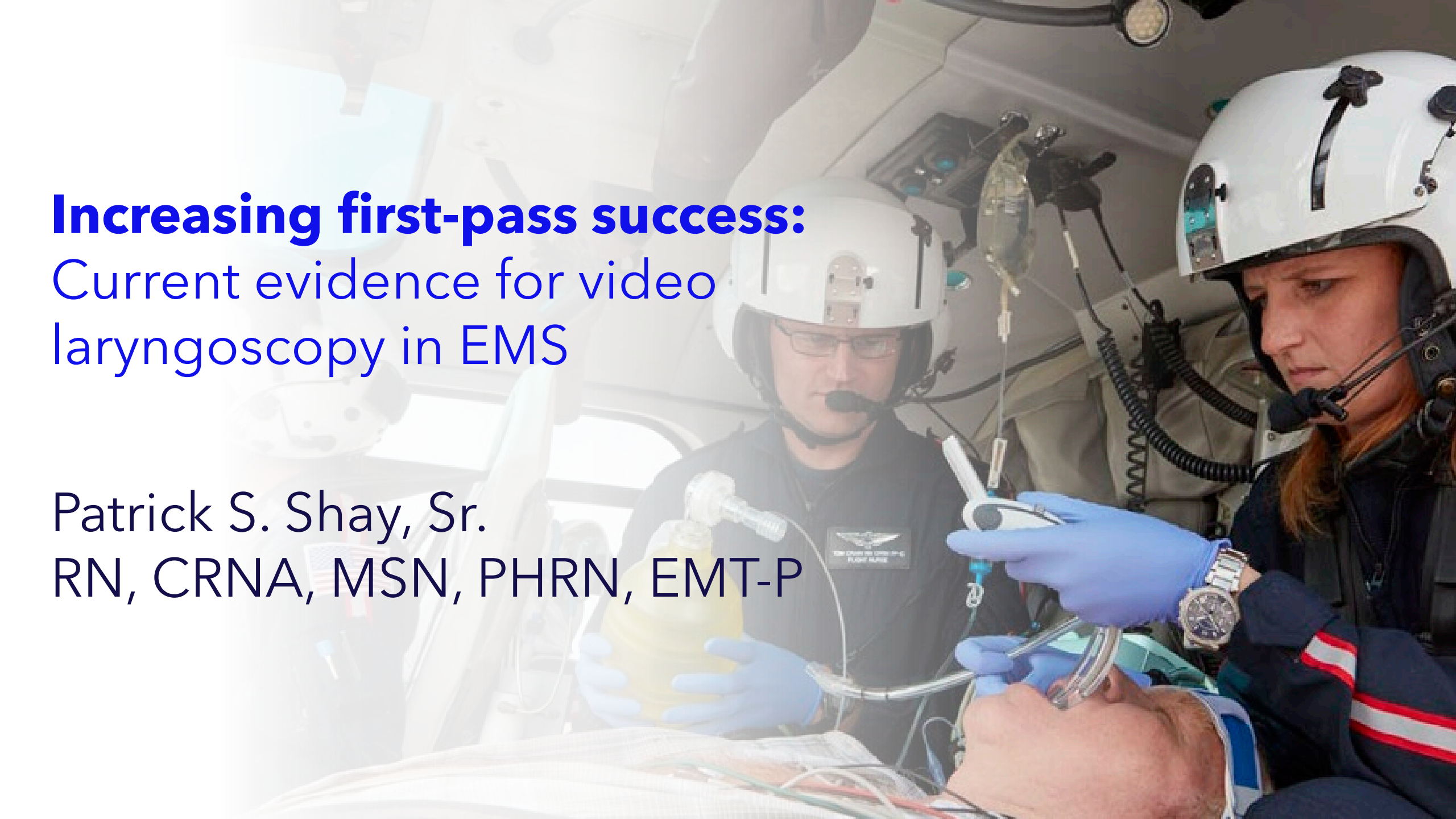
Increasing first-pass success: Current evidence for video laryngoscopy in EMS

Patrick S. Shay, Sr.
RN, CRNA, MSN, PHRN, EMT-P



About the Speaker

Mr. Shay has over 30 years EMS experience as an Advanced Life Support (ALS) level provider, serving as a Paramedic, Flight Nurse, field supervisor, line officer, preceptor, and instructor. He also has over 10 years experience as a Certified Registered Nurse Anesthetist (CRNA) for the Department of Anesthesiology and a Staff Development instructor at UPMC Health Systems. He is a Pennsylvania EMS education sponsor and adjunct faculty for Harrisburg Area Community College Paramedic and Prehospital RN programs and lectures extensively as a subject matter expert on basic, advanced, and difficult airway management.

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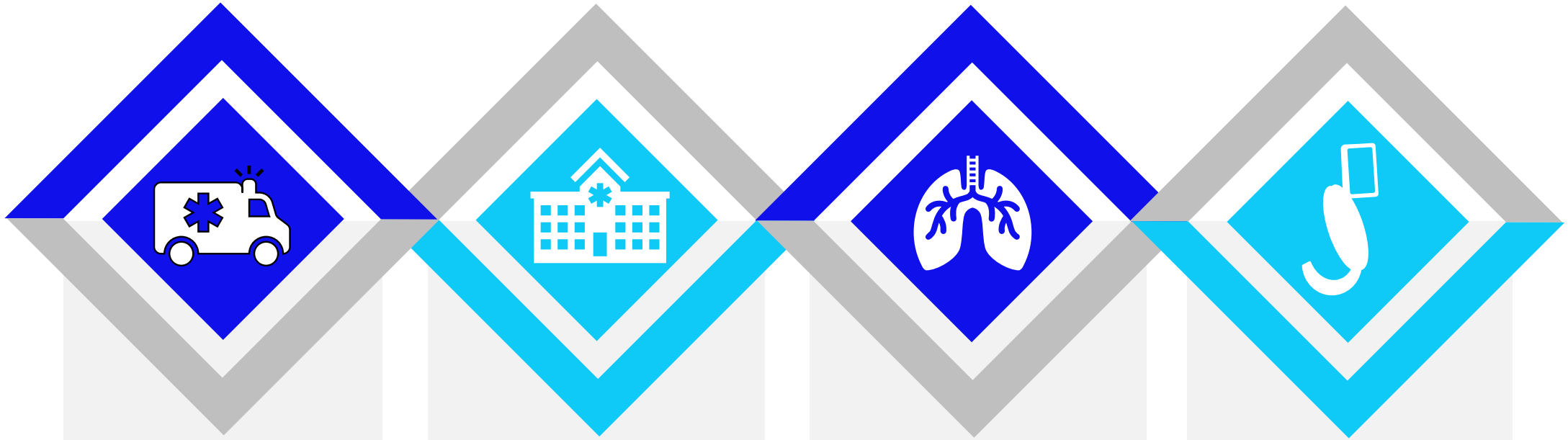
Objectives



Discuss the role of endotracheal intubation (ETI) in EMS

Describe the similarities, differences, and challenges between in-hospital and out-of-hospital advanced airway management.

Discuss direct laryngoscopy (DL) versus video laryngoscopy (VL)

Review the available evidence regarding the correlation between VL, First-Pass Success, and improved patient outcomes in EMS

Emergency Medical Services (EMS)

EMS providers function in a **uniquely challenging** and **dynamic environment**, and are **strategically positioned** to perform skills that:

- Improve ventilation/oxygenation
- Correct hypoxia
- Decrease morbidity and mortality

Endotracheal Intubation

An essential resuscitative procedure routinely utilized in EMS, emergency care, critical care, and anesthesia.

An advanced airway:

- Is considered the "gold-standard" for effective ventilation and airway protection from aspiration.[1]
- Delivers an efficient and reliable means of ventilation and oxygenation.
- Allows for positive pressure ventilation (PPV), positive end expiratory pressure (PEEP), pulmonary clearance, and reliable waveform capnography.

2 Miller's Anesthesia, 7th Edition (p 1251-5): 2009

Endotracheal Intubation

Prehospital patients requiring endotracheal intubation are likely:

- Critically ill or injured
- Hypoxic
- Hypercarbic
- Hemodynamically unstable
- Poorly optimized
- Poorly accessible
- Rarely fasting

Endotracheal Intubation

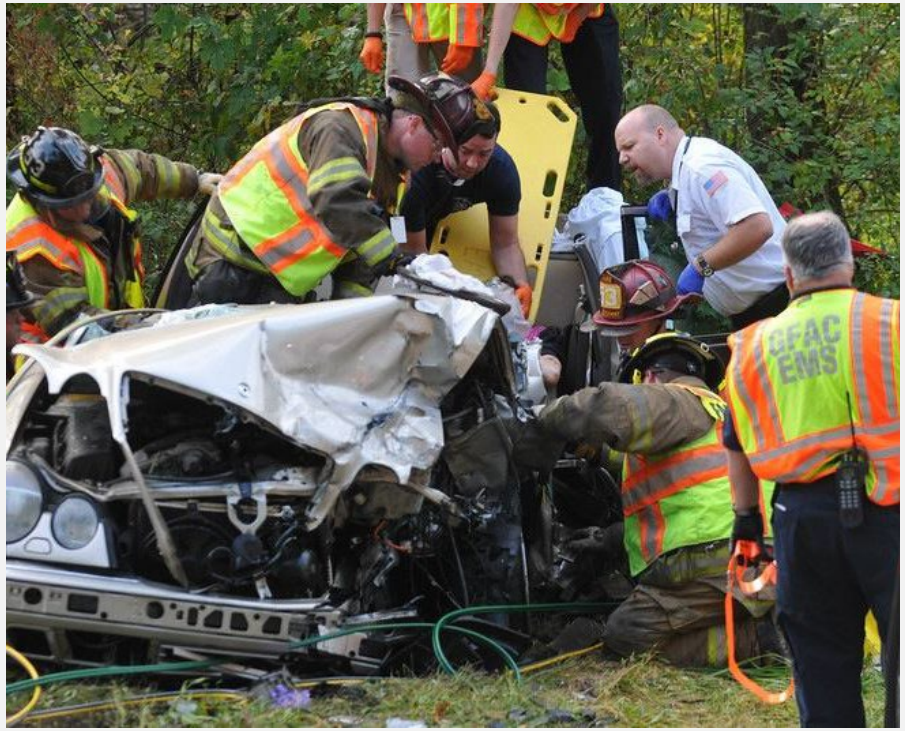
Indications include:

- Altered / decreased mental status
- Severe trauma
- Poor ventilation
- Poor oxygenation
- Respiratory failure
- Respiratory arrest
- Cardiopulmonary arrest
- General anesthesia

Endotracheal Intubation

Performed in multiple environments, all with varying degrees of positioning, lighting, control, and assistance:

- Emergency Departments
- Operating Rooms
- “Ectopic airways”
- Prehospital – in homes, ambulances, aircraft, outdoors, and vehicles – rarely in optimal conditions



Endotracheal Intubation

- Many of the issues that EMS providers face when attempting endotracheal intubation mimic those faced by Emergency Department and Anesthesia providers.
- Assume that every patient encountered by EMS who requires endotracheal intubation is a potential difficult airway.

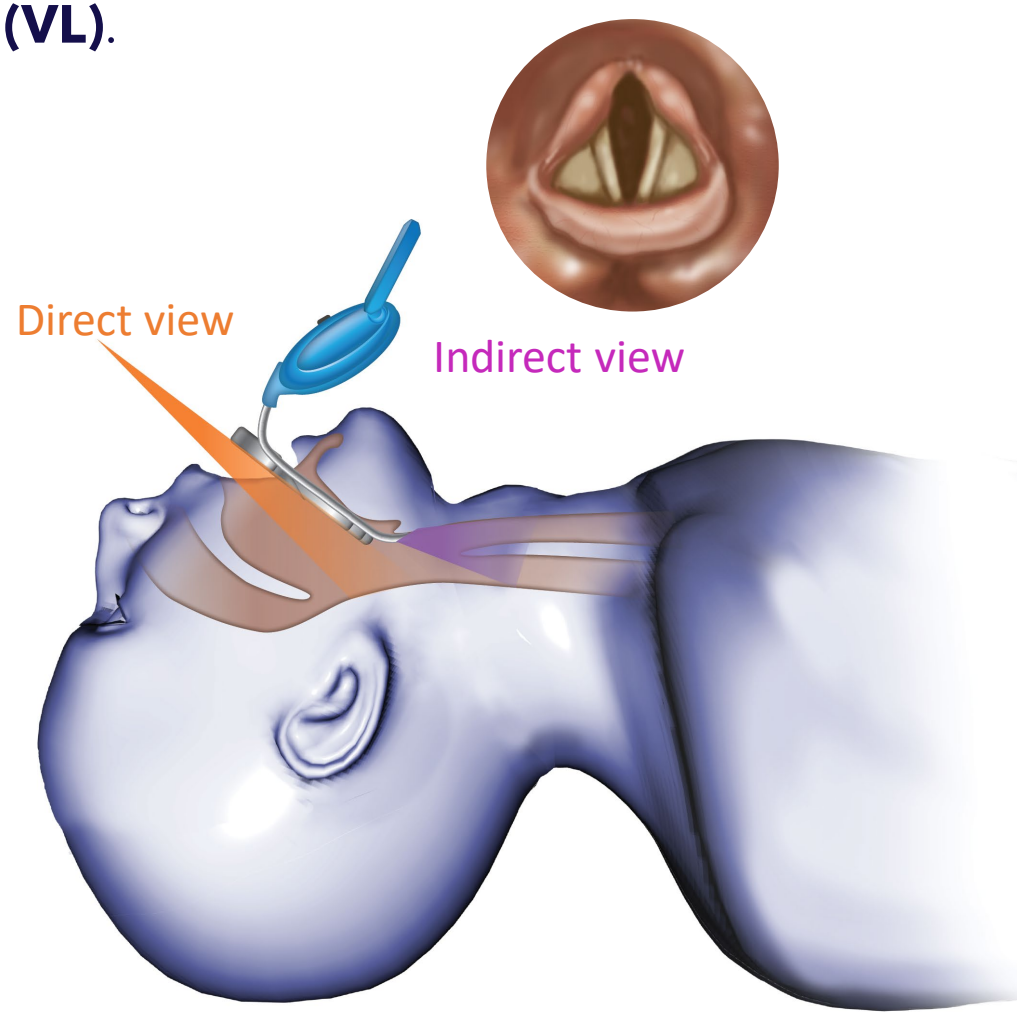
Endotracheal Intubation

The two most common approaches to endotracheal intubation are **direct laryngoscopy (DL)** and **video laryngoscopy (VL)**.

DL and VL have the same three goals:

1. Visualize the glottic opening.
2. Intubate the trachea.
3. Perform both actions on the **first attempt.**

This is known as **"First-Pass Success."**



First-Pass Success

Three “Ps” for First-Pass Success in advanced airway management:

PREPARATION

- Preoxygenation
- Assessment
- Equipment

POSITIONING

- Sniffing
- Ramping
- Reverse Trendelenburg

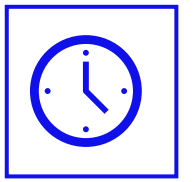
PERFORMANCE

- Plan – A, B, C
- Execution
- Evaluation

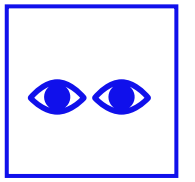
First-Pass Success - Preparation

If possible, preoxygenate with 100% O_2 for at least one minute prior to ETI with high-flow NC, NRBM, or BVM ventilation

Take the time to perform a rapid airway assessment



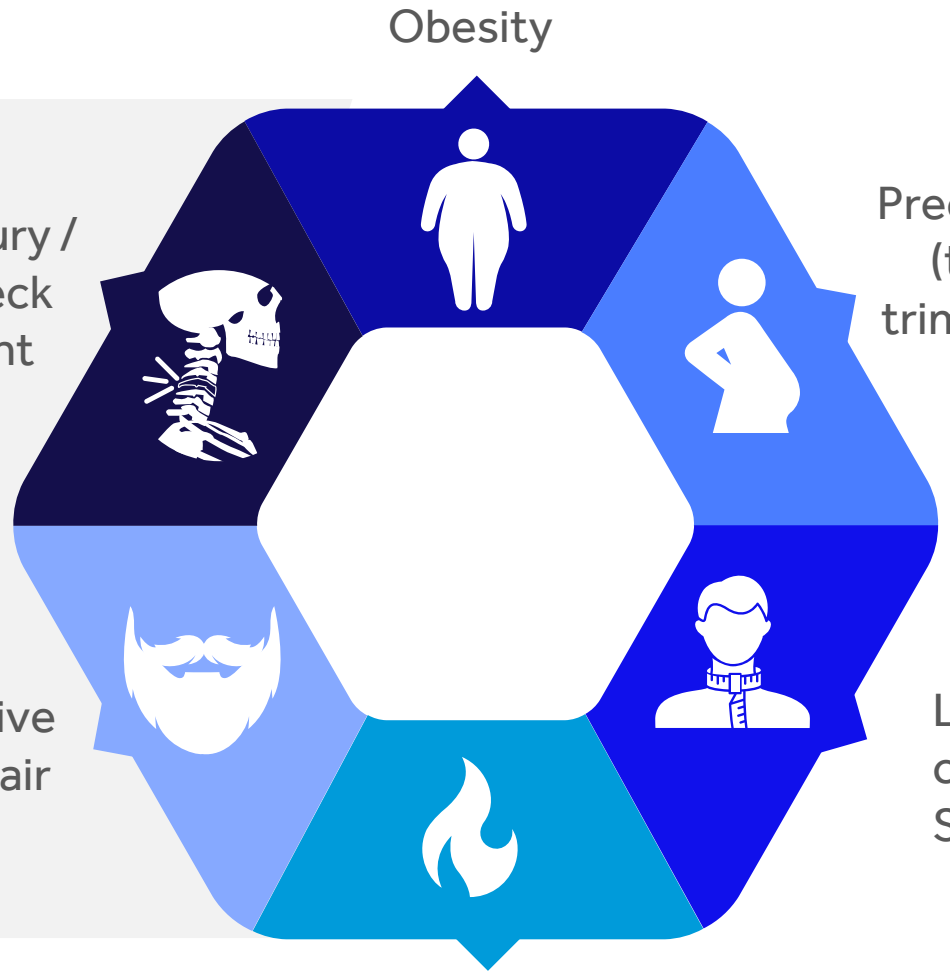
Look for signs of a potential difficult airway



Assume every airway will be difficult until proven otherwise

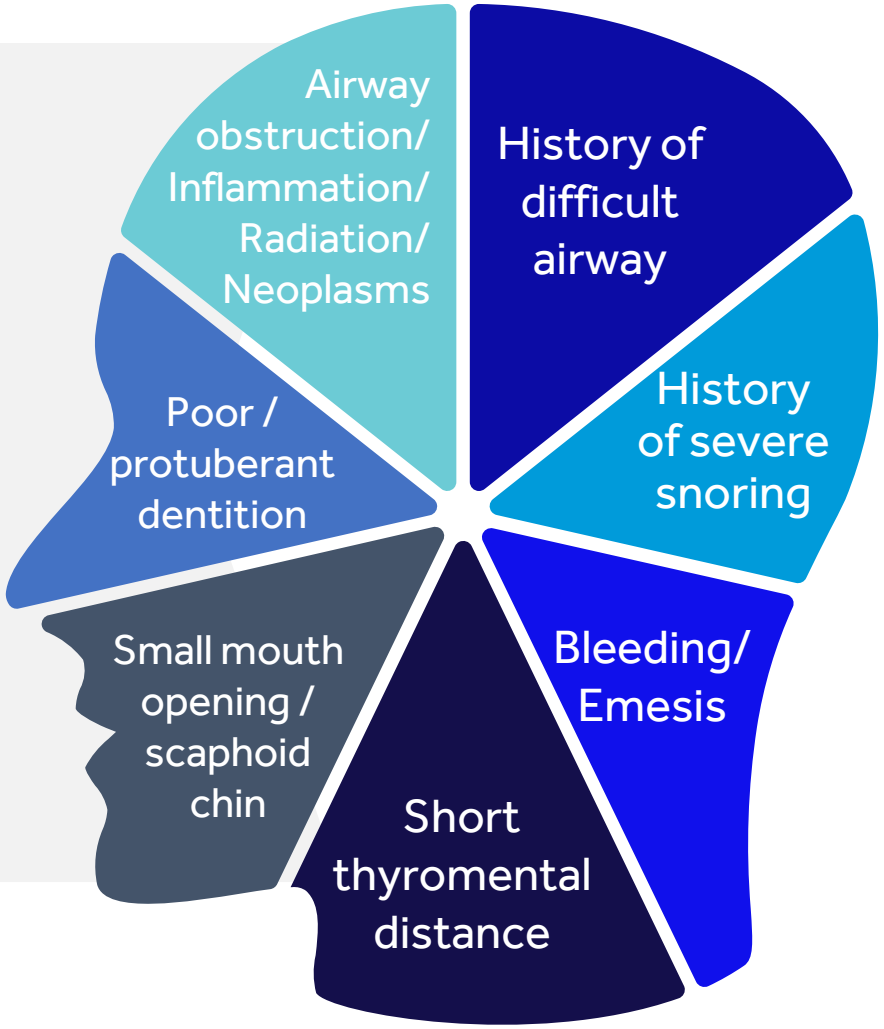
First-Pass Success - Assessment

Signs of a potential difficult airway include:



First-Pass Success - Assessment

Signs of a potential difficult airway include:



First-Pass Success – Preparation / Positioning

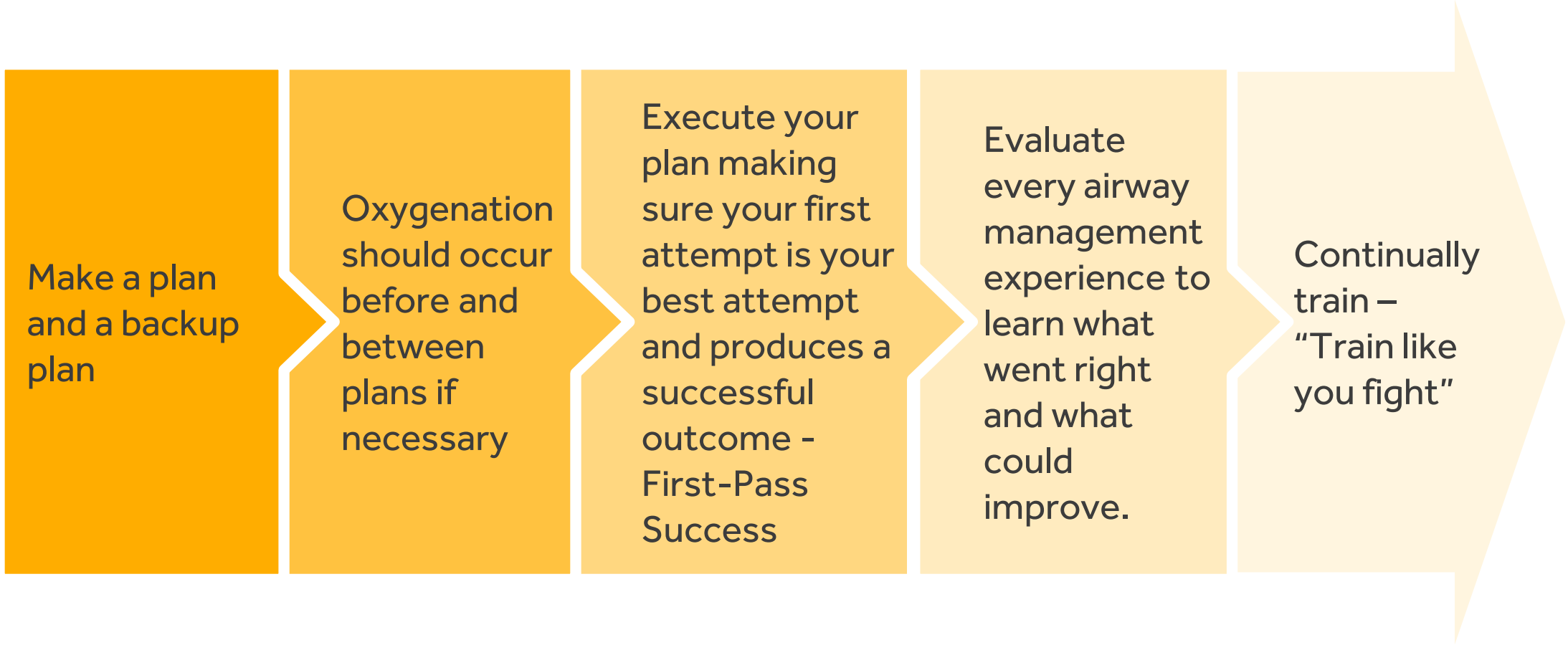
Choose the best equipment available and make sure your equipment supports your planned approach and subsequent backup plan approach

Assemble and prepare all equipment within easy reach

Take the time to position your patient

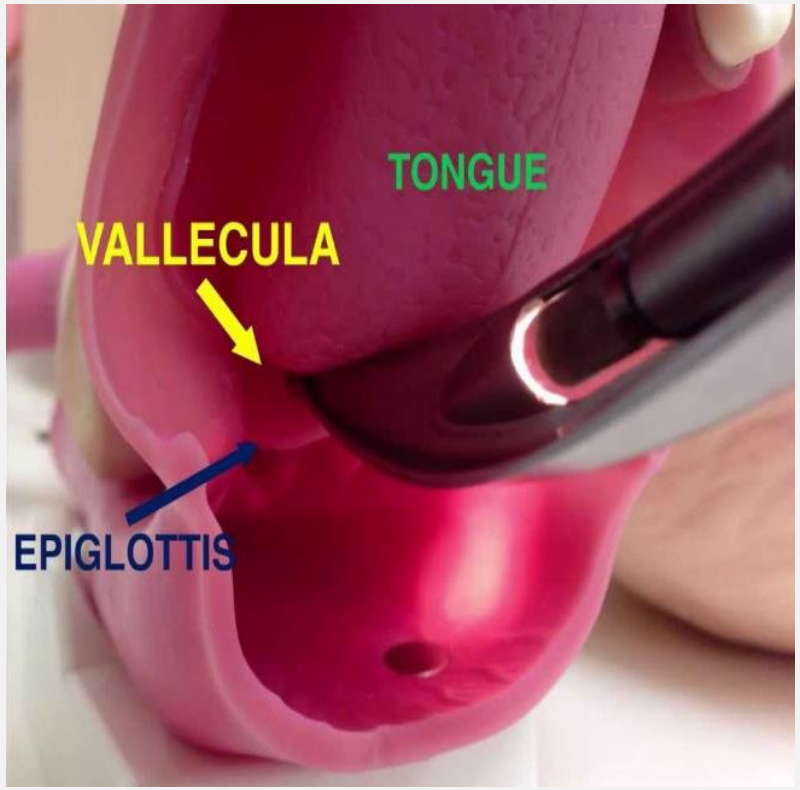
- ✓Always intubate down – never intubate up
- ✓Head – extended and sniffing
- ✓Ramping / elevation strategies
- ✓Reverse Trendelenburg for immobilized patients

First-Pass Success - Performance



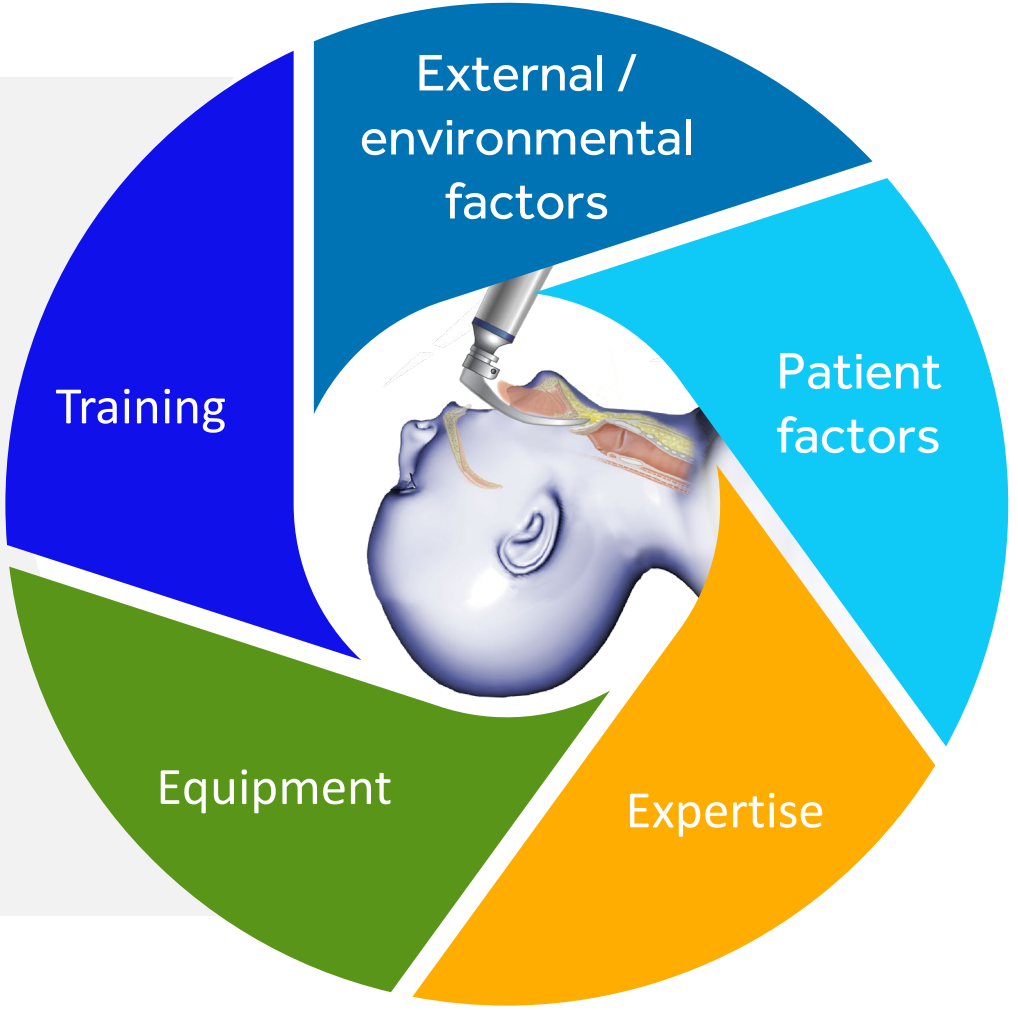
Direct Laryngoscopy (DL)

- Historically the primary method of performing endotracheal intubation
- Goal is to compress and distract the tissues of the upper airway to create a direct line of sight between provider and glottic opening
- While simple in theory, multiple factors can create challenges and limitations making DL technically difficult or even impossible



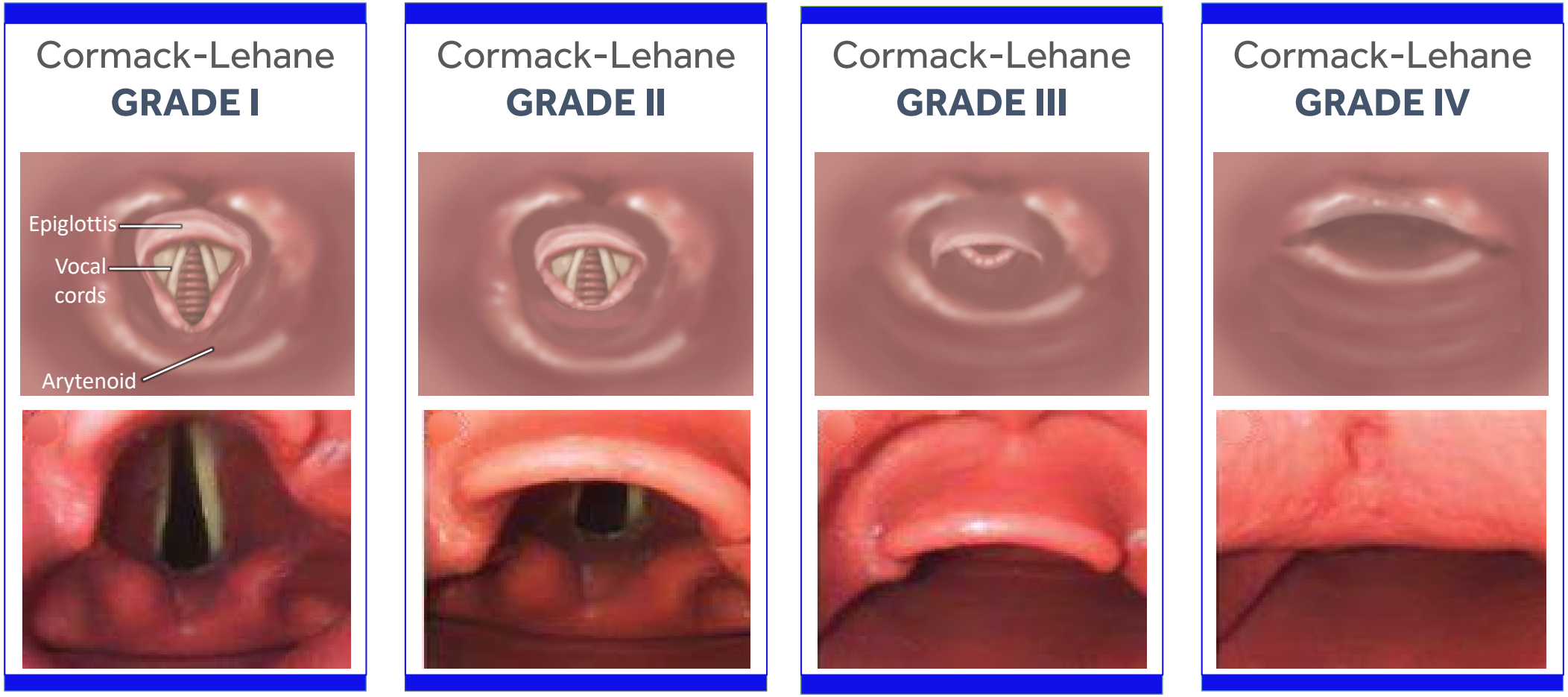
Direct Laryngoscopy (DL)

Multiple, inherent limitations



Cormack – Lehane view[2]

Graded view of glottis during laryngoscopy.



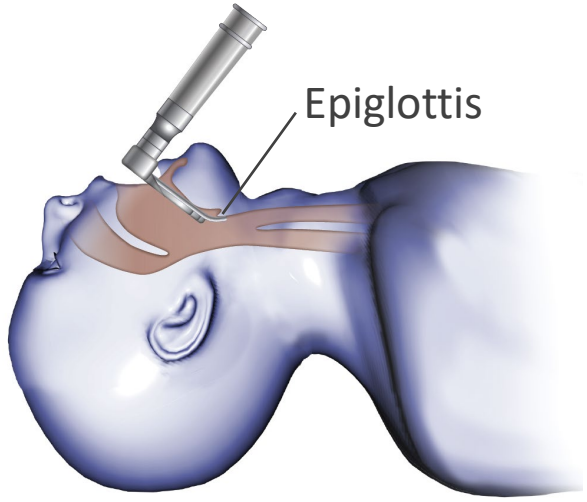
2. Krage R, et al. Cormack–Lehane classification revisited. *British Journal of Anaesthesia* 105 (2): 220–7 (2010)

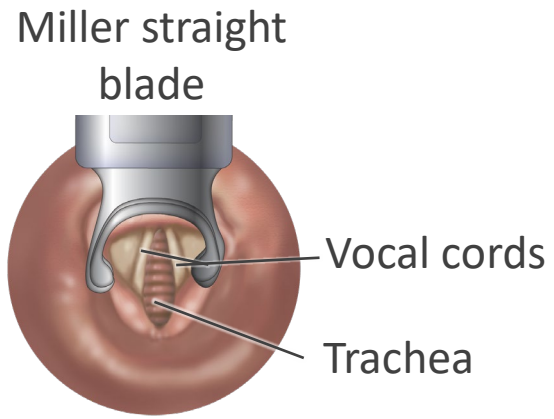
Direct Laryngoscopy (DL)

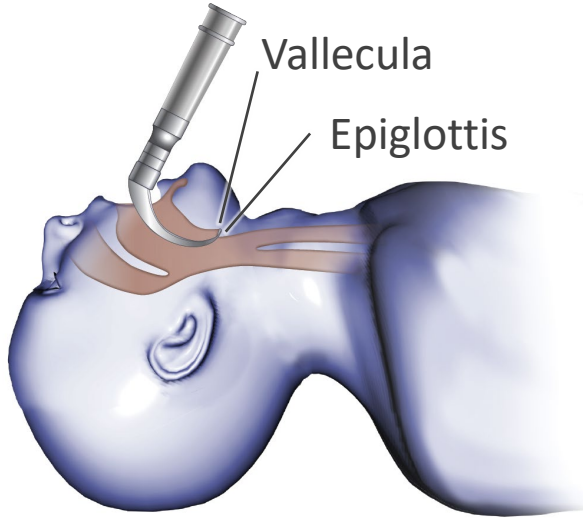
In experienced hands, DL has a high success rate

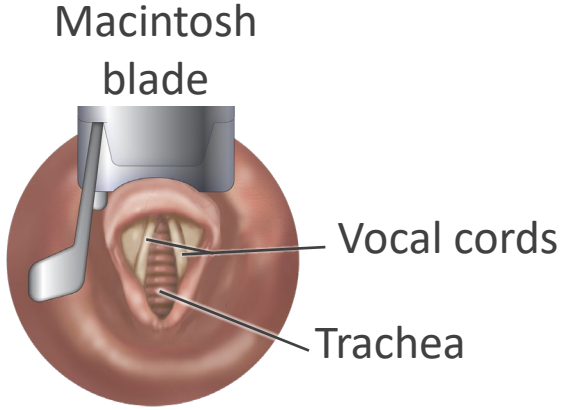
Equipment is inexpensive, reliable, and widely available for EMS, emergency department, and anesthesia providers

May require significant experience to gain / maintain proficiency compared to VL









Video Laryngoscopy (VL)

New and emerging technology in airway management

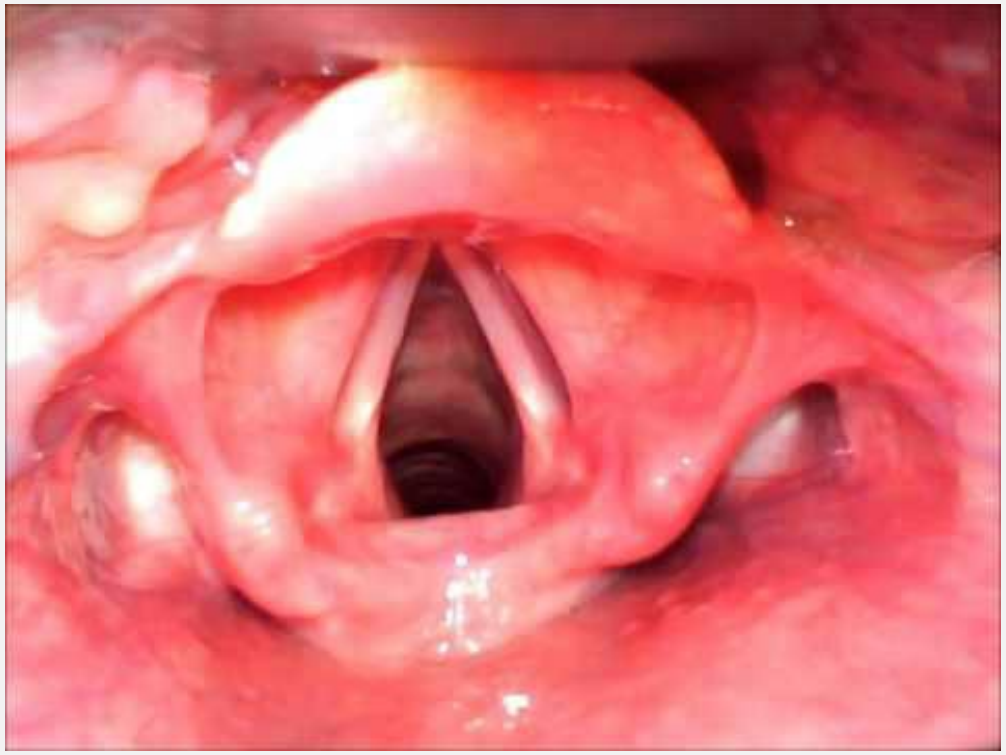
First use of commercially available VL performed in 2001

Numerous VL devices are now available in clinical practice

All VL devices vary considerably in design and functionality

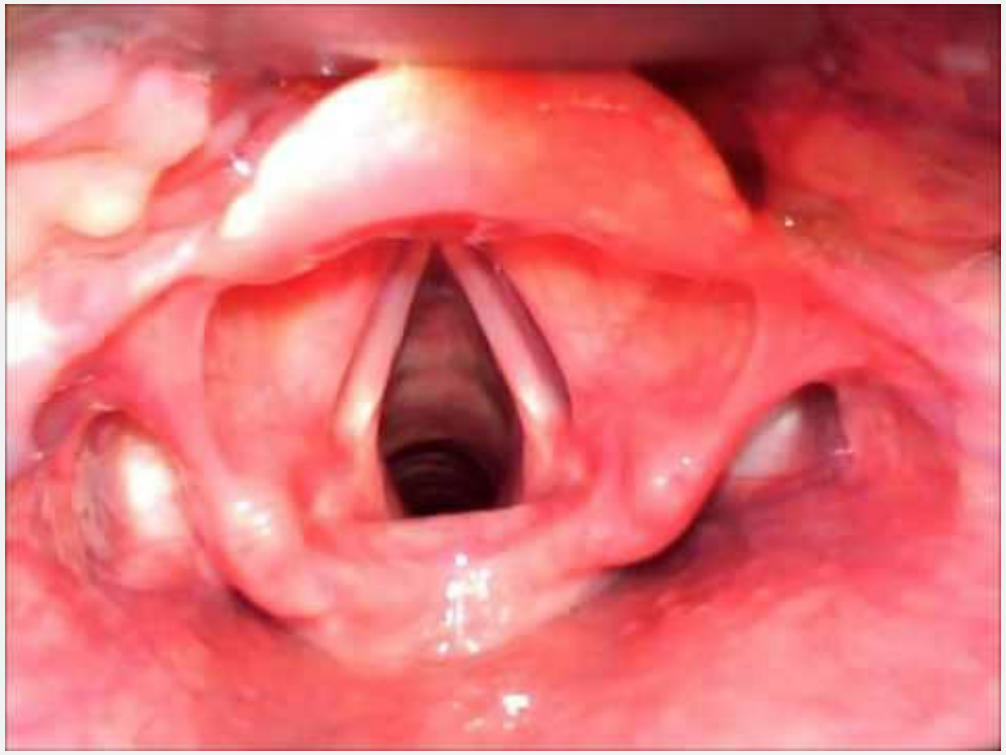
Video Laryngoscopy (VL)

All VL devices have one thing in common: they all provide an indirect view of the laryngeal anatomy on a monitor allowing intubation to be performed without requiring line of sight and without having to move any obstructing tissue to obtain an acceptable view



Video Laryngoscopy (VL)

- Increases viewing angle: DL=10 degrees versus VL=60 degrees
- May require less force / tissue manipulation / jaw and neck manipulation
- Allows magnification of airway structures
- Some devices allow photo / video documentation



Video laryngoscopy in Anesthesia

Video laryngoscopy is a **significant** advancement in airway management for Anesthesia and represents a paradigm shift in both laryngoscopy and patient care.

VL performance **superior** to DL not only for known or suspected difficult airways but for all patients.[4-8]

VL provides **improved** respiratory and hemodynamic benefits compared to DL.[9-11]

Many guidelines recommend VL as the **first-line** intubation technique for routine and most potentially difficult, known difficult, and rescue intubations for both Anesthesia and Emergency Medicine.[12-17]

Video Laryngoscopy in Anesthesia

Video laryngoscopy consistently shows:

- Improved glottic exposure and laryngeal view[5,7]
- Increased rate of first-pass intubation success[4-8]
- Decreased rates of esophageal intubations[11,14]
- Increased overall intubation success rates – both inside and outside the OR [4-8,18]
- Both EMS and Anesthesia share similar strategies and technologies to achieve similar goals: enhance patient care and improve patient outcomes.

Video Laryngoscopy in EMS

Regardless of choice or utilization, abundant evidence **strongly suggests VL should be readily available** and regularly utilized by EMS to achieve First-Pass Success.[4-17]

An examination of the current evidence clearly shows improved First-Pass success with VL and a direct correlation between First-Pass Success and improved patient outcomes.[4-11]

First-Pass Success outcomes

Moy (2015) related a recent study using data from 40 states that demonstrated an overall prehospital ETI success rate of 85.3%.[3] **Jarvis, et al (2015)** performed a study looking at an EMS system's intubation experience before and after implementing VL:[4]

Using only DL,[4]

the first pass success rate was

43.8%

and the overall success rate was

64.9%

After mandatory proficiency training with VL,[4]

the first pass success rate increased to

74.2%

and the overall success rate increased to

91.5%

3 Moy HP, et al. Evidence-Based EMS: Endotracheal Intubation. EMS World, Jan 2015
4 Jarvis JL, McClure SF, Johns D. EMS Intubation Improves with King Vision Video Laryngoscopy. Prehospital Emergency Care, 19:4, 482-489

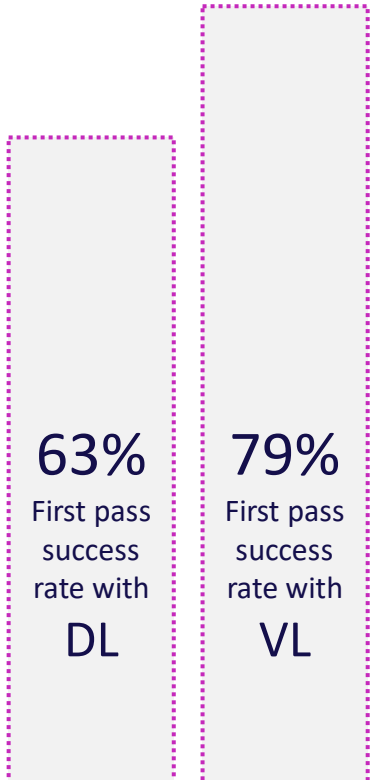
First-Pass Success outcomes

Eberlein et al (2019) studied first-pass success rates using VL versus DL in a retrospective prehospital ambulance study.[5]

First-pass success rates were **12.6% higher** with VL compared to DL

Li et al (2021) compared DL versus VL with first-pass success in 164 trauma patients.[6]

VL was associated with higher odds – a **16% increase** – of first-pass success compared with DL



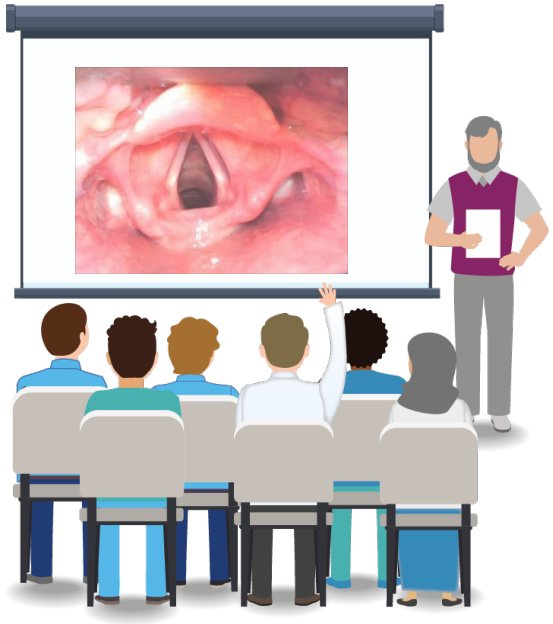
5 Eberlein CM, et al. First-Pass Success Intubations Using Video Laryngoscopy Versus Direct Laryngoscopy: A Retrospective Prehospital Ambulance Service Study. *Air Medical Journal* 38 (2019) 356–358
6 Li TL, et al. Video laryngoscopy is associated with improved first-pass intubation success compared with direct laryngoscopy in emergency department trauma patients. *JACEP Open* 2021;2:e12373

First-Pass Success outcomes[7]

Eismann et al, (2017), studied the use of DL versus VL in unexperienced participants.

Participants were a mix of physicians, medical students, and paramedics with **minimal endotracheal intubation training or experience**.

All participants participated in a lecture and hands-on workshop **prior to device use**.



Main outcome parameters were:

- **time to obtain a view** using both the Cormack-Lehane (CL) grade score and percentage of visualization of the glottic opening (POGO) score
- **time to successful intubation**

7 Eismann H, et al. Improved success rates using videolaryngoscopy in unexperienced users: a randomized crossover study in airway manikins. Eur J Med Res (2017) 22:27

First-Pass Success outcomes[7]

Eismann et al, (2017), studied the use of DL versus VL in unexperienced participants.

Participants found **improved C-L grades** with VL compared to DL

Participants achieved **better visibility of the glottic opening** with VL compared to DL

While there was no significant difference in time to intubation using either device, VL provided **improved visualization.**

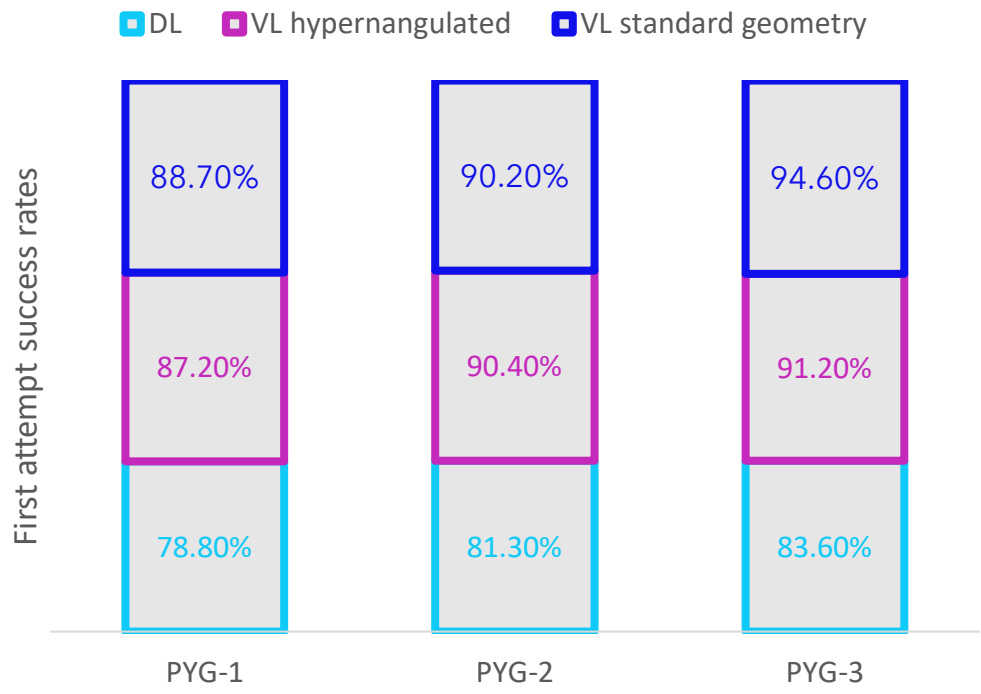
7 Eismann H, et al. Improved success rates using videolaryngoscopy in unexperienced users: a randomized crossover study in airway manikins. Eur J Med Res (2017) 22:27

VL and First-Pass Success Outcomes[8]

Garcia et al, (2022), compared intubation first-attempt success with standard DL, hyper-angulated VL, and standard geometry VL among emergency medicine residents at various years of training.

Results:

- VL outperformed DL in ALL operator groups.
- 1st year residents achieved higher first-attempt success with standard geometry VL that 3rd year residents using standard DL.
- Overall success rates for 3rd year residents was 94.6% with VL compared to 83.6% with DL.



8 Garcia SI, et al. First-Attempt Intubation Success Among Emergency Medicine Trainees by Laryngoscopic Device and Training Year: A National Emergency Airway Registry Study. Annals of Emergency Medicine (2022) 1-9

VL and First-Pass Success Outcomes[8]

Garcia et al, (2022), compared intubation first-attempt success with standard DL, hyper-angulated VL, and standard geometry VL among emergency medicine residents at various years of training.

Key takeaways:

- VL in the hands of a novice is better than DL in the hands of a more experienced provider.†
- There is a 10% incremental first-attempt success benefit with VL compared with DL at any stage of training.
- While experience improves performance, one might conclude that DL should not be used for first intubation attempts and, in fact, VL is clearly superior in achieving first-pass success.

"Our findings add to abundant data that first-attempt success with the direct laryngoscope does not support its routine use for emergency airway management."

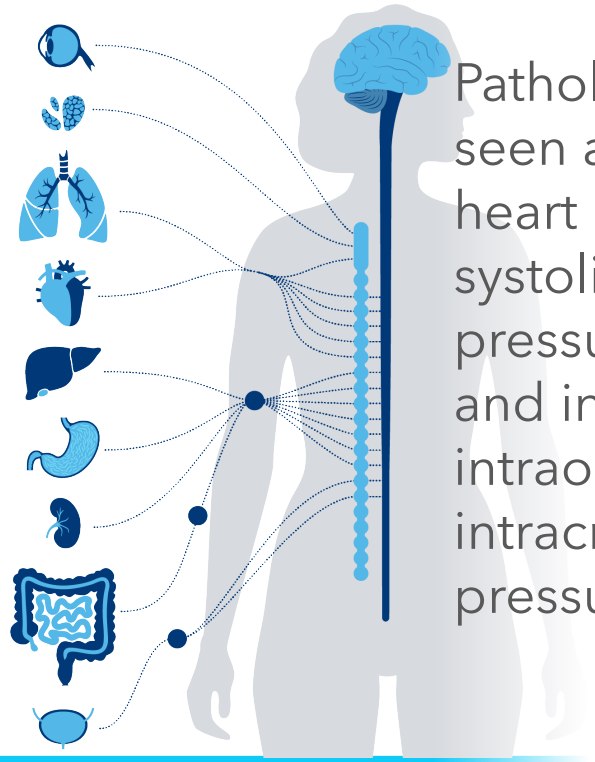
- Garcia et al, (2022)

† First year resident (PYG-1) vs. third year resident (PYG-3)

8. Garcia SI, et al. First-Attempt Intubation Success Among Emergency Medicine Trainees by Laryngoscopic Device and Training Year: A National Emergency Airway Registry Study. Annals of Emergency Medicine (2022) 1-9

VL and Patient Outcomes[9]

Laryngoscopy, and to a lesser extent, tracheal intubation, stimulate the sympathetic nervous system to increase plasma catecholamine release.



Pathologic effects seen as increased heart rate (HR), systolic blood pressure (SBP), and intravascular, intraocular, and intracranial pressures.

VL may ameliorate these effects by decreasing distention and realignment forces created by DL, resulting in decreased hemodynamic derangements.

VL and Patient Outcomes[9]

Altun et al (2018) studied the hemodynamic effects of laryngoscopy using four different laryngoscopes: a classic MacIntosh direct laryngoscope (DL), a McCoy flip-tip direct laryngoscope (DL), a C-MAC video laryngoscope (VL), and a McGrath video laryngoscope (VL).

Primary outcomes of the study were HR and SBP changes triggered by the four devices.

Secondary outcomes evaluated included time to successful intubation and incidence of sore throat.

160 patients received a standard general anesthesia induction and were successfully intubated on the first attempt, being randomized to one of the four devices (40 patients for each device).

Hemodynamic measurements performed immediately after intubation and then in 1-minute intervals for an additional 5 minutes post-intubation.

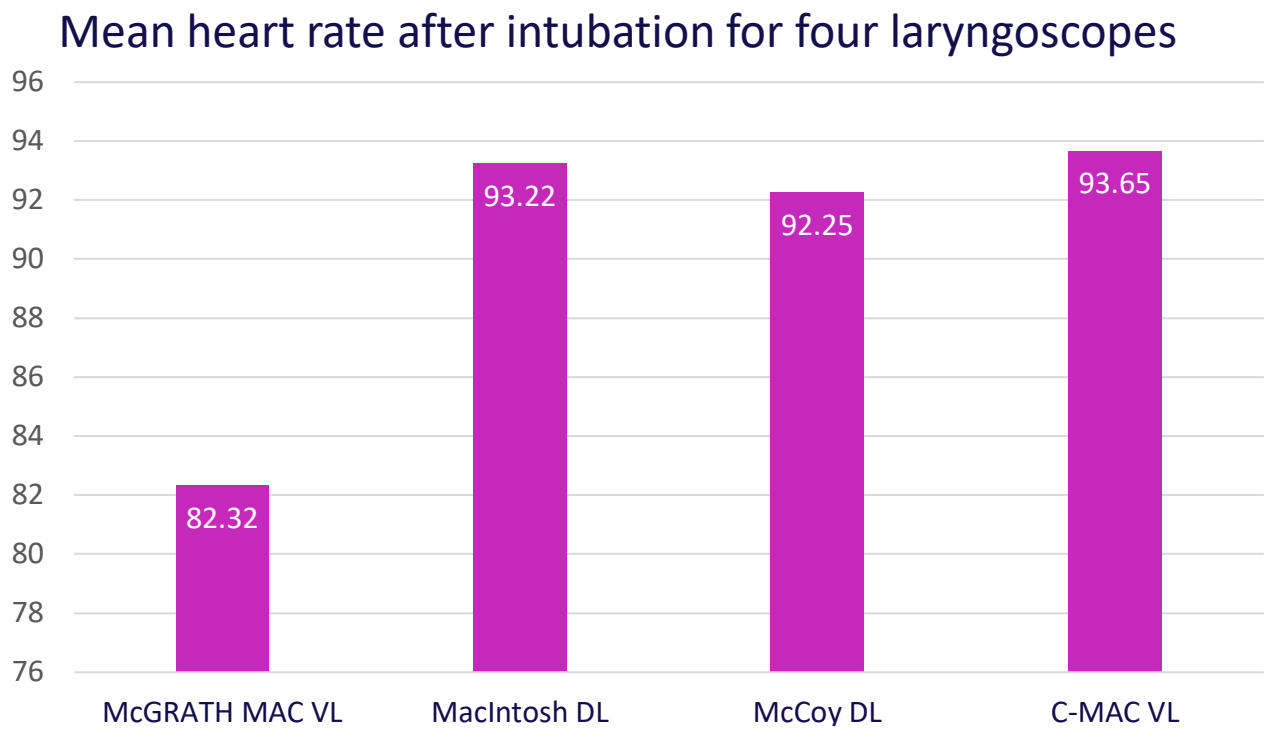
9 Altun D, et al. Haemodynamic Response to Four Different Laryngoscopes. *Turk J Anaesthesiol Reanim* 2018; 46(6): 434-40

VL and Patient Outcomes[9]

Both HR and SBP increased in a parallel fashion for all groups except for the McGrath VL group which **showed no significant change in HR or SBP throughout measurement.**

The McGrath VL device offered **less hemodynamic stimulation and cardiovascular stress responses** compared with other devices studied.

Intubation time was shorter, and **incidence of sore throat was lessened**, with the McGrath VL device compared to other devices.

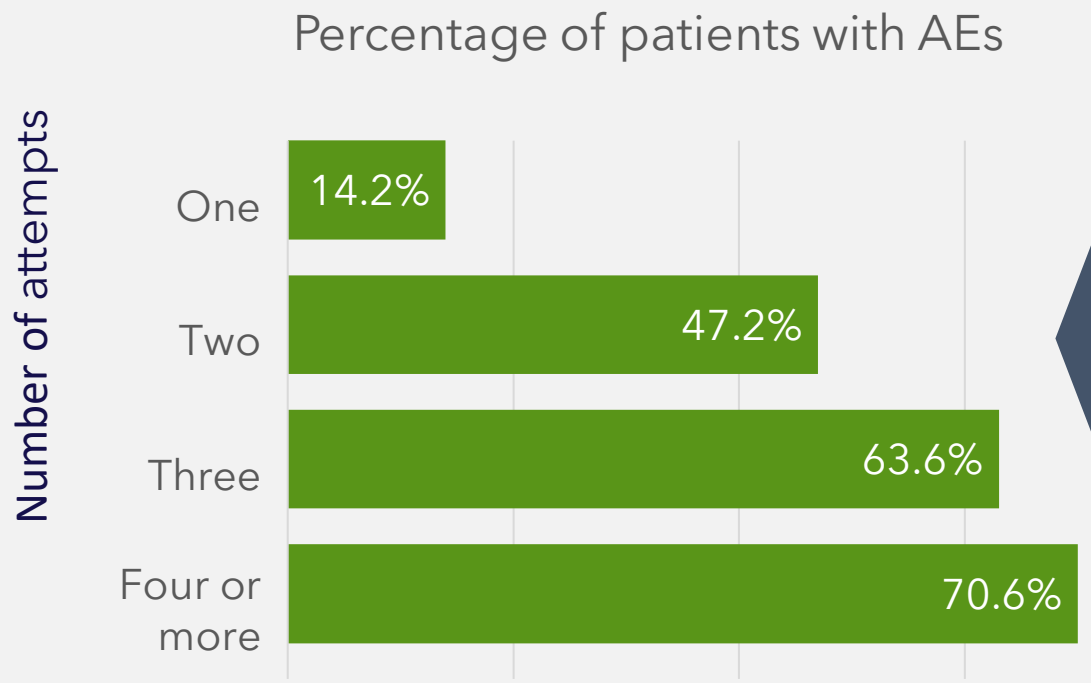


9 Altun D, et al. Haemodynamic Response to Four Different Laryngoscopes. *Turk J Anaesthesiol Reanim* 2018; 46(6): 434-40

First-Pass Success and Patient Outcomes[10]

Sakles et al (2015) analyzed the importance of first-pass success with the incidence of adverse events in a 4-year study of 1,828 patients receiving ETI in an academic Emergency Department setting.

Adverse events (AEs) included aspiration, oxygen desaturation, esophageal intubation, hypotension, dysrhythmia, and cardiac arrest.



Relatively **small incidence of AEs** with first-pass success. As number of attempts increase, incidence of AEs increase substantially.

10 Sakles JC, et al. The Importance of First Pass Success When Performing Orotracheal Intubation in the Emergency Department. *Acad Emerg Med.* 2013 January ; 20(1): 71–78

VL, First-Pass Success, and Patient Outcomes[11]

Pass et al (2023) reveals the recently published INTUBE study and DEVICE trial findings which both demonstrate the clear benefit of VL over DL in emergency and critical care.

>90%
overall first-pass success with VL

VL associated with **fewer overall complications**

Data strongly supports the **widespread and regular use of VL** to achieve first-pass success and decrease potential complications

11 Pass M, et al. Videolaryngoscopy in critical care and emergency locations: moving from debating benefit to implementation. British Journal of Anaesthesia (2023) 1-5

COVID -19 and Provider Safety[12]

The COVID – 19 pandemic changed our collective approach to airway management.

Approaches to advanced airway management must include a balance between **minimizing** time and number of attempts with **optimizing** both patient and provider safety and **increasing** First-Pass success.

Foley et al (2021) provided a statement by the Society of Airway Management regarding difficult airway management in adult COVID – 19 patients to optimize successful airway management while minimizing exposure risk.

VL is recommended as the first-line strategy and primary intubation approach for airway management for patients with COVID – 19 pneumonia.

12 Foley LJ, et al. Difficult Airway Management in Adult Coronavirus Disease 2019 Patients: Statement by the Society of Airway Management. *Anesth Analg* 2021;133:876–90

VL, First-Pass Success, and Patient Outcomes

- VL **improves glottic visualization and first-pass success rates** potentially decreasing hypoxia and subsequent hypoxic-related injury, respiratory failure, and cardiac arrest. [4-8]
- VL **decreases airway complications** such as adverse hemodynamic responses (tachycardia, HTN, pressure derangements), soft tissue trauma, dental trauma, cervical spine trauma, and inadvertent esophageal placement. [9-11]
- VL is currently the **most frequently used rescue technique** for failed / difficult intubation and has the **highest first-pass success rate** compared to all other traditional and alternative techniques in both pre-hospital and in-hospital settings.[4-8]

VL, First-Pass Success, and Patient Outcomes

Obviates the need for airway re-instrumentation – removal of an alternative rescue device and replacement with an ETT.

First-Pass Success with an ETT provides improved ventilation, oxygenation, PEEP, pulmonary clearance, waveform capnography, aspiration protection, and multiple ventilation modes.

First-Pass Success with VL provides additional provider safety when caring for patients with airborne / respiratory infections such as increased distance from airway, faster identification of glottic opening and decreased time / attempts for securing airway.

Summary

EMS providers are first responders who provide immediate basic and advanced airway management care

Advanced level EMS providers are strategically positioned to perform emergency advanced airway management such as endotracheal intubation.

Endotracheal intubation is considered the “gold standard” for advanced airway management in emergency medicine, critical care medicine, and anesthesia.

EMS providers have varying success with ETI and are frequently faced with difficult airways.

Summary

Both direct laryngoscopy (DL) and video laryngoscopy (VL) may be used by EMS to perform endotracheal intubation

Main goal is First-Pass Success

Preparation, Positioning, and Performance influence First-Pass Success

Evidence clearly shows that VL is superior to DL in achieving First-Pass Success in EMS

First-Pass Success may improve patient outcomes

The ideal VL device must be safe, efficient, reliable, portable, affordable, cost-effective, usable across all age groups, usable in any location or environment, and easy to teach and master compared to traditional direct laryngoscopy methods

Summary

The ***MOST IMPORTANT*** skill is to ***MANAGE THE AIRWAY!***

Bibliography

1. Miller's Anesthesia, 7th Edition (p 1251-5): 2009
2. Krage R, et al. Cormack–Lehane classification revisited. *British Journal of Anaesthesia* 105 (2): 220–7 (2010)
3. Moy HP, et al. Evidence-Based EMS: Endotracheal Intubation. EMS World, Jan 2015
4. Jarvis JL, McClure SF, Johns D. EMS Intubation Improves with King Vision Video Laryngoscopy. *Prehospital Emergency Care*, 19:4, 482-489
5. Eberlein CM, et al. First-Pass Success Intubations Using Video Laryngoscopy Versus Direct Laryngoscopy: A Retrospective Prehospital Ambulance Service Study. *Air Medical Journal* 38 (2019) 356–358
6. Li TL, et al. Video laryngoscopy is associated with improved first-pass intubation success compared with direct laryngoscopy in emergency department trauma patients. *JACEP* Open 2021;2:e12373.
7. Eismann H, et al. Improved success rates using videolaryngoscopy in unexperienced users: a randomized crossover study in airway manikins. *Eur J Med Res* (2017) 22:27
8. Garcia SI, et al. First-Attempt Intubation Success Among Emergency Medicine Trainees by Laryngoscopic Device and Training Year: A National Emergency Airway Registry Study. *Annals of Emergency Medicine* (2022) 1-9
9. Altun D, et al. Haemodynamic Response to Four Different Laryngoscopes. *Turk J Anaesthesiol Reanim* 2018; 46(6): 434-40
10. Sakles JC, et al. The Importance of First Pass Success When Performing Orotracheal Intubation in the Emergency Department. *Acad Emerg Med*. 2013 January; 20(1): 71–78
11. Pass M, et al. Videolaryngoscopy in critical care and emergency locations: moving from debating benefit to implementation. *British Journal of Anaesthesia* (2023) 1-5
12. Foley LJ, et al. Difficult Airway Management in Adult Coronavirus Disease 2019 Patients: Statement by the Society of Airway Management. *Anesth Analg* 2021;133:876–90
13. Apfelbaum JL, Hagberg CA, Connis RT, et al. 2022 American Society of Anesthesiologists Practice Guidelines for Management of the Difficult Airway. *Anesthesiology*. Jan 1 2022;136(1):31-81.
14. Chrimes N, Higgs A, Hagberg CA, et al. Preventing unrecognised oesophageal intubation: a consensus guideline from the Project for Universal Management of Airways and international airway societies. *Anaesthesia*. Dec 2022;77(12):1395- 1415.
15. Cook TM, El-Boghdadly K, McGuire B, McNarry AF, Patel A, Higgs A. Consensus guidelines for managing the airway in patients with COVID-19: Guidelines from the Difficult Airway Society, the Association of Anaesthetists the Intensive Care Society, the Faculty of Intensive Care Medicine and the Royal College of Anaesthetists. *Anaesthesia*. Jun 2020;75(6):785- 799.
16. Brewster DJ, Chrimes N, Do TB, et al. Consensus statement: Safe Airway Society principles of airway management and tracheal intubation specific to the COVID-19 adult patient group [published correction appears in Med J Aust. 2020 Oct;213(7):312]. *Med J Aust.* 2020;212(10):472-481.
17. Alhazzani W, Evans L, Alshamsi F, et al. Surviving Sepsis Campaign Guidelines on the Management of Adults With Coronavirus Disease 2019 (COVID-19) in the ICU: First Update. *Crit Care Med*. Mar 1 2021;49(3):e219-e234.
18. Kriege M, Noppens RR, Turkstra T. EMMA Trial Investigators Group. A multicentre randomised controlled trial of the McGrath™ Mac videolaryngoscope versus conventional laryngoscopy. *Anaesthesia*. 2023;78(6):722–729.