

Loan Lifelife Calculator

$$cost = \left(\frac{\text{rate}}{12} \right) \cdot \text{price} \cdot \left[1 - \left(1 + \frac{\text{rate}}{12} \right)^{-\text{duration}} \right] \cdot \text{duration}$$

[Ventilator Pocket Guide](#)

Foundational Equations

Ohm's Law	$\Delta P = FR = P_{aw} - P_{alv} = P_{pl} - PEEP_{total}$
Equation of Motion	$P_{aw} = FR + \frac{V_t}{C} + PEEP_{total}$
Compliance	$C = \frac{\Delta V}{\Delta P}$
Natural Decay Equation	$V_i(t) = \frac{V_o}{e^{\frac{t}{RC}}} = \frac{V_o}{e^{\frac{t}{\tau}}}$
Calculating τ, General Case	$\tau = \frac{V_t}{F} \cdot \left(\frac{PIP - P_{plt}}{P_{plt} - PEEP_{total}} \right)$
Alveolar Gas Equation	$P_{AO_2} = F_{iO_2}(P_{atm} - P_{H_2O}) - \frac{P_{aCO_2}}{RQ}$, where $RQ = 0.80$
Mech Power, VC	$MP_{VC} = 0.098 \cdot RR \cdot V_t \left[PIP - \frac{1}{2}(P_{plat} - PEEP) \right]$
Mech Power, PC	$MP_{VC} = 0.098 \cdot RR \cdot V_t \left[PEEP + \Delta P_{insp} \left(1 - e^{-\frac{T_{insp}}{RC}} \right) \right]$

Respiratory Equations

Mechanical Power

Volume Control

$$MP_{VC} = 0.098 \cdot RR \cdot V_t \left[PIP - \frac{1}{2}(P_{plat} - PEEP) \right] \approx \frac{MV(P_{peak} + PEEP + \frac{Q_{insp}}{6})}{20}$$

Pressure Control

$$MP_{VC} = 0.098 \cdot RR \cdot V_t \left[PEEP + \Delta P_{insp} \left(1 - \exp\left(\frac{-T_{insp}}{RC} \right) \right) \right]$$

$$MP_{VC} = 0.098 \cdot RR \cdot V_t \left[PEEP + \Delta P_{insp} \left(1 - e^{-\frac{T_{insp}}{RC}} \right) \right] \approx 0.098 \cdot RR \cdot V_t (PEEP + \Delta P_{insp})$$

- [Vent Waveforms](#)

Alveolar Gas Equation

$$P_{AO_2} = F_{iO_2}(P_{atm} - P_{H_2O}) - \frac{P_{aCO_2}}{RQ}$$

substituting back in to RQ equation: $RQ = \frac{P_{ACO_2}}{\frac{V_{AP_{ACO_2}}}{V_{O_2}} \cdot k} = \frac{V_{O_2}}{V_a} \cdot k$

$$V_T = V_A + V_D, \text{ where } V_A = 350 \text{ and } V_D = 150$$

Shunt Equation (Berggren Equation)

$$\frac{Q_s}{Q_t} = \frac{C_{C_{O_2}} - C_{a_{O_2}}}{C_{C_{O_2}} - C_{v_{O_2}}}$$

where:

- Q_s = pulmonary physiology shunt ($\frac{mL}{min}$)
- Q_t = cardiac output ($\frac{mL}{min}$)
- $C_{C_{O_2}}$ = end-pulmonary-capillary oxygen content
- $C_{a_{O_2}}$ = arterial oxygen content
- $C_{v_{O_2}}$ = mixed venous oxygen content

So, you will need an ABG and a true mixed VBG (art line + SGC).

Derivation

Dead Space Fraction

$$\frac{V_D}{V_T} = \frac{P_{ACO_2} - P_{ECO_2}}{P_{ACO_2}}$$

Formal measurement of P_{ECO_2} requires volumetric capnography, which requires a capable ventilator or a dedicated measurement device.

Thankfull, $P_{ECO_2} \approx ETCO_2$, so an approximation would $\frac{V_D}{V_T} = \frac{P_{ACO_2} - ETCO_2}{P_{ACO_2}}$

Alveolar ventilation

$$P_{AO_2} = F_{iO_2}(P_{atm} - P_{H_2O}) - \frac{P_{AO_2}}{RQ}$$

$$\dot{V}_A = k \frac{\dot{V}CO_2}{P_{ACO_2}} \implies \dot{V}CO_2 = \frac{\dot{V}_A P_{ACO_2}}{k}$$

To convert F_{ACO_2} into P_{ACO_2} , we have $F_{ACO_2}(P_{atm} - P_{H_2O}) = P_{ACO_2}$ Similarly, using F_{ECO_2} , we can show $P_{ECO_2} = F_{ECO_2}(P_{atm} - P_{H_2O})$

$$Volume_{expiredCO_2} = Volume_{producedAlvCO_2}$$

$$V_{TF_{ECO_2}} = V_{AF_{ACO_2}}$$

$$V_{TF_{ECO_2}} = (V_T - V_D)F_{ACO_2}, \text{ and we can convert } F_{ACO_2} \text{ into } P_{ACO_2}$$

PULM

Equation of Motion

$$P_{\text{delivered}} = P_{\text{resistive}} + P_{\text{elastic}}$$

$$P_{\text{aw}} = \dot{V}R + \frac{V_t}{C} + \text{PEEP}_{\text{total}} + P_{\text{musc}}$$

CPET Testing

Heart rate reserve

$$\text{HRR} = \text{HR}_{\text{achieved}}^{\text{max}} - \text{HR}_{\text{predicted}}^{\text{peak}},$$

$$\text{where } \text{HR}_{\text{predicted}}^{\text{peak}} = 220 - \text{age}$$

Slope of work efficiency

$$m(\text{work}_e) = \frac{\Delta \text{VO}_2}{\Delta \text{WR}}$$

Slope of heart rate rise

$$\frac{\Delta \text{HR}}{\Delta \text{VO}_2}$$

CARDS

$$\text{TPG} = \text{mPAP} - \text{PCWP}$$

$$\text{SVR} = \frac{\text{MAP} - \text{CVP}}{\text{CO}} \cdot 80$$

$$\text{PVR} = \frac{\text{mPAP} - \text{PCWP}}{\text{CO}} \cdot 80$$

$$\text{CO} = \text{LVOT}_{\text{area}} \cdot \text{LVOT}_{\text{VTI}} \cdot \text{HR}$$

Swan-Ganz Equations

$$\text{CO} = \frac{\text{VO}_2}{C_a - C_v}, \text{ where } C_v = \text{ScvO}_2 \text{ (mixed venous oxygen content)}$$

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