

HEALTH SYSTEM BARRIERS TO INTRAVENOUS FLUID ADMINISTRATION AMONG NURSES IN A COUNTY REFERRAL HOSPITAL IN KENYA: A CROSS-SECTIONAL STUDY

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ABSTRACT

Background: Intravenous (IV) fluid administration is a high-risk nursing process. Health system barriers, particularly nurse staffing shortages, constrain safe infusion therapy and patient safety in resource-constrained LMIC settings and contribute to missed nursing care. This study examined health-system factors associated with IV fluid administration and monitoring practices by nurses in a county referral hospital in Kenya.

Methods: A descriptive cross-sectional study was conducted among 52 registered and enrolled nurses in adult medical and surgical wards selected by proportionate simple random sampling. Data were collected using a validated self-administered semi-structured questionnaire. Quantitative data were analyzed with descriptive statistics and Pearson chi-square tests (SPSS v22). Open-ended responses underwent thematic analysis (NVivo).

Results: Nursing staffing shortage was the predominant reported barrier (96.2 %; $\chi^2=44.31$, $p<0.001$). Shortage of intravenous fluids, cannulas, and infusion sets (32.7 %) and insufficient time for fluid-balance monitoring and documentation (25.0 %) were also significant (all $p<0.05$). Wards relied on gravity infusion sets and lacked infusion pumps or flow regulators. The reported challenges were significantly associated with IV fluid administration and fluid-balance documentation practices ($\chi^2=23.512$, $p<0.001$). Only 19.2% of participants had received additional IV fluid therapy training. Nurses recommended increased staffing, improved availability of supplies, infusion-control devices, and additional training.

Conclusion: Nurse staffing shortages, absent infusion-control technology, and limited in-service training constitute interrelated health-system barriers to safe intravenous fluid therapy. Addressing staffing, supplies, equipment, and continuing professional development is essential to strengthen infusion therapy and safeguard patient safety in comparable resource-constrained settings.

Keywords: Intravenous fluid therapy; Health system barriers; nurse staffing shortages; patient safety; LMIC missed nursing care; fluid balance monitoring; infusion therapy; Kenya county referral hospital.

INTRODUCTION

Health system conditions, nurse staffing shortages, and infusion therapy limitations continue to influence patient safety and the quality of intravenous fluid therapy in hospitals worldwide. Intravenous (IV) fluid administration is documented as a near-universal intervention across acute medical and surgical admissions, serving as one of the most frequently performed

invasive clinical procedures worldwide, with crystalloids representing the primary fluid choice (Hammond et al., 2017). Fluids are prescribed for fluid resuscitation, maintenance, replacement of ongoing losses, correction of fluid or electrolyte disturbances, and as a vehicle for pharmacological and nutritional agents (Lyons et al., 2018). However, because IV administration is the fastest route for delivering



fluids and medications into the circulation, errors can rapidly translate into patient harm.

Inappropriate prescription, suboptimal administration, and inadequate monitoring are associated with significant morbidity, including fluid overload, electrolyte disturbances, and acute kidney injury (Royal College of Physicians, 2017; Soni, 2009). Safe intravenous fluid therapy therefore depends on a coherent sequence of clinical assessment, appropriate prescription, accurate administration, and regular reassessment. By 2013, national guidance had already formalized these requirements, emphasizing the “5 Rs” (resuscitation, routine maintenance, replacement, redistribution and reassessment), daily monitoring of fluid status, laboratory values and fluid-balance charts, and the need for staff competence (Royal College of Physicians, 2017).

Despite the availability of clinical guidelines, evidence from high-income settings consistently demonstrates deficiencies in IV fluid administration and monitoring practices, with errors in prescribing, documentation, and infusion rate control frequently compounded by insufficient reassessment of patients' evolving fluid status (Forryan & Mishra, 2017; Royal College of Physicians, 2017). In a South African intensive care audit, 79% of fluid balance records deviated by more than 50 mL from audited calculations, and a significant association was demonstrated between inaccurate fluid balance calculation and diuretic administration (Diacon & Bell, 2014).

Delivery of safe intravenous fluid therapy depends not only on individual nurse knowledge and skill but also on the work environment in which nursing care is delivered. Adequate nurse staffing, manageable nursing workload, reliable supplies of fluids and administration sets, functional infusion equipment, and robust documentation systems are essential enablers (Griffiths et al., 2016). Conversely, nurse staffing shortages, high patient-to-nurse ratios, missing supplies, and incomplete fluid-

balance monitoring create health-system barriers that compromise patient safety. Systematic evidence available by 2018 showed that lower registered-nurse staffing was associated with greater omission of nursing care, while broader reviews linked nurse staffing with patient and nurse outcomes (Griffiths et al., 2018; Shin et al., 2018). These findings are relevant to IV fluid administration because inadequate staffing and competing clinical demands may constrain the time available for administration, reassessment, and documentation.

Evidence from medical and surgical wards consistently shows persistent vulnerabilities in intravenous fluid administration and monitoring. Multi-center observational studies have documented high rates of rate errors, incomplete or inaccurate fluid-balance charts, and deviations from prescribed regimens, often linked to workload pressures and limited time for monitoring (Dolan et al., 2016; Keers et al., 2015; Schnock et al., 2018; Vincent & Mahendiran, 2015). These health system barriers are particularly consequential in resource-constrained settings.

Kenyan public-sector nurse-to-population densities have historically been far below recommended levels, with marked inter-county variation and heavy reliance on nurses as the primary bedside providers (Wakaba et al., 2014). Evidence from Kenya also identified broader health-workforce shortages and skill gaps that constrain service delivery (Miseda et al., 2017; Sousa et al., 2014). However, evidence examining how such system constraints affect routine IV fluid administration and monitoring by nurses in Kenyan county referral hospitals remains limited.

This study therefore examined health system barriers to intravenous fluid administration by nurses at a county referral hospital in Kenya, focusing on adult medical and surgical wards where IV fluid use is highest. Specifically, it sought to identify staffing, supplies, equipment, training-related barriers, and organizational



constraints to safe infusion therapy and patient safety in a resource-constrained setting.

METHODOLOGY

A descriptive cross-sectional study was conducted in adult medical and surgical wards of a county referral hospital in Kenya. These wards were selected as they administer the highest volumes of intravenous (IV) fluids outside critical care units, making them optimal settings for examining health system factors influencing safe infusion practice (Royal College of Physicians, 2017).

The hospital's total nursing establishment was 288. The target population comprised approximately 60 registered and enrolled nurses working in the adult medical and surgical wards. A sample of 52 nurses was calculated using Fisher's formula with finite population correction, followed by proportionate allocation by ward and simple random sampling. This yielded participation of 86.7% of the accessible population. Inclusion criteria required current employment in the medical or surgical wards and direct involvement in intravenous fluid administration during the study period.

Data were collected using a self-administered, semi-structured questionnaire developed from the literature. Sections covered socio-demographic characteristics, health system factors (including nurse staffing and supplies), and challenges encountered during administration and monitoring. Face and content validity were established through expert review and pre-testing with 10 nurses at a comparable facility; the instrument was revised accordingly. Test-retest reliability yielded a correlation coefficient of 0.82.

Quantitative data were analyzed in SPSS version 22 using descriptive statistics and bivariate chi-square tests to examine associations between reported challenges and IV fluid administration practice; significance $p \leq 0.05$. Qualitative

responses were coded and thematically analyzed using NVivo to identify recurrent patterns and recommendations.

Ethical approval was obtained from the National Commission for Science, Technology and Innovation (NACOSTI/P/16/66942/12664), and the County Referral Hospital's Ethical Review Committee. The study adhered to the Declaration of Helsinki. Written informed consent was obtained from all participants; anonymity and confidentiality were maintained throughout.

RESULTS

Socio-demographic characteristics of the respondents

Of the 52 nurses who met the eligibility criteria and were approached, all participated (response rate 100%). Most nurses worked in the surgical wards (61.5%, Figure 1). The majority were female (69.2%) and aged 40–49 years (51.9%). More than half had ≥ 20 years of nursing experience, and 78.8% held a diploma-level nursing qualification. Only a minority (19.2%) had received additional training in intravenous fluid therapy.

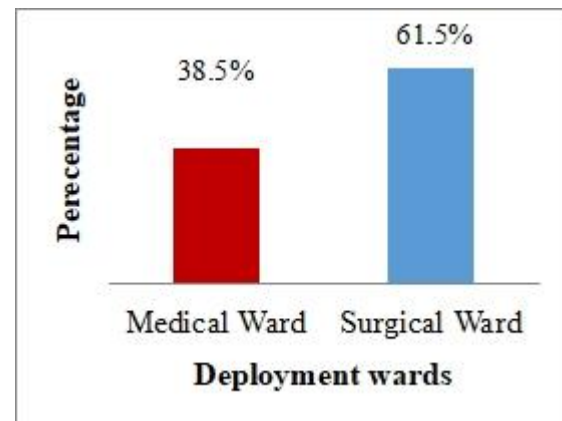


Figure 1: Distribution of study participants by ward (n=52)

Health-system barriers to intravenous fluid administration

Nurses reported multiple health system challenges during intravenous (IV) fluid administration **Table 1**. Nursing staff shortage was the dominant challenge, reported by nearly all respondents (96.2%). Shortages of IV fluids, IV cannulas, and infusion sets were reported by 32.7% of participants, while 25.0% reported insufficient time to complete patients' fluid-balance charts.

No participant reported inadequate availability of fluid-balance charts (0%). Observation

Table 1. Reported health-system barriers affecting intravenous fluid administration by nurses in the medical and surgical wards (n = 52)

Challenges encountered	n	%	χ^2	df	p value
Nursing staff shortage	50	96.2	44.31	1	0.0001
Lack of time	13	25.0	13.00	1	0.0002
Shortage of supplies (IV fluid, cannulas, IV infusion sets)	17	32.7	6.23	1	0.013

Note. Percentages are based on the full sample and are not mutually exclusive. χ^2 = Pearson chi-square test; df = 1 for all tests. Statistical significance was set at $p \leq .05$.

Association between challenges and intravenous fluid administration practices

Bivariate analysis showed a statistically significant overall association between the reported health-system challenges and nurses' intravenous fluid administration /

revealed that IV fluids were administered using gravity infusion sets, and the study wards reportedly had no infusion pumps or flow regulators.

Chi-square analysis indicated statistically significant associations between nursing staff shortage ($\chi^2=44.31$, $p=0.0001$), lack of time ($\chi^2=13.00$, $p=0.0002$), shortage of supplies ($\chi^2=6.23$, $p=0.013$), and IV fluid administration/fluid balance chart completion practices.

fluid-balance chart completion practices (Pearson $\chi^2 = 23.512$, $df = 8$, $p < 0.001$) (Table 2), indicating that nurses who reported greater system-level constraints were more likely to describe suboptimal IV fluid administration practices.

Table 2. Overall association between reported health-system challenges and intravenous fluid administration practices (n = 52)

Test	χ^2	df	p
Pearson Chi-Square	23.512	8	0.001
Likelihood Ratio chi-square	27.012	8	0.001

Note. χ^2 = chi-square statistic; df = degrees of freedom; p = two-sided significance level. n = 52.



Qualitative recommendations

Qualitative responses highlighted four recurring recommendation themes. First, nurses called for increased recruitment to address staffing shortages and improve service delivery (“Employ more nurses”). Second, they emphasized the need for consistent availability of IV fluids and administration sets (“Supply enough IV fluids”). Third, several respondents recommended the introduction of infusion control devices to improve flow rate regulation and safety. Fourth, nurses requested structured in-service training on IV fluid composition, administration, and complication management to strengthen competence and confidence in infusion therapy.

DISCUSSION

This study’s dominant finding, that nursing staff shortage was reported by 96.2% of respondents and was the most strongly associated challenge with fluid administration practice ($p=0.0001$), situates this study firmly within a well-established pattern linking inadequate staffing to compromised nursing care processes, including missed care. This aligns with international evidence linking lower registered nurse staffing to greater omissions of nursing care, including incomplete monitoring and documentation (Griffiths et al., 2018; Hessels et al., 2015). Systematic reviews have also shown that higher nurse-to-patient ratios increase burnout and job dissatisfaction (Shin et al., 2018), which may further compromise attention to IV fluid monitoring. Additionally, Kenyan health workforce evidence shows persistently low nurse-to-population ratios, and broader national analyses identify structural shortages in specialized health personnel as a constraint on service delivery and progress toward universal health coverage (Miseda et al., 2017; Wakaba et al., 2014). These findings suggest that staffing constraints may reduce the time available for rate checks, fluid-balance charting, and timely discontinuation of infusions, elevating the risk of fluid mismanagement.

The reported absence of infusion pumps and flow regulators, with reliance on gravity infusion sets, without pumps or flow regulators, compounds this staffing pressure. Where administration relies on manual rate calculation and visual monitoring rather than device-assisted control, the consequences of reduced nursing time become more acute, since gravity-regulated infusions demand closer, more frequent nurse oversight to maintain prescribed rates. This removes a critical technological safeguard against rate errors, a vulnerability repeatedly documented in observational studies of intravenous administration (Hessels et al., 2015). This aligns with findings elsewhere that inadequate reassessment and monitoring are recurrent contributors to fluid administration error (Gao et al., 2015). These significant equipment gaps mirror broader evidence of medical device shortages in Kenyan public facilities (Tsofa et al., 2017). Supply chain failures disrupt timely therapy and force nurses to prioritise competing clinical demands.

The association between lack of time and challenges completing fluid-balance documentation ($p < 0.001$) mirrors documentation-accuracy concerns identified in critical care and other settings, where a substantial proportion of fluid balance records have been found to deviate materially from calculated values (Diacon & Bell, 2014; Njung’e et al., 2017). Furthermore, the overall significant association between reported challenges and administration practices underscores that these barriers do not operate in isolation. Critically, the low proportion of nurses (19.2%) who had received IV fluid training suggests missed opportunities for continuing professional development. Participants’ recommendations for recruitment of additional nurses, reliable supply chains, introduction of infusion-control devices and structured in-service training map directly onto the system-level interventions supported by the wider literature (Schnock et al., 2018). These findings support a systems perspective: safe IV fluid therapy depends not only on nurses’ competence but also on sufficient

staffing, time, equipment, supplies, and reliable clinical documentation processes.

Limitations. The cross-sectional, single-site design precludes causal inference and limits generalizability to other Kenyan facilities or critical-care settings. Reliance on self-reported measures may be affected by social-desirability bias.

Implications. These findings support prioritizing safe staffing levels, uninterrupted supply of intravenous consumables, and equipment investment, particularly infusion regulation devices, as system-level interventions for safer IV fluid therapy in comparable Kenyan county hospitals. Hospital administrators should mandate regular in-service training on IV fluid therapy. Future multi-site studies incorporating patient-outcome measures would strengthen the evidence base for system-level interventions in resource-constrained settings.

CONCLUSION

Nurse staffing shortage was the predominant health-system barrier to safe intravenous fluid administration in the medical and surgical wards, reported by 96.2 % of nurses and strongly associated with suboptimal practice ($p < 0.001$). This staffing deficit was compounded by reliance on gravity infusion in the absence of flow-regulation devices, inadequate supplies, and insufficient time for monitoring and fluid-balance documentation. Collectively, these health system barriers heighten the risk of fluid mismanagement in this resource-constrained Kenyan county referral hospital, underscoring that safe intravenous fluid therapy depends as much on an enabling work environment as on individual nurse competence. Competent nurses cannot consistently deliver safe IV therapy when essential health system conditions are unreliable. Priority actions include recruitment toward minimum nurse-to-patient ratios, reliable supply chains for intravenous fluids and

administration sets, progressive introduction of infusion-control devices, and structured in-service training. Strengthening these system-level foundations is essential to safeguarding intravenous fluid therapy and patient safety in similarly resource-constrained settings.

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