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Nurses' knowledge, practices, and attitudes of intravenous fluid therapy at a healthcare facility in the Volta Region of Ghana: A cross-sectional study.

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ABSTRACT

Background:

Intravenous infusion therapy is essential to clinical care but poses risks, including phlebitis, fluid overload, and infections when inadequately managed. Nurses play a crucial role in ensuring safe and effective Intravenous administration. This study assessed nurses' knowledge, practices, and attitudes regarding intravenous infusion therapy at a healthcare facility in the Volta Region of Ghana.

Methods:

A quantitative exploratory-descriptive cross-sectional survey was conducted using convenience sampling to recruit 269 registered nurses through a self-reporting questionnaire. Descriptive statistics and chi-square tests analysed relationships between knowledge, practices, and attitudes.

Results:

Overall knowledge levels were satisfactory; 96.7% identified correct IV insertion sites, 81.4% correctly calculated infusion rates, and 85.5% confirmed drug compatibility. However, gaps existed in recognising air embolism symptoms (43.1%). Practice analysis revealed 81.8% of nurses assess IV sites regularly and 75.1% recognise phlebitis symptoms, yet nearly half (49.1%) do not practice correct peripheral IV dressing change frequency. Additionally, 29.7% provided incorrect responses regarding medication administration through active IV lines. Significant associations were found between self-reported IV competence and phlebitis management knowledge ($\chi^2 = 17.342$, df = 4, p = 0.002) and between formal IV training and infusion rate adjustment knowledge ($\chi^2 = 6.478$, df = 1, p = 0.011).

Conclusion:

Nurses demonstrated satisfactory knowledge, practices, and positive attitudes toward IV therapy. Knowledge deficits in key safety areas underscore the need for targeted training and institutional support.

Recommendation:

Healthcare facilities should implement structured in-service training programs that target specific knowledge gaps, particularly in recognising air embolism and preventing phlebitis. Developing and disseminating standardised institutional protocols and national guidelines is essential for enhancing Intravenous infusion practice consistency and safety.

Keywords: *intravenous infusion therapy, nurses, knowledge, practices, attitude, Ghana, hospital, intravenous infusion management*
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Introduction

The administration of intravenous infusions represents a fundamental component of contemporary nursing practice, facilitating the direct introduction of therapeutic fluids, pharmaceutical agents, and blood components into patients' circulatory systems (Gorski et al., 2021). Competent nursing practice in this domain requires the integration of theoretical understanding, technical proficiency, and appropriate professional conduct to safeguard patient wellbeing (Tolera, Kasaye & Abicho, 2024). Healthcare delivery in resource-constrained environments, such as Ghana, faces significant obstacles, including inadequate staffing levels, restricted training opportunities, and variable oversight mechanisms, all of which compromise optimal intravenous therapy administration (Abwalaba, 2018; Othman & Ahmed, 2020).

Research has documented considerable variations in nursing competencies related to infusion management. Pakistani healthcare settings demonstrated satisfactory foundational skills in medication preparation and delivery; however, deficiencies emerged in ensuring comprehensive safety protocols during IV therapy management (Ahmed et al., 2025). Similarly, investigations conducted in Nepal identified insufficient knowledge bases and suboptimal

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clinical practices among nursing staff managing intravenous infusions (Lamsal & Shrestha, 2019).

Evidence from African healthcare contexts, including Kenya (Njung'e & Kamolo, 2021), Egypt (Musa & Mahmood, 2022), and Namibia (Tomas & Kamati, 2024), reveals substantial gaps in nurses' understanding of essential components of intravenous therapy. These deficiencies encompass a limited comprehension of fluid composition, inadequate skills in flow rate calculations, poor knowledge of pharmaceutical compatibility, and insufficient strategies for preventing phlebitis (Njung'e & Kamolo, 2021; Musa & Mahmood, 2022; Tomas & Kamati, 2024). Such knowledge deficits contribute to adverse outcomes, including catheter-associated infections, excessive fluid administration, and pharmaceutical administration errors (Maison et al., 2019).

Within Ghana, the regulatory framework established by the Nursing and Midwifery Council explicitly includes pharmaceutical administration, encompassing intravenous therapy, within nurses' professional scope of practice (Nursing and Midwifery Council of Ghana, 2022). Despite this clear mandate, empirical investigations examining Ghanaian nurses' competencies, clinical practices, and professional attitudes toward intravenous infusion management remain limited. This study, therefore, aimed to assess the knowledge, practices, and attitudes of nurses toward IV infusion therapy at a teaching hospital in Ghana.

Methods

Study design and setting

The study employed a quantitative exploratory-descriptive cross-sectional design (Grove & Gray, 2023). Data collection was conducted between October and December 2024. The study was conducted in a public teaching hospital in the Volta Region of Ghana and was contextual in nature. The chosen teaching hospital comprises numerous departments, including medical, surgical, high-level wards (such as intensive care units and neonatal intensive care units), and accident and emergency, with a total of more than 300 beds. The hospital is a referral hospital that caters to patients from other hospitals and countries.

Population and sample

The study population comprised registered nurses working in medical, surgical, paediatric, accident and emergency, and high-level wards. These nurses were the target population and were selected due to their roles in the clinical units, where they play a pivotal role in the administration, monitoring, and management of IV therapy as stipulated in the Ghana Nurses' Scope of Practice (Scope of Practice for Nurses and Midwives in Ghana, 2022).

A total of 269 nurses were conveniently recruited and sampled, encompassing all nursing categories. The eligibility criteria required participants to be full-time employees at the designated teaching hospital, with recent hands-on experience in intravenous infusion care and management. This requirement was established to ensure the relevance and accuracy of their responses. Nurses were excluded from the study if they were working in administrative roles or non-clinical departments at Ho Teaching Hospital, were on leave during the data collection period, did not work at Ho Teaching Hospital, had less than 6 months of experience in administering IV infusions, were in supervisory, administrative, or teaching-only positions who did not regularly administer IV infusions, had documented substance abuse or addiction that may impair clinical judgment, had severe documented mental health conditions that may significantly impair accurate self-reporting, or were directly involved in developing IV infusion training materials or institutional IV policies at the study site.

Data collection

Data were collected using a structured self-administered questionnaire developed from existing literature (Tolera et al., 2024; Tomas and Kamati, 2024). The tool covered demographics, knowledge, practices, and attitudes. It was pre-tested with 20 nurses for validity. Data collection was facilitated through ward visits, QR codes, and survey links.

Addressing Potential Bias

Several measures were implemented to minimise potential sources of bias in this study. To reduce selection bias, all registered nurses meeting the inclusion criteria across the designated wards were invited to participate, ensuring broad representation. Self-reporting bias was addressed through assurance of anonymity and confidentiality, with emphasis that responses would not affect employment or performance evaluations. The questionnaire was pre-tested with 20 nurses to identify and eliminate ambiguous questions that could lead to measurement bias. To minimize response bias, participants were provided with adequate time to complete the questionnaire without pressure, and both digital and paper-based options were available to accommodate different preferences. Social desirability bias was mitigated through clear communication that the study aimed to identify system-level gaps rather than individual competence. Additionally, the research team maintained independence from the hospital's management structure to ensure participants felt comfortable providing honest responses.

Ethical considerations

The study was approved by the Tshwane University of Technology Research Ethics Committee (Ref #: REC2024=05=004 (SCI)) on 27 September 2024 and the Ho Teaching Hospital Research Ethics Committee (Ref #: HTH-REC (24) Fc_2t524) on 12 September 2024. Ethical principles were adhered to throughout the study in accordance with the Declaration of Helsinki, such as respect for persons, beneficence, and justice (World

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Medical Association, 1964). Participation in the study was entirely voluntary, and all respondents were assured of anonymity and confidentiality throughout the research process. Informed consent was obtained from each participant before data collection, ensuring they understood the study's objectives, their right to withdraw without penalty, and the measures for data security and privacy.

Data analysis

Data was analysed using SPSS version 25. Descriptive statistics were employed, including frequencies, percentages, means, and standard deviations. Chi-square tests were conducted to examine the associations between variables, such as knowledge levels, practices, and attitudes, and their corresponding demographic and professional characteristics. A 95% confidence level and a p-value of less than 0.05 were used.

Results

Demographics

A total of 269 nurses responded to the study. Most participants were males (80.3%, n = 216) and 19.7% females (n = 53). The majority of participants (85.1%, n = 229) held a bachelor's degree or diploma in nursing as their highest qualification, and 50.0% (n = 135) had more than five years of clinical nursing experience. Most participants were working in surgical wards (33.5%, n=90), followed by those working in medical wards (32.0%, n=86). The minority worked in Accident and Emergency (8.6%) and high-level care wards (5.2%). Table 1 presents the demographic characteristics of the 269 participants of the study.

Table 1: Demographic Characteristics (n=269)

Variable	Frequency (n=269)	Percentage (%)
Males	216	80.3
Females	53	19.7
Qualification (Bachelor's or Diploma)	229	85.1
Experience (>5 years)	135	50.0
Ward – Surgical	90	33.5
Ward– Medical	86	32.0
Ward– Paediatric	56	20.8
Ward - Accident and Emergency	23	8.6
Ward- high-level wards	14	5.2

Knowledge of IV Therapy

The data outlines performance in knowledge areas related to intravenous (IV) infusion, revealing a high accuracy rate in identifying correct IV infusion sites (96.7%, n=260) and confirming drug compatibility (85.5%). However, there are notable opportunities for improvement in recognising early signs of infiltration (55.4%) and symptoms of air embolism (43.1%), as well as in understanding best practices to prevent phlebitis (44.2%) and the primary considerations for adjusting infusion rates (55.4%). Table 2 illustrates the participants' knowledge of IV therapy.

Table 2: Knowledge of IV Therapy

Knowledge Area	Correct Response (%)	Incorrect responses
Correct site for IV infusion (vein)	96.7	3.3
Primary consideration for adjusting the IV infusion rate	55.4	54.6
Recognition of early signs of IV infiltration	55.4	54.6
Best practices to prevent phlebitis	44.2	66.8
Symptoms suggestive of air embolism	43.1	67.9
Calculation of IV infusion rate	81.4	19.6
Recognition of signs of fluid overload	70.6	29.4
Confirmation of IV drug compatibility	85.5	14.5
Best practice for preventing CLABSI	65.1	34.9
Use of an antiseptic solution before IV catheter insertion	75.1	24.9
First step of intervention in IV catheter occlusion	83.3	17.7
Importance of monitoring fluid status during IV administration	76.2	23.8

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Figure 1 further illustrates the relationship between correct and incorrect responses of participants.

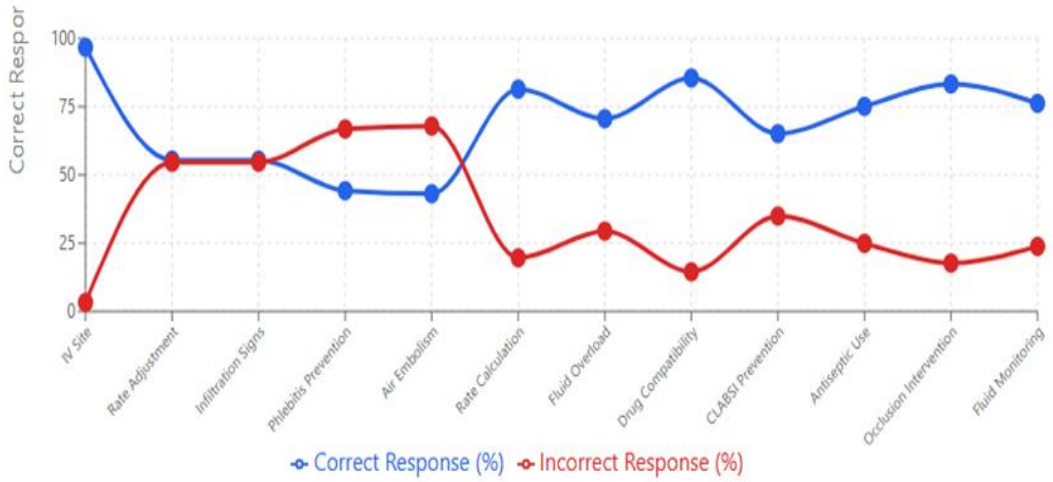

Figure 1: IV Therapy Knowledge Scores

Statistically significant associations were found between knowledge of air embolism symptoms and employment rank ($\chi^2 = 17.389$, df = 7, p = 0.015), between knowledge of IV infusion rate calculation and employment rank ($\chi^2 = 14.089$, df = 7, p = 0.050), and between knowledge of IV rate adjustment and the frequency with which nurses cared for patients receiving IV infusions ($\chi^2 = 22.575$, df = 4, p = 0.000).

Practice of Nurses on Intravenous (IV) Infusion Therapy

The analysis of nurses' practice in IV infusion therapy showed good compliance with essential clinical protocols. Most participants correctly responded to key items, such as aspects related to assessing the IV sites during continuous infusion (81.8%, n=220), 75.1% (n=202) recognised phlebitis symptoms, and 75.5% (n=203) identified the correct step when changing IV dressings. Furthermore, 79.2% (n = 213) reported correctly on the appropriate first steps to follow when phlebitis develops on the IV site, indicating satisfactory practical skills in routine IV care.
However, a notable deficiency in practice was found regarding the frequency of changing peripheral IV dressings (49.1%, n = 132) and medication administration through an active IV line (29.7%, n = 80). Practices toward IV therapy are presented in Table 2.

Table 2: Practice of Nurses

Practices Area	Correct Response (%)	Incorrect Response (%)
Frequency of IV site assessment during continuous infusion	81.8	18.2
Recognition of phlebitis symptoms at the IV site	75.1	24.9
Crucial step when changing an IV catheter dressing	75.5	24.5
Recognition of signs of phlebitis at the IV site	79.2	20.8
Changing of dressings on the peripheral IV site	50.9	49.1
Action before administering medication through the IV line in use	70.3	29.7

The overall practice analysis indicates a firm adherence to IV care protocols, as evidenced by high correct response rates in key areas such as the frequency of IV site assessment (81.8%) and recognizing phlebitis symptoms (75.1%). However, there were notable areas for improvement, particularly in the frequency of changing dressings over peripheral IV sites, where responses were evenly split (50.9% correct vs. 49.1% incorrect).

Statistically significant associations emerged between practice competence and knowledge areas. Notably, those confident in IV infusion were more likely to identify the correct first response to phlebitis ($\chi^2 = 17.342$, p = 0.002). Formal training was linked to better knowledge of infusion rate adjustment ($\chi^2 = 6.478$, p = 0.011), while the need for additional training correlated with understanding of CLABSI prevention ($\chi^2 = 8.015$, p = 0.005). Availability of

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protocols improved knowledge of infusion rate control (χ^2 = 9.468, p = 0.002), and national guideline support was associated with better phlebitis management knowledge (χ^2 = 16.087, p = 0.003). Confidence in IV dosage calculations was also linked to knowledge of phlebitis prevention (χ^2 = 4.361, p = 0.037).

Attitudes

The data in Table 3 highlights the attitudes of nurses regarding IV therapy, showing that 88.8% of participants felt confident in their skills, while 89.2% acknowledged the need for further training. Although more than half have received formal training, many felt unsupported due to a lack of available standard operating procedures, with 52.8% reporting this issue. Strong support for national guidelines to enhance consistency is evident, with 94.0% in favour. These findings emphasise the need for ongoing training and resources to boost healthcare providers' proficiency and confidence in IV administration.

Table 3: Attitudes of Nurses

Item	Positive Response (%)	Negative Response (%)
Very confident or confident in IV infusion administration	88.8%	11.2%
Received formal training in IV infusion administration	54.3%	45.7%
Self-reflected need for IV training	89.2%	10.8%
Availability of SOP in the hospital	47.2%	52.8%
Support for national guidelines to improve consistency	94.0%	6.0%
Felt adequately trained in IV dosage calculations	63.2%	36.8%

Statistically significant associations were found between self-reported competence in IV infusion administration and knowledge of the first action to take when signs of phlebitis appear (χ^2 = 17.342, df = 4, p = 0.002), between formal IV infusion training and knowledge of the primary consideration for adjusting an infusion rate (χ^2 = 6.478, df = 1, p = 0.011), and between the need for additional IV training and knowledge of CLABSI prevention practices (χ^2 = 8.015, df = 1, p = 0.005). Additional statistically significant associations were also found between the availability of standardised protocols or SOPs and knowledge of infusion rate adjustment (χ^2 = 9.468, df = 1, p = 0.002), between support for national guidelines and knowledge of phlebitis management (χ^2 = 16.087, df = 4, p = 0.003), and between confidence in IV dosage calculations and knowledge of phlebitis prevention (χ^2 = 4.361, df = 1, p = 0.037).

Discussion

The current study explored the knowledge, practices, and attitudes of nurses regarding intravenous infusion therapy in the Volta Region of Ghana. The findings revealed that the overall knowledge of nurses in the selected teaching hospital in the Volta region was satisfactory. In the current study, there was a higher proportion of male participants compared to female participants. This finding is comparable with a study conducted in Ethiopia (Tolera, Kasaye, & Abicho, 2024). Meanwhile, in Africa, studies conducted in Kenya and Namibia revealed that more female nurses participated than males (Njung'e & Kamolo, 2021; Tomas & Kamati, 2024).

The current study revealed that the overall knowledge of participants was satisfactory. The majority of participants demonstrated a good understanding of key areas, including the appropriate site for IV infusion insertion, calculation of infusion rates, and medication compatibility. In contrast to findings from other studies conducted in Kenya, Namibia, and Iraq, which reported poor calculation skills among nurses (Njung'e & Kamolo, 2021; Tomas & Kamati, 2024; Musa & Mahmood, 2022), nurses in the Volta Region displayed adequate knowledge of IV infusion therapy, particularly in recognising phlebitis and adjusting infusion rates. Nonetheless, significant gaps were observed in areas such as drug compatibility and the prevention of air embolism. These limitations reflect similar challenges reported in studies from Kenya, Ethiopia, and South Korea (Njung'e & Kamolo, 2021; Tolera, Kasaye & Abicho, 2024; Kim & Choi, 2024).

Nurses working in high-level units, such as the ICU and NICU, had significantly higher knowledge levels compared to those working in general wards. This supports the idea that specialised exposure and training enhance clinical competence. Similar patterns were reported in a study conducted among nurses in Sudan (Gassmalla, Hussein, & Hamid, 2022). The importance of structured and routine in-service training cannot be overstated. These findings emphasise the critical need for ongoing professional development and targeted training programs to foster nursing expertise and improve patient care across all nurses in different departments in the hospital.

The current study revealed that nurses demonstrated commendable self-reported practices in IV infusion therapy. The findings highlighted a strong awareness among the

nursing staff regarding essential procedures, such as the necessity of conducting regular assessments of IV sites and the ability to identify phlebitis, a common complication of IV therapy. This proficiency aligns with studies from countries such as Egypt, Indonesia, and South Korea (Hamdan, Albqoor, & Shaheen, 2022; Indarwati, Munday, & Keogh, 2022; Kim & Choi, 2024), suggesting a shared standard of knowledge and practice in IV infusion therapy among nurses worldwide. Overall, the study suggests that, with a solid foundation in core protocols, nurses at Ho Teaching Hospital are well-equipped to deliver safe and effective care, benefiting patient outcomes.

Notable practice gaps were observed. Nearly half of the participants reported unsatisfactory practice regarding the frequency of changing IV dressings and identifying steps before administering medications through active IV lines. Comparable challenges were noted in Nepal, Canada, and the UK, where institutional constraints and training gaps affected adherence to IV standards (Osti et al., 2019; Pinkney et al., 2019; Castro-Sánchez et al., 2014).

These findings are consistent with previous studies in Italy and Kenya, which also reported favourable attitudes among nurses regarding IV therapy (Di Muzio et al., 2017; Njung'e & Kamolo, 2021). This positive attitude reflects a strong foundation for ensuring patient safety and delivering effective care. The elevated level of confidence in administering IV therapy suggests that nurses feel prepared to manage the complexities associated with this critical aspect of patient care. Moreover, the willingness to pursue further training indicates that nurses recognise the importance of ongoing professional development in enhancing their skills and competencies.

More than half of the participants reported that their units lacked standardized protocols for intravenous (IV) infusion therapy. This challenge has also been noted in other studies conducted in Egypt and Ethiopia (Weheida et al., 2023; Teshome et al., 2023). Nevertheless, the majority of participants expressed support for the implementation of national guidelines to promote consistency and enhance safety in IV infusion practices.

While just over sixty per cent felt adequately trained in dosage calculations, the remaining participants highlighted the ongoing need for structured educational interventions, as supported by international evidence (Grugnetti et al., 2014; Wuyts et al., 2022). While it is encouraging to note that over sixty percent of participants felt trained in dosage calculations, it is concerning that a significant portion still expressed the need for improved educational interventions. This highlights the ongoing need for structured training programs that can equip healthcare professionals with the essential skills they need. International evidence supports this need, illustrating that targeted educational initiatives can lead to better outcomes in clinical settings.

The findings of this study demonstrate applicability beyond the immediate research setting, though with important considerations. The teaching hospital setting in the Volta Region of Ghana serves as a referral center, attracting patients from diverse geographic areas and representing a range of clinical complexities typical of tertiary healthcare facilities in Ghana. The demographic profile of participants, including varied experience levels and educational backgrounds, enhances the representativeness of the sample to the broader nursing workforce in similar settings. However, the generalisability of findings to other contexts requires careful interpretation. This study was limited to a selected healthcare facility within the Volta Region of Ghana, which restricts the direct generalizability of findings to other regions with different resource allocations, staffing patterns, and training infrastructures. Rural healthcare facilities and lower-tier hospitals might present different patterns of knowledge, practices, and attitudes due to variations in resource availability, patient acuity, and access to continuing professional development opportunities. Additionally, the predominantly male nursing workforce in this study differs from the typical gender distribution in nursing globally, suggesting that organizational or regional factors influence workforce composition in ways that limit generalizability to settings with different demographic profiles.

Despite these limitations, the study findings align with patterns observed in similar African contexts, including Kenya, Ethiopia, and Namibia, suggesting that the identified knowledge gaps and practice challenges reflect broader systemic issues in resource-constrained healthcare environments. The core competencies and deficits identified in this study likely resonate with comparable tertiary care settings across sub-Saharan Africa, making the findings valuable for informing regional training initiatives and policy development. Nevertheless, adaptation of recommendations should account for local contexts, including available resources, existing training infrastructure, and specific patient population needs.

The predominantly positive attitudes exhibited by nurses in this study, including confidence in IV administration and willingness to pursue further training, suggest a favourable environment for implementing improvement interventions at the study site. This positive disposition may be characteristic of teaching hospital settings where continuous professional development is emphasized and valued. However, such attitudes may differ in non-teaching hospitals or resource-limited facilities where access to training and institutional support structures is less robust. The high level of support for national guidelines (94.0%) indicates readiness for standardization efforts, though the feasibility of implementing such guidelines may vary across different healthcare settings with varying levels of administrative support and resources.

Nevertheless, adaptation of recommendations should account for local contexts, including available resources, existing training infrastructure, and specific patient population needs.

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Conclusion

This study concludes that participants exhibit adequate knowledge, practices, and attitudes toward IV infusion therapy; gaps remain in areas such as drug compatibility and the prevention of complications. The study highlights the pressing need to develop evidence-based guidelines for IV therapy in Ghana, as well as routine in-service training and supervision for all categories of nurses involved in IV infusion.

Limitations

This study was limited to a selected healthcare facility within the Volta Region of Ghana, which restricts the generalisability of the findings to other regions or national contexts. The sample size, although adequate, does not fully represent the broader nursing workforce across diverse healthcare settings in Ghana. Additionally, the reliance on self-reported data introduces the possibility of response bias, as participants could have over- or under-reported their knowledge, practices, and attitudes. The cross-sectional design captured data at a single time point, preventing assessment of changes in knowledge and practices over time or following interventions. Furthermore, the convenience sampling approach, while practical, limits the statistical generalizability of findings beyond the study population.

Recommendations

To overcome geographic constraints and improve generalisability, future studies should adopt a multi-regional approach that encompasses diverse healthcare facilities across Ghana, including both urban and rural settings, tertiary hospitals, and other levels of care where nurses administer IV infusions. The sample size should be substantially increased through multi-site collaboration and the use of stratified sampling methods to ensure adequate representation across different nursing categories, experience levels, and educational backgrounds. To address the inherent bias in self-reported data, researchers should implement mixed-methods approaches that combine quantitative surveys with qualitative interviews and focus group discussions, while incorporating objective assessment tools such as practical skills evaluations, case-based scenarios, and direct observation of IV infusion practices.

Additionally, longitudinal study designs may provide valuable insights into how knowledge, practices, and attitudes evolve, particularly following training interventions. The development of culturally appropriate and psychometrically validated instruments specific to the Ghanaian healthcare context is essential for reliable measurement. These research improvements should be coupled with practical applications, including the development of targeted training programmes based on identified knowledge gaps.

Abbreviations

CLABSI: Central Line-Associated Bloodstream Infection
CPD: Continuing Professional Development
ICU: Intensive Care Unit
IV: Intravenous Infusion
NICU: Neonatal Intensive Care Unit
SOP: Standard Operating Procedure
SPSS: Statistical Package for the Social Sciences

Data Availability Statement:

All data supporting the findings are available from the corresponding author upon request.

Conflict of Interest:

The authors declare no conflict of interest for this paper.

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Author Contributions:

Seyram Kpormegbe-Sallah: Conceptualisation, methodology, data collection, formal analysis, writing – original draft preparation, project administration.
Siyanda A Ngema: Supervision, methodology, validation, writing, review and editing, project administration.
Tendani S Ramukumba: Supervision, conceptualisation, validation, writing, review and editing, and resources.
All authors have read and approved the final version of the manuscript.

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