Parameter Definition for Aerosol-Generating Medical Procedures in Hospitals

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ABSTRACT

The demand for high-fidelity, clinically relevant computer models for airborne disease spread during aerosol generating medical procedures (AGMPs) has drastically risen due to the COVID-19 pandemic. AGMPs are routinely performed in hospital rooms of various size, ventilation rate, equipment layout, procedure acuity, and many more clinically variable parameters that may significantly change the risk level of airborne disease spread. Several studies have demonstrated the importance of human thermal plumes (HTPs), human movement, and ventilation system design when predicting the distribution of aerosols in healthcare settings. Some of these studies also show the effectiveness of new preventative technologies. Comparing the relative influence of each parameter and preventative device between each study is difficult because each individual experiment/simulation takes place in a specific or relatively narrow range of hospital settings. By applying Design of Experiment (DOE) methodologies, the relative importance of each clinically variable parameter and new preventative technology can be systematically tested. However, to run effective DOE screening studies, ranges of each input parameter need to be quantified. The purpose of this study is to present descriptive statistics for each room type where AGMPs may occur.

A survey was circulated to healthcare workers in Interior Health (IH) to gather information about the crowdedness level, number of occupants, number of moving occupants, duration, and walking speed during different times of a standard endotracheal intubation procedure. Survey participants were asked to quantify these values for all room types that may house intubation. Endotracheal intubation was chosen because it is a high-risk, compound AGMP. Other AGMPs, such as positive pressure ventilation and high-flow supplemental oxygen, occur before and after intubation. Survey results indicate that intubations may occur in trauma, ICU, or general ward rooms with either positive or negative pressure ventilation, for a total of 6 room types. Additionally, drawings for over 20 IH hospitals were reviewed to quantify room sizes, ceiling heights, supply vent area and number, exhaust vent area and number, light area and number, and ventilation rates of all 6 room types. Vent layouts were qualitatively recorded as well. Descriptive statistics for each clinically variable parameter are presented in this study. Significant differences between room types determined by analysis of variance (ANOVA) and Tukey-Kramer tests are presented as well. The statistics shown for each room type will help future researchers choose clinically relevant room parameters when investigating disease spread in healthcare settings.