

4

Research and Design Perspectives

Research on respiratory requirements and powered air purifying respirator (PAPR) design is being conducted to improve the use of PAPRs and other respirators by health care workers. Four workshop speakers discussed the physiological needs of health care workers and how to improve PAPR mechanical function for the health care setting.

RESPIRATORY DEMANDS OF THE HEALTH CARE WORKFORCE

Philip Harber, University of Arizona

Focusing on the personal protective equipment (PPE) needs of health care workers involves examining the types of work they are performing and the real-world situations that they must deal with while in protective gear. Much of the research discussed in this presentation applies to all types of respirators and is not specific to PAPRs. Harber's presentation focused on four key points:

1. Human respiratory physiology is complex, and therefore, a single flow rate criterion is not the solution.
2. Assessments of real-life utilization may be more important than the protection factor.
3. Design features for PAPRs or other types of PPE can affect utilization and need to be measured and assessed in laboratory settings.
4. Health care workers are diverse and have differing respiratory demands depending on their physiology and the types of work they are doing, in addition to other factors.

Respirator design must account for the respiratory burden to the user as well as the impact of the action of breathing on a respirator's protection—that is, on the respirator's effectiveness. To assess PAPR burden on the user, laboratory methods should be as noninvasive as possible in order to avoid interfering with normal breathing or with the operation of the PAPR. Measures of chest and abdominal movement can provide fairly accurate and direct measurements.

Breathing does not occur at a constant rate; inhalation and exhalation rates are not constant and can vary considerably. Thus, pressure and flow rates can vary widely depending on the level of physical exertion and other factors. Respirators should provide protection at the peak inspiratory flow rate. The pressure gradient is another key factor in physiological studies of the impact and effectiveness of respiratory protection.

The pathway to respiratory protection involves numerous steps including but not limited to identifying the agent, identifying persons at risk, choosing the proper respirator, training users, motivating users, making the respirator available, ensuring proper respirator function (e.g., battery is available and working), checking that the respirator is properly used, ensuring an adequate facial seal and filter effectiveness, and confirming proper equipment maintenance. Although some of the answers may not be available and quantifiable (e.g., filtration effectiveness), it is possible to “set up reasonable ranges and then look at which factors have the bigger influence on the overall utility.”

Just as the engineering design is tested in the certification process, it is possible to conduct more testing on implementation issues, including donning and doffing times and effectiveness, training measures, and subjective and comfort issues. A decision support system could be effective.

EVALUATING PHYSIOLOGICAL REQUIREMENTS WHEN USING PAPRs

Edward Sinkule

National Personal Protective Technology Laboratory

The National Personal Protective Technology Laboratory (NPPTL) is conducting research to characterize the physiological and subjective responses to PAPR use. This research examines work rates that are similar to those found in health care settings. It is ongoing work, so final results are not yet available. The three parts of the ongoing study are (1) to conduct physiological measurements of participants using a treadmill to

The Use and Effectiveness of
Powered Air Purifying
RESPIRATORS
in Health Care

WORKSHOP SUMMARY

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Margaret A. McCoy, *Rapporteurs*

Board on Health Sciences Policy

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The serpent has been a symbol of long life, healing, and knowledge among almost all cultures and religions since the beginning of recorded history. The serpent adopted as a logotype by the Institute of Medicine is a relief carving from ancient Greece, now held by the Staatliche Museen in Berlin.

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