National Clinical Guideline Centre

Draft for consultation

IV fluids in children

Intravenous fluid therapy in children and young people in hospital

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Appendix J

May 2015

Draft for consultation

Commissioned by the National Institute for Health and Care Excellence

Royal College of Physicians

The Royal College of Surgeons of England

RC GP Royal College of General Practitioners

Royal College of Nursing

NICE accredited www.nice.org.uk/accreditation

Disclaimer
Healthcare professionals are expected to take NICE clinical guidelines fully into account when exercising their clinical judgement. However, the guidance does not override the responsibility of healthcare professionals to make decisions appropriate to the circumstances of each patient, in consultation with the patient and/or their guardian or carer.

Funding
National Institute for Health and Care Excellence

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J.1.1 Methods of assessing IV fluid requirements

J.1.1.1 Body weight versus body surface area

None

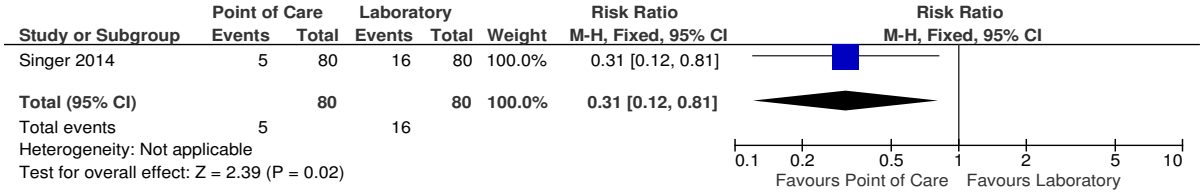
J.1.2 Methods of calculating IV fluid requirements

J.1.2.1 Measurement and documentation

None

J.1.2.2 Point of care versus laboratory testing

Figure 1: Mortality: Point of care versus laboratory testing



J.1.2.3 Assessing dehydration and hypovolaemia

None

J.2 IV fluid therapy for fluid resuscitation

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J.2.1.1.1 Colloids versus crystalloids

J.2.1.1.1.1 Dextran 6% versus Ringer's lactate solution

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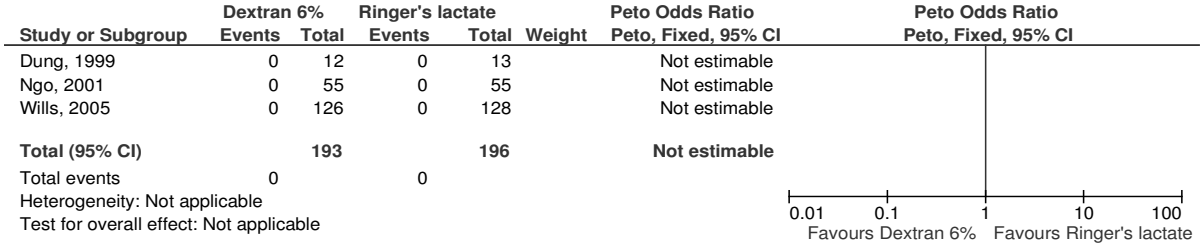
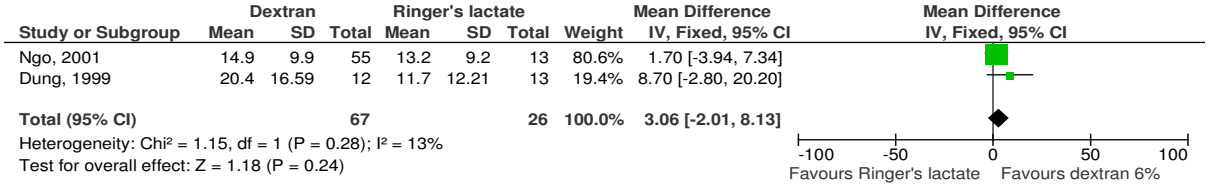


Figure 3: Decrease in pulse at 1 or 2 hours (beats per minute): Dengue shock syndrome patients



J.2.1.1.1.2 Gelatin versus 0.9% sodium chloride

Figure 4: Mortality: Sepsis patients

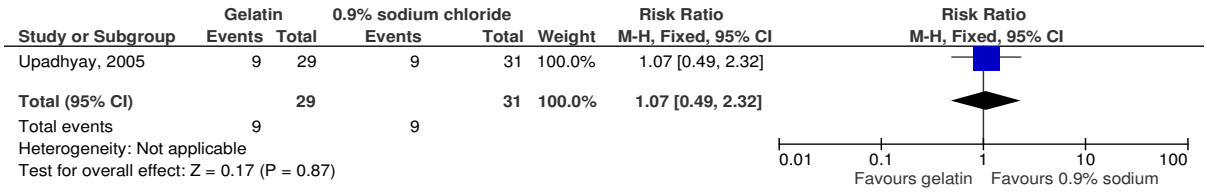


Figure 5: Haemodynamically stable at 6 hours: Sepsis patients

Figure 6: Haemodynamically stable at 12 hours: Sepsis patients

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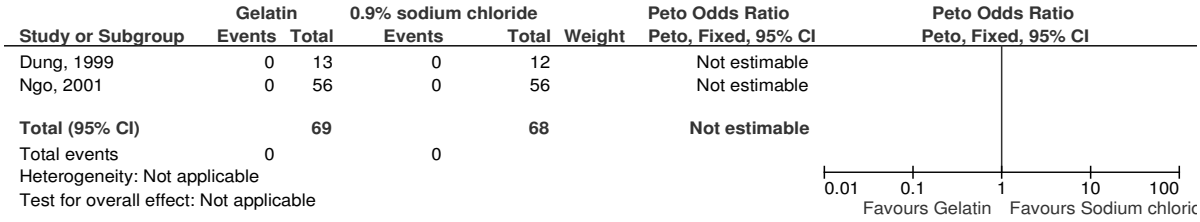
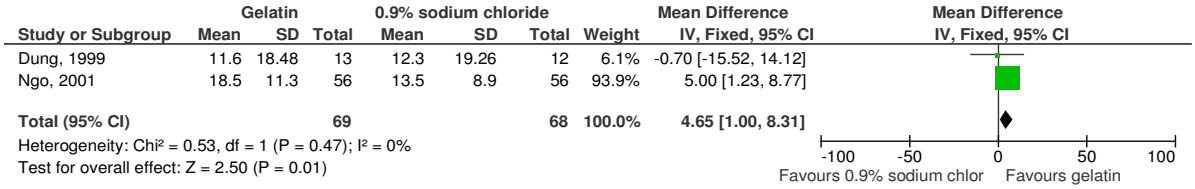


Figure 8: Decrease in pulse at 1 or 2 hours (beats per minute): Dengue shock syndrome patients



J.2.1.1.1.3 Dextran versus 0.9% sodium chloride

Figure 9: Mortality: Dengue shock syndrome patients

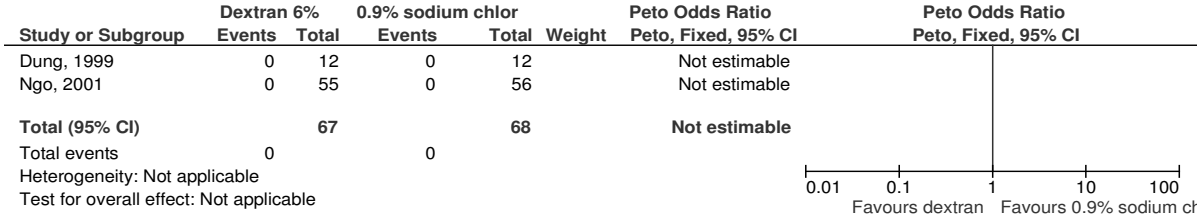
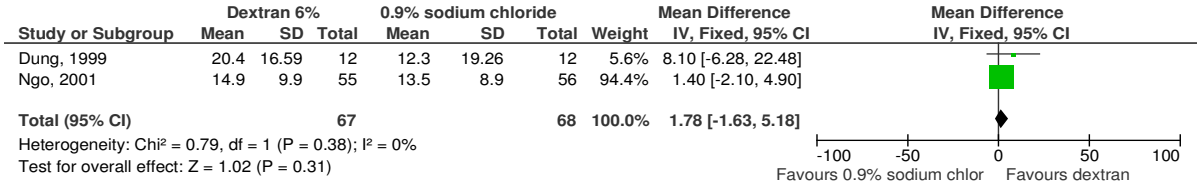


Figure 10: Decrease in pulse rate at 2 hours (beats per minute): Dengue shock syndrome patients



J.2.1.1.1.4 Gelatin versus Ringer's lactate solution (balanced crystalloids)

Figure 11: Mortality: Dengue shock syndrome patients

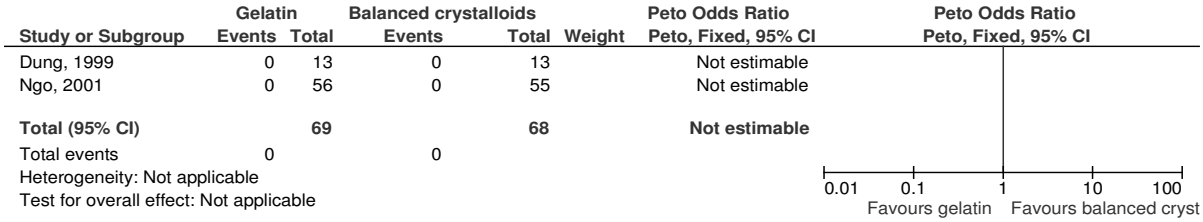
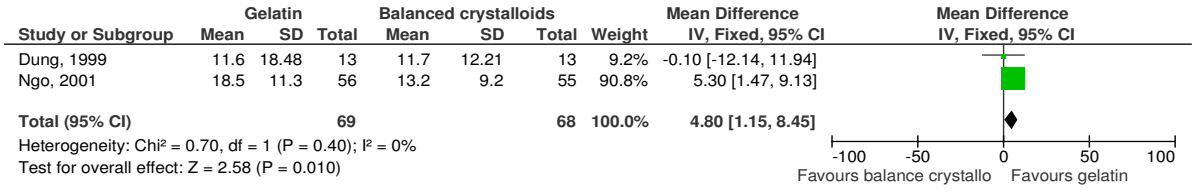


Figure 12: Decrease in pulse at 1 or 2 hours (beats per minute): Dengue shock syndrome patients



J.2.1.1.1.5 Dextran versus gelatin – sepsis patients

Figure 13: Mortality

Study or Subgroup	Dextran Events	Dextran Total	Gelatin Events	Gelatin Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Dung 1999	0	12	0	13		Not estimable
Ngo 2001	0	53	0	56		Not estimable
Total (95% CI)		**65**		**69**		**Not estimable**
Total events	0		0			

Heterogeneity: Not applicable
Test for overall effect: Not applicable

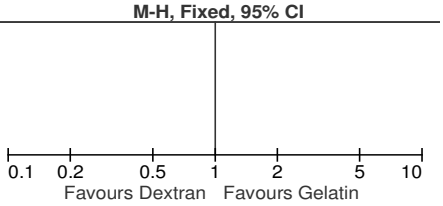
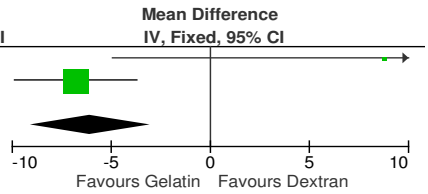


Figure 14: Cardiovascular compromise (change in heart rate)

Study or Subgroup	Dextran Mean	Dextran SD	Dextran Total	Gelatin Mean	Gelatin SD	Gelatin Total	Weight	Mean Difference IV, Fixed, 95% CI
Dung 1999	20.4	16.59	12	11.6	18.46	13	4.8%	8.80 [-4.94, 22.54]
Ngo 2001	11.5	3.3	53	18.3	11.3	56	95.2%	-6.80 [-9.89, -3.71]
Total (95% CI)			**65**			**69**	**100.0%**	**-6.05 [-9.06, -3.03]**

Heterogeneity: Chi² = 4.71, df = 1 (P = 0.03); I² = 79%
Test for overall effect: Z = 3.93 (P < 0.0001)



J.2.1.1.2 Colloids versus albumin

J.2.1.1.2.1 Colloids versus albumin – sepsis patients

Figure 15: Mortality

Study or Subgroup	Colloid Events	Colloid Total	Albumin Events	Albumin Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Akech 2006	7	44	1	44	100.0%	7.00 [0.90, 54.55]
Total (95% CI)		**44**		**44**	**100.0%**	**7.00 [0.90, 54.55]**
Total events	7		1			

Heterogeneity: Not applicable
Test for overall effect: Z = 1.86 (P = 0.06)

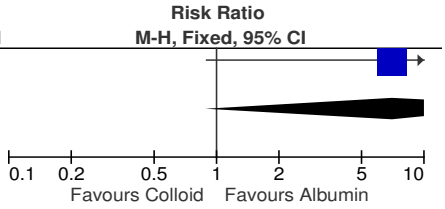
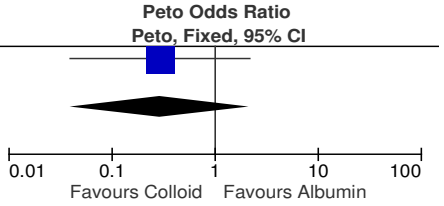


Figure 16: Neurological compromise

Study or Subgroup	Colloid Events	Colloid Total	Albumin Events	Albumin Total	Weight	Peto Odds Ratio Peto, Fixed, 95% CI
Akech 2006	1	44	3	37	100.0%	0.29 [0.04, 2.18]
Total (95% CI)		**44**		**37**	**100.0%**	**0.29 [0.04, 2.18]**
Total events	1		3			

Heterogeneity: Not applicable
Test for overall effect: Z = 1.20 (P = 0.23)



J.2.1.1.3 Albumin versus crystalloids

J.2.1.1.3.1 Albumin versus 0.9% sodium chloride (crystalloids)

Figure 17: Mortality at 28 days

Study or Subgroup	Albumin Events	Albumin Total	0.9% sodium chloride Events	0.9% sodium chloride Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Maitland, 2011	137	1063	135	1063	100.0%	1.01 [0.81, 1.27]
Total (95% CI)		**1063**		**1063**	**100.0%**	**1.01 [0.81, 1.27]**
Total events	137		135			

Heterogeneity: Not applicable
Test for overall effect: Z = 0.13 (P = 0.90)

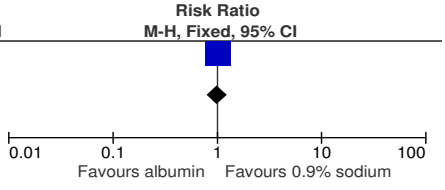


Figure 18: Mortality at 8 hours

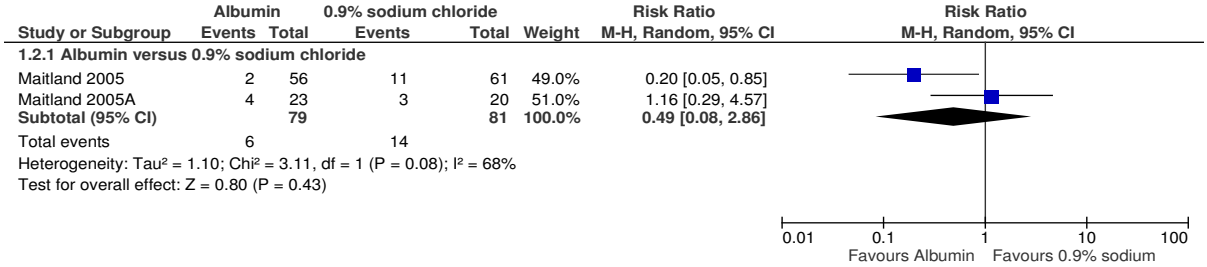


Figure 19: Pulmonary oedema

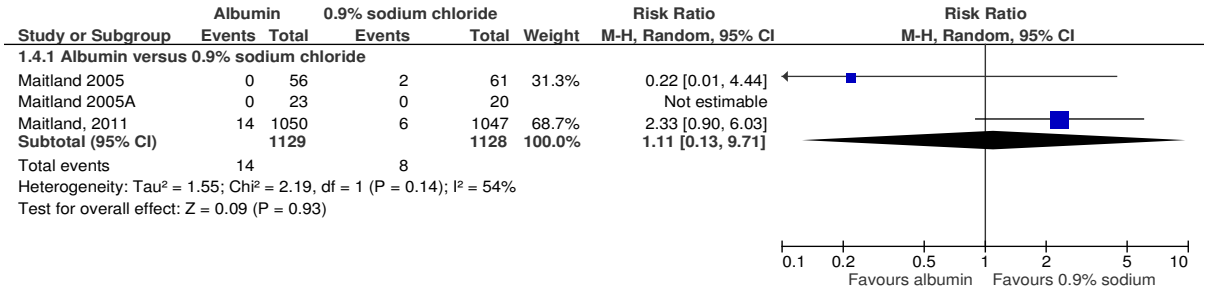


Figure 20: Neurological deterioration

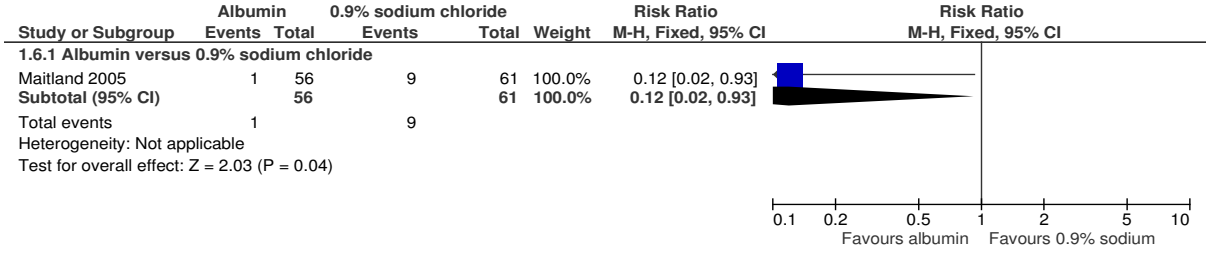


Figure 21: Neurological sequelae

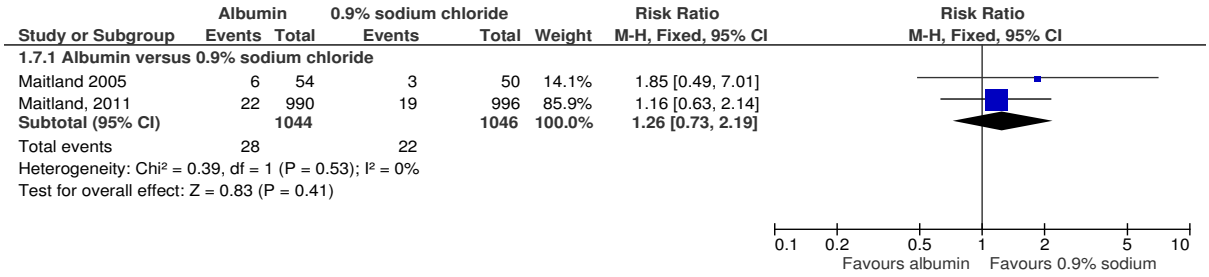
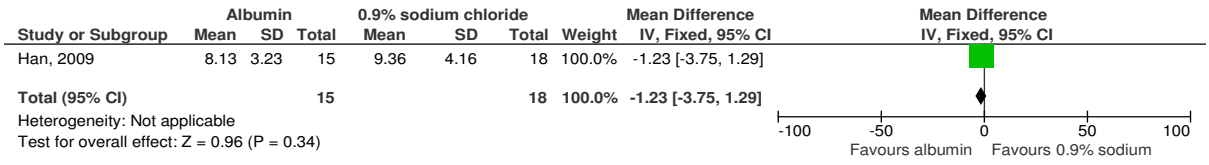


Figure 22: Length of hospital stay



J.2.1.1.3.2 Ringer's lactate solution versus hypertonic sodium chloride

Figure 23: Mortality (death at 3-15 days)

Study or Subgroup	Ringer's Lactate Events	Total	Hypertonic Saline Events	Total	Weight	Risk Ratio M-H, Random, 95% CI
Belba 2009	5	55	5	55	63.0%	1.00 [0.31, 3.26]
Bowser 1986	3	19	0	19	10.5%	7.00 [0.39, 126.92]
Caldwell 1979	1	17	2	20	16.5%	0.59 [0.06, 5.94]
Simma 1998	2	17	0	15	10.0%	4.44 [0.23, 85.83]
Total (95% CI)		**108**		**109**	**100.0%**	**1.31 [0.51, 3.34]**
Total events	11		7			

Heterogeneity: Tau² = 0.00; Chi² = 2.70, df = 3 (P = 0.44); I² = 0%
Test for overall effect: Z = 0.56 (P = 0.58)

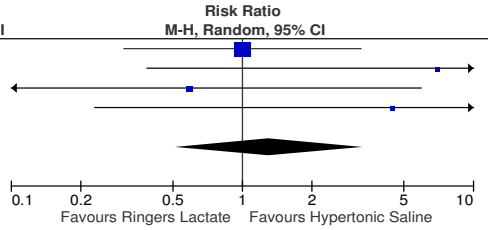


Figure 24: Cardiovascular compromise (incidence of ARDS)

Study or Subgroup	Ringer's Lactate Events	Total	Hypertonic Saline Events	Total	Weight	Peto Odds Ratio Peto, Fixed, 95% CI
Simma 1998	4	17	0	15	100.0%	8.04 [1.02, 63.46]
Total (95% CI)		**17**		**15**	**100.0%**	**8.04 [1.02, 63.46]**
Total events	4		0			

Heterogeneity: Not applicable
Test for overall effect: Z = 1.98 (P = 0.05)

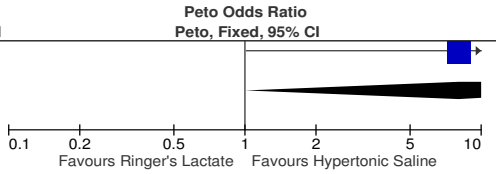


Figure 25: Cardiovascular compromise (arrhythmia)

Study or Subgroup	Ringer's Lactate Events	Total	Hypertonic Saline Events	Total	Weight	Peto Odds Ratio Peto, Fixed, 95% CI
Simma 1998	3	17	0	15	100.0%	7.48 [0.72, 78.00]
Total (95% CI)		**17**		**15**	**100.0%**	**7.48 [0.72, 78.00]**
Total events	3		0			

Heterogeneity: Not applicable
Test for overall effect: Z = 1.68 (P = 0.09)

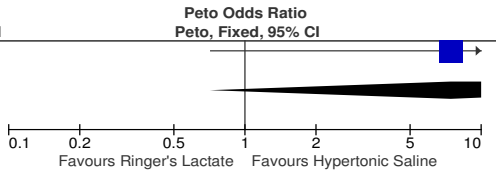
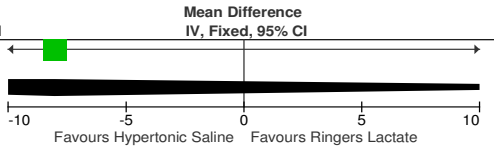


Figure 26: Length of hospital stay (days)

Study or Subgroup	Ringer's Lactate Mean	SD	Total	Hypertonic Saline Mean	SD	Total	Weight	Mean Difference IV, Fixed, 95% CI
Simma 1998	42	31	17	50	41	15	100.0%	-8.00 [-33.45, 17.45]
Total (95% CI)			**17**			**15**	**100.0%**	**-8.00 [-33.45, 17.45]**

Heterogeneity: Not applicable
Test for overall effect: Z = 0.62 (P = 0.54)



J.2.2 Volume and rate of administration for fluid resuscitation

None

J.3 IV fluid therapy for routine maintenance

J.3.1 Fluid type for routine maintenance

J.3.1.1 Additional glucose

Figure 27: Ringer's lactate solution versus Ringer's lactate solution + 5% dextrose: Neurological sequalae

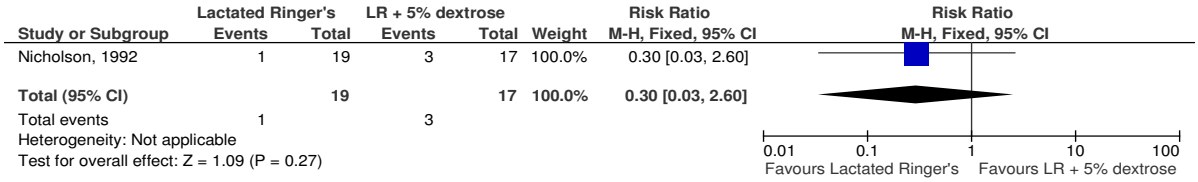


Figure 28: 0.9% sodium chloride versus Ringer's lactate solution + 5% dextrose: Mortality

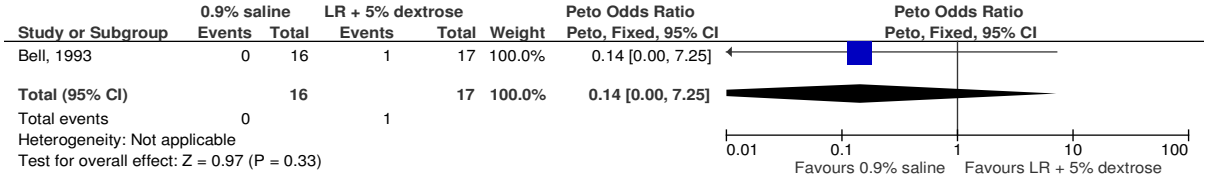


Figure 29: 0.9% sodium chloride versus Ringer's lactate solution + 5% dextrose: Cardiorespiratory arrest

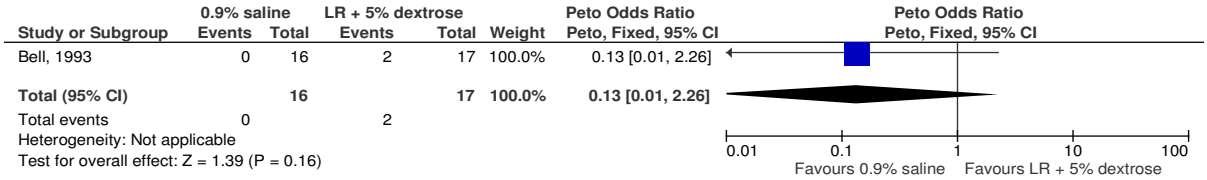


Figure 30: 0.9% sodium chloride versus Ringer's lactate solution + 5% dextrose: Mean days in ICU

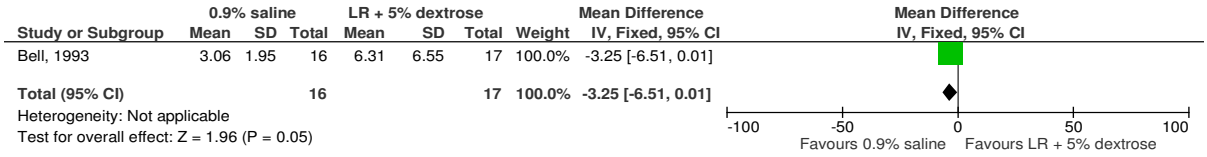


Figure 31: 0.9% sodium chloride versus Ringer's lactate solution + 5% dextrose: Mean days to discharge in hospital

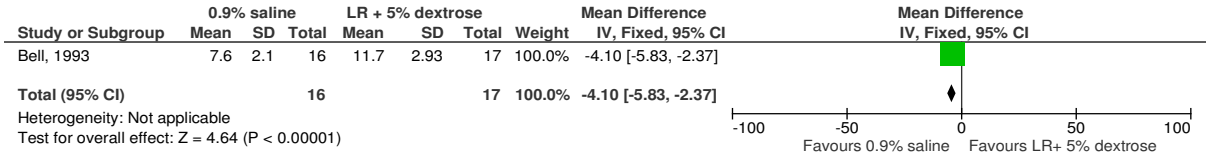
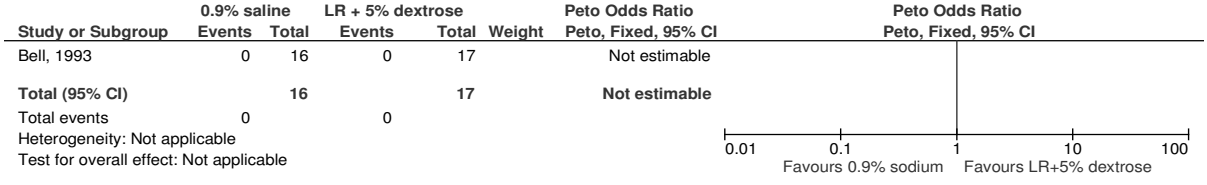


Figure 32: 0.9% sodium chloride versus Ringer's lactate solution + 5% dextrose: Hypoglycaemia



J.3.1.2 Isotonic versus hypotonic solution for routine maintenance in children aged 48 hours to 28 days

Figure 33: Hyponatraemia

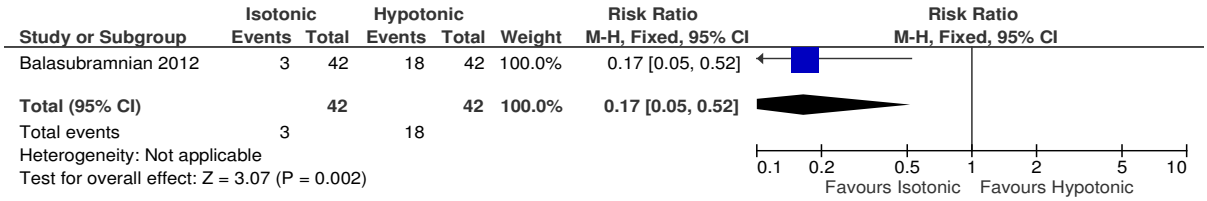


Figure 34: Severe hyponatraemia

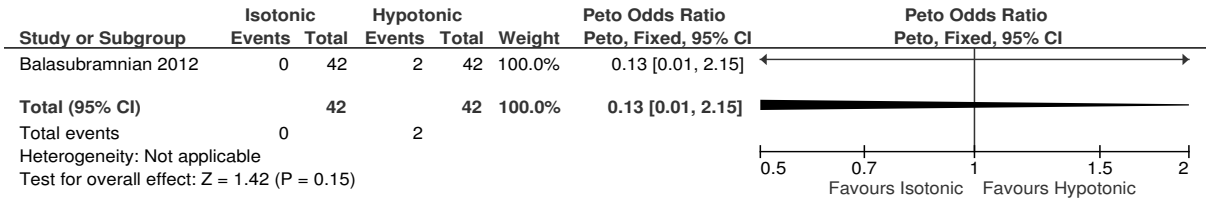
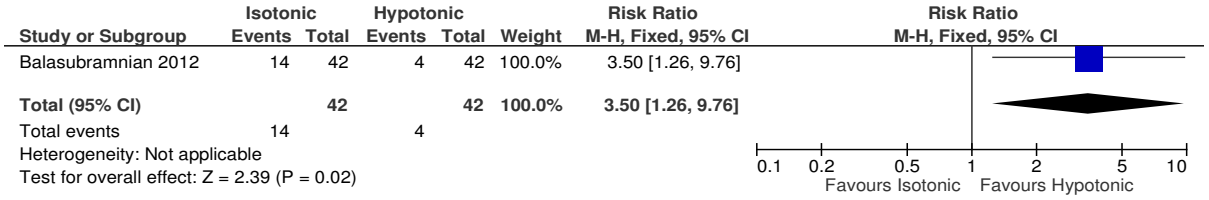


Figure 35: Hypernatraemia



J.3.1.3 Isotonic versus hypotonic solution for routine maintenance in children aged 28 days to 16 years

Figure 36: Mortality

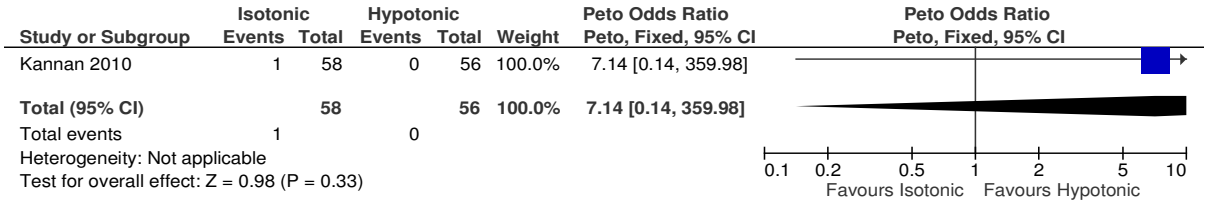


Figure 37: Hyponatraemia

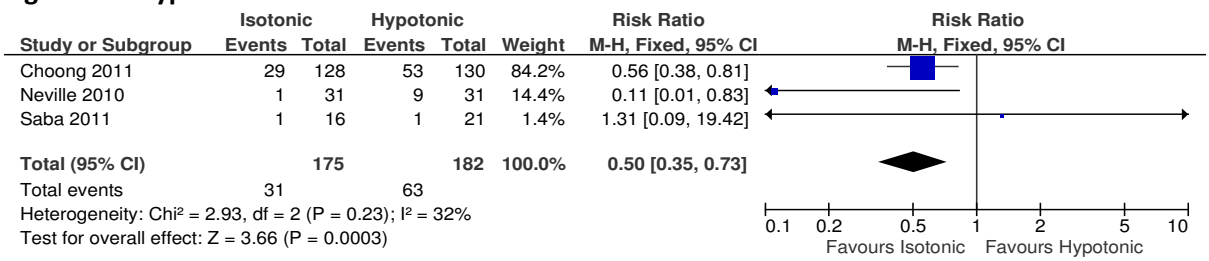


Figure 38: Severe hyponatraemia

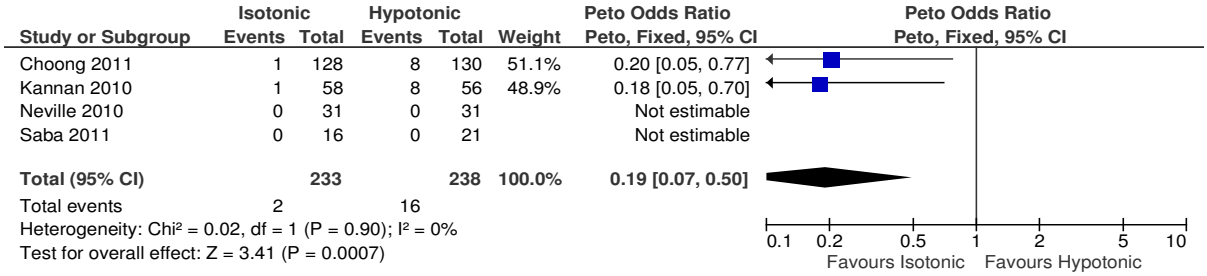


Figure 39: Hypernatraemia

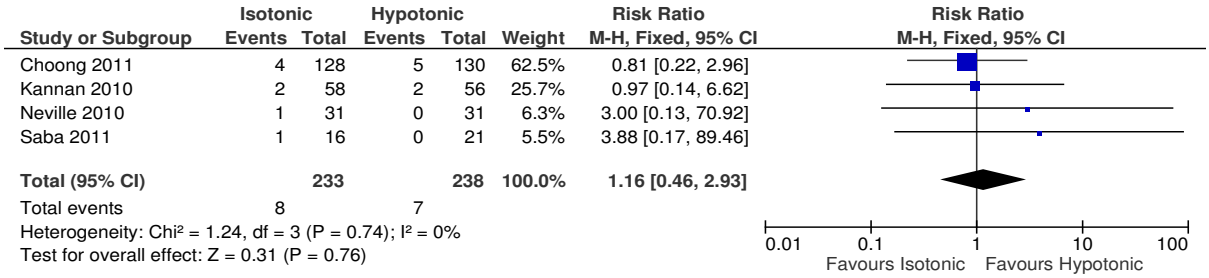


Figure 40: Hypoglycaemia

J.3.1.4 Isotonic versus hypotonic solution for routine maintenance in children within a specialist unit

Figure 41: Mortality

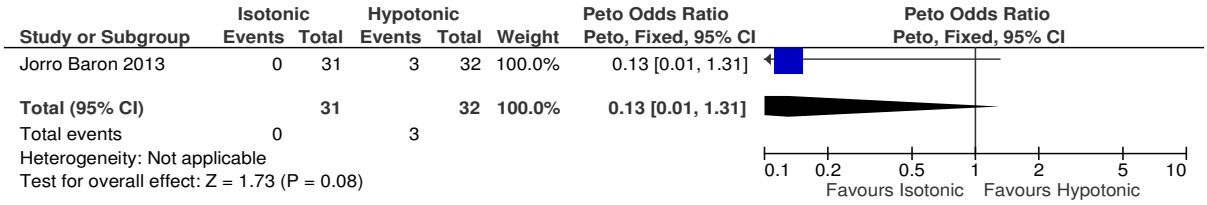


Figure 42: Length of PICU stay

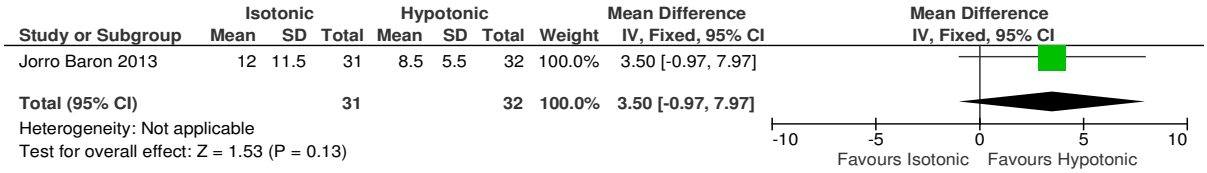


Figure 43: Hyponatraemia

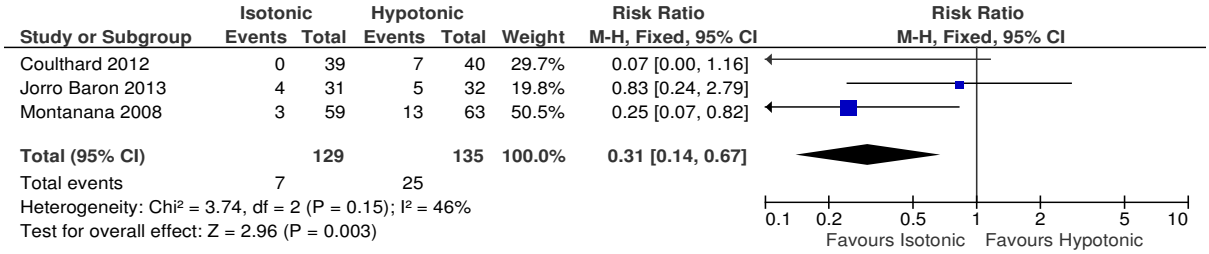


Figure 44: Severe hyponatraemia

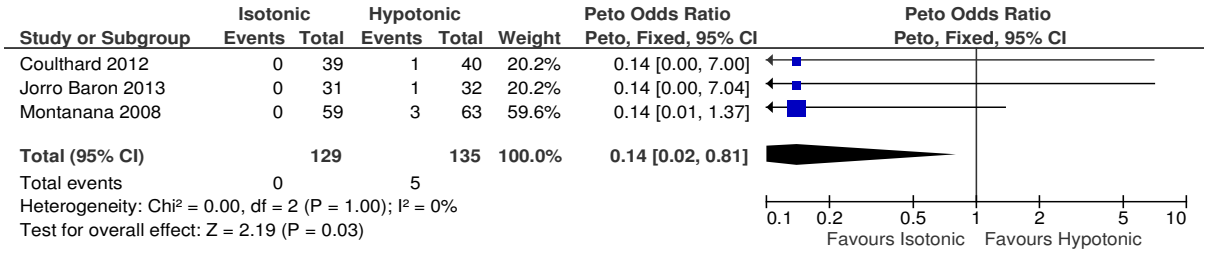


Figure 45: Hypernatraemia

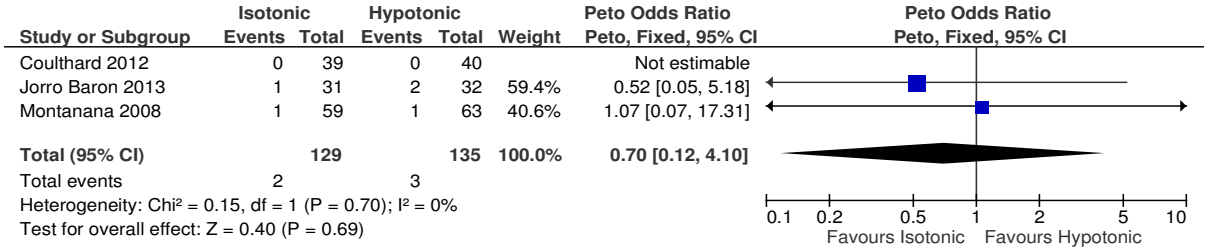
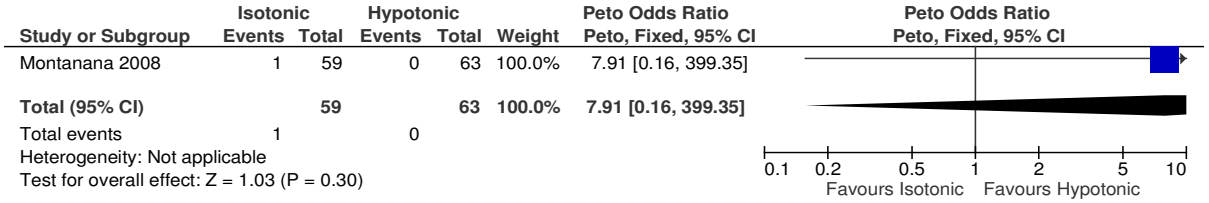


Figure 46: Hypoglycaemia



J.3.2 Rate of administration for routine maintenance

J.3.2.1 Isotonic crystalloid at normal rate versus restricted rate

Figure 47: Hyponatraemia at 8 hours

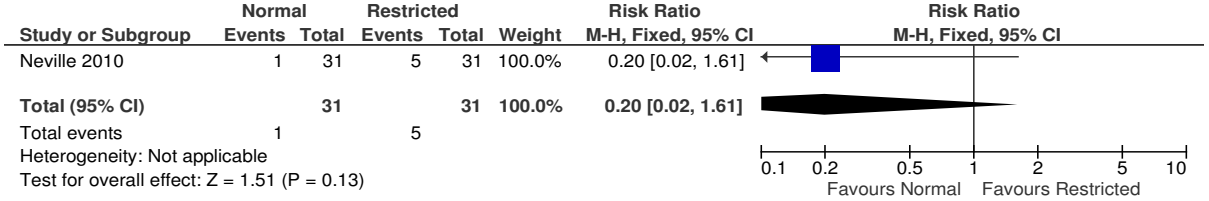


Figure 48: Hyponatraemia at 24 hours

Study or Subgroup	Normal Events	Normal Total	Restricted Events	Restricted Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Neville 2010	4	19	1	12	100.0%	2.53 [0.32, 19.99]
Total (95% CI)		**19**		**12**	**100.0%**	**2.53 [0.32, 19.99]**
Total events	4		1			

Heterogeneity: Not applicable
Test for overall effect: Z = 0.88 (P = 0.38)

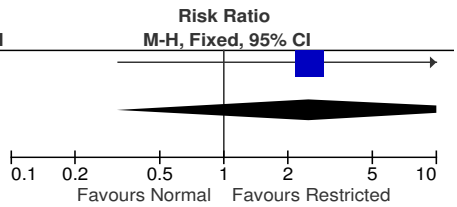


Figure 49: Hypernatraemia at 8 hours

Study or Subgroup	Normal Events	Normal Total	Restricted Events	Restricted Total	Weight	Peto Odds Ratio Peto, Fixed, 95% CI
Neville 2010	0	31	3	31	100.0%	0.13 [0.01, 1.26]
Total (95% CI)		**31**		**31**	**100.0%**	**0.13 [0.01, 1.26]**
Total events	0		3			

Heterogeneity: Not applicable
Test for overall effect: Z = 1.76 (P = 0.08)

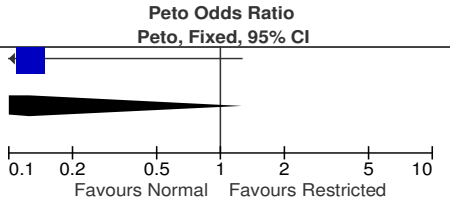
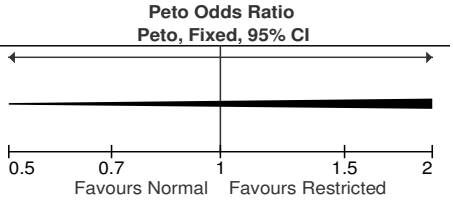


Figure 50: Hypoglycaemia at 24 hours

Study or Subgroup	Normal Events	Normal Total	Restricted Events	Restricted Total	Weight	Peto Odds Ratio Peto, Fixed, 95% CI
Neville 2010	2	31	0	31	100.0%	7.64 [0.47, 124.98]
Total (95% CI)		**31**		**31**	**100.0%**	**7.64 [0.47, 124.98]**
Total events	2		0			

Heterogeneity: Not applicable
Test for overall effect: Z = 1.43 (P = 0.15)

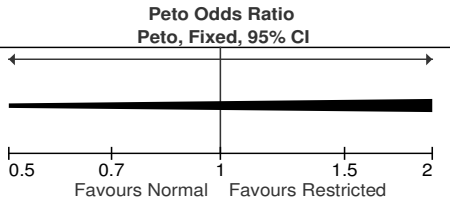


J.3.2.2 Normal versus restricted in a specialist unit

Figure 51: Hypoglycaemia at 24 hours

Study or Subgroup	Normal Events	Normal Total	Restricted Events	Restricted Total	Weight	Peto Odds Ratio Peto, Fixed, 95% CI
Yung 2009	1	11	0	13	100.0%	8.86 [0.17, 452.79]
Total (95% CI)		**11**		**13**	**100.0%**	**8.86 [0.17, 452.79]**
Total events	1		0			

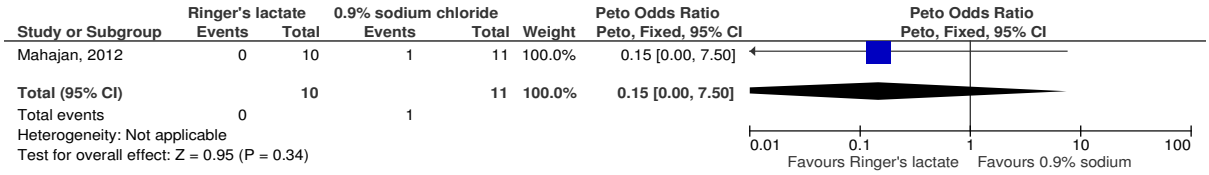
Heterogeneity: Not applicable
Test for overall effect: Z = 1.09 (P = 0.28)



J.4 IV fluid therapy for replacement and redistribution

J.4.1 Ringer's lactate solution versus 0.9% sodium chloride

Figure 52: Ringer's lactate solution versus 0.9% sodium chloride



J.5 Managing hypernatraemia and hyponatraemia developing during IV fluid administration

J.5.1 Management of hypernatraemia

None

J.5.2 Management of hyponatraemia

None

J.6 Training and education of healthcare professionals for management of IV fluid therapy

None