Usability and Operational Integration of Real-Time Ventilation Feedback in a Military Field Hospital Setting: A Mixed Methods Study

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How easy is a real-time manual ventilation feedback device (the Sotair® flow-limiting valve) to use and did military medical personnel find it helpful in a simulated field hospital setting.

BACKGROUND

- Manual ventilation is a fundamental skill in both USA based healthcare and deployed settings, but variations in provider experience and operational demands often lead to inconsistent performance
- While feedback-enabled tools can maintain accuracy, their acceptance by military medical personnel is underexplored.

OBJECTIVE

To evaluate the usability, perceived usefulness, and impact on ventilation quality of a real-time feedback device (Sotair®) in a simulated field hospital environment during the 2025 Global Medic exercise.

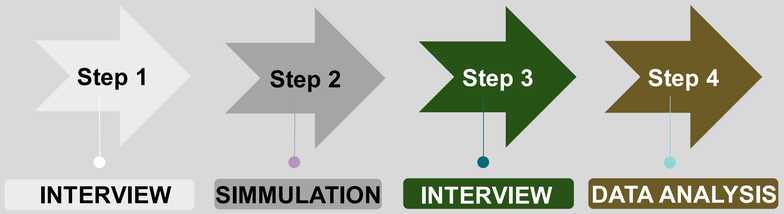
METHODS

Mixed-Methods: Data collection and participant feedback about the Sotair® flow-limiting valve (safeBVM, Boston, MA).

Qualitative Data Collection: All military medical provider participants underwent pre- and post-simulation interviews, with manual ventilation performance assessed through direct observation.

Quantitative Data Collection: 45 of the participants completed 60-second pre- and post-device ventilation trials for quantitative analysis.

Data Analysis: The qualitative data was analyzed thematically using the Technology Acceptance Model (TAM) framework. Quantitative performance data was analyzed to evaluate the impact of feedback devices on ventilation consistency. Data from both sources were triangulated to provide a comprehensive understanding of the devices' effectiveness and usability.



RESULTS

- **N = 70** military medical providers. Roles include EMTs (41%), Paramedics (29%), RNs (14%), Physicians (9%), and Respiratory Therapists (3%).
- Quantitative findings: Target tidal volume (420-570 mL) accuracy rose from 36.9% (baseline) to 47.6% (with device).
- This improvement was statistically significant ($p = 0.003$).
- Qualitative responses reflected improved awareness of ventilation quality and strong provider support for real-world implementation.

Figure 1: Operational Training. Military medical providers being briefed on the Sotair® flow-limiting valve and simulation protocols during the Global Medic exercise.

Figure 2: Performance Assessment. Quantitative data collection using real-time feedback to measure ventilation quality and tidal volume accuracy.

Figure 3: Operational Integration. Assessing device usability within the high-stress, simulated field hospital environment of a joint military medicine exercise.

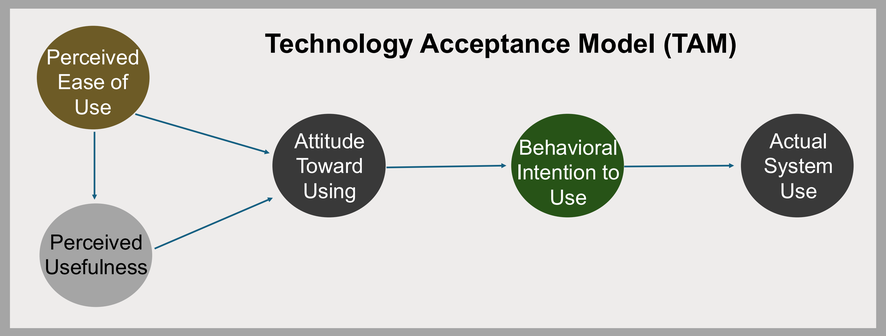


Figure 4: Technology Acceptance Model (TAM)
Participants described the devices as intuitive **Perceived Ease of Use** and beneficial for improving ventilation quality **Perceived Usefulness**. These perceptions contributed to a positive **Attitude Toward Using** the devices and a strong **Behavioral Intention to Use** them. Participants stated **Actual System Use** could be integrated into training without disrupting workflow.

In a military field hospital environment, the Sotair® real-time ventilation feedback device was associated with high perceived usefulness, favorable ease of use, and strong desire for integration into training/operational contexts.

DISCUSSION & CONCLUSION

- This study evaluated how easy a real-time manual ventilation feedback device (the Sotair® flow-limiting valve) was to use and whether military medical personnel found it helpful in a simulated field hospital setting.
- Quantitative findings showed that feedback devices improved tidal volume consistency and pressure delivery compared to no-feedback control.
- Qualitatively, providers described the devices as intuitive and helpful, supporting future use in practice when paired with training.
- These findings align with prior studies suggesting feedback improves performance in simulated clinical skills.
- Implications include potential for transformation in clinical standards, training, and operational readiness within military medical environments.
- Limitations include small quantitative sample size (n = 45) and simulation-only design, warranting caution in generalizing findings to live operations.
- Future research should explore field implementation, clinical outcomes, and long-term adoption.
- In conclusion, real-time ventilation feedback devices are associated with improved performance and high provider acceptance, supporting their integration into training and practice.

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