

## ORIGINAL ARTICLE

## KNOWLEDGE OF MAINTENANCE INTRAVENOUS FLUID THERAPY IN ACUTELY ILL HOSPITALIZED CHILDREN AMONG RESIDENTS

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**Background:** Isotonic saline is recommended as maintenance intravenous fluid therapy (MIVFT) for most of the acutely ill hospitalized children. The aim of this study is to assess the current knowledge of paediatric residents regarding the selection of MIVFT in hospitalized children. **Methods:** We conducted a paper-based questionnaire survey to paediatric residents from ten centres asking selection of MIVFT in four common clinical scenarios in 6-month and 10-year old patients as well as monitoring of fluid balance and electrolyte. **Results:** 445 responses were collected (>90% response rate). Majority [78.3% (n=348)] of them were FCPS-trainees. The 0.9%, 0.45% and 0.2% solution were selected by 45.8%, 43.98% and 10.92% respectively. The isotonic and hypotonic solution was prescribed in 6-mo (35.22% vs. 64.76% [ $p<0.001$ ]) and 10-year (54.49% vs. 44.98%) in four different clinical scenarios respectively. 0.45% solution was most commonly prescribed MIVFT in pneumonia (50.22%) and meningitis (45.39%) and 0.9% solution was most commonly selected in acute gastroenteritis (55.05%) and post-operative patients (51.23%). Fluid balance and electrolyte monitoring were selected by 96.9% and 55.7% respondents respectively. **Conclusion:** Our survey reports that more than fifty percent of paediatric residents have inadequate knowledge about maintenance intravenous fluid therapy in acutely ill hospitalized children.

**Keywords:** Children, maintenance intravenous fluid, knowledge, residents

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## INTRODUCTION

Maintenance intravenous fluid therapy (MIVFT) is a common therapeutic intervention used in the care of acutely ill hospitalized children. Maintenance therapy is defined as fluid and electrolyte requirement needed by the average individual with normal ICF/ECF volumes over a 24-hr period.<sup>1</sup> MIVFT in children has revolutionized in the last two decades.<sup>2</sup> There has been growing evidence of “Hospital-Acquired Hyponatremia” with incidence as high as 50% from administration of traditional maintenance intravenous hypotonic fluid in presence of excess antidiuretic hormone (ADH).<sup>3,4</sup> Most of the hospitalized children have one or more triggers of ADH release. Hyponatremic encephalopathy and even death is the most serious complication of hospital-acquired hyponatremia.<sup>5-7</sup> Moritz and Ayus *et al* asserts that use of isotonic (0.9%) solution as a maintenance fluid is safe solution and the most physiologic approach as the prophylaxis against hospital-acquired hyponatremia.<sup>3-8</sup> Several regulatory agencies have abandoned the use of hypotonic fluid in acutely ill hospitalized children as well as emphasize on daily monitoring of fluid balance and monitoring of serum electrolyte like National Patient Safety Agency (NPSA) from the United Kingdom and Institute of Safe Medications Practices (ISMP) from Canada and the United States. The use of isotonic solution as MIVFT is the current standard of care in acutely ill hospitalized children.<sup>2</sup>

There is scarce of information regarding the use of MIVFT in acutely ill hospitalized children from a developing country like Pakistan. The aim of this questionnaire survey among paediatric residents is to assess their current knowledge about prescribing MIVFT in four common situations in hospitalized children.

## MATERIAL AND METHODS

This study was approved by Ethical Review Committee. Respondents were informed that responses were anonymous. This prospective, observational study was conducted during two month from June to July 2014 at ten paediatric residency training centres across Pakistan.

We conducted a self-administered, paper-based questionnaire survey to paediatric residents. It takes less than ten minute to complete survey form. The questionnaire has two components. In the first part, respondents were asked to provide demographical data like gender, type, year, location of training and signed the informed consent as a participant. There were ten questions asked to answer from respondents in the second part. Eight questions were regarding the selection of one type of maintenance intravenous fluid therapy (0.9% NS, 0.45% NS or 0.2% NS) for two different ages (6 month and 10 year) in four common clinical conditions (Pneumonia, Acute Gastroenteritis, Meningitis and Postoperative care after exploratory laparotomy). The respondents were asked to assume that all children were of average weight, had no electrolyte

abnormality, stable hemodynamic with good urine output and these patients were nil per oral (NPO). In the third component, respondents were asked about the monitoring of fluid balance and electrolyte monitoring during MIVFT. The last two questions were regarding daily monitoring of fluid balance and measurement of electrolytes. The two different ages for MIVFT were analysed separately. The MIVFT was divided into two groups: Isotonic (0.9NSD5W) and hypotonic (0.2NSD5W and 0.45NSD5W) solution for purpose of analysis. In Pakistan, there are two-types of post-graduate training in paediatrics. Four-year training programs are Fellow of College of Physician and Surgeon (FCPS in Paediatrics) and Doctor of Medicine (MD). Two-year programs are Diploma in Child Health (DCH) and Member of College of Physician and Surgeon (MCPS). We also enrolled all those who have completed training in paediatrics but have not yet passed the examination (TC).

The primary outcome of this study was to assess the current knowledge among paediatric trainees regarding maintenance intravenous fluid therapy.

All data was entered into SPSS 20V (SPSS, Chicago, IL, USA) for statistical analysis and was expressed as mean±SD or % with range as appropriate. Univariate odds ratios and 95% confidence intervals were then calculated and compared hypotonic fluid against isotonic fluid in each group for all clinical scenarios. Fisher's exact test was used to assess differences between groups in proportions.

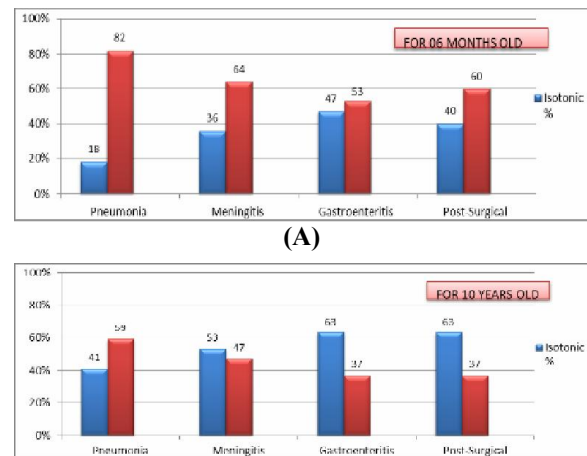
**RESULTS**

A total of 445 participants from ten paediatric postgraduate centres completed questionnaires-based survey, yielding >90% response rate. Among total, 78.2% (n=348) respondents were FCPS-trainees and 43 (9.7%), 38 (8.5%) and 16 (3.6%) were trainees of MCPS, DCH and MD respectively as shown in table-1.

Figure-1 (A & B) shows the selection of fluid in 6-mo and 10-year old patients for each scenario respectively. The most commonly prescribed solution was 0.9% solution (45.8%), the least commonly prescribed solution was 0.2% solution (10.92%) and 43.98% selected 0.45% solution. The isotonic solution was prescribed by 45.8% and the hypotonic solution was prescribed by 54.9% in general. The hypotonic solution and isotonic solution were prescribed in 64.76% and 35.22% in 6-month old infant respectively (p value 0.001, OR 2.21 [95% CI 1.93–2.53]). The hypotonic solution and isotonic solution were prescribed in 44.98% and 54.94% in 10-year old child respectively (p value <0.001, OR 0.44 [95% CI 0.38–0.5]).

Both age and disease affect the choice of fluid among respondents. In Pneumonia, the hypotonic fluid and isotonic fluid were prescribed 81.57% vs. 18.42% in 6-month old infant and 59.1% vs. 40.89% in 10-year

old child respectively (p<0.0001; OR 0.056, 95% CI 0.024–0.132). In Acute Gastroenteritis, the hypotonic fluid and isotonic fluid were prescribed 52.8% vs. 47.19% and 37.07% vs. 62.92% in 6-month old and 10-year old patient respectively (p<0.0001; OR 0.068, 95% CI 0.038–0.120). In clinical scenario of Meningitis, the hypotonic fluid and isotonic fluid were prescribed 64.2% vs. 35.73% in 6-month old infant and 46.97% vs. 53.03% in 10-year old child respectively (p<0.0001; OR 0.073, 95% CI 0.041–0.131). In post-operative case, the hypotonic fluid and isotonic fluid were prescribed 60.45% vs. 39.6% and 37.01% vs. 62.90% in 6-month old and 10-year old patient respectively (p<0.0001; OR 0.067, 95% CI 0.034–0.133). Fluid balance monitoring was selected by 96.9% respondents and electrolyte monitoring was selected only by 55.7%.



**Figure 1. Fluid selected for each clinical scenario by pediatric residents for (A) 6-month old infant and (B) 10-year old child**

**Table-1: Characteristics of Participants**

Total (n)	445
Institutions	10
+50	4
Gender (M)	199 (44.7%)
<b>Types of Training:</b>	
FCPS (Fellow, College of Physicians and Surgeons)	348 (78.2%)
MCPS (Member, College of Physicians and Surgeons)	43 (9.7%)
DCH (Diploma in Child Health)	38 (8.5%)
MD (Doctor of Medicine)	16 (3.6%)
<b>PGY:</b>	
I	207 (46.5%)
II	81 (18.2%)
III	42 (9.4%)
IV	38 (8.5%)
TC (Training Completed)	77 (17.3%)

**DISCUSSIONS**

Our survey showed that the more than half (54.9%) of paediatric residents preferred to use hypotonic fluid as a maintenance fluid therapy in children especially in young infant (64.76%). However, several retrospective, prospective randomized clinical trials and recently published few met-analyses demonstrated that hypotonic fluid as a MIVFT in acutely ill hospitalized children is associated with high incidence of hospital-

acquired hyponatremia.<sup>9-12</sup> Brain damage and deaths in previously healthy children have been reported from hospital-acquired hyponatremia due to administration of traditional hypotonic intravenous maintenance fluid therapy.<sup>6</sup> Several regulatory authorities and agencies have issued warning on use of hypotonic fluid in acutely ill hospitalized children and recommended also electrolyte monitoring in such patients.<sup>2</sup>

Two recent surveys found that most of the paediatric residents still preferred using hypotonic fluid as a maintenance fluid therapy in acutely ill hospitalized children despite a lot of published literature on MIVFT in children.<sup>13,14</sup> Freeman *et al* reported in their survey that hypotonic solution was selected in 78% of children and higher (88.2%) in 6 month old infants.<sup>13</sup> Lee *et al* also assessed the knowledge of intravenous fluid prescription in Korean paediatric residents and found that the majority (69.2–97.8%) prescribed the hypotonic fluid as a maintenance fluid therapy in children.<sup>14</sup> However, our survey results seem to be better than these two surveys because only 54.9% selected hypotonic tonic solution as a maintenance therapy. Fluid selection was also varied in different disease. Isotonic solution was more prescribed in children with acute gastroenteritis and postoperative care in our survey while was for meningitis in Freeman *et al* reports. Hypotonic solution was more preferred in young age in all reports which is most likely related to content of sodium in fluid. The intravenous maintenance fluid therapy is a vital component of care in acutely ill hospitalized children and it should be prescribed as a drug. The knowledge assessment is the first step in updating clinical practice. In current clinical practice, it is not only necessary safe medical practice, but it is also essential for excellent quality of care. These reports including our report emphasize the importance of teaching MIVFT during residency as a part of curriculum and should be asked in their examination to standardize the clinical practice and improve the quality of care. Our survey has several limitations. The major was self-administered and answers don't necessarily reflect actual clinical practice. Our study has little strength. It is the first to assess the knowledge of paediatric residents about use of MIVFT in hospitalized children from various illnesses from multiple institutions of a developing country like Pakistan. Our response rate was >90%.

## CONCLUSION

Our questionnaire-based survey portrayed that that more than fifty percent of paediatric residents have inadequate

knowledge about maintenance intravenous fluid therapy in acutely ill hospitalized children. This deficiency in knowledge clearly requires focused education and training in prescribing maintenance fluid therapy to improve education and prevents death from hospital-acquired hyponatremia.

## AUTHORS CONTRIBUTION

Conception of idea, study design, manuscript writing, study design and final guarantor: AH; Data Collection: SKJ, SM, MFA, FN, KMK; Manuscript assistance: MFA, HH

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