

## 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>	$\tau = \frac{V_t F}{\ln(\frac{P_{pl} - P_{total}}{P_{pl}})}$
<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:  $RQ = \frac{P_{ACO_2}}{\frac{V_{APACO_2}}{kVO_2} + \frac{VO_2}{V_a}}$

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

### 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.

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

### Alveolar ventilation

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

$$\dot{V}_A = k \frac{\dot{V}_{CO_2}}{P_{ACO_2}} \implies \dot{V}_{CO_2} = k \dot{V}_{APACO_2}$$

To convert  $F_{ACO_2}$  into  $P_{ACO_2}$ , we have  $F_{ACO_2}(P_{atm} - PH_2O) = P_{ACO_2}$ . Similarly, using  $F_{ECO_2}$ , we can show  $P_{ECO_2} = F_{ECO_2}(P_{atm} - P_{H_2O})$

$$Volume_{expiredCO2} = Volume_{producedAlvCO2}$$

$$V_{TF\_ECO\_2} = V_{AF\_ACO\_2}$$

$$V_{TF\_ECO\_2} = (V_T - V_D)F_{ACO_2}$$
, and we can convert  $F_{ACO_2}$  into  $P_{ACO_2}$

## PULM

### Equation of Motion

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

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

## CARDS

$$TPG = mPAP - PCWP$$

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

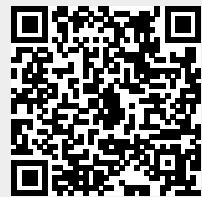
$$CO = LVOT_{\text{area}} \cdot LVOT_{\text{VTI}} \cdot HR$$

### Swan-Ganz Equations

$$CO = \frac{VO_2}{C_a - C_v}, \text{ where } C_v = ScvO_2 \text{ (mixed venous oxygen content)}$$

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