA, Obeagu EI (2023) Distribution of ABO and Rhesus Blood Grouping with HIV Infection among Blood Donors in Ekiti State Nigeria. Medicine (Baltimore) 102(47): e36342.

82. Echefu SN, Udosen JE, Akwiwu EC, Akpotuzor JO, Obeagu EI (2023) Effect of Dolutegravir Regimen against other Regimens on some Hematological Parameters CD4 Count and Viral Load of People living with HIV Infection in South Eastern Nigeria. Medicine (Baltimore) 102(47): e35910.

83. Alum EU, Obeagu EI, Ugwu OPC, Samson AO, Adepoju AO, et al. (2023) Inclusion of Nutritional Counseling and Mental Health Services in HIV/AIDS Management A Paradigm Shift. Medicine (Baltimore) 102(41): e35673.

84. Obeagu EI, Obeagu GU, Obiezu J, Ezeonwumelu C, Ogunnaya FU, et al. (2023) Hematologic Support in HIV Patients Blood Transfusion Strategies and Immunological Considerations. Applied Sciences (NIJBAS) 3(3).

85. Obeagu EI, Ubosi NI, Uzoma G (2023) Storms and Struggles Managing HIV Amid Natural Disasters. Int J Curr Res Chem Pharm Sci 10(11): 14-25.

86. Obeagu EI, Obeagu GU (2023) Human Immunodeficiency Virus and Tuberculosis infection A Review of Prevalence of Associated Factors. Int J Adv Multidiscip Res 10(10): 56-62.

87. Alum EU, Ugwu OP, Obeagu EI, Aja PM, Okon MB, et al. (2023) Reducing HIV Infection Rate in Women A Catalyst to Reducing HIV Infection Pervasiveness in Africa. International Journal of Innovative and Applied Research 11(10): 1-6.

88. Soni N, Thomas B (2008) The Benefits of Allogeneic Erythrocyte Transfusion: What Evidence do we have?. Transfusion Alternatives in Transfusion Medicine 10(3): 147-159.

89. Attaullah S, Khan S, Khan J (2012) Trend of Transfusion Transmitted Infections Frequency in Blood Donors Provide a Road Map for its Prevention and Control. J Transl Med 10(20): 1-5.

90. Obeagu EI, Obeagu GU, Obiezu J, Ezeonwumelu C, Ogunnaya FU, et al. (2023) Immunomodulatory Effects of Transfusions on Maternal Immunity in Pregnancy. Applied Sciences (NIJBAS) 3(3).

91. Kwenti TE (2018) Malaria and HIV Coinfection in Sub-Saharan Africa Prevalence Impact and Treatment Strategies. Res Rep Trop Med 9: 123-136.

92. Laufer MK, Plowe CV (2007) The Interaction between HIV and Malaria in Africa. Curr Infect Dis Rep 9(1): 47-54.