

Original article

Blood management during the 2025 Thai-Cambodian border crisis

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Abstract:

Introduction: The Regional Blood Centre V, Nakhon Ratchasima Province, Thai Red Cross Society, plays a primary role in supplying blood to its network of 59 affiliated hospitals. The 2025 Thai-Cambodian border crisis resulted in an abrupt surge in blood demand, particularly for low-titer group O whole blood (LTOWB). **Objective:** This study aimed to analyze the efficacy of crisis blood management by the National Blood Centre, Regional Blood Centre V and to obtain synthesized strategic lessons through the mechanism of seamless integrated collaboration.

Materials and Methods: This case study extracted lessons from actual operations conducted between 24 July and 30 September 2025 by analyzing empirical data across four dimensions: blood mobilization, inventory and logistics management, coordination, and contingency planning, including the development of the rapid preparation process for low-titer group O whole blood (LTOWB) in urgent conditions. **Results:** During the first 6 days of the crisis, 1,897 units of blood were mobilized, and low-titer group O whole blood (LTOWB) along with blood components were delivered to field hospitals within 2 hours. The blood request fulfillment rate increased from 25.05% in the normal period to 56.66% during the crisis and 98.00% in the recovery phase. However, quality and safety issues were observed, with the rate of donors failing screening increasing by 9.20% and the prevalence of transfusion-transmissible infections in blood rising by 0.26% compared with the post-crisis period. **Conclusion:** The blood management system suggested a strong capability for effective response in crisis conditions, primarily attributable to the seamless integrated collaboration mechanism and the rapid preparation of specialized blood products. Strategic recommendations include implementing comprehensive written Business Continuity Plan (BCP), developing proactive communication strategies to reduce donor deferral rates, and conducting regular joint drills with partners to ensure stability of the blood service.

Keywords : ● Crisis blood management ● Whole blood group O low titer ● Seamless integration
● Business continuity plan (BCP)

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นิพนธ์ต้นฉบับ

การบริหารจัดการโลหิตในภาวะวิกฤตการณ์ชายแดนไทย-กัมพูชา พ.ศ. 2568

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¹ภาคบริการโลหิตแห่งชาติที่ 5 จังหวัดนครราชสีมา สภากาชาดไทย ²ศูนย์บริการโลหิตแห่งชาติ สภากาชาดไทย

บทคัดย่อ

บทนำ ภาคบริการโลหิตแห่งชาติที่ 5 จังหวัดนครราชสีมา สภากาชาดไทย มีบทบาทหลักในการจัดหาโลหิตให้กับโรงพยาบาลเครือข่าย 59 แห่ง วิกฤตการณ์ชายแดนไทย-กัมพูชา พ.ศ. 2568 ส่งผลให้ความต้องการโลหิตเพิ่มขึ้นอย่างฉับพลัน โดยเฉพาะโลหิตครบส่วนหมู่โอไทเตอร์ต่ำ (whole blood group O low titer) ซึ่งส่งผลกระทบต่อห่วงโซ่อุปทานโลหิตระดับภูมิภาคอย่างมีนัยสำคัญ **วัตถุประสงค์** เพื่อวิเคราะห์ประสิทธิภาพการบริหารจัดการโลหิตในภาวะวิกฤตของศูนย์บริการโลหิตแห่งชาติ ภาคบริการโลหิตแห่งชาติที่ 5 และ สังเคราะห์บทเรียนเชิงกลยุทธ์ผ่านกลไกความร่วมมือแบบบูรณาการไร้รอยต่อ **วัสดุและวิธีการ** การวิจัยเชิงกรณีศึกษา ดำเนินการถอดบทเรียนจากการปฏิบัติงานจริงระหว่างวันที่ 24 กรกฎาคม ถึงวันที่ 30 กันยายน พ.ศ. 2568 โดยวิเคราะห์ข้อมูลเชิงประจักษ์ใน 4 มิติ ได้แก่ การระดมจัดหาโลหิต การบริหารจัดการคลังและโลจิสติกส์ การประสานงาน และแผนเผชิญเหตุ รวมถึงการพัฒนาระบบการเตรียม whole blood group O low titer ในสภาวะเร่งด่วน **ผลการศึกษา** ในช่วง 6 วันแรกของวิกฤตสามารถระดมจัดหาโลหิตได้ 1,897 ยูนิต และจัดส่ง whole blood group O low titer รวมถึงส่วนประกอบโลหิตไปยังโรงพยาบาลสนามได้ภายใน 2 ชั่วโมง อัตราการจ่ายโลหิตเพิ่มขึ้นจากร้อยละ 25.05 ในสภาวะปกติ เป็นร้อยละ 56.66 ในช่วงวิกฤต และร้อยละ 98.00 ในระยะฟื้นฟู อย่างไรก็ตาม พบประเด็นสำคัญด้านคุณภาพและความปลอดภัย โดยอัตราผู้บริจาคที่ไม่ผ่านการคัดกรองเพิ่มขึ้นร้อยละ 9.20 และความชุกของการติดเชื้อในโลหิตเพิ่มขึ้นร้อยละ 0.26 เมื่อเทียบกับระยะหลังวิกฤต **สรุป** การบริหารจัดการโลหิตแสดงศักยภาพในการตอบสนองในภาวะวิกฤตอย่างมีประสิทธิภาพ โดยมีปัจจัยความสำเร็จหลักคือกลไกความร่วมมือที่ไร้รอยต่อและการเตรียมโลหิตชนิดพิเศษอย่างรวดเร็ว ข้อเสนอแนะเชิงยุทธศาสตร์ ให้ความสำคัญกับการสื่อสารเชิงรุกเพื่อยกระดับการคัดกรองคุณภาพผู้บริจาคโลหิต และการจัดทำแผนเผชิญเหตุและฝึกซ้อมร่วมกับภาคีเครือข่ายอย่างสม่ำเสมอเพื่อความมั่นคงด้านการบริการโลหิต

คำสำคัญ : ● โลหิตภาวะวิกฤต ● โลหิตครบส่วนหมู่โอไทเตอร์ต่ำ ● การบูรณาการไร้รอยต่อ ● แผนเผชิญเหตุ

วารสารโลหิตวิทยาและเวชศาสตร์บริการโลหิต. 2569;36:169-78.

Introduction

Regional Blood Centre V, Nakhon Ratchasima Province, Thai Red Cross Society (RBC V) holds the primary responsibility for blood procurement and supply to a network of 59 hospitals across four provinces: Nakhon Ratchasima, Chaiyaphum, Buriram and Surin. Prior to the crisis, the centre faced a persistent challenge of inadequate supply, typically only 20-30% of total hospital demand. The sudden escalation of hostilities along the Thai-Cambodian border in Surin Province on 24 July 2025 critically tested the resilience of the regional blood supply chain, triggering a rapid surge in demand for blood reserves for frontline hospitals. This incident highlighted the urgent needs for whole blood group O low titer—a product essential for the resuscitation of battlefield casualties.¹ This study aimed to analyze the efficacy of blood management during the crisis implemented by the National Blood Centre (NBC) and RBC V. The analysis focused on operational processes across four key dimensions and the integrated cooperation mechanism. The findings are intended to serve as the basis for policy guidelines designed to enhance the efficacy and resilience of the national blood management system.

Materials and Methods

This retrospective descriptive study designed to derive lessons from the operational response of the NBC, RBC V and partner agencies during the border crisis from 24 July to 30 September 2025. A documentary analysis of empirical data and daily operational statistics was conducted, evaluating the border blood management mechanism across four dimensions:^{2,3}

1. Blood mobilization and procurement: assessing public outreach strategies, inter-agency blood mobilization, and collection during the acute crisis phase (24-29 July 2025).⁴

2. Inventory and logistics management: examining coordination for redistributing excess blood from hospitals and other Regional Blood Centres (RBCs) to mitigate

expiration, alongside protocols for rapid, per-standards transportation.^{5,6}

3. Roles and coordinated response: analyzing the defined roles and the seamlessly integrated cooperation mechanism between RBC V and all responding entities throughout the study period.^{3,7}

4. Post-crisis impact and development of a Business Continuity Plan (BCP): reviewing outcomes and the formulation of contingency plans for blood transport, including scenarios involving public transit suspension.^{3,6,11,15} A key component of the analysis included examining the rapid development and deployment of a protocol for preparing whole blood group O low titer—a component created by combining packed red cells group O with fresh frozen plasma group AB— for urgent use in casualty resuscitation.¹

Results

Mobilization and procurement

During the six-day crisis period (24-29 July 2025), RBC V mobilized a total of 1,897 units of blood.^{4,8} Mobilization was activated through a coordinated information-sharing mechanism established at 09:00 AM on 24 July 2025, involving Army Region 2, the Nakhon Ratchasima Provincial Governor's Office, RBC V, and local media outlets. Concurrently, RBC V coordinated with hospitals network to ascertain existing blood reserves. This inventory data was reported real-time to the NBC, Army Region 2 and the Nakhon Ratchasima Provincial Public Health Office (PPHO) in order to enable rapid procurement planning and meet the escalating demand from hospitals in the border region. At 10:00 AM on 25 July 2025, the provincial governor convened a meeting to establish the operational framework and assign specific responsibilities for public outreach and donor recruitment. Attendees included RBC V, the Provincial Red Cross Chapter, Maharaj Hospital, the PPHO, and the Provincial Public Relations Office. To consolidate crisis communication, a LINE group named "Border Blood" was created to address operational obsta-

cles and coordinate resource requests. For the specific logistics of supplying the conflict zone, a separate “Army Blood Management” (ABM) LINE group was established, comprising Ministry of Defence Hospitals, Royal Thai Army’s Armed Forces Institute of Pathology (AFIP), Fort Weerawatyothin Hospital, Fort Suranari Hospital, together with the RBC V leveraged the pre-existing line group called “Ror Por Kreur Khai Nakornchaiburin” to coordinate real-time blood inventory status and needs across its four-province network. Regarding the provision of specialized blood products, the NBC received an urgent request at 10:00 AM on 24 July 2025 from the AFIP for whole blood group O low titer to support the field hospital. In response, NBC experts expedited and standardized a preparation protocol by reconstituting whole blood group O low titer from packed red cells group O and fresh frozen plasma group AB. Production was initiated on 25 July 2025. The first delivery of 10 units reached the designated field hospital, Prasat Hospital in Surin Province, on 26 July 2025.⁸ A second delivery of 25 units followed on 28 July 2025, comprising 20 units from the NBC and 5 units prepared independently by RBC V. Prasat Hospital served as the blood reserve hub, distributing supplies to Phanam Dong Rak Hospital, which was situated immediately adjacent to the conflict zone. In total, the field hospital received 35 units of whole blood group O low titer, supplemented by 427 units of other critical components, including packed red blood cells and platelets concentrates. The system’s operational performance was measured by the fulfillment rate, defined as the percentage of hospital blood requests met. The rate varied significantly across the crisis timeline. During the pre-crisis baseline period (1-23 July 2025), the average fulfillment rate was 25.05% (15.00-42.60%). This increased to an average of 56.66% (14.80-100%) during the acute crisis phase (24-31 July 2025). Performance improved markedly during the recovery period (1-31 August 2025), with the average fulfillment rate reaching 98.00% (91.40-100%).^{7,9,10} A total of 73 units of low-titer group O whole blood were issued

to Prasat Hospital during the study period (Table 3), of which 35 units were delivered during the acute crisis period, 6 of those were transfused to injured soldiers.

Dual-impact phenomenon: volume vs. safety

The massive surge of donations presented with significant operational and safety challenges. The surge in donors forced some collection sites to extend operations until 10 PM, leading to excessive, unsustainable inventory at multiple hospitals that risked expiration. Furthermore, several collection facilities, facing resource constraints, utilized double blood collection bags instead of quadruple blood collection bags and omitted component separation. This divergence from standard protocol resulted in the production of lower-quality blood components. In response, the NBC, RBC V, and partners including Army Region 2 initiated urgent public communications to strategically defer donations and implement daily collection quotas. This intervention aimed to stabilize inventory levels and ensure a consistent supply of safe, high-quality blood throughout the prolonged crisis. The study showed that during the combat period (24-31 July 2025), the proportion of first-time donors rose sharply to 19.84%, compared to a baseline of 4.32%. Concurrently, the donor deferral rate increased to 19.46% (from 10.26% at baseline), highlighting significant gaps in public knowledge regarding donor eligibility and pre-donation preparation. Most critically, the seroprevalence of transfusion-transmissible infections among donated units increased to 1.43%, representing a 0.26 percentage-point increase from the post-crisis period.¹¹ This higher infection rate indicates a higher residual risk of bloodborne pathogens entering the supply, providing direct evidence that a surge in donations exceeding operational capacity can jeopardize patient safety.

Inventory and logistics management

Although the public donation surge demonstrated strong civic engagement, the resulting inventory significantly exceeded immediate clinical demand. This surplus not only carried a high risk of wastage due to expiration but also threatened to precipitate a severe

Table 1 Blood distribution efficacy (fulfillment rate) Regional Blood Centre V, July to October 2025

Time period	Average number of hospitals requesting blood per day (hospitals)	Average number of blood units requested per day (units)	Average number of blood units supplied per day (units)	Blood fulfillment rate (%)	Remarks
1-23 July 2025 (normal situation)	29	451	113	25.05 (15.00-42.60)	Supplied below demand
24-31 July 2025 (crisis period)	22	300	170	56.66 (14.80-100)	Increased blood supply
1-31 August 2025 (recovery period)	16	137	133	98.00 (91.40-100)	Blood supply met demand
1-30 September 2025 (post-crisis period)	21	196	139	70.84 (34.01-100)	Supplied below demand
1-31 October 2025 (post-crisis period)	27	365	103	28.41 (14.66-59.13)	Supplied below demand

Table 2 Blood component receipt from the National Blood Centre (NBC) and other Regional Blood Centres (RBCs) for distribution to network hospitals of the RBC V during 24 July to 30 September 2025

NBC / RBCs	Red blood cells components			Total	Platelets components			Total
	24-31 Jul 2025	1-31 Aug 2025	1-30 Sep 2025		24-31 Jul 2025	1-31 Aug 2025	1-30 Sep 2025	
NBC	142	273	1,187	1,602	11	86	155	252
RBC II Lopburi	64	40	2	106	0	4	0	4
RBC III Ratchaburi	50	1	49	100	0	0	0	0
RBC IV Chonburi	0	160	0	160	0	0	0	0
RBC VI Khon Kaen	45	90	0	135	0	32	47	79
RBC VII Ubon Ratchathani	0	50	0	50	0	2	0	2
RBC VIII Nakhon Sawan	0	2	0	2	0	0	0	0
RBC IX Phitsanulok	0	100	0	100	0	0	0	0
RBC X Chiang Mai	0	30	0	30	0	0	0	0
RBC XII Songkhla	0	0	290	290	0	0	0	0
RBC Hua Hin	0	2	0	2	0	0	0	0
RBC Phuket	0	0	2	2	0	0	0	0
Total	301	748	1,530	2,579	11	124	202	337

Table 3 Whole blood group O low titer receipt and distribution to Prasat Hospital during 24 July to 30 September 2025

Whole blood group O low titer, NBC issued to Prasat Hospital			Whole blood group O low titer, RBC V issued to Prasat Hospital		Total
24-31 Jul 2025	1-31 Aug 2025	1-30 Sep 2025	24-31 Jul 2025		
30	33	5	5		73
Prasat Hospital issued 5 units to Phanom Dong Rak Hospital, which were used for treating soldiers on 28 July 2025.			Prasat Hospital issued 1 units to Phanom Dong Rak Hospital, which were used for treating soldiers on 28 July 2025.		

Remarks: Of these, 35 units were delivered during 26–28 July 2025 and 6 units were transfused to injured soldiers

Table 4 Number of donated blood units collected by Regional Blood Centre V (RBC V) during 24-29 July 2025 (crisis period)

Blood donation sites	July 2025						Total
	24	25	26	27	28	29	
RBC V Building	67	196	147	101	128	123	762
Terminal 21 Korat Shopping Mall	132	288	142	125	134	63	884
Mobile blood donation units	133	103	-	-	-	15	251
Total	332	587	289	226	262	201	1,897

Table 5 Blood donation statistics at Regional Blood Centre V donation room, Terminal 21 Korat Shopping Mall and Regional Blood Centre V Building during 24 July to 30 September 2025

Date	Number of prospective blood donors	Number of successful blood donors	Successful blood donations (%)	Number of donors not eligible after screening	Donors not eligible after screening (%)	Number of first-time blood donors	First-time blood donors (%)	Number of repeat blood donors	Repeat blood donors (%)
Crisis period									
24-31 July 2025	2,221	1,789	80.54	432	19.46	355	19.84	1,434	80.16
Post-crisis period									
1-31 August 2025	1,668	1,434	85.97	234	14.03	138	9.62	1,296	90.38
1-30 September 2025	1,160	1,041	89.74	119	10.26	45	4.32	996	95.68
Total / average	2,828	2,475	87.52	353	12.48	183	7.40	2,292	92.60

Summary: During the crisis period (24-31 July 2025), the percentages of first-time blood donors and donors not eligible after screening were higher than those in the post- crisis period.

Table 6 Comparison of the number of blood samples and infection rates detected by serological and NAT testing Regional Blood Centre V (RBC V) during 1-30 June 2025 (normal situation), 24-28 July 2025 (crisis period) and 1-30 September 2025 (post-crisis period)

Network hospitals (province)	1-30 June 2025 (normal situation)			24-28 July 2025 (crisis period)			1-30 September 2025 (post-crisis period)		
	Number of blood samples	Infection rate (%)		Number of blood samples	Infection rate (%)		Number of blood samples	Infection rate (%)	
RBC V	3,175	0.72		1,696	0.64		2,679	0.63	
Nakhon Ratchasima	858	1.40		625	2.24		639	1.40	
Buriram	2,635	1.51		3,381	1.45		2,408	1.07	
Surin	2,752	1.38		3,024	1.72		2,501	1.43	
Chaiyaphum	2,338	2.05		729	1.37		2,198	1.59	
Total	11,758	1.36		9,455	1.43		10,425	1.17	

Remarks: On 27 July 2025 blood samples were sent for testing to RBC XII Songkhla (533 samples) and RBC II Lopburi (652 samples)

shortage in the subsequent months as supplies were depleted. In response to this challenge, the NBC mandated all Regional Blood Centre (RBCs) to implement close monitoring of hospital inventory levels for at least one month. Acting as a centralized redistribution hub, RBC V coordinated the acceptance of soon-to-expire blood units from other hospitals and RBCs, facilitating their prompt transfer to hospitals with immediate usage requirements. Through this hub function, RBC V coordinated the redistribution of 301 units from 24-31 July 2025 and 748 units from 1-31 August 2025, sourced from the NBC and other RBCs. Furthermore, by acting as an intermediary, RBC V enabled the direct transfer of a further 181 units among the network hospitals, optimizing the use of existing stock across the region. A significant obstacle was the absence of a standardized policy for financial reimbursement during inter-hospital blood transfers. Originating hospitals frequently sought to apply standard service fees, while receiving hospitals, aware the units were near expiration, contended that fees should be waived or aligned with the NBC's lower rate. This financial disincentive directly hindered redistribution efforts and contributed to wastage. There was a case that a hospital reporting 229 units expiring on-site.

For transportation logistics, RBC V served as the central consolidation and dispatch point for all blood products destined for the conflict zone. A multimodal transport system was employed. The standard methods, including railways, commercial buses, and private couriers, were used for routine delivery, while special military assets such as Royal Thai Air Force aircraft were deployed for urgent, high-priority transfers. One-hundred units of packed red cells were transported via air from Bhumibol Adulyadej Hospital, Directorate of Medical Services, Royal Thai Air Force (BAH), to RBC V. In particular, the critical last-mile delivery leg to the frontline hospitals was managed using the RBC V's vans, achieving a delivery time of 2 hours to the Prasat Field Hospital and 2 hours and 43 minutes to Surin Hospital.

Roles of key agencies and integrated seamless cooperation mechanism

Effective crisis management hinged on a rapid, coordinated response supported by well-defined responsibilities and robust communication among all agencies involved. Analysis of the operational response revealed a coordination structure organized according to the primary mission of each of the agencies:

1. Headquarter of blood centres: NBC served in this strategic capacity. Its responsibilities encompassed establishing national policy and operational guidelines for hospitals and RBCs, coordinating with external agencies, including Provincial Red Cross Chapters and Ministry of Defence Hospitals, and managing public communication regarding the blood supply situation. The NBC was also responsible for the centralized collection of data on inventory and demand, and for the strategic allocation of critical resources, including manpower and production capacity.

2. Frontline operational blood centre: RBC V fulfilled this role. It acted as the pivotal operational liaison, coordinating between the NBC, military authorities, local civilian support units, and hospitals in the border region. Its core functions comprised of real-time monitoring of blood demand; managing the continuous production and supply chain for whole blood group O low titer; facilitating the donation surge by distributing blood samples to other Regional Blood Centres for screening to maintain turnaround times; and serving as the primary hub for the redistribution of excess inventory to minimize wastage due to expiration.

3. Military headquarters: The Royal Thai Army's 2nd Army Region (Army Region 2) was integral to the operational framework. It formally designated Prasat Hospital as the military's liaison for blood coordination with RBC V. Beyond mobilizing its personnel as donors, the army's most critical contribution was leveraging its high degree of public trust to amplify official public health communications. This support was pivotal not only for encouraging donations during the initial surge

but also, for securing public compliance with calls for strategic donor deferral, ensuring a manageable and safe supply.

4. Provincial administration centre: The Nakhon Ratchasima Provincial Governor led this civilian sector of coordination. The governor's office established the provincial crisis management centre, coordinating the Provincial Red Cross Chapter and the Provincial Public Relations Office. Nakhon Ratchasima Provincial Public Health Office played a critical operational role by aggregating real-time data on blood reserves from all four provinces in the region and supplying this situational awareness to RBC V. Furthermore, RBC V, in collaboration with Maharaj Nakhon Ratchasima Hospital, established high-capacity blood donation facilities capable of accommodating large numbers of donors. These facilities were located at RBC V building, Terminal 21 Korat Shopping Mall, Central Korat, The Mall Korat, and M Park. Additionally, volunteer support was mobilized, particularly from public health volunteers and nursing students, to facilitate blood donation activities.

Consequences and alternative plan

Analysis of the post-crisis period revealed three significant unintended consequences for the regional blood supply: 1) a substantial volume of blood components expired due to initial over-collection; 2) the quality of collected blood was jeopardized at some sites due to non-standard collection practices; and 3) a severe shortage emerged in October 2025 with average fulfillment rate 28.41%, driven by donor depletion, which necessitated heavy reliance on replacement donations at many hospitals. To mitigate these risks and ensure a stable blood supply during and after future crises, the study highlights the necessity of a formalized donor management strategy. This strategy must include defined daily collection targets and a mechanism to actively reschedule donors when targets are exceeded. Additionally, a pre-established contingency transport plan is required. This plan should outline protocols for deploying alternative assets, such as helicopters or

military vehicles from Army Region 2, with coordination channels—for example, through the office of the Surgeon General of Army Region 2 explicitly defined for scenarios where conventional transport routes are disrupted.

Discussion

The 2025 Thai–Cambodia border crisis, while not graded as a major international event under the WHO Health Emergencies Program (WHE) framework, this crisis serves as a significant case study demonstrating the resilience and rapid response capacity of Thailand's national blood service system.^{4,9,10} The response entailed efficient, coordinated action executed under clearly defined institutional roles. In contrast to the documented practice in several nations including Lebanon, Afghanistan, Iran, Jordan, and Pakistan where dedicated emergency blood donation teams are mobilized to manage crisis collections, Thailand's response was predominantly driven by spontaneous public donation.^{9,10,12,13} This donor surge critically revealed systemic operational constraint. That is, numerous collection sites lacked essential equipment, such as refrigeration units, agitator scales, and centrifuges.⁸ This deficit likely undermined blood component quality and limited the ability to process all donations into standard components rendering sites incapable of fully processing all donated blood into its individual therapeutic components.

A further challenge identified, mirroring issues reported in other national contexts, was the lack of clear, unified mandates for blood inventory management during a crisis. This ambiguity resulted in parallel reporting structures, wherein both the Provincial Public Health Office and the RBCs independently collected inventory data from hospitals. This duplicative effort created confusion and imposed an unnecessary reporting burden on healthcare facilities, which highlights the necessity for nationally standardized, clearly defined crisis inventory management protocols. A key operational success was Thailand's capacity to rapidly develop, produce, and deploy whole blood group O low titer within two days

of the incident. This provided an immediately available universal blood product for emergency resuscitation in the conflict zone, effectively addressing a well-documented need in such settings without the delay of pre-transfusion compatibility testing.^{1,8,11,13,14} However, persistent logistical challenges were noted. Emergency blood transport during the crisis frequently relied on personnel lacking specific training in cold chain protocols.^{6,10,13} This resulted in protocol deviations, including premature opening of transport containers or improper packing and risk of damaging temperature excursions and jeopardized product quality and safety. Moreover, the study identified gaps in inter-agency communication, specifically a lack of clear, pre-established dissemination regarding the defined roles and contact information of key blood agencies to external partners, which hindered seamless coordination.¹⁴ Furthermore, the implementation of the National Blood Centre's directive for daily donation quotas was inconsistent across provinces. This lack of uniform adherence led to avoidable over-collection and subsequent wastage in areas that did not follow the coordinated strategy.

Based on the findings of this case study, the following strategic recommendations are proposed to strengthen national blood crisis preparedness:

1. Formalize a comprehensive Business Continuity Plan (BCP): Successful ad-hoc operational guidelines employed during this crisis should be formalized into a standardized, written national BCP for blood management during emergencies.^{2,3,15}

2. Implement a proactive donor education and pre-screening strategy: develop targeted communication and easy-to-use self-assessment tools to improve public understanding of donor eligibility. This strategy aims to reduce deferral rates on-sites and enhance the overall quality and safety of the blood supply.^{12,13,15} Results of the Z-test for two proportions showed that the proportion of transfusion-transmissible infections (TTIs) in donated blood was 1.43% during the crisis period compared with 1.17% in the post-crisis period

($p = 0.11$). Despite the absence of statistical significance, the 0.26% absolute increase reflects elevated residual risk and reduced blood safety associated with large-scale donor mobilization during the crisis.

3. Establish a national coordination mechanism for inventory redistribution: create a formal system with clear protocols and financial agreements to facilitate the efficient transfer of blood components between hospitals and regions. This mechanism is critical to prevent wastage due to "relocated expiry" and to optimize inventory use across the network.^{5,10,12}

4. Develop a strategic reserve protocol for low-titer O whole blood: formulate guidelines for maintaining a rotating stockpile of whole blood group O low titer at key frontline hospitals. The protocol must include pathways to reallocate unused units for civilian trauma or elective surgery, thereby preventing expiration and maximizing resource utility.

Conclusion

This case study of the 2025 Thai-Cambodia border crisis demonstrates the resilience and adaptive capacity of Thailand's blood service system in executing a rapid, integrated response to a sudden-onset conflict. The most significant achievements were the expedited development and deployment of a whole blood group O low titer protocol and the activation of a seamless, multi-sectoral cooperation mechanism that consolidated a clear command structure within 24 hours. This mechanism effectively integrated the Thai Red Cross Society, government authorities, the military, private sector, and volunteer networks. While the dual-impact phenomenon presented immediate challenges to donor screening and blood safety, it simultaneously revealed a strategic opportunity to expand the donor base by converting surge participants into committed, repeat donors. The lessons derived from this experience provide critical, evidence-based insights for strengthening national blood security and preparedness for future disasters.

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