Comparative Efficacy of Humidifiers in Noninvasive Infant Respiratory Support

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BACKGROUND

Infant respiratory distress is a significant problem worldwide with considerable need for affordable respiratory support devices in resource-limited settings (RLS). The gold standard respiratory support involves electric heat and humidification to mitigate nasal discomfort and breakdown; however, these devices are quite expensive. Thus, RLS often use passive non-electric bubbling humidifiers. In these experiments we compare the efficacy of a Fisher Paykel heated humidifier, a custom-built low-cost heated humidifier, a standard passive non-electric bubbling humidifier, and a control with no humidifier.

METHODS

In a hospital patient room (22ºC, 50% humidity), the temperature and humidity delivered to a balloon-simulated patient lung (38ºC) via a BC161-10 Fisher Paykel bubble CPAP system was measured with the following devices: Fisher Paykel heated humidifier, custom-built heated humidifier, passive Salter Labs bubbling humidifier, and a control with no humidifier. Delivered CPAP was set to 5 cm H_2O and the flow rate was varied from 4 to 8 L/min in 2 L/min increments.

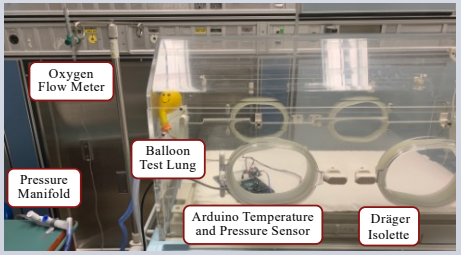


Figure 1. Control Setup

METHODS

Figure 2. Passive Bubble Humidifier

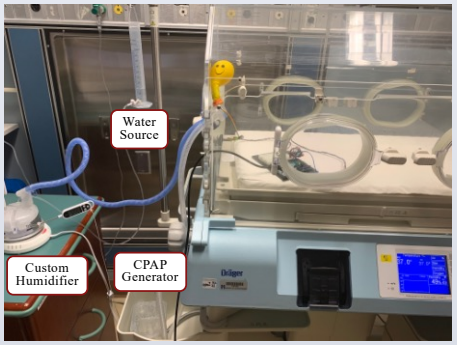


Figure 3. Custom Heated Humidifier

Figure 4. F&P Bubble CPAP System

METHODS

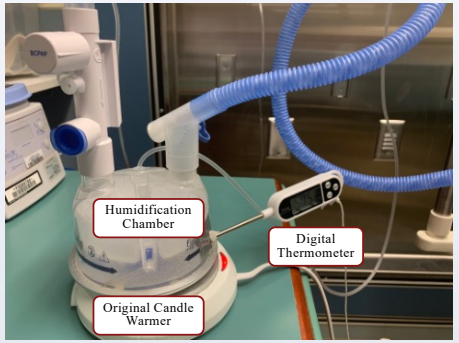


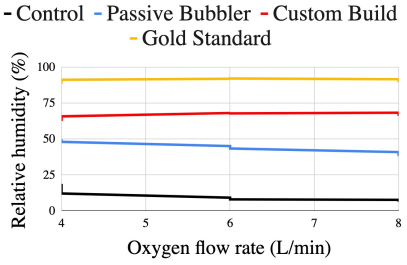
Figure 5. Detailed View of Custom-Built Heated Humidifier.

Constructed from a modified Original Candle Warmer base with F&P Humidification Chamber.

RESULTS

As the flow rate was varied from 4-8 L/min, the delivered relative humidity (standard deviation) with each humidifier was as follows: control 10% (3.6%), passive bubbler 44% (3.7%), custom-built humidifier 67% (1.7%), heated humidifier 91% (0.86%).

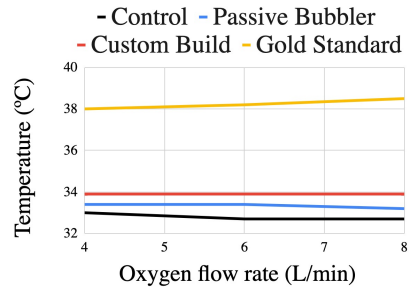
Figure 6. Average Relative Humidity (%) at Nares from 4-8 L/min



RESULTS

The delivered temperature with the F&P humidifier was 38-39ºC, the temperature for the heated device was 34ºC, and the temperature for both the bubble cup and the control was 33ºC.

Figure 7. Average Temperature (ºC) at Nares from 4-8 L/min



DISCUSSION

There is a significant difference in relative humidity generated by each device. The F&P humidifier provides the highest humidity, the passive bubbler provides considerably more humidity than the control, and the custom-built device provides an intermediate degree of humidification. Through further improvement of this concept with a heated inspiratory circuit and sensor-based control of the heating element, an effective yet inexpensive solution for heat and humidification could be developed.

ACKNOWLEDGEMENTS

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