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

Remember that some of the lung air is dead space 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 to 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 = (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. 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. For each patient, calculate the alveolar ventilation.
3. If you were monitoring only the pulmonary ventilation you might conclude that these patients were all equally well off. How do the other data give us a better overall picture of each patient?
4. Which of these patients has a physically active lifestyle? Which is likely mostly sedentary? Support your opinion.
5. Which patient(s) would you be concerned about? Why?
6. What might be a cause of the problem in these patients?
7. What might you recommend for these patients? Why?
8. What kinds of things can affect the tidal volume and respiratory rate? Why are they affected by these things?
9. Why is it important for doctors to look at a variety of vital statistics before making a diagnosis?