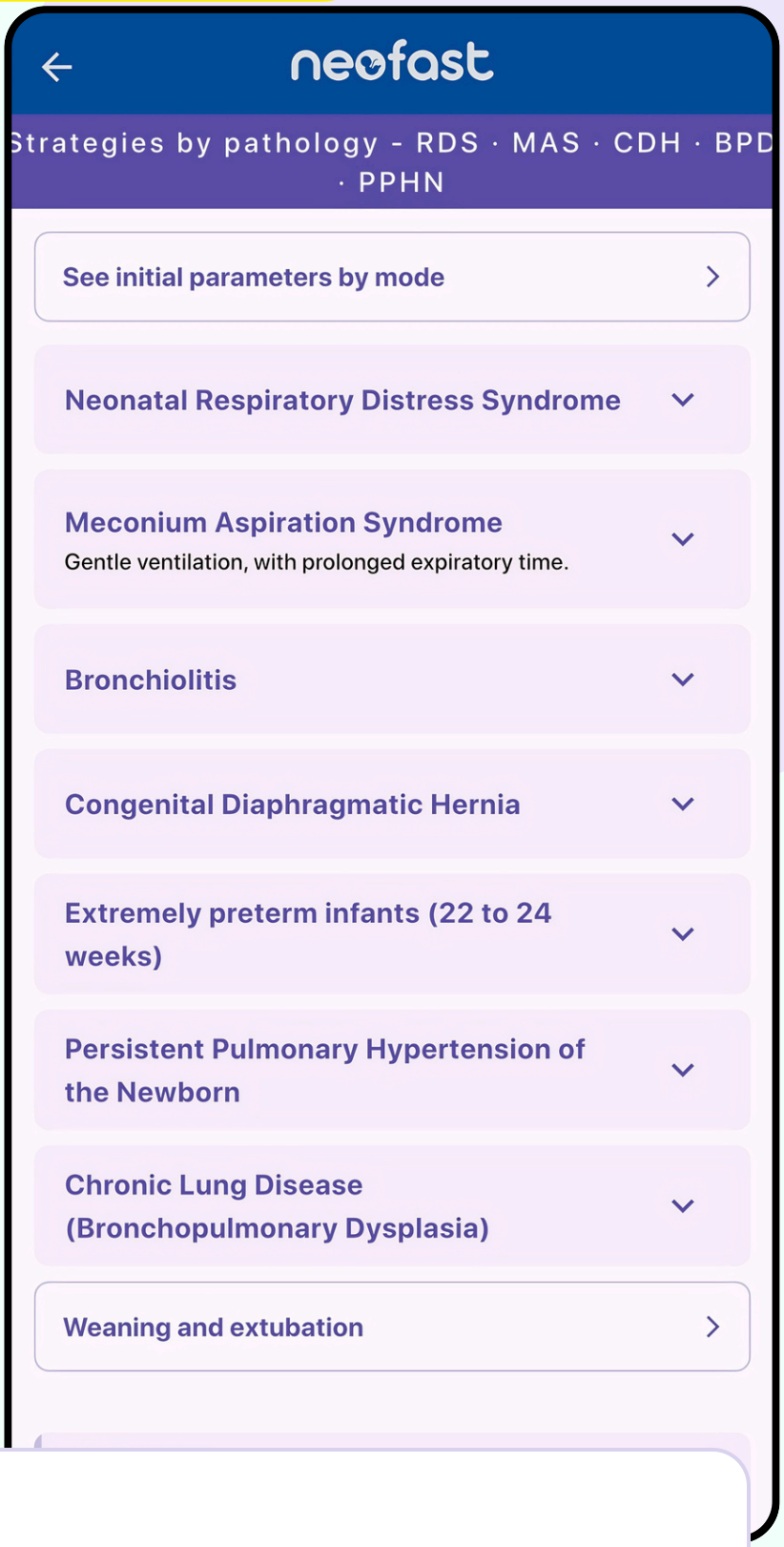
Neonatal Mechanical Ventilation

GOLDSMITH'S

One APP. Five diseases. Zero page-flipping at 3 a.m.

Disease-specific ventilation strategies, already inside **NeoFast**.

RDS MAS CDH BPD PPHN

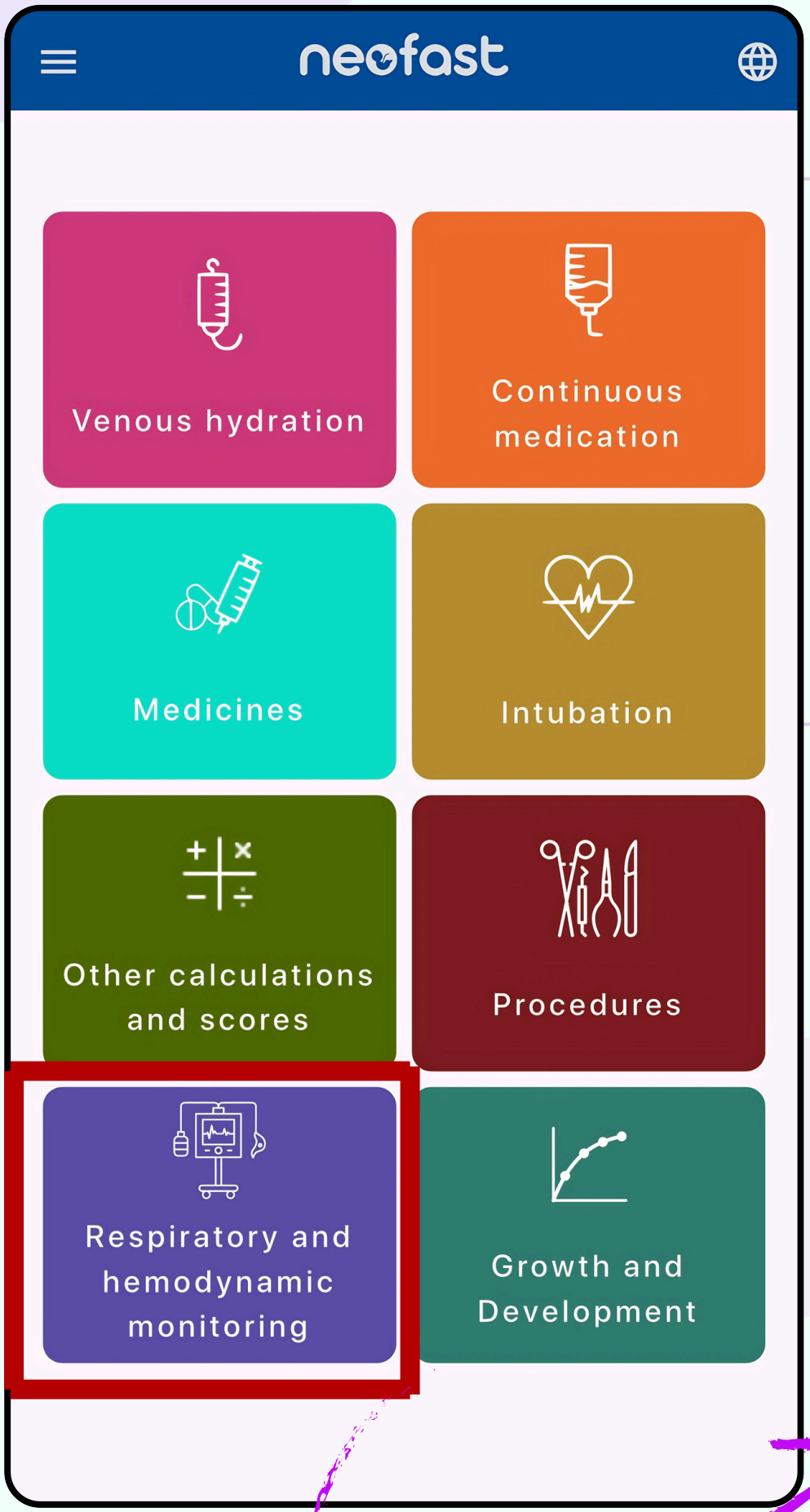


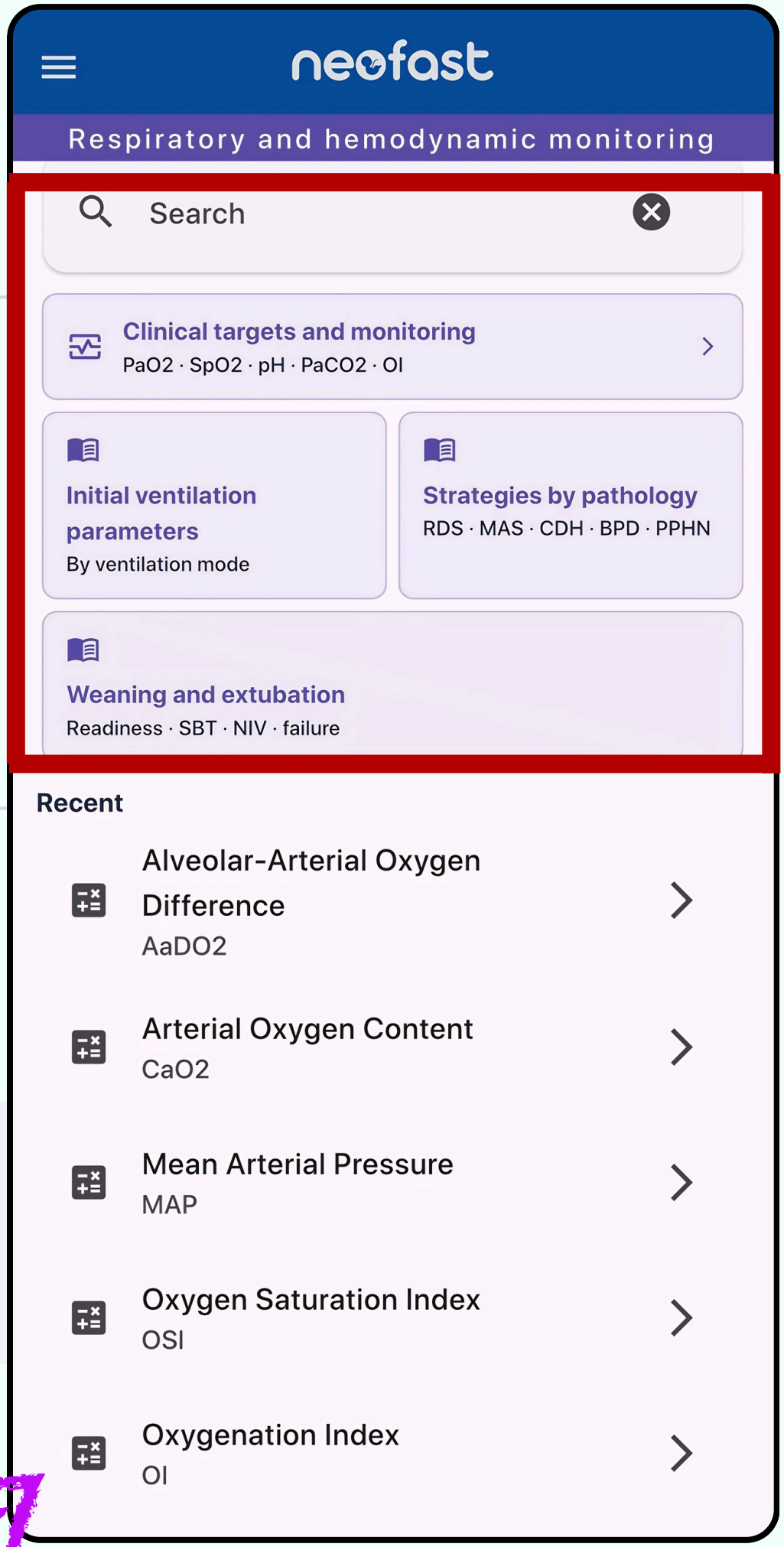
REFERENCE

Yoder BA, Grubb PH. Mechanical Ventilation: Disease-Specific Strategies. In: Keszler M, Gautham KS, eds. *Goldsmith's Assisted Ventilation of the Neonate: An Evidence-Based Approach to Newborn Respiratory Care*. 7th ed. Philadelphia: Elsevier; 2022. Chapter 25, p. 288–302.

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The ventilator doesn't make the difference.
You do.





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Ventilate the pathophysiology, not the diagnosis label.

Identify the dominant problem first — it changes, so reassess often.

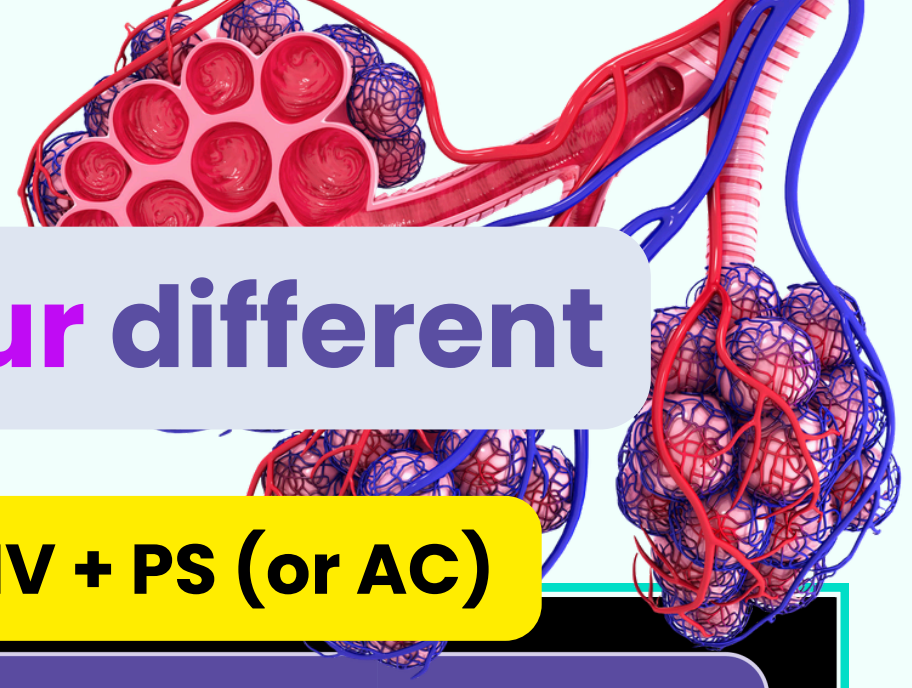
Disease	Dominant problem	Ventilation goal
RDS	Diffuse alveolar disease, surfactant deficiency, microatelectasis	Recruit and keep the lung open; avoid overstretch
MAS	Heterogeneous: air trapping + atelectasis + pulmonary hypertension	Individualize; long expiratory time when gas trapping dominates
CDH / lung hypoplasia	Small lung, abnormal pulmonary vascular bed	"Gentle ventilation": small V_T, low P_{aw}, tolerate CO_2
Severe-chronic BPD	High airway resistance, long time constants, ↑ dead space, malacia	Larger V_T, long I-time, slow rate, higher PEEP
PPHN	Pulmonary vasoconstriction, hypoxemia	Optimize inflation (no hyperinflation); iNO as indicated

In NeoFast: Monitoring → **Strategies by pathology**.
RDS · MAS · CDH · BPD · PPHN, one card each.

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CONVENTIONAL VENTILATION

Same ventilator. Four different lungs.



Volume-targeted SIMV + PS (or AC)

	RDS	MAS	Lung hypoplasia	Chronic-severe BPD
V_T mL/kg	4–6	5–6	4–5 PIP <26	7–12 (or higher)
Rate/min	30–60	<30	40–60	15–30
I-time s	0.30–0.35	0.35–0.50	0.25–0.40	0.50–1.00
PEEP cmH_2O	5–8	4–7	3–5	8–12 “stent” airways
PS	⅔–¾ of set V_T	⅔–¾ of set VT	—	⅔–¾ of set VT
Extra	Surfactant	Surfactant ± iNO	Surfactant only if RDS features	Longer Ti for resistance; slow rate to empty

Early / mild-moderate BPD: V_T 6–8 mL/kg · rate 20–40 · I-time 0.35– 0.45 s · PEEP 5–8.

PPHN: minimize hyperinflation, iNO and adjunct therapies.

HIGH-FREQUENCY VENTILATION · STARTING POINTS

HFOV or jet? The disease the frequency.



	HFOV	HFJV
RDS	8–12 Hz · P_{aw} 10–16 ΔP ≈ 2× P_{aw}, adjust to chest/abd vibration · I:E 1:2	360–420 /min · on-time 0.020 s PEEP 7–10 · minimal/no back-up
MAS	**6–8 Hz** · ΔP to vibrate chest/abd Paw for ~9-rib inflation	**240–360 /min** (passive exhalation!) ↑ on-time if needed · back- up 0–5 · PEEP 5–7
Lung hypoplasia	8–10 Hz · P_{aw} 10–13 ΔP ≈ 2× P_{aw} · I:E 1:2	360–420 /min · PEEP 5–8 minimal/no back-up
BPD	Similar to MAS	Similar to MAS; may need back-up rate. Rarely used in chronic-severe BPD

Air trapping alert: exhalation is passive on jet and flow-interrupter ventilators. In MAS, keep the rate low (240–360) to give the lung time to empty.

RDS - Initial settings - HFOV ΔP adjustments.

RDS: start by weight, adjust by gas.



	<1000 g	1000–2500 g	>2500 g
HFOV			
Frequency	10 Hz	10 Hz	8–10 Hz
Paw cmH_2O	10–12	10–14	12–16
ΔP	2 × P_{aw}		
SIMV			
Rate /min	30–60	30–60	20–40
VT mL/kg	5–6	~5	4–5
PEEP cmH_2O	5–8	5–8	6–9
I-time / PS	Ti 0.3–0.4 s, adjust by graphics · PS 8–12, then ⅔ PIP for V_T		

PCO_2 >65 ↑
ΔP 5–10

PCO_2 55–65
↑ ΔP 2–5

PCO_2 35–45
↓ ΔP 2–5

PCO_2 <35 ↓
ΔP 5–10

MAS - TREAT THE PHENOTYPE IN FRONT OF YOU

MAS is three diseases in one baby.

	Air trapping	Low lung volume	Pulmonary hypertension
Why	↑ Resistance ↑ Time constant Hyperexpansion	↓ Surfactant function ↓ Compliance ↑ V/Q mismatch	↓ NO synthase Hypoxemia Acidosis
SIMV	V_T 5–6 mL/kg · rate <30 · PEEP 4–6 · shorter Ti · PS ~¾	Surfactant · higher PEEP (5–8) as needed · monitor lung volume	iNO · SpO_2 92– 98% Consider inodilators Optimize sedation **for any mode**
HFOV	6–8 Hz · P_{aw} ≈ conventional · ΔP to vibrate chest/abd	Paw 3–5 above conventional · aim ~9 ribs	
HFJV	240–360 /min · longer on-time · minimal back-up	PEEP for ~9 ribs · back-up 3–5	

The dominant picture can change fast, especially after surfactant and in the **first 12–24 h**. ***Reassess clinically, radiographically and by gases.***

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CDH · LUNG HYPOPLASIA

Small lung. Gentle hands.

	HFOV	HFJV	SIMV
ΔP / PIP	24–28	20–25 cmH_2O	V_T 4–5 mL/kg max PIP <25
P_{aw} / PEEP	10–12	10–12 / 6–8	4–5 cmH_2O
Max P_{aw}	Rarely >16	Rarely >16	–
Frequency	8–10 Hz	360–420 /min	40–60 /min
I:E / Ti	1:2	0.02 s	0.3 s
Initial FiO_2	0.40		
$PaCO_2$	Goal 45–55 mmHg · tolerated <65 mmHg		
Chest X-ray	~9-rib inflation of the contralateral lung		

In the authors' center, starting HFOV at a **lower P_{aw} (10–12 vs 13–15 cmH_2O)**, together with other changes, was associated with less iNO, inotropes and ECMO, and better survival.

BPD - Approach by severity

Severe BPD: big, slow, long breaths.

	Mild / moderate	Severe-chronic
V_T mL/kg	5–8	**6–12** (↑ dead space)
PEEP cmH_2O	Often 6–8, to optimize inflation	**Often 8–10** to "stent" large airways
I-time s	0.35–0.45	**0.5–1.0** to overcome resistance
Rate /min	20–40, based on effort	**15–30** for complete exhalation
SpO_2	92–98%	92–98%
$PaCO_2$ mmHg	45–60	50–60

Why bigger V_T? Less gas-exchange surface, alveolar dead space, acquired tracheomegaly and leak.

Malacia: the authors have used PEEP up to 14 cmH_2O, with caution for regional overinflation.

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WEANING STARTS ON DAY ONE

PROTOCOLS get babies off the ventilator.

~90%

of infants meeting criteria extubated within 24 h

−40%

ventilator days in the authors' QI program

Extubation thresholds by *current weight* (stable airway, minimal apnea):

	< 1000 g	1000–2000 g	2000–3000 g	>3000 g
HFOV · FIO_2 <0.40				
P_{aw}	8	9–10	10–12	12
ΔP	16	18	20	22
PC-SIMV OR SIMV + VG, WITH PSV				
PIP	<16	16–20	20	—
PEEP	<6	<7	<8	—
Others	PS <6–8 · FiO_2 <0.40 · rate 16–20 /min · V_T 4–5 mL/kg (VG)			

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NOW IMAGINE ALL OF THIS...

...in your pocket, at the bedside.

One hub

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Clinical targets and monitoring - PaO2 · SpO2 · pH · PaCO2 · OI

Oxygenation and ventilation targets

PaO2 (RDS)	50 to 70 mmHg
SpO2 (RDS)	90 to 94%
pH	7.25 to 7.40
PaCO2 (RDS)	35 to 45 mmHg
PaCO2 (MAS)	45 to 55 mmHg

SpO2 by condition, according to Goldsmith

MAS and PPHN	92 to 98%
Mild to moderate BPD	92 to 95%
Severe BPD	92 to 98%
Pre-ductal CDH	Above 85% in the first hour, then 88 to 98%

Permissive hypercapnia

PaCO2	46 to 60 mmHg, frequently tolerated in Congenital Diaphragmatic Hernia and Meconium Aspiration Syndrome, to minimize lung injury

Permissive hypercapnia, according to Goldsmith

PaCO2	45 to 55 mmHg or higher, provided pH remains above 7.20 to 7.25
CDH	45 to 65 mmHg
Severe BPD	50 to 65 mmHg, accepting compensated respiratory acidosis

Standardizing CO2 targets prevents the clinical inertia of keeping the infant on high support just to achieve normal blood gases, and it is one of the facilitators of weaning.

Oxygenation Index (OI)

Formula	OI = (MAP × FiO2 × 100) ÷ PaO2
OI between 15 and 25	Consider inhaled nitric oxide (iNO)
OI ≥ 40	Indication for ECMO

Targets by disease

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Initial ventilation parameters - By ventilation mode

See strategies by pathology

NON-INVASIVE RESPIRATORY SUPPORT

- Nasal CPAP
- High-flow nasal cannula
- Nasal intermittent positive pressure ventilation

INVASIVE MECHANICAL VENTILATION

- PCV — Pressure controlled ventilation
- VCV — Volume controlled ventilation
- SIMV, A/C and PSV — trigger modes
  How the ventilator responds to the infant's effort. According to Goldsmith.
- VG / VTV — Volume guarantee
- NAVA — Neurally adjusted ventilatory assist
- HFJV — High-frequency jet ventilation

Settings by mode

NOW IMAGINE ALL OF THIS...

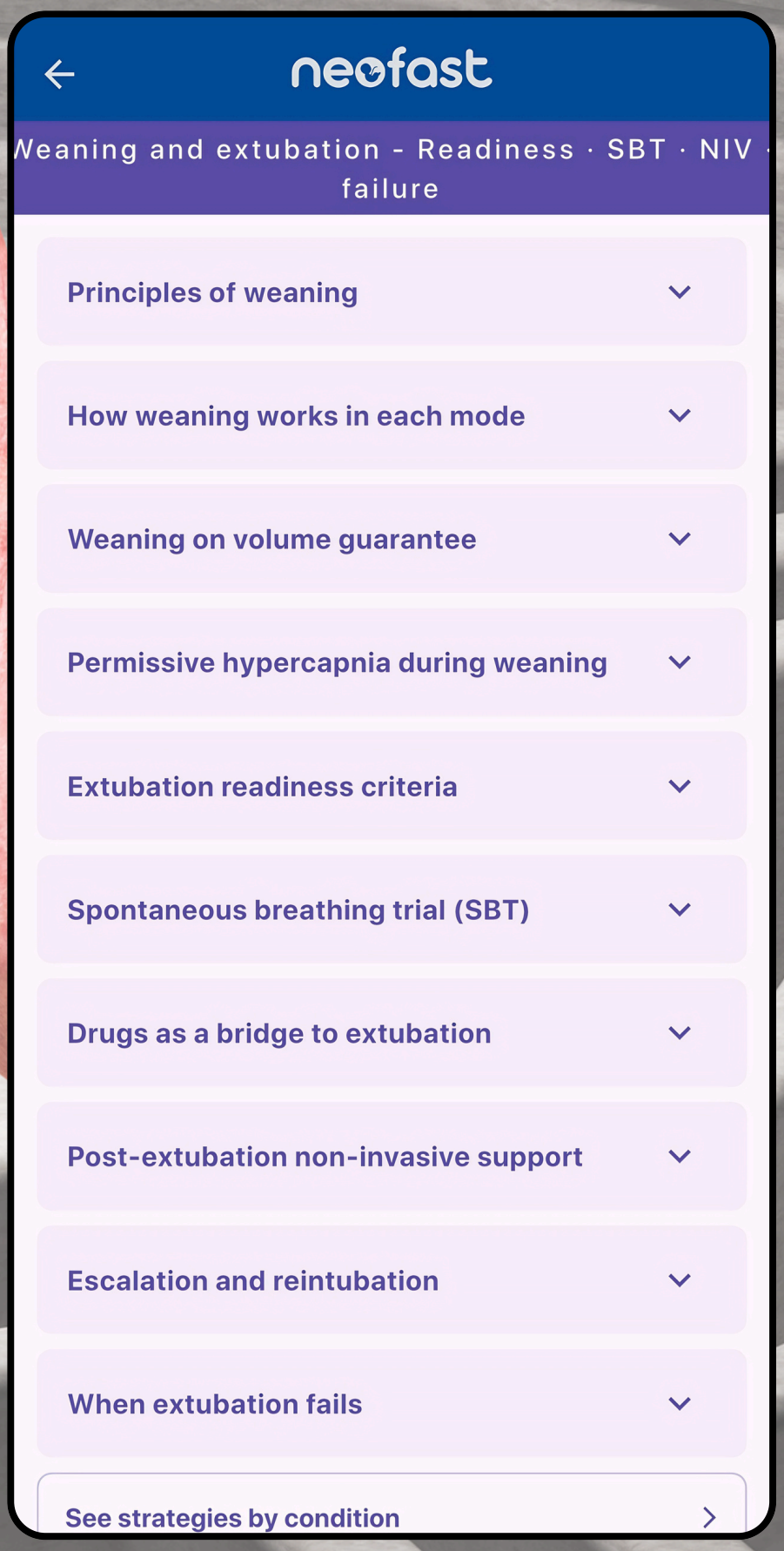
...in your pocket, at the bedside.

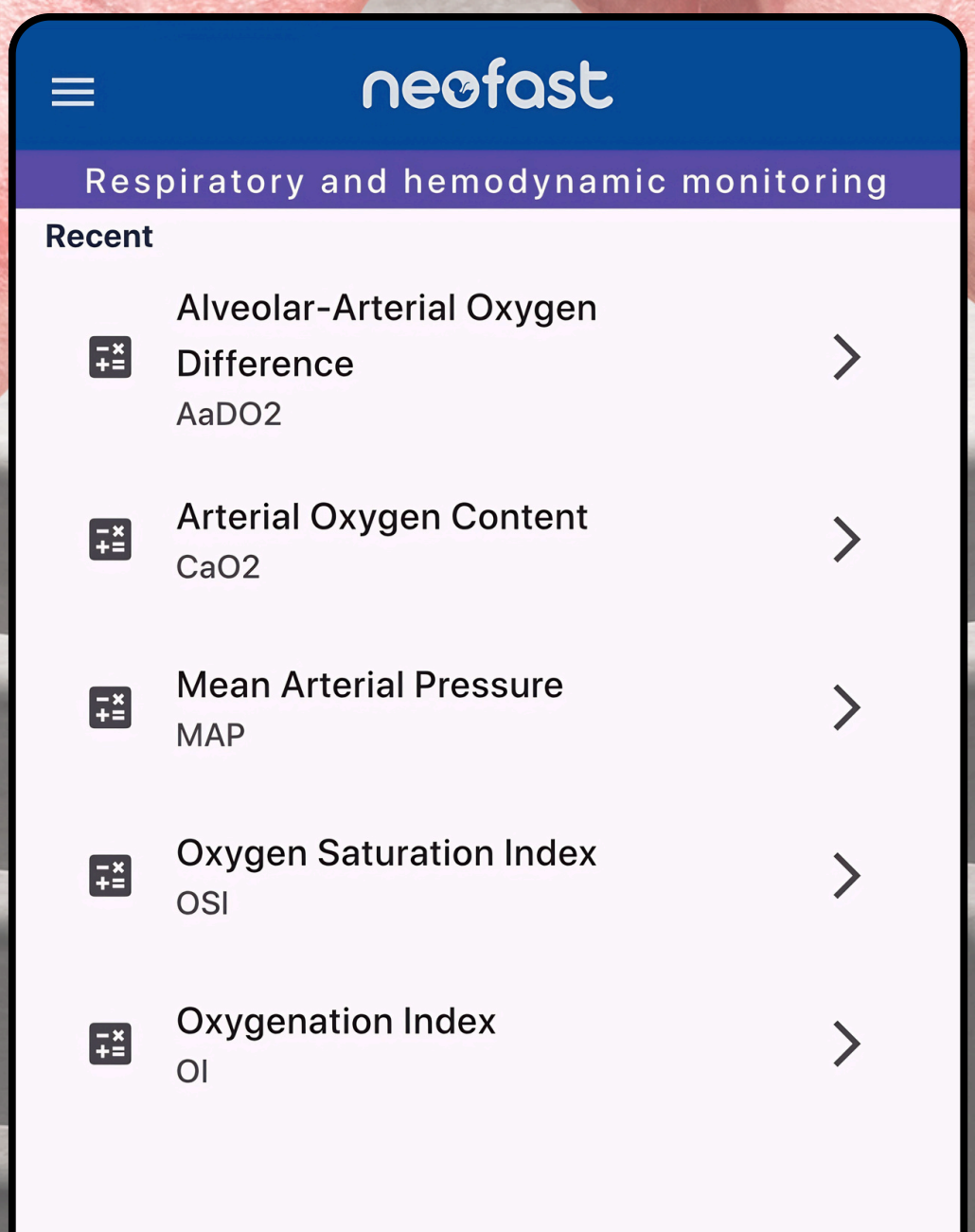
✓ **Strategies by pathology**: RDS, MAS, CDH, BPD, PPHN

✓ **Clinical targets**: SpO_2, $PaCO_2$, pH, OI

✓ **Initial parameters**: CPAP to HFJV and NAVA

✓ **Weaning and extubation**: readiness, SBT, failure



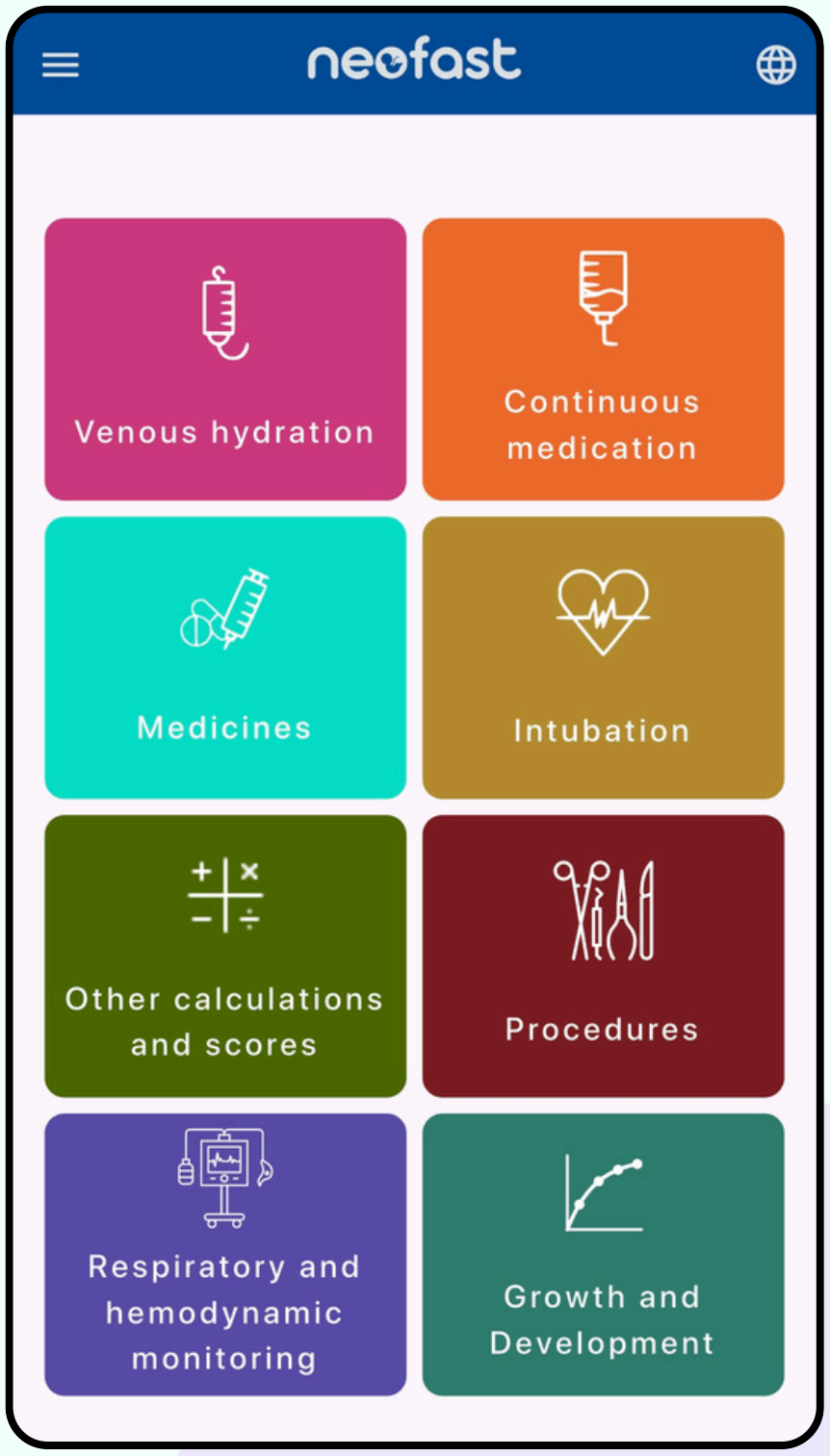


Weaning

Respiratory monitoring

LESS SEARCHING. MORE CARING.

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Educational content. Settings are suggested starting points from the cited chapter; always individualize to the patient and follow your unit's protocols. Source: Yoder BA, Grubb PH. In: Keszler M, Gautham KS, eds. Goldsmith's Assisted Ventilation of the Neonate. 7th ed. Elsevier; 2022. Ch. 25.

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