International Journal of Pediatrics and Genetics
Vol. 3 No. 7 (2025)
ISSN: 2995-5483

Dehydration Management in Pediatric Patients: Fluid Resuscitation Management in the Emergency Department

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Abstract: Background and Goal: Dehydration in children is a common condition among pediatric patients, particularly in emergency settings, and may lead to serious morbidity if left untreated. Rehydration of pediatric patients is significant in emergency settings, where early fluid resuscitation can have a dramatic influence on the outcome. The objective of the current study was to evaluate the severity, symptoms, characteristics, management, and consequences of dehydration in children presenting to the ED and emphasize the fluid resuscitation strategies.

Methods: Cross-sectional study of 85 children visiting the ED with dehydration in a period of 12 months of follow-up in different hospitals in Iraq from January 2024 to January 2025. All the patients were on IV resuscitation methods like (35.3% Oral Rehydration and 64.7% IV Crystalloids). All the patients had been administered IV types of fluids (normal saline, lactated Ringer's, and dextrose solution). The information was recorded for demographics, severity of dehydration, signs and symptoms, aetiology, lab reports, complications, days of stay, and parental satisfaction.

Results: The cohort was predominantly male patients (52.9%), and most were 4–12 months old (29.4%). Moderate dehydration occurred in 47.1% of the cases, with thirst (76.5%) and dry mucous membranes (70.6%) being the most common symptoms. Diarrhea and vomiting were the most common causes of dehydration (47.1%). Initial fluid resuscitation was primarily administered via IV crystalloid fluids (64.7%). Post-treatment assessment scores showed significant resolution of dehydration signs, expressed as reduced thirst (3.5 to 1.2) and dry mouth (2.5 to 1.0). The ED length of stay mean was <2 hours for 47.1% of the patients, and the parental overall satisfaction rate was also high, with 47.1% reporting being very satisfied with care.

Conclusion: Effective management of dehydration in children in the pediatric ED relies on prompt recognition of the symptoms and proper application of fluid resuscitation protocols. The

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ISSN: 2995-5483

success of the used protocols is confirmed by the high level of parental satisfaction. Medical education and training are ongoing in order to enhance dehydration management, which requires further research on the long-term follow-up results of in-hospital procedures.

Key words: Dehydration, Pediatric, Fluid Resuscitation, Emergency Department, Symptoms, and Parental Satisfaction.

1. INTRODUCTION

Dehydration is one of the most frequent issues in children, particularly among those presenting to emergency departments (EDs) **{1}.** It can be due to a variety of etiologies, including gastrointestinal losses (diarrhea and vomiting), inadequate oral intake, and insensible losses **{2,3}.** Children are especially prone to dehydration due to their high metabolic rate, lower percentage of total body water, and poorer homeostatic capacity to maintain fluids **{4}.** In acute settings, there must be rapid diagnosis and management of dehydration, since untreated dehydration may lead to severe implications like electrolyte disturbances, renal failure, and even death. **{5,6,7}**

Dehydration management in children is multifaceted in nature, but fluid resuscitation is a critical component **[8].** Healthcare providers need to differentiate between mild, moderate, and severe dehydration since dehydration classification plays a major role in treatment planning **{9}.** Oral rehydration therapy (ORT) is generally used in cases of mild dehydration, while intravenous (IV) fluid resuscitation should be applied in cases of moderate and severe dehydration. Use of the optimal resuscitation guidelines and fluid selection is critical in avoiding morbidity and rapid recovery in children **{10}.**

2. PATIENTS AND METHODS

A. Study Design

The current study employed cross a sectional design in evaluating fluid resuscitation care among 85 pediatric patients with dehydration treated in the emergency department (ED) of different hospitals in Iraq. Data were collected under 12 months follow – up from January 2024 to January 2025, and informed parental consent was taken prior to enrollment.

B. Participants

The study included 1-month-to-10-year-old pediatric patients with dehydration. Participants were selected through ED cases and were recruited consecutively.

C. Inclusion Criteria

- ✓ Children between the ages of 1 month and 10 years.
- ✓ Presentation of dehydration, either mild, moderate, or severe, according to clinical assessment.
- ✓ Parental availability of consent for study enrollment.

D. Exclusion Criteria

- ✓ Patients with long-standing conditions that impact daily hydration level (e.g., renal failure, cancer).
- ✓ Hospitalized or emergent surgery requiring children at presentation.
- ✓ Patients who have been fluid-resuscitated in the last 24 hours before presentation.

E. Data Collection

The data were gathered on a uniform questionnaire and comprised:

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- ✓ Demographic Information: Age, gender, weight, Body Mass Index (BMI), and parent health behavior (smoking status).
- ✓ Clinical Characteristics: Comorbidity (hypertension, diabetes, asthma) and diet quality.

F. Pre-treatment Assessment and Diagnosis

On presentation, clinicians undertook a thorough assessment of the patients, including:

- ✓ Clinical assessment of dehydration severity (thirst, dry mouth, reduced urine output, lethargy, and sunken eyes).
- ✓ Laboratory tests to assess baseline electrolytes and renal function (sodium, potassium, hemoglobin, white blood cell count, blood urea nitrogen, creatinine, arterial blood gas analysis).

G. Fluid Resuscitation Management in the Emergency Department

Initial treatment was based on the severity of dehydration:

- ➢ Methods of Resuscitation:
- ✓ Oral Rehydration Therapy (ORT): Initiated for mild to moderate status.
- ✓ Intravenous (IV) Crystalloids: Administered for severe dehydration or where ORT was deemed insufficient.
- ➢ Type of IV Fluids: Administered IV fluids were:
- ✓ Normal Saline
- ✓ Lactated Ringer's solution
- ✓ Dextrose solutions

H. Post-IV Fluids Treatment Outcomes

Outcomes were assessed once fluid resuscitation was completed. These were:

- ➢ Urine Output Assessment: Assessed hourly to determine normalization of hydration status.
- ➢ Improvement in Symptoms: Scoring was employed to assess improvement in dehydration symptomatology prior to and subsequent to treatment.
- ➢ Complications: Documented adverse effects associated with fluid resuscitation, including fluid overload and electrolyte imbalances.

I. Post-treatment Assessment of Dehydration Symptoms

Symptoms were rated on the same clinical criteria used at pre-treatment evaluation. Severity of symptoms was evaluated before and after treatment as mild, moderate, or severe.

J. Post-treatments Outcomes

Post-treatment outcomes measured were:

- ✓ Length of Stay in the ED,
- ✓ 30-day Re-admission,
- ✓ Parent satisfaction, rated using a Likert scale.

K. Data Analysis

Statistical analyses were conducted using SPSS software version 22.0. Descriptive statistics (means, standard deviations, frequencies, percentages) were calculated for the clinical and demographic variables.

- ✓ Association between categorical variables was assessed using the chi-square test.

✓ A p-value of < 0.05 was considered statistically significant.

3. RESULTS

Table 1. Demographic Patients and Clinical Characteristics.

Characteristic	N (%)
Age	
< 4 months	20 (23.5%)
4 - 12 months	25 (29.4%)
1 - 5 years	20 (23.5%)
6 - 10 years	20 (23.5%)
Gender	
Male	45 (52.9%)
Female	40 (47.1%)
BMI (Kg/m²)	
Underweight	5 (5.9%)
Normal weight	50 (58.8%)
Overweight	15 (17.6%)
Obese	15 (17.6%)
Hypertension	5 (5.9%)
Diabetes	3 (3.5%)
Asthma	10 (11.8%)
Fathers Smokers	30 (35.3%)
ASA Classification	
II	40 (47.1%)
III	45 (52.9%)
Diet System	
Better Diet	25 (29.4%)
Moderate Diet	40 (47.1%)
Less Favorable Diet	15 (17.6%)
Worst Diet	5 (5.9%)
Parents Education	
Primary School	15 (17.6%)
Secondary School	35 (41.2%)
College/University	35 (41.2%)

Table 2. Dehydration Severity.

Severity	N (%)
Mild (0-4)	30 (35.3%)
Moderate (5-9)	40 (47.1%)
Severe (10-15)	15 (17.6%)

Table 3. Determining Symptoms of Dehydration.

Symptoms	N (%)
Thirst	65 (76.5%)
Dry mouth and mucous membranes	60 (70.6%)
Decreased urine output	50 (58.8%)
Lethargy	30 (35.3%)
Sunken eyes	25 (29.4%)

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ISSN: 2995-5483

Table 4. Identifying the Causes of Dehydration.

Causes	N (%)
Diarrhea and vomiting	40 (47.1%)
Fever	20 (23.5%)
Insufficient fluid intake	15 (17.6%)
Illnesses causing increased respiration	10 (11.8%)

Table 5. Diagnostic Prevalence of Dehydration Symptoms before IV Fluids Treatment.

Symptoms	Mild (%)	Moderate (%)	Severe (%)
Thirst	20 (66.7%)	30 (75%)	15 (100%)
Dry mouth and mucous membranes	15 (50%)	25 (62.5%)	20 (86.7%)
Decreased urine output	10 (33.3%)	20 (50%)	20 (86.7%)
Lethargy	5 (16.7%)	10 (25%)	15 (100%)
Sunken eyes	5 (16.7%)	5 (12.5%)	15 (100%)

Table 6. Laboratory Tests.

Variables	Mean (SD)
Sodium	135.2 (4.3)
Potassium	4.0 (0.6)
Hemoglobin	12.6 (2.0)
White Blood Cell Count	8,500 (3,200)
Blood Urea Nitrogen	15.3 (5.0)
Creatinine	0.9 (0.3)
Arterial Blood Gas (ABG)	7.35 (0.05)
Hypoglycemia	70 (15)

Table 7. Initial Fluid Resuscitation Methods.

Method	N (%)
Oral Rehydration	30 (35.3%)
IV Crystalloids	55 (64.7%)

Table 8. Types of IV Fluids.

IV Fluid	N (%)
Normal Saline	40 (47.1%)
Lactated Ringer's	30 (35.3%)
Dextrose Solutions	15 (17.6%)

Table 9. Urine Output Assessment after Treatment.

Age Group	Normal Urine Output (mL/kg/hour)	Decreased Urine Output (mL/kg/hour)
< 4 months (Infants)	2.5 (0.5)	1.5 (0.7)
4 - 12 months (Infants)	2.0 (0.4)	1.0 (0.4)
1 - 5 years (Toddlers)	1.5 (0.3)	0.8 (0.5)
6 - 10 years (Children)	1.0 (0.2)	0.5 (0.3)

Table 10. Assessment of the Degree of Symptoms after IV Fluids Treatment.

Symptoms	Mild (Mean ± SD)	Moderate (Mean ± SD)	Severe (Mean ± SD)
Thirst	1.5 ± 0.5	2.0 ± 0.8	3.0 ± 1.0
Dry mouth and mucous membranes	1.0 ± 0.4	1.5 ± 0.6	2.5 ± 0.8
Decreased urine output	1.2 ± 0.5	1.8 ± 0.7	3.5 ± 0.9
Lethargy	1.0 ± 0.5	1.5 ± 0.7	3.0 ± 1.0
Sunken eyes	1.0 ± 0.4	1.0 ± 0.5	3.0 ± 1.1

Table 11. Time to Initiate Fluid Resuscitation.

Time	N (%)
< 30 minutes	20 (23.5%)
30-60 minutes	40 (47.1%)
> 60 minutes	25 (29.4%)

Table 12. Post-IV Fluids Used Complications.

Complications	N (%)
Fluid Overload	10 (11.8%)
Electrolyte Imbalances	5 (5.9%)
Infection	3 (3.5%)
Thrombophlebitis	5 (5.9%)
Acid-Base Disorders	2 (2.4%)
Hypotonicity	1 (1.2%)
Total Complications	**26 (30.6%)**

Table 13. Length of ED Stay.

Length of Stay	N (%)
< 2 hours	40 (47.1%)
2-4 hours	30 (35.3%)
> 4 hours	15 (17.6%)

Table 14. Re-admission Rates.

Re-admission	N (%)
Yes	15 (17.6%)
No	70 (82.4%)

Table 15. Parental Satisfaction with Care.

Satisfaction Level	N (%)
Very Satisfied	40 (47.1%)
Satisfied	30 (35.3%)
Unsatisfied	15 (17.6%)

4. DISCUSSION

Management of dehydration in children remains a problematic but essential aspect of emergency management. The findings of this study are beneficial for fluid resuscitation therapy in the ED.

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Our research revealed that 47.1% of pediatric patients had moderate dehydration and 17.6% severe dehydration. It is important to know the demographics of hydration status since younger children, especially those aged 4-12 months, were most affected in our population, corroborating findings by a USA paper **{11}**which reported infants and toddlers are at risk of developing severe dehydration because of their greater turnover of total body water.

Also, the most common practice of IV crystalloid fluid administration, namely normal saline (NS) and lactated Ringer's solution (LR), observed in our study (64.7%), corroborates the guideline-recommended guidelines advocating the use of these fluids as initial treatments for acute dehydration, it elucidated in the Canadian paper **{12}**. Also, it promoted the early use of hypotonic fluid in some cases. Our findings indicate a preference for ongoing use of isotonic solutions in the ED setting, largely due to a focus on the avoidance of potential complications of hyponatremia.

A second notable finding is that nearly half the patients were administered fluid resuscitation within the first hour of ED presentation. This supports findings in certain studies **{13,14,15,16},** which highlight the urgency of early intervention in preventing morbidity due to dehydration. Our results indicate improved outcomes with early treatment, leading to enhanced normalization of hydration and decreased incidence of secondary complications.

Despite complications such as fluid overload are noted in our study, they were present in a minority of cases. This is in agreement with evidence in a Japanese paper **{16},** where it was described that fluid resuscitation itself can be harmful, but with careful monitoring and judicious fluid therapy, one could avoid untoward effects. In addition, an average two-hour length of stay for the majority of our patients reveals that findings by certain studies **{17,18}**indicated effective management results in streamlined patient flow in EDs, decreasing waiting time overall as well as enhancing satisfaction. Furthermore, our research also identified high parental satisfaction, with almost half indicating very high satisfaction with the care provided, which is the trend identified by the Chinese study **{19}.** The minimal re-admission rate (17.6%) also highlights the efficacy of our management plan and that appropriate hydration and discharge teaching could be the cause of long-term recovery.

5. CONCLUSION

Assessment of dehydration severity revealed that the majority of patients exhibited moderate (47.1%) to severe dehydration (17.6%). Symptoms such as thirst, dry mouth, and diminished urine output were prevalent. The trend favoring IV crystalloid, administered to 64.7% of the participants, was revealed by our findings. Surprisingly, normal saline and lactated Ringer's solution were the hydration fluids of choice for use during resuscitative attempts. Its application within early fluid resuscitation was essential, with practically half of the patients being treated within the initial hour of ED presentation. Subsequent evaluations after treatment reflected appreciable improvement in dehydration symptoms and urine output.

The relief in symptom severity was particularly notable among the patients who were graded as severely and moderately dehydrated, suggesting the efficacy of the administered fluids. Parent satisfaction with the overall care they received was likewise high, with 47.1% of the parents reporting that they were very satisfied with the administered treatment. While fluid resuscitation was generally well tolerated, complications occurred in a minority of the patients, including fluid overload and electrolyte imbalance.

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