Rural Rounds: Pediatric Airways

Dr. Krittika Bhende

11 June 2026 | 0800-0900

THE UNIVERSITY OF BRITISH COLUMBIA
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Faculty of Medicine

Land Acknowledgement

I would like to acknowledge that I am presenting today from the traditional, ancestral and unceded territory of the Skwxwú7mesh (Squamish), xʷməθkwəy̓əm (Musqueam), and Sə̓lílwətaʔ/Selilwitulh (Tsleil-Waututh) Nations, where I have the privilege to live, work and play.

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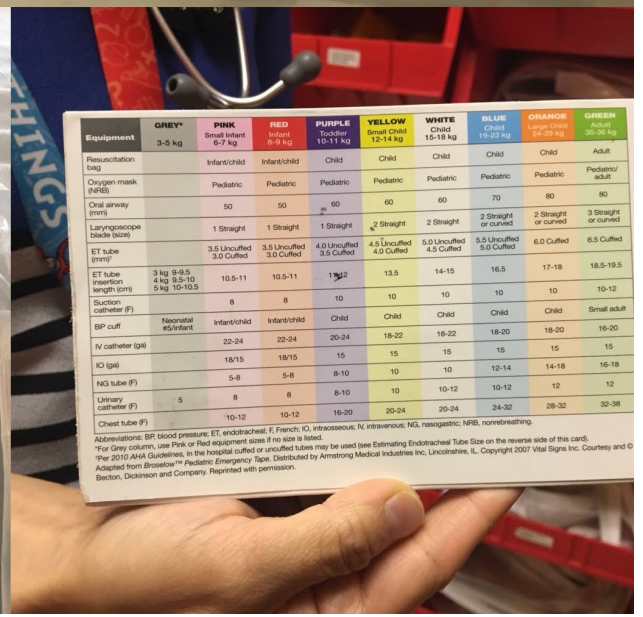
STEEP LEARNING CURVE...



Equipment	GREY* 3-5 kg	PINK Small Infant 6-7 kg	RED Infant 8-9 kg	PURPLE Toddler 10-11 kg	YELLOW Small Child 12-14 kg	WHITE Child 15-18 kg	BLUE Child 19-23 kg	ORANGE Large Child 24-29 kg	GREEN Adult 30-36 kg
Resuscitation bag		Infant/child	Infant/child	Child	Child	Child	Child	Child	Adult
Oxygen mask (NRB)		Pediatric	Pediatric	Pediatric	Pediatric	Pediatric	Pediatric	Pediatric	Pediatric/ adult
Oral airway (mm)		50	50	60	60	60	70	80	80
Laryngoscope blade (size)		1 Straight	1 Straight	1 Straight	2 Straight	2 Straight	2 Straight or curved	2 Straight or curved	3 Straight or curved
ET tube (mm)†		3.5 Uncuffed 3.0 Cuffed	3.5 Uncuffed 3.0 Cuffed	4.0 Uncuffed 3.5 Cuffed	4.5 Uncuffed 4.0 Cuffed	5.0 Uncuffed 4.5 Cuffed	5.5 Uncuffed 5.0 Cuffed	6.0 Cuffed	6.5 Cuffed
ET tube insertion length (cm)	3 kg 9-9.5 4 kg 9.5-10 5 kg 10-10.5	10.5-11	10.5-11	11-12	13.5	14-15	16.5	17-18	18.5-19.5
Suction catheter (F)		8	8	10	10	10	10	10	10-12
BP cuff	Neonatal #5/Infant	Infant/child	Infant/child	Child	Child	Child	Child	Child	Small adult
IV catheter (ga)		22-24	22-24	20-24	18-22	18-22	18-20	18-20	16-20
IO (ga)		18/15	18/15	15	15	15	15	15	15
NG tube (F)		5-8	5-8	8-10	10	10	12-14	14-18	16-18
Urinary catheter (F)	5	8	8	8-10	10	10-12	10-12	12	12
Chest tube (F)		10-12	10-12	16-20	20-24	20-24	24-32	28-32	32-38

Abbreviations: BP, blood pressure; ET, endotracheal; F, French; IO, intraosseous; IV, intravenous; NG, nasogastric; NRB, nonrebreathing.
*For Grey column, use Pink or Red equipment sizes if no size is listed.
†Per *2010 AHA Guidelines*, in the hospital cuffed or uncuffed tubes may be used (see Estimating Endotracheal Tube Size on the reverse side of this card.
Adapted from *Broselow™ Pediatric Emergency Tape*. Distributed by Armstrong Medical Industries Inc, Lincolnshire, IL. Copyright 2007 Vital Signs Inc. Courtesy and © Becton, Dickinson and Company. Reprinted with permission.

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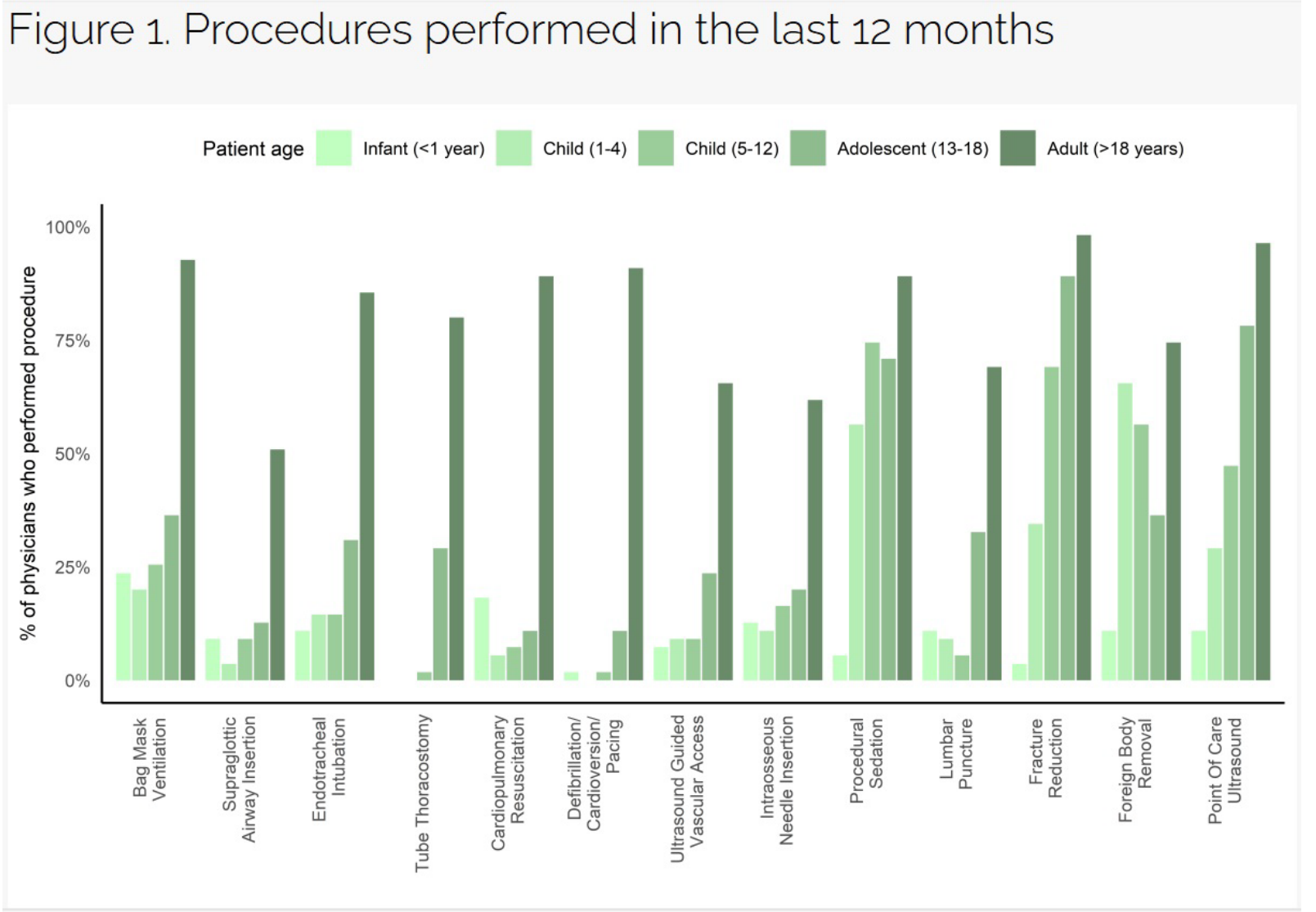
RARE!



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Unpublished data: Frequency of use and comfort with procedures amongst general emergency department physicians who regularly care for adults and children in British Columbia. A survey study. K.Bhende, G.Meckler

COGNITIVE LOAD

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LEARNING OBJECTIVES

- **Discuss** anatomic and physiologic differences of pediatric airways
- **Demonstrate** approaches to pediatric airway management
- **Examine** difficult rural airway cases that require action before transfer, with context-specific management approaches
- **Review** cognitive aids and available support when faced with a pediatric patient

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PRESENTER DISCLOSURES

I have no relationship or commercial interests to disclose.

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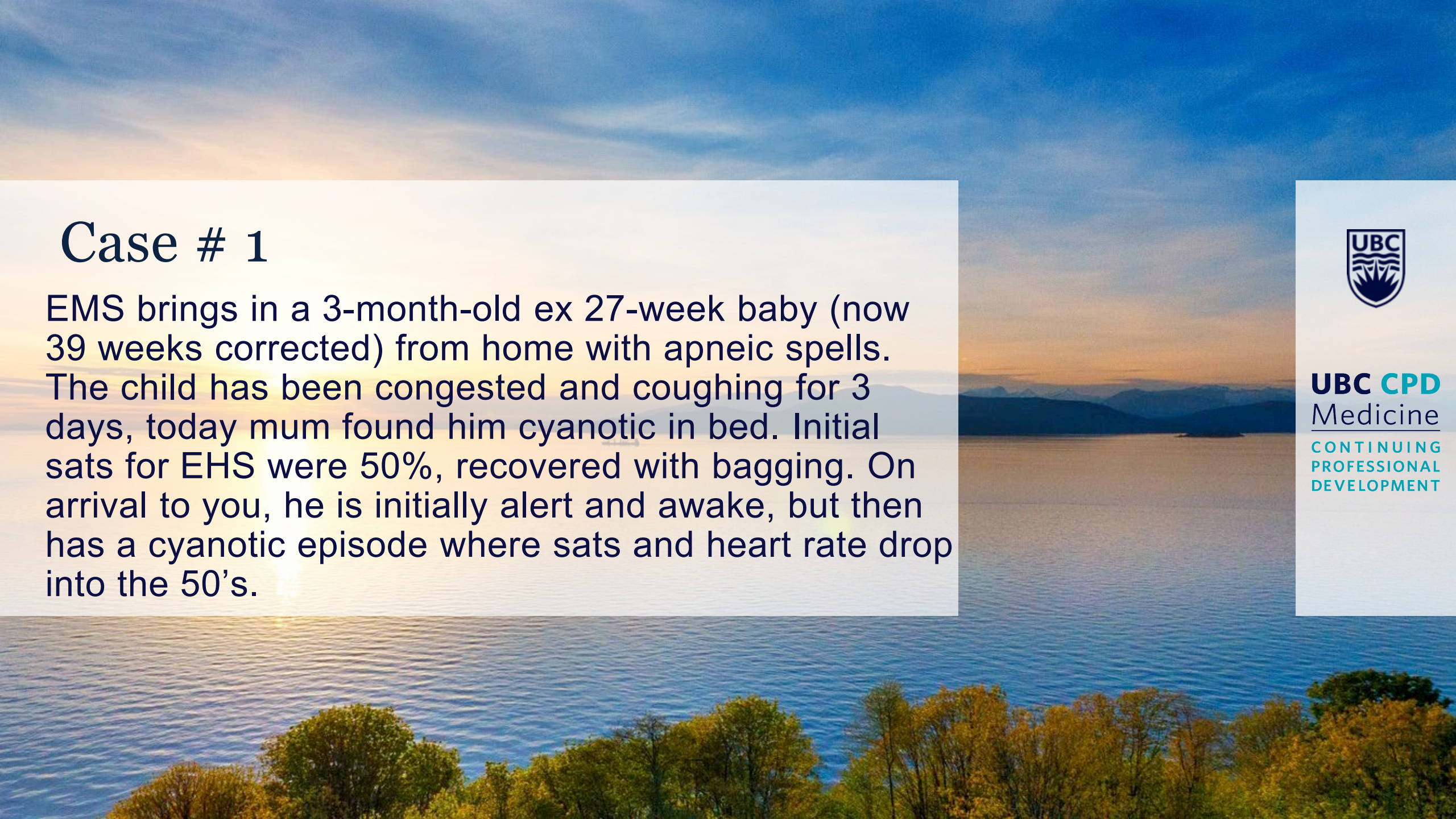
Case # 1

EMS brings in a 3-month-old ex 27-week baby (now 39 weeks corrected) from home with apneic spells. The child has been congested and coughing for 3 days, today mum found him cyanotic in bed. Initial sats for EHS were 50%, recovered with bagging. On arrival to you, he is initially alert and awake, but then has a cyanotic episode where sats and heart rate drop into the 50's.



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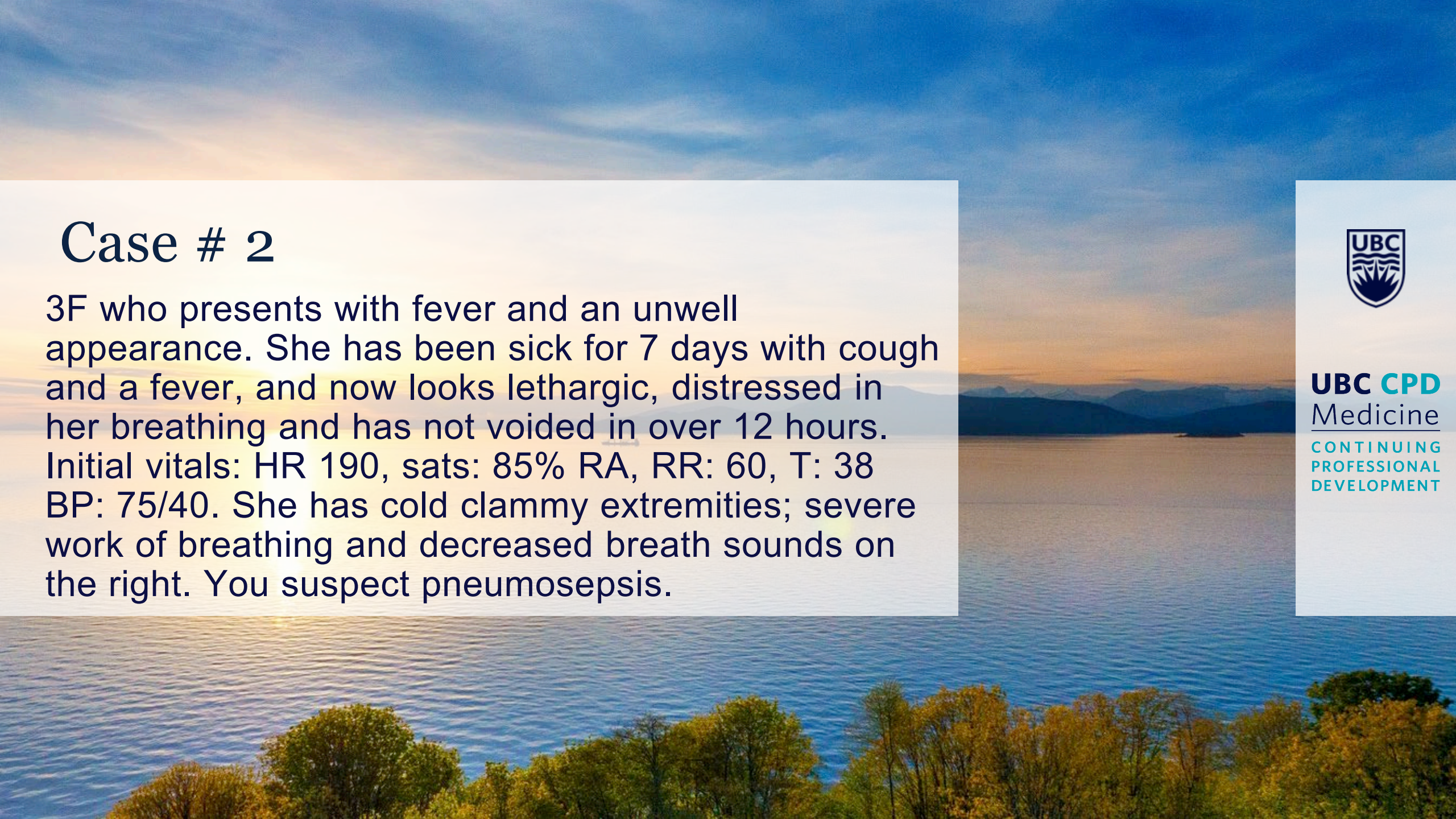
Case # 2

3F who presents with fever and an unwell appearance. She has been sick for 7 days with cough and a fever, and now looks lethargic, distressed in her breathing and has not voided in over 12 hours. Initial vitals: HR 190, sats: 85% RA, RR: 60, T: 38 BP: 75/40. She has cold clammy extremities; severe work of breathing and decreased breath sounds on the right. You suspect pneumosepsis.



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Case # 3

A 9-month-old otherwise healthy child is rushed into your trauma room at your community hospital. He was crawling around on the floor at grandma's house when he had a sudden coughing fit, turned blue and purple in the face. He has continued to look distressed. He looks cyanotic and significant cough and stridor on arrival and is now somnolent.

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KIDS: SMALL ADULTS?

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YES!

Same Rules Apply for needing help with airway management

1. Assistance with oxygenation
2. Assistance with ventilation
3. Failure to protect their airway
4. Expected clinical course (deterioration)

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APPROACH

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RSI – ASSESSMENT AND PREP

L (Look)	Gestalt (small chin/ short neck/ dysmorphic?)
~~E~~ (Evaluate)	3:3:2 (use child's fingers!)
~~M~~ (Mallampati)	limited
O (Obstruction)	Hx + PE
N (Neck mobility)	Usually, trauma related
S (Saturation)	lung pathology? Age?

Patient?

Anatomy?

Physiology?

Provider?

Best available person?

Context?

Where?

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DIFFERENCES

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KIDS: ANATOMY

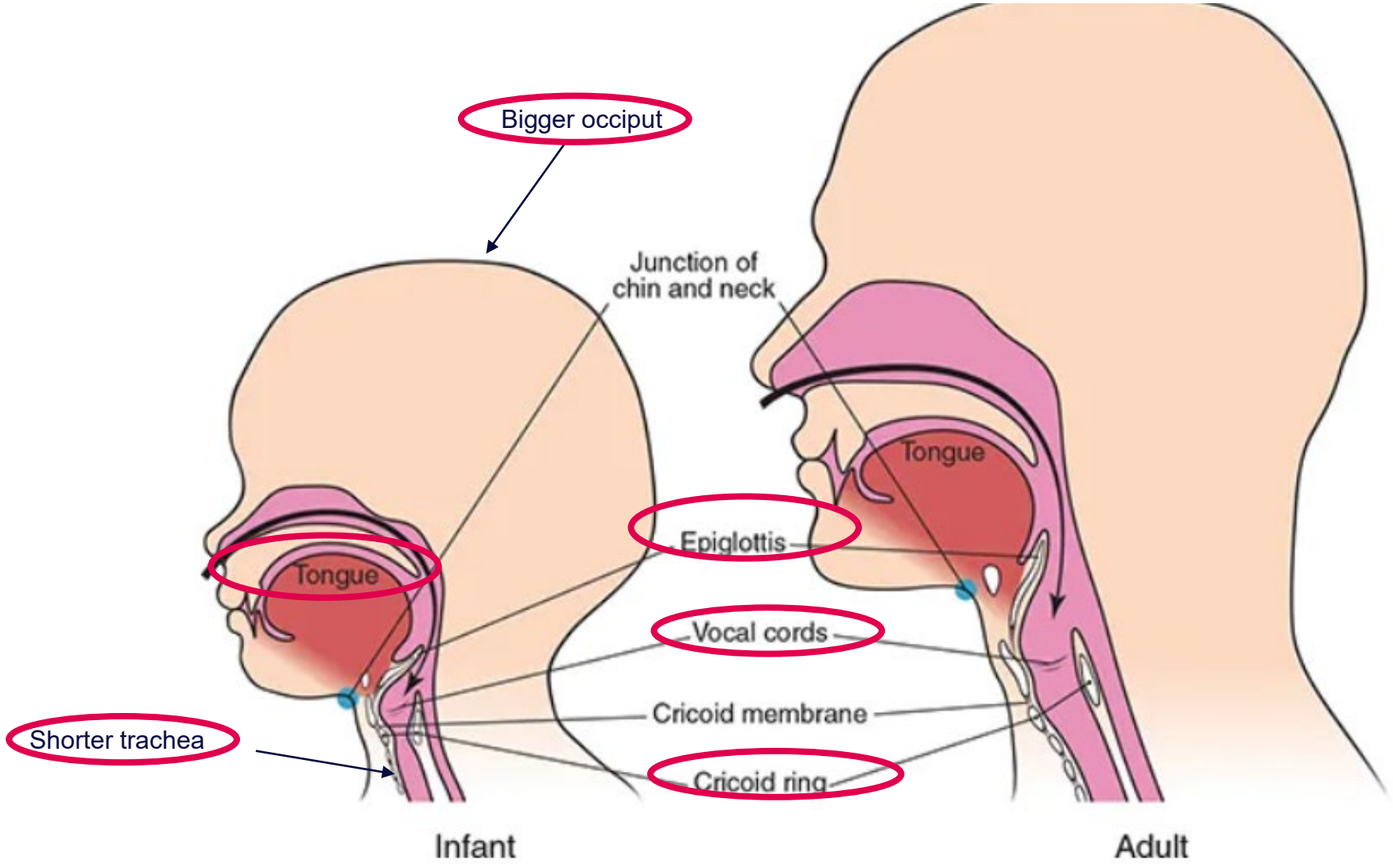

Photo Courtesy: Anesthesia Key Article – Differentiating aspects of the pediatric airway

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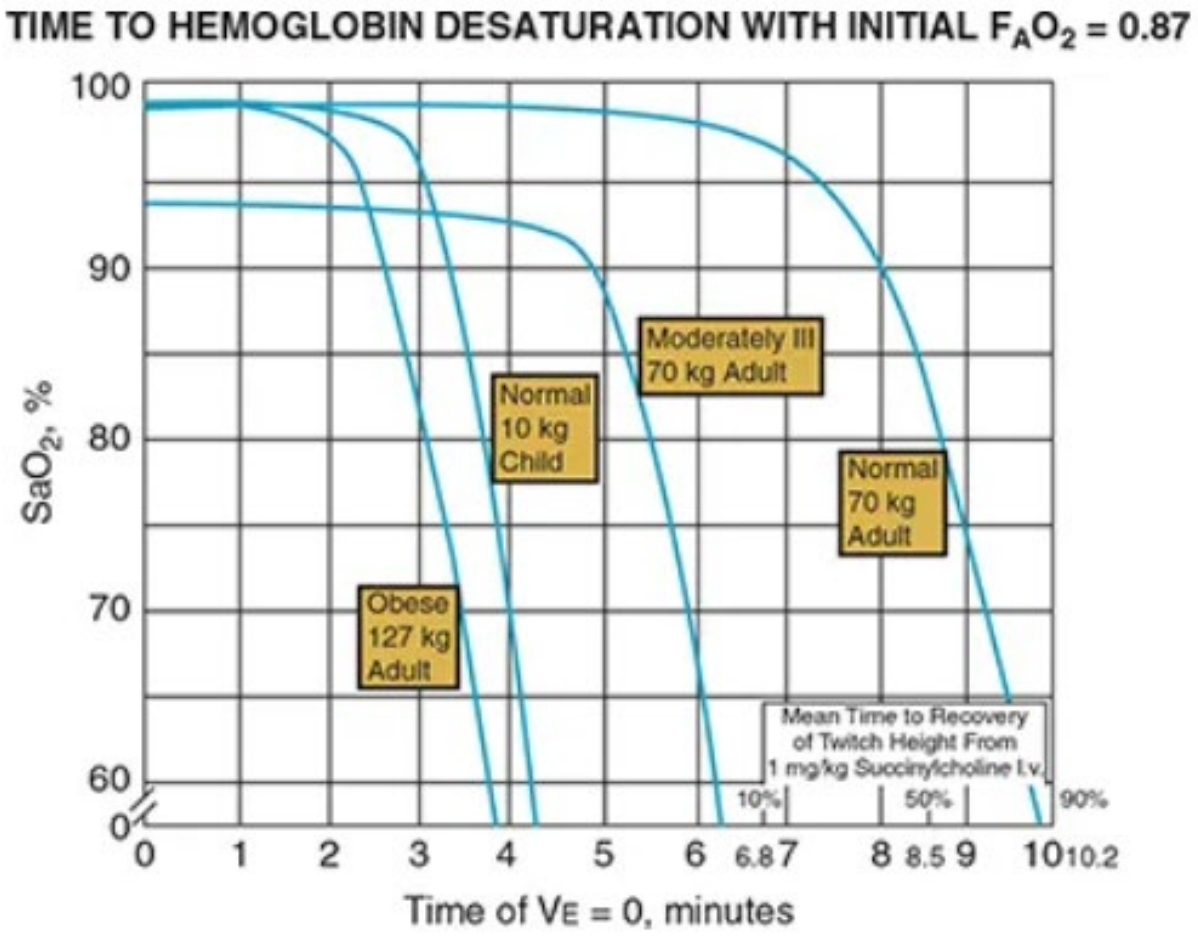
KIDS: PHYSIOLOGY AND DEVELOPMENT

1. Increased oxygen consumption
2. Lower Functional Residual Capacity
3. Dependent on their chest wall muscles to breathe
4. May be nervous or scared!



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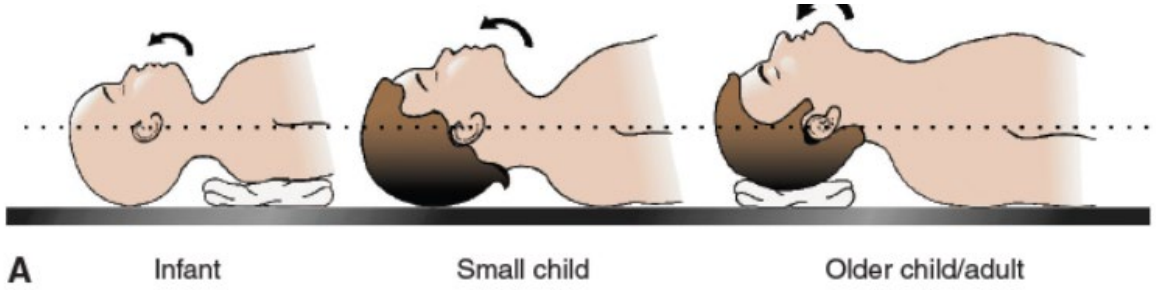
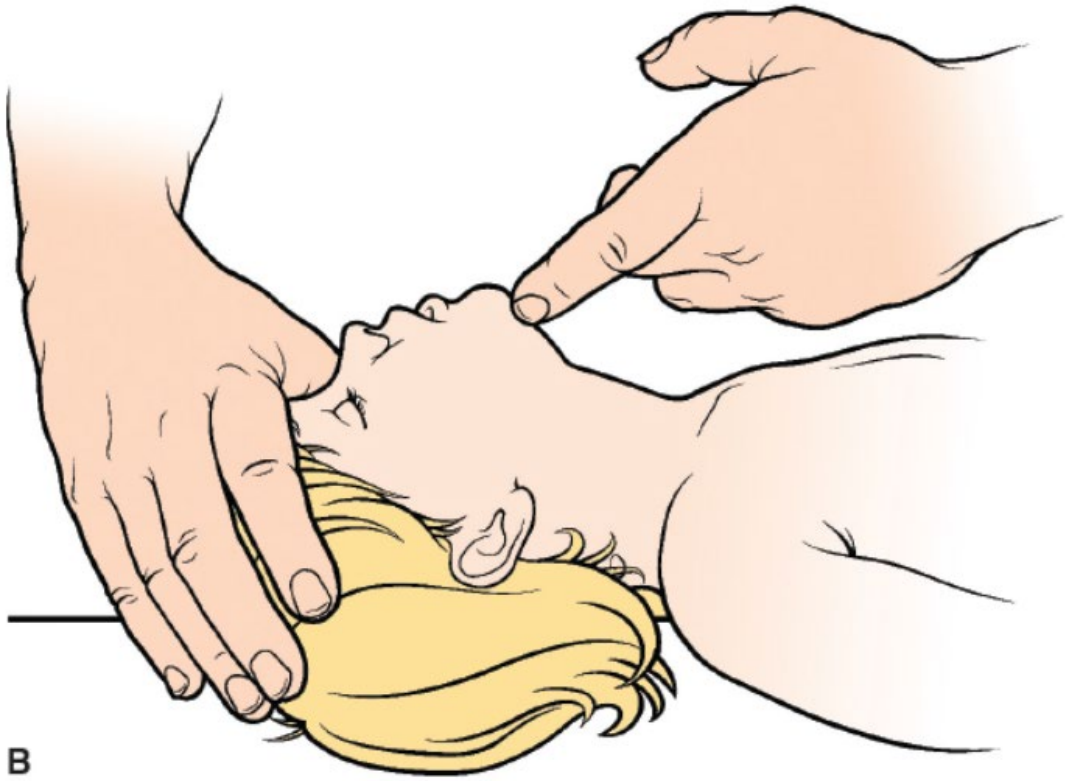
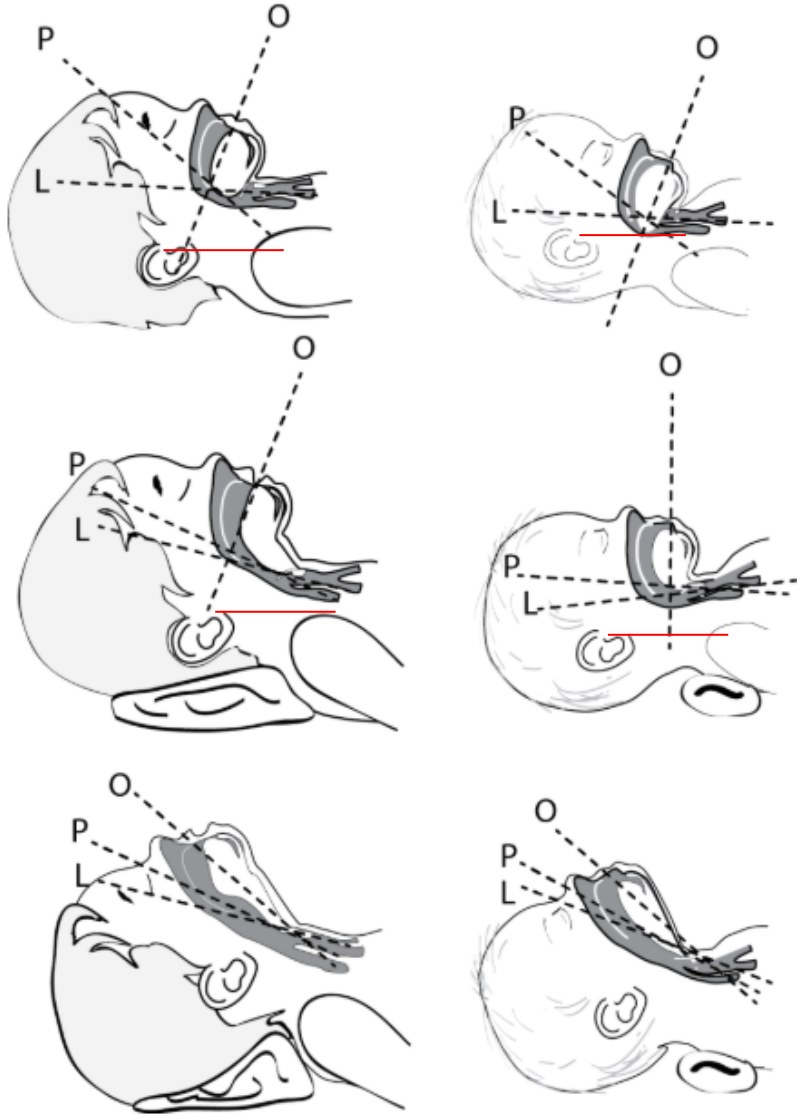
POSITION: TO OPEN THEIR AIRWAY







When preparing for intubation, head and neck positioning can be key. For an infant, placing a small rolled towel under the shoulders lifts the body and compensates for the large round occiput, bringing the ear canal into alignment with the sternal notch.Older children may need a towel under their head.

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BAG VALVE MASK

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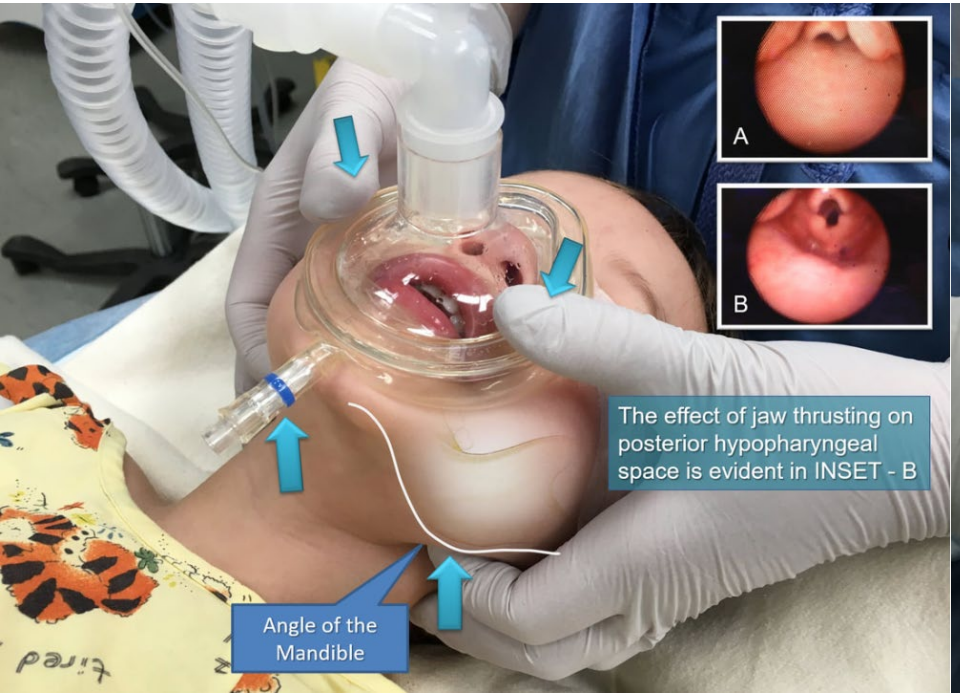
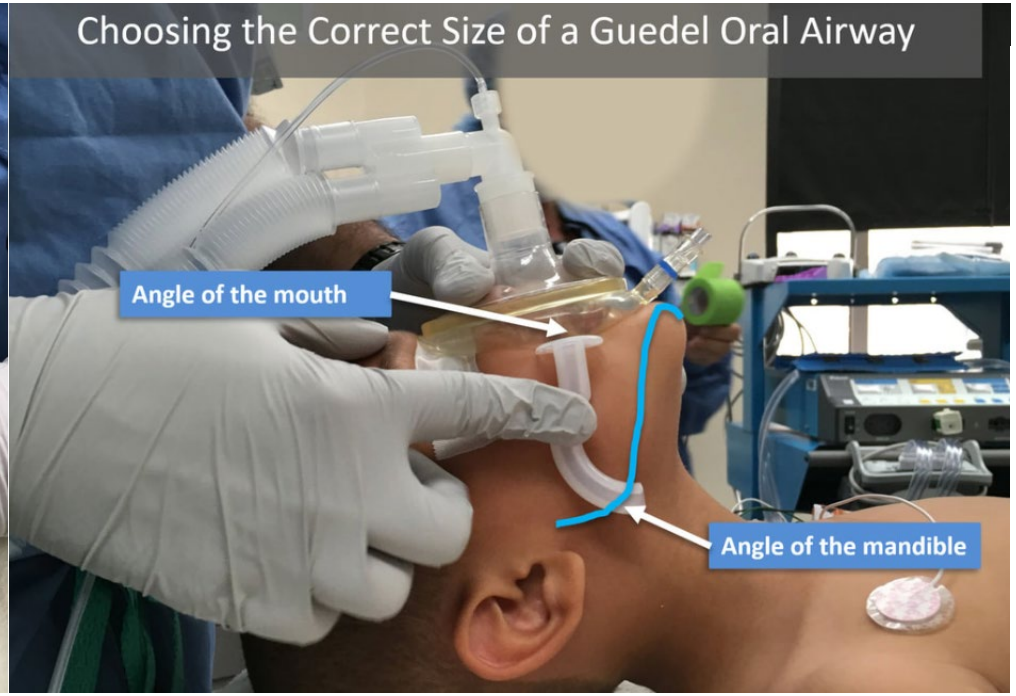
OBSTRUCTION RELIEF





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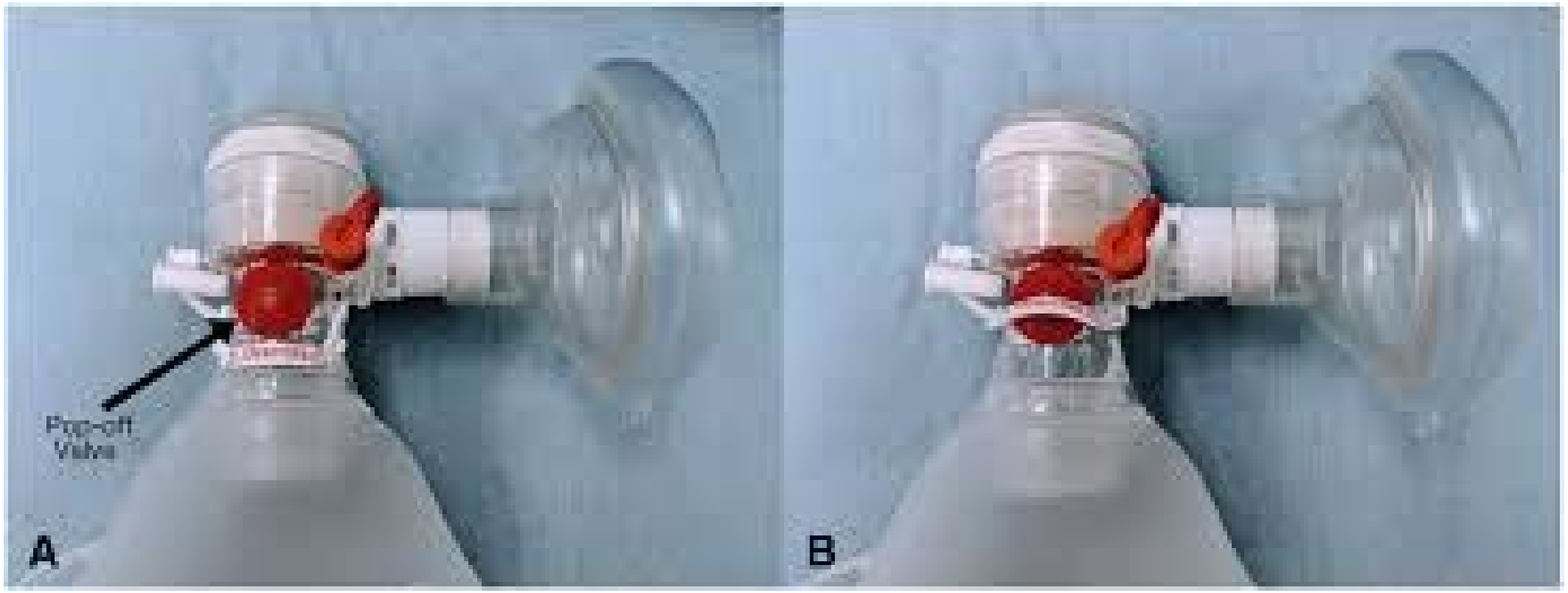
Pictures from: Whitten CE. *Pediatric Airway Management: A Step-by-Step Guide*. San Diego, CA: Mooncat Publications; 2018.

POP OFF VALVE



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INTUBATION

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PRE-OXYGENATION

1. SIT UP + Nasal Prongs + Pediatric Non-Rebreather at 15L/min

1. SIT UP + BIPAP/ HFNC (100%FiO2) for increased recruitment

2. NP + BVM with tight seal (100% Fio2) -> *unconscious or baby*

APNEIC OXYGENATE: DURING INTUBATION

1. Nasal prongs:

   < 1 year: 5L/ minute

   1-7 year: 10L/ minute

   > 7 years: 15 L/ minute

1. HFNC (2cc/kg) or nasal NIV

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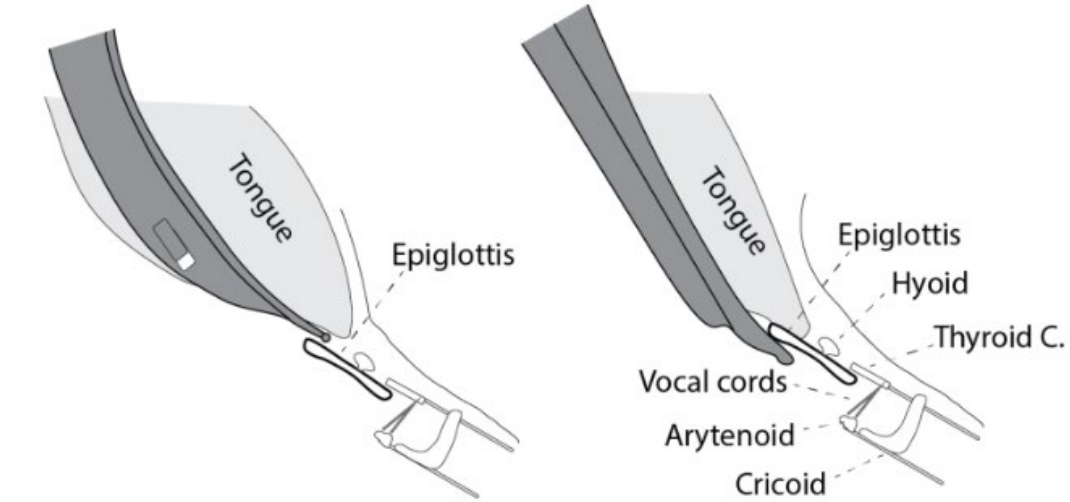
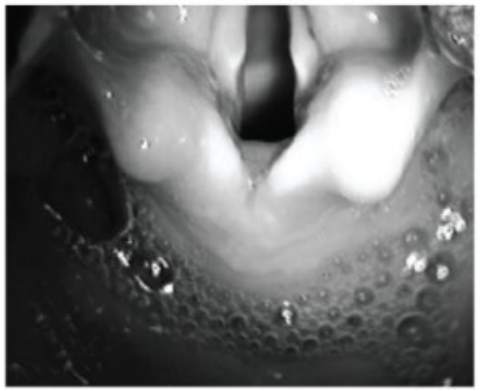
EPIGLOTTIS IN THE WAY: STRAIGHT BLADE



Curved Blade
Note tip in vallecula
Blade shifts tongue forward

Straight Blade
Note tip lifting epiglottis
Blade flattens tongue

a.



b.

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ANTERIOR LARYNX: ELM

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POOR VIEW: VIDEO LARYNGOSCOPE

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SHORT TRACHEA : ETT ISSUES

- Right mainstem or tube slippage?
- Calculate insertion distance: Broselow or 3X ETT size
- **Tape marker** on number pre-insertion
- See cuff go just past the cords
- Listen to breath sounds, pullback if necessary
- **CXR** for placement (aim for position around T2)
- **Tape** the tube to the hard palate, **immobilize the neck if needed!**

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EQUIPMENT SIZING

Pediatric Invasive Ventilation Size Guide (1 month – 17 years minus a day)

Bagger Size

Less than 10 kg	Infant bagger
0 – 30 kg	Pediatric bagger
30 kg and up	Adult bagger

Image Source (right): Elsevier skill "Endotracheal Tube Intubation (Pediatric)", Nov. 2023

Correct	Incorrect	
A: Covers mouth and nose but not eyes	B: Too Large: Covers eyes	C: Too Small: Does not cover mouth and nose

EtCO2

ETT > 4.0: Adult / Pediatric ETT ≤ 4.0: Neonatal / Infant

ETT Securing

Neobar *(to be used on ETT < 5.0. For greater than 5.0, consider alternative securing device)*

Measure from tragus to mid-line under the nose. Position NeoBar® across center of mouth between upper and lower lip. It should not contact lips. Tabs must be just in front of ear. **Wrap cloth tape completely around NeoBar platform, then tape ETT to NeoBar spiraling tape towards ETT connector.**

Intubation

Color	Weight (kg)	Cuffed OETT*	Depth (cm)	Blade
Grey	3 – 5	3.0	9.0 - 10.5	1 Mil, lopro 1
Pink	6 – 7	3.0	10.5 - 11	1 Mil, lopro 2
Red	8 – 9	3.0	10.5 - 11	1 Mil, lopro 2
Purple	10 – 11	3.5	11 - 12	1 Mil, lopro 2
Yellow	12 – 14	4.0	13.5	2 Mac / Mil, lopro 2.5
White	15 – 18	4.5	14 - 15	2 Mac / Mil, lopro 2.5
Blue	19 – 23	5.0	16.5	2 Mac / Mil, lopro 2.5
Orange	24 – 29	6.0	17 - 18	2 Mac / Mil, lopro 2.5
Green	30 – 36	6.5	18.5 - 19.5	3 Mac, lopro 3

*Age/4 + 3.5 for cuffed ETT.

Inline Suction Size

ETT tube size	Inline suction size*
3.0 – 3.5	6 Fr
3.5 – 4.5	8 Fr
5.0 – 6.0	10 Fr
6.0 – 7.0	12 Fr

*ETT size × 2. Round down

Settings

Circuit Size (applies to Fisher & Paykel 950 System) **Neonatal: < 25 kg** **Adult: ≥ 25 kg**

Age	Mode	RR (brs / min)	Ti (sec)	PEEP	VT (actual body weight)
< 1 year	Volume Guarantee (PRVC, APV CMV) or Pressure Control* *PC if large leak or difficulty ventilating	25 – 35	0.60 – 0.70	5 – 8 cm H_2O	6 – 8 mLs / kg
1 – 3 years		20 – 26	0.70 – 0.75		
4 – 5 years		18 – 24	0.75 – 0.80		
6 – 10 years		16 – 20	0.80 – 0.90		
> 10 years		15 – 20	0.80 – 1.0		

ETT: Endotracheal Tube; RR: Respiratory Rate; Ti: Inspiratory Time; PEEP: Positive End Expiratory Pressure; VT: Tidal Volume; PRVC: Pressure Regulated Volume Control; APV: Adaptive Pressure Ventilation; CMV: Controlled Mandatory Ventilation

The Pediatric Critical Care Outreach project would like to recognize the work of Dr Neil Long KGH Emerg, Dr Rebecca Munk KGH Anaesthesia, Renee Faubert IH RRT on the early iterations of this document.

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INTUBATION MEDICATIONS

Intubating Medications	Ketamine 1.5 mg/kg (max 100mg) Rocuronium 1mg/kg (*(max 100mg)* *Use less ketamine if hemodynamically unstable, same dose of roc*
Neonatal Medications	Atropine 0.02mcg/kg Fentanyl 2mcg/kg (*slow push 3 minutes*) Succinylcholine 2mg/kg
Pre-Medications	Atropine 0.02mcg/kg (kids < 1, vagal induced bradycardia) Fentanyl 1- 3mcg/kg (optional, blunt increased ICP response)

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DRUG BASED RESUSCITATION SHEETS

IN A HURRY

DRUG RESOURCES

Weight-based Drug Sheets

Guidance for Usage Document	3 kg (~Newborn) Document	4 Kg (~1 mos) Document
5 kg (~2 mos) Document	6 Kg (~3 mos) Document	7 Kg (~5 mos) Document
8 kg (~6 mos) Document	9 kg (~9 mos) Document	10 Kg (~1 year) Document
12 Kg (~2 years) Document	14 Kg (~3 years) Document	16 Kg (~4 years) Document

FIRST SHOT, BEST SHOT

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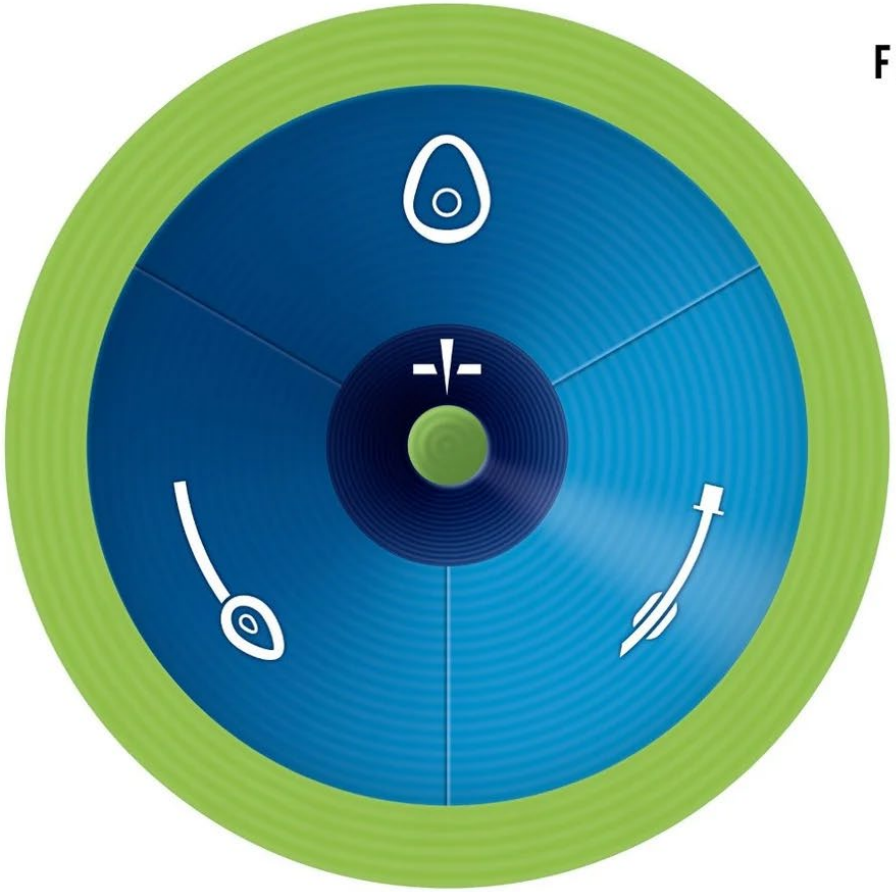
BACK UP PLAN

THE VORTEX



FOR EACH LIFELINE CONSIDER:

- **MANIPULATIONS:**
  - HEAD & NECK
  - LARYNX
  - DEVICE
- **ADJUNCTS**
- **SIZE / TYPE**
- **SUCTION / O_2 FLOW**
- **MUSCLE TONE**

MAXIMUM THREE ATTEMPTS AT EACH LIFELINE (UNLESS GAMECHANGER)
AT LEAST ONE ATTEMPT SHOULD BE BY MOST EXPERIENCED CLINICIAN
PRIMING STATUS ESCALATES WITH UNSUCCESSFUL BEST EFFORT AT ANY LIFELINE

VortexApproach.org

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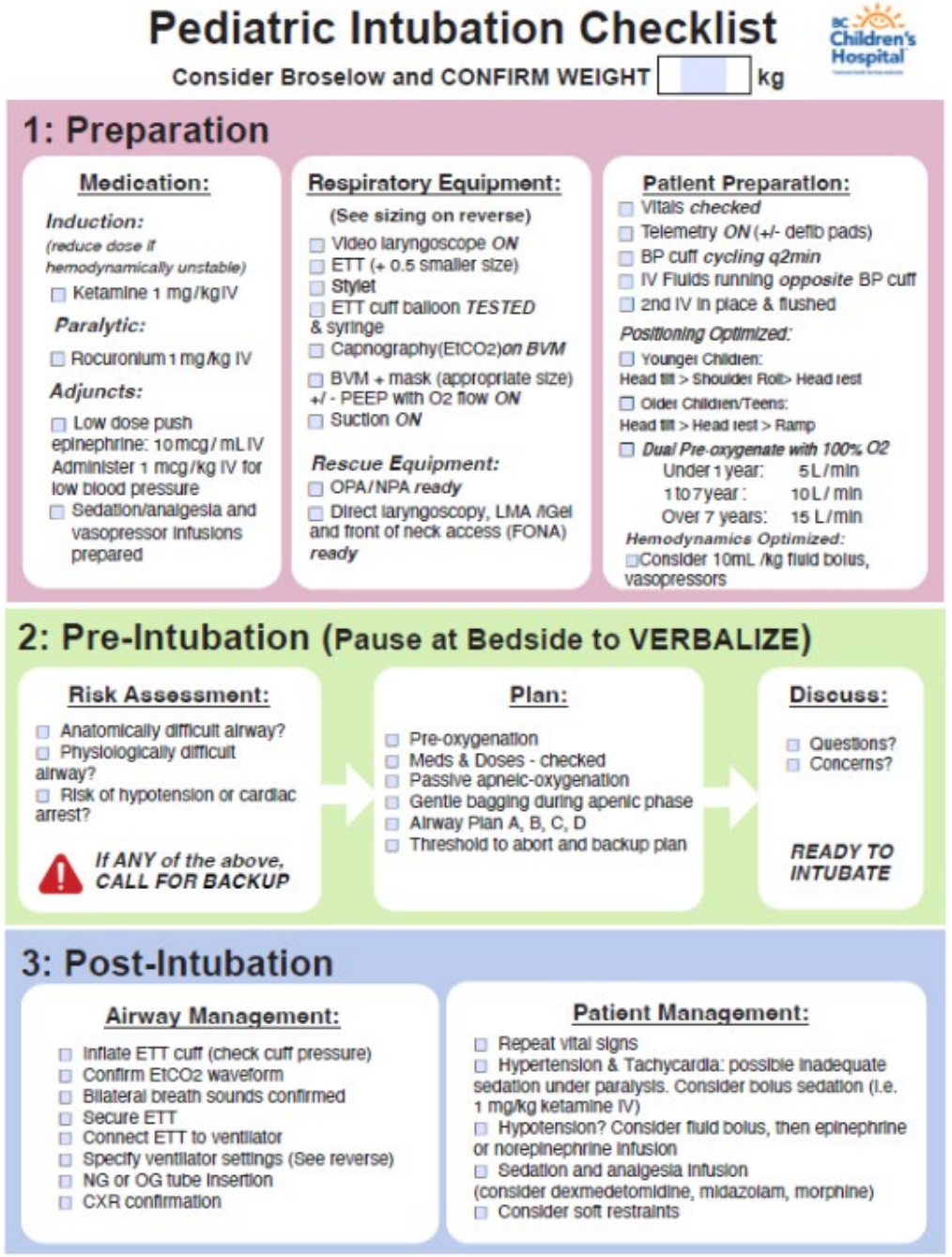
CHECKLIST



Pediatric Intubation Checklist

BC Children's Hospital

Consider Broselow and CONFIRM WEIGHT ____ kg

1: Preparation

Medication:

Induction:
(reduce dose if hemodynamically unstable)
- ☐ Ketamine 1 mg/kg IV

Paralytic:
- ☐ Rocuronium 1 mg/kg IV

Adjuncts:
- ☐ Low dose push epinephrine: 10 mcg/mL IV Administer 1 mcg/kg IV for low blood pressure
- ☐ Sedation/analgesia and vasopressor infusions prepared

Respiratory Equipment:

(See sizing on reverse)
- ☐ Video laryngoscope *ON*
- ☐ ETT (+ 0.5 smaller size)
- ☐ Stylet
- ☐ ETT cuff balloon *TESTED* & syringe
- ☐ Capnography(EtCO2)*on BVM*
- ☐ BVM + mask (appropriate size) +/- PEEP with O2 flow *ON*
- ☐ Suction *ON*

Rescue Equipment:
- ☐ OPA/NPA *ready*
- ☐ Direct laryngoscopy, LMA /iGel and front of neck access (FONA) *ready*

Patient Preparation:
- ☐ Vitals *checked*
- ☐ Telemetry *ON* (+/- defib pads)
- ☐ BP cuff *cycling q2min*
- ☐ IV Fluids running *opposite* BP cuff
- ☐ 2nd IV in place & flushed

Positioning Optimized:
- ☐ Younger Children: Head tilt > Shoulder Roll> Head rest
- ☐ Older Children/Teens: Head tilt > Head rest > Ramp
- ☐ *Dual Pre-oxygenate with 100% O2*
  - Under 1 year: 5 L/min
  - 1 to 7 year: 10 L/min
  - Over 7 years: 15 L/min

Hemodynamics Optimized:
- ☐ Consider 10mL /kg fluid bolus, vasopressors

2: Pre-Intubation (Pause at Bedside to VERBALIZE)

Risk Assessment:
- ☐ Anatomically difficult airway?
- ☐ Physiologically difficult airway?
- ☐ Risk of hypotension or cardiac arrest?

⚠ *If ANY of the above, CALL FOR BACKUP*

Plan:
- ☐ Pre-oxygenation
- ☐ Meds & Doses - checked
- ☐ Passive apneic-oxygenation
- ☐ Gentle bagging during apenic phase
- ☐ Airway Plan A, B, C, D
- ☐ Threshold to abort and backup plan

Discuss:
- ☐ Questions?
- ☐ Concerns?

READY TO INTUBATE

3: Post-Intubation

Airway Management:
- ☐ Inflate ETT cuff (check cuff pressure)
- ☐ Confirm EtCO2 waveform
- ☐ Bilateral breath sounds confirmed
- ☐ Secure ETT
- ☐ Connect ETT to ventilator
- ☐ Specify ventilator settings (See reverse)
- ☐ NG or OG tube insertion
- ☐ CXR confirmation

Patient Management:
- ☐ Repeat vital signs
- ☐ Hypertension & Tachycardia: possible inadequate sedation under paralysis. Consider bolus sedation (i.e. 1 mg/kg ketamine IV)
- ☐ Hypotension? Consider fluid bolus, then epinephrine or norepinephrine infusion
- ☐ Sedation and analgesia infusion (consider dexmedetomidine, midazolam, morphine)
- ☐ Consider soft restraints

ETT: Endotracheal Tube; BVM: Bag Mask Ventilation; OPA: Oropharyngeal Airway; NPA: Nasopharyngeal Airway; PEEP: Positive End Expiratory Pressure; NG: Nasogastric; OG: Orogastric; BP: Blood Pressure; CXR: Chest X-Ray; EtCO2: End Tidal Carbon Dioxide; LMA: Laryngeal Mask Airway

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BACK TO OUR CASES

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Case # 1

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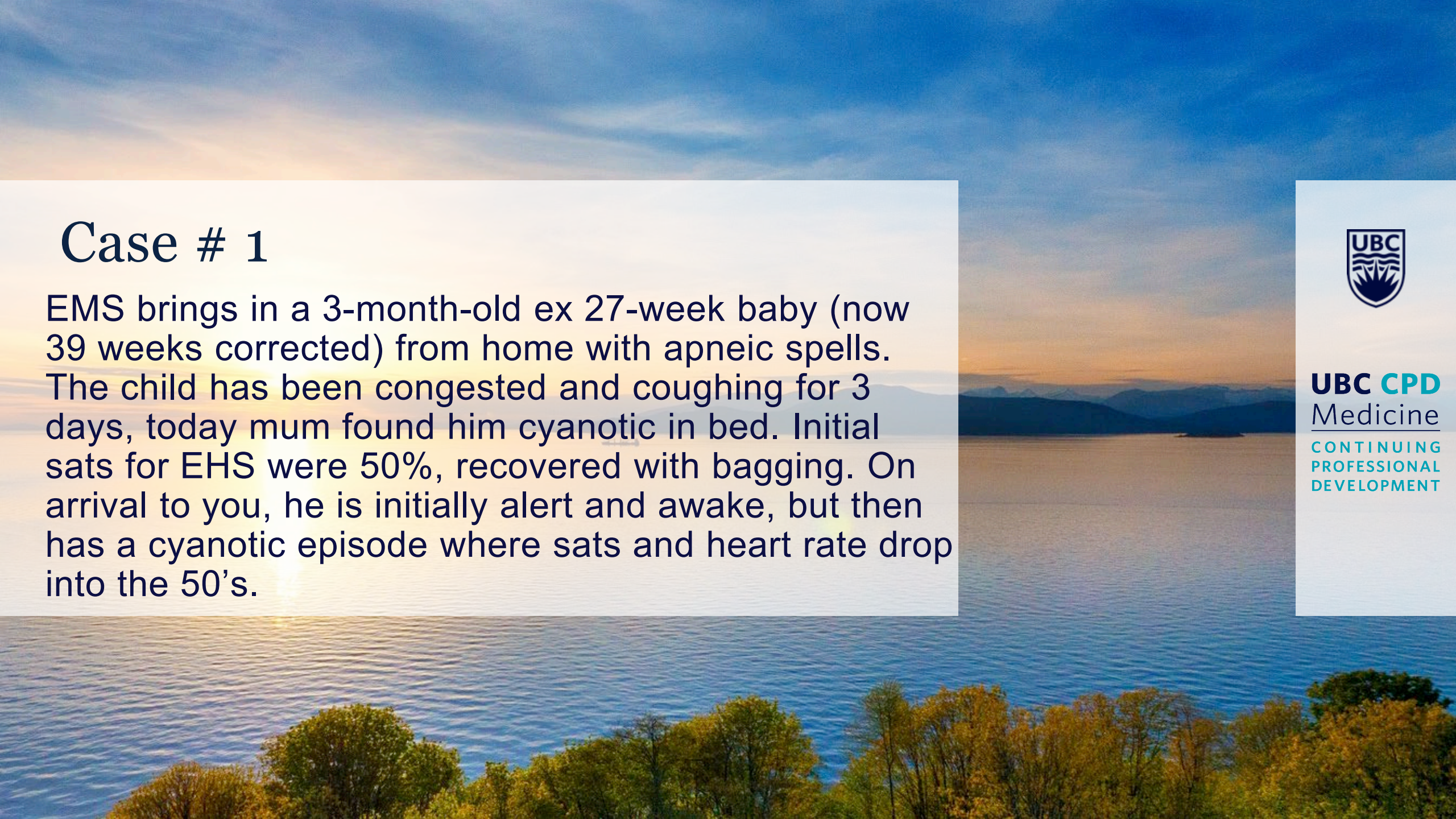

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APPROACH (5KG CHILD)

STEP 1: PREPARE

- **WARMER**
- NPO, Oxygen
- IV/ IO access, Investigations
- Support (PTN/ PICU/ CHARLIE? CODE? SPECIALIST SUPPORT?
- **Equipment:** infant bagger, 3.5 and 3 ETT *with stylet*, **Miller 1 Blade**, Suction ready, Size 1 LMA, OPA

STEP 2: PRE-OXYGENATE

- **BIPAP/ High flow + Bag with 100% fiO2 + NP 5L/min once meds pushed**

STEP 3: PHYSIOLOGICAL OPTIMIZATION/ PREMEDICATION

- **ATROPINE 0.02mcg/kg** to reduce bradycardia due to vagal response.

STEP 4: PARALYSIS with INDUCTION

- Ketamine 1.5mg/kg + rocuronium 1mg/ kg

STEP 5: POSITIONING (**shoulder roll, head extension, ELM**)

STEP 6: PLACEMENT WITH PROOF

STEP 7: POST INTUBATION MANAGEMENT

- **TAPE!** Ventilation + sedation management with PICU support.

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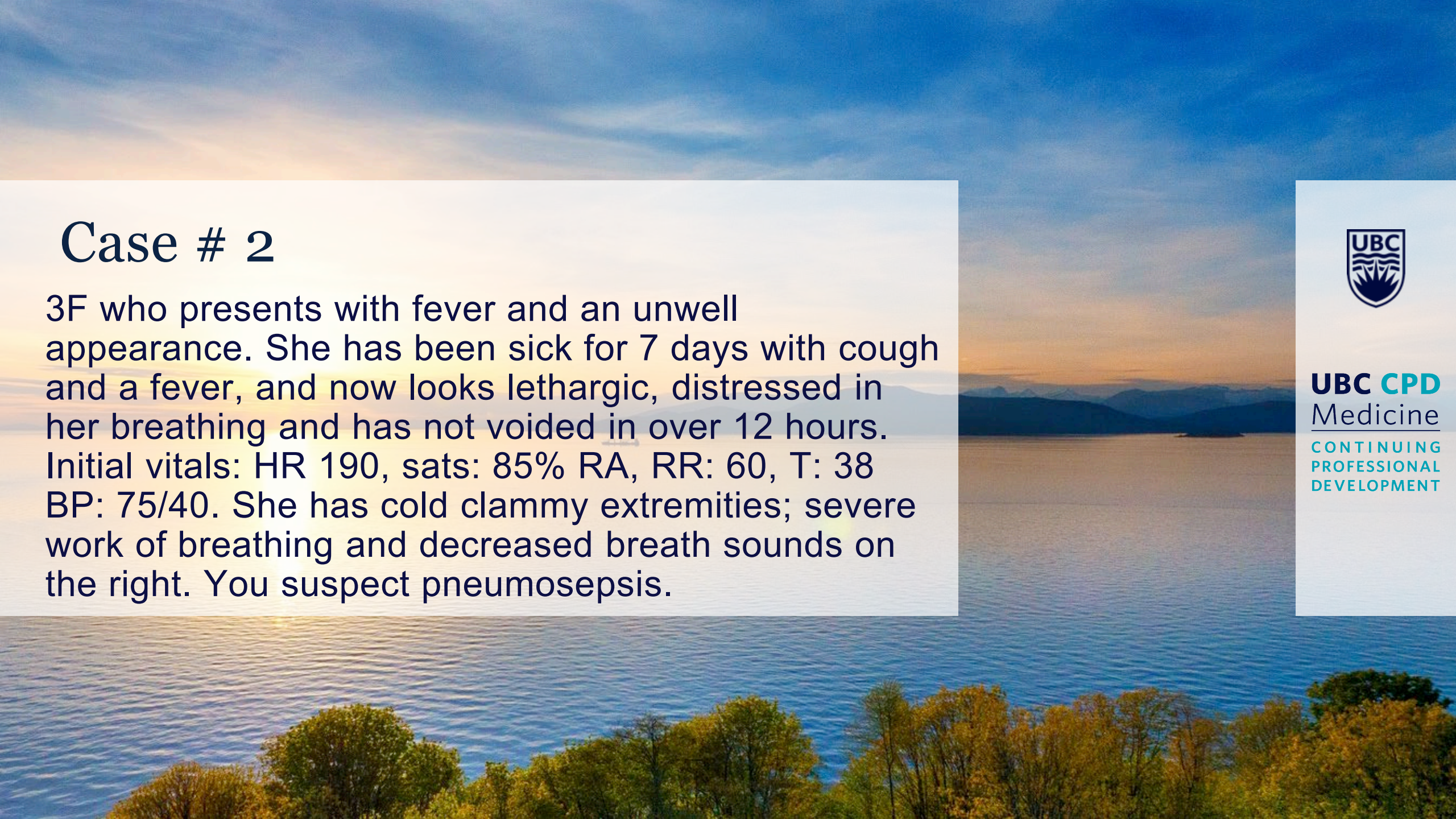
Case # 2

3F who presents with fever and an unwell appearance. She has been sick for 7 days with cough and a fever, and now looks lethargic, distressed in her breathing and has not voided in over 12 hours. Initial vitals: HR 190, sats: 85% RA, RR: 60, T: 38 BP: 75/40. She has cold clammy extremities; severe work of breathing and decreased breath sounds on the right. You suspect pneumosepsis.



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ANATOMICALLY DIFFICULT AIRWAY

KEEP CALM and CALL for HELP

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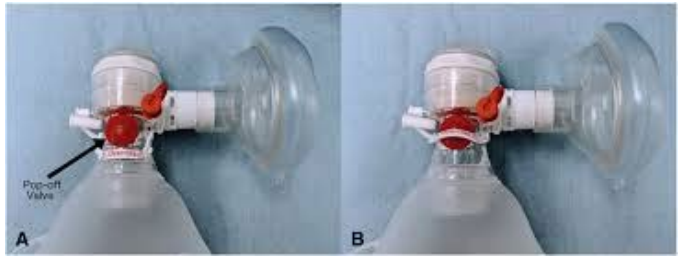
1. Position of Comfort
2. Epinephrine nebulized in oxygen, oral Dex (? Croup)
3. Nasal trumpet and side lying position or sniffing position
4. Early use of positive pressure (CPAP/ BIPAP/ BVM) with light sedation
5. Ultimately if <u>needing</u> to intubate ourselves:
   - Plan A: RSI **VS** Ketamine and “awake” look
     - VL/ bougie/ ELM/ smaller sized ETT
   - Plan B: supraglottic airway (<u>short term rescue</u>)
   - Plan C: Bag with OPA and 2 handed jaw thrust + **close pop off valve!** (<u>short term rescue</u>)
   - **Plan D: surgical tracheostomy/ needle cricothyrotomy**



SURGICAL AIRWAY

- Fortunately, **Rare** in pediatrics

- Many techniques:
- Surgical cricothyrotomy (> 8y)
- Scalpel bougie trach (< 8 y)
- Needle cricothyrotomy (optional)

- **Preparation essential**

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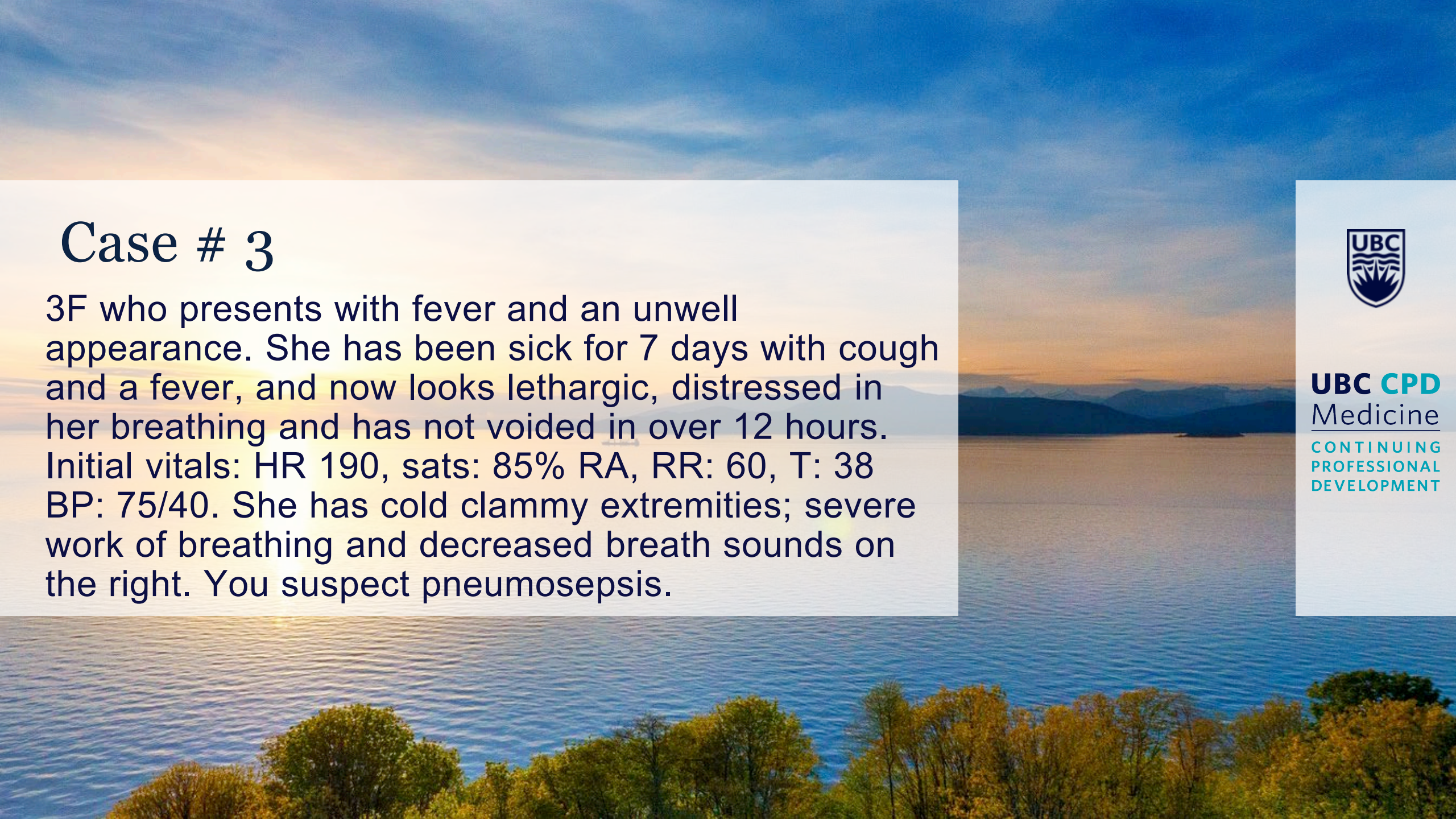
Infant (<10kg) Scalpel Kit: Size 10 broad blade disposable scalpel, 5 Fr solid bougie, Size 3.0 micro cuff ETT, scissor, clamps
Small Child (10-30kg) Scalpel Kit: Size 10 broad blade disposable scalpel, 8 Fr hollow bougie, Size 4.0 microcuff ETT, scissor, clamps
Large Child (>30kg) Scalpel Kit: Size 10 broad blade disposable scalpel, 8/11 Fr hollow bougie, Size 5.0 microcuff ETT, scissor, clamps
(Monash Health, Melbourne Australia)

Case # 3

3F who presents with fever and an unwell appearance. She has been sick for 7 days with cough and a fever, and now looks lethargic, distressed in her breathing and has not voided in over 12 hours. Initial vitals: HR 190, sats: 85% RA, RR: 60, T: 38 BP: 75/40. She has cold clammy extremities; severe work of breathing and decreased breath sounds on the right. You suspect pneumosepsis.



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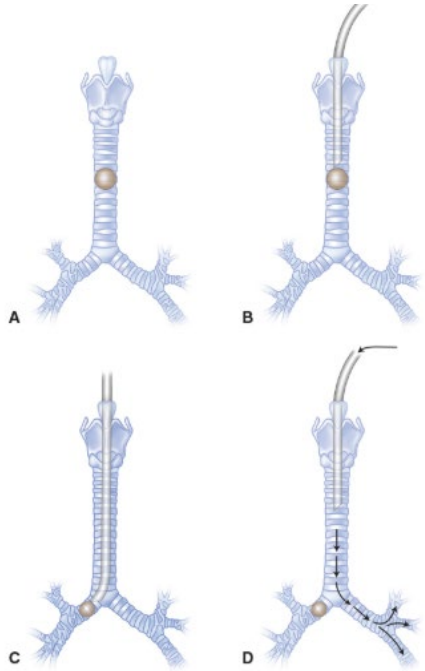
FOREIGN BODY IN AIRWAY



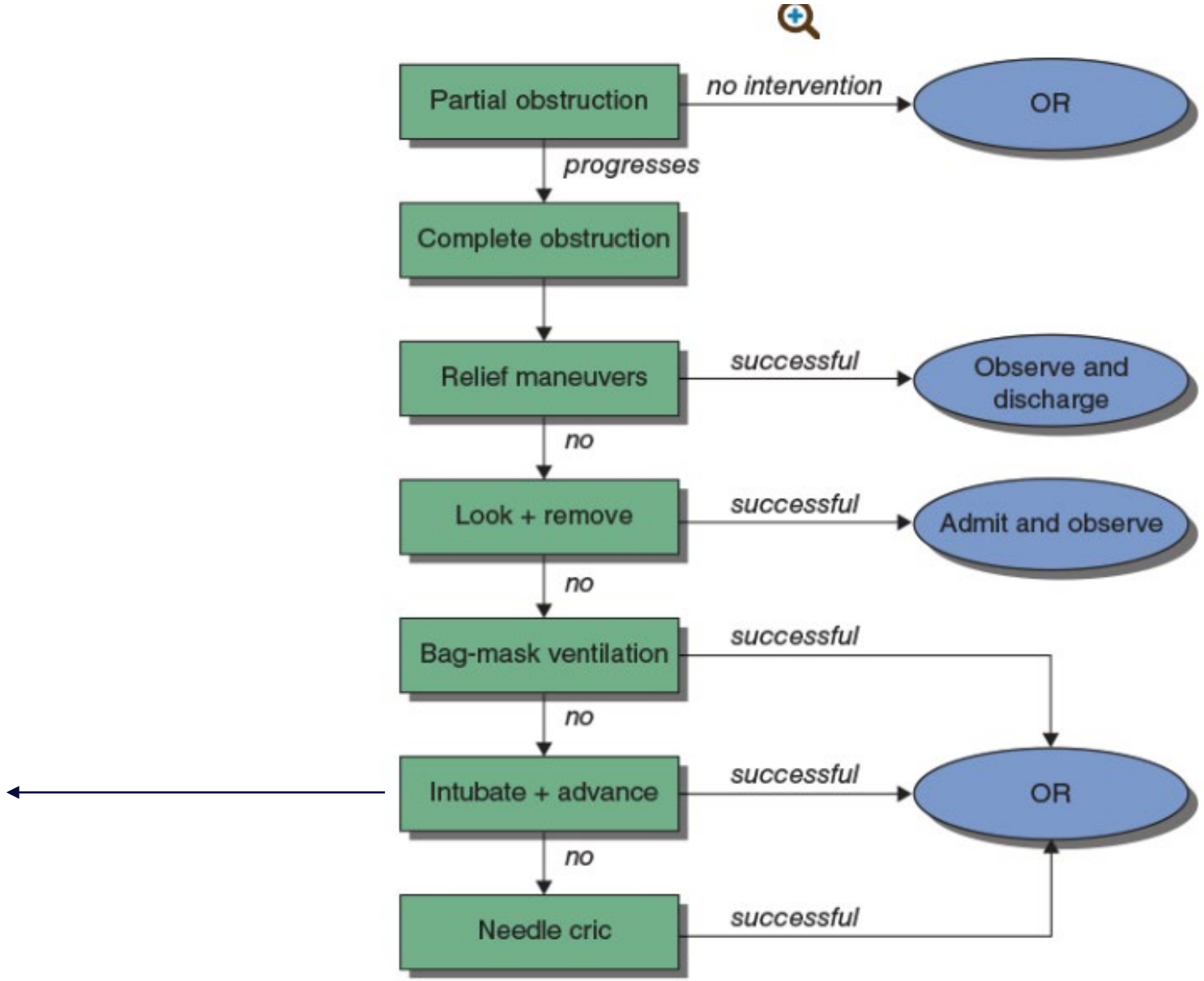


Figure 28.2: Stepwise approach for the management of an aspirated foreign body.

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Brown CA, III, Sakles JC, Mick NW. *The Walls Manual of Emergency Airway Management, 6e*. Lippincott Williams & Wilkins, a Wolters Kluwer 2023.

RESOURCES

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CONTINUOUS LEARNING

1. Take a Course
2. Longitudinal skills practice
3. Advocacy/ Pediatric ready
4. Translational Simulation
5. Debrief

the CARE course

StEP
Stabilization Essentials in Pediatrics

the difficult airway course
INTERNATIONAL EXCELLENCE IN AIRWAY MANAGEMENT

Rural Coordination Centre OF BRITISH COLUMBIA

AIME AIRWAY

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In-Community CPD

Real-Time Virtual Support (RTVS) Simulation

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RESOURCES

1. Cognitive Aids:

- Broselow TAPE and CART
- Child Health BC – in a HURRY resources
  (*drug-based sheets, intubation checklist, ventilation parameters*)
- ECBC -> Rural Airway Emergency Guide (not peds specific, but FANTASTIC!)
- TREKK Algorithms for pediatric emergencies
- PEDMED. org (BCCH Formulary for peds dosing)

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2. Practitioner Support:

- RTVS Program (RUDI/ CHARLIE) : Add Zoom contact: charlie1@rccbc.ca | Phone: 236.305.5352
- Critical Care Outreach Nurse: CALL 604-875-2133, ask for CCON nurse
- PTN/ PICU/ Neonatal Support

Q&A

POST YOUR QUESTIONS IN THE CHATBOX

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