ASPA 2024

Neonatal Airway Management

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IRCCS Ist. G. Gaslini, University of Genoa, Italy

20th ASPA Conference & 3rd Paediatric Anaesthesia Meeting of MSPA

SAFE: Safe & Sustainable Anaesthesia for Every Child

11 - 14 July 2024

Borneo Convention Centre, Kuching (BCCK)

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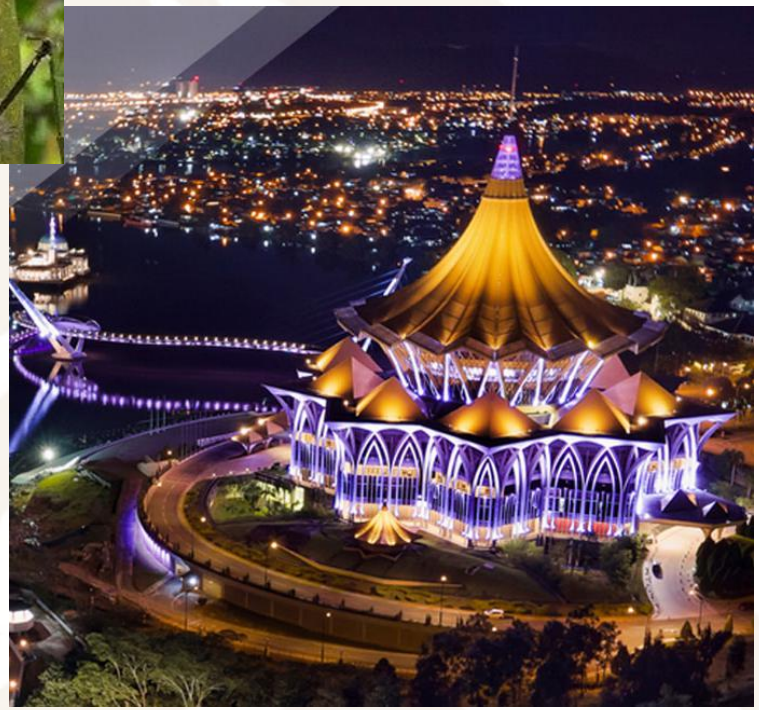
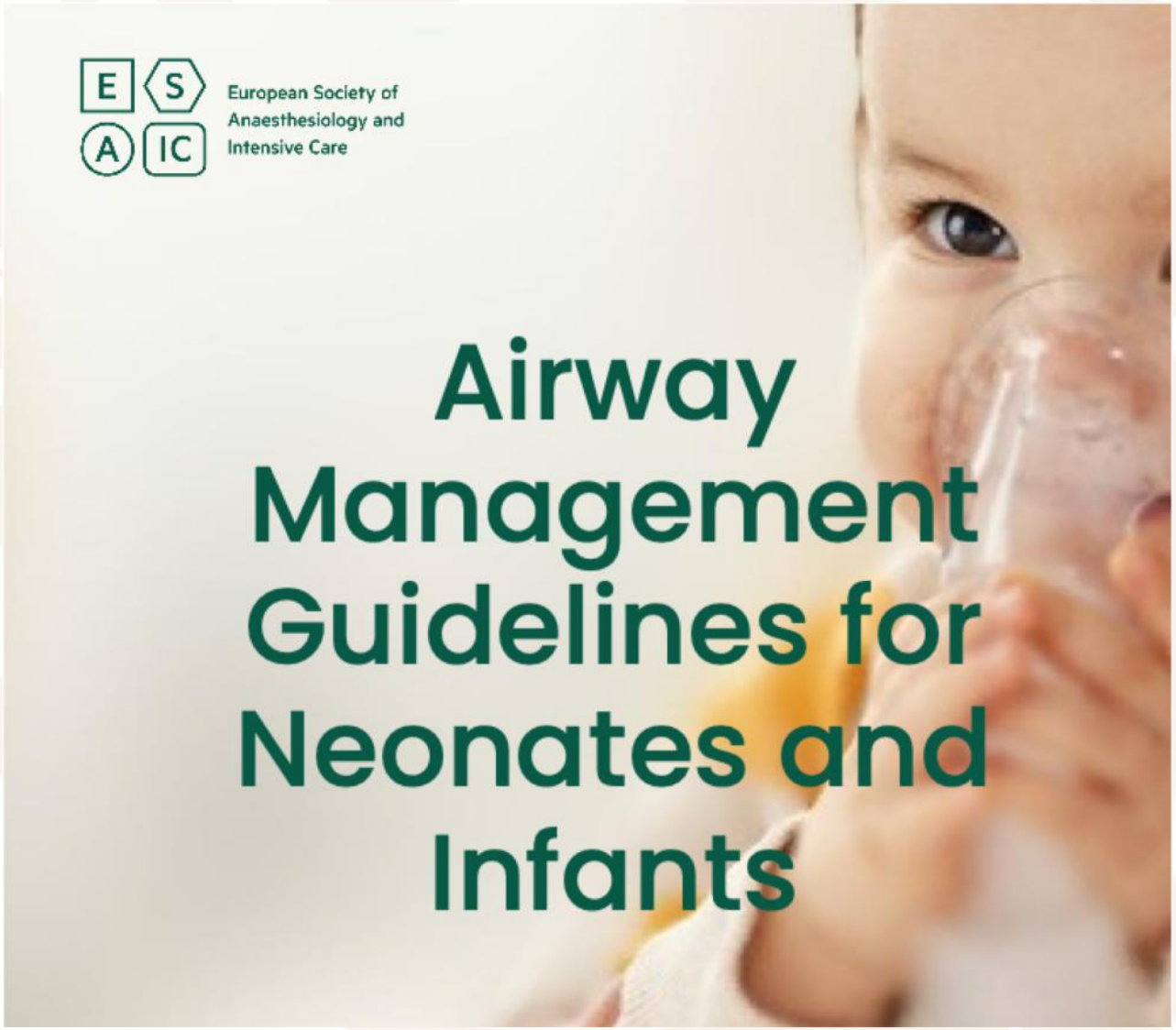




01 Plan

Share your plan and ensure equipment & expertise are available

02 Identify

Anticipate difficult airway management through medical history and physicalexamination

03 Oxygenate

Provide peri-procedural oxygen: From pre-oxygenation to apnoeic oxygenation

04 Anaesthetize and Paralyze

Provide adequate anaesthesia/sedation for all children and paralysis if spontaneous breathing is not required

05 Video Laryngoscopy

Videolaryngoscopy improves the first attempt success rate and can be used for teaching and feedback

06 Rescue

Supraglottic airway devices should be used as rescue for ventilation and oxygenation and for fibreoptic guided intubation

07 Tracheostomy & ECMO

Surgical tracheostomy and ECMO should be considered if oxygenation and ventilation are severely impaired and spontaneous respiration cannot be restored

08 Extubation

Planning for extubation is as important as for intubation

09 Human Factors

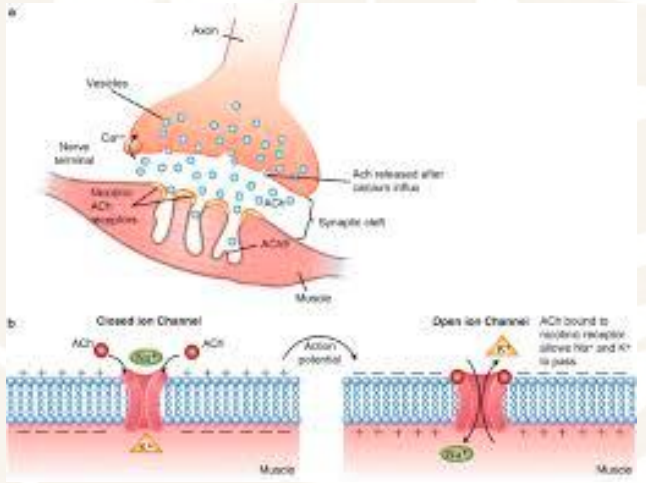
Identification of human factors improves communication and teamwork

PICO 1. Pre-operative airway assessment to predict difficulty

We <u>recommend</u> the use of medical history and physical examination to predict difficult airway management in neonates and infants. (1C)

PICO 2. Pharmacology

- We <u>recommend</u> **adequate level of sedation or general anaesthesia** in during airway management (1B).
- We <u>recommend</u> **neuromuscular blockade** prior to tracheal intubation, when spontaneous breathing is not necessary (1C).



PICO 3. Tracheal intubation

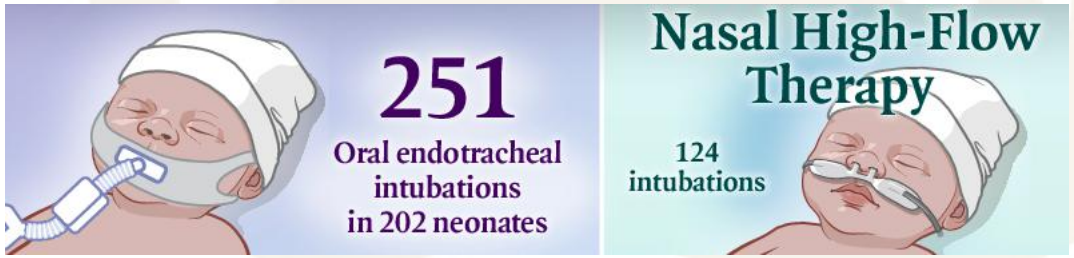
- R: We recommend **video-laryngoscopy** as **first choice** for tracheal intubation of neonates and infants (1B), including for tracheal intubation in the lateral position (1C)
- CPS: Video-laryngoscopy should also be used for **teaching** purposes using a “dual approach”.

First-attempt success rate of video laryngoscopy in small infants (**VISI**). Lancet. 2020;396(10266):1905-1913.

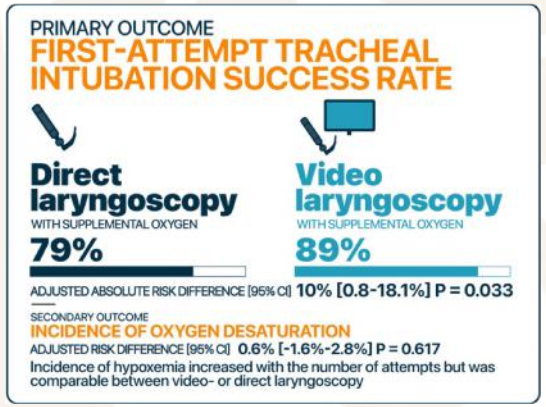
Direct vs video laryngoscopy and supplemental oxygen for neonatal and infant intubation (**OPTIMISE**). Lancet Child Adolesc Health. 2023;7(2):101-111.

Apnoeic oxygenation

We recommend the use of apnoeic oxygenation during tracheal intubation in neonates (1B), and in older children when they are at risk of hypoxemia



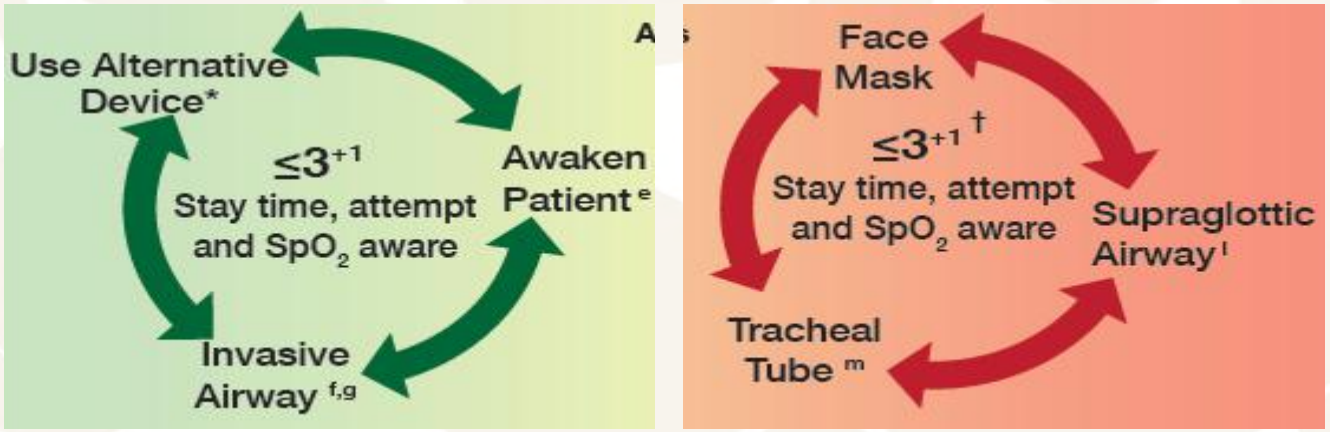
N Engl J Med. 2022 Apr 28;386(17):1627-1637.



Lancet Child Adolesc Health. 2023;7(2):101-111.

PICO 4. Difficult intubation

- We <u>recommend</u> limiting the number of tracheal intubation attempts (3+1), by reassessing the clinical condition and by considering a change to a different technique and/or a different provider after every single attempt (1C).



PICO 5. Confirmation of tracheal intubation

- We recommend the immediate verification of successful intubation with both clinical assessment and end-tidal carbon dioxide ($EtCO_2$).

- A “second look” with videolaryngoscopy in complex patients, if the above is not enough (1C)

PICO 6. Strategies for extubation

- We suggest to assess clinical signs to predict successful extubation. (2C). Equipment for re-intubation should be immediately available at extubation, and an extubation plan is in place



Road to Excellence

1. Apnoeic oxygenation

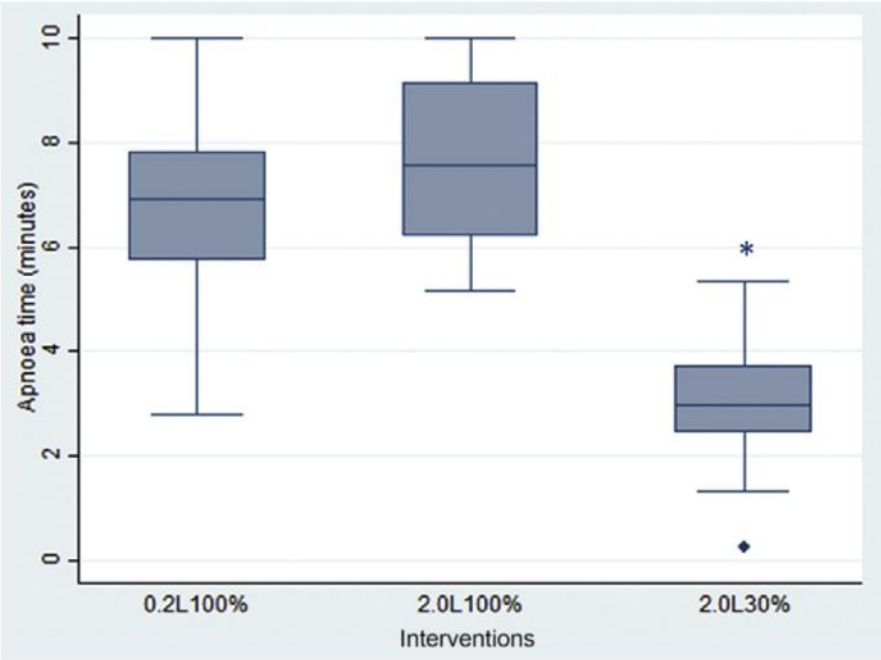
High-flow vs low-flow

Transnasal humidified rapid insufflation ventilatory exchange for oxygenation of children during apnoea: a prospective randomised controlled trial

T. Riva[1,#], T. H. Pedersen[1,*,#], S. Seiler[1], N. Kasper[1], L. Theiler[1], R. Greif[1] and M. Kleine-Brueggeney[1,2]

[1]Department of Anaesthesiology & Pain Therapy, Bern University Hospital, Inselspital, Freiburgstrasse 8, 3010 Bern, Switzerland and [2]Department of Anaesthesia, Evelina London Children's Hospital, Guy's and St. Thomas' NHS Foundation Trust, London, UK

- 1-6 years, 10-20kg



	Low-flow 100% O_2 0.2 litres kg^{-1} min^{-1} (n=18)	THRIVE 100% O_2 2.0 litres kg^{-1} min^{-1} (n=20)	THRIVE 30% O_2 2.0 litres kg^{-1} min^{-1} (n=20)	P-value
Apnoea time reaching 10 min	2 (11)	4 (20)	0 (0)	<0.001*
Transcutaneous CO_2 65 mmHg	13 (72)	16 (80)	0 (0)	
SpO_2 95%	3 (17)	0 (0)	20 (100)	

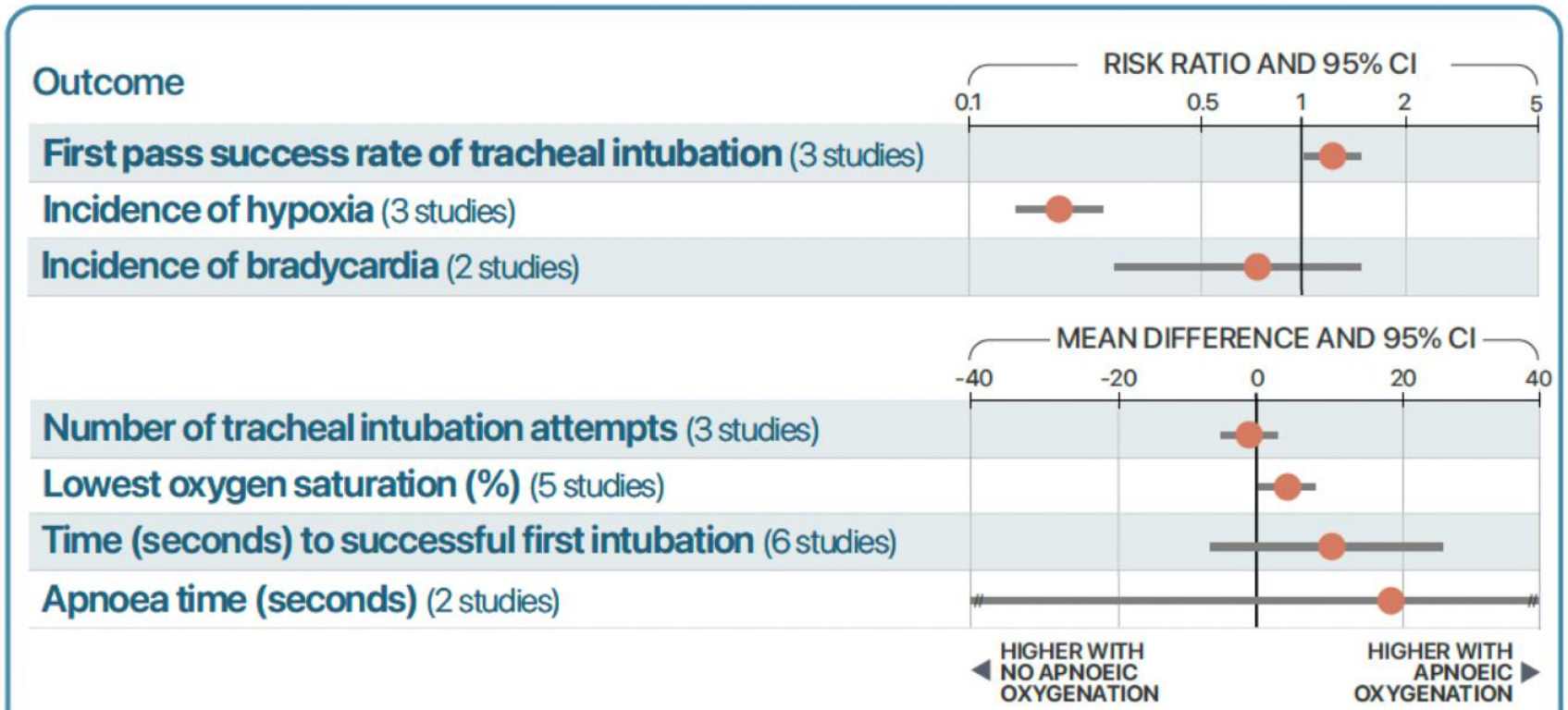
Apnoeic oxygenation during paediatric tracheal intubation: a systematic review and meta-analysis

Alexander Fuchs[1,2,*,†], Gabriela Koepp[1,†], Markus Huber[1], Jonas Aebli[1], Arash Afshari[3], Rachele Bonfiglio[2], Robert Greif[4,5], Andrea C. Lusardi[2], Carolina S. Romero[6], Marc von Gernler[7], Nicola Disma[2,‡] and Thomas Riva[1,‡]

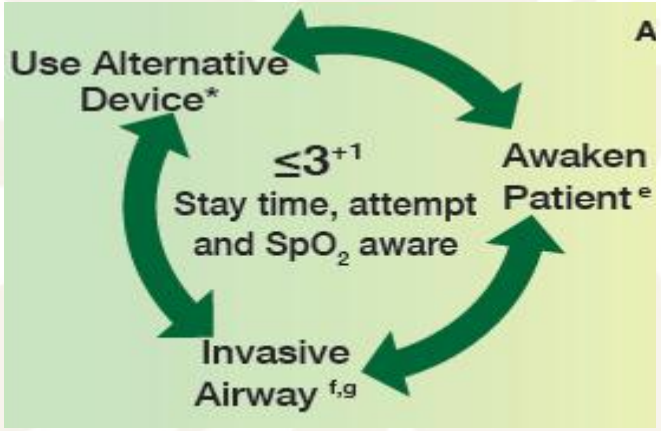
15 studies included
- 10 randomised
- 4 pre-post studies
- 1 prospective observational

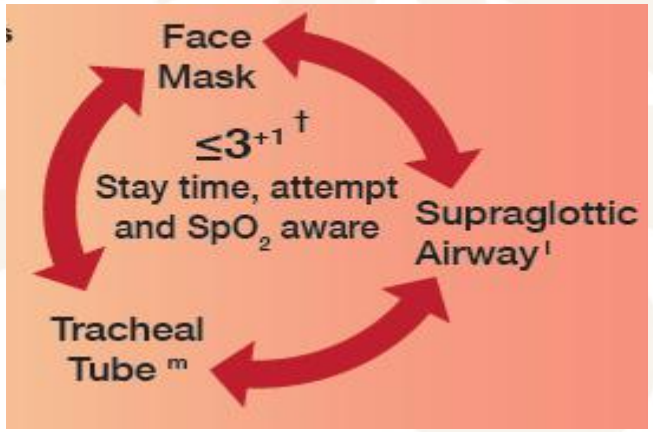
8 randomised trials included in meta-analysis

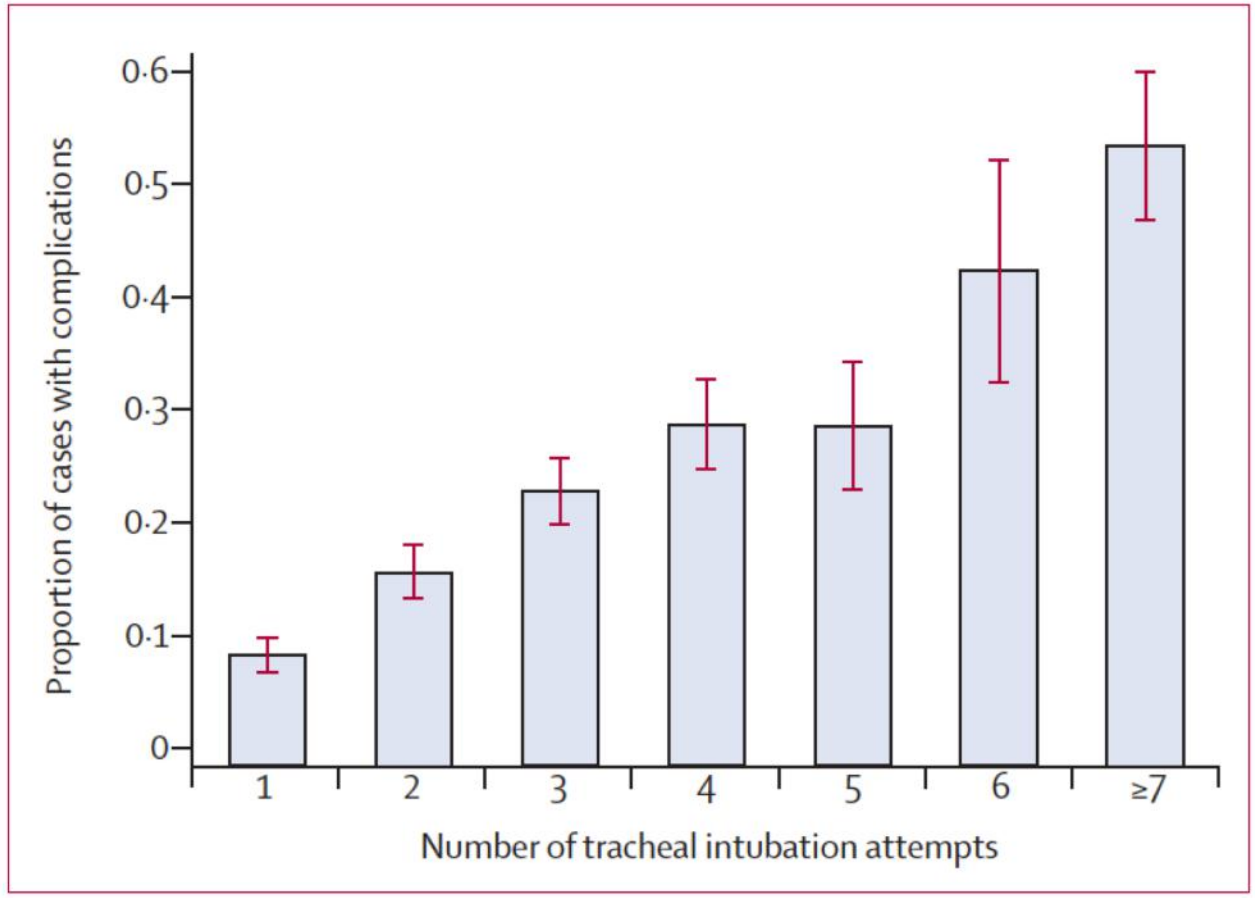
9,802 paediatric patients (age<16 years) requiring tracheal intubation



2. Limit the number of attempts

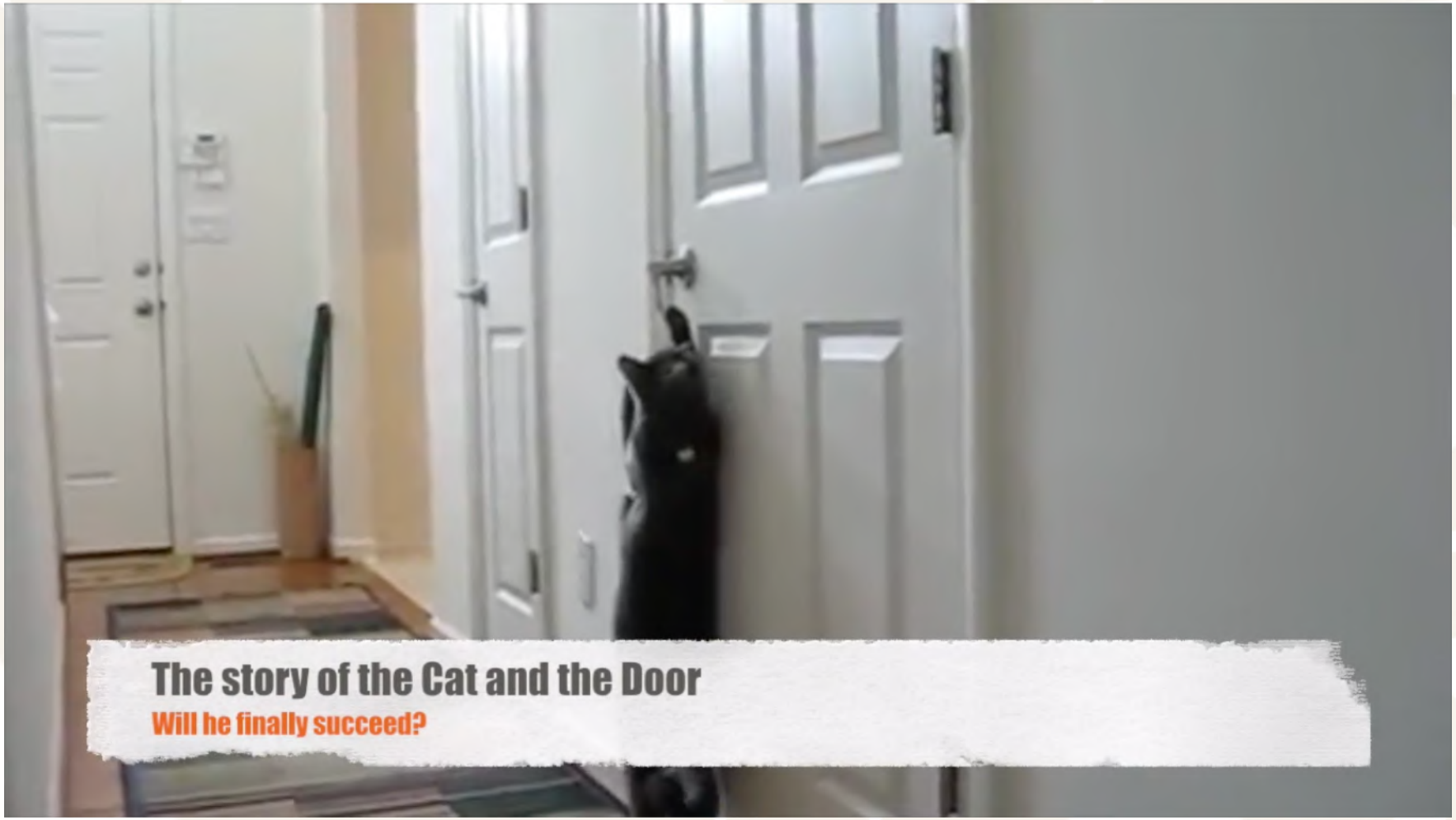






Lancet Respir Med 2016; 4: 37–48

Perseverance is not always your friend



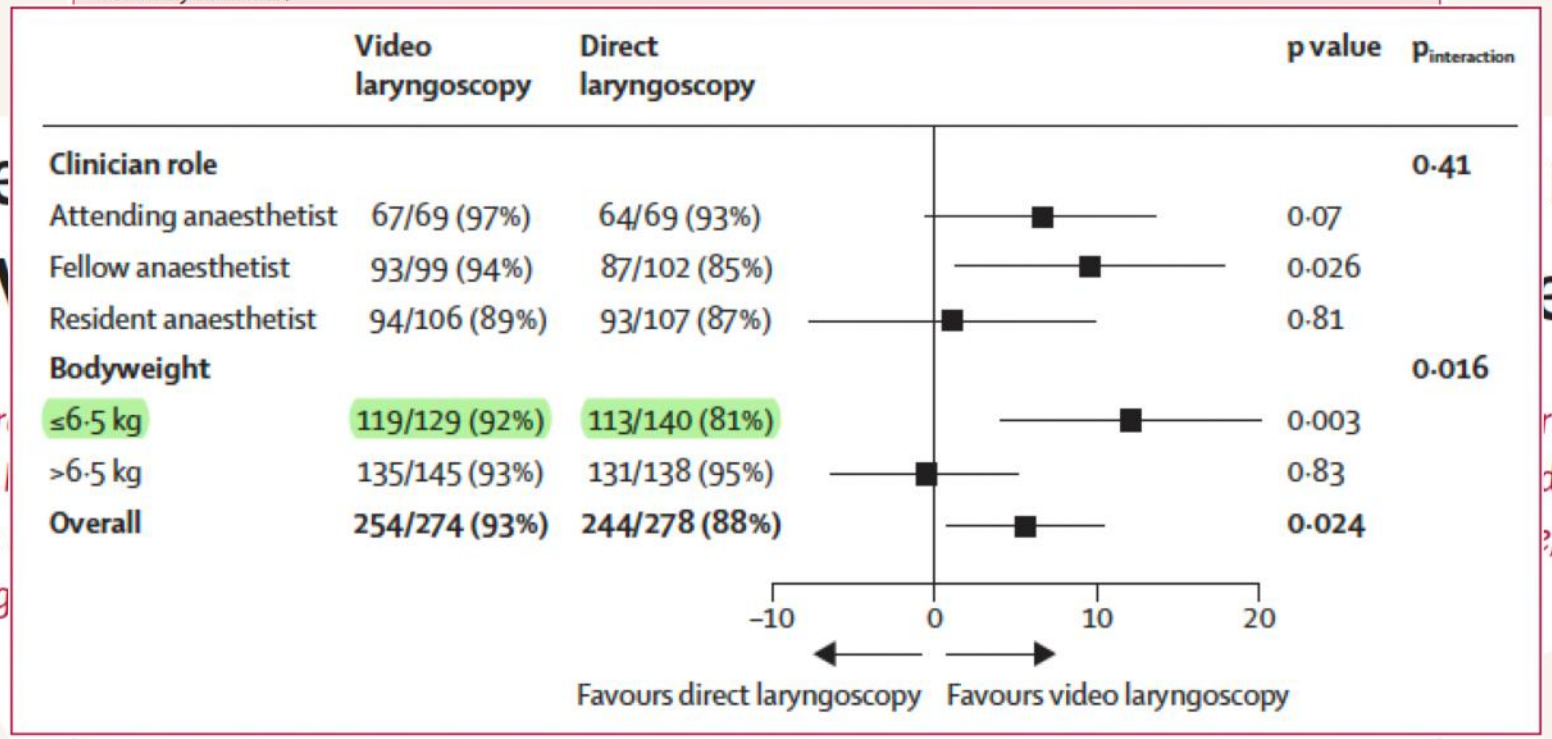
3. VL vs DL

Vs

First-atte … n small infants (V … ed trial

Annery G Garcia-Mar … r Sathyamoorthy, Adolfo Gonzalez, Siri … d Sommerfield, Heather Griffis, Akira … e, on behalf of the PeDI Collaborative investig…

	All patients (n=552)	Video laryngoscopy (n=274)	Direct laryngoscopy (n=278)	Adjusted absolute risk difference (95% CI)*	p value
Successful first-attempt intubation					
Modified Intention-to-treat analysis	498 (90%)	254 (93%)	244 (88%)	5·5 (0·7 to 10·3)	0·024
Per-protocol analysis	496/550 (90%)	252/272 (93%)	244/278 (88%)	5·4 (0·6 to 10·2)	0·028
Secondary outcomes†					
Yes	91 (17%)	30 (11%)	61 (22%)	..	..
Unknown**	162 (30%)	82 (30%)	80 (29%)	..	..



Data are n (%) or n/N (%), unless otherwise indicated. POGO=percentage of glottic opening. GEE=generalised estimating equation. *GEE models with exchangeable working correlation structures were used to adjust for clustering of patient outcomes within the same clinician and site. Imbalanced variables (ie, gestational age), stratification variables (ie, site identification and clinician role), and a priori variables (ie, American Society of Anesthesiologists physical status and weight group) were included as covariates in the model. †Secondary outcome results are exploratory. ‡Defined as lowest oxygen saturation less than 90%. §Defined as lowest oxygen saturation less than 90% but greater than 80%. ¶Defined as lowest oxygen saturation 80% or less but greater than 50%. ||Defined as lowest oxygen saturation 50% or less. **Unknown values for cricoid or laryngeal pressure use were not included in the adjusted GEE model.

Table 2: **Primary and secondary outcomes by assigned treatment groups**

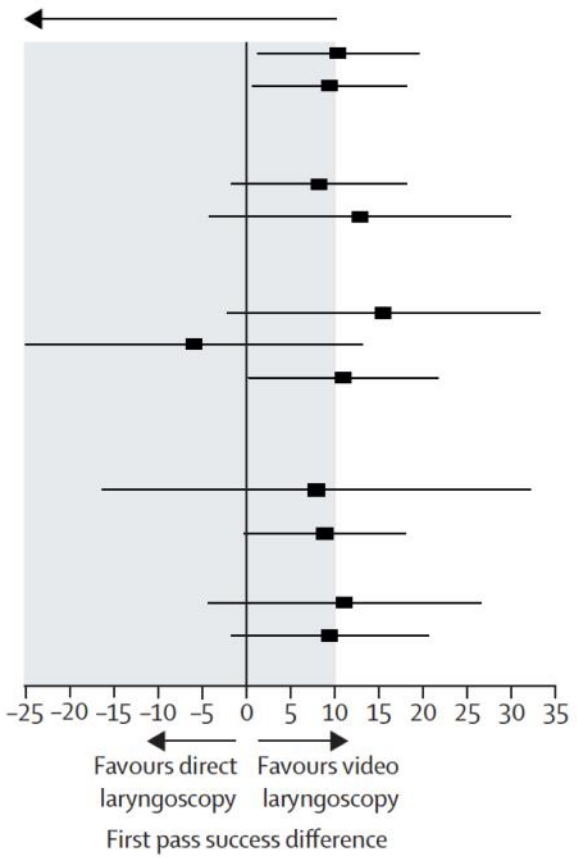
Direct versus video laryngoscopy with standard blades for neonata oxygen controll

Thomas Riva, Tho
Walid Habre, Mark
OPTIMISE Collabo

Lancet Child Adolesc

Published Online
November 24, 2022
https://doi.org/10.10

	Number of patients with first-attempt success rate/number of patients (%)		Adjusted 95% CI	p value	$p_{interaction}$
	Direct laryngoscopy	Video laryngoscopy			
All patients					
Unadjusted	97/123 (79%)	108/121 (89%)	10·4% (1·3% to 19·5%)	0·025	
Adjusted	97/123 (79%)	108/121 (89%)	9·5% (0·8% to 18·1%)	0·033	
Technique of choice					0·59
Oral intubation	75/95 (79%)	87/98 (89%)	8·2% (−1·6% to 18·1%)	0·101	
Nasal intubation	22/28 (79%)	21/23 (91%)	12·9% (−4·2% to 29·9%)	0·139	
Operator's experience					0·22
Trainee or registrar	25/35 (71%)	30/34 (88%)	15·6% (−2·1% to 33·2%)	0·084	
<5 years experience	21/24 (88%)	19/23 (83%)	−5·9% (−24·9% to 13·1%)	0·543	
≥5 years experience	51/64 (80%)	59/64 (92%)	11·0% (0·3% to 21·7%)	0·044	
Birthweight					0·53
<2·5 kg	20/30 (67%)	15/20 (75%)	8·0% (−16·3% to 32·2%)	0·520	
≥2·5 kg	77/93 (83%)	93/101 (92%)	8·9% (−0·1% to 18·0%)	0·054	
Age at birth					0·99
<37 weeks	35/46 (76%)	35/40 (88%)	11·2% (−4·2% to 26·6%)	0·156	
≥37 weeks	62/77 (81%)	73/81 (90%)	9·5% (−1·6% to 20·6%)	0·094	



Video versus Direct Laryngoscopy for Urgent Intubation of Newborn Infants

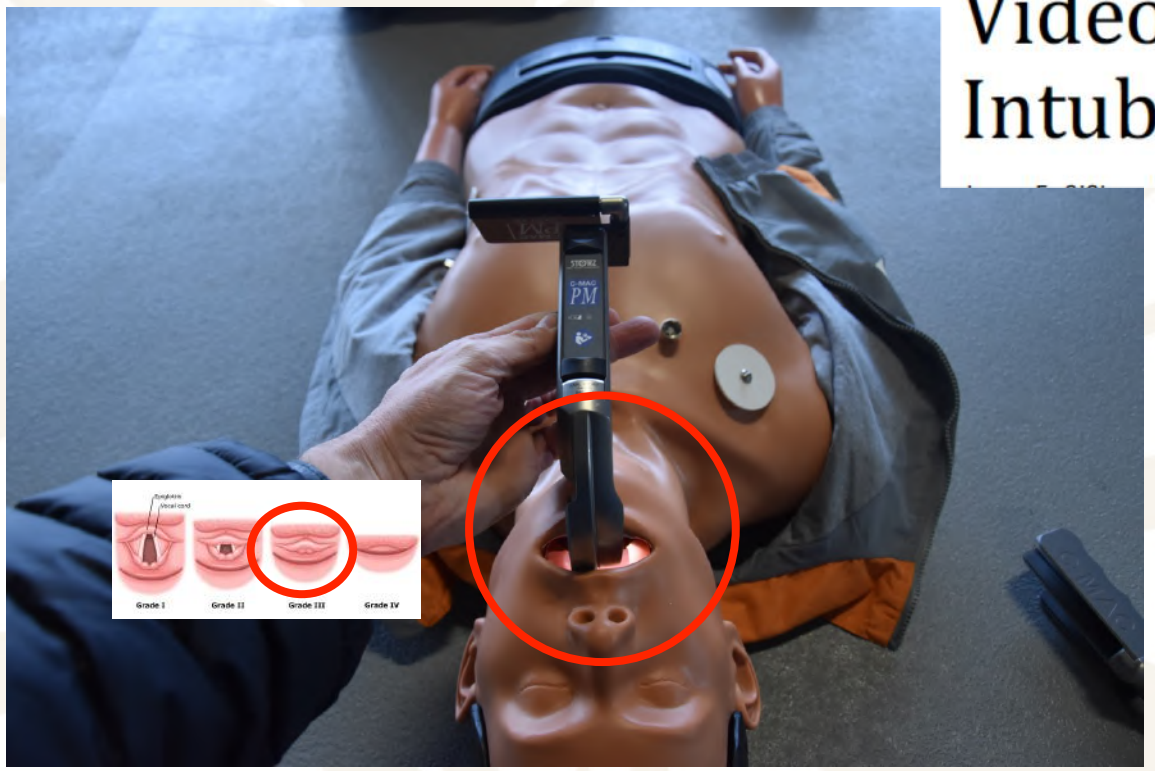
Lucy E. Geraghty, M.B., Emma A. Dunne, M.B., Ph.D., Caitríona M. Ní Chathasaigh, M.B., Akke Vellinga, Ph.D., Niamh C. Adams, M.B., Eoin M. O'Currain, M.B., Ph.D., Lisa K. McCarthy, M.B., Ph.D., and Colm P.F. O'Donnell, M.B., Ph.D.

This article was published on May 5, 2024, at NEJM.org.

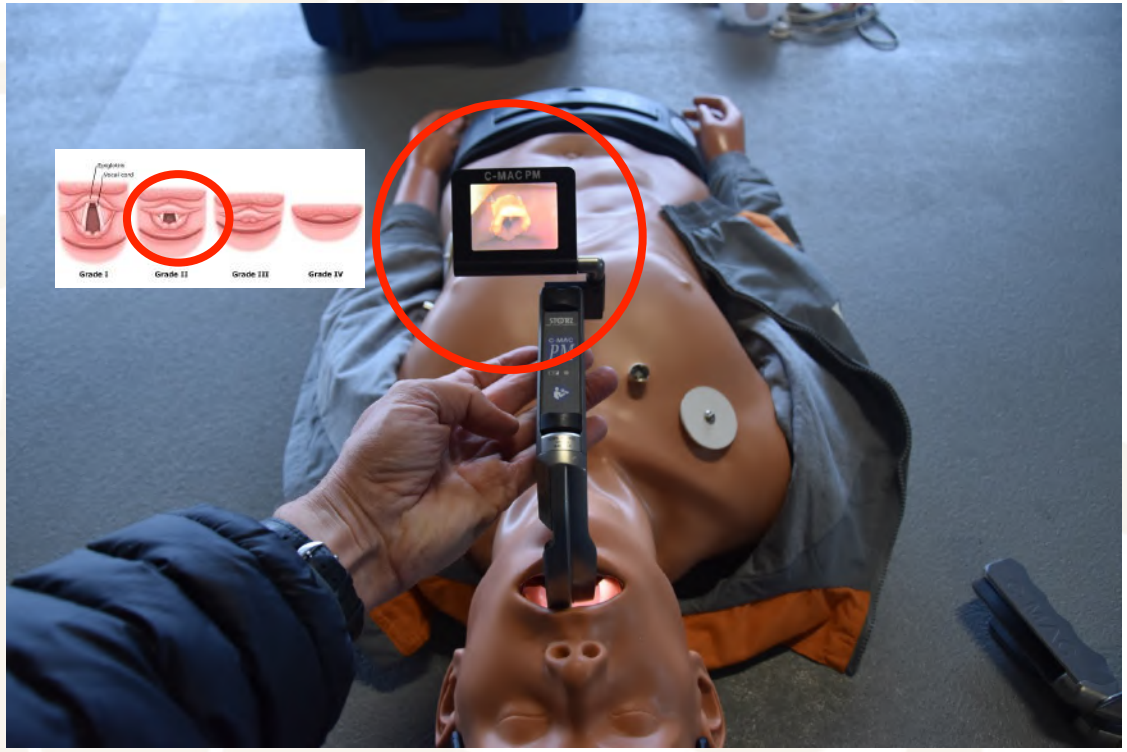
Outcome	Video-Laryngoscopy Group (N=107)	Direct-Laryngoscopy Group (N=107)
Primary outcome: successful intubation on first attempt (overall)		
No. of patients	79	48
Percentage of patients (95% CI)	74 (66–82)	45 (35–54)
P value for video laryngoscopy vs. direct laryngoscopy	<0.001	—

Outcome	Video-Laryngoscopy Group (N=107)	Direct-Laryngoscopy Group (N=107)
Oxygen saturation		
No. of patients assessed	98	100
Median lowest oxygen saturation during procedure (95% CI) — %	74 (65–78)	68 (62–74)
<90% — % of patients*	74 (65–82)	90 (84–96)
<80% — % of patients*	61 (52–71)	75 (66–84)
<70% — % of patients*	45 (35–55)	53 (43–63)

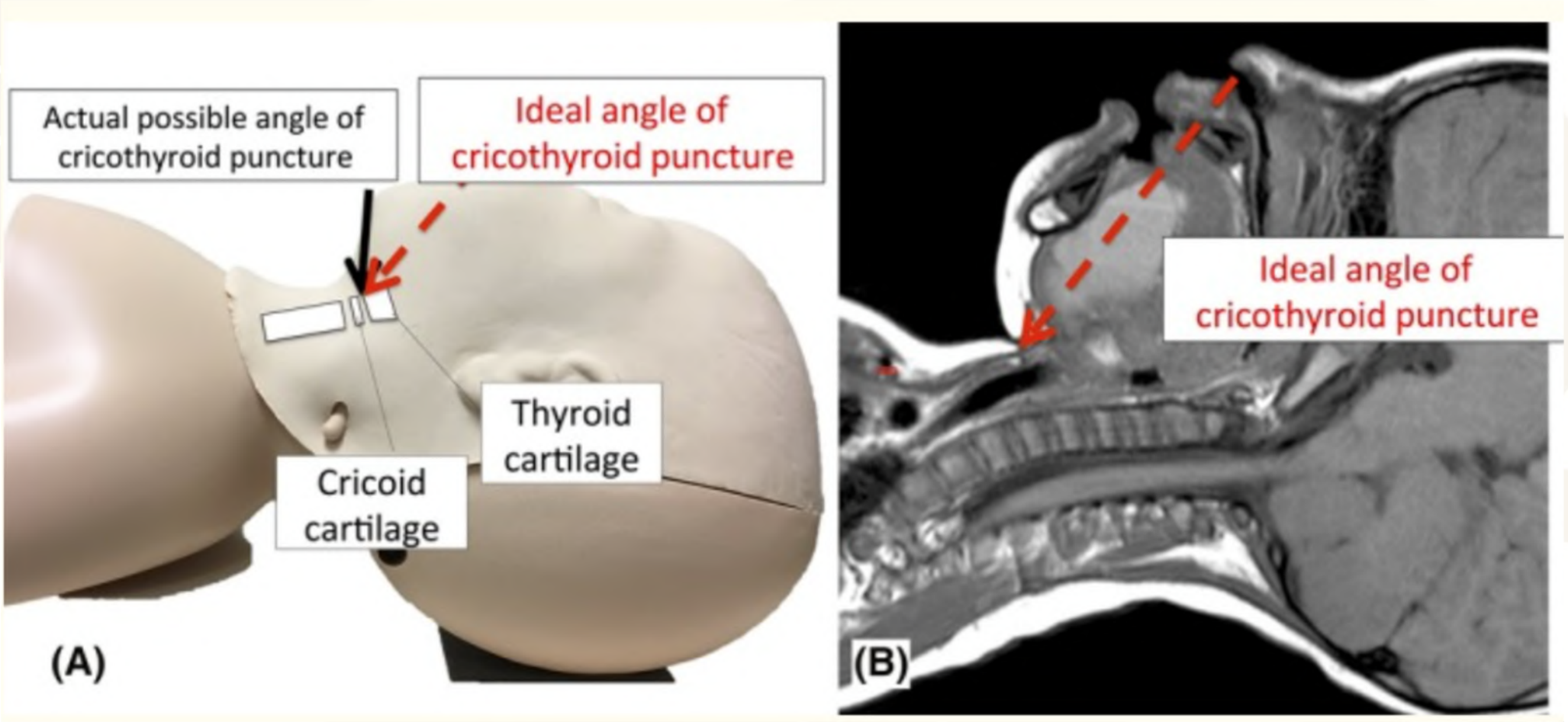
3. Use technology for teaching



Videolaryngoscopy to Teach Neonatal Intubation: A Randomized Trial



4. CICO management



Methods

“Rapid Sequence Tracheotomy” RST

Ulmer et al, 2019

SCAN ME

Skin incision + trachea preparation (blade #10)

Luxation of the trachea with 3rd backhaus clamp

Tracheal puncture with tip-scissors of no more than 2 tracheal rings

Insertion of the tracheal tube

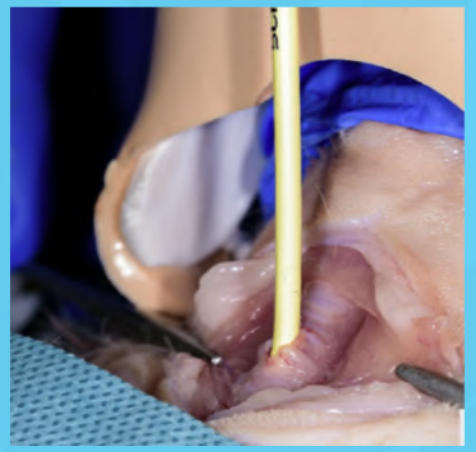
“Scalpel Bougie Tracheotomy” SBT

Both et al, 2021

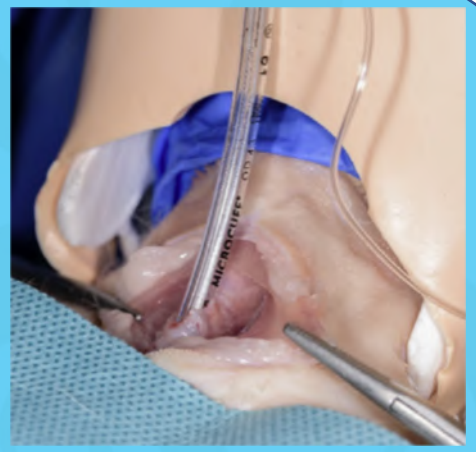
SCAN ME

Skin incision + trachea preparation (blade #11)

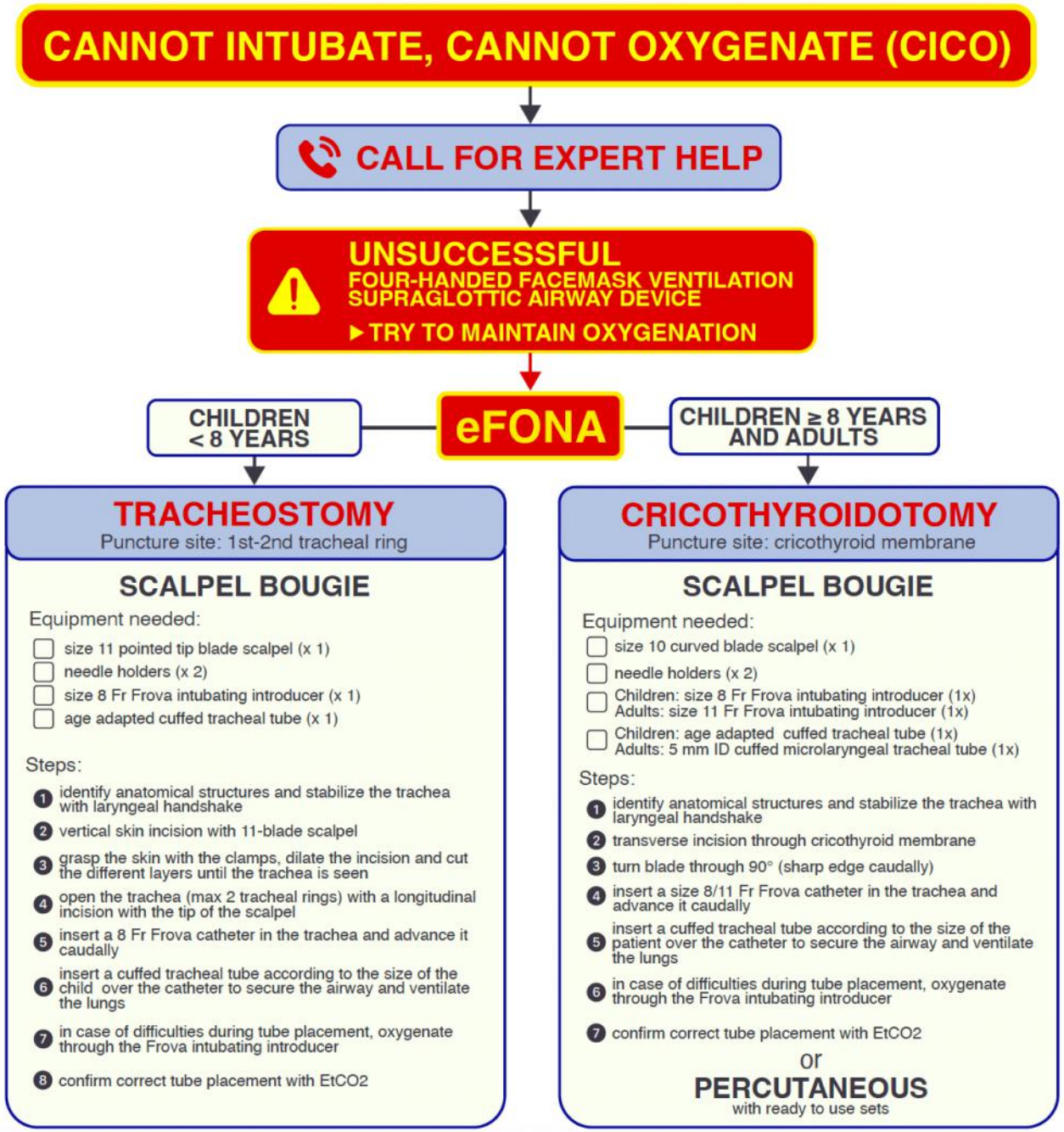
Tracheal puncture with a scalpel (blade #11)



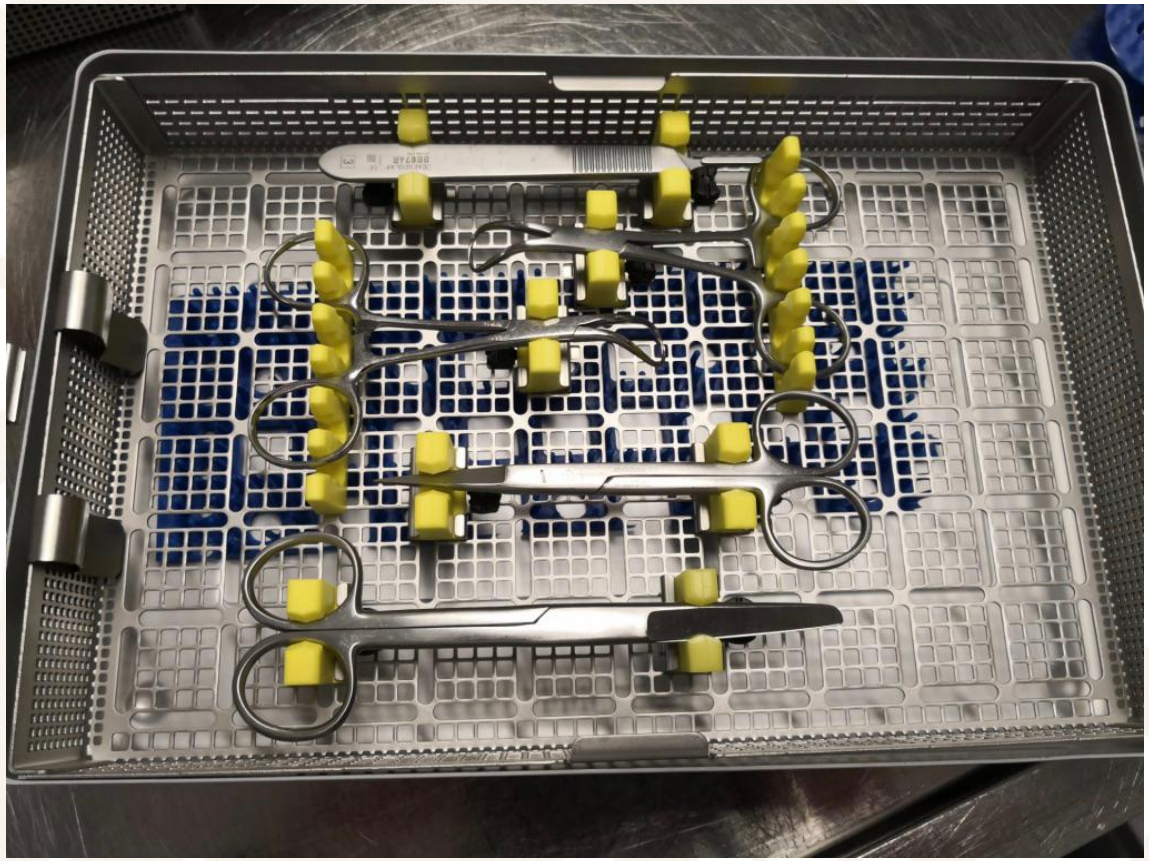
8 Fr Frova catheter is inserted



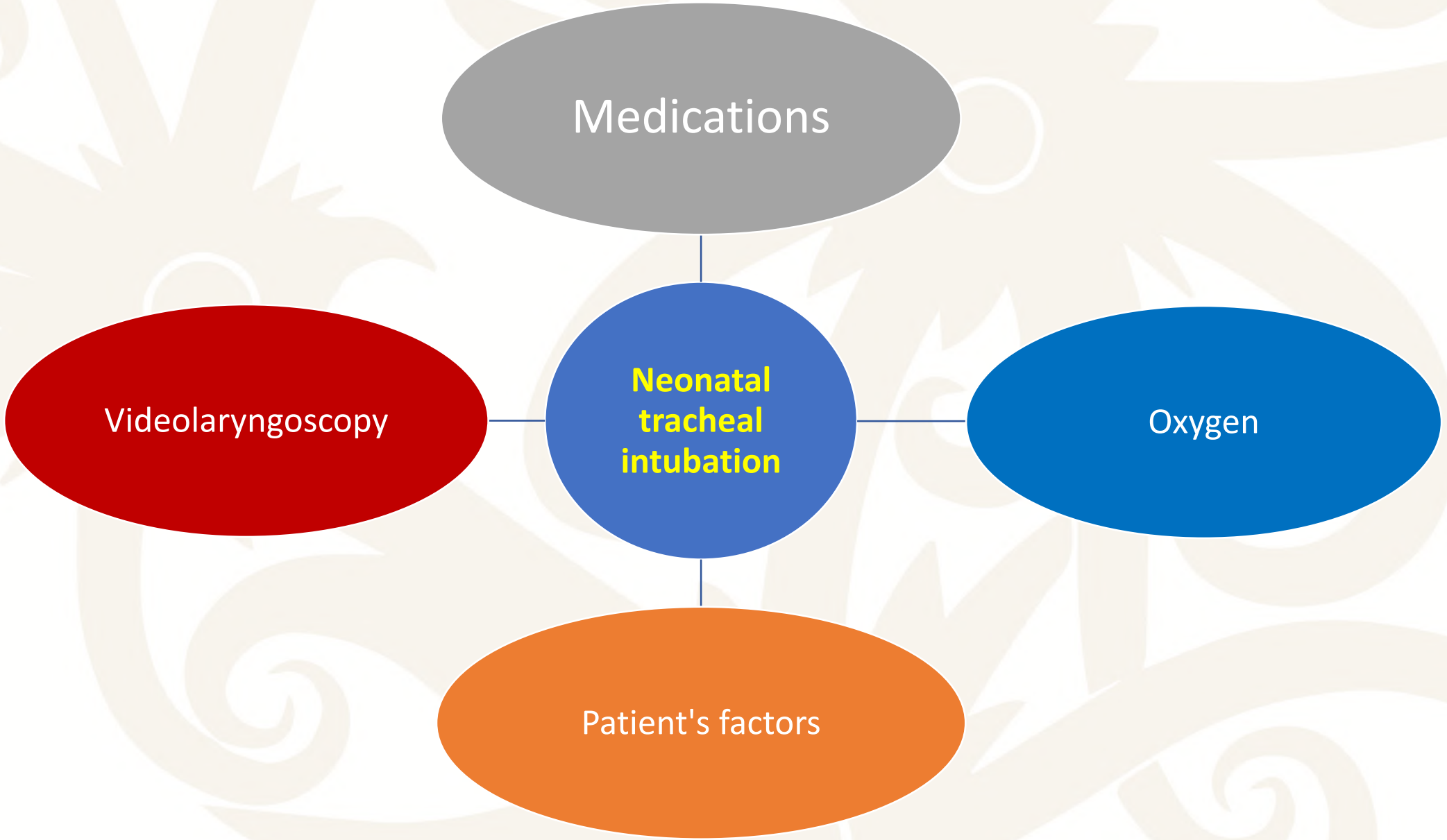
Insertion of the tracheal tube

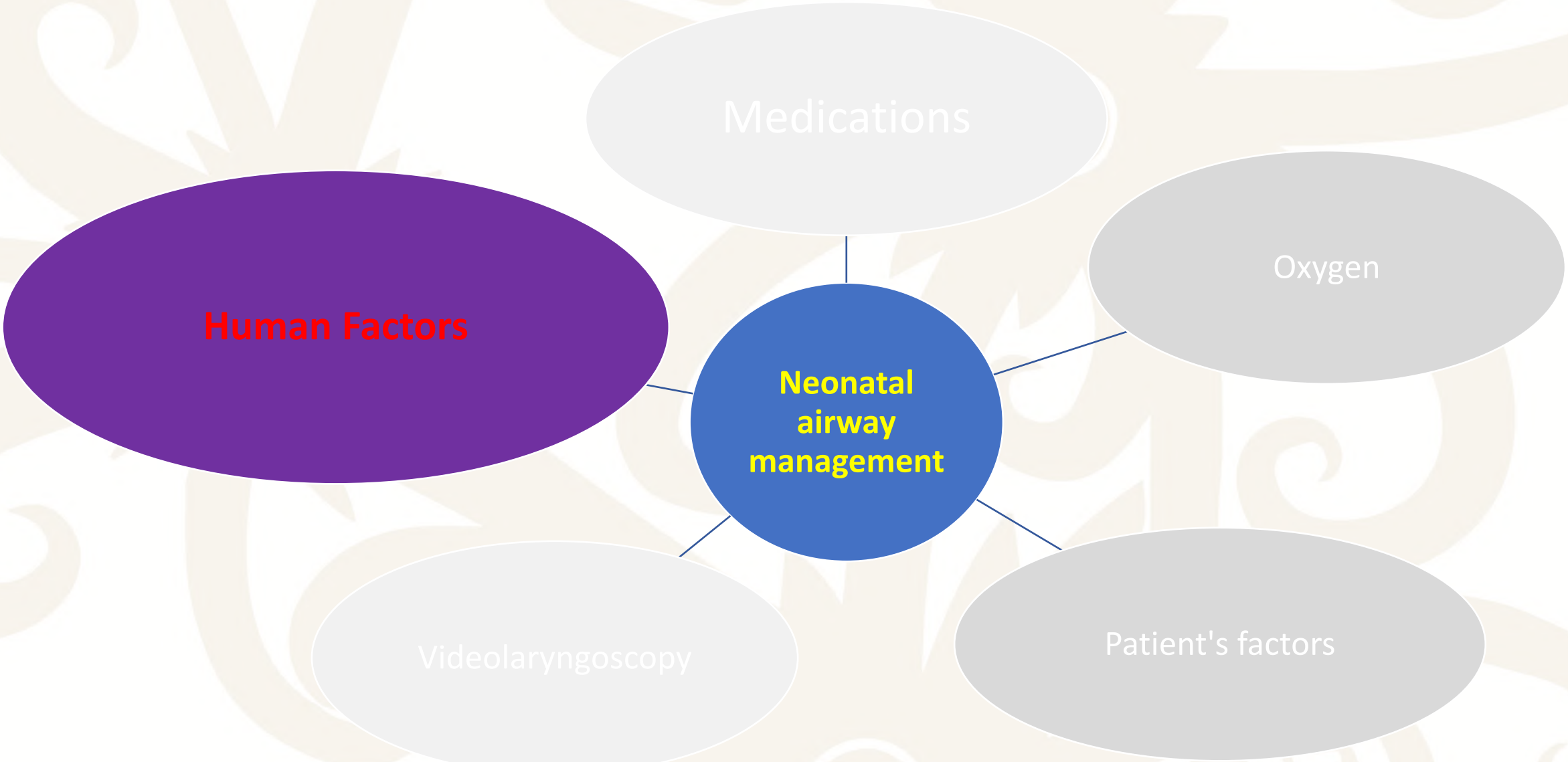

CANNOT INTUBATE, CANNOT OXYGENATE (CICO)
CALL FOR EXPERT HELP
UNSUCCESSFUL
FOUR-HANDED FACEMASK VENTILATION
SUPRAGLOTTIC AIRWAY DEVICE
▶TRY TO MAINTAIN OXYGENATION
CHILDREN < 8 YEARS
eFONA
CHILDREN ≥ 8 YEARS AND ADULTS
TRACHEOSTOMY
Puncture site: 1st-2nd tracheal ring
SCALPEL BOUGIE
Equipment needed:
size 11 pointed tip blade scalpel (x 1)
needle holders (x 2)
size 8 Fr Frova intubating introducer (x 1)
age adapted cuffed tracheal tube (x 1)
Steps:
1 identify anatomical structures and stabilize the trachea with laryngeal handshake
2 vertical skin incision with 11-blade scalpel
3 grasp the skin with the clamps, dilate the incision and cut the different layers until the trachea is seen
4 open the trachea (max 2 tracheal rings) with a longitudinal incision with the tip of the scalpel
5 insert a 8 Fr Frova catheter in the trachea and advance it caudally
6 insert a cuffed tracheal tube according to the size of the child over the catheter to secure the airway and ventilate the lungs
7 in case of difficulties during tube placement, oxygenate through the Frova intubating introducer
8 confirm correct tube placement with EtCO2
CRICOTHYROIDOTOMY
Puncture site: cricothyroid membrane
SCALPEL BOUGIE
Equipment needed:
size 10 curved blade scalpel (x 1)
needle holders (x 2)
Children: size 8 Fr Frova intubating introducer (1x)
Adults: size 11 Fr Frova intubating introducer (1x)
Children: age adapted cuffed tracheal tube (1x)
Adults: 5 mm ID cuffed microlaryngeal tracheal tube (1x)
Steps:
1 identify anatomical structures and stabilize the trachea with laryngeal handshake
2 transverse incision through cricothyroid membrane
3 turn blade through 90° (sharp edge caudally)
4 insert a size 8/11 Fr Frova catheter in the trachea and advance it caudally
5 insert a cuffed tracheal tube according to the size of the patient over the catheter to secure the airway and ventilate the lungs
6 in case of difficulties during tube placement, oxygenate through the Frova intubating introducer
7 confirm correct tube placement with EtCO2
or
PERCUTANEOUS
with ready to use sets

Emergency tracheotomy set



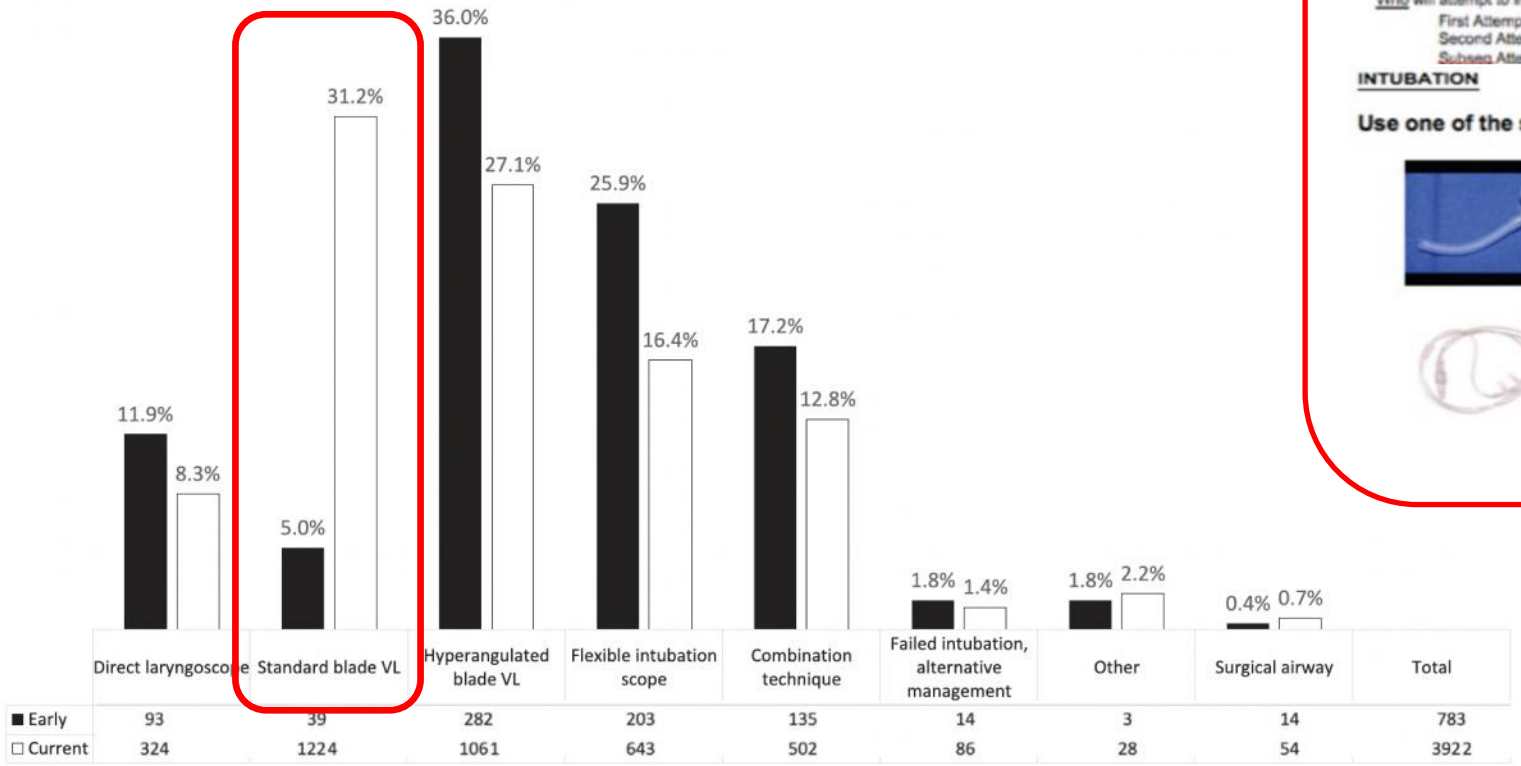
Human factors and paediatric competencies


Medications
Videolaryngoscopy
Neonatal tracheal intubation
Oxygen
Patient's factors

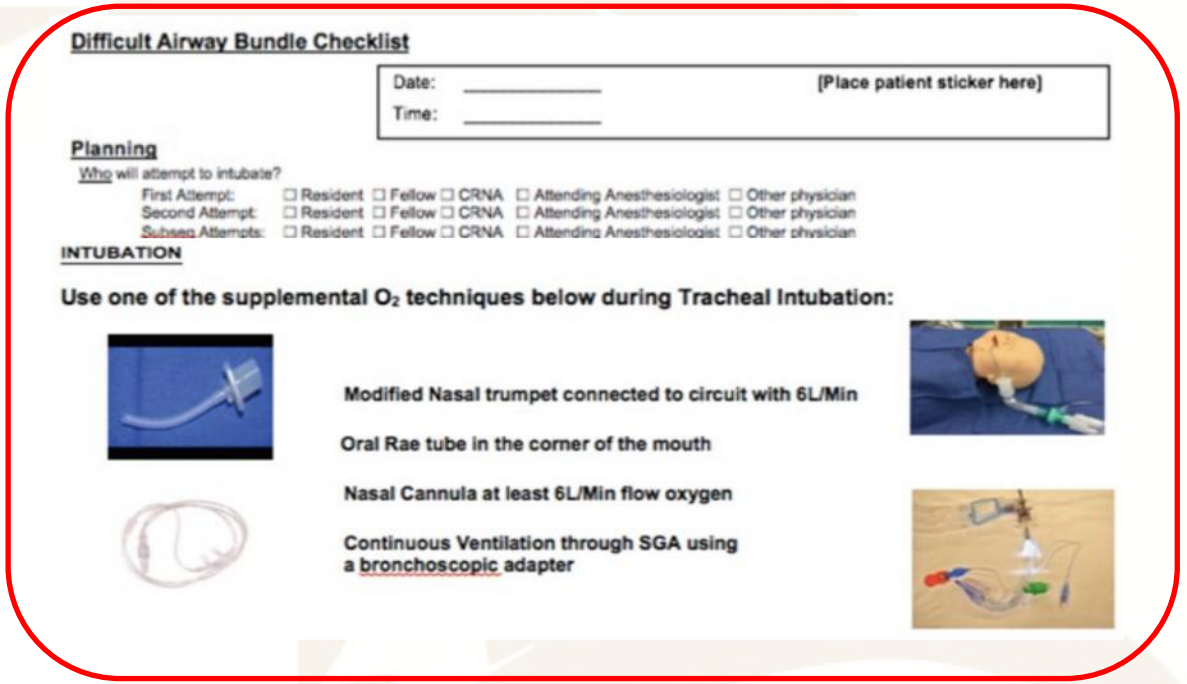

Medications
Human Factors
Neonatal airway management
Oxygen
Videolaryngoscopy
Patient's factors

Airway management in the paediatric difficult intubation registry: a propensity score matched analysis of outcomes over time

Mary Lyn Stein,[a,*] Lina Andrea Sarmiento Argüello,[b] Steven J. Staffa,[a] Julia Heunis,[c] Chinyere Egbuta,[a] Stephen G. Flynn,[a] Sabina A. Khan,[d] Stefano Sabato,[e] Brad M. Taicher,[f] Franklin Chiao,[g] Adrian Bosenberg,[h] Angela C. Lee,[i] H. Daniel Adams,[j] Britta S. von Ungern-Sternberg,[k] Raymond S. Park,[a] James M. Peyton,[a] Patrick N. Olomu,[l] Agnes I. Hunyady,[h] Annery Garcia-Marcinkiewicz,[m] John E. Fiadjoe,[a,n] and Pete G. Kovatsis,[a,n] for the PeDI Collaborative Investigators



	Direct laryngoscope	Standard blade VL	Hyperangulated blade VL	Flexible intubation scope	Combination technique	Failed intubation, alternative management	Other	Surgical airway	Total
■ Early	93	39	282	203	135	14	3	14	783
□ Current	324	1224	1061	643	502	86	28	54	3922



Difficult Airway Bundle Checklist

Date: _____ [Place patient sticker here]
Time: _____

Planning

Who will attempt to intubate?

First Attempt: ☐ Resident ☐ Fellow ☐ CRNA ☐ Attending Anesthesiologist ☐ Other physician
Second Attempt: ☐ Resident ☐ Fellow ☐ CRNA ☐ Attending Anesthesiologist ☐ Other physician
Subseq Attempts: ☐ Resident ☐ Fellow ☐ CRNA ☐ Attending Anesthesiologist ☐ Other physician

INTUBATION

Use one of the supplemental O_2 techniques below during Tracheal Intubation:

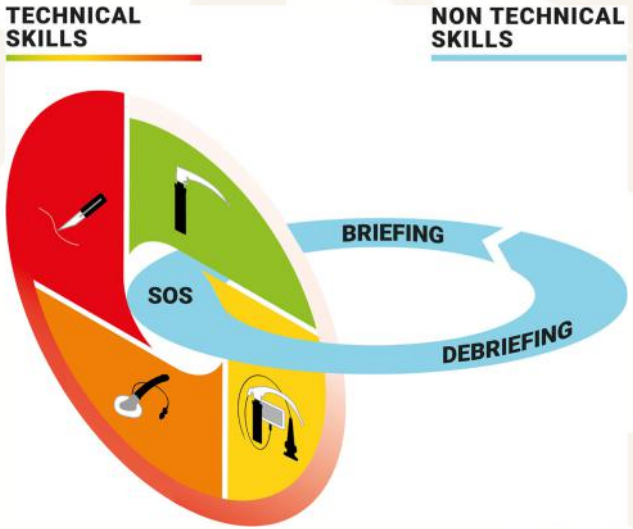
Modified Nasal trumpet connected to circuit with 6L/Min

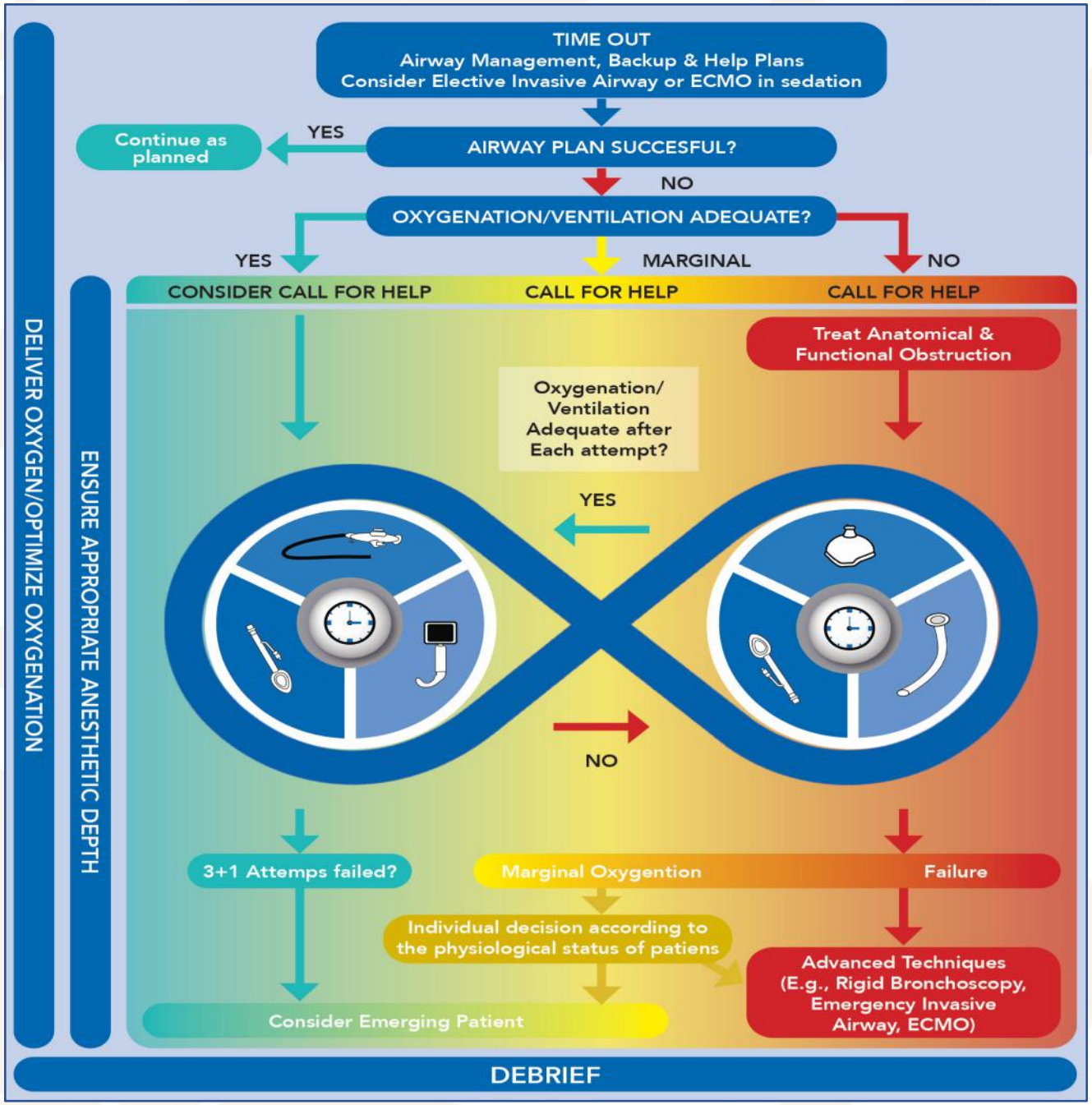
Oral Rae tube in the corner of the mouth

Nasal Cannula at least 6L/Min flow oxygen

Continuous Ventilation through SGA using a bronchoscopic adapter

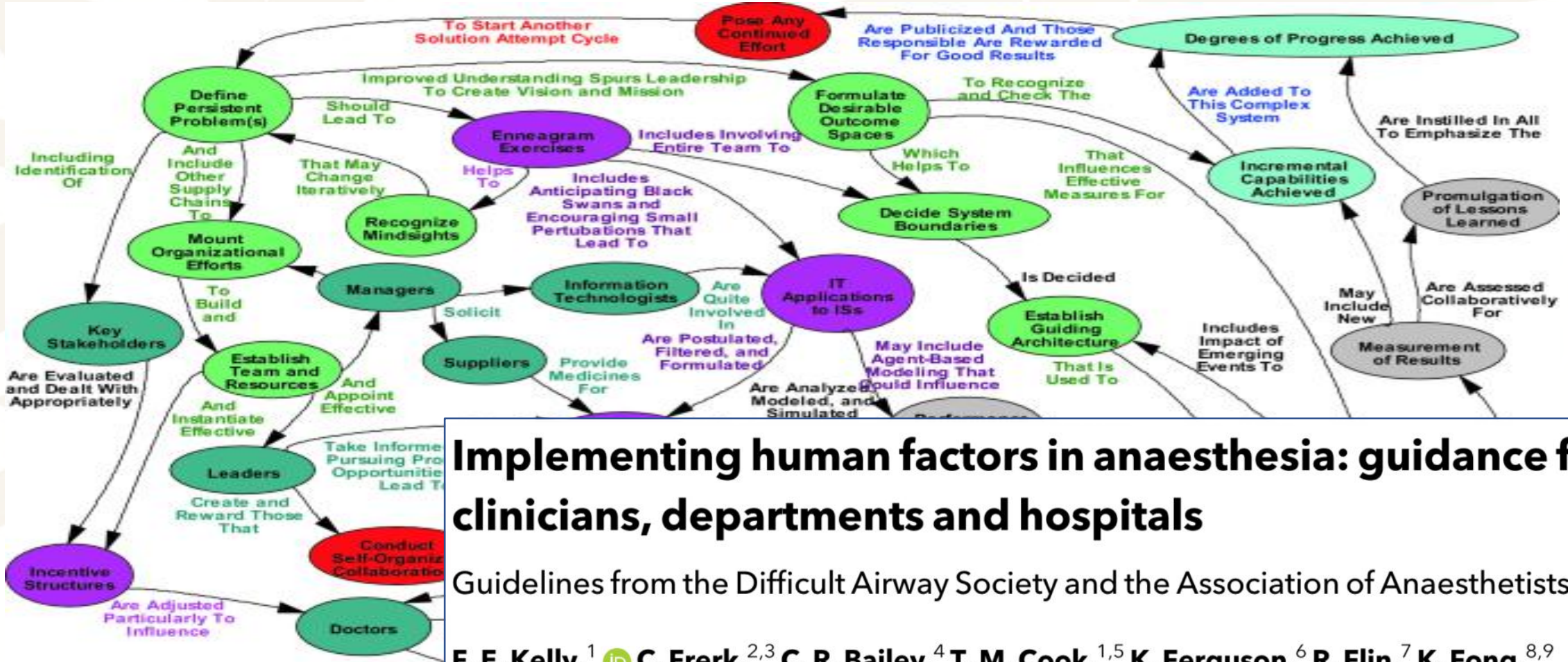

DIRECT INTUBATION
MACINTOSH BLADE OR VIDEO-ASSISTED
OXYGENATION
FRONT-OF-NECK ACCESS
Surgical
Percutaneous if CTM is identified
O2PTIM SOS
INDIRECT INTUBATION
HYPER-ANGULATED BLADE VIDEO-ASSISTED
with/without guiding channel
FLEXIBLE ENDOSCOPY
COMBINED =
video-assisted + flexible endoscopy
VENTILATION
FACE MASK
2ND GENERATION EXTRAGLOTTIC DEVICES
PRIMING FOR RESCUE PLAN / AWAKENING


TECHNICAL SKILLS
NON TECHNICAL SKILLS
BRIEFING
SOS
DEBRIEFING


DELIVER OXYGEN/OPTIMIZE OXYGENATION
ENSURE APPROPRIATE ANESTHETIC DEPTH
TIME OUT
Airway Management, Backup & Help Plans
Consider Elective Invasive Airway or ECMO in sedation
AIRWAY PLAN SUCCESFUL?
YES
Continue as planned
NO
OXYGENATION/VENTILATION ADEQUATE?
YES
MARGINAL
NO
CONSIDER CALL FOR HELP
CALL FOR HELP
CALL FOR HELP
Treat Anatomical & Functional Obstruction
Oxygenation/ Ventilation Adequate after Each attempt?
YES
NO
3+1 Attemps failed?
Marginal Oxygention
Failure
Individual decision according to the physiological status of patiens
Advanced Techniques (E.g., Rigid Bronchoscopy, Emergency Invasive Airway, ECMO)
Consider Emerging Patient
DEBRIEF

ERROR TRAPS	COGNITIVE BIASES	PROPOSED SOLUTIONS
Preparation Error • Inadequate planning • Communication	**Anchoring**: fixation or tunnel vision on an initial assessment or intervention and not adjusting to changes **Authority**: tendency to concede to viewpoint of an authority figure **Omission**: inaction from fear of being wrong or doing harm **Overconfidence**: overestimation of one's skills, or not recognizing the need for help	• Anticipate difficult intubation • Time out/Huddle • Assign roles • Set expectations for primary & backup plans
Performance Error • Unnecessary attempts • Relying on direct laryngoscopy • Inadequate anesthetic depth		• Passive oxygenation • Use advanced airway techniques early • Spontaneous vs. controlled ventilation
Proficiency Error • Unfamiliar with advanced airway techniques • Skill degradation		• Do not wait for difficult airway to practice skills • Use of cognitive aids • Availability of experienced help

Complex Systems and Medicine



Implementing human factors in anaesthesia: guidance for clinicians, departments and hospitals

Guidelines from the Difficult Airway Society and the Association of Anaesthetists

F. E. Kelly,[1] C. Frerk,[2,3] C. R. Bailey,[4] T. M. Cook,[1,5] K. Ferguson,[6] R. Flin,[7] K. Fong,[8,9] P. Groom,[10] C. John,[11] A. R. Lang,[12] T. Meek,[13] K. L. Miller,[14] L. Richmond,[15] N. Sevdalis[16] and M. R. Stacey[17]

Take home messages

- Successful intubation is the result of multiple factors
- VL, $O_{2,}$ “adequate” anaesthesia are fundamental on daily practice
- Be prepared to the extremes (CICO)
- Human factors can have a predominant influence (+/-)

……..and……

.....aim for first attempt success!