‘Modern’ fluid therapy

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Intensive Care Medicine
www.icmjournal.esicm.org

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REGION Rigshospitalet

University of Copenhagen

clinical research network

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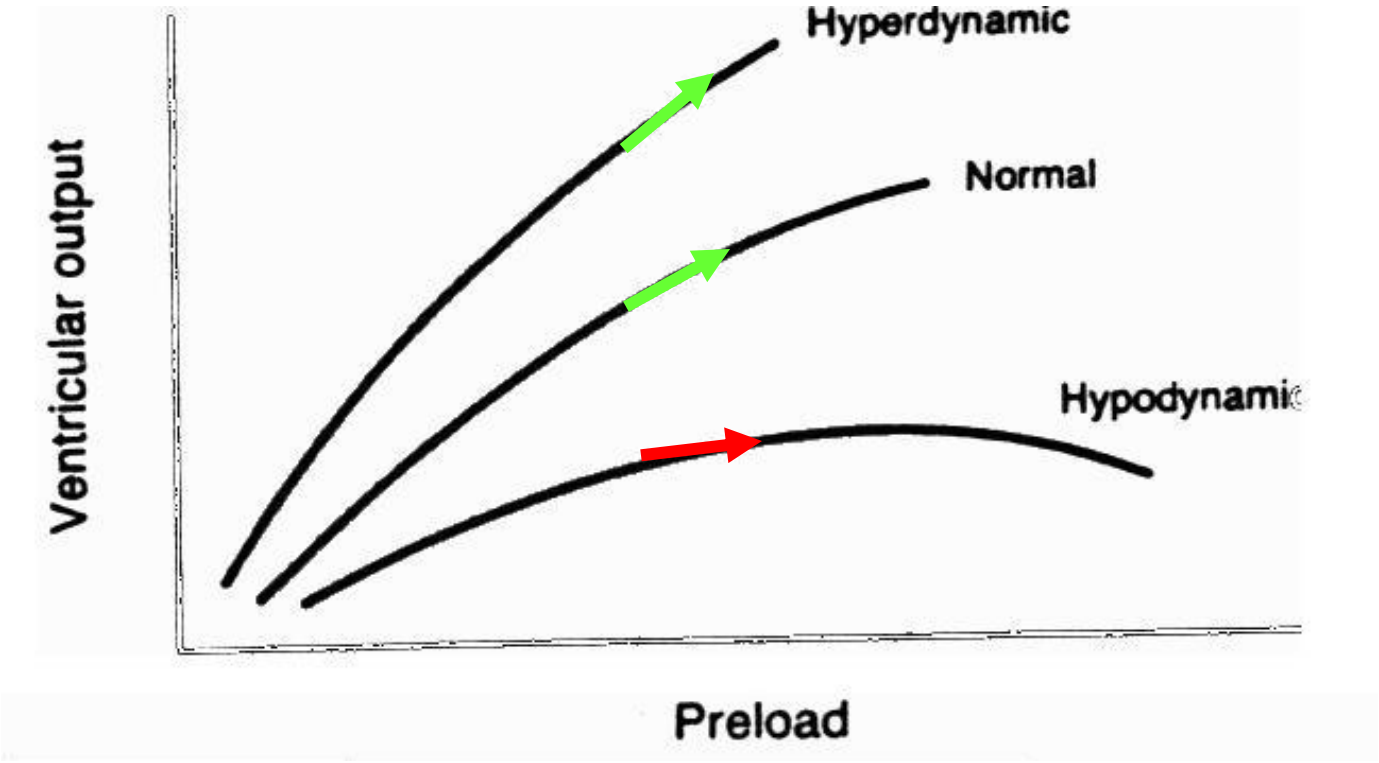
....fluid therapy

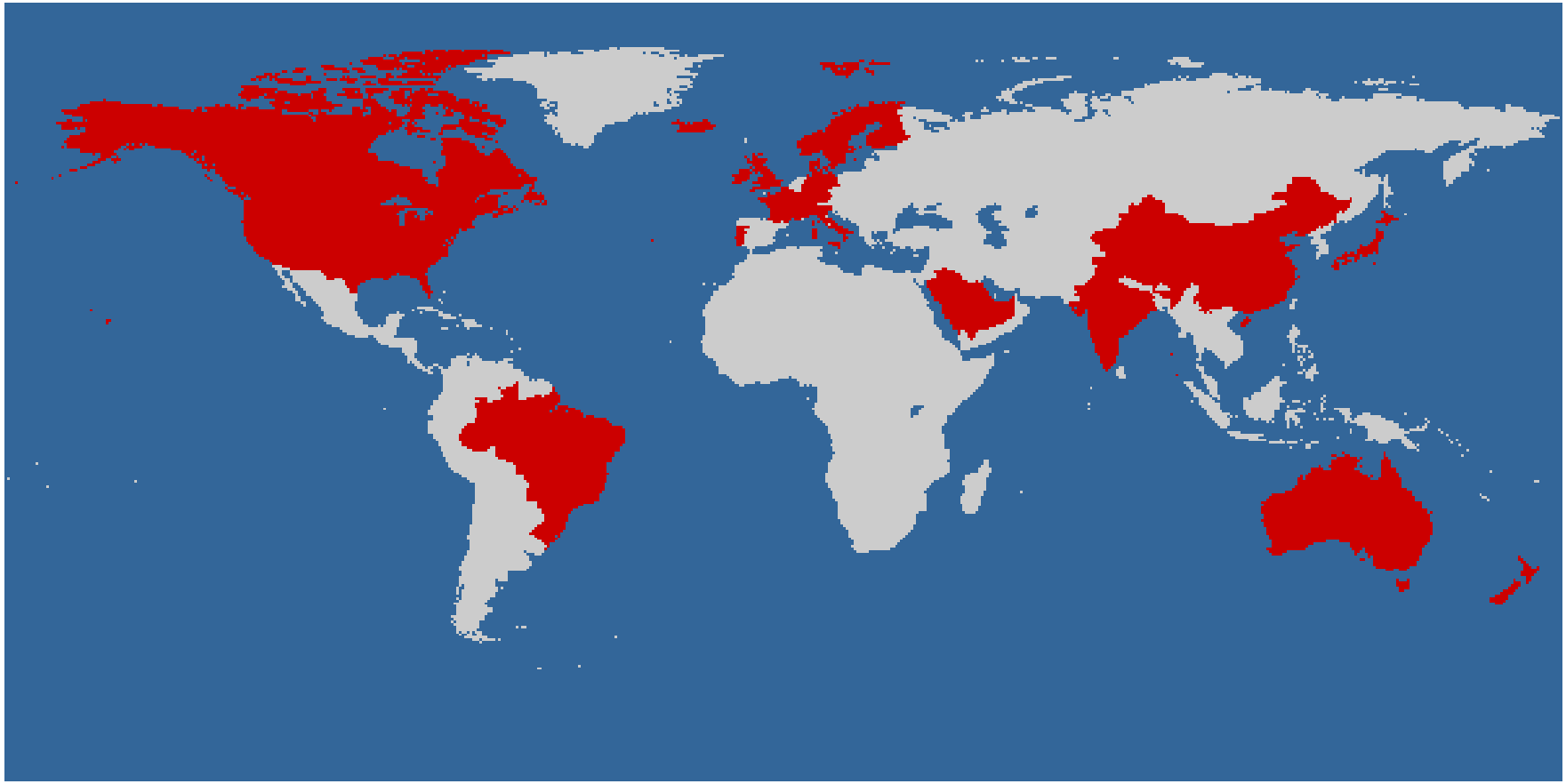
- Why do we give fluids?
- Have we got it right?
- When should we give fluids?
- How much should we give?
- What should we give?

Why do we give fluids?
FRANK-STARLING



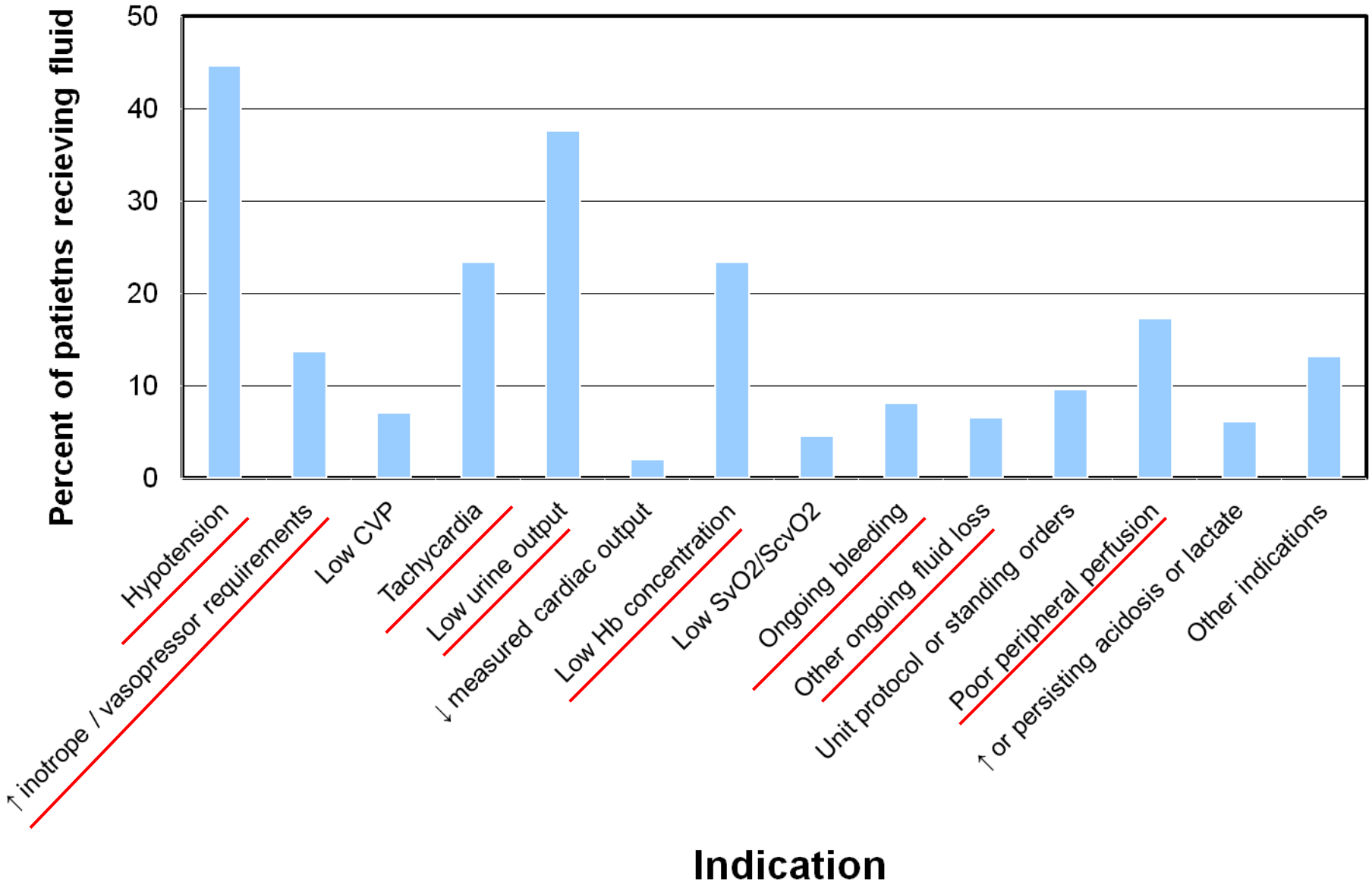
SAFE TRIPS

390 ICUs in 24 countries
1955 patients requiring resuscitation fluid on a single day



Finfer et al. Critical Care 2010, 14:R185

What triggered a fluid bolus in ICU?



Indications for fluid bolus in ICU

- Low MAP / increasing pressor 50%
- Low urinary output
- Poor peripheral perfusion / lactate
- Tachycardia
- Objective loss 20%

Have we got it right?

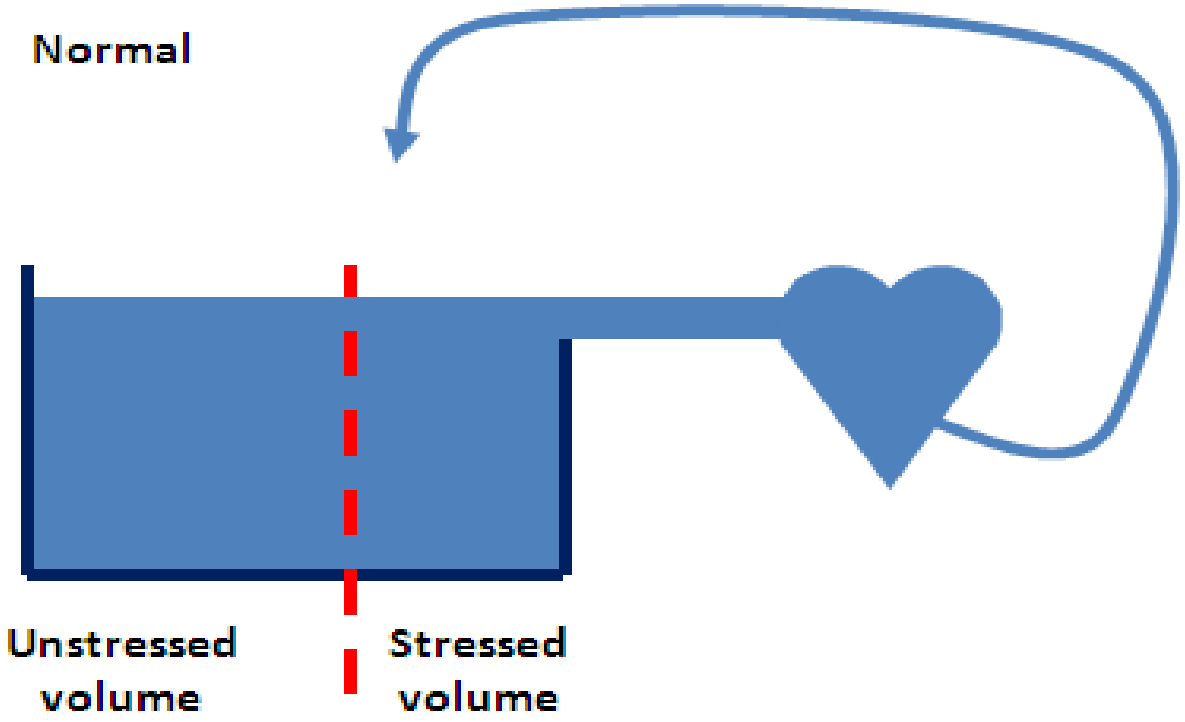
- Low MAP / increasing pressor + (?)
- Low urinary output + (??)
- Poor peripheral perfusion / lactate +
- Tachycardia ?
- Objective loss ++

Effect of fluid in ICU studies

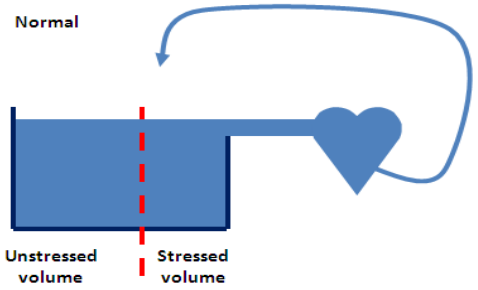
- **50% of fluid boluses increase CO**

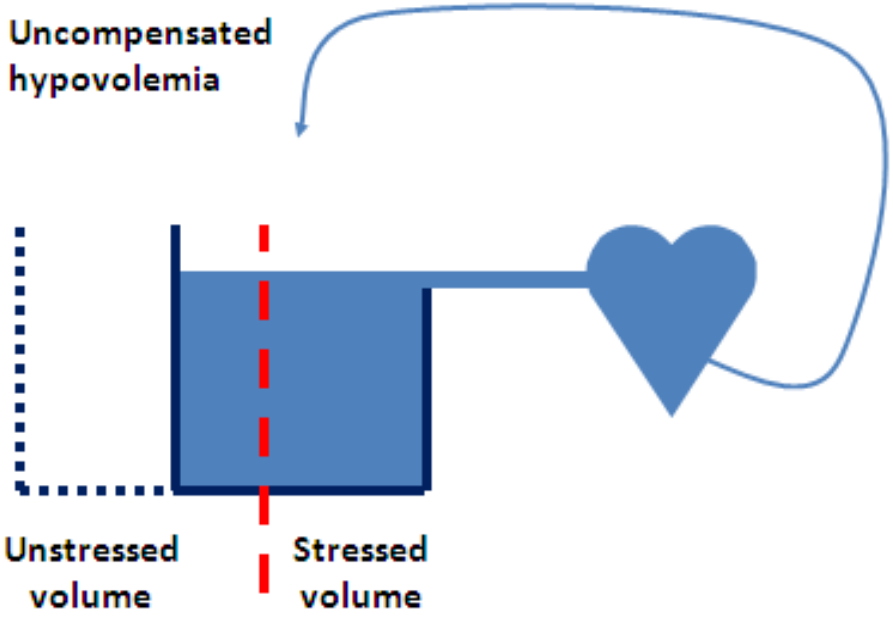
Marik et al. CCM 2009

Venous return function

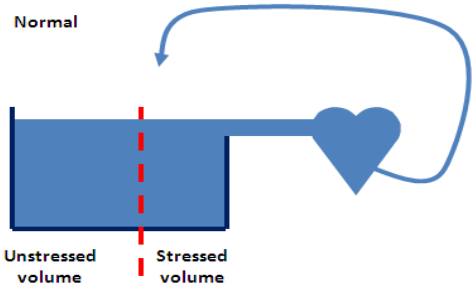


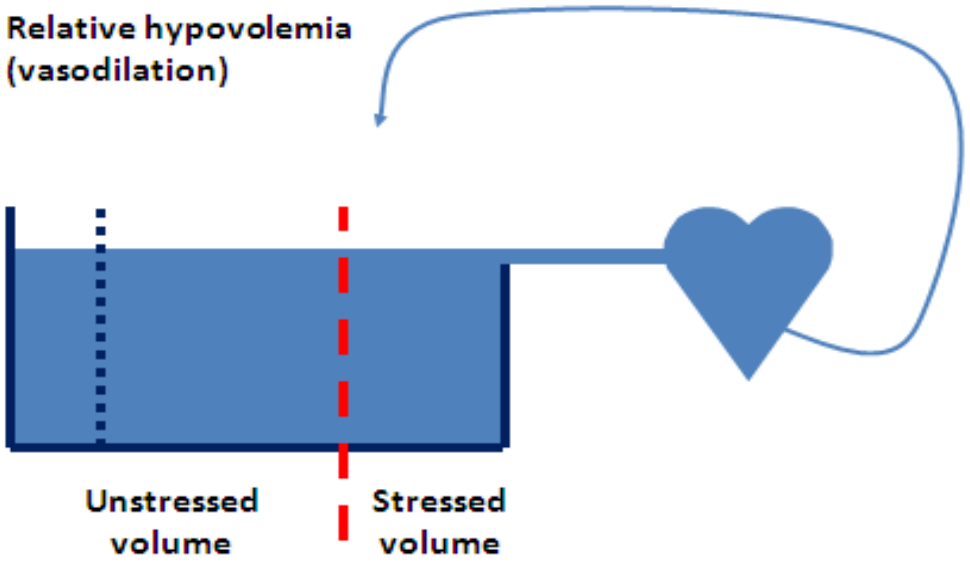
Perner & De Backer, ICM 2014





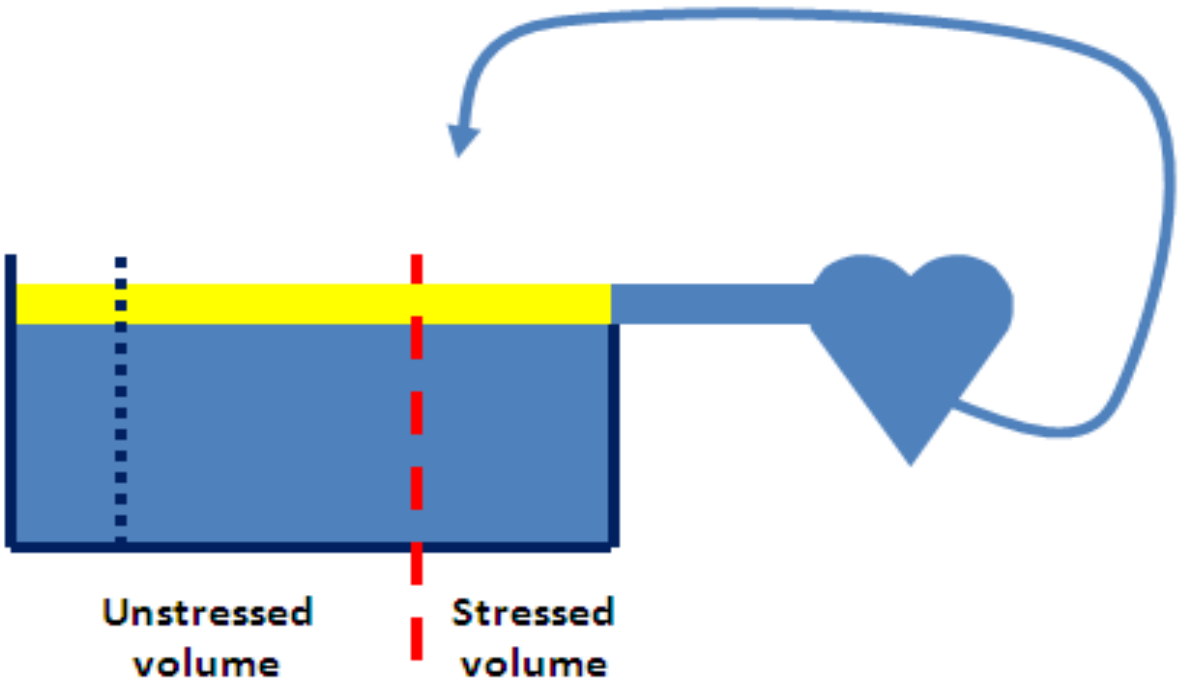
Perner & De Backer, ICM 2014





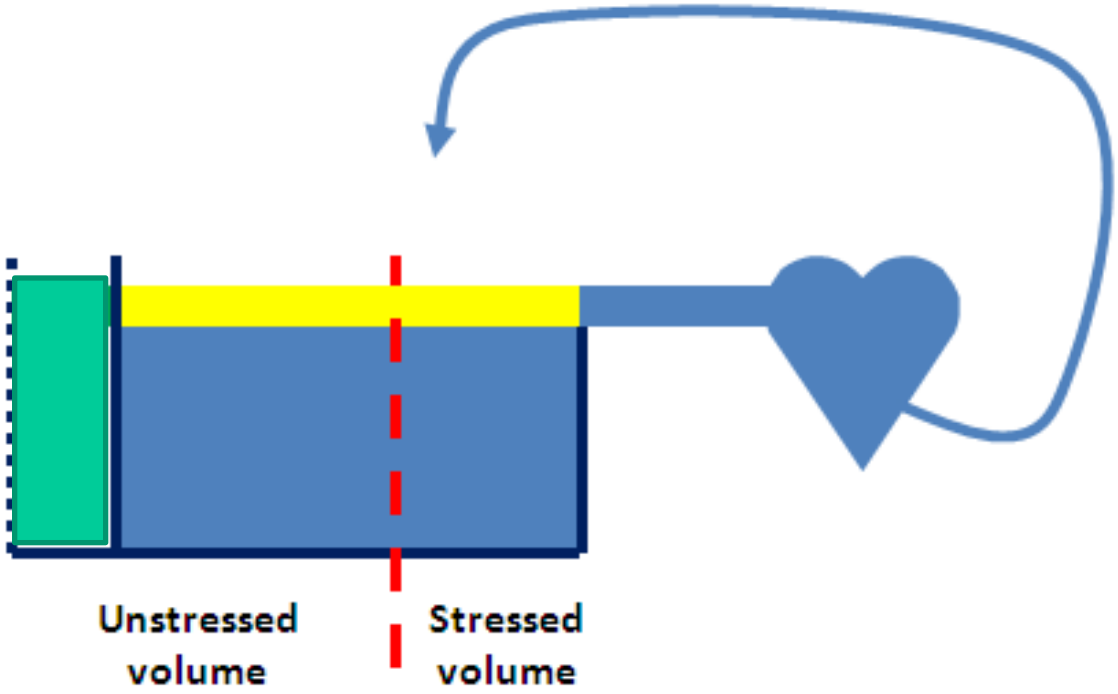
Perner & De Backer, ICM 2014

Vasodilation + fluids



Perner & De Backer, ICM 2014

Vasodilation + vasopressors

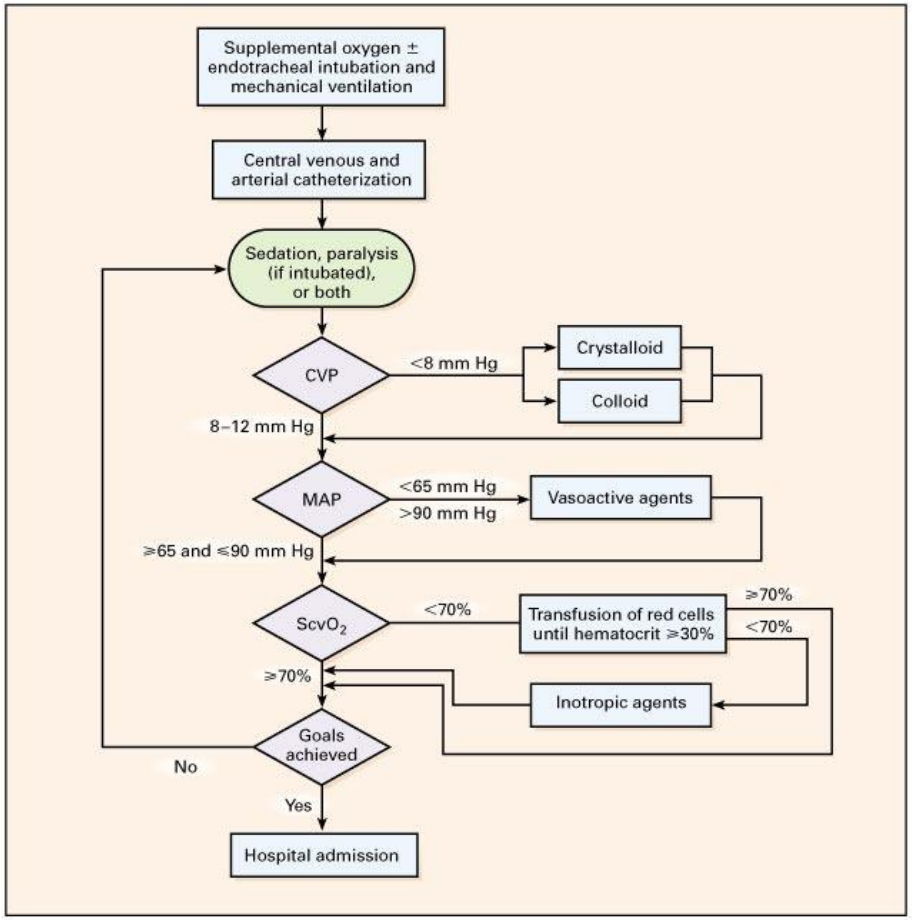


Perner & De Backer, ICM 2014

- **Fluid vs noradrenalin**

- **How much fluid should we give?**

Early Goal-Directed Therapy in sepsis



More……

Fluids early
Inotropes
RBCs

Marked improvement in survival

...in a 240 patient single centre trial

Rivers, E et. al. NEJM 2001;345:1368-77

The NEW ENGLAND JOURNAL of MEDICINE

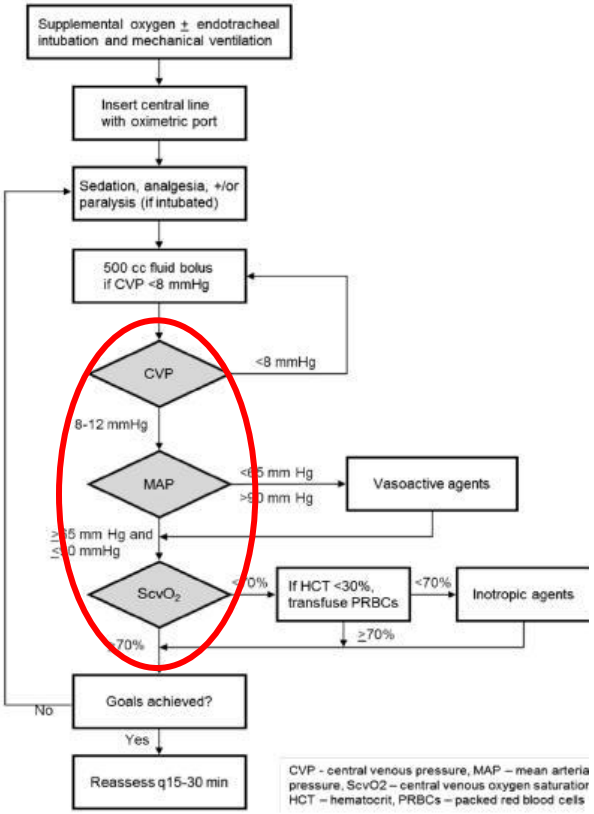
ORIGINAL ARTICLE

A Randomized Trial of Protocol-Based Care for Early Septic Shock

The ProCESS Investigators*

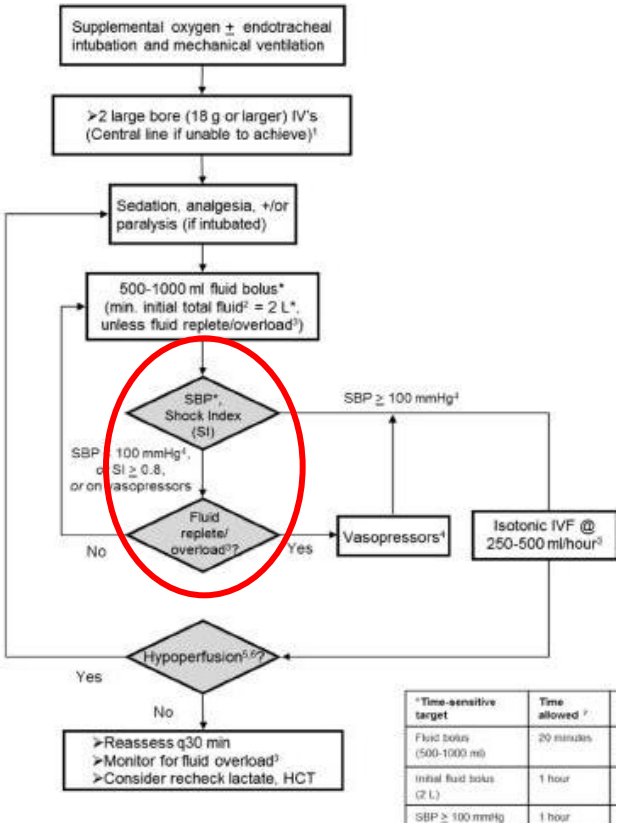
Protocols

EGDT



vs

Protocolled standard care



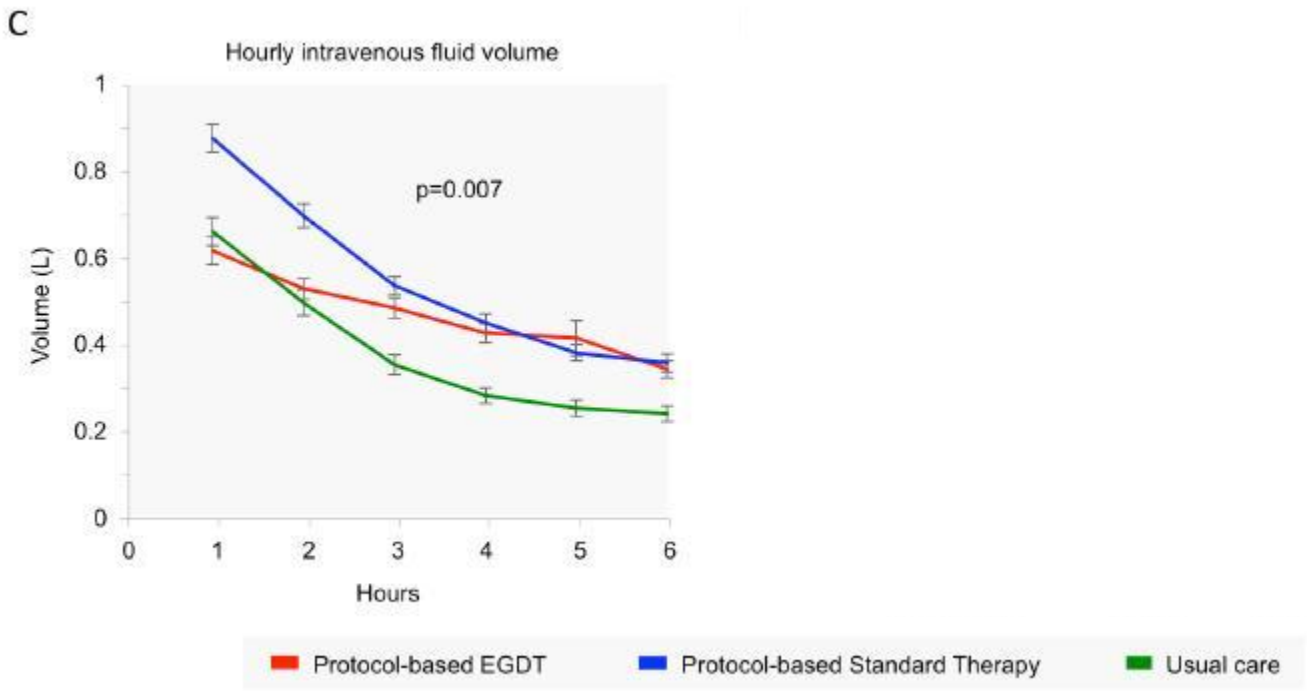
vs

Usual care

No protocol

Interventions

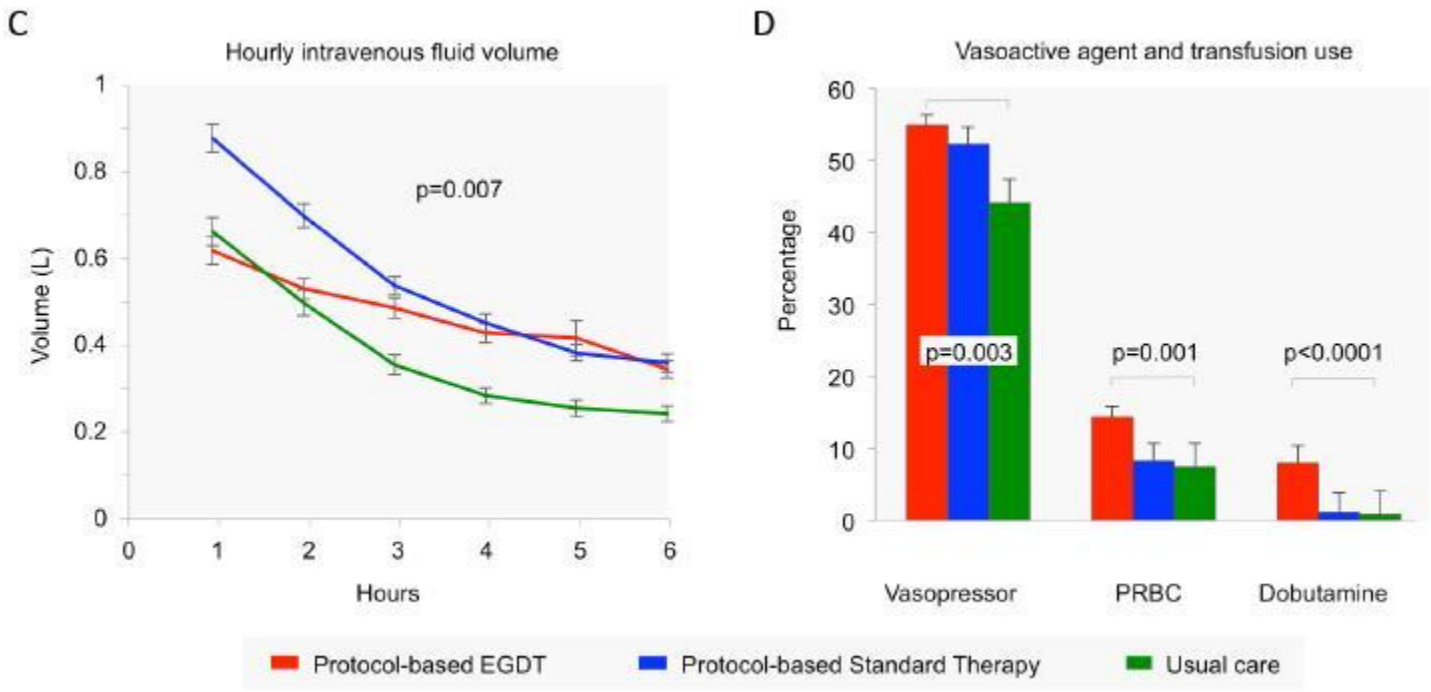
Fluids

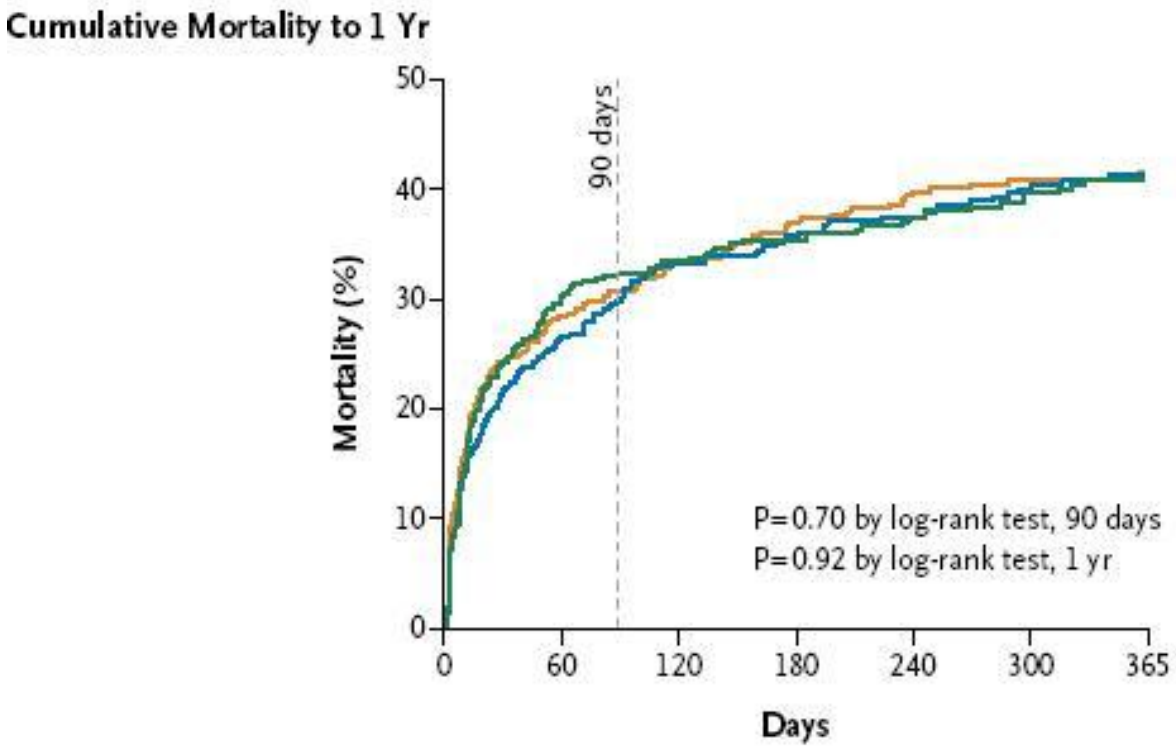


Interventions

Fluids

Vasoactives & RBCs



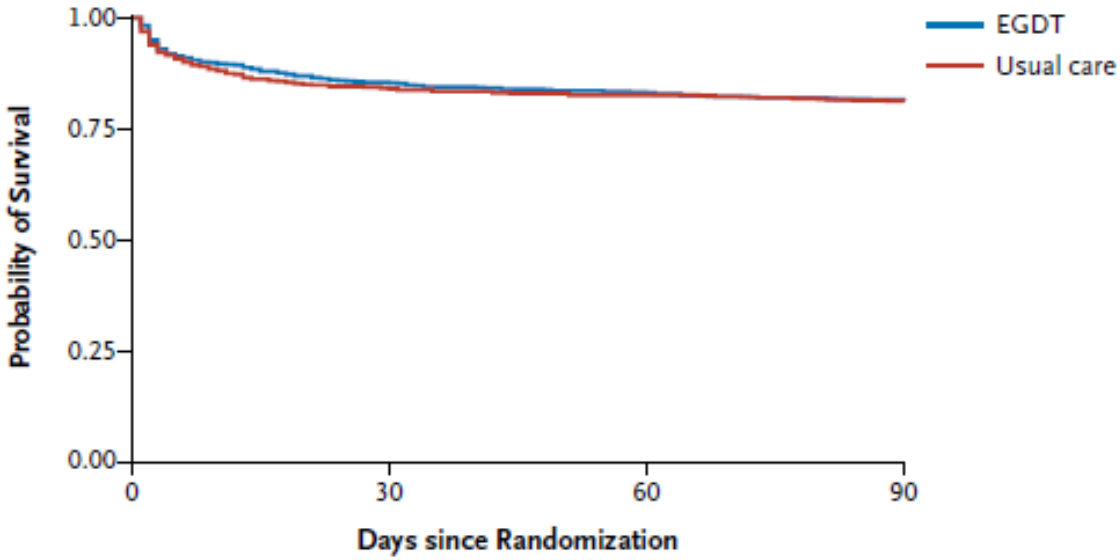

Cumulative Mortality to 1 Yr
Mortality (%)
50
40
30
20
10
0
90 days
P=0.70 by log-rank test, 90 days
P=0.92 by log-rank test, 1 yr
0
60
120
180
240
300
365
Days

The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

Goal-Directed Resuscitation for Patients with Early Septic Shock

The ARISE Investigators and the ANZICS Clinical Trials Group*



Protocolized vs. usual care in PROCESS and ARISE resulted in

- **More fluids**
- **More vasopressors**
- **More inotropes**
- **More RBCs**

- **Similar outcomes**

When should we give fluids?

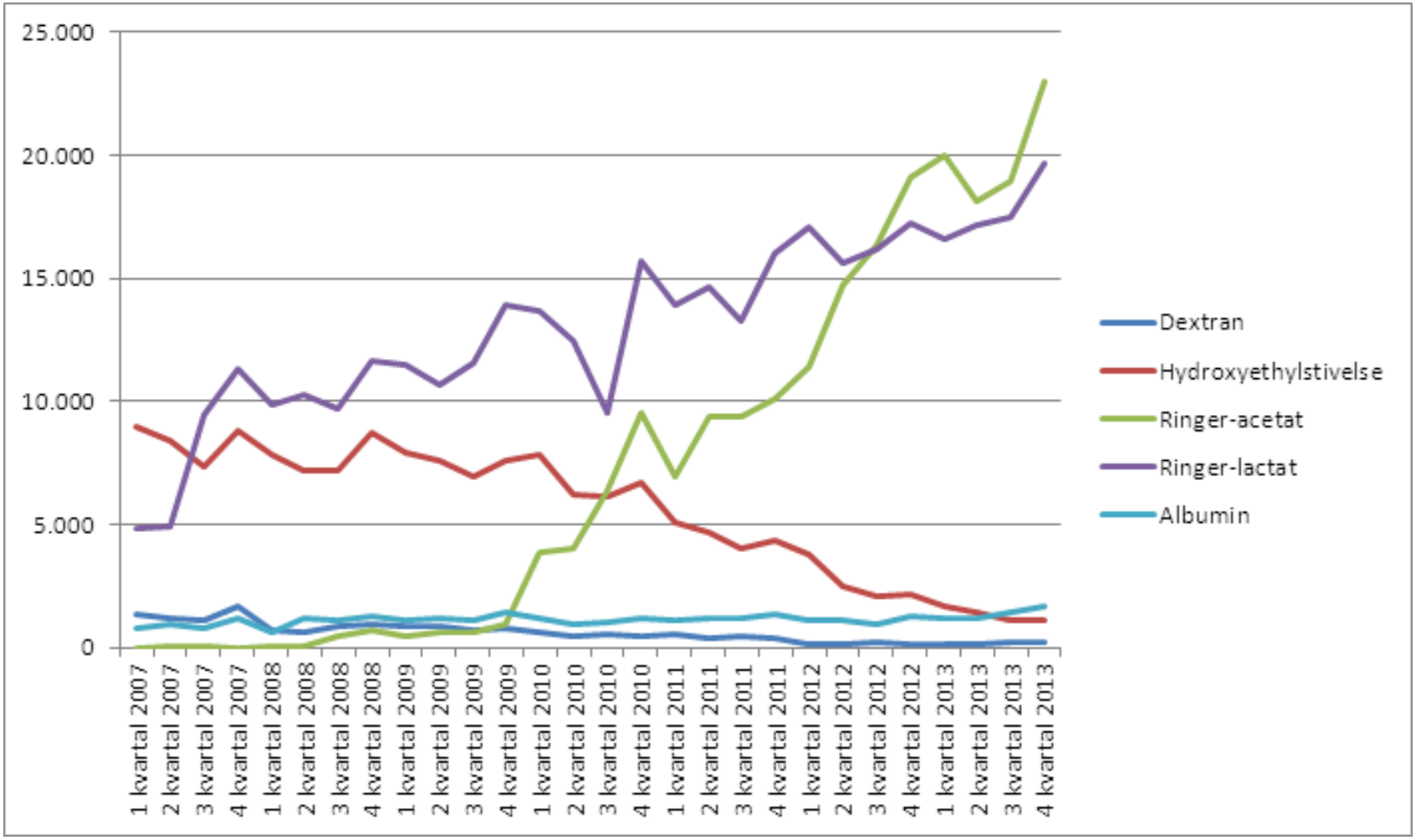
- Initial shock therapy
- Objective volume loss
- Hypoperfusion and low CO
- Hypoperfusion and normal / high CO??
- Dehydration, low fluid intake < 1.5 l, forced diuresis (myoglobinemia, drugs)

Why bother?

- Positive fluid balance associated to increased mortality
- Fluid restriction and diuresis reduce time on mechanical ventilation
- Hypernatremia clinically problematic and associated to increased mortality
- Highly significant ($P<0.0001$) variation in fluid volumes among sites in 6S

- **What should we give?**

Fluid purchase in the Capital Region, DK



Colloids vs crystalloids

REVIEW ARTI

Scandinavian clinical practice guideline on choice of fluid in resuscitation of critically ill patients with acute circulatory failure

A. Perner[1], E. Junttila[2], M. Haney[3], K. Hreinsson[4], R. Kvåle[5], P. O. Vandvik[6] and M. H. Møller[1]

[1]Department of Intensive Care, Rigshospitalet, Copenhagen University Hospital, Copenhagen, Denmark
[2]Department of Anaesthesiology, Division of Intensive Care, Oulu University Hospital and Department of Anaesthesiology, Tampere University Hospital, Tampere, Finland
[3]Anaesthesiology and Intensive Care Medicine, Umeå University, Umeå, Sweden
[4]Department of Anaesthesiology and Intensive Care Medicine, Landspitali University Hospital, Reykjavik, Iceland
[5]Department of Intensive Care, Haukeland University Hospital, Bergen, Norway
[6]Department of Medicine, Innlandet Hospital Trust-Division Gjøvik, Norway and Norwegian Knowledge Centre for the Health Services, Oslo, Norv

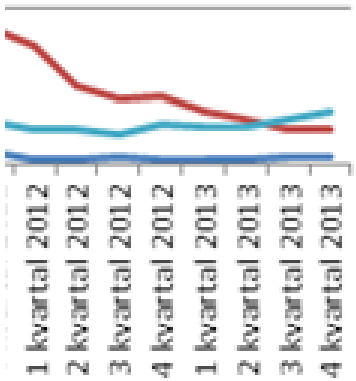
Conclusions: We recommend using crystalloid solutions rather than colloid solutions for resuscitation in the majority of critically ill patients with acute circulatory failure.

AAS 2014, online Nov. 4th

Crystalloid to colloid volume ratio in blinded trials

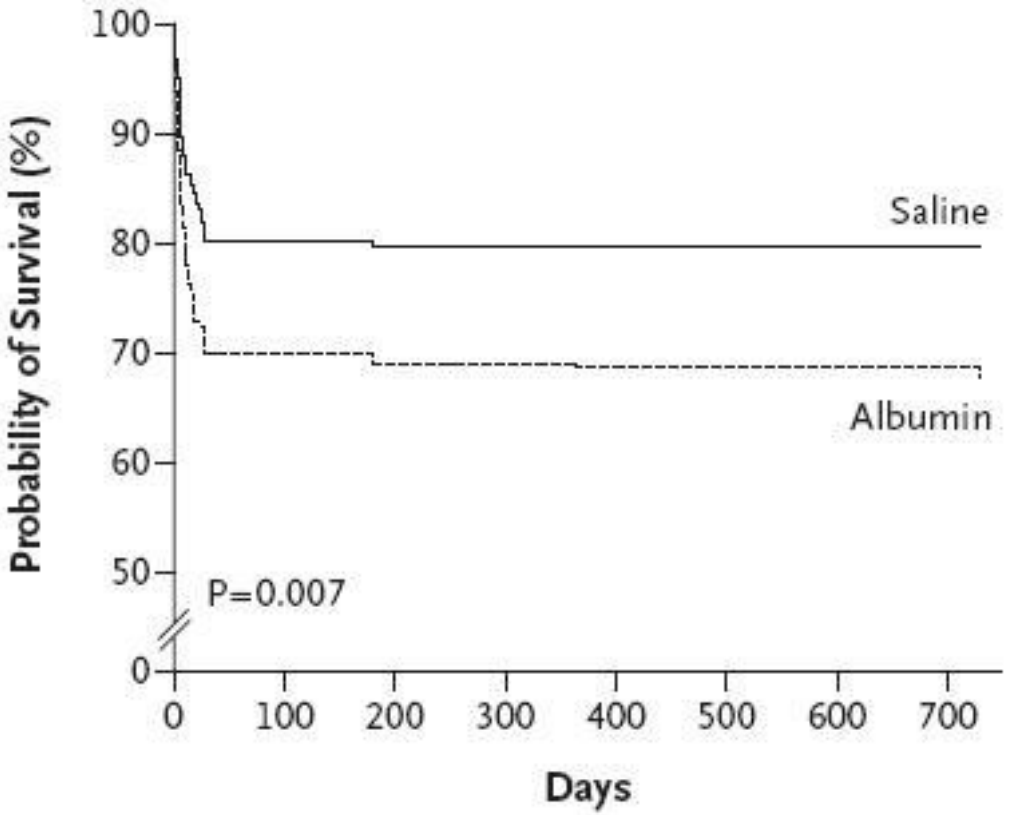
				Ratio
SAFE	**NaCl**	**vs**	**4% albumin**	**n=7000**
CHEST	**NaCl**	**vs**	**6% HES130**	**n=7000**
6S trial	**Ringer**	**vs**	**6% HES130**	**n= 800**
CRYSTMAS	**NaCl**	**vs**	**6% HES130**	**n= 196**

Increasing use albumin



Is it worth the cost?

Increased mortality with 4% albumin in TBI



J Myburgh et al NEJM 2007

Surviving Sepsis Campaign: International Guidelines for Management of Severe Sepsis and Septic Shock: 2012

Dellinger et al

TABLE 6. Recommendations: Hemodynamic Support and Adjunctive Therapy

G. Fluid Therapy of Severe Sepsis

1. Crystalloids as the initial fluid of choice in the resuscitation of severe sepsis and septic shock (grade 1B).
2. Against the use of hydroxyethyl starches for fluid resuscitation of severe sepsis and septic shock (grade 1B).
3. Albumin in the fluid resuscitation of severe sepsis and septic shock when patients require substantial amounts of crystalloids (grade 2C).

ICM 2013;39:165
CCM 2013;41:580

thebmj

CrossMark
click for updates

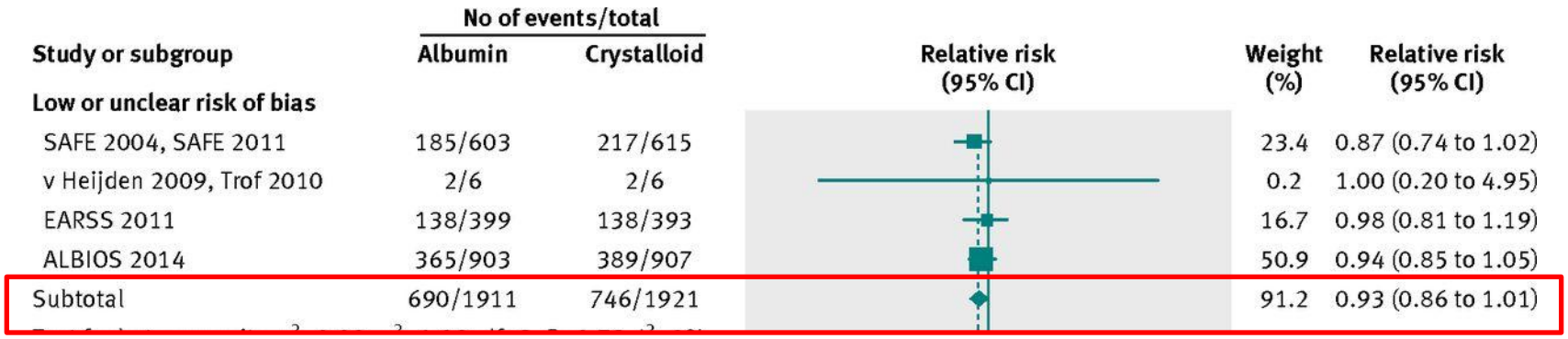
BMJ 2014;349:g4561 doi: 10.1136/bmj.g4561 (Published 22 July 2014)

RESEARCH

Randomised trials of human albumin for adults with sepsis: systematic review and meta-analysis with trial sequential analysis of all-cause mortality

Amit Patel *specialist registrar and clinical lecturer*[1 2 3], Michael A Laffan *professor and consultant*[3], Umeer Waheed *consultant*[1], Stephen J Brett *reader and consultant*[1]

Relative risk of all-cause mortality in patients with sepsis randomised to albumin vs crystalloid



Study or subgroup	No of events/total: Albumin	No of events/total: Crystalloid	Relative risk (95% CI)	Weight (%)	Relative risk (95% CI)
Low or unclear risk of bias					
SAFE 2004, SAFE 2011	185/603	217/615		23.4	0.87 (0.74 to 1.02)
v Heijden 2009, Trof 2010	2/6	2/6		0.2	1.00 (0.20 to 4.95)
EARSS 2011	138/399	138/393		16.7	0.98 (0.81 to 1.19)
ALBIOS 2014	365/903	389/907		50.9	0.94 (0.85 to 1.05)
Subtotal	690/1911	746/1921		91.2	0.93 (0.86 to 1.01)

Patel A et al. BMJ 2014;349:bmj.g4561

Albumin

An expensive and limited resource without apparent benefit

which crystalloid?

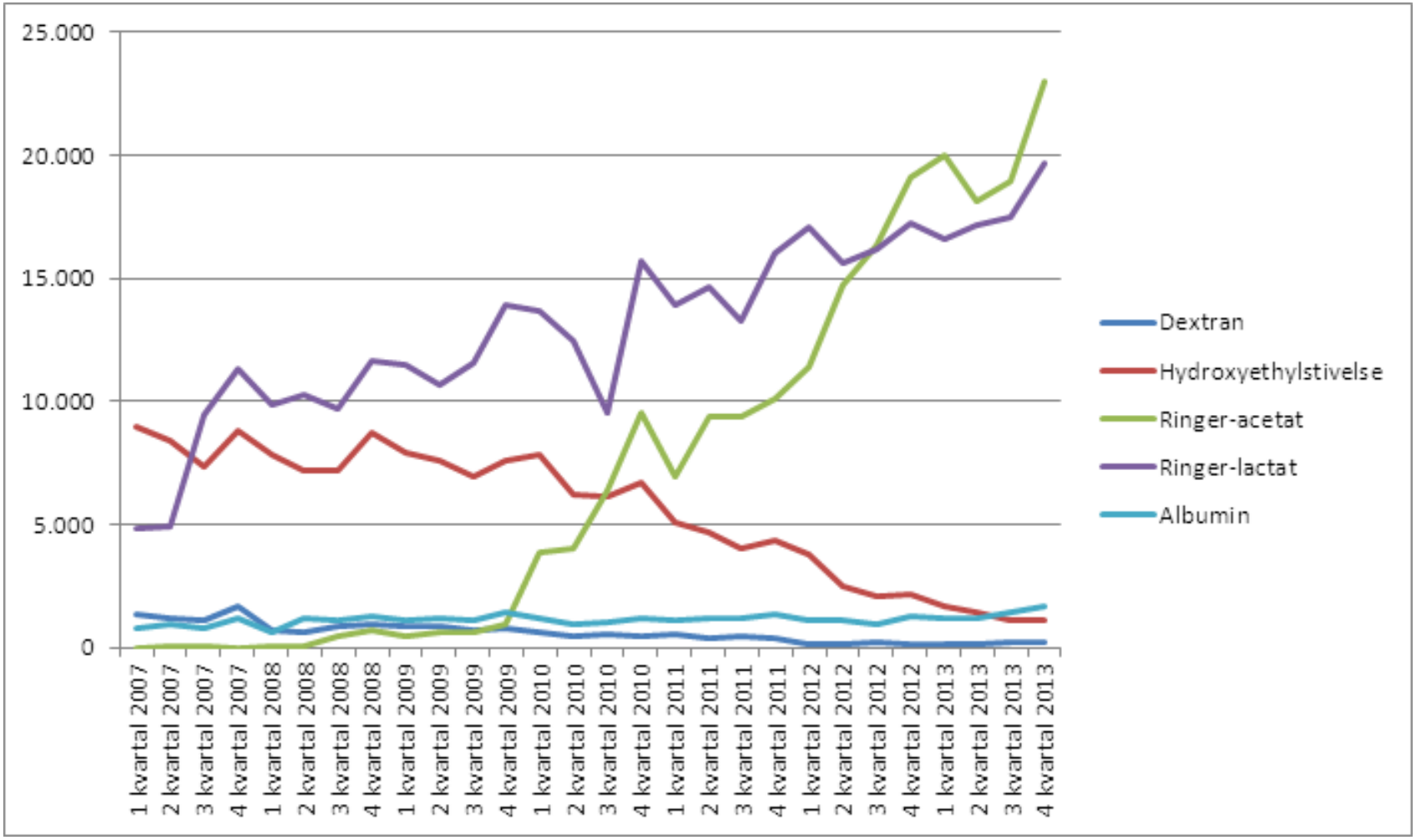
No fluids match plasma water

which crystalloid?

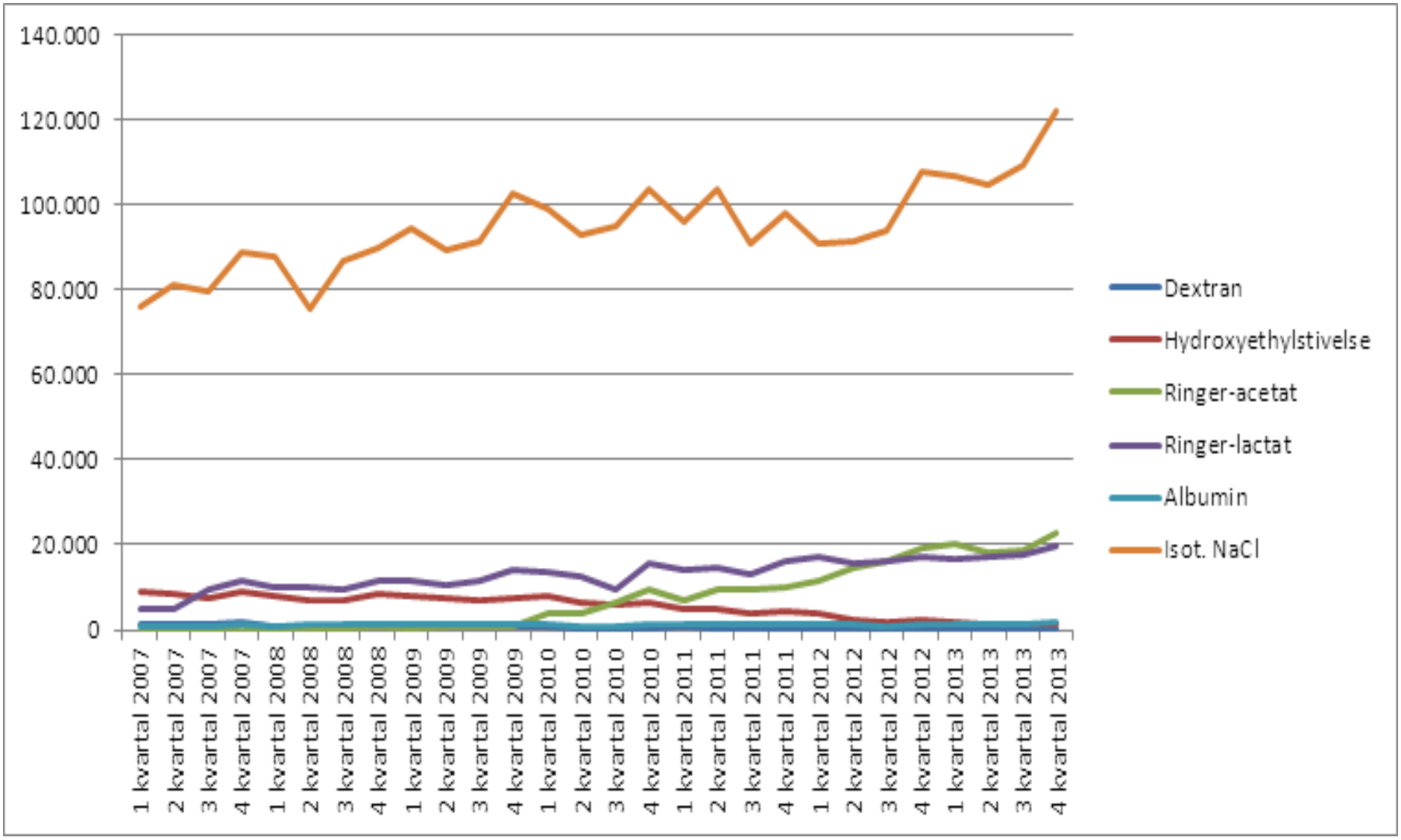
No fluids match plasma water

NaCl	- hyperchloraemic acidose
Ringer's solutions	- hypotonic
	- lactataemia
	- acetate/gluconate/malate?

Fluid purchase in the Capital Region, DK



Fluid purchase in the Capital Region, DK



Association Between a Chloride-Liberal vs Chloride-Restrictive Intravenous Fluid Administration Strategy and Kidney Injury in Critically Ill Adults

Nor'azim Mohd Yunos, MD
Rinaldo Bellomo, MD, FCICM
Colin Hegarty, BSc
David Story, MD
Lisa Ho, MClinPharm
Michael Bailey, PhD

Context Administration of traditional chloride-liberal intravenous fluids may precipitate acute kidney injury (AKI).

Objective To assess the association of a chloride-restrictive (vs chloride-liberal) intravenous fluid strategy with AKI in critically ill patients.

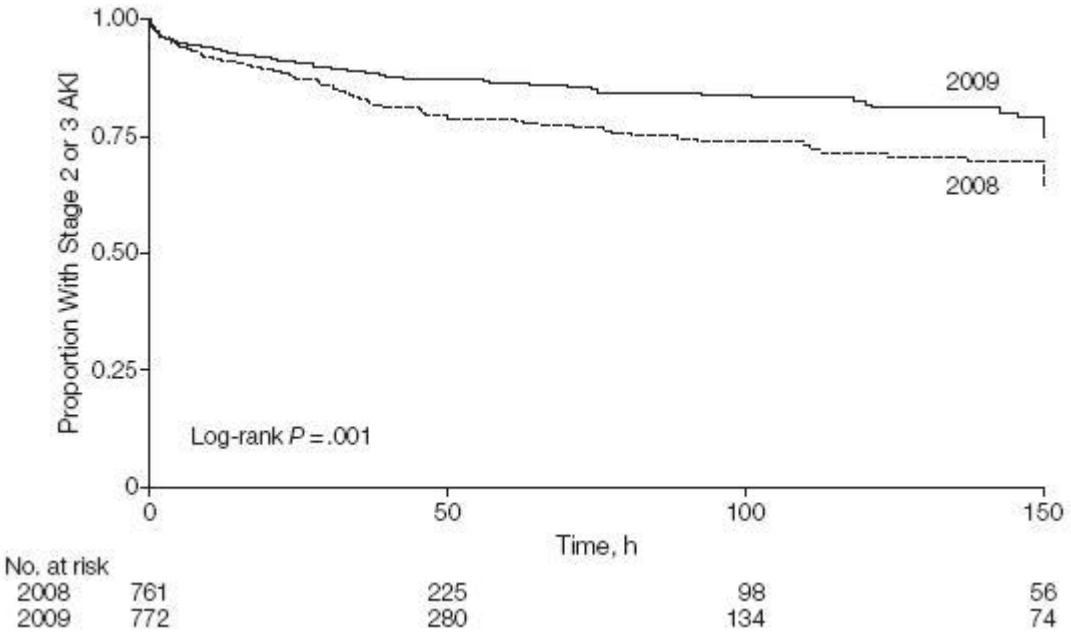
Design, Setting, and Patients Prospective, open-label, sequential period pilot study of 760 patients admitted consecutively to the intensive care unit (ICU) during the control period (February 18 to August 17, 2008) compared with 773 patients admitted

- **Before-and-after-study in a single ICU in Melbourne**
- **Patients: All ICU patients**
- **Intervention: restriction of chlorid-containing fluids**
- **Outcome: AKI, RRT**

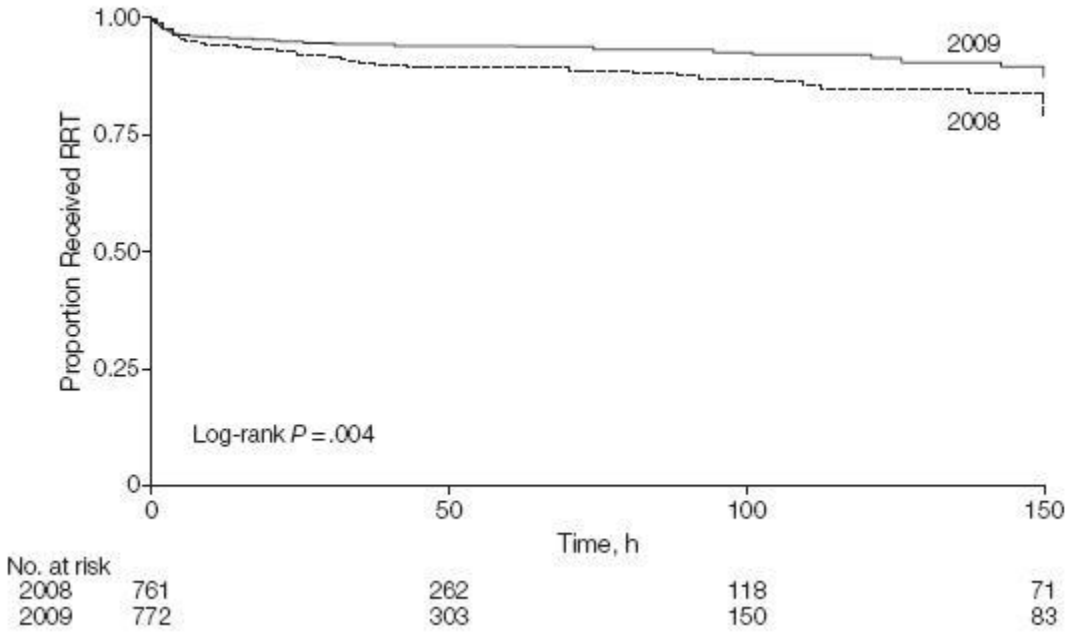
Chlorid restriction

	2008	*vs*	2009
Saline	**3.2 l/pt**	**vs**	**0.1 l/pt**
Gelatin	**0.7 l/pt**	**vs**	**0.0 l/pt**
4% albumin	**0.4 l/pt**	**vs**	**0.1 l/pt**
Ringers lactate	**0.6 l/pt**	**vs**	**4.1 l/pt**
20% albumin	**0.1 l/pt**	**vs**	**0.4 l/pt**

AKI


1.00
0.75
0.50
0.25
0
Proportion With Stage 2 or 3 AKI
2009
2008
Log-rank P = .001
0
50
100
150
Time, h
No. at risk
2008 761 225 98 56
2009 772 280 134 74

RRT


1.00
0.75
0.50
0.25
0
Proportion Received RRT
2009
2008
Log-rank P = .004
0
50
100
150
Time, h
No. at risk
2008 761 262 118 71
2009 772 303 150 83

Modern fluid therapy?

Fluids have effects related to CO

Fluids have side-effects related to volume and content

???.....

Higher vs lower volume

NaCl vs Ringer

Lactate vs acetate

Na, Cl restriction

Albumin in ARDS, burn and very low p-albumin (<15 g/l)

. Holstebro

Lemvig Folkeblad 5/7-12

Saltvand redder liv på lokale sygehuse

HOLSTEBRO: Patienter, der er i chok på grund af svær blodforgiftning, får væske direkte i årene for at kickstarte blodcirkulationen. Nu viser helt ny forskning, at det er muligt at redde flere liv ved at behandle patienterne med saltvandsopløsning frem for væske med stivelse.

På de intensive afsnit i Herning og Holstebro er man gået over til den nye praksis, fortæller overlægerne Robert Winding og Claude Kancir, som er tovholdere på projektet på Anæstesiologisk Afdeling i Hospitalsenheden Vest.

De intensive afsnit i Herning og i Holstebro har, sammen med Rigshospitalet og en række andre danske og skandinaviske hospitaler, været med til at undersøge effekten af væskebehandså alvorlig, at den oftest er livstruende.

I undersøgelsen opdagede forskerne en markant forskel både i dødeligheden og i behovet for dialysebehandling hos overlevende patienter ved at sammenligne de to former for væske. Blandt de patienter, der fik væsken med stivelse, var der flere, som fik behov for dialyse og blodtransfusion.

Væskebehandling med salt er mindre risikofyldt for patienten i det lange løb, og derfor har de intensive afsnit i Herning og Holstebro ændret praksis.

Godt 800 patienter med svær blodforgiftning indgik i undersøgelsen, heraf 34 patienter på regionshospitalerne i Herning og Holstebro.

Resultaterne af undersøgelsen udkommer på tryk i »New England Journal of

Rigshospitalet

University of Copenhagen

clinical research network

SCCTG Scandinavian Critical Care Trials Group

ICM INTENSIVE CARE MEDICINE

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