

IV fluids in children

Intravenous fluid therapy in children and young people in hospital

Appendix K

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Draft for consultation

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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.

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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
Perelman 1966 ¹⁹⁸	Incorrect study design (example of revised intake and output charts)
Perelman 1964 ¹⁹⁷	Incorrect study design (example of revised intake and output charts)
Bryan 2004 ⁴³	Incorrect intervention (patient's diaries of 2 fluid volume charts for mean voided volume; no details of fluid volume charts)

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 ⁴⁹	Non-comparative study. Non-specified intervention (multi-frequency bioimpedance).
Dawson 1991 ⁶³	Non-comparative study measuring factors associated with dehydration
Duggan 1996 ⁷⁰	Non-comparative study
Durukan 2009 ⁷¹	Non comparative study. Validation of shock index.
Goldman 2008 ⁸⁵	Validation study for clinical assessment tool
Gorelick 1997 ⁸⁷	Non-comparative study
Gross 1992 ⁸⁸	Non-comparative study

Reference	Reason for exclusion
Hayajneh 2010 ¹⁰⁴	Diagnostic accuracy study for clinical signs of dehydration
Hooper 2012 ¹⁰⁹	Study protocol
Kc 2006 ¹²⁷	Non-comparative case series
Liebelt 1998 ¹⁴⁰	Narrative review
Logan-sprenger 2013 ¹⁴⁴	Incorrect population. Healthy adults.
Mackenzie 1989 ¹⁴⁸	Diagnostic study of factors associated with dehydration
Molaschi 1997 ¹⁶³	Non-comparative study
Morrison 2011 ¹⁶⁵	Conference abstract
Munoz 2013 ¹⁶⁸	Incorrect population. Healthy adult population.
Perren 2011 ¹⁹⁹	Non-comparative. Does not fit population or study protocol. Assessing fluid balance sheet.
Perrier 2013 ²⁰⁰	Non-comparative biochemical study
Pruvost 2013 ²¹⁰	Validation study of post-illness weight as a marker of dehydration. Non-comparative.
Schriger 1991 ²²⁹	Non-comparative validation study for capillary refill
Shaoul 2004 ²³⁵	Study compares laboratory and non-laboratory assessments
Shimizu 2012 ²³⁹	Diagnostic accuracy study
Steiner 2004 ²⁴⁹	Narrative review
Tam 2014 ²⁶⁰	Study correlates laboratory markers with levels of dehydration
Teach 1997 ²⁶²	Diagnostic accuracy of laboratory measures
Ugale 2012 ²⁶⁶	Non-comparative study. Measures association between laboratory assessment and dehydration.
Van dommelen 2014 ²⁶⁹	Non-IV fluid population
Vega 1997 ²⁷²	Diagnostic accuracy study. Non-comparative.
Vila 1998 ²⁷³	Non-comparative study
Wakefield 2008 ²⁷⁷	Compares long-term outcomes following dehydration
Yilmaz 2002 ²⁹¹	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 (HES 6% but patients are not hypovolaemic); abstract
Bocanegra 1966 ³⁴	Incorrect population (adults)
Boldt 1993 ³⁶	Article withdrawn from literature

Reference	Reason for exclusion
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 ⁵⁰	Incorrect comparison (HES)
CHEST 2011 ⁶⁰	Incorrect study design (protocol for a RCT)
Cifra 2003 ⁵⁴	Incorrect comparison (HES)
Collis 1999 ⁵⁷	Inappropriate study design. Retrospective cohort study.
Deorari 1995 ⁶⁵	Incorrect intervention (plasma)
Faraklas 2011 ⁷⁴	Incorrect study design (retrospective cohort study)
Ford 2012 ⁷⁷	Systematic review and meta-analysis. Included studies do not meet our protocol.
Gattas 2013 ⁸²	Systematic review is not relevant to review question or unclear PICO. Considers HES (130/0.4 and 130.42) in adults.
Goodwin 1983 ⁸⁶	Incorrect population (adults)
Guidet 2007 ⁹⁰	Incorrect study design (non-RCT registry data)
Gutierrez-Alvarez ⁹¹	Foreign language systematic review
Haas 2007 ⁹²	Study reports surrogate measures following IV treatment (coagulation and laboratory testing). Not specific to protocol.
Hall 1973 ⁹⁴	Incorrect study design (control trial, not randomised)
Hanart 2009 ⁹⁶	Incorrect comparison (HES)
Hans 2000 ⁹⁹	Inappropriate comparison. Compares albumin with unstated control treatment. Outcomes do not match protocol.
Hartog 2011 ¹⁰¹	Systematic review is not relevant to review question or unclear PICO. General synopsis of the use of colloids in the population.
James 2011 ¹¹⁷	Incorrect population (adults)
Kalayanarooj 2008 ¹¹⁹	Patients received sodium chloride prior to entering trial. Not first line.
Lawrence 2010 ¹³⁴	Incorrect population (adults) and incorrect study design (retrospective)
Levy 2013 ¹³⁹	Incorrect comparison
Liet 2003 ^{141,141}	Outcomes not appropriate. Measures haemodynamic response to fluid and incidence of creatinemia.
Liet 2006 ¹⁴²	Incorrect comparison (HES). Incorrect population (pre-term neonates).
Liet 2006 ¹⁴²	Incorrect population (gestational age is below 30 weeks)
Lynch 2002 ¹⁴⁷	Abstract
Lynch 2008 ¹⁴⁶	Incorrect population (premature babies; gestational age is 30 weeks)
Mahajan 2012 ¹⁵⁰	Indirect population. Study compares Ringer's lactate solution and normal sodium chloride for dehydration.
Mahler 2011 ¹⁵²	Incorrect population (adult)
Maitland 2003 ^{153,230}	Incorrect study design (phase I study, not an RCT)
Maitland 2004 ¹⁵⁴	Incorrect study design (prospective cohort study)
Maningas 1989 ¹⁵⁶	Incorrect population (adults)
Mattox 1991 ¹⁵⁷	Incorrect population (adults)
Modi 2012 ¹⁶¹	Incorrect population (adult)

Reference	Reason for exclusion
Mulavisala 2012 ¹⁶⁶	Incorrect comparison (HES)
Mullett 2002 ¹⁶⁷	Unable to obtain paper
Neff 2003 ¹⁷²	Incorrect interventions. Compares 2 HES products (6% HES 130/0.4 versus HES 200/0.5).
Nguyen 2006 ¹⁷⁴	Incorrect study design (non-RCT)
Niermeyer 2006 ¹⁷⁵	Narrative review
Niang 2010 ¹⁷¹	Incorrect study design (mini review)
Northern Neonatal Nursing Initiative Trial Group (ANON) 1996A ¹	Incorrect population (pre-term babies)
Oca 1999 ¹⁸²	Unable to obtain paper
Oca 2003 ¹⁸³	Incorrect population (under 28 weeks gestational age)
Olupot-Olupot 2012 ¹⁸⁷	Abstract for Maitland 2011
Orgev 1969 ¹⁸⁸	Incorrect study design. Non-RCT.
Osborn 2004 ¹⁹⁰	Incorrect population; Cochrane review in pre-term infants
Osthaus 2009 ¹⁹²	Study population and results included under Witt 2009
Perel 2013 ¹⁹⁶	Cochrane review of studies with adults and children
Phin 2003 ²⁰²	Incorrect population. Population undergoing replacement strategy. One of the intervention groups required naso-gastric administration (non-IV). Non-specific outcomes.
Pockaj 1994 ²⁰³	Incorrect study design (prospective cohort study); incorrect population (adults).
Ranucci 2013 ²¹³	Lecture abstract. Compares crystalloids and colloids.
Recinos 1975 ²¹⁴	Incorrect study design (prospective cohort study)
Riegger 2002 ²¹⁸	Incorrect intervention (additional albumin to EC prime compared to crystalloid prime solution)
Rother 1994	Retrospective cohort study. Non-RCT.
Rothmaier 1995 ²²²	No relevant outcomes; serum preparation for partial exchange transfusion
Rueddel 2012 ²⁶³	Incorrect population (systematic review and meta-analysis where children and adult data not separated)
Stoddart 1996 ²⁵³	No outcomes matching protocol
Russell 2004 ²²³	Incorrect population (meta-analysis of studies with adults and children)
Schroth 2006 ²³⁰	Incorrect interventions. Study uses fluid not routinely administered in children (hypertonic-hyperoncotic).
Senagore 2009 ²³²	Incorrect population (adults)
Shatney 1983 ²³⁷	Incorrect population (adults)
Shaw 2012 ²³⁸	Includes paediatric population but results not reported separately by age
Simbruner 2003 ²⁴¹	Editorial on study. No appropriate outcomes considered.
Simma 1996 ²⁴³	Abstract only. Full study included.
Simma 2001 ²⁴²	No outcomes can be extracted applicable to protocol
So 1997 ²⁴⁴	Incorrect population (preterm infants 23 to 34 weeks)
Standl 2008 ²⁴⁷	Incorrect comparison (HES)
Standl 2009 ²⁴⁸	Narrative response to query. No appropriate data included.
Stockwell 1992 ²⁵¹	Adult study (all patients over 18 years old). Indirect population.
Stockwell 1992 ²⁵²	Adult study (all patients over 18 years old). Indirect population.

Reference	Reason for exclusion
Sudhakar 2008 ²⁵⁶	Incorrect population (adults)
Sumpelmann 2008 ^{230,257}	Incorrect study design (cohort study)
Todd 2013 ²⁶⁴	Additional paper for further information
Van der Linden 2013 ²⁶⁸	Incorrect comparison (HES)
Vassar 1991 ²⁷¹	Incorrect population (adults)
Vassar 1993 ²⁷⁰	Incorrect population (adults)
Vlasakov 2011 ²⁷⁴	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 ²⁷⁵	Incorrect study design (retrospective cohort study)
Wade 1997 ²⁷⁶	Incorrect population (adults)
Wiedermann 2004 ²⁸³	Narrative review of safety and efficacy of HES
Wilkes 2001 ²⁸⁴	Meta-analysis of studies most likely in adults (no details given)
Wills 2001 ²⁸⁵	Incorrect study design (literature review)
Witt 2008 ²⁸⁶	Incorrect comparison (HES)
Wong 1997 ²⁸⁷	No relevant outcomes
Wu 2001 ²⁸⁹	Incorrect population (adults)
Yang 2011 ²⁹⁰	Incorrect population (adults)
Younes 1997 ²⁹²	Incorrect population (adults)
Younes 1998 ²⁹³	Incorrect intervention (pentastarch solution added to treatment)
Zunini 2011 ²⁹⁶	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 maintenance – maintenance rate differs)
Cole 2013 ⁵⁵	Intervention not relevant to review question (2 provider-endorsed manual resuscitation techniques)
Cole 2014 ^{56,230}	Population does not match protocol (simulated children)
Freedman 2011 ⁸¹	Intervention does not match protocol (5ml given every 5 minutes for an hour; mix of resuscitation and replacement fluid)
Freedman 2011C ⁷⁹	Abstract and have full paper (see Freedman 2011)
Freedman 2013 ⁸⁰	Intervention does not match protocol (5ml given every 5 minutes for an hour; mix of resuscitation and replacement fluid)
Glaser 2013 ⁸⁴	Intervention does not match (mix of resuscitation and replacement fluid)
Hanson 2009 ¹⁰⁰	Interventions do not match protocol (not comparing rate)
Harvey 2012A ¹⁰²	Abstract and have full paper (see Harvey 2013)
Harvey 2013 ¹⁰³	Population does not match protocol (simulated children)
Kanaan 2003 ¹²¹	Study not relevant to review question
Kavvadia 1999 ¹²⁵	Population does not match protocol (pre-term infants)
Kavvadia 2000 ¹²⁶	Population does not match protocol (pre-term infants)

Reference	Reason for exclusion
Kavvadia 2000A ¹²⁴	Population does not match protocol (pre-term infants)
Nager 2010 ¹⁶⁹	Intervention does not match protocol (replacement)
Okabayashi 2001 ¹⁸⁵	Study not relevant to review question
Oliveira 2008 ¹⁸⁶	Intervention does not match protocol (not only sodium chloride); no relevant outcome data
Sambandamoorthy 2013A ²²⁵	Study design does not match protocol (abstract of a cohort study)
Zak 1999 ²⁹⁵	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 ⁵²	Narrative review
Cuello 2012 ⁶¹	Abstract only
Dicembrino 2013 ⁶⁶	Abstract only
Disma 2013 ⁶⁸	Abstract only. Incorrect interventions.
Fosel 1996 ⁷⁸	Outcomes do not match protocol (change in glucose level, not hypoglycaemia)
Heidari 2011 ¹⁰⁵	Adult study
Heshmati 2004 ¹⁰⁶	Compares fluid volume not type. Incorrect comparison.
Karabocuoglu 2006 ¹²³	Abstract only
Khan 2014 ¹²⁹	Non-randomised study
Larsson 1990 ¹³³	Incorrect stratum. Pre-term. Population excluded.
Lim 1997 ¹⁴³	Outcomes do not match the protocol (increase and decrease in blood glucose concentration)
Long 2009 ¹⁴⁵	Abstract of Coultard 2012
Mcnab 2011 ¹⁵⁸	Protocol of Cochrane review
McNab 2014 ¹⁵⁹	Cochrane analysis. Population stratified differently to our protocol.
Mikawa 1991 ¹⁶⁰	Outcomes do not match protocol
Modi 2012 ¹⁶¹	Adult population

Reference	Reason for exclusion
Moritz 2012 ¹⁶⁴	Editorial article
Neville 2006 ¹⁷³	Patients presented at baseline with hyponatraemia
Nili 2005 ¹⁷⁶	Pre-term population. Excluded population.
Nishina 1995 ¹⁷⁷	Outcomes do not match protocol (hypoglycaemia cannot be extracted)
Nuutinen 1975 ¹⁷⁹	Incorrect stratum. Intervention does not match protocol (5% glucose versus 0.9% sodium chloride).
Powell 1990 ²⁰⁸	Compares rate of administration
Rey 2011 ²¹⁷	Patients presented at baseline with hyponatraemia
RodriguezCeJudo 2014 ²²¹	Abstract only
Vaidya 1995 ²⁶⁷	Incorrect interventions. Pre-term population excluded by guideline.
Welborn 1987 ²⁸¹	Outcomes do not match protocol (change in glucose level, not hypoglycaemia)
Yung 2009 ²⁹⁴	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 ⁵⁹	Incorrect interventions. Study compares Hartmann's solution with 0.45% sodium chloride.
Flaring 2011 ⁷⁶	Study protocol
Kannan 2010 ¹²²	Incorrect interventions. Compares 0.18% sodium chloride at different maintenance rates.
Stroustrup 2012 ²⁵⁴	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 ⁹⁵	Incorrect population (not replacement)
Juca 2005 ¹¹⁸	Incorrect population (not replacement)
Levy 2013 ¹³⁹	Incorrect population (not replacement)
Mahalanabis 1972 ¹⁵¹	Incorrect outcome (not reporting outcomes of interest separately for non-cholera patients)
Neville 2006 ¹⁷³	Incorrect outcomes (the only relevant outcome was hyponatraemia, and many of the patients had hyponatraemia at the start of the trial)
Rahman 1988 ²¹²	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 ⁶⁷	Incorrect study design (retrospective study in adult population)
Eke 1996 ⁷²	Unable to obtain text
Elbayoumi 2012 ⁷³	Population does not match the protocol; hypernatraemia not developed during IV fluid administration and N less than minimum in protocol
Habel 1976 ⁹³	Population does not match protocol; hypernatraemia not developed during IV fluid administration and N less than minimum in protocol
Hoorn 2007 ¹¹⁰	Comparison does not match the protocol and it is not comparing fluids
Huang 2010 ¹¹³	Population does not match protocol; hypernatraemia not developed during IV fluid administration. Adult population.
Huston 2007 ¹¹⁶	Population does not match protocol; hypernatraemia not developed during IV fluid administration
Koopmans 2010 ¹³⁰	Incorrect study design (retrospective study in adult population)
Kraft 2005 ¹³¹	Incorrect study design (non-systematic review), adult population
Oh 1992 ¹⁸⁴	Incorrect study design (non-systematic review)
Orgun 2010 ¹⁸⁹	Population does not match protocol, hypernatraemia not developed during IV fluid administration
Pokaharel 2011 ²⁰⁴	Incorrect study design (non-systematic review)
Polderman 1999 ²⁰⁵	Comparison does not match protocol; not comparing fluids and N less than minimum in protocol
Robertson 2007 ²²⁰	Population does not match protocol; hypernatraemia not developed during IV fluid administration. Comparison does not match protocol and not comparing fluids.
Sam 2012 ²²⁴	Population does not match protocol; hypernatraemia not developed during IV fluid administration. Adult population and N less than minimum in protocol.
Shackford 1987 ²³³	Population does not match protocol (not hypernatraemia)
Wells 2012 ²⁸²	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 ⁵¹	Adult population. Abstract only. Includes drug intervention (Tolvaptan).
Chung 1987 ⁵³	Paper provides clinical assessment of factors contributing to hyponatraemia in adults (n=58)
Cuello 2012 ⁶¹	Reports on incidence of hyponatraemia between isotonic and hypotonic IV fluids in paediatric patients
Dasta 2013 ⁶²	Adult population (n=3795). Health economic outcomes were generally considered. History of hyponatraemia not defined.
Decaux 2010 ⁶⁴	Adult population (n=50) who acquired hyponatraemia outside of hospital. Non- randomised study.
Dominguez 2013 ⁶⁹	Non-randomised adult study (n=49) comparing 3% sodium chloride and drug use (Conivaptan)
Farooqui 2003 ⁷⁵	Retrospective review in adult population (n=35) detailing comorbidities associated with death and severe hyponatraemia
Gross 2008 ⁸⁹	Review of hyponatraemia treatment in adults. No outcomes related to protocol.
Hanna 2003 ⁹⁸	Study reports incidence and management of hyponatraemia in patients with respiratory syncytial virus bronchiolitis. Indirect population.
Hanna 2010 ⁹⁷	Study reports incidence of hyponatraemia. Does not consider hyponatraemia management.
Higgins 1996 ¹⁰⁷	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 ¹¹¹	Paper considers factors relating to development of hyponatraemia. Does not report on management of condition.
Hoorn 2006 ¹¹²	Study comparing outcomes between hospital acquired and non-hospital acquired hyponatraemia (n=131). Not appropriate to outcome. Incorrect age group.
Huda 2006 ¹¹⁴	Indirect adult population (n=104). IV fluid administration not responsible for hyponatraemia.
Lehmann 2013 ¹³⁶	Adult population (n=36) with subarachnoidal haemorrhage. Outcomes not specific to protocol (looks at the number of patients who develop hyponatraemia).
Lemaire 2010 ¹³⁷	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 ¹⁴⁹	Non-randomised adult trial (n=3204). Causes of hyponatraemia are not specific to in-hospital population.

Reference	Reason for exclusion
Mohmand 2007 ¹⁶²	Adult population (n=62) with SIADH treated with hypertonic sodium chloride. Non-randomised study.
Nagler 2013 ¹⁷⁰	Review of clinical guidelines in adults. Does not report specific outcomes to protocol.
Naing 2010 ¹⁷¹	Review article comparing incidence of hyponatraemia between crystalloids and colloids. Does not consider management of condition.
Nzerue 2003 ¹⁸⁰	Retrospective review of adult population detailing the factors related to adverse outcomes in hyponatraemia
Phillips 1997 ²⁰¹	Prospective, comparative study comparing 5% Mannitol and 1.5% Glycine in preventing of Hyponatraemia in pregnant women (n=122). Intervention not specific to protocol and indirect population.
Rabinstein 2011 ²¹¹	Meta-analysis of adult population with aneurysmal SAH. Considers drug treatments primarily (vasopressin receptor antagonists).
Reeder 1989 ²¹⁵	Retrospective study in an adult population (n=48) with SIADH. Interventions (0.9% sodium chloride versus urea) non-specific to protocol.
Sarnaik 1991 ²²⁷	Population is not following administration on IV fluids
Sato 2011 ²²⁸	Study detailing risk factors associated with hospital acquired hyponatraemia. Does not consider management.
Shann 1985 ²³⁴	Reports on the relationship between hyponatraemia with pneumonia and bacterial meningitis. Not following administration of IV fluids. No applicable outcomes to protocol.
Sharf 1993 ²³⁶	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 ²⁴⁰	Interim report of observational registry in adult population. Hyponatraemia not due to IV fluid administration. No outcomes reported.
Sood 2013 ²⁴⁵	Adult population (n=25) looking at service quality improvement. Indirect populations as patients not admitted following administration of IV fluids.
Sterns 1994 ²⁵⁰	Adult population (n=56) with severe hyponatraemia and non-randomised population.
Suarez 1999 ²⁵⁵	Case review of adult population (n=199) with hypernatraemia and cerebral vasospasm. Retrospective review with indirect population.
Tarnow-mordi 1981 ²⁶¹	Retrospective study of pregnant subjects and factors causing hyponatraemia in new born population. Indirect population which does not consider management of condition.
Wattad 1992 ²⁷⁸	Study reports frequency and causes of in-hospital hyponatraemia. Does not consider management of condition.
Woo 2009 ²⁸⁸	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.

Reference	Reason for exclusion
	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 ⁴⁸	Knowledge of paediatricians. Not specific to IV fluids. Not IV fluid training and education.
Considine 2007 ⁵⁸	Before and after study. Nurses' knowledge after a paediatric fever education programme; Australia
Glaser 1997 ⁸³	Difference in fluid management of paediatric diabetic ketoacidosis by specialty. Not IV fluid training and education.
Hirschberg 2008 ¹⁰⁸	Adults and children's clinicians' knowledge; USA. Not IV fluid training and education.
Hussein 2001 ¹¹⁵	Practices and priorities. Not IV fluid training and education.
Kamal 2012 ¹²⁰	Practice of paediatric doctors; abstract. Not IV fluid training and education.
Keijzers 2012 ¹²⁸	Fluid calculation, choice and practice scenarios; Australia. Not IV fluid training and education.
Lang 2011 ¹³²	Practice following guidelines; abstract. Not IV fluid training and education.
Lee 2013 ¹³⁵	Prescription practices; Korea. Not IV fluid training and education.
Lester-Smith 2010 ¹³⁸	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 ¹⁵⁵	Abstract of full study (see Parker 2013)
Nunez 2012 ¹⁷⁸	Dehydration treatment practices in paediatric-trained and non-paediatric trained emergency physicians in the USA
O'Leary 2014 ¹⁸¹	Identification of suboptimal care in paediatric emergencies; Australia. Not IV fluid training and education.
Oshikoya 2009 ¹⁹¹	Knowledge of clinical pharmacology and therapeutics of interns in Nigeria. Not IV fluid education and training.
Paltridge 2008 ¹⁹³	Confidence in clinical skills; Australia. Not IV fluid training and education.
Parker 2013 ¹⁹⁴	Attitudes, preferences and beliefs of health care providers working in acute care settings regarding paediatric fluid resuscitation performance in Australia
Patwari 1991 ¹⁹⁵	Not paediatric doctors; India. Knowledge and perceptions of residents of case-managing acute diarrhoea.
Potts 1996 ²⁰⁶	Family practice versus paediatric residents tested for calculation of fluids and maths skills. Not IV fluid training and education.
Powell 2003 ²⁰⁷	Test ordering practices. Not IV fluid training and education.
Preissig 2010 ²⁰⁹	Actual centres' practices compared to attitudes; USA. Not IV fluid training and education.
Remes 2003 ²¹⁶	Not paediatric doctors; performance in procedures. Not specifically IV fluid training and education.
Roberts 2005 ²¹⁹	Emergency treatment equipment and procedures in UK paramedics. Not IV fluid training and education.
Santschi 2013 ²²⁶	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 ²³¹	Emergency department practice of managing gastro-enteritis; Australia

Reference	Reason for exclusion
	and New Zealand
Sparrow 2002 ²⁴⁶	Not relevant: UK survey of fluid choice after a publication of a systematic review that demonstrated a higher mortality in patients treated with human albumin solution
Szajewska 2000 ²⁵⁸	Practice following guidelines; Europe. Not IV fluid training and education.
Tabbers 2010 ²⁵⁹	How a guideline was implemented and the barriers to this. Not IV fluid training and education.
Tuthill 1998 ²⁶⁵	Paediatric knowledge of resuscitation; New Zealand. Not IV fluid training and education.
Way 2006 ²⁷⁹	UK study of current fluid practice. Not IV fluid training and education
Weisgerber 2007 ²⁸⁰	Survey of paediatricians, specific to training course administered. Not IV fluid training and education.

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