

Ventilator Pocket Guide

**Foundational Equations**

<b>Ohm's Law</b>	$\Delta P = FR = P_{aw} - P_{alv} = P_{pl} - PEEP_{total}$
<b>Equation of Motion</b>	$P_{aw} = FR + \frac{V_t}{C} + PEEP_{total}$
<b>Compliance</b>	$C = \frac{\Delta V}{\Delta P}$
<b>Natural Decay Equation</b>	$V_i(t) = \frac{V_o}{e^{\frac{t}{RC}}} = \frac{V_o}{e^{\frac{t}{\tau}}}$
<b>Calculating <math>\tau</math>, General Case</b>	$\tau = \frac{V_t}{F} \cdot \left( \frac{PIP - P_{plt}}{P_{plt} - PEEP_{total}} \right)$
<b>Alveolar Gas Equation</b>	$P_{AO_2} = F_{iO_2}(P_{atm} - P_{H_2O}) - \frac{P_{aCO_2}}{RQ}$ , where $RQ = 0.80$

- [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:  $RQ = \frac{P_{aCO_2}}{\frac{V_{AP_{ACO_2}}}{kV_{O_2}} - \frac{V_{O_2}}{V_a}k}$

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

**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**

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

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

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

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

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

## CARDS

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

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

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

## 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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