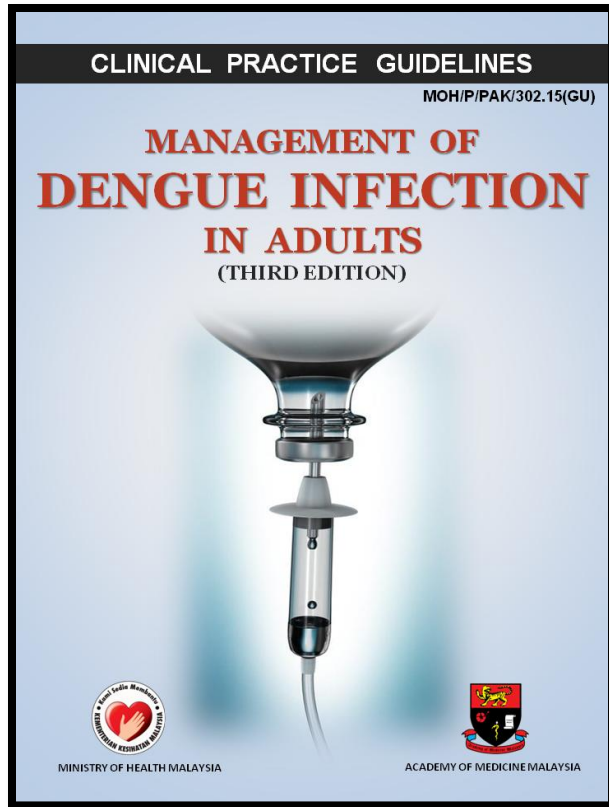




FLUID MANAGEMENT



LEARNING OBJECTIVES (1)

- ▶ Fluid therapy (oral and IV) is the mainstay of therapy in dengue infection
- ▶ Appropriate Intravenous fluid therapy will improve clinical outcome
- ▶ Calculation of IV fluid maintenance therapy based on weight (adjusted body weight for those obese patient)

LEARNING OBJECTIVES (2)

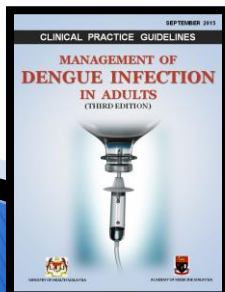


- ▶ IV fluid therapy only indicated for those who has on going plasma leakage
- ▶ Recognition of DSS – compensated shock is most important
- ▶ Recognition of occult bleeding in DSS – require blood transfusion

What's in the current CPG?

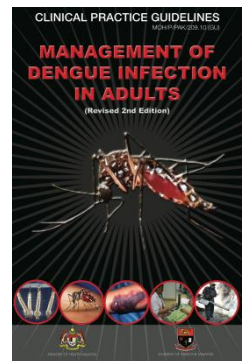
CPG 2015

- ▶ Common pitfalls in fluid therapy
- ▶ Emphasis on oral fluid intake
- ▶ IV fluid therapy only indicated in certain group
- ▶ Easier calculation of maintenance fluid requirement (NICE)
- ▶ Stress on adjusted body weight in obese patient



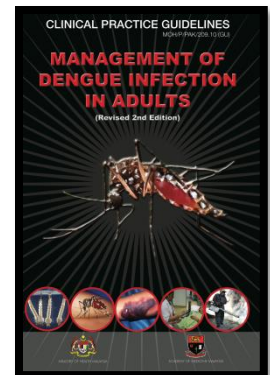
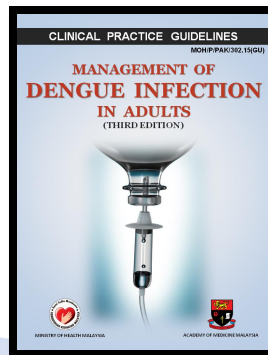
CPG revised edition 2010

- ▶ Common pitfalls in fluid therapy
- ▶ IV boluses fluid therapy being emphasized for warning signs patient
- ▶ Calculation of maintenance fluid according to **Halliday-Segar formula (4/2/1)**
- ▶ Applying IBW for overweight/ obese patient



In severe dengue

- ▶ Algorithm A – compensated shock (no change)
 - ▶ Algorithm B – Decompensated shock –
 - ▶ Algorithm C – Refractory shock (non responders) **(NEW)**
 - ▶ Assessment:
 - Stress on fluid responsiveness parameter
 - Clinical
 - Laboratory
 - **Imaging**
- ▶ Algorithm A – compensated shock
 - ▶ Algorithm B – Decompensated shock –
 - ▶ Assessment :
 - Clinical parameters
 - Laboratory



3rd CPG – Fluid therapy

Non Shock dengue patient :

- ▶ In patients without co-morbidities who can tolerate orally, adequate oral fluid intake of **2–3 litres daily** should be encouraged.
- ▶ This group of patients may not require intravenous fluid therapy.
- ▶ Inappropriate intravenous fluid therapy had been shown to prolong hospitalisation with a tendency to develop more fluid accumulation



Indication for IV fluid therapy

- ▶ increasing HCT **with** evidence of ongoing plasma leakage, despite increased oral intake.
- ▶ IV fluid therapy should also be considered in patients who are vomiting, severe diarrhoea and not tolerating orally

The normal maintenance requirement for IV fluid therapy

Non-obese patients

- Maintenance fluid can be calculated based on the following formula :
 - 1.2 to 1.5 ml/kg/hour

Adapted : National Clinical Guideline Centre (UK). Intravenous Fluid Therapy: Intravenous Fluid Therapy in Adults in Hospital [Internet]. London: Royal College of Physicians (UK); 2013 Dec. Available from <http://www.ncbi.nlm.nih.gov/books/NBK247761/>

Overweight and obese patients (BMI ≥ 27.5 kg/m²)

Maintenance fluid can be calculated based on adjusted body weight

- Adjusted bodyweight (ABW) can be calculated using the formula.
 - $ABW = IBW + 0.4 (\text{actual weight} - IBW)^{**}$
 - Ideal bodyweight (IBW) can be estimated based on the following formula.
 - Female: $45.5 \text{ kg} + 0.91(\text{height} - 152.4) \text{ cm}$
 - Male: $50.0 \text{ kg} + 0.91(\text{height} - 152.4) \text{ cm}$

CAUTION : Fluid intake and urine output must be reviewed and adjusted according to clinical response. Use of volumetric pumps is encouraged, especially in patients requiring close fluid monitoring.

Example

- ▶ Dengue infection in Day 4 with vomiting and poor oral intake,
- ▶ Day 3 HCT 40 and now Day 4 HCT is 42
- ▶ Temp 38 degree C
- ▶ Body weight : 50 kg
- ▶ Oral intake – minimal ~ 500 cc /day
- ▶ Full maintenance :
- ▶ $1.5 \text{ ml} \times 50/\text{h} = 75 \text{ cc/ hour} ; 1800 \text{ cc/ day}$
- ▶ $\text{IVD} = 1800 - 500 = 1300\text{cc (roughly } 1500 \text{ cc /day)}$

Caution

- ▶ Frequent adjustment of maintenance fluid regime is needed during the critical phase.
- ▶ Often 1.2 to 1.5 X the maintenance will be required during the critical phase.
- ▶ Patients may be able to take oral fluids after a few hours of IV therapy.(need to adjust rate)
- ▶ If the fluid infusion rate $>$ the maintenance requirement, the infusion rate should be reviewed within 2 to 4 hours.

- ▶ In patients with persistent warning signs with increasing or persistently high HCT, the graded fluid bolus may be initiated with caution

Graded Fluid Bolus Regime

- Obtain a baseline HCT before fluid therapy.
- Give crystalloids solution (such as 0.9% saline).
- Start with 5 ml/kg/hour for 1–2 hours, then reduce to 3 ml/kg/hr for 2–4 hours, and then reduce to 2 ml/kg/hr or less according to the clinical response.
- If the clinical parameters are worsening and HCT is rising, increase the rate of infusion.
- Reassess the clinical status, repeat the HCT and review fluid infusion rates accordingly.

Table 3: Warning Signs

- Any abdominal pain/tenderness
- Persistent vomiting (≥ 3 times over 24 hours)
- Persistent diarrhoea (≥ 3 times over 24 hours)
- Third space fluid accumulation (such as ascites, pleural and pericardial effusion)
- Spontaneous bleeding tendency
- Lethargy/restlessness/confusion
- Tender liver
- Raised HCT with rapid drop in platelet:
 - HCT male ≤ 60 years - 46
 - HCT male > 60 years - 42
 - HCT female (all age groups) - 40

*median value of normal HCT in Malaysian population^{33, level II-2.}

Adapted : World Health Organization. Dengue Guidelines for Diagnosis, Treatment, Prevention and Control - New Edition 2009. WHO: Geneva; 2009

TO REDUCE IV DRIP

- ▶ Reduce or consider discontinuation of IV fluid therapy when patients begin to show signs of recovery (usually after 24–48 hours of defervescence, or the HCT drops in a stable patient).

Recommendation

Recommendation 5

- In dengue patients without co-morbidities who can tolerate orally, adequate oral fluid intake of two to three litres daily should be encouraged. These patients may not require intravenous (IV) fluid therapy.
- IV fluid should be instituted in dengue patients with:
 - vomiting, unable to tolerate oral fluids or severe diarrhoea
 - increasing haematocrit (with other signs of ongoing plasma leakage) despite increased oral intake
- In patients with persistent warning signs with increasing or persistently high HCT, the graded fluid bolus may be initiated with caution.
- Crystalloids solution should be the fluid of choice for non-shock dengue patients.

DSS

- ▶ Dengue shock syndrome is a medical emergency.
- ▶ **Recognition of shock** in its early stage (compensated shock) and prompt fluid resuscitation will give a good clinical outcome.
- ▶ Pulse pressure of < 20 mmHg and systolic pressure < 90 mmHg are late signs of shock in adults.
- ▶ Failure to recognise the phase of compensated shock will ultimately lead to decompensated (hypotensive) shock with a more complicated disease course and organ failures.

DSS– GICU/HDU

- ▶ All patients DSS should be managed in high dependency or intensive care units.
- ▶ Prompt fluid resuscitation should be done and should not be delayed while waiting for admission to ICU or high dependency unit.
- ▶ Following initial resuscitation there maybe recurrent episodes of shock because capillary leakage can continue for 24 to 48 hours.
- ▶ Continue to closely monitor clinically and laboratory + imaging (fluid responsiveness to therapy)

Choice of fluid in DSS

- ▶ IV fluid therapy is the mainstay of treatment for dengue shock.
- ▶ This CPG recommendations are extrapolated from studies of fluid therapy in children with DSS
- ▶ There is **no clear advantage of using any** of the colloids over crystalloids in terms of the overall outcome and mortality.
- ▶ However **colloid may be preferable** as the fluid of choice in patients with **intractable** shock in the initial resuscitation.

In this CPG

Colloids

- ▶ choice of colloids include gelatin solution and albumin
- ▶ HES should not be used as in the recent meta-analysis, in non-dengue critically ill patients with sepsis, was associated with an increase in the rate of renal replacement therapy and coagulation abnormalities
- ▶ **Colloid should be used mainly for resuscitation.**
- ▶ Prolonged use of colloid as sole maintenance fluid should be avoided.

Other solutions

- ▶ **Albumin** as resuscitation fluid in DSS has not been studied, however from extensive use in critically ill patients, 4%–5% albumin is comparable to crystalloid and may be better in subgroup of septic patients
- ▶ **Hypertonic sodium lactate** in DSS has shown positive results in only one study. However, there is lack of clear evidence to support the use of this solution and furthermore, the product is not available in this country.

COMPENSATED SHOCK

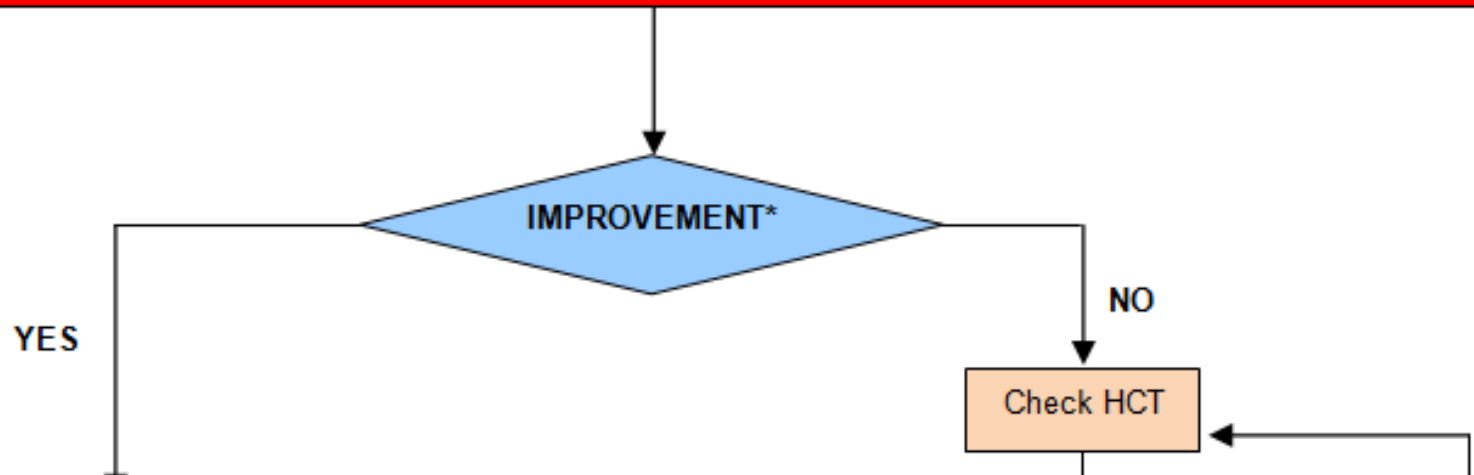
ALGORITHM A

ALGORITHM A - FLUID MANAGEMENT IN COMPENSATED SHOCK

COMPENSATED SHOCK

(systolic pressure maintained but has signs of reduced perfusion)

- Fluid resuscitation with isotonic crystalloid 5-10 ml/kg/hr over 1 hour
- Obtain FBC, HCT, RP, LFT, RBS, PT/APTT, CK, Lactate/HCO₃, GXM¹ level before fluid resuscitation.



Improvement clinically

Table 9 : Fluid Responsiveness Parameters

A. Clinical response parameters

- ✓ Improvement of general well being/ mental state
- ✓ Warm peripheries
- ✓ Capillary refill time <2sec
- ✓ BP stable
- ✓ Improving pulse pressure
- ✓ Reducing tachycardia
- ✓ Improving urine output
- ✓ Less tachypnoea

B. Laboratory parameters

- ✓ Appropriate decrease in HCT
- ✓ Improvement in metabolic acidosis and lactate clearance

Assessment

C. Imaging parameters (recommended but not mandatory)

- ✓ Improvement of IVC collapsibility index (spontaneous breathing patient)

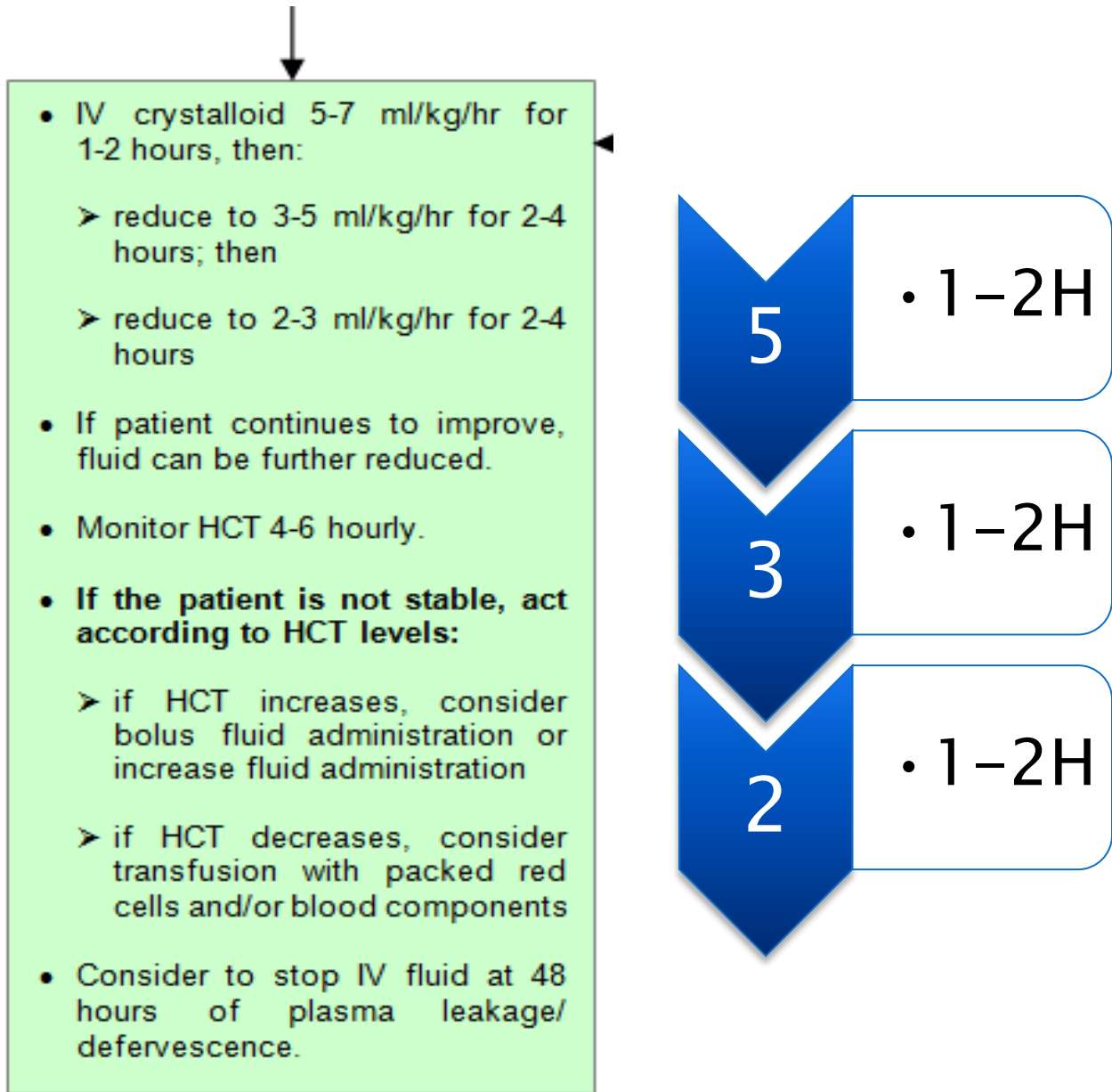
$$\frac{\text{IVC expiratory diameter} - \text{IVC inspiratory diameter}}{\text{IVC expiratory diameter}} \times 100 = \text{Caval index (\%)}$$

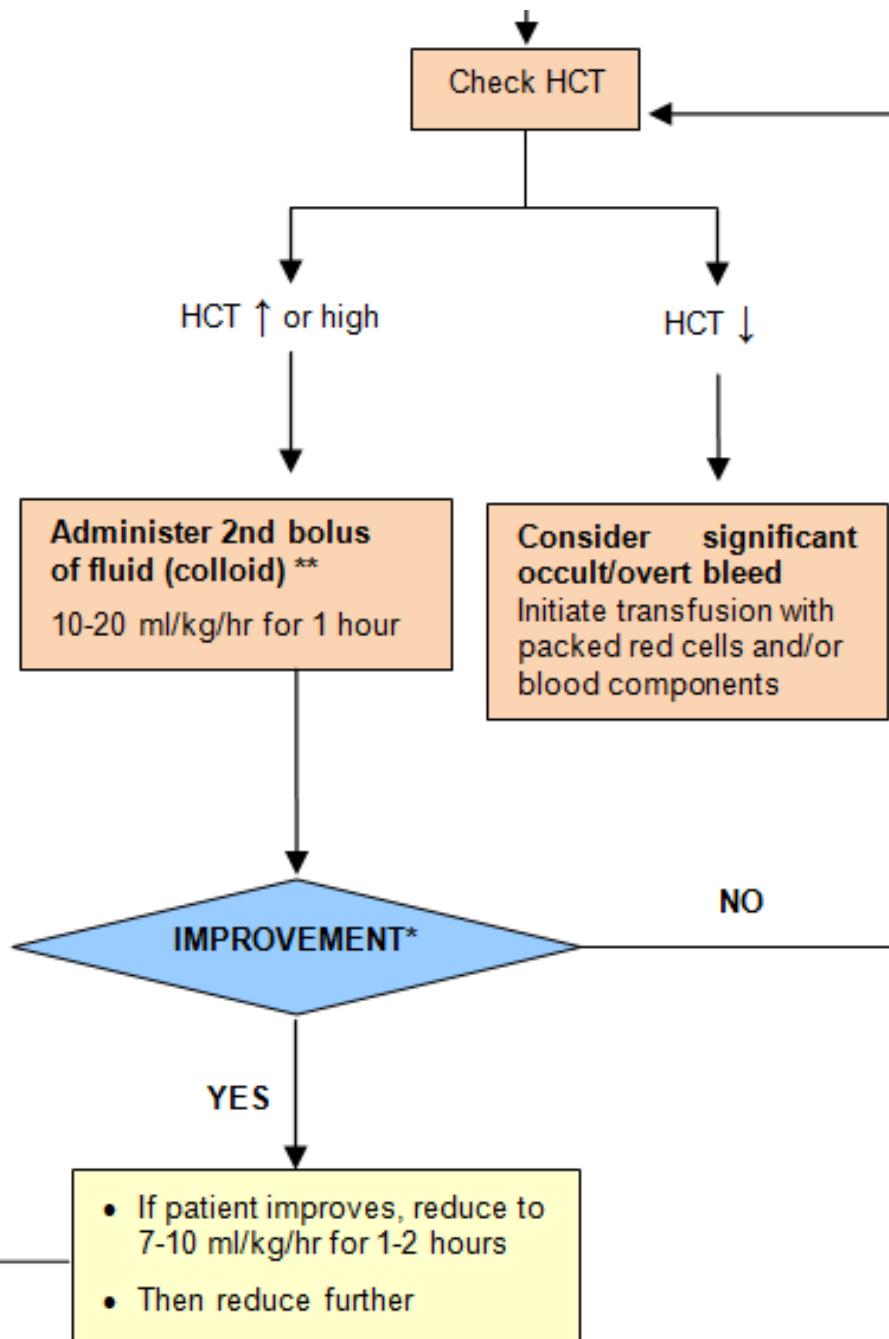
*Caval index close to 100% is indicative of almost complete collapse, therefore volume depletion and 0% suggests minimal collapse i.e. likely volume overload.
>40% collapse will be fluid responsive.⁷²

Adapted : Goldflam K, Saul T and Lewiss R. Focus on: inferior vena cava ultrasound. ACEP News 6. 2011. pp 24-25. (available at : <http://www.acep.org/Content.aspx?id=80791>)

CAUTION : IVC assessment should be performed by trained personnel and not to be interpreted in isolation.

After first 5–10 ml/kg resuscitation – YES improving





After first 5–10 ml/kg
resuscitation –
NOT improving

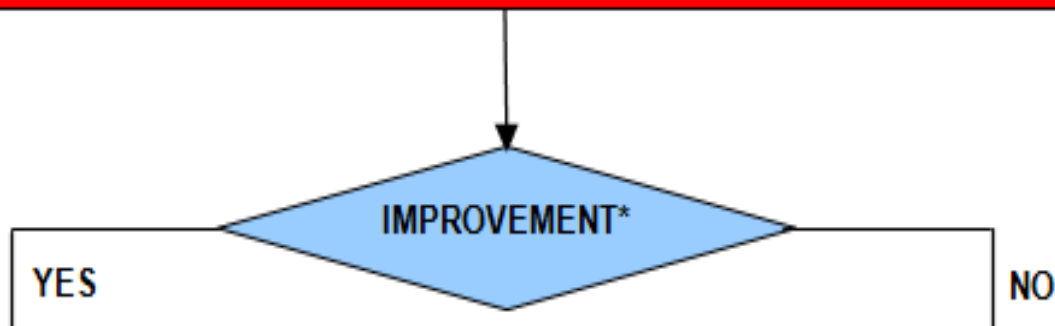
DECOMPENSATED SHOCK

ALGORITHM B

ALGORITHM B - FLUID MANAGEMENT IN DECOMPENSATED SHOCK

DECOMPENSATED SHOCK

- Fluid resuscitation with 20 ml/kg/hr colloid / crystalloid over 15 – 30 minutes.
- Obtain HCT/FBC, RP, LFT, RBS, PT/APTT, CK, Lactate/HCO₃, GXM¹ level before fluid resuscitation.



Improvement clinically

Table 9 : Fluid Responsiveness Parameters

A. Clinical response parameters

- ✓ Improvement of general well being/ mental state
- ✓ Warm peripheries
- ✓ Capillary refill time <2sec
- ✓ BP stable
- ✓ Improving pulse pressure
- ✓ Reducing tachycardia
- ✓ Improving urine output
- ✓ Less tachypnoea

B. Laboratory parameters

- ✓ Appropriate decrease in HCT
- ✓ Improvement in metabolic acidosis and lactate clearance

Assessment

C. Imaging parameters (recommended but not mandatory)

- ✓ Improvement of IVC collapsibility index (spontaneous breathing patient)

$$\frac{\text{IVC expiratory diameter} - \text{IVC inspiratory diameter}}{\text{IVC expiratory diameter}} \times 100 = \text{Caval index (\%)}$$

*Caval index close to 100% is indicative of almost complete collapse, therefore volume depletion and 0% suggests minimal collapse i.e. likely volume overload.
>40% collapse will be fluid responsive.⁷²

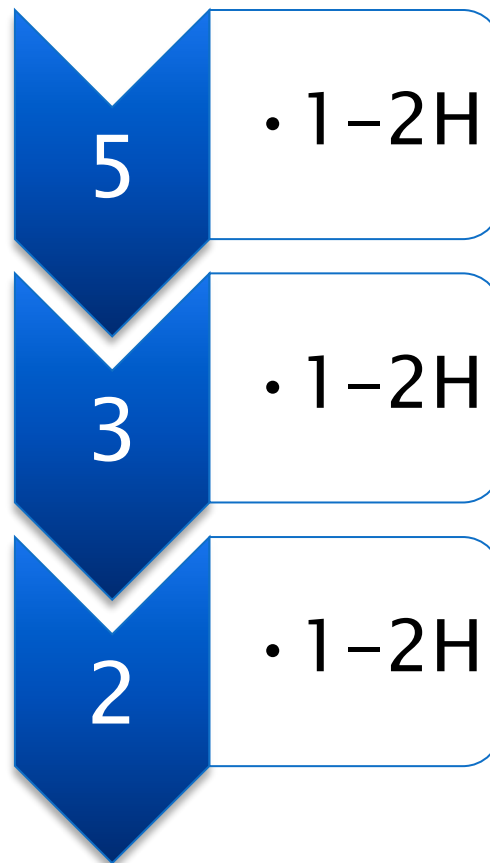
Adapted : Goldflam K, Saul T and Lewiss R. Focus on: inferior vena cava ultrasound. ACEP News 6. 2011. pp 24-25. (available at : <http://www.acep.org/Content.aspx?id=80791>)

CAUTION : IVC assessment should be performed by trained personnel and not to be interpreted in isolation.

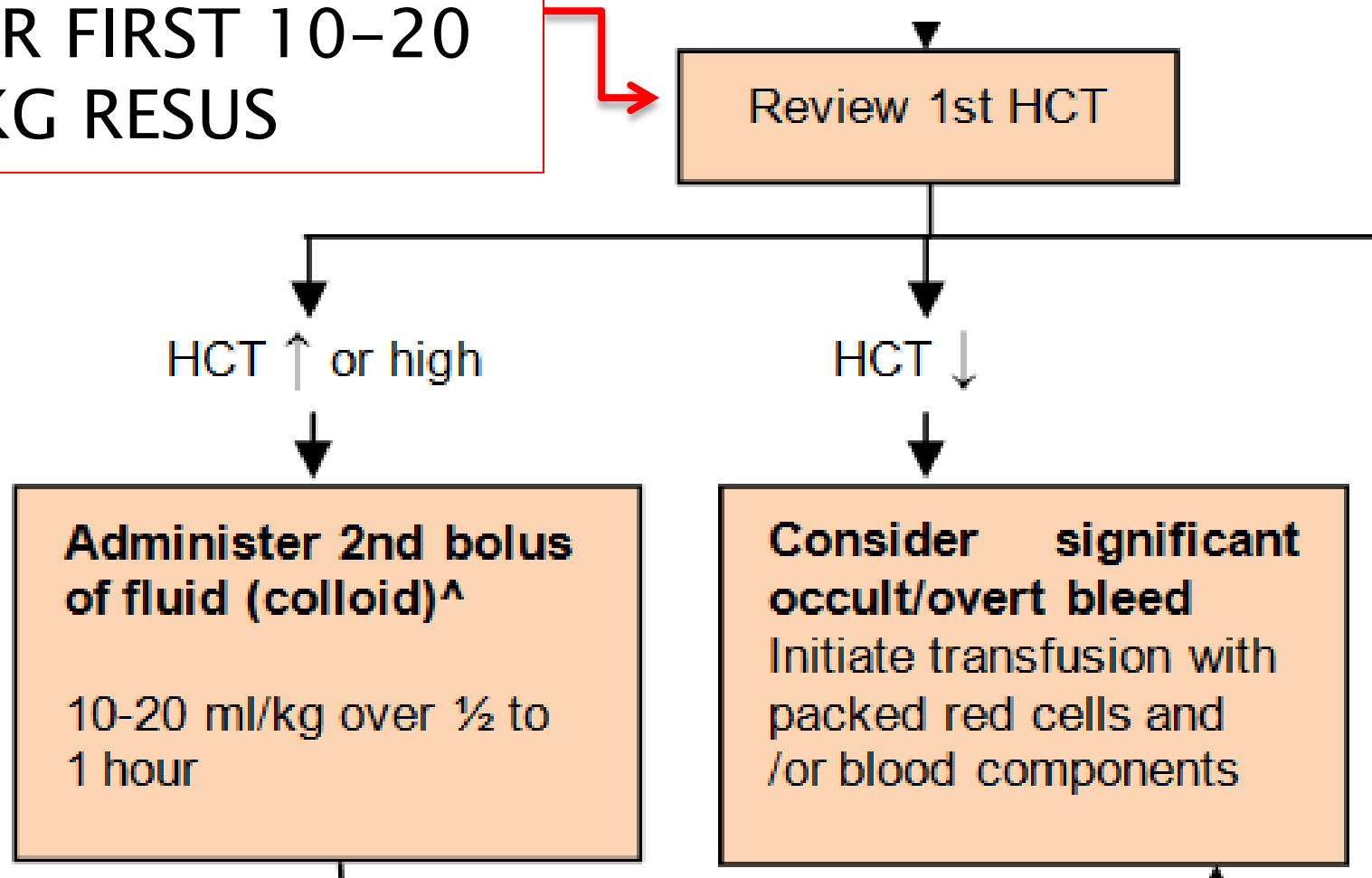
After first 10–20 ml/kg resuscitation – YES improving



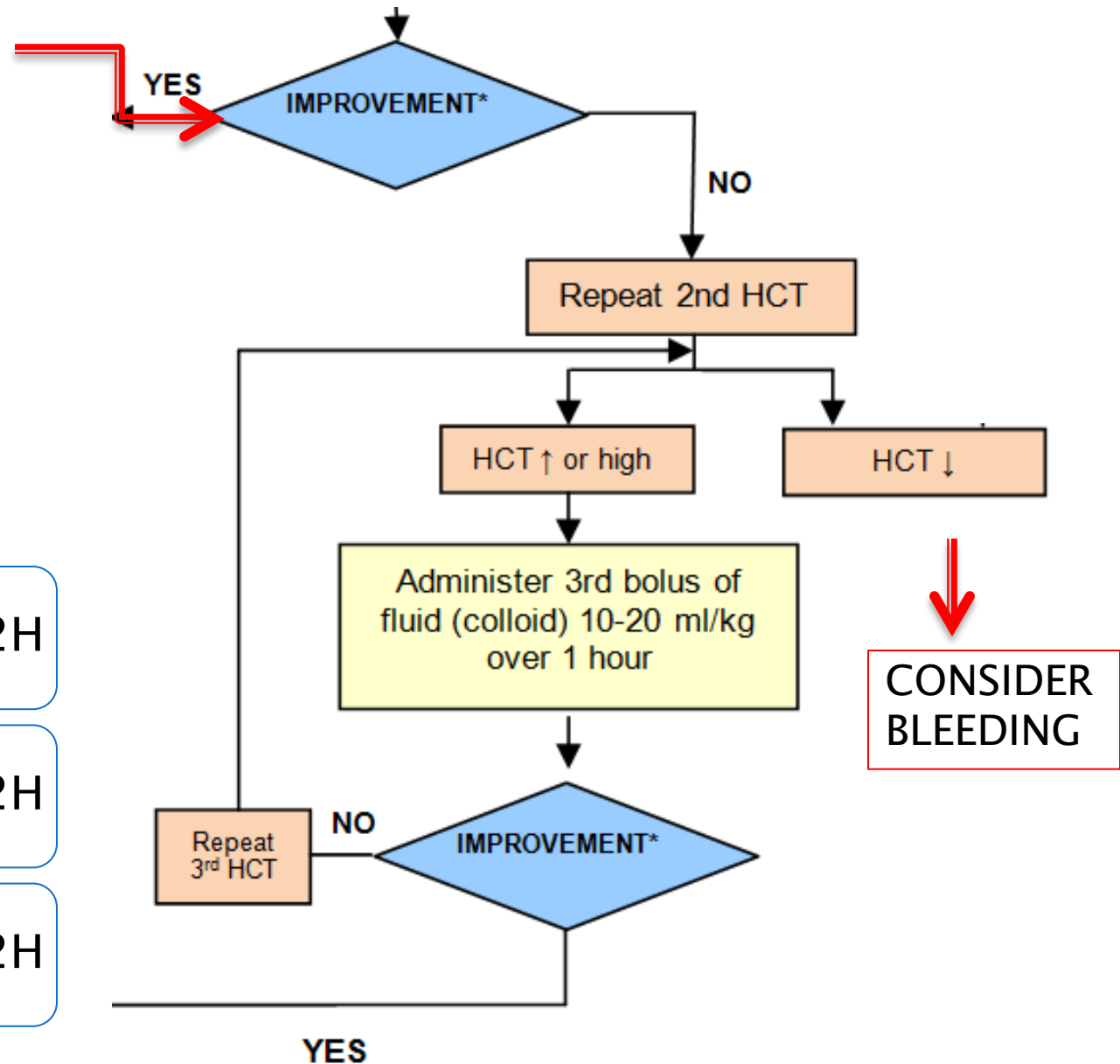
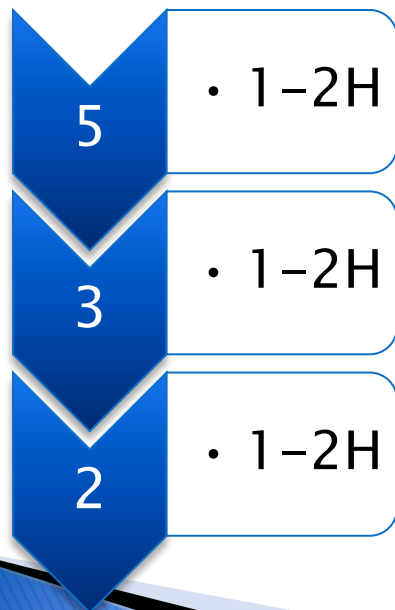
- Crystalloid/colloid 10ml/kg/hr for 1 hour, then continue with:
 - IV crystalloid 5-7 ml/kg/hr for 1-2 hours; then
 - reduce to 3-5 ml/kg/hr for 2-4 hours; then
 - reduce to 2-3 ml/kg/hr for 2-4 hours
- If patient continues to improve, fluid can be further reduced.
- Monitor HCT 4 hourly or more frequent as indicated.
- **If the patient is not stable, act according to HCT levels:**
 - if HCT increases, consider bolus fluid administration or increase fluid administration;
 - if HCT decreases, consider transfusion with packed red cells
- Consider to stop IV fluid at 48 hours of plasma leakage/defervescence.



**NO IMPROVEMENT
AFTER FIRST 10–20
ML/KG RESUS**



AFTER 2ND
10-20
ML/KG



REFRACTORY SHOCK

WITH NOT MUCH CHANGE ON HCT
ALGORITHM C

TAKE HOME MESSAGE

Recommendation 6

- Crystalloids solution should be the preferred choice in Dengue Shock Syndrome (DSS).
- Patients with DSS who do not respond to initial crystalloid resuscitation should receive colloids as the second fluid bolus.
- In DSS with persistent shock, other causes of shock should be aggressively looked for and treated accordingly.

THANK YOU

Case 1

History

In OPD:

- ▶ 23 year old lady
 - ▶ Fever for 4 days
 - ▶ High grade fever, nausea , and vomit once
 - ▶ Myalgia
 - ▶ Headaches
-
- ▶ Temp: 39 degree C
 - ▶ BP 115/74 HR : 90
 - ▶ FBC : TW 1.95/ Hb 13/ HCT 36.7/ Plt 102
(11.30 am)

Q1 What is the diagnosis?

- ☒ Dengue fever
- ☒ Dengue infection in febrile phase
- ☒ Dengue infection with warning sign in critical phase
- ☐ Dengue hemorrhagic fever

Diagnosis:

Dengue infection in febrile phase

- ❖ Poor oral intake : NOT a warning sign
- ❖ Mild nausea and vomiting is NOT warning sign
- ❖ Persistent vomiting ($> 3X/day$) is warning signs
- ❖ Febrile phase – not yet critical phase
- ❖ No hemo concentration (HCT 36.7)

Admission

HX : D4 fever, nausea and vomiting
HCT 36.2 , plt 102, TW 1.95
Temp: 39 degree C
BP 115/74 HR : 90
CCTVR – OK

- ▶ Weight : 72 kg Height : 1.58 m
- ▶ Ideal body weight : 54 Kg
- ▶ **Adjusted BW = 60 Kg**

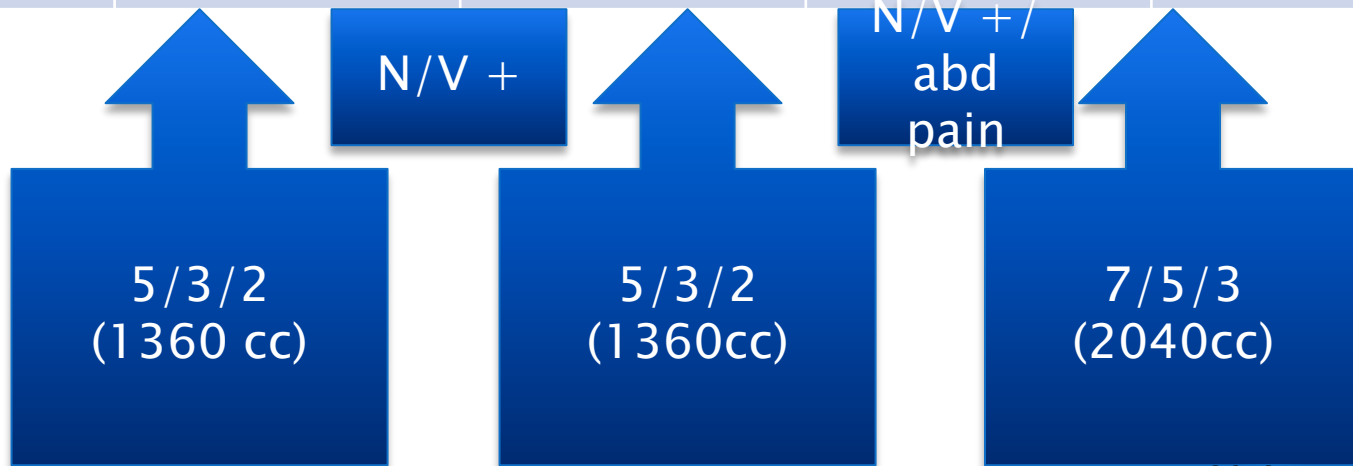
Q2 What is the fluid regime for this patient?

-  resuscitation 10 ml/kg/H for 2 H and then 7 ml/kg/H for 2 H , followed by 5 ml/kg/H for 2 H
-  Graded boluses IVD 5 ml/Kg/H X 2 H then 3 ml/Kg/H X 2 H, then 2 ml/Kg/H X 2
-  Full maintenance IVD 90ml/H (60 X 1.5 ml/H)
-  No IVD, encourage orally

ABW 60
Kg

Real life

FBC	D4 11.30 am	D4 6.30 pm	D5 4am	
TW	1.95	1.64	1.21	
HCT	36.7	34.9	32.7	
PLT	102	78	60	
BP	115/75	120/80	124/85	
HR	90	86	80	



TOTAL 4760 cc over 18 H

Urine
Output:
2200 cc

CRITICAL
PHASE ↓

CRITICAL PHASE
14H ↓

Temp

39

38.5

FBC	D4 11.30 am 37.6	D4 6.30 pm	D5 4am 37	D5 8 am
TW	1.95	1.64	1.21	1.41
HCT	36.7	34.9	32.7	34.4
PLT	102	78	60	48
BP	115/75	120/80	124/85	115/78
HR	90	86	80	80



Total input 4760 ml/ Output
2200 cc
+ 2560cc

c/o abdominal
discomfort

IVD 5 pint
/day

CRITICAL
PHASE



CRITICAL PHASE 22
H



Temp

39

37

38.5

37

37.6

FBC	D4 11.30 am	D4 6.30 pm	D5 4am	D5 8 am	D5 4 pm
TW	1.95	1.64	1.21	1.41	1.59
HCT	36.7	34.9	32.7	34.4	37.7
PLT	102	78	60	48	41
BP	115/75	120/80	124/85	115/78	114/82
HR	90	86	80	80	86

+ Balance 2560 cc

IVD 5 pint
/day

Still complaint of nausea , and abdominal pain
(distended)

WHAT WOULD YOU DO ?

Q3 WHAT WOULD YOU DO ?



Continue IVD Full Maintenance 5 pint /



Graded bolus therapy 5/3/2



Reduce IVD to 1 ml/kg/hour (60 ml/h) and
monitor closely



IV frusemide due to fluid overloaded

CRITICAL
PHASE



CRITICAL PHASE 22
H



Temp

39

37

38.5

37

37.6

FBC	D4 11.30 am	D4 6.30 pm	D5 4am	D5 8 am	D5 4 pm
TW	1.95	1.64	1.21	1.41	1.59
HCT	36.7	34.9	32.7	34.4	37.7
PLT	102	78	60	48	41
BP	115/75	120/80	124/85	115/78	114/82
HR	90	86	80	80	86

+ Balance 2560 cc

IVD 5 pint
/day

Still complaint of nausea , and abdominal pain
(distended)

IN REAL LIFE : Due to HCT 37.7
MO decided to do again 5/3/2 resuscitation

CRITICAL
PHASE



CRITICAL PHASE
26 H



FBC	D4 11.30 am	D4 6.30 pm	D5 4am	D5 8 am	D5 4 pm	D5 8 pm
TW	1.95	1.64	1.21	1.41	1.59	2.3
HCT	36.7	34.9	32.7	34.4	37.7	39.8
PLT	102	78	60	48	41	24
BP	115/75	120/80	124/85	115/78	114/82	123/84
HR	90	86	80	80	86	80



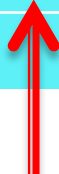
+ 2560 ml



IVD 5 pint
/day



5/3/2
Bolus



Pt c/o severe
abdomen
distension



CRITICAL PHASE
26H



FBC	D4 11.30 am	D4 6.30 pm	D5 4am	D5 8 am	D5 4 pm	D5 8 pm	D6 8 am
TW	1.95	1.64	1.21	1.41	1.59	2.3	2.6
HCT	36.7	34.9	32.7	34.4	37.7	39.8	39.8
PLT	102	78	60	48	41	24	26
BP	115/75	120/80	124/85	115/78	114/82	123/84	110/78
HR	90	86	80	80	86	80	70



CONTINUE FULL
MAINT

C/O severe
abdomen
distension



Q 4 Which phase is this ?



FBC	D4 11.30 am	D4 6.30p m	D5 4am	D5 8 am	D5 4 pm	D5 8 pm	D6 8 am	D6 4 pm
TW	1.95	1.64	1.21	1.41	1.59	2.3	2.6	4.1
HCT	36.7	34.9	32.7	34.4	37.7	39.8	39.8	40.2
PLT	102	78	60	48	41	24	26	28
BP	115/7 5	120/8 0	124/8 5	115/7 8	114/8 2	123/8 4	110/7 8	118/8 0
HR	90	86	80	80	86	80	70	80

Which phase is this ?

FBC	D4 11.30 am	D4 6.30 pm	D5 4am	D5 8 am	D5 4 pm	D5 8 pm	D6 8 am	D6 4 pm
TW	1.95	1.64	1.21	1.41	1.59	2.3	2.6	4.1
HCT	36.7	34.9	32.7	34.4	37.7	39.8	39.8	40.2
PLT	102	78	60	48	41	24	26	28

Reviewed by specialist :

Afebrile 24 H

Patient CCTVR good, abdominal pain is distended
due to ascitis

Lungs basal crepitations

Impression: fluid overloaded (positive balance of >
6 L for two days)

Decided to stop IVD even HCT 39.8–40

FBC	D5 4am	D5 8 am	D5 4 pm	D5 8 pm	D6 8 am	D6 4 pm	D7 12 mn	D7 6am	D8 6 am
TW	1.21	1.41	1.59	2.3	2.6	4.1	4.3	4.2	5.4
HCT	32.7	34.4	37.7	39.8	39.8	40.2	38.2	36.3	34
PLT	60	48	41	24	26	28	28	30	42
BP	124/ 85	115/ 78	114/ 82	123/ 84	110/ 78	118/ 80	110/ 70	110/ 75	110/72
HR	80	80	86	80	Stop IVD		70	75	74

Stop IVD

IV Frusemide 20 mg stat dose at D7 8 am
Abdomen distension less

Pitfall in fluid therapy

- ▶ **Common pitfalls in fluid therapy:**
- ▶ Treating patient with unnecessary fluid bolus based on raised HCT as the sole parameter without considering other clinical parameters.
- ▶ Excessive and prolonged fixed fluid regime in stable patients.
- ▶ Infrequent monitoring and adjustment of infusion rate.
- ▶ Continuation of intravenous fluid during the recovery phase.
- ▶ Inappropriate fluid therapy in patients with co-morbidities (such as heart disease and renal disease).

Point to learn

- ▶ DO not resuscitate with 5/3/2 if patient is just complaining about nausea and vomiting
- ▶ Review input and output chart cautiously
- ▶ Overzealous fluid therapy caused more leakage and more ascitis with pleural effusion
- ▶ Abdominal pain : distension with ascitis (mistaken as warning sign)
- ▶ Do not chase after HCT (assess patient clinically)
- ▶ HCT may rise at the end of critical phase, may not need to increase IVD with bolus if patient is tolerating orally.

Normal maintenance fluid therapy is 25–30 ml/Kg/day

~ 1.25 ml/kg/H

In Dengue – taking into consideration of fever, additional
100–300 cc/day is acceptable

30ml/kg (50 Kg)/ day = 1500 cc/ day

In dengue : $1.5 \times 50 \times 24 = 1800$ cc /day (+ 300 cc / day)

Hyperosmolar sodium lactate

RESEARCH

Open Access

Early resuscitation of dengue shock syndrome in children with hyperosmolar sodium-lactate: a randomized single-blind clinical trial of efficacy and safety

Dadang H Somasetia¹, Tatty E Setiati^{2^}, Azhali M Sjahrodji¹, Ponpon S Idjradinata¹, Djatnika Setiabudi¹, Hubert Roth³, Carole Ichai⁴, Eric Fontaine^{3*} and Xavier M Lerverve^{3^}

Methods: A prospective randomized single-blind clinical trial including 50 DSS children was conducted in the Pediatrics Department of Hasan Sadikin Hospital, Bandung, Indonesia. Only pediatric patients (2 to 14 years old) fulfilling the WHO criteria for DSS and new to resuscitation treatments were eligible. Patients were resuscitated with either HSL (5 ml/kg/BW in 15 minutes followed by 1 ml/kg/BW/h for 12 hours), or RL (20 ml/kg/BW in 15 minutes followed by decreasing doses of 10, 7, 5, and 3 ml/kg BW/h for 12 hours).

Results: In total, 50 patients were randomized and included in outcome and adverse-event analysis; 46 patients (8.2 ± 0.5 years; 24.9 ± 1.9 kg; mean $\pm$ SEM) completed the protocol and were fully analyzed (24 and 22 subjects in the HSL and RL groups, respectively). Baseline (prebolus) data were similar in both groups. Hemodynamic recovery, plasma expansion, clinical outcome, and survival rate were not significantly different in the two groups, whereas fluid accumulation was one third lower in the HSL than in the RL group. Moreover, HSL was responsible for a partial recovery from endothelial dysfunction, as indicated by the significant decrease in sVCAM-1.

Conclusion: Similar hemodynamic shock recovery and plasma expansion were achieved in both groups despite much lower fluid intake and fluid accumulation in the HSL group.

Trial Registration: ClinicalTrials.gov NCT00966628. Registered 26 August 2009.

SAFE (Albumin vs NS)

- ▶ **THE SAFE Study** (Saline versus Albumin fluid evaluation)
- ▶ Of the 6997 patients who underwent randomization, 3497 were assigned to receive albumin and 3500 to receive saline;
- ▶ There were 726 deaths in the albumin group, as compared with 729 deaths in the saline group (relative risk of death, 0.99; 95 percent confidence interval, 0.91 to 1.09; $P=0.87$).
- ▶ The proportion of patients with new single-organ and multiple-organ failure was similar in the two groups ($P=0.85$).
- ▶ There were no significant differences between the groups in the mean ($\pm$ SD) numbers of days spent in the ICU (6.5 ± 6.6 in the albumin group and 6.2 ± 6.2 in the saline group, $P=0.44$), days spent in the hospital (15.3 ± 9.6 and 15.6 ± 9.6 , respectively; $P=0.30$), days of mechanical ventilation (4.5 ± 6.1 and 4.3 ± 5.7 , respectively; $P=0.74$), or days of renal-replacement therapy (0.5 ± 2.3 and 0.4 ± 2.0 , respectively; $P=0.41$).
- ▶ **Conclusion:** use of either 4 percent albumin or normal saline for fluid resuscitation results in similar outcomes at 28 days.