Fluid and Vasopressor Therapy in Septic Shock Patients What's New in 2026?

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SPECIAL ARTICLE

Surviving Sepsis Campaign: International Guidelines for Management of Sepsis and Septic Shock 2026

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Sepsis, life-threatening acute organ dysfunction due to infection (1), is a global health priority (2, 3) with approximately 49 million cases and 13 million sepsis-related deaths each year (4–6). Beyond being acutely deadly, sepsis contributes to new and worsened physical, cognitive, and mental health problems in many survivors (7, 8). Early identification and treatment are critical to improving outcomes.

The Surviving Sepsis Campaign (SSC) guidelines are intended to support clinicians caring for adult patients with sepsis, focusing on management in the hospital, the immediate prehospital setting, and the immediate post-hospital setting. These guidelines incorporate principles of antimicrobial stewardship through responsible antimicrobial use, proper diagnostic strategies, and de-escalation of antimicrobial therapy. The recommendations reflect evidence-based best practice, distilling a large body of research into actionable recommendations. They empower individuals and health systems to make informed choices about care and support improvements in management and outcomes of sepsis (**Table 1**).

2004 Original
2008 Update
2012 Update

2016 Update
2021 Update
2026 Update

Statements of 2026 Sepsis Guidelines

Screening and early management	15
Infection	26
Hemodynamic management	23
Respiratory support	14
Additional and adjunctive therapies	21
Goals of care	8
Transitions of care	16
Long-term outcomes and recovery	6
Total	**129**

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CONFERENCE REPORTS AND EXPERT PANEL

European Society of Intensive Care Medicine (ESICM) 2025 clinical practice guideline on fluid therapy in adult critically ill patients: part 2—the volume of resuscitation fluids

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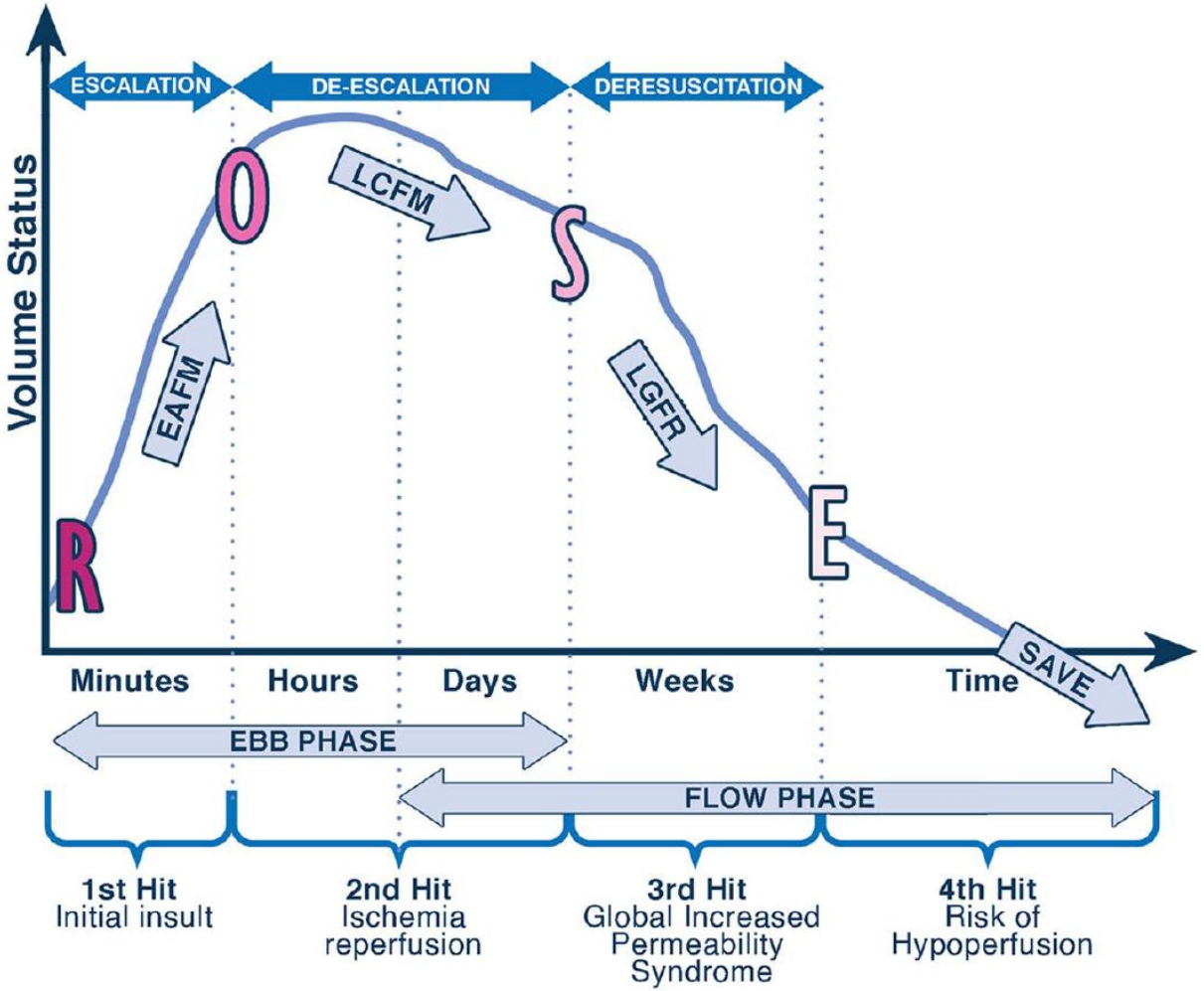
Fluid Resuscitation

Fluid Resuscitation

- Fluid types
  - Crystalloids (balanced crystalloids vs. normal saline)
  - Colloids (albumin, ~~starches~~, ~~gelatin~~)
  - Blood components

- Fluid dosing
  - Dose (fluid amount / infusion rate)
  - Fluid responsiveness

Concept of Fluid Stewardship



R Life saving **Resuscitation** phase with focus on **patient rescue** and early adequate fluid management (EAFM), eg 30ml/kg/1hr according to SSCG or a fluid challenge/bolus of 4ml/kg given in 5-10 minutes.

O **Optimization** phase with focus on **organ rescue** (maintenance) and avoiding fluid overload (fluid creep). Aiming for neutral fluid balance.

S **Stabilization** phase with focus on **organ support** (homeostasis).
Late conservative fluid management (LCFM) is defined as two consecutive negative FB within 1st week after initial insult.

E **Evacuation** phase with focus on **organ recovery** and resolving fluid overload (in case of no flow state) with active late goal directed fluid removal (LGFR) and negative FB.

Malbrain. Intensive Care Med. 2022

Clinical Trials of Fluid Resuscitation

	Initial phase	Optimization phase
Fluid dosing strategy	Goal directed Fixed dose Protocolized	Liberal vs. Restrictive
Fluid type	Crystalloid (Saline vs balanced crystalloid) Colloid	Crystalloid (Saline vs balanced crystalloid) Colloid

Initial Resuscitation #10

10. For adults with sepsis-induced hypoperfusion or septic shock, we "suggest" administering at least 30 mL/kg of IV crystalloid in the first 3 hr. Revisited

(conditional recommendation, low certainty evidence)

Remark: Consideration should be given to individual patient characteristics and context when selecting initial fluid volume.

Remark: Clinicians prescribing fluids should perform frequent, ongoing reassessment and closely monitor patients to avoid harms of under- or over-resuscitation.

Remark: Weight-based fluid volume should be calculated based on actual body weight, or by adjusted or ideal body weight in patients with body mass index > 30 kg/m^2 (**Table 4**).

30 mL/kg crystalloids (SSC 2016~)

vs.

Other approaches

- lower volume resuscitation
- individualized approach
- vasopressor first approach

ESICM 2025 guidelines

In adults with sepsis or septic shock who require fluid resuscitation for circulatory failure, we suggest administering up to 30 ml/kg of intravenous crystalloids in the initial phase.

The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

Early, Goal-Directed Therapy for Septic Shock — A Patient-Level Meta-Analysis

N Engl J Med 2017;376:2223-34.

Patient-level meta-analysis of the ProCESS, ARISE, and ProMISe trials

Table 1. (Continued.)

Characteristic	EGDT (N=1857)	Usual Care (N=1880)
Time from ED presentation to first IV antimicrobial agents — min**		
Median	75	72
IQR	42–120	42–119
IV fluids administered before hospital presentation until randomization — no./total no. (%)	1801/1846 (97.6)	1818/1871 (97.2)
Volume administered — ml		
Median	2000	2000
IQR	1250–3000	1200–3000
Volume administered per kilogram of body weight — ml		
Median	27.5	27.7
IQR	16.5–42.3	16.2–41.7

Timing of Vasopressor Initiation #11

11. For adults with sepsis-induced hypotension, we "suggest" initial IV crystalloid fluid bolus resuscitation followed by vasopressor support if hypotension persists.

New

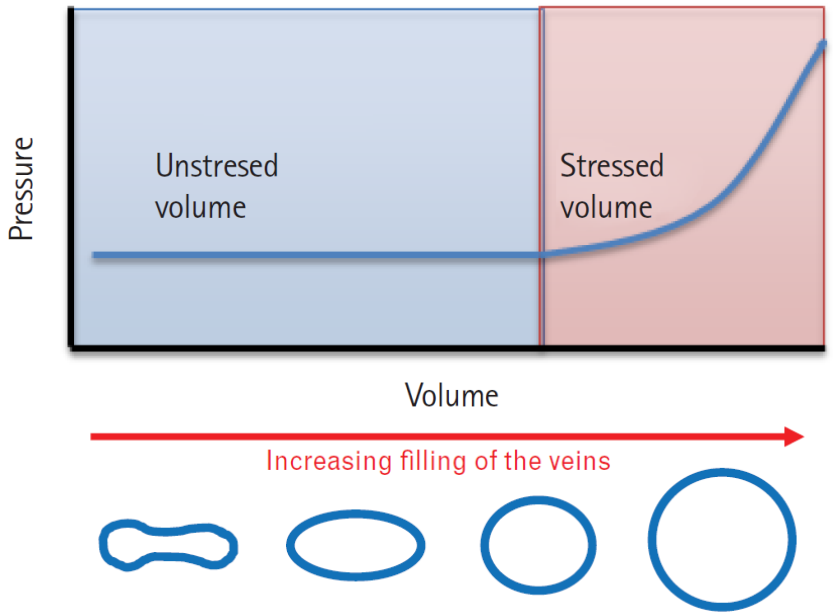
(conditional recommendation, very low certainty evidence)

Remark: In patients with unstable septic shock, immediate concurrent administration of vasopressors together with IV crystalloid fluid may be warranted on a case-by-case basis. Presence of unstable shock should be determined by physical examination. Suggestive clinical features of unstable shock include severely reduced blood pressure, mottled skin, ashen appearance, cyanosis/decreased oxygen saturation, tachycardia, and altered mentation.

Rationale for earlier vasopressor initiation:

- Faster restoration of BP
- Prevention of fluid overload

Concept of **Stressed Volume**



Liberal vs. Conservative Approach #48

Liberal Vs. Conservative Approach to Resuscitation

48. For adults with sepsis or septic shock who have already received fluid resuscitation with 30 mL/kg and have persistent hypoperfusion, we "suggest" using either a liberal or a restrictive fluid resuscitation strategy based on individual patient and health system factors. Revisited

(conditional recommendation, low certainty evidence)

Remark: There was wide variability in the protocols used and the volume of fluids received in the liberal vs. restrictive arms across trials. Patient and health system factors to be considered include patients' current clinical conditions and chronic illnesses (e.g., heart failure) and the availability of monitored beds (i.e., if a restrictive approach necessitates vasopressor use).

- Optimization phase (after 30 mL/kg initial resuscitation)
- Wide variability in the protocols

ESICM Guidelines about Optimization Phase Resuscitation

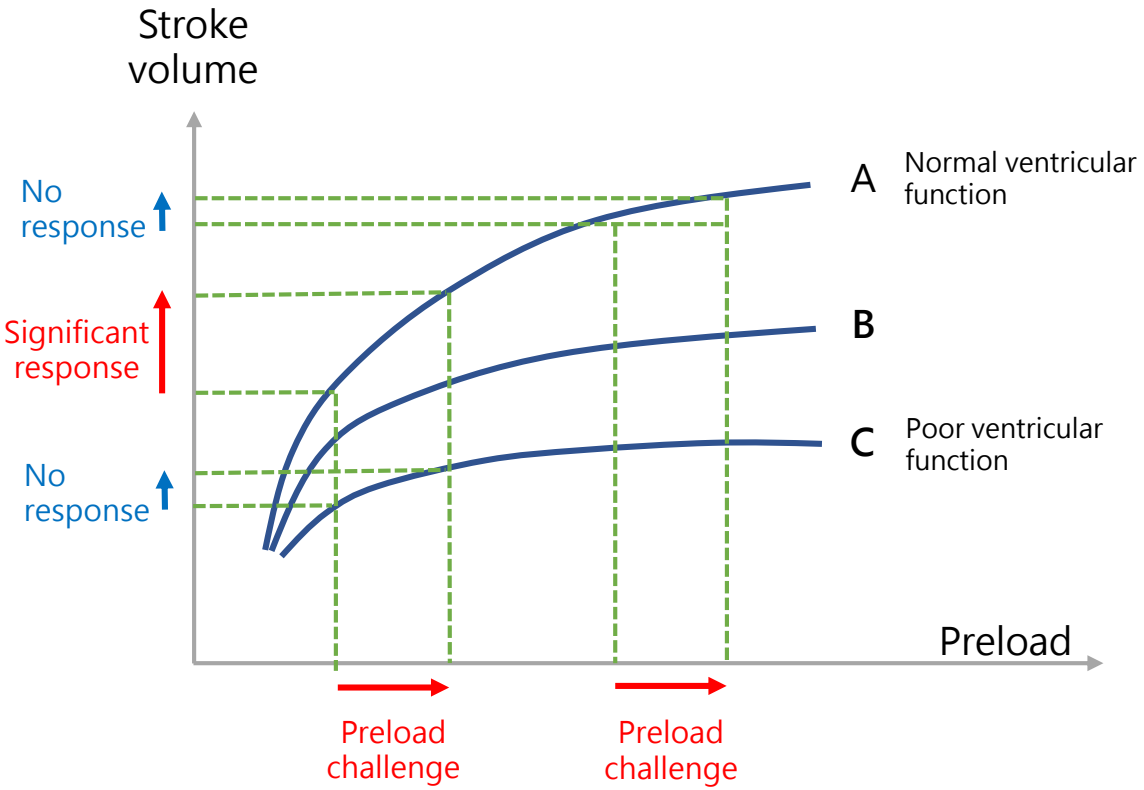
Should a liberal vs. restrictive strategy be used in the optimization phase of resuscitation of circulatory failure in critically ill patients with sepsis or septic shock?	**Should an individualized approach vs a non-individualized approach be used for the optimization phase of resuscitation of circulatory failure in critically ill patients with sepsis or septic shock?**
In adults with sepsis or septic shock who need fluid resuscitation for circulatory failure, we **cannot recommend for or against** systematic restrictive or liberal fluid administration (no recommendation; moderate level of evidence for no effect).	In adults with sepsis or septic shock who require fluid resuscitation for circulatory failure, we **suggest using an individualized approach** compared with a non-individualized approach during the optimization phase (conditional recommendation, very low certainty of evidence).

Fluid Responsiveness #49

Fluid Resuscitation Guided by Dynamic Measures

49. For adults with sepsis or septic shock, we "suggest" using dynamic measures to guide fluid resuscitation over physical examination or static measures alone. (conditional recommendation, low certainty evidence) *Remark*: Dynamic measures include response to a passive leg raise or a fluid bolus using stroke volume (SV), stroke volume variation (SVV), pulse pressure (PP), or pulse pressure variation (PPV).	Revisited

Frank-Starling Curve



Predicting "Fluid Responsiveness"

Table 1 Summary of methods predicting preload responsiveness with diagnostic threshold and limitations

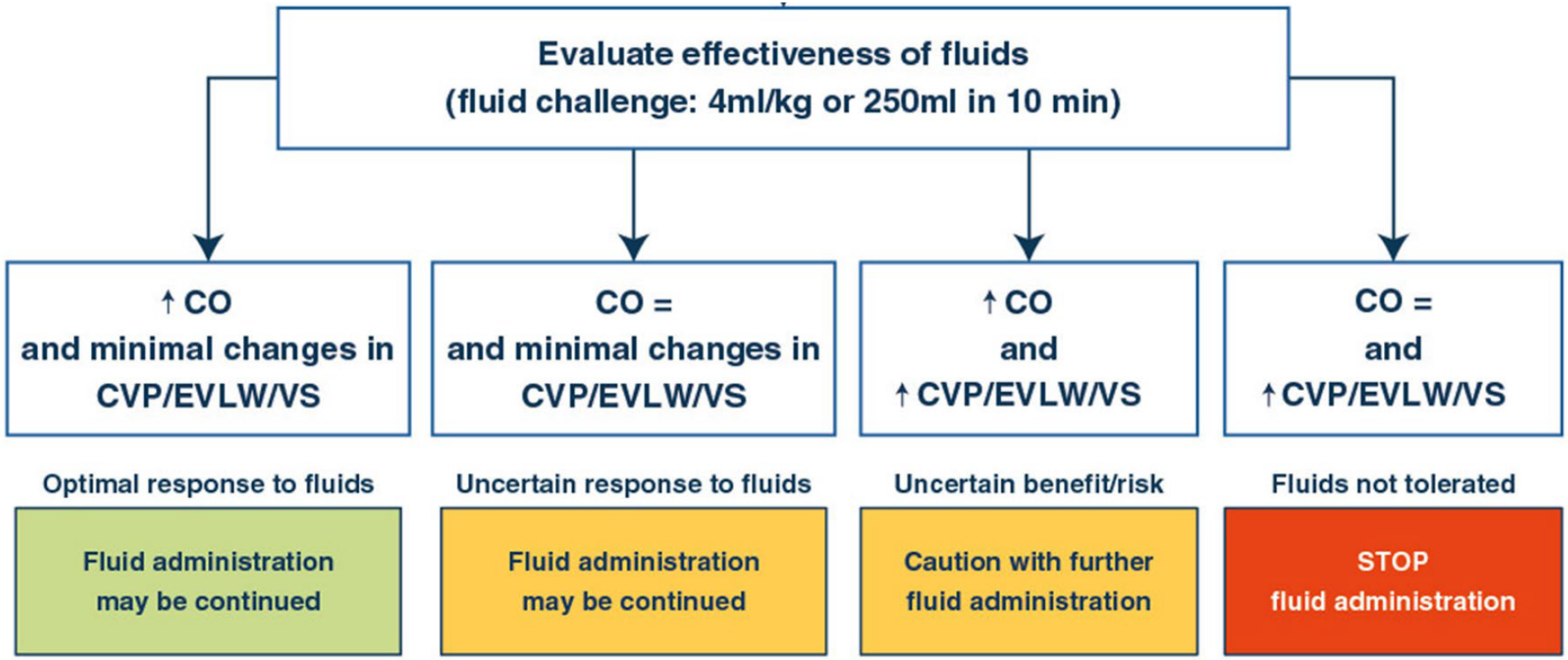
Method	Threshold	Main limitations
Pulse pressure/stroke volume variations [22]	12%	Cannot be used in case of spontaneous breathing, cardiac arrhythmias, low tidal volume/lung compliance
Inferior vena cava diameter variations [44]	12%	Cannot be used in case of spontaneous breathing, low tidal volume/lung compliance
Superior vena caval diameter variations [44]	36%*	Requires performing transesophageal Doppler Cannot be used in case of spontaneous breathing, low tidal volume/lung compliance
Passive leg raising [55]	10%	Requires a direct measurement of cardiac output
End-expiratory occlusion test [75]	5%	Cannot be used in non-intubated patients Cannot be used in patients who interrupt a 15-s respiratory hold
"Mini"-fluid challenge (100 mL) [84]	6%**	Requires a precise technique for measuring cardiac output
"Conventional" fluid challenge (500 mL) [81]	15%	Requires a direct measurement of cardiac output Induces fluid overload if repeated

* Thresholds from 12 to 40% have been reported

** 10% is more compatible with echography precision. Citations indicate the most important reference regarding the test

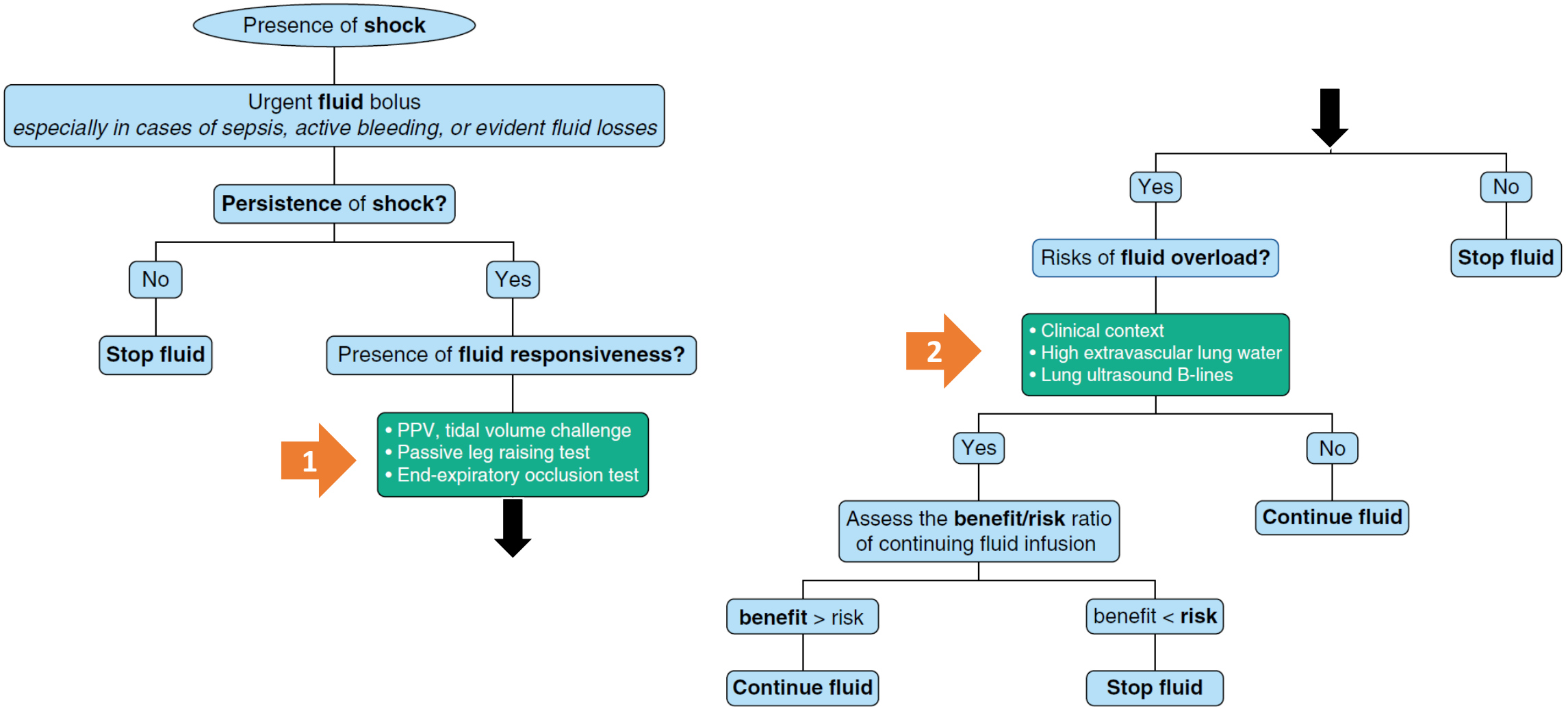
Monnet. Ann Intensive Care 2016

Fluid Challenge



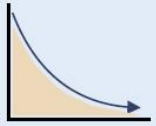
Backer. Intensive Care Med 2022

Decision Algorithm for Fluid Administration



Teboul. Am J Respir Crit Care Med 2019

Evolution of Septic Shock Resuscitation Concepts:
From Single Targets to Personalized Physiology-Guided Therapy

	2001	2010	2014	2019	2022	2025
Key trials Milestones	**EGDT** $ScvO_2$-guided resuscitation	**LACTATE** Lactate-guided resuscitation	**SEPSISPAM** MAP Targets	**ANDROMEDA-SHOCK** CRT targeted resuscitation	**CLASSIC** Restrictive vs. liberal fluid strategies	**ANDROMEDA-SHOCK 2** CRT targeted personalized resuscitation
Physiological paradigm	**Optimizing global oxygen delivery**  Correcting low $ScvO_2$ by improving DO_2 to restore DO_2/VO_2 balance	**Metabolic resuscitation**  Hyperlactatemia as a marker of tissue hypoperfusion and resuscitation target	**Higher pressure targets**  Higher perfusion pressures might improve tissue perfusion	**CRT as a reperfusion signal**  CRT normalization may be a signal of successful reperfusion	**Avoiding fluid excess**  Restrictive fluids might prevent fluid-induced harm	**Toward tailored, physiology-guided care**  Sequential, multilayered assessment targeting on pathophysiology-guided interventions
Conceptual evolution	**Perfusion-oriented resuscitation**  Use of physiological information to guide resuscitation	**From marker to target**  Shift from a prognostic marker to a quantifiable treatment target	**Context defines MAP meaning**  Interpreting MAP requires a physiological perspective	**Targeting peripheral perfusion**  CRT as a target to tailor fluids, vasopressors and inotropes	**Fluid therapy needs individualization**  Fluid therapy to become a physiology-guided, individualized intervention	**Personalization of resuscitation**  Personalized, phenotype-driven resuscitation with serial reassessment

Hernandez. Crit Care 2026

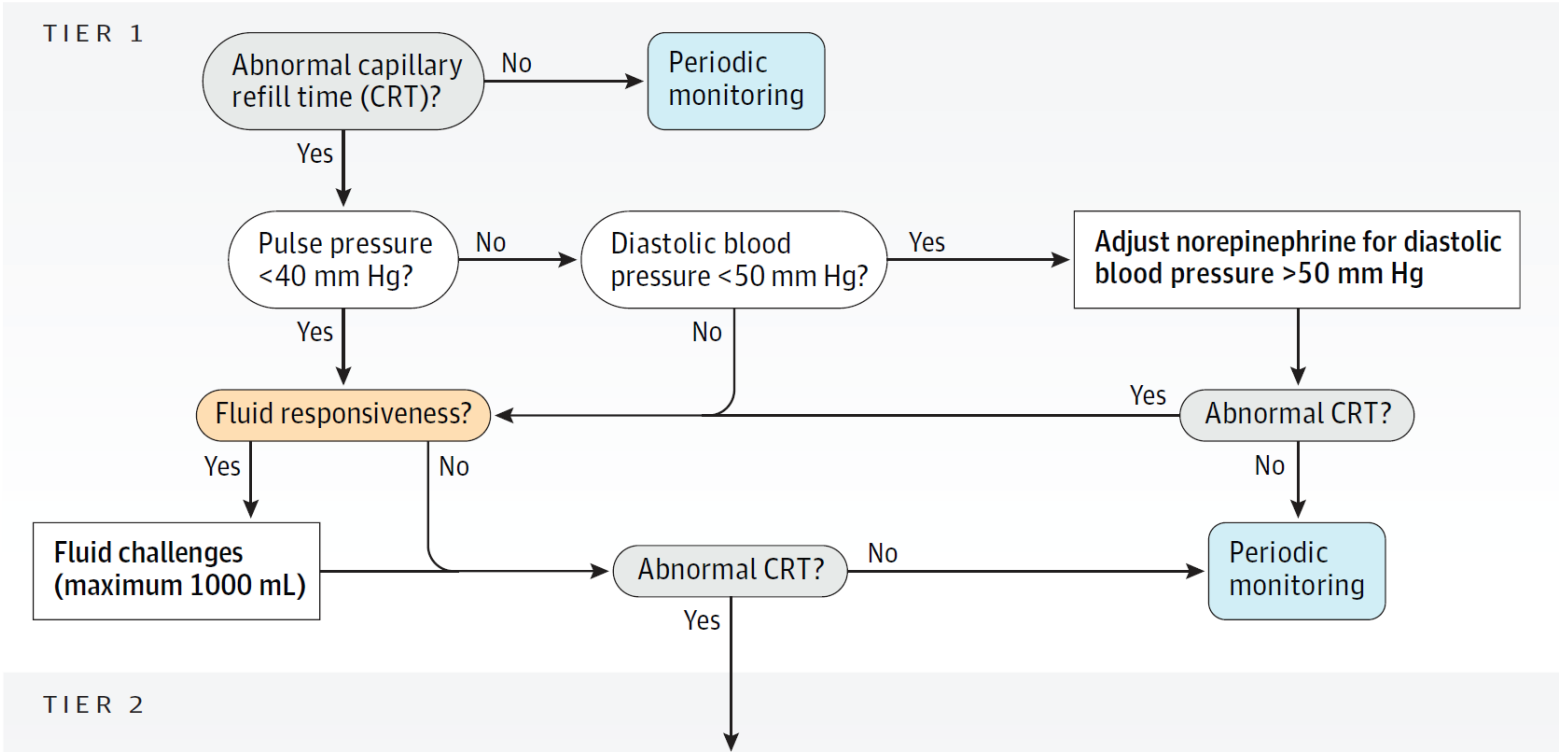
JAMA | Original Investigation | CARING FOR THE CRITICALLY ILL PATIENT

Personalized Hemodynamic Resuscitation Targeting Capillary Refill Time in Early Septic Shock

The ANDROMEDA-SHOCK-2 Randomized Clinical Trial

The ANDROMEDA-SHOCK-2 Investigators for the ANDROMEDA Research Network, Spanish Society of Anesthesiology, Reanimation and Pain Therapy (SEDAR), and Latin American Intensive Care Network (LIVEN)

Personalized hemodynamic resuscitation protocol targeting capillary refill time (CRT-PHR)



Fluid Type

Fluid Formulations

Balanced crystalloids

	Human plasma	Colloids		Crystalloids			
		25% albumin	5% albumin	0.9% NaCl	0.45% NaCl	Plasma-Lyte	Lactated Ringer's
Osmolarity (mOsm/L)	280-290			308	154	294	284
Na+ (mmol/L)	135-145	130-160	130-160	154	77	140	130
K+ (mmol/L)	4.5-5.0					5	4
Ca2+ (mmol/L)	2.2-2.6					0	2.7
Mg2+ (mmol/L)	0.8-1.0						
Cl- (mmol/L)	94-111			154	77	98	109
Buffering agent (Bicarbonate precursors)						Acetate 27 Gluconate 23	Lactate 28
pH	7.35-7.45	6.4-7.4	6.4-7.4	5.5		7.4	6.5
Intravascular volume expansion		400% (?)	100%	25%	15%		25%

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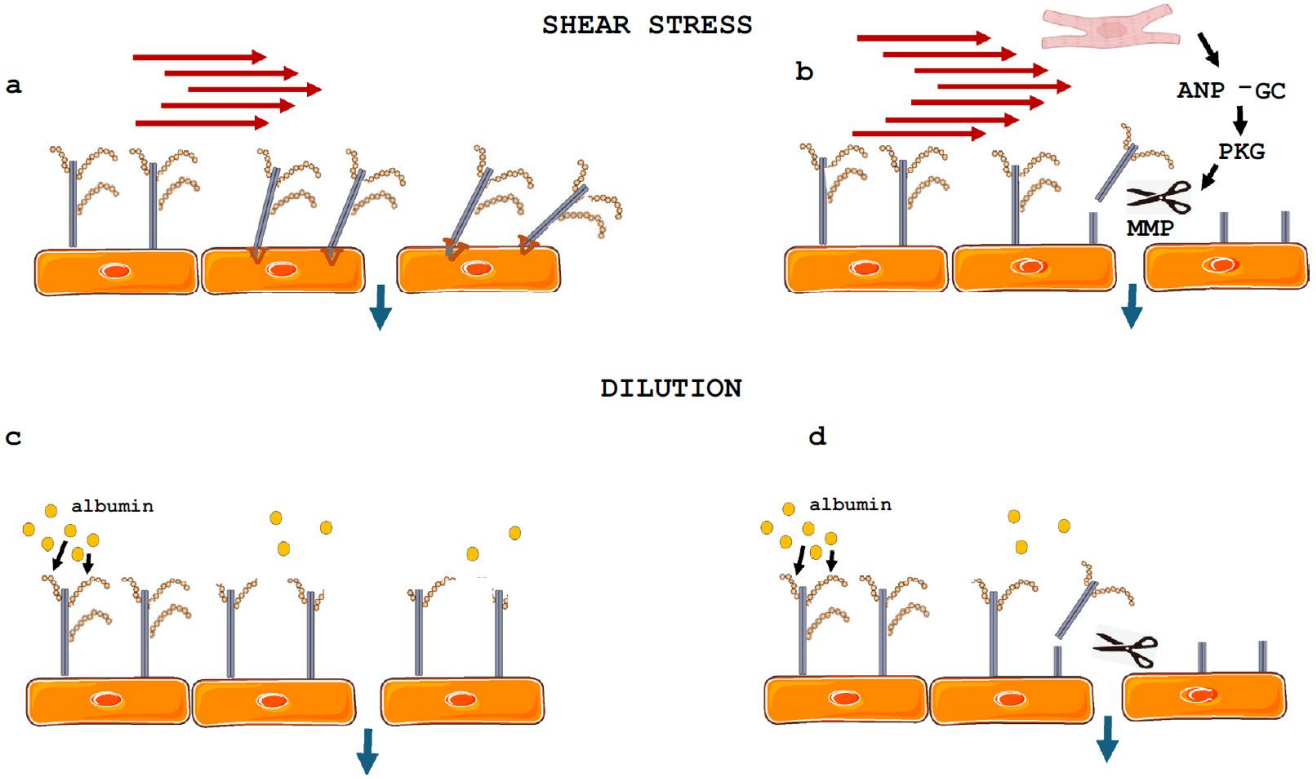
WHAT'S NEW IN INTENSIVE CARE

Vascular permeability and loss of glycocalix in sepsis: the role of fluid resuscitation

Nicole P. Juffermans[1,2*], Peter Radermacher[3,4] and Jérémie Joffre[5,6]



"Glycocalyx-friendly" resuscitation strategy

Fluid Type (Crystalloid vs Colloid) #43 # 45

43. For adults with sepsis or septic shock, we "recommend" using crystalloids as first-line fluid for resuscitation.
(strong recommendation, moderate certainty evidence)

Carryover

45. For adults with sepsis or septic shock, we "suggest" using crystalloids alone over crystalloids with supplemental albumin for fluid resuscitation.
(conditional recommendation; moderate certainty evidence)
Remark: Use of supplemental albumin may be appropriate for patients who already received large crystalloid volumes or have cirrhosis. Supplemental albumin should be avoided in patients with ~~traumatic brain injury~~.

Revisited

- Crystalloids v.s. colloids
  - No clear benefit for colloids administration compared to crystalloid solutions.
  - Crystalloids are inexpensive and widely available.
- Rationale for post large-volume-crystalloids (ALBIOS trial)
  - higher blood pressure
  - higher static filling pressures
  - lower net fluid balance with albumin

Albumin vs. Crystalloids (2024 ESICM Guideline)

Q1 **Should albumin vs. crystalloids be used for volume expansion in adult critically ill patients in general?**

R We suggest using crystalloids rather than albumin for volume expansion in adult critically ill patients in general.[a]

MODERATE CERTAINTY OF EVIDENCE

Q2 **Should albumin vs. crystalloids be used for volume expansion in adult critically ill patients with sepsis?**

R We suggest using crystalloids rather than albumin for volume expansion in adult critically ill patients with sepsis.

MODERATE CERTAINTY OF EVIDENCE

Q3 **Should albumin vs. crystalloids be used for volume expansion in adult critically ill patients with acute respiratory failure?**

R We suggest using crystalloids rather than albumin for volume expansion in adult critically ill patients with acute respiratory failure.

VERY LOW CERTAINTY OF EVIDENCE

Q4 **Should albumin vs. crystalloids be used for volume expansion in adult critically ill patients with traumatic brain injury?**

R We suggest using isotonic saline rather than albumin for volume expansion in adult critically ill patients with traumatic brain injury.[b,c]

VERY LOW CERTAINTY OF EVIDENCE

Q5 **Should albumin vs. crystalloids be used for volume expansion in adult critically ill patients in the perioperative period and patients with bleeding or at risk for bleeding?**

R We suggest using crystalloids rather than albumin for volume expansion in adult critically ill patients in the perioperative period and patients with bleeding or at risk for bleeding.

VERY LOW CERTAINTY OF EVIDENCE

Q6 **Should albumin vs. crystalloids be used for volume expansion in adult critically ill patients with cirrhosis?**

R We suggest using albumin rather than crystalloids for volume expansion in adult critically ill patients with cirrhosis

VERY LOW CERTAINTY OF EVIDENCE

Critically ill patients

Sepsis

Acute respiratory failure

Traumatic brain injury

Perioperative period

Cirrhosis

Fluid Type (Saline vs Balanced crystalloid) #44

44. For adults with sepsis or septic shock undergoing initial resuscitation, we "suggest" using balanced crystalloids over 0.9% saline. Revisited

(conditional recommendation, moderate certainty evidence)

Remark: For patients with sepsis and traumatic brain injury, we suggest using 0.9% saline.

- Individual data meta-analysis (Lancet Respir Med. 2024)
  - 34685 participants from 6 trials
  - Small effect on mortality
  - Small effect on new RRT
- Potential harms of normal saline:
  - Hyperchloremic metabolic acidosis
  - Renal vasoconstriction & AKI
  - Increased cytokine secretion

Vasopressors

Drug	Receptor binding				Hemodynamic effects
	α_1	β_1	β_2	D	
Norepinephrine (0.016-0.064 mg/mL D5W)					
0.02-3 µg/kg/min	++++	++	+	-	SVR↑↑ CO ↑/↔
Epinephrine (0.008-0.064 mg/mL N/S or D5W)					
0.01-0.05 µg/kg/min	++	++++	+++	-	CO ↑↑ SVR ↔
0.05-2 µg/kg/min	++++	+++	+	-	SVR↑↑ CO ↑↑
Vasopressin (N/S or D5W)					
0.01-0.04 U/min	V1 receptor				SVR↑
Dopamine (0.8-3.2 mg/mL N/S or D5W)					
0.5-2 µg/kg/min	-	+	-	+++	CO ↑
5-10 µg/kg/min	+	+++	-	++	CO ↑↑ SVR↑
10-20 µg/kg/min	+++	++	-	++	SVR↑↑ CO ↑
Dobutamine (0.5-4 mg/mL N/S or D5W)					
2.5-20 µg/kg/min	+	++++	++	-	CO ↑↑ SVR↓
Milrinone (0.1-1 mg/mL N/S or D5W)					
0.125-0.75 µg/kg/min	Phosphodiesterase-3 inhibitor				CO ↑ SVR↓

Vasopressors #53 #55

53. For adults with septic shock, we "recommend" using norepinephrine as the first-line agent over dopamine, epinephrine, or selepressin. (strong recommendation) Dopamine. High-certainty evidence Epinephrine. Low certainty evidence Selepressin. Low certainty evidence	Carryover
55. For adults with septic shock, we "suggest" using norepinephrine as the first-line agent over vasopressin or angiotensin II. (conditional recommendation) Vasopressin. Low certainty evidence Angiotensin II. Very low certainty evidence	Revisited

Vasopressors #56 (Vasopressin)

- For adults with septic shock on escalating doses of norepinephrine, we suggest adding vasopressin.
- Rationale:
  - Adjunctive vasopressin vs norepinephrine monotherapy:
    - less atrial fibrillation
    - more digital ischemia.
  - Vasopressin initiation: median dose of 0.3 (IQR, 0.2-0.5) µg/kg/min of norepinephrine.

2021 SSC Guidelines:

- Relative vasopressin deficiency.
- Catecholamine-sparing effect.
- Unlike most vasopressors, vasopressin is not titrated to response, but it is usually administered at a fixed dose of 0.03 units/min for the treatment of septic shock.

Vasopressors #57 #58 (Epinephrine)

57. For adults with septic shock and inadequate MAP levels despite norepinephrine and vasopressin, we "suggest" adding epinephrine. (conditional recommendation, very low certainty evidence) — Revisited

Remark: In settings where vasopressin is not available, epinephrine can be added to norepinephrine alone.

Norepinephrine → Vasopressin → Epinephrine

58. For adults with septic shock with concomitant cardiac dysfunction, we "suggest" using either norepinephrine or epinephrine as first line vasopressor. (conditional recommendation, very low certainty evidence) — New

Remark: Norepinephrine may be preferred in patients with tachyarrhythmia or significant sinus tachycardia. Conversely, epinephrine may be preferred in patients with bradyarrhythmia or significant sinus bradycardia.

Septic + Cardiogenic shock

Take-home Message

- Administer 30 mL/kg of IV crystalloids within the first 3 hours for sepsis-induced hypoperfusion or shock.
- Fluid Choice: Prefer balanced crystalloids over 0.9% normal saline.
- Using dynamic measures to guide fluid resuscitation over physical examination.
- Norepinephrine remains the preferred initial vasopressor. Add vasopressin as a catecholamine-sparing agent if norepinephrine requirements escalate.

Thank You for Listening

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