

REBOA in Low-Resource and Austere Hemorrhage Care: A Structured Narrative Review and Readiness Framework

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Resuscitative endovascular balloon occlusion of the aorta (REBOA) is considered a bridge to definitive hemorrhage control when transport, operating-room access, blood, or endovascular resources are constrained. These same conditions magnify risks from failed femoral access, prolonged occlusion, ischemia, thrombosis, and delayed hemostasis. This narrative review maps evidence from prehospital systems, military and combat care, interfacility transfer, and resource-constrained trauma centers. Expert-led series demonstrate technical feasibility and proximal hemodynamic improvement, but physiologic signals should not be equated with neurologically intact survival. Traumatic cardiac arrest evidence remains sparse, heterogeneous, and predominantly uncontrolled. The UK-REBOA randomized trial found no mortality benefit and a signal toward harm. We propose a seven-domain REBOA Readiness Bundle, a competency-based training model, and a staged clinical implementation pathway. REBOA should be adopted as a governed system capability that links selection, access, resuscitation, occlusion-time control, definitive hemostasis, and vascular surveillance rather than as an isolated device.

Keywords: REBOA; Hemorrhagic Shock; Austere Medicine; Prehospital Trauma; Military Medicine; Low-Resource Settings

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INTRODUCTION

Noncompressible torso and pelvic hemorrhage remains a time-critical cause of preventable death. REBOA can transiently increase proximal perfusion and reduce distal arterial inflow, creating a bridge to operative or endovascular hemorrhage control. The clinical appeal is especially strong in prehospital, military, rural, remote, humanitarian, and resource-constrained systems, where definitive care might be delayed. Yet those same environments might lack the vascular-access expertise, ultrasound,

blood products, invasive monitoring, transport coordination, receiving-center readiness, and vascular rescue capability needed to use the technique safely [1–3].

The central question is therefore not whether a balloon can be inflated in the aorta, but whether the entire care pathway can convert temporary aortic control into timely definitive hemostasis without adding preventable harm. Broader systematic reviews have found low-certainty and heterogeneous evidence, and a dedicated review of civilian and military austere use similarly emphasized the dominance of small observational reports [4,5]. Algorithms and consensus documents increasingly treat REBOA as one component of a resuscitation system rather than as a stand-alone intervention [2,3,6,7].

This narrative review synthesizes representative evidence from austere and low-resource hemorrhage care, incorporates recent reports from Thailand, Ukraine, Ecuador, and transfer systems, and translates the evidence into a practical readiness framework. The primary aim was to examine technical feasibility, physiologic effects, survival signals, safety, and system requirements

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across these settings. The secondary aim was to convert those findings into a competency model, staged implementation pathway, and minimum dataset for governed adoption.

SCOPE AND REVIEW APPROACH

A structured, non-exhaustive literature-mapping approach was used. Search concepts combined “REBOA,” “resuscitative endovascular balloon occlusion,” and “aortic balloon occlusion” with terms for prehospital, military, combat, austere, rural, remote, transfer, low-resource, resource-limited, low- and middle-income country, and implementation. PubMed/MEDLINE and PubMed Central records, journal websites, contemporary guidance, and backward citation chains were reviewed. No fixed lower publication-date restriction was applied because foundational mechanistic and implementation reports were retained. The original evidence map was updated to 13 July 2026; a targeted peer-review update for physiology, traumatic cardiac arrest, and training was completed on 9 August 2026. Priority was given to original human clinical or implementation reports that provided information on deployment, physiology, survival, complications, transport, or system requirements.

This method was selected because formal duplicate screening, a prospectively registered protocol, exhaustive database coverage, and a locked study-exclusion log were not available. Accordingly, the article is explicitly a structured narrative review. It does not claim exhaustive capture, does not assign formal risk-of-bias or GRADE (Grading of Recommendations Assessment, Development, and Evaluation) ratings, and does not pool clinically incompatible proportions. Numerical findings are presented as descriptive signals with their original denominators.

WHY AUSTERE AND RESOURCE-CONSTRAINED SETTINGS ARE DIFFERENT

Austere care is not a single setting. It includes forward military care, civilian prehospital services, rural hospitals, interfacility transport, trauma centers in resource-constrained health systems, and disaster or humanitarian environments. Their shared problem is a mismatch between the speed of hemorrhage and the speed of definitive control. Their differences—injury mechanism, operator cadre, imaging access, blood supply, transport time, and receiving capability—are clinically consequential and should not be collapsed into one category.

REBOA changes physiology immediately but does not treat the bleeding source. Complete occlusion transfers risk from exsanguination to ischemia, reperfusion injury, proximal hypertension, and time pressure. Partial occlusion might attenuate distal ischemia, but it adds a titration task and requires reliable proximal and distal pressure monitoring. Current Joint Trauma System guidance emphasizes simultaneous damage-control resuscitation, expedient damage-control surgery, deliberate occlusion-time management, and structured post-deflation limb surveillance [2]. These requirements are often hardest to guarantee where REBOA appears most attractive.

A responsible implementation analysis must therefore examine the whole chain: candidate recognition, exclusion of major thoracic bleeding, common femoral artery access, balloon positioning, blood-product resuscitation, monitoring, transport or operative activation, definitive hemostasis, sheath removal, vascular surveillance, and rescue of access complications. Failure at any link can erase the value of technically successful inflation.

EVIDENCE BY SETTING

A representative evidence timeline across settings is shown in Figure 1.

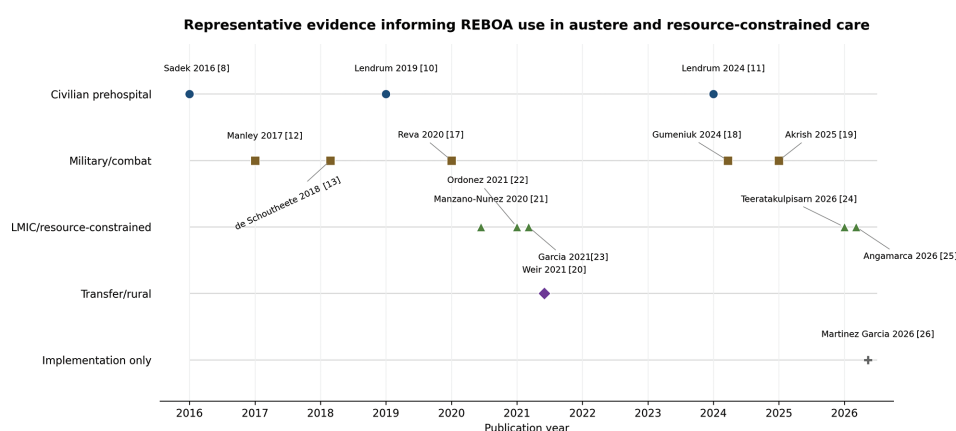


Figure 1 Representative evidence timeline. Representative reports are grouped by primary setting. The timeline is not an exhaustive search result and distinguishes treated-patient evidence from implementation-only work. REBOA: resuscitative endovascular balloon occlusion of the aorta; LMIC: low- and middle-income country.

Civilian Prehospital Systems

Early civilian prehospital reports demonstrated that trained physician-led teams could place REBOA outside the hospital in highly selected patients [8,9]. In the 2019 London series, REBOA was attempted in 19 patients with exsanguinating pelvic hemorrhage and was successfully deployed in 13; survival was reported in 8 of 13 successful cases and 2 of 6 failed attempts, but the comparison is profoundly confounded by access success, physiology, injury pattern, and survivorship [10]. Distal arterial thrombus requiring thrombectomy was reported in 10 of 13 successful cases, making vascular safety inseparable from feasibility.

The 2024 prospective prehospital cohort focused on Zone I complete followed by partial REBOA in patients with suspected exsanguinating subdiaphragmatic hemorrhage and recent or imminent traumatic cardiac arrest. Eleven of 14 attempted REBOA cases achieved balloon inflation, partial REBOA was achieved in 8 of 11, and 2 of 11 survived to hospital discharge [11]. The study demonstrates procedural capability in a mature expert system; it does not establish a mortality benefit or generalizability to services without comparable training, blood, monitoring, governance, and receiving pathways.

Military, Combat, and Prolonged Field Care

Combat and austere military reports provide some of the clearest examples of REBOA as an operational bridge. Manley and colleagues reported four out-of-hospital combat casualties with successful deployment, 18–65 minutes of balloon inflation, and survival to the next echelon without reported access or REBOA complications [12]. The de Schoutheete series described three austere military prehospital uses with dynamic partial occlusion and successful deployment, but two sheath-site thromboses [13]. Northern and colleagues described aortic balloon occlusion within broader special-operations damage-control resuscitation, while case reports from mass-casualty and rotary-wing settings illustrated operator and platform feasibility [14–16].

Additional combat experience has expanded the implementation map. A Russian series described three battlefield casualties treated in a field hospital; two survived to discharge and no REBOA-related complication was reported [17]. A 2024 Ukrainian series included five mine-blast casualties treated at Role 1 or 2 facilities; four were evacuated after REBOA, occlusion times ranged from 15 to 50 minutes, and one femoral artery thrombosis was reported [18]. A 2025 Ukrainian case used five minutes of complete and 50 minutes of partial Zone I occlusion, including transport, with distal pressure titration and survival through the early postoperative period [19]. These reports are valuable for logistics and workflow, but their small, selected denominators preclude treatment-effect inference.

Transfer, Rural, and Resource-Constrained Trauma Centers

Interfacility transfer is a distinct use case because the balloon may function as a contingency rather than continuous full occlusion. A five-patient rural transfer program reported that all patients reached a Level I trauma center, with close coordination among the referring, transport, and receiving teams [20]. This model depended on predefined activation, trained escorts, blood products, communication, and a destination capable of immediate definitive care.

Resource-constrained trauma-center evidence is heterogeneous. International registry work compared REBOA-treated patients across country-income contexts and highlighted differences in access strategy and management, but it did not compare REBOA with no REBOA [21]. Colombian studies described a transition from larger to lower-profile access and a retrospective adjusted mortality association in penetrating trauma; both are vulnerable to era effects, learning curves, and confounding by indication [22,23].

Recent reports extend the evidence beyond earlier mapping. A 23-patient Thai cohort from a tertiary center reported an average systolic blood-pressure increase of 39.8 mmHg, return of spontaneous circulation in 19 patients, 24-hour survival in 6, and 28-day survival in 5. Acute kidney injury occurred in 5 patients and no lower-limb ischemia was reported [24]. A 2026 Ecuador case demonstrated technical feasibility in a second-level hospital without interventional radiology, but the patient arrived after an approximately 8-hour delay and died of multiorgan failure, underscoring that procedural capability cannot compensate for a failed trauma system [25]. A Spanish HEMS (Helicopter Emergency Medical Service) document-based study identified 103 potential candidates among 2,303 patients but involved no actual REBOA deployment; it informs case-volume planning rather than clinical effectiveness [26]. Representative clinical and implementation evidence is summarized in Table 1.

WHAT THE EVIDENCE SUPPORTS—AND WHAT IT DOES NOT

Technical Feasibility Is Real but Context-Bound

Across reports with extractable attempt denominators, technical success ranged from 13 of 19 in the 2019 civilian prehospital series to 4 of 4 and 3 of 3 in very small military series, with 11 of 14 successful Zone I inflations in the 2024 prehospital cohort [10–13]. Early arterial access has also been associated with greater REBOA utilization in battlefield casualties [27]. These proportions should not be pooled because “attempt,” “access,” “deployment,” and “successful inflation” were defined differently, and several series came from highly selected

Table 1 Representative clinical and implementation evidence in austere or resource-constrained settings.

<i>Study</i>	<i>Setting/Design</i>	<i>Main Signal</i>	<i>Key Limitation</i>
Sadek [8]	Civilian prehospital; early report	Prehospital deployment described	Case-based; limited denominator detail
Manley [12]	Out-of-hospital combat; case series	4/4 deployed; all transported to next echelon	Four patients; no control
Northern [14]	Special-operations combat report	Operational use within damage-control resuscitation	Extractable patient-level outcomes limited
de Schoutheete [13]	Austere military prehospital; 3 cases	3/3 deployed; dynamic partial occlusion	2/3 sheath-site thrombosis
Lendrum [10]	Civilian physician-led prehospital; 19 attempts	13/19 deployed; BP improvement	10/13 distal thrombus requiring thrombectomy
Reva [17]	Field hospital combat; 3 cases	2 survivors to discharge	Selected case series; blind positioning common
Manzano-Nunez [21]	International registry; income-context comparison	Resource and access-strategy differences described	Not REBOA versus no-REBOA effectiveness
Ordonez [22]	Colombian trauma center; device-era comparison	Access complications 8/36 with 11 Fr vs 0/14 with 7 Fr	Era and learning-curve confounding
Garcia [23]	Colombian penetrating trauma cohort	Adjusted mortality association favored REBOA	Severe confounding by indication
Weir [20]	Rural/interfacility transfer; 5 patients	All reached Level I definitive care	Small program; highly coordinated pathway
Lendrum [11]	Prospective civilian prehospital cohort	11/14 inflations; partial REBOA 8/11; 2/11 discharge survival	No control; selected expert system
Gumeniuk [18]	Ukraine Role 1/2; 5 combat casualties	4 evacuated after REBOA; occlusion 15–50 min	One femoral artery thrombosis; small series
Akrish [19]	Ukraine prolonged field care; case report	55 min total: 5 complete + 50 partial; transport included	Single case
Teeratakulpisarn [24]	Thailand tertiary center; 23 patients	SBP + 39.8 mmHg; 24-h survival 6/23; 28-day survival 5/23	Small observational cohort; no contemporaneous control
Angamarca [25]	Ecuador second-level hospital; case report	Technically feasible without IR/ hybrid suite	Eight-hour delay; death from multiorgan failure
Martinez Garcia [26]	Spanish HEMS feasibility; 2,303 records	103 potential candidates (4.47%)	No actual REBOA deployment

Note: Evidence is representative rather than exhaustive. Case reports and candidate-volume studies inform implementation but cannot estimate treatment effect. BP: blood pressure; REBOA: resuscitative endovascular balloon occlusion of the aorta; SBP: systolic blood pressure; IR: interventional radiology; HEMS: helicopter emergency medical service.

expert teams. The reproducible conclusion is narrower: deployment can be achieved in selected systems that invest in access competence, equipment, rehearsal, and destination readiness.

Study-specific deployment proportions are shown in Figure 2, and selected descriptive quantitative signals are summarized in Table 2.

Hemodynamic Improvement Is a Physiologic Signal, Not Proof of Benefit

Immediate systolic blood-pressure improvement or stabilization is consistently described in uncontrolled reports [10–13,19,24]. This is mechanistically plausible and clinically useful during profound shock, but it is a surrogate outcome. A rise in proximal pressure does not demonstrate improved neurologically intact survival, nor does it quantify distal ischemic cost, delay to definitive control, or complications caused by access and reperfusion.

REBOA as a Physiological Resuscitation Tool

Beyond temporary hemorrhage control, aortic occlusion redistributes a limited circulating volume toward the proximal circulation and can increase central arterial pressure, coronary perfusion pressure, carotid flow, and cerebral oxygen delivery. In a porcine model of class IV hemorrhagic shock, balloon occlusion increased central aortic pressure, carotid blood flow, and brain oxygenation compared with no occlusion [28]. A 2026 porcine study using cerebral microdialysis found that Zone 1 total REBOA moved lactate-pyruvate ratios toward baseline after hemorrhagic shock, including in animals with experimentally elevated intracranial pressure; the study did not establish absence of tissue injury or long-term neurologic recovery [29]. In a prolonged cardiac-arrest swine model, inflation increased coronary perfusion pressure and common carotid flow, while animals achieving return of spontaneous circulation (ROSC) had higher coronary perfusion pressure, carotid flow, and end-tidal carbon dioxide (ETCO₂) than animals without ROSC.

Table 2 Selected quantitative signals; descriptive only.

Study	Outcome Definition	Events/Total	Estimate	Interpretation
Manley [12]	Technical deployment	4/4	100% (Wilson 51.0–100%)	Very small expert combat series
de Schoutheete [13]	Technical deployment	3/3	100% (Wilson 43.9–100%)	Very small austere series
Lendrum [10]	Technical deployment	13/19	68.4% (Wilson 46.0–84.6%)	Attempt denominator available
Lendrum [11]	Zone I inflation	11/14	78.6% (Wilson 52.4–92.4%)	Prospective expert-system cohort
Lendrum [10]	Distal thrombus requiring thrombectomy	10/13	76.9% (Wilson 49.7–91.8%)	Outcome definition is severe and specific
Ordonez [22]	Groin/access complications, 11 Fr	8/36	22.2% (Wilson 11.7–38.1%)	Device-era comparison
Ordonez [22]	Groin/access complications, 7 Fr	0/14	0% (Wilson 0–21.5%)	Era and learning-curve effects
Lendrum [11]	Thrombus requiring thrombectomy	2/11	18.2% (Wilson 5.1–47.7%)	Modern prehospital cohort
Gumeniuk [18]	Femoral artery thrombosis	1/5	20.0% (Wilson 3.6–62.4%)	Combat series
Teeratakulpisarn [24]	24-hour survival	6/23	26.1% (Wilson 12.6–46.5%)	Not causal effectiveness
Teeratakulpisarn [24]	28-day survival	5/23	21.7% (Wilson 9.7–41.9%)	Not causal effectiveness
Martinez Garcia [26]	Potential candidate volume	103/2,303	4.47%	Implementation planning only

Note: Confidence intervals are Wilson intervals where shown. Outcomes and denominators are heterogeneous and should not be pooled without harmonization.

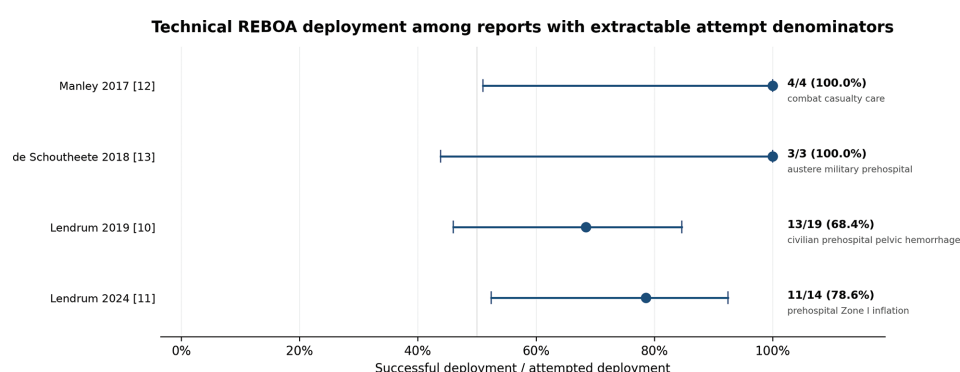


Figure 2 Technical REBOA deployment. Study-specific successful-deployment proportions among reports with extractable attempt denominators. Horizontal lines are Wilson 95% confidence intervals. No pooled estimate is shown because denominators and procedural definitions differ. REBOA: resuscitative endovascular balloon occlusion of the aorta.

[30]. These studies support REBOA as a physiologic resuscitation maneuver, but the endpoints remain experimental or surrogate and must be weighed against distal ischemia, reperfusion injury, and time to hemostasis.

Potential Role in Traumatic Cardiac Arrest

In traumatic cardiac arrest (TCA), REBOA may be considered only for narrowly selected patients with presumed subdiaphragmatic hemorrhage after major thoracic bleeding, tension pneumothorax, and pericardial tamponade have been addressed or excluded. In 11 patients with traumatic arrest, high-fidelity recordings showed that closed-chest compressions during aortic occlusion generated mean systolic, mean arterial, and

diastolic pressures of 70, 43, and 26 mm Hg, respectively [31]. A larger single-center series reported ROSC in 29 of 50 arrest patients and 30-day survival in 5; its uncontrolled design and highly selected institutional pathway preclude causal inference [32]. The recent prehospital cohort likewise shows that inflation and partial occlusion can be achieved in selected patients with recent or imminent arrest, but only 2 of 11 inflated cases survived to discharge [11]. Proximal pressure, ETCO₂, and ROSC can therefore be used as real-time physiologic response signals, not as evidence that REBOA improves neurologically intact survival. Futility rules, uninterrupted resuscitation, and immediate access to definitive hemorrhage control remain essential.

Survival Benefit Remains Unproven

Survival outcomes are reported using a range of endpoints, including survival to transport, 24-hour survival, 28- or 30-day survival, and survival to hospital discharge. These outcomes are derived from selected case series that differ in injury mechanisms and cardiac arrest status, making direct comparisons across studies inappropriate. The only randomized trial, UK-REBOA, evaluated an emergency-department REBOA strategy in major trauma centers rather than an austere program. Ninety-day mortality was 54% with the REBOA strategy and 42% with standard care; only 19 of 46 patients allocated to REBOA received balloon inflation [1]. The trial does not resolve every expert-system or partial-REBOA question, but it decisively rejects the assumption that adding REBOA automatically improves survival.

Vascular Safety Is a Program Outcome

Access and vascular events are among the most actionable findings. Reported events include sheath-site thrombosis, distal thrombus requiring thrombectomy, groin complications, and femoral artery thrombosis [10,11,13,18,22]. A prior meta-analysis estimated groin-access complications in the range of 4–5%, but definitions and device generations varied [33]. An updated complications review reinforces that access injury, limb ischemia, thrombosis, embolization, and reperfusion injury require deliberate mitigation [34]. Lower-profile devices might reduce risk, but device size cannot substitute for ultrasound-guided access, correct

common femoral puncture, sheath management, and a vascular rescue pathway.

Selected access and vascular event proportions are shown in Figure 3.

Partial REBOA May Extend the Bridge—but Raises the Readiness Threshold

Partial REBOA is attractive where transport or definitive control cannot occur within a short complete-occlusion window. Recent prehospital and combat reports show that titratable partial occlusion can be maintained during transport [11,19]. However, partial occlusion is not simply “less balloon.” It requires a compatible device, proximal and distal pressure measurement, repeated titration, continuous attention to bleeding and perfusion, and a trained clinician accompanying the patient. Current Joint Trauma System guidance conditionally favors partial over complete occlusion when the required training and equipment exist, suggests distal pulsatile systolic pressure targets of approximately 20–50 mmHg, and emphasizes defined time limits and surveillance [2]. These recommendations should be adapted through local governance rather than copied without system validation.

THE REBOA READINESS BUNDLE

The literature supports a readiness decision rather than a binary pro- or anti-REBOA position. We propose seven linked domains. A program is only as strong as its least reliable domain, and absence of an executable definitive hemorrhage-control pathway is a stop condition. The seven linked domains and their operational tests are summarized in Table 3 and Figure 4.

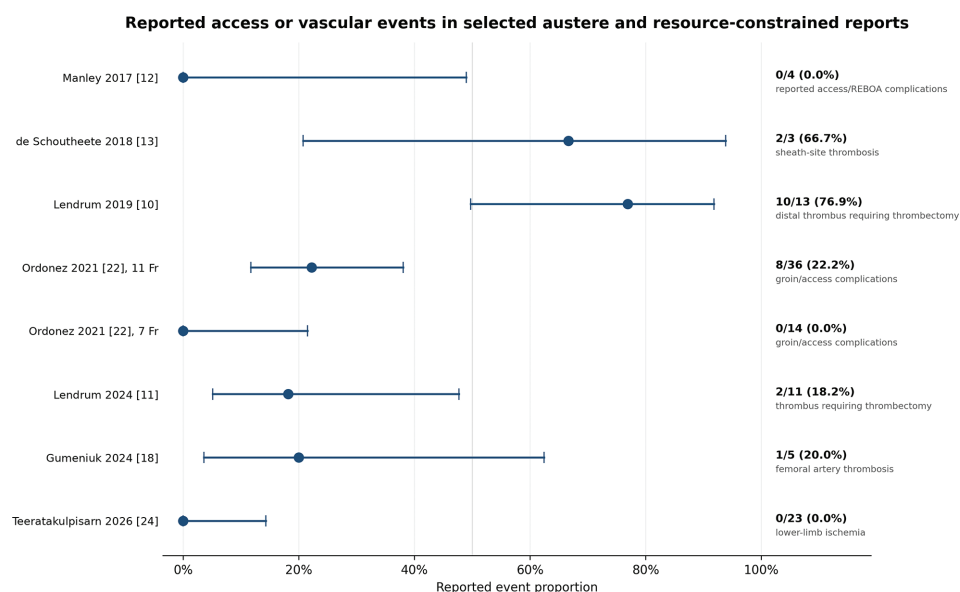


Figure 3 Reported access or vascular events. Selected study-specific event proportions with Wilson 95% confidence intervals. Event definitions range from access-site complications to thrombosis requiring intervention. These outcomes are not interchangeable; no pooled estimate is shown. REBOA: resuscitative endovascular balloon occlusion of the aorta.

Table 3 REBOA Readiness Bundle.

Domain	Minimum Capability	Operational Test
1. Trigger and exclusions	Defined physiology and suspected bleeding territory; exclude major thoracic source and futility	Protocolized activation and stop rules
2. Access competence	Ultrasound-guided common femoral access, bailout options, competency-based credentialing, and scheduled rehearsal	Objective checklist, maintenance plan, and attempt/failure denominator captured
3. Device and monitoring	Compatible low-profile device, placement strategy, proximal pressure; distal pressure for partial REBOA	Standardized cart and equipment checks
4. Damage-control resuscitation	Blood products, warming, calcium, coagulopathy management, team leadership	REBOA never substitutes for blood
5. Occlusion strategy and clock	Zone, complete/partial strategy, pressures, inflation volume, cumulative time	Real-time documentation and conversion thresholds
6. Definitive control/transport	Immediate OR/IR or credentialed transfer with trained escort and receiving-team activation	No definitive-care pathway = no program
7. Aftercare and governance	Sheath plan, limb surveillance, vascular rescue, registry, case review, de-implementation criteria	Safety is measured through 24 h and beyond

Note: All domains are linked. Lack of immediate definitive hemorrhage control or vascular rescue is a stop condition. OR: operating room; IR: interventional radiology; REBOA: resuscitative endovascular balloon occlusion of the aorta.

REBOA readiness framework: a system-dependent bridge, not an isolated procedure

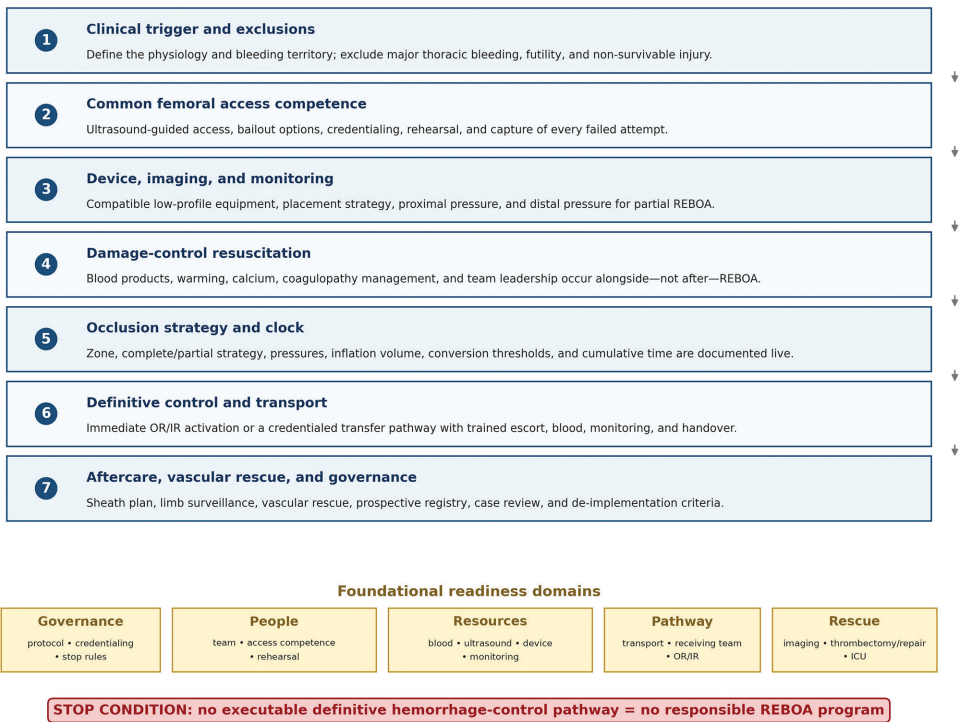


Figure 4 REBOA readiness framework. Seven linked clinical domains are supported by foundational governance, personnel, resources, pathways, and rescue capability. The framework treats REBOA as a system-dependent bridge to definitive hemorrhage control. REBOA: resuscitative endovascular balloon occlusion of the aorta; OR: operating room; IR: interventional radiology; ICU: intensive care unit.

- (1) Clinical trigger and exclusion discipline. Protocols should define the physiology, suspected bleeding territory, and rescue intent that justify REBOA. Major thoracic hemorrhage, pericardial tamponade, non-survivable injury, and situations in which
- occlusion will predictably delay definitive care require explicit exclusion or escalation rules [2,3].
- (2) Common femoral artery access competence. Teams need ultrasound-guided access skills, bailout options, deliberate early arterial access when appropriate,

objective credentialing, scheduled rehearsal, and a documented maintenance plan. Access should be practiced as a core resuscitation skill rather than first attempted *in extremis* [27,35–37].

- (3) Device, imaging, and monitoring capability. A program needs an appropriate catheter and sheath, reliable placement strategy, proximal pressure monitoring, and distal pressure monitoring when partial occlusion is intended. Equipment standardization reduces cognitive load and prevents incompatible components.
- (4) Damage-control resuscitation capacity. REBOA should occur alongside balanced blood-product resuscitation, warming, calcium replacement, and correction of coagulopathy, not instead of them. A balloon cannot replace blood or definitive hemostasis.
- (5) Occlusion strategy and clock discipline. The zone, complete or partial strategy, inflation volume, proximal and distal pressures, and cumulative occlusion time should be documented in real time. Teams need pre-agreed thresholds for conversion to partial flow, deflation, abandonment, or escalation.
- (6) Definitive control and transport pathway. The operating room, interventional radiology suite, or receiving trauma center must be activated before or at balloon inflation. Transfer use requires a trained escort, blood, monitoring, communication, catheter-security plan, and immediate acceptance by a destination team.
- (7) Aftercare, vascular rescue, and governance. Sheath removal, distal pulse checks, duplex or angiographic assessment when indicated, thrombectomy or repair access, complication reporting, and multidisciplinary case review are part of the intervention. Programs should maintain a prospective registry with attempt denominators and stop implementation if safety signals exceed predefined thresholds.

Competency, Credentialing, and Maintenance of Proficiency

Training should be competency-based rather than attendance-based. A core curriculum should assess candidate selection and exclusions, ultrasound-guided common femoral access, device preparation and zone selection, complete and partial occlusion, pressure-guided titration, clock discipline, controlled deflation, vascular aftercare, team communication, and handover. In an 11-resident pilot, a 12-hour multimodal curriculum using lectures, case studies, task trainers, and perfused cadavers improved knowledge and achieved correct indication recognition and placement in all participants at the immediate assessment; most participants retained knowledge and skills at four months [35]. A separate 28-participant course using a puncture model and vascular circuit model shortened procedure time on repeat

attempts [37]. These studies demonstrate that performance can be trained and objectively assessed, but neither defines a universal threshold for independent practice.

Credentialing should therefore be local, multidisciplinary, and linked to the actual care pathway. Suggested requirements include completion of a validated course, objective checklist performance, supervised or proctored cases where feasible, and explicit authorization for access, balloon management, and post-procedure care. Maintenance should combine scheduled low-frequency simulation, review of access and deployment failures, device drills, and case-based quality assurance; the optimal retraining interval is not established. Community-program experience also emphasizes interprofessional roles, team dynamics, financial and equipment planning, and continual quality assurance [36]. In low-volume or austere systems, loss of proficiency or inability to rescue complications should trigger retraining, restriction, or program suspension.

A STAGED IMPLEMENTATION PATHWAY

Stage 0—Not ready. Systems without reliable blood products, access competence, immediate definitive hemorrhage control, or vascular rescue should not deploy REBOA clinically. Training and trauma-system repair take precedence over device purchase.

Stage 1—Foundational capability. Build ultrasound-guided femoral access, massive transfusion, competency-based training, objective credentialing, periodic simulation, device standardization, documentation, receiving-center agreements, and a registry. Candidate-volume studies may inform planning, but they should not be mistaken for proof of benefit.

Stage 2—Controlled in-hospital implementation. Begin with narrowly defined indications in a center able to move directly to surgery or endovascular control. Require a credentialed operator, dual-operator or proctor oversight during initial implementation, real-time occlusion tracking, and mandatory vascular follow-up.

Stage 3—Transfer or prehospital extension. Expand only after demonstrated in-hospital reliability, documented competency maintenance, and governed outcomes. Prehospital or transfer programs require additional capabilities: mobile blood, transport-compatible monitoring, catheter fixation, partial-occlusion titration where used, remote consultation, and rehearsed handover.

This staged pathway is deliberately conservative. It treats technical success as an implementation metric, not as a patient-centered endpoint, and it makes deimplementation possible when complications, delay, case volume, or loss of proficiency undermine net benefit. Figure 5 summarizes the readiness gate and patient pathway from selection through definitive hemostasis, vascular aftercare, and case review.

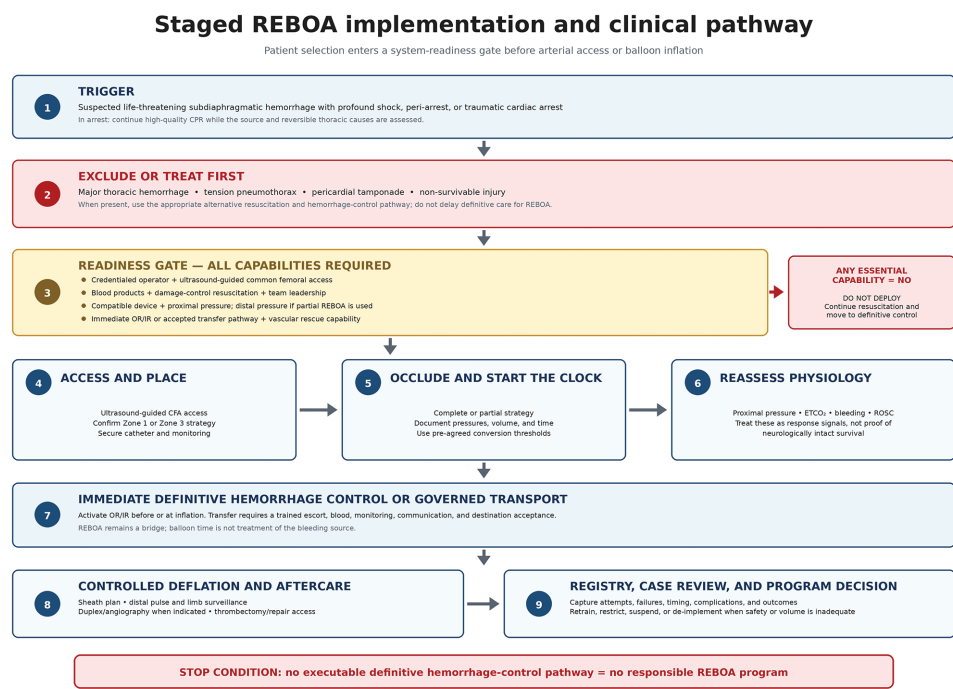


Figure 5 Staged REBOA implementation and clinical pathway. Suspected life-threatening subdiaphragmatic hemorrhage enters a readiness gate before arterial access. Failure of any essential capability is a stop condition. Physiologic response signals, including proximal pressure, end-tidal carbon dioxide (ETCO₂), or return of spontaneous circulation (ROSC), guide resuscitation but do not substitute for immediate definitive hemorrhage control. REBOA: resuscitative endovascular balloon occlusion of the aorta; CFA: common femoral artery; CPR: cardiopulmonary resuscitation; IR: interventional radiology; OR: operating room.

MINIMUM DATASET AND RESEARCH PRIORITIES

Future studies should report all eligible patients, all arterial-access attempts, all balloon-deployment attempts, failures, reasons for non-use, and the complete timing chain from injury to access, inflation, definitive control, and deflation. Outcomes should include standardized survival time points, neurologic status, proximal pressure and ETCO₂ response where applicable, blood products, organ ischemia, acute kidney injury, access complications, limb ischemia, thrombectomy or repair, and device failure.

Prospective multicenter registries should stratify by setting, mechanism, arrest status, zone, complete versus partial occlusion, device profile, operator cadre, and transfer time. Comparative questions require aligned estimands and careful control of confounding by indication. Qualitative implementation research should evaluate training burden, governance, cost, blood and transport constraints, and reasons why programs stop or fail to mature. The most important evidence gap is not another isolated technical success; it is the denominator-based performance of complete care systems. The proposed minimum implementation dataset is detailed in Table 4.

LIMITATIONS OF THIS REVIEW

This is a narrative review and might not identify every relevant report. The evidence map includes heterogeneous settings and publication types, and many numerical details derive from very small selected cohorts. Formal duplicate screening, protocol registration, risk-of-bias scoring, and meta-analysis were not performed. Several recent reports are single-center or case-based, and publication bias toward successful or novel use is likely. The readiness framework is an evidence-informed proposal that requires prospective validation.

CONCLUSIONS

REBOA can be deployed and can improve proximal hemodynamics in selected austere, prehospital, military, transfer, and resource-constrained systems. These physiologic responses might be useful during profound shock or selected TCA, but they do not establish neurologically intact survival. Current evidence does not demonstrate a mortality benefit, and vascular or access complications remain clinically important. Partial REBOA might expand the bridge window only when monitoring, titration, transport, and definitive-care requirements

Table 4 Minimum dataset for implementation studies and registries.

Domain	Required Fields
Denominators	Eligible patients; access attempts; deployment attempts; inflations; partial-occlusion cases; non-use reasons
Timing	Injury, arrival, decision, arterial access, balloon inflation, definitive-control start, deflation, sheath removal
Patient state	Mechanism, bleeding territory, arrest status, SBP/MAP/DBP, ETCO ₂ where applicable, lactate/base deficit, transfusion before inflation
Procedure	Operator, training, ultrasound, sheath/device, zone, complete/partial, proximal/distal pressures, migration
Resuscitation	Blood products, calcium, warming, vasopressors, co-interventions, transport mode and duration
Definitive control	Operation/embolization, time to hemostasis, receiving-center capability, transfer failure or delay
Outcomes	ROSC, 3-h/24-h/30-d/discharge survival, neurologic status, ICU/hospital stay, organ failure
Safety	Access injury, thrombosis, limb ischemia, embolization, AKI, bowel ischemia, amputation, vascular intervention
Implementation	Case volume, protocol deviations, equipment failures, staff burden, cost, governance actions, program suspension

Note: Prospective capture of failures and non-use decisions is essential to avoid success-only reporting. SBP: systolic blood pressure; MAP: mean arterial pressure; DBP: diastolic blood pressure; ETCO₂: end-tidal carbon dioxide; ROSC: return of spontaneous circulation; ICU: intensive care unit; AKI: acute kidney injury.

are met. The highest-yield implementation decision is therefore not whether to buy a catheter, but whether the system can reliably deliver the entire REBOA pathway. Adoption should proceed through competency-based training, a governed readiness bundle, staged implementation, denominator-based surveillance, and an immediate route to definitive hemorrhage control.

Ethics Statement

Not applicable. This narrative review analyzes previously published literature and contains no new human or animal data.

Conflicts of Interest

The authors report no conflicts of interest or other relevant financial or non-financial relationships.

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Author Contributions

NAS: conceptualization, investigation, writing—original draft, project administration. AK: methodology, validation, supervision, writing—review and editing. LA: investigation, data curation, visualization, writing—original draft. RU: conceptualization, methodology, data curation, visualization, writing—original draft, writing—review and editing, project administration. AZ: methodology, validation, supervision, writing—review and editing. SA: investigation, data curation, writing—review and editing. HU: investigation, data curation, writing—review and editing. All authors

reviewed and approved the final manuscript and agree to be accountable for the work.

Data Availability

All evidence discussed in this review is available in the cited publications. The manuscript tables provide a structured traceability summary.

Declaration of the Use of Generative AI and AI-Assisted Technologies in the Writing Process

During the preparation of this work, the authors used OpenAI ChatGPT (GPT-5.6 Pro; accessed 9 August 2026) to assist with organization, language editing, and drafting reproducible figure code. The tool was not used as an evidence source or to make independent clinical judgments. After using this tool, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

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