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Airway management in critically ill children and adults: systematic review of international guidelines

J. Miteo[1], A. Makembi Bunkete[2], K. Anga[1], D. Tonduangu[1], W. Mbombo[1], G. Mfulani[1], S. Mutombo[1], M. Kamwanga[1], E. Ngombe[1], A. Mutombo[1], J. Nsiala[1], M. Bulabula[1], B. Barhayiga[1]

[1]Department of Anesthesia and Intensive Care, University Clinics of Kinshasa, University of Kinshasa, Kinshasa, Democratic Republic of Congo
[2]Department of Internal Medicine, Kinshasa University Clinics, University of Kinshasa, Kinshasa, Democratic Republic of Congo

Corresponding author: Arriel Makembi Bunkete, Department of Internal Medicine, University Clinics of Kinshasa, University of Kinshasa, Kinshasa, Democratic Republic of Congo. Email: docteur.makarriel2017@gmail.com.

Keypoints

This systematic review aimed to synthesize existing international guidelines on airway management in critically ill adults and children, identify differences between populations, challenges in resource-limited settings, and evidence-based strategies to optimize safety and first-pass success.

Abstract

Introduction

Airway management is a critical skill in intensive care, as tracheal intubation carries significant risks. Optimizing safety and first-pass success is essential in both adults and children. In resource-limited settings, equipment constraints and training gaps further complicate this management, highlighting the need for standardized, evidence-based approaches. ***Objectives**:* This systematic review aimed to synthesize existing international guidelines on airway management in critically ill adults and children, identify differences between populations, challenges in resource-limited settings, and evidence-based strategies to optimize safety and first-pass success.

Methods

A systematic search was conducted in PubMed, Embase, the Cochrane Library, and national and international guideline databases up to January 2025. Guidelines published since 2010, concerning adult or pediatric populations and including pharmacological and/or non-pharmacological recommendations, were eligible. Two reviewers independently selected studies, extracted data, and assessed methodological quality using the AGREE II tool. Recommendations were compared according to population, type of intervention, and level of evidence, and results were synthesized qualitatively.

Results

Among 1,482 references, 42 guidelines were included: 18 for adults, 12 for children, and 12 for resource-limited settings. The main recommendations for adults included optimized preoxygenation, bougie-assisted intubation, and systematic preparation to reduce complications. Pediatric guidelines emphasized anatomical and physiological adaptations, the use of videolaryngoscopy, and trained teams. In resource-limited settings, priority was given to simplified bundles, standardized protocols, and targeted training. The certainty of evidence was high for adults, moderate for pediatric recommendations, and variable for resource-limited settings.

Conclusion

Despite universal principles, their implementation must take into account patient age, physiological differences, and resource availability. Standardized protocols, appropriate use of airway management tools, and dedicated

team training are essential to reduce complications and improve first-pass success. This review provides clinicians and policymakers with practical guidelines for safe and effective airway management in various critical care settings.

Keywords

Airway management; Critical care; Intensive care units; Pediatrics; Adults; Guidelines

Introduction

Airway management is a critical skill in intensive care units, where complications related to tracheal intubation can be serious or even fatal. In both adults and children, optimizing the safety and success of the first attempt is a priority recognized by major international societies [1–6]. The guidelines of the American Society of Anesthesiologists (ASA) and the Difficult Airway Society (DAS) emphasize the importance of standardized approaches tailored to each population to reduce complications [1–3], while the American Heart Association and European Resuscitation Council recommendations for pediatric and adult resuscitation emphasize advance planning and adapting techniques to age and clinical context [4,5].

In adults, recent studies on critically ill patients show that tracheal intubation remains associated with a substantial risk of complications, despite technical advances such as video laryngoscopy and the systematic use of bougies [7–13]. The INTUBE study and the NEAR registry have demonstrated that successful first-pass intubation and the prevention of adverse events depend as much on preparation and standardized protocols as on operator skill [8,10]. Preoxygenation techniques, including high-flow oxygenation, are now considered essential for minimizing hypoxemia during intubation [12].

In pediatrics, the situation is even more complex due to the anatomical and physiological characteristics of children, such as reduced respiratory reserve and vulnerability to rapid hypoxemia [14,15]. Recent multicenter studies and registries, such as NEAR4KIDS and NEAR4NEOS, have shown that first-pass success and the safety of intubation maneuvers depend on specialized training and the adaptation of equipment to pediatric airways [16–20]. The use of videolaryngoscopy and systematic confirmation of endotracheal tube placement by capnography are now recommended to reduce the risk of complications [17].

Airway management in resource-limited settings poses an additional challenge. Disparities in available equipment, training, and standardized protocols lead to higher complication rates in both adults and children [21–25]. Simple interventions, such as the implementation of safety bundles and targeted staff training, have been shown to be effective in improving intubation safety in these settings [25].

Despite the publication of robust guidelines for adults and children, differences between pediatric and adult populations, as well as the specific constraints of resource-limited settings, remain underestimated in the literature. There is therefore an urgent need for a systematic synthesis to compare recommendations, identify discrepancies, and provide benchmarks for clinical practice in all critical populations [1–6,7–30].

Objective of this review: This systematic review aims to synthesize existing recommendations for airway management in adult and pediatric critically ill patients, focusing on key differences, challenges in resource-limited settings, and evidence-based practices to optimize the safety and success of intubation.

Methods

Inclusion and exclusion criteria

We included guidelines published since 2010 on airway management in pediatric and adult populations, available in English or French. Documents had to contain pharmacological and/or non-pharmacological recommendations to be eligible. Isolated experimental studies, unvalidated local recommendations, and publications prior to 2010 were excluded.

Sources of information and search strategy

The search was conducted exhaustively in PubMed, Embase, Cochrane Library, as well as in national and international guideline databases, with a final consultation in January 2025. The keywords used included "guidelines," "recommendations," "pediatrics," "adults," and "systematic review." The reference lists of the identified guidelines were scanned to identify additional documents, ensuring that all relevant literature was captured.

Selection process

Each identified article was independently reviewed by two reviewers. Disagreements were resolved by consensus. Publications deemed potentially eligible were evaluated in their entirety to confirm their inclusion, ensuring a rigorous and reproducible process.

Data collection

The data extracted included the target population, type of intervention, level of evidence, specific recommendations, and notable differences between pediatric and adult approaches. Each extraction was performed by two independent reviewers to minimize the risk of error.

Risk of bias assessment

The methodological quality of the guidelines was assessed using the AGREE II tool, considering scientific rigor, editorial independence, clarity, and precision of recommendations.

Data synthesis recommendations were compared according to:

1. The Differences between pediatric and adult populations.
2. The type of intervention (pharmacological vs. non-pharmacological).
3. The level of scientific evidence.

The results were summarized qualitatively and presented in comparative tables and narrative summaries to highlight the similarities and differences between guidelines.

Compliance with PRISMA standards

The entire methodological process was carried out in accordance with the PRISMA 2020 recommendations [31] to ensure the transparency, reproducibility, and scientific rigor of this systematic review.

Results

Study selection

The systematic search initially identified 1,482 references after removing duplicates. After rigorous screening of titles and abstracts, 176 articles were selected for full text review. Following a thorough evaluation, 42 guidelines were deemed eligible and included for analysis. A detailed flow chart (Figure 1) illustrates this process, in accordance with PRISMA recommendations [31].

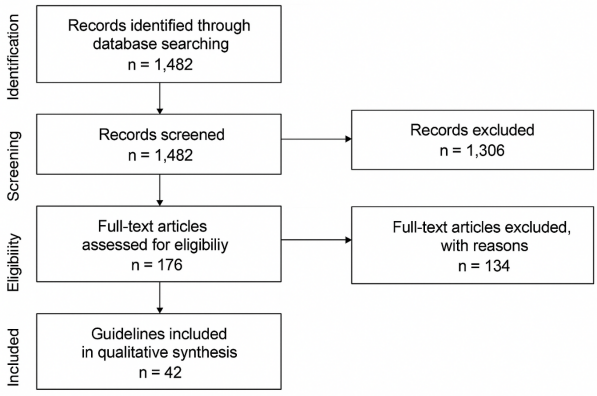

Figure 1. Flow chart

Among the documents excluded at the full-text review stage, 21 initially appeared relevant but were discarded for specific reasons: publications prior to 2010 (n=9), unvalidated local recommendations (n=7), and isolated experimental studies without clinical relevance or consolidated guidelines (n=5). This sorting ensured that only robust and contemporary recommendations were analyzed, guaranteeing the validity and applicability of the results.

Characteristics of the included guidelines

The 42 guidelines selected covered a variety of complementary contexts:

1. Critical adults: 18 documents, including ASA 2022 [1], DAS 2015 [2], ERC 2021 [5], and the INTUBE 2022 international consensus [11]. These guidelines were characterized by a high level of methodological rigor and an abundance of data from multicenter registries and controlled trials.

2. Critical pediatrics: 12 documents, including DAS Pediatric 2020 [3], PALS 2020–2024 [4], and the NEAR4KIDS [20] and NEAR4NEOS [19] registries. These guidelines are distinguished by recommendations contextualized to pediatric anatomy and physiology, with an emphasis on necessary adaptations for infants and young children.
3. Resource-limited settings : 12 documents, including WHO 2020 [6] and LMIC studies [21–25]. These guidelines specifically address the structural, logistical, and training constraints encountered in resource-limited critical care units.

Recommendations included both pharmacological (induction, sedation, RSI) and non-pharmacological (preoxygenation, use of bougie, confirmation of endotracheal tube) strategies, and were accompanied by varying levels of evidence, ranging from consensus expertise to multicenter randomized trials.

Assessment of risk of bias

The AGREE II tool was used to assess the methodological quality of the guidelines. Standardized international documents (ASA, DAS, ERC) scored highly for scientific rigor, editorial transparency, and clarity of recommendations. Recommendations from LMIC contexts scored slightly lower in the "scientific rigor" section, mainly due to less formalized local methodologies and the absence of certain primary data.

Summary of recommendations by population

a) Critically ill adults:
- Preoxygenation, whether via high-flow nasal cannula or face mask, remains universally recommended [12,26].
- The "candle-first" approach is strongly supported by the data, significantly improving first-pass success [27].
- Serious complications, although rare, include hypoxemia and intubation-related trauma, as confirmed by the INTUBE and NAP4 registries [10,13,29].

b) Critical pediatrics:
- Video laryngoscopy increases first-pass success in emergency situations [17,19].
- Recommendations take into account the anatomical and physiological variations specific to infants and young children, particularly with regard to the choice of devices and pharmacological doses [14,15].
- Complications are more common in resource-limited countries, often due to inadequate equipment or a lack of specific training [18,24].

c) Resource-limited settings (LMICs):
- The guidelines emphasize the implementation of simple bundles, combining standardized equipment, clear protocols, and targeted training [21,25].
- Adapting techniques to the available equipment, including the strategic use of candles and manual preoxygenation, is essential [22,23].

Comparison and summary A comparative synthesis (Table 1) highlighted:

- Notable differences between pediatrics and adults, particularly in the choice of intubations techniques and pharmacological doses.
- The distinction between pharmacological and non-pharmacological interventions : the latter are universal and standardized, while pharmacological interventions vary according to age and context.
- The level of evidence: recommendations for adults are based on randomized trials and prospective registries [7–11], while those for pediatrics and LMICs are based more on expertise and observational studies [16,18,24].

Population / Setting	Key Recommendations	Type of Intervention	Grade	References
Critically ill adults	• Optimized preoxygenation (high-flow nasal cannula or face mask) • Bougie-assisted intubation to improve first-pass success • Systematic preparation and anticipation of complications	Both non-pharmacological and pharmacological	**A**	1,2,5,7–13,26–27,29
Critically ill children	• Use of video-laryngoscopy to increase first-pass success • Adaptation to pediatric anatomical and physiological characteristics • Trained teams and appropriate equipment • Systematic confirmation of endotracheal tube placement with capnography	Both non-pharmacological and pharmacological	**B**	3–5,14–20,28
Resource-limited settings (LMICs)	• Simple, standardized bundles combining adapted equipment, clear protocols, and targeted training • Pragmatic adaptation of techniques to available equipment • Team preparation and training to compensate for lack of advanced devices	Mainly non-pharmacological; pharmacological adapted as needed	**C**	6,21–25

Table 1. Summary of airway management recommendations in critically ill adults, children, and resource-limited settings

Publication bias and certainty of evidence

The risk of bias due to missing results was considered moderate, particularly for LMIC settings where some local recommendations are not published. The overall certainty of evidence is high for adults, moderate for pediatrics, and variable for LMICs, reflecting the disparity in available data and the need to contextualize recommendations according to resources.

Discussion

The synthesis of guidelines on airway management in critical care reveals remarkable convergence around fundamental principles applicable to both adult and pediatric populations. Optimal preoxygenation, careful preparation of appropriate devices, and anticipation of difficulties are unanimously recognized as essential measures to reduce complications and improve intubation success [1–6,26–30]. Video laryngoscopy and the systematic use of a bougie in difficult intubations are among the most robust recommendations, supported by recent data indicating an increase in first-pass success and a decrease in adverse events [7–9,27]. In children, critical airway management requires precise adaptation to pediatric anatomy and physiology. Recommendations emphasize vigilance for rapid desaturation, the choice of age-appropriate equipment, and the key role of teams trained specifically for critical care pediatrics [14–20]. In resource-limited settings, the emphasis is on simplified protocols, minimal standardization of equipment, and targeted training of teams to compensate for the lack of sophisticated equipment and maximize safety [21–25]. Reliable confirmation of endotracheal tube placement, ideally by continuous capnography, and preparation for complications such as hypoxia or hypotension are cross-cutting recommendations for all populations [28–30]. Pharmacological strategies, particularly rapid induction sequences, must be tailored to the patient's profile, with particular care for children [26]. These results show that, although the principles are universal, their implementation must be adapted to the available resources, the patient's physiological characteristics, and the skills of the team. For clinicians, this implies the systematic integration of recommendations into daily practice, the standardization of

local procedures, and an emphasis on continuing education. For policymakers and managers, the review provides a framework for developing airway safety policies, even in resource-limited settings. Finally, for future research, there is a critical need for additional data on pediatric populations and in LMICs to strengthen the certainty of recommendations and reduce heterogeneity in practices. In summary, this systematic synthesis provides not only a map of current recommendations but also a guide for translating these recommendations into safe, contextualized practice- , emphasizing the importance of preparation, training, and evidence-guided implementation [31].

Conclusion

This systematic review highlights the importance of recommendations tailored to age, physiology, and contextual constraints in critical airway management. Standardized strategies, judicious use of tools such as video laryngoscopy or bougies, and team training appear essential to reduce complications and improve intubation success. Differences between adults and children, as well as limitations related to resource-limited settings, guide priorities for practical implementation and future research. The summary of guidelines presented here provides clinicians and policymakers with reliable benchmarks for optimizing the safety and effectiveness of critical care, while highlighting areas requiring additional evidence.

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Competing interests

The authors declare that they have no competing interests.

Author contributions

J. Miteo, K. Anga, D. Tonduangu, W. Mbombo, G. Mfulani, and S. Mutombo contributed to study conception, literature search, data extraction, and drafting of the manuscript. A. M. Bunkete supervised the project, contributed to study design, data interpretation, and manuscript revision. M. Kamwanga, E. Ngombe, A. Mutombo, J. Nsiala, M. Bulabula, and B. Barhayiga participated in critical revision of the manuscript and approved the final version. All authors meet the ICMJE criteria for authorship.

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Consent for Publication

Not applicable, as this study does not include individual patient data.

Availability of Data and Material

All data generated or analyzed during this study are included in this published article and its supplementary materials. Additional data can be made available from the corresponding author upon reasonable request.

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