

CLINICAL AUDIT ON NURSES' ADHERENCE TO ARTERIAL LINE CARE IN CRITICAL CARE UNITS

Ms. Sakshi Rajiv Rajpurkar

M.Sc. Nursing Practitioner in Critical Care , First Year Department of Nursing
MGM New Bombay College of Nursing, Kamothe, Navi Mumbai, India

Mrs. Smruti V. Parkar

Assistant Professor

Department of M.Sc. Nursing Medical Surgical Nursing

MGM New Bombay College of Nursing, Kamothe, Navi Mumbai, India

Abstract: This clinical audit assessed nurses' adherence to arterial line care practices in the critical care units of a tertiary care hospital in Navi Mumbai and identified specific domains in which gaps in practice exist. A quantitative, descriptive, observational design was used. A sample of 66 staff nurses was selected from a population of 80 using the Yamane formula with a convenience sampling technique, across the SICU, MICU, EMS ICU, CVTS ICU, CCU, and Casualty units. Data were collected using a 25-item structured observational checklist, scored on a four-point scale (Done = 3, Partially Done = 2, Not Done = 1, Not Applicable = 0; maximum score 75), validated by 15 subject experts. Most nurses were aged 23 to 24 years (43.93%) with 0 to 3 years of clinical experience (65.15%), and 50 of 66 (75.75%) had received no prior training on arterial line care. None of the nurses, 0 (0%), achieved good compliance (score 59-75); 48 (72.72%) demonstrated moderate compliance (score 42-58); and 18 (27.27%) demonstrated poor compliance (score 25-41). Compliance was higher for routine and technical tasks, such as maintaining a closed pressure-monitoring system and documentation, and markedly lower for infection-control practices, including hub disinfection before blood collection and aseptic blood sampling, both performed in 0% of observed instances. The findings indicate that, while many nurses perform several components of arterial line care adequately, comprehensive adherence across all domains, particularly infection control and clinical assessment, remains inconsistent. Structured training, standardised protocols, and regular clinical audit with feedback are recommended to close these gaps and improve patient safety in critical care settings.

Index Terms—arterial line, arterial catheter, nurses' adherence, clinical audit, critical care, infection control, compliance.

I. INTRODUCTION

Arterial catheterisation is a widely used invasive monitoring technique in intensive care units, providing continuous, beat-to-beat blood pressure measurement and facilitating repeated arterial blood sampling for blood gas and acid-base analysis.¹ Compared with non-invasive methods, arterial lines offer greater reliability in haemodynamically unstable patients, which has made them a cornerstone of monitoring in septic shock, respiratory failure, multi-organ dysfunction, and major surgery.²

Despite their clinical value, arterial catheters carry a recognised risk of complications, including catheter-related bloodstream infection, thrombosis, haemorrhage, catheter dysfunction, and distal limb ischaemia, all of which can prolong intensive care unit stay and increase healthcare costs.³ Bloodstream infection rates

associated with arterial catheters have historically been reported in the range of 0.9 to 3.4 per 1000 catheter-days, a figure comparable to that of central venous catheters, challenging the earlier assumption that arterial lines carry minimal infection risk.⁴ A more recent systematic review and meta-analysis of peripheral intravenous and arterial devices reported substantial rates of catheter failure and infection, showing that these complications are not negligible and require systematic preventive strategies.⁵

International guidelines, including those of the Centers for Disease Control and Prevention and the Infusion Nurses Society, recommend strict adherence to infection prevention measures such as hand hygiene, maximal sterile barrier precautions, chlorhexidine skin antisepsis, and routine assessment of catheter necessity.^{6,7} Adherence to these recommendations remains inconsistent in practice, however; audits of insertion and maintenance behaviour have repeatedly found that compliance with full sterile precautions and aseptic technique falls well short of guideline standards.⁸ The insertion site itself further influences risk, with femoral access associated with higher infection rates than radial access, and ultrasound guidance shown to reduce insertion-related complications and improve first-attempt success.^{9,10}

Nurses occupy a central role in the ongoing maintenance, monitoring, and early detection of arterial line complications, and their adherence to evidence-based practice is critical to patient safety.¹¹ Yet a persistent gap between guideline knowledge and actual bedside practice has been documented across nursing settings internationally, often attributed to inadequate training, high workload, and the absence of standardised institutional protocols.⁸

Clinical audit has been identified as an effective strategy for closing this gap. By systematically comparing current practice against established standards, audits enable the identification of deficiencies and the design of corrective, evidence-based interventions.¹² Structured audit and feedback, particularly when combined with targeted education and standardised care bundles, has been associated with measurable improvements in compliance and reductions in catheter-related complications.¹⁰

In many healthcare settings, including those in India, empirical data on nursing adherence to arterial line care protocols in critical care units remain limited. This gap restricts the ability of nurse educators and hospital administrators to design targeted quality improvement initiatives. The present clinical audit was therefore undertaken to assess nurses' adherence to arterial line care practices in the critical care units of a tertiary care hospital in Navi Mumbai, and to identify specific domains in which practice gaps exist.

1.1 Need for the Study

The invasive nature of arterial catheterisation means that even minor lapses in aseptic technique or maintenance can result in serious adverse outcomes, including catheter-related bloodstream infection, thrombosis, haematoma formation, and catheter occlusion, each of which adds to morbidity, prolongs hospital stay, and increases cost of care. Although organisations such as the Centre's for Disease Control and Prevention and the Infusion Nurses Society have published evidence-based guidance for vascular access device care, observed compliance with these recommendations continues to vary widely across institutions and individual practitioners.⁷ Nursing staff are responsible for the great majority of day-to-day arterial line care, and their knowledge and adherence to guidelines have a direct bearing on patient outcomes; however, workload, staffing patterns, and the availability of structured institutional protocols have all been identified as factors that influence the consistency of this adherence.¹³

Clinical audit, supported by structured feedback and reinforced through staff education, has repeatedly been shown to improve compliance with infection-prevention protocols and to reduce catheter-related complication rates.¹⁴ Conducting such an audit in this setting is intended to generate setting-specific evidence that can inform staff training, institutional protocols, and ongoing quality improvement, in keeping with the broader patient safety goals reflected in Sustainable Development Goal 3 (Good Health and Well-Being).

1.2 Problem Statement

Clinical audit on nurses' adherence to arterial line care in critical care units.

1.3 Objectives

1. To assess nurses' compliance with arterial line care in critical care units.
2. To identify gaps in arterial line care among nurses in critical care units.

II. REVIEW OF LITERATURE

2.1 Studies Related to Arterial Line Care

A randomised controlled trial comparing ultrasound-guided radial artery cannulation with the conventional palpation technique found that the ultrasound-guided approach achieved a higher first-attempt success rate and fewer complications such as haematoma and arterial injury, supporting the use of ultrasound guidance to improve procedural accuracy and patient safety.⁹

A meta-analysis examining the empirical treatment of short-term central venous and arterial catheter-related infections found that insertion site was an important determinant of infection risk, with the femoral site associated with higher infection rates than the radial or subclavian sites, reinforcing the importance of careful site selection and aseptic technique during insertion.¹⁵

The Infusion Therapy Standards of Practice, an internationally referenced guideline document, sets out detailed evidence-based standards for vascular access device care, including hand hygiene, chlorhexidine-based skin antisepsis, and use of sterile precautions, and is widely used as a benchmark for evaluating institutional adherence to safe catheter care.⁶

A scoping review of care bundles for peripheral arterial catheters reported that standardised, bundled implementation of evidence-based practices was associated with improved adherence and reduced infection rates compared with non-bundled care, in contrast to the more ad hoc practice typically seen without such protocols.¹⁰

A scoping review of adverse events associated with arterial catheters in intensive care units identified limb ischaemia, thrombosis, haemorrhage, accidental removal, pseudo-aneurysm, and bloodstream infection as the principal harms reported in the literature, occurring across the full lifecycle of the catheter from insertion to removal, and linked many of these events to choices in infusion solution, securement, and dressing practice.⁵

A systematic review and meta-analysis of arterial catheters as a potential source of bloodstream infection concluded that, although infection rates with arterial catheters are generally lower than with central venous catheters, the absolute risk is not negligible and warrants the same rigour of infection-prevention practice applied to other vascular access devices.¹⁶

A narrative review of short-term peripheral venous catheter-related bloodstream infection similarly emphasised that adherence to hand hygiene, aseptic insertion technique, and timely device removal are the central modifiable factors influencing infection risk across vascular access device types.¹⁷

2.2 Studies Related to Nurses' Adherence to Arterial Line Care

A study evaluating nurses' knowledge, attitudes, and adherence to national guidelines for preventing central line-associated bloodstream infection in adult intensive care units found an overall guideline-adherence score of only 65%, with merely 5% of nurses reporting complete adherence to evidence-based practice; higher knowledge was significantly associated with greater clinical experience, more senior positions, and attendance at infection-prevention training, consistent with a role for structured education in improving compliance.⁸

A best-practice implementation project introducing a standardised peripheral venous catheter care bundle, supported by staff education, found a significant improvement in nurses' compliance with catheter care and assessment criteria following the intervention, demonstrating that structured education paired with a defined bundle can measurably raise adherence to aseptic technique.¹⁴

A systematic review and meta-analysis of peripheral intravenous catheter infection and failure across 41 observational studies and 28 randomised controlled trials found wide variability in adherence across different components of catheter care, with routine, highly visible tasks generally better performed than more complex monitoring and assessment activities, a pattern consistent with variation by task complexity rather than uniform compliance.⁵

An analysis of peripheral intravenous catheter audit data spanning five years found persistent variation in complication rates and adherence across audit cycles, and concluded that regular, appropriately powered clinical audits are necessary to reliably detect gaps in practice and guide quality improvement efforts.¹⁸

2.3 Studies Related to Complications of Improper Arterial Line Care

A scoping review of adverse events associated with arterial catheters in intensive care units, already discussed above, also reported that adherence to maintenance protocols was inversely associated with the frequency of mechanical and infectious complications, reinforcing the clinical importance of consistent practice.⁵

An early study of catheter-related infection among critically ill patients identified prolonged catheterisation duration as a significant risk factor for infection, supporting the recommendation that catheters be assessed regularly for continued necessity and removed promptly when no longer required.¹⁹

A meta-analysis evaluating chlorhexidine-impregnated dressings for the prevention of catheter-related bloodstream infection, which included arterial catheters used for haemodynamic monitoring, found a significant reduction in both catheter colonisation and bloodstream infection associated with their use, supporting their adoption as part of a standard arterial line care bundle.²⁰

The Guidelines for the Prevention of Intravascular Catheter-Related Infections, a widely cited evidence-based guideline document, concluded that poor adherence to recommended aseptic practice is a major contributor to catheter-related complications and associated healthcare costs, and that strict protocol adherence improves patient outcomes.¹¹

Summary

The literature reviewed confirms the clinical importance of arterial catheters in critical care, the recognised risk of infectious and mechanical complications associated with their use, and the consistent finding that nurses' adherence to evidence-based care practices varies considerably and is often incomplete, particularly for infection-control and assessment-related tasks. These findings support the rationale for the present clinical audit, which aims to quantify the current level of adherence to arterial line care among nurses in a tertiary care critical care setting and to identify specific domains requiring improvement

III. MATERIALS AND METHODS

3.1 Research Approach and Design

A quantitative research approach with a descriptive, observational design was used to assess nurses' adherence to arterial line care practices without manipulating any variables.

3.2 Study Setting

The study was conducted in the critical care units of a selected tertiary care hospital in Navi Mumbai, comprising the Surgical Intensive Care Unit (SICU), Medical Intensive Care Unit (MICU), Emergency Medical Services Intensive Care Unit (EMS ICU), Cardiovascular and Thoracic Surgery Intensive Care Unit (CVTS ICU), Coronary Care Unit (CCU), and Casualty.

3.3 Population and Sample

The target population comprised all staff nurses working in the critical care units of the selected hospital (N = 80). The sample size was calculated using the Yamane formula with a margin of error of 0.05, yielding a final sample of 66 staff nurses. A convenience sampling technique was used; nurses who met the inclusion criteria and were available during the data collection period were enrolled.

-Inclusion Criteria

- Staff nurses providing direct care to patients with arterial lines.
- Staff nurses present in the unit at the time of observation.
- Staff nurses willing to participate in the study.

-Exclusion Criteria

- Staff nurses not directly involved in arterial line care.
- Staff nurses absent during the data collection period.
- Staff nurses unwilling to participate.

3.4 Data Collection Tool

An investigator-developed structured observational checklist was used as the data collection tool. The tool was prepared following a review of literature, expert consultation, and development of a blueprint, and comprised two sections.

Section A: Demographic data, including age, gender, educational qualification, years of clinical experience, years of ICU experience, working department, prior training on arterial line care, and work shift.

Section B: A 25-item structured observational checklist assessing nurses' actual practice across eight domains: hand hygiene; assessment of the arterial line site and distal circulation; line maintenance and infection-control practices; placement and positioning of the arterial line; dressing care; ongoing evaluation; post-procedure care; and documentation.

3.5 Tool Validity and Scoring

Content validity of the checklist was established through review by 15 experts in critical care and medical-surgical nursing; items were refined based on expert feedback for relevance, clarity, and adequacy. Each item was scored on a four-point scale: Done = 3, Partially Done = 2, Not Done = 1, and Not Applicable = 0, yielding a maximum possible score of 75. Compliance was categorised using equal class-interval distribution as Good (78.66%-100%; score 59-75), Moderate (56%-80.55%; score 42-58), and Poor (33.33%-54.66%; score 25-41).

3.6 Data Collection Procedure

Formal permission was obtained from the hospital authorities prior to data collection. The investigator observed nursing practices directly using the structured checklist, without interfering with routine clinical work, until the required sample size was achieved.

3.7 Ethical Considerations

Ethical approval was obtained from the Institutional Ethics Committee of MGM Biomedical and Allied Health Research Institute, Kamothe (Reference No. IEC/MGM-BAHR/2026/01/0000152A). Informed consent was obtained from all participants, and confidentiality and anonymity were maintained throughout. The study involved no physical or emotional risk to participants, as data were collected solely through non-interventional observation.

3.8 Statistical Analysis

Collected data were analysed using descriptive statistics, including frequency and percentage distributions, and presented in tabular form.

IV. RESULTS

4.1 Socio-Demographic Profile of Nurses (Table 1)

Of the 66 nurses observed, the largest age group was 23-24 years (29, 43.93%), followed by 25-26 years (16, 24.24%), 27-28 years (15, 22.72%), 21-22 years (4, 6.06%), and 29-30 years (2, 3.03%). The sample was predominantly female (61, 92.42%), with males comprising 5 (7.57%). Regarding educational qualification,

35 (53.03%) held a B.Sc. Nursing degree, 20 (30.3%) held a GNM diploma, 8 (12.12%) were Nurse Practitioners, 2 (3.03%) held a post-basic B.Sc. Nursing degree, and 2 (3.03%) held an M.Sc. Nursing degree.

Most nurses had 0-3 years of clinical experience (43, 65.15%), followed by 3-6 years (21, 31.81%) and 6-9 years (2, 3.03%); a similar pattern was observed for ICU experience, with 42 (63.63%) having 0-3 years, 22 (33.33%) having 3-6 years, and 2 (3.03%) having 6-9 years. By department, the largest proportion of nurses worked in the MICU (20, 30.3%), followed by the SICU (19, 28.78%), EMS ICU (17, 25.75%), CCU (5, 7.57%), CVTS ICU (4, 6.06%), and Casualty (1, 1.51%). Only 16 (24.24%) nurses had received prior training specific to arterial line care, while 50 (75.75%) had not. By work shift, 25 (37.87%) nurses were observed in the morning shift, 22 (33.33%) in the evening shift, and 19 (28.78%) in the night shift.

Table 1: distribution of nurses based on socio-demographic characteristics (N = 66)

Variable	Category	Frequency (f)	Percentage (%)
Age (years)	21-22	4	6.06
	23-24	29	43.93
	25-26	16	24.24
	27-28	15	22.72
	29-30	2	3.03
Gender	Female	61	92.42
	Male	5	7.57
Educational qualification	B.Sc. Nursing	35	53.03
	GNM	20	30.30
	Nurse Practitioner	8	12.12
	Post-Basic B.Sc. Nursing	2	3.03
	M.Sc. Nursing	2	3.03
Clinical experience (years)	0-3	43	65.15
	3-6	21	31.81
	6-9	2	3.03
ICU experience (years)	0-3	42	63.63
	3-6	22	33.33
	6-9	2	3.03
Department	MICU	20	30.30
	SICU	19	28.78
	EMS ICU	17	25.75
	CVTS ICU	4	6.06
	CCU	5	7.57
	Casualty	1	1.51
Prior training on arterial line care	Yes	16	24.24
	No	50	75.75
Work shift	Morning	25	37.87
	Evening	22	33.33
	Night	19	28.78

4.2 Overall Compliance with Arterial Line Care (Table 2)

None of the 66 nurses observed, 0 (0%), achieved good compliance (score 59-75). The majority, 48 (72.72%), demonstrated moderate compliance (score 42-58), and 18 (27.27%) demonstrated poor compliance (score 25-41).

Table 2: distribution of nurses based on overall compliance with arterial line care (N = 66)

Compliance category	Score range	Frequency (f)	Percentage (%)
Good	59-75	0	0.00
Moderate	42-58	48	72.72
Poor	25-41	18	27.27

4.3 Item-Wise Practice (Table 3)

Compliance varied considerably across the eight domains of the checklist. Hand hygiene before care was fully performed by 23 (34.8%) nurses, partially performed by 34 (51.51%), and not performed by 9 (13.63%). Closed pressure-monitoring systems were maintained by 49 (74.24%) nurses, and 47 (71.21%) ensured the pressure bag was maintained at 300 mmHg or above, reflecting comparatively higher compliance with technical, routine tasks.

In contrast, infection-control practices showed the lowest compliance recorded in this audit: disinfection of the port or hub before blood collection and aseptic precautions during blood collection were each fully performed by 0 (0%) nurses, with 55 (83.33%) not performing either task at all. Assessment-related practices were similarly deficient: distal circulation assessment was fully performed by only 4 (6.06%) nurses, and arterial waveform assessment was fully performed by only 2 (3.03%), with 49 (74.24%) not performing waveform assessment at all.

Table 3: item-wise practice regarding adherence to arterial line care (selected items, N = 66)

Domain / Item	Done f (%)	Partially done f (%)	Not done f (%)
Hand hygiene before care	23 (34.80)	34 (51.51)	9 (13.63)
Use of gloves	26 (39.39)	31 (46.96)	9 (13.63)
ANTT maintained	26 (39.39)	29 (43.93)	11 (16.66)
Assessment of AL insertion site	18 (27.27)	28 (42.42)	20 (30.30)
Assessment of distal circulation	4 (6.06)	27 (40.90)	35 (53.03)
Closed pressure-monitoring system maintained	49 (74.24)	17 (25.77)	0 (0.00)
Aseptic flushing of arterial line	4 (6.06)	27 (40.90)	35 (53.03)
Disinfecting port/hub before blood collection	0 (0.00)	11 (16.66)	55 (83.33)
Aseptic precautions during blood collection	0 (0.00)	11 (16.66)	55 (83.33)
Transducer at phlebostatic axis	42 (63.63)	23 (34.84)	1 (1.51)
Pressure bag maintained ≥ 300 mmHg	47 (71.21)	19 (28.78)	0 (0.00)
Zeroing each shift / after repositioning	14 (21.21)	20 (30.30)	32 (48.48)
Waveform assessment	2 (3.03)	15 (22.72)	49 (74.24)
Dressing performed per protocol	50 (75.75)	11 (16.66)	0 (0.00)
Daily assessment for continued line necessity	23 (34.84)	28 (42.42)	15 (22.72)
Informing abnormal findings promptly	31 (46.96)	23 (34.84)	12 (18.18)
Hand hygiene after arterial line care	30 (45.45)	27 (40.90)	9 (13.63)
Documentation in nursing records	43 (65.15)	14 (21.21)	9 (13.63)

V. DISCUSSION

5.1 Socio-Demographic Profile and Compliance Overview

The majority of nurses in this audit were aged between 23 and 24 years and had three years or fewer of clinical and intensive care unit experience, reflecting a relatively young and less experienced workforce. Limited clinical experience can affect technical proficiency, clinical judgement, and confidence in performing complex procedures, which may partly explain the variability observed in adherence to arterial line care practices in this study.

A substantial majority of nurses, 50 of 66 (75.75%), had received no prior training specifically on arterial line care. Structured training has consistently been associated with improved compliance with aseptic technique and catheter care bundles in nursing practice; an implementation project introducing a standardised peripheral venous catheter care bundle alongside staff education found a significant improvement in compliance with catheter care and assessment criteria following the intervention.¹⁴ The absence of comparable structured training for the majority of nurses in the present audit is therefore a plausible contributor to the moderate-to-poor compliance levels observed.

The overall compliance findings showed that none of the 66 nurses, 0 (0%), achieved good compliance with arterial line care (score 59-75); 48 (72.72%) demonstrated moderate compliance (score 42-58); and 18 (27.27%) demonstrated poor compliance (score 25-41). This pattern, in which moderate compliance predominates and no participant achieves the highest category, mirrors findings from a cross-sectional study of intensive care unit nurses' adherence to central line-associated bloodstream infection prevention guidelines, which reported an overall adherence score of only 65%, with just 5% of nurses achieving complete adherence to evidence-based practice.⁸ Taken together, these findings suggest that although nurses are performing many components of arterial line care, consistent adherence across all domains remains uncommon.

5.2 Domain-Specific Findings

Adherence was generally higher for routine, technical, and highly visible tasks, such as maintaining a closed pressure-monitoring system, keeping the pressure bag inflated to at least 300 mmHg, and documentation, than for infection-control and assessment-related tasks. A systematic review and meta-analysis of peripheral intravenous catheter infection and failure similarly found wide variability in adherence across different components of catheter care, with routine and standardised tasks generally better performed than more complex monitoring and assessment activities.⁵ This pattern is consistent with the hypothesis that task visibility and procedural simplicity, rather than perceived clinical importance, may drive which components of care nurses are most likely to complete consistently.

In contrast, infection-control practices, including hub disinfection before blood collection, aseptic technique during blood sampling, and hand hygiene, showed some of the lowest compliance rates recorded in this audit. This finding is consistent with internationally recognised guidance, which identifies non-compliance with aseptic technique as a major contributor to catheter-related bloodstream infection and other hospital-acquired infections.^{7,11} Assessment and monitoring practices, including distal circulation assessment and arterial waveform evaluation, were also inadequately performed, indicating gaps in clinical observation and judgement. Adequate nurse staffing and protected time for clinical assessment have been linked to improved patient outcomes in critical care settings, and the workload pressures common to many intensive care units may similarly constrain nurses' capacity to perform thorough, ongoing assessment of arterial lines.¹³

Variation in adherence across the different domains of arterial line care points to inconsistency in practice that may be influenced by workload, staffing patterns, and the level of clinical supervision available on a given shift.¹³ These findings support the use of structured, recurring clinical audits, combined with feedback to staff, as a mechanism for sustaining improvement; audit and feedback interventions have been shown to produce small but consistent improvements in professional adherence to clinical guidelines across a wide

range of healthcare settings.¹²

The overall pattern observed, in which technical and routine tasks are well performed while infection-control and assessment tasks lag behind, supports the conclusion that continuous training, regular monitoring, and structured audit feedback are necessary to close the remaining gaps in arterial line care and to move nursing practice from the moderate compliance observed in this audit toward consistently good compliance.²¹

VI. CONCLUSION

This clinical audit found that nurses working in critical care units demonstrate a generally moderate level of adherence to arterial line care practices, with no nurse achieving good compliance and more than a quarter showing poor compliance. Compliance was comparatively higher for routine and technical tasks, but significant gaps were identified in infection-control practices and clinical assessment, particularly hub disinfection, aseptic blood sampling, and waveform assessment. These findings point to substantial scope for improvement and support the case for structured training, standardised protocols, and continuous evaluation of nursing practice to improve care quality and reduce complications associated with arterial lines.

VII. IMPLICATIONS

7.1 Nursing Practice

The gaps identified in infection control and clinical assessment indicate a need to strengthen day-to-day practice through strict adherence to standardised protocols, regular supervision, and bedside reinforcement of evidence-based technique, particularly for aseptic procedures during blood sampling and hub care.

7.2 Nursing Education

The high proportion of untrained nurses identified in this audit points to a need for competency-based training in arterial line care, including simulation-based skill demonstration and regular continuing nursing education updates on current guidelines.

7.3 Nursing Administration

Hospital administrators should institute regular clinical audits, in-service education, and competency assessments, and ensure adequate nurse staffing and resource availability to support consistent adherence to arterial line care protocols.

7.4 Nursing Research

This audit provides baseline data on nurses' adherence to arterial line care that can inform future research evaluating the effectiveness of targeted training interventions or standardised care bundles, ideally across larger, multi-centre samples.

VIII. RECOMMENDATIONS

- Conduct regular in-service education and training programmes on arterial line care, with emphasis on aseptic technique and hub disinfection.
- Implement structured orientation and competency-based training modules for newly recruited and existing critical care staff.
- Organise periodic skill-based workshops and simulation training to strengthen clinical assessment and monitoring skills.
- Institutionalise regular clinical audits with structured feedback for continuous quality improvement.
- Develop and implement a standardised arterial line maintenance checklist across all critical care units.
- Conduct similar audits with larger, multi-centre samples to evaluate the effectiveness of training and checklist-based interventions.

IX. LIMITATIONS

- The relatively small sample size may limit the generalisability of the findings to nurses across other healthcare settings.
- Contextual factors such as workload, nurse-patient ratio, and resource availability were not assessed, and may have influenced the adherence levels observed.

REFERENCES

- [1] Saugel B, Kouz K, Meidert AS, Schulte-Uentrop L, Romagnoli S. How to measure blood pressure using an arterial catheter: a systematic 5-step approach. *Crit Care*. 2020;24(1):172. DOI: <https://doi.org/10.1186/s13054-020-02859-w>
- [2] Vincent JL, De Backer D. Circulatory shock. *N Engl J Med*. 2013;369(18):1726-1734. DOI: <https://doi.org/10.1056/NEJMr1208943>
- [3] Maria no-Gomes PM, Ouverney-Braz A, Oroski-Paes G. Adverse events with arterial catheters in intensive care units: a scoping review. *Enferm Intensiva (Engl Ed)*. 2024;35(4):410-427. DOI: <https://doi.org/10.1016/j.enfie.2024.06.001>
- [4] Scheer B, Perel A, Pfeiffer UJ. Clinical review: complications and risk factors of peripheral arterial catheters. *Crit Care*. 2002;6(3):199-204. DOI: <https://doi.org/10.1186/cc1489>
- [5] Marsh N, Larsen EN, Ullman AJ, Mihala G, Cooke M, Chopra V, et al. Peripheral intravenous catheter infection and failure: A systematic review and meta-analysis. *Int J Nurs Stud*. 2023;151:104673. DOI: <https://doi.org/10.1016/j.ijnurstu.2023.104673>
- [6] Gorski LA, Hadaway L, Hagle ME, Broadhurst D, Clare S, Kleidon T, et al. Infusion Therapy Standards of Practice, 8th Edition. *J Infus Nurs*. 2021;44(1S Suppl 1):S1-S224. DOI: <https://doi.org/10.1097/NAN.0000000000000396>
- [7] Centers for Disease Control and Prevention. Guidelines for the Prevention of Intravascular Catheter-Related Infections. Atlanta: CDC; 2017.
- [8] Almalki AI, Alghamdi HA, Tashkandy NA. Assessment of Knowledge, Attitude, and Adherence to National Guidelines for Preventing Central Line-Associated Bloodstream Infections Among ICU Nurses of Adult Patients in Jeddah, Saudi Arabia: A Cross-Sectional Survey. *Cureus*. 2023;15(7):e42304. DOI: <https://doi.org/10.7759/cureus.42304>
- [9] Wang J, Lai Z, Weng X, et al. Modified Long-Axis In-Plane Ultrasound Technique Versus Conventional Palpation Technique for Radial Arterial Cannulation: A Prospective Randomized Controlled Trial. *Medicine (Baltimore)*. 2020;99(2):e18747. DOI: <https://doi.org/10.1097/MD.00000000000018747>
- [10] Reynolds H, Gowardman J, Woods C. Care bundles and peripheral arterial catheters. *Br J Nurs*. 2024;33(2):S34-S41. DOI: <https://doi.org/10.12968/bjon.2024.33.2.S34>
- [11] O'Grady NP, Alexander M, Burns LA, Dellinger EP, Garland J, Heard SO, et al. Guidelines for the Prevention of Intravascular Catheter-Related Infections. *Am J Infect Control*. 2011;39(4 Suppl 1):S1-S34. DOI: <https://doi.org/10.1016/j.ajic.2011.01.003>
- [12] Ivers N, Jamtvedt G, Flottorp S, Young JM, Odgaard-Jensen J, French SD, et al. Audit and Feedback: Effects on Professional Practice and Healthcare Outcomes. *Cochrane Database Syst Rev*. 2012;(6):CD000259. DOI: <https://doi.org/10.1002/14651858.CD000259.pub3>
- [13] Aiken LH, Sloane DM, Bruyneel L, Van den Heede K, Griffiths P, Busse R, et al. Nurse staffing and education and hospital mortality in nine European countries: a retrospective observational study. *Lancet*. 2014;383(9931):1824-1830. DOI: [https://doi.org/10.1016/S0140-6736\(13\)62631-8](https://doi.org/10.1016/S0140-6736(13)62631-8)

- [14] Gunasundram S, Tan M, Lim KZH, Loh VMP. Reducing the incidence of phlebitis in medical adult inpatients with peripheral venous catheter care bundle: a best practice implementation project. *JB Evid Implement*. 2020;19(1):68-83. DOI: <https://doi.org/10.1097/XEB.0000000000000245>
- [15] Buetti N, Ruckly S, Lucet JC, Perozziello A, Mimoz O, Souweine B, Timsit JF. The insertion site should be considered for the empirical therapy of short-term central venous and arterial catheter-related infections. *Crit Care Med*. 2020;48(5):739-744. DOI: <https://doi.org/10.1097/CCM.00000000000004270>
- [16] O'Horo JC, Maki DG, Krupp AE, Safdar N. Arterial catheters as a source of bloodstream infection: a systematic review and meta-analysis. *Crit Care Med*. 2014;42(6):1334-1339. DOI: <https://doi.org/10.1097/CCM.0000000000000166>
- [17] Mermel LA. Short-term peripheral venous catheter-related bloodstream infections: a systematic review. *Clin Infect Dis*. 2017;65(10):1757-1762. DOI: <https://doi.org/10.1093/cid/cix562>
- [18] Marsh N, Larsen E, Hewer B, Monteagle E, Ware RS, Schults J, Rickard CM. 'How many audits do you really need?': Learnings from 5-years of peripheral intravenous catheter audits. *Infect Dis Health*. 2021;26(3):182-188. DOI: <https://doi.org/10.1016/j.idh.2021.03.001>
- [19] Lorente L, Villegas J, Martín MM, Jiménez A, Mora ML. Catheter-related infection in critically ill patients. *Intensive Care Med*. 2004;30(8):1681-1684. DOI: <https://doi.org/10.1007/s00134-004-2332-3>
- [20] Safdar N, O'Horo JC, Ghufra A, Bearden A, Didier ME, Chateau D, Maki DG. Chlorhexidine-impregnated dressing for prevention of catheter-related bloodstream infection: a meta-analysis. *Crit Care Med*. 2014;42(7):1703-1713. DOI: <https://doi.org/10.1097/CCM.0000000000000319>
- [21] World Health Organization. Guidelines on Core Components of Infection Prevention and Control Programmes. Geneva: WHO; 2020.

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