

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>	$\tau = \frac{V_t}{F} \cdot \left( \frac{PIP - P_{plt}}{PEEP_{total}} \right)$						
<b>Alveolar Gas Equation</b>	$P_{AO_2} = F_{iO_2}(P_{atm} - P_{H_2O}) - \frac{P_{aCO_2}}{RQ}$ , where $RQ = 0.80$						
<b>Alveolar Gas Equation, Substituted RQ</b>	$P_{AO_2} = F_{iO_2}(P_{atm} - P_{H_2O}) - \frac{VO_2}{V_a}k$						
<b>Patient</b>	<b>Mode</b>	<b>TV</b>	<b>Rate</b>	<b>Ppeak</b>	<b>Pplat</b>	<b>PEEPauto</b>	<b>PEEPset</b>

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**Alveolar Gas Equation**

$$PAO_2 = FiO_2(P_{atm} - P_{H_2O}) - \frac{PaCO_2}{RQ}$$

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

$V_T = V_A + V_D$ , where  $V_A = 350$  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**

$$P_{A}O_2 = F_{iO_2}(P_{atm} - P_{H_2O}) - \frac{P_{AO_2}}{RQ}$$

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

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  $P_{ECO_2} = F_{ECO_2}(P_{atm} - P_{H_2O})$

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

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

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

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