

## Lipemic Blood in Sudanese Transfusion Practice: A Policy Gap in Transfusion Safety

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### ABSTRACT

*In Sudan's challenged healthcare system, blood transfusions are essential for both emergency and chronic care. However, lipemic blood, marked by elevated plasma lipids, presents underappreciated hazards that could jeopardize transfusion safety and effectiveness. This policy perspective examines the clinical, laboratory, and ethical implications of lipemic blood donations in Sudanese contexts, characterized by inadequate diagnostic infrastructure and a gap in current transfusion safety guidance. We emphasize that lipemia may interfere with certain laboratory assays and potentially affect transfusion processing, while the clinical implications remain incompletely defined. This article advocates for context-specific guidelines, pilot studies, and practical mitigation strategies to address this overlooked issue. Strengthening policy guidance on the management of lipemic donations could improve transfusion safety in healthcare facilities with limited resources.*

### Keywords

Lipemia, Plasma turbidity, Blood transfusion safety, Transfusion risk management, Sudan healthcare system.

### Introduction

Blood transfusion, a crucial element of emergency and chronic treatment in Sudan, is vital for trauma management, postpartum hemorrhage, severe anemia, and infectious diseases like malaria and dengue. In resource-constrained environments such as Port Sudan and Khartoum, the impact of inadequate laboratory facilities is significant, often leading to transfusion decisions under duress and with limited capacity for comprehensive donor screening or post-collection quality assurance [1,2]. While formal prevalence data are lacking, operational observations from blood transfusion services in Khartoum suggest that lipemic plasma is encountered periodically among donors, particularly those with metabolic risk factors [2].

Despite the expansion of transfusion safety protocols to include infectious disease screening and ABO compatibility assessments,

one overlooked risk remains: lipemia, characterized by unusually elevated lipid levels in donor blood. Lipemic plasma, frequently manifesting as turbid or milky, is generally linked to metabolic diseases such as uncontrolled diabetes mellitus, familial hyperlipidemia, or acute pancreatitis [3]. In affluent nations, lipemic donations are frequently identified and deferred due to concerns about diagnostic interference and transfusion safety. However, in regions with blood shortages and inadequate donor screening, such as Sudan, lipemic blood may inadvertently reach the transfusion pool [4]. Without clear national guidance on lipemic blood donations, transfusion services in Sudan lack standardized procedures for identifying and managing these units, revealing a critical policy gap.

### The Hidden Hazards of Lipemic Blood

This presents multiple dangers. Lipemia may disrupt serological testing, crossmatching, and certain pathogen-screening, particularly in laboratories that rely on visual inspection or spectrophotometric assays [5]. "Secondly, markedly elevated lipid concentrations in donor plasma may potentially influence red blood cell membrane

properties and microvascular flow, raising a theoretical concern that microcirculatory perfusion could be affected in critically ill recipients such as those with sepsis, sickle cell disease, or dengue-related coagulopathy [6]. Third, while rare, the occurrence of excessive lipid particles in transfused plasma have been posited as a theoretical contributor to microvascular blockage or fat embolism-like phenomena, especially in susceptible recipients or after extensive transfusion. Although direct causal evidence is limited, observations from related clinical contexts suggest this possibility warrants further examination [5,7].

### Laboratory Challenges in Low-Resource Settings

Laboratories in Sudan, particularly those in Port Sudan, often rely on manual techniques and visual assessment. The prevalence of lipemic samples in these settings presents unique diagnostic challenges:

The interference caused by lipemic samples in serological testing is significant. Research indicates that lipemia can interfere with biochemical, serological, and immunoassay-based diagnostic techniques. In laboratories using manual interpretation or spectrophotometric methods, such interference may reduce analytical accuracy and potentially affect infectious disease screening outcomes; the extent of this impact varies depending on the assay platform used [8]. Turbid plasma may mask agglutination reactions, complicating crossmatching and pathogen screening. Spectrophotometric Distortion: Lipids deflect light, leading to erroneous measurements of hemoglobin, bilirubin, and coagulation assays. Reticulocyte and Morphological Confusion: Lipemia may obscure supravital stains and alter cell morphology, impacting hematologic assessment [3]. These concerns not only jeopardize transfusion safety but also impede timely diagnosis and treatment in urgent instances.

### Ethical and Operational Dilemmas

Neonates, pregnant women, ICU patients, and individuals with chronic conditions are disproportionately impacted by problems associated with transfusions. In Sudan, where blood shortages are prevalent and donor screening is inadequate, the ethical quandary of utilizing lipemic blood becomes evident. Deferring lipemic donors may mitigate danger, but simultaneously intensifies supply limitations. A risk-stratified approach that emphasizes lipid screening for high-risk individuals may provide a practical solution [5,7]. Successful execution demands synchronized collaboration among clinicians, laboratory specialists, and national transfusion regulators.

### Policy and Research Priorities for Sudan's Transfusion System

Lipemia, despite its potential implications, is inadequately studied within Sudanese transfusion medicine. Essential guidelines comprise:

#### 1. Clinical Research Priorities

It is of utmost importance that Sudanese research is conducted to evaluate the prevalence of lipemia among blood donors and its clinical implications for transfusion recipients. These studies should categorize risk by recipient type (e.g., ICU patients,

pediatric cases) and evaluate associations with transfusion-related consequences, including delayed recovery, inflammatory responses, or diagnostic interference. Although direct outcome data for Sudanese patients are lacking, international case studies indicate diminished efficacy of transfused lipemic plasma and an elevated risk of febrile responses [9]. These results highlight the need for prudent application and further investigation.

#### 2. Policy and Guideline Development

The criteria of Sudan's National Blood Transfusion Service do not yet account for lipemia, despite recommendations from the WHO and the EU to reject altered plasma; this policy deficiency leaves frontline personnel without explicit protocols. This may entail setting triglyceride levels for plasma clarity, establishing visual inspection protocols for milky plasma, and establishing deferral or filtration protocols for lipemic units. Such methods must strike a balance between safety and supply limitations, particularly in areas experiencing persistent blood shortages.

#### 3. Technological and Operational Advancement

Inexpensive filtering or clarification technologies, such as lipid adsorption filters or centrifugation-based plasma separation, could provide viable alternatives for hospitals in Sudan. Pilot studies could evaluate the cost-effectiveness and clinical efficacy of these therapies, especially at tertiary institutions such as Port Sudan Teaching Hospital or the Blood Transfusion Center in Red Sea State.

A cost-benefit analysis suggests that implementing lipid filtration or donor deferral based on visual examination may be viable in high-volume clinics. Decreased waste rates and enhanced transfusion safety mitigate filtration expenses (Table 1).

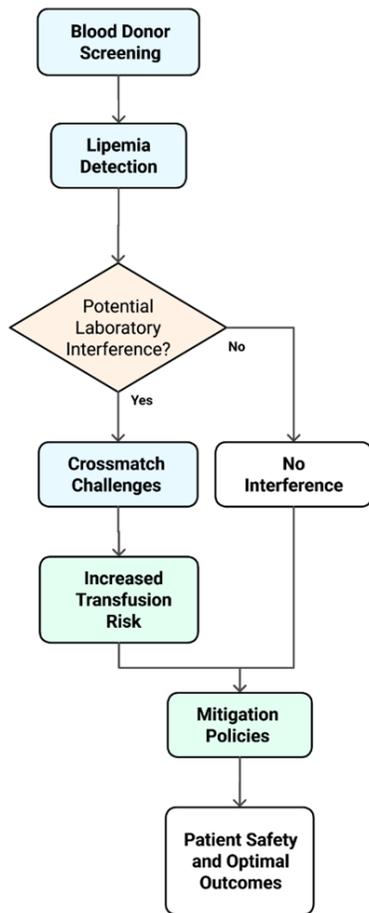
**Table 1:** Comparative Evaluation of Proposed Solutions for Lipemic Blood in Sudan.

Intervention	Estimated Cost	Potential Benefit	Feasibility in Sudan
Visual Inspection of Plasma	Minimal	Quick identification; no equipment needed	Highly feasible; already practiced
Donor Deferral Based on Lipemia	Low	Avoids problematic units	Feasible in urban centers
Lipid Filtration (Post-collection)	Moderate	Clarifies plasma; preserves usable units	Feasible in tertiary hospitals
Biochemical Lipid Screening	Moderate–High	Accurate detection of triglyceride levels supports data collection	Limited feasibility
Donor Education on Fasting	Minimal	Reduces transient lipemia; improves donor quality	Highly feasible
Policy Integration & SOP Updates	Low	Standardizes practice; empowers lab staff	Feasible with NBTS support

#### Proposed Operational Workflow

The operational pathway illustrating how lipemic blood may

influence different stages of the transfusion process—from donor presentation to mitigation policies—is summarized in Figure 1.



**Figure 1:** Operational pathway illustrating the impact of lipemic blood on the transfusion process in resource-limited settings.

### Integration with Public Health Strategy

Addressing lipemia in transfusion medicine should be assessed in relation to overall metabolic health measures. Public awareness initiatives, donor education, and the incorporation of non-communicable disease screening programs may diminish the incidence of lipemic donations over time. Integrating physicians, laboratory technicians, and NBTS officials through seminars or surveys could help tailor interventions to local circumstances. Initial input from Port Sudan personnel suggests robust endorsement for more explicit lipemia guidelines.

### Stakeholder Mapping and Implementation Roles

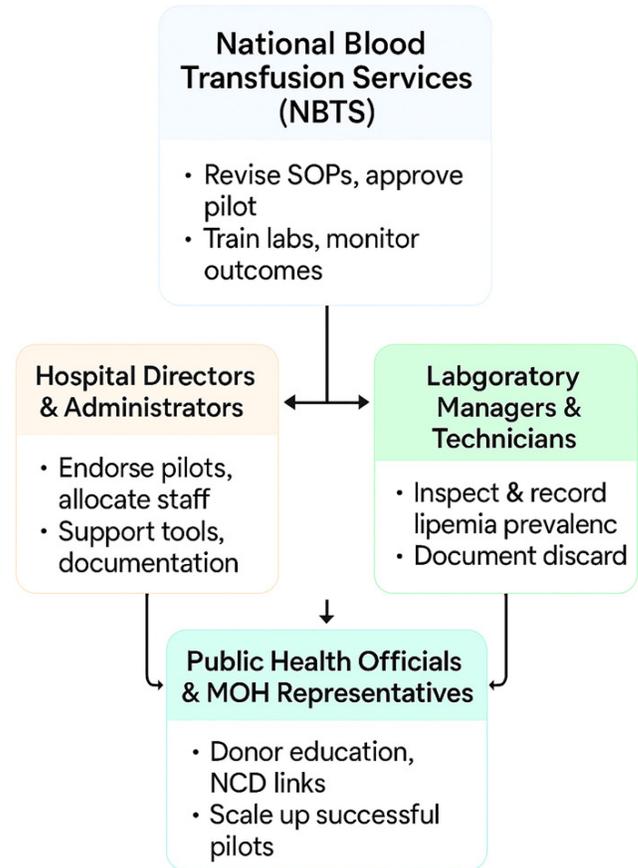
Addressing lipemic donations requires coordinated policy implementation across the transfusion system. Mitigating lipemia within Sudan's transfusion system requires coordinated efforts across multiple tiers. The stakeholders include (Figure 2):

**National Blood Transfusion Service (NBTS):** Revision of Standard Operating Procedures, development of training modules, and management of pilot programs.

**Hospital Directors and Laboratory Managers:** Execution of filtration protocols and donor education initiatives.

**Clinicians and Ward Personnel:** Identification of high-risk recipients and evaluation of transfusion outcomes

**Public Health Officials:** Incorporation of NCD screening and donor engagement. Defining roles can facilitate policy implementation and guarantee accountability throughout the system.



**Figure 2:** Operational Framework for Lipemic Blood Screening and Stakeholder Coordination.

### Limitations and Call to Action

From a policy perspective, this article draws on the available literature and contextual observations rather than on primary outcome data from Sudan. Limitations include the scarcity of extensive Sudanese data and the transient nature of postprandial lipemia. Nonetheless, even anecdotal evidence underscores the necessity for pilot studies and donor education on fasting before donation.

Introducing lipemia awareness into Sudan's transfusion policy through SOP revisions, personnel training, and pilot audits is a cost-effective, high-impact strategy to improve blood safety. It is particularly crucial in resource-constrained environments where each unit is significant.

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### Final Thoughts: Vigilance Over Alarmism

Lipemia may not represent the pressing challenge in Sudan's transfusion system; yet, its overlooked risks demand careful attention. In a system already encumbered by infectious diseases, trauma, and constrained resources, every drop of blood must be maximized. Integrating lipemia insight into transfusion policy via simple measures—such as standardized visual screening, donor education on fasting, and pilot filtration initiatives—could represent a pragmatic advancement in enhancing blood safety in Sudan. In resource-limited healthcare systems, where each unit of blood is precious, even minor policy enhancements can provide significant therapeutic benefits.

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