Intravenous fluid therapy in critically ill adults

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I.V. fluid therapy plays a vital role in establishing and maintaining cellular homeostasis in hospitalized patients. I.V. fluid administration is one of the most frequently used therapies provided in hospitals. The most common indications for fluid bolus therapy in critically ill patients include the management of severe hypovolaemia, sepsis, perioperative correction of large volume losses, and haemodynamic alterations, oliguria, or both that is believed to be volume responsive.

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The inappropriate use of i.v. fluids ranges from inadequate resuscitation or rehydration leading to tissue hypoperfusion to excessive fluid infusion leading to tissue oedema and severe electrolyte derangement.

This results in high levels of morbidity, prolongation of hospitalization, and even excess mortality.

For this reason, it has been recommended that the use of fluid therapy should be accorded similar status as drug prescribing

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similar to other drugs, the adverse effects of fluids are dependent on the type and dose of fluid administered and the specific context in which they are given.

fluids should be considered as any other drug, with specific indications and contraindications. The type of fluid, rate of fluid administration, and dose should also be carefully considered

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Terminology

Fluid bolus: a rapid infusion to correct hypotensive shock. It typically includes the infusion of at least 500 ml over a maximum of 15 min

Fluid challenge: 100–200 ml over 5–10 min with reassessment to optimize tissue perfusion

Fluid infusion: continuous delivery of i.v. fluids to maintain homeostasis, replace losses, or prevent organ injury (e.g. prehydration before operation or for contrast nephropathy)

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Terminology

Maintenance: fluid administration for the provision of fluids for patients who cannot meet their needs by oral route. This should be titrated to patient need and context and should include replacement of ongoing losses. In a patient without ongoing losses, this should probably be no more than 1 –2 ml /kg/h

Daily fluid balance: daily sum of all intakes and outputs

Cumulative fluid balance: sum total of fluid accumulation over a set period of time

Fluid overload: cumulative fluid balance expressed as a proportion of baseline body weight. A value of 10% is associated with adverse outcomes

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Stages of fluid therapy

Rescue

Optimization

Stabilization

De-escalation

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Logically, these describe the four different clinical phases of fluid therapy, occurring over a time course in which patients experience a decreasing severity of illness.

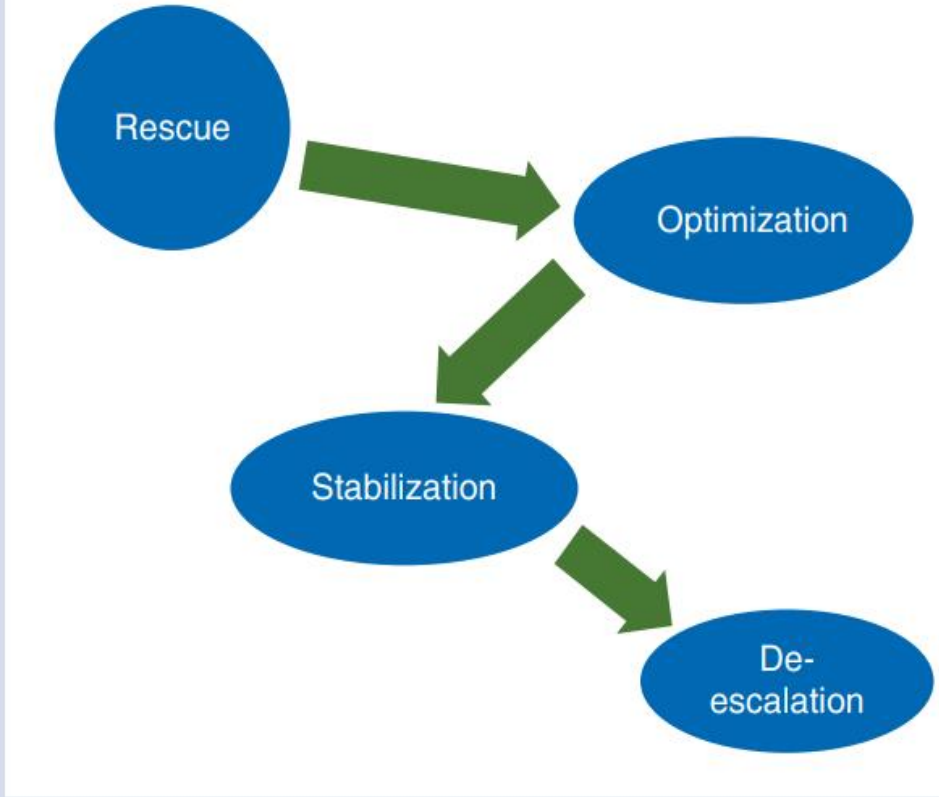

Fig 1 Relationship between the different stages of fluid resuscitation. Reproduced with permission from ADQI (www.ADQI.org).

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The Rescue

The Rescue phase anticipates an immediate escalation of fluid therapy, for resuscitation of the patient with life threatening shock (characterized by low arterial pressure, signs of impaired perfusion, or both), and characterized by the use of fluid bolus therapy

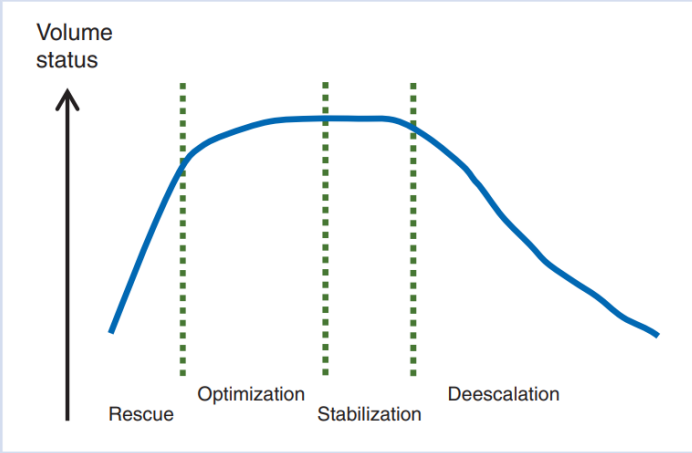

Fig 2 Patients' volume status at different stages of resuscitation. Reproduced with permission from ADQI (www.ADQI.org).

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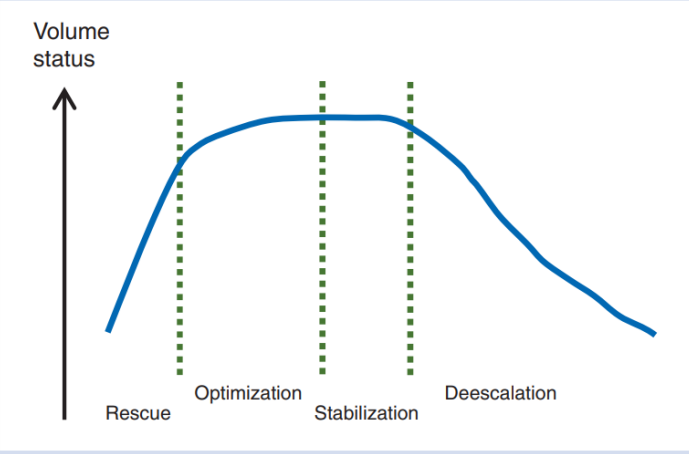
In the Rescue phase, initial management should be initiated using a combination of clinical and haemodynamic parameters together with near-patient diagnostics and without need for sophisticated initial assessment such as echocardiography. In this phase, reassessment and re-challenge should be performed without the clinician leaving the bedside; it requires constant observation of the patient's haemodynamic situation in order to prevent life-threatening over- or undertreatment



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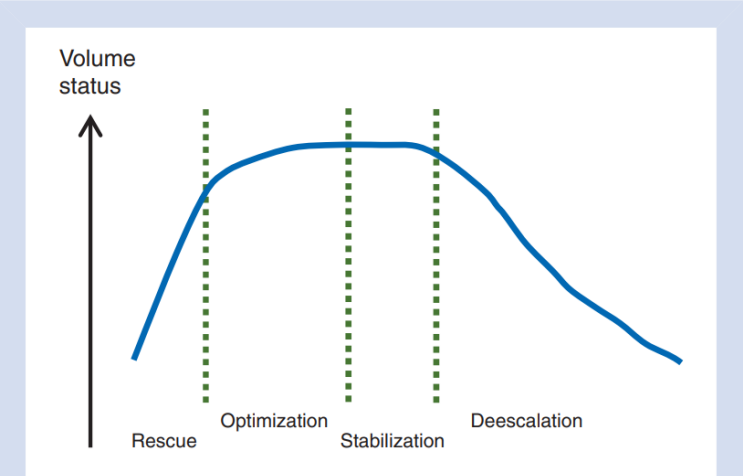
Optimization

In Optimization, the patient is no longer in immediate life-threatening danger but is in a stage of compensated shock (but at high risk of decompensation) and any additional fluid therapy is given more cautiously, and titrated with the aim of optimizing cardiac function to improve tissue perfusion with ultimate goal of mitigating organ dysfunction



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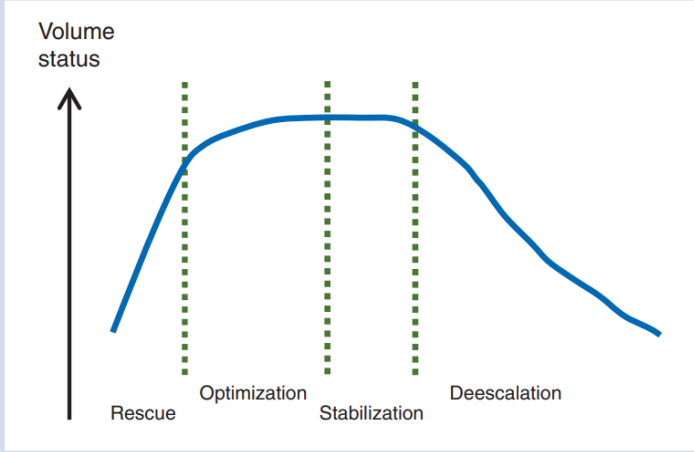
The workgroup felt strongly that a clear distinction had to be made between a ‘fluid bolus’, that is, large volume given rapidly to rescue, without close monitoring, and a ‘fluid challenge’ which was considered as a test where the effects of a more modest volume given more slowly are assessed, in order to prevent inadvertent fluid overload



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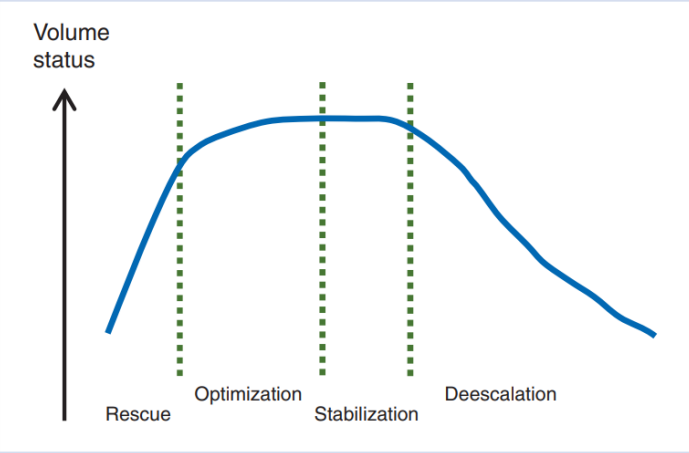
In the Optimization phase, the emphasis of fluid therapy moves away from saving the life of the patient to ensuring adequate blood and therefore oxygen delivery to at-risk organs. The aim in this phase is to prevent subsequent organ dysfunction and failure because of both hypoperfusion and tissue oedema.



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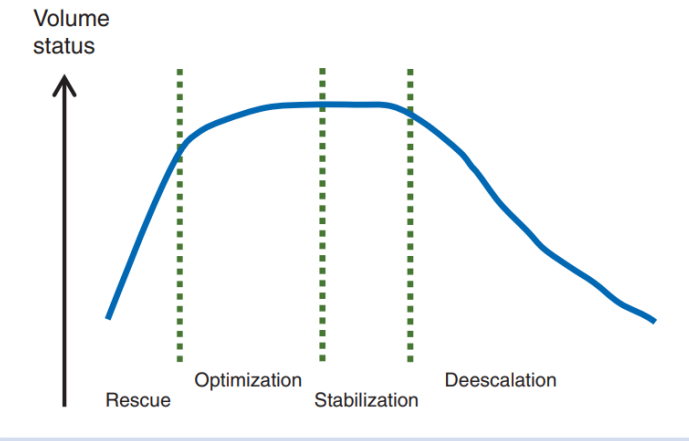
Stabilization

Stabilization reflects the point at which a patient is in a steady state so that fluid therapy is now only used for ongoing maintenance either in setting of normal fluid losses (i.e. renal, gastrointestinal, insensible), but this could also be fluid infusion (including rehydration) if the patient was experiencing ongoing losses because of unresolved pathology



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De-escalation

Finally, while in the first three stages ('SOS'), fluids are usually administered, in the last stage (D), fluids will also be removed from the patient and usually, the goal will be to promote a negative fluid balance

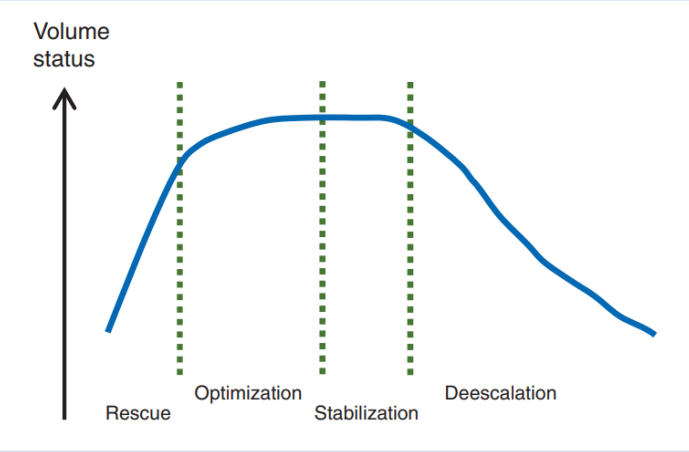

Fig 2 Patients' volume status at different stages of resuscitation. Reproduced with permission from ADQI (www.ADQI.org).

While daily fluid and electrolyte requirements can be reasonably well estimated for the average person, it is becoming more apparent

that patients, and certainly seriously ill patients, are not 'average' and have widely varying and individual requirements. To enable the clinician to assess fluid requirements, we propose a minimum and desirable monitoring set at each stage of fluid therapy

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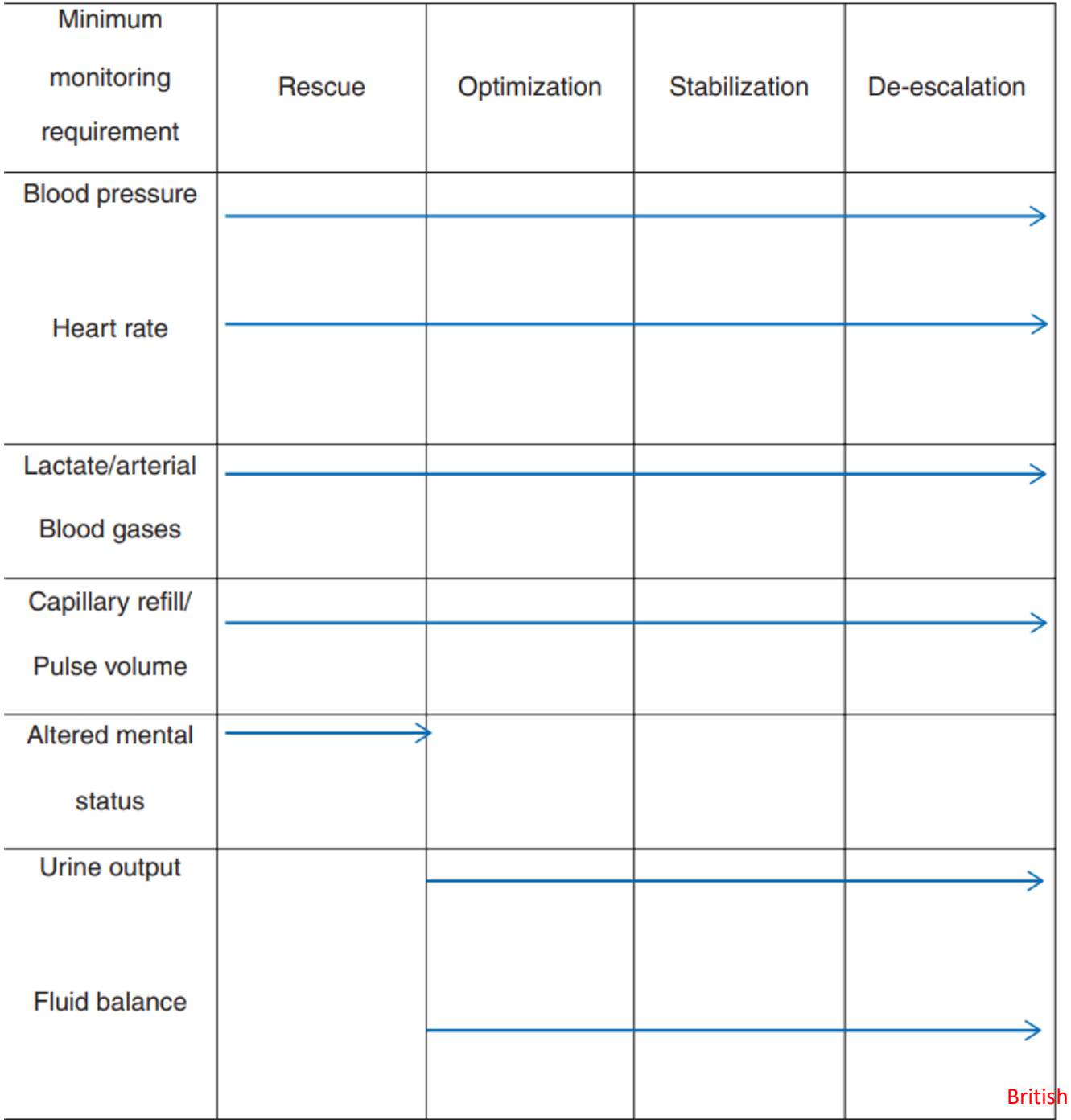

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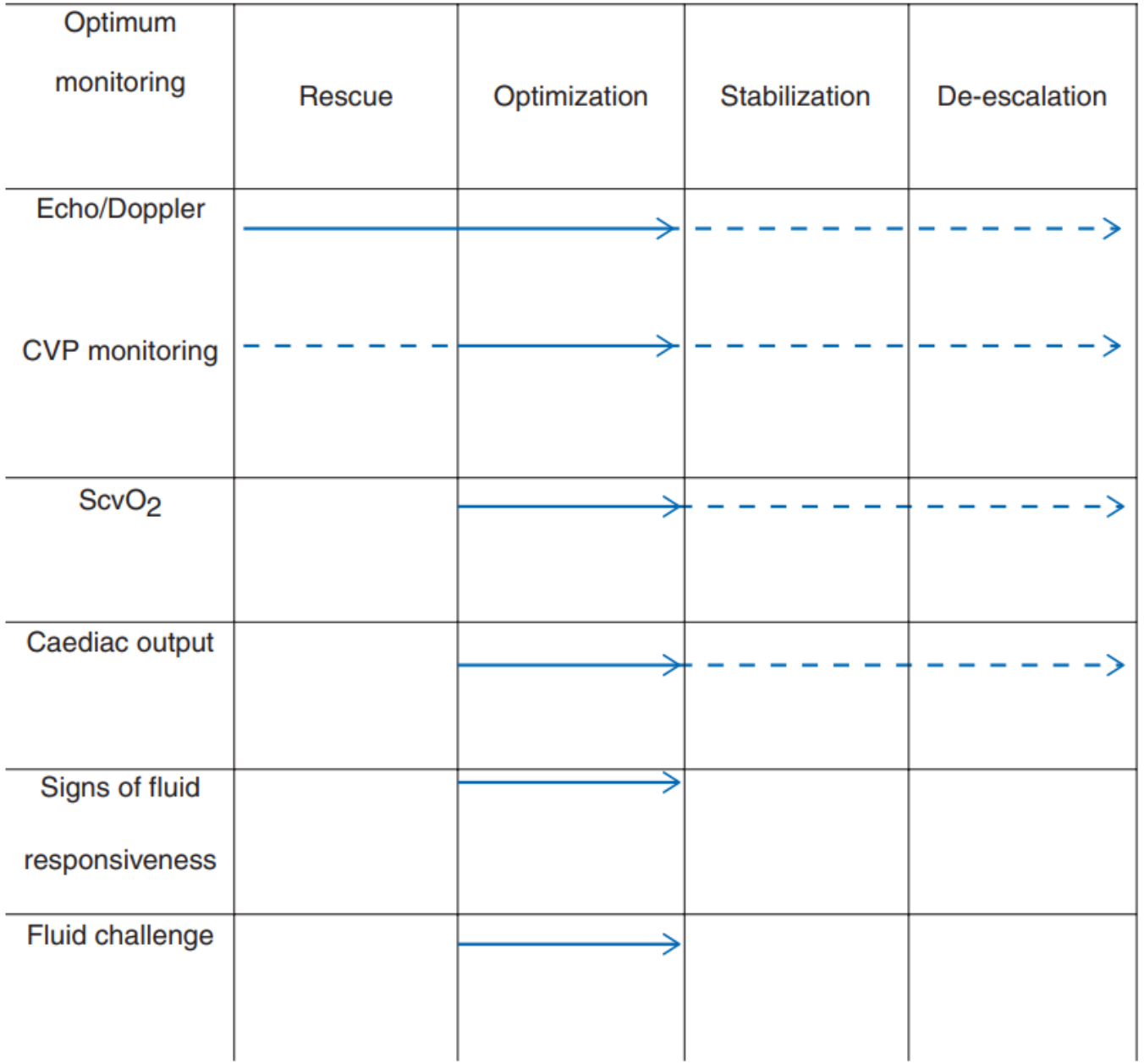

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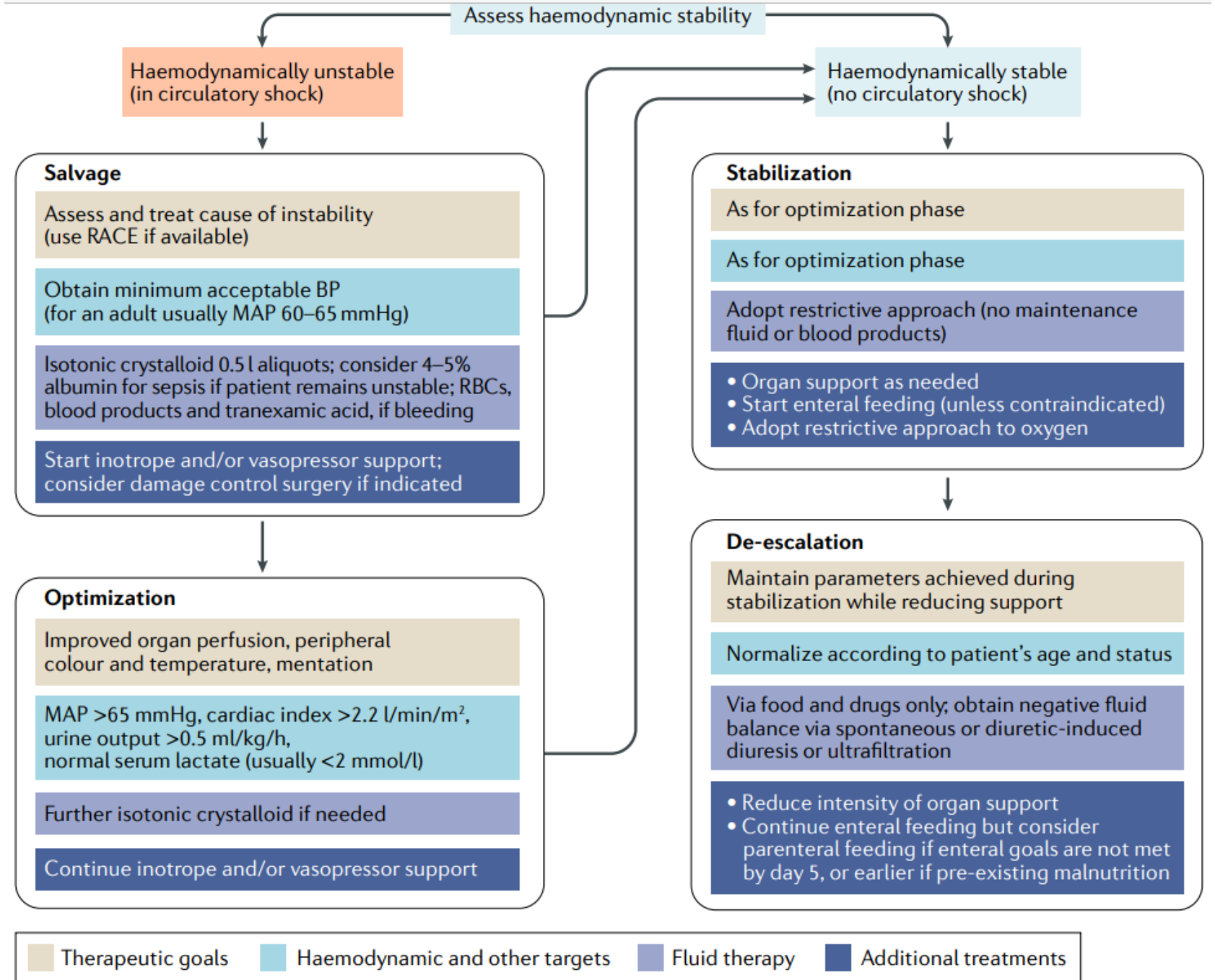
Assess haemodynamic stability
Haemodynamically unstable (in circulatory shock)
Haemodynamically stable (no circulatory shock)
Salvage
Assess and treat cause of instability (use RACE if available)
Obtain minimum acceptable BP (for an adult usually MAP 60–65 mmHg)
Isotonic crystalloid 0.5 l aliquots; consider 4–5% albumin for sepsis if patient remains unstable; RBCs, blood products and tranexamic acid, if bleeding
Start inotrope and/or vasopressor support; consider damage control surgery if indicated
Optimization
Improved organ perfusion, peripheral colour and temperature, mentation
MAP >65 mmHg, cardiac index >2.2 l/min/m², urine output >0.5 ml/kg/h, normal serum lactate (usually <2 mmol/l)
Further isotonic crystalloid if needed
Continue inotrope and/or vasopressor support
Stabilization
As for optimization phase
As for optimization phase
Adopt restrictive approach (no maintenance fluid or blood products)
• Organ support as needed
• Start enteral feeding (unless contraindicated)
• Adopt restrictive approach to oxygen
De-escalation
Maintain parameters achieved during stabilization while reducing support
Normalize according to patient's age and status
Via food and drugs only; obtain negative fluid balance via spontaneous or diuretic-induced diuresis or ultrafiltration
• Reduce intensity of organ support
• Continue enteral feeding but consider parenteral feeding if enteral goals are not met by day 5, or earlier if pre-existing malnutrition
Therapeutic goals
Haemodynamic and other targets
Fluid therapy
Additional treatments

Table 1 Characteristics of different stages of resuscitation: 'Fit for purpose fluid therapy'. GDT, goal directed therapy; DKA, diabetic keto acidosis; NPO, nil per os; ATN, acute tubular necrosis; SSC, surviving sepsis campaign

	Rescue	Optimization	Stabilization	De-escalation
Principles	Lifesaving	Organ rescue	Organ support	Organ recovery
Goals	Correct shock	Optimize and maintain tissue perfusion	Aim for zero or negative fluid balance	Mobilize fluid accumulated
Time (usual)	Minutes	Hours	Days	Days to weeks
Phenotype	Severe shock	Unstable	Stable	Recovering
Fluid therapy	Rapid boluses	Titrate fluid infusion conservative use of fluid challenges	Minimal maintenance infusion only if oral intake inadequate	Oral intake if possible Avoid unnecessary i.v. fluids
Typical clinical scenario	- Septic shock - Major trauma	- Intraoperative GDT - Burns - DKA	- NPO postoperative patient - 'Drip and suck' management of pancreatitis	- Patient on full enteral feed in recovery phase of critical illness - Recovering ATN
Amount	Guidelines, for example, SSC, pre-hospital resuscitation, trauma, burns, etc.			

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I.V. fluid therapy can be lifesaving but like all medical interventions carries with it a degree of risk. The aims of the workgroup were to define 'Fit for purpose fluid therapy' tailored to the specific indications, time-, phase-dependent variables, or both, and the context of the patient.

Ideally, fluid therapy, like other medical therapies, should be tailored to the needs of the individual patient.

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THANK YOU