03 - IV Fluids, Electrolytes & Infusions

FDMSEC Insights | March -2026

From

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Message From Dr. Bhaskar Pal

Dr. Bhaskar Pal
President FOGSI-2026

It gives me great pleasure to share a few words for this April 2026 issue of FDMSEC Insights, which takes up a subject that is central to everyday clinical practice, though not always discussed with the seriousness it deserves.

A difficult consultation is not necessarily about a difficult diagnosis. More often, it is about a difficult moment. It may arise when the patient has already decided the treatment, when internet-based information has created confusion, or when the doctor has to explain why a requested option is not the safest one. In such situations, medical knowledge alone is not enough. Clarity, judgement and balance become equally important.

This issue addresses these realities through very relevant topics such as “When the Patient Has Already Decided the Treatment,” “Google-Informed, Half-Informed, Misinformed: Managing the New Patient,” and “How to Say No Without Losing the Patient.” These are situations that every Obstetrician and Gynaecologist faces, irrespective of place of practice or years of experience.

I am particularly happy that the issue has focused on practical communication within the framework of safe and responsible care. When a doctor explains well, listens carefully, and guides firmly without losing respect for the patient’s concerns, better decisions become possible. I compliment Dr Asha Jain, Chairperson, FDMSEC, for choosing a theme of immediate relevance and for developing it in a manner that is useful to practicing doctors. I am sure this issue will be read with interest and applied in day-to-day work.
With best wishes,
Dr Bhaskar Pal
President, FOGSI

Message from Dr Suvarna Khadilkar

Dr. Suvarna Khadilkar
Secretary General FOGSI

Safe systems are as important as correct prescriptions.

Infusion therapy does not depend only on the drug prescribed; it also depends on the systems through which that therapy is delivered. Equipment, monitoring processes and staff coordination all play an important role in ensuring patient safety.

This issue of FDMSEC Insights highlights several operational aspects of infusion therapy that deserve greater attention. One such area is the safe use of infusion pumps. These devices are designed to improve accuracy in drug delivery, but their benefits depend on correct programming, regular checks and adequate staff familiarity with their functioning.

Another important concern is extravasation injury, which can occur when medications leak outside the vein during infusion. Early recognition and prompt action are essential to prevent tissue damage. Clear protocols and staff awareness can significantly reduce the impact of such events.

The issue also draws attention to labeling and line errors, which remain a preventable source of medication incidents in busy hospital environments. Simple measures such as clear labeling and systematic line tracing can prevent serious mistakes.

Finally, the importance of structured infusion protocols for clinics and hospitals is emphasised. Standardised systems ensure that safe practices are followed consistently across teams and settings. Strengthening these operational safeguards is an important step toward improving patient safety and quality of care.

Dr. Suvarna Khadilkar
Secretary General FOGSI

Message From Dr.Vidya Thobbi

Dr.Vidya Thobbi
VP South Zone FOGSI
Incharge FDMSEC

Electrolyte therapy demands precision.
Electrolyte management is a routine part of hospital care, yet it is an area where small errors can have significant consequences. Accurate dosing, correct dilution and careful monitoring are essential whenever electrolyte replacement is undertaken.

This issue of FDMSEC Insights draws attention to the safe use of **high-alert electrolyte therapies**, particularly potassium replacement. Although potassium supplementation is commonly required, it remains one of the medications most associated with preventable complications when administered incorrectly. Safe infusion rates, appropriate dilution and vigilant monitoring are therefore essential safeguards.

Another important topic discussed in this issue is the growing role of **intravenous iron therapy**. Iron infusions have become an effective option in the management of anaemia, especially in obstetric and gynecological care. At the same time, correct dose calculation, patient selection and careful monitoring during infusion remain critical for safe practice.

The issue also highlights a practical clinical reality that electrolyte imbalance can sometimes arise from medical intervention rather than the underlying disease. Avoiding rapid correction and maintaining close clinical observation are therefore key principles.

By focusing on these aspects of electrolyte therapy, this issue encourages clinicians to review prescribing habits and reinforce systems that support safer patient care.

Dr.Vidya Thobbi
VP South Zone FOGSI
Incharge FDMSEC

Message From Dr.Asha Jain

Dr.Asha Jain

Chairperson

FOGSI FDMSE Committee

FOREWORD

At the outset, I express my sincere gratitude to **Dr Bhaskar Pal, President FOGSI, Dr Vidya Thobbi, Vice President-in-Charge**, and **Dr Suvarna Khadilkar, Secretary General**, for their continued guidance and encouragement for the work of the Food, Drugs & Medicosurgical Equipment Committee. Their support allows initiatives such as FDMSEC Insights to address practical issues that influence everyday clinical practice.

The March 2026 issue focuses on a subject that is both routine and critical in hospital care- I**V Fluids, Electrolytes and Infusions**. Intravenous therapy is among the most common interventions in clinical medicine. Because it is used so frequently, it is sometimes approached casually. Yet errors in fluid selection, infusion rates, electrolyte correction, line identification or monitoring can lead to avoidable complications. Safe systems and careful prescribing therefore remain essential.

The articles in this issue examine different aspects of infusion safety in a practical manner. They discuss the overuse of intravenous fluids, the evolving understanding of normal saline, and the caution required when administering potassium. Important clinical areas such as iron infusions and iatrogenic electrolyte imbalance are also addressed. The issue further explores operational aspects of care including infusion pump vigilance, prevention of extravasation injuries, safe handling of high-alert infusions in the labour room, and the importance of proper labeling of lines. The concluding article emphasises the need for structured infusion protocols in clinics and hospitals.

I would like to thank all the contributors to this issue- **Dr Ananthalakshmi**, **Dr Priyanka Rai**, **Dr Geetika Sharma**, **Dr R.J. Mahajan**, **Dr Vishnupriya KMN**, **Dr Sugandha Goel**, **Dr Poushali Sanyal**, **Dr Pratibha Baldawa**, **Dr V. Padmaja** and **Dr Prabhdeep Kaur-** for sharing their insights and practical guidance.

This issue also includes Toolkit and Red Flags sections, which translate knowledge into quick reference points that clinicians and teams can use in everyday practice.

Our aim through FDMSEC Insights is simple: to highlight areas where awareness, systems and small changes in routine practice can make patient care safer. I hope readers will find the discussions in this issue useful and will carry these lessons into their own institutions and clinics.

Warm regards,

Dr Asha Jain

Chairperson, FOGSI Committee on Food, Drugs & Medicosurgical Equipment (FDMSEC)

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IV Fluids: The Most Misused Prescription in Hospitals

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INTRODUCTION:

"IV fluids are among the most commonly prescribed therapies in hospitals; however, they are frequently underestimated and regarded as routine, harmless interventions."they are usually started casually, continued indiscrimately and rarely reviewed with the same stringently as any other drug. Though often perceived as harmless therapy, they are in fact more potent drugs with significant physiological effects, starting from fluidoverload & electrolyte imbalance to acute kidney injury & increased morbidity which are often preventable. Recognizing IV fluids as pharmacological agents rather than a passive supportive therapy &perceiving it as a clinical decision rather as a 'Default-order' is the first step towards safer and more rational use.

Like any other drugs, IV fluids also require;

Indication (For Replacement/ resuscitation/ maintenance)
Type of IV fluids indicated
Dose
Side effects
Contraindications
Definite duration
Monitoring for adverse effects

Indications for fluid therapy

1.Resuscitation- Hypovolemic Shock, Haemorrhage, Sepsis Etc
2.Maintanace- Patient Unable To Take Oral Fluid
3. Replacement- Ongoing Losses
4. Correction- Electrolyte Imbalances

Types of IV Fluids:

IV fluids are broadly classified based on their composition and effect on body fluid compartments.

	Description	Common types:
CRYSTALLOIDS first-line in most situations	Solutions of small molecules that easily pass through vascular membranes.	• Normal Saline (0.9% NaCl) • Ringer Lactate (RL) / Hartmann's solution • Dextrose solutions (5% dextrose, DNS) • Plasma-Lyte
COLLOIDS Has specific indications	Large molecules that remain in the intravascular space and exert oncotic pressure.	Albumin Dextran Hydroxyethyl starch (HES) Gelatins
BASED ON TONICITY Determines fluid shift and complications	Description	Examples
a) Isotonic Fluids	Same osmolarity as plasma Stay mainly in extracellular space	Normal saline Ringer lactate
b) Hypotonic Fluids	Lower osmolarity than plasma Water moves into cells	0.45% saline 5% dextrose (acts hypotonic after metabolism)
c) Hypertonic Fluids	Higher osmolarity than plasma Pulls water out of cells	3% saline Dextrose 10%

Misuse By Habit, Not By Intent

1. Routine post-operative fluids without calculating the actual fluid & electrolyte requirement for that patient.
2. Prescribing fixed volumes without individualizing patient care.
3. Continuation of IV fluids solely due to the presence of a cannula.
4. The use of iv fluids for nonspecific symptoms, such as generalized weakness.
5. Lack of timely discontinuation of IV fluids in clinically stable patients with adequate oral intake.
6. Failure to account for ongoing fluid losses.

Such practices convert a therapeutic intervention into one that is inappropriate and potentially detrimental.

Adverse Clinical Outcomes Associated with Misuse of Intravenous Fluids

	Fluid overload	**Dehydration**	**Electrolyte abnormalities**	**Other outcomes**
	Pulmonary and peripheral oedema	Acute kidney injury	Hypernatraemia and hyponatraemia	elastin and starches associated with acute kidney injury
	Delayed recovery after surgery (wound healing, chest infections, mobility	Hypotension and shock	Hyperkalaemia and hypokalaemia	
	Chest infections	Arrhythmias	Hyperchloraemic acidosis	Albumin associated with poorer outcomes from traumatic brain injury

Heightened Risk in Vulnerable Clinical Contexts:

1. Pregnancy:

Reduced tolerance to fluid overload, with an increased risk of pulmonary oedema, especially in the setting of preeclampsia.

2. Elderly patients:

Reduced cardiac and renal reserve predisposes to increased susceptibility to fluid-related complications.

3. Renal disease:

There is a reduced capacity to excrete excess fluid and maintain electrolyte homeostasis.

A Practical Approach to Rational Intravenous Fluid Prescription: The '5R' Framework.

1. Resuscitation
2. Routine Maintenance
3. Replacement
4. Redistribution
5. Reassessment

Intravenous fluid therapy should only be initiated following a comprehensive clinical evaluation, including assessment of indication, choice of fluid, dose, risk stratification, and a clear plan for reassessment Ongoing monitoring must encompass vital parameters, urine output, serial body weight measurements, and serum electrolyte evaluation, supported by accurate maintenance of fluid balance charts.

Clinical calculation of iv fluids to be given as replacement : is based on the :Holliday-Segar method : (the "4-2-1 rule"), which estimates hourly fluid requirements to replace insensible losses and maintain urine output.

Calculate based on the patient's :actual body weight (using ideal body weight if morbidly obese):
Patient Weight : Hourly Rate
First 10 kg : 4 mL/kg/hour
Next 10 kg (11–20 kg) : 2 mL/kg/hour
Each kg > 20 kg : 1 mL/kg/hour

Example Calculations

*70 kg adult: (10 kg × 4) + (10 kg × 2) + (50 kg × 1) = 40 + 20 + 50 = 110 mL/hour
*50 kg adult: (10 kg × 4) + (10 kg × 2) + (30 kg × 1) = 40 + 20 + 30 = 90 mL/hour
Total Daily Volume (Simplified)
A common shortcut for adults (especially those 50–70 kg) is:
30 mL/kg/day: (e.g., 70 kg → ~2100 mL/day or ~85–90 mL/hour)
Scenario Adjustment
Obese patient (BMI > 40): Use ideal body weight or 14 mL/kg actual weight/day
Elderly or heart failure: Start at 2/3 of calculated rate (e.g., 70–80 mL/hour)
Fever (>37°C): Add 2.5 mL/kg/day per 1°C rise (roughly +5–10% of rate) |
Hyperventilation: Add 5–10% for tachypnea without fever |
Post-operative: Often 75–100 mL/hour (many surgeons use 100–125 mL/hour for first 24 hours)

Real-World Challenges in Intravenous Fluid Management in Rural India.

In many rural settings across India, intravenous fluids are often perceived as a symbol of potent or definitive treatment. It is not uncommon to encounter patient narratives such as, 'Doctor administered a bottle of saline, and I felt better,' reflecting this deeply ingrained belief.

Such prevailing perceptions exert significant pressure on clinicians. The decision to withhold intravenous fluids in the absence of clear clinical indication may lead to patient dissatisfaction and attrition to alternative providers.

As a result, intravenous fluids are often administered to align with patient expectations and maintain therapeutic rapport, rather than being guided strictly by evidence-based clinical need.

Practical Strategies for Safer Clinical Practice

1. Strengthening education and training of healthcare providers
2. Enhancing patient education and fostering trust while avoiding overtreatment
3. Implementation of standardized, evidence-based protocols
4. Regular clinical auditing and feedback mechanisms
5. Avoidance of defensive prescribing practices
6. Promoting the recognition of intravenous fluids as pharmacologically active interventions, not merely supportive therapy

Conclusion

Intravenous fluids, though fundamental to patient care, are frequently misused due to habitual practices, misconceptions, and systemic pressures. Recognizing IV fluids as pharmacologically active interventions rather than benign supportive therapy is essential. Rational prescribing, guided by clear indications, individualized assessment, and regular reassessment, is critical to prevent avoidable harm. A shift towards evidence-based practice, supported by education, protocol-driven care, and patient awareness, is imperative to ensure safer and more effective use of intravenous fluids in all clinical settings.

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02 Normal Saline Is Not Always Normal

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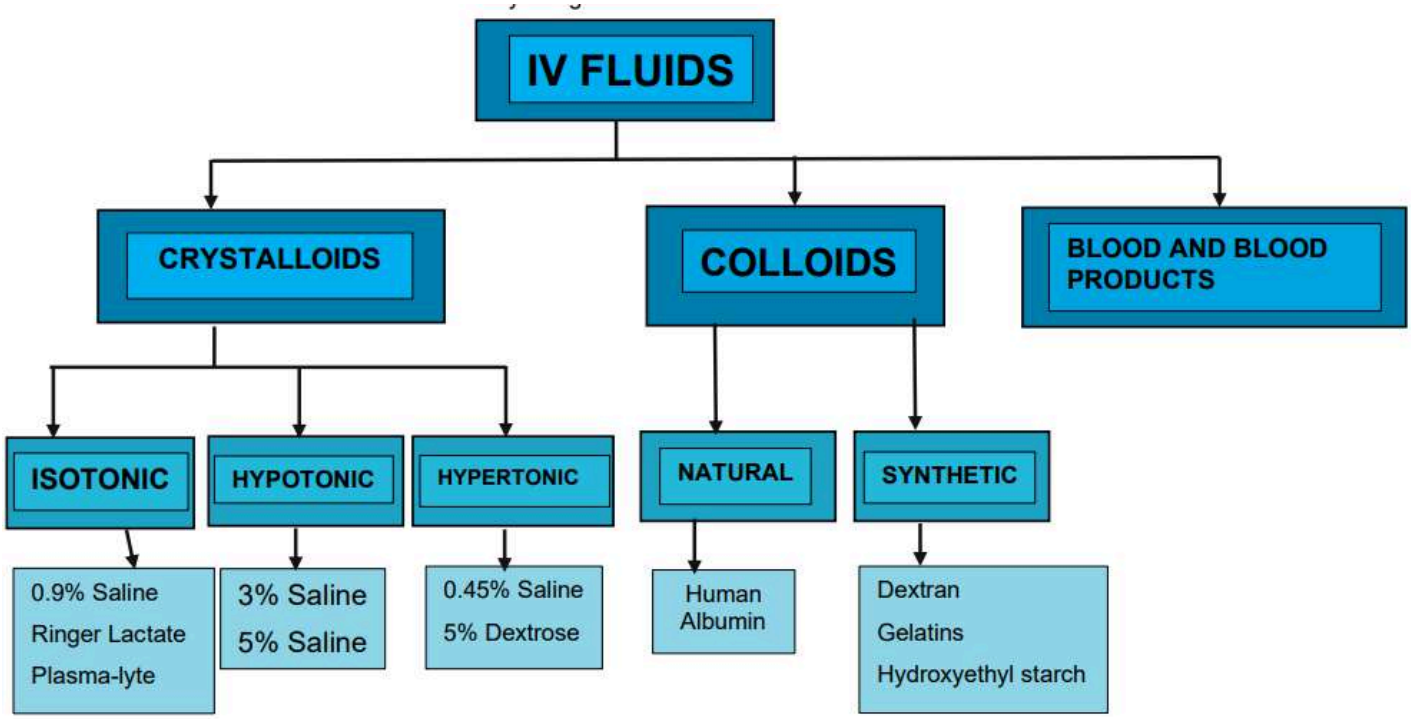
Introduction

0.9% Saline was first described by Dr. Hartold Jacob Hamburber in 1890s, who named it as "indifferent fluid" as it had a similar freezing point to human serum and caused no visible erythrolysis. With time it was named as "Normal Saline" or "Physiological Saline".



Today, till date normal saline is one of the most frequently used crystalloids for patients with variety of medical illnesses.

Composition of 0.9% Saline and Chloride load

- Though 0.9% saline is called 'Normal Saline', but in comparison to human serum, saline has 10% higher Sodium(Na+) concentration and 50% higher Cl- concentration.

Composition of Normal Serum versus Normal Saline

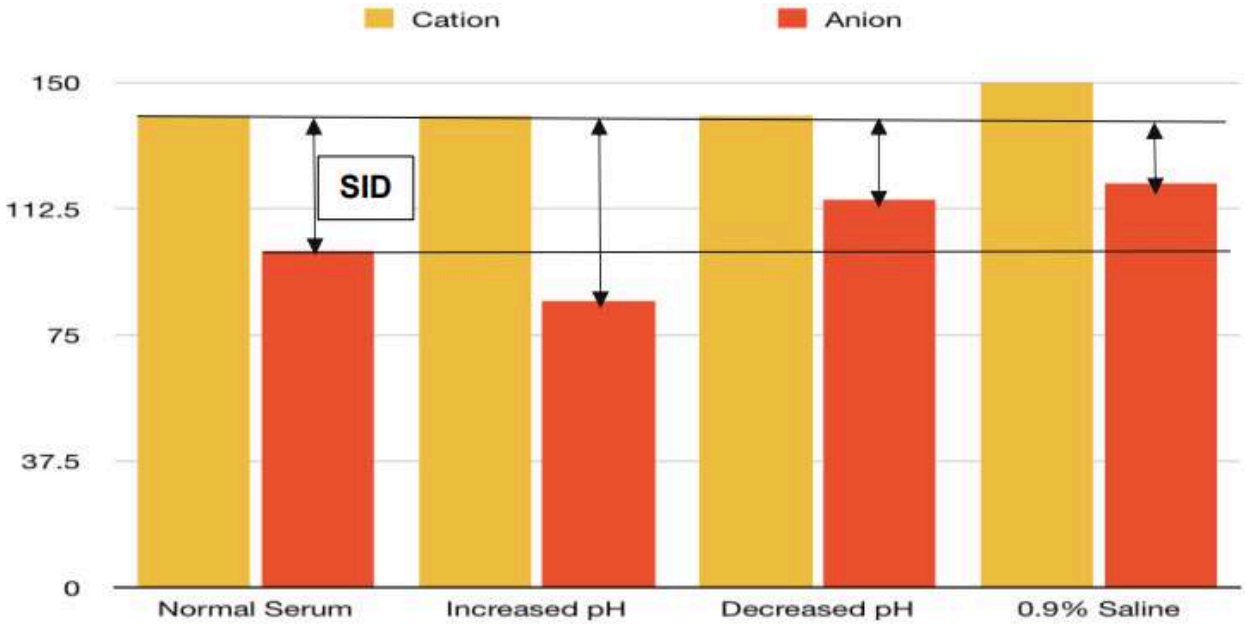
Composition (in mmol/l)	Normal Serum	Normal Saline
Na+	135-145	154
K+	3.6-5.2	0
Cl-	98-107	154
Ca2+ (in mg/dl)	8.9-10.1	0
Mg2+ (in mg/dl)	1.7-2.3	0

- Normal pH of Normal Serum is 7.35-7.45.
- According to **Stewart's Model of Acid Base balance**, there are 3 independent determinates of circulating acid base status

1. Strong Ion Difference (SID)- it is the most predominant factor. It is the difference of fully dissociated cations and anions. In normal serum, it is 40 mmol/l.

2. **Total Concentration of non volatile weak acid** (Atot)

3. **Partial pressure of CO2**



Graph showing difference in cations and anions in normal human serum, increased pH (Alkalosis), decreased pH (Acidosis) and 0.9% Saline Use.

- 0.9% saline infusion causes elevation in both Na and Cl levels, but Cl- increases in a larger magnitude, resulting in a net SID reduction and acidosis. Though, i.v. NS dilutes existing circulating albumin and phosphate, thus reducing Atot leading metabolic alkalosis. But the effect of SID reduction, overpowers Atot reduction resulting in Net Metabolic Acidosis, in absence of pre- existing Acid base disturbance.

COMMON SIDE EFFECTS OF EXCESSIVE SALINE USE

1. Hyperchloremic Metabolic Acidosis
2. Acute Kidney Injury
3. Multiple clinical symptoms including abdominal discomfort, abdominal distension and pain, nausea, drowsiness and decreased mental capacity

Hyperchloremic Metabolic Acidosis

- Cl- is most abundant anion in ECF, having role in maintainence of acid base balance, osmotic pressure, water distribution and muscular activity in the body.
- Because of its high concentration, Cl- is most important anion in balancing extracellular cations.
- Cellular Cl- alterations due to dysfunction in Cl- channels result in a broad spectrum of diseases.

1. Stomach- Decreased gastric flow and delayed recovery of gut function
2. Kidney- Excrete extra ammonia and inhibition of growth factor mediated protein synthesis
3. Intestine- Activation of lymphocyte Na-H exchanger leading to fluid retention
4. Muscles- Decreased Ca2+ sensitivity
5. Electrolyte- Shifts K+ out of cells leading to hyperkalemia

AKI risk with excessive saline use

- Saline infusion causes Kidney Volume Expansion and subcapsular pressure elevation which in turn leads to intraregional tissue ischemia. This leads to regional activation of RAS, which increases proximal Sodium absorption and enhanced Tubuloglomerular Feedback (TGF) activity, leading to afferent arterial vasoconstriction causing decreased GFR
- Cl- enters through macula densa and causes vasoconstriction in afferent arterioles leading to decreased GFR
- Extra renal pressure due to ascitis and intracapsular intrarenal pressure causes decrease in pressure gradient across renal arterioles leads to decreased renal blood flow and renal flow velocity causing decreased GFR.
- Decreased GFR causes less urine production and longer time to first micturition following infusion.
- Evidences suggest increased risk of Acute Kidney Injury with large volume 0.9% Saline use and a higher need for renal replacement therapy in critically ill patients.

Balanced crystalloids: When and why?

- Balanced crystalloid a.k.a. Buffered crystalloids (e.g. lactated Ringer's, Plasma lyte) have a Na+, K+ and Cl- content closer to that of ECF.
- In balanced crystalloids, Cl- is replaced by bicarbonates or buffers to reduce changes in acid base balance resulting from fluid administration, but because of instability of HCO3- containing solutions alternatives such as lactate, acetate and gluconate are used.
- Balanced crystalloids are either lactate buffered (RL) or acetate/ gluconate buffered (Plasma lyte/ Ringer's acetate).
- Lactate buffered crystalloids causes small increase in serum lactate concentration, especially in patients with hepatic impairment. In normal patients, lactate is metabolised to CO2 and H2O, which equilibrates with bicarbonate.

• In Acetate buffered crystalloids, acetate is metabolised through citric acid cycle into CO_2 and H_2O. In large doses, sodium acetate may be channelled to alternate pathway producing NO and hemodynamic instability.

When to Prefer Balanced Fluids?

- Large-volume resuscitation (e.g., PPH, sepsis)
- Perioperative fluid management
- Critically ill obstetric patient
- Cases where metabolic acidosis is a concern

When NS May Still Be Preferred?

- Hyponatremia (especially symptomatic)
- Metabolic alkalosis
- Concurrent blood transfusion (NS compatible; RL contains calcium)
- Neurosurgical cases (to avoid hypotonicity concerns)

• For acutely/ critically ill patients, data from several recent large randomised trials like PLUS and BaSICS suggest that using balanced crystalloids decreases risk of death / severe kidney dysfunction.

Practical Decision Making for OBGYN Practice

In obstetric practice, where physiological changes of pregnancy alter fluid dynamics and emergencies evolve rapidly, careful and individualized decision-making becomes even more critical.

1. In PPH, rapid restoration of circulating volume often involves crystalloids while arranging for blood products. Balanced crystalloids are preferred as they help avoid worsening acidosis, which can aggravate coagulopathy and worsen outcomes in hemorrhagic shock.
2. In sepsis, balanced crystalloids should be preferred to minimize the risk of acidosis and kidney injury.
3. In Hypertensive Diseases of Pregnancy, a restrictive fluid approach is preferred as these patients are at high risk of developing pulmonary edema.
4. In operative gynaecology, the choice and volume of IV fluids should be guided by the type and duration of surgery, preoperative status, and intraoperative events.

Despite the growing preference for balanced solutions, normal saline still has specific and important indications. It remains the fluid of choice in patients with hyponatremia where a higher sodium concentration is required. It is also preferred in metabolic alkalosis where chloride replenishment is beneficial. Additionally, normal saline is compatible with blood products and is therefore used during transfusion.

Ultimately, good clinical judgment, regular reassessment, and a patient-centered approach are the keys to effective and safe fluid management.

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03 Potassium: Small Dose, Big Danger

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Introduction

Potassium is one of the most essential electrolytes in clinical practice, playing a critical role in cardiac conduction, neuromuscular activity, and cellular function. In obstetrics, electrolyte correction is frequently required in conditions such as hyperemesis gravidarum, dehydration, preeclampsia, and critical illness.

However, intravenous (IV) potassium- particularly potassium chloride and potassium phosphate- is also one of the most dangerous medications used in hospitals. Even small errors in dose, dilution, or infusion rate can lead to fatal cardiac arrhythmias or cardiac arrest.

The Institute for Safe Medication Practices (ISMP) classifies potassium as a **high-alert medication**, alongside insulin, anticoagulants, opioids, and neuromuscular blockers, due to its potential to cause serious harm or death when used incorrectly.

This article focuses on **common errors, practical safety principles, and real-world precautions** relevant to obstetric practice.

Why Potassium is High Risk

Potassium is high-risk for several reasons:

- **High Risk of Fatal Harm:** Rapid or concentrated administration can cause immediate arrhythmias, ventricular fibrillation, or cardiac arrest. It is among the drugs most commonly implicated in fatal medication errors.

- **Irreversibility of Errors:** Once potassium is given incorrectly (e.g., undiluted or too rapidly), its cardiac effects may not be reversible in time.

- **Narrow Therapeutic Window:** There is a very small margin between therapeutic and toxic levels, making precise dosing essential.

- **Preparation Risks:** Concentrated potassium requires careful dilution and mixing; failure can result in a dangerous bolus effect.

- **Look-Alike/Sound-Alike Errors:** Ampoules may resemble normal saline or sterile water, leading to wrong-drug administration.

- **Concentration Variability:** Different preparations (e.g., potassium phosphate vs chloride) contain varying potassium concentrations, increasing overdose risk.

Common Errors in Practice

1. Prescription Errors

- Vague or incomplete orders (missing dose, dilution, rate)
- Prescribing in "ampoules" instead of mmol/mEq
- Excess dosing, especially in renal impairment
- Lack of standardized protocols

2. Dilution and Preparation Errors

- Failure to dilute concentrated potassium
- Using insufficient IV fluid volume
- Inadequate mixing ("layering" effect in IV bags)
- Use of incorrect diluent (e.g., sterile water causing haemolysis)
- Misidentification of ampoules

Key Tip: Always mix IV bags thoroughly (invert 10-15 times).

3. Administration Errors

- IV bolus or push (strictly prohibited)
- Rapid infusion due to pump errors
- High concentration via peripheral line
- Incompatible Y-site administration
- Inadvertent bolus during line flushing

Safe Use: Practical Guidance

Route

- Prefer **oral potassium** whenever possible
- Use IV route only when oral intake is not feasible

Safe Concentration and Rate

- Peripheral line: ≤ 40 mmol/L
- Central line: higher concentrations under monitoring
- Infusion rate:
  - ≤ 10 mmol/hour (routine)
  - Up to 20 mmol/hour (with ECG monitoring)

Never administer potassium as IV bolus or IM/SC injection.

NICE-Based Practical Points

- Daily requirement: ~1 mmol/kg/day
- Avoid potassium if serum K^+ >5 mmol/L
- Use pre-mixed solutions whenever possible
- Always use infusion pumps
- Avoid manual addition of potassium in wards

Monitoring: Essential for Safety

ECG Monitoring

Required in:

- Infusion rates >10 mmol/hour
- Severe hypokalemia
- ICU patients

Watch for:

- Peaked T waves
- Prolonged PR interval
- Widened QRS
- Arrhythmias

Renal Monitoring

- Check serum creatinine and urine output
- Reduce dose in renal impairment
- Avoid in oliguria unless closely monitored

Special Concerns in Obstetric Practice

Labour Room Risks

Obstetric patients are particularly vulnerable due to rapid fluid administration and physiological stress.

Major risks:

- Maternal cardiac arrest from rapid infusion
- Severe extravasation causing tissue necrosis
- Fluid overload in preeclampsia
- Fetal distress due to maternal hyperkalaemia

Additional considerations:

- Obstructed labour may worsen electrolyte imbalance
- Potassium use in fetal reduction requires extreme caution
- Post-caesarean ileus may be linked to potassium imbalance

ICU Risks

- Hyperkalaemia from rapid correction
- Renal failure leading to accumulation
- Infusion pump programming errors
- Central line misplacement
- Precipitation with calcium (especially potassium phosphate)

High variability in potassium levels is associated with increased mortality- **slow and controlled correction is essential**

ISMP-Based Safety Recommendations

- Remove concentrated potassium from ward stock
- Use **pre-mixed solutions only**
- Avoid dispensing ampoules to nursing areas
- Store potassium separately with **high-alert labels**
- Ensure **independent double-checks** before administration
- Use infusion pumps for all IV potassium
- Conduct regular safety audits and training

Quick Safety Checklist

Before prescribing:

Check potassium level and renal function

Prefer oral route if possible

While prescribing:

Write in mmol (not ampoules)

Specify dilution and rate

During preparation:

Use correct diluent

Mix thoroughly

Label as “HIGH ALERT”

During administration:

Use infusion pump

Never give IV push

Monitor IV site

During monitoring:

Repeat electrolytes

Monitor ECG (if needed)

Track urine output

Conclusion

Potassium is a life-saving electrolyte but also one of the most dangerous drugs in hospital practice. In obstetrics, where IV fluids are commonly used, the risk of error is significant.

Most complications are preventable through **simple, system-based safeguards:**

- Clear prescriptions
- Proper dilution
- Controlled infusion
- Vigilant monitoring

As clinicians, we must remember:

"Potassium is not just another electrolyte—it is a high-alert drug that demands respect."

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04

Iron Infusion: Avoidable Errors We Still Make

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Iron deficiency anaemia (IDA) remains one of the most prevalent nutritional disorders among women of reproductive age, particularly in low- and middle-income countries. Intravenous (IV) iron therapy has become an important tool in obstetrics and gynecology for rapid correction of anemia when oral iron is ineffective or impractical. Modern IV iron preparations have significantly improved safety profiles, yet avoidable errors in their use persist in clinical practice. These include inappropriate indications, unnecessary test doses, dose miscalculations, inadequate monitoring, poor preparedness for hypersensitivity reactions, and deficient documentation. Such lapses compromise patient safety and increase medicolegal vulnerability. This article reviews common pitfalls associated with iron infusion in obstetric and gynaecologic practice and highlights evidence-based strategies for safe administration, with emphasis on correct indications, dose calculation, anaphylaxis preparedness, observation protocols, and proper documentation.

Introduction

Iron deficiency anaemia affects a large proportion of women worldwide, with particularly high prevalence in South Asia. Pregnancy increases iron requirements substantially due to expanded maternal red cell mass and foetal demands. In gynecology, chronic blood loss due to heavy menstrual bleeding, fibroids, adenomyosis, or malignancy frequently results in depleted iron stores.

While oral iron therapy remains the first-line treatment for mild anemia, several limitations reduce its effectiveness, including gastrointestinal intolerance, poor compliance, slow hemoglobin response, and impaired absorption. Intravenous iron therapy allows rapid replenishment of iron stores and faster haemoglobin recovery, thereby reducing the need for blood transfusion in many situations.

Over the past decade, newer IV iron preparations such as iron sucrose, ferric carboxymaltose, and ferric derisomaltose have made outpatient iron infusion feasible and relatively safe. However, despite these advances, several avoidable errors continue to occur in routine clinical practice. Many of these errors stem from outdated practices, lack of standardized protocols, or inadequate awareness of modern guidelines.
Recognizing and correcting these mistakes is essential to ensure safe and effective treatment.

Indications for Intravenous Iron in Obstetrics and Gynaecology

Appropriate patient selection is fundamental for safe and effective IV iron therapy.

Obstetric Indications

IV iron is recommended in the following situations:

• Moderate to severe iron deficiency anemia during the **second or third trimester**
• **Failure or intolerance of oral iron therapy**
• **Malabsorption syndromes** affecting iron absorption
• **Late pregnancy anemia (after 32–34 weeks)** requiring rapid correction before delivery
• Situations where **blood transfusion is not immediately indicated but rapid improvement is needed**

Postpartum Indications
• Postpartum anemia with haemoglobin **7–10 g/dL in hemodynamically stable women**
• Poor tolerance or non-response to oral iron
• Need for rapid restoration of maternal iron stores and functional recovery

Gynaecological Indications
• Heavy menstrual bleeding leading to iron deficiency anaemia
• Preoperative correction of anemia before major gynaecological surgery
• Chronic blood loss conditions such as fibroids or adenomyosis
• Intolerance or poor response to oral iron therapy

A common clinical error is **using IV iron for mild anaemia**, which can usually be corrected with oral therapy. Conversely, **delaying IV iron in late pregnancy** often results in suboptimal hemoglobin improvement before delivery.

Test Dose: Myths Versus Evidence
Historically, test doses were recommended when administering high molecular weight iron dextran because of significant risk of severe hypersensitivity reactions.

Current Evidence
Modern IV iron preparations have markedly improved safety profiles.
Test doses are **not required for:**
• Iron sucrose
• Ferric carboxymaltose
• Ferric derisomaltose

Moreover, test doses **do not reliably predict severe reactions** and may give false reassurance.

Precautions
Instead of relying on test doses, clinicians should:
• Take a detailed history of previous drug allergies
• Avoid IV iron in active systemic infection
• Begin infusion slowly with close observation
• Ensure emergency resuscitation equipment is available

Thus, **preparedness for hypersensitivity reactions is more important than routine test dosing.**

Dose Calculation Errors

Incorrect dose calculation is a common avoidable mistake.

Ganzoni Formula

Total iron deficit (mg) =

Body weight (kg) × (Target Hb – Actual Hb) × 2.4 + 500 mg (iron stores)

Common Errors

• Ignoring the additional **500 mg needed for iron stores**
• Using arbitrary dosing such as 500 mg for all patients
• Exceeding recommended **maximum single-dose limits**
• Not adjusting dose according to **body weight**

Maximum Single Dose Limits

Iron preparation	**Maximum single dose**
Iron sucrose	200 mg per infusion
Ferric carboxymaltose	Up to 1000 mg
Ferric derisomaltose	Large single dose depending on weight

Failure to respect dosing limits increases the risk of adverse reactions.

Risk of Iron Overdose

Repeated or excessive IV iron administration without reassessment can lead to iron overload.

Possible Complications

• Oxidative stress and tissue damage
• Hepatic iron deposition
• Increased infection risk
• Hypophosphatemia (especially with ferric carboxymaltose)

Prevention

• Confirm **iron deficiency before therapy**
• Avoid IV iron when ferritin levels are adequate
• Reassess haemoglobin and ferritin before repeat infusion

Hypersensitivity Reactions and Anaphylaxis Preparedness

Severe hypersensitivity reactions are rare but potentially life-threatening.

Early Symptoms

• Flushing
• Chest tightness
• Dyspnoea
• Hypotension
• Urticaria

Risk Factors

• Previous IV iron reaction
• Multiple drug allergies
• Severe atopy
• Rapid infusion rate

Essential Emergency Preparedness

Every facility administering IV iron should have:

• **Adrenaline (epinephrine)** readily available
• Oxygen and airway equipment
• Antihistamines and corticosteroids
• Staff trained in **basic life support**

Prompt administration of **intramuscular adrenaline** remains the cornerstone of anaphylaxis management.

Observation Protocols

Patients must be observed carefully during and after infusion.

Recommended Monitoring

• Vital signs during infusion
• Continuous observation for symptoms
• **Minimum 30-minute observation after completion**

Allowing patients to leave immediately after infusion is an avoidable and unsafe practice.

Documentation and Medicolegal Safety

Inadequate documentation is a frequent medicolegal vulnerability.

Essential Documentation

• Indication for IV iron therapy
• Baseline haemoglobin and iron parameters
• Type and dose of iron preparation
• Dilution and infusion rate
• Time of administration
• Monitoring observations
• Any adverse events and management

Accurate records protect both the patient and the clinician.

Informed Consent

Patients must receive adequate counselling before iron infusion.

Discussion should include:

• Reason for IV iron therapy
• Expected benefits
• Possible side effects

• Rare risk of allergic reactions
• Available alternative treatments
Documenting consent significantly reduces medicolegal risk.

Practical Checklist for Safe Iron Infusion

Before Infusion

Confirm indication
Calculate total iron requirement
Check for contraindications
Obtain informed consent
Ensure emergency drugs are available

During Infusion

Use correct dilution and rate
Monitor patient continuously
Watch for hypersensitivity reactions

After Infusion

Observe for at least 30 minutes
Document procedure and observations
Plan follow-up hemoglobin assessment

Key Clinical Practice Points

• IV iron is highly effective for **moderate-to-severe anemia in pregnancy and postpartum period.**
• **Routine test doses are unnecessary** for most modern IV iron preparations.
• Accurate **dose calculation is essential** to avoid under- or overdosing.
• Facilities administering IV iron must be **prepared to manage anaphylaxis.**
• **Observation for at least 30 minutes after infusion** is recommended.
• Proper **documentation and informed consent** are critical for medicolegal safety.

Conclusion

Intravenous iron therapy plays a vital role in the management of iron deficiency anemia in obstetric and gynaecologic practice. When used appropriately, it offers rapid correction of anemia and reduces the need for blood transfusion. However, several avoidable errors persist in routine practice, including inappropriate indications, outdated test-dose practices, incorrect dose calculations, inadequate monitoring, and poor documentation.

Adherence to standardized protocols, careful patient selection, and preparedness for rare adverse reactions are essential to ensure safe administration. By recognizing and addressing these common pitfalls, clinicians can improve both patient outcomes and medicolegal safety in the use of IV iron therapy.

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05 Electrolyte Imbalance Caused by Doctors-Not Disease

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Electrolytes are substances that dissociate into ions in solution and acquire the capacity to conduct electricity, making them essential for normal physiological function. These ions are distributed unevenly between intracellular and extracellular compartments, with this gradient maintained primarily by active transport mechanisms such as the Na^+/K^+-ATPase pump.

Key electrolytes are as follows:

- Sodium - principal extracellular cation and plays a key role in regulating extracellular fluid volume and osmolarity,
- Potassium - predominant intracellular cation and is critical for maintaining resting membrane potential and normal neuromuscular function.
- Bicarbonate and chloride contribute to acid–base balance and electroneutrality
- calcium and magnesium are vital for enzymatic activity, muscle contraction, andneuronal transmission. Electrolyte

Common Electrolytes: Functions & Disorders

Electrolyte	Major Functions	Hypo-state (↓) Causes & Effects	Hyper-state (↑) Causes & Effects
Sodium (Na^+)	Fluid balance, nerve function	**Hyponatremia** • Vomiting, SIADH • Confusion, seizures	**Hypernatremia** • Dehydration, DI • Thirst, weakness
Potassium (K^+)	Cardiac & muscle function	**Hypokalemia** • Diuretics, vomiting • Arrhythmias, weakness	**Hyperkalemia** • Renal failure, ACE inhibitors • Arrhythmias, paralysis
Calcium (Ca^{2+})	Bone health, neuromuscular activity	**Hypocalcemia** • Hypoparathyroidism • Tetany, seizures	**Hypercalcemia** • Hyperparathyrodism • Stones, AMS
Magnesium (Mg^{2+})	Enzyme function, cardiac stability	**Hypomagnesemia** • Malnutrition, PPIs • Tremors, arrhythmias	**Hypermagnesemia** • Renal insufficiency • Lethargy, ↓reflexes
Chloride (Cl^-)	Acid-base balance	**Hypochloremia** • Vomiting, NG suction • Alkalosis	**Hyperchloremia** • 1 Saline IVF • Acidosis
Phosphate (PO_4^{3+})	Energy production, bone health	**Hypophosphatemia** • Refeeding syndrome • Weakness, confusion	**Hyperphosphatemia** • Renal failure • Ca^+ deposits

Electrolyte imbalance commonly arises from fluid disturbances, disease states, and iatrogenic factors. They are generally diagnosed with blood investigations, urine tests and ECGs. Symptoms of electrolyte imbalance include

- Muscle cramps
- Palpitations
- Fatigue
- Nausea and Vomiting
- Confusion
- Headache
- Tingling
- Numbness
- Excessive thirst
- Seizures

Common causes include:

- Dehydration
- Gastrointestinal losses - vomiting, diarrhea, and nasogastric suction can result in depletion of sodium, potassium, and chloride
- Renal causes, including acute and chronic kidney disease, impair the regulation ofelectrolyte excretion and reabsorption
- Chronic illness
- Poor Diet
- Excessive diet

While electrolyte disturbances are traditionally attributed to underlying disease processes, iatrogenic factors- particularly medications and medical interventions- play a significant and often underrecognized role. Drug-induced electrolyte abnormalities are among the most frequent causes in clinical practice. Drugs that cause electrolyte imbalance are as follows

- Diuretics promote renal loss of sodium, potassium, and magnesium, leading to hyponatremia and hypokalemia.
- Laxatives can cause potassium depletion and metabolic alkalosis. Angiotensin converting enzyme inhibitors, angiotensin receptor blockers, and potassium-sparing diuretics may precipitate hyperkalemia by reducing renal potassium excretion.
- Antibiotics, chemotherapeutic agents, and proton pump inhibitors have been implicated in electrolyte abnormalities like hypomagnesemia and hyponatremia.

Although electrolyte imbalances are often perceived as the domain of internal medicine, they are highly relevant in obstetrics and gynaecology, where they significantly influence maternal and perioperative outcomes.

In obstetrics, even subtle electrolyte disturbances can have serious maternal and fetal consequences.

- Hyponatremia may occur due to excessive oxytocin infusion or hypotonic fluid administration and can result in maternal neurological symptoms, seizures, and fetal hyponatremia.
- Hypokalemia and hypomagnesemia are particularly relevant in hyperemesis gravidarum and preeclampsia, where they predispose to arrhythmias and neuromuscular complications. Magnesium is especially important, as both deficiency and excess can lead to severe complications.

In gynaecological patients, electrolyte imbalance plays a crucial role in surgical safety and recovery. Preoperative disturbances may increase anaesthetic risk. Intraoperative factors such as fluid shifts, blood loss, and irrigation fluids can result in acute electrolyte changes. Postoperative mismanagement, particularly the continued administration of hypotonic fluids, can exacerbate these disturbances. Electrolyte imbalance in the postoperative period can impair wound healing and delay recovery.

The maintenance of water and electrolyte homeostasis is critical for cellular and systemic function. Many therapeutic interventions, both intentional and inadvertent, can disrupt these finely regulated mechanisms, leading to clinically significant disturbances.

CASE DISCUSSION

This case highlights a classic example of iatrogenic electrolyte imbalance in the postoperative setting, emphasizing the role of therapeutic interventions rather than primary disease pathology. A 56-year-old postmenopausal woman with multiple comorbidities (type 2 diabetes mellitus, hypertension, hypothyroidism) underwent total laparoscopic hysterectomy with bilateral salpingo-oophorectomy for a left ovarian mature cystic teratoma. Her immediate postoperative course was complicated by acute symptomatic deterioration on post operative day 2, characterized by vomiting, giddiness, hypotension, and a significant fall in hemoglobin. Initial concerns included hemorrhagic shock, the patient's hemodynamic response to fluids, absence of persistent tachycardia, and imaging findings argued against ongoing bleeding as the primary driver. A more detailed evaluation, revealed hyponatremia (Na^+ 126 mEq/L) with concurrent acute kidney injury (creatinine 1.59 mg/dL). The electrolyte imbalance appeared multifactorial but predominantly iatrogenic in origin. Several contributing factors could be identified- 1)The patient received multiple intravenous fluids including DNS, RL, and NS in the perioperative period which predisposes to dilutional hyponatremia. 2)Polypharmacy and Antihypertensives- The patient was on multiple antihypertensives including telmisartan, cilnidipine, and chlorthalidone. Thiazide diuretics (chlorthalidone) are a well-known cause of iatrogenic hyponatremia, particularly in elderly females. 3)Insulin Therapy may have contributed indirectly to electrolyte shifts, including intracellular movement of potassium and dilutional effects via concurrent fluid administration. Following the diagnosis, Management in this case appropriately focused on:

1)Withholding antihypertensives temporarily

2)Blood transfusion for anemia

3)Controlled Fluid resuscitation and hemodynamic stabilization

4) Close monitoring of electrolytes and renal function.

The patient subsequently improved and was discharged uneventfully. This case underscores that iatrogenic causes are a major contributor to postoperative electrolyte disturbances with polypharmacy (particularly diuretics) and inappropriate IV fluid selection remaining the key modifiable risk factors. Early recognition is crucial, as these disturbances are often reversible with timely intervention.

PREVENTION

- Maintain adequate hydration: Ensure appropriate fluid intake based on age, climate, and activity level.
- Balanced diet: Include electrolyte-rich foods (fruits, vegetables, dairy, nuts) to maintain normal levels.
- Avoid excessive losses: Promptly treat vomiting, diarrhea, and excessive sweating.
- Judicious use of medications: Avoid unnecessary or prolonged use of diuretics, laxatives, and other electrolyte-altering drugs.
- Regular monitoring in at-risk individuals: Elderly, pregnant women, patients with renal/cardiac disease, or those on long-term medications.
- Appropriate fluid therapy in hospitals: Use isotonic fluids when indicated and avoid indiscriminate IV fluid administration.
- Perioperative vigilance: Monitor fluid balance, urine output, and electrolytes in surgical patients.
- Educate patients: Awareness about hydration, drug side effects, and early symptoms (weakness, confusion, palpitations).
- Early recognition and intervention: Timely correction of imbalances to prevent complications.
- Avoid rapid correction: Especially in sodium disorders, to prevent neurological complications.

CONCLUSION

Electrolyte imbalances are not solely disease-driven; iatrogenic causes are a major contributor in hospitalized patients. In obstetrics and gynaecology, careful fluid management and rational drug use are essential. Early recognition of iatrogenic causes can significantly reduce morbidity and improve outcomes.

LEARNING POINT

- Not all electrolyte imbalances are disease-driven—many are treatment-induced. Vigilant monitoring and rational prescribing are key to prevention.
- Rehydration with electrolyte-rich solutions, dietary adjustments, medication adjustments and treatment of underlying conditions and mainstay in managing electrolyte imbalance.

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06 Infusion Pumps: Safety Checks You Skip

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Introduction

Syringe infusion pumps are widely used for continuous and precise intravenous (i.v.) administration of highly concentrated drugs at low flow rates such as 0.1–10 ml h^{-1} (microinfusion).(1) Microinfusion, in contrast to macroinfusion (7–50 ml h^{-1}), is used in critical care medicine and anaesthesia to prevent fluid overload, particularly in neonates and infants and also in patients receiving multiple infusions.

Many newer infusion pumps are equipped with predetermined clinical guidelines, dose error reduction systems (DERSs), and drug libraries that provide a comprehensive list of medicines and fluids with dose, volume, and flow rate details. These "smart pumps" are designed to address the programming errors that traditional pumps are susceptible to by notifying a user when there is a risk of an adverse drug interaction or when the pump's parameters are set outside of specified safety limits for the medication being administered. (2)

Reported Infusion Pump Problems

Software problems:

- A software error message is displayed, stating that the pump is inoperable. This occurs in the absence of an identifiable problem.
- The infusion pump interprets a single keystroke as multiple keystrokes (a problem called a "key bounce"). For example, the user programs an infusion rate of 10 mL/hour, but the device registers an infusion rate of 100 mL/hour

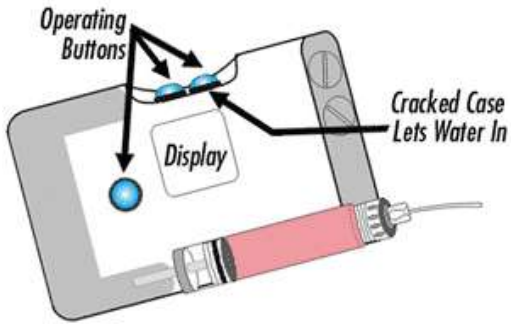
Alarm errors:

- The infusion pump fails to generate an audible alarm for a critical problem, such as an occlusion (e.g., clamped tubing) or the presence of air in the infusion tubing.
- The infusion pump generates an occlusion alarm in the absence of an occlusion.

Inadequate user interface design ("human factors" issues):

- The design of the infusion pump screen confuses the user, or the infusion pump does not respond as it should (i.e., with a warning or alarm) when inappropriate data is entered.
- The infusion pump screen doesn't make clear which units of measurement the user is expected to enter. For example, the user may enter weight in pounds when the infusion pump requires it in kilograms.

Broken components:



Graphic: Cracks between operating buttons allow water inside.

Battery failures:

- A design issue causes over-heating of the battery and leads to premature battery failure.
- A patient returns from ambulating and forgets to plug in the infusion pump. The infusion pump alarms with a low battery message, but the speaker volume is set too low, and the alarm goes unnoticed. The infusion pump powers off after the battery is depleted.

Fire, sparks, charring, or shocks:

- The user plugs in or unplugs the device from an electrical outlet and receives a shock, and/or sparks are seen.(3)

The infusion pump may have been dropped or damaged during use, which may result in an over-infusion or an under-infusion if the pump continues to be used without being repaired.

Dose-rate and Infusion-Rate Mix-Ups

Confusing the medication dose-rate with the infusion rate is a relatively frequent pump programming error type that is often unreported.12,25 This type of wrong-field programming error in which the intended infusion rate is entered in the dose-rate field can result in the patient receiving too much or too little solution and poses significant risk of patient harm. These mistakes can be related to differences in the names that these infusion parameters are given and the sequence in which they are listed in the medication administration record (MAR) versus the smart pump screen.(4)

Custom Concentrations/Wildcards

Programing a custom concentration, also known as a wildcard, entails selecting a drug from the library but then manually entering the concentration (e.g., xx mg/xx mL). Serious errors have occurred when practitioners have unnecessarily selected a custom concentration option, and then entered the wrong concentration, even though a standard concentration option for the drug was available in the pump library. Some of the errors appear to be mental mix-ups in which the “dose per hour” was paired with the total infusion volume (e.g., heparin 800 units/hour from a 25,000 units/250 mL bag was inadvertently entered as a concentration of 800 units/250 mL). Mix-ups have also occurred in which the “per mL” concentration was paired with the total infusion volume (e.g., a 0.2 mg/mL concentration of milrinone in a 20 mg/100 mL bag was entered as a 0.2 mg/100 mL concentration). Sometimes, the way the concentration is expressed on the label also contributes to concentration mistakes.(5)

Clinical Tips to improve patient safety when using syringe infusion pump systems

1. Train all users on their specific infusion pump system
2. Establish and maintain proper protocol management for i.v. drug infusions
3. Use infusion syringes that have been validated by the syringe pump manufacturer
4. Use the smallest appropriately sized Luer lock syringe
5. Keep the compliance and resistance of the infusion pump system as low as possible
6. Minimise the number of infusion pumps connected to the same venous catheter lumen
7. Avoid vertical displacement of an infusion pump during drug delivery
8. Avoid very low flow rates
9. Use the most sensitive occlusion alarm pressure reasonably possible
10. Minimise pump start-up delays and flow irregularities during pump changeover (6-8)

To mitigate the risks, a holistic approach to infusion safety is mandatory. It is not enough to simply provide the technology; healthcare providers must adhere to the clinical best practices outlined in this paper, such as using validated syringes, maintaining low system resistance, and avoiding vertical displacement of the pump.

Ultimately, patient safety in micro infusion is a shared responsibility between the manufacturer's design and the clinician's technical proficiency. By combining rigorous staff training with a strict adherence to established protocols and the full utilization of Dose Error Reduction Systems (DERS), healthcare facilities can significantly reduce the margin for error. The goal must be to move beyond a reliance on the "smart" pump's autonomy and return to a standard of care where technology is supported by vigilant, informed clinical practice.

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07 Extravasation Injuries: Prevention and Immediate Action

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Extravasation injuries occur when intravenous (IV) drugs or fluids inadvertently leak into the surrounding tissue, rather than remaining within the vascular system. Such incidents can result in pain, tissue necrosis, infection, and long-term functional impairment. Effective management and prevention require awareness of high-risk drugs, vigilance in early detection, prompt bedside action, thorough documentation, and adherence to prevention protocols.

High-Risk Drugs for Extravasation

Certain medications are more likely to cause severe tissue injury when extravasated. These are commonly categorized as **vesicants**, which can induce blistering and necrosis, and **irritants**, which may cause pain, inflammation, and local tissue irritation without overt necrosis[1].

1. **Chemotherapeutic agents-** Anthracyclines (e.g., doxorubicin, epirubicin), vinca alkaloids (e.g., vincristine, vinblastine), and taxanes (e.g., paclitaxel) are notorious for causing severe extravasation injuries.
2. **Hyperosmolar solutions-** Agents such as total parenteral nutrition (TPN), concentrated dextrose solutions (>10%), and high-concentration electrolytes (e.g., potassium chloride) can damage tissues rapidly[1].
3. **Vesicant antibiotics-** Medications such as vancomycin and acyclovir can induce local tissue necrosis if extravasated.
4. **Other irritants**- Certain contrast media, dopamine, and calcium solutions can cause tissue irritation and localized injury.

Medications need to be categorised by their vesicant potential and healthcare providers should be trained to recognize and handle these drugs safely[2]. Risk stratification should guide the selection of cannula sites and monitoring intensity.

Early Warning Signs Often Missed by Nurses

Prompt recognition of extravasation is critical to minimize tissue damage. However, subtle early signs are frequently overlooked:

- Pain or burning at the IV site beyond what is expected from cannula insertion.
- Swelling or edema around the infusion site, particularly if the cannula has been stable.
- Erythema or localized redness that progresses during infusion.

- Blanching or cool skin near the catheter tip, suggesting compromised perfusion.
- Resistance during infusion or inability to flush the cannula without discomfort.

The protocol of structured observation of IV sites should be followed, with nursing staff trained to assess both subjective patient complaints and objective signs systematically[2]. Frequent checks- at least hourly during high-risk infusions- are recommended, along with immediate escalation when any warning signs are detected[2,3].

Immediate Bedside Action Steps

When extravasation is suspected or confirmed, prompt intervention is crucial to limit tissue injury. The following steps should be followed:

1. **Stop the infusion immediately-** Do not remove the cannula yet, as it may be used to aspirate infiltrated drug[2].
2. **Aspirate the drug-** Using a syringe, attempt gentle aspiration of any residual medication from the cannula[3]. Avoid excessive force that could worsen tissue trauma.
3. **Remove the cannula carefully-** After aspiration, remove the cannula while maintaining aseptic technique.
4. **Mark and elevate the affected area-** Elevation reduces swelling, while marking the site aids ongoing monitoring[4].
5. **Apply appropriate local therapy**- Depending on the drug, various guidelines recommend either warm or cold compresses:
    - **Cold compresse**s for most vesicants to limit tissue spread.
    - **Warm compresses** for agents that respond to vasodilation to enhance absorption (e.g., vinca alkaloids).

1. **Administer antidotes if indicated-** Some vesicants have specific antidotes, such as dexrazoxane for anthracycline extravasation or hyaluronidase for vinca alkaloids[4]. Administer according to institutional protocol.
2. **Pain management**- Local analgesics and systemic analgesics should be provided as needed.

Timeliness is critical; the likelihood of avoiding necrosis declines sharply after the first few hours post-extravasation.

Documentation and Medico-Legal Considerations

Accurate documentation is both a clinical and legal imperative. Key components include:

- **Patient details and infusion specifics**- Drug name, dose, concentration, infusion rate, cannula type, and site.
- **Time and description of events-** Exact time of extravasation detection, observed signs, and patient complaints.
- **Interventions performed-** Aspiration, compress application, antidote administration, and nursing notifications.
- **Follow-up plan-** Frequency of site monitoring, expected healing timeline, and referral to specialists if needed.

A structured and meticulous documentation supports patient safety, continuity of care, and accountability[2,4]. From a medico-legal perspective, failure to document or promptly act may expose practitioners and institutions to liability, particularly if severe tissue injury occurs. Consent for high-risk infusions and patient education should also be noted in the record.

Prevention Protocols for Clinics and Wards

Preventing extravasation requires proactive strategies that integrate staff training, patient education, and system-level protocols:

1. **Staff training and competency assessment-** All nursing and clinical staff should be competent in IV insertion, identification of high-risk drugs, and early recognition of extravasation signs. Simulation-based training improves response times[5,6].
2. **Site selection and cannula choice-** Peripheral veins on the forearm are preferred over the dorsum of the hand for vesicant administration. Central venous access may be warranted for prolonged therapy with high-risk drugs. Cannula size and material should match the drug characteristics.
3. **Infusion monitoring protocols-** High-risk drugs should be infused via pump with frequent site checks. WHO recommends continuous observation for the first 10–15 minutes of infusion, then periodic checks every 15–30 minutes[2].
4. **Patient education-** Patients should be instructed to report pain, burning, or swelling immediately. Engaged patients serve as an additional layer of surveillance.
5. **Standardized emergency kits-** Clinics should maintain extravasation kits containing syringes, compresses, antidotes, and dressing supplies, readily accessible at all high-risk infusion sites.
6. **Audit and feedback-** Regular review of extravasation incidents, near misses, and compliance with monitoring protocols helps identify system gaps and improve safety culture[2,6].

WHO guidelines emphasize a systematic approach to prevention: combining staff competence, patient engagement, and organizational support to minimize extravasation risk[2].

Conclusion

Extravasation injuries are preventable adverse events that demand vigilance, structured monitoring, and rapid response. Awareness of high-risk drugs, recognition of subtle early warning signs, immediate bedside intervention, accurate documentation, and adherence to prevention protocols form the cornerstone of safe IV therapy. Aligning clinical practice with WHO recommendations ensures both patient safety and institutional accountability, while fostering a culture of proactive care in wards and clinics[2].

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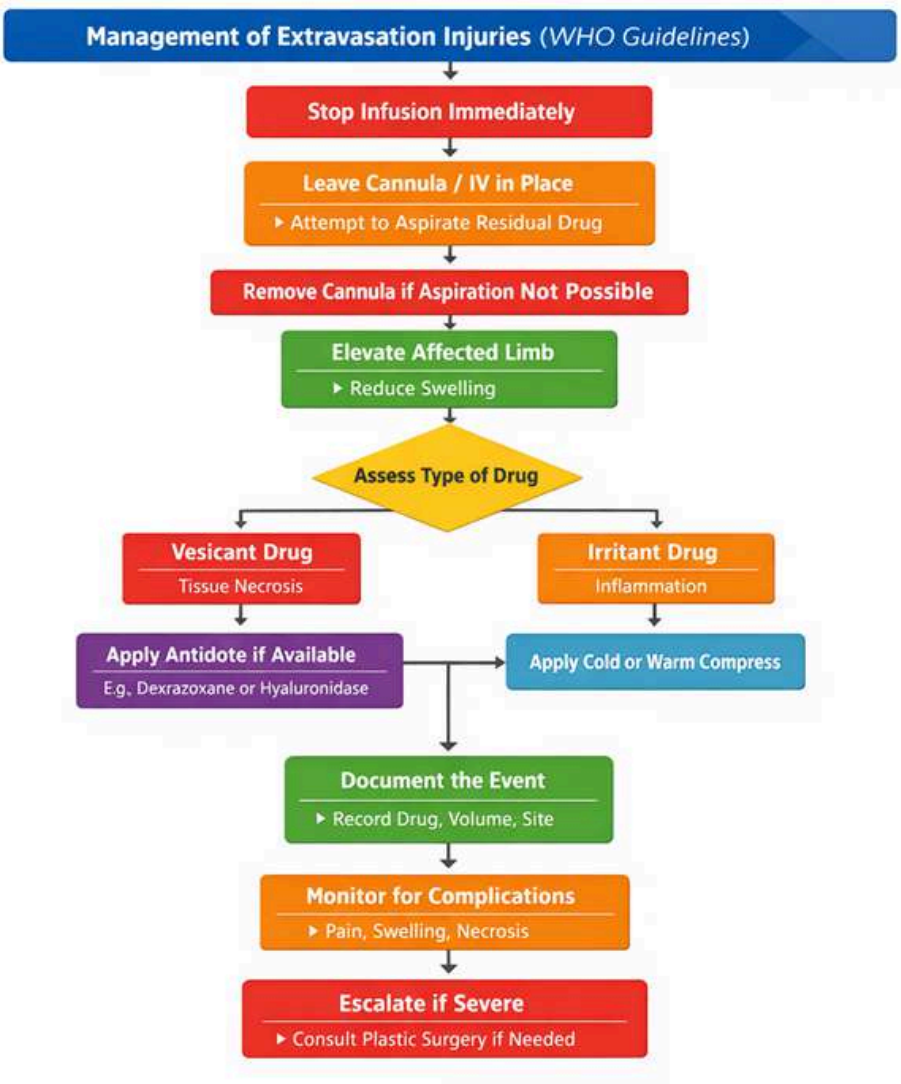
Figure - Flow Diagram- Management of Extravasation Injuries



08 High-Alert Infusions in the Labour Room: Ensuring Maternal and Fetal Safety

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Introduction

The labour room is a dynamic clinical environment where rapid decision-making and simultaneous management of both mother and fetus are essential. Intravenous medications are frequently administered during labour for induction, augmentation, seizure prophylaxis, glycemic control, and electrolyte correction. Some of these medications are classified as **high-alert medications** because they have a **heightened risk of causing significant patient harm when used incorrectly**. Even small dosing errors, incorrect infusion rates, or accidental bolus administration can result in severe maternal or fetal complications.

In obstetric practice, commonly used high-alert infusions include **oxytocin, magnesium sulfate, insulin, and potassium chloride**. Because these medications affect critical physiological systems such as uterine activity, neuromuscular transmission, metabolic control, and cardiac function, strict protocols and monitoring systems are required. The safe administration of these drugs requires standardization of infusion protocols, clear labeling, staff training, and vigilant monitoring of maternal and fetal parameters.

Concept of High-Alert Medications

High-alert medications are drugs that bear a **high risk of causing serious harm if used in error**, although the frequency of errors may not necessarily be higher than with other drugs.

The **Institute for Safe Medication Practices (ISMP)** includes medications such as **intravenous oxytocin, magnesium sulfate injection, insulin, and concentrated potassium chloride** in its list of high-alert medications because dosing mistakes or administration errors can rapidly lead to life-threatening consequences.

In the labour room, medication errors may arise from multiple factors including:

- Look-alike or sound-alike drug names
- Similar infusion bags and tubing
- Mis programming of infusion pumps
- Communication errors between staff
- Emergency situations requiring rapid intervention

These errors may result in uterine hyperstimulation, respiratory depression, cardiac arrhythmias, severe hypoglycemia, or electrolyte imbalance affecting both mother and fetus.

Common High-Alert Infusions in the Labour Room

1. Oxytocin

Oxytocin is one of the most frequently used medications in obstetrics for **induction and augmentation of labour** and for the **prevention and management of postpartum hemorrhage.**

However, oxytocin is also classified as a high-alert medication because inappropriate dosing or infusion rates can lead to uterine tachysystole, **uterine rupture, fetal distress, or water intoxication.**

Errors commonly occur due to incorrect pump programming or accidental bolus administration. Excessive uterine contractions can compromise uteroplacental blood flow and cause fetal hypoxia. Therefore, oxytocin infusion must always be administered using a **controlled infusion pump with standardized dilution and titration protocols.**

2. Magnesium Sulfate

Magnesium sulfate is widely used in obstetrics for **prevention and treatment of eclamptic seizures** and occasionally for fetal neuroprotection or short-term tocolysis.

Despite its benefits, magnesium sulfate has a **narrow therapeutic window** and toxicity can occur if the infusion rate is excessive.

Clinical signs of magnesium toxicity include:

- Loss of deep tendon reflexes
- Respiratory depression
- Hypotension
- Cardiac conduction abnormalities

Because magnesium is primarily excreted through the kidneys, careful monitoring of **urine output, respiratory rate, and reflexes** is essential during therapy.

3. Insulin Infusion

Intravenous insulin infusions may be required during labour in women with **diabetes mellitus** to maintain optimal glycemic control. Poorly controlled blood glucose can lead to neonatal hypoglycemia, metabolic complications, and adverse perinatal outcomes.

Insulin is classified as a high-alert medication because dosing errors may cause **severe hypoglycemia or hyperglycemia.**

In labour units, insulin is often administered along with **dextrose infusions and other medications such as oxytocin or magnesium sulfate**, increasing the risk of line mix-ups or accidental bolus administration. Dedicated infusion lines and strict protocols are therefore recommended.

4. Potassium Chloride

Potassium chloride is sometimes administered intravenously to treat **hypokalemia** in obstetric patients. However, concentrated potassium solutions can cause **fatal cardiac arrhythmias if administered rapidly or in excessive doses.**

For this reason, potassium chloride is included among the most dangerous high-alert medications.
Safety recommendations include dilution before infusion, administration via infusion pump, and continuous monitoring of cardiac rhythm and serum electrolytes.

Look-Alike and Sound-Alike Medication Risks
Medication errors in labour rooms are often linked to **look-alike or sound-alike drug names** and similar packaging. For example:

- Oxytocin and other uterotonics
- Magnesium sulfate and other electrolyte solutions
- Similar IV fluid bags or tubing

Confusion between infusion bags or incorrect labeling can lead to administration of the wrong medication. Cases have been reported where magnesium sulfate was accidentally infused instead of IV fluids due to bag mix-ups.

Implementing **clear labeling, color coding, and standardized drug preparation** can significantly reduce these risks.

Line Segregation and Infusion Labeling
One of the most effective strategies for preventing infusion errors is **line segregation**.

Key principles include:
- Use **dedicated intravenous lines** for high-alert medications.
- Avoid multiple medications through the same tubing whenever possible.
- Clearly **label infusion lines and pumps**.
- Use **color-coded tubing or connectors** for high-risk drugs.
- Minimize stopcocks or injection ports that could allow accidental bolus administration.

Such measures help prevent accidental infusion changes during emergencies or patient transfers.

Monitoring Mother and Fetus
Because high-alert infusions affect both maternal and fetal physiology, continuous monitoring is essential.

Maternal monitoring should include:
- Blood pressure
- Pulse rate
- Respiratory rate
- Urine output
- Neurological status (for magnesium therapy)

Fetal monitoring should include:
- Continuous fetal heart rate monitoring
- Assessment of uterine contractions
- Evaluation of fetal distress patterns

Close monitoring allows early detection of adverse effects and timely intervention, thereby reducing morbidity for both mother and baby.

Standardisation of Labour Room Infusions

Standardization is a cornerstone of medication safety in obstetrics. Hospitals should implement **institution-wide protocols** for high-alert medications in the labour room.

Key components include:

1. **Standard dilution and concentration charts**
2. **Smart infusion pumps with drug libraries and dose limits**
3. **Pre-printed medication order sets**
4. **Double-check systems for preparation and administration**
5. **Regular staff training and simulation drills**
6. **Incident reporting systems for medication errors**

Standardization reduces variability in practice and minimizes the likelihood of human error.

Conclusion

High-alert infusions are integral to modern obstetric care but carry significant risks if not administered carefully. Medications such as oxytocin, magnesium sulfate, insulin, and potassium chloride are essential in managing labour complications but require meticulous attention to dosing, infusion protocols, and monitoring.

Ensuring safety in the labour room requires a multidisciplinary approach involving obstetricians, anesthesiologists, nurses, and pharmacists. Standardization of infusion practices, clear labeling, dedicated IV lines, and continuous maternal-fetal monitoring are critical components of safe care.

Ultimately, strengthening medication safety systems in labour rooms can significantly reduce preventable errors and improve outcomes for both mothers and newborns.

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09

Labelling & Line Errors: How Accidents Happen

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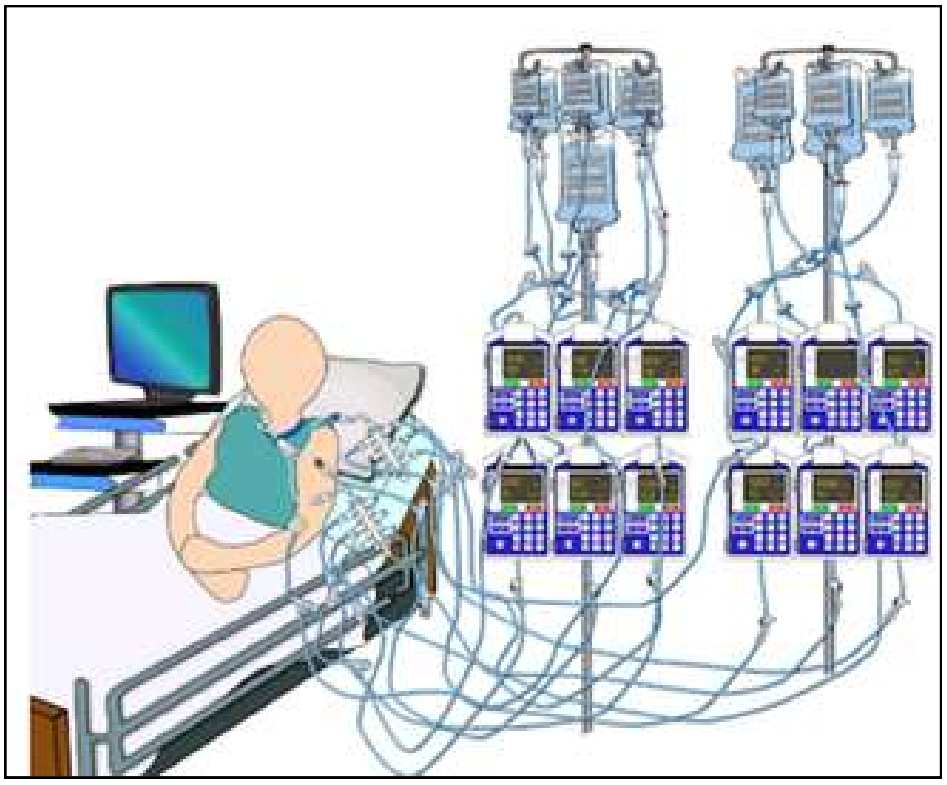
In our busy hospitals, IV medication errors like wrong line, wrong drug, or wrong patient can lead to serious harm or even death. These preventable mistakes happen daily, but simple labelling and process changes can save lives.



Common Errors in Practice

We often see nurses or doctors rushing in case of emergency, where errors in connecting a drug infusion to the wrong IV line can occur amid multiple infusions, especially in ICUs. Wrong patient errors occur when bedsides look similar or charts are misread during night shifts. Administering oral drugs via IV- like liquid paracetamol or antibiotics- has caused cardiac arrests because they lack IV-specific labels.[1].

Shift changes amplify risks; handover notes sometimes miss line details, miss handing over the drug adminstration details , which can lead to bolus into the wrong infusion.

Multiple lines from one cannula confuse tracing, causing incompatible drug mixes or rate errors. In India,high workloads and similar drug packaging add to these slips.

Common Error	Example	Potential Harm
Wrong line	Noradrenaline pushed into saline line	Hypertension or arrhythmia
Wrong drug	Oral syrup via IV	Airway obstruction, death
Wrong patient	Dopamine to adjacent bed	Severe hypotension
Multiple infusions	Incompatible drugs mixed	Precipitation, embolism

Guidance from Standards

WHO's Medication Without Harm campaign stresses clear labelling to cut severe errors by 50%. They recommend tall-man lettering (e.g., DOPamine vs. DOBUTamine) and avoiding colour-only coding to prevent mix-ups.[2,3]

In India, NABH 5th edition mandates double-checks for high-risk IV drugs, proper labelling with drug name, dose, and expiry, and pharmacist verification.[4] ISMP [Institute for Safe Medication Practices]advises against routine colour-coding for non-anaesthesia IV lines but supports it for high-alert drugs like vasopressors (violet labels). Australia's National Labelling Standard requires flags on lines and bags for continuous infusions.

Shift Handovers : For shift handovers, use SBAR (Situation-Background-Assessment-Recommendation) focused on IVs: List lines, rates, next doses. Ban handwritten labels; switch to pre-printed or automated systems where possible. Train teams quarterly on these, and audit weekly.

Air in the IV line (AIL)

Inspite of knowing how to avoid it , air in iv line is a common occurrence when nurses multitask in operation theatre , icu and wards .This can lead to adverse effects on vascular system and air embolism . Use ofInfusion pumps that have adesign to alarm when air in the IV line (AIL) reaches a set threshold can decrease this but causesdisruptions in drug delivery . Removal of AIL is usually done by disconnecting IV tubing or manual aspiration (77%) which can pose a risk to healthcare workers too. Constant reskilling of nursing staff is necessary to tackle this ubiquitous problem [5]

Practical Prevention Steps

Implement colour-coded line labels immediately- blue for opioids, red for neuromuscular blockers- tested to speed identification and cut errors. Use manifolds for multiple infusions to reduce dead space and confusion. [2].

IV Line Labelling Checklist

- Label every bag and line segment: Drug name (tall-man), strength, date/time, patient name/ID.
- Trace line from pump to cannula before any injection—two-person check for high-risk drugs.
- Flush between meds with compatible fluid at correct rate.

Shift Handover Algorithm Incoming nurse traces all lines aloud with outgoing nurse.

1. Confirm patient ID, allergies, high-risk drugs.
2. Document IV details in shared chart.
3. Verbalise: "Three lines: Saline at 100ml/hr, insulin 5u/hr, heparin 500u/hr—no recent changes."

These steps take seconds but prevent disasters—start today in your ward

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10 Creating a Safe Infusion Protocol for Clinics

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Intravenous infusions are among the most commonly used medical interventions in obstetric and gynaecological practice. From administering oxytocin in labour to magnesium sulphate in eclampsia and antibiotics during surgery, IV therapy is routine in OPD procedure rooms, operating theatres, and labour rooms.

However, infusion errors are also among the **most preventable causes of patient harm**. Incorrect dilution, wrong infusion rates, drug mix-ups and poor monitoring can lead to severe complications including hypotension, toxicity, fluid overload and medication errors.

Many small clinics and maternity centres function without a **written infusion protocol**, relying instead on individual practice habits. Establishing a simple, standardised protocol significantly reduces errors and improves patient safety.

This article outlines a **practical infusion protocol that can be implemented in most clinics and nursing homes.**

Why Infusion Protocols Matter

Medication safety studies consistently show that **intravenous drugs carry higher risk than oral medications**, mainly because they act rapidly and errors cannot be easily reversed.

In obstetrics, the consequences can affect both **mother and fetus**. Examples include:

• Oxytocin overdose causing uterine hyperstimulation and fetal distress
• Rapid magnesium sulphate infusion leading to respiratory depression
• Incorrect antibiotic dosing increasing infection risk
• Fluid overload in pre-eclampsia patients

Most of these complications arise from **system errors rather than lack of knowledge**.
Common causes include:

- Absence of standard dilution charts
- Verbal drug orders without written confirmation
- Similar-looking drug ampoules

- Incorrect pump settings
- Inadequate staff training

A **standard infusion SOP (Standard Operating Procedure)** helps create uniform safe practices across all clinical areas.

Standard Infusion SOP for Clinics

The same basic principles should apply in the **OPD procedure room, labour room and operation theatre**.

1. Prescription Stage

Every infusion must include the following written details:

Parameter	Required Information
Drug name	Generic name preferred
Dose	Total dose required
Dilution	Type and volume of diluent
Route	IV infusion / IV push
Rate	ml/hour or time duration
Indication	Clinical reason
Prescriber signature	Name and time

Avoid **verbal or telephonic orders except in emergencies**, and ensure they are documented immediately.

2. Preparation Stage

Drug preparation should ideally occur in a **designated medication preparation area.**

Basic steps include:

1. Hand hygiene
2. Confirm patient identity
3. Verify drug name and expiry date
4. Check dilution chart
5. Label the infusion bag or syringe

Prepared infusions must always be labelled with:

- Drug name
- Dose
- Date and time of preparation
- Prepared by
- Patient name

Unlabelled syringes or infusion bags should **never be used**.

3. Double-Check System

High-risk drugs should undergo **independent double verification**.

Drugs commonly requiring double check in obstetric practice include:

Drug	Reason
Oxytocin	Risk of uterine hyperstimulation
Magnesium sulphate	Respiratory depression risk
Insulin	Hypoglycaemia
Potassium chloride	Cardiac arrhythmia
Heparin	Bleeding complications

The **two-person check** must confirm:

- Correct drug
- Correct dilution
- Correct patient
- Correct infusion rate

Drug Storage and Dilution Charts

Drug safety begins with **organised storage systems.**

Storage Recommendations

• Separate **high-risk drugs** from routine medications
• Use **clearly labelled shelves or bins**
• Maintain temperature-sensitive drugs in monitored refrigerators
• Avoid storing look-alike ampoules together
• Keep emergency drugs easily accessible

Tall-man lettering (e.g., DOPamine vs DOBUTamine) can reduce confusion between similar names.

Example Dilution Chart (Labour Room)

Drug	Standard Dilution	Infusion Notes
Oxytocin	10 units in 500 ml RL	Titrate slowly
Magnesium sulphate	20 g in 500 ml RL	Monitor reflexes
Ceftriaxone	1 g in 100 ml NS	Infuse over 30 min
Metronidazole	100 ml IV ready solution	20–30 min infusion

A laminated dilution chart near the drug preparation area is extremely useful for staff.

Monitoring During Infusion

Safe infusion practice requires continuous patient monitoring.

Key parameters include:

• Vital signs
• IV site inspection
• Infusion rate verification
• Drug-specific monitoring

Examples:

- **Magnesium sulphate:** reflexes, respiratory rate, urine output
- **Oxytocin:** uterine contractions and fetal heart rate
- **Antibiotics:** allergic reactions

Every infusion should be documented in the **patient's medication chart**.

Emergency Readiness

Every labour room or OT must have **readily accessible emergency drugs and equipment.**

Essential items include:

- Adrenaline
- Hydrocortisone
- Antihistamines
- Calcium gluconate (for magnesium toxicity)
- Oxygen supply
- Suction apparatus
- Ambu bag

Emergency drugs should be checked **daily and after each use.**

A **crash cart checklist** helps maintain readiness.

Staff Training and Competency

Even the best protocols fail without trained staff.

Clinics should conduct **periodic training sessions** covering:

- Infusion pump use
- Drug dilution principles
- Recognition of adverse drug reactions
- Emergency management

New nurses should undergo **supervised training before independently administering infusions.**
Annual competency assessments improve safety culture.

Audit Points for Clinics

Regular audits help identify gaps in practice.

Simple audit indicators include:

Indicator	Target
Labelled infusion bags	100%
Written prescriptions	100%
Dilution chart availability	Present
Staff training record	Updated yearly
Emergency drug tray check	Daily

Even small clinics can perform **quarterly safety audits** using these indicators.

Practical Points for Clinicians

A few simple practices greatly reduce infusion-related errors:

1. Maintain a **written infusion SOP** in every clinical area
2. Display **standard drug dilution charts**
3. Use **two-person verification for high-risk medications**
4. Label every prepared infusion
5. Conduct **periodic staff training and safety audits**

Safe infusion practices do not require expensive technology. **Clear protocols, trained staff and disciplined implementation** can significantly improve patient safety in obstetric and gynaecological practice.

Printable Clinic Infusion Protocol Template

Clinics may display the following **quick reference protocol:**

Before infusion

Verify prescription
Check patient identity
Confirm drug, dose and dilution

During preparation

Hand hygiene
Check expiry date
Label infusion bag

Before administration

Double-check high-risk drugs
Confirm infusion rate

During infusion

Monitor vital signs

Observe for reactions

After infusion

Document administration

Dispose of sharps safely

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APPENDIX

TOOLKITT

IV Fluids, Electrolytes & Infusions – Safety Toolkit

1. IV Fluid Prescription Checklist

- Clear indication written (resuscitation / maintenance / correction)
- Type of fluid justified (NS / RL / balanced crystalloid)
- Volume and rate specified (no “run slow / fast”)
- Renal status reviewed (urine output, creatinine if available)
- Daily reassessment documented

2. Electrolyte Prescription Safety

- Serum electrolyte value documented before correction
- Target correction range written
- Maximum safe rate mentioned (esp. potassium, sodium)
- ECG monitoring planned if indicated
- Repeat electrolyte testing scheduled

3. Potassium Infusion SOP (High-Alert)

- Never IV bolus
- Dilution as per standard chart only
- Infusion pump mandatory
- Separate line preferred
- Double-check by doctor + nurse

4. Iron Infusion Safety Steps

- Indication documented (Hb, trimester, diagnosis)
- Dose calculated and recorded
- Emergency tray checked before start
- Monitoring for 30–60 minutes post infusion
- Adverse reaction documented, even if mild

5. Infusion Pump Safety

- Correct drug–rate–dose entered
- Alarm limits not silenced
- Line traced from bottle to patient
- Pump setting rechecked at shift change

6. Extravasation Immediate Action Card

- Stop infusion immediately
- Do NOT remove cannula initially
- Elevate limb
- Inform doctor
- Document event + photograph if required

B. RED FLAGS

IV Fluids & Infusions: 20 Mistakes That Harm Kidneys

1. Prescribing IV fluids without indication
2. “Normal saline for everyone” approach
3. No daily fluid review
4. Potassium added without recent value
5. Potassium written as “add to bottle”
6. Fast correction of hyponatremia
7. No ECG monitoring during K^+ infusion
8. Iron infusion without emergency preparedness
9. Test dose complacency
10. Multiple infusions through same line
11. Unlabelled IV lines
12. Pump alarms ignored or silenced
13. Extravasation recognised late
14. No documentation of infusion start/end time
15. Fluid overload in pre-eclampsia
16. Liberal fluids in elderly / renal compromise
17. Shift-change handover gaps
18. No standard dilution charts available
19. Nurses forced to “adjust rates” verbally
20. Assuming complications are disease-related, not iatrogenic

C. FDMSEC COMMITTEE RECOMMENDATIONS

1. Treat IV fluids and electrolytes as **high-risk drugs**
2. Mandate written indication for every IV fluid order
3. Standardise electrolyte dilution and correction charts
4. Label every IV line clearly
5. Use infusion pumps for all high-alert infusions
6. Implement double-check for potassium and magnesium
7. Maintain an iron infusion safety protocol
8. Train staff annually on extravasation management
9. Review fluids daily- stop early
10. Link fluid safety directly to **kidney protection**

D. LAMINATED "SAFE INFUSION WALL CHART"

SAFE INFUSION = SAFE KIDNEYS

Before You Start

- Why is this infusion needed?
- Is the fluid choice correct?
- Is the rate safe?
- Is kidney function considered?

High-Alert Drugs

- Potassium
- Magnesium
- Oxytocin
- Insulin
- Hypertonic saline

Never Forget

- No IV potassium bolus
- No unlabelled lines
- No pump alarms silenced
- No correction without monitoring

If Something Goes Wrong

STOP → CHECK → INFORM → DOCUMENT

03 - IV Fluids, Electrolytes & Infusions

FDMSEC Insights | March -2026

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