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Review Article

Clinical Review of Intravenous Fluid Prescribing Patterns in Tertiary Care Hospitals

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ABSTRACT

Intravenous (IV) fluid therapy constitutes a fundamental component of patient care in tertiary healthcare settings, contributing significantly to hemodynamic stabilization, electrolyte balance, and organ perfusion. Despite its routine use, inappropriate prescribing of IV fluids continues to represent a major clinical challenge, leading to increased morbidity, extended hospital stays, and additional healthcare burden. This review aims to critically examine existing prescribing practices of intravenous fluids in tertiary care hospitals, evaluate adherence to established clinical guidelines, and identify commonly encountered prescribing errors. A narrative review of literature published between 2000 and 2025 was performed using major biomedical databases. Evidence suggests that a considerable proportion of IV fluid prescriptions are suboptimal, particularly in terms of fluid selection, dosage, infusion rate, and electrolyte composition. Contributing factors include inadequate clinical training, absence of standardized institutional protocols, and insufficient patient assessment. Although balanced crystalloids are increasingly recommended due to their improved safety profile, their adoption remains inconsistent in routine practice. The implementation of evidence-based guidelines, along with continuous medical education and regular clinical audits, is essential to enhance prescribing practices and improve patient outcomes. Rationalization of IV fluid therapy is crucial for promoting patient safety and optimizing clinical care in tertiary healthcare institutions.

INTRODUCTION

Intravenous (IV) fluid therapy represents a fundamental component of patient management in contemporary clinical practice and is extensively utilized across various hospital settings, particularly in tertiary care institutions where critically ill patients are treated[1]. The

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administration of IV fluids is essential for preserving intravascular volume, maintaining electrolyte homeostasis, and ensuring adequate tissue perfusion in a wide range of clinical conditions[2]. It has been reported that a significant proportion of hospitalized patients receive intravenous fluids during their course of treatment, emphasizing its importance as one of the most frequently prescribed therapeutic interventions[3].

Although IV fluid therapy is routinely practiced, it is increasingly acknowledged as a complex clinical intervention that demands careful evaluation and individualized decision-making. Fluids should be regarded as pharmacologically active agents, with specific indications, contraindications, dosing considerations, and potential adverse effects[4]. Inappropriate prescribing practices, including incorrect selection of fluid type, volume, or rate of administration, may result in serious complications such as fluid overload, electrolyte imbalance, acid–base disturbances, and increased risk of morbidity and mortality[5]. Evidence from clinical studies indicates that nearly one-fifth of hospitalized patients may experience adverse outcomes related to suboptimal fluid management[6].

In tertiary care hospitals, the responsibility of prescribing IV fluids frequently lies with junior clinicians, interns, or early-career practitioners, who may not always possess adequate training or clinical expertise in fluid therapy[7]. Several studies have demonstrated that healthcare professionals often face challenges in accurately assessing a patient's fluid status, determining appropriate fluid requirements, and selecting the most suitable type of fluid for specific clinical scenarios[8]. This lack of confidence and structured training contributes to considerable variability and inconsistency in prescribing patterns.

To improve clinical practice, evidence-based guidelines such as those issued by the National Institute for Health and Care Excellence (NICE) have proposed a systematic framework for IV fluid therapy, categorizing it into resuscitation, maintenance, replacement, and reassessment phases[9]. Despite the availability of such guidelines, adherence remains inconsistent across healthcare institutions due to factors such as limited awareness, absence of standardized hospital protocols, and variability in clinical judgment[10].

Another important concern in fluid therapy is the inappropriate choice between different types of fluids, particularly crystalloids and colloids. Normal saline continues to be widely used in many clinical settings; however, excessive administration has been associated with complications such as hyperchloremic metabolic acidosis and renal dysfunction[11]. Recent evidence increasingly supports the use of balanced crystalloids, which are associated with improved physiological outcomes and reduced risk of adverse effects[12]. Nevertheless, the adoption of these alternatives varies considerably across institutions and clinical specialties.

Furthermore, inadequate monitoring of patients receiving IV fluids, including poor documentation of fluid balance, lack of regular reassessment, and insufficient electrolyte surveillance, further contributes to inappropriate fluid therapy[13]. The dynamic nature of fluid requirements in hospitalized patients necessitates continuous evaluation to prevent both under-resuscitation and fluid overload.

Given the complexity of IV fluid therapy and the significant impact of prescribing errors on patient outcomes, it is imperative to critically evaluate current prescribing practices in tertiary care settings. Identifying common patterns, gaps in

guideline adherence, and areas of clinical concern can provide valuable insights for improving patient care. Therefore, this review aims to comprehensively assess intravenous fluid prescribing patterns in tertiary care hospitals, evaluate compliance with established guidelines, and highlight potential strategies to promote rational, safe, and evidence-based fluid therapy.

2. METHODOLOGY

The present review was conducted as a systematic narrative review with the objective of critically analyzing intravenous fluid prescribing patterns in tertiary care hospital settings. A structured and comprehensive literature search strategy was employed to ensure the inclusion of relevant and high-quality studies addressing fluid therapy practices and their clinical implications.

A detailed search of electronic databases, including PubMed, Scopus, Web of Science, and Google Scholar, was performed to identify studies published between January 2000 and March 2025. These databases were selected to ensure wide coverage of peer-reviewed biomedical literature and to capture both classical and recent evidence related to intravenous fluid therapy[14].

The search strategy involved the use of multiple keywords and their combinations, such as *"intravenous fluid therapy," "fluid prescribing patterns," "tertiary care hospitals," "crystalloids," "colloids," "fluid therapy errors,"* and *"clinical audit of IV fluids."* Boolean operators (AND, OR) were applied to refine the search results and improve specificity. Additional manual screening of reference lists from selected articles was also performed to identify further relevant studies that might not have been captured during the initial search process[15].

All identified studies were subjected to a preliminary screening based on titles and abstracts, followed by full-text evaluation to determine eligibility. The selection process was guided by predefined inclusion and exclusion criteria to maintain consistency and reduce selection bias.

2.1 Inclusion Criteria

The following criteria were used for selecting studies:

1. Research conducted in tertiary care hospitals or similar advanced healthcare settings
2. Observational studies, prospective or retrospective analyses, randomized controlled trials, clinical audits, and review articles
3. Studies focusing on intravenous fluid prescribing patterns, adherence to clinical guidelines, or associated patient outcomes
4. Articles published in the English language with accessible full text

2.2 Exclusion Criteria

Studies were excluded based on the following conditions:

1. Research conducted in primary care or community healthcare settings
2. Case reports, editorials, letters to the editor, and conference abstracts without sufficient data
3. Studies lacking clearly defined outcome measures or methodological transparency

2.3 Data Extraction And Synthesis

Relevant data from the selected studies were systematically extracted, including information on

study design, sample size, clinical setting, types of intravenous fluids prescribed, prescribing indications, adherence to established guidelines, and reported clinical outcomes. Particular emphasis was placed on identifying trends in prescribing behaviour, common errors, and variations in clinical practice.

The extracted data were synthesized using a qualitative approach, allowing for a comprehensive interpretation of findings across diverse study designs. Key themes such as inappropriate fluid selection, deviations from recommended guidelines, and inadequate monitoring practices were analyzed in detail. The review also considered adherence to widely accepted clinical guidelines, particularly those proposed by the National Institute for Health and Care Excellence (NICE), which provide a structured framework for fluid therapy in hospitalized patients[9].

To enhance the reliability of the findings, priority was given to studies published in high-impact, peer-reviewed journals. Variations in prescribing practices across different specialties and geographical regions were also examined to provide a broader understanding of the issue[16].

3. TYPES OF INTRAVENOUS FLUIDS

Intravenous fluids are broadly categorized into crystalloids and colloids, each differing in composition, distribution characteristics, and clinical applications[11]. The appropriate selection of fluid type is a critical determinant of therapeutic success, as different fluids exert varying effects on intravascular volume, interstitial balance, and electrolyte homeostasis.

3.1 Crystalloids

Crystalloids are solutions composed of water and low-molecular-weight solutes, such as electrolytes or glucose, which readily diffuse across semi-permeable membranes. Due to their ease of availability, lower cost, and favourable safety profile, crystalloids are the most frequently administered intravenous fluids in both emergency and routine clinical care[12].

These fluids distribute rapidly within the extracellular compartment, with only a fraction remaining in the intravascular space after infusion. Despite this, they are widely used for volume resuscitation, maintenance therapy, and correction of electrolyte imbalances.

Classification of Crystalloids:

1. **Isotonic solutions:**

These fluids have an osmolarity similar to plasma and primarily expand the extracellular fluid compartment.

Examples: 0.9% Normal Saline (NS), Ringer's Lactate (RL)

2. **Hypotonic solutions:**

These have lower osmolarity than plasma and facilitate movement of water into cells, making them useful in cellular dehydration.

Example: 0.45% Sodium Chloride

3. **Hypertonic solutions:**

These possess higher osmolarity and draw water from intracellular to extracellular compartments.

Example: 3% Sodium Chloride

Balanced crystalloids, such as Ringer's Lactate and Plasma-Lyte, are increasingly preferred over normal saline due to their closer resemblance to

plasma electrolyte composition and reduced risk of hyperchloremic metabolic acidosis and renal dysfunction[12].

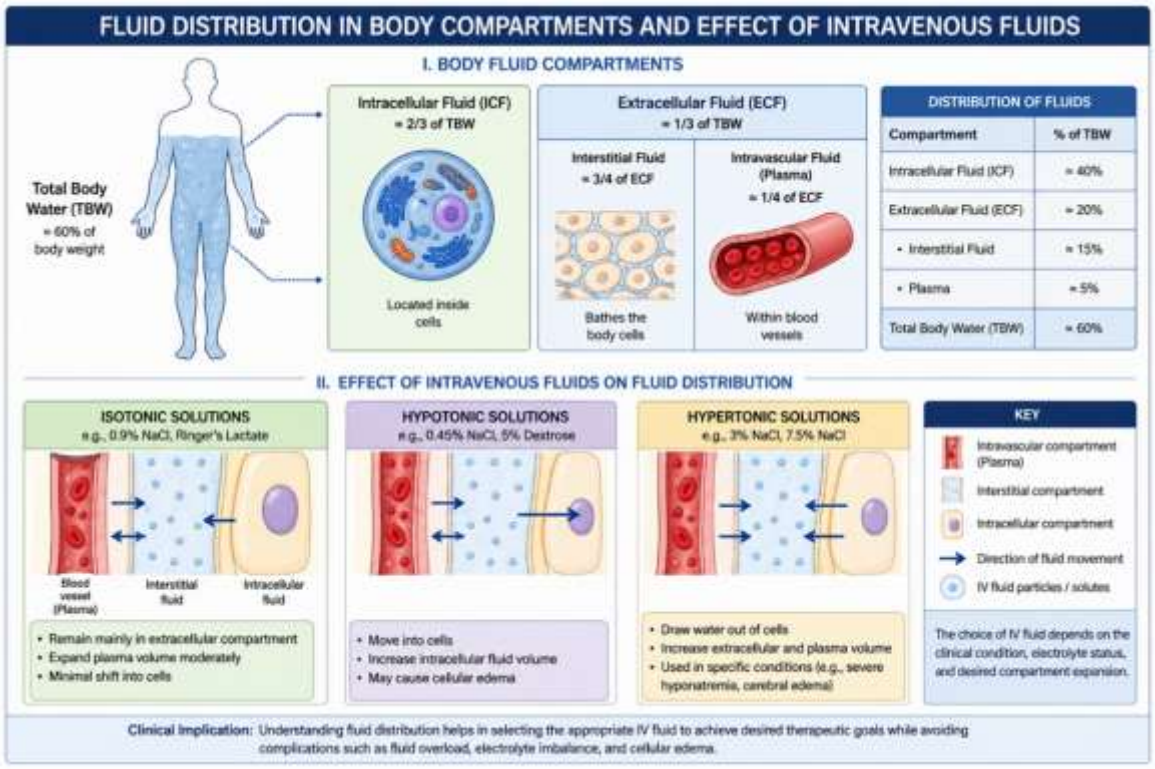

Figure 1: Fluid distribution in body compartments and effect of intravenous fluids

3.2 Colloids

Colloids are solutions containing high-molecular-weight substances, such as proteins or synthetic polymers, which remain within the intravascular compartment for a longer duration compared to crystalloids[11]. These fluids exert oncotic pressure, thereby promoting plasma volume expansion with relatively smaller infused volumes.

Commonly used colloids include:

1. Human albumin
2. Dextrans
3. Hydroxyethyl starch (HES)

Although colloids offer theoretical advantages in maintaining intravascular volume, their clinical use has declined due to concerns regarding higher cost, risk of anaphylactic reactions, coagulopathy, and potential renal toxicity, particularly with synthetic starches[13]. Current evidence suggests that crystalloids are generally preferred for most clinical indications, except in selected cases requiring targeted plasma expansion.

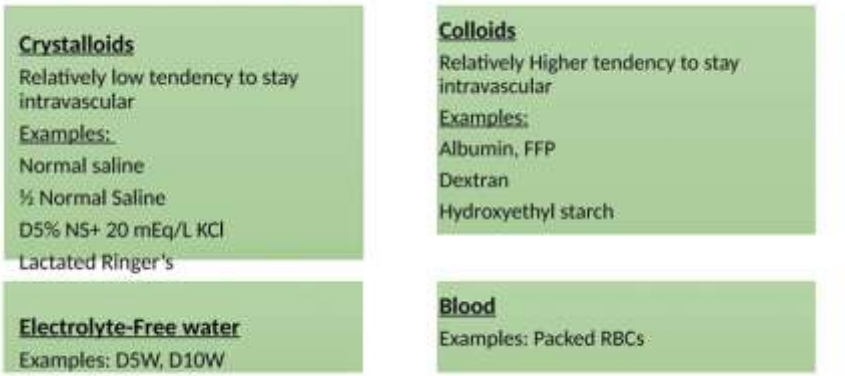

Figure 2: Category of IV Fluids

Table 1: Classification and Clinical Characteristics of Intravenous Fluids

Category	Examples	Composition	Distribution	Clinical Indications
Isotonic Crystalloids	Normal Saline, Ringer's Lactate	Electrolytes similar to plasma	Extracellular	Fluid resuscitation, dehydration
Hypotonic Fluids	0.45% NaCl	Lower sodium concentration	Intracellular shift	Cellular dehydration
Hypertonic Fluids	3% NaCl	High sodium concentration	Pulls fluid into vessels	Severe hyponatremia, cerebral edema
Colloids	Albumin, Dextran, HES	Large molecules	Intravascular retention	Plasma volume expansion

3.3 Clinical Considerations In Fluid Selection

The selection of intravenous fluids should be individualized based on patient-specific factors, including age, underlying disease, hemodynamic status, electrolyte balance, and organ function[16]. In critically ill patients, inappropriate fluid selection can significantly influence clinical outcomes.

Key considerations include:

1. Assessment of fluid deficit and ongoing losses
2. Monitoring of serum electrolytes and renal function
3. Avoidance of fluid overload, especially in cardiac or renal patients
4. Preference for balanced crystalloids in most clinical scenarios

Recent clinical evidence supports a restrictive and goal-directed fluid strategy, which has been associated with improved patient outcomes and reduced complications such as pulmonary edema and acute kidney injury[15].

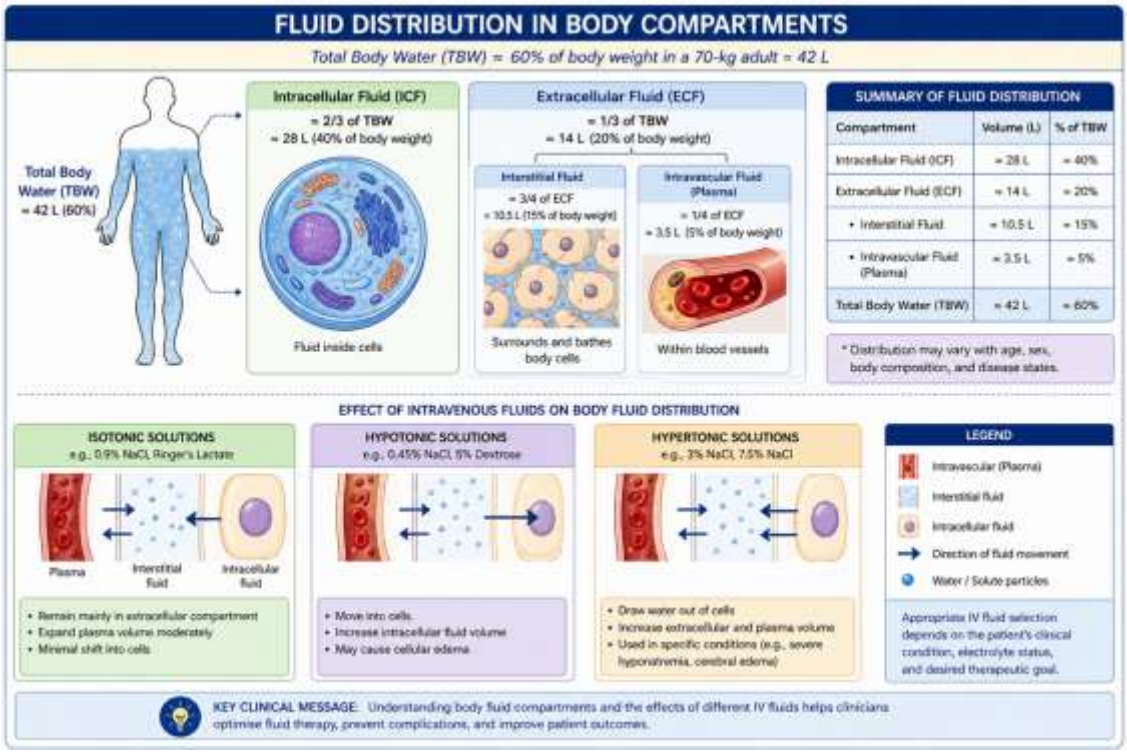

Figure 3: Fluid Distribution in Body Compartments

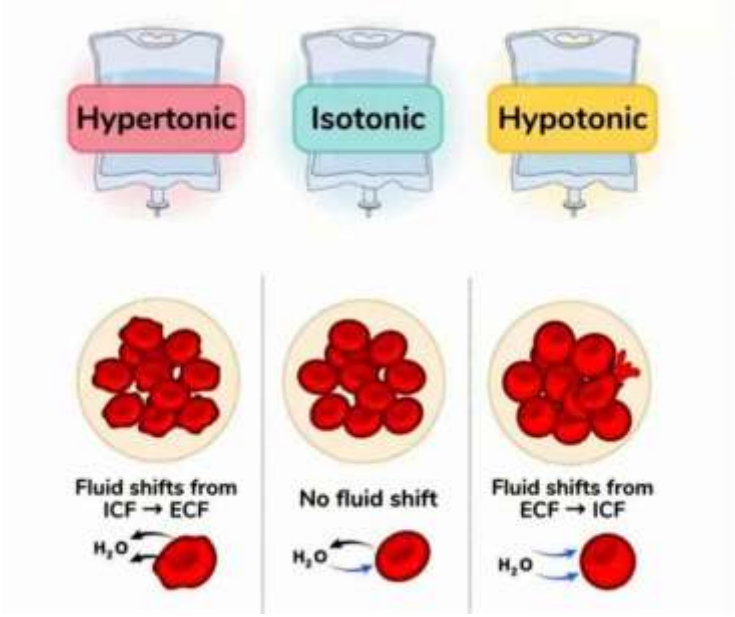

Figure 4: Types of IV Solution

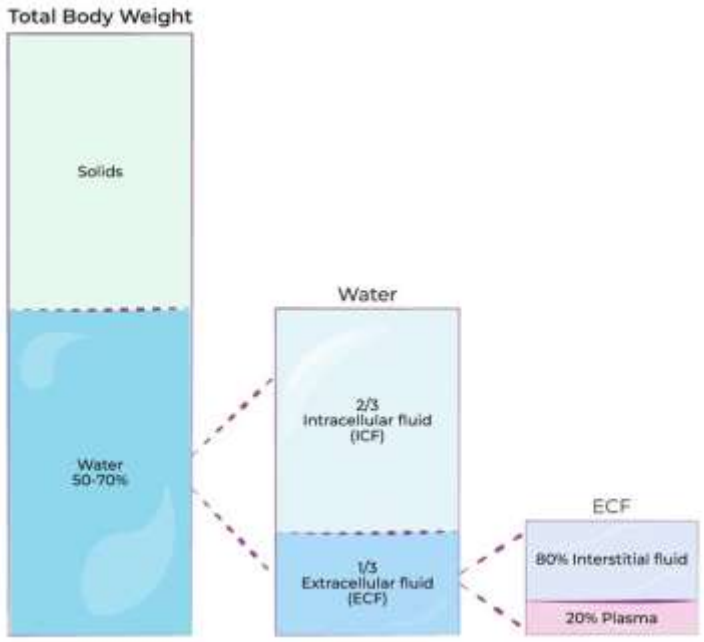

Figure 5: Body water compartments

4. INTRAVENOUS FLUID PRESCRIBING PATTERNS

Intravenous fluid prescribing practices in tertiary care hospitals demonstrate considerable variability across different clinical departments and levels of expertise among healthcare professionals. Despite the availability of well-established clinical guidelines, multiple studies have reported inconsistent adherence and frequent deviations from recommended practices, which may adversely affect patient outcomes[14]. The complexity of patient conditions in tertiary care settings further contributes to variability in prescribing behaviour.

4.1 Choice Of Fluid

The selection of an appropriate intravenous fluid is a critical aspect of patient management. 0.9% normal saline (NS) continues to be the most frequently prescribed fluid in many healthcare settings due to its widespread availability and familiarity among clinicians. However, emerging evidence increasingly supports the use of balanced crystalloids, such as Ringer's Lactate and Plasma-Lyte, owing to their closer physiological composition and improved safety profile[12].

Excessive administration of normal saline has been linked to hyperchloremic metabolic acidosis, impaired renal perfusion, and an increased risk of acute kidney injury[15]. Despite this, the transition toward balanced solutions remains inconsistent, highlighting a gap between evidence and clinical practice.

4.2 Volume And Rate Of Administration

Determining the correct volume and infusion rate of intravenous fluids is essential to achieving optimal therapeutic outcomes. Errors in this domain are among the most commonly reported prescribing issues. Both under-resuscitation and over-resuscitation can have serious consequences, including tissue hypoperfusion, organ dysfunction, or fluid overload[16].

In many cases, fluid prescriptions are not adequately individualized and may not account for

patient-specific factors such as age, comorbidities, renal function, or ongoing fluid losses. Lack of continuous reassessment further exacerbates these problems.

4.3 Indication-Based Prescribing

A rational approach to intravenous fluid therapy requires clear identification of the clinical indication, which is typically categorized into:

1. Resuscitation – rapid restoration of intravascular volume in critically ill patients
2. Maintenance – provision of daily fluid and electrolyte requirements
3. Replacement – correction of ongoing losses (e.g., vomiting, diarrhoea, drains)

However, clinical studies indicate that these categories are frequently overlooked or poorly differentiated in practice, resulting in inappropriate prescribing decisions[17]. Failure to align fluid therapy with its intended purpose often leads to suboptimal patient management.

4.4 Departmental Variations In Prescribing

Prescribing patterns may vary significantly across hospital departments such as intensive care units (ICUs), general medicine wards, and surgical units. For instance, ICU settings may demonstrate more adherence to protocol-based fluid management, whereas general wards often exhibit inconsistent practices due to limited monitoring and oversight[16]. These variations highlight the importance of standardized institutional protocols.

4.5 Factors Influencing Prescribing Patterns

Several factors contribute to variability in IV fluid prescribing, including:

1. Level of clinician experience
2. Availability of institutional guidelines
3. Clinical workload and time constraints
4. Lack of structured training programs
5. Inadequate documentation systems

Addressing these factors is crucial for improving prescribing accuracy and patient safety.

5. COMMON PRESCRIBING ERRORS

Inappropriate intravenous fluid therapy remains a significant concern in clinical practice, with multiple studies identifying recurrent prescribing errors that can compromise patient safety[18]. These errors are particularly prevalent among junior doctors and trainees, often due to insufficient clinical training and limited supervision[19].

Common Errors Include:

1. Selection of inappropriate type of fluid for the clinical condition
2. Incorrect calculation of fluid volume or infusion rate
3. Failure to perform adequate initial patient assessment
4. Inadequate monitoring of electrolytes and fluid balance
5. Poor or incomplete documentation of fluid therapy

These issues collectively contribute to complications such as fluid overload, electrolyte disturbances, and increased morbidity.

Table 2: Common Errors in IV Fluid Prescribing and Clinical Impact

Error Type	Description	Clinical Consequence
Incorrect Fluid Selection	Use of inappropriate fluid (e.g., NS instead of balanced fluids)	Metabolic acidosis, renal dysfunction
Inappropriate Volume	Over- or under-prescription of fluids	Fluid overload or hypovolemia
Wrong Infusion Rate	Too rapid or too slow administration	Hemodynamic instability
Poor Assessment	Lack of evaluation of patient fluid status	Inaccurate therapy
Inadequate Monitoring	Failure to track electrolytes and fluid balance	Electrolyte imbalance
Documentation Errors	Missing or incomplete records	Poor continuity of care

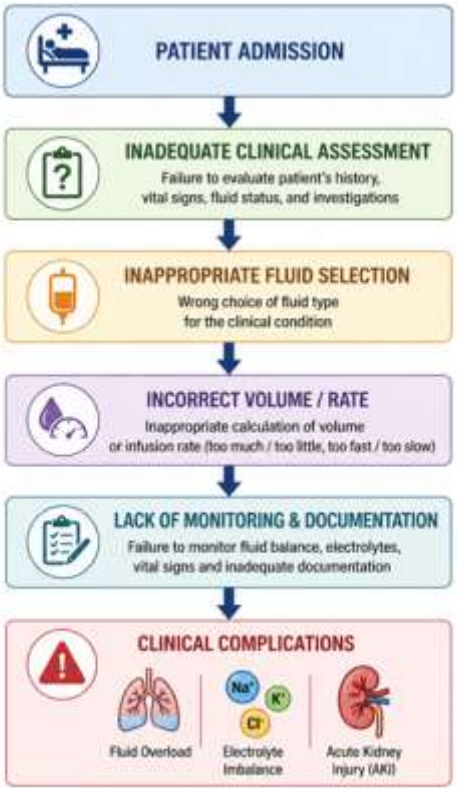

Figure 6: Common Errors in IV Fluid Prescribing

5.1 Clinical Implications Of Prescribing Errors

The consequences of inappropriate fluid prescribing extend beyond immediate physiological disturbances. They may lead to:

1. Increased length of hospital stay
2. Higher treatment costs
3. Greater risk of intensive care admission
4. Increased mortality in critically ill patients

Therefore, improving prescribing practices through education, clinical audits, and guideline implementation is essential for optimizing patient outcomes.

6. CLINICAL IMPACT OF INAPPROPRIATE FLUID THERAPY

Inappropriate administration of intravenous fluids is associated with a wide range of adverse clinical outcomes, particularly in hospitalized patients with complex medical conditions. Errors in fluid selection, volume, and monitoring can disrupt physiological balance and significantly compromise patient safety[20].

One of the most frequently observed complications is fluid overload, which may result in pulmonary edema, impaired gas exchange, and increased need for ventilatory support. This is especially critical in patients with underlying cardiac or renal dysfunction, where even modest fluid excess can precipitate clinical deterioration.

Electrolyte disturbances are another major concern associated with improper fluid therapy. Conditions such as hyponatremia and hypernatremia may arise due to inappropriate choice of fluid or inadequate monitoring, leading to neurological complications ranging from confusion to seizures. Similarly, excessive chloride administration from normal saline has been linked to metabolic acidosis and renal vasoconstriction, further exacerbating patient morbidity[20].

Acute kidney injury (AKI) is a well-documented consequence of both fluid overload and inappropriate fluid composition. Altered renal perfusion, combined with electrolyte imbalance, contributes to worsening renal function and may increase the need for renal replacement therapy in severe cases.

Furthermore, inappropriate fluid therapy has been associated with prolonged hospital stay, increased healthcare costs, and higher mortality rates, particularly in critically ill populations. In contrast, studies have demonstrated that the use of balanced crystalloid solutions and goal-directed fluid therapy strategies can significantly improve patient outcomes by minimizing complications and optimizing hemodynamic stability[21].

Given these findings, it is evident that intravenous fluids should be prescribed with the same level of caution and precision as pharmacological agents, with continuous monitoring and reassessment to ensure safe and effective therapy.

7. DISCUSSION

The findings of this review reveal substantial variability in intravenous fluid prescribing practices across tertiary care hospitals, reflecting inconsistencies in clinical decision-making and guideline implementation. Despite the availability of evidence-based recommendations, adherence to standardized protocols remains suboptimal, particularly in non-critical care settings.

A key issue identified is the persistent overuse of normal saline, despite growing evidence supporting the benefits of balanced crystalloids. This discrepancy highlights a gap between current research and routine clinical practice. Additionally, the lack of individualized fluid therapy—where patient-specific factors such as age, comorbidities, and fluid status are not adequately considered—contributes to inappropriate prescribing patterns.

Another critical concern is the inadequate monitoring of fluid therapy, including insufficient documentation of fluid balance and lack of regular reassessment. These deficiencies increase the likelihood of complications and hinder timely clinical intervention. The problem is further compounded by the fact that IV fluid prescribing is often delegated to junior doctors, who may have limited training and confidence in fluid management.

Encouragingly, several studies have demonstrated that targeted educational interventions, including structured teaching programs and simulation-based training, can significantly enhance clinicians' understanding of fluid therapy and improve prescribing accuracy[22]. Similarly, the implementation of standardized hospital protocols, electronic prescribing systems, and clinical decision support tools has been shown to reduce errors and promote adherence to guidelines.

Regular clinical audits and feedback mechanisms also play a vital role in identifying gaps in practice and ensuring continuous quality improvement. By integrating these strategies, healthcare institutions can foster a culture of safe and evidence-based fluid management.

8. CONCLUSION

Intravenous fluid therapy remains an essential component of patient care; however, it continues to be a frequently underestimated and mismanaged aspect of clinical practice in tertiary care hospitals. The evidence presented in this review underscores the significant impact of inappropriate fluid prescribing on patient outcomes, including increased morbidity, prolonged hospitalization, and preventable complications.

There is an urgent need to adopt a structured and patient-centered approach to fluid therapy, emphasizing accurate clinical assessment, appropriate fluid selection, and continuous monitoring. Strengthening clinician education, particularly among junior healthcare professionals, is crucial for improving competency in fluid management.

Moreover, strict adherence to evidence-based guidelines, supported by institutional protocols and regular audit systems, can greatly enhance prescribing practices. The integration of goal-directed fluid therapy and balanced crystalloid use should be encouraged to optimize clinical outcomes.

In conclusion, improving intravenous fluid prescribing practices requires a multidisciplinary effort, combining education, guideline implementation, and ongoing evaluation. Such measures are essential to ensure safe, rational, and effective fluid therapy, ultimately leading to improved patient safety and quality of care.

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