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Video-laryngoscopy use before and after the initial phases of the COVID-19 pandemic The report of the VL-iCUE survey with responses from 96 countries

Nia W. Wylie, Emma L. Durrant, Emma C. Phillips, Audrey De Jong, Patrick Schoettker, Izumi Kawagoe, Marcio de Pinho Martins, Juliana Zapatero, Catriona Graham and Alistair F. McNarry, on behalf of the VL-iCUE Group

From the

South East Scotland School of Anaesthesia, NHS Lothian, Edinburgh UK (NWW, ELD, ECP),

Department of Anesthesia and Intensive Care unit, Regional University Hospital of Montpellier, St-Eloi Hospital, University of Montpellier, PhyMedExp, Université de Montpellier, Inserm, CNRS, CHRU de Montpellier, Montpellier, France (ADJ),

Department of Anesthesiology, Lausanne University Hospital, Switzerland (PS),

Department of Anesthesiology and Pain Medicine, Juntendo University, Faculty of Medicine, Graduate School of Medicine, Japan (IK),

Department of Anesthesia, Critical Care and Pain Medicine, Central Hospital of the Military Police of Rio de Janeiro, Rio de Janeiro, Brazil (MP),

Hospital Clinic de Barcelona, Spain (JZ),

Edinburgh Clinical Research Facility, University of Edinburgh, Western General Hospital, Crewe Road South, Edinburgh, UK (CG),

Western General and St Johns Hospitals, NHS Lothian, Edinburgh UK (AFMN)

Correspondence to

Alistair F. Mc Narry, MA, MB BChir, FRCA, Department of Anaesthesia, Western General Hospital, Crewe Road South, NHS Lothian, Edinburgh, UK EH4 2XU.

Tel: +44 777 88 15 14 0;

e-mail:

althegasman@btinternet.com

BACKGROUND

The potential benefit of “videolaryngoscopy use in facilitating” tracheal intubation has already been established. Its use was actively encouraged during the COVID-19 pandemic as it was likely to improve intubation success and increase the patient-operator distance.

OBJECTIVES

We sought to establish videolaryngoscopy use before and after the early phases of the pandemic, whether institutions had acquired new devices during the COVID-19 pandemic, and whether there had been teaching on the devices acquired.

DESIGN

We designed a survey with 27 questions made available via the Joint Information Scientific Committee JISC online survey platform in English, French, Spanish, Chinese, Japanese and Portuguese. This was distributed through 18 anaesthetic and airway management societies.

SETTING

The survey was open for 54 to 90 days in various countries. The first responses were logged on the databases on 28 October 2021, with all databases closed on 26 January 2022. Reminders to participate were sent at the discretion of the administering organisations.

PARTICIPANTS

All anaesthetists and airway managers who received the study were eligible to participate.

MAIN OUTCOME MEASURES

Videolaryngoscopy use before the COVID-19 pandemic and at the time of the survey.

RESULTS

We received 4392 responses from 96 countries: 944/4336 (21.7%) were from trainees. Of the 3394 consultants, 70.8% (2402/3394) indicated no change in videolaryngoscopy use, 19.9% (675/3394) increased use and 9.3% (315/3393) reduced use. Among trainees 65.5% (618/943) reported no change in videolaryngoscopy use, 27.7% (261/943) increased use and 6.8% (64/943) reduced use. Overall, videolaryngoscope use increased by 10 absolute percentage points following the pandemic.

CONCLUSIONS

Videolaryngoscopy use increased following the early phase of the COVID-19 pandemic but this was less than might have been expected

Introduction

The COVID-19 pandemic caused fear and concern throughout the world not least because of the risk to healthcare workers and specifically, the risk to those who were involved in airway management. Soon after the nature of the pandemic became clear, several airway management guidelines were published, designed to facilitate optimal airway care for this group of patients.^{1–7} These guidelines advocated videolaryngoscopy to improve the incidence of first pass success at tracheal intubation and to increase the patient operator distance.⁸

The potential benefits of videolaryngoscopy have previously been highlighted by several guidelines,^{9–14} advocated as a standard of care¹⁵ and supported by high level evidence.¹⁶ A 2015 survey identified that videolaryngoscopy was widely available in high and upper middle income countries and in almost 50% of lower middle and low income countries.¹⁷ In the same survey, self-reported confidence with videolaryngoscopy was also high.

Despite this, surveys have repeatedly shown a failure to adopt videolaryngoscopy into routine practice.^{18,19} One survey published in January 2020, just prior to the declaration of COVID-19 as a public health emergency of international concern by the WHO,²⁰ reported that videolaryngoscopy was reserved for difficult intubations in the majority (84%) of French intensive care units.²¹

Editorials reported the increased use of videolaryngoscopy to intubate suspected SARS-CoV-2 positive patients.^{22, 23} A videolaryngoscope was used as the first attempt device to facilitate tracheal intubation in almost 80% of cases reported to the intubate COVID study.²⁴ One study has investigated before and after practices of a small group of clinicians, reporting that preference for videolaryngoscopy rose by 19% (24–43%), with the number using it more than 76% of the time increasing from 15% to 26%. Unfortunately, only 91 clinicians returned the second survey.²⁵

In October 2021, we wished to investigate how videolaryngoscope use may have changed due to clinicians' experience during the pandemic and the impact of the various guidelines. We aimed to establish:

- (1) If videolaryngoscopy use had changed before and after the early phases of the pandemic,
- (2) If institutions had acquired new devices during the COVID-19 pandemic, and
- (3) Whether there had been teaching on the devices acquired.

Methods

Favourable ethical review was granted by the University of Edinburgh Medical School Research Ethics Committee (REC Reference: 21-EMREC-053, 3 December 2021) to facilitate dissemination in countries where ethical review was required for survey distribution.

We used a cross sectional survey design with convenience sampling to examine practice at two time points, before the COVID-19 pandemic and approximately 21 months after the pandemic was declared. A small team devised the original questionnaire using the JISC electronic survey platform (www.onlinesurveys.co.uk) who then recruited a pragmatic group of collaborators. This was given the acronym VL-iCUE (Videolaryngoscopy in COVID Use and Experience). It was reviewed and adapted by the VL-iCUE collaborators before a final version with 27 questions was created in English (see supplementary materials, <http://links.lww.com/EJA/A896>). The questions related to videolaryngoscopy use, preferences, acquisition of and training in new devices, and respondents' practice before the pandemic and at the point of the survey. Access to the JISC account was password protected and limited to AMcN, NW, EP and ED. In addition, no respondent identifiable information was collected. Translation of the questionnaire into five further languages (French, Spanish, Mandarin Chinese, Portuguese, Japanese) was supervised by senior anaesthetists with an interest in airway management and who were fluent in that language to ensure translation accuracy. We recognise that there are several methods of confirming translations. We relied on native speaking airway specialists. By managing the translations in such a way, we were confident in capturing the subtle meaning of words, text and sentences, including cultural and contextual detail. The languages were chosen because, between them, they represent five of the ten most commonly spoken languages by number of native speakers. 26

The questionnaire in its various translations was piloted and completed 63 times by the authors, collaborators and their colleagues including those with a specific interest in airway management and those without. During this pilot phase iterative changes were made based on feedback received. The final versions in each language were identical, to facilitate combination of the questionnaire results for analysis.

Through the collaborators, an electronic link to the questionnaire was then distributed (either directly or via a newsletter link) by the following organisations: All India Difficult Airways Association, Brazilian Society of Anesthesiology, Canadian Anesthesiologists' Society, Confederation of Latin American Societies of Anaesthesiology, Difficult Airway Society, European Society of Anaesthesiology and Intensive Care, Evidence Based Perioperative Medicine collaboration, International Air-way Management Society, New Zealand Society of Anaesthetists, North Star Hospital Group (USA), Pakistani Society of Anaesthetists, Safe Airway Society, Sociedad Espanola de Anestesiologia Reanimacion y Terapeutica del Dolor, Société Française d'Anesthésie et de Réanimation, Society Airway Management, South African Society of Anaesthetists, Swiss Fondation Latine des Voies Aériennes, US Anesthesia Partners. Reminder emails or posts were sent at the discretion of the distributing Society or Organisation.

Members of the VL-iCUE group also used personal contacts to promote distribution. All respondents had a minimum of 54 and a maximum of 90 days to complete the survey as a rolling method of distribution was used while the various organisations gave approval. The first responses were logged on 28 October 2021, with all databases closing on 26 January 2022.

The data were combined into a single Excel file for analysis using the JISC survey combination tool and inspected for duplicate entries. Data responses were ordered and inspected to look for duplicates, with any apparent matches being examined completely. We followed the CROSS Checklist for the reporting of surveys; 27 the survey was treated as if it were a postal questionnaire and missing data was regarded as “completely at random” (MCAR). Given the described mode of distribution follow up of non-responders was not possible.

The survey used the phrase “following the pandemic” to mean the point at which the questionnaire was completed.

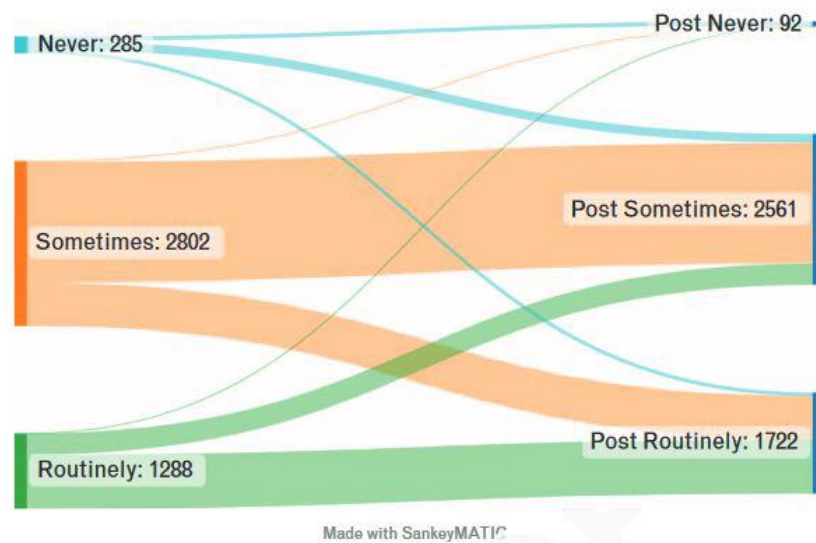
Data and statistical analysis

Associations between categorical variables were examined using the χ^2 test and where expected counts dictated, Fisher's exact test. In paired observations McNemar's test has been used to test the distribution of discordant results. Results are presented graphically using Sankey plots (SankeyMatic <https://www.sankeymatic.com>). Analysis was conducted using GraphPad Prism 9.4.1 and SPSS v24.

Table 1 Respondent data

		<i>n</i> (4392)	%
Grade	Consultant	3392	77.2
	Trainee	944	21.5
	Missing	56	1.3
Experience	0 to <5 years	646	14.7
	5 to <10 years	736	16.8
	10 to <15 years	702	16.0
	15 to <20 years	586	13.3
	20 to <25 years	629	14.3
	25 years or more	1065	24.2
	Missing	28	0.6
Area of practice	Adult Anaesthesia	3739	85.1
	Paediatric Anaesthesia	160	3.6
	Critical Care	318	7.2
	Pre-hospital medicine	27	0.6
	Emergency Medicine	69	1.6
	Other	51	1.2
	Missing	28	0.6
Member of airway society	Yes	1218	27.7
	No	3092	70.4
	Missing	82	1.9
Language	English	2354	53.6
	Spanish	885	20.2
	French	764	17.4
	Japanese	148	3.4
	Chinese	129	2.9
	Portuguese	112	2.6
Income classification country	Lower	2	0.0
	Low Middle	660	15.0
	Upper Middle	803	18.3
	High	2717	61.9
	Country not categorised	8	0.2
	Missing	202	4.6
Country (top 5)	France	665	15.1
	India	484	11.0
	United Kingdom	437	9.9
	Spain	333	7.6
	Canada	208	4.7
	Other	2068	47.1
	Missing	197	4.5

Fig. 1 Sankey plot of videolaryngoscope use pre and following COVID-19.



Videolaryngoscopy use pre and post the COVID-19 pandemic (up until January 2022). Figures on the left represent pre-COVID-19 use.

Results

Participants

We received 4392 responses. Not all questionnaires were fully completed but all data have been used for analysis with the variable denominator noted by 'n='. Given the volume of data collected this primary article reports videolaryngoscope use and type, education and acquisition in the early phases of the pandemic. Responses to individual questions are included in supplementary material. Of those reporting their grade (n = 4336), 944/4336 (21.8%) were trainees. Table 1 shows grade and experience of respondent, area of practice, membership of an airway society, and language of response. Fifty one percent of respondents (2127/4195) came from five countries (France, India, United Kingdom, Spain and Canada), with responses submitted from clinicians practising in 96 countries worldwide (see supplementary material, <http://links.lww.com/EJA/A888>). More than two thirds reported having intubated a patient who was confirmed (2979/4364, 68.2%) and/or suspected (2910/4364, 66.7%) to be SARS-CoV-2 positive.

Videolaryngoscope use before the pandemic and at the time of response

Overall routine videolaryngoscope use has increased by 10 percentage points (29.5–39.4%) since before the COVID-19 pandemic and the date of our survey (supplementary material, <http://links.lww.com/EJA/A888>). The number of clinicians using a videolaryngoscope before the pandemic and at the point of response are shown in Figure 1. Of the 3391 consultants, 2402 (70.8%) indicated no change in their use of videolaryngoscopy, 675 (19.9%) had increased their frequency of use and 315 (9.3%) reduced their frequency of use. Among

trainees 618 (65.5%) of 943 indicated no change in use of videolaryngoscopy while 261 (27.7%) had increased their frequency of use and 64 (6.8%) reduced their frequency of use (see supplementary material, <http://links.lww.com/EJA/A888>) (Fig. 2).

There is evidence of an association between grade of respondent and how frequently videolaryngoscopy was used before the pandemic (X^2 , $P < 0.001$). The number of 'never' users was significantly less in both consultant and trainee respondent groups at the time of survey completion compared to before the pandemic (Fisher's exact test, $P < 0.0001$ both groups). Considering all respondents answering both the 'prior to and following COVID videolaryngoscope practice' ($n = 4375$), 797 switched from never/sometimes videolaryngoscope use to routine while 363 reported changing from routine use to never/sometimes (McNemar's test, $P < 0.001$, tabulation table in supplementary material, <http://links.lww.com/EJA/A888>). According to our survey responses, Macintosh style videolaryngoscopes were preferred at all points before, during the initial peaks and at the point of survey completion. This is shown in Figure 3 alongside clinician preference for the most popular videolaryngoscopes. Choice of device blade type is shown in Figure 4.

The number of respondents who stated they would never use a videolaryngoscope before the pandemic was 285 (6.5%), falling to 92 (2.1%) at the time of submitting the survey. Reasons for not using a videolaryngoscope (by these respondents) are shown in Figure 5.

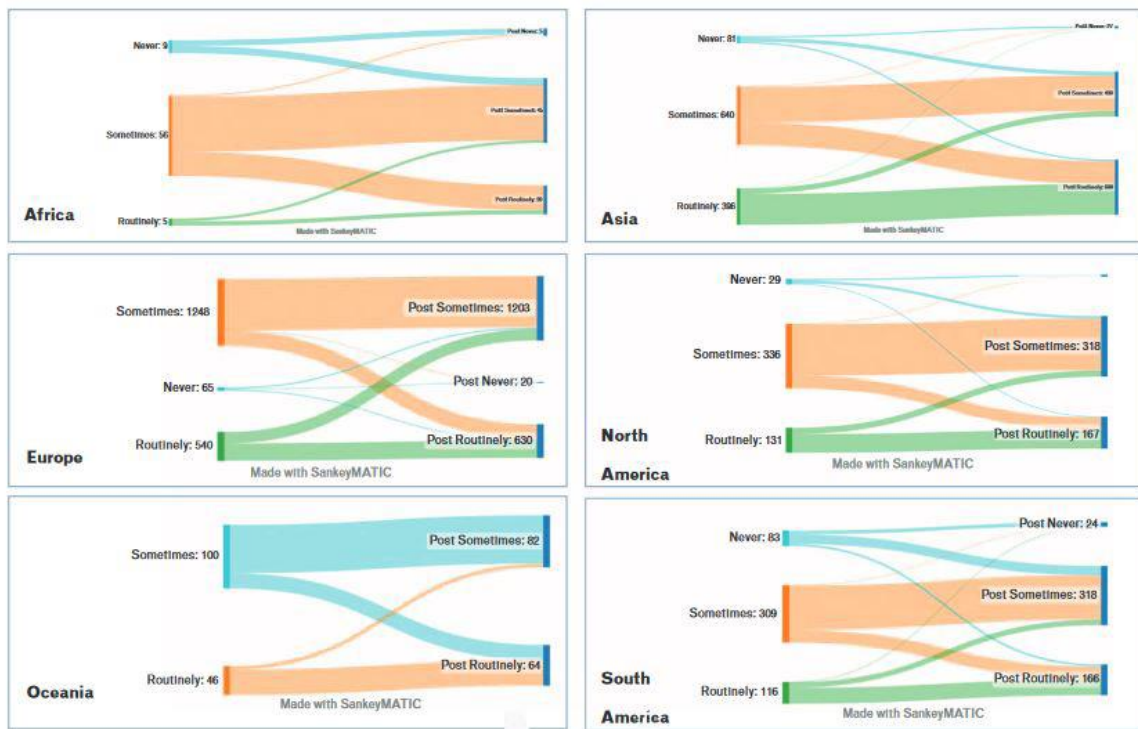
Videolaryngoscope acquisition and training

New videolaryngoscopes were reportedly acquired by the departments of 2076 (47.3%) respondents, not acquired in 1894 (43.1%) respondents' departments and 406 (9.2%) respondents were unsure. Thirty two percent of those acquiring new videolaryngoscopes recorded receiving training (659/2069), seven did not answer the training question, 50.3% (1041/2069) stated that they did not need training as they were already familiar with the devices purchased and 17.8% (369/2069) received no training.

Discussion

Our results are based on the voluntary responses of 4392 clinicians and show an overall increase in videolaryngoscopy use when comparing use before and during the COVID-19 pandemic and at the point of submitting the survey (mostly towards the end of 2021).

Fig. 2 Sankey plots of frequency of videolaryngoscope use pre and following the COVID-19 pandemic by continent.



Videolaryngoscopy use pre and post the COVID-19 pandemic according to continent. Figures on the left represent pre-COVID-19 utilisation.

Whilst we found an increase in videolaryngoscope use of 34%, this represents an absolute increase of only 10 percentage points in self-reported routine videolaryngoscope use. The results of the INTUBE study (17% videolaryngoscope use)²⁸ support the initial low baseline, but the relatively small absolute increase at the point of survey completion is surprising. It is, however, mirrored in the Croatian institutional survey of videolaryngoscope use during the pandemic, where routine videolaryngoscope use rose from 16% to 21% on COVID wards,²⁹ and the survey of EAMS (European Airway Management Society) members which reported an increase in routine use of 12.5% to 38.9%.²⁵

Conversely, Granell Gil et al.'s survey of 1125 Spanish clinicians in the early phase of the pandemic (April/May 2020) reported that 70.5% of respondents would choose a videolaryngoscope to intubate COVID-19 patients.³⁰ This is much more in keeping with the findings of the intubate COVID study²⁴ where 76% of respondents reported a videolaryngoscope as their first choice device for intubation. These results imply that the initial large increase in videolaryngoscope use has not been sustained. It is difficult to speculate why this might be, especially as a 2017 Cochrane review had been published underlining the benefits of videolaryngoscopy,³¹ and their use was such a prominent feature of COVID airway management guidelines. 1–7

The intubate COVID registry reported results from 1718 participants,²⁴ the top five countries reporting data were all high-income countries (HIC). In our survey four of the top five countries were HIC. Canada and UK were common to both top five reporting groups. Whilst we used different survey populations, the shared income demographic means that this alone is unlikely to explain the difference in videolaryngoscope use between the two surveys.

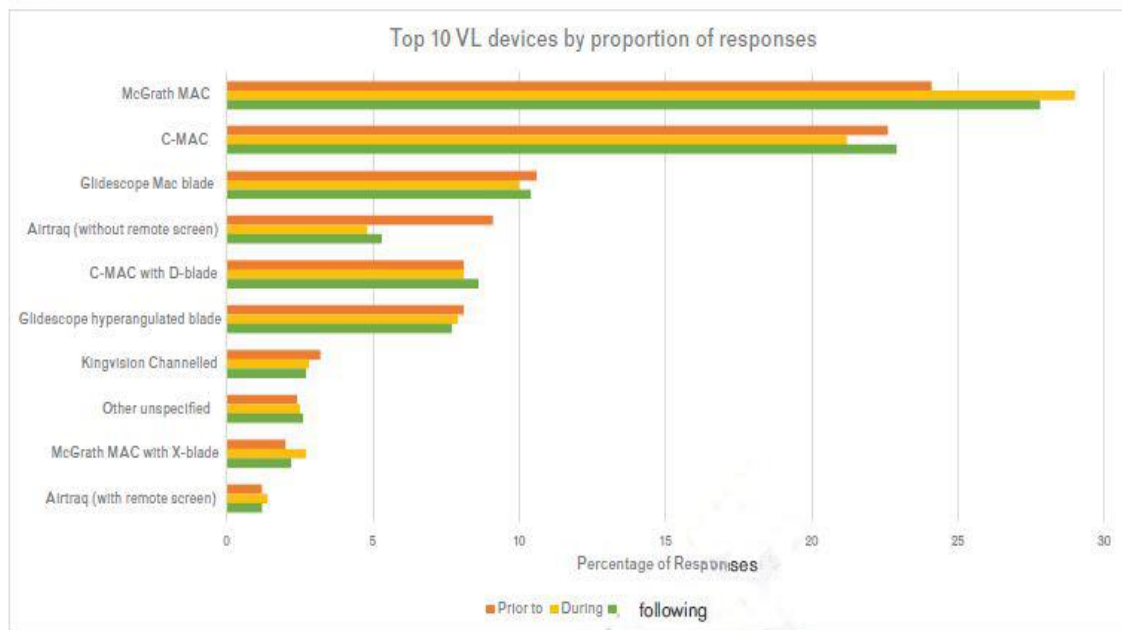
The pandemic increased videolaryngoscope use; this may in part have been due to the perceived decreased risk of viral transmission videolaryngoscopy afforded the operator.⁸ This was not sustained in airway managers' plans as the phases of the pandemic progressed, at least in part because of the downgrading of intubation as an aerosol generating procedure, the availability of vaccines, and the fact that, when 'normality' returned, the actual incidence of difficult airways out with the pandemic was low.³²

The answers from those 'never' using a videolaryngoscope cited wanting to retain skills in direct laryngoscopy as one reason. Similar results have been published previously when considering the potential loss of skills in flexible bronchoscopic intubation.³³ This reflects the findings in our 2019 single institution survey of videolaryngoscope use³⁴ and is despite the earlier published work by Cook et al.'s study.³⁵ In Cook's investigation, even the majority of trainees who had moved away from the study centre to other hospitals reported positive support for the impact of videolaryngoscopy on training.

Training for new devices has been recognised as important in delivering benefit,^{36,37} whilst a lack of training has been implicated in ineffective use of videolaryngoscopes.³⁸ Despite an increased availability of videolaryngoscopes reported in our survey, which might imply institutional support for their provision, 18% of those acquiring new devices reported that they had never been trained in their use, meaning that the benefit of videolaryngoscopy may not be effectively realised.

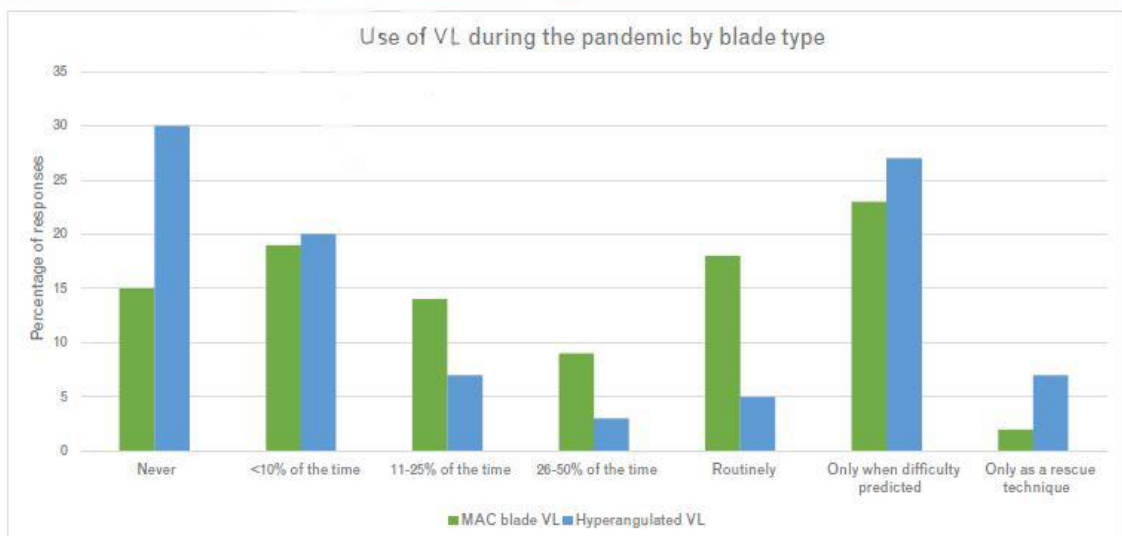
Carvalho's network meta-analysis found that the C-MAC and C-MAC D Blade were the top ranked devices for avoiding failed intubation but they could not differentiate between any two distinct videolaryngoscopes.³⁹ Our respondents favoured the McGrath MAC over the C-MAC(1st and 2nd) but we did not collect information on the drivers for this choice. Survey respondents reported favouring Macintosh like videolaryngoscopes in comparison to hyperangulated blades, although we did not investigate why people were more likely to choose one over the other. Possibly familiarity with a Macintosh type device, lack of experience or a perceived steeper learning curve to achieve successful intubation with a hyperangulated blade may be part of the reason for this. The most recent Cochrane review⁴⁰ reported that hyperangulated blades were specifically more likely to prevent oesophageal intubation than a conventional blade and were more likely to be effective when used on those with a known or predicted difficult airway, underlining the potential benefits of these type of blades.

Fig. 3 Preferred videolaryngoscopes prior to, peri and following COVID-19.



Number of responses to prior to COVID-19 question = 4247. Number of responses to during COVID-19 question = 4181. Number of responses to following COVID-19 question = 4183. Numerical data for this graph is shown in the supplementary material, <http://links.lww.com/EJA/A888>.

Fig. 4 Videolaryngoscope use during the pandemic according to blade type.

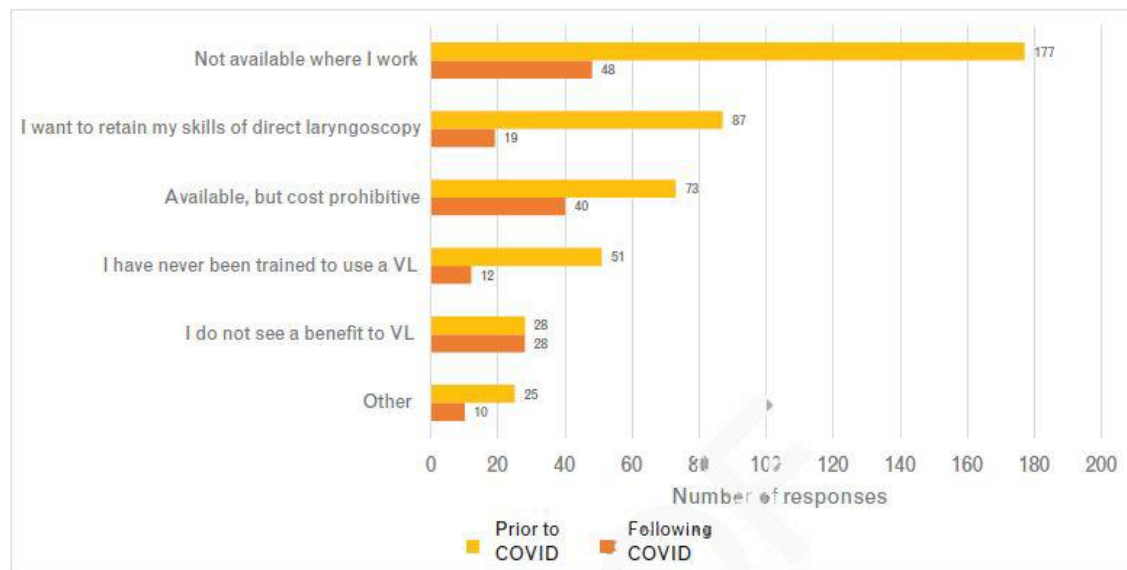


Frequency and choice of videolaryngoscope during the pandemic, according to blade type. Number of responses for MAC blade question = 4074. Number of responses for hyperangulated blade question = 3841.

Our study has several weaknesses. Questionnaires report the views only of those who chose to respond. We reached out to individual collaborators rather than societies. This was a pragmatic and opportunistic approach and is one of the potential weaknesses of our survey methodology. However, approaching every anaesthetic society formally would have delayed distribution and potentially compounded recall bias, discussed below. In view of the wide distribution, the potential for overlap of members between lists, and the method used, it was not possible to determine a survey denominator and therefore the response rate. Nevertheless,

we believe our respondents reflect global practices. In addition, we cannot tell how many people received a link to the survey but chose not to complete it. Another inherent limitation of such surveys is that the reliability of individual responses cannot be ensured. Our questionnaire also asked for frequency of use of certain devices and adjuncts which may be difficult to recall accurately. Given the timing of our study there is a potential for recall bias for pre-pandemic recollection; conducting the study at other points during the pandemic may have altered the results as the availability of devices may have changed as the pandemic unfolded.

Fig. 5 Reasons cited for never using a videolaryngoscope prior to and following the pandemic.



Reasons cited for never using a videolaryngoscope, for those answering Never. Multiple responses were possible. Number answering pre COVID question = 380. Number answering following COVID-19 question = 182.

We received responses from 96 countries, representing almost half of the countries in the world and including 148 responses from China and 508 from South America, highlighting the benefit of making the questionnaire available in multiple languages and distributing it through local societies even though this made calculating a denominator impossible. Fifty five percent of responses came from six countries representing four continents, 58 countries had fewer than 10 respondents, accounting for 196 responses overall. The geographical diversity of respondents is to be welcomed, but the small numbers from some nations may make extrapolation for individual countries more difficult, hence, our decision to provide Sankey charts by continent. Despite these weaknesses, we believe the large number of respondents with varying levels of experience in a survey with good worldwide representation, could fairly represent global practice.

Since our survey closed there have been four further significant developments in the available literature on videolaryngoscopy. The first, the updated Cochrane Review on Videolaryngoscopy,⁴⁰ emphasised the benefit of videolaryngoscopy in facilitating tracheal intubation. The 2022 revision of the review did not generate advice on individual device selection but it is likely that re-analysis of the data will do this in time. Similarly, in 2023 the

DEVICE trial was published clarifying the benefit of videolaryngoscopy use in the emergency department and intensive care unit.⁴¹

In August 2022, the Project for the Universal Management of the Airway (PUMA) produced guidance aimed at reducing the incidence of unrecognised oesophageal intubation.⁴² These non-COVID guidelines called explicitly for “Routine use of a videolaryngoscope. . . whenever feasible.” This supported the recommendation by the Canadian Airway Focus Group that a videolaryngoscope should be used to facilitate all tracheal intubations.⁴³ Ahmad acknowledged that despite the guidance, adoption of routine videolaryngoscopy would be hard; a difficulty which is supported by the relatively small increase in videolaryngoscopy use we report.⁴⁴ Finally, De Jong and colleagues demonstrated how routine videolaryngoscopy use could be increased from 0.27% to 66% as first intention device,⁴⁵ but this took three years, was associated with a widespread education programme and came from a centre with a reputation for research into videolaryngoscopy.⁴⁶

In conclusion, our survey showed that although videolaryngoscopy use increased by 34% compared to pre-pandemic levels, the absolute increase of only 10 percentage points is disappointing. Cook and Aziz concluded their editorial⁴⁷ by stating “Videolaryngoscopy is now a core component of modern airway management. Universal availability and training are required to achieve these goals.” However, if the evidence of two systematic reviews,^{16,40} a large RCT,³⁸ the recommendations of respected airway organisations^{9,42,43,48} and the experience of a pandemic have failed to achieve this, we fear universal videolaryngoscopy, despite its documented benefits, may be some way off.

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Conflict of interest:

AFMcN has received speaker's bureau fees from Medtronic on the subject of videolaryngoscopy and payments from Fisher and Paykel Healthcare for educational lectures and clinical advice on the subject of high flow nasal oxygen (Optiflow). He is an associate editor of the EJA.

PS reports receiving remuneration for presentations from Medtronic, Masimo and MSD.

ADeJ reports receiving remuneration for presentations from Medtronic, Drager, Viatrix and Fisher & Paykel.

Presentation: Preliminary data were presented at the Scottish Airway Group meeting (online; May 2022) and the Euroanaesthesia Symposia (Milan; June 2022). This manuscript was handled by Robert Greif.

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