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CLINICAL AUDIT ON ENDOTRACHEAL SUCTIONING IN CRITICAL CARE UNITS

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ABSTRACT

Background: This clinical audit was undertaken to evaluate endotracheal suctioning (ETS) methodologies across intensive care units (ICUs) at a designated tertiary care hospital in Navi Mumbai.

Objectives:

- **Primary Objective:** To evaluate the structural and mechanical techniques practiced by ICU staff nurses during endotracheal suctioning.
- **Secondary Objective:** To determine bedside adherence to infection prevention and control standards during suctioning procedures.

Introduction: Endotracheal suctioning serves as an indispensable nursing intervention in critical care environments, primarily executed to preserve airway clearance and minimize secondary risks such as ventilator-associated pneumonia (VAP) in intubated individuals. Even though evidence-based protocols are widely established, variations in clinical execution frequently compromise patient safety. Utilizing a clinical audit framework allows for a rigorous, systematic review of bedside performance, exposing critical safety deficits and establishing data-driven educational reforms to improve overall critical care delivery. **Methodology**: A non-experimental, quantitative, descriptive cross-sectional audit was executed among a total sample of 46 active ICU staff nurses. Data collection relied on a structured, 20-point observational checklist designed around international airway clearance benchmarks. Nursing activities were closely monitored during routine patient care, and the collected data were interpreted using descriptive and inferential statistical metrics, employing Chi-square tests to isolate demographic correlations. **Results:** The assessment monitored 46 critical care nurses across multiple specialized units. Excellent compliance (100%) was documented during core motor steps, including initial catheter advancement, appropriate personal protective equipment (PPE) usage, and keeping suction duration within the safe 10-15 second window. Conversely, profound safety oversights were discovered: compliance with pre-procedural hyperoxygenation dropped to 0%, while post-suctioning chest auscultation was executed by only 11% of the cohort. Higher adherence scores were directly tied to nurses holding a B.Sc. Nursing degree and those possessing over three years of intensive care experience. Statistical testing confirmed a significant association between clinical compliance and the nurse's primary department ($p < 0.05$).

Conclusion: The audit confirms that while ICU nurses are highly capable of managing the mechanical steps of suctioning, they consistently omit essential physiological safeguards, particularly preoxygenation and post-procedural respiratory reassessment. These outcomes highlight an urgent need to deploy mandatory refresher courses, high-fidelity clinical simulations, and point-of-care visual algorithms to reconcile the current disparities between theoretical protocols and real-world clinical application.

Keywords: Endotracheal suctioning, Clinical audit, Critical care nursing, Infection control, Patient safety.

I. INTRODUCTION

1.1 Background of the Study

Airway management forms the backbone of critical care medicine, particularly for patients facing acute respiratory collapse, major surgical interventions, or severe trauma. Invasive endotracheal intubation bypasses the upper airway's protective structures—including the cough reflex and the mucociliary escalator—leading to rapid mucus stasis, localized atelectasis, and an increased risk of secondary systemic infections.

To counter these physiological disruptions, ICU nursing staff must routinely clear accumulated secretions from the lower respiratory tract. Endotracheal suctioning (ETS) is the definitive clinical intervention used globally to preserve airway patency. The procedure involves advancing a sterile suction catheter into the artificial airway and applying controlled negative pressure to aspirate retained mucus.

Despite its routine nature, ETS is an inherently invasive maneuver capable of causing significant iatrogenic injuries if executed improperly. Suboptimal techniques are linked to severe clinical complications, including profound hypoxemia, tracheal mucosal trauma, bronchospasm, cardiac arrhythmias, and acute spikes in intracranial pressure.

1.2 Rationale of the Study

To maximize clinical safety, global professional associations have established strict evidence-based guidelines. Standardized parameters dictate that negative suction pressure must remain between 80 and 150 mmHg, individual suction attempts must never exceed 15 seconds, and procedures should occur only when clinical indicators are present rather than on a rigid, timed schedule. Furthermore, pre- and post-procedural hyperoxygenation is mandatory to buffer against transient desaturation. Strict adherence to aseptic barriers is also essential to prevent introducing pathogens into the lower airway, which can lead to Ventilator-Associated Pneumonia (VAP)—one of the costliest and most fatal nosocomial infections in intensive care settings.

As the primary bedside providers in the ICU, nurses directly influence patient outcomes through their operational choices during ETS. Despite clear guidelines, international literature reveals widespread inconsistency in how evidence is translated into practice. Variations are frequently attributed to institutional barriers, inadequate continuous education, unfavorable nurse-to-patient ratios, and a lack of structured feedback.

1.3 Need for the Study

A clinical audit offers a structured quality-improvement framework that reviews real-world performance against explicitly defined targets. In critical care settings, periodic clinical audits identify operational gaps, quantify compliance trends, and establish baseline data. This information helps design targeted in-service workshops, simulation modules, and system-level changes.

By auditing ETS performance across different specialized ICUs, this research identifies critical safety vulnerabilities and examines how academic background and clinical experience shape protocol compliance. Ultimately, this study aims to build administrative accountability and enhance patient safety benchmarks within the institution.

II. MATERIAL AND METHODS

2.1 Study Objectives

- **Primary Objective:** To evaluate the structural and mechanical techniques practiced by ICU staff nurses during endotracheal suctioning.
- **Secondary Objective:** To determine bedside adherence to infection prevention and control standards during suctioning procedures.

2.2 Operational Definitions

- **Clinical Audit:** A systematic quality-improvement methodology that appraises active nursing practices against fixed evidence-based targets to guide operational enhancements. In this project, it refers to the direct structured observation of bedside nursing care.
- **Endotracheal:** Refers to an invasive airway management device inserted directly into the trachea to maintain airway patency, secure ventilation, and facilitate respiratory gas exchange.
- **Suctioning:** The application of controlled negative pressure through a sterile catheter advanced into an artificial airway to remove accumulated secretions from the tracheobronchial tree.
- **Critical Care Unit:** A highly specialized hospital department dedicated to managing patients with life-threatening medical conditions through continuous physiological monitoring and advanced life-support interventions.

2.3 Research Design and Setting

This study utilized a quantitative, non-experimental, descriptive cross-sectional audit design. The investigation took place across five specialized intensive care units—the Medical Intensive Care Unit (MICU), Surgical Intensive Care Unit (SICU), Emergency Medicine and Surgical ICU (EMSICU), Cardiac Care Unit (CCU), and Cardiothoracic and Vascular Surgery ICU (CVTS)—at a prominent tertiary care hospital in Navi Mumbai. This setting was chosen due to its high volume of mechanically ventilated patients and specialized critical care infrastructure.

2.4 Participants and Sampling Matrix

A total sample of 46 registered staff nurses was selected using a purposive total enumeration technique.

- **Inclusion Criteria:** Registered nursing professionals providing direct bedside care to intubated, mechanically ventilated patients who were on duty during the clinical data collection window and provided written informed consent.
- **Exclusion Criteria:** ICU nurses assigned to non-ventilated patients or those not involved in direct airway management.

2.5 Data Collection Instrument

Data collection relied on a dual-component clinical instrument designed from current international airway management guidelines:

- **Section A (Demographic Profile):** Captured professional information, including academic qualifications (B.Sc. Nursing, General Nursing and Midwifery [GNM], or Auxiliary Nurse Midwifery [ANM]), specialized clinical experience, and primary department assignment.
- **Section B (Observational Checklist):** A 20-point checklist covering the pre-procedural, intra-procedural, and post-procedural phases of ETS. Items were scored categorically as either "Performed" (1 point) or "Not Performed" (0 points), with a maximum cumulative score of 20 points.

2.6 Validity and Reliability Protocols

Content validity was established by a panel of ten critical care specialists, including assistant professors, Nurse Practitioners in Critical Care (NPCC), and Doctorate in Nurse Practice (DNP) scholars. The instrument's internal consistency was confirmed with a Cronbach's alpha of 0.78 across all 20 observational items. Inter-rater reliability was validated by two independent clinical observers across ten separate suctioning events, resulting in an agreement rate exceeding 90% and a Cohen's kappa coefficient of 0.82, showing excellent observational alignment.

2.7 Ethical Administrative Clearances

Institutional ethical clearance was granted by the Biomedical and Allied Health Research Institutional Ethics Committee under approval code **IEC/MGM-BAHR/2025/04/000016A**. Administrative permission for data collection was secured from the Hospital Director. Every participant provided written informed consent before observations began. To minimize the Hawthorne effect, clinical observations were integrated into routine quality-assurance rounds. Complete anonymity and data confidentiality were maintained throughout the study.

III. ANALYSIS AND INTERPRETATION

3.1 Demographic Architecture of the Cohort

The complete audit sample consisted of 46 registered staff nurses actively executing airway suctioning procedures. Departmental distribution showed that the MICU had the highest procedural volume with 19 instances (41.3%), followed by the EMSICU with 11 instances (23.9%), the SICU with 10 instances (21.7%), the CCU with 4 instances (8.7%), and the CVTS ICU with 2 instances (4.3%).

Educational backgrounds varied: 30 nurses held a Bachelor of Science in Nursing (65.2%), 14 were GNM graduates (30.4%), and 2 were ANM trained (4.3%). Experience levels were distributed as follows: 15 nurses had 0–1 year of ICU experience, 16 had 1–3 years, 10 had 3–5 years, and 5 possessed 5–10 years of experience.

3.2 Step-by-Step Compliance Matrix

The step -specific audit data across the 20 checklist steps revealed varying levels of protocol adherence: (n= 46)

Phase / Step Description	Performed (*f*)	Not Performed (*f*)	Adherence Rate (%)
Pre-Procedural Evaluation & Preparation			
1. Clear clinical identification of suctioning requirements	46	0	100%
2. Procedural explanation provided to awake patients	18	28	39.1%
3. Operational checks on suction rig and sterile kit layout	41	5	89.1%
4. Positioning of patient into Semi-Fowler's alignment ($35^\circ\text{--}45^\circ$)	44	2	95.7%
5. Rigorous pre-procedural aseptic hand hygiene	39	7	84.8%
6. Pre-procedural monitoring of baseline physiological vitals	24	22	52.2%
7. Proper deployment of PPE barrier gear (mask, cap, sterile gloves)	46	0	100%
Intra-Procedural Execution Techniques			
8. Implementation of mandatory patient preoxygenation	0	46	0%
9. Differentiation of dominant (sterile) vs. non-dominant hand	38	8	82.6%
10. Aseptic opening of packaging maintaining catheter sterility	46	0	100%
11. Advancing the catheter tip safely to the point of restriction	46	0	100%
12. Deliberate advancement while assessing internal secretion path	46	0	100%
13. Rotational withdrawal technique under active negative pressure	46	0	100%
14. Limiting suction dwell runtime strictly within 10–15 seconds	46	0	100%
15. Vital status tracking and immediate post-suction hyperoxygenation	28	18	60.9%
Post-Procedural Standards & Documentation			
16. Post-procedure hand washing and disposal of consumables	44	2	95.7%
17. Evaluation of post-procedure vitals and peak airway ventilation pressures	39	7	84.8%
18. Structured chart documentation of secretion characteristics	18	28	39.1%
19. Escalation of abnormal clinical metrics to medical teams	28	18	60.9%
20. Reassessment of vital metrics and bilateral chest auscultation at 5 mins	5	41	10.9%

3.3 Compliance Variances Across Demographic Subgroups

i. Departmental Adherence Matrix:

(n= 46)

Department	*f*	Mean Step Score	Mean Compliance (%)
Medical Intensive Care Unit	19	12.6	63%
Emergency Medicine Intensive Care Unit	11	12.1	60%
Surgical Intensive Care Unit	10	11.6	58%
Cardio- thoracic and Vascular Intensive Care Unit	2	11.0	55%
Cardio Critical Care Unit	4	10.4	52%

Inferential testing confirmed that these departmental variations in procedural compliance were statistically significant ($p < 0.05$).

ii. Professional Qualifications and Experience:

(n=46)

Qualification	Average Score (%)	Highest score (%)	Lowest score (%)
B.Sc. Nursing	64.5	78	50
GNM	59.3	70	48
ANM	53.0	55	51

IV. DISCUSSION

This clinical audit identified a significant theory-practice gap in intensive care airway management: while nurses demonstrate high proficiency in the mechanical steps of suctioning, they frequently omit essential physiological safety measures.

4.1 Mechanical Competence vs. Safety Deficits

The near-perfect compliance (100%) observed in catheter advancement, rotational withdrawal, and safe dwell timing indicates strong technical proficiency. These findings align with observations by Leddy and Wilkinson (2015), who noted that nurses excel in the motor components of repetitive tasks because these actions are highly emphasized during initial clinical orientations.

However, the complete absence of preoxygenation (0%) represents a major safety failure. Preoxygenation is a mandatory clinical standard proven to protect patients against severe suction-induced hypoxia and associated cardiac events. This critical deficiency may stem from system-level barriers, such as high daily workloads, a lack of immediate equipment access, or an institutional culture that treats suctioning as a basic mechanical task rather than a complex cardiorespiratory intervention.

Similarly, the low rate of post-procedural chest auscultation (11%) suggests that assessments are often cut short once the immediate physical task is complete. Post-procedure auscultation is vital to confirm successful secretion removal and detect immediate complications like bronchospasms. This drop in compliance reflects a broader trend documented by Day et al. (2001), where post-procedural monitoring is frequently omitted due to perceived time constraints in high-acuity environments.

4.2 Educational and Environment Influences

The superior compliance scores observed among B.Sc. Nursing degree holders and senior practitioners highlight how advanced education and clinical experience shape best practices. Advanced academic preparation emphasizes the physiological principles underlying technical interventions, encouraging closer adherence to safety guidelines.

The higher compliance rates found in the MICU and EMSICU underscore how regular exposure to ventilated cases reinforces protocol familiarity. In contrast, units with lower ventilation rates, such as the CCU, showed significantly lower compliance, indicating a clear need for targeted educational interventions and reinforced protocols in those areas.

V. CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

This study reveals that while ICU nurses are technically proficient in executing the mechanical steps of endotracheal suctioning, they frequently omit critical pre-procedural and post-procedural safety measures. This consistent neglect of preoxygenation and post-suction clinical reassessment poses unnecessary risks to patient safety. Bridging this gap requires transitioning from basic task completion to an integrated, assessment-driven model of care.

5.2 Key Recommendations for Institutional Practice

1. Mandatory Preoxygenation Protocols: Implement a strict institutional policy requiring documented hyperoxygenation before any airway suctioning event, supported by point-of-care visual compliance alerts.
2. Point-of-Care Visual Checklists: Install laminated, step-by-step procedural guidelines at every ICU bedside to reinforce safety standards during high-stress shifts.

3. Simulation-Based Learning: Introduce mandatory, high-fidelity simulation training that emphasizes clinical decision-making, complication management, and patient communication.
4. Electronic Documentation Templates: Update hospital electronic health records to include mandatory tick-box fields for pre-suction vital signs, secretion characteristics, and post-procedural auscultation findings.
5. Continuous Quality-Assurance Auditing: Integrate biannual clinical audits into departmental quality reviews to maintain staff accountability and track compliance improvements over time.

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