National Clinical Guideline Centre

IV fluids in children

Intravenous fluid therapy in children and young people in hospital

Appendix K

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Royal College of Physicians

The Royal College of Surgeons of England

Royal College of General Practitioners

Royal College of Nursing

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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.

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Contents

Appendix K: Excluded clinical studies

K.1 Assessment and monitoring

K.1.1 Methods of assessing IV fluid requirements

K.1.1.1 Body weight versus body surface area

Table 1: Studies excluded from the clinical review

Reference	Reason for exclusion
Bowser1986A[39]	Resuscitation strategy is based on % area of burns in burn patients. Outcomes are not relevant to review question.

K.1.2 Methods of calculating IV fluid requirements

K.1.2.1 Measurement and documentation

Table 2: Studies excluded from the clinical review

Reference	Reason for exclusion
Bekhof2013[29]	Incorrect comparison; the study looks at fluid balance sheet compared to no fluid balance sheet, therefore does not look at the included components
Bryan 2004[43]	Incorrect intervention (patient's diaries of 2 fluid volume charts for mean voided volume; no details of fluid volume charts)
Burton 1994[48]	Incorrect study design (not an RCT or cohort study); incorrect population (adults)
Daffurn 1994[63]	Incorrect study design (not an RCT or cohort study); incorrect population (adults)
Lodeserto 2009[146]	Incorrect study design (Abstract; not an RCT); incorrect population (adults)
Maylor 1992[161]	Incorrect study design (not an RCT or cohort study); incorrect population (adults)
McConnell 2002[162]	Incorrect study design (not an RCT or cohort study); incorrect population (adults)
Ozuna 1993[198]	Incorrect study design (not an RCT or cohort study); incorrect population (adults)
Perelman 1964[203]	Incorrect study design (example of revised intake and output charts)
Perelman 1966[204]	Incorrect study design (example of revised intake and output charts)
Schatzel 1985[235]	Incorrect study design (not an RCT or cohort study); incorrect population (adults)
Van Pelt 1961[277]	Incorrect study design (not an RCT or cohort study); incorrect population (adults)

K.1.2.2 Laboratory-based methods versus point-of-care testing

None

K.1.2.3 Assessing dehydration and hypovolaemia

Table 3: Studies excluded from the clinical review

Reference	Reason for exclusion
Akpede 1995[5]	Study compares implementation of oral rehydration programmes. Audit.
Bonadio 1989[38]	Non-comparative study. Validation for blood urea nitrogen measure.
Burge 1993[47]	Non-comparative study
Caravaca 2011[50]	Non-comparative study. Non-specified intervention (multi-frequency bioimpedance).
Dawson 1991[65]	Non-comparative study measuring factors associated with dehydration
Duggan 1996[72]	Non-comparative study
Durukan 2009[73]	Non comparative study. Validation of shock index.
Goldman 2008[87]	Validation study for clinical assessment tool
Gorelick 1997[89]	Non-comparative study
Gross 1992[90]	Non-comparative study
Hayajneh 2010[106]	Diagnostic accuracy study for clinical signs of dehydration
Hooper 2012[111]	Study protocol
Kc 2006[129]	Non-comparative case series
Liebelt 1998[142]	Narrative review
Logan-sprenger 2013[147]	Incorrect population. Healthy adults.
Mackenzie 1989[151]	Diagnostic study of factors associated with dehydration
Molaschi 1997[168]	Non-comparative study
Morrison 2011[170]	Conference abstract
Munoz 2013[173]	Incorrect population. Healthy adult population.
Perren 2011[205]	Non-comparative. Does not fit population or study protocol. Assessing fluid balance sheet.
Perrier 2013[206]	Non-comparative biochemical study
Pruvost 2013[216]	Validation study of post-illness weight as a marker of dehydration. Non-comparative.
Schriger 1991[236]	Non-comparative validation study for capillary refill
Shaoul 2004[242]	Study compares laboratory and non-laboratory assessments
Shimizu 2012[246]	Diagnostic accuracy study
Steiner 2004[256]	Narrative review
Tam 2014[267]	Study correlates laboratory markers with levels of dehydration
Teach 1997[269]	Diagnostic accuracy of laboratory measures
Ugale 2012[273]	Non-comparative study. Measures association between laboratory assessment and dehydration.
Van dommelen 2014[276]	Non-IV fluid population
Vega 1997[280]	Diagnostic accuracy study. Non-comparative.
Vila 1998[281]	Non-comparative study
Wakefield 2008[285]	Compares long-term outcomes following dehydration
Yilmaz 2002[299]	Non-comparative study

K.2 IV fluid therapy for fluid resuscitation

K.2.1 Fluid type for fluid resuscitation

Table 4: Studies excluded from the clinical review

Reference	Reason for exclusion
Akech 2010[3]	Incorrect comparison (hydroxyethyl starch [HES])
Akech 2010A[4]	Incorrect interventions. Study compares Ringer's lactate solution and half-strength Darrow's solution with dextrose in sepsis population.
Alejandria 2009 [7]	Systematic review of crystalloids versus colloids
Allison 1999[8]	Incorrect population (adults)
Aukerman 1998[17]	Incorrect study design (retrospective case-controlled study)
Awad 2012[18]	Incorrect population (adults)
Baibarina 2010[21]	Incorrect comparison (6% HES but patients are not hypovolaemic); abstract
Bocanegra 1966[34]	Incorrect population (adults)
Boldt 1993[36]	Article withdrawn from literature
Bowser-Wallace 1986[39]	Same study population as study already included
Brutocao 1996[42]	Study does report appropriate outcomes. Reports on surrogate measures including clinical bleeding and laboratory measures including fibrinogen.
Bulger 2008[46]	Incorrect age group (adult study)
Bulger 2010[44]	Incorrect population (adults)
Bulger 2011[45]	Incorrect population (children and adult data not separated)
Chaudhary 2008[51]	Incorrect comparison (HES)
CHEST 2011[61]	Incorrect study design (protocol for a RCT)
Cifra 2003[55]	Incorrect comparison (HES)
Collis 1999[58]	Inappropriate study design. Retrospective cohort study.
Deorari 1995[67]	Incorrect intervention (plasma)
Faraklas 2011[76]	Incorrect study design (retrospective cohort study)
Ford 2012[79]	Systematic review and meta-analysis. Included studies do not meet our protocol.
Gattas 2013[84]	Systematic review is not relevant to review question or unclear PICO. Considers HES (130/0.4 and 130.42) in adults.
Goodwin 1983[88]	Incorrect population (adults)
Guidet 2007[92]	Incorrect study design (non-RCT registry data)
Gutierrez-Alvarez [93]	Foreign language systematic review
Haas 2007[94]	Study reports surrogate measures following IV treatment (coagulation and laboratory testing). Not specific to protocol.
Hall 1973[96]	Incorrect study design (control trial, not randomised)
Hanart 2009[98]	Incorrect comparison (HES)
Hans 2000[101]	Inappropriate comparison. Compares albumin with unstated control treatment. Outcomes do not match protocol.
Hartog 2011[103]	Systematic review is not relevant to review question or unclear PICO. General synopsis of the use of colloids in the population.
James 2011[119]	Incorrect population (adults)
Kalayanarooj 2008[121]	Patients received sodium chloride prior to entering trial. Not first line.

Reference	Reason for exclusion
Lawrence 2010[136]	Incorrect population (adults) and incorrect study design (retrospective)
Levy 2013[141]	Incorrect comparison
Liet 2003[143,143]	Outcomes not appropriate. Measures haemodynamic response to fluid and incidence of creatininemia.
Liet 2006[144]	Incorrect comparison (HES). Incorrect population (pre-term neonates).
Liet 2006[144]	Incorrect population (gestational age is below 30 weeks)
Lynch 2002[150]	Abstract
Lynch 2008[149]	Incorrect population (premature babies; gestational age is 30 weeks)
Mahajan 2012[153]	Indirect population. Study compares Ringer's lactate solution and normal sodium chloride for dehydration.
Mahler 2011[155]	Incorrect population (adult)
Maitland 2003[156,237]	Incorrect study design (phase I study, not an RCT)
Maitland 2004[157]	Incorrect study design (prospective cohort study)
Maningas 1989[159]	Incorrect population (adults)
Mattox 1991[160]	Incorrect population (adults)
Modi 2012[166]	Incorrect population (adult)
Mulavisala 2012[171]	Incorrect comparison (HES)
Mullett 2002[172]	Unable to obtain paper
Neff 2003[177]	Incorrect interventions. Compares 2 HES products (6% HES 130/0.4 versus HES 200/0.5).
Nguyen 2006 [179]	Incorrect study design (non-RCT)
Niermeyer 2006 [180]	Narrative review
Niang 2010[176]	Incorrect study design (mini review)
Northern Neonatal Nursing Initiative Trial Group (ANON) 1996A[1]	Incorrect population (pre-term babies)
Oca 1999[187]	Unable to obtain paper
Oca 2003[188]	Incorrect population (under 28 weeks gestational age)
Olupot-Olupot 2012[192]	Abstract for Maitland 2011
Orgev 1969 [193]	Incorrect study design. Non-RCT.
Osborn 2004[195]	Incorrect population; Cochrane review in pre-term infants
Osthaus 2009[197]	Study population and results included under Witt 2009
Perel 2013[202]	Cochrane review of studies with adults and children
Phin 2003[208]	Incorrect population. Population undergoing replacement strategy. One of the intervention groups required naso-gastric administration (non-IV). Non-specific outcomes.
Pockaj 1994[209]	Incorrect study design (prospective cohort study); incorrect population (adults).
Ranucci 2013[219]	Lecture abstract. Compares crystalloids and colloids.
Recinos 1975[220]	Incorrect study design (prospective cohort study)
Riegger 2002[224]	Incorrect intervention (additional albumin to EC prime compared to crystalloid prime solution)
Rother 1994	Retrospective cohort study. Non-RCT.
Rothmaier 1995[228]	No relevant outcomes; serum preparation for partial exchange transfusion
Rueddel 2012[270]	Incorrect population (systematic review and meta-analysis where children

Reference	Reason for exclusion
	and adult data not separated)
Stoddart 1996[260]	No outcomes matching protocol
Russell 2004[229]	Incorrect population (meta-analysis of studies with adults and children)
Schroth 2006[237]	Incorrect interventions. Study uses fluid not routinely administered in children (hypertonic-hyperoncotic).
Senagore 2009[239]	Incorrect population (adults)
Shatney 1983[244]	Incorrect population (adults)
Shaw 2012[245]	Includes paediatric population but results not reported separately by age
Simbruner 2003[248]	Editorial on study. No appropriate outcomes considered.
Simma 1996[250]	Abstract only. Full study included.
Simma 2001[249]	No outcomes can be extracted applicable to protocol
So 1997[251]	Incorrect population (preterm infants 23 to 34 weeks)
Standl 2008[254]	Incorrect comparison (HES)
Standl 2009[255]	Narrative response to query. No appropriate data included.
Stockwell 1992[258]	Adult study (all patients over 18 years old). Indirect population.
Stockwell 1992[259]	Adult study (all patients over 18 years old). Indirect population.
Sudhakar 2008[263]	Incorrect population (adults)
Sumpelmann 2008[237,264]	Incorrect study design (cohort study)
Todd 2013[271]	Additional paper for further information
Van der Linden 2013[275]	Incorrect comparison (HES)
Vassar 1991[279]	Incorrect population (adults)
Vassar 1993[278]	Incorrect population (adults)
Vlasakov 2011[282]	Incorrect population (abstract of a systematic review where children and adult data not separated). Incorrect interventions. Systematic review on the use of gelatin. No specific albumin colloid comparison.
Vrancken 2005[283]	Incorrect study design (retrospective cohort study)
Wade 1997[284]	Incorrect population (adults)
Wiedermann 2004[291]	Narrative review of safety and efficacy of HES
Wilkes 2001[292]	Meta-analysis of studies most likely in adults (no details given)
Wills 2001[293]	Incorrect study design (literature review)
Witt 2008[294]	Incorrect comparison (HES)
Wong 1997[295]	No relevant outcomes
Wu 2001[297]	Incorrect population (adults)
Yang 2011[298]	Incorrect population (adults)
Younes 1997[300]	Incorrect population (adults)
Younes 1998[301]	Incorrect intervention (pentastarch solution added to treatment)
Zunini 2011[304]	Incorrect study design (retrospective cohort study)

K.2.2 Volume and rate of administration for fluid resuscitation

Table 5: Studies excluded from the clinical review

Reference	Reason for exclusion
Bakes 2011[22]	Abstract; intervention does not match protocol (mix of resuscitation and maintenance – maintenance rate differs)
Bakes 2011A[23]	Abstract; intervention does not match protocol (mix of resuscitation and

Reference	Reason for exclusion
	maintenance – maintenance rate differs)
Cole 2013[56]	Intervention not relevant to review question (2 provider-endorsed manual resuscitation techniques)
Cole 2014[57,237]	Population does not match protocol (simulated children)
Freedman 2011[83]	Intervention does not match protocol (5 ml given every 5 minutes for an hour; mix of resuscitation and replacement fluid)
Freedman 2011C[81]	Abstract and have full paper (see Freedman 2011)
Freedman 2013[82]	Intervention does not match protocol (5 ml given every 5 minutes for an hour; mix of resuscitation and replacement fluid)
Glaser 2013[86]	Intervention does not match (mix of resuscitation and replacement fluid)
Hanson 2009[102]	Interventions do not match protocol (not comparing rate)
Harvey 2012A[104]	Abstract and have full paper (see Harvey 2013)
Harvey 2013[105]	Population does not match protocol (simulated children)
Kanaan 2003[123]	Study not relevant to review question
Kavvadia 1999[127]	Population does not match protocol (pre-term infants)
Kavvadia 2000[128]	Population does not match protocol (pre-term infants)
Kavvadia 2000A[126]	Population does not match protocol (pre-term infants)
Nager 2010[174]	Intervention does not match protocol (replacement)
Okabayashi 2001[190]	Study not relevant to review question
Oliveira 2008[191]	Intervention does not match protocol (not only sodium chloride); no relevant outcome data
Sambandamoorthy 2013A[231]	Study design does not match protocol (abstract of a cohort study)
Zak 1999[303]	Study not relevant to review question

K.3 IV fluid therapy for routine maintenance

K.3.1 Fluid type for routine maintenance

Table 6: Studies excluded from the clinical review

Reference	Reason for exclusion
Adenekan 2014[2]	Compares 4.3% dextrose in 0.18% sodium chloride (fluid excluded from protocol)
Alves 2011[11]	Narrative review
Almedia 2014 [9]	Abstract only
Aouifi 1997[13]	Intervention does not match protocol (5% glucose versus Ringer's lactate solution)
Ang 2010[12]	Incorrect intervention (D5NM) and abstract only
Apfel 2012[14]	Systematic review is not relevant to review question or unclear PICO
Baris 2011[25]	Abstract only
Baron 2013[26]	Incorrect age group
Beck 2007[28]	Narrative review
Brazel 1996[40]	Hypotonic group consist of 4% dextrose and 0.3% sodium chloride. Incorrect interventions.
Choong 2007[53]	Narrative review
Cuello 2012[62]	Abstract only

Reference	Reason for exclusion
Dicembrino 2013[68]	Abstract only
Disma 2013[70]	Abstract only. Incorrect interventions.
Fosel 1996[80]	Outcomes do not match protocol (change in glucose level, not hypoglycaemia)
Heidari 2011[107]	Adult study
Heshmati 2004[108]	Compares fluid volume not type. Incorrect comparison.
Karabocuoglu 2006[125]	Abstract only
Khan 2014 [131]	Non-randomised study
Larsson 1990[135]	Incorrect stratum. Pre-term. Population excluded.
Lim 1997[145]	Outcomes do not match the protocol (increase and decrease in blood glucose concentration)
Long 2009[148]	Abstract of Coultard 2012
Mcnab 2011[163]	Protocol of Cochrane review
McNab 2014 [164]	Cochrane analysis. Population stratified differently to our protocol.
Mikawa 1991[165]	Outcomes do not match protocol
Modi 2012[166]	Adult population
Moritz 2012[169]	Editorial article
Neville 2006 [178]	Patients presented at baseline with hyponatraemia
Nili 2005[181]	Pre-term population. Excluded population.
Nishina 1995[182]	Outcomes do not match protocol (hypoglycaemia cannot be extracted)
Nuutinen 1975[184]	Incorrect stratum. Intervention does not match protocol (5% glucose versus 0.9% sodium chloride).
Powell 1990[214]	Compares rate of administration
Rey 2011 [223]	Patients presented at baseline with hyponatraemia
RodriguezCeJudo 2014 [227]	Abstract only
Vaidya 1995[274]	Incorrect interventions. Pre-term population excluded by guideline.
Welborn 1987[289]	Outcomes do not match protocol (change in glucose level, not hypoglycaemia)
Yung 2009[302]	Only reports rate of sodium change. Surrogate measure.

K.3.2 Rate of administration for routine maintenance

Table 7: Studies excluded from the clinical review

Reference	Reason for exclusion
Bell 1979[30]	Abstract only
Benakatti 2012[31]	Abstract only
Coulthard 2012[60]	Incorrect interventions. Study compares Hartmann's solution with 0.45% sodium chloride.
Flaring 2011[78]	Study protocol
Kannan 2010[124]	Incorrect interventions. Compares 0.18% sodium chloride at different maintenance rates.
Stroustrup 2012[261]	Population not of full gestational age

K.4 IV fluid therapy for replacement and redistribution

Table 8: Studies excluded from the clinical review

Reference	Reason for exclusion
Han 2009[97]	Incorrect population (not replacement)
Juca 2005[120]	Incorrect population (not replacement)
Levy 2013[141]	Incorrect population (not replacement)
Mahalanabis 1972[154]	Incorrect outcome (not reporting outcomes of interest separately for non-cholera patients)
Neville 2006[178]	Incorrect outcomes (the only relevant outcome was hyponatraemia, and many of the patients had hyponatraemia at the start of the trial)
Rahman 1988[218]	Incorrect population (resuscitation not replacement; Dhaka solution for cholera)

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

K.5.1 Management of hypernatraemia

Table 9: Studies excluded from the clinical review

Reference	Reason for exclusion
Al Shammari 2013[6]	Incorrect study design (retrospective study in adult population)
Alshayeb 2011[10]	Incorrect study design (retrospective study in adult population)
Apte 2009[15]	Intervention and comparison do not match protocol; frusemide and spironolactone versus placebo
Bagshaw 2009[20]	Incorrect study design (non-systematic review)
Banister 1975[24]	Population does not match protocol; hypernatraemia not developed during IV fluid administration and N less than minimum in protocol
Bolat 2013[35]	Population does not match protocol; hypernatraemia not developed during IV fluid administration
Dickerson 2013[69]	Incorrect study design (retrospective study in adult population)
Eke 1996[74]	Unable to obtain text
Elbayoumi 2012[75]	Population does not match the protocol; hypernatraemia not developed during IV fluid administration and N less than minimum in protocol
Habel 1976[95]	Population does not match protocol; hypernatraemia not developed during IV fluid administration and N less than minimum in protocol
Hoorn 2007[112]	Comparison does not match the protocol and it is not comparing fluids
Huang 2010[115]	Population does not match protocol; hypernatraemia not developed during IV fluid administration. Adult population.
Huston 2007[118]	Population does not match protocol; hypernatraemia not developed during IV fluid administration
Koopmans 2010[132]	Incorrect study design (retrospective study in adult population)
Kraft 2005[133]	Incorrect study design (non-systematic review), adult population
Oh 1992[189]	Incorrect study design (non-systematic review)
Orgun 2010[194]	Population does not match protocol, hypernatraemia not developed during IV fluid administration
Pokaharel 2011[210]	Incorrect study design (non-systematic review)

Reference	Reason for exclusion
Polderman 1999[211]	Comparison does not match protocol; not comparing fluids and N less than minimum in protocol
Robertson 2007[226]	Population does not match protocol; hypernatraemia not developed during IV fluid administration. Comparison does not match protocol and not comparing fluids.
Sam 2012[230]	Population does not match protocol; hypernatraemia not developed during IV fluid administration. Adult population and N less than minimum in protocol.
Shackford 1987[240]	Population does not match protocol (not hypernatraemia)
Wells 2012[290]	Incorrect study design (retrospective study in adult population)

K.5.2 Management of hyponatraemia

Table 10: Studies excluded from the clinical review

Reference	Reason for exclusion
Ayus 1987[19]	Adult population (n=33). Prospective non-randomised study relating rate of fluid administration to brain damage. All patients receive hypertonic sodium chloride (no comparison).
Bartos 2010[27]	Adult population. Retrospective review of management of hyponatraemia. Non-randomised study.
Bhaskar 2010[32]	Adult population in a non-randomised study (n= 58)
Brenkert 2013[41]	Retrospective report of paediatric patients receiving hypertonic sodium chloride following admission to emergency department
Chiong 2014[52]	Adult population. Abstract only. Includes drug intervention (Tolvaptan).
Chung 1987[54]	Paper provides clinical assessment of factors contributing to hyponatraemia in adults (n=58)
Cuello 2012[62]	Reports on incidence of hyponatraemia between isotonic and hypotonic IV fluids in paediatric patients
Dasta 2013[64]	Adult population (n=3795). Health economic outcomes were generally considered. History of hyponatraemia not defined.
Decaux 2010[66]	Adult population (n=50) who acquired hyponatraemia outside of hospital. Non- randomised study.
Dominguez 2013[71]	Non-randomised adult study (n=49) comparing 3% sodium chloride and drug use (Conivaptan)
Farooqui 2003[77]	Retrospective review in adult population (n=35) detailing comorbidities associated with death and severe hyponatraemia
Gross 2008[91]	Review of hyponatraemia treatment in adults. No outcomes related to protocol.
Hanna 2003[100]	Study reports incidence and management of hyponatraemia in patients with respiratory syncytial virus bonchiolitis. Indirect population.
Hanna 2010[99]	Study reports incidence of hyponatraemia. Does not consider hyponatraemia management.
Higgins 1996[109]	Compares sodium levels following administration of Hartmann's solution and 5% glucose in pregnant subjects. Considers prevention of hyponatraemia and not management. Indirect population and non-specific outcomes.
Hoorn 2004[113]	Paper considers factors relating to development of hyponatraemia. Does

Reference	Reason for exclusion
	not report on management of condition.
Hoorn 2006[114]	Study comparing outcomes between hospital acquired and non-hospital acquired hyponatraemia (n=131). Not appropriate to outcome. Incorrect age group.
Huda 2006[116]	Indirect adult population (n=104). IV fluid administration not responsible for hyponatraemia.
Lehmann 2013[138]	Adult population (n=36) with subarachnoidal haemorrhage. Outcomes not specific to protocol (looks at the number of patients who develop hyponatraemia).
Lemaire 2010[139]	Reports the characteristics at baseline of patients who develop hyponatraemia in a hospital setting. Does not report about management of disorder. Abstract only.
Madiba 1998[152]	Non-randomised adult trial (n=3204). Causes of hyponatraemia are not specific to in-hospital population.
Mohmand 2007[167]	Adult population (n=62) with SIADH treated with hypertonic sodium chloride. Non-randomised study.
Nagler 2013[175]	Review of clinical guidelines in adults. Does not report specific outcomes to protocol.
Naing 2010[176]	Review article comparing incidence of hyponatraemia between crystalloids and colloids. Does not consider management of condition.
Nzerue 2003[185]	Retrospective review of adult population detailing the factors related to adverse outcomes in hyponatraemia
Phillips 1997[207]	Prospective, comparative study comparing 5% Mannitol and 1.5% Glycine in preventing hyponatraemia in pregnant women (n=122). Intervention not specific to protocol and indirect population.
Rabinstein 2011[217]	Meta-analysis of adult population with aneurysmal SAH. Considers drug treatments primarily (vasopressin receptor antagonists).
Reeder 1989[221]	Retrospective study in an adult population (n=48) with SIADH. Interventions (0.9% sodium chloride versus urea) non-specific to protocol.
Sarnaik 1991[233]	Population is not following administration on IV fluids
Sato 2011[234]	Study detailing risk factors associated with hospital-acquired hyponatraemia. Does not consider management.
Shann 1985[241]	Reports on the relationship between hyponatraemia with pneumonia and bacterial meningitis. Not following administration of IV fluids. No applicable outcomes to protocol.
Sharf 1993[243]	Non-specific definition of patient population (that is, not following administration of IV fluid). Reports on time to administration of hypertonic sodium chloride (not rate or separate interventions).
Sigal 2012[247]	Interim report of observational registry in adult population. Hyponatraemia not due to IV fluid administration. No outcomes reported.
Sood 2013[252]	Adult population (n=25) looking at service quality improvement. Indirect populations as patients not admitted following administration of IV fluids.
Sterns 1994[257]	Adult population (n=56) with severe hyponatraemia and non-randomised population.
Suarez 1999[262]	Case review of adult population (n=199) with hypernatraemia and cerebral vasospasm. Retrospective review with indirect population.
Tarnow-mordi 1981[268]	Retrospective study of pregnant subjects and factors causing

Reference	Reason for exclusion
	hyponatraemia in a newborn population. Indirect population which does not consider management of condition.
Wattad 1992[286]	Study reports frequency and causes of in-hospital hyponatraemia. Does not consider management of condition.
Woo 2009[296]	Evaluation of a hypertonic sodium chloride administration protocol in adults (n=49) with hyponatraemia. Retrospective review.

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

Table 11: Studies excluded from the clinical review

Reference	Reason for exclusion
Asuncion 2011[16]	Management of children compared to adults for fluid resuscitation. Abstract. Not IV fluid training and education.
Biese 2009[33]	Before and after study in USA of knowledge after intervention for paediatric resuscitation. Not specifically looking at IV fluids in patients.
Bonacruz, 1996[37]	Identification of hypoglycaemia; Australia. Not IV fluid training and education.
Buss 1993[49]	Knowledge of paediatricians. Not specific to IV fluids. Not IV fluid training and education.
Considine 2007[59]	Before and after study. Nurses' knowledge after a paediatric fever education programme; Australia.
Glaser 1997[85]	Difference in fluid management of paediatric diabetic ketoacidosis by specialty. Not IV fluid training and education.
Hirschberg 2008[110]	Adults and children's clinicians' knowledge; USA. Not IV fluid training and education.
Hussein 2001[117]	Practices and priorities. Not IV fluid training and education.
Kamal 2012[122]	Practice of paediatric doctors; abstract. Not IV fluid training and education.
Keijzers 2012[130]	Fluid calculation, choice and practice scenarios; Australia. Not IV fluid training and education.
Lang 2011[134]	Practice following guidelines; abstract. Not IV fluid training and education.
Lee 2013[137]	Prescription practices; Korea. Not IV fluid training and education.
Lester-Smith 2010[140]	Teaching programme with students rating their level of confidence prior to and after the tutorial; comments from students were specific to tutorials and assessment
Manan 2012[158]	Abstract of full study (see Parker 2013)
Nunez 2012[183]	Dehydration treatment practices in paediatric-trained and non-paediatric trained emergency physicians in the USA
O'Leary 2014[186]	Identification of suboptimal care in paediatric emergencies; Australia. Not IV fluid training and education.
Oshikoya 2009[196]	Knowledge of clinical pharmacology and therapeutics of interns in Nigeria. Not IV fluid education and training.
Paltridge 2008[199]	Confidence in clinical skills; Australia. Not IV fluid training and education.
Parker 2013[200]	Attitudes, preferences and beliefs of healthcare providers working in acute care settings regarding paediatric fluid resuscitation performance in Australia

Reference	Reason for exclusion
Patwari 1991[201]	Not paediatric doctors; India. Knowledge and perceptions of residents of case-managing acute diarrhoea.
Potts 1996[212]	Family practice versus paediatric residents tested for calculation of fluids and maths skills. Not IV fluid training and education.
Powell 2003[213]	Test ordering practices. Not IV fluid training and education.
Preissig 2010[215]	Actual centres' practices compared to attitudes; USA. Not IV fluid training and education.
Remes 2003[222]	Not paediatric doctors; performance in procedures. Not specifically IV fluid training and education.
Roberts 2005[225]	Emergency treatment equipment and procedures in UK paramedics. Not IV fluid training and education.
Santschi 2013[232]	Not specific to IV fluids; survey of centres' use of crystalloids for fluid resuscitation of septic patients. Not IV fluid training and education.
Schutz 2008[238]	Emergency department practice of managing gastroenteritis; Australia and New Zealand
Sparrow 2002[253]	Not relevant: UK survey of fluid choice after publication of a systematic review that demonstrated a higher mortality in patients treated with human albumin solution
Szajewska 2000[265]	Practice following guidelines; Europe. Not IV fluid training and education.
Tabbers 2010[266]	How a guideline was implemented and the barriers to this. Not IV fluid training and education.
Tuthill 1998[272]	Paediatric knowledge of resuscitation; New Zealand. Not IV fluid training and education.
Way 2006[287]	UK study of current fluid practice. Not IV fluid training and education.
Weisgerber 2007[288]	Survey of paediatricians, specific to training course administered. Not IV fluid training and education.

K.7 References

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