

Overview of evidence-based clinical practice guidelines for difficult airway management in adults: a systematic review

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Abstract

Background : The aim of the clinical practice guidelines (CPGs) in the management of difficult airway is to provide optimal responses to a potentially life-threatening clinical problem.

Objective : to summarize and compare relevant recommendations and algorithms from evidence-based CPGs (EB-CPGs).

Methods : We conducted a systematic review (overview) of CPGs, following Cochrane methods. We summarized recommendations, its supporting evidence and strength of recommendations according to the GRADE methodology. In July 2018, we searched CPGs that were published in the last 10 years, without language restrictions, in electronic databases, and searched specific CPG sources, reference lists and consulted experts. We searched PubMed, EMBASE, Cochrane Library, LILACS, Tripdatabase and additional sources. Pairs of independent reviewers selected EB-CPGs and rated their methodological quality using the AGREE-II instrument. We included those EB-CPGs reporting standard methods for identification, data collection, study risk of bias assessment and recommendations' level of evidence. Discrepancies were solved by consensus.

Results: We included 11 EB-CPGs out of 2505 references identified in literature searches within the last ten years. Only three of them used the GRADE system. The domains with better performance in the AGREE-II assessment, were 'adequate description of scoping' and 'objectives' while those with worst performance were 'Guidelines' applicability' and 'monitoring'. As a result, only three EB-CPGs were classified as 'Highly recommended, two as 'Recommended' and six as 'Not recommended. We summarized 22 diagnostic recommendations, 22% of which were supported by high/moderate quality of evidence (41% of them were considered by developers as strong recommendations), and 16 therapeutic/preventive recommendations, 59% of which were supported by high/moderate quality of evidence (76% strong). Only half of the EB-CPGs were updated in the past five years.

Conclusions : The main EB-CPGs in the management of difficult airway in anesthesia presented significant heterogeneity in terms of their quality and system of grading the evidence and strength of recommendation used, and most used their own systems. We present many strong recommendations that are ready to be considered for implementation, and we reveal opportunities to improve guidelines' quality.

Background

An estimated 234 million major surgical procedures are undertaken every year worldwide [1]. The number of patients who receive surgery is increasing, as well as the frequency of comorbidities [2]. Because of the inherent risks of death and complications, the safety of different management strategies becomes a significant public-health concern.

Difficult airway (DA) is defined as the clinical situation in which a conventionally trained anesthesiologist experiences difficulty with facemask ventilation, with tracheal intubation, or with both [3]. The rate of difficult intubation is from 0.5 to 10% in patients undergoing general anesthesia, depending on the definition adopted [4–8]. The rate of difficult mask ventilation (DMV) ranges from 0.9 to 12.8% of patients undergoing general anesthesia in different series. Difficult intubation and DMV are closely associated [8]. It is a true emergency situation because if not solved immediately, it could lead to catastrophic outcomes such as permanent brain damage or even death [9,10].

Different surveys provided detailed information about the factors contributing to poor outcomes associated with airway management and highlighted deficiencies relating to judgement, communication, planning, equipment, and training [2].

The uptake of clinical practice guidelines (CPG) may lead to increased quality and safety of care. Their aim is to provide a structured response to a potentially life-threatening clinical problem both in unanticipated and known difficult intubation. Usually, recommendations balance risks and benefits of a specific diagnostic or therapeutic procedure, and propose an algorithm pathway for management. Standardization of processes promotes high-quality care in a cost-effective manner. By creating this consensus of bundles of procedures and alerts, and by promoting further research in specific directions, academic societies aim to support health care systems in improving the level of care in patients DA.

However, the standardization of procedures for a given health facility, and subsequent benefits are only as good as the quality of the CPGs themselves. Notwithstanding the fact that not every procedure counts with strong scientific evidence, those CPGs whose recommendations are not fully supported by the best evidence available might promote inappropriate strategies both for patients and health systems.

Multiple medical societies and organizations around the world have published management of difficult airway CPGs; however, many of them are not based on solid scientific evidence. Additionally, not all of them harness the best methods like the Grading of Recommendations Assessment, Development, and Evaluation (GRADE) approach, that is the most relevant system for rating the quality of evidence in systematic reviews and CPGs [11]. GRADE offers a transparent and structured process for developing and presenting evidence summaries and making recommendations [11].

The difficult airway management represents a complex interaction between patient factors, the clinical setting, and the skills of the practitioner. There exist different settings around a difficult airway situation, and the guidelines cannot consider every scenario. This is a limitation we predefine to select the scope of our statement. For this reason, through a systematic review (overview), we aimed to identify and synthesize Evidence Based-CPGs (EB-CPG) on DA care in anesthesia that were published globally, in the last 10 years. We also intended to rate their quality, describing levels of evidence and the strength of their recommendations according to the GRADE approach [11].

Methods

We performed a systematic review (overview) of EB-CPGs following Cochrane methods [12] and the Argentinean Academy of Medicine Guide for the adaptation of CPGs to select the CPGs [13]. We followed the PRISMA statement [14] and a specific guideline for overviews of systematic reviews (see Online supplemental material 1. PRISMA checklist) [15]. Inclusion criteria of EB-CPGs on difficult airway were as follows[16]: The EB-CPGs must have included a) description of the guideline's development by an expert panel; b) standard methods for identification, data collection and study risk of bias assessment; c) report of the level of evidence that supports each recommendation. Guidelines were excluded if they were limited to single specific conditions (e.g. Asthma) since we focused on more general recommendations.

Search strategy: In June 2018, we searched CPGs published in the last 10 years without language limitations in main electronic databases, metasearch engines, specific CPG sources, reference lists, and in the websites of the national and international scientific societies related to difficult airway management, including different specialties like general surgery, gynecology and emergency care. We also did a consultation with experts. Sources included PubMed, EMBASE, Cochrane Library, LILACS, Tripdatabase and additional sources: National Guideline Clearinghouse, NeLH Guidelines Finder, 'Guía Salud' from Spain, GAC guidelines, CMA Infobase: Clinical Practice Guidelines Database (CPGs), New Zealand Guidelines, Scottish Clinical Guidelines, EBM Guidelines, Health Services/Technology Assessment Text (HSTAT), National Institute for Health and Clinical Excellence (NICE) and Institute for Clinical Systems Improvement (ICSI). (See Online supplemental material 2. Search strategies for details of these sources and our search strategy for difficult airway management guidelines).

Selection and Data Extraction: Pair of independent reviewers selected (by title and abstract, first, and full text eligible studies, afterwards) the articles retrieved, using the software COVIDENCE to facilitate the initial phases of systematic reviews (<https://www.covidence.org/>). One reviewer extracted data while the other audited it in a previously piloted form (which included variables such as search date, objective, setting, target population, target professionals, recommendations, classification system of the quality of evidence and of the strength of the recommendation, quality of evidence by recommendation, and the strength of each recommendation). Discrepancies were solved by a consensus of the whole team. The protocol of this review was not registered.

Guideline quality appraisal and classification: Independent pairs of reviewers rated each EB-CPGs using the AGREE-II tool, consisting of 23 key items organized in six domains: scope and purpose, stakeholder involvement, rigor of development, clarity of presentation, applicability, editorial independence and two overall evaluation items [17,18]. Each item was graded using a scale of 7 points: from 1, meaning 'Strongly disagree', to 7, meaning 'Strongly agree'. Each domain was graded by summing up all the item scores in a domain and showing the total as a percentage of the maximum possible score for that domain (from 0 to 100%). We present the AGREE-II domain scores expressed as a percentage across CPGs.

We also categorized each EB-CPGs according to the extent to which they successfully addressed AGREE-II criteria [13] as: 'Strongly recommended' (++) for CPGs whose standardized score exceeds 60% in ≥ 4 AGREE-II domains. The scores of the remaining domains must be $\geq 30\%$ and $>60\%$ for the domain rigor of development, 'Recommended' (+), for CPGs whose standardized score range from 30 to 60% in ≥ 4 AGREE-II domains. The rigor of development score must be between 30% and 60%, and 'Not recommended' (-) for CPGs whose standardized score is $<30\%$ in ≥ 4 AGREE-II domains or if rigor of development score is less than 30%. To deal with discrepancies between the direction and strength of the CPG recommendations, we applied a rule to decide 'doing or not doing the recommendation' as follows: Yes (Y) / No (N) when $\geq 2/3$ recommendations in the same direction (for/against) and $\geq 2/3$ strong recommendations; Probably yes (PY) - Probably no (PN) when $\geq 2/3$ recommendations in the same direction (for/against) and $<2/3$ strong recommendations, and finally Uncertain when $<2/3$ recommendations were in the same direction (for/against).

Synthesis of results: We conducted a tabular synthesis of the whole set of recommendations to better describe their strength and level of evidence according to the GRADE methodology [11], and approximating the original grading system used in the guideline to GRADE whenever necessary, to compare and integrate the results for each recommendation in a unified manner. GRADE quality of evidence may be scored as high, moderate, low and very low.

Randomized clinical trials (RCTs) start always from high quality of evidence and the non-randomized studies initiate always from a low quality of evidence. Five criteria can be applied to downgrade one or two levels: methodological quality (study limitations), inconsistency of results, indirectness, imprecision and publication bias. In cases where there are no methodological limitations, there are three criteria that can upgrade one or two levels: magnitude of effect, dose-response effect, and confounders underestimating the effect. Regarding the strength of a recommendation, which is defined as the extent to which one can be confident that the desirable consequences of an intervention outweigh its undesirable consequences, GRADE uses four simple categories: 'strong' or 'weak', and 'for' or 'against' a certain diagnostic or therapeutic approach. We presented descriptive statistics as percentages or means with standard deviations.

Results

The search strategy identified 2588 references after the elimination of duplicates. After the selection process we identified **81** full-text studies assessed for eligibility and 11 EB-CPGs published in the last 10 years (**Figure 1:** Study flowchart, Table 1). Three were developed in America (1 from United States & 2 from Canada), five in Europe (1 from Italy, 1 from Scandinavia, 1 from Germany and 2 from United Kingdom) and three in Asia (1 from Japan and 2 from India). Eight of eleven (72 %) of the EB-CPGs conducted their searches within the last five years.

Out of the 11 EB-CPGs identified, seven addressed the specific intubation in anesthetic setting, two focused on obese patients, one related to obstetric setting, one included intensive care patients and other the pre-hospital airway management. CPGs differed in the recommendation grading systems used by their authors. The grading system used were: GRADE (3 EB-CPGs)¹⁹⁻²¹, Oxford Centre for Evidence-Based Medicine 2011 (1 EB-CPGs)²² and the other utilized their own or modified systems. We presented the scores as a percentage per each AGREE-II domain. The domains with the higher mean \pm SD score were Scope and Objective ($87\% \pm 12$), Clarity of presentation ($74 \pm 10\%$) and Editorial independence ($65 \pm 19\%$). Stakeholder involvement ($55 \pm 17\%$) and rigor of development ($54 \pm 14\%$) had an intermediate performance while 'applicability' was the most deficient ($37 \pm 10\%$). Regarding the guideline recommendation category, 3/11 (37%) were classified as highly recommended, 2 as recommended and the rest as not recommended. An overall AGREE-II score was also presented in Table 2, which provides a general description of the included EB-CPGs.

Table 1 General description of the EB-CPGs included

Acronym /Year of publication	Title	Country
ASA 2013 ²³	Practice guidelines for management of the difficult airway: An updated report by the American Society of Anesthesiologists Task Force on Management of the Difficult Airway	USA
DAS 2015 ²⁴	Difficult Airway Society 2015 guidelines for management of unanticipated difficult intubation in adults	UK
Law 2013-1 ²⁰	The difficult airway with recommendations for management - Part 1 - Intubation encountered in an unconscious/induced patient	Canada
Law 2013-2 ¹⁹	The difficult airway with recommendations for management - Part 2 - Difficult airway	Canada
Mushambi 2015 ²⁵	Obstetric Anesthetists' Association and Difficult Airway Society guidelines for the management of difficult and failed tracheal intubation in obstetrics	UK
AIDAA 2016 ²⁶	All India difficult airway association 2016 guidelines for the management of unanticipated difficult tracheal intubation in adults	India
SIAARTRI 2016 ²⁷	Perioperative and periprocedural airway management and respiratory safety for the obese patient: 2016 SIAARTI Consensus	Italy
S1 guidelines ²⁸	S1 guidelines on airway management: Guideline of the German Society of Anesthesiology and Intensive Care Medicine	Germany
Ramkumar ²⁹	All India difficult airway association 2016 guidelines for the management of unanticipated difficult tracheal intubation in obstetrics	India
SSAI 2016 ²¹	Scandinavian SSAI clinical practice guideline on pre-hospital airway management	Norway, Denmark, Sweden, Iceland, Finland
JSA 2014 ³⁰	JSA airway management guideline 2014: To improve the safety of induction of anesthesia	Japan

Table 2 Diagnostic recommendations, level of evidence and recommendation strength of the EB-CPG with the methodological rigor AGREE-II score.

Guideline- year of publication	AGREE II Domains performance (from 0 to 100%)						Quality 1=lowest 7= Highest	Recommendation (++,+,-)
	Objec- tives	Parti- cants	Methodo-logical rigor	Clarity in presentation	Applica- bility	Editorial Independency		
ASA 2013	89	50	60	72	50	83	5,5	+
DAS 2015	83	44	50	56	29	92	5,5	+
Law 2013 part 1	97	58	52	83	40	46	6	++
Law 2013 part 2	97	61	52	78	35	50	6	++
Mushambi 2015	100	67	45	83	48	50	6	+
Myatra 2016	86	42	49	72	41	88	5,5	+
Petrini 2016	92	78	75	86	54	50	6	+
Piepho 2015	69	33	35	69	29	46	4,5	-
Ramkumar 2016	86	58	36	67	27	63	5	+
Rehn 2016	97	83	84	86	35	58	6,5	++
JSA 2014	64	31	52	64	21	88	5	-
Average	87,27	55,00	53,64	74,18	37,18	64,91	5,5	
ED	11,70	16,99	14,81	9,86	10,47	18,87	0,58	

++: Strongly recommended, +: Recommended, -: Not recommended

We identified four recommendations related to the pre-anesthetic preparation (studies required, strategies, equipment), nine related to the strategies during the intubation procedure, five referred to the intubation failure and three to the post-extubating period.

We detected one recommendation, referred to the pre-anesthetic studies in patients presumed to have difficult intubation, with a very low level of evidence and weak recommendations, while nine referred to the strategies during the intubation related to the protection against gastric reflux and aspirated pneumonitis. These nine were strong recommendations, but based on a low level of evidence. Four guidelines specified the equipment necessary to be included in this setting of difficult airway intubation, all with strong level of recommendation but again, with low level of evidence.

Some discrepancies could be related to the specific population included, the urgency of the procedure and the setting analyzed.

Table 3: The 21 key questions representing the GRADE level of evidence and the strength of recommendation according to each guideline.

The American Society of Anesthesiologist (ASA) defined a difficult airway as the clinical situation in which an anesthesiologist with a standard training has difficulty ventilating with a mask, intubate or both. The Canadian guide defines the same situation when a professional has difficulty in mask ventilation, direct or indirect laryngoscopy, intubation, use of supraglottic devices (DSG) or in achieving surgical access to the airway must be experienced in handling of airway. The rest of the guidelines, although addressing these concepts, do not explicit a definition of DAV.

Other definitions related to difficult airway management described in some of the guidelines are: a) Difficult insertion of a DSG: when multiple attempts are required, in the presence or absence of tracheal pathology (ASA), b) Difficult ventilation with bag and mask or DSG: when adequate ventilation is not achieved due to one or more of the following problems: improper sealing, leakage or excessive resistance during gas inlet or outlet the Canadian guide describes the difficulty for bag and mask ventilation as a continuum that goes from the absence of difficulty to the inability to achieve it, multiple head and neck adjustments or the help of a second operator is required, and c) Difficult laryngoscopy: the ASA guideline describes it as the total invisibility of the vocal cords, after multiple attempts at conventional laryngoscopy. Other guidelines use a description of the vision obtained to classify it: -the Canadian guide uses Cormack-Lehane grades classifies 1 and 2 as simple laryngoscopy, and 3 and 4 as difficult and impossible laryngoscopy, respectively, and regardless of whether intubation is achieved [31]. -The German guide defines it as the inability to visualize the glottis with direct laryngoscopy [32]. These guidelines do not define attempted intubation, while the Difficult Airway Society (DAS) guide defines an intubation attempt as the insertion of a laryngoscope branch into the patient's mouth [33]. In this regard, a 'Difficult intubation' is defined when multiple attempts are required, in the presence or absence of tracheal disease, and a 'Failed intubation' entails the failure of placement of the endotracheal tube after several attempts [11]; failure in intubation in two attempts [34] or in obtaining a successful intubation in a maximum of three attempts, regardless of the technique used [31].

Regarding the physical characteristics of the patients that can be associated with a VAD, the ASA guide refers to age, obesity and the presence of mediastinal masses as predictors. The guidelines that describe a specific population as obese and pregnant women detail the reasons why it is more common for difficulties in airway management in these patients [11,35-37]. The Canadian Advance VAD Guide provides strategies to adopt in obese, pregnant patients and patients with obstructive airway pathology [38]. The ASA guide adds other pathologies that are associated with VAD as obstructive apnea of the sleep, snorers, ankylosis, degenerative osteoarthritis, subglottic stenosis, lingual thyroid, tonsillar hypertrophy, Treacher-Collins syndromes, Pierre Robin or Down.

At the moment of the intubation, seven guidelines strongly recommended preoxygenation, four (67%) referred low and three (47%) moderate level of evidence. We identified four ECAs in the literature referred to the use of neuromuscular blockade. The five guidelines that mentioned this indication had polar different recommendations and reported antagonist's levels of evidence in this item.

In the other items referred to the intubation we observed High disparity criteria between the guidelines: in 65 different recommendations the majority were strong in favor (56%), 35% were weak in favor and only 3 and 6% were strong or weak against, respectively. However, the level of evidence sustaining these recommendations were low or very low in 71% of the items.

In some issues considered important or critical in the setting of difficult intubation care, we searched for systematic reviews. In these items the level of certainty of the outcomes observed was low or very low in 55% of the cases.

Only one guideline made recommendations about extubation technique with weak strength and very low level of evidence. The evidence referred to reintubation is also weak (low 60% and 40% very low), despite 80% of the recommendations have been reported as strong in the guidelines. The recommendations are summarized in table 4.

Table 4. Diagnostic, therapeutic, and preventive recommendations for the management in difficult airway setting according to international guidelines.

Recommendations	Difficult airway	
Diagnostic	Number of specific recommendations	22
	% supported by high/moderate certainty of evidence	22%
	% of strong recommendations	41%
Therapeutic / Preventive	Number of specific recommendations	16
	% supported by high/moderate certainty of evidence	56%
	% of strong recommendations	76%

Discussion

It has been estimated that airway management resulted in one serious complication per 22,000 general anesthetics, with death or brain damage complicating 1:150,000.³⁹ Guidelines provides structured and optimal responses to a potentially life-threatening clinical problem. However, their recommendations are not always based on high quality evidence-based trials.

Recommendation	Guideline	GRADE level of evidence	Strength of the recommendation
1. What complementary tests should be performed prior to anesthesia in case of suspected Difficult Airway?			
Chest X-ray, CT	ASA	Very low	Weak
2. Should the volume and pH of the gastric content be decreased?			
Fasting, antacids including anti H2 and proton pump inhibitors (PPIs) and mechanical drainage with nasogastric tube	DAS	Moderate	Strong
Fasting, antacids including anti H2 and proton pump inhibitors (PPIs), mechanical drainage with nasogastric tube and metoclopramide	India OBST	Low	Strong
	AIDAA	Moderate	Strong
3. What equipment should be available for difficult airway management?			
Supraglottic devices and material for surgical airway	JSA	High	Strong
Portable difficult airway storage unit	ASA	Very low	Strong
Different masks and laryngoscopes with Macintosh / McCoy branches, video laryngoscope, tubes of different diameter, and equipment for emergency cricothyroidotomy	India Obst	Low	Strong
Flexible fibroscope, facial mask, Guedel and Wendl tubes, alternative laryngoscope to the conventional Macintosh (eg video laryngoscope). Stilettos for insertion of tubes and equipment for translaryngeal/ transtracheal access.	S1	Low	Strong
4. Should patients be preoxygenated?			
Yes	DAS	Low	Strong
	India OBST	Low	Strong
	JSA	Low	Strong
	Law 2	Moderate	Strong
	S1	Moderate	Strong
	AIDAA	Low	Strong
	ASA	Moderate	Strong
5. Should neuromuscular blockers be used in anesthetic induction?			
Yes	DAS	High	Strong
	India OBST	Low	Weak
	S1	Low	Strong
	JSA	Low	Weak
	AIDAA	Low	Weak
6. What is the optimal position for intubation?			
Ramp position	DAS	Moderate	Strong
	India OBST	Low	Strong
	SIAARTRI	Very Low	Strong
	AIDAA	Low	Strong
	JSA	Moderate	Strong
Sniffing position			
7. Should cricoid pressure / external laryngeal manipulation be used in intubation?			
Yes	DAS	Moderate	Weak
	India OBST	Low	Weak

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	JSA	High	Strong
	AIDAA	Low	Weak
Laryngeal manipulation if there are difficulties with laryngoscopy	Law 1	Moderate	Strong
	Law 2	Low	Strong
Does not recommend cricoid pressure	Law 1	Low	Weak
8. Should cricoid pressure / external laryngeal manipulation be used during supraglottic device insertion?			
Yes	DAS	Moderate	Strong
No	India OBST	Low	Weak
	AIDAA	Low	Weak
	S1	Low	Weak
	JSA	Low	Weak
9. ¿Is video laryngoscope recommended?			
Yes	Rehn	Low	Weak
	DAS	High	Strong
	ASA	High	Strong
	Law 1	Low	Strong
	India OBST	Low	Strong
	S1	Low	Weak
	ASA	High	Strong
	AIDAA	Low	Weak
	JSA	Low	Weak
10. In anticipated difficult airway is it recommended to intubate with an awake patient?			
Yes	ASA	Very Low	Strong
	SIAARTRI	Very Low	Strong
	Law 2	Low	Strong
	JSA	Low	Strong
11. Is the use of supraglottic devices recommended for ventilation in patients with DAV?			
Yes	ASA	Very Low	Strong
	Rehn	Low	Weak
	Law 1	Moderate	Strong
	AIDAA	Low	Strong
	SIAARTRI	Low	Strong
	S1	Moderate	Strong
	Indian obst	Low	Strong
JSA	Low	Weak	
12. Is the use of TET chucks and exchangers recommended?			
Yes	DAS	Moderate	Weak
	Law 1	Moderate	Strong
	ASA	Very Low	Weak
	AIDAA	Low	Weak
	S1	Low	Strong
13. What is the maximum number of intubations attempts that should be made?			

3	Law 1	Moderate	Strong
	DAS	Low	Weak
2	India OBST	Low	Strong
	S1	Low	Strong
	AIDAA	Low	Weak
	JSA	Low	Strong
14. What is the maximum number of attempts to place Supraglottic Device should be made?			
3	DAS	Moderate	Weak
2	India OBST	Low	Strong
	JSA	Low	Strong
15. How should the correct intubation be corroborated?			
Visual confirmation bilateral expansion of thorax, auscultation, capnography, videolaryngoscopy, fibroscope or ultrasound	DAS	High	Strong
	India OBST	Low	Weak
Auscultation	S1	Low	Strong
Capnography	ASA	Very Low	Strong
	Law 1	Moderate	Strong
Visual	AIDAA	Low	Strong
16. Should percutaneous or surgical cricothyroidotomy be performed in a No Oxygenation No Intubation scenario?			
Surgical	India obst	Low	Strong
	JSA	Low	Strong
	AIDAA	Low	Strong
Literature does not conclude about the recommended technique and limiting options facilitates decision making	Rehn	Low	Weak
	Law	Low	Strong
Considered as high risk, only recommended for life threatening situation and with high qualified personnel	DAS	Low	Strong
Trans-laryngeal or trans-tracheal access	S1	Low	Strong
17. Should the management of the scenario No Oxygenation No Intubation be trained with simulators?			
Yes	S1	Low	Strong
	JSA	Moderate	Strong
18. Should the patient be extubated already awake or before returning to consciousness?			
Depending on type of surgery, patients' characteristics and training of the anesthesiologist	ASA	Very Low	Weak
19. Should there be a plan for reintubation if the return to spontaneous ventilation fails?			
Yes	ASA	Very Low	Strong
	S1	Low	Strong
	Indian obst	Low	Strong
	DAS	Low	Strong
20. Should devices be used as guides or stylets to facilitate reintubation?			
Yes	ASA	Very Low	Weak
	Law 2	Low	Strong
	S1	Low	Strong
	AIDAA	Low	Weak
	DAS	Low	Strong
21. Is special follow-up recommended when a patient presented with VAD?			

Yes, including a description of the difficulty encountered and the techniques that were used	ASA	Very Low	Weak
	AIDAA	Low	Strong

To our best knowledge the present study is the first overview of guidelines encompassing a broad spectrum of difficult airway care in anesthetic patients' recommendations.

We observed higher level of evidence supporting therapeutic than diagnostic recommendations (high/moderate quality of evidence 56 vs 22%, respectively). It is not surprising, because cross-sectional or cohort studies can provide high quality evidence for test accuracy but indirect evidence for patient-important outcomes. Furthermore, high level of heterogeneity is almost the rule in diagnostic studies, downgrading even more the level of evidence because inconsistency [40-42]. Although there is consensus on some practices such as the use of neuromuscular blockers, the importance of patient preoxygenation and the relevant role of video laryngoscopy, not all recommendations present an adequate level of evidence to support them considering relevant outcomes for patients. In contrast, no consensus was found on the necessary material that should be available when a difficult airway is expected or on the preferred technique for performing a rescue cricothyroidotomy.

The strength of a recommendation is defined as the extent to which one can be confident that the desirable effects of an intervention outweigh its undesirable ones. We found only 41% 'strong' diagnostic recommendations statements (for and against) based on high/moderate level of evidence and 56% for therapeutic/preventive care recommendation. Although it would be desirable higher proportions of high-quality supporting evidence a guide panel must consider additional factors. To assess competing management alternatives, GRADE proposes to consider four domains: estimates of effect for desirable and undesirable outcomes, confidence in the estimates of effect, values and preferences, and resource use. Guideline panels must integrate these factors to make a strong or weak recommendation for or against an intervention [43].

Our updated overview of EB-CPGs may be a useful resource for the professionals involved in difficult airway management to consult. We present many strong recommendations that are routinely implemented in clinical practice. Although, there is still no published evidence on whether the adoption of CPGs results in an improvement in patient critical outcomes and in many recommendations there is a lack of consensus among practitioners as to which approaches to airway management should be adopted.

However, any decision should be taken considering local contextual factors. The heterogeneous settings represent itself a limitation to generalize every recommendation. However, we analyze the differences in accordance with the setting that was evaluated, based on the expert opinion in a second review of the results. These resolutions are highlighted when the key questions are presented. The experts who collaborate with the project remarked that some specific maneuvers as the laryngeal manipulation could be acceptable depending the situation and the additional materials to facilitate the intubation. In the unexpected emergency situation, it could be the most available maneuver associated to stylets or TE, but in a schedule anesthetic procedure video-laryngoscopy and muscular blockers (if no contraindication) should be preferred. In contrast, no consensus was found on the necessary material that should be available when a difficult airway is expected or on the preferred technique for performing a rescue cricothyroidotomy. The unexpected difficult intubation/ventilation and the characteristics of the patients or the procedures make more difficult the universality of the recommendations.

Recommendations can be adopted, modified or even not implemented, depending on institutional or national requirements and legislation and local availability of devices, drugs and resources [44]. Decision-makers at the national and subnational levels should be provided with the information they need to apply the evidence and recommendations in their setting [45]. As a limitation, including only EB-CPGs could have resulted in omitting some information, but we prioritized summarizing the highest quality evidence. Our exclusion criteria for CPGs, limiting the scope to specific conditions, may represent an additional caveat since some particular diagnostic or therapeutic interventions could have been also excluded. Nevertheless, the large amount of recommendations summarized in our study suggest that this could have been only a minor limitation.

Our study will be useful for future difficult airway guideline developers or adapters. Consistently with other overviews of clinical guidelines, the domain that received the lowest mean score was the 'applicability' domain of the AGREE-II tool. Similarly, the heterogeneity of evidence and the strength of recommendations grading systems [46-48] in this overview echo that of other clinical guideline overviews. We also found some discrepancies, mainly in the evidence level, in each recommendation that did not always discriminate between universal interventions and those suitable only for special target groups or specific surgeries.

Guideline developers should ensure rigorous methodological processes and make also recommendations formulated and disseminated in ways they facilitate understanding and application by end-users.

Our overview identified several controversies, evidence gaps and problems regarding difficult airway care guidelines that warrant future research and reveal opportunities to improve their quality.

We are aware that it is not possible to study some difficult airway management rare events in prospective trials, so our most valuable insights come from the detailed analyses of adverse events. Every adverse event is unique, and its outcome will be ultimately influenced by patient co-morbidities, urgency of the procedure, skill set of the anesthetist, and available resources [2,31].

Standardized management plans are directly transferable from one hospital to another and make it less likely that team members will encounter unfamiliar techniques and equipment during an unfolding emergency. We encourage guideline developers to adopt GRADE [11] and AGREE-II [18] tools to elaborate future sound preoperative care guidelines.

Conclusion

We found significant heterogeneity of guidelines' quality and rating systems, as well as deficiencies in several guideline quality domains, which reveal opportunities for quality improvement which deserve careful consideration by future guideline developers. Nevertheless, we present many strong recommendations ready to be considered at present for implementation or discontinuation.

Declarations

Authors' contributions:

Concept and design: AC, AB. Formal analysis: HCA, LP, GS and AC. Supervision: AB, AC. Review, interpretation and discussion of the results: AC, AB, LP, HCA, GS. Writing original draft: HCA, GS and LP. Writing, review and editing: AC, AB, GS, HCA and LP.

Conflicts of interest

Agustín Ciapponi, Lucas Perelli, Hernán Cohen Arazi, Germán E. Solioz¹ and Ariel Bardach have no conflicts of interest that are directly relevant to the content of this article.

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Availability of data and material

The data that support the findings of this study are available in this article.

Consent for publication

Not applicable.

Ethics approval and consent to participate

Not applicable.

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Figures

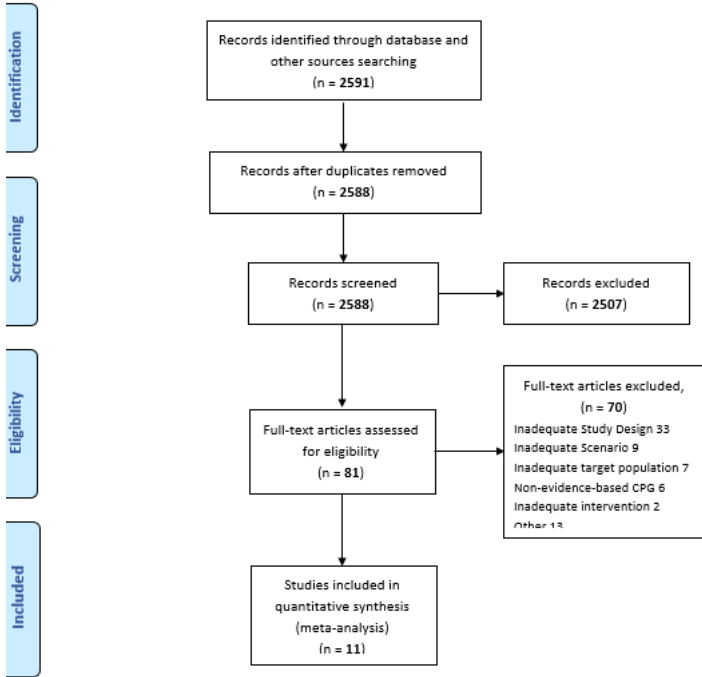


Figure 1

Study flowchart

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