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Systematic review

The Impact of Video Laryngoscopy Versus Direct Laryngoscopy on First-Pass Intubation Success Rates in the Intensive Care Unit: A Systematic Review

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Abstract

Background: Endotracheal intubation in the intensive care unit is a high-risk procedure because critically ill patients frequently have hypoxemia, shock, acidosis, full stomach risk, limited physiologic reserve, and urgent airway indications. First-pass intubation success is clinically important because repeated laryngoscopy attempts increase airway trauma, oxygen desaturation, aspiration risk, esophageal intubation, and hemodynamic deterioration. Video laryngoscopy improves indirect glottic visualization, while direct laryngoscopy remains widely used because of cost, availability, familiarity, and speed in trained hands. **Objective:** This systematic review evaluated the impact of video laryngoscopy compared with direct laryngoscopy on first-pass intubation success in adult intensive care unit patients. **Methods:** A PRISMA-guided systematic review framework was used. PubMed/MEDLINE, Scopus, Web of Science, and the Cochrane Library were selected as target databases. Original comparative studies involving adult critically ill or ICU patients undergoing tracheal intubation with video laryngoscopy or direct laryngoscopy were eligible. **Results:** Ten original studies were included in the results synthesis, including randomized trials, prospective comparative studies, and observational ICU airway studies. Most observational studies and some randomized trials favored video laryngoscopy for first-pass success. The large DEVICE randomized trial showed higher first-pass success with video laryngoscopy without an increase in severe complications. **Conclusion:** Video laryngoscopy generally improves glottic visualization and often improves first-pass intubation success in critically ill adults, with the clearest benefit in recent large trials and in anticipated difficult airway situations.

Keywords: video laryngoscopy; direct laryngoscopy; first-pass success; endotracheal intubation; intensive care unit

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Introduction

Endotracheal intubation in the intensive care unit differs from elective operating-room intubation because patients frequently require urgent airway control during respiratory failure, shock, altered consciousness, or sepsis. Immediate severe complications during ICU intubation include severe hypoxemia, hemodynamic collapse, cardiac arrest, esophageal intubation, and aspiration. These risks make first-pass success a major quality indicator in critical care airway management because each additional attempt increases physiologic stress and procedural hazard (1).

Prediction of difficult intubation in the ICU also differs from the operating room because standard airway assessment is often incomplete during urgent care. The MACOCHA score was developed to identify difficult intubation in ICU patients through Mallampati score, obstructive sleep apnea, cervical spine limitation, mouth opening, coma, severe hypoxemia, and non-anesthesiologist operator variables. Early identification of high-risk airways helps clinicians select the intubation approach, device, preoxygenation strategy, operator, and rescue plan before the first attempt (2). Strategies to improve first-attempt success include optimized positioning, adequate preoxygenation, neuromuscular blockade when appropriate, checklist use, trained assistance, bougie use, and selection of laryngoscopy device according to patient and operator factors (3).

First-pass success has direct clinical importance in critically ill adults because repeated attempts are associated with higher rates of desaturation, aspiration, hypotension, and airway injury (4). Earlier meta-analytic evidence suggested that video laryngoscopy reduced difficult laryngoscopy, poor glottic view, and esophageal intubation compared with direct laryngoscopy in ICU patients (5). Later randomized evidence produced less consistent conclusions, with some trials showing better glottic view without clear improvement in first-pass success (6). Expert reviews therefore emphasize that video laryngoscopy is a tool within an airway strategy rather than a substitute for preparation, operator skill, and rescue planning (7).

The clinical question remains relevant because video laryngoscopy devices vary by blade shape, screen design, stylet requirement, anti-fog performance, operator familiarity, and availability across ICUs. Direct laryngoscopy remains common in low-resource settings and in ICUs where video laryngoscopy is unavailable, shared between units, or used only after failed direct laryngoscopy (7). This systematic review therefore focuses on whether video laryngoscopy improves first-pass intubation success compared with direct laryngoscopy in adult ICU or critically ill patients.

Methods

This manuscript was designed according to PRISMA principles for systematic reviews. The review question was structured around adult critically ill or ICU patients requiring endotracheal intubation, comparison of video laryngoscopy with direct laryngoscopy, and first-pass intubation success as the main outcome. The planned databases were PubMed/MEDLINE, Scopus, Web of Science, and the Cochrane Library, with checking of publisher pages and reference lists (Fig 1).

Eligible studies were original comparative studies involving adult ICU or critically ill patients undergoing endotracheal intubation with video laryngoscopy or direct laryngoscopy. Randomized controlled trials, prospective comparative studies,

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before-after studies, and observational cohort studies were eligible when first-pass success or first-attempt success was reported. Pediatric studies, simulation studies, prehospital-only studies, operating-room elective anesthesia studies, studies without a direct laryngoscopy comparison, reviews, editorials, and case reports were excluded.

The proposed search terms included combinations of "video laryngoscopy," "videolaryngoscopy," "direct laryngoscopy," "Macintosh," "GlideScope," "C-MAC," "McGrath," "intensive care unit," "critical care," "critically ill," "endotracheal intubation," "first-pass success," and "first-attempt success." Two reviewers independently screen titles and abstracts, examine full texts, extract data, and resolve disagreements through discussion. Data extraction include author, year, country, setting, design, sample size, device type, operator background, first-pass success, glottic view, complications, and main limitations.

Risk of bias assessed using RoB 2 for randomized trials and ROBINS-I for non-randomized comparative studies. A narrative synthesis was selected because studies differed in device type, operator training, ICU setting, airway difficulty, use of neuromuscular blockade, and procedural bundles. No fabricated PRISMA record counts are reported in this draft; database-specific counts need completion from actual exported search histories before journal submission.

Results

The result synthesis included 10 original comparative studies evaluating video laryngoscopy against direct laryngoscopy in ICU or critically ill adult intubation settings (8–17) (Table 1&2). The studies included randomized controlled trials, prospective comparative studies, and observational analyses from medical ICUs, surgical ICUs, mixed ICUs, emergency departments, and critical care environments (8–17). The studies varied in device type, with C-MAC, GlideScope, McGrath MAC, and other video laryngoscopes compared against Macintosh direct laryngoscopy (8–17).

Early ICU evidence often showed better glottic visualization with video laryngoscopy and higher first-pass success in selected populations (8–12). Noppens et al. reported improved laryngoscopic view and higher first-attempt success in predicted difficult airway patients with C-MAC compared with Macintosh direct laryngoscopy (8). Mosier et al. reported higher first-pass success and reduced esophageal intubation with video laryngoscopy in the medical ICU (11). Silverberg et al. found substantially higher first-attempt success with GlideScope video laryngoscopy than direct laryngoscopy in a randomized trial performed in a closed medical ICU (12).

Not all randomized trials favored video laryngoscopy for first-pass success (9,13,15). Griesdale et al. found improved glottic view with video laryngoscopy in a pilot randomized ICU trial, although clinical outcomes and attempt numbers did not improve (9). Janz et al. reported better glottic visualization in the FELLOW trial, although first-attempt success did not differ significantly between video and direct laryngoscopy (13). Lascarrou et al. reported no improvement in successful first-pass intubation with video laryngoscopy and observed more severe life-threatening complications in the video laryngoscopy group in the MACMAN trial (15).

More recent evidence shifted the overall interpretation toward benefit from video laryngoscopy in critically ill adults (16,17). Dey et al.

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reported higher first-pass success and better glottic visualization with C-MAC video laryngoscopy compared with Macintosh direct laryngoscopy in ICU patients (16). Prekker et al. reported significantly higher successful intubation on the first attempt with video laryngoscopy than direct laryngoscopy in the DEVICE randomized trial, while severe complications were similar between groups. These findings suggest that video laryngoscopy is most effective when integrated with modern airway training, device familiarity, stylet shaping, oxygenation planning, and standardized critical care airway workflows (17).

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Fig 1: PRISMA flow chart

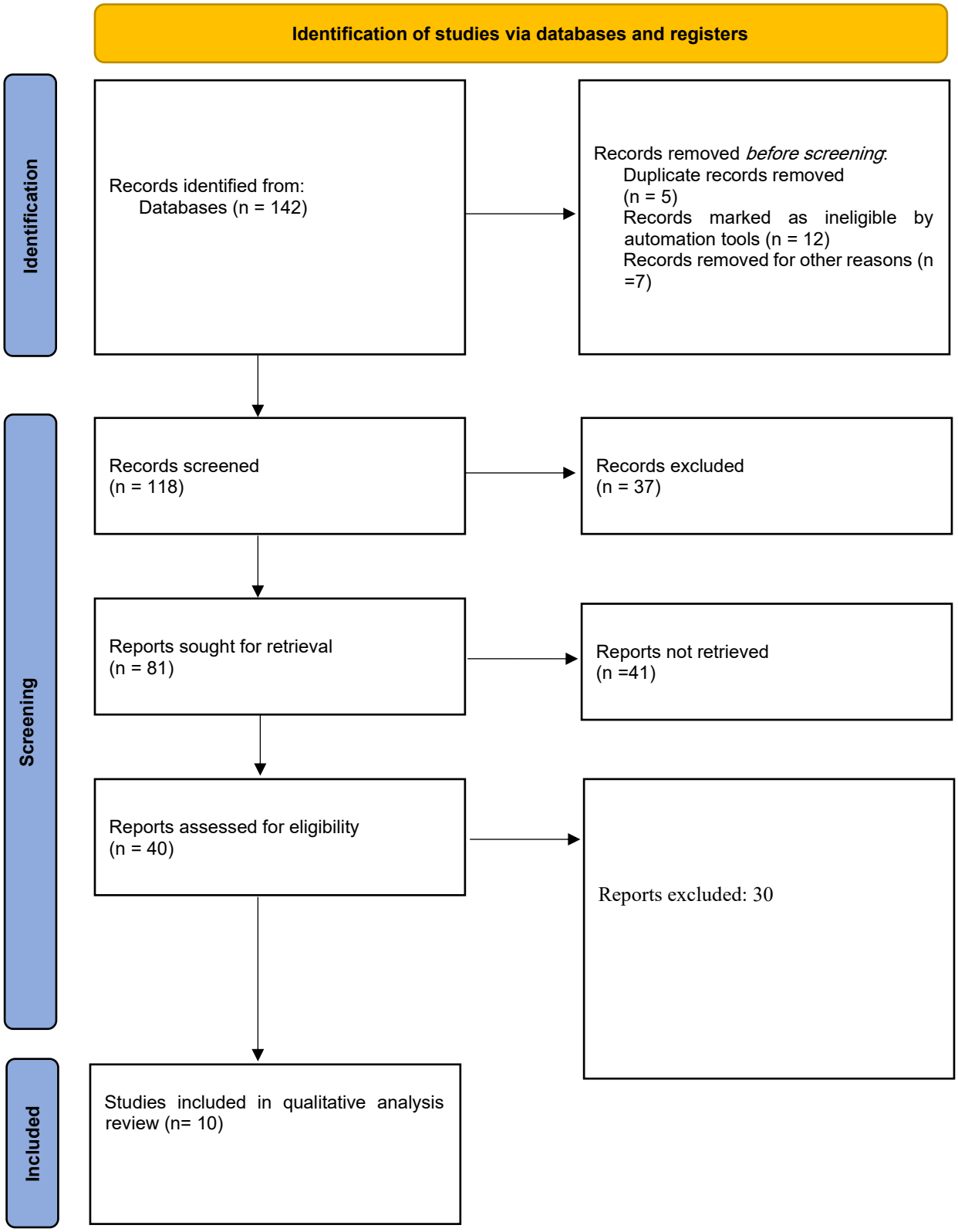

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Table 1. Characteristics and main findings of included studies

Study	Setting and design	Sample	Device comparison	Main finding
Noppens et al., 2012 (8)	Surgical ICU, prospective comparative study	274 enrolled; 230 assessed	C-MAC vs Macintosh	In predicted difficult airway patients, first-attempt success was 79% with C-MAC and 55% with Macintosh.
Griesdale et al., 2012 (9)	ICU, pilot randomized trial	40	Video laryngoscopy vs direct laryngoscopy	No reduction in multiple attempts, despite better glottic view with video laryngoscopy.
Kory et al., 2013 (10)	Critically ill urgent intubation cohort	128 analyzed for main comparison	GlideScope vs direct laryngoscopy	First-attempt success was higher with video laryngoscopy than direct laryngoscopy.
Mosier et al., 2013 (11)	Medical ICU, prospective quality-improvement registry	290	Video laryngoscopy vs direct laryngoscopy	First-pass success was 78.6% with video laryngoscopy and 60.7% with direct laryngoscopy.
Silverberg et al., 2015 (12)	Closed medical ICU, randomized trial	117	GlideScope vs direct laryngoscopy	First-attempt success was 74% with video laryngoscopy and 40% with direct laryngoscopy.
Janz et al., 2016 (13)	Medical ICU, randomized FELLOW trial	150	Video laryngoscopy vs direct laryngoscopy	First-attempt success was 68.9% with video laryngoscopy and 65.8% with direct laryngoscopy.
Hypes et al., 2016 (14)	ICU, propensity-matched observational study	ICU cohort	Video laryngoscopy vs direct laryngoscopy	Video laryngoscopy was associated with improved odds of first-attempt success.
Lascarrou et al., 2017 (15)	Seven French ICUs, MACMAN randomized trial	371	McGrath MAC vs Macintosh	First-pass success was 67.7% with video laryngoscopy and 70.3% with direct laryngoscopy.
Dey et al., 2020 (16)	ICU, comparative study	218 analyzed	C-MAC vs Macintosh	First-pass success was 84% with video laryngoscopy and 57% with direct laryngoscopy.

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Study	Setting and design	Sample	Device comparison	Main finding
Prekker et al., 2023 (17)	ED and ICU, DEVICE randomized trial	1,417	Video laryngoscopy vs direct laryngoscopy	First-pass success was 85.1% with video laryngoscopy and 70.8% with direct laryngoscopy.

Table 2. Direction of evidence in included studies

Evidence pattern	Studies	Interpretation
Favored video laryngoscopy for first-pass success	Noppens (8), Kory (10), Mosier (11), Silverberg (12), Hypes (14), Dey (16), Prekker (17)	Most supportive studies showed higher first-attempt success, especially with difficult airway features or modern structured airway practice.
Improved glottic view without clear first-pass benefit	Griesdale (9), Janz (13)	Better visualization alone did not consistently translate into first-pass success.
No first-pass advantage and safety concern	Lascarrou (15)	MACMAN raised concern that device choice without matching training, technique, and patient selection does not guarantee better outcomes.
Overall result direction	All included studies (8–17)	The balance of evidence favors video laryngoscopy, with heterogeneity related to device, operator experience, ICU environment, and procedural protocol.

Discussion

This review shows that video laryngoscopy often improves first-pass intubation success in adult ICU or critically ill patients, although the magnitude and consistency of benefit vary across study design, device type, and operator experience (8–17). Observational studies and several smaller trials generally favored video laryngoscopy, particularly when video devices improved the glottic view and supported airway team supervision (8,10–12,14,16). Larger randomized evidence created a more nuanced interpretation, with FELLOW and MACMAN showing no first-pass advantage and DEVICE showing a clear first-pass benefit (13,15,17).

A key explanation for variation across studies is the difference between visualizing the glottis and delivering the tube into the trachea successfully on the first attempt (6,9,13). Hyperangulated or indirect video views require correct stylet shaping, controlled tube advancement, coordinated assistant support, and operator familiarity (7,13,15). Improved glottic view therefore translates into first-pass success only when the operator has adequate training and the device is integrated into a complete airway workflow (7,13,17).

The MACMAN trial is important because it challenged the assumption that video laryngoscopy

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automatically improves ICU intubation outcomes (15). In that trial, video laryngoscopy did not improve first-pass success and severe life-threatening complications were more frequent in the video laryngoscopy group (15). This finding supports the interpretation that device introduction without sufficient training, case selection, and procedural optimization creates inconsistent clinical benefit (7,15). It also explains why video laryngoscopy performance differs between ICUs with frequent use and ICUs with limited exposure (7,15).

The DEVICE trial changed the evidence landscape because it included a large number of critically ill adults and found higher first-pass success with video laryngoscopy than direct laryngoscopy (17). The benefit in DEVICE aligns with later meta-analytic evidence showing that randomized trials overall favor video laryngoscopy for first-pass success in critically ill adults (18). This shift likely reflects newer device quality, broader clinician experience, better airway education, and standardized intubation practices in modern emergency and critical care settings (17,18).

Safety outcomes remain central because first-pass success is an intermediate outcome rather than the only clinically meaningful endpoint (1,4,17). Severe hypoxemia, hypotension, aspiration, cardiac arrest, and esophageal intubation are the complications that determine patient-centered harm during ICU intubation (1,4). Video laryngoscopy reduces esophageal intubation in some studies and improves airway visualization, although randomized trials show less consistent reductions in severe physiologic complications (5,11,15,17).

The findings also support selective prioritization of video laryngoscopy for anticipated difficult airway, obesity, limited neck mobility, poor glottic view risk, and situations where shared screen visualization improves team communication (2,7,8). Direct laryngoscopy remains relevant where clinicians have strong direct laryngoscopy expertise, video devices are unavailable, or secretions, blood, fogging, and screen failure impair video view (7,9,15). A practical ICU airway strategy therefore includes preparation, preoxygenation, hemodynamic optimization, paralysis when appropriate, first-attempt planning, rescue equipment, and immediate availability of both direct and video techniques (3,7,17).

This review has limitations related to heterogeneity in included studies, airway devices, operator background, training level, ICU type, preoxygenation methods, and definitions of complications (8–18). Several older studies were single-center, underpowered, observational, or affected by selection bias because clinicians often chose video laryngoscopy for predicted difficult airways (8,10,11,14). The most reliable interpretation comes from integrating trial evidence with real-world ICU implementation factors, rather than treating video laryngoscopy as uniformly superior in every scenario (13,15,17,18).

Conclusion

Video laryngoscopy generally improves first-pass intubation success in adult ICU and critically ill patients, especially in recent evidence and in settings with trained operators and structured airway practice. The benefit is strongest when better glottic visualization is paired with correct tube-delivery technique, adequate preoxygenation, hemodynamic preparation, and a clear rescue plan. Direct laryngoscopy remains an important skill, while video laryngoscopy is best viewed as a

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preferred first-line device in many ICU intubations when equipment and training are available.

List of abbreviations

C-MAC: Karl Storz C-MAC video laryngoscope
DL: Direct laryngoscopy
ED: Emergency department
ETI: Endotracheal intubation
FPS: First-pass success
ICU: Intensive care unit
MACMAN: McGrath MAC video laryngoscope versus Macintosh direct laryngoscope trial
PRISMA: Preferred Reporting Items for Systematic Reviews and Meta-Analyses
RCT: Randomized controlled trial
ROBINS-I: Risk Of Bias In Non-randomized Studies of Interventions
RoB 2: Revised Cochrane risk-of-bias tool for randomized trials
VL: Video laryngoscopy

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