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Prevalence of Endotracheal Intubation in Emergency and Intensive Care Settings in Mahajanga, Madagascar

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Abstract

Objective: To evaluate the prevalence of patients with an indication for endotracheal intubation and the proportion of patients actually intubated in emergency departments in Mahajanga, Madagascar.

Design: Prospective, descriptive study conducted over a 4-month period (April–July 2024).

Setting: Emergency and intensive care units across two university hospitals and one private referral hospital in Mahajanga, Madagascar.

Participants: A total of 111 patients with a formal indication for endotracheal intubation were included. Among them, 27 underwent intubation.

Main outcome measures: Prevalence of indicated endotracheal intubation, rate of performed intubation, clinical characteristics, and factors associated with non-intubation.

Results: The prevalence of patients requiring endotracheal intubation was 24.3%. Most patients presented with severe clinical conditions, including impaired consciousness (52.3% with Glasgow Coma Scale <8) and respiratory distress (58.6%). Neurological conditions were the most frequent indications. Intubation was performed in only 24.3% of indicated cases. The main barriers to intubation included lack of qualified personnel (33.3%), limited experience, and clinical instability. Overall mortality was high (95.2%), particularly among patients not intubated.

Conclusion: There is a substantial gap between the need for and the actual performance of endotracheal intubation in emergency settings in Madagascar. System-level constraints, particularly human resources and training deficits, appear to significantly impact airway management and patient outcomes. Strengthening emergency airway training and improving access to critical care resources may help reduce avoidable mortality.

Keywords: Airway Management, Intubation, Emergency Medicine, Health Resources

Introduction

Airway management is a critical step in the stabilization of patients admitted to emergency settings. Endotracheal intubation (ETI) is considered the gold standard method to secure airway patency and ensure adequate ventilation in patients with life-threatening respiratory compromise [1]. In emergency departments, the decision to intubate is based on rapid clinical assessment, often in unstable and resource-constrained situations. However, the actual performance of intubation may be limited by several factors, including lack of trained personnel, insufficient equipment, and organizational constraints, particularly in low-resource settings [2]. In sub-Saharan Africa and similar contexts, data regarding the frequency of intubation indications and the actual rate of intubation in emergency settings remain limited [3]. In this context, the main objective of our study was to assess the prevalence of patients with an indication for endotracheal intubation and the proportion of patients who were actually intubated in emergency departments in Mahajanga.

Methods

Study Design and Setting

We conducted a prospective, descriptive, multicentre study between 1 April and 31 July 2024 in several emergency and critical care facilities in Mahajanga, Madagascar.

The participating included two public university hospitals: the university hospital Professor ZAFISAONA Gabriel (UHPZAGA) and the university hospital Mahavoky Atsimo (CHUMa) as well as a private referral hospital, the hospital St. Jean Paul II.

The study was conducted in the postoperative unit, the emergency and intensive care unit, the emergency triage unit, and the paediatric emergency department. These institutions represent the main referral for emergency care in the Boeny region.

All units operated continuously, 24 hours a day, and were staffed by on-call anaesthesiologists, emergency physicians, resident doctors, and nursing staff. Technical resources varied between hospitals, with some lacking invasive mechanical ventilation equipment.

Study Population

All patients admitted to participating services during the study period who had an indication for endotracheal intubation, or who underwent intubation outside the operating theatre, were eligible for inclusion.

Patients younger than one month of age, those intubated exclusively in the operating theatre for anaesthesia purposes, and those without a clinical indication for intubation were excluded.

Incomplete medical records were excluded from the final analysis.

Inclusion Criteria

Patients were included if they had at least one recognised indication for endotracheal intubation.

Cardiovascular Indications

- Cardiac arrest requiring advanced airway management;
- Severe cardiopulmonary decompensation with refractory hypoxaemia or hypercapnia;
- Haemodynamic instability requiring airway protection and ventilatory support.

Respiratory Indications

- Upper airway obstruction;
- Acute respiratory failure;
- Severe hypoxaemia despite oxygen therapy or non-invasive ventilation;
- Cervicofacial trauma compromising airway patency.

Neurological Indications

- Severe alteration of consciousness;
- Glasgow Coma Scale < 8;
- Neurological conditions associated with respiratory failure or inability to protect the airway.

Data Collection

Data were collected prospectively using a standardised data collection form developed prior to study initiation. Information was obtained from medical records and direct interviews with healthcare staff involved in patient management.

The following variables were collected:

- sociodemographic characteristics (age and sex);
- admission diagnosis and presenting complaints;
- medical history;
- indications for intubation;
- management modalities;
- factors limiting intubation;
- patient outcomes.

Statistical Analysis

Data entry and analysis were performed using SPSS version 27.0 (IBM Corp., Armonk, NY, USA). Categorical variables were expressed as frequencies and percentages. Continuous variables were presented as mean ± standard deviation or median with interquartile range, depending on distribution.

Ethical Considerations

Approval to conduct the study was obtained from the heads of the participating departments prior to data collection. Anonymity and confidentiality of patient information were strictly maintained. The study was conducted in accordance with ethical principles regarding respect for persons and protection of medical data.

Study Limitations

Several limitations should be considered when interpreting the results. The design may have introduced heterogeneity in clinical practices and data collection procedures. In addition, several center lacked advanced monitoring and invasive mechanical ventilation equipment, which may have influenced clinical decision-making.

Patients' financial constraints may also have limited access to optimal care. Finally, the absence of longitudinal follow-up prevented assessment of patient outcomes after hospital discharge.

Results

Study Population

During the study period, 111 patients with at least one indication for endotracheal intubation were included. Among them, 27 patients underwent intubation, corresponding to a prevalence of 24.3% (Fig 1).

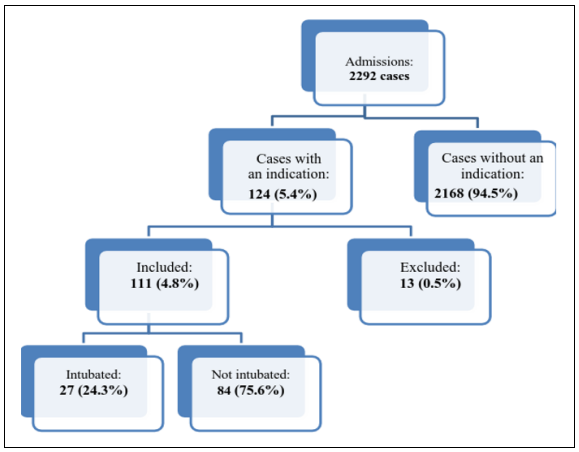

Fig 1: Flow diagram of the included patients

Patient Characteristics

Patients aged under 15 years accounted for 34.2% of the study population. Among adults, the mean age was 49.0 ±

21.1 years (range: 16–84 years), while the mean age of paediatric patients was 2.1 years. A male predominance was observed, with a sex ratio of 1.31. The most common reasons for admission were altered mental status (50.4%) and dyspnoea (27.9%). The most frequent comorbidities were hypertension (30.6%), diabetes mellitus (10.8%), and tuberculosis (10.8%). At admission, most patients presented with severe clinical signs. Oxygen desaturation was observed in 77.5% of patients, tachypnoea in 61.3%, and signs of respiratory distress in 58.6%. More than half of the patients had a Glasgow Coma Scale score < 8 (52.3%). Shock was present in 31.5% of patients, while hypertension was recorded in 30.6%.

Final Diagnoses

Neurological conditions were the most common diagnoses (35.1%), followed by haemodynamic failure (27.0%). Eight patients (7.2%) presented with combined neurological and respiratory failure. Other diagnoses included exacerbations of chronic obstructive pulmonary disease (9%), renal failure (6.3%), advanced cancers (6.3%), and toxic coma (2.7%).

Airway Management

Among the 111 patients with an indication for intubation, only 27 were intubated. Intubation rates varied across centres. The highest rate was observed at Hôpital Saint Jean Paul II, where more than half of the indicated patients underwent intubation.

Most intubations were performed by nurse anaesthetists (55.6%), followed by resident physicians (25.9%) and intensive care physicians (18.5%).

Intubation was performed at admission in 29.6% of patients, while others were intubated within the first 24 hours of hospitalisation.

Propofol was the most frequently used induction agent (70.4%). Two patients were intubated without sedation.

Causes of Non-Intubation

Several factors contributed to the non-performance of intubation. Lack of trained personnel was the most frequently reported reason (33.3%). Factors related to healthcare workers' experience, including lack of familiarity with the procedure or fear of performing intubation, were also observed (Table 1). Clinical factors sometimes limited the procedure, including haemodynamic instability, technical difficulty of intubation, and high infectious risk. In non-intubated patients, oxygen therapy via high-flow mask or nasal cannula was most commonly used as an alternative. A Guedel airway was used in combination with these devices in nearly three-quarters of cases.

Table 1: Main causes of non-intubation

Causes	Number (n)	Percentage (%)
Lack of trained personnel	28	33.3
Clinically unstable patient	15	17.9
Unfamiliarity with intubation procedure	14	16.7
Fear of performing intubation	11	13.1
High infectious risk	8	9.5
Lack of equipment	8	9.5

Patient outcomes

Outcomes were marked by a very high mortality rate, estimated at 95.2%.

Discussion

Our study highlights a low proportion of endotracheal intubations performed in patients who nonetheless had a clear indication for airway management in an emergency setting. Among the 111 patients included, only 24.3% were actually intubated. These findings appear to reflect the persistent challenges in airway management in resource-limited settings, particularly in emergency departments across sub-Saharan Africa and other low- and middle-income countries [4, 5]. The study population was relatively young, with more than one-third of patients aged under 15 years. This substantial proportion of paediatric patients may be explained by the inclusion of a regional paediatric referral centre. In addition, the male predominance observed in our study is consistent with the literature on emergency and critical care admissions, where males are generally more frequently represented [6, 7]. Altered mental status was the leading reason for admission. This finding is consistent with the high frequency of neurological conditions observed in our series. In emergency settings, severe neurological impairment remains one of the main indications for intubation to secure the airway and prevent aspiration [8, 9]. Most patients presented with signs of clinical severity at admission, including oxygen desaturation, tachypnoea, or a Glasgow Coma Scale score below 8. These parameters are classically associated with an increased risk of acute respiratory failure and intensive care mortality [10, 11]. Moreover, the high frequency of shock states in our study likely reflects delayed presentation as well as the severity of underlying conditions.

Neurological disorders were the most frequent diagnoses, followed by haemodynamic failure. Several studies have shown that severe neurological emergencies, including stroke, traumatic brain injury, and infectious encephalopathies, are common indications for intubation in critical care settings [12, 13].

One of the key findings of our study is the low overall intubation rate despite clear clinical indications. This observation reflects structural and organisational limitations faced by emergency services in resource-limited settings. Recent studies highlight that lack of equipment, insufficient training, and shortage of skilled personnel remain major barriers to safe emergency intubation in several African countries [4, 14, 15].

In our study, most intubations were performed by nurse anaesthetists. This may be explained by the limited availability of specialist physicians in the studied facilities. In many low-resource settings, nurse anaesthetists play a crucial role in airway management and emergency care, particularly where physician shortages exist [16, 17].

Propofol was the most commonly used induction agent. This finding is consistent with current recommendations in anaesthesia and emergency medicine, where propofol remains widely used for rapid sequence induction despite its potential haemodynamic adverse effects in unstable patients [18]. However, the absence of neuromuscular blockade in our series may reflect drug availability constraints or challenges related to post-intubation monitoring.

Lack of trained personnel was the most frequently reported reason for non-performance of intubation. Fear of performing the procedure and lack of familiarity were also commonly reported. These findings are consistent with the literature showing that operator experience directly influences intubation success and peri-intubation

complications [19, 20]. In emergency settings, several authors recommend the implementation of simulation-based training and continuous education to improve airway management skills [4, 21].

The extremely high mortality observed in our study likely reflects both the severity of the patients' conditions and the challenges in managing life-threatening emergencies in our context. All patients with an indication for intubation who were not intubated died. Although causality cannot be established, these findings suggest that limited access to intubation and mechanical ventilation may have contributed to the poor outcomes observed.

Conclusion

This study demonstrates a relatively low rate of endotracheal intubation among patients with a clear indication for airway management in emergency settings. Most patients presented with severe clinical conditions, yet only a minority received invasive airway management.The findings suggest that multiple organisational, human, and technical factors influence the actual performance of intubation, particularly lack of trained personnel and equipment constraints. These limitations may have a significant impact on patient outcomes, as reflected by the extremely high mortality observed in this series. In this context, strengthening healthcare workers' training, improving access to ventilation equipment, and standardising airway management protocols should be considered priorities. Such improvements may contribute to better management of life-threatening emergencies in resource-limited settings.

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