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Role of Hematopoietic Stem Cell Transplantation in Aplastic Anemia and HIV: A Review

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Abstract

Aplastic anemia (AA) is a life-threatening hematologic condition marked by bone marrow failure, resulting in pancytopenia. Hematopoietic stem cell transplantation (HSCT) is the only curative treatment for severe cases, offering the potential to restore normal blood cell production. However, in patients with concomitant HIV infection, the management of AA becomes significantly more complex. HIV-related immunosuppression, compounded by the demands of HSCT, introduces challenges in immune reconstitution, infection control, and drug interactions, making therapeutic strategies particularly intricate. With the success of antiretroviral therapy (ART), HIV has transitioned into a chronic condition, allowing for greater feasibility of HSCT in HIV-positive individuals. Studies and case reports suggest that, with careful management of ART and prophylactic measures, HSCT can be successfully performed in these patients. However, risks remain, including prolonged immune suppression, increased susceptibility to opportunistic infections, and complications such as graft-versus-host disease (GVHD). Advances in reduced-intensity conditioning (RIC) regimens and GVHD prevention have improved outcomes, though challenges persist.

Keywords: Aplastic anemia, hematopoietic stem cell transplantation, HIV, immunosuppression, bone marrow failure

Introduction

Aplastic anemia (AA) is a rare but serious disorder of the bone marrow, characterized by its failure to produce adequate blood cells, leading to pancytopenia. This condition results in low levels of red blood cells, white blood cells, and platelets, causing anemia, increased susceptibility to infections, and heightened bleeding risks. The etiology of AA is multifactorial, with idiopathic

causes accounting for most cases. Other known causes include exposure to toxic chemicals, certain medications, viral infections, and autoimmune disorders. Severe aplastic anemia (SAA) requires urgent treatment, with hematopoietic stem cell transplantation (HSCT) being the only curative option for many patients. HSCT allows for the replacement of the defective marrow with healthy donor cells, restoring normal hematopoiesis and long-term survival in most patients. The success of HSCT in AA patients largely depends on several factors, including the patient's age, overall health, availability of a human leukocyte antigen (HLA)-matched donor, and the presence of comorbidities. In ideal conditions, HSCT offers a curative potential for AA. However, complications such as graft-versus-host disease (GVHD), infections, and transplant-related mortality remain significant concerns. For younger patients with a matched sibling donor, the success rates of HSCT are high, with many experiencing long-term remission. On the other hand, patients without a suitable donor or those who are older face greater risks during the transplantation process, and alternative treatments such as immunosuppressive therapy (IST) may be considered.¹

HIV infection adds an additional layer of complexity to the treatment of AA. Since the onset of the HIV/AIDS epidemic, HIV has been associated with various hematological abnormalities, including cytopenias, which can exacerbate the clinical presentation of AA. HIV itself induces a state of chronic immune activation and dysregulation, which affects the bone marrow. Furthermore, opportunistic infections, neoplasms, and the direct effects of antiretroviral therapy (ART) contribute to the pathophysiology of bone marrow suppression. In this context, treating AA with HSCT in HIV-positive patients poses unique challenges, particularly due to the immunosuppressive nature of both the disease and the treatment. Historically, HIV infection was considered a contraindication to HSCT, given the high risk of infections and poor immune recovery. However, with the advent of highly active antiretroviral therapy (HAART) in the 1990s, the landscape of HIV treatment shifted dramatically. HAART has transformed HIV from a fatal illness to a manageable chronic condition, allowing patients to live longer and healthier lives. This development has opened new avenues for HIV-positive individuals to receive previously unavailable therapies, including HSCT. Over time, clinicians and researchers have gained greater insight into managing the complex interplay between HIV and the immune system, leading to improved outcomes in HSCT for these patients. In patients with HIV, immune reconstitution following HSCT presents a significant challenge. The depletion of CD4+ T cells, a hallmark of HIV infection, combined with the immunosuppressive effects of HSCT, makes patients highly vulnerable to infections. Reconstituting the immune system after transplantation is a slow process, especially in HIV-positive patients. Prolonged periods of immune suppression can lead to opportunistic infections, complicating recovery. Moreover, interactions between ART and the immunosuppressive drugs used in HSCT protocols require careful management to prevent adverse effects and ensure viral suppression.¹¹⁻²⁰

Another key concern in the context of HSCT for HIV-positive patients is graft-versus-host disease (GVHD), a common complication in allogeneic stem cell transplantation where donor immune cells attack the recipient's tissues. The immune dysregulation caused by HIV infection may exacerbate the severity of GVHD, complicating its management. To mitigate these risks, reduced-intensity conditioning (RIC) regimens, which cause less damage to the immune system while still allowing for engraftment, have been increasingly used in HIV-positive patients undergoing HSCT. RIC regimens have been associated with lower rates of transplant-related mortality, although they

come with their own set of challenges, such as increased relapse rates. While the primary goal of HSCT in HIV-positive patients with AA is to restore normal blood cell production, there is also ongoing interest in the potential of HSCT to achieve HIV remission. A widely known example is the "Berlin patient," an HIV-positive individual who received HSCT for acute myeloid leukemia (AML) from a donor with a CCR5-delta32 mutation. This genetic mutation renders cells resistant to HIV, and post-transplant, the patient was declared functionally cured of HIV. This case has sparked significant interest in the possibility of using HSCT not only to treat AA in HIV-positive patients but also as a potential component of HIV cure strategies. Despite these advancements, the treatment of AA with HSCT in HIV-positive individuals remains a high-risk procedure, with many unanswered questions. Current data on the long-term outcomes of HIV-positive patients undergoing HSCT for AA are limited, and larger studies are needed to establish standardized protocols. Moreover, patient selection, donor availability, and the timing of ART in relation to HSCT are all critical factors that require further exploration.²¹⁻³⁰

Overview of Aplastic Anemia and Hematopoietic Stem Cell Transplantation

Aplastic anemia (AA) is a rare hematological disorder characterized by bone marrow failure, leading to pancytopenia-marked reductions in red blood cells, white blood cells, and platelets. This results in symptoms such as fatigue, recurrent infections, and bleeding tendencies. The disease can be either inherited or acquired, with idiopathic cases being the most common. Environmental factors such as exposure to toxic chemicals, radiation, certain medications, or viral infections (e.g., hepatitis, Epstein-Barr virus) may also trigger the condition. In AA, the bone marrow becomes hypocellular, meaning it has significantly fewer blood-producing stem cells, rendering the body incapable of maintaining adequate blood cell levels. Severe aplastic anemia (SAA) requires urgent treatment due to the high risk of infection and bleeding. Hematopoietic stem cell transplantation (HSCT) is the definitive curative treatment for AA, particularly for patients with severe or very severe forms of the disease. HSCT involves the infusion of healthy hematopoietic stem cells from a donor into the patient, with the goal of replacing the defective bone marrow and restoring normal hematopoiesis. These stem cells can be obtained from bone marrow, peripheral blood, or umbilical cord blood. The transplantation process typically requires a conditioning regimen, which includes chemotherapy and/or radiation, to suppress the patient's immune system, prevent graft rejection, and create space in the bone marrow for the donor stem cells to engraft. For younger patients with an HLA-matched sibling donor, the success rate of HSCT is high, and long-term survival is common. The success of HSCT in AA is influenced by several factors, including the patient's age, overall health, the severity of the disease, and the availability of a suitable donor. HLA matching is critical for reducing the risk of complications such as graft-versus-host disease (GVHD), a condition in which the donor immune cells attack the recipient's tissues. For patients without a matched sibling donor, alternative donor options such as matched unrelated donors (MUD) or haploidentical (partially matched) donors may be considered, though these come with increased risks of complications. Immunosuppressive therapy (IST) is another treatment option for patients who are not candidates for HSCT or do not have an available donor, but it offers lower cure rates and is associated with a higher risk of relapse.³¹⁻⁴⁰

HIV and Hematopoietic Stem Cell Transplantation: Considerations

Hematopoietic stem cell transplantation (HSCT) in HIV-positive patients presents a unique set of challenges due to the complex interplay between HIV-induced immunosuppression and the **Citation**: Obeagu EI, Kanu SN. Role of Hematopoietic Stem Cell Transplantation in Aplastic

Anemia and HIV: A Review. Elite Journal of Medical Sciences, 2024; 2(9):111-120

immunosuppressive effects of the transplantation process itself. Historically, HIV infection was considered a contraindication to HSCT, largely because of the severe immunosuppression that accompanies both conditions, leading to heightened risks of infection, graft failure, and poor immune recovery. However, with the introduction of highly active antiretroviral therapy (HAART), the prognosis for HIV-positive individuals has improved significantly, making HSCT a more viable treatment option for certain conditions, including aplastic anemia (AA). One of the primary concerns in performing HSCT on HIV-positive patients is the ability to manage their immune system during the process of stem cell transplantation. HIV itself causes chronic immune activation and depletes CD4+ T cells, impairing the body's ability to fight infections. HSCT, particularly in the setting of a conditioning regimen involving chemotherapy or radiation, further suppresses the immune system, leading to a prolonged state of vulnerability. This makes infection control and immune reconstitution critical aspects of post-transplant care for HIV-positive patients. Careful management of opportunistic infections and close monitoring of immune recovery are essential to avoid life-threatening complications.⁴¹⁻⁵⁰

The timing and compatibility of antiretroviral therapy (ART) with the transplant process is another important consideration. ART must be maintained to prevent HIV replication and maintain viral suppression, but the immunosuppressive drugs used during HSCT can interact with ART, leading to potential drug toxicity or reduced efficacy. Immunosuppressive agents such as calcineurin inhibitors (used to prevent graft rejection) and ART can have overlapping toxicities, necessitating close monitoring and possible adjustment of the ART regimen. Additionally, the selection of a conditioning regimen, particularly reduced-intensity conditioning (RIC), plays a crucial role in minimizing transplant-related mortality and complications in HIV-positive patients while still allowing for successful engraftment of the donor stem cells.⁵¹⁻⁵⁵

Outcomes of HSCT in Aplastic Anemia with HIV

The outcomes of hematopoietic stem cell transplantation (HSCT) in patients with aplastic anemia (AA) and HIV have shown both promising advances and significant challenges. Historically, HIVpositive individuals were excluded from undergoing HSCT due to concerns over poor immune reconstitution, high infection risks, and the potential for graft-versus-host disease (GVHD) to be exacerbated by the presence of HIV. However, with the advent of highly active antiretroviral therapy (HAART), HIV has been transformed into a manageable chronic condition, opening the possibility for HSCT in this patient population. Early case reports and clinical trials have demonstrated that, with proper management, HSCT can be performed successfully in HIV-positive patients with AA. Key to these successes is the use of HAART, which controls HIV replication and reduces the risk of opportunistic infections. Patients with well-controlled HIV and stable CD4+ T cell counts before transplantation tend to have better outcomes. Studies indicate that, with careful selection of conditioning regimens and prophylactic measures, HIV-positive patients can achieve similar rates of engraftment and survival compared to HIV-negative counterparts undergoing HSCT for AA. Reduced-intensity conditioning (RIC) regimens have been particularly beneficial, as they cause less immune suppression while still allowing for successful donor cell engraftment, reducing transplant-related mortality.⁵⁶⁻⁶⁵

Advances in Hematopoietic Stem Cell Transplantation for HIV-Positive Patients

Significant advances in hematopoietic stem cell transplantation (HSCT) have improved the viability of this treatment for HIV-positive patients, particularly those with conditions such as aplastic anemia (AA) or hematological malignancies. Previously, HIV-positive individuals were not considered suitable candidates for HSCT due to the immunosuppressive nature of the procedure, which compounded the already weakened immune state caused by HIV. However, advancements in antiretroviral therapy (ART) and transplant techniques have shifted this perspective, making HSCT a more accessible and safer option. One of the most notable advances in HSCT for HIV-positive patients is the development of reduced-intensity conditioning (RIC) regimens. RIC involves using lower doses of chemotherapy and radiation than traditional conditioning regimens, minimizing immune system suppression and reducing transplant-related complications. This approach has been particularly beneficial for HIV-positive patients, as it lowers the risk of infections and graft-versus-host disease (GVHD), two major concerns in this population. RIC regimens allow for sufficient engraftment of donor stem cells while preserving a degree of immune function, leading to better post-transplant outcomes.⁶⁶⁻⁷⁵

Another key advance has been in the management of ART during the transplant process. The compatibility between ART and immunosuppressive drugs used during HSCT has been optimized, allowing for continuous HIV suppression during and after the transplant. Drug interactions between ART and transplant medications, which were once a major obstacle, are now better understood, enabling clinicians to tailor ART regimens to avoid toxicity and ensure viral control. In addition, the use of newer ART drugs with fewer side effects and interactions has contributed to improved transplant outcomes in HIV-positive patients. These advances, coupled with better supportive care and prophylaxis for infections, have made HSCT a more viable curative option for HIV-positive patients with AA and other serious conditions.⁷⁶⁻⁸⁷

Conclusion

Hematopoietic stem cell transplantation (HSCT) has emerged as a viable curative option for aplastic anemia (AA) in HIV-positive patients, a possibility once deemed unattainable due to the complexities surrounding HIV infection and immunosuppression. Advances in antiretroviral therapy (ART), reduced-intensity conditioning (RIC) regimens, and infection management have significantly improved the outcomes of HSCT in this population. Despite the challenges of heightened infection risks, graft-versus-host disease (GVHD), and immune reconstitution, HIV-positive patients with well-controlled viral loads and stable CD4+ counts can now experience survival rates and long-term remission comparable to those of HIV-negative individuals.

References

- 1. Furlong E, Carter T. Aplastic anaemia: Current concepts in diagnosis and management. Journal of paediatrics and child health. 2020;56(7):1023-1028.
- 2. Chichetto NE, Polanka BM, So-Armah KA, Sung M, Stewart JC, Koethe JR, Edelman EJ, Tindle HA, Freiberg MS. Contribution of behavioral health factors to non-AIDS-related comorbidities: an updated review. Current HIV/AIDS Reports. 2020; 17:354-372.
- 3. Obeagu EI, Anyiam AF, Obeagu GU. Managing Hematological Complications in HIV: Erythropoietin Considerations. Elite Journal of HIV, 2024; 2(1): 65-78

- 4. Obeagu EI, Obeagu GU, Hauwa BA, Umar AI. Hematocrit Variations in HIV Patients Coinfected with Malaria: A Comprehensive Review. Journal home page: http://www. journalijiar. com.;12(01).
- 5. Obeagu EI, Obeagu GU. Maternal Influence on Infant Immunological Responses to HIV: A Review. Elite Journal of Laboratory Medicine, 2024; 2(1): 46-58
- 6. Obeagu EI, Obeagu GU. The Impact of Erythropoietin on Preeclampsia in HIV-Positive Women: A Review. Elite Journal of Nursing and Health Science, 2024; 2(1):21-31
- 7. Obeagu EI, GU Obeagu. Unmasking the Truth: Addressing Stigma in the Fight Against HIV. Elite Journal of Public Health, 2024; 2 (1): 8-22
- 8. Obeagu EI, Obeagu GU. Platelet-Driven Modulation of HIV: Unraveling Interactions and Implications. Journal home page: http://www.journalijiar.com. 2024;12(01).
- 9. Obeagu EI, Obeagu GU. Understanding B Lymphocyte Functions in HIV Infection: Implications for Immune Dysfunction and Therapeutic Strategies. Elite Journal of Medicine, 2024;2(1): 35-46
- 10. Obeagu EI, Obeagu GU. Implications of B Lymphocyte Dysfunction in HIV/AIDS. Elite Journal of Immunology, 2024; 2(1): 34-46
- 11. Obeagu EI, Anyiam AF, Obeagu GU. Unveiling B Cell Mediated Immunity in HIV Infection: Insights, Challenges, and Potential Therapeutic Avenues. Elite Journal of HIV, 2024; 2(1): 1-15
- Obeagu EI, Obeagu GU. Eosinophil-Associated Changes in Neonatal Thymic T Regulatory Cell Populations in HIV-Infected Pregnancies. Elite Journal of Health Science, 2024; 2(1): 33-42
- 13. Obeagu EI, Obeagu GU. Maternal Eosinophilic Responses in HIV-Positive Pregnant Women: Unraveling Immunological Dynamics for Improved Maternal-Fetal Health. Elite Journal of Immunology, 2024; 2(1): 47-64
- 14. Obeagu EI, Obeagu GU. CD8 Dynamics in HIV Infection: A Synoptic Review. Elite Journal of Immunology, 2024; 2(1): 1-13
- 15. Felker-Kantor EA, Wallace ME, Madkour AS, Duncan DT, Andrinopoulos K, Theall K. HIV stigma, mental health, and alcohol use disorders among people living with HIV/AIDS in New Orleans. Journal of urban health. 2019; 96:878-888.
- 16. Obeagu EI, Obeagu GU. Mental Health and Psychosocial Effects of natural disaster on HIV Patients. Asian J Dental Health Sci 2024;4(1):38-44. Available from: <u>http://ajdhs.com/index.php/journal/article/view/63</u>
- 17. Obeagu EI, Anyanwu CN, Obeagu GU. Challenges and Considerations in Managing Blood Transfusion for Individuals with HIV. Elite Journal of HIV, 2024; 2(2): 1-17
- 18. Obeagu EI, Obeagu GU.Understanding Hematocrit Fluctuations in HIV-Malaria Coinfection for Improved Management. Elite Journal of Public Health, 2024; 2 (1): 22-34
- 19. Skalski LM, Sikkema KJ, Heckman TG, Meade CS. Coping styles and illicit drug use in older adults with HIV/AIDS. Psychology of Addictive Behaviors. 2013;27(4):1050.
- 20. Obeagu EI, Ayogu EE, Obeagu GU. Interactions between Blood Transfusion and Antiretroviral Medications: Implications for Patient Care. Elite Journal of Medicine, 2024; 2(2):104-115
- Alum EU, Ugwu OP, Obeagu EI, Okon MB. Curtailing HIV/AIDS spread: impact of religious leaders. Newport International Journal of Research in Medical Sciences (NIJRMS). 2023;3(2):28-31.

- 22. Obeagu EI, Malot S, Obeagu GU, Ugwu OP. HIV resistance in patients with Sickle Cell Anaemia. Newport International Journal of Scientific and Experimental Sciences (NIJSES). 2023;3(2):56-59.
- 23. Obeagu EI, Obeagu GU, Paul-Chima UO. Stigma Associated With HIV. AIDS: A Review. Newport International Journal of Public Health and Pharmacy (NIJPP). 2023;3(2):64-7.
- 24. Alum EU, Obeagu EI, Ugwu OP, Aja PM, Okon MB. HIV infection and cardiovascular diseases: the obnoxious duos. Newport International Journal of Research in Medical Sciences (NIJRMS). 2023;3(2):95-99.
- 25. Hill K, Kuo I, Shenoi SV, Desruisseaux MS, Springer SA. Integrated care models: HIV and substance use. Current HIV/AIDS Reports. 2023;20(5):286-295.
- 26. Obeagu EI, Obeagu GU. Hematological Changes Following Blood Transfusion in Young Children with Severe Malaria and HIV: A Critical Review. Elite Journal of Laboratory Medicine, 2024; 2(1): 33-45
- 27. Obeagu EI, Obeagu GU. The Role of Blood Transfusion Strategies in HIV Management: Current Insights and Future Directions. Elite Journal of Medicine, 2024; 2(1):10-22
- Viola N, Kimono E, Nuruh N, Obeagu EI. Factors Hindering Elimination of Mother to Child Transmission of HIV Service Uptake among HIV Positive Women at Comboni Hospital Kyamuhunga Bushenyi District. Asian J Dental Health Sci [Internet]. 2023 Jun. 15 [cited 2024 Sep. 7];3(2):7-14. Available from: http://ajdhs.com/index.php/journal/article/view/39
- 29. Obeagu EI, Obeagu GU. Transfusion-Related Complications in Children Under 5 with Coexisting HIV and Severe Malaria: A Review. Int. J. Curr. Res. Chem. Pharm. Sci. 2024;11(2):9-19.
- Obeagu EI, Anyiam AF, Obeagu GU. Managing Anemia in HIV through Blood Transfusions: Clinical Considerations and Innovations. Elite Journal of HIV, 2024; 2(1): 16-30
- Alum EU, Obeagu EI, Ugwu OP, Samson AO, Adepoju AO, Amusa MO. Inclusion of nutritional counseling and mental health services in HIV/AIDS management: A paradigm shift. Medicine. 2023 Oct 13;102(41):e35673.
- 32. Obeagu EI, Obeagu, GU. Counting Cells, Shaping Fates: CD4/CD8 Ratios in HIV. Elite Journal of Scientific Research and Review, 2024; 2(1): 37-50
- 33. Obeagu EI, Obeagu GU. Eosinophil Dynamics in Pregnancy among Women Living with HIV: A Comprehensive Review. Int. J. Curr. Res. Med. Sci. 2024;10(1):11-24.
- 34. Obeagu EI, Obeagu GU, Hauwa BA, Umar AI. Neutrophil Dynamics: Unveiling Their Role in HIV Progression within Malaria Patients. Journal home page: http://www.journalijiar.com.;12(01).
- 35. Goodwin M. Black markets: the supply and demand of body parts. Cambridge University Press; 2006.
- 36. Obeagu EI, Obeagu GU. Eosinophilic Changes in Placental Tissues of HIV-Positive Pregnant Women: A Review. Elite Journal of Laboratory Medicine, 2024; 2(1): 14-32
- 37. Obeagu EI, Obeagu, GU. P-Selectin and Platelet Activation in HIV: Implications for Antiviral Therapy. Elite Journal of Scientific Research and Review, 2024; 2(1): 17-41
- Obeagu EI, Obeagu GU. The Intricate Relationship Between Erythropoietin and HIV-Induced Anemia: Unraveling Pathways for Therapeutic Insights. Int. J. Curr. Res. Chem. Pharm. Sci. 2024;11(2):30-40.

- 39. Obeagu EI, Anyiam AF, Obeagu GU. Erythropoietin Therapy in HIV-Infected Individuals: A Critical Review. Elite Journal of HIV, 2024; 2(1): 51-64
- 40. Obeagu EI, Obeagu GU. Strength in Unity: Building Support Networks for HIV Patients in Uganda . Elite Journal of Medicine, 2024; 2(1): 1-16
- 41. Mandania EW. Haematological and Immunological Abnormalities in People Living With HIV: A Review. Journal of Medical and Biomedical Laboratory Sciences Research. 2024;4(1).
- 42. Obeagu EI, Obeagu, GU. The Crucial Role of Erythropoietin in Managing Anemia in HIV: A Review. Elite Journal of Scientific Research and Review, 2024; 2(1): 24-36
- Obeagu EI, Ubosi NI, Obeagu GU, Obeagu AA. Nutritional Strategies for Enhancing Immune Resilience in HIV: A Review. Int. J. Curr. Res. Chem. Pharm. Sci. 2024;11(2):41-51.
- 44. Obeagu EI, Obeagu GU. Assessing Platelet Functionality in HIV Patients Receiving Antiretroviral Therapy: Implications for Risk Assessment. Elite Journal of HIV, 2024; 2(3): 14-26
- 45. Obeagu EI, Elamin EAI Obeagu GU. Understanding the Intersection of Highly Active Antiretroviral Therapy and Platelets in HIV Patients: A Review. Elite Journal of Haematology, 2024; 2(3): 111-117
- 46. Obeagu EI, Obeagu GU. Understanding ART and Platelet Functionality: Implications for HIV Patients. Elite Journal of HIV, 2024; 2(2): 60-73
- Obeagu EI, Obeagu GU. Understanding Immune Cell Trafficking in Tuberculosis-HIV Coinfection: The Role of L-selectin Pathways. Elite Journal of Immunology, 2024; 2(2): 43-59
- 48. Obeagu EI, Obeagu GU, Obiezu J, Ezeonwumelu C, Ogunnaya FU, Ngwoke AO, Emeka-Obi OR, Ugwu OP. Hematologic Support in HIV Patients: Blood Transfusion Strategies and Immunological Considerations. Applied Sciences (NIJBAS). 2023;3(3).
- 49. Obeagu EI, Obeagu GU. Neonatal Outcomes in Children Born to Mothers with Severe Malaria, HIV, and Transfusion History: A Review. Elite Journal of Nursing and Health Science, 2024; 2(3): 38-58
- 50. Obeagu EI. Erythropoietin and the Immune System: Relevance in HIV Management. Elite Journal of Health Science, 2024; 2(3): 23-35
- 51. Obeagu EI, Obeagu GU. Anemia and Erythropoietin: Key Players in HIV Disease Progression. Elite Journal of Haematology, 2024; 2(3): 42-57
- 52. Obeagu EI, Obeagu GU. Optimizing Blood Transfusion Protocols for Breast Cancer Patients Living with HIV: A Comprehensive Review. Elite Journal of Nursing and Health Science, 2024; 2(2):1-17
- 53. Obeagu EI, Obeagu GU. Hematologic Considerations in Breast Cancer Patients with HIV: Insights into Blood Transfusion Strategies. Elite Journal of Health Science, 2024; 2(2): 20-35
- 54. Obeagu EI, Ayogu EE, Obeagu GU. Impact on Viral Load Dynamics: Understanding the Interplay between Blood Transfusion and Antiretroviral Therapy in HIV Management. Elite Journal of Nursing and Health Science, 2024; 2(2): 5-15
- 55. American Psychiatric Association. Practice guideline for the treatment of patients with HIV/AIDS. American Psychiatric Pub; 2000.

- 56. Alum EU, Ugwu OP, Obeagu EI, Aja PM, Okon MB, Uti DE. Reducing HIV Infection Rate in Women: A Catalyst to reducing HIV Infection pervasiveness in Africa. International Journal of Innovative and Applied Research. 2023;11(10):01-6.
- Obeagu EI, Obeagu GU. Immune Modulation in HIV-Positive Neonates: Insights and Implications for Clinical Management. Elite Journal of Nursing and Health Science, 2024; 2(3): 59-72
- 58. Obeagu EI, Obeagu GU. Advancements in HIV Prevention: Africa's Trailblazing Initiatives and Breakthroughs. Elite Journal of Public Health, 2024; 2 (1): 52-63
- 59. Sukumaran RK. Long-Term Follow-Up and Chronic Complications. Contemporary Bone Marrow Transplantation. 2021:641-665.
- 60. Obeagu EI, Obeagu GU. Platelet Aberrations in HIV Patients: Assessing Impacts of ART. Elite Journal of Haematology, 2024; 2(3): 10-24
- Obeagu EI, Obeagu GU. The Role of L-selectin in Tuberculosis and HIV Coinfection: Implications for Disease Diagnosis and Management. Elite Journal of Public Health, 2024; 2 (1): 35-51
- 62. Obeagu EI, Obeagu GU. Harnessing B Cell Responses for Personalized Approaches in HIV Management. Elite Journal of Immunology, 2024; 2(2): 15-28
- 63. Obeagu EI, Obeagu GU. Unveiling the Role of Innate Immune Activation in Pediatric HIV: A Review. Elite Journal of Immunology, 2024; 2(3): 33-44
- 64. Obeagu EI, Obeagu GU. Unraveling the Role of Eosinophil Extracellular Traps (EETs) in HIV-Infected Pregnant Women: A Review. Elite Journal of Nursing and Health Science, 2024; 2(3): 84-99
- 65. Lyimo RA, Stutterheim SE, Hospers HJ, de Glee T, van der Ven A, de Bruin M. Stigma, disclosure, coping, and medication adherence among people living with HIV/AIDS in Northern Tanzania. AIDS patient care and STDs. 2014;28(2):98-105.
- 66. Obeagu EI, Obeagu, GU. Impact of Blood Transfusion on Viral Load Dynamics in HIV-Positive Neonates with Severe Malaria: A Review. Elite Journal of Scientific Research and Review, 2024; 2(1): 42-60
- 67. Obeagu EI, Obeagu GU. Impact of Maternal Eosinophils on Neonatal Immunity in HIV-Exposed Infants: A Review. Elite Journal of Immunology, 2024; 2(3): 1-18
- 68. Obeagu EI, Obeagu GU. L-selectin and HIV-Induced Immune Cell Trafficking: Implications for Pathogenesis and Therapeutic Strategies. Elite Journal of Laboratory Medicine, 2024; 2(2): 30-46
- 69. Obeagu EI, Obeagu GU. Exploring the Role of L-selectin in HIV-related Immune Exhaustion: Insights and Therapeutic Implications. Elite Journal of HIV, 2024; 2(2): 43-59
- 70. Obeagu EI, Obeagu GU. P-Selectin Expression in HIV-Associated Coagulopathy: Implications for Treatment. Elite Journal of Haematology, 2024; 2(3): 25-41
- 71. Obeagu EI, Obeagu GU. P-Selectin and Immune Activation in HIV: Clinical Implications. Elite Journal of Health Science, 2024; 2(2): 16-29
- 72. Obeagu EI, Amaeze AA, Ogbu ISI, Obeagu GU. B Cell Deficiency and Implications in HIV Pathogenesis: Unraveling the Complex Interplay. Elite Journal of Nursing and Health Science, 2024; 2(2): 33-46
- 73. Obeagu EI, Obeagu, GU. Platelet Dysfunction in HIV Patients: Assessing ART Risks. Elite Journal of Scientific Research and Review, 2024; 2(1): 1-16

- 74. Banerjee N, Goodman ZT, McIntosh R, Ironson G. Cognition, coping, and psychological distress in HIV. AIDS and Behavior. 2022;26(4):1074-1083.
- 75. Grau LE, Griffiths-Kundishora A, Heimer R, Hutcheson M, Nunn A, Towey C, Stopka TJ. Barriers and facilitators of the HIV care continuum in Southern New England for people with drug or alcohol use and living with HIV/AIDS: perspectives of HIV surveillance experts and service providers. Addiction science & clinical practice. 2017; 12:1-4.
- 76. Yu Y, Luo D, Chen X, Huang Z, Wang M, Xiao S. Medication adherence to antiretroviral therapy among newly treated people living with HIV. BMC public health. 2018; 18:1-8.
- 77. Li H, Wu X, Shen J, Lou S. Perspective and experience of patients with aplastic anemia on medication adherence. Patient preference and adherence. 2023:2215-2225.
- 78. Beichler H, Grabovac I, Dorner TE. Integrated care as a model for interprofessional disease management and the benefits for people living with HIV/AIDS. International Journal of Environmental Research and Public Health. 2023;20(4):3374.
- 79. Rajabiun S, Tryon J, Feaster M, Pan A, McKeithan L, Fortu K, Cabral HJ, Borne D, Altice FL. The influence of housing status on the HIV continuum of care: results from a multisite study of patient navigation models to build a medical home for people living with HIV experiencing homelessness. American Journal of Public Health. 2018;108(S7):S539-45.
- 80. Dale SK, Safren SA. Striving towards empowerment and medication adherence (STEP-AD): a tailored cognitive behavioral treatment approach for black women living with HIV. Cognitive and Behavioral Practice. 2018;25(3):361-376.
- 81. Ngcobo S, Scheepers S, Mbatha N, Grobler E, Rossouw T. Roles, barriers, and recommendations for community health workers providing community-based HIV Care in Sub-Saharan Africa: a review. AIDS Patient Care and STDs. 2022;36(4):130-144.
- 82. Obeagu EI, Ogu RIO, Ngwoke AO. Psychosocial Impact of Aplastic Anemia Diagnosis in HIV Patients: A Narrative Review. Elite Journal of Public Health, 2024; 2 (7): 35-46
- 83. Obeagu EI, Akinleye CA. Stabilizing Hemoglobin Levels: A Vital Aspect of Blood Transfusions in HIV Management. *Elite Journal of Haematology, 2024; 2(9):* 1-8
- 84. Obeagu EI, Akinleye CA. Promoting Fertility: Blood Transfusions and Reproductive Health in HIV-Positive Individuals. *Elite Journal of Haematology, 2024; 2(9):* 9-16
- **85.** Obeagu EI, Akinleye CA. Minimizing Treatment-Related Depression: Blood Transfusions and Mental Health Support in HIV Care. Elite Journal of Public Health, 2024; 2 (7): 16-24
- **86.** Obeagu EI, Akinleye CA. Promoting Social Integration: Blood Transfusions and Improved Social Well-being in HIV Patients. Elite Journal of Public Health, 2024; 2 (7): 25-34
- 87. Obeagu EI, Akinleye CA. Optimizing Physical Endurance: Blood Transfusions in HIV and the Improvement of Exercise Capacity. Elite Journal of Medicine, 2024; 2(9): 1-9