Respiratory Rate and Tidal Volume

The total amount of air moved in and out of the lungs each minute (pulmonary ventilation) depends upon 2 factors: size of each breath (tidal volume) and number of breaths/minute (respiratory rate). The equation is PV = TV x RR

For example, suppose your tidal volume is 500 mL (0.5 liters) and you breathe 15 times/minute. Your pulmonary ventilation = 15 breaths/min x 0.5 L/breath = 7.5 L/min.

Some of the space inside the lungs is dead space that doesn't get ventilated and does not exchange gases and that only air in the alveoli exchanges gases with the blood. Air in the pharynx, larynx, trachea, bronchi and bronchioles does not exchange gases. The air that reaches the alveoli = tidal volume - dead space. An average human adult at rest has a tidal volume of around 0.5 L and a dead space of around 0.15 liters (~30% of TV). This means that the fresh air to the alveoli is around 0.35 L (~70% of TV).

Total Alveolar Ventilation (mL/min) = (Respiratory rate) x (TV - dead space)

Consider a group of patients with the same pulmonary ventilation. All measurements were taken while patients were resting quietly.

Patient	**Tidal Volume**	**Respiratory Rate**	**Pulmonary Ventilation**	**Dead Space**	**Alveolar Ventilation**
1	1000 mL		6000 mL/min	150 mL	
2	500 mL		6000 mL/min	150 mL	
3	300 mL		6000 mL/min	150 mL	
4	200 mL		6000 mL/min	150 mL	
5	150 mL		6000 mL/min	150 mL	

Questions

1. [SP 5] The nurse forgot to fill in the respiratory rate for each patient. Rather than bother her, you decide to simply calculate this from the other data you have.

2. [SP 5] Calculate the alveolar ventilation for each patient.

3. [SP 1, SP6] By monitoring only the pulmonary ventilation, one might conclude these patients are in similar health. Explain the importance of considering all the data to provide a better overall picture of the condition of each patient.

4. [SP4, SP 6] Identify the patient most likely to have a physically active lifestyle and the patient which is most likely sedentary. Justify your choices.

5. [SP4, SP 6] Identify the patient(s) you would be concerned about. Justify your response.

6. [SP4, SP 6] Propose a possible cause of the condition of the patient(s) you identified in Q5.

7. [SP 1] Propose some recommendations for a patient that has a similar condition.

8. [SP 1] Identify some things can have long term effects on the tidal volume and respiratory rate. Explain why they have the effects they have.

9. [SP 1] Propose a reason for the importance of doctors considering a variety of vital statistics before making a diagnosis.