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Fluid management and active fluid removal practices: a global survey of paediatric critical care physicians

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Abstract

Aims Fluid accumulation (FA) in critically ill children is associated with poor clinical outcomes. While conservative fluid management has been proposed, evidence to guide practice is scarce. We surveyed paediatric critical care (PCC) physicians worldwide regarding their perceptions of FA, active fluid removal (AFR) practices, safety parameters, and willingness to participate in a clinical trial on the topic.

Methods Cross-sectional international electronic survey of PCC physicians, distributed through research networks worldwide.

Results A total of 409 PCC physicians from 48 countries participated in the survey; 40% (164/409) cared for cardiac patients. The majority believed FA was a modifiable source of morbidity (88%, 359/407) and expressed support for a trial on conservative fluid management trial (94%, 383/407). Restriction of maintenance fluid was more commonly practiced (87%, 335/387) than resuscitation fluid (54%, 210/387), with variability observed among individuals and patient categories. AFR was widely practiced (93%, 361/387), yet significant differences existed in patient selection, timing, modality, and rate. The most common reported time for starting AFR was 48 h (49%, 172/384), with most respondents (92%, 355/385) comfortable doing so in the setting of catecholamine infusions. While most respondents would continue diuretics with mild electrolyte or acid–base disturbances, 52% (179/342) would withhold them in cases of mild hypotension.

Conclusions Fluid accumulation remains a significant concern among paediatric intensivists. The observed practice variability underscores the challenges in establishing evidence-based guidelines. Our survey highlights an urgent need for randomized trials in this field and provides valuable insights to inform the design of such future studies.

Keywords Fluid therapy, Diuretics, Water-electrolyte balance, Children, Critical illness

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Introduction

Fluid management remains a controversial topic in paediatric critical care [1, 2]. During resuscitation, critically ill children often receive high volumes of rapid intravenous fluid (boluses) with the aim of improving cardiac output. Following resuscitation, fluid administration continues in PICU in the form of maintenance fluids, nutrition, drug diluents, or blood products [3]. This fluid administration, coupled with increased endothelial permeability and reduced urine output secondary to endocrine and renal factors of critical illness, invariably leads to fluid accumulation (FA) [4, 5].

Observational studies consistently link FA with poor clinical outcomes, including mortality, across both paediatric and adult populations [6–9]. Therefore, there is a compelling rationale for conducting randomized clinical trials (RCTs) on conservative approaches to fluid administration. While a conservative fluid resuscitation strategy has shown a survival benefit in East-African children with shock [10], its efficacy in other paediatric settings has not been consistently replicated [11–13]. Moreover, adult trials have failed to demonstrate definitive benefit or harm [14]. Furthermore, conservative post-resuscitation fluid management in clinical practice poses challenges and is unlikely to be sufficient alone to prevent FA [15].

Consequently, active fluid removal (AFR) using diuretics and/or renal replacement therapies (RRT) is often employed as a complementary strategy. Adult data suggest that this approach, also known as *de-escalation or de-resuscitation* [16], may reduce the duration of mechanical ventilation, ICU stay, and even mortality [17], although potential long-term cognitive effects have been suggested [18]. In critically ill children, the impact of AFR on outcomes remains largely unknown. Factors such as patient selection, timing, modality, rate, and extent of AFR are likely crucial, yet specific evidence to inform clinical practice is lacking [19].

While several paediatric surveys have assessed various aspects of fluid management in critical care, focusing on maintenance, resuscitation, and replacement fluids [20–23], none have specifically addressed the role of AFR for FA prevention and treatment. Thus, to elucidate current practices and inform the design of future RCTs, we conducted a global survey of paediatric critical care (PCC) physicians. Our objectives were to describe the perceptions and approaches to FA and AFR, evaluate the acceptability of different AFR approaches, determine acceptable safety parameters, and assess paediatric intensivists' willingness to participate in clinical trials of this topic.

Methods

Study design

This was a cross-sectional electronic survey study of PCC physicians working in a PICU at attending (or consultant) level worldwide. The survey was endorsed by the following scientific societies: UK Paediatric Critical Care Society (PCCS); Australian and New Zealand Intensive Care Society Paediatric Study Group (ANZICS PSG); European Society Paediatric & Neonatal Intensive Care (ESPNIC); Pediatric Acute Lung Injury and Sepsis Investigators Network (PALISI); Pediatric Acute and Critical Care Medicine Asian Network (PACCMAN); Latin American Society of Pediatric Intensive Care (SLACIP) and World Federation of Pediatric Intensive & Critical Care Societies (WFPICCS). The study received ethical approval from The University of Queensland, Australia (2022/HE001836). All procedures were followed in accordance with the Helsinki Declaration of 1975.

Questionnaire development and content

Following a literature review [20–25], we adapted the questionnaire used in this study from a previous survey conducted among adult intensivists in the UK and Canada [26]. The survey underwent content-validation by an international expert panel comprising six members and was piloted on three PCC physicians with varying experience to ensure face-validity. Based on the feedback received, the final survey was refined and implemented in the REDCap secure web application, hosted by the University of Queensland [27, 28].

The questionnaire was initially developed in English and subsequently translated into Spanish, with forward and back translation testing and validation. Respondents were given the option to answer in either language.

Comprising 30 questions divided into six sections, the final survey covered demographics, attitudinal, self-reported practice, and safety parameters questions, along with clinical scenarios and feedback. The survey utilized multiple-choice questions, Likert scales and free-text responses. A response to each question was required to proceed to the following one.

FA was defined as a positive fluid balance with peripheral oedema, while AFR was defined as the strategy to achieve a negative fluid balance using diuretics and/or RRT. The full questionnaire is available in the Supplementary Material.

Survey distribution and data collection

The web-based survey was electronically distributed worldwide to members of the scientific societies mentioned above, as well as the Spanish Society of Paediatric Intensive Care (SECIP), the Indian Academy of

Paediatrics- Intensive Care Chapter (IAP) and a distribution list of Middle East paediatric intensivists. Two subsequent reminders were sent at days 14 and 21 from the initial distribution date. Data collection took place between October 2022 and April 2023. Before accessing the survey, respondents were required to confirm their status as a consultant (attending physician). Participation was voluntary, and completion of the survey implied consent for participation. The survey was anonymous, although participants had the option to provide comments and personal information not linked to their responses. There was no restriction on the number of respondents per centre. Survey responses were securely stored within the REDCap study database.

Statistical analysis

Categorical variables were presented as number and proportion; where there was missing data, the denominator is also shown. Data from Likert scales were enumerated as ordinal data ranging from 1 to 5. Responses to selected questions are presented by respondent working in a non-cardiac vs cardiac [dedicated cardiac and mixed (general and cardiac)] unit; as the study was not powered to assess differences, *p*-values are not reported for such comparisons. Free-text responses were allocated to themes when possible and presented descriptively. Statistical analysis was performed using Stata v16.0 (StataCorp Pty Ltd, College Station, Texas).

Results

Demographics

The survey was distributed across five continents through nine scientific societies, resulting in 679 responses from 48 countries. Of these, 409 (60%) provided a response to at least one clinical question and were included in the final analysis. There were unknown numbers of non-physicians on several email distribution lists, and recipients may have received invitation emails through multiple distribution lists.

Table 1 summarizes the demographic characteristics of the respondents. Most participants had a paediatric training background (392; 96%), with over 10 years of professional experience (246; 60%),and worked in general PICUs (232; 55%). The countries with the largest number of respondents were USA (113; 28%), United Kingdom (69; 16.9%) and India (53; 13%). Spanish-speaking countries contributed 92 (23%) responses, and a total of 72 (18%) responses were from lower-middle or low-income countries [29] (Supplementary Table 1).

Table 1 Characteristics of survey respondents (*N* = 409)

	n	%
Training background:		
Pediatrics	392	95.8
Anesthesia	7	1.7
Adult Critical Care	4	1
Other[a]:	6	1.5
Country[b]		
United States of America	113	27.6
United Kingdom	69	16.9
India	53	13.0
Spain	31	7.6
Australia	25	6.1
Colombia	17	4.2
Argentina	14	3.4
Uruguay	12	2.9
Years of experience:		
< 5 years	61	14.9
5–10 years	102	24.9
11–20 years	144	35.2
> 20 years	102	24.9
Type of PICU[b]:		
General	232	55.0
Dedicated cardiac	23	5.6
Mixed (general and cardiac)	141	33.5
Other[c]:	13	3.3

PICU Pediatric Intensive Care Unit

[a] Other: Anesthesia and Adult Crit Care *N* = 1; Anesthesia and Pediatrics *N* = 1; Pediatric and Adult Crit Care *N* = 2; Pediatric Cardiology and Pediatric Crit Care *N* = 1; Pediatric Oncology and Pediatric Crit Care *N* = 1

[b] Countries with > 10 respondents presented; full listing of respondent's countries available in Supplementary Table 1

[c] Other: Oncologic PICU *N* = 6; Mixed (pediatric and adult) *N* = 4; Mixed (pediatric and neonatal) *N* = 2; Neonatal ICU *N* = 1

Attitudinal questions

Figure 1 provides an overview of paediatric intensivists' perceptions regarding FA in clinical practice. Most respondents agreed that FA is a modifiable consequence of fluid administration from various sources (370/408, 91%), as well as a modifiable cause of morbidity (359/407, 88%). Additionally, a significant number (293/403, 73%) believed FA leads to prolonged respiratory support. Other reported morbidities associated with FA included abdominal compartmental syndrome and kidney injury, congestive heart failure, feeding intolerance, poor wound healing, difficult iv access, cerebral oedema, increased risk of infection, prolonged PICU and hospital stays, and mortality. Importantly, only a small fraction respondents considered FA to be benign (20/408, 5%).

A large majority of participants recognized the importance of studying whether AFR in critically ill children with FA improves patient outcomes (331/406, 82%), and expressed willingness to participate in a

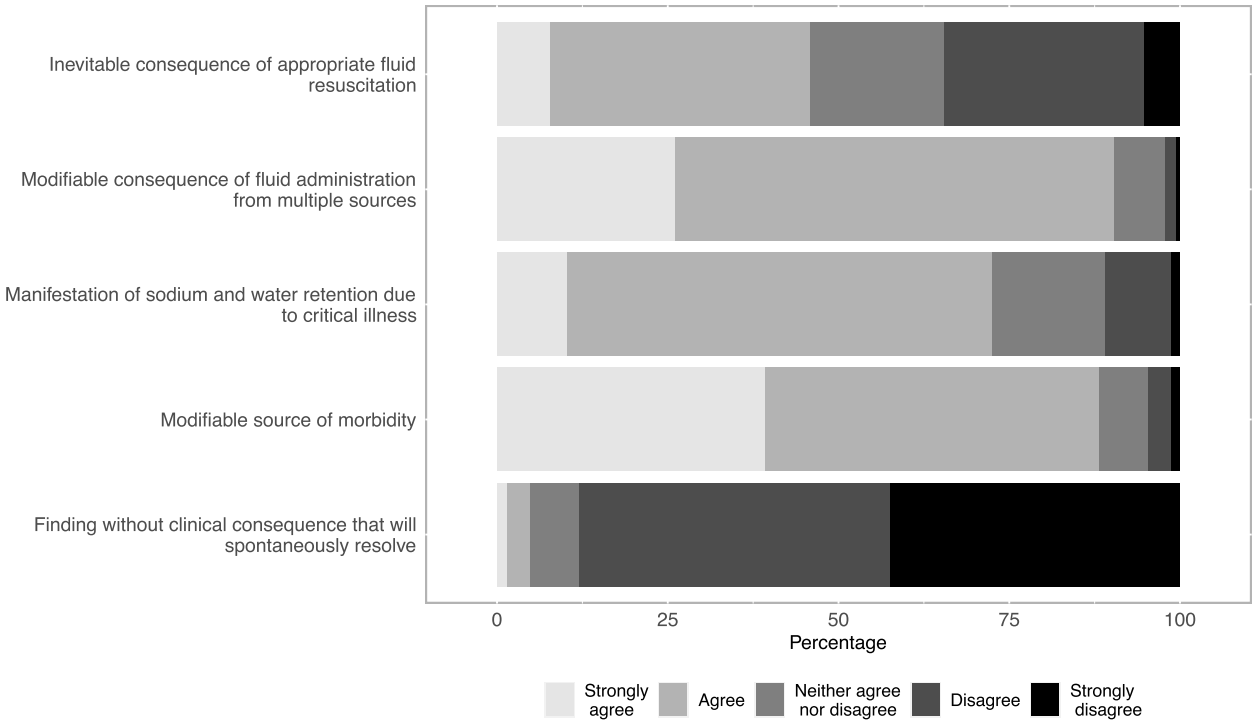

Fig. 1 Perceptions of fluid accumulation

RCT to address this knowledge gap (yes would enrol, 307/407, 75%; may enrol, 76/407, 19%) (Supplementary Table 2). Some concerns raised about the design of a future RCT related to the definition of the control arm, the need for individualization of patient management, and the timing of the intervention.

Self-reported practice

Table 2 summarizes respondents' self-reported practices regarding FA and AFR presented by respondent working in a non-cardiac vs cardiac [dedicated cardiac and mixed (general and cardiac)] unit. Supplementary Tables 3 and 4 present data categorized by respondents' years of professional experience and world region, respectively.

Most respondents (346/387, 89%) described FA as a common occurrence in their clinical practice. Among the various preventative and treatment strategies reported, the most common was AFR with diuretic administration (361/387, 93%), followed by conservative fluid administration with restriction or avoidance of maintenance fluid (335/387, 87%). Additionally, approximately half of the respondents reported using minimization of resuscitation fluid (210/387, 54%) and AFR with RRT (213/387, 55%) as additional strategies to prevent or treat FA.

Conservative fluid administration

To gain insight into fluid restriction practices, respondents were asked to specify the percentage of total daily fluid intake (calculated using the Holliday-Segar formula [30]) they would prescribe for four hypothetical patients on invasive ventilation: a 6 month-old infant with bronchiolitis, a postoperative cardiac neonate, a child with neurosurgical condition, and a child with septic shock. Figure 2 illustrates that respondents tended to be generally conservative with the postoperative cardiac patient and liberal with the patient in septic shock, albeit with considerable variation in practice. Interestingly, the introduction of enteral feeding did not appear to result in a clear increase in the total daily fluid intake allowance. Between 9–18% of respondents indicated they would not restrict fluid intake under any circumstance.

Regarding parenteral nutrition, 137/385 (36%) respondents reported usually or always restricting parenteral nutrition to achieve their daily fluid target allowance, while 79/385 (20.5%) reported doing so rarely or never.

Active fluid removal

As indicated in Table 2, more than half of the respondents (223/385, 58%) estimated that on a standard working day in the PICU, at least half of their patients receive diuretics to treat FA. Additionally, most respondents

Table 2 Self-reported practice, presented by respondents working in non-cardiac and cardiac[a] units

	Non-Cardiac		Cardiac[a]		Total	
	n	%	n	%	n	%
Q10.Is FA (defined as a positive fluid balance with peripheral oedema) a common occurrence in your PICU?	*N* = 230		*N* = 157		*N* = 387	
Yes	203	88.3	143	91.1	346	89.4
No	24	10.4	11	7.0	35	9.0
Not sure	3	1.3	3	1.9	6	1.6
Q11.What strategies do you use to manage FA?	*N* = 230		*N* = 157		*N* = 387	
Minimisation of resuscitation fluid	119	51.7	91	58.0	210	54.3
Restriction or avoidance of maintenance fluid	199	86.5	136	86.6	335	86.6
Minimisation of drug diluents and/or intravenous flushes as per PICU protocol	165	71.7	115	73.5	280	72.4
Use of diuretics to prevent or treat FA	208	90.4	153	97.5	361	93.3
Use of RRT to prevent or treat FA	105	45.7	108	68.8	213	55.0
None of the above; I do not consider FA to be a problem	2	0.9	1	0.6	3	0.8
Q15.How many patients in your PICU are receiving diuretics to treat FA on a standard morning round?	*N* = 228		*N* = 157		*N* = 385	
All or almost all patients (≥ 75%)	25	11.0	46	29.3	71	18.4
Some patients (≥ 50 to 75%)	86	37.7	66	42.0	152	39.5
A few patients (≥ 25 to 50%)	93	40.8	41	26.1	134	34.8
None or almost none of the patients (< 25%)	24	10.5	4	2.6	28	7.3
Q18.What is your first line approach to AFR?	*N* = 229		*N* = 156		*N* = 385	
Intermittent loop diuretic, enteral	14	6.1	8	5.1	22	5.7
Intermittent loop diuretic, intravenous	173	75.6	105	67.3	278	72.2
Infusion of loop diuretic	21	9.2	22	4.1	43	11.2
Initial bolus dose of loop diuretic followed by infusion	12	5.2	17	10.9	29	7.5
Removal by RRT	0		2	1.3	2	0.5
Other[b]	9	3.9	2	1.3	11	2.9
Q17.What day after PICU admission do you most commonly start AFR?	*N* = 228		*N* = 156		*N* = 384	
Within the first day of PICU admission (Day 0)	13	5.7	9	5.8	22	5.7
Day 1	49	21.5	63	40.4	112	29.2
Day 2	111	48.7	61	39.1	172	44.8
Day 3 or beyond	55	24.1	23	14.7	78	20.3
Q21a.Do you ever start vasoactive drugs to spare fluid administration?	162 *(N = 229)*	70.7	132 *(N = 156)*	84.6	294 *(N = 385)*	76.4
Q21b.Do you ever start vasoactive drugs to faciliate fluid removal?	142 *(N = 229)*	62.0	128 *(N = 156)*	82.1	270 *(N = 385)*	70.1
Q20.If a patient is on adrenaline or noradrenaline infusion, would you be comfortable to administer diuretics for AFR?	*N* = 229		*N* = 156		*N* = 385	
No	25	10.9	5	3.2	30	7.8
Yes, if dose is ≤ 0.1 mcg/kg/min	82	35.8	65	41.7	147	38.2
Yes, if dose is ≤ 0.2 mcg/kg/min	27	11.8	11	7.1	38	9.9
Yes, no absolute maximum dose	95	41.5	75	48.1	170	44.2

FA fluid accumulation, *RRT* Renal replacement therapy, *AFR* active fluid removal

[a] Cardiac units: respondent working in a dedicated cardiac or mixed (general and cardiac) unit

[b] Other: Variable depending on patient's hemodynamic status, age, or presence of acute kidney injury *N* = 5, fluid restriction *N* = 3, passive mobilization *N* = 1, optimisation of serum oncotic load *N* = 1, intermittent loop diuretic with spironolactone *N* = 1

(172/384, 45%) typically initiate AFR from 48 h of PICU admission, although many noted that timing is highly individualized and dependent on disease process and hemodynamic stability. The three most important clinical parameters considered by respondents in their decision to initiate AFR were signs of pulmonary congestion on lung imaging, ongoing need for respiratory support, and the resolution of the underlying pathology (Supplementary Table 5). Intermittent bolus doses of intravenous loop diuretics (278/385, 72%) were the most common

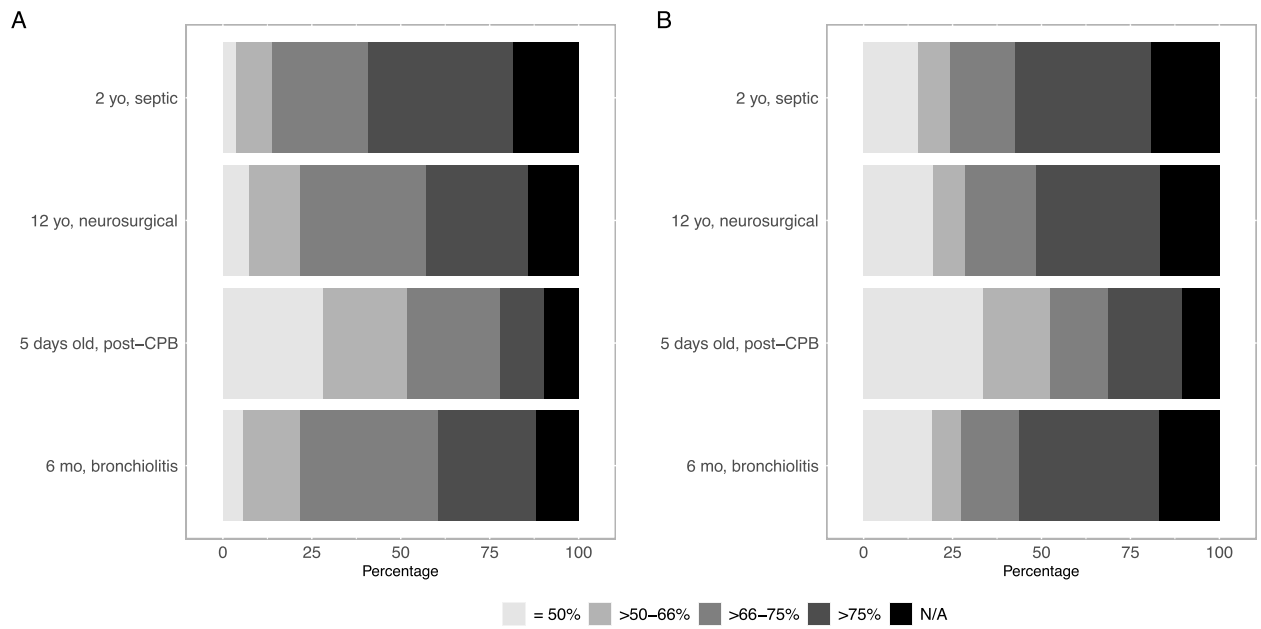

Fig. 2 Proportion of preferred daily total fluid restriction based on the Holiday and Segar formula for four hypothetical categories of invasively ventilated patients. **A** Assumes patients are not receiving enteral feeds (nil by mouth) (*N* = 377); **B** Assumes patients are receiving enteral feeds (*N* = 376)

initial approach to AFR, with potassium-sparing agents being the most frequently used adjunct agent (always or frequently, 146/385, 37.9%). Most respondents (355/385, 92.2%) reported being comfortable with administering diuretics for AFR to patients receiving continuous infusions of catecholamines, with almost half (170/385, 44%) reporting no dose ceiling above which they would consider diuretics contraindicated.

Clinical scenarios

Survey participants were presented with two clinical scenarios designed to further explore fluid management and AFR practices.

The first scenario described a 13-year-old following abdominal surgery with overt FA and abnormal haemodynamics. Despite enteral feeding being advanced, only one-third of respondents (117/349, 34%) indicated they would discontinue intravenous maintenance fluids (Fig. 3). Moreover, after an inadequate response to an initial furosemide bolus, although many respondents (233/347, 67%) were inclined to start a continuous infusion of furosemide, there was no clear consensus on the preferred method of diuretic administration (Supplementary Fig. 1).

The second scenario involved a neonate post-cardiac surgery with acute kidney injury and associated FA. Respondents were asked to consider the use of diuretics or RRT for AFR. While most respondents (very likely/likely 233/345, 68%) favoured diuretics, 208/345 (60%) also opted for peritoneal dialysis, and 39.7% (54/345 very likely; 83/345 likely) for continuous veno-venous hemofiltration (CVVH). The maximum doses of furosemide used in this scenario varied widely, ranging from < 0.5 to > 5 mg/kg/dose as intermittent boluses, and from < 0.1 to > 5 mg/kg/h as a continuous infusion (Supplementary Table 6). Respondents also demonstrated significant variability in the negative fluid balance they aimed for over the next 24 h (Supplementary Fig. 2).

Safety aspects

Clinical responses to possible side effects of diuretic therapy are presented in Supplementary Table 7. Most respondents indicated a willingness to continue diuretics with close monitoring in cases of mild electrolyte disturbances or metabolic alkalosis. However, in the event of mild hypotension (MAP < 25th percentile of normal), over half of the respondents (179/342, 52%) would temporarily withhold AFR. Other potential areas of concern included worsening renal function (97/324, 30%), cardiovascular compromise including hypovolemia and hypotension (69/324, 21%), more severe or other electrolyte disturbances such as hypomagnesemia or hypocalcaemia (72/324, 22%), and ototoxicity (N 29/324, 9%).

Discussion

This global survey provided insights into the perceptions and practices of paediatric intensivists worldwide regarding FA and AFR strategies. The findings suggest that FA

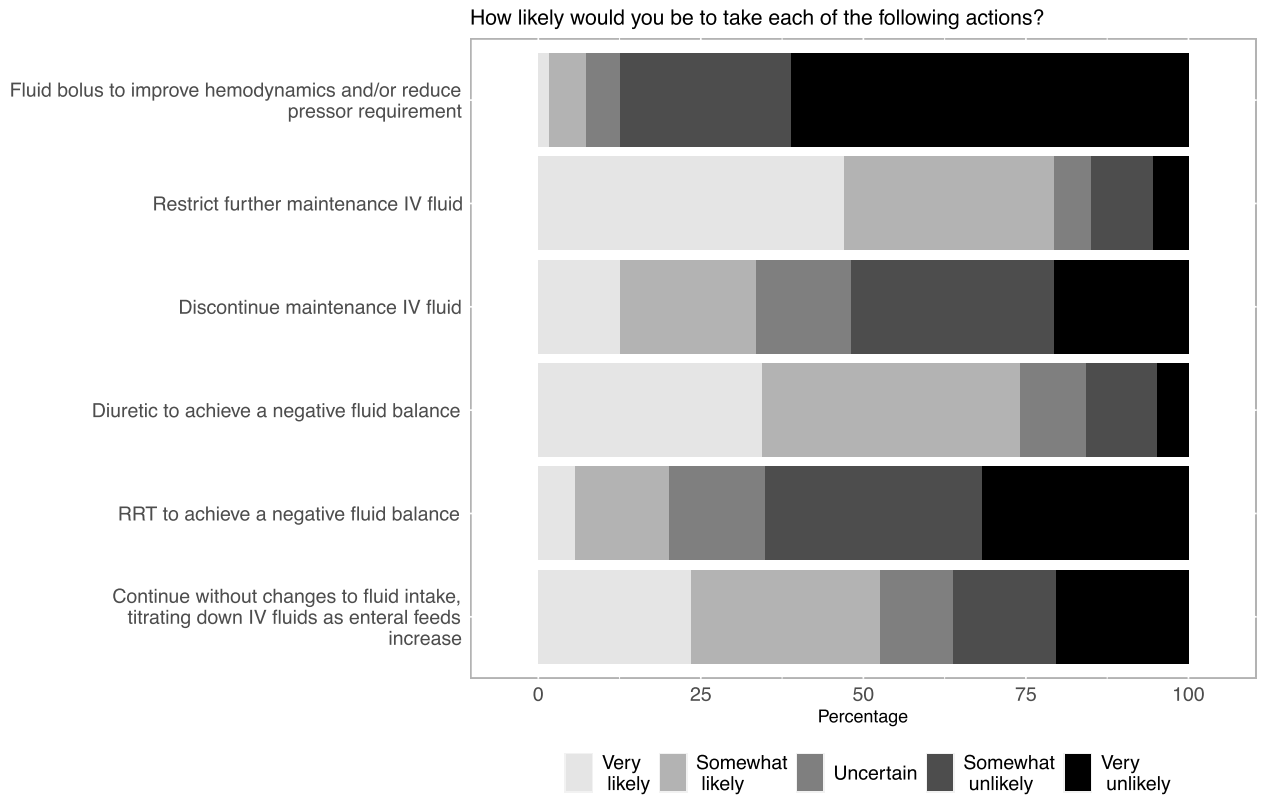

Fig. 3 Clinical scenario 1. A 13-year-old boy, 40 kg, was admitted 5 days ago post-laparotomy for midgut volvulus. During the first 48 h in PICU, he received over 100 ml/kg of fluid boluses and infusion of vasoactive drugs due to shock. On morning rounds, he remains intubated and ventilated (FiO2 = 0.5, PEEP = 8; SpO2 = 97%). His heart rate is 118 bpm and blood pressure is 95/50 mmHg (MAP 65) on noradrenaline (norepinephrine) at 0.1 ug/kg/min, CVP = 12 mmHg and serum lactate = 1.6 mmol/L. His creatinine is 50 umol/L (0.57 mg/dL), and urine output is 20–40 ml/hr. His temperature reached 38.3 degrees Celsius (101 degrees Fahrenheit) overnight. He is diffusely oedematous, and his cumulative fluid balance is + 4 L since PICU admission. Enteral feeding is slowly being advanced. He is currently receiving 20 ml/hour of enteral feeds and 40 ml/hour of a crystalloid as maintenance fluid. How likely would you be to take each of the following actions

is widely recognized as a major modifiable source of morbidity in critically ill children. While fluid restriction and diuretics are commonly used, substantial practice variability exists in patient selection, timings, modes, or therapeutic targets. Importantly, there is widespread recognition of conservative fluid management as an important research topic, with strong support for RCTs to elucidate its impact on clinical outcomes.

Several prior surveys have explored other aspects of iv fluid therapy in critically ill children, echoing findings similar to ours [20–23]. These include wide heterogeneity in practices, a lack of evidence-based guidelines, and a recognized need for RCTs. Despite the consistent message emphasizing fluid management as a top research priority [1, 2], only a few small-scale paediatric RCTs comparing restrictive versus liberal fluid strategies have been conducted [31, 32] since the landmark FEAST trial over a decade ago [10]. Identifying optimal indications, timing, thresholds, and therapeutic targets for preventing and/or treating FA in a RCT setting is challenging. Moreover, the limited efficacy of restrictive strategies alone in preventing FA, as demonstrated in both paediatric and adult feasibility trials [15, 33], underscores the importance of incorporating an AFR strategy to protocolized fluid restriction in an optimal conservative fluid management intervention.

Restriction of maintenance fluid in mechanically ventilated patients was a prevalent practice among our survey respondents (85%). In our clinical scenarios, however, the extent of restriction applied varied among individuals and across different patient categories, underscoring the lack of evidence-based guidelines [34]. Concerns about hypoglycaemia, may explain why discontinuation of all intravenous maintenance fluid was infrequent among our respondents, even in the context of evident FA in an older child. Additionally, 75% of our respondents reported restricting parenteral nutrition to achieve the fluid balance target at least occasionally. Notably, a prior survey revealed that 45% of respondents strongly agreed with reducing energy requirements to maintain a satisfactory

fluid balance [20]. However, whether a conservative fluid strategy should limit nutrition volume remains unclear. Future fluid trials will need to consider adequate delivery of nutrition as an important co-intervention.

AFR was also highly prevalent among our survey respondents, with diuretics being the most used strategy (93%) to treat FA while RRT, was utilized by 55%. Despite the threshold and timing for fluid AFR were considered critical decisions to be individualized, approximately 75% of respondents reported a general practice of initiating AFR between day 1 and 2 of admission. Interestingly, a recent secondary analysis of the AWARE study identified FA ≥ 5% and 10% by the end of PICU Day 1 and PICU Day 2 respectively as critical combinations associated with adverse outcomes, supporting an early intervention as reported by participants in our survey [35]. Although many respondents highlighted stabilization of haemodynamics as the tipping point for starting AFR, a large majority were comfortable initiating diuretics in the presence of vasoactive support. Concerns were raised, however, about potential cardiovascular compromise related to AFR strategies, despite evidence to date does not support it [18, 33]. Furthermore, concerns around renal dysfunction due to AFR persist despite evidence and physiological rationale for safety and possible benefit [36, 37]. Importantly, our second case scenario highlighted significant practice variability in determining the rate for AFR during RRT, ranging from neutral to negative 100 ml/kg per day. While this aligns with adult practice [38], recent epidemiological studies have indicated that moderate net ultrafiltration rates of 1.01–1.75 ml/kg/hour are associated with the lowest mortality [39]. Lastly, despite the well-recognized self-reporting bias of survey studies, the perception of some of AFR as standard of care may be a challenge in defining the intervention to be tested in a trial. Addressing these issues will be key to the success of future trials.

Our study has several limitations. Firstly, despite the large number of responses and participating countries, the estimated survey response rate was low and skewed towards the USA and UK. Secondly, as participation was voluntary, our study population may have been biased towards individuals with greater interest and stronger views on the topic. Thirdly, the survey was available only in English and Spanish. All these factors likely introduced a selection bias and affect the generalizability of our results. Fourthly, it is unclear how health-care systems influenced the responses, as responses were received globally, and significant proportion of respondents reported not using any RRT modality. Fifthly, when inquiring about fluid restriction for different patient groups, the concept of total daily fluid intake allowance was not defined and might have been interpreted differently by different responders. Sixthly, one of the clinical scenarios presented a cardiac patient, while a significant percentage of respondents reported working in a general unit. Lastly, as with all surveys, reported practice may differ from actual practice. Nevertheless, survey results underscore wide variability in clinical practice in the absence of evidence, highlighting the need for trials to address this important question of high interest to the PICU community.

Conclusions

Paediatric intensivists worldwide perceived FA as a common and modifiable source of morbidity and mortality in critically ill children. While conservative fluid administration is frequently employed to prevent FA, the extent of restriction varies greatly among individuals and patient categories. Additionally, AFR is a prevalent strategy to manage FA, but its implementation varies widely in terms of patient selection, timing, modality, and rate. Clinicians strongly advocate for randomized trials to address the uncertainties surrounding FA, and our study provides valuable insights to inform the design of future trials.

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1007/s44253-024-00038-1.

Supplementary Material 1.

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Code availability
Not applicable.

Authors' contributions
The study was initially conceived and designed by AA, JAS and PR. Survey construction was performed by AA, JAS and SR. Survey distribution was done through global research networks. Analysis was performed by KG. The first draft of the manuscript was written by AA and all authors commented on all versions of the manuscript. All authors read and approved the final manuscript.

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Availability of data and materials
All data is available from the corresponding author on request.

Declarations

Ethics approval and consent to participate
The study received ethical approval from The University of Queensland, Australia (2022/HE001836, Medicine Low and Negligible Risk Sub-Committee).

Consent for publication
All participants were informed of the purpose of the survey and therefore consent for publication was assumed upon completion.

Competing interests
The authors declare that they have no conflicts of interest to disclose.

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