Review Article

Implementation of default videolaryngoscopy instead of direct laryngoscopy for tracheal intubation: a narrative review of evidence and experiences

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Summary

Introduction Default videolaryngoscopy – use of a videolaryngoscope in preference to a direct laryngoscope – remains a hotly debated topic. High-risk tracheal intubations performed during the COVID-19 pandemic added to the extensive existing evidence of advantages of videolaryngoscopy for patients and staff. Despite this, and calls for implementation of default videolaryngoscopy, it has not been adopted widely.

Methods We summarise current evidence for the benefits of videolaryngoscopy and discuss (and where appropriate dispute) the common reasons given for not using videolaryngoscopy. The experiences of five UK NHS hospitals which have made a move to default videolaryngoscopy are described, with practical advice to assist other hospitals planning similar projects.

Results Several recent large randomised controlled trials and meta-analyses, incorporating data from over 200 trials, support the use of videolaryngoscopes. Guidelines and reports published since 2015 have recommended immediate access to videolaryngoscopes plus training and skill acquisition in the required techniques. Recent guidelines have recommended the routine use of videolaryngoscopes whenever possible. Reported advantages include: technical benefits (improved safety, efficacy and ease of tracheal intubation plus fewer complications); non-technical benefits (including improved teamwork and communication); improved direct laryngoscopy training; and environmental benefits. Reasons cited for not using a videolaryngoscope include concerns that they: are unnecessary; lead to decay in or failure to learn direct laryngoscopy skills; videolaryngoscopy failure; ineffectiveness in a soiled airway; cost; and challenges relating to decontamination of reusable blades. We discuss these and, where appropriate, provide counter arguments.

Discussion This narrative review provides the relevant evidence and information for clinicians, managers, procurement teams and sterile services departments to use, should a business case be proposed to implement default videolaryngoscopy. We describe effective practical strategies for addressing implementation challenges.

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Plain Language Summary may be found on PubMed and in the Supporting Information.

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Introduction

Direct laryngoscopy using a standard Macintosh laryngoscope has been the default technique for tracheal intubation since its invention by Robert Macintosh in 1943. However, there has been a shift in practice and opinion over the past decade, with increasing interest in the use of videolaryngoscopes based on the findings of randomised controlled trials and systematic reviews.

This narrative review aims to describe the current evidence base for videolaryngoscopy as a default technique. To be explicit, this means use of a videolaryngoscope in preference to direct laryngoscopy and is not a call for the use of videolaryngoscopy for all tracheal intubations. There will be circumstances where tracheal intubation is better achieved with use of a flexible bronchoscope, awake tracheostomy, cricothyroidotomy or other technique. When a Macintosh or straight blade videolaryngoscope is used, it may be used for videolaryngoscopy (i.e. using the view seen on the screen to facilitate tracheal intubation) or as a direct laryngoscope (when the screen is ignored); thus, both use a videolaryngoscope but only the former is videolaryngoscopy. Here, we try to distinguish these by describing the ´use of a videolaryngoscope´ and ´videolaryngoscopy´ as appropriate.

Despite increasing evidence for the advantages of using a videolaryngoscope, default videolaryngoscopy has not been adopted widely. This narrative review explores commonly cited reasons for this, discussing the evidence relevant to each issue. In addition, the main challenges to implementation are explored and strategies used successfully to drive this change in practice are described.

Multiple international guidelines and publications now recommend the use of videolaryngoscopes across a range of clinical settings. These include the Difficult Airway Society (DAS) guidelines 2015 [1]; DAS guidelines for tracheal intubation of patients who are critically ill (2018) [2]; COVID-19 airway guidelines (2020) [3]; Canadian airway guidelines (2021) [4]; International guidelines for the prevention of unrecognised oesophageal intubation (2023) [5]; Society for Obesity and Bariatric Anaesthesia guidelines [6]; European neonatal and paediatric guidelines (2024) [7]; British Association of Perinatal Medicine guidelines (2024) [8]; and guidelines for the management of suspected or confirmed traumatic spinal cord injury (2024) [9]. A Health Services Safety Investigations Body national report, compiled as a result of the death of a child following complications of airway management, recommended that videolaryngoscopes are used whenever possible [10]. More recent guidelines recommend the default use of videolaryngoscopy in preference to direct laryngoscopy [3–6, 9, 10]. No guideline that we are aware of recommends direct laryngoscopy in preference to videolaryngoscopy in any setting.

Methods

A literature search was performed using MEDLINE in March 2024 and updated on 26 March 2025, with limits set to papers published since 27 February 2021 (the date of the last search from a Cochrane review on videolaryngoscopy in 2022 [11]) and randomised controlled trials. Reference lists of each selected paper were also reviewed. Example search terms used are in online Supporting Information Appendix S1.

Results

Benefits of videolaryngoscopes

Technical benefits

Evidence of the technical benefits of videolaryngoscopes is widely published [11–16]. These include an improved view of the larynx [11, 14, 15, 17–20]; fewer failed tracheal intubations [11, 14, 20–22]; and improved first-pass tracheal intubation success [11, 14, 15, 18–26]. These benefits are seen alongside reductions in: oesophageal intubations [5, 11, 14–16, 24, 27]; hypoxic events [11, 14]; force applied to tissues [17]; soft tissue trauma [18, 28]; sore throat [28]; aspiration of gastric contents [24]; and dental injury [18, 28]. Videolaryngoscopy also led to the facilitation of a two-person two-step verbal tracheal intubation check [29, 30]. Meta-analysis indicates that the potential benefits are not marginal, but dramatic, with reductions of up to seven-fold in poor laryngeal views; at least two-fold reduction in tracheal intubation failure; up to a seven-fold reduction in hypoxaemia; and two-fold reduction in oesophageal intubation [12]. Thus, these benefits are not simply procedurally and statistically significant, but are clinically relevant and represent an opportunity to improve patient safety.

The evidence base supporting the use of videolaryngoscopes has grown recently, with major randomised controlled trials [19–23, 25, 26, 31–33] and meta-analyses [15, 18, 24, 34] showing benefit. Technical performance advantages have been shown for both experienced [15, 26, 33, 35] and inexperienced intubators [26, 36, 37] in adult patients, and also for the tracheal intubation of children [36, 38–40] and neonates [31–33]. Benefits have also been shown in settings outside of the operating theatre, such as the ICU [2, 23, 24] and emergency department [23, 41]. The evidence for

Table 1 Summary of recent large randomised controlled studies comparing videolaryngoscopy with direct laryngoscopy.

Study	Setting and country	Device comparison	Main outcomes	Main result
Kriege [19]	Adults undergoing anaesthesia n = 2092	McGrath Macintosh VL vs. Macintosh DL	FPS Laryngeal views Adverse events	McGrath VL increased FPS (94% vs. 82%, ARR 12.1%, 95%CI 10.9–13.6%) with 3-fold reduction in the risk of unsuccessful FPS (OR 0.34, 95%CI 0.26–0.45, $p < 0.001$) McGrath VL reduced Cormack and Lehane grade ≥ 3 views (0.7% vs. 8% $p < 0.001$) No significant difference in complications
Kriege [26]	Adults undergoing anaesthesia n = 1000	RCT of McGrath Macintosh VL vs. Macintosh DL during RSI	FPS Laryngeal views Adverse events.	McGrath VL increased FPS (94% vs. 72%, OR 1.31, 95%CI 1.23–1.39, $p < 0.001$) McGrath VL reduced grade ≥ 3 views (1% vs. 19%, $p < 0.001$) McGrath VL reduced complications (3% vs. 12%, $p < 0.001$)
Kohl [20]	Adults undergoing anaesthesia with predicted difficult airways n = 182	RCT of C-Mac D-blade vs. Macintosh DL	FPS Laryngeal view	FPS improved (97% vs. 67%, $p = 0.002$) Improved percentage of glottic opening (89% vs. 54%, $p < 0.001$)
Ruetzler [22]	Adults undergoing anaesthesia n = 8429	GlideScope hyperangulated VL vs. Macintosh DL	Tracheal intubation attempts Failure Adverse events	Glidescope VL reduced multiple attempts (1.7% vs. 7.6%, proportional OR 0.20, 95%CI 0.14–0.28, $p < 0.001$) and failed tracheal intubations (0.27% vs. 4.0%, RR 0.06, 95%CI 0.03–0.14, $p < 0.001$) with no change in adverse outcomes (0.93% vs. 1.1%)
Prekker [23]	Adults in the emergency department n = 1417	VL (device not standardised) vs. Macintosh DL	FPS Severe complications	VL increased FPS (85% vs. 71%, absolute risk difference 14.3%, 95%CI 9.9–18.7, $p < 0.001$) without reduction in severe complications (21.4% vs. 20.9%). Trial stopped at interim analysis for efficacy VL had greater efficacy for all users except those with considerable DL experience (> 200 used) combined with very limited (< 20%) videolaryngoscopy experience

ARR, absolute risk reduction; DL, direct laryngoscopy; FPS, first-pass success; OR, odds ratio; RCT, randomised controlled trial; RR, relative risk; VL, videolaryngoscopy.

prehospital emergency medicine remains heterogeneous but generally positive [13].

Evidence for technical benefits from recent large studies

In the last two years, several large high-quality studies of videolaryngoscopy have been published [19, 20, 22, 23, 26] (Table 1), but are too recent to have been included in meta-analyses published to date. The studies provide data from approximately 13,000 patients, both in and outside the operating theatre.

De Jong et al. introduced the McGrath Macintosh videolaryngoscope (Medtronic Ltd., Dublin, Ireland) as a "*first-intention device for tracheal intubation*" in a hospital in France, comparing this with a control hospital where no change was made [21]. Using data from around 12,000 tracheal intubations, "*easy airway management*" increased in the study hospital from 94% to 99%, an increase of 4.4% (95%CI 3.7–5.1%, $p < 0.001$). In contrast, no performance improvements were seen during the same period in the control hospital. Further, all secondary outcome measures also favoured videolaryngoscopy. Of note, compliance with default videolaryngoscopy rose only to around 55% for much of the evaluation period, before then climbing to > 90% during the COVID-19 pandemic [21]. These findings are consistent with a previous observational study of 17,583 emergency tracheal intubations from the National Emergency Airway Registry [41], which reported an increased use of videolaryngoscopy from 1% to 27% over 3 years and an increase in first-pass success rates from 80% to 86% (risk difference 6.2%, 95% CI 4.2%–7.8%) over the same period.

Taboada et al. compared the process and complications of tracheal intubation in around 2500 patients before and after implementing default videolaryngoscopy, with rates of videolaryngoscope use rising from 6.9% to 100% [42]. Default videolaryngoscopy was associated with statistically significant improvements in easy tracheal intubation and laryngoscopy, with reduced rates of adjunct use, change in operator, change in device and complications. The likelihood of easy tracheal intubation (good laryngeal view, first-attempt success and no use of an adjunct) increased 2.4-fold.

Non-technical benefits

Non-technical advantages include creation of a `shared airway´, where, if using a videolaryngoscope with a separate screen, the whole team observe the laryngoscopy view [30, 33, 38, 43–46]. Reported benefits of this include: improving team work and communication [43–48]; facilitating a `shared mental model´ [30, 37, 47, 48]; improving team anticipation of `the next step´ of the tracheal intubation process [43, 44]; enabling an early call for help if necessary [43, 44]; reducing mental workload [13, 49, 50]; improving situation awareness [47, 51]; freeing up the cognitive capacity of the intubating team [13, 30, 47–51]; improving reaction times [49]; and reducing cognitive bias [30, 51].

Teaching and training benefits

The benefits for teaching direct laryngoscopy by using videolaryngoscopy with a Macintosh blade have been shown in several studies [46, 52–60]. Advantages have been described for learners at all stages of training. Novice intubators benefit from the trainer being able to show laryngeal structures on the videolaryngoscope screen and provide coaching in real-time [28, 38, 46, 51, 61, 62]. Intermediate trainees are able to intubate the trachea using direct laryngoscopy while the trainer can observe on the videolaryngoscope screen [28, 38, 51, 61, 62], enabling *``graded independence´´* [38]. Experienced trainee intubators are able to undertake more complex tracheal intubations under supervision. These intubators are more likely to complete tracheal intubation without the trainer taking over, with videolaryngoscopy enabling the trainer to provide continuous monitoring for patient safety and provide coaching in real time [28, 38, 51, 61, 62]. Training advantages have been established for intubators of adult patients [37, 45, 46, 52–54, 57–60] and children [38, 53], and for training intubator assistants [44, 51, 56, 59]. Videolaryngoscopy reduces trainer cognitive load and stress levels [38, 49, 50]. Of note, many of these training benefits are maximised by use of a videolaryngoscopy system with a large separate screen rather than a small integrated screen.

Videolaryngoscopy may address ethical concerns relating to tracheal intubation training by allowing the trainer to continuously and directly observe the videolaryngoscope blade and tracheal tube placement on the videolaryngoscope screen, coach or intervene as necessary to optimise success and prevent any potential patient harm [63].

Other benefits

The environmental advantages of using reusable videolaryngoscope blades rather than single-use standard Macintosh laryngoscopes and blades are of increasing interest [64], with one hospital reducing its laryngoscope-related carbon footprint by 73% with this change in practice [64].

The use of personal protective equipment during tracheal intubation to prevent transmission of airborne infections [3] is associated with difficulty [3, 65–68]. This has been shown to be mitigated by the use of a videolaryngoscope [47, 65–68]. Rapid sequence induction is also associated with reduced first-pass tracheal intubation success and increased rates of failed tracheal intubation [26, 69], and mitigation of these challenges has been reported by videolaryngoscope use [26, 69]. Videolaryngoscopy enables the intubator's assistant to optimise the application of cricoid force [30, 44–46, 59] and/or apply external laryngeal manipulation if required.

Musculoskeletal benefits for intubators using a videolaryngoscope have been described, including improved posture and likely reduced muscular strain on the neck, shoulder and back [48, 70]. The efficacy of laryngeal nerve neuromuscular monitoring for thyroid surgery is improved by tracheal tube placement using videolaryngoscopy [71].

Clinicians' concerns regarding videolaryngoscopy

Despite these described advantages, guidelines and recommendations, many clinicians continue to express reservations about a switch to default videolaryngoscopy [12, 15, 72–74] (Fig. 1). We list these concerns and address them in turn.

Concern 1: Modern day airway management is safe and videolaryngoscopes are not needed for a patient whose airway is predicted to be straightforward

The fact that most airway management is uncomplicated and safe has been used as an argument against the use of

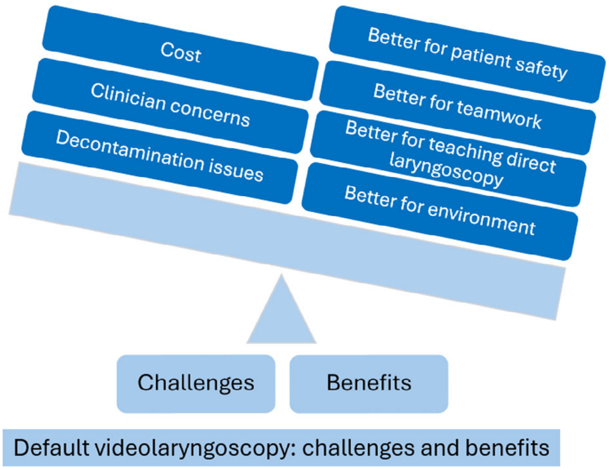

Figure 1 Main advantages of implementing default videolaryngoscopy, plus commonly cited clinician concerns about such a change in practice.

videolaryngoscopy [45, 72]. However, tracheal intubation is a procedure with potential for infrequent but very serious patient harm [13, 16, 28, 36, 75]. Bedside tests to predict airway difficulty are unreliable [76, 77]. Multiple tracheal intubation attempts are associated with increasing complications with each attempt [28, 36, 78–81], and first-attempt tracheal intubation success without complications is at a premium. The infrequency of serious airway adverse events makes it difficult to analyse morbidity and mortality in airway management [16]. The fact that airway device efficacy studies are often restricted to low-risk settings and patients means that they are a poor tool to study such events [16, 82, 83].

A wealth of contemporary evidence points towards ongoing airway-related patient harm and avoidable deaths. Numerous airway deaths have occurred in patients with predicted straightforward airways [5, 13, 84–91] and cared for by experienced clinicians [5, 10, 13, 84–91], with guidelines and reports subsequently recommending the use of default videolaryngoscopy as a strategy to prevent future similar deaths. Four Regulation 28 Prevention of Future Death reports have been issued to the Royal College of Anaesthetists since 2015 [84–86, 91]. In the absence of a national confidential inquiry or registry of airway deaths [92], it is likely that the extent of these tragedies is both unknown and underestimated [16, 93].

Almost half of all cases reported to the 4th National Audit Project (NAP4) of the Royal College of Anaesthetists and Difficult Airway Society [75] involved complications of airway management that followed primary problems with tracheal intubation [28, 75]. In 2023, NAP7 reported that 13% of peri-operative cardiac arrests and 9% of related deaths were due to airway and respiratory causes [94]. Reports of harm from unrecognised oesophageal intubation increased between NAP4 and NAP7, and clinical tests traditionally used to confirm tracheal intubation have been shown to be inaccurate [95], with videolaryngoscopy at least a partial solution to this problem [16, 29, 30, 78, 94]. An analysis of litigation against anaesthetists in the UK, published in 2022, reported that the claims related to airway management had proportionately increased in the previous decade and accounted for 9% of all claims, but these were associated with claims with poor outcomes (58% severe or fatal outcomes), high costs and accounted for 31% of claims-related deaths [96].

These data reveal that patient harm from airway management continues [13, 16, 29, 84–91, 93] and that avoidable deaths occur [16, 85–87, 92, 94]. Default videolaryngoscopy can counter these risks by: improving first-attempt tracheal intubation success [11, 13, 16, 23, 25, 28, 36, 40]; minimising multiple tracheal intubation attempts [11, 13, 14, 16, 21, 28, 39]; reducing complications [13, 16, 21, 27, 28, 38, 61, 97] including hypoxaemia [11, 14] and oesophageal intubation [11, 14, 16, 24, 27]; and can avoid escalation from a `cannot intubate, *can* oxygenate´ situation to a `cannot intubate, *cannot* oxygenate´ situation [28, 51, 61, 97]. Further, when a videolaryngoscope is used routinely, the rescue intubating device is always immediately available [13, 45, 50, 51, 61, 97]; staff rapidly become familiar and then proficient in its use [13, 45, 47, 48, 50, 51, 97]; standardisation of equipment is improved [45, 47, 48, 51, 97]; and choice of equipment at the point-of-care is reduced, facilitating transition through airway algorithms [47, 48, 51, 97]. All of these are potentially beneficial in improving ´institutional´ and ´personal preparedness´ [45, 47, 48, 97]. This will reduce staff cognitive load in high pressure situations [47, 48, 51]; improve individual and team performance (due to reduced chance of staff moving into a zone of ´frazzle´ or even ´freeze´ [47, 48, 51]); and improve overall safety [47, 48, 51].

Concern 2: Using videolaryngoscopes for all tracheal intubations will result in a whole generation of clinicians never learning direct laryngoscopy skills

Contrary to this view [72, 74], teaching direct laryngoscopy using a Macintosh videolaryngoscope has been shown in multiple studies to be more effective than teaching with direct laryngoscopy as described above [37, 46, 52–60]. A recent meta-analysis confirms this, showing teaching direct laryngoscopy by means of videolaryngoscopy improved first-attempt tracheal intubation success rates in adults and children [98]. In contrast, teaching direct laryngoscopy while the trainee intubator uses a standard Macintosh laryngoscope has been described as ``*teaching to intubate while wearing a blindfold*´´ [51]. Using a videolaryngoscope with both Macintosh and hyperangulated blades allows intubators to learn the technique for both direct and videolaryngoscopy [38, 62]. Two training algorithms have been described [62, 73].

Following the implementation of default videolaryngoscopy in one NHS hospital (Bath, UK), resident anaesthetists were surveyed 8 months after the 2-month default videolaryngoscopy trial [61]. Although 24/26 of resident anaesthetists had opposed a change to default videolaryngoscopy before it happened, due to concerns about the impact on their training, 8 months later 16/19 reported that their airway training had been improved by intensive exposure to videolaryngoscopes, 3/19 were neutral, none reported a detrimental impact on their training and 18/19 were fully supportive of a move to default videolaryngoscopy [61].

Concern 3: Videolaryngoscopy will result in a decay of my direct laryngoscopy skills

Although some authors voice this concern [74], we are not aware of any studies that have formally explored whether routine use of videolaryngoscopy leads to loss of direct laryngoscopy skills. Of note, use of a Macintosh videolaryngoscope allows performance of direct laryngoscopy, and therefore maintenance of that skill if the user so chooses. In a recent case series, 787/994 (79%) of tracheal intubations with a Macintosh videolaryngoscope included at least some attempt at direct laryngoscopy [69], supporting the view that videolaryngoscope use does not prevent the intubator from undertaking direct laryngoscopy.

Setting operator skills to one side, there is a strong ethical argument that safe patient care should take priority over clinical skill retention [13, 16, 62, 63]. Similar arguments about loss of operator skill occurred when laryngeal masks were introduced [99, 100], and when the routine use of ultrasound was recommended for guiding central venous catheter insertion [46, 101] and regional anaesthesia blocks [102].

Concern 4: Videolaryngoscopes fail in a soiled airway

Concerns have been raised that a videolaryngoscope camera may become obscured when the airway is soiled by blood or gastric contents, making videolaryngoscopy ineffective [28, 74, 76, 103]. While this is possible, it appears to be uncommon [103]. Sakles et al. examined the impact of a soiled airway on first-pass tracheal intubation success with video- and direct laryngoscopy in 1985 patients in the emergency department, 590 of whom had a soiled airway [103]. First-pass tracheal intubation success in clean airways was 91% with videolaryngoscopy and 75% with direct laryngoscopy, whereas in soiled airways success rates fell to 81% and 65%, respectively. Videolaryngoscopy therefore maintained its 14% absolute benefit and its relative success rate increased [103]. Taboada et al., in a study of around 5000 patients in the operating theatre, reported that implementation of default videolaryngoscopy reduced views obscured by a soiled airway from 2.3% to 1.6% [42].

Concern 5: A hyperangulated videolaryngoscope blade gives an excellent view of the larynx but tracheal intubation may still be problematic

This opinion was expressed commonly when videolaryngoscopes were introduced [28, 34, 73]. It is now recognised widely that the technique for using a hyperangulated videolaryngoscope (HAVL) is necessarily different to that for direct or videolaryngoscopy using a Macintosh blade [13, 25, 30, 34, 61, 62, 103–107]. Several techniques have been described [108] but no single technique has been proven to be optimal. It is widely accepted that the chosen technique needs to be learned, practised and perfected as a team [13, 25, 30, 103–107]. The use of a stylet is reported to improve success when intubating the trachea with a HAVL [25, 62, 103, 109], and failure to use a stylet, ineffective stylet technique or poor stylet design may explain failure of tracheal tube delivery [25, 109]. While a recent study found a benefit for use of a bougie rather than a stylet with HAVL [110], this study was criticised [109] and a subsequent manikin study reported that both stylets and dynamic bougies outperformed a static bougie, with benefit increased when tracheal intubation was difficult [111]. Further research investigating optimal HAVL tracheal intubation technique and effective adjuncts is needed [107, 112].

Studies investigating the number of HAVL tracheal intubations that are needed to gain expertise have had variable findings. Cortellazzi et al. reported that expertise is acquired after 76 tracheal intubations with a GlideScope HAVL (Verathon Inc., Bothell, WA, USA) [106]; Ott et al. reported proficiency with a GlideScope HAVL after 12 tracheal intubations [113]; and Penders et al. reported that proficiency was acquired after 10 tracheal intubations with a C-MAC D blade (Karl Storz, Tuttlingen, Germany) [69]. Failure to convert a good view at laryngoscopy with a HAVL into an easy tracheal intubation is, in many cases, an issue with intubator technique rather than device performance [13, 16, 34, 62, 109]. This is readily overcome by training and routine use.

Concern 6: Videolaryngoscopy can fail and need to be rescued by using direct laryngoscopy

There is a concern that the videolaryngoscopic tracheal intubation process may fail [72, 74], but two issues warrant consideration. First, the incidence of tracheal intubation failure with videolaryngoscopy is much lower than with direct laryngoscopy. In the most recent Cochrane review, rates of failed tracheal intubation were reduced when using both Macintosh videolaryngoscopes (RR 0.41, 95%CI 0.26–0.65, 41 studies, 4615 participants) and HAVL (RR 0.51, 95%CI 0.34–0.76, 63 studies, 7146 participants) when compared with a direct laryngoscope [11]. In the DEVICE study, failed tracheal intubation occurred at least twice as often with direct than with videolaryngoscopy, irrespective of blade design [23], and in the largest ever randomised controlled trial of videolaryngoscopy by Reutzler et al., failed tracheal intubation occurred 15 times more often with direct laryngoscopy [22].

Second, multiple case series have been published where videolaryngoscopy was used to rescue failed direct laryngoscopy, with success rates ranging between 80% and 100% [102, 114–118]. Conversely, direct laryngoscopy has been used in far fewer reported cases to rescue failed videolaryngoscopy, and when these did occur, advanced techniques were commonly required. In one large series, videolaryngoscopy succeeded in rescuing failed direct laryngoscopy in 94% of cases, while direct laryngoscopy succeeded in rescuing failed videolaryngoscopy in 47% of cases [114].

Concern 7: Videolaryngoscopes are unreliable devices that can fail and need to be rescued by using a standard Macintosh laryngoscope

Concerns regarding videolaryngoscope device failure include: power supply failure; battery failure; and poor lead connection [72]. However, published data suggest that these are uncommon [69]. One study enrolling 1417 patients found that device failure of a direct laryngoscope occurred twice as often when compared with a videolaryngoscope (0.6% vs. 0.3%) [23].

Concern 8: It's safer to stick to the standard Macintosh laryngoscope that I know and trust

While this opinion has been voiced in the literature [72], others have dismissed this as being largely an issue of training [13, 16, 50, 77, 105]. Experienced clinicians report that their direct laryngoscopy skills, perfected by using a standard Macintosh laryngoscope over many years of practice, are highly transferable and can be used to undertake tracheal intubation using a Macintosh videolaryngoscope [13, 61, 69].

The technique for using a videolaryngoscope with a hyperangulated blade is different as discussed above [13, 25, 31, 62, 104–106], but this can be taught easily in out-of-theatre airway workshops [30, 69, 119], tea trolley training [104, 120] and in-theatre training. The hyperangulated blade results in an improved view of the larynx [11, 13, 14, 28, 30, 36, 104–106] and improved tracheal intubation success [11, 13, 14, 21, 36], with laryngeal view being better than the direct laryngoscopy view in around 90% of cases [36, 69]. Airway training for all teams involved in tracheal intubation is recommended in national guidelines [1–3, 5, 121], with recent calls for this to become mandatory [30, 47, 93, 122].

With the weight of evidence for the technical and non-technical benefits of videolaryngoscopy, combined with the unpredictability of tracheal intubation failure, oesophageal intubation and patient harm, it is difficult to present a robust patient-centred argument for being a skilled airway manager without having developed the skills needed to use a videolaryngoscope [13, 16, 105]. We argue that expertise in Macintosh videolaryngoscopy and skill with a HAVL are core contemporary airway skills [12, 13, 16, 105].

Concern 9: Videolaryngoscopes are expensive and not always available in my hospital

This is a significant issue for those working in low- and middle-income countries [12]. However, in high-income settings, current opinion suggests that this is a question of operational choice and institutional preparedness [12, 35, 47, 48, 61, 97]. Anaesthesia is traditionally a low-cost hospital specialty, with anaesthetic equipment generally being significantly less expensive than that used by surgical colleagues. One example often quoted is that the cost of equipping a hospital with videolaryngoscopes is equivalent to the cost of purchasing one surgical robot.

When considering the financial implications of a move to default videolaryngoscopy, it is important to examine all costs associated with tracheal intubation, as the difference between using videolaryngoscopes and standard Macintosh laryngoscopes may be less than anticipated due to `savings downstream´ [12, 21, 45, 61]. `Hidden´ savings associated with videolaryngoscope use include: fewer difficult and failed tracheal intubations with subsequent reduced use of airway rescue devices such as Aintree catheters and flexible bronchoscopes [13, 21, 114]; reduced delays to operating lists and cancellation of operations; fewer ICU admissions following airway emergencies; reduced emergency front of neck airways (eFONAs); and less litigation. Some of the most costly legal claims against anaesthetists are those associated with airway-related harm, usually related to complications of tracheal intubation with poor outcomes [96, 123]. Litigation is an important concern but is perhaps only a surrogate of the unquantifiable burden of suffering experienced by a patient, family and staff involved in an airway catastrophe [16, 93] and the reputational cost to a department or hospital [61].

The cost of decontaminating one reusable videolaryngoscope blade is approximately £2.50 ($3.24, €2.88) per tracheal intubation. By comparison, it costs £5–6 ($6.31–$7.57, €5.76–€6.91) per tracheal intubation to decontaminate a reusable standard Macintosh blade plus handle (personal communication, Mr S. Joseph, Royal United Hospital, Bath) or to purchase a single-use standard Macintosh laryngoscope. These financial calculations do not factor in the environmental costs of transport, disposal and waste of multiple single-use devices and their batteries. The main advantages of implementing default videolaryngoscopy, plus commonly cited clinician concerns about such a change in practice, are summarised in Fig. 1.

Practical experience of implementation of default videolaryngoscopy in UK hospitals

Royal United Hospital, Bath

Implementation of default videolaryngoscopy occurred in 2017, with change prompted by the need to replace all standard Macintosh laryngoscopes and a business case based on improved patient safety [61]. A 2-month pilot study, using a loan set of videolaryngoscopes, resulted in a significant swing in opinion among tracheal intubators and intubation assistants (Fig. 2) [61]. A clinical evaluation exercise was used to choose a videolaryngoscope with the following attributes: reusable blades (superior quality, improved technical performance and environmental advantages) [61]; both Macintosh-shaped blades (for every day use) and hyperangulated blades (for anticipated difficulty and as a rescue device), with the ability to switch rapidly between the two [61]; and a screen separate from the blade, to benefit the whole intubating team by seeing the view at laryngoscopy and to facilitate learning [61].

Decontamination of blades, by thermal disinfection at 93°C, now occurs in the Central Sterile Services Department

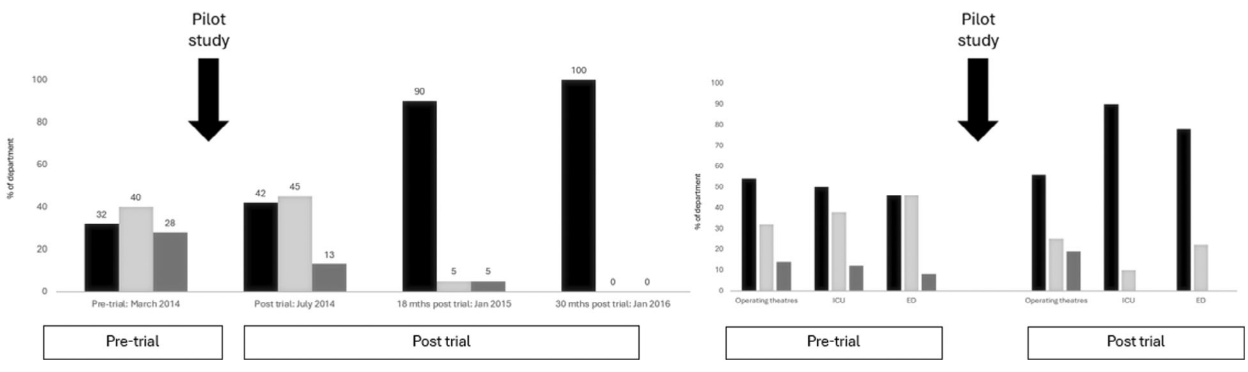

Figure 2 Anaesthetic departmental surveys regarding the pilot study of default videolaryngoscopy in Bath and Reading showing a rise in support for the project following a 2-month pilot of using videolaryngoscopes for all tracheal intubations. Data labels indicate the proportion of respondents supportive of a change to videolaryngoscopy: black, fully supportive; light grey, partially supportive; dark grey, not supportive.

(CSSD) – one floor down from the main operating theatre complex – to enable compliance with national infection control guidelines [124], ensure standardised processes and packaging and optimise tracking and traceability. The turnaround time, including transport to and from operating theatres to CSSD, is approximately 3 h. Non-bladed components are decontaminated using Clinell™ antimicrobial wipes (Gama Healthcare Ltd, Hemel Hempstead, UK).

All adult tracheal intubations in operating theatres, ICU, the emergency department and on the wards have been undertaken using videolaryngoscopes since 2017, and most since 2015. All paediatric tracheal intubations are now undertaken using videolaryngoscopes. Data from 1099 tracheal intubations performed between March 2020 and March 2022 showed high levels of tracheal intubation success (100%); high first-pass tracheal intubation success rates (87.3% overall and 92% with a hyperangulated videolaryngoscope); high first-pass success without complications (87%); low oesophageal intubation rate (0.2%); and low frequency of complications associated with tracheal intubations (0.6%) [69].

University Hospital of Wales, Cardiff

Default videolaryngoscopy was introduced in 2023. The drivers for this were patient safety; infection control standards [124, 125]; and four sustainability policies, including the NHS net zero policy [126], the Public Health Wales decarbonisation and sustainability plan [127, 128] and the Wellbeing of Future Generations Act Wales [129].

New infection control guidelines [124] mandated that laryngoscope blades and handles should be single-use or suitable for fully automated decontamination, necessitating an equipment upgrade. A move to single-use laryngoscopes would have resulted in the disposal of approximately 10,000 laryngoscopes (including bulbs, batteries and plastic components) every year. Life cycle assessments were undertaken for a single-use direct laryngoscope, a single-use videolaryngoscope and a reusable videolaryngoscope, with the last option predicted to reduce carbon emissions by 73% compared with the first option [64].

The videolaryngoscopes are decontaminated in a dedicated sterile services unit located within the main operating theatre suite, with a team of six staff and a turnaround time of approximately 30 min. An ozone drying machine and storage system is used, with decontaminated blades stored in 'Typhoon bags' (Pentax Medical, Slough, UK) enabling them to be kept clean, dry and ready to use for 30 days. Repeated life cycle assessments since implementation have showed a 67% reduction in carbon emissions compared with the previous years.

Royal Berkshire Hospital, Reading

Videolaryngoscopes were made available for all tracheal intubations across operating theatres, ICU and the emergency department in 2019. A set of loan videolaryngoscopes was acquired, and, following 2 months of familiarisation and training, these were used for all tracheal intubations for a trial period. A rise in departmental support for this change in practice was seen after this trial period (Fig. 2), and the business case – based on patient safety advantages – was approved in 2020.

Both reusable and single-use videolaryngoscope blades were procured. The reusable blades are decontaminated off-site and as a result the turnaround time is approximately 24 h. The single-use videolaryngoscope blades have not proved popular with clinicians due to their bulky shape and adverse environmental impact. As a result, and due to damage to many reusable blades, only 60% of tracheal intubations are currently performed using a videolaryngoscope.

Royal Liverpool University Hospital, Liverpool

A change from using single-use standard Macintosh laryngoscopes to a videolaryngoscope with a reusable handle, integral screen and a disposable plastic blade was implemented in 2022. This videolaryngoscope was already in place across all hospital difficult airway trolleys and additional staff training was therefore not required. The successful business case was based on the significant cost savings that the change was projected to generate, plus improved patient safety and sustainability. The business case showed that the investment in videolaryngoscopes would be recouped after one year and subsequently generate an ongoing annual saving of approximately £60,000 ($71,558, €69,114), based on prices in 2022.

Ninewells Hospital and Medical School, Dundee

Hyperangulated blade videolaryngoscopes were introduced in Tayside in 2008 and initially only used by airway enthusiasts. In 2012, a Macintosh videolaryngoscope made by the same Scottish manufacturer became available, and a business case to provide videolaryngoscopes in all operating theatres, ICU and the emergency and radiology departments was approved.

There were initially mixed views across the anaesthetic department, with a degree of scepticism from some senior

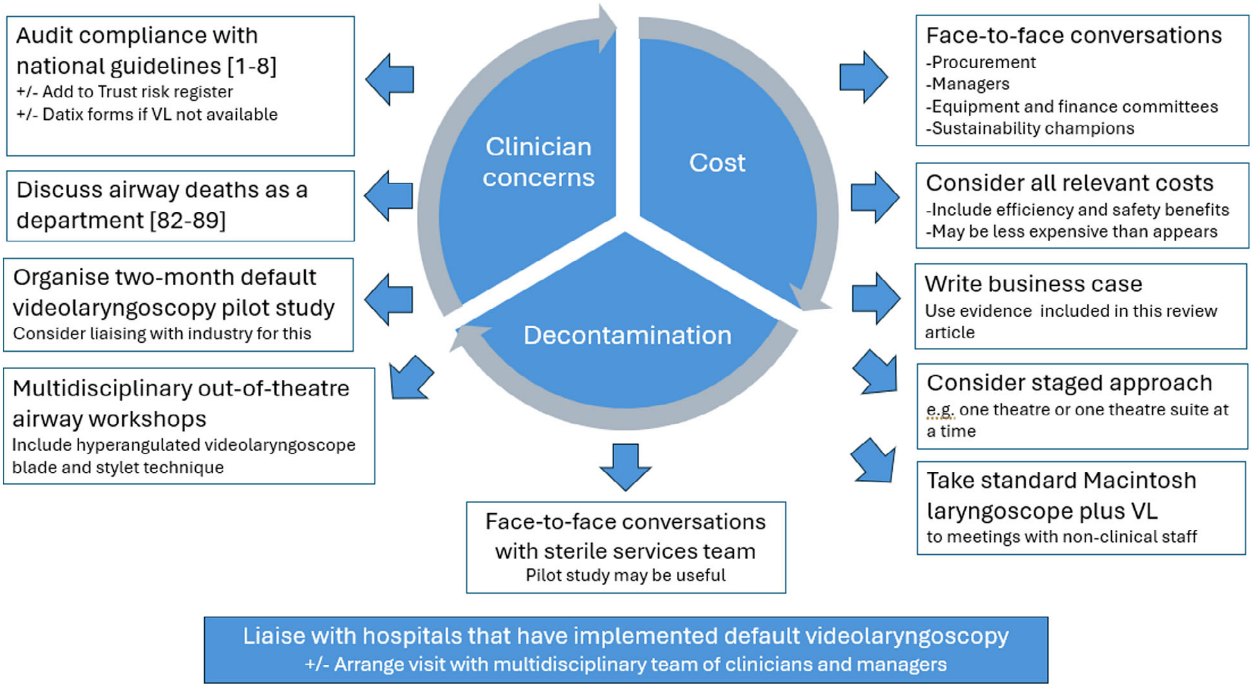

Figure 3 Implementation of default videolaryngoscopy. Common themes encountered and practical advice and strategies recommended by five UK hospitals that have made such a change in practice. VL, videolaryngoscope.

anaesthetists primarily related to potential loss of direct laryngoscopy skills. It was therefore decided to provide `universal videolaryngoscope availability´ rather than mandating their use for all tracheal intubations, with the hope that this would allow adoption through education and sharing of evidence, and enable members of the department to see their benefits for themselves.

Use of the Macintosh videolaryngoscopes increased steadily, starting from 17% of all tracheal intubations in the first data collection period, reaching 57% after 2 years, 67% after 5 years and now exceeding 90% of all tracheal intubations on all sites. Macintosh videolaryngoscopes are now the default tracheal intubation device and are used for all tracheal intubations by novice anaesthetists.

A device with a disposable blade or disposable sheath over a fixed, curved baton and an integral screen was chosen. Disinfection is provided by sheath disposal and on-site wiping of the reusable handle/baton (as agreed by the manufacturer and local policy).

Implementation issues and strategies

Commonly occurring themes encountered during implementation by these five UK hospitals included: addressing clinician concerns; cost implications; and the practicalities of reusable videolaryngoscope blade decontamination. These themes, plus practical advice and strategies from clinicians in these hospitals, are summarised in Figure 3 and outlined in online Supporting Information Appendix S2. Guidelines and recommendations are only as effective as their uptake and implementation [130]. Clinicians are likely to benefit from working with implementation scientists and we believe that this is an area worth exploring further. More details of these projects are outlined in online Supporting Information Appendix S3.

The burden of proof no longer lies with those who want to change

The data indicating videolaryngoscope benefits has resulted in many calls for the debate over efficacy to now stop [12, 13, 15, 16, 35, 62, 105]. Guidelines are increasingly adopting a `videolaryngoscopy first´ approach and the realm in which videolaryngoscopy is not recommended is becoming ever smaller. Continuing to choose to use a standard Macintosh laryngoscope can be argued to be a clinician-focused strategy rather than a patient-centred one [13, 16, 62, 105]. Some authors have called for clinicians to consider what is better for our patients [12, 16, 35, 51, 62], and what a patient would choose if they were able to do so, informed by evidence [13, 16]. The era of `heroic healthcare´ is long gone, and we are now in one of shared decision-making in which clinicians act as expert and experienced advocates on behalf of the best interests of our patients [16].

There is an argument for the focus of research and debate to move from `whether to use a videolaryngoscope´ to `which videolaryngoscope(s) performs best´ [12–15, 28, 34, 131–133]. Evidence in the literature establishes that not all videolaryngoscopes perform equally [13, 34, 36, 131–136], with blade geometry, blade bulk, light intensity, image quality and viewing angle altering performance [13, 15, 33, 34, 131, 133, 134]. Reusable devices tend to be of better quality and lower bulk than single-use devices, and therefore are likely to perform better [13, 61, 131] but there are no formal evaluations of this. A videolaryngoscope with a screen separate from the videolaryngoscope blade enables multiple people to be involved with tracheal intubation, and although this `shared airway´ might be expected to have significant benefits [28–30, 38, 43, 45–47, 132], this not been formally studied [13].

In conclusion, videolaryngoscopes have been shown to have greater efficacy and provide technical and non-technical benefits that enhance safety and ease of tracheal intubation. Their use has potential benefits in terms of human factors, sustainability and education. The evidence base is now sufficiently strong to prompt many to call for the debate concerning `whether to use a videolaryngoscope´ to stop and move onto discussions and research focusing on `which videolaryngoscope design or blade performs best.´ Cost implications of a move to default videolaryngoscopy use appear challenging, but on full analysis the differences are not as marked as initially suspected. An increasing number of UK hospitals have used patient safety and sustainability as major drivers for business cases, and ongoing deaths from unrecognised oesophageal intubation may drive more hospitals to follow.

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The anaesthetic department at Royal United Hospital, Bath, has received free or at cost airway equipment from several airway device manufacturers for evaluation or research purposes. This includes several manufacturers of videolaryngoscopes. The videolaryngoscopes used in the evaluation were purchased by the hospital in which the service evaluation took place. Cardiff and Vale University Health Board has been loaned equipment for airway workshops, plus two videolaryngoscope systems during the COVID-19 pandemic. Royal Berkshire Hospital, Reading has received free loan airway equipment for evaluation purposes. Liverpool University Hospitals Foundation Trust has received free airway equipment from several device manufacturers for research purposes, including a manufacturer of videolaryngoscopes, different from the device they now use. Ninewells Hospital, Dundee has received loan equipment from Aircraft Medical Ltd. BM has received honoraria from Medtronic for his contributions to symposia on videolaryngoscopy. No other competing interests declared.

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Supporting Information

Additional supporting information may be found online via the journal website.

Plain Language Summary.

Appendix S1. Example search terms.

Appendix S2. Practical advice for hospitals keen to implement videolaryngoscopy for all intubations.

Appendix S3. Practical experience of implementation of default videolaryngoscopy in UK hospitals – further details.