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# The Hematological Crisis Continuum: An Integrative Review of Multidisciplinary Management for Acute Hemolytic and Thrombotic Emergencies

**Fayez Saleem Aldhaferi [(1)] , Wejdan Ali Alwan Fadhel [(2)] , Anwar Ali Mohammed Sharawi [(3)] , Fahd Omar Amer Alsahafi [(4)] , Mohammed Ali Mohammed Al-Asmari [(5)] , Salamah Sarih Salamah Alsharari [(6)] , Trkei Dhifallah Dahiman Alshrari [(7)] , Abdallah Ayed H Alshrari [(8)] , Ahmed Aqla Kh Alsharari [(9)] , Adel Aqla Khalaf Alsharari [(10)] , Shouq Addad Mufathi Alenzi [(11)] , Eman Abdullah Alawaji [(12)] , Saeeda Hanen Sofyani [(13)] , Salha Saeed Alahmari [(14)]**

*(1) Hafr Al Batin Regional Laboratory,Ministry of Health, Saudi Arabia,*
*(2) General Hospital Abuarish,Ministry of Health, Saudi Arabia,*
*(3) General Jizan Hospital,Ministry of Health, Saudi Arabia,*
*(4) King Abdulaziz Hospital, Jeddah, Ministry of Health, Saudi Arabia,*
*(5) King Fahd General Hospital, Jeddah,Ministry of Health, Saudi Arabia,*
*(6) Issawiya General Hospital,Ministry of Health, Saudi Arabia,*
*(7) Tabarjal General Hospital,Ministry of Health, Saudi Arabia,*
*(8) Qurayyat Dental Center,Ministry of Health, Saudi Arabia,*
*(9) Disaster And Crisis Management Qurayyat,Ministry of Health, Saudi Arabia,*
*(10) Disaster And Crisis Management in Qurayyat,Ministry of Health, Saudi Arabia,*
*(11) Qurayyat Mental Health Hospital,Ministry of Health, Saudi Arabia,*
*(12) Al Khazan Health Center in Riyadh,Ministry of Health, Saudi Arabia,*
*(13) King Khaled Hospital,Ministry of Health, Saudi Arabia,*
*(14) Aseer Central Hospital, Abha,Ministry of Health, Saudi Arabia*

## Abstract

**Background:** Acute hematological crises, encompassing conditions like sickle cell vaso-occlusive crises (VOCs), thrombotic thrombocytopenic purpura (TTP), and catastrophic antiphospholipid syndrome (CAPS), represent high-stakes emergencies requiring rapid, precise intervention. Traditional siloed care models often fail to address the multifaceted needs of these patients, leading to delays in diagnosis, suboptimal management, and poor outcomes.

**Aim:** This integrative narrative review aims to examine the coordinated continuum of care from emergency recognition through definitive treatment, analyzing the specific, interdependent roles of emergency medicine, laboratory science, pharmacy, nursing, physical therapy, psychology, health assistants, health management, and health security.

**Methods:** A comprehensive literature search of PubMed, CINAHL, Web of Science, and PsycINFO databases (2010-2024) was conducted.

**Results:** Effective management is predicated on a seamless, protocol-driven continuum. Key findings highlight: emergency medicine's role in rapid triage and initial stabilization; the laboratory's critical function in providing timely, accurate diagnostics (e.g., ADAMTS13 activity, peripheral smear); pharmacy's stewardship of high-risk therapies (thrombolytics, anticoagulants, C5 inhibitors); nursing's holistic monitoring and pain management; and the supportive roles of physical therapy, psychology, and health assistants. Health management ensures resource availability, while health security safeguards the blood product chain.

**Conclusion:** Optimizing outcomes for hematological crises demands a paradigm shift from episodic, specialist-centric care to an integrated, system-wide continuum. Institutional investment in structured multidisciplinary frameworks, interoperable technology, and cross-specialty education is essential to standardize care, reduce morbidity and mortality, and improve the patient experience during these acute events.

**Keywords:** Hematologic Emergency, Interdisciplinary Teams, Thrombotic Microangiopathy, Sickle Cell Disease, Care Continuum.

## Introduction

Acute hematological crises represent a distinct class of medical emergencies where time to diagnosis and intervention is inextricably linked to morbidity and mortality (Joseph et al., 2023). Conditions such as sickle cell vaso-occlusive crisis (VOC), thrombotic thrombocytopenic purpura (TTP), hemolytic uremic syndrome (HUS), and catastrophic antiphospholipid syndrome (CAPS) are characterized by rapid onset, multisystem involvement, and the


*Corresponding author e-mail: Aldhaferif@Hotmail.Com (Fayez Saleem Aldhaferi).
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need for highly specialized, often resource-intensive therapies (Joly et al., 2022). Unlike many emergencies where a single definitive procedure or medication can be life-saving, the management of these crises is a complex orchestration of diagnostic precision, pharmacological nuance, supportive care, and psychological support, unfolding over hours to days. The stakes are further heightened by the potential for iatrogenic harm; for instance, inappropriate platelet transfusion in TTP can exacerbate thrombosis, and inadequate analgesia in sickle cell crisis can lead to a cycle of suffering and mistrust (Scully et al., 2012).

Historically, the management of these patients has been fragmented, often reliant on the heroic efforts of a single specialist—typically a hematologist or emergency physician—navigating disparate hospital systems for diagnostics, pharmacy approvals, and bed placement. This siloed approach is fundamentally inadequate (Boghossian et al., 2023). It introduces dangerous delays, fosters communication gaps, and fails to address the holistic needs of patients who are frequently marginalized by chronic, debilitating illness (Phillips et al., 2022). The journey from an emergency department (ED) presentation to stabilization is a continuum that touches nearly every facet of hospital operations (Pokhrel et al., 2023).

This integrative narrative review posits that optimal outcomes for acute hemolytic and thrombotic emergencies are achievable only through a deliberate, multidisciplinary continuum of care. This "crisis continuum" model views the patient's trajectory not as a series of discrete handoffs but as a unified pathway, actively coordinated and populated by professionals whose expertise is interwoven. By mapping this continuum, we argue for the systematic implementation of integrated crisis protocols as a standard of care, transforming chaotic emergencies into managed clinical pathways.

**Recognition and Initial Stabilization**

The continuum begins at the moment of healthcare entry, most commonly the ED. Here, the emergency physician's role is that of a rapid diagnostician and resuscitator, but with a critical nuance: they must recognize patterns suggestive of a hematological crisis amidst a wide differential (Welch-Coltrane et al., 2021). For sickle cell VOC, this involves eliciting a characteristic pain history and identifying triggers like infection or dehydration, while simultaneously ruling out life-threatening mimics such as acute chest syndrome or septicemia (Puri et al., 2018). For thrombotic microangiopathies (TMAs) like TTP, the classic pentad (thrombocytopenia, microangiopathic hemolytic anemia, neurological symptoms, renal dysfunction, fever) is often incomplete at presentation, requiring a high index of suspicion based on isolated lab abnormalities (thrombocytopenia and schistocytes) (Scully et al., 2023; Bull et al., 2022).

The emergency team's initial actions set the trajectory for the entire continuum. Key responsibilities include rapid triage and activation: implementing specific "Code TTP" or "Sickle Cell Crisis" alerts that notify the multidisciplinary team (hematology, apheresis, pharmacy) simultaneously, bypassing sequential consults (Xie et al., 2023). Initial stabilization: managing airway, breathing, and circulation, with careful attention to fluid resuscitation—aggressive hydration is the cornerstone in VOC but may be contraindicated in renal-limited HUS or CAPS with cardiac involvement. Diagnostic catalyst: ordering the critical first-tier tests: a complete blood count (CBC) with manual differential/review for schistocytes, lactate dehydrogenase (LDH), haptoglobin, creatinine, and a type and screen (Elverdi et al., 2021). Perhaps most importantly, the emergency physician must ensure the proper collection and expedited delivery of the peripheral blood smear and citrated blue-top tube for ADAMTS13 testing, as these are time-sensitive and pre-analytically sensitive (Peyvandi et al., 2017). Empirical therapy initiation: in high-suspicion cases, beginning first-dose therapy per protocol (e.g., high-dose steroids for suspected TTP, first-dose opioid for VOC) while awaiting definitive results, in close collaboration with pharmacy.

**The Diagnostic Crucible**

While the ED initiates the pathway, the clinical laboratory provides the definitive data that confirms the diagnosis and guides targeted therapy. Its role is active, not passive. In TTP, the peripheral blood smear review by a trained medical laboratory scientist or pathologist for schistocytes (>1% is suggestive) is a rapid, low-cost, but highly operator-dependent test that can prompt urgent therapy (George, 2010). The send-out test for ADAMTS13 activity (<10% is diagnostic for immune-mediated TTP) is the gold standard, but often has a turnaround time of hours to days. Thus, laboratories must have clear protocols for prioritizing these samples and communicating critical values immediately to the clinical team (Balasubramaniyam et al., 2023).

For sickle cell crises, while the diagnosis is clinical, the laboratory monitors for complications. Rising white count may indicate infection; dropping hemoglobin may signal splenic sequestration or hyperhemolysis; and increasing creatinine signals renal injury. The lab also supports exchange transfusion therapy by providing phenotype-matched blood and monitoring post-exchange hematocrits (Yerigeri et al., 2023). In complex cases like atypical HUS (aHUS), specialized testing for complement factor mutations and autoantibodies (e.g., CFH, CFI, CFB genes, anti-CFH antibodies) is guided by the

laboratory's expertise, often in consultation with a molecular pathologist (Noris et al., 2021).

The laboratory's function within the continuum is therefore threefold: to provide rapid, accurate initial data to support the working diagnosis; to perform definitive diagnostic testing with minimal delay; and to offer interpretive consultation to clinicians, helping them navigate complex results like inhibitor titers in CAPS or subtle smear findings in microangiopathy.

**Pharmacological Stewardship**

Once a diagnosis is confirmed or strongly suspected, the pharmacy assumes a central role in the safe, effective, and timely administration of high-stakes, often high-cost therapies. This involves several critical domains of stewardship:

**TTP/aHUS/CAPS Biologics and Immunomodulation**

For TTP, the immediate initiation of caplacizumab (an anti-von Willebrand factor nanobody) alongside plasma exchange (PEX) and immunosuppression has become standard, dramatically reducing time to platelet count recovery and exacerbations (Peyvandi et al., 2021; Djulbegovic et al., 2023). The pharmacy must ensure rapid access to this costly agent, manage its subcutaneous administration logistics, and monitor for bleeding risks. For aHUS, eculizumab or ravulizumab (C5 inhibitors) require intricate dosing, meningitis prophylaxis, and coordination with payers. Pharmacy-led protocols for these agents are essential (Scully et al., 2019).

**Anticoagulation and Thrombolytics in Thrombotic Crises**

In CAPS or heparin-induced thrombocytopenia (HIT), the pharmacy manages the transition from heparin to direct thrombin inhibitors (argatroban, bivalirudin) or factor Xa inhibitors, requiring careful dose titration in organ failure. They also oversee protocols for thrombolysis in massive pulmonary embolism complicating these disorders.

**Analgesia Stewardship in Sickle Cell VOC**

This is a paradigmatic example of multidisciplinary pharmacy. Working alongside nursing and pain management teams, clinical pharmacists develop and implement patient-specific pain plans for individuals with frequent admissions, helping to balance adequate opioid analgesia against risks of tolerance, opioid-induced hyperalgesia, and addiction stigma (Ciriello et al., 2021). They advocate for multimodal analgesia (e.g., adding NSAIDs, ketamine, or gabapentinoids) and manage patient-controlled analgesia (PCA) pumps, ensuring both safety and efficacy (Knisely et al., 2021).

**Supportive Therapy Management**

Pharmacy oversees the complex electrolyte replacement needed during massive PEX, manages antibiotic prophylaxis in immunosuppressed patients, and ensures the safe use of corticosteroids and rituximab in immune-mediated conditions.

**Holistic Monitoring and Support**

The pharmacological and procedural interventions occur within a context of continuous human support and monitoring, primarily led by nursing but extending to allied health.

Nursing is the constant in the continuum, responsible for: monitoring for clinical deterioration, recognizing signs of neurological change in TTP, respiratory compromise in acute chest syndrome, or bleeding complications on anticoagulation (Clayton-Jones et al., 2019). Pain assessment and management: executing the analgesia plan, utilizing validated pain scales, and providing non-pharmacological comfort. Procedure support: assisting with and monitoring patients during PEX, blood transfusions, and complex infusions. Patient and family education: explaining complex diseases and treatments, a role that builds trust and improves adherence (Jenerette et al., 2023).

Physical Therapy (PT) addresses the functional consequences of crisis. In prolonged VOC, PT interventions focus on pain-modulating modalities (e.g., transcutaneous electrical nerve stimulation), gentle mobility strategies to prevent deconditioning without exacerbating pain, and education on energy conservation (Almeida et al., 2021). For patients recovering from thrombotic events (e.g., stroke in CAPS, renal impairment), early PT is crucial for rehabilitation and preventing long-term disability (Boma et al., 2023).

Psychology addresses the profound mental health burden. Hematological crises are traumatic events, often recurring in the context of chronic illness (Markozannes et al., 2017). Psychologists provide acute crisis intervention: managing anxiety, panic, and distress during the emergency. Chronic pain management: utilizing cognitive-behavioral therapy (CBT), acceptance and commitment therapy (ACT), and biofeedback to help patients cope with chronic pain, reducing the emotional component of suffering and potentially decreasing opioid reliance (Bernardy et al., 2019). Adjustment support: helping patients and families cope with the life-altering diagnosis of a chronic, unpredictable condition (Vergeld et al., 2021).

Health assistants/nursing assistants provide essential foundational support: performing frequent vital signs, assisting with activities of daily living for immobile patients, and offering consistent human presence and reassurance. They are often the first to notice subtle changes in a patient's condition (Table 1). Figure 1 illustrates the multidisciplinary continuum of care for acute hematological emergencies.

**Table 1: The Multidisciplinary Crisis Continuum**

| Phase & Lead Domain | Key Actions & Decisions | Critical Interdisciplinary Handoffs & Collaboration |
|---|---|---|
| **Phase 1: Recognition (ED)** | - Suspect diagnosis based on history/exam.<br>- Activate "Code" protocol (e.g., Code TTP).<br>- Draw critical labs (CBC, smear, LDH, citrate tube).<br>- Initiate empiric therapy (steroids, analgesia, fluids). | **To Lab:** Prioritize smear & ADAMTS13 sample.<br>**To Pharmacy:** Alert for caplacizumab/eculizumab.<br>**To Hematology/Apheresis:** Immediate consult. |
| **Phase 2: Diagnosis (Lab)** | - Perform stat peripheral smear review.<br>- Expedite ADAMTS13, complement testing.<br>- Communicate critical results (e.g., schistocytes, <10% activity).<br>- Provide phenotype-matched blood for exchange. | **To ED/Clinical Team:** Phone call for critical values.<br>**To Pharmacy:** Confirm diagnosis for targeted drug release.<br>**To Apheresis:** Confirm need for PEX. |
| **Phase 3: Therapy (Pharmacy)** | - Release & dose protocol-driven biologics (caplacizumab, eculizumab).<br>- Manage complex anticoagulation (argatroban in HIT/CAPS).<br>- Steward opioid/ multimodal pain regimen in VOC.<br>- Overside PEX/transfusion adjunct medications. | **To Nursing:** Provide dosing/admin instructions.<br>**To Clinical Team:** Recommend therapy adjustments.<br>**To Health Management:** Address drug access/coverage. |
| **Phase 4: Support (Nursing/Allied Health)** | - **Nursing:** Continuous monitoring, pain admin, patient education, procedure support.<br>- **PT:** Early mobility, pain modulation, functional assessment.<br>- **Psychology:** Crisis intervention, chronic pain CBT, distress screening.<br>- **Health Asst.:** ADL support, vigilant vital sign monitoring. | **To All:** Document & communicate patient responses in EHR.<br>**Nursing to Team:** Report clinical changes.<br>**Psychology to Team:** Input on pain-coping & mental status. |

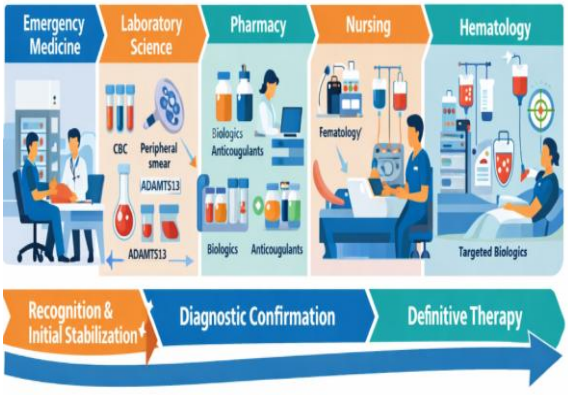


**Figure 1. The Hematological Crisis Continuum From Recognition to Definitive Therapy**

**Management and Security**

The clinical continuum operates within a system managed by health administrators and protected by health security protocols.

Health management is responsible for the operational infrastructure that makes the continuum possible. This includes developing and maintaining clinical pathways: creating standardized order sets for TTP, VOC, etc., that embed laboratory, pharmacy, and nursing protocols into the EHR. Resource allocation: ensuring 24/7 availability of apheresis services, specialized blood products, and critical medications. Performance measurement: tracking metrics like door-to-PEX time for TTP, door-to-analgesia time for VOC, and readmission rates, using data to drive pathway improvements (Zheng, 2021). Financial navigation: working with social work and pharmacy to secure coverage for expensive therapies, removing a major barrier to care.

Health security plays a vital, often overlooked role in safeguarding the integrity of the treatment chain, particularly for blood and plasma products. Responsibilities include chain of custody: ensuring secure tracking of blood products from donation to transfusion, preventing errors, and

diversion. Biologic drug security: safeguarding high-cost, temperature-sensitive medications like eculizumab. Information security: protecting sensitive patient genetic data (e.g., from complement gene testing) and treatment histories. Supply chain integrity: mitigating risks of shortages or contamination in critical supplies like plasma for exchange.

**Operationalizing the Continuum through Protocols and Technology**

The described multidisciplinary model is theoretical without concrete implementation structures. Two proven tools are essential:

**Multidisciplinary Hematology Crisis Teams (MHCTs)**

These are formalized, regularly meeting groups comprising hematology, emergency medicine, laboratory medicine, transfusion medicine, pharmacy, nursing leadership, and social work. For complex cases, they convene ad hoc (Mauger et al., 2020). The MHCT develops the pathways, reviews adverse events, and provides real-time consultation for difficult cases, ensuring consistency and expertise (Hamroun et al., 2023).

**Integrated Health IT and EHR Protocols**

The electronic health record must be leveraged to hardwire the continuum. This includes: Best practice alerts (BPAs) that fire in the ED when a patient with sickle cell disease presents or when thrombocytopenia with anemia is ordered, prompting the crisis pathway; Smart order sets that bundle all necessary labs, imaging, and first-dose medications; and Shared dashboards that allow all team members to track key milestones (e.g., "ADAMTS13 sample drawn," "caplacizumab administered," "apheresis line placed") in real-time (Table 2). Figure 2 highlights how integrated, protocol-driven multidisciplinary management improves outcomes in acute hemolytic and thrombotic crises.

**Table 2: Key Performance Indicators (KPIs) for the Hematological Crisis Continuum**

| KPI Category | Specific Metric | Target | Responsible Domains for Tracking |
|---|---|---|---|
| **Timeliness of Diagnosis** | Door-to-peripheral smear result time | < 60 minutes | Laboratory, Emergency Medicine |
| | Door-to-ADAMTS13 sample draw time | < 90 minutes | Nursing, Emergency Medicine |
| **Timeliness of Therapy** | Door-to-first dose analgesia (VOC) | < 30 minutes | Nursing, Pharmacy, Emergency Medicine |
| | Door-to-caplacizumab administration (TTP) | < 3 hours | Pharmacy, Apheresis, Hematology |
| | Door-to-PEX initiation (TTP) | < 6-8 hours | Apheresis, Health Management (resources) |
| **Clinical Outcomes** | Exacerbation/relapse rate (TTP) | < 20% | Hematology, Pharmacy |
| | Hospital length of stay (VOC) | Benchmark reduction | Health Management, Nursing |
| | 30-day readmission rate for VOC | < 30% | Health Management, Multidisciplinary Team |
| **Process & Safety** | Appropriate platelet transfusion avoidance in TTP | 100% | Pharmacy, Transfusion Medicine |
| | Adherence to phenotype-matched RBCs in SCD | 100% | Laboratory, Transfusion Medicine |
| | Patient-reported experience of care | > 90th percentile | Nursing, Health Management |

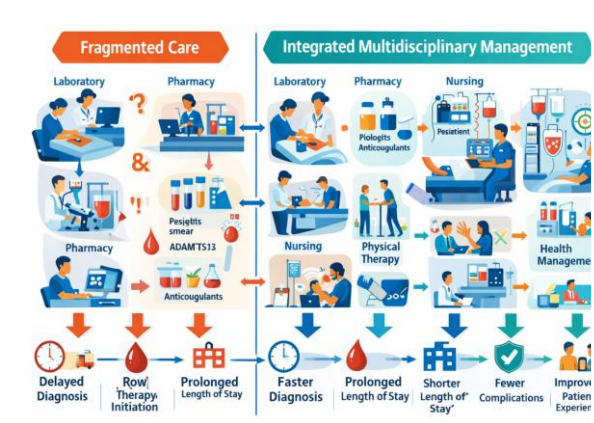


**Figure 2. Multidisciplinary Roles and Outcomes in Acute Hemolytic and Thrombotic Emergencies**

**Conclusion**

Acute hemolytic and thrombotic emergencies test the very fabric of a healthcare system. This review demonstrates that optimal patient outcomes—reduced mortality, shorter hospital stays, less long-term disability, and improved patient experience—are not the product of any single specialist's skill but of a meticulously coordinated, multidisciplinary continuum of care. This continuum spans from the initial clinical suspicion in the ED, through the diagnostic precision of the laboratory and the pharmacological stewardship of the pharmacy, to the holistic support provided by nursing, physical therapy, psychology, and health assistants, all enabled by smart management and protected by robust security protocols.

The path forward requires a deliberate dismantling of silos. Institutions must invest in formalized crisis pathways with embedded multidisciplinary roles; interprofessional education that fosters mutual understanding of roles and constraints across these nine domains; advanced health IT that supports rather than hinders coordinated care; and leadership commitment to measuring and rewarding continuum performance. For patients facing the terror and pain of a hematological crisis, the difference between a chaotic, fragmented experience and a smooth, efficient, and compassionate continuum of care is not merely operational—it is fundamentally therapeutic. Building this continuum is an ethical and clinical imperative for modern hematology and emergency care.

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