

Experience of nurses in the prevention of Ventilator-Associated Pneumonia among critically ill patients at Muhimbili National Hospital in Dar Es Salaam

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ABSTRACT

Background: Ventilator-associated pneumonia (VAP) is one of the most common nosocomial infections that occur more than 48 hours after intubation and initiation of mechanical ventilation. It is associated with morbidity and mortality, increased health costs, and prolonged hospital stays. The estimated incidence of VAP globally is about 5-40% whereby in low and middle-income countries is about 47.9 per 1000 ventilator days. The prevention of VAP requires the successful implementation of VAP prevention strategies. However, there is limited literature about VAP prevention in hospitals in Tanzania. Therefore, this study aimed to explore nurses' experience in the prevention of VAP at a tertiary hospital in Tanzania.

Methods: An exploratory descriptive study design was conducted with 15 nurses who were purposefully recruited from medical and surgical ICUs. A semi-structured interview guide consisting of main questions and probes was used to collect data. All interviews were audio-recorded and transcribed verbatim. Data were analyzed using an inductive thematic analytical approach.

Results and conclusion: Four main themes emerged; nurses' roles in the prevention of VAP, nurses' challenges and burnout toward care provision, nurses' competency in implementing VAP prevention strategies, and enablers toward the implementation of VAP. The revealed prevention strategies were suctioning, early weaning, head of bed elevation of 30-45°, oral care, administration of medication, and implementation of IPC measures. The study has also revealed important barriers such as inadequate equipment, lack of VAP prevention protocols, shortage of staff, and inadequate knowledge. However, the major facilitators were responsible leadership, a quality control team, the availability of IPC guidelines, and individual motivation. Therefore, we recommend that nurses update their knowledge on the prevention of VAP through job training and research. Moreover, the hospital management should initiate training, prepare protocols, and ensure a constant supply of equipment.

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Key words: Ventilator-associated pneumonia, strategies, experience, nurses, critically ill patients.

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1. Introduction

Ventilator-Associated Pneumonia (VAP) is one of the most common nosocomial infections that occur 48 hours after intubation and initiation of mechanical ventilation. (1,2) It is a significant cause of high morbidity and mortality, increased health care cost, length of hospital stay, and delayed weaning among ventilated patients. (2) The most common causes of VAP are gram-negative bacteria, which account for 50-80%. Moreover, Methicillin-resistant *Staphylococcus aureus* (MRSA), *Streptococcus pneumoniae*, and *Haemophilus influenzae* are most common within 4 to 7 days of hospitalization. Whereas *Pseudomonas aeruginosa*, MRSA, and enteric gram-negative organisms become more common with increasing duration of intubation or hospitalization. (3) The risk factors for VAP include patient comorbidities, immunosuppression, age, number of intubations, sedatives, prior antibiotic therapy, soiled ventilator circuit, endotracheal tube (ETT), positioning, aspiration, and prolonged ventilation for more than five days. (4)

Globally, the incidence of VAP is estimated to be 5-40% and the mortality rate ranges between 10-50%. However, the variation in incidences and mortality depends on the country's strategies for VAP prevention, the type of ICU, and the number of days that patients spent on the mechanical ventilator. (5) The estimated incidence in low and middle-income countries is 47.9 cases per 1000 ventilator days. (6) The prevalence of VAP in Tanzania is about 53% (7) which is very alarming. Furthermore, one study conducted at Muhimbili National Hospital revealed that there were no clear and contextualized protocols for VAP prevention to guide nurses. (8)

To mitigate VAP, several measures have been employed such as continuous nurses' education on VAP prevention, adequate staffing, avoiding intubation, initiation of subglottic suctioning protocols, maintenance of artificial airways, and adherence to Infection Prevention and Control (IPC) guidelines. (9) However, the most used strategy for VAP prevention is the utilization of combined guideline (VAP bundle) consisting of the head of a bed elevation 30-45°, mouthwash with chlorhexidine, peptic ulcers prophylaxis, deep vein thrombosis prophylaxis (DVT), daily sedation vacation, assessing readiness to extubate, sterile subglottic suctioning, effective hand washing, and use of Personal Protective Equipment (PPE). (8,9)

The implementation of the VAP bundle requires teamwork, individual motivation, commitment, knowledge, strong leadership, good infrastructure, nurses' training, and availability of Standard Operating Procedures. However, the successful implementation of VAP prevention strategies has been affected by some barriers such as limited professional knowledge of weaning protocols and mouth care, poor attitude, lack of competence, heavy workload, shortage of staff, low job motivation, ineffective managerial and supervisory abilities, and unfavorable environmental condition. (9) Despite the alarming rates of VAP and lack of clear and contextualized VAP protocols in Tanzania, little is documented on what nurses do and experience to prevent VAP among critically ill patients. Therefore, this study aimed to explore nurses' experience in the prevention of VAP at a tertiary hospital in Tanzania.

2. Methodology

Study design

An exploratory descriptive study design was employed to explore nurses' experience in the

prevention of VAP among critically ill patients.⁽¹¹⁾ The qualitative research approach was used to ensure the provision of rich descriptions and a comprehensive picture of nurses' experience in the prevention of VAP.

Study setting

This study was conducted at Muhimbili National Hospital (MNH) which is in Upanga ward, Ilala District, Dar es Salaam. MNH is a National referral Hospital, Research center, and University teaching hospital with a bed capacity of 1,500. It attends about 2,000 outpatients per day and 250 critically ill patients in the ICU per month. The setting was considered because it is a tertiary health facility in Tanzania offering advanced services with modern equipment and technology. Also, it provides care to critically ill patients with different conditions admitted to the ICU including referral cases from rural and urban.

Participants and recruitment

The study involved registered nurses working in medical and surgical ICUs at MNH. The inclusion criteria were registered nurses with a diploma level or above and having experience of two years and above in managing critically ill patients. ICU nurses were involved because they are in constant and direct contact with patients more than other healthcare providers, they have encountered several critically ill patients and therefore, they would give rich descriptions to broaden the understanding based on their experiences. (13) The purposive sampling method (14) was used to recruit 15 participants from medical and surgical ICUs where critically ill patients are managed based on the principle of data saturation. (15) The sampling method was chosen because it enabled the recruitment of participants with particular characteristics, to enhance a detailed exploration of the topic and

obtain useful and rich data. Potential participants were identified and selected in collaboration with those in charge of ICUs. Thereafter, the first author (JZ), met with the participants, provided information about the study, and set an appointment for an interview at a time that was convenient for the participants who agreed to participate.

Data collection methods and procedures

The semi-structured interview guide was developed by the first author (JZ) based on the study objectives, and expertise consultation. The guide was composed of open-ended questions and probes to explore a broader understanding of the topic from participants. Thereafter, it was reviewed by the fourth author (MN) a critical care nurse specialist and a qualitative researcher. Before data collection, the guide was pre-tested among three participants to check the consistency of questions. The data collection was conducted between March and April 2022. Data were collected from medical and surgical ICUs through face-to-face interviews using a semi-structured interview guide. (16) A semi-structured interview guide helped the researcher to explore detailed information about a person's thoughts, behaviors, and experiences with the use of questions and probes which were relevant to the research topic. The first author (JZ) provided information to the participants about the purpose of the study, procedures, privacy, confidentiality, consent, benefits, and risk of participating in the study. Participants who consented to participate in the study using a written consent form, and oral consent for audio recording were interviewed. An appropriate date and time for the interviews were arranged based on the participant's preference and choice. We conducted a total of fifteen (15) interviews with nurses from medical and surgical ICUs after the completion of their

duties to prevent interaction during interviews. The interviews were conducted in a quiet and private room to facilitate proper hearing, recording, and confidentiality. The time taken for each interview was between 30 to 45 minutes. All interviews were conducted by the first author (JZ) in Kiswahili, the national language that is spoken fluently by participants.

Data analysis

Data were analyzed using an inductive thematic analytical approach with six phases according to Braun and Clarke (2020). These include familiarization with data, coding the data, generating initial themes, reviewing and developing themes, refining, defining, and naming themes, and producing the report. (17) The first author (JZ) listened to the audio records, transcribed the data verbatim, and read and re-read the transcripts to note things of potential interest, ideal to explore further in coding and gain familiarity with the data. The Kiswahili transcripts were translated into English by the first author (JZ), and then validated by the supervisors (MLN and DLM) before coding. The translated transcripts were imported into the open code software of UMEA University for easy organization of the text to facilitate smooth manual coding. Meaningful units were identified that were further refined into codes. Thereafter, relevant codes were sorted, organized, and combined based on similarities and differences to generate sub-themes. Identified sub-themes were further examined, refined, and condensed into four main themes. Finally, sub-themes and themes have been reported along with succinct quotes to represent participants' accounts.

Trustworthiness

The quality or soundness of the findings was based on the concepts of credibility, transferability, dependability, and

conformability. (18) To ensure credibility the researcher identified suitable participants and provided all the information about the study, and participants consented before participation. The researcher was fully engaged with the participants during data collection by utilizing a semi-structured interview guide, and data collection stopped after saturation. During the interview, Kiswahili language was used because it influenced getting rich and truthful responses as it is a language spoken comfortably by all participants. Furthermore, the research ensured dependability and confirmability by providing sufficient information on the whole research process and its implementation, reviewing the interview guide from the insight of former interviews, and sharing each step of data analysis with the supervisor MLN. The researcher also provided a rationale for the methodology, and analysis approach used. Furthermore, the interviews were recorded, and the findings were supported by quotes to ensure that they were abstracted from the experiences and ideas of the participants and not the individualities and favorites of the researcher. To ensure transferability, the researcher provided a clear, thorough, and exhaustive explanation of the context, characteristics of study participants, data collection method, analysis, and study findings.

3. Results

This study produced four main themes and nine subthemes (See Table 1). The main themes are nurses' roles in the prevention of VAP, nurses' challenges and burnouts toward care provision, nurses' competency in implementing VAP prevention strategies, and enablers toward the implementation of VAP. The description of the themes from the study is supported by direct quotes as shown in italics.

Table 1. Main themes, sub-themes, and codes developed from text data.

Main themes	Sub-themes	Codes
Nurses' roles in the prevention of VAP	Nursing assessment of patient's condition	Physical assessment Neurological assessment
	Nursing interventions for VAP prevention	Suctioning Early weaning Head of the bed elevation Oral care Administer medications. Implement IPC measures
Nurses' challenges toward care provision	Inadequate equipment, supplies, and other resources	Few suction machines Shortage of suction catheter Shortage of Sterile gloves Malfunctioning beds Lack of VAP protocols
	Shortage of staff	Shortage of time Workload Exhaustion Failure to accomplish a task
	Lack of learning opportunities	Lack of in-service training Need training in critical care Need for out-service training
Nurses' competency in implementing VAP prevention strategies	Knowledge of VAP prevention	Inadequate knowledge of VAP prevention Inadequate knowledge of the VAP protocol
	Confidence of nurses in implementing the VAP bundle	Indecisiveness in taking action. Lack of enough skills
Enablers toward implementation of VAP Prevention strategies	Institutional support for VAP prevention	Presence of IPC guideline Quality control team Responsible leadership
	Individual motivation toward care provision	Personal aspiration Empathy Individual passion

Nurses' roles in the prevention of VAP

Nursing care is an important aspect of the health care providers toward the improvement of patient conditions. Participants expressed different ways of caring for patients on the mechanical ventilator that are aimed to prevent VAP; Nurses' roles in the prevention of VAP emerged as the main theme having two sub-themes; Nursing assessment of the patient condition and Nursing interventions on VAP prevention.

Nursing assessment of the patient's condition

"I also assess the airway to make sure that the endotracheal tube is in the correct place and there is enough air entry into both lungs.

Although, some of us are not competent enough. Also, I continue checking for the presence of secretions in the tube and other things as usual" (P1, Female, Medical ICU).

Another participant reported that nurses must assess to identify patient needs and prioritize care. One of the participants stated that:

"Patient on mechanical ventilator requires total nursing care, first of all during the morning you have to assess before planning anything" (P13, female, surgical ICU).

Nursing interventions for VAP prevention

Prevention of VAP requires the implementation of different measures such as the utilization of

VAP bundle components. The preventive strategies reported by participants were suctioning, early weaning, head of bed elevation of 30-45°, oral care, administration of medications, and implementation of IPC measures. As narrated by one of the participants:

"...the things that we do is to make sure the ETT is patent by doing suction, we elevate their bed at 30°-45°. Also, we wean the patient early from the ventilator and perform oral care using normal saline. We also, give medication..." (P2, Male, Surgical ICU).

Furthermore, other participants reported that:

"Most of the time, we avoid patients lying flat because they can aspirate and end up with VAP. We put them on semi-fowler's position 30-45°, we change position every two hours, we perform suction and feeding according to patient's body weight" (P8, female, medical ICU).

Nurses' challenges toward care provision

Study findings revealed challenges experienced by healthcare workers during the provision of care including shortage of equipment and supplies, lack of VAP prevention protocols, shortage of staff, and lack of training on VAP prevention. All these hindered the implementation of VAP prevention strategies.

Shortage of equipment such as suction machines, suction catheters, sterile gloves, and malfunctioning beds, limited the ability of nurses to implement VAP prevention strategies. As reported by one of the participants:

"Availability of suction catheter is a challenge; normally you must use it once then you discard it, but due to shortage every patient is given one suction catheter in the morning and we use it several times...this is inappropriate..." (P9, Male, Medical ICU).

On the same issue, another participant reported that:

"The most challenges are on shortage of equipment like a suction machine. We had only two and we shouted a lot for more machines, assume that only two machines are operating, you have 18 beds with patients of which three-quarters of them are ventilated..." (P14, female, Surgical ICU).

The inadequate number of staff was reported to increase workload and hindered the provision of quality care. Another participant reported that:

"Staff shortage is very big because you can find yourself having up to three patients on a mechanical ventilator and you are required to perform each task: turning...suctioning...feeding..." (P10, Female, Surgical ICU).

Similarly, another participant narrated:

"...Most of the time you find that many nurses are doing suction alone, by doing so, they transmit infection to patients because how can you do suction alone while it is a sterile procedure? But we do so because of shortage" (P12, female medical ICU).

The lack of a VAP prevention protocol hindered the provision of consistent and quality care. As explained by one of the participants:

"For sure we don't have protocols for VAP prevention, that's why we are facing difficulties on how to care for patients and prevent VAP because there is no uniformity of care" (P3, Female, Medical ICU).

Lack of learning opportunities hindered nurses to implement VAP prevention strategies successfully. One of the participants narrated:

"Another challenge is lack of training among staff, there is no training for VAP prevention for example, during weaning trials some of the

nurses are not aware if a patient is ready for extubation. Also, some nurses are not competent in performing some of the procedures like suction" (P7, Male, Medical ICU).

Nurses' competency in implementing VAP prevention strategies

Professional competency is crucial in preventing VAP in patients on mechanical ventilators. Participants reported having inadequate professional capability for the prevention of VAP using effective strategies. This was attributed to inadequate knowledge of VAP prevention and indecisiveness in acting. One of the participants narrated:

"We need to be trained... and that is very important. You may find that a nurse is shifted from ward 5 to ICU and he/she doesn't know anything about care of the patient on a ventilator" (P1, Female, Medical ICU).

Participants reported that some nurses did not perform their work as required due to being uncertain about the VAP bundle. As expressed by one of the participants:

"... For example, on the issue of early weaning, some of us can't decide weaning patients because of not being sure if the patient is ready for weaning...So we wait for doctors" (P5, Female, Surgical ICU).

Enablers toward the implementation of VAP Prevention strategies

The participant reported that regardless of the challenges they face, some aspects of institutional support and individual motivation keep them working, to ensure that patients on a mechanical ventilator are well cared for. Supported by the quote below:

"The hospital management and the quality control team provided IPC guidelines from the

Ministry, also we have hand-out placed on the notice board so that we remind ourselves on how to maintain sterility during suction and how to wash hands" (P11, Male, Surgical ICU).

Participants expressed that they wish to care for critically ill patients because they are internally motivated as nurses to ensure that critically ill patients are recovering well without developing VAP.

"I imagine that if the patient could be me, I would need good care, therefore I take care of the patients the way I wish it to be done to me regardless of the challenges I'm facing" (P6, NO, and Medical ICU).

4. Discussion

Strategies used for preventing VAP among critically ill patients

The study showed that nurses adhere to VAP prevention strategies by assessing the patient's condition. However, most of the nurses expressed that they are not competent enough on performing neurological examinations (assessment of the level of consciousness and readiness to extubate). This indicates that nursing assessment is an integral aspect of nursing care that should be done first to prioritize care. Similar results from a study conducted in India revealed that assessment of redness to extubate, trial extubation, maintenance of ETT cuff pressure, and suctioning were the roles in preventing VAP. (19)

Furthermore, the study has revealed early weaning, head of bed elevation of 30-45°, oral care, administration of medication (antibiotics/prophylaxis), and implementation of IPC measures as the common nursing interventions for VAP prevention. This shows that nurses were implementing the VAP bundle components in their setting, In support of the

above findings, previous work from India, USA, and Spain revealed that early weaning, head of bed elevation of 30-45°, oral care, administration of medication (antibiotics/prophylaxis), and implementation of IPC measures were important nursing interventions in the prevention of VAP. (17,18,19) However, contrary to our findings, studies from the USA, and Australia showed additional strategies such as avoiding intubation, preventing re-intubation, use of sedation protocols, early initiation of enteral feeding, oral care with toothbrush and chlorhexidine, non-invasive positive pressure ventilation prone position, and changing ventilator circuits when soiled were the common strategies used to prevent VAP. (10,22)

Barriers to preventing VAP

Participants of this study reported that shortage of equipment and supplies, and lack of protocol for VAP prevention were the barriers to implementing VAP prevention strategies. Our findings are in line with previous findings from Jordan, and Iran which reported that inadequate equipment, lack of VAP protocols, non-standard physical structure, lack of time, lack of closed suctioning system, and failure to practice sterile techniques were the barriers to the prevention of VAP. (6,21)

Staff shortage was reported as a significant barrier to preventing VAP. Participants reported a high number of patients as compared to the number of nurses, and this increased workload as one nurse was responsible to provide care to almost more than two patients. This suggests that workload and busy environment hindered the provision of all necessary care, hence the failure to implement VAP prevention strategies. Our study is consistent with findings from five public hospitals in Almadinah Saud Arabia, and

Iran which showed that the shortage of nursing staff was one of the important barriers to the implementation of VAP prevention strategies. (25,26) Furthermore, lack of training was reported as a barrier to preventing VAP. This suggests that nurses are not updated on the VAP bundle therefore, this hinders the provision of quality care. our findings are similar to studies conducted in the Philippines, Italy, and Nepal which revealed that there was a lack of formal training on the components of VAP prevention strategies. (20,25,27)

A lack of appropriate knowledge of VAP prevention was discovered in a significant number of nurses. This suggests the need to recruit competent staff, continuous training, and supportive supervision. In support of these findings, a study from Tanzania and Iraq revealed that nurses had low knowledge and inadequate skills in the prevention of VAP. (28,29) Contrary to our findings, a study from Australia, and India revealed that nurses had good knowledge regarding VAP prevention though they showed poor adherence to VAP prevention protocol. (27,30)

Facilitators for preventing VAP

Participants reported utilization of IPC measures focused on VAP prevention like hand washing, putting on gloves, and performing sterile suctioning. This indicates that the availability of guidelines in a health care setting is an effective measure toward quality health care delivery as well as VAP prevention. Similar findings from Saud Arabia, and the USA revealed that nurses had good practice toward VAP prevention by adhering to IPC measures (hand washing, putting on PPE, and performing sterile suction). (33,34)

Moreover, it was reported that the hospital management was responsible to ensure the quality control team in reminding staff to adhere

to IPC measures in their daily work, as one of the VAP prevention strategies. This signifies that strong organization, leadership support, and supportive supervision creates a conducive environment and motivate staff toward quality care provision. The findings are similar to the studies from Spain and South Africa which reported that VAP bundle implementation requires a committed hospital management team and IPC team in enhancing VAP prevention. (35,36)

Individual motivation toward the provision of care was reported by participants as one of the facilitators of VAP prevention. This indicates that nurses were able to implement VAP prevention strategies because of individual passion, desire, and compassion toward the patient. In line with the above findings, a study from Switzerland revealed that the main facilitator toward VAP prevention was reflective motivation (perceived seriousness of VAP, and self-efficacy to prevent VAP). (37) In addition, findings from China show that ICU nurses' cognitive level was positively correlated with their attitude and behavior toward VAP prevention. (38) Contrary to the findings from our study, finding from a study done in Iran revealed that lack of motivation and the complex nature of the nursing profession were the barriers to preventing VAP. (39)

Study limitation and mitigation

In this study, the researcher's preconceived idea and experience of what was studied could influence/affect the interpretation of the results. This was mitigated by the prolonged engagement of the researcher during data collection, and proper utilization of interview skills, ensuring that participants have more time in explaining issues without unnecessary interference. Moreover, the translation of the quotes, codes, sub-themes, and themes from

Swahili to English had the potential of losing the original meaning of the participants. To mitigate this, the researcher consulted an expert in Swahili and English languages who compared and validated the transcripts. Furthermore, because the study involved a purposive sampling method its finding cannot be generalized. However, its goal was to provide a rich description and comprehensive information on the experience of nurses in the prevention of VAP, rather than generalization.

5. Conclusion and Recommendation

This study provides insights into the experience of nurses in the prevention of VAP. Nurses face several challenges including a shortage of staff, shortage of equipment and supplies, lack of training, lack of VAP prevention protocols, and inadequate knowledge of VAP prevention. Despite these challenges, nurses in their capacity are involved in VAP preventive measures. The study recommends that hospital management initiate training, prepare protocols for VAP prevention and ensure a constant supply of equipment to enhance VAP prevention.

Abbreviation

ETT: Endo Trachea Tube
ICU: Intensive Care Unit
IPC: Infection Prevention and Control
MNH: Muhimbili National Hospital
PPE: Personal Protective Equipment
VAP: Ventilator-Associated Pneumonia

Author Contributions

The following authors were involved in the study as follows; JZ was involved in the conceptualization of the research idea, title, study design, methodologies, data collection and analysis, and manuscript preparation. MDN was involved in manuscript development, editing, and reviewing. MLN and DLM supervised the

research from proposal to manuscript development and review. Furthermore, MLN critically reviewed the manuscript. The final manuscript was read and agreed upon by all authors.

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Conflict of Interest

The authors declare that they have no competing interest

Data Availability

The datasets generated and/or analyzed during the current study are not publicly available due to the obligation to maintain confidentiality and unauthorized/improper use but are available from the corresponding author upon reasonable request.

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