Maintenance fluid practices in paediatric intensive care units in Australia and New Zealand

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ABSTRACT

Background: Maintenance fluid administration is a common practice in paediatric intensive care units (PICUs), contributing to daily fluid intake and fluid balance, but little is known about this practice.

Objectives: To determine the volume and type of maintenance fluid delivered to PICU patients, and to assess changes in practice compared with a previous time point.

Methods: A prospective, observational, single-day, point prevalence study of paediatric patients from 11 Australian and New Zealand PICUs, conducted in 2014.

Results: Seventy-two patients were enrolled. The median age and weight of infants aged < 1 year (n = 34) were 2 months (interquartile range [IQR],1–4) and 5 kg (IQR, 4–6), respectively; while in children ≥ 1 year of age (n = 38), these were 4 years (IQR, 2–8) and 17 kg (IQR, 12–23), respectively. On the study day, 19 infants (56%) and 19 children aged ≥ 1 year (50%) received maintenance fluids. Infants received a median of 23 mL/kg (IQR, 12–45) of maintenance fluid in addition to 51 mL/kg (IQR, 40–72) of fluid and nutrition from other sources; maintenance fluids contributed 29% (IQR, 13%–60%) of the total daily fluid intake. Children ≥ 1 year of age received a median of 18 mL/kg (IQR, 9–37) of maintenance fluid in addition to 39 mL/kg (IQR, 25–53) of fluid and nutrition from other sources; maintenance fluids contributed 33% (IQR, 17%–69%) of the total daily fluid intake. When compared with similar data from 2011, there was no change in the amount of maintenance fluid given, which was administered mostly as isotonic fluids.

Conclusion: Maintenance fluid contributes about a third of total fluid administration in children in Australian and New Zealand PICUs and is mostly administered as isotonic solutions.

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Children in intensive care are frequently administered fluids as part of routine care for resuscitation, medication delivery, nutrition, line patency and maintenance fluid therapy (MFT). The practice of intravenous MFT for hospitalised children began 60 years ago, based on theoretical considerations of fluid requirements related to cellular metabolism and energy expenditure.[1] This practice continues today and is highly prevalent.[2]

Multiple randomised trials and cohort studies have found that medical and surgical populations of hospitalised children receiving MFT develop attributable adverse effects, such as hyponatraemia, cerebral oedema or death.[3-13] These data have contributed to concerns about tonicity and volume of intravenous fluid administered to hospitalised children.[14,15] Previous point prevalence studies have also found that children and adults in intensive care have a positive fluid balance overall and receive an amount of sodium in fluid therapy that often exceeds the daily recommended sodium intake.[2,16,17]

In modern paediatric intensive care units (PICUs), children are exposed to many sources of fluid for various indications, including circulatory support, line patency and hydration.[2] There is accumulating evidence that excessive fluid administration, in terms of volume[18] and composition,[19] is harmful, and the practice of MFT warrants further investigation.[20] In this study, we sought to understand the contemporary practice of administering MFT to children admitted to intensive care and to evaluate whether this practice has changed over time.

Methods

We conducted a cross-sectional, multicentre, observational, point prevalence study on either 24 September or 22 October 2014, in 11 Australian and New Zealand PICUs. The study was conducted in collaboration with the Paediatric Study Group of the Australian and New Zealand Intensive Care Society Clinical Trials Group (see the Appendix online at cicm.org.au/Resources/Publications/Journal). Human research ethics committee approval for a waiver of consent was obtained at all sites. The study included all paediatric patients (aged < 16 years) in participating PICUs at 10 am on the study day, and data were collected over 24 hours. Neonatal ICUs, defined as units caring solely for newborn infants, were excluded.

Demographic and clinical data collected for all patients included age, sex, weight (estimated or measured), Paediatric Index of Mortality score at admission, high- or low-risk diagnosis (reason for PICU admission), admission diagnosis and specific diagnoses on the study day (trauma at admission, acute respiratory distress syndrome, sepsis), PICU

admission source and bed-block status. Major treatment interventions (eg, invasive mechanical ventilation, non-invasive mechanical ventilation, renal replacement therapy, extracorporeal membrane oxygenation) on the study day were also documented. Information on vital status 28 days after the study day was collected from hospital administrative databases. Study data were collected and managed using an electronic data capture system (REDCap) hosted at the George Institute for Global Health, Sydney, Australia.[21]

Data were collected on:

- the amount and type of maintenance fluids (ie, continuous fluid administered for maintenance or to replace fluid losses; not for resuscitation purposes);
- resuscitation fluids (defined as a bolus of crystalloid; a crystalloid infusion of 5 mL/kg/h [or 400 mL/h] or greater for 1 or more hours; a colloid bolus; any colloid by infusion; or transfusion of whole blood, packed red blood cells, fresh frozen plasma or platelets);
- fluids administered as diluent or vehicles for drug infusions and boluses;
- enteral and parenteral feeds; and
- estimated intravenous flushes associated with haemodynamic monitoring (arterial and central venous lines).

Data on patients receiving an oral diet (where it was estimated that at least 50% of dietary requirements were met by normal oral intake, without supplementation by enteral or parenteral feeds) were recorded. Information on daily total fluid administration, urine output and fluid balance were also collected. Data for infants (aged < 1 year) and children aged ≥ 1 year were analysed separately. Results were compared with data from a separate point prevalence study conducted in 2011.[2]

Statistical analysis

Descriptive data are presented as medians and interquartile ranges (IQRs) or proportions and percentages, as appropriate. We used χ^2, Mann–Whitney U tests and independent sample *t* tests as appropriate to compare data between 2011 and 2014. For all analyses, a two-sided *P* value of less than 0.05 was considered statistically significant. Statistical analysis was performed using SPSS, version 21.0 (IBM).

Results

Patient characteristics

A total of 72 paediatric patients from 11 PICUs were enrolled (Appendix). There were 34 infants and 38 children aged ≥ 1 year on the study day. The median age and weight of infants were 2 months (IQR, 1–4) and 5 kg (IQR, 4–6), respectively. In children ≥ 1 year of age, median age and weight were 4 years (IQR, 2–8) and 17 kg (IQR, 12–23), respectively. Forty-seven per cent (*n* = 34) of all study patients were receiving invasive mechanical ventilation on the study day. The sources of admission of the study patients were: elective ICU admission (17; 24%), post-cardiopulmonary bypass (8; 11%), transferred from hospital floor (24; 33%), transferred from emergency department (14; 19%), transferred from operating theatre (14; 19%), transferred from another ICU (10; 14%) and transferred from another hospital (10; 14%). The median length of ICU stay up to and including the study day was 1 day (IQR, 1–3) (Table 1). A full 24-hour ICU chart was available for 52 patients (72%). In the remainder, who were studied on either the first or last day of their admission, data were available for a median of 11 hours (IQR, 6–16).

On the study day, 53% (95% CI, 41%–64%) of all study patients were administered MFT. The median amount of

Table 1. Patient characteristics on the study day

Characteristic	No. (%)*
Total patients†	72
Total ICUs contributing data	11
Infants	34
Median age, months (IQR)	2 (1–4)
Median weight, kg (IQR)	5 (4–6)
Children aged ≥ 1 year	38
Median age, years (IQR)	4 (2–8)
Median weight, kg (IQR)	17 (12–23)
Male	46 (64%)
PIM high risk	8 (11%)
PIM low risk	17 (24%)
Median ICU length of stay up to and including study day, days (IQR)	1 (1–3)
Diagnosis	
Trauma	5 (7%)
Sepsis	3 (4%)
Acute respiratory distress syndrome	1 (1%)
Procedure	
Invasive mechanical ventilation	34 (47%)
Non-invasive mechanical ventilation	7 (10%)
Requiring vasopressors	12 (17%)
Renal replacement therapy	2 (3%)
Extracorporeal membrane oxygenation	3 (4%)
Bed-blocked on study day	7 (10%)
Discharged from ICU at Day 28	59 (82%)
Discharged from hospital at Day 28	49 (72%)
Mortality at Day 28	4 (6%)

ICU = intensive care unit. IQR = interquartile range. PIM = Paediatric Index of Mortality. * Unless otherwise indicated. † Full 24-hour ICU chart was available for 52 patients (72%); for the remainder, an ICU chart was available for a median of 11 hours (IQR, 6–16).

Table 2. Comparison of patients who did and did not receive maintenance fluid on the study day (*n* = 72)

Characteristic	Maintenance fluid	No maintenance fluid	*P*
Total patients	38 (53%)	34 (47%)	
Infants	19 (50%)	15 (44%)	0.64
Children aged ≥ 1 year	19 (50%)	19 (56%)	
Male	25 (66%)	21 (62%)	0.80
Median weight, kg (IQR)	10 (4–21)	9 (5–13)	0.56
Median ICU length of stay up to and including study day, days (IQR)	2 (1–5)	1 (1–2)	0.86
PIM high risk diagnosis	5 (13%)	3 (9%)	0.71
PIM low risk diagnosis	7 (18%)	10 (29%)	0.78
Invasive mechanical ventilation	19 (50%)	15 (44%)	0.64
Median total fluid administered on study day, mL/kg (IQR)	77 (50–99)	75 (38–120)	0.29
Median total fluid balance on study day, mL/kg (IQR)	13 (8 to 28)	9 (6 to 37)	0.97
Discharged from ICU at Day 28	32 (84%)	27 (79%)	0.76
Discharged from hospital at Day 28	27 (71%)	22 (64%)	0.61
Mortality at Day 28	2 (5%)	2 (6%)	1.00

ICU = intensive care unit. IQR = interquartile range. PIM = Paediatric Index of Mortality.

MFT administered was 193 mL (IQR, 95–415) (20 mL/kg; IQR, 11–38), and MFT contributed 32% (IQR, 16%–61%) of the total amount of daily fluid intake. Overall, there were no differences in baseline demographic characteristics, total administered fluid or fluid balance, ICU and hospital length of stay or mortality in patients who did and did not receive maintenance fluid (Table 2).

Among 34 patients requiring invasive mechanical ventilation on the study day, 19 (56%) received MFT, with a median amount administered of 193 mL (IQR, 96–402) (19 mL/kg; IQR, 13–46).

When comparing patients whose ICU length of stay was less than 3 days (*n* = 53) with those ≥ 3 days (*n* = 19), there was no difference in the proportion receiving MFT (26 [49%] *v* 12 [63%]; *P* = 0.42) or the total amount of MFT administered (22 mL/kg [IQR, 11–34] *v* 15 mL/kg [IQR, 9–46]; *P* = 0.44).

Infants

The median total amount of fluid administered to infants on the study day was 93 mL/kg (IQR, 58–120); in 19 infants (56%), some of this fluid was given as MFT. Data regarding all fluids, including feeds and fluid balance, for all 34 infants are shown in Table 3.

Infants who received maintenance fluid

Details of all fluid administration to infants who received MFT on the study day (*n* = 19) are shown in Table 4. The median amount of MFT administered was 100 mL (IQR, 67–216) (23 mL/kg; IQR, 12–45). Six infants (32%) also received fluid resuscitation on the study day. The median amount of fluid resuscitation received was 40 mL (IQR, 23–78) (8 mL/

Table 3. Fluid administration in infants (aged < 1 year)

Variable	No. (%)*
Total patients†	34 (47%)
Male	24 (71%)
Median ICU length of stay up to and including day of study, days (IQR)	1 (1–6)
Resuscitation fluid	8 (24%)
Median amount of resuscitation fluid, mL (IQR)	40 (18–55)
Maintenance fluid	19 (56%)
Median amount of maintenance fluid, mL (IQR)	100 (67–216)
Fluids as drug vehicles (infusions and boluses)	24 (71%)
Median amount of fluids as drug vehicles, mL (IQR)	78 (28–145)
Indwelling arterial flush-based catheter	17 (50%)
Indwelling central venous flush-based catheter	12 (35%)
Predominant oral feeds	4 (12%)
Enteral feeds	26 (76%)
Median amount of enteral feed, mL (IQR)	229 (109–425)
Total parenteral nutrition	5 (15%)
Median amount of total parenteral nutrition, mL (IQR)	196 (54–231)
Median total fluid administered on study day, mL/kg (IQR)	93 (58–120)
Median total urine output on study day, mL/kg (IQR)	57 (30–96)
Median total fluid balance on study day, mL/kg (IQR)	9 (–4 to 38)

ICU = intensive care unit. IQR = interquartile range. * Unless otherwise indicated. † Full 24-hour ICU chart was available for 22 patients (65%); for the remainder, an ICU chart was available for a median of 9 hours (IQR, 5–19).

Table 4. Fluid administration in infants (aged < 1 year) receiving maintenance fluids (*n* = 19)

Variable	No. (%)*
Median amount of maintenance fluid, mL; mL/kg (IQR)	100 (67–216); 23 (12–45)
Resuscitation fluid	6 (32%)
Median amount of resuscitation fluid, mL (IQR)	40 (23–78)
Median amount of fluids as drug vehicles, mL (IQR)	60 (26–123)
Indwelling arterial flush-based catheter	13 (68%)
Indwelling central venous flush-based catheter	9 (47%)
Predominant oral feeds	1 (5%)
Enteral feeds	14 (74%)
Median amount of enteral feed, mL (IQR)	161 (79–344)
Total parenteral nutrition	2 (11%)
Median amount of total parenteral nutrition, mL (IQR)	28–199
Median maintenance fluid as proportion of total administered fluid (IQR)	29% (13%–60%)
Median total fluid administered on study day, mL/kg (IQR)	87 (59–102)
Median total urine output on study day, mL/kg (IQR)	60 (27–150)
Median total fluid balance on study day, mL/kg (IQR)	26 (–7 to 32)

IQR = interquartile range. * Unless otherwise indicated.

kg). Drug boluses and infusions accounted for a median of 78 mL (IQR, 28–145) (16 mL/kg) of fluid. Thirteen (68%) and nine (47%) infants had an indwelling arterial and central venous flush-based line, respectively, in place on the study day. These flush-based lines contribute 1 mL/h to the patients, so about 24 mL of fluid per line was administered as flushes, accounting for a median of 5 mL/kg (IQR, 0–11) of administered fluid. Among the 19 infants receiving maintenance fluids, 14 (74%) also received enteral nutrition (median, 161 mL; IQR, 79–344) and two (11%) received total parenteral nutrition (amounts, 28 mL and 99 mL) on the study day. One infant received a predominantly oral diet. Overall, infants who received MFT were also administered an additional median amount of 232 mL (IQR, 144–432) (median, 51 mL/kg; IQR, 40–72) of fluid and nutrition from other sources. Intravenous MFT contributed 29% (IQR, 13%–60) of the total amount of daily fluid intake (Table 4).

Children aged 1 year or older

The median total amount of all fluid administered to children aged ≥ 1 year on the study day was 62 mL/kg (IQR, 40–86); in 19 children (50%), some of this fluid was given as MFT. Data regarding all fluids, including feeds and fluid balance, for all 38 children aged ≥ 1 year are shown in Table 5.

Table 5. Fluid administration in children aged ≥ 1 year

Variable	No. (%)*
Total patients†	38 (53%)
Male	22 (58%)
Median ICU length of stay up to and including day of study, days (IQR)	1 (1–2)
Resuscitation fluid	6 (16%)
Median amount of resuscitation fluid, mL (IQR)	233 (88–623)
Maintenance fluid	19 (50%)
Median amount of maintenance fluid, mL (IQR)	402 (192–560)
Fluids as drug vehicles (infusions and boluses)	25 (66%)
Median amount of fluids as drug vehicles, mL (IQR)	67 (38–239)
Indwelling arterial flush-based catheter	11 (29%)
Indwelling central venous flush-based catheter	6 (16%)
Predominant oral feeds	11 (29%)
Enteral feeds	26 (68%)
Median amount of enteral feed, mL (IQR)	750 (444–982)
Total parenteral nutrition	1 (3%)‡
Median total fluid administered on study day, mL/kg (IQR)	62 (40–86)
Median total urine output on study day, mL/kg (IQR)	41 (24–74)
Median total fluid balance on study day, mL/kg (IQR)	10 (–9 to 25)

ICU = intensive care unit. IQR = interquartile range. * Unless otherwise indicated. † Full 24-hour ICU chart was available for 30 patients (79%); for the remainder, an ICU chart was available for a median of 12 hours (IQR, 8–14). ‡ Amount of total parenteral nutrition in this one patient was 175 mL.

Children aged 1 year or older who received maintenance fluid

Details of all fluid administration to children ≥ 1 year of age who received MFT on the study day (*n* = 19) are shown in Table 6. The median amount of MFT administered was 402 mL (IQR, 192–560) (median, 18 mL/kg; IQR, 9–37). Five children (26%) also received fluid resuscitation on the study day. The median amount of fluid resuscitation received was 233 mL (IQR, 88–623) (14 mL/kg). Drug boluses and infusions accounted for a median of 105 mL (IQR, 47–293) (6 mL/kg) of fluid. Seven (37%) and four (21%) children had an indwelling arterial and central venous flush-based line, respectively, in place on the study day. These flush-based lines contribute 1 mL/h to the patients, so about 24 mL of fluid per line was administered as flushes, accounting for a median of 0 mL/kg (IQR, 0–2) of administered fluid. Among the 19 children receiving maintenance fluids, 11 (58%) also received enteral nutrition (median, 560 mL; IQR,

Table 6. Fluid administration in children aged ≥ 1 year receiving maintenance fluids (*n* = 19)

Variable	No. (%)*
Median amount of maintenance fluid, mL; mL/kg (IQR)	402 (192–560); 18 (9–37)
Resuscitation fluid	5 (26%)
Median amount of resuscitation fluid, mL (IQR)	233 (88–623)
Median amount of fluids as drug vehicles, mL (IQR)	105 (47–293)
Indwelling arterial flush-based catheter	7 (37%)
Indwelling central venous flush-based catheter	4 (21%)
Predominant oral feeds	7 (37%)
Enteral feeds	11 (58%)
Median amount of enteral feed, mL (IQR)	560 (400–1092)
Median maintenance fluid as proportion of total administered fluid (IQR)	33% (17%–69%)
Median total fluid administered on study day, mL/kg (IQR)	58 (40–85)
Median total urine output on study day, mL/kg (IQR)	39 (25–69)
Median total fluid balance on study day, mL/kg (IQR)	11 (–11 to 26)

IQR = interquartile range. * Unless otherwise indicated.

400–1092) on the study day. Seven children (37%) received a predominantly oral diet. Overall, children ≥ 1 year of age who received MFT were also administered an additional median amount of 773 mL (IQR, 389–1059) (median, 39 mL/kg; IQR, 25–53) of fluid and nutrition from other sources. Intravenous MFT contributed 33% (IQR, 17%–69%) of the total amount of daily fluid intake (Table 6).

Fluid administration compared with data from 2011

Between 2011 and 2014, there was no significant change in the proportion of patients receiving maintenance fluids or resuscitation fluids. There was also no difference in the total amount of fluid administered or fluid balance during this period (Table 7). There was no significant change in the median volume of maintenance fluid administered to patients between 2011 and 2014. Use of 0.9% saline remained high, while use of balanced salt solutions remained low (Table 7).

Discussion

This point prevalence study found that MFT was used in 53% of infants and children in ICUs in Australia and New Zealand. This is similar to a previously reported prevalence in the same population.[2] We have shown that these findings did not change between the two time points 3 years apart and that isotonic fluid remains most often used. Infants and children were administered maintenance fluids in addition to fluids from other sources, such as resuscitation fluids, fluids used as vehicles for drug infusions, drug boluses, intravenous flushes and feeds. MFT contributes about a third of total fluid intake in all critically ill children. Our study also found a similar median positive fluid balance in infants and children for both time points.

Table 7. Comparison of maintenance fluid types in 2011 and 2014*

Variable	2011	2014	P
Total patients receiving maintenance fluids	34 (52%)	38 (53%)	1.00
Total patients receiving resuscitation fluids	16 (25%)	14 (19%)	0.53
Median amount of maintenance fluid, mL (IQR)	305 (106–625)	193 (95–415)	0.40
Median maintenance fluid as proportion of total administered fluid (IQR)	41% (16%–62%)	32% (16%–61%)	0.68
Median fluid administered, mL/kg (IQR)	81 (50–111)	76 (46–102)	0.65
Median fluid balance, mL/kg (IQR)	9 (–1 to 41)	11 (–7 to 30)	0.35
Maintenance fluid types			
Isotonic fluids			0.27
0.9% saline	8	10	
Balanced salt solutions†	2	2	
5% glucose + saline	6	3	
10% glucose + saline	5	12	
2.5% glucose + saline	5	11	
Hypotonic fluids			0.19
5% or 10% glucose	1	2	
4% glucose + 1/5 saline	2	1	
0.45% saline	4	1	
Hypertonic saline	2	3	1.00

IQR = interquartile range. * Some patients received more than one type of maintenance fluid on the study day. † Hartmann's solution or Plasma-Lyte 148.

Fluid balance

At both time points examined in this and the previous study, infants and children were found to be in positive fluid balance, with MFT contributing about 30% of daily fluid administration in children who received MFT. This represents a potential area of intervention to optimise fluid balance in the ICU. The relationship between positive fluid balance, impaired respiratory mechanics and mortality in both children and adults in critical care is concerning.[22-28] In a large randomised study of goal-directed therapy in adults, nearly 50% of patients remained fluid-overloaded by Day 3, almost doubling the odds of medical interventions such as diuresis and thoracocentesis and, critically, death.[27] Similarly, critically ill Finnish patients who were fluid-overloaded at commencement of continuous renal replacement therapy (CRRT) had double the mortality.[29] An association between the presence of fluid overload and increased risk of death or impaired lung function has been shown in children in PICUs,[22] on extracorporeal membrane oxygenation[30] or CRRT,[31] after congenital heart disease surgery[32,33] and with acute lung injury;[28] and in adults after cardiac surgery.[34] MFT has been a fundamental therapy consistently administered to fasted or unwell hospitalised children for decades. Original estimates of fluid requirement were based on estimated energy expenditure.[1] For the critically unwell child, however, the combination of pathophysiological responses to illness, fluid resuscitation and antidiuretic hormone secretion, combined with the complexities of assessing hydration status or intravascular volume, renders this approach inadequate for estimating the need for fluid therapy. In this context, the merit of MFT is questionable and it is reasonable to believe that it may contribute to undesirable consequences for organ function and patient-centred outcomes.

Fluid tonicity and composition

In addition to fluid volume, hypotonicity contributes to adverse events in hospitalised paediatric patients. Prevalence of hypotonic fluid use has previously been described.[2] However, we found that use of hypotonic fluids remains uncommon, with most MFT administered as isotonic fluid, most often as 0.9% saline, sometimes with glucose added. This is in keeping with recommendations from randomised controlled studies and meta-analyses comparing fluid tonicity in hospitalised children, including children in intensive care, which have shown that isotonic saline reduces the risk of hyponatraemia by about half when compared with hypotonic saline.[5,19,35-37]

We found that only four of 72 patients (5%) were administered a balanced salt solution (Hartmann's solution or Plasma-Lyte 148) during the two time points. Balanced crystalloid solutions improve acid–base balance and may reduce renal injury in critically ill adults,[38,39] and they have gained popularity in adult practice as concerns emerge about the biochemical and renal perfusion effects of saline.[40] In a heterogeneous adult intensive care population, however, Plasma-Lyte 148, when compared with 0.9% saline, did not alter rates of kidney injury or mortality.[41] Administration of 0.9% saline is recognised as a continuing cause of acidosis in resuscitated children[42] and can lead to high levels of administered sodium in critically ill children.[2] It therefore seems physiologically appropriate to consider buffered isotonic solutions for children, as well as adults, in intensive care.

Nutrition

In this study, up to three-quarters of patients were receiving some enteral feeds, yet only 12% of infants and 29% of children aged ≥ 1 year were receiving predominantly enteral feeds. Parenteral nutrition was administered in 15% and 3% of infants and children aged ≥ 1 year, respectively. This feeding status may be explained by the fact that 19% of the population had been admitted from the operating theatre, but it does suggest that few patients were receiving optimal daily nutrition. This is in keeping with previous observational studies of nutritional intake in similar populations.[43,44]

Strengths and limitations

The strengths of this study are that it examined contemporary practices of MFT in children in all the major PICUs in Australia and New Zealand, and it describes MFT as a proportion of total daily fluid administration in addition to total fluid balance.

A limitation is that the sample comprised a relatively small number of heterogeneous patients in terms of age and clinical features. Although we attempted to group the population based on age, we recognise that younger children represent a different spectrum of physiological development and ontogeny of fluid homeostasis. In addition, the casemix of patients included elective surgical, cardiac surgical and medical patients, with just under half requiring mechanical ventilation. Data were available for less than 24 hours for a proportion of patients because of the methods of the Point Prevalence Program.[45]

Conclusion

Over half the children in Australian and New Zealand PICUs receive MFT, which is almost exclusively administered as isotonic solutions, and this contributes about a third of total daily fluid administration. Future studies should examine the role of MFT in contemporary practice, and clinical trials of conservative fluid resuscitation strategies may be enhanced by considering the contribution of maintenance fluids to fluid overload.

Competing interests

None declared.

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Appendix

This appendix was part of the submitted manuscript and has been peer reviewed. It is posted as supplied by the authors.

Point Prevalence Study Day: 24th September and 22 October 2014

Intensive Care Unit	Principal Investigator/s	Research Co-ordinator/s
John Hunter Hospital	Peter Harrigan	Miranda Hardie
Royal Darwin Hospital	Dianne Stephens	Jane Thomas
Middlemore Hospital	Tony Williams	Anna Tilsley
Waikato	Annette Forrest	Mary La Pine John Durning
Mackay Base Hospital	Neeraj Bhadange	
Royal Children's Hospital, Brisbane	Anthony Slater	Debbie Long Tara Williams
Princess Margaret Hospital for Children	Simon Erickson	
Starship Children's Hospital	John Beca	Claire Sherring
Royal Children's Hospital, Melbourne	Warwick Butt	Carmel Delzoppo
Sydney Children's Hospital	Mary Lou Morritt Gary Williams	Janelle Young
Mater Health Services	Andreas Schibler	Michelle Cauz