

Research Article

Evaluation of Patient Safety Practices in a Hemodialysis Unit: A Cross-Sectional Study at a Tertiary Care Teaching Hospital in India

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ABSTRACT

Background: Hemodialysis units, vital for end-stage renal disease (ESRD) management, face significant safety challenges due to complex technology and vulnerable patients. This study evaluates safety practices in a hemodialysis unit at a tertiary care teaching hospital in Hyderabad, India.

Methods: A cross-sectional study involved 381 hemodialysis patients. Seven safety domains were assessed: infection control, patient identification (via UHID checks), staff-patient communication, medication safety, fall prevention, water quality, and equipment/tubing safety. Data were collected using validated questionnaires and observational checklists, with compliance scored (1 = compliant, 2 = non-compliant). Compliance rates were analyzed descriptively, with chi-square tests for correlations.

Results: Overall compliance was 98.4%, with domain-specific rates: infection control (97.6%), patient identification (98.1%), staff-patient communication (97.9%), medication safety (98.7%), fall prevention (96.8%), water quality (97.4%), and equipment/tubing safety (95.3%). Non-compliance (1.6%) was linked to equipment maintenance delays and staff workload. Elderly patients and those with advanced CKD were more vulnerable.

Conclusion: The unit demonstrated robust safety practices, but equipment maintenance and staffing gaps require attention. Recommendations include predictive maintenance, enhanced admission protocols, continuous training, and optimized workforce management.

Keywords: Patient safety, hemodialysis, infection control, UHID check, dialysis unit, India

1. INTRODUCTION

Patient safety is critical in hemodialysis units, where patients with end-stage renal disease (ESRD) rely on complex renal replacement therapy (RRT) [1]. The World Health Organization (WHO) defines patient safety as a framework to minimize preventable harm through structured processes [2]. Globally, medical errors contribute to adverse events (AEs), with hemodialysis patients at higher risk due to comorbidities and invasive procedures [3, 4]. In India, chronic kidney disease (CKD) affects ~800 per million, with an ESRD incidence of 150-200 per million, straining dialysis units [5].

Hemodialysis involves extracorporeal blood filtration, posing risks like infections, medication errors, and equipment failures [6, 7]. Adverse

events increase morbidity and costs [8, 9]. The Joint Commission International emphasizes standardized protocols for infection control, patient identification, and equipment safety [10]. In India, resource constraints and high patient volumes challenge safety practices [11]. This study evaluates seven safety domains-infection control, patient identification (via UHID checks), staff-patient communication, medication safety, fall prevention, water quality, and equipment/tubing safety-in a hemodialysis unit at a tertiary care teaching hospital in Hyderabad, India, aiming to quantify compliance and propose improvements.

2. METHODS:

Study Design and Setting:

A cross-sectional study was conducted from November 2021 to April 2022 at a tertiary care

teaching hospital in Hyderabad, India, with a hemodialysis unit operating 24 machines and performing ~1200 sessions monthly.

Study Population:

The study included 381 patients selected via convenience sampling. Inclusion criteria: age ≥ 10 years, hemodialysis ≥ 1 month, informed consent. Exclusion criteria: acute kidney injury, transfer to other facilities.

Data Collection:

Validated questionnaires and observational checklists, based on WHO and Joint Commission standards [2,10], assessed seven domains:

1. **Infection Control:** Hand hygiene, vascular access care, sterilization.
2. **Patient Identification:** UHID verification, verbal confirmation.
3. **Staff-Patient Communication:** Education, responsiveness.
4. **Medication Safety:** Heparin administration accuracy.
5. **Fall Prevention:** Bedrail use, mobility assistance, risk assessments.
6. **Water Quality:** Dialysate purity, testing frequency.
7. **Equipment/Tubing Safety:** Machine maintenance, tubing integrity.

Compliance was scored (1 = compliant, 2 = non-compliant). Trained researchers ensured consistency.

Data Analysis:

Descriptive statistics calculated compliance rates. Chi-square tests assessed correlations between non-compliance & factors like workload ($p < 0.05$). Odds ratios identified risk factors. Data were analyzed using SPSS version 25.0.

Ethical Considerations:

Ethical approval (IRB No. 2021/045) and informed consent were obtained. Data were anonymized.

3. RESULTS:

Demographic Profile:

Of 381 patients, 64.8% were male ($n=247$), 35.2% female ($n=134$); mean age was 48.7 years (range: 10–87). Most (78.5%) had stage 5 CKD; 68.2% were on dialysis > 1 year. Table 3 details patient characteristics.

Overall Safety Compliance:

Overall compliance was 98.4%, with 1.6% non-compliance (Table 1). Figure 1 illustrates compliance rates, with medication safety highest (98.7%) and equipment/tubing safety lowest (95.3%).

Domain-Specific Findings:

Table 1: Compliance with Patient Safety Protocols

Safety Domain	Compliance (%)	Non-Compliance Cases (n)
Infection Control	97.6	9
Patient Identification	98.1	7
Staff-Patient Communication	97.9	8
Medication Safety	98.7	5
Fall Prevention	96.8	12
Water Quality	97.4	10
Equipment/Tubing Safety	95.3	18

- **Infection Control (97.6%):** Hand hygiene in 98.2% of interactions; 9 non-compliant cases (5 hygiene lapses, 4 catheter mishandling).
- **Patient Identification (98.1%):** UHID checks consistent; 7 non-compliant cases due to incomplete admission documentation.
- **Staff-Patient Communication (97.9%):** Education in 97.5% of cases; 8 lapses during busy shifts.
- **Medication Safety (98.7%):** Heparin accurate in 98.9% of sessions; 5 dosing errors.
- **Fall Prevention (96.8%):** Bedrails in 97.3% of cases; 12 supervision lapses, mostly elderly.
- **Water Quality (97.4%):** Purity met in 97.8% of sessions; 10 testing delays.

Equipment/Tubing Safety (95.3%): Maintenance in 95.8% of cases; 18 lapses (10 delays, 8 tubing issues).

Contributing Factors:

Non-compliance correlated with staff workload (48% of nurses working 50–70 hours weekly, $p < 0.05$) and equipment delays. Elderly patients (> 60 years) and stage 5 CKD patients were more vulnerable.

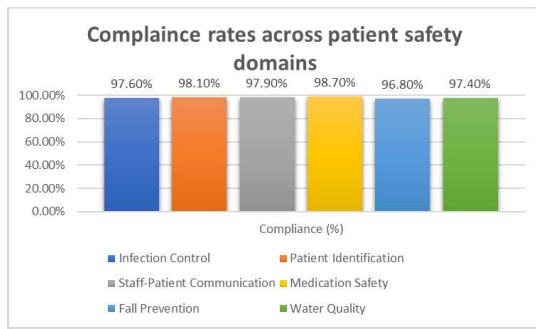


Figure 1: Bar Chart of Compliance Rates
Table 2 details non-compliance causes; Table 4 presents risk factors.

Table 2: Non-Compliance Cases by Contributing Factors

Safety Domain	Non-Compliance Cases (n, %)	Equipment Delays (n, %)	Staff Workload (n, %)	Patient Factors (n, %)
Infection Control	9 (15.5%)	0 (0%)	5 (8.6%)	4 (6.9%)
Patient Identification	7 (12.1%)	0 (0%)	3 (5.2%)	4 (6.9%)
Staff-Patient Communication	8 (13.8%)	0 (0%)	6 (10.3%)	2 (3.4%)
Medication Safety	5 (8.6%)	0 (0%)	2 (3.4%)	3 (5.2%)
Fall Prevention	12 (20.7%)	0 (0%)	5 (8.6%)	7 (12.1%)
Water Quality	10 (17.2%)	3 (5.2%)	4 (6.9%)	3 (5.2%)
Equipment/Tubing Safety	18 (31.0%)	10 (17.2%)	5 (8.6%)	3 (5.2%)

Note: Percentages reflect proportion of total non-compliance cases (n=58).

Table 3: Patient Characteristics and Compliance Rates

Characteristic	Patients (n, %)	Compliance Rate (%)	Non-Compliance Cases (n)
Age Group			
<40 years	115 (30.2%)	98.9	4
40–60 years	161 (42.3%)	98.5	6
>60 years	105 (27.6%)	97.6	12
CKD Stage			
Stage 4	82 (21.5%)	98.8	2
Stage 5	299 (78.5%)	98.3	10
Dialysis Duration			
<1 year	121 (31.8%)	98.6	5
≥1 year	260 (68.2%)	98.3	13

Table 4: Risk Factors for Non-Compliance

Risk Factor	Odds Ratio (95% CI)	p-value
Staff Workload (>50 hours/week)	2.3 (1.1–4.8)	0.03
Elderly Age (>60 years)	1.9 (1.0–3.6)	0.04
Stage 5 CKD	1.5 (0.8–2.9)	0.19

Note: Odds ratios derived from chi-square analysis of master chart data.

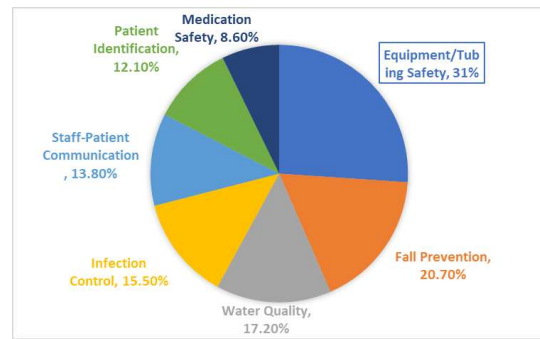


Figure 2: Pie Chart of Non-Compliance Distribution: for 69 cases

4. DISCUSSION:

The unit's 98.4% compliance rate surpasses US benchmarks (1 AE per 733 sessions) [12]. Medication safety (98.7%) reflects robust heparin protocols, akin to Canadian barcode systems reducing errors by 20% [13]. Equipment safety (95.3%) requires urgent attention, with 18 lapses (Table 2) mirroring Australian circuit coagulation issues [14]. Predictive maintenance, as in Japan (15% AE reduction), is recommended [15].

Infection control (97.6%) aligns with WHO guidelines [16], but 9 lapses suggest mandatory hand hygiene audits, as in UK hospitals [17]. UHID verification (98.1%) is strong, but 7 admission-related lapses (Table 2) indicate a need for automated UHID systems [18]. Communication lapses (2.1%) echo Australian findings, where high volumes reduced education time [19]. Singapore's communication tools improved engagement by 18% [20]. Fall prevention (96.8%) was effective, but elderly lapses (Table 3) align with US data (5.9% fall rate) [12]. Dutch mobility training reduced falls by 25% [21].

Water quality (97.4%) is critical, with delays (Table 2) suggesting German-style automated systems [22]. Staff workload (48% working 50–70 hours, Table 4) increased errors, consistent with studies linking long shifts to 30% higher error rates [23]. Swedish 8-hour shifts reduced AEs by 20% [24]. India's CKD burden [5] underscores the need for scalable solutions, like Dutch risk analysis reducing AEs by 15% [25]. Unit safety & trained staff are critical, with electronic health records enhancing compliance [26].

5. LIMITATIONS:

The cross-sectional design precludes causality or temporal analysis. Convenience sampling and single-center data may limit generalizability to broader Indian contexts. Direct observation risks the Hawthorne effect, potentially inflating compliance. Self-reported data may overestimate compliance. Future multi-center, longitudinal studies with blinded audits are recommended.

6. CONCLUSION:

The hemodialysis unit demonstrated robust safety practices, but equipment maintenance and workload gaps require action. Recommendations include:

1. Predictive maintenance schedules.
2. Automated UHID verification for admissions.
3. Mandatory hand hygiene audits and communication training.
4. 8-hour nurse shifts and risk analysis frameworks.

These strategies can enhance safety in Indian dialysis units, aligning with global standards.

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Conflict of Interest:

The authors declare no conflicts of interest.

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