

# Lifesaving Measures: How Blood Transfusions Benefit Individuals Living with HIV

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## Abstract

Blood transfusions are a critical intervention for individuals living with HIV, particularly for those suffering from anemia, a common complication associated with the disease. Anemia not only exacerbates fatigue and weakness but also increases the risk of opportunistic infections, significantly impacting the overall quality of life. This review examines how blood transfusions can enhance immune function and improve clinical outcomes in HIV patients, highlighting their role as a lifesaving measure in the management of this chronic condition. The mechanisms through which blood transfusions benefit HIV patients include the restoration of hemoglobin levels, enhancement of immune cell function, and mitigation of systemic inflammation. By replenishing red blood cells, transfusions improve oxygen delivery to tissues, which is crucial for maintaining cellular metabolism and supporting immune responses. Additionally, improved oxygenation can stimulate the proliferation and activation of CD4+ T cells, thereby bolstering the adaptive immune response necessary for combating infections. While blood transfusions offer significant benefits, it is essential to consider the associated risks, such as transfusion reactions, infection transmission, and iron overload. Careful monitoring and individualized assessments are necessary to mitigate these risks and ensure patient safety.

**Kew Words:** antiretroviral therapy

## Introduction

The Human Immunodeficiency Virus (HIV) remains a significant global health challenge, affecting millions of individuals and leading to acquired immunodeficiency syndrome (AIDS) if left untreated. Despite advancements in antiretroviral therapy (ART), HIV continues to impact the immune system, resulting in various complications, including opportunistic infections and hematological disorders. Among these disorders, anemia is particularly prevalent and can severely affect the quality of life and clinical outcomes for individuals living with HIV. [1-2] Anemia in HIV patients is multifactorial, often resulting from the direct effects of the virus, nutritional deficiencies, and the side effects of antiretroviral medications. The prevalence of anemia in this population varies widely, with estimates indicating that up to 50% of individuals with HIV may experience this condition at some point during their disease course. The presence of anemia not only leads to debilitating symptoms such as fatigue and weakness but also contributes to the risk of severe health complications, including increased morbidity and mortality. [3-5] The management of anemia in HIV patients is crucial for improving their overall health and quality of life. Blood transfusions have emerged as a vital therapeutic intervention for individuals experiencing severe anemia, particularly those who do not respond adequately to other treatments, such as iron supplementation or erythropoiesis-stimulating agents. By restoring hemoglobin levels and enhancing oxygen delivery to tissues, blood transfusions can alleviate symptoms and improve functional capacity. [6-7] In addition to addressing anemia, blood transfusions may offer several immune-enhancing benefits for individuals living with HIV. The restoration of hemoglobin levels can

improve oxygenation, which is essential for optimal immune cell function. Enhanced oxygen delivery can lead to increased activation and proliferation of CD4+ T cells, critical components of the adaptive immune response. This immune enhancement is particularly important for HIV patients, as the depletion of CD4+ T cells is a hallmark of disease progression. [8-9]

Furthermore, blood transfusions may help mitigate systemic inflammation, which is often elevated in individuals living with HIV. Chronic inflammation can lead to immune exhaustion and increased susceptibility to opportunistic infections, making it essential to restore immune balance. Blood transfusions may provide anti-inflammatory mediators and dilute pro-inflammatory cytokines, promoting a more favorable immune environment for HIV patients. [10-11] Despite the potential benefits, blood transfusions are not without risks. Transfusion-related complications, such as allergic reactions, febrile non-hemolytic reactions, and the risk of transfusion-transmitted infections, must be carefully considered. Additionally, repeated blood transfusions can lead to iron overload, which poses its own set of complications. Therefore, healthcare providers must weigh the risks and benefits of transfusion therapy on a case-by-case basis, ensuring that patients receive appropriate monitoring and follow-up care. [12-13] The implications for transfusion strategies in HIV patients are profound, necessitating individualized approaches that consider the unique needs and circumstances of each patient. Collaboration among healthcare providers, including HIV specialists and transfusion medicine experts, is essential to optimize transfusion therapy and ensure patient safety. Developing evidence-based

protocols and guidelines for blood transfusions in this population can enhance the quality of care and improve clinical outcomes. [14-15]

### Anemia in HIV

Anemia is a prevalent and multifactorial complication in individuals living with HIV, significantly impacting their overall health and quality of life. Defined as a reduction in the number of red blood cells (RBCs) or hemoglobin concentration, anemia can lead to symptoms such as fatigue, weakness, pallor, and decreased exercise tolerance. The World Health Organization (WHO) classifies anemia in adults as a hemoglobin level below 13 g/dL in men and 12 g/dL in women. [16-17] The etiology of anemia in HIV patients is complex and arises from various mechanisms. One primary cause is the direct effect of HIV on the bone marrow, where the virus can impair erythropoiesis, the process of red blood cell production. Additionally, HIV-associated chronic inflammation can disrupt the production of erythropoietin, a hormone essential for red blood cell formation. Nutritional deficiencies, particularly in iron, folate, and vitamin B12, also contribute to the development of anemia in this population. Furthermore, certain antiretroviral therapies (ART) may have myelosuppressive effects, further exacerbating anemia. [18-19] The prevalence of anemia in individuals with HIV varies widely across different populations and settings. Studies indicate that approximately 30% to 50% of HIV-infected individuals may experience anemia, with higher rates observed in those with advanced disease or low CD4+ T cell counts. The incidence of anemia is often associated with disease progression, opportunistic infections, and other comorbidities, making it a significant concern in the management of HIV patients. Identifying and addressing anemia is essential to improving clinical outcomes and overall patient well-being. [20-21] Anemia in HIV patients is associated with several negative consequences, including increased morbidity and mortality. Individuals with anemia are at a higher risk of developing opportunistic infections, as their immune response is compromised. Furthermore, anemia can lead to reduced adherence to ART, as the debilitating symptoms may affect the patient's ability to maintain their treatment regimen. Consequently, the presence of anemia can create a vicious cycle that accelerates disease progression and worsens the patient's quality of life. [21-22]

The management of anemia in HIV patients requires a comprehensive approach that addresses its underlying causes. Initial assessments should include a thorough evaluation of the patient's medical history, physical examination, and laboratory tests to determine the type and severity of anemia. Treatment options may include nutritional supplementation, erythropoiesis-stimulating agents, and, in cases of severe anemia, blood transfusions. Each treatment option should be tailored to the individual patient, considering factors such as the cause of anemia, overall health status, and potential risks associated with interventions. [23] Blood transfusions play a crucial role in the management of severe anemia in HIV patients, particularly when other treatment options are ineffective or inappropriate. By rapidly increasing hemoglobin levels and improving oxygen delivery to tissues, transfusions can alleviate the symptoms of anemia, enhance functional capacity, and improve the overall quality of life for affected individuals. Additionally, the immune-enhancing effects of transfusions can provide further benefits in the context of HIV, as patients may experience improved immune function and a reduced risk of opportunistic infections. [24-25]

### Mechanisms of Action

Blood transfusions serve as a critical intervention for individuals living with HIV, particularly for those experiencing anemia. The mechanisms through which transfusions exert their beneficial effects are multifaceted, encompassing improvements in hemoglobin levels, enhanced immune function, and the modulation of inflammatory responses. [26] The primary and most immediate effect of blood transfusions is the restoration of hemoglobin levels in patients with anemia. Hemoglobin is the protein in red blood cells responsible for oxygen transport throughout the body. In individuals with HIV, who may experience anemia due to various factors, including the disease itself and the side effects of antiretroviral therapy,

blood transfusions can rapidly increase hemoglobin concentrations. This restoration enhances the oxygen-carrying capacity of the blood, alleviating symptoms such as fatigue, weakness, and diminished exercise tolerance, thereby improving the overall quality of life. [27-28] By increasing hemoglobin levels, blood transfusions improve oxygen delivery to tissues and organs. Adequate oxygenation is vital for cellular metabolism and overall physiological function. Improved oxygen delivery enhances the performance of various organ systems, including the immune system, which relies on optimal oxygen levels for the activation and proliferation of immune cells. This is particularly relevant for individuals living with HIV, as their immune systems may be compromised, making effective oxygen transport crucial for maintaining immune health. [29-30] Blood transfusions have been shown to enhance immune function in HIV patients. Improved oxygenation from transfused red blood cells can stimulate the activation and proliferation of CD4+ T cells, which play a central role in the adaptive immune response. Higher CD4+ T cell counts are associated with better immune control over opportunistic infections, which are common in individuals living with HIV. Additionally, transfusions may promote the production of other immune mediators, further bolstering the immune response against pathogens. [31-32]

Chronic inflammation is a common feature in individuals living with HIV and can contribute to immune dysfunction and the progression of the disease. Blood transfusions may help modulate inflammatory responses by diluting pro-inflammatory cytokines and introducing anti-inflammatory mediators present in the transfused blood. This modulation can promote a more balanced immune environment, reducing the risk of immune exhaustion and enhancing the overall immune response to infections. [33-34] In some cases, blood transfusions may inadvertently address underlying nutritional deficiencies contributing to anemia. For example, red blood cell transfusions can provide not only hemoglobin but also trace elements and nutrients such as iron, which is vital for erythropoiesis. By replenishing these nutrients, transfusions may support the body's ability to produce new red blood cells, complementing other therapeutic strategies aimed at correcting anemia. [35] The effects of blood transfusions extend beyond mere physiological improvements. By alleviating the symptoms of anemia, transfusions can significantly enhance the psychological well-being of individuals living with HIV. Patients often report increased energy levels, improved mood, and enhanced functional capacity following transfusion therapy. This overall improvement in quality of life can lead to better adherence to antiretroviral therapy and increased engagement in health-promoting behaviors. [36-37]

The benefits of blood transfusions can be both immediate and sustained. While the restoration of hemoglobin levels and the associated symptomatic relief can occur quickly, the long-term effects may depend on the underlying causes of anemia and the patient's overall health status. Ongoing monitoring and follow-up care are essential to assess the durability of the transfusion benefits and to address any recurrent anemia or complications. [38] By enhancing immune function and correcting anemia, blood transfusions may contribute to a reduced risk of opportunistic infections in HIV patients. Improved immune responses can help control viral replication and prevent the onset of infections that commonly affect this population. This protective effect is particularly valuable for patients with advanced disease or those with low CD4+ T cell counts, who are at the highest risk for opportunistic infections. [39] The timing and indications for blood transfusions are critical for maximizing their benefits. Transfusions should be considered in patients with severe anemia, particularly those with hemoglobin levels below critical thresholds or who exhibit significant symptoms. Assessing the individual patient's clinical status, comorbidities, and response to previous treatments is essential to determine the appropriateness of transfusion therapy.

### Clinical Evidence

The clinical evidence supporting the use of blood transfusions in individuals living with HIV is extensive, demonstrating both the therapeutic benefits in managing anemia and the potential for improving immune function and overall health. Numerous studies have documented the high prevalence of anemia among individuals living with HIV, emphasizing the need for

effective management strategies. Research indicates that anemia affects approximately 30% to 50% of HIV-infected individuals, particularly those with advanced disease and low CD4+ T cell counts. The presence of anemia is associated with increased morbidity, including a higher risk of opportunistic infections, greater healthcare utilization, and diminished quality of life. These findings underscore the importance of addressing anemia in the context of HIV management. [39-40] Clinical trials and observational studies have demonstrated the benefits of blood transfusions in improving hemoglobin levels and alleviating the symptoms of anemia. Research has also indicated that blood transfusions can enhance immune function in individuals living with HIV. Several studies have explored the relationship between blood transfusions, clinical outcomes, and survival rates in HIV patients. While the benefits of blood transfusions are well-documented, safety concerns remain a critical aspect of clinical decision-making. The risk of transfusion-related reactions, including allergic responses and the transmission of infectious agents, must be carefully evaluated. However, advances in blood screening and transfusion protocols have significantly reduced these risks. [41-42] Clinical guidelines from organizations such as the Centers for Disease Control and Prevention (CDC) and the World Health Organization (WHO) endorse the use of blood transfusions in specific clinical scenarios, particularly for individuals with severe anemia and significant symptoms. These guidelines emphasize the importance of individualized assessments to determine the appropriateness of transfusion therapy and to balance the potential benefits against the associated risks.

Comparative studies have examined the effectiveness of blood transfusions versus alternative treatments for anemia in HIV patients. The long-term effects of blood transfusions on health outcomes in individuals living with HIV have also been investigated.[43]

### Risks and Considerations

While blood transfusions offer significant benefits for individuals living with HIV, particularly in managing anemia and enhancing immune function, there are inherent risks and considerations that healthcare providers must address. Transfusion-related reactions can occur in response to blood transfusions, ranging from mild allergic reactions to more severe complications. Common mild reactions include fever, chills, and urticaria (hives), while more serious reactions, such as acute hemolytic reactions, can lead to significant morbidity. It is essential for healthcare providers to monitor patients closely during and after transfusion to identify and manage any adverse reactions promptly. Pre-medication with antihistamines or corticosteroids may be considered in patients with a history of allergic reactions.<sup>35</sup> Although the risk of transfusion-transmitted infections has significantly decreased due to stringent screening and testing protocols, it is not entirely eliminated. Patients receiving blood transfusions may still be at risk for viral infections, including HIV, hepatitis B, hepatitis C, and other pathogens. This risk is particularly relevant for individuals living with HIV, as they may have compromised immune systems. Healthcare providers must ensure that blood products are rigorously screened and that patients are educated about potential risks associated with transfusions. Repeated blood transfusions can lead to iron overload, a condition characterized by excessive accumulation of iron in the body. This can result in damage to vital organs, including the liver, heart, and pancreas. Patients with chronic anemia requiring multiple transfusions should be monitored for signs of iron overload and may benefit from chelation therapy to reduce excess iron levels. Balancing the need for transfusions with the risk of iron overload is critical in managing long-term care for individuals living with HIV.[36]

There is ongoing debate regarding the potential immunosuppressive effects of blood transfusions. Some studies have suggested that transfusions may contribute to immune modulation, potentially impacting the immune response in HIV patients. While transfusions can enhance immune function in the short term by improving oxygen delivery and supporting CD4+ T cell counts, long-term effects on immune system dynamics require further investigation. Providers should weigh the immediate benefits of transfusions against potential long-term impacts on immune health. [37] Given the

complexities associated with blood transfusions, individualized assessment is crucial in determining the appropriateness of transfusion therapy for each patient. Healthcare providers should consider the severity of anemia, the underlying causes, the patient's overall health status, and any existing comorbidities when deciding on the necessity of transfusions. Collaborative discussions with the patient about the risks and benefits of transfusion therapy can facilitate informed decision-making. Determining the appropriate timing and thresholds for transfusion is essential to maximize the benefits while minimizing risks. Current guidelines suggest that transfusions should be considered for patients with hemoglobin levels below critical thresholds (e.g., <7-8 g/dL) or those experiencing significant symptoms related to anemia. However, these thresholds may vary based on individual patient factors and clinical scenarios, necessitating careful clinical judgment. Patient education plays a vital role in the transfusion process. Healthcare providers should ensure that patients understand the purpose of the transfusion, the potential risks involved, and what to expect during and after the procedure. Open communication fosters trust and allows patients to voice any concerns, which can enhance their overall experience and adherence to treatment recommendations.

A multidisciplinary approach is beneficial in managing HIV patients who may require blood transfusions. Collaboration among HIV specialists, hematologists, transfusion medicine experts, and nursing staff can optimize care and ensure comprehensive assessments of patient needs. Regular team meetings can facilitate communication regarding patient status, transfusion indications, and follow-up care.<sup>38</sup> post-transfusion monitoring is essential to identify any immediate adverse reactions and assess the effectiveness of the intervention. Regular follow-up appointments should be scheduled to evaluate hemoglobin levels, monitor for potential complications (such as iron overload), and adjust treatment plans as needed. Continuous assessment allows for timely interventions and helps maintain optimal health outcomes.

### Implications for Transfusion Strategies

The implementation of effective transfusion strategies for individuals living with HIV is essential to maximize the benefits of blood transfusions while minimizing associated risks. Given the complexities surrounding anemia management and the unique challenges faced by this population, healthcare providers must adopt a comprehensive and tailored approach to transfusion therapy. Developing individualized transfusion protocols is critical for ensuring that each patient receives appropriate care based on their specific needs. Factors such as the severity of anemia, underlying causes, comorbidities, and patient preferences should guide transfusion decisions. For instance, patients with symptomatic anemia may require more aggressive intervention than those with asymptomatic mild anemia. By tailoring transfusion strategies to each patient, healthcare providers can optimize outcomes and enhance patient satisfaction.[39] Adherence to evidence-based guidelines for blood transfusions is paramount in the management of anemia in HIV patients. Organizations such as the CDC and WHO provide recommendations regarding hemoglobin thresholds, indications for transfusion, and monitoring protocols. These guidelines help standardize care and ensure that transfusion decisions are grounded in scientific evidence, reducing the risk of inappropriate transfusions and adverse events. A multidisciplinary approach is essential in managing the complexities of transfusion therapy for individuals living with HIV. Collaboration among HIV specialists, hematologists, transfusion medicine experts, and nursing staff can enhance the quality of care. Regular team meetings and case discussions can facilitate communication regarding patient status, transfusion indications, and follow-up care, ensuring that all aspects of the patient's health are considered.[40]

Conducting a thorough pre-transfusion assessment is critical to identify patients who would benefit most from transfusion therapy. This assessment should include a detailed medical history, physical examination, and laboratory evaluations to determine hemoglobin levels, underlying causes of anemia, and the presence of any contraindications. By ensuring a comprehensive understanding of the patient's health status, healthcare providers can make informed transfusion decisions. Post-transfusion



monitoring and follow-up care are essential components of transfusion strategies. Patients should be closely monitored during and after transfusions to identify any immediate adverse reactions. Follow-up appointments should assess hemoglobin levels, evaluate the effectiveness of the transfusion, and monitor for potential complications, such as iron overload. Regular assessments allow for timely interventions and adjustments to treatment plans as needed. Educating patients about blood transfusions, their potential benefits, and associated risks is vital for fostering informed decision-making. Healthcare providers should communicate openly with patients, addressing any concerns and emphasizing the importance of adherence to transfusion protocols. Engaging patients in their care promotes trust and enhances their overall experience, ultimately leading to better health outcomes.[41]

Implementing risk mitigation strategies is crucial to minimize the potential complications associated with blood transfusions. Healthcare providers should ensure that blood products are thoroughly screened and tested for infectious agents to reduce the risk of transfusion-transmitted infections. Additionally, adopting protocols for monitoring and managing transfusion-related reactions can enhance patient safety and confidence in the procedure. While blood transfusions are a vital intervention for severe anemia, exploring alternative therapies may also be beneficial. For instance, erythropoiesis-stimulating agents (ESAs) and iron supplementation can be effective in managing anemia in certain patients. Incorporating these alternative treatments into transfusion strategies allows for a more comprehensive approach to anemia management and can reduce the need for transfusions in some cases. Socioeconomic factors can significantly influence access to transfusion therapy and overall health outcomes for individuals living with HIV. Healthcare providers should consider these factors when developing transfusion strategies and strive to ensure equitable access to care. Addressing barriers such as transportation, financial constraints, and healthcare literacy is essential for improving patient outcomes and promoting adherence to treatment. [42-43]

## Conclusion

Blood transfusions represent a vital intervention for individuals living with HIV, particularly in managing anemia and enhancing overall health. The prevalence of anemia in this population is significant, often resulting from a combination of factors, including the disease itself and the effects of antiretroviral therapy. Transfusion therapy has demonstrated considerable benefits, including the restoration of hemoglobin levels, improvement of oxygen delivery, and enhancement of immune function, all of which contribute to better clinical outcomes and quality of life for patients. However, the implementation of transfusion strategies must be approached with caution, given the associated risks and complexities. Healthcare providers must consider individual patient factors, adhere to evidence-based guidelines, and employ a multidisciplinary approach to ensure safe and effective transfusion practices. Comprehensive pre-transfusion assessments, diligent monitoring, and patient education are essential components of a successful transfusion strategy.

## References

- Obeagu EI, Obeagu GU. (2024). Counting Cells, Shaping Fates: CD4/CD8 Ratios in HIV. *Elite Journal of Scientific Research and Review*, 2(1): 37-50
- Obeagu EI, Obeagu GU. (2024). Hematological Changes Following Blood Transfusion in Young Children with Severe Malaria and HIV: A Critical Review. *Elite Journal of Laboratory Medicine*; 2(1): 33-45
- Obeagu EI, Obeagu GU. (2024). The Role of Blood Transfusion Strategies in HIV Management: Current Insights and Future Directions. *Elite Journal of Medicine*; 2(1):10-22
- Obeagu EI, Obeagu GU, Ukibe NR, Oyebadejo SA. (2024). Anemia, iron, and HIV: decoding the interconnected pathways: A review. *Medicine*;103(2): e36937.
- Volberding P. (2002). The impact of anemia on quality of life in human immunodeficiency virus—infected patients. *The Journal of infectious diseases*;185(Supplement 2): S110-114.
- Montoro M, Cucala M, Lanas Á, Villanueva C, Hervás AJ, ET ALL., (2022). Indications and hemoglobin thresholds for red blood cell transfusion and iron replacement in adults with gastrointestinal bleeding: An algorithm proposed by gastroenterologists and patient blood management experts. *Frontiers in Medicine*; 9:903739.
- Obeagu EI, Obeagu GU. (2024). Eosinophil Dynamics in Pregnancy among Women Living with HIV: A Comprehensive Review. *Int. J. Curr. Res. Med. Sci*;10(1):11-24.
- 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.
- Busch MP, Bloch EM, Kleinman S. (2019). Prevention of transfusion-transmitted infections. *Blood, The Journal of the American Society of Hematology*;133(17):1854-1864.
- Obeagu EI, Obeagu GU. (2024). Transfusion-Related Complications in Children Under 5 with Coexisting HIV and Severe Malaria: A Review. *Int. J. Curr. Res. Chem. Pharm. Sci*;11(2):9-19.
- Obeagu EI, Obeagu GU, Hauwa BA, Umar AI. Neutrophil Dynamics: Unveiling Their Role in HIV Progression within Malaria Patients. *Journal home page: http://www.journalijar.com*;12(01).
- Heron SE, Elahi S. (2017). HIV infection and compromised mucosal immunity: oral manifestations and systemic inflammation. *Frontiers in immunology*; 8:241.
- Obeagu EI, Obeagu, GU. (2024). P-Selectin and Platelet Activation in HIV: Implications for Antiviral Therapy. *Elite Journal of Scientific Research and Review*; 2(1): 17-41
- Obeagu EI, Obeagu GU. (2024). The Intricate Relationship Between Erythropoietin and HIV-Induced Anemia: Unraveling Pathways for Therapeutic Insights. *Int. J. Curr. Res. Chem. Pharm. Sci*;11(2):30-40.
- Obeagu EI, Anyiam AF, Obeagu GU. (2024). Erythropoietin Therapy in HIV-Infected Individuals: A Critical Review. *Elite Journal of HIV*; 2(1): 51-64
- Obeagu EI, Obeagu GU. (2024). Strength in Unity: Building Support Networks for HIV Patients in Uganda. *Elite Journal of Medicine*; 2(1): 1-16
- Bloch EM, Vermeulen M, Murphy E. (2012). Blood transfusion safety in Africa: a literature review of infectious disease and organizational challenges. *Transfusion medicine reviews*;26(2):164-180.
- Obeagu EI, Obeagu GU. (2024). Eosinophilic Changes in Placental Tissues of HIV-Positive Pregnant Women: A Review. *Elite Journal of Laboratory Medicine*; 2(1): 14-32
- Obeagu EI, Obeagu, GU. (2024). The Crucial Role of Erythropoietin in Managing Anemia in HIV: A Review. *Elite Journal of Scientific Research and Review*; 2(1): 24-36
- Cunningham-Rundles S, McNeeley DF, Moon A. (2005). Mechanisms of nutrient modulation of the immune response. *Journal of Allergy and Clinical Immunology*;115(6):1119-1128.
- Obeagu EI, Ubosi NI, Obeagu GU, Obeagu AA. (2024). Nutritional Strategies for Enhancing Immune Resilience in HIV: A Review. *Int. J. Curr. Res. Chem. Pharm. Sci*;11(2):41-51.
- Obeagu EI, Obeagu GU. (2024). Assessing Platelet Functionality in HIV Patients Receiving Antiretroviral Therapy: Implications for Risk Assessment. *Elite Journal of HIV*; 2(3): 14-26
- Obeagu EI, Elamin EAI Obeagu GU. (2024). Understanding the Intersection of Highly Active Antiretroviral Therapy and Platelets in HIV Patients: A Review. *Elite Journal of Haematology*; 2(3): 111-117
- Lotfi R, Kaltenmeier C, Lotze MT, Bergmann C. (2016). Until death do us part: necrosis and oxidation promote the tumor microenvironment. *Transfusion Medicine and Hemotherapy*. Mar 8;43(2):120-32.
- Cunha PP, Minogue E, Krause LC, Hess RM, Bargiela D, ET ALL., (2023). Oxygen levels at the time of activation determine T cell persistence and immunotherapeutic efficacy. *Elife*;12: e84280.
- Obeagu EI, Obeagu GU. (2024). Neonatal Outcomes in Children Born to Mothers with Severe Malaria, HIV, and Transfusion History: A Review. *Elite Journal of Nursing and Health Science*; 2(3): 38-58
- Obeagu EI. (2024). Erythropoietin and the Immune System: Relevance in HIV Management. *Elite Journal of Health Science*; 2(3): 23-35
- Zicari S, Sessa L, Cotugno N, Ruggiero A, Morrocchi E, at all., (2019). Immune activation, inflammation, and non-AIDS co-morbidities in HIV-infected patients under long-term ART. *Viruses*;11(3):200.
- Obeagu EI, Obeagu GU. (2024). Understanding Immune Cell Trafficking in Tuberculosis-HIV Coinfection: The Role of L-selectin Pathways. *Elite Journal of Immunology*; 2(2): 43-59
- Obeagu EI, Obeagu GU. (2024). Anemia and Erythropoietin: Key Players in HIV Disease Progression. *Elite Journal of Haematology*; 2(3): 42-57
- Balderson BH, Grothaus L, Harrison RG, McCoy K, Mahoney C, ET ALL., (2013). Chronic illness burden and quality of life in an aging HIV population. *AIDS care*;25(4):451-458.

32. Obeagu EI, Ayogu EE, Obeagu GU. (2024). Impact on Viral Load Dynamics: Understanding the Interplay between Blood Transfusion and Antiretroviral Therapy in HIV Management. *Elite Journal of Nursing and Health Science*; 2(2): 5-15
33. Obeagu EI, Obeagu GU. (2024). Immune Modulation in HIV-Positive Neonates: Insights and Implications for Clinical Management. *Elite Journal of Nursing and Health Science*; 2(3): 59-72
34. Chakraborty R, Cannella L, Cottone F, Efficace F. (2020). Quality of patient-reported outcome reporting in randomised controlled trials of haematological malignancies according to international quality standards: a systematic review. *The Lancet Haematology*;7(12): e892-901.
35. Hébert PC, Fergusson D, Blajchman MA, Wells GA, Kmetz A, ET ALL., (2003). Clinical outcomes following institution of the Canadian universal leukoreduction program for red blood cell transfusions. *Jama*;289(15):1941-1949.
36. Vamvakas EC, Blajchman MA. (2009). Transfusion-related mortality: the ongoing risks of allogeneic blood transfusion and the available strategies for their prevention. *Blood, The Journal of the American Society of Hematology*;113(15):3406-3417.
37. Kaur P, Basu S. (2005). Transfusion-transmitted infections: existing and emerging pathogens. *Journal of postgraduate medicine*;51(2):146-151.
38. Wiersum-Osselton JC, Whitaker B, Grey S, Land K, Perez G, et al., (2019). Revised international surveillance case definition of transfusion-associated circulatory overload: a classification agreement validation study. *The Lancet Haematology*;6(7): e350-358.
39. Smit-Sibinga C, Pitman JP. (2011). Transmission of HIV through blood—how to bridge the knowledge gap. In *HIV and AIDS-Updates on biology, immunology, epidemiology and treatment strategies*: 583-618. *InTech*, Rijeka, Croatia.
40. Slonim AD, Bish EK, Xie RS. (2014). Red blood cell transfusion safety: probabilistic risk assessment and cost/benefits of risk reduction strategies. *Annals of Operations Research*; 221:377-406.
41. Steffen KM, Spinella PC, Holdsworth LM, Ford MA, Lee GM, ET ALL., (2021). Factors influencing implementation of blood transfusion recommendations in pediatric critical care units. *Frontiers in Pediatrics*; 9:800461.
42. Barro L, Drew VJ, Poda GG, Tagny CT, El-Ekiaby M, ET ALL., (2018). Blood transfusion in sub-Saharan Africa: understanding the missing gap and responding to present and future challenges. *Vox Sanguinis*; 113(8):726-736.
43. Ako S, Njunda LA, Akum EA, Benjamin PT, Assob J. (2018). Hematological related disorders and transfusion of HIV patients on highly active antiretroviral therapy (HAART) in the South West Region of Cameroon: hematological monitory parameters for HIV follow-up. *J HIV Retrovirus*;4(1):5.



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