ORIGINAL ARTICLE

Assessment of paramedic awareness of prehospital intravenous fluid use in the Eastern Province of Saudi Arabia

Mohammed Al-Khuwaitem[1*], Salem Al-Qahtani[1], Talal Al-Shammari[1], Hani Ellouly[1]

ABSTRACT

Background: Intravenous (IV) fluid administration is an important component of prehospital emergency care. However, knowledge among paramedics regarding IV fluid use in prehospital settings remains insufficiently explored in Saudi Arabia. This study aims to assess decision-making among paramedics regarding prehospital IV fluid administration in the Eastern Province of Saudi Arabia.

Methodology: A descriptive cross-sectional study was conducted using a structured, self-administered modified questionnaire distributed to a convenience sample of paramedics working in government and private healthcare sectors in the Eastern Province. Forty-two paramedics participated. The questionnaire assessed decision-making regarding prehospital IV fluid use. Data were analyzed descriptively.

Results: Among the 42 participants, normal saline was the most commonly selected IV fluid (33/42, 78.6%). Overall, 29/42 (69.0%) reported difficulty or occasional difficulty in selecting the appropriate IV fluid, while 22/42 (52.4%) reported receiving hands-on training and 15/42 (35.7%) were unsure about their training status. In the fluid volume question, 17/42 (40.5%) selected 500 ml, whereas 7/42 (16.7%) were unsure. Regarding infusion rate, 26/42 (61.9%) selected a fast infusion over 15-30 minutes, while 7/42 (16.7%) were unsure.

Conclusion: This study provides preliminary insights into paramedics' knowledge of prehospital IV fluid use in the Eastern Province of Saudi Arabia. These findings highlight the need for further evaluation of structured educational interventions and larger-scale studies to further evaluate and improve prehospital IV fluid practices.

Keywords: Intravenous fluids, paramedics, prehospital care, emergency medical services, emergency medicine, Saudi Arabia.

Introduction

Adequate intravenous (IV) fluid therapy is essential in emergency care, particularly for hemorrhage, shock, and severe dehydration, [4,5] as timely administration may help maintain circulation and tissue perfusion. [1,2] IV fluids are commonly classified as crystalloids, colloids, and hypertonic solutions, each with distinct clinical indications, advantages, and risks. [1,6,7]

Crystalloids are commonly used in prehospital care because they are widely available, familiar to clinicians, and suitable for initial resuscitation in many emergencies. However, larger volumes may be required for intravascular volume expansion, increasing the risk of fluid overload in selected patients. [1,6] Colloids, such as albumin and hydroxyethyl starch, remain in the intravascular space longer and may provide plasma volume expansion with smaller infused volumes. Nevertheless, their use has been associated with complications, including coagulopathy, renal impairment, and hypersensitivity reactions. [2,6]

Hypertonic solutions, including hypertonic saline combined with starch or dextran, may rapidly expand intravascular volume by shifting water into the

Correspondence to: Mohammed Al-Khuwaitem
*Department of Emergency Medical Care, College of Applied Medical Sciences, Imam Abdulrahman Bin Faisal University, Dammam EHAB7754, Saudi Arabia.
Email: Mr.alkhuwaitem@gmail.com
Full list of author information is available at the end of the article.
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AMEM

circulation. They may be useful in selected emergencies but can increase the risk of hypernatremia and renal dysfunction. [7] Therefore, appropriate prehospital IV fluid administration requires clinical judgment, with fluid type, volume, and infusion rate guided by the patient's clinical condition, suspected cause of hypovolemia, and risks of over- or under-resuscitation. [1,3]

Uncertainty regarding fluid administration has been reported among prehospital personnel, particularly in determining whether fluids are needed and the appropriate volume. [8] Inappropriate fluid selection, volume, or infusion rate may contribute to inconsistent clinical decision-making, particularly in time-sensitive situations. Despite the important role of paramedics in prehospital fluid resuscitation, evidence on their knowledge, awareness, and decision-making regarding IV fluid use in Saudi Arabia remains unknown. In patients with visible hemorrhage or systolic blood pressure below 90 mmHg, IV fluids may help restore intravascular volume and maintain vital organ perfusion until definitive treatment is available. [9]

Early recognition and appropriate resuscitation are particularly important in trauma care. [9]

The present study focused on paramedics because they are often among the first healthcare providers to assess and manage medical and traumatic emergencies in the prehospital setting. IV fluids are widely available and frequently used in emergency care; however, their administration carries potential risks. [5,1] In a prospective study of 71 patients, 10.0% developed tachyarrhythmia and 7.0% experienced clinical fluid overload. [10]

Several challenges have been reported in prehospital fluid resuscitation, including uncertainty about the required volume, limited guidance on fluid therapy, and difficulty determining whether fluid administration is clinically indicated. In one study, most prehospital critical care anesthesiologists reported no difficulty with fluid administration; however, 14.0% were uncertain whether patients required fluids, and 13.0% reported a lack of evidence in this field. In the same study, 67.0% of field clinicians considered the evidence on prehospital fluid resuscitation in patients with infection to be insufficient.[8]

Sepsis may require early fluid-related decision-making in the prehospital setting. In hemorrhagic conditions, however, fluid administration requires caution, as increasing blood pressure before bleeding is controlled may disrupt early clot formation and increase recurrent hemorrhage. Therefore, prehospital fluid resuscitation should balance maintaining tissue perfusion against the risk of worsening uncontrolled bleeding.[9]

A study of 1,018 trauma patients at Lausanne University Hospital reported that 76.0% received normal saline, 8.0% received a balanced solution, and 16.0% received no IV fluids. Low-to-moderate volumes of normal saline may reduce complications, while excessive administration should be avoided. Current recommendations generally suggest limiting prehospital normal saline to approximately 1,000-1,500 ml when appropriate. [12]

Previous multicenter studies have demonstrated variation in prehospital fluid practices across EMS systems, which may limit the generalizability of their findings. [11]

However, evidence regarding IV fluid use by paramedics in the Saudi prehospital setting remains limited. Therefore, this study used a structured self-administered questionnaire to assess paramedics' knowledge regarding IV fluid types, indications, and decision-making in the Eastern Province of Saudi Arabia. The study also explored selected factors that may influence practice and provided preliminary insights to support future educational efforts and larger-scale research on prehospital fluid administration.

Subjects and Methods

Study design and setting

A descriptive cross-sectional study was designed to assess knowledge and decision-making among paramedics regarding IV fluid use in prehospital settings in the Eastern Province of Saudi Arabia. Data were collected using a structured, self-administered questionnaire to assess knowledge. The primary outcomes were participants' reported IV fluid types and indications, potential complications, and factors influencing prehospital decision-making.

Survey instrument and validity

An online, structured, self-administered questionnaire was used to assess paramedics' knowledge and decision-making regarding prehospital IV fluid use in the Eastern Province of Saudi Arabia. The questionnaire was adapted from a previously published survey by Jensen et al. [8] and modified to reflect the study objectives and the Saudi prehospital EMS context as detailed in Supplementary file 1 including the questions that were added, removed, or modified. Permission to adapt the questionnaire was obtained by contacting the corresponding author, Jensen MK, by email.

The questionnaire included multiple-choice and Likert-scale questions addressing participants' demographic and professional characteristics, knowledge, and perceptions of IV fluid therapy, fluid selection, indications for fluid administration, reported challenges, previous hands-on training, fluid volume, and infusion rate.

The questionnaire consisted of three main sections: (1) baseline demographic and professional characteristics, (2) knowledge, perceptions, education, and experience related to prehospital IV fluid administration, and (3) clinical knowledge-based questions addressing fluid selection, volume, and infusion rate.

The questionnaire was reviewed by a faculty member with expertise in emergency medicine before distribution to assess its relevance and clarity. No formal reliability testing or psychometric validation of the adapted questionnaire was performed.

Data collection procedures

The survey was distributed using an online, self-administered questionnaire electronically through direct digital invitations to eligible paramedics with an embedded survey link. No a priori sample size calculation was performed. The study was considered exploratory because participants were recruited through convenience sampling. The survey was distributed on July 11, 2025, and the final response was received on February 17, 2026. Responses were anonymous. Participation was voluntary, and informed consent was obtained at the beginning of the survey. The survey was sent to 120 eligible participants across different hospitals and stations. A total of 42 responses were received, corresponding to a response rate of 35%. No duplicate responses were identified, as each response has different start and completion time. No incentives were offered. All responses were collected through Microsoft online survey. All responses were complete because respondents were required to answer all questions before submitting the survey.

Ethical considerations

Ethical approval was obtained from the Institutional Review Board at Imam Abdulrahman Bin Faisal University before data collection (approval number: IRB-PGS-2025-03-0359; approval date: May 19, 2025) through an expedited review process. Participation was voluntary, and no identifying information was collected.

Statistical analysis

Data were analyzed using descriptive statistics. Categorical variables were summarized as frequencies and percentages. Analyses were performed using SPSS (IBM Corp., Armonk, NY), with support from biostatistical specialists.

Results

Participant demographics

Among the 42 respondents, 23 (54.8%) were aged 20-24 years, 15 (35.7%) were aged 25-34 years, and 4 (9.5%) were aged 35-44 years. No participants were aged <20 or 45-54 years. Most participants were men (35/42; 83.3%), while 7/42 (16.7%) were women.

Regarding professional experience, 17/42 participants (40.5%) had less than 1 year of experience, 8/42 (19.0%) had 1-2 years, 8/42 (19.0%) had 3-4 years, 5/42 (11.9%) had 5-6 years, and 4/42 (9.5%) had more than 10 years. No participants reported 7-10 years of experience. Overall, the sample predominantly comprised early-career paramedics. (Table 1). Detailed results for all questionnaire items, including response frequencies and percentages, are provided in Supplementary File 1.

Clinical fluid utilization and choice

Normal saline was the most commonly selected IV fluid, reported by 33/42 participants (78.6%). Ringer's lactate was selected by 3/42 participants (7.1%), while 5/42 (11.9%) based their choice on guideline recommendations. One participant (2.3%) was unsure of the appropriate fluid, and none selected dextrose. (Fig. 2)

Table 1. *Participant demographics and professional experience (n = 42).*

Characteristic	n/N	%
Age group		
<20 years	0/42	0.0%
20-24 years	23/42	54.8%
25-34 years	15/42	35.7%
35-44 years	4/42	9.5%
45-54 years	0/42	0.0%
Gender		
Male	35/42	83.3%
Female	7/42	16.7%
Professional experience		
<1 year	17/42	40.5%
1-2 years	8/42	19.0%
3-4 years	8/42	19.0%
5-6 years	5/42	11.9%
7-8 years	0/42	0.0%
9-10 years	0/42	0.0%
>10 years	4/42	9.5%

Parameters used to assess fluid requirements

When assessing patients' fluid requirements, participants were asked to select the five parameters they most frequently used to guide fluid administration. Among the 42 participants, each participant selected five parameters, resulting in a total of 210 selections. Therefore, the percentages reported in Figure 1 were calculated based on the total number of selections (n = 210), rather than the number of participants (n = 42). Blood pressure was the most frequently selected parameter (41/210, 19.5%), followed by capillary refill time and shock index (27/210, 12.9% each). History taking was selected 22 times (22/210, 10.5%), while skin turgor was selected 14 times (14/210, 6.7%). Other reported parameters included pulse (12/210, 5.7%), mean arterial pressure (10/210, 4.8%), and consciousness assessment using AVPU/GCS (9/210, 4.3%) (Fig. 1).

Clinical challenges and decision-making

Regarding field practice, 8/42 participants (19.0%) reported difficulty selecting the appropriate IV fluid, while 21/42 (50.0%) reported experiencing difficulty sometimes. Overall, 29/42 participants (69.0%) reported difficulty or occasional difficulty with IV fluid selection.

When asked about challenges in prehospital fluid treatment, 12/42 participants (28.6%) reported no challenges, while 10/42 (23.8%) were unsure whether the patient needed fluid. In addition, 7/42 participants (16.7%) were unsure about the required fluid volume, and 6/42 (14.3%) reported that they did not know. Other reported challenges included a lack of guidelines (3/42, 7.1%), heterogeneity among patients with suspected infection (2/42, 4.8%), limited time for fluid initiation

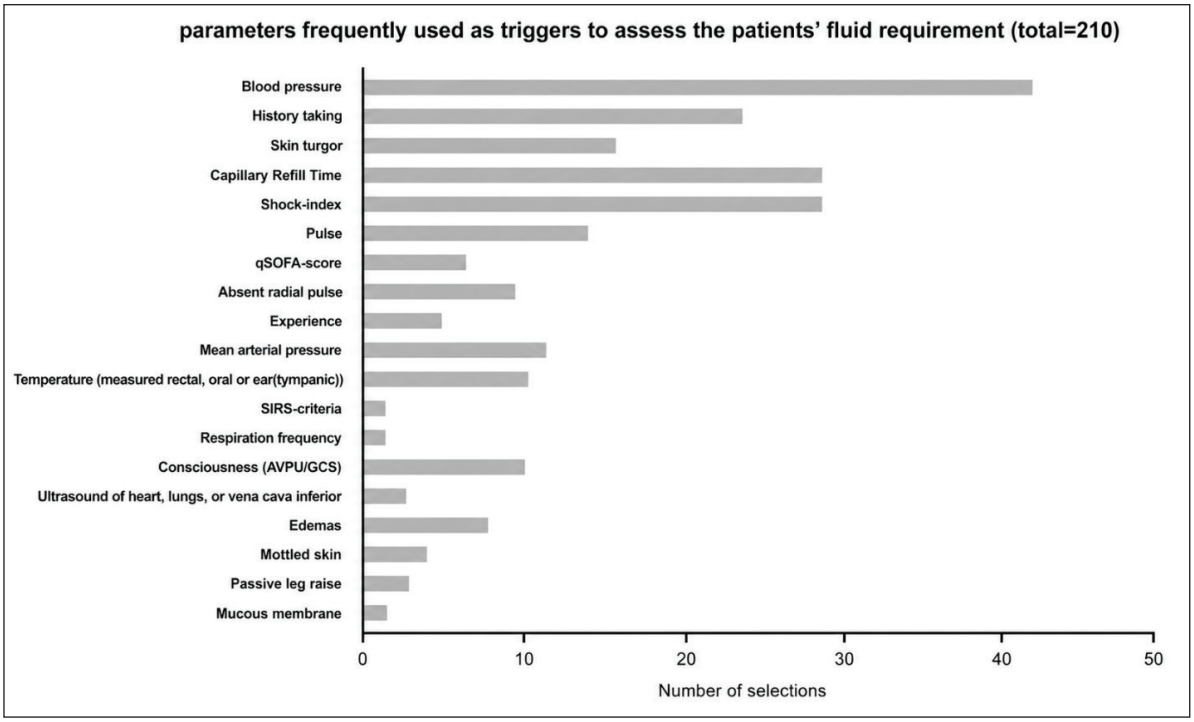


Figure 1. *Parameters frequently used as triggers to assess the patients' fluid requirement (total = 210) (n = 42).*

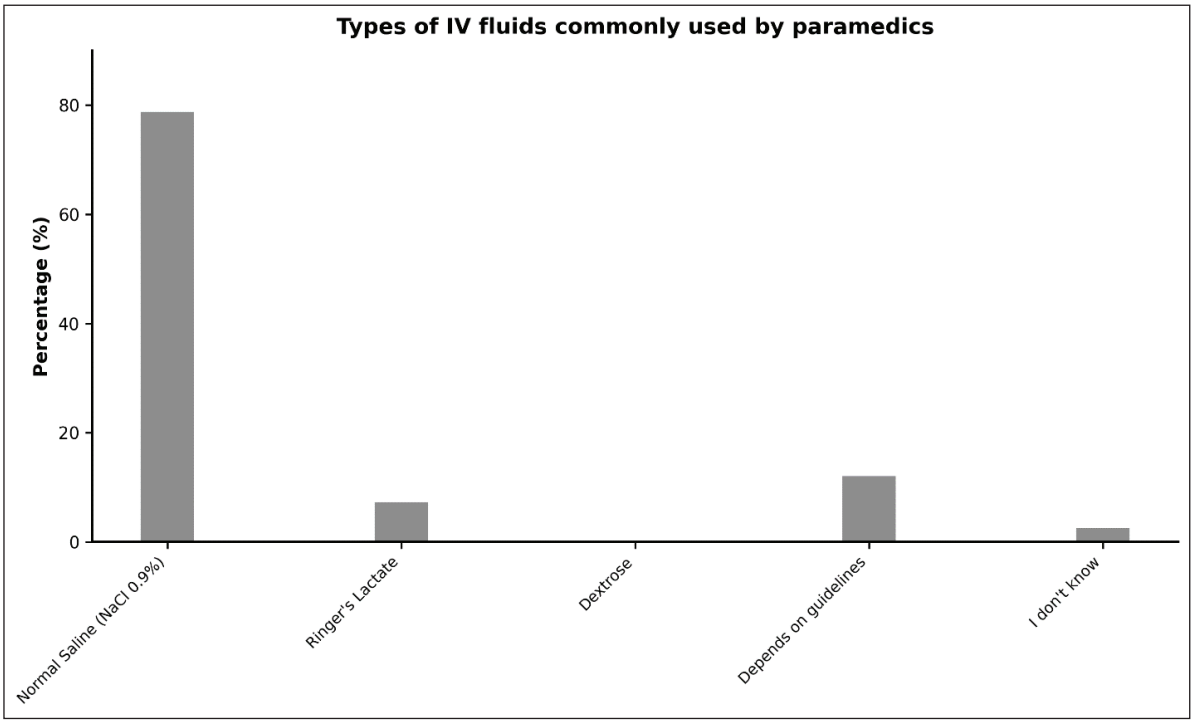


Figure 2. *Types of intravenous (IV) fluids selected by paramedics in prehospital settings (n = 42).*

(1/42, 2.4%), and lack of evidence in the field (1/42, 2.4%) (Fig. 3).

Regarding practical training, 22/42 participants (52.4%) reported receiving hands-on training in IV fluid administration, 15/42 (35.7%) were unsure, and 5/42 (11.9%) had not received such training.

In the volume assessment question, 17/42 participants (40.5%) selected 500 ml, 12/42 (28.6%) selected 250 ml, 7/42 (16.7%) were unsure, 4/42 (9.5%) selected 1,000 ml, and 2/42 (4.8%) selected 2,000 ml. No participants selected no fluid or 1,500 ml.

Regarding infusion rates, 26/42 participants (61.9%) selected fast infusion over 15-30 minutes, 5/42 (11.9%) selected slow infusion over more than 30 minutes, 4/42 (9.5%) selected infusion as fast as possible, and 7/42 (16.7%) were unsure.

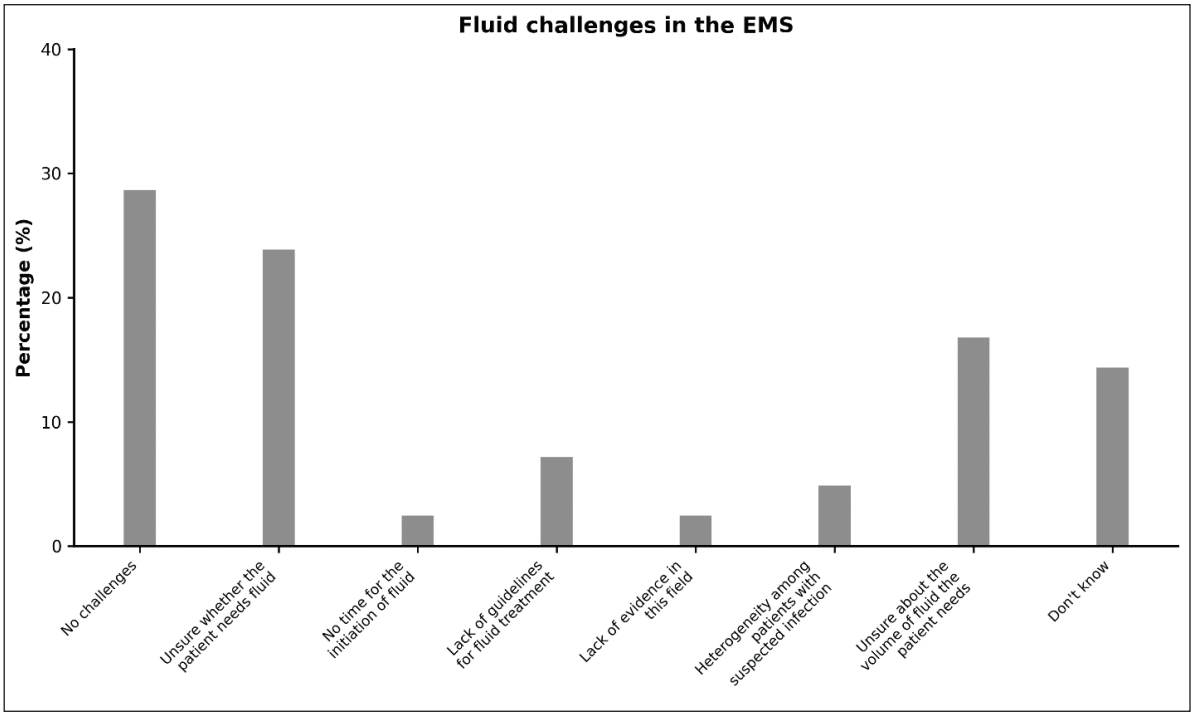


Figure 3. *Difficulty in selecting appropriate intravenous fluids in prehospital settings (n = 42).*
EMS Emergency medical services

Discussion

The findings indicate that participants demonstrated basic awareness, but uncertainty remained in clinical decision-making, particularly regarding fluid selection, volume, and infusion rate.

Normal saline was the most commonly selected prehospital IV fluid (33/42; 78.6%), likely reflecting its widespread availability and longstanding use in emergency care. This finding is consistent with previous prehospital survey research, in which normal saline was also commonly used for prehospital fluid administration on patients with suspected infection [10]. Only 3/42 participants (7.1%) selected Ringer's lactate, while 5/42 (11.9%) based their choice on guideline recommendations. This preference for normal saline may reflect familiarity, local ambulance availability, training exposure, or uncertainty regarding the appropriate use of alternative fluids. These explanations were not directly assessed in the present study and therefore should be considered hypothetical.

The finding that 29/42 participants (69.0%) reported difficulty or occasional difficulty in selecting the appropriate IV fluid suggests that fluid selection remains a common challenge in prehospital practice. The reported uncertainty regarding whether fluids were needed and the appropriate fluid volume indicates that decision-making may remain challenging in the prehospital setting, particularly when clinical information is limited or time-sensitive as shown in Figure 3. This finding is consistent with previous survey research in which prehospital personnel reported uncertainty regarding fluid administration, including whether fluids were needed and the volume required [8]. This uncertainty may reflect variations in patient presentation, limited exposure to different fluid types, or uncertainty regarding the advantages and limitations of each option in the field.

The predominance of early-career paramedics may also have reduced differences between experience groups.

Another issue was variation in hands-on training. Although practical training is important for field decision-making, 15/42 participants (35.7%) were unsure whether they had received hands-on training in IV fluid administration, while 5/42 (11.9%) reported no such training. This may reflect inconsistencies in how IV fluid training is delivered, documented, or reinforced, particularly when theoretical teaching is not accompanied by scenario-based practice or simulation.

Uncertainty was also evident in responses to questions on fluid volume and infusion rate, with 7/42 participants (16.7%) unsure of the appropriate response for each. Similar uncertainty regarding fluid volume has been reported among prehospital personnel in previous survey research [8]. These findings suggest that general awareness may not always translate into confidence in field decision-making, particularly when determining appropriate fluid volume and infusion rate in time-sensitive situations.

Overall, the findings suggest that paramedics may benefit from clearer guidance and more consistent practical training in IV fluid use in prehospital EMS settings. Unlike hospital-based care, the prehospital environment is characterized by limited resources, time-sensitive decisions, and variable patient presentations. Structured education, scenario-based training, and locally relevant guidance may therefore support more consistent decision-making regarding fluid selection, volume, and infusion rate. However, given the small convenience sample,

these findings are preliminary and require confirmation in larger studies.

This study has some limitations. First, the small sample of 42 participants limited statistical power and the ability to make comparisons between groups. Second, convenience sampling from one region may limit the generalizability of the findings to paramedics across Saudi Arabia. Third, the self-reported questionnaire may have introduced recall bias, while voluntary participation may have introduced selection bias. Fourth, online distribution may have underrepresented paramedics who were less familiar with digital survey tools. In addition, the questionnaire was reviewed by a single faculty member, and formal pilot testing and reliability assessment were not performed. Finally, differences in EMS education and training may have influenced awareness and complicated assessment of the effect of previous training on field practice. Further studies with larger samples and more rigorous questionnaire validation are recommended.

Conclusion

This study provides preliminary insights into paramedics' awareness and decision-making regarding prehospital IV fluid use in the Eastern Province of Saudi Arabia. The findings highlight variation in fluid selection and uncertainty regarding fluid volume and infusion rate. Given the small convenience sample, these findings should be interpreted cautiously and should not be generalized to the wider paramedic population. Larger studies are needed to further characterize paramedics' knowledge and decision-making regarding prehospital IV fluid administration and identify potential educational needs.

List of Abbreviations

EMS Emergency Medical Services
IV Intravenous

Conflict of interest

The authors declare no conflicts of interest regarding the publication of this article.

Funding

None.

Consent for participation

Written informed consent was obtained from all participants included in the study.

Ethical approval

Ethical approval was granted by the Institutional Review Board at Imam Abdulrahman Bin Faisal University (approval number: IRB-PGS-2025-03-0359; approval date: 19 May 2025).

Author details

Mohammed Al-Khuwaitem[1], Salem Al-Qahtani[1], Talal Al-Shammari[1], Hani Ellouly[1]

1. Department of Emergency Medical Care, College of Applied Medical Sciences, Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia

Supplementary content (If any) is available online.

References

1. National Institute for Health and Care Excellence. Intravenous fluid therapy in adults in hospital. NICE clinical guideline no. National Institute for Health and Care Excellence; 2013.
2. Myburgh JA, Finfer S, Bellomo R, Billot L, Cass A, Gattas D, et al. Hydroxyethyl starch or saline for fluid resuscitation in intensive care. N Engl J Med. 2012;367(20):1901–11. https://doi.org/10.1056/nejmoa1209759.
3. Taghavi S, Nassar AK, Askari R. Hypovolemic shock. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2023. Available from: https://www.ncbi.nlm.nih.gov/books/NBK513297/
4. Médecins Sans Frontières. Severe dehydration. In: Management of a cholera epidemic. MSF Medical Guidelines; 2025. Available from: https://medicalguidelines.msf.org/en/viewport/CHOL/english/5-3-severe-dehydration-32409706.html.
5. Marik PE, Varon J. Treatment of severe hypovolemia or hypovolemic shock in adults. In: Vincent JL, editors. UpToDate; 2023. Available from: https://www.uptodate.com/contents/treatment-of-severe-hypovolemia-or-hypovolemic-shock-in-adults
6. Perel P, Roberts I. Colloids versus crystalloids for fluid resuscitation in critically ill patients. Cochrane Database of Syst Rev. 2012;(6):CD000567. https://doi.org/10.1002/14651858.cd000567.pub5.
7. Baker AJ, Rhind SG, Morrison LJ, Black S, Crnko N, Shek PN, et al. Resuscitation with hypertonic saline-dextran reduces serum biomarker levels and correlates with outcome in severe traumatic brain injury patients. J Neurotrauma. 2009;26(8):1227–40. https://doi.org/10.1089/neu.2008.0868.
8. Jensen ME, Jensen AS, Meilandt C, Jørgensen KW, Væggemose U, Bach A, et al. Prehospital fluid therapy in patients with suspected infection: a survey of ambulance personnel›s practice. Scand J Trauma Resusc Emerg Med. 2022;30(1):38. https://doi.org/10.1186/s13049-022-01025-1.
9. National Institute for Health and Care Excellence. Prehospital initiation of fluid replacement therapy in trauma (technology appraisal guidance no [Internet] 2004. Available from: https://www.nice.org.uk/guidance/ta74/resources/prehospital-initiation-of-fluid-replacement-therapy-in-trauma-pdf-2294758518469. Last accessed 2026 Nov 3.
10. Walsh SR, Walsh CJ. Intravenous fluid-associated morbidity in postoperative patients. Ann R Coll Surg Engl. 2005;87(2):126–30. https://doi.org/10.1308/147870805x28127.
11. Sung CW, Sun JT, Huang EPC, Shin SD, Song KJ, Hong KJ, et al. Association between prehospital fluid resuscitation with crystalloids and outcome of trauma patients in Asia by a cross-national multicenter cohort study. Sci Rep. 2022;12(1):4100. https://doi.org/10.1038/s41598-022-06933-x.
12. Bossel D, Bourgeat M, Pantet O, Zingg T. Effect of prehospital intravenous fluids on initial metabolic acid-base status in trauma patients: a retrospective cohort study. Metabolites. 2023;13(8):937. https://doi.org/10.3390/metabo13080937.