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GERIATRIC COAGULOPATHIES ACROSS SOCIOECONOMIC CONTEXTS: COMPARATIVE INSIGHTS FROM AFRICA AND THE AMERICAS- A NARRATIVE REVIEW

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ABSTRACT

Geriatric coagulopathies, encompassing disorders of blood clotting that lead to thrombosis or bleeding, are increasingly significant as the global elderly population grows. These conditions arise from age-related physiological changes, polypharmacy, and comorbidities. However, the burden and management of coagulopathies differ markedly between low-income and high-income settings due to disparities in healthcare infrastructure, diagnostic capabilities, and access to therapies. This review compares geriatric coagulopathies in Africa and America, highlighting epidemiological trends, underlying pathophysiology, and clinical challenges unique to each region. In African settings, infectious diseases, nutritional deficiencies, and limited resources complicate diagnosis and treatment, while in American contexts, lifestyle-related factors and advanced healthcare systems shape disease profiles and management strategies. These contrasting environments illustrate the complexity of delivering optimal care to elderly patients with coagulation disorders.

Keywords: *Geriatric coagulopathies, Aging and hemostasis, Low-income healthcare, Anticoagulation management, Africa and America health disparities*

Introduction

Coagulopathies encompass a broad spectrum of disorders characterized by abnormalities in blood clotting mechanisms, leading to either an increased risk of bleeding or thrombotic events.[1-2] Among the elderly population, these disorders assume heightened clinical importance due to the physiological alterations associated with aging, such as changes in vascular integrity, platelet function, and coagulation factor levels. Additionally, the presence of multiple chronic diseases and polypharmacy further complicate the hemostatic balance in older adults, increasing both the incidence and severity of coagulopathies.[3-4] Globally, the burden of geriatric coagulopathies is growing in tandem with increasing life expectancy and demographic shifts toward aging populations. However, this burden is not evenly distributed, with substantial disparities observed between low-income and high-income countries. These differences are influenced by variations in healthcare infrastructure, availability of diagnostic tools, access to therapeutic agents, and the prevalence of comorbidities that modulate coagulation status. Such disparities necessitate a contextualized understanding of coagulopathy management tailored to specific socioeconomic and geographic settings.[5-7]

Africa and America offer contrasting yet instructive perspectives on geriatric coagulopathies. Many African countries continue to face challenges associated with limited healthcare resources, underdeveloped diagnostic capacity, and a dual burden of infectious and non-communicable diseases.[8-9] In contrast, high-income countries like the United States benefit from advanced medical technologies, comprehensive screening programs, and a wider array of anticoagulant therapies.[10-11] These differences underscore the impact of systemic factors on disease outcomes and management strategies. In African settings, infectious diseases such as HIV/AIDS, tuberculosis, and malaria frequently intersect with coagulation disorders, complicating the clinical picture. Malnutrition and micronutrient deficiencies, common in resource-limited environments, further disrupt coagulation pathways. Moreover, the under-recognition and under-reporting of geriatric coagulopathies in many parts of Africa impede epidemiological understanding and hinder the development of targeted interventions.[12-14] Conversely, in high-income American settings, lifestyle-related factors including obesity, diabetes, and cardiovascular disease predominate as contributors to coagulopathy in the elderly.[15-16] The widespread use of anticoagulant and antiplatelet medications, while reducing thrombotic risks, introduces the challenge of managing drug-related bleeding complications.[17-18] Comprehensive clinical guidelines and risk assessment tools facilitate individualized patient care but require continuous adaptation to

emerging evidence and demographic changes.

Aim

This review aims to provide a comprehensive analysis of geriatric coagulopathies by examining their epidemiology, pathophysiology, diagnostic challenges, and management strategies in low- and high-income settings, with a particular focus on contrasting experiences from Africa and America.

Methods

This narrative review was conducted to provide a comprehensive synthesis of current knowledge on geriatric coagulopathies across diverse socioeconomic contexts, with a focus on Africa and the Americas. A structured literature search was performed using electronic databases, including PubMed, Scopus, and Google Scholar, covering publications from January 2000 to December 2025. Keywords and MeSH terms included "geriatric coagulopathies," "aging and hemostasis," "thrombosis in elderly," "bleeding disorders in older adults," "Africa," "Americas," and "socioeconomic disparities."

Eligible studies included original research articles, systematic reviews, meta-analyses, and clinical guidelines addressing pathophysiology, epidemiology, diagnosis, and management of coagulopathies in adults aged 60 years and older. Articles were screened for relevance based on title and abstract, followed by full-text review. Non-English publications and studies without clear geriatric data were excluded.

Data were extracted and synthesized qualitatively, focusing on patterns of coagulopathy, clinical manifestations, diagnostic approaches, and therapeutic strategies, with particular attention to differences between low- and high-income settings. Emphasis was placed on contextual factors such as healthcare infrastructure, resource availability, and access to anticoagulation monitoring, to highlight the influence of socioeconomic status on disease outcomes.

Epidemiology of Geriatric Coagulopathies

The epidemiology of coagulopathies in the geriatric population reflects the complex interplay between aging physiology, comorbidities, and environmental factors. Globally, the incidence and prevalence of both thrombotic and bleeding disorders increase with age due to age-related alterations in the hemostatic system, including elevated levels of procoagulant factors, reduced fibrinolysis, and vascular changes. However, epidemiological data reveal significant variations when comparing low-income and high-income regions, shaped by differences in healthcare systems, disease burden, and population demographics. In high-income countries such as the United States, coagulopathies in the elderly are well-documented and extensively studied. Venous thromboembolism (VTE), which includes deep vein thrombosis and pulmonary embolism, is particularly prevalent, with incidence rates rising exponentially after the age of 60. Similarly, atrial fibrillation—a common arrhythmia in older adults—significantly increases the risk of ischemic stroke, often managed with anticoagulation therapy. Aging populations in these regions also experience bleeding complications

related to anticoagulant use, highlighting the dual challenges of thrombosis prevention and hemorrhage risk. The availability of robust surveillance systems and electronic health records allows for precise tracking of incidence, outcomes, and treatment patterns.[19-22]

In contrast, epidemiological data on geriatric coagulopathies in many African countries remain sparse and fragmented. The continent faces unique challenges, including a younger overall population structure, limited access to diagnostic tools, and competing health priorities such as infectious diseases. Nonetheless, the elderly population in Africa is gradually expanding due to improvements in public health and infectious disease control, foreshadowing an increasing burden of age-related coagulopathies.[24-25] Reports suggest a high prevalence of coagulation abnormalities linked to infectious etiologies like HIV and tuberculosis, as well as malnutrition-related bleeding disorders.[26-27] However, underreporting and diagnostic limitations result in underestimation of the true burden. Risk factors contributing to geriatric coagulopathies also differ markedly between these settings. In America, lifestyle factors such as obesity, sedentary behavior, diabetes, and cardiovascular disease predominate, driving thrombotic events and necessitating long-term anticoagulation.[28] Polypharmacy, including the use of antiplatelet and anticoagulant agents, further complicates management and influences epidemiological trends. Conversely, in African countries, infectious diseases, chronic inflammation, nutritional deficiencies, and genetic factors such as sickle cell disease play significant roles in shaping coagulation profiles in the elderly.[29-30] Furthermore, socioeconomic determinants of health heavily influence epidemiological patterns. In low-income African settings, limited healthcare access, delayed presentation, and inadequate follow-up contribute to poorer outcomes and higher morbidity and mortality rates.[31] In high-income settings, disparities persist among minority and underserved populations, with differential access to care and treatment adherence impacting disease incidence and prognosis.[32] These factors underscore the need for context-specific epidemiological surveillance and public health interventions.

Pathophysiological Considerations

The pathophysiology of coagulopathies in the elderly is multifactorial, rooted in age-related alterations of the hemostatic system that predispose to both thrombosis and bleeding. Aging is associated with a shift toward a prothrombotic state characterized by increased plasma concentrations of clotting factors such as fibrinogen, factor VIII, and von Willebrand factor, alongside decreased natural anticoagulants like protein C and antithrombin. Additionally, impaired fibrinolysis due to elevated plasminogen activator inhibitor-1 (PAI-1) further promotes clot persistence. Endothelial dysfunction, a hallmark of vascular aging, contributes to altered hemostasis through reduced nitric oxide bioavailability and increased expression of procoagulant molecules, thereby exacerbating thrombotic risk.[33-34] At the same time, elderly individuals often experience conditions that increase bleeding

susceptibility, creating a complex clinical balance. These include diminished bone marrow reserve, thrombocytopenia, platelet dysfunction, and decreased synthesis of vitamin K-dependent clotting factors, particularly in the presence of liver disease or malnutrition. Polypharmacy, particularly the use of anticoagulants and antiplatelet agents, amplifies this bleeding risk, necessitating careful therapeutic management. Furthermore, age-related changes in renal and hepatic function can alter drug metabolism, impacting coagulation status and drug efficacy.[35-37]

In low-income African settings, additional pathophysiological factors compound these age-related changes. Infectious diseases such as HIV, tuberculosis, and malaria induce systemic inflammation and immune activation, which can trigger disseminated intravascular coagulation (DIC) and consumption coagulopathy. Chronic inflammatory states enhance tissue factor expression and activate coagulation cascades, while malnutrition and micronutrient deficiencies (e.g., vitamin K, folate) impair the synthesis of essential clotting components. Genetic conditions such as sickle cell disease, prevalent in parts of Africa, contribute to vascular injury and hypercoagulability, complicating the hemostatic profile in elderly patients.[38-40] By contrast, in high-income American populations, lifestyle-related diseases such as obesity, diabetes mellitus, and atherosclerosis are dominant contributors to coagulopathy pathogenesis in the elderly. Chronic metabolic inflammation and endothelial dysfunction associated with these conditions promote a hypercoagulable milieu. Furthermore, the widespread use of cardiovascular devices, surgical interventions, and long-term anticoagulation therapies influences coagulation dynamics, requiring sophisticated monitoring and risk stratification to prevent complications (Table 1).[41]

Table 1: Pathophysiological Considerations in Geriatric Coagulopathies suitable for your review:

Pathophysiological Aspect	Mechanism in the Elderly	Clinical Implication	Socioeconomic Considerations
Prothrombotic Shift	Increased fibrinogen, factor VIII, and von Willebrand factor levels; enhanced coagulation cascade activation	Elevated risk of venous thromboembolism (VTE) and arterial thrombosis	High-income regions: early detection and prophylaxis feasible; low-income regions: underdiagnosis and limited prophylaxis
Platelet Function Alterations	Impaired aggregation or hyperreactivity due to aging platelets	Increased risk of bleeding or thrombotic events depending on context	Limited access to platelet function testing in low-resource settings
Endothelial Dysfunction	Reduced nitric oxide, increased oxidative stress, chronic inflammation	Predisposition to atherosclerosis, thrombosis, and impaired hemostasis	Preventive interventions (statins, antioxidants) more accessible in high-income settings
Comorbidities	Cardiovascular disease, diabetes, kidney disease affecting coagulation	Exacerbates both bleeding and thrombosis risk	Comorbidity management varies; low-resource settings may have limited monitoring

	pathways		and therapy
Polypharmacy	Concomitant use of anticoagulants, antiplatelets, NSAIDs	Increased bleeding risk, drug interactions, and therapy complications	Monitoring constraints in low-income regions may elevate adverse event rates
Nutritional Deficiencies	Vitamin K, folate, or protein deficiencies affecting clotting factor synthesis	Higher susceptibility to bleeding disorders	Malnutrition more prevalent in low-income settings, contributing to coagulopathy

Diagnostic and Therapeutic Challenges

Diagnosing and managing coagulopathies in the elderly presents unique challenges that are heavily influenced by healthcare resource availability, patient factors, and disease complexity. In high-income countries such as the United States, access to advanced laboratory testing—including prothrombin time (PT), activated partial thromboplastin time (aPTT), D-dimer assays, thromboelastography, and platelet function tests—facilitates accurate and timely diagnosis. Imaging modalities like Doppler ultrasonography and computed tomography pulmonary angiography (CTPA) are routinely employed to confirm thrombotic events. Moreover, specialist expertise in hematology and geriatrics supports comprehensive evaluation and individualized treatment plans. However, even in these settings, polypharmacy, comorbidities, and bleeding risk complicate therapeutic decision-making.[42-45] In contrast, many low-income African settings face considerable diagnostic limitations. Basic coagulation tests are often unavailable or inaccessible, and advanced diagnostics such as D-dimer or imaging studies are scarce or prohibitively expensive. Consequently, healthcare providers frequently rely on clinical judgment and limited laboratory data, which may delay or obscure diagnosis. The overlap of coagulopathies with infectious diseases and malnutrition adds further complexity. This scarcity of diagnostic resources impedes effective risk stratification and hinders appropriate treatment initiation, contributing to increased morbidity and mortality (Table 2).[46-47]

Table 2: Diagnostic and Therapeutic Challenges in Geriatric Coagulopathies Across Socioeconomic Contexts:

Domain	Challenge in Geriatrics	Impact on Care	Socioeconomic Considerations
Laboratory Diagnostics	Limited access to specialized tests (factor assays, thromboelastography, D-dimer, platelet function tests)	Delayed or missed diagnosis; inadequate risk stratification	High-income regions: routine advanced testing; low-income regions: reliance on basic coagulation tests (PT, aPTT)
Imaging	Doppler ultrasound, CT, MRI often unavailable in resource-limited settings	Missed or late detection of thrombotic or hemorrhagic events	Advanced imaging widely available in Americas; limited availability in many African settings
Risk Stratification	Underutilization of validated tools (CHA_2DS_2-VASc, HAS-BLED)	Difficulty balancing anticoagulation benefits and bleeding	High-income regions: guideline-based risk assessment; low-income

		risks	regions: informal or clinical judgment-based assessment
Anticoagulation Management	Warfarin requires INR monitoring; DOACs may be unaffordable	Increased risk of bleeding or thrombosis due to suboptimal dosing	Low-income regions: limited monitoring and affordability; high-income regions: structured dosing and monitoring
Polypharmacy and Drug Interactions	Multiple comorbidities increase complexity	Higher risk of adverse events, bleeding, or thrombosis	High-income regions: careful monitoring possible; low-income regions: monitoring often inconsistent
Patient Education and Adherence	Cognitive decline, low health literacy	Non-adherence to therapy, improper dosing, increased complications	High-income regions: access to educational programs; low-income regions: limited patient counseling and follow-up
Nutritional and Comorbidity Considerations	Malnutrition, chronic disease affecting hemostasis	Exacerbates bleeding or thrombotic risk	More prevalent in low-income settings; impacts therapy efficacy and outcomes

Therapeutic management of geriatric coagulopathies requires balancing thrombosis prevention against bleeding risk, a particularly delicate task in older adults. In high-income settings, anticoagulants such as vitamin K antagonists and direct oral anticoagulants (DOACs) have transformed care by enabling more predictable pharmacokinetics and fewer monitoring requirements. Nonetheless, drug interactions, renal impairment, and adherence issues remain significant challenges. Comprehensive risk assessment tools (e.g., CHA2DS2-VASc, HAS-BLED scores) guide therapy choices, but clinical judgment remains essential in complex cases.[48-49] In low-resource African environments, therapeutic options are constrained by drug availability, cost, and monitoring challenges. Warfarin remains the mainstay anticoagulant, but limited access to regular INR monitoring complicates safe dose management. The lack of reversal agents and protocols for managing bleeding further increases treatment risks. Additionally, traditional medicines and variable health literacy can affect adherence and safety. Integrating anticoagulation management into primary healthcare and task-shifting to community health workers are potential strategies to mitigate these challenges but require robust training and support.[47] Patient-related factors such as cognitive decline, frailty, and multimorbidity further complicate diagnosis and treatment adherence across all settings. Polypharmacy increases the risk of adverse drug reactions, necessitating frequent medication reviews. Moreover, the psychosocial context, including family support and socioeconomic status, influences healthcare access and outcomes, underscoring the need for a holistic, multidisciplinary approach.

Management Strategies and Outcomes

In high-income settings such as the United States, evidence-based clinical guidelines support the use of anticoagulant therapies tailored by validated risk assessment tools like the CHA2DS2-VASc and HAS-BLED scores. These frameworks help clinicians individualize treatment, optimizing the

benefit-risk ratio for conditions such as atrial fibrillation, venous thromboembolism, and mechanical heart valves. The availability of novel oral anticoagulants (NOACs) has further improved management by offering fixed dosing without routine coagulation monitoring, thereby enhancing patient adherence and reducing complications.[50-51] Multidisciplinary care models involving hematologists, geriatricians, pharmacists, and nurses contribute significantly to improved outcomes in these settings. Patient education on medication adherence, lifestyle modifications, and monitoring of adverse effects is integral to therapy success. Additionally, comprehensive anticoagulation clinics provide specialized monitoring and rapid intervention in cases of bleeding or thrombosis. Despite these advances, challenges persist, including managing drug interactions, renal impairment, and bleeding complications, which require ongoing vigilance and individualized care plans.[52] In contrast, the management landscape in many African countries is constrained by limited healthcare resources, lack of access to newer anticoagulants, and inadequate laboratory monitoring facilities. Warfarin remains the predominant anticoagulant, necessitating regular international normalized ratio (INR) testing to avoid under- or over-anticoagulation. However, INR monitoring is often sporadic or unavailable, increasing the risk of adverse outcomes. Furthermore, the cost and inconsistent supply of medications hinder long-term treatment adherence. Health system limitations and a shortage of trained healthcare personnel compound these difficulties, leading to suboptimal anticoagulation management.[53]

To address these barriers, innovative strategies such as task-shifting anticoagulation management to trained community health workers and integrating coagulopathy care into primary healthcare services have been proposed and piloted in some regions. Educational initiatives aimed at both healthcare providers and patients are essential to improve understanding of anticoagulation benefits and risks. International collaborations and support from global health organizations are increasingly facilitating access to essential medicines and point-of-care diagnostic tools, offering promise for improved care delivery in low-income settings.[54] Outcomes for geriatric coagulopathy patients vary significantly between high- and low-income contexts. In high-income countries, advances in diagnosis, monitoring, and therapy have contributed to reductions in thromboembolic events and bleeding-related mortality, although these complications remain significant concerns in elderly patients with complex health profiles. In low-income African settings, delayed diagnosis, inconsistent treatment, and comorbid infectious and nutritional disorders contribute to higher morbidity and mortality rates. Addressing these disparities requires targeted investment in healthcare infrastructure, workforce training, and public health initiatives to strengthen chronic disease management (Figure 1).[55]

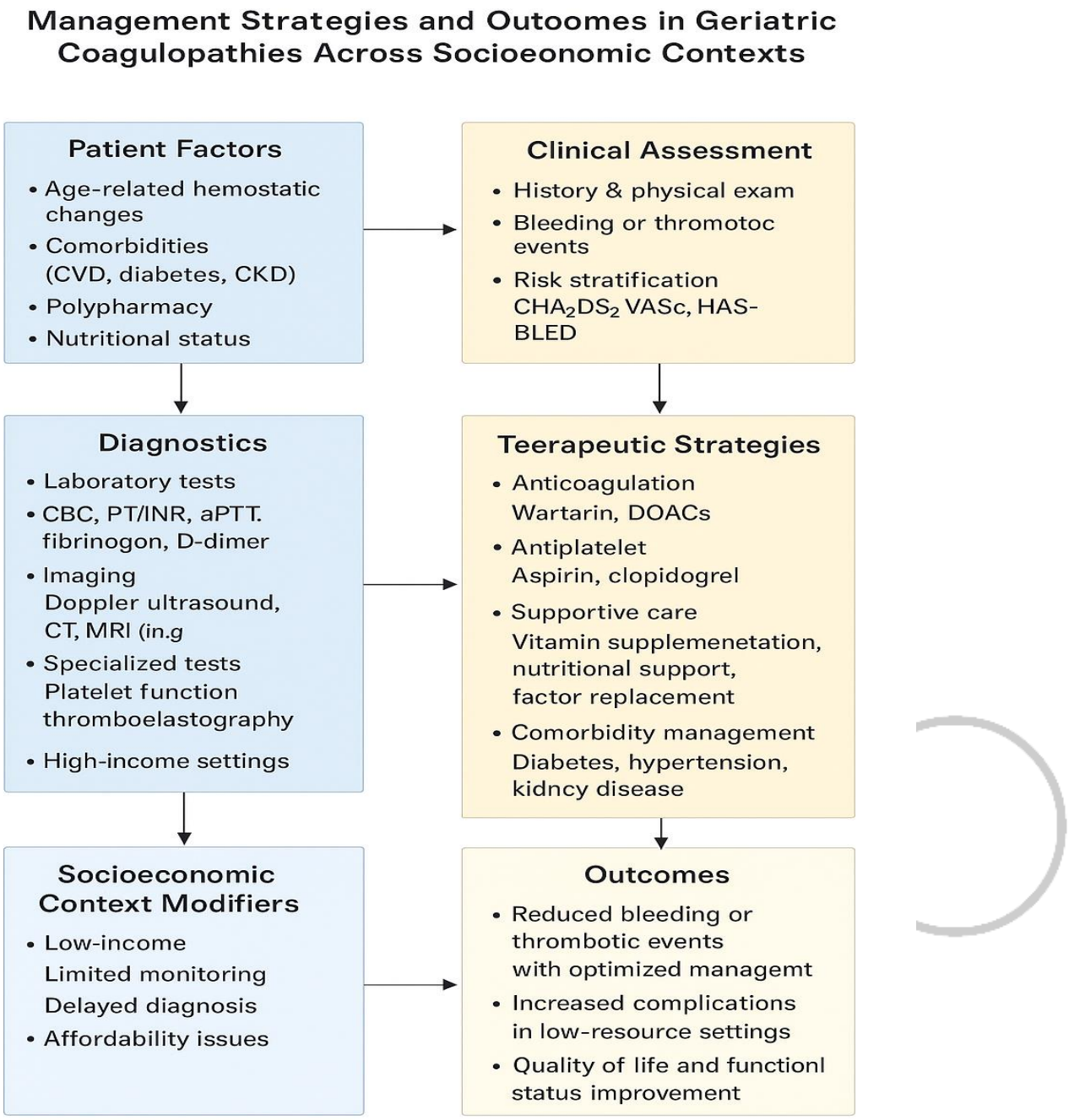

Figure 1: Management Strategies and Outcomes

Conclusion

Geriatric coagulopathies represent a complex and increasingly prevalent challenge worldwide, profoundly influenced by the interplay of aging physiology, comorbidities, and healthcare disparities. This review highlights significant contrasts between low-income African and high-income American settings in the epidemiology, pathophysiology, diagnosis, and management of coagulation disorders among elderly populations. While high-income countries benefit from advanced diagnostic tools, comprehensive risk assessment models, and a wider range of therapeutic options,

many African contexts continue to face substantial barriers including limited diagnostic capacity, restricted access to anticoagulant therapies, and competing infectious disease burdens. Addressing these disparities requires concerted efforts to strengthen healthcare infrastructure, expand diagnostic and treatment capabilities, and tailor management strategies to regional realities. Innovative approaches such as task-shifting, integration of coagulopathy care into primary healthcare, and enhanced patient education are critical to improving outcomes in resource-limited settings. Moreover, ongoing research and surveillance are essential to deepen understanding of geriatric coagulopathies' unique characteristics in diverse populations.

Conflicts of Interest

The author declares no conflict of interest

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List of Abbreviations

aPTT – Activated Partial Thromboplastin Time
CVD – Cardiovascular Disease
DIC – Disseminated Intravascular Coagulation
DVT – Deep Vein Thrombosis
HIC – High-Income Country
HIV – Human Immunodeficiency Virus
INR – International Normalized Ratio
LIC – Low-Income Country
NCD – Non-Communicable Disease
PT – Prothrombin Time
VKA – Vitamin K Antagonist
VTE – Venous Thromboembolism
WHO – World Health Organization

References

1. Smolkin MB, Shmookler AD. Molecular diagnostics for coagulopathies. InDiagnostic Molecular Pathology 2024: 241-253. Academic Press.
2. Miceli G, Ciaccio AM, Tuttolomondo A. From Circulating Biomarkers to Polymorphic Variants: A Narrative Review of Challenges in Thrombophilia Evaluation. Journal of Clinical Medicine. 2025;14(10):3448.
3. Kang Y, Yang Q, Ding H, Hu Y, Shen J, Ruan F, Chen B, Feng Y, Jin Y, Xu S, Jiang L. Analysis of risk factors for trauma-induced coagulopathy in elderly major trauma patients. World Journal of Emergency Medicine. 2024;15(6):475.
4. Michaelides C, Raio C, Bulba N, Shah R, Fasanya C, Petrou S, Klein L. The utility of coagulation factor testing in non-anticoagulated elderly patients presenting with low-risk mechanical falls in the emergency department. The American Journal of Emergency Medicine. 2025; 92:43-47.
5. Baghshomali S, Gomez FE, Tadevosyan A, Kumar MA. Neurological complications of platelet disorders and disorders of coagulation. Oxford Textbook of Neurohaematology. 2024:173.
6. Jiang S, Bera K, Ohs ZA, Ekpunobi IO, Azar NR, Tirumani SH, Ramaiya NH. Age is more than just a Number–Tailoring Radiologic Practice for the Geriatric Population. Current Problems in Diagnostic Radiology. 2025.

7. Vara-Luiz F, Mendes I, Palma C, Mascarenhas P, Simas D, Gomes P, Ruge Gonçalves A, Simão I, Teixeira M, Ramos Lopes S, Côrte-Real F. Upper gastrointestinal bleeding differences between older and younger adults: should bleeding in non-cirrhotic patients be considered a geriatric syndrome? Therapeutic Advances in Gastroenterology. 2025; 18:17562848251343416.
8. Goswami N. A dual burden dilemma: Navigating the global impact of communicable and non-communicable diseases and the way forward. International Journal of Medical Research. 2024;12(3):65-77.
9. Manoel PZ, Uwishema O, Manoel AZ, Dike IC, Yassin N, Mshaymesh S. Exploring the burden of non-communicable diseases on surgical services in Africa: a comprehensive literature review. Annals of Medicine and Surgery. 2025;87(5):2847-2854.
10. d'Angela D, Orso M, Migliore A, Polistena B, Spandonaro F, Bernardini S. HTA model for laboratory medicine technologies: overview of approaches adopted in some international agencies. Clinical Chemistry and Laboratory Medicine (CCLM). 2024.
11. Kaur G, Masket D, Reddy T, Revankar S, Satish P, Paquin A, Mulvagh S, O'Donoghue ML, Zieroth S, Farkouh M, Gulati M. Socioeconomic Disparities in Women's Cardiovascular Health in United States and Canada. Canadian Journal of Cardiology. 2024.
12. Obeagu EI, Obeagu GU. Preventive measures against HIV among Uganda's youth: Strategies, implementation, and effectiveness. Medicine (Baltimore). 2024;103(44): e40317.
13. Obeagu EI, Obeagu GU, Ukibe NR, Oyebadejo SA. Anemia, iron, and HIV: decoding the interconnected pathways: A review. Medicine (Baltimore). 2024;103(2): e36937.
14. Obeagu EI, Obeagu GU. Protecting maternal health: Strategies against HIV and malaria in pregnancy. Medicine (Baltimore). 2024;103(36): e39565.
15. Pikula A, Gulati M, Bonnet JP, Ibrahim S, Chamoun S, Freeman AM, Reddy K. Promise of lifestyle medicine for heart disease, diabetes mellitus, and cerebrovascular diseases. Mayo Clinic Proceedings: Innovations, Quality & Outcomes. 2024;8(2):151-165.
16. Rahelić V, Perković T, Romić L, Perković P, Klobučar S, Pavić E, Rahelić D. The Role of Behavioral Factors on Chronic Diseases—Practice and Knowledge Gaps. InHealthcare 2024; 12(24): 2520.
17. Al-Worafi YM. Thrombosis Management in Developing Countries. InHandbook of Medical and Health Sciences in Developing Countries: Education, Practice, and Research 2024:1-45. Cham: Springer International Publishing.
18. Hanna IA, Arribas AR, All-Atabakhsh A, Valenza JA. Pharmacologic Management of Patients with Drug-Related Coagulopathies. InContemporary Dental Pharmacology: Evidence-Based Considerations 2024: 53-77. Cham: Springer International Publishing.
19. Shah SJ, Fang MC, Jeon SY, Gregorich SE, Covinsky KE. Geriatric syndromes and atrial fibrillation: prevalence and association with anticoagulant use in a national cohort of older Americans. Journal of the

American Geriatrics Society. 2021;69(2):349-356.
20. Tschan SL, Bolliger D. Coagulation and aging: implications for the anesthesiologist. Current Anesthesiology Reports. 2021:1-9.
21. Busko AM, Solano JJ, Clayton LM, Hughes PG, Paley RJ, Shih RD, Alter SM, Busko A, Clayton L. The role of thromboelastography in identifying coagulopathy among geriatric traumatic brain injury patients. Cureus. 2022;14(12).
22. Marlowe N, Lam D, Krebs W, Lin W, Liangpunsakul S. Prevalence, co-morbidities, and in-hospital mortality of patients hospitalized with alcohol-associated hepatitis in the United States from 2015 to 2019. Alcoholism: Clinical and Experimental Research. 2022;46(8):1472-1481.
23. Aynalem M, Shiferaw E, Gelaw Y, Enawgaw B. Coagulopathy and its associated factors among patients with a bleeding diathesis at the University of Gondar Specialized Referral Hospital, Northwest Ethiopia. Thrombosis journal. 2021; 19:1-2.
24. Mujuni E, Wangoda R, Ongom P, Galukande M. Acute traumatic coagulopathy among major trauma patients in an urban tertiary hospital in sub Saharan Africa. BMC emergency medicine. 2012; 12:1-7.
25. Lippi G, Favaloro EJ, Franchini M. Coagulopathies and thrombosis: usual and unusual causes and associations, Part IV. In Seminars in thrombosis and hemostasis 2011; 37(03): 175-180.
26. Obeagu EI, Isiko I, Obeagu GU. Climate change and HIV prevention: Towards sustainable solutions - a narrative review. Medicine (Baltimore). 2025;104(16): e42198.
27. Obeagu EI. Influence of cytokines on the recovery trajectory of HIV patients on antiretroviral therapy: A review. Medicine (Baltimore). 2025;104(1): e41222.
28. Prabhakaran K, Gogna S, Lombardo G, Latifi R. Venous thromboembolism in geriatric trauma patients—risk factors and associated outcomes. Journal of Surgical Research. 2020; 254:327-333.
29. Fall AO, Proulle V, Sail A, Mbaye A, Ba PS, Diao M, Seck M, Gadji M, Gning SB, Diop S, Dièye TN. Risk factors for thrombosis in an African population. Clinical Medicine Insights: Blood Disorders. 2014;7: CMBD-S13401.
30. Frydman GH, Boyer EW, Nazarian RM, Van Cott EM, Piazza G. Coagulation status and venous thromboembolism risk in African Americans: a potential risk factor in COVID-19. Clinical and Applied Thrombosis/Hemostasis. 2020; 26:1076029620943671.
31. Okello CD, Niyonzima N, Ferraresso M, Kadhumbula S, Ddungu H, Tarlock K, Balagadde-Kambugu J, Omoding A, Ngendahayo L, Karagu A, Mwaiselage J. Haematological malignancies in sub-Saharan Africa: east Africa as an example for improving care. The Lancet Haematology. 2021;8(10): e756-769.
32. Winer LK, Salyer C, Beckmann N, Caldwell CC, Nomellini V. Enigmatic role of coagulopathy among sepsis survivors: a review of coagulation abnormalities and their possible link to chronic critical illness. Trauma Surgery & Acute Care Open. 2020;5(1).
33. Tieu BH, Holcomb JB, Schreiber MA. Coagulopathy: its pathophysiology and treatment in the injured patient. World journal of surgery. 2007;31(5):1055-1064.

34. Giustozzi M, Ehrlinder H, Bongiovanni D, Borovac JA, Guerreiro RA, Gąsecka A, Papakonstantinou PE, Parker WA. Coagulopathy and sepsis: pathophysiology, clinical manifestations and treatment. Blood reviews. 2021; 50:100864.
35. Mador B, Nascimento B, Hollands S, Rizoli S. Blood transfusion and coagulopathy in geriatric trauma patients. Scandinavian journal of trauma, resuscitation and emergency medicine. 2017; 25:1-8.
36. Duque P, Calvo A, Lockie C, Schöchl H. Pathophysiology of trauma-induced coagulopathy. Transfusion medicine reviews. 2021;35(4):80-86.
37. Kang Y, Yang Q, Ding H, Hu Y, Shen J, Ruan F, Chen B, Feng Y, Jin Y, Xu S, Jiang L. Analysis of risk factors for trauma-induced coagulopathy in elderly major trauma patients. World Journal of Emergency Medicine. 2024;15(6):475.
38. Mujuni E, Wangoda R, Ongom P, Galukande M. Acute traumatic coagulopathy among major trauma patients in an urban tertiary hospital in sub Saharan Africa. BMC emergency medicine. 2012; 12:1-7.
39. Obeagu EI, Obeagu GU. Building a Healthier Future: A Narrative Review on Early Infant Diagnosis's Role in HIV Prevention. Health Sci Rep. 2025;8(3): e70591.
40. Obeagu EI, Obeagu GU. Utilization of immunological ratios in HIV: Implications for monitoring and therapeutic strategies. Medicine (Baltimore). 2024;103(9): e37354.
41. Esper SA, Subramaniam K, Tanaka KA. Pathophysiology of cardiopulmonary bypass: current strategies for the prevention and treatment of anemia, coagulopathy, and organ dysfunction. InSeminars in cardiothoracic and vascular anesthesia 2014; 18(2): 161-176
42. Wagenlehner FM, Pilatz A, Weidner W, Naber KG. Urosepsis: overview of the diagnostic and treatment challenges. Urinary Tract Infections: Molecular Pathogenesis and Clinical Management. 2017:135-157.
43. Maegele M. The diagnosis and treatment of acute traumatic bleeding and coagulopathy. Deutsches Ärzteblatt International. 2019;116(47):799.
44. Katz SE, Williams DJ. Pediatric community-acquired pneumonia in the United States: changing epidemiology, diagnostic and therapeutic challenges, and areas for future research. Infectious disease clinics of North America. 2017;32(1):47.
45. Viehweg TL, Roberson JB, Hudson JW. Epistaxis: diagnosis and treatment. Journal of oral and maxillofacial surgery. 2006;64(3):511-518.
46. Karumai T, Kotani Y, Yamamoto R, Tonai M, Hayashi Y. Septic coagulopathy: pathophysiology, diagnosis, and therapeutic strategies. Current Infectious Disease Reports. 2024;26(3):91-106.
47. Okoye HC, Nwagha TU, Ugwu AO, Menuba IE, Duru AN, Ugwu EO, Ezebialu FU, Eze SC, Ugwu AO. Diagnosis and treatment of obstetrics disseminated intravascular coagulation in resource limited settings. African health sciences. 2022;22(1):183-190.
48. Neuenfeldt FS, Weigand MA, Fischer D. Coagulopathies in intensive care medicine: balancing act between thrombosis and bleeding. Journal of clinical medicine. 2021;10(22):5369.
49. Arahata M, Asakura H. Antithrombotic therapies for elderly patients: handling

problems originating from their comorbidities. Clinical Interventions in Aging. 2018:1675-1690.
50. Czempik PF, Wiórek A. Management strategies in septic coagulopathy: a review of the current literature. In Healthcare 2023; 11(2): 227.
51. Wong H, Lovett N, Curry N, Shah K, Stanworth SJ. Antithrombotics in trauma: management strategies in the older patients. Journal of blood medicine. 2017:165-174.
52. Lange NW, Salerno DM, Berger K, Cushing MM, Brown Jr RS. Management of hepatic coagulopathy in bleeding and nonbleeding patients: an evidence-based review. Journal of Intensive Care Medicine. 2021;36(5):524-541.
53. Giustozzi M, Castellucci LA, Barnes GD. Management of anticoagulant treatment and anticoagulation-related complications in nonagenarians. Hämostaseologie. 2020;40(03):292-300.
54. Vitale MA, VanBeek C, Spivack JH, Cheng B, Geller JA. Pharmacologic reversal of warfarin-associated coagulopathy in geriatric patients with hip fractures: a retrospective study of thromboembolic events, postoperative complications, and time to surgery. Geriatric orthopaedic surgery & rehabilitation. 2011;2(4):128-134.
55. Maegele M, Schöchl H, Menovsky T, Maréchal H, Marklund N, Buki A, Stanworth S. Coagulopathy and haemorrhagic progression in traumatic brain injury: advances in mechanisms, diagnosis, and management. The Lancet Neurology. 2017;16(8):630-647.