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REVIEW ARTICLE/BRIEF REVIEW

Airway recommendations for perioperative patients during the COVID-19 pandemic: a scoping review

Recommandations pour la prise en charge des voies aériennes des patients périopératoires pendant la pandémie de COVID-19 : une étude de portée

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Abstract

Purpose *Numerous guideline recommendations for airway and perioperative management during the COVID-19 pandemic have been published. We identified, synthesized, and compared guidelines intended for anesthesiologists.*

Source *Member society websites of the World Federation of Societies of Anesthesiologists and the European Society of Anesthesiologists were searched. Recommendations that focused on perioperative airway management of patients with proven or potential COVID-19 were included. Accelerated screening was used; data were extracted by one reviewer and verified by a second. Data were organized into themes based on perioperative phase of care.*

Principal findings *Thirty unique sets of recommendations were identified. None reported methods for systematically searching or selecting evidence to be included. Four were updated following initial publication. For induction and airway management, most recommended minimizing personnel and having the most experienced anesthesiologist perform tracheal intubation. Significant*

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congruence was observed among recommendations that discussed personal protective equipment. Of those that discussed tracheal intubation methods, most (96%) recommended videolaryngoscopy, while discordance existed regarding use of flexible bronchoscopy. Intraoperatively, 23% suggested specific anesthesia techniques and most (63%) recommended a specific operating room for patients with COVID-19. Postoperatively, a minority discussed extubation procedures (33%), or care in the recovery room (40%). Non-technical considerations were discussed in 27% and psychological support for healthcare providers in 10%.

Conclusion *Recommendations for perioperative airway management of patients with COVID-19 overlap to a large extent but also show significant differences. Given the paucity of data early in the pandemic, it is not surprising that identified publications largely reflected expert opinion rather than empirical evidence. We suggest future efforts should promote coordinated responses and provide suggestions for studying and establishing best practices in perioperative patients.*

Study registration *Open Science Framework (https://osf.io/a2k4u/); date created, 26 March 2020.*

Résumé

Objectif *De nombreuses recommandations ont été publiées pour la prise en charge des voies aériennes et périopératoires pendant la pandémie de COVID-19. Nous avons identifié, synthétisé et comparé les lignes directrices destinées aux anesthésiologistes.*

Sources *Les sites internet des sociétés membres de la Fédération mondiale des sociétés d'anesthésiologistes et de la Société européenne d'anesthésiologie ont été consultés. Les recommandations axées sur la prise en charge périopératoire des voies aériennes des patients atteints de COVID-19 prouvée ou potentielle ont été incluses. Une sélection accélérée a été utilisée; les données ont été extraites par un examinateur et vérifiées par un second. Les données ont été thématiquement organisées en fonction de la phase périopératoire des soins.*

Constatations principales *Trente ensembles uniques de recommandations ont été identifiés. Aucun de ces ensemble n'a fait état de méthodes de recherche ou de sélection systématiques des données probantes à inclure. Quatre ont été mis à jour après leur publication initiale. Pour l'induction et la prise en charge des voies aériennes, la plupart ont recommandé de minimiser le personnel et de demander à l'anesthésiologiste le plus expérimenté de réaliser l'intubation trachéale. Une congruence significative a été observée parmi les recommandations qui portaient sur les équipements de protection individuelle. Parmi les lignes directrices évoquant les méthodes d'intubation trachéale, la plupart (96 %) ont recommandé la vidéolaryngoscopie, alors qu'il existait une discordance concernant l'utilisation de bronchoscopes flexibles. En peropératoire, 23 % ont suggéré des techniques d'anesthésie spécifiques et la plupart (63 %) ont recommandé une salle d'opération spécifique pour les patients atteints de COVID-19. En postopératoire, une minorité a abordé le sujet des procédures d'extubation (33 %) ou des soins en salle de réveil (40 %). Les considérations non techniques ont été traitées dans 27 % des cas et le soutien psychologique aux fournisseurs de soins de santé dans 10 %.*

Conclusion *Les recommandations pour la prise en charge périopératoire des voies aériennes des patients atteints de COVID-19 se chevauchent dans une large mesure, mais montrent également des différences significatives. Compte tenu de la rareté des données au début de la pandémie, il n'est pas surprenant que les publications identifiées reflètent en grande partie l'opinion d'experts plutôt que de se fonder sur des données probantes empiriques. Nous suggérons que les efforts futurs soient déployés de manière à promouvoir des réponses coordonnées et proposer des*

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suggestions pour étudier et établir les meilleures pratiques chez les patients en période périopératoire.
Enregistrement de l'étude *Open Science Framework (https://osf.io/a2k4u/); date de création, 26 mars 2020.*

Keywords COVID-19 · perioperative · guidelines · recommendations · airway management

A defining feature of COVID-19 has been its rapid human-to-human transmission,[1] largely through respiratory droplets and aerosols. Based mainly on retrospective evidence from the 2003 severe acute respiratory syndrome (SARS) epidemic, aerosol-generating medical procedures such as tracheal intubation and extubation, and close proximity to the airway of perioperative patients were thought to increase the infection risk of anesthesiologists.[2] In response, there has been a rapid proliferation of guidelines, recommendations, opinion pieces, checklists, and cognitive aids for the airway and perioperative management of patients with COVID-19. For the purposes of this review, we labelled these diverse sources of information as "recommendations". These recommendations have allowed perioperative health systems, anesthesiology societies, and departments of anesthesiology to establish policies and protocols to optimize the safety of both patients and healthcare providers.

The initial rapid rise in recommendations may appropriately reflect regional differences in perioperative environments and resources. Nevertheless, the publication of a large number of recommendations may limit knowledge translation, confuse providers, and potentially make it more difficult to adopt specific protocols. Contradictory information or discrepancies between recommendations may also decrease the perceived credibility of their sources, further delaying standardization of care. Indeed, the *choice overload hypothesis* would suggest that a larger number of choices may reduce motivation and have less effective consequences for behaviour change.[3]

Given what we perceived to be a large number of guidance documents being published, we systematically identified and synthesized these perioperative airway management recommendations. This scoping review aimed to identify and review the breadth of recommendations for anesthesiologists and compare their content. Our scoping review also provides an important opportunity to assess one aspect of our community's response to the COVID-19 pandemic and assist in establishing consistency to improve patient outcomes and minimize resource utilization, while decreasing unnecessary practice variation as we prepare for the endemic phase of this disease.

Methods

Our proposed scoping review followed a standard framework first defined by Arksey and O'Malley,[4] expanded by Levac *et al*,[5] and summarized by the Joanna Briggs Institute.[6] Our protocol was posted *a priori* on Open Science Framework (https://osf.io/a2k4u/) (date created, 26 March 2020). Our final review is reported in accordance with the PRISMA extension for scoping reviews (PRISMA-ScR) (checklist in eAppendix 1, Electronic Supplementary Material [ESM]).[7]

Inclusion criteria

To be eligible for inclusion in the review, sources had to meet the following criteria:

1. The target population included adult patients requiring surgery. Patient populations undergoing both cardiac and non-cardiac surgery were included.
2. Recommendations were for the perioperative airway management of patients with potential or proven COVID-19. "Perioperative" was defined as any patient expected to have surgery, having surgery, or recently post surgery, who are directly cared for by an anesthesiologist or anesthesia care provider.

Exclusion criteria

Sources that provided recommendations for perioperative airway management of patients with COVID-19 exclusively for obstetric, pediatric, or nonoperative (e.g., endoscopy) populations were excluded. Sources that focused on airway management in nonoperating room settings (intensive care units, trauma bay, hospital ward, prehospital care) were excluded.

Literature search

A search was conducted of national anesthesia organization webpages. We used the list of 136 member societies (representing 150 countries) of the World Federation of Societies of Anesthesiologists (WFSA) as well as the European Society of Anesthesiology and Intensive Care (ESAIC). Additionally, we searched the websites of other relevant organizations such as the Anesthesia Patient Safety Foundation and Safe Airway Society. Homepages of each society were opened in Google Chrome and, if needed, the translation function was activated. The

homepage for each organization was reviewed for any information regarding COVID airway management guidelines, along with searches for "COVID" and "coronavirus" where webpage search functions were available. We extracted data from English, French, Croatian, Serbian, or Bosnian language recommendation documents (languages spoken by the review team).

Data extraction

References were uploaded to DistillerSR (Evidence Partners, Ottawa, ON, Canada), an audit-ready cloud-based program that assists with the design and conduct of systematic reviews. Full texts of included recommendations were screened independently and in duplicate. Initial disagreements were resolved by further discussion or, if necessary, a third senior author was consulted.

Data charting

The data abstraction form focused on five general themes: personal protective equipment (PPE), airway equipment, nontechnical skills, induction and extubation methods, and mental health of healthcare providers. Questions were refined via an iterative process involving all investigators and the data extraction form was then piloted using five of the included published recommendations (eAppendix 2, ESM). Senior investigators reviewed the data abstraction of the five published recommendations to ensure the data abstracted were consistent with the research question and purpose as recommended by Levac *et al.*[5] Data from included recommendations were transcribed into DistillerSR by one reviewer; a second reviewer independently verified accuracy of the data input. All data were verified by at least one team member with perioperative clinical experience.

To synthesize the results, data extracted were organized into five *a priori*-determined themes based on perioperative phase of care: preoperative, induction/airway management, intraoperative, extubation/recovery, and general recommendations (i.e., not specific to a phase of care). Data were exported to Excel (Microsoft Corporation, Redmond, WA, USA). Frequencies of items are reported.

Changes in scoping review protocol

In keeping with scoping review methodology, iterative changes were made in our protocol and have been documented in our registration. We originally searched MEDLINE, LitCovid, and Google for guidelines and recommendations surrounding the perioperative airway management of patients with COVID-19. These searches were conducted with the assistance of an information specialist (Risa Shorr, MLS, Ottawa Hospital Learning Services, Ottawa, ON, Canada). As we updated our search, the number of captured publications proliferated. The number of records from our initial search increased exponentially from 94 in March 2020 to over 4,000 in July 2020. In consultation with our information specialist, we modified our search to maintain feasibility, resulting in 885 citations. Even with this modified search, 4,951 records were retrieved by July 2021. Following screening, the majority of relevant publications identified were authored by small groups of individuals unassociated with national or international anesthesiology organizations. As such, our study group decided to restrict our search to websites of member societies of the WFSA and ESAIC to ensure that recommendations included in this scoping review were widely accessible and endorsed by national organizations or anesthesia societies, therefore potentially representing the highest quality and evidence-based recommendations as well as perceived as the most credible by clinicians for practice change. Furthermore, a single reviewer assessed whether included publications used systematic methods to search for evidence or described the criteria used for selecting evidence.

Results

A total of 176 publications were retrieved from anesthesia society websites. Following screening, 30 publications, each representing a unique set of recommendations, met our eligibility criteria and were included in our analysis (eAppendix 3, ESM).

Recommendation characteristics

Original publication dates were reported in 28/30 (93%) publications and ranged from February 2020 to August 2020. We found updated versions for 4/30 (13%) publications, with the most recent being updated in June 2021. Of the included articles, 23/30 (77%) referred to their publication as "recommendations" and 5/30 (17%) referred to their publication as "guidelines". None of the included publications used systematic methods to search for evidence or described the criteria used for selecting evidence. The majority (20/30, 67%) specified that the target patients of their publication were confirmed SARS-CoV-2-positive patients, whereas 10/30 (33%) did not specify a target population (i.e., confirmed positive, suspected or asymptomatic, tested or untested) (Fig. 1).

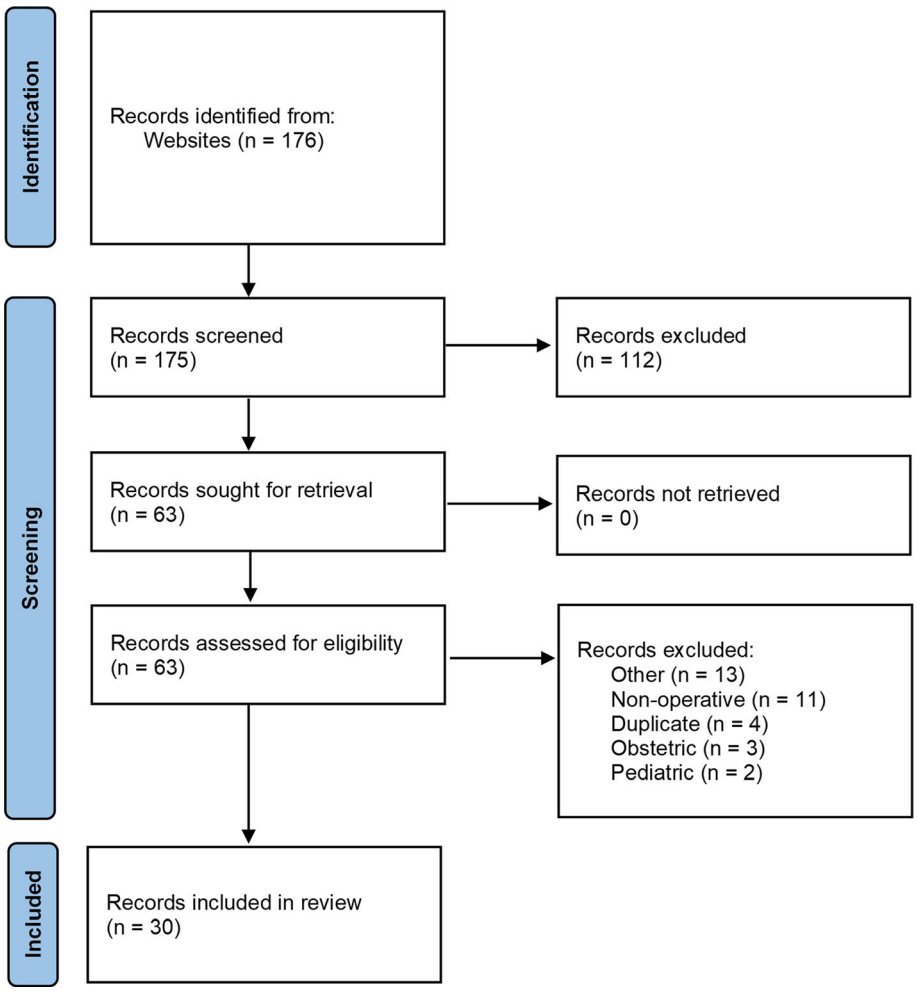

Fig. 1 PRISMA flow diagram of recommendation selection.

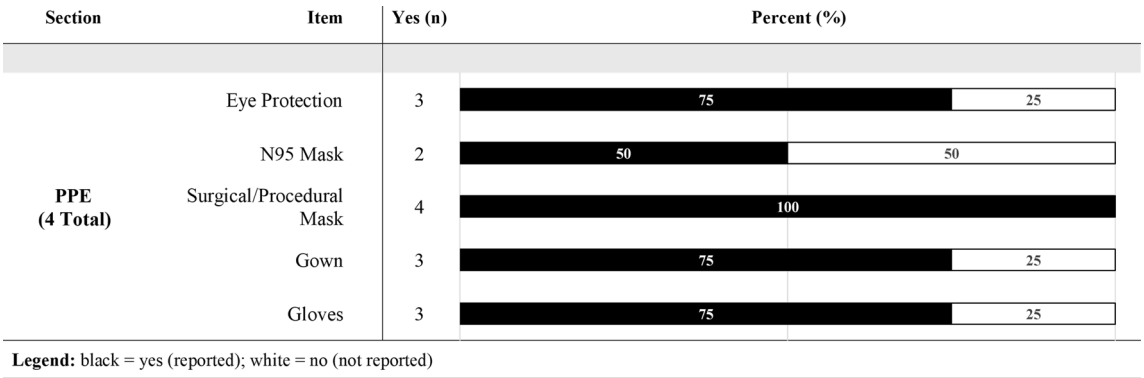

Fig. 2 Summary of preoperative assessment recommendations from the included publications (n = 30).

Phase of care: preoperative

A minority (7/30, 23%) of publications discussed the preoperative patient assessment. These included preoperative hygiene processes (e.g., hand hygiene) (7/30, 23%) and PPE for clinicians during preoperative assessment (4/30, 13%; Fig. 2). Five publications (17%) recommended amendments to the usual preanesthetic history and physical examination; four suggested the addition of temperature measurement. Other recommendations included in these seven publications were a detailed risk assessment history (e.g., travel, COVID-19-specific symptoms, and treatment), emphasis on chest examination and other organ systems affected by

COVID-19 disease, and consideration of imaging such as chest x-ray or computed tomography scan (especially in emergencies or if COVID-19 status is indeterminate). One publication suggested the use of telemedicine when possible. Approximately half (14/30, 47%) of publications recommended PPE for patients, specifically the donning of a surgical/procedure mask.

Fig. 3 Summary of induction and airway instrumentation recommendations from the included publications (n = 30).

Phase of care: induction/airway management

The majority of publications (24/30, 80%) provided recommendations for specific team members and roles during anesthesia induction and airway management (Fig. 3). Of these, 20/24 advised minimizing the number of personnel in the operating room to only those directly involved in establishing in the airway. Six publications provided specific suggestions for clearly defined roles (e.g., primary anesthesiologist, a second/assisting anesthesiologist, one "runner" within the operating room, and one "runner" outside the operating room or in the anteroom). One article recommended a team leader distinct from the primary anesthesiologist to coordinate the team, manage drugs, observe monitoring, and provide airway assistance if necessary. The majority of publications (19/30, 63%) provided recommendations on who should perform tracheal intubation. All 19 publications recommended tracheal intubation be performed by the most experienced anesthesiologist. Of note, two of these publications provided recommendations to consider excluding staff who may be vulnerable (e.g., immunocompromised) from the airway team.

Personal protective equipment

The majority of publications (26/30, 87%) discussed PPE for anesthesia induction and airway management. Personal protective equipment included gloves (23 publications), isolation gowns (20 publications), N95 masks (23 publications), and goggles or face shield (22 publications). Two publications discussed self-check for the donning/doffing of PPE in this phase of care, and six discussed PPE spotter-checks.

Airway equipment

The majority of publications (23/30, 77%) provided specific suggestions for airway equipment, of which 22/30 (73%) recommended videolaryngoscopy. Thirteen publications specifically recommended against the use of flexible bronchoscopy for tracheal intubation; conversely, two publications supported its use. The majority of publications (22/30, 73%) provided specific suggestions surrounding use of a filter on the anesthetic circuit, with seven recommending a high efficiency particulate absorbing filter and four recommending a heat and moisture exchanger filter. Most publications (21/30, 70%) suggested the use of an intraoperative suction system, with 14 of these specifically describing a closed-suction system.

Preoxygenation

The majority of publications (20/30, 67%) discussed preoxygenation with all highlighting adequate preoxygenation specifically to avoid manual ventilation post induction. Some suggested techniques to minimize potential aerosolization during preoxygenation included use of low flow oxygen (e.g., < 6 L·min^{-1}), two-handed face mask ventilation, a well-sealed/fitted face mask, and the application of wet gauze over the patient's nose and mouth to block secretions.

Induction

Specific processes for the induction of anesthesia were mentioned in 24/30 (80%) publications, all of which recommended rapid sequence induction. Four publications specified dosing of neuromuscular blocking agents (rocuronium > 1.2 mg·kg^{-1} total body weight or > 1.5 mg·kg^{-1} ideal body weight, succinylcholine 1.5 mg·kg^{-1} total body weight). Two specifically recommended that sufficient time be provided for onset of neuromuscular blockade. Three publications discussed the use of pharmacologic adjuncts during induction of anesthesia to reduce the risk of aerosolization. Suggested agents included atropine or glycopyrrolate for secretion reduction and prophylactic antiemetics.

Difficult airway

Less than half of the publications mentioned approaches to a difficult airway (11/30, 37%). With respect to awake tracheal intubation, two publications recommended against use of awake tracheal intubation techniques, while three stated awake techniques could be used if required. Among these three studies, suggestions included the use of sufficient sedation and topicalization with lidocaine or tetracaine, involvement of a senior anesthesiologist, and (in cases of failure to intubate) use of the scalpel-bougie technique for front of neck airway. With respect to airway rescue techniques, four recommended the use of a supraglottic airway as a rescue device for hypoxia and four discussed the use of cricothyroidotomy in a cannot-intubate-cannot-oxygenate scenario.

Phase of care: intraoperative

Type of anesthesia

A minority of publications (7/30, 23%) recommended a specific type of anesthetic technique (Fig. 4). Of these seven, four suggested the use of regional/neuraxial techniques when possible. Of note, most publications

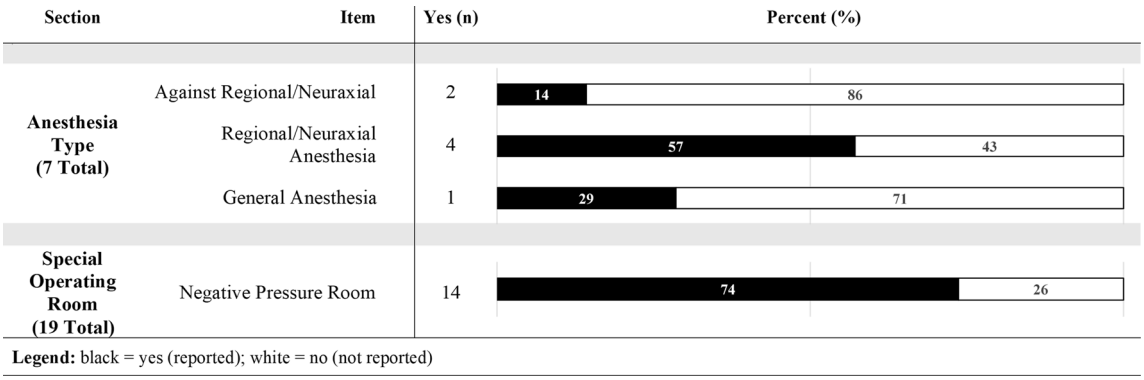

Fig. 4 Summary of intraoperative management recommendations from the included publications (n = 30).

recommended the donning of a surgical/procedure mask on nonintubated patients during surgical procedures.

Operating rooms

Nineteen of 30 (63%) publications mentioned having a specific operating room for patients with COVID-19. Of these publications, 14 recommended using a negative pressure operating room (Fig. 4). In situations where a negative pressure operating room was not available, several publications recommended turning off the positive pressure and air conditioning systems commonly present in standard operating rooms. Identifying COVID-19 operating rooms with specific signs was recommended in 16 publications. Personal protective equipment for the intraoperative phase of case was discussed in two publications. Operating room disinfection was mentioned in 9/30 (30%) publications. Of these, three suggested implementing a waiting period between operations (e.g., 30–60 min). Two publications recommended a minimum rate of air exchange (12 and 25 exchanges per hour).

Equipment cleaning

Nine publications (30%) commented on anesthesia machine cleaning. Of these publications, one recommended the use of disposable anesthetic machine covers and four recommended the use of "hospital approved" or Environmental Protection Agency-approved disinfectant for anesthesia machine cleaning. Seven publications recommended that high-touch surfaces of the anesthetic machine be cleaned and disinfected and 20/30 (67%) recommended disinfection of equipment and/or the use of single-use equipment. Proper disposal of medical waste was mentioned in 14/30 (47%, e.g., a designated, labelled COVID-19 waste bin).

Phase of care: postoperative

Extubation

Extubation was discussed in 10/30 (33%) publications, with recommendations for the specific extubation procedure provided in six (Fig. 5). The most common suggestion for extubation involved the use of antitussive techniques. Specifically, one article recommended use of spontaneously breathing deep extubation and laryngeal mask airway exchange using a closed system.

Personal protective equipment

Personal protective equipment for extubation was mentioned in 4/30 (13%) publications, the most common including the donning of gloves, an isolation gown, an N95 mask, and goggles or face shield (Fig. 5). Doffing processes were discussed in 19/30 (61%) publications (Fig. 5). Among these publications, 13 highlighted the importance of proper hand hygiene after doffing. Five publications recommended a designated environment for doffing, four highlighted the need to avoid self-contamination (i.e., touching their own face/hair) and three recommended the presence of a spotter/coach.

Postanesthesia care unit

Fourteen publications (47%) discussed patient transport to recovery and twelve (40%) discussed care in the postanesthesia care unit. General recommendations included wearing appropriate PPE, minimizing transport time, donning of a mask by the patient, and the use of a nonpermeable patient cover during transport. Recommendations for tracheally intubated patients included minimizing the number and duration of breathing circuit disconnections, adequate paralysis, and clamping of the endotracheal tube during movement from one closed ventilation system to another to prevent

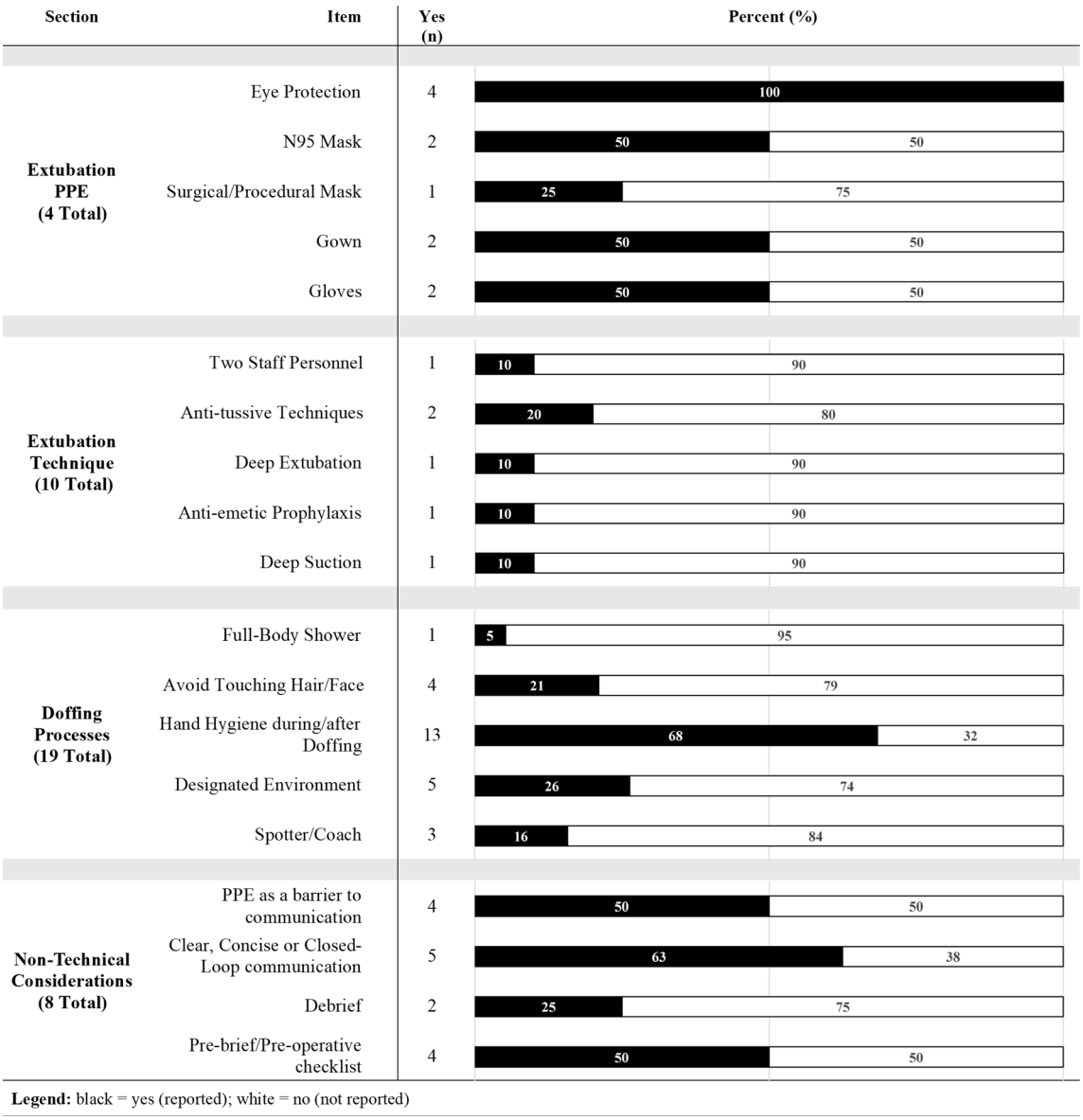

Fig. 5 Summary of postoperative management recommendations from the included publications (n = 30).

aerosolization. One publication suggested a single dose of a 5-hydroxytryptamine receptor antagonist to prevent postoperative nausea and vomiting. A minority of publications discussed PPE during recovery room care (4/30, 13%) the most common of which was the use of gloves (two publications), an isolation gown (two publications), a surgical/procedure mask (two publications), and eye protection (two publications).

Support, surveillance, and nontechnical considerations

Psychological support for healthcare providers (HCPs) was discussed in 3/30 (10%) publications. Suggestions included having available psychologic support services for HCPs, having adequate time off-work between shifts, and preparing for mental and physical fatigue. Surveillance of HCPs for potential COVID-19 symptoms and exposures was discussed in 5/30 (17%) of publications, of which two recommended HCPs keep a clinical logbook. Nontechnical considerations were discussed in 8/30 (27%) publications (Fig. 5). Of these, four recommended the use of a prebrief/preoperative checklist and two recommended a debrief. Five publications highlighted the importance of clear, concise, or closed-loop communication, and four identified the use of PPE as an important barrier to effective communication. Twenty (67%) publications recommended training. Of those that recommended training, the majority (15/20, 75%) recommended PPE

training (donning, doffing). Eight of 20 (40%) recommended simulation-based training and 8/20 (40%) specifically recommended infection control training.

Discussion

In the present scoping review, we found substantial agreement between societies on numerous aspects of COVID-19 perioperative airway management, despite the number and scope of publications reviewed. Most included similar PPE recommendations and approaches to tracheal intubation including minimizing personnel present and suggested having the most experienced airway manager perform tracheal intubation. There was substantial agreement regarding specific tracheal intubation techniques, with most publications recommending a rapid sequence approach with videolaryngoscopy. It is reassuring that most societies provided congruent recommendations on multiple key components of perioperative airway management and care. Nevertheless, it is also important to note that managing the airway of patients with COVID-19 is likely to be more difficult at baseline, given the complicating physiologic (e.g., hypoxemia) and contextual (e.g., novel environment with fewer support personnel, use of unfamiliar PPE) factors. Consistency in recommendations provided to anesthesiologists may have eased clinical decision-making and improved adherence to best safety practices in the COVID-19 era.

Although most publications provided similar suggestions, heterogeneity remains. For example, while some publications specifically recommended against flexible tracheal intubation in the difficult COVID-19 airway, others supported its use. There was substantial discordance in recommendations for airway management techniques and PPE use during extubation. There is also a lack of guidance regarding PPE to be worn during the intraoperative phase of care, during the period after tracheal intubation. Our findings highlight the absence of a unified consensus for perioperative airway management in patients with COVID-19. Given the paucity of evidence available to inform the development of these publications at the onset of the pandemic, it is not surprising that we observed significant discrepancies. The recommendations made reflected expert opinion and were also primarily informed by comparable experiences (e.g., the SARS outbreak in 2003). Conflicting recommendations may result in significant confusion for the individual practitioner, department, or healthcare system when adopting best-practice protocols, potentially delaying local adoption of a specific protocol.

Similar to a previous study regarding COVID-19 airway management, most recommendations identified in our review were not developed in a methodologically rigorous manner.[8] None of the included guidelines used systematic methods to search for evidence nor did any clearly describe the criteria used for selecting evidence (two major components of evidence-based guideline development).[9] This is likely a result of the relatively rapid nature in which these recommendations were developed and published, especially in the early days of the pandemic wherein our collective understanding of the virulence, routes or duration of transmission, and life cycle of the SARS-CoV-2 virus was limited. Even in situations where there is a lack of evidence, systematic methods in the creation of guidelines and recommendations should still be applied (e.g., the AGREE II framework that provides a methodological strategy for guideline development).[9] The lack of methodologic rigour in the development of the included recommendations may limit their successful uptake and implementation.[10] Nevertheless, in the initial phases of a pandemic with a novel virus, precautionary principles and expert opinion must inform rapid initial recommendations prior to such knowledge being available. The Campbell Inquiry, a federal government inquiry into the healthcare response to SARS in 2003, provides some principles for approaching a new public healthcare threat. Judge Campbell emphasized the use of the precautionary principle, which dictates that when there are two conflicting recommendations during an unclear healthcare threat, that the safer approach be followed.[11] This results in frontline healthcare providers trusting that the recommendations made by national or society structures are to protect them. Once more evidence is gleaned, or other protections such as vaccination are widespread, recommendations should change to reflect the current situation.

Of greatest concern is the lack of updates to the majority of recommendations. As our knowledge and understanding of COVID-19 continues to grow, these documents have not kept pace. Authors of guidelines should carefully consider emerging or evolving evidence which may support or oppose certain recommendations, for example from registry studies such as intubateCOVID.[12] Significant concerns have also been raised surrounding aerosolization of SARS-CoV-2 during tracheal intubation; however, recent evidence has suggested that tracheal intubation in paralyzed patients may not be aerosol-generating.[13] High-resolution environmental monitoring in ultraclean operating rooms has suggested that detectable aerosols during tracheal intubation might be 15-fold lower than with extubation, and detectable aerosols during extubation might be 35-fold lower than a volitional cough.[13] As another example, recommendations generally suggested that negative pressure rooms may provide greater protection during aerosol-generating medical procedures

performed in patients with COVID-19.[14–17] Nevertheless, negative pressure rooms have since been suggested to contribute to the increased risk of developing pulmonary aspergillosis (which is commonly observed in patients with COVID-19).[18,19] Considering the rapidly emerging evidence, it is not surprising that outdated recommendations remain readily accessible. This undoubtedly contributes to ongoing confusion about, and lack of adherence to, the most up-to-date best practices.

Our study has limitations. First, our results provide an overview of the current literature rather than answer a single, predefined question. Second, the recommendations included in our scoping review were not comprehensively assessed for methodologic quality (since this is not usually conducted for scoping reviews), although we would anticipate that included recommendations would likely score poorly in both methodological rigour and transparency of development. Furthermore, relevant recommendations that were independent from anesthesiology society websites were not captured in our final search strategy and only non-English publications in languages familiar to our review team were included.

Reflecting on our experiences with the COVID-19 pandemic, our study should inform future efforts to improve and streamline the pandemic response (Tables 1 and 2). For example, several groups of critical care specialists were able to both create and organize emerging evidence and facilitate the creation of internationally applicable guidelines that could be locally modified as needed. In addition, their creation of the REMAP-CAP and RECOVERY trials provided a global research platform to efficiently adapt to the COVID-19

Table 1 Key issues and knowledge gaps to be addressed in perioperative airways guideline development

Key considerations and questions	Suggestions
Provide structure to improve reproducibility of recommendations*	Systematic and transparent methods for development of guidelines should be followed (e.g., as per AGREE II[9]). Even if evidence is limited or absent, implement and report standardized grading of evidence.*
Guideline amendments as evidence evolves*	Development of living documents to be reviewed and updated at predetermined intervals. Ensure outdated recommendations are removed from relevant platforms.
	Obtain support from anesthesia and airway societies worldwide (e.g., Anesthesia Patient Safety Foundation, World Anesthesia Society, Difficult Airway Society) to develop this infrastructure and promote knowledge translation (e.g., implementation and deimplementation).*
Optimal intubation and extubation techniques to effectively reduce viral transmission remains unknown	Ongoing development and use of appropriate aerosol science techniques (e.g., development and use of methods to differentiate water-containing from non-water-containing aerosols).
	Compare the effectiveness of different intubation and extubation strategies in reducing aerosolization.
	Provide suggestions for alternative techniques for the anticipated difficult airway.
	Include risk assessments in high-risk exposure settings (e.g., awake intubation).
Assessment of the long-term impacts of increased perioperative precautions	Determine impact of deferring elective/semiurgent surgeries on patient outcomes and health systems.
	Determine time required for safe operating room ventilation exchange between operative cases.
	Determine the environmental impact of perioperative precautions (e.g., use of plastic coverings, disposable PPE) and mitigation strategies
	Assessment of the impact of such precautions on medical education opportunities and potential detrimental effects at both undergraduate and post-graduate levels. Create mitigating strategies for the assessed issues.
Improve implementation and knowledge translation of guidelines*	Generate strategies for formal communication of implementation and de-implementation strategies as evidence evolves and policies are updated.*
Improve our preparedness and response to future pandemics	Development of international, multicentre, perioperative initiatives and organizations to conduct rapid synthesis, evaluation, and communication of data, and establish up-to-date consensus guidelines.
	Increase perioperative representation at a governmental level to ensure perioperative issues are considered when pandemic responses are developed.

*These suggestions are considered universal to development of all guidelines, regardless of topic.

Table 2 Key items for future perioperative airway guidelines

General	PPE donning and doffing processes
	Training including simulation
	Nontechnical considerations
	Psychological support for anesthesia providers
	Self-surveillance for signs and symptoms
	Disposal of medical waste
Preoperative	Standardized team member roles
	PPE
	Triage of cases
	Preoperative assessment
	Infectious disease testing
	PPE for patients (e.g., surgical mask)
Induction and airway management	Team member roles and who should be present
	PPE
	Who should manage the airway/perform tracheal intubation
	Filters on anesthesia machines
	Suction
	Intubation equipment
	Preoxygenation
	Induction medication/methods
	Difficult airway procedures
Intraoperative	Team member roles and who should be present
	PPE
	Type of anesthesia
	Dedicated operating room
	Specific signage
	Anesthesia machine cleaning
	Disinfection of operating rooms
	Optimal room air turnover time between operative cases
Postoperative	Team member roles and who should be present
	PPE for extubation
	PPE doffing processes
	Patient recovery (e.g., location, transport)
	PPE for recovery room

PPE = personal protective equipment

pandemic, and rapidly evaluate various treatments in an expeditious manner.[20–22] Similar international, multicentre initiatives within the perioperative research space were seldom observed, representing an important avenue of exploration to improve preparedness for future pandemics. Furthermore, a significant number of recommendations identified in our searches of MEDLINE, LitCOVID, and Google were authored by small groups of individuals unassociated with national or international anesthesia societies. We would suggest that the time and resources expended on these recommendations may provide greater benefit if directed towards the development of an international set of consensus-based guidelines, or the creation of an international registry to facilitate the access and management of pandemic-related guidelines. Early synthesis and organization of evidence without redundancy in efforts will facilitate development of a judicious response to future pandemics.

Our scoping review may be considered as one of the first needed steps to learn from experience. Just like individuals learn from reflexive practice,[23] institutions are increasingly becoming learning organizations and we would like to suggest that specialty societies may adopt the same approach to become "learning societies" to optimize

future patient care.[24] By using the lessons from the COVID-19 pandemic, we may dramatically reduce the lead time to robust recommendations in perioperative care while potentially avoiding the deleterious impact of pandemic-related restrictions. For example, the widespread cancellation of semiurgent and elective surgeries in Ontario at the onset of the pandemic occurred in anticipation of a surge in patients with COVID-19.[25] The complete impact of these increased wait times on population health has yet to be determined, and is ongoing.[26] An important first step involves analyzing and identifying gaps in our current methods of creating and updating clinical practice guidelines, with a particular focus on how these processes should be refined in the context of a global pandemic and as COVID-19 evolves into an endemic disease.

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