

CAN AEROSOL DRUG DELIVERY BY SVN BE PREDICTED? – Michael McPeck BS RRT, Russell King and Glenn Samford CNMT. Healthline Aerosol Medicine, Baldwin Park CA.

BACKGROUND: Prediction of aerosol drug delivery (Inhaled Mass, IM) would be welcomed for its ability to allow practitioners to intentionally vary drug concentrations and nebulizer fill volumes in order to customize treatments and reduce treatment time. However, accurate prediction of inhaled mass (IMp) has been impractical because the efficiency of many SVNs and their delivery systems is generally low and drug delivery is variable and imprecise due to differences in patient's breathing patterns. We sought to determine whether a high efficiency aerosol drug delivery system that negated the effect of different breathing patterns would reduce the variability and permit application of a predictive formula. **METHODS:** We proposed the following formula for predicted Inhaled Mass (IMp) as mg of aerosolized albuterol that would be delivered to the mouth-piece during therapy with the Healthline Medicator[®] Plus Aerosol Maximizer:

$$\text{IMp} = \text{C} \times \text{NE} \times \text{AGR} \times \text{SE} \times \text{TT}$$

where, C = drug concentration in mg/mL, NE = Nebulizer Efficiency fraction, AGR = Aerosol Generation Rate of nebulizer in mL/min, SE = System Efficiency fraction, and TT = Treatment Time. To test the validity of the prediction formula, aerosolized albuterol delivery to HEPA filters placed at the mouthpiece of six volunteer subjects [3 males, 3 females, mean age 29.3 (range 15-38) years] was determined while the subjects received a 10 minute SVN "treatment" with radiolabeled (^{99m}Tc) unit-dose albuterol (2.5 mg in 3 mL 0.9% NaCl) administered by the Medicator[®] Plus. After each treatment filters were measured in a radioisotope counter and the Inhaled Mass fraction (^{99m}Tc on filter / ^{99m}Tc in initial nebulizer charge) was determined. Mass of albuterol (mg) delivered to the HEPA filter was determined by multiplying the Inhaled Mass fraction by 2.5 mg (the mass of albuterol initially placed in the nebulizer) and the resulting value compared to the prediction.

RESULTS: The IMp for albuterol was 0.59 mg taking into account a previously measured NE of 53%, an albuterol concentration (C) of 0.83 mg/mL, AGR of 0.24 mL/min, SE of 56% and TT of 10 minutes. The actual IM [Mean (±SD)] was 0.57 (±0.11) mg with range of from 0.41 to 0.70 mg and a coefficient of variation of 19.5%. **SUMMARY:** While this preliminary study is hardly definitive, it does suggest the feasibility of grossly predicting IM when factors such as NE and SE are known and controlled, and when a delivery system is used that negates the effect of different breathing patterns (i.e., I:E ratios). NE is the percent of drug mass placed in nebulizer that is nebulized; it is dependent upon nebulizer design and flowrate. SE (% of drug aerosol that is generated that is actually inhaled) is dependent on breathing pattern and delivery system design. In typical continuously-operated SVNs it is ordinarily low due to wasting of aerosol generated during the patient's exhalation phase. **CONCLUSION:** Because the Medicator[®] Plus avoids aerosol waste by storing aerosol generated during exhalation in a reservoir bag and returns it to the patient on the subsequent inhalation, this appears to diminish the adverse effect of the breathing pattern on aerosol delivery, increase SE, and may make the application of this or other Inhaled Mass prediction formulas possible.

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