Actualités sur le remplissage peropératoire

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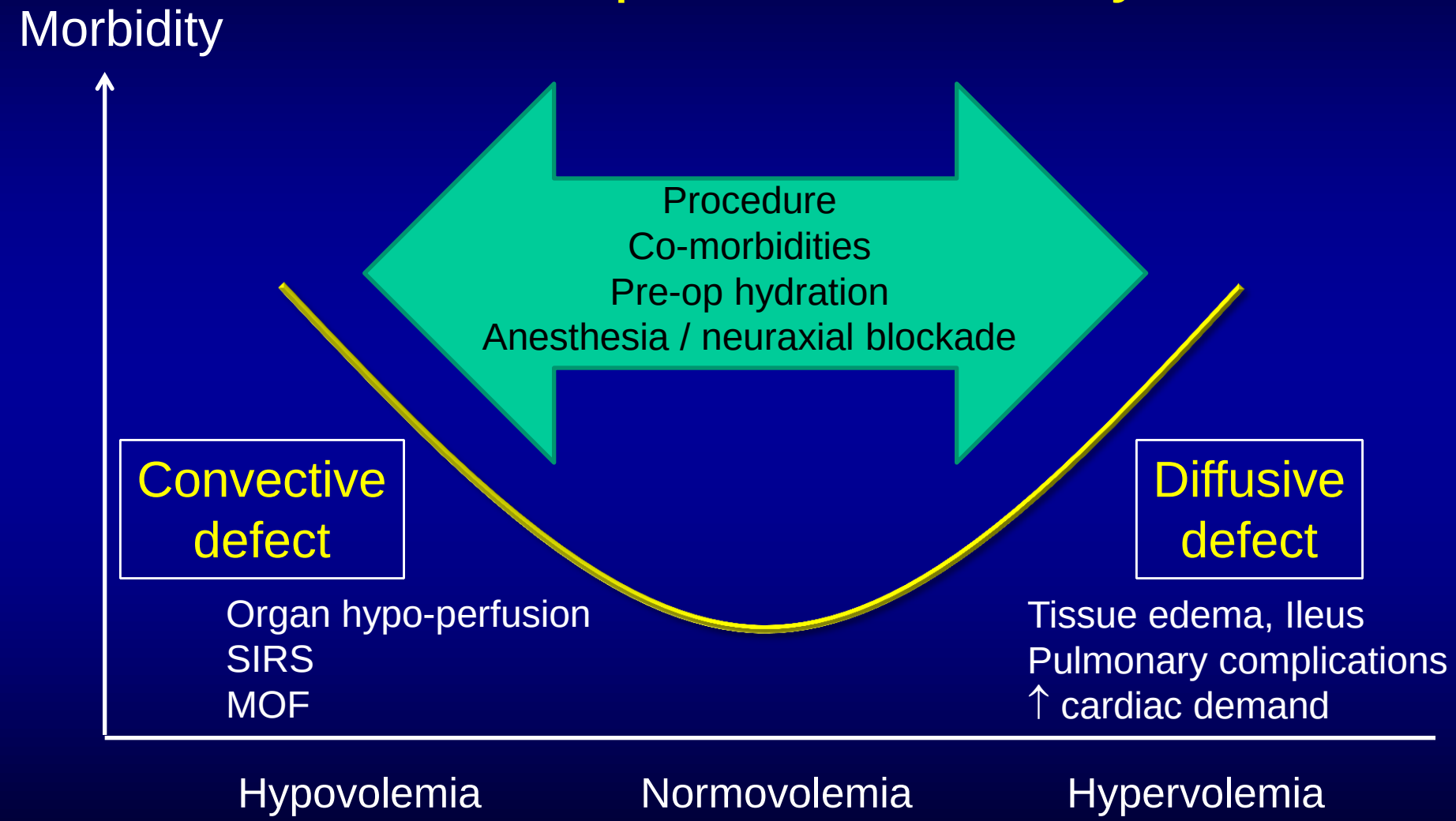
Perioperative Fluid Volume Administration & Postoperative Morbidity



Adapted from Belamy MC et al. Br J Anaesth 97:755-7, 2006.

The Royal College of Surgeons of England

Ann R Coll Surg Engl 2005; **87**: 126–130
doi 10.1308/147870805X28127

Audit

Intravenous fluid-associated morbidity in postoperative patients

SR Walsh, CJ Walsh

Colorectal Unit, Arrowe Park Hospital, Upton, Wirral, UK

- Complications associated with fluid therapy: 17%
- Fluid overload: 7%
- Hypovolemia: 11%

Resuscitation Fluid Use In Critically Ill Adults

- ✓Cross-sectional study in 391 ICU across 25 countries
- ✓ 24-hours study period
  - 37% patients (1955/5274) received fluids during 4488 resuscitation episodes
  - Overall, colloids were more frequently used and during more resuscitation episodes than crystalloids

From Finfer S et al. Crit Care 14 R185, 2010.

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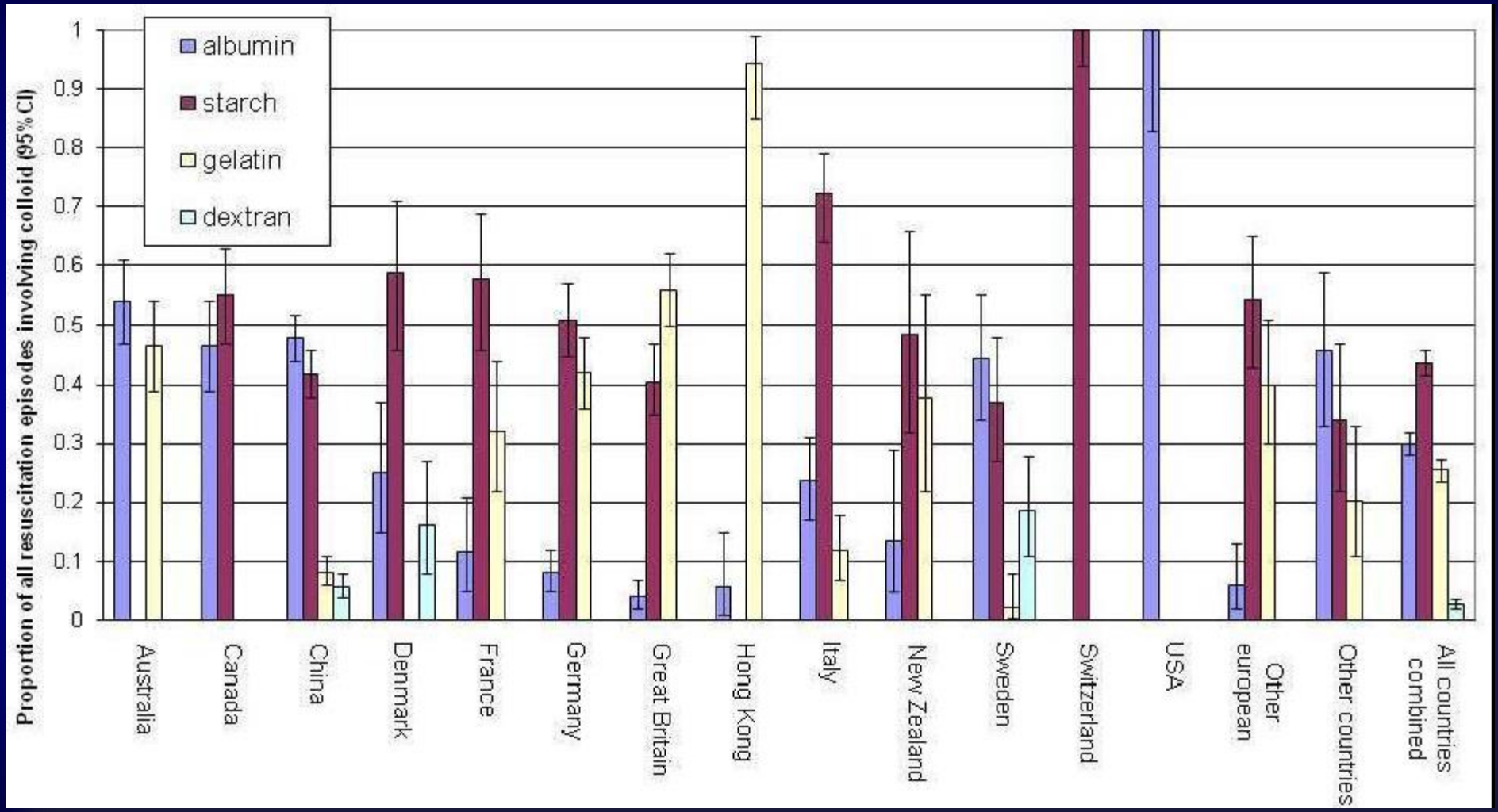

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✓Cross-sectional study in 391 ICU across 25 countries

✓ 24-hours study period

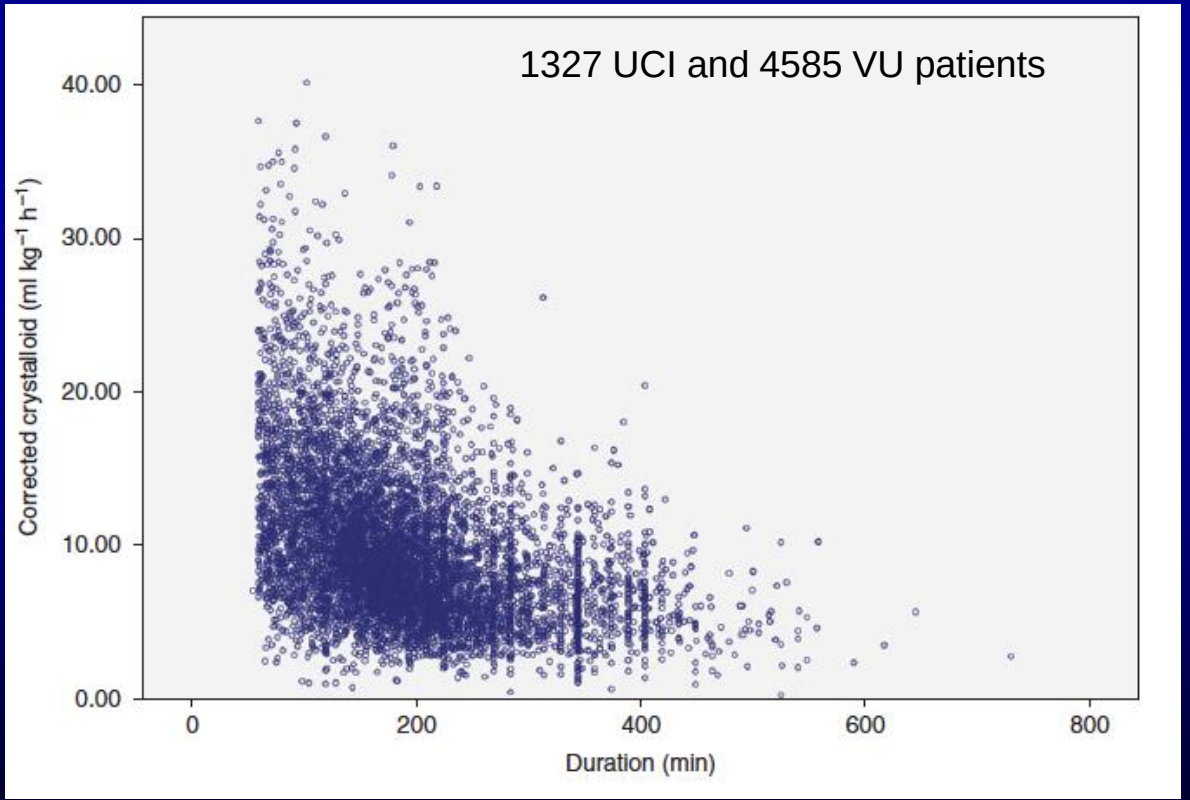
- 37% patients (1955/5274) received fluids during 4488 resuscitation episodes
- Overall, colloids were more frequently used and during more resuscitation episodes than crystalloids

✓The fluid used varied substantially between ICUs and local practice rather than patient characteristics appears to be the main factor in fluid choice

From Finfer S et al. Crit Care 14 R185, 2010.

Variability in practice and factors predictive of total crystalloid administration during abdominal surgery: retrospective two-centre analysis

- ✓ Two-centre retrospective analysis of fluid administration in patients undergoing intra-abdominal procedures during uncomplicated elective surgery with minimal blood loss (2009-2012).
- ✓ The final regression model strongly favoured the personnel as predictors of this variability, over other patients predictors



From Lilot M et al. Br J Anaesth 2015, Jan 13 (Epub ahead of print).

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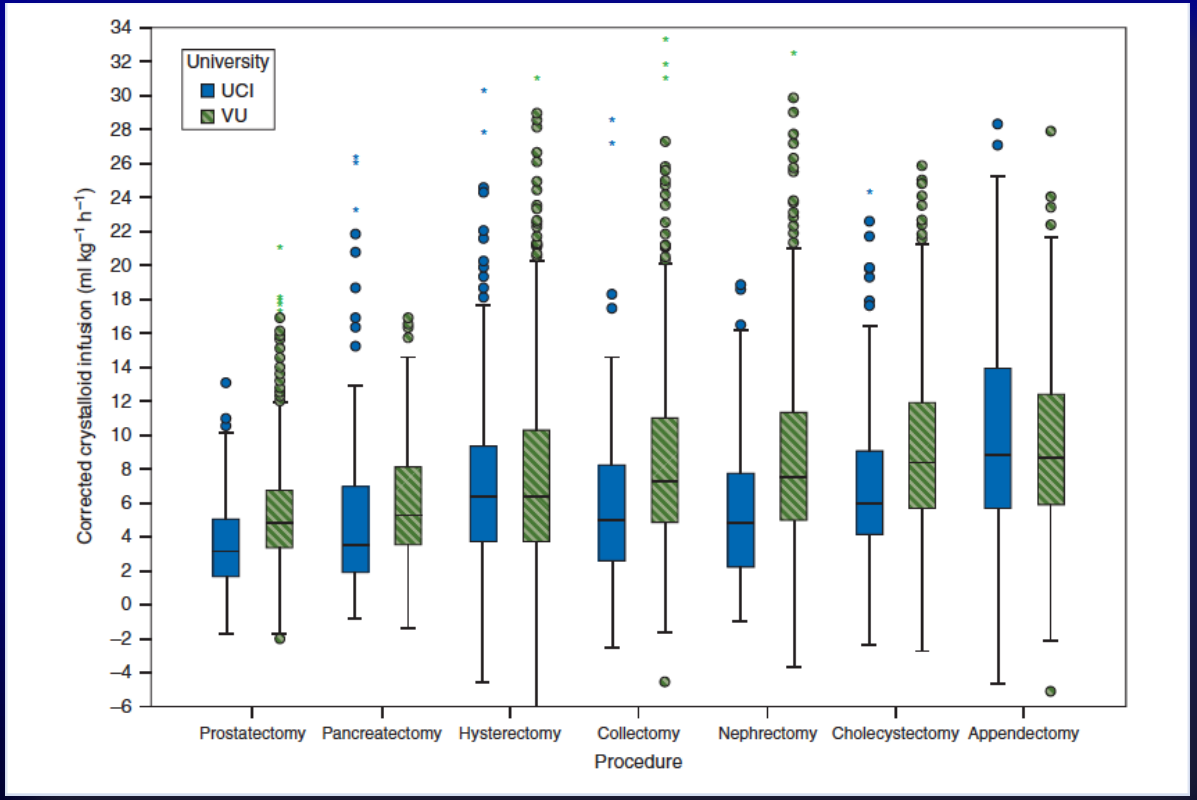
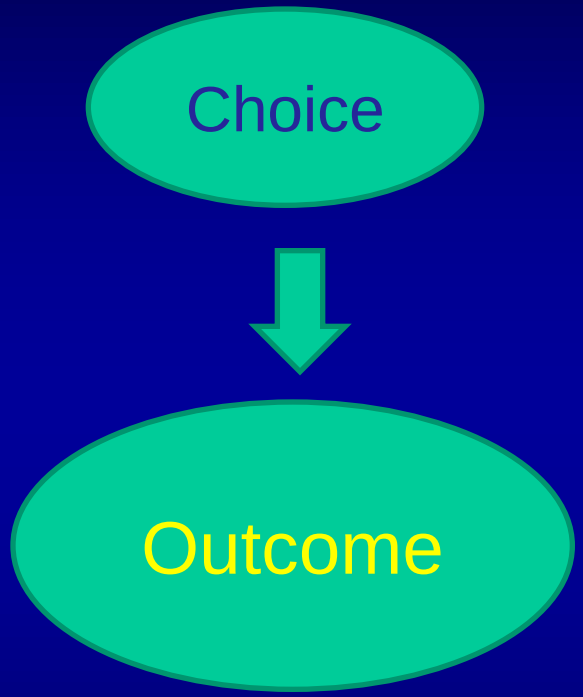


From Lilot M et al. Br J Anaesth 2015, Jan 13 (Epub ahead of print).

The Influence of Fluid Volume Management On Outcome



The Ideal Resuscitation Fluid

- ✓ Produces a predictable and sustainable increase in intravascular volume
- ✓ Has a chemical composition as close as possible to that of extracellular fluid
- ✓ Is metabolized and completely excreted without accumulation in tissues
- ✓ Does not produce adverse metabolic or systemic effects
- ✓ Is cost effective in terms of improving patient outcome

From Myburgh GA & Mythen MG. N Engl J Med 369:1243-51, 2013.

Fluid Electrolyte Compositions

Variable	Human Plasma	Colloids									Crystalloids		
		4% Albumin	Hydroxyethyl Starch						4% Succinylated Modified Fluid Gelatin	3.5% Urea-Linked Gelatin	0.9% Saline	Compounded Sodium Lactate	Balanced Salt Solution
			10% (200/0.5)	6% (450/0.7)	6% (130/0.4)		6% (130/0.42)						
Trade name		Albumex	Hemohes	Hextend	Voluven	Volulyte	Venofundin	Tetraspan	Gelofusine	Haemaccel	Normal saline	Hartmann's or Ringer's lactate	PlasmaLyte
Colloid source		Human donor	Potato starch	Maize starch	Maize starch	Maize starch	Potato starch	Potato starch	Bovine gelatin	Bovine gelatin			
Osmolarity (mOsm/liter)	291	250	308	304	308	286	308	296	274	301	308	280.6	294
Sodium (mmol/liter)	135–145	148	154	143	154	137	154	140	154	145	154	131	140
Potassium (mmol/liter)	4.5–5.0			3.0		4.0		4.0		5.1		5.4	5.0
Calcium (mmol/liter)	2.2–2.6			5.0				2.5		6.25		2.0	
Magnesium (mmol/liter)	0.8–1.0			0.9		1.5		1.0					3.0
Chloride (mmol/liter)	94–111	128	154	124	154	110	154	118	120	145	154	111	98
Acetate (mmol/liter)						34		24					27
Lactate (mmol/liter)	1–2			28								29	
Malate (mmol/liter)								5					
Gluconate (mmol/liter)													23
Bicarbonate (mmol/liter)	23–27												
Octanoate (mmol/liter)		6.4											

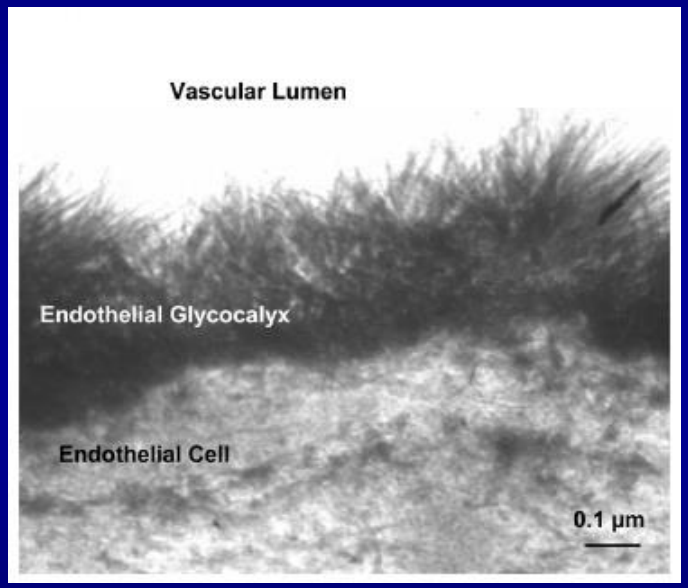
From Myburgh GA & Mythen MG. N Engl J Med 369:1243-51, 2013.

Choice of a Plasma Substitute

- ✓ Volume expansion
- ✓ Micro-circulatory effects
  - Hemo-rheological properties
  - Anti-inflammatory properties
- ✓ Side effects
  - Anaphylaxis
  - Hemostasis
  - Renal function
  - Miscellaneous
- ✓ Costs

The Endothelial Glycocalyx: the Double-barrier Concept of Vascular Permeability

✓Healthy endothelium is coated by the endothelial glycolalyx, a layer of membrane-bound proteoglycans and glycoproteins



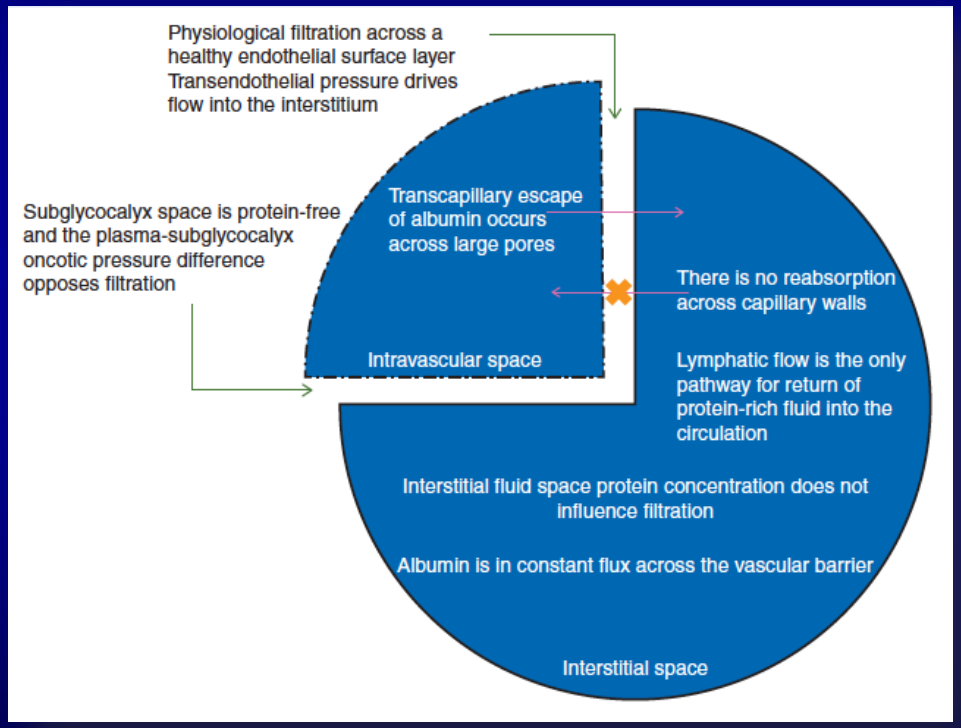
Endothelial glycocalyx binds plasma proteins and fluids with a functional thickness of more than 1 µm. The amount of plasma not participating to the normal blood circulation is about 700-1000 mL in humans

✓By exerting a vital role on the physiologic endothelial permeability barrier, and preventing leucocyte and platelet adhesion, it mitigates inflammation and tissue edema

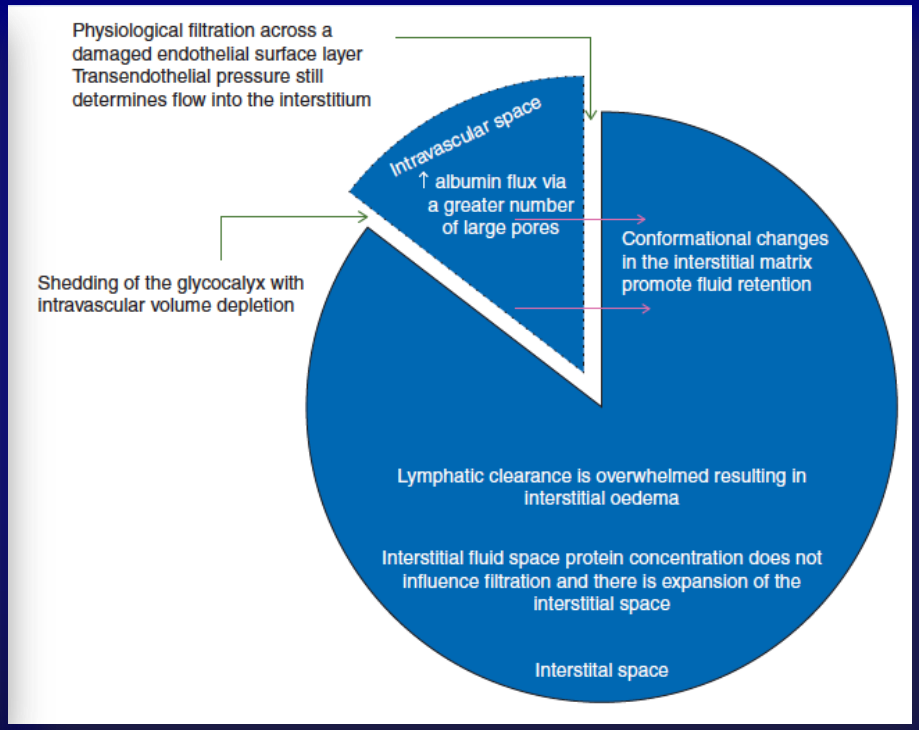
From Chappell D et al. Anesthesiology 109:724-740, 2008.

Choice of fluid in acute illness: what should be given? An international consensus‡

The revised Starling model in health

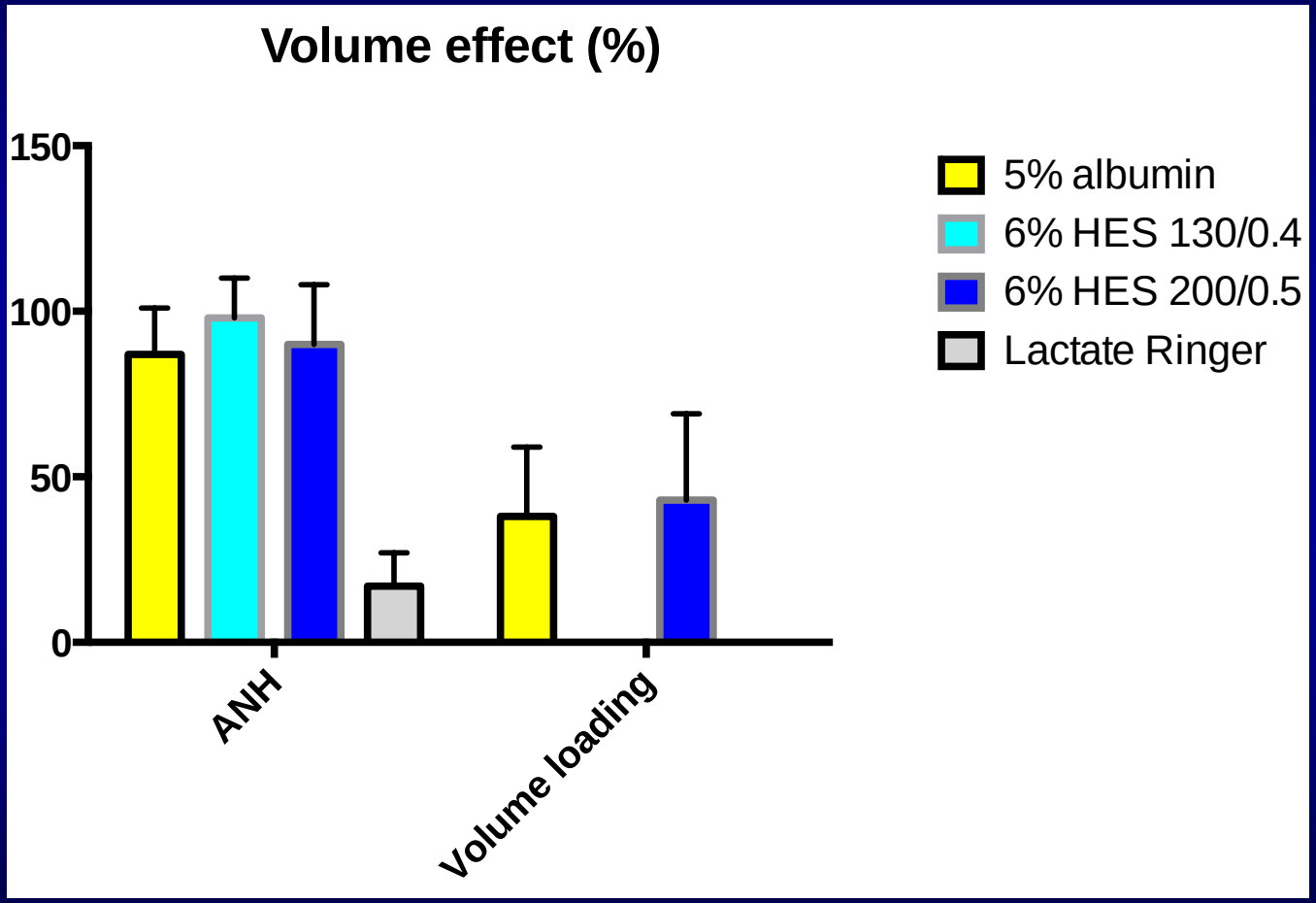


The revised Starling model during critical illness



From Raghunathan K et al. Br J Anaesth 113:772-83, 2014.

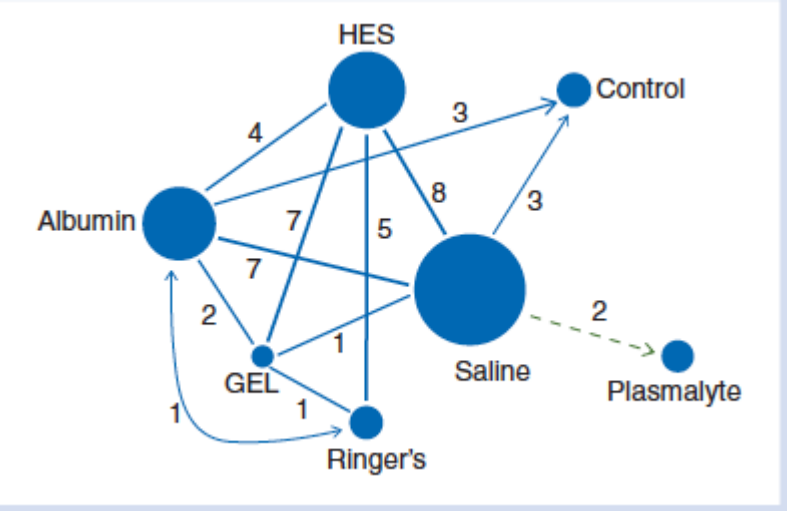
Volume Effects of Fluids Are Context-sensitive



From Jacob M & Chappell D. Curr Opin Crit Care 19:282-9, 2013.

Choice of fluid in acute illness: what should be given? An international consensus‡

A network meta-analysis

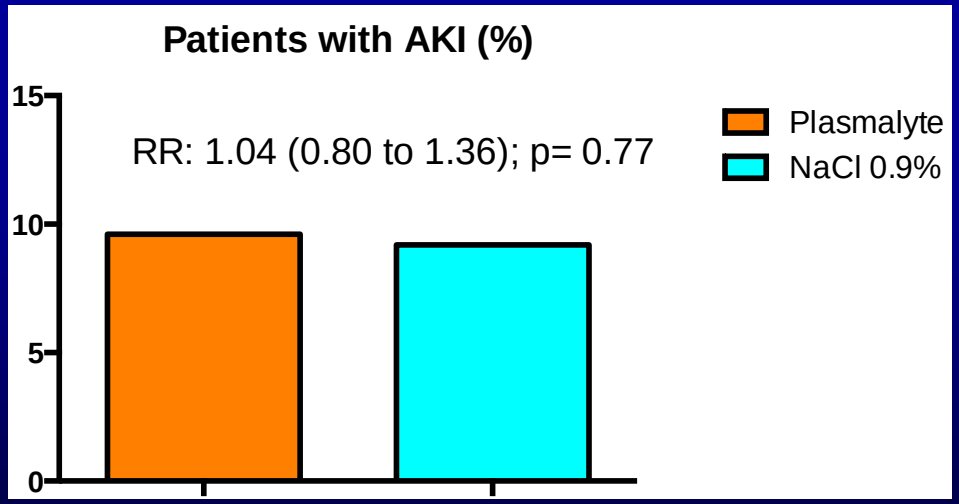


Comparison	No. of studies	No. of patients	Crude mortality rate	Relative risk (95% CI)	Heterogeneity (I^2)	Risk of confounding	Risk of publication bias
Albumin vs saline[20 23 29 49 50]	5	12 696	18.2	0.99 (0.90–1.05)	5%	Low	Low
HES vs saline[29 51–58]	9	9211	18.9	0.99 (0.85–1.14)	26%	Low	Low
HES vs Ringer's[2 19 55–60]	7	2408	33.9	1.10 (0.97–1.25)	6%	Moderate	Low
HES vs Gel[58 61–66]	7	780	26.5	1.10 (0.91–1.35)	0%	Moderate	High
HES vs albumin[64–67]	4	212	28%	1.01 (0.66–1.52)	0%	Moderate	High
Albumin vs control[23 49 50]	3	2201	9%	1.4 (1.05–1.84)	0%	Low	Moderate
Saline vs control[23 49 50]	3	2195	9.1%	1.38 (1.06–1.81)	0%	Low	Moderate
Saline vs Plasmalyte[43 44]	2	5237	4.7%	1.04 (0.8–1.35)	0%	High	High
Saline vs Ringer[45]	1	8532	2.4%	1.6 (1.2–2.1)	NA	Very high	High

From Raghunathan K et al. Br J Anaesth 113:772-83, 2014.

Buffered Crystalloid Solution Vs. Saline in ICU Patients: The SPLIT Trial

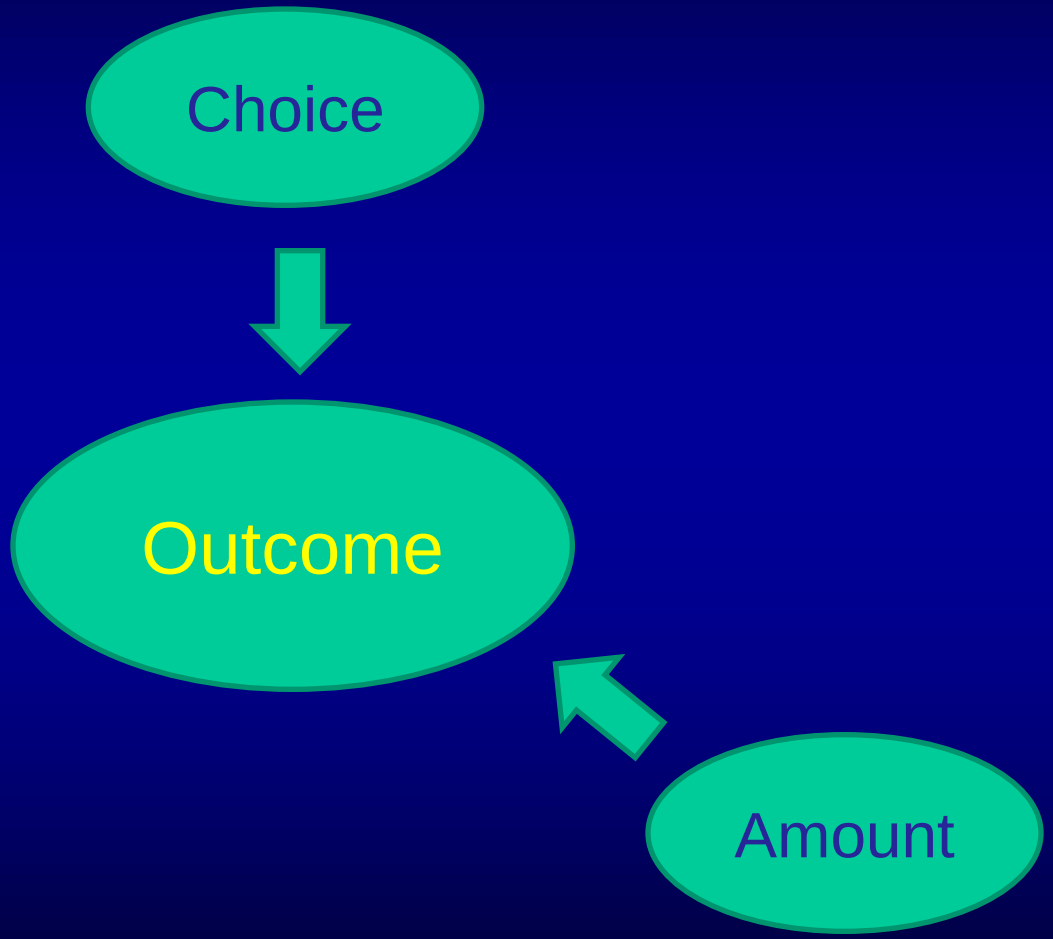
- ✓ Multicenter double-blind, cluster randomized double crossover-trial
- ✓ ICU patients requiring crystalloid fluid therapy
  - ➢ NaCL 0.9%: N=1110
  - ➢ Plasmalyte: N=1162
- ✓ Primary outcome: proportion of patients with AKI



- ✓ Secondary outcomes: need for RRT, in-hospital mortality: NS

From Young P et al. JAMA doi: 101001/jama 2015.12334

The Influence of Fluid Volume Management On Outcome



Fluid Administration Strategies

- ✓ The « recipe » book approach
- ✓ Intravascular pressure measurement
- ✓ Systolic and pulse pressure variation
- ✓ « Fluid » challenge
  - Intravascular pressure measurement
  - Blood flow measurement
- ✓ Measurement of tissue perfusion

From Grocott MPW et al. Anesth Analg 100:1093-106, 2005.

Dynamic changes in arterial waveform derived variables and fluid responsiveness in mechanically ventilated patients: A systematic review of the literature*

- ✓ 29 studies – 685 patients

Method	Technology	AUROC (95% CI)
Pulse pressure variation	Arterial wave form	0.94 (0.93-0.95)
Systolic pressure variation	Arterial wave form	0.86 (0.82-0.90)
Stroke volume variation	Pulse contour analysis	0.88 (0.78-0.88)
LV end-diastolic area	Echocardiography	0.64 (0.53-0.74)
Global end-diastolic volume	Transpulmonary hemodilution	0.56 (0.37-0.67)
Central venous pressure	Central venous catheter	0.55 (0.18-0.62)

From Marik PE et al. Crit Care Med 37:2642-7, 2009.

Preload Markers to Predict Fluid Responsiveness

- ✓ There are no data to support the widespread practice of using CVP to guide fluid therapy
  Marik PE and Cavallazzi R. Crit Care Med 41:1774-81, 2013.

- ✓ Large studies are required to define the circumstances under which stroke volume variation (SVV) and pulse pressure variation (PPV) could be recommended to guide IV fluid therapy in routine clinical practice
  MacDonald N et al. Br J Anaesth 2014, Dec 11 (Epub ahead of print)

REVIEW

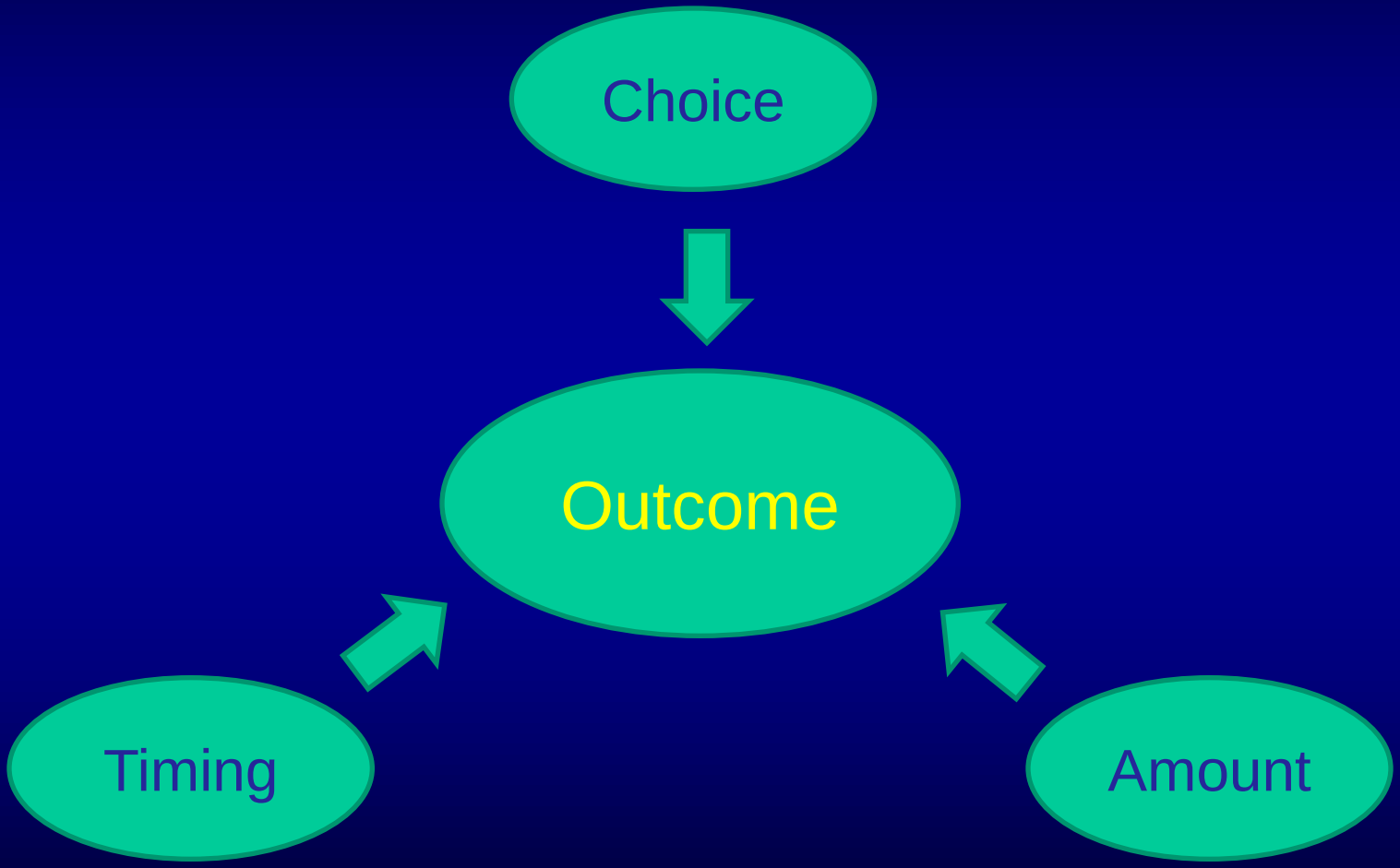
Clinical review: What are the best hemodynamic targets for noncardiac surgical patients?

✓ Goals of therapy, monitors and main outcomes

Variable	Monitor	Reported clinical effects [references]
Dynamic indices of fluid responsiveness		
Corrected flow time	TED	Decrease LOS or complications [22,24,28], increase LOS [61,62]
Stroke volume	TED, Vigileo FloTracsystem™, LiDCOrapid™	Decrease LOS or complications [23-28]
Pulse pressure variation	Multiparametric monitor, LiDCOrapid™	Decrease LOS and complications [30]
Plethysmography variability index	Plethysmography	None [31]
Stroke volume variation	Vigileo/FloTracsystem™, LiDCOrapid™	Decrease LOS and complications [32]
Systolic pressure variation	PiCCOplus™	None [33]
Flow indices		
Oxygen delivery	PAC, LiDCOplus™, Vigileo/FloTracsystem™	Decrease mortality [35-38], decrease complications [35-38,64,65,68], none [66]
Cardiac index	PAC	Decrease complications [39], none [40-43]
Indices of adequacy of perfusion		
Venous oxygen saturation	PAC	None [52]
Oxygen extraction ratio	Blood gas	Decrease complications [53]

From Lobo SM & de Oliveira NE. Crit Care 17:210, 2013.

The Influence of Volume Management On Outcome



Goals of Fluid Management

- ✓ To achieve and maintain adequate effective circulating volume during rescue and the optimization phase
- ✓ To minimize complications during the stabilization phase
- ✓ To restore a more normal fluid balance during de-escalation

The choice of fluid should be guided by contextual patient-specific factors

From Raghunathan K et al. Br J Anaesth 113:772-83, 2014.

Perioperative Fluid Administration

✓ Replacement of “physiologic” losses (urine production, insensible perspiration…)

→ crystalloids in a ‘balanced” form

✓ Replacement of “non physiologic” losses (mainly blood losses…)

→ colloids, blood products

Perioperative Fluid Administration

✓Preoperative fasting does not normally cause intravascular hypovolemia

Rehm M et al. Anesthesiology 95:849-56, 2002.

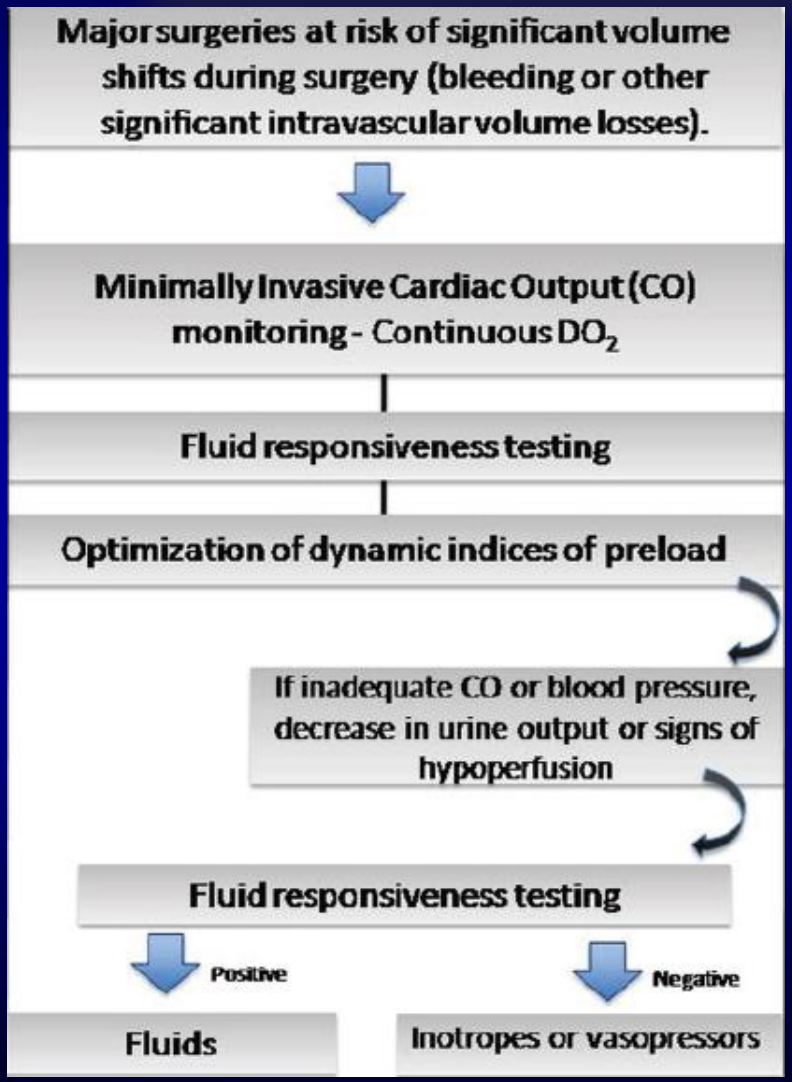
✓ The evidence supporting the concept that hemorrhage or operation is associated with the development of a « third space » is weak

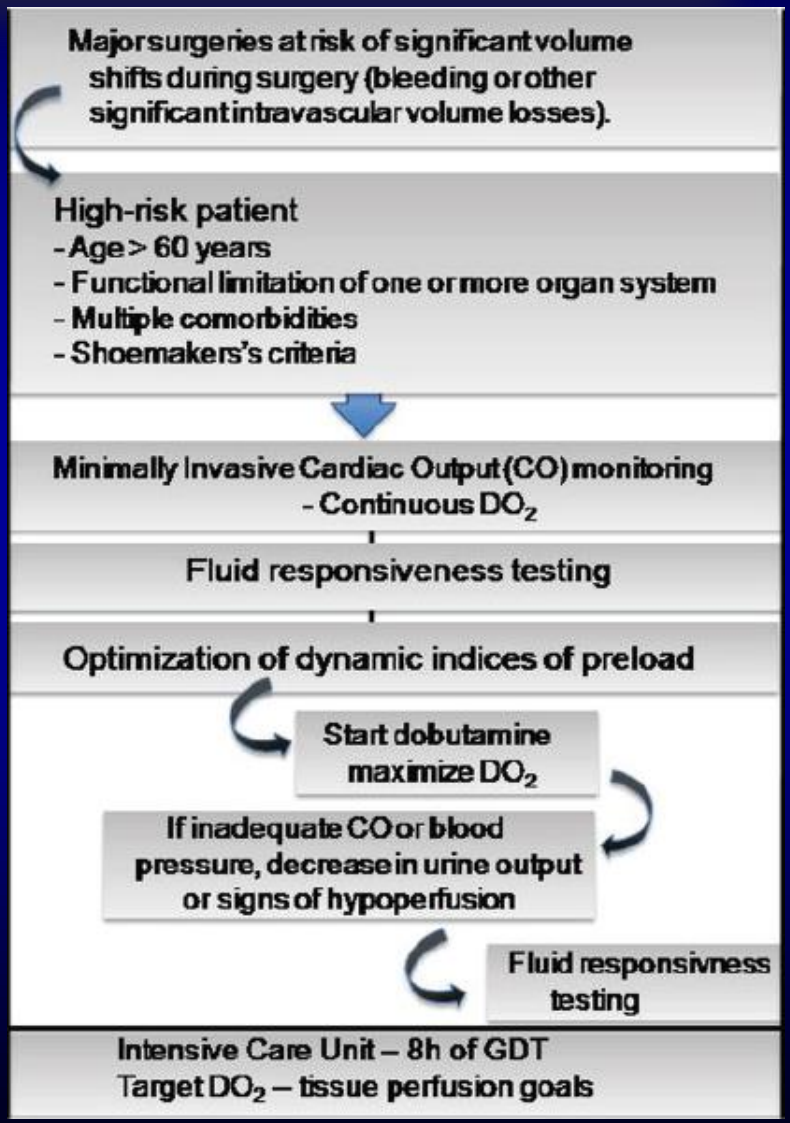
Brandstrup B et al. Surgery 139:419-432, 2006.

✓The measured basal evaporative water loss is only about 0.5 ml/kg.h, increasing to a maximum of 1.0 ml/kg.h during major surgery

Lamke LO et al. Acta Chir Scand 143:279-84,1977.

Clinical review: What are the best hemodynamic targets for noncardiac surgical patients?





From Lobo SM et al. Crit Care 17:210, 2013.

Original Investigation | CARING FOR THE CRITICALLY ILL PATIENT

Effect of a Perioperative, Cardiac Output–Guided Hemodynamic Therapy Algorithm on Outcomes Following Major Gastrointestinal Surgery

- ✓ Pragmatic multicenter randomized observer-blinded trial in high-risk surgical patients
  - Usual care (N=366)
  - Cardiac output (LIDCOrapid)-guided hemodynamic therapy for IV fluids + dopexamine infiusion during and 6h following surgery (N=368)
- ✓ Primary outcome: a composite of predefined 30-day moderate or major complications and mortality
- ✓ Secondary outcomes: morbidity on day 7, infection, ICU-free days, 30-day and 180-day mortality

From Pearse RM et al. JAMA 311: 2181-90, 2014.

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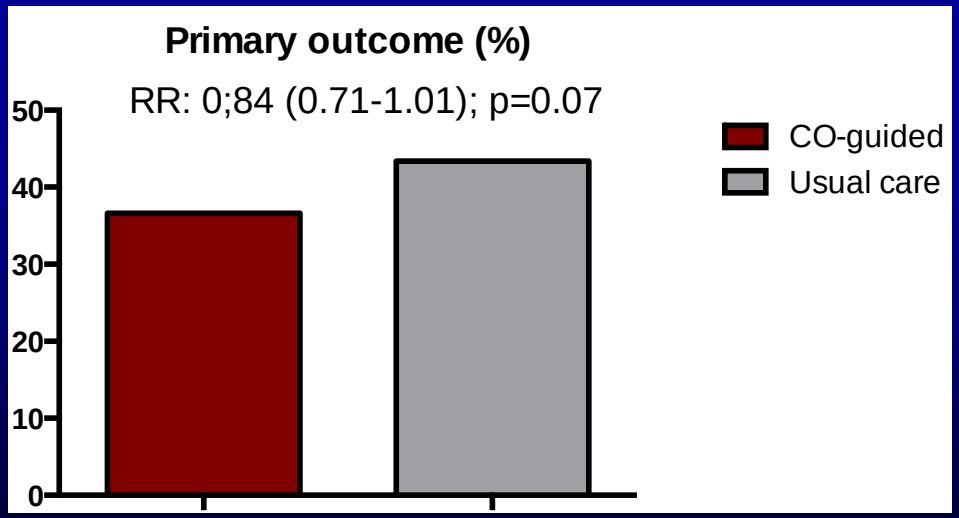

Pre-specified subgroup analyses
- urgency: NS
- planned procedure: NS
- timing of recruitment: p=0.019

From Pearse RM et al. JAMA 311: 2181-90, 2014.

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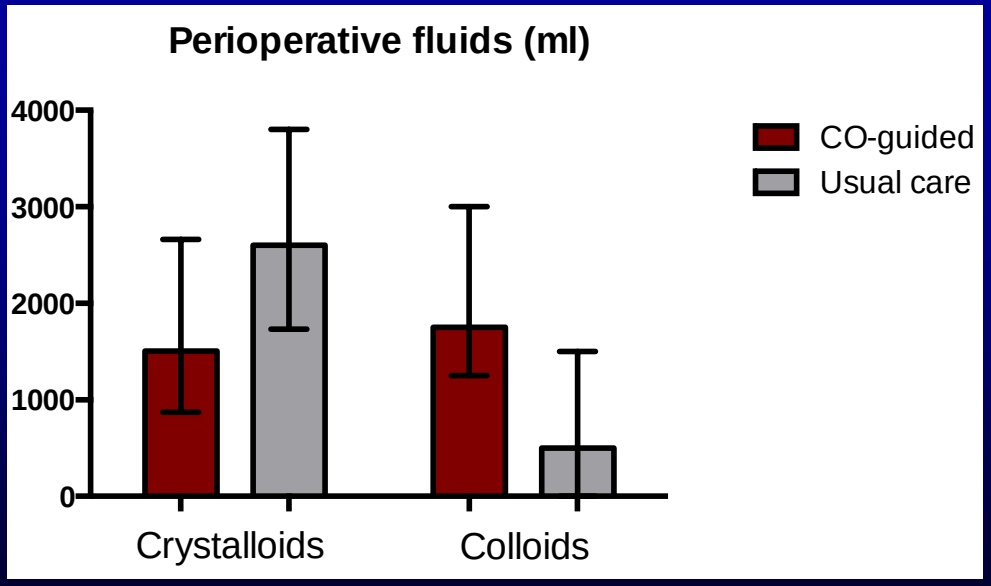

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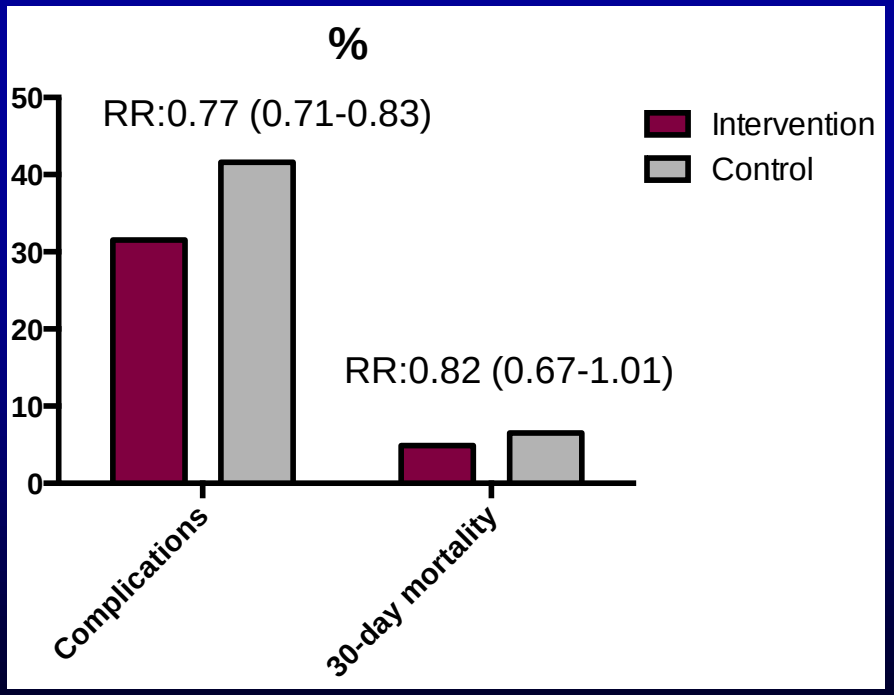
Original Investigation | CARING FOR THE CRITICALLY ILL PATIENT

Effect of a Perioperative, Cardiac Output–Guided Hemodynamic Therapy Algorithm on Outcomes Following Major Gastrointestinal Surgery

- ✓ Updated systematic review & meta-analysis 1966-2014: 38 trials from which 23 described the composite outcome of predefined 30-day moderate or major complications and mortality (N=3024)

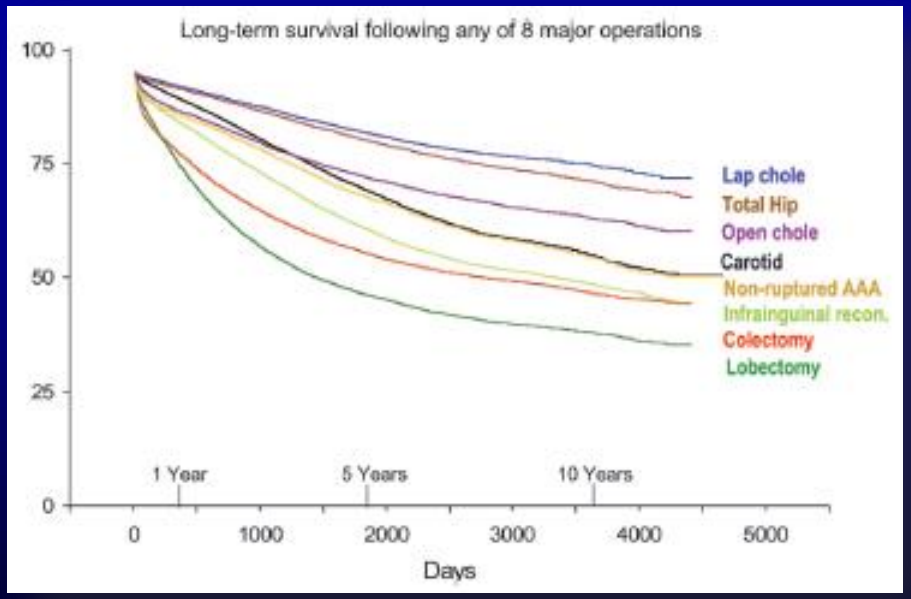
Intervention was associated with a reduced duration of hospital stay: 0.79 (0.96-0.62)

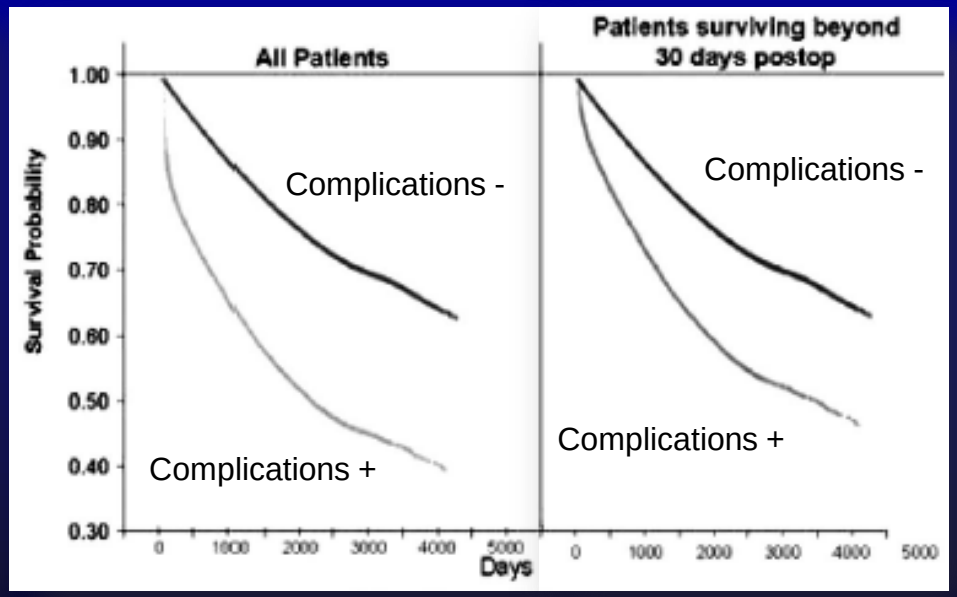


From Pearse RM et al. JAMA 311: 2181-90, 2014.

Determinants of Long-Term Survival After Major Surgery and the Adverse Effect of Postoperative Complications

- ✓ Merging of NSQIP data and BIRLS to determine the vital status of 105,951 patients who underwent 8 types of operations (1991-1999) with an average follow-up of 8 years
- ✓ Logistics and Cox regression analyses to identify predictors of 30-day mortality and long term survival





From Khuri SF et al. Ann Surg 242:326-43,2005.

REVIEW ARTICLE

CRITICAL CARE MEDICINE

Simon R. Finfer, M.D., and Jean-Louis Vincent, M.D., Ph.D., *Editors*

Resuscitation Fluids

John A. Myburgh, M.B., B.Ch., Ph.D., and Michael G. Mythen, M.D., M.B., B.S.

- ✓ Fluids should be administered with the same caution that is used for any intravenous drug
- ✓ Fluid resuscitation is a component of a complex physiological process
- ✓ Fluid requirements change over time in critically ill patients
- ✓ Specific considerations apply to different categories of patients

N Engl J Med 2013;369:1243-51.

Conclusions

Primary goal of fluid volume therapy:

- To correct absolute or relative volume deficit
- To optimize tissue oxygen delivery

The optimal amount at the right moment with a combination of crystalloids AND colloids

Further studies are needed:

- To improve monitoring measures to recognize fluid deficits and guide fluid therapy
- To better define patients who may benefit from a particular kind of fluid