



**TITLE: Powered Air Purifying Respirators for Infection Prevention in Patients with Suspected or Confirmed Communicable Disease: Clinical Effectiveness, Cost-Effectiveness and Guidelines**

**DATE:** 21 July 2015

## **RESEARCH QUESTIONS**

1. What is the clinical effectiveness of powered air purifying respirators used by healthcare workers when providing care for patients with suspected or confirmed communicable disease?
2. What is the cost-effectiveness of powered air purifying respirators used by healthcare workers when providing care for patients with suspected or confirmed communicable disease?
3. What are the evidence-based guidelines regarding the use of powered air purifying respirators used by healthcare workers when providing care for patients with suspected or confirmed communicable disease?

## **KEY FINDINGS**

One economic evaluation and one evidence-based guideline were identified regarding powered air purifying respirators used by healthcare workers when providing care for patients with suspected or confirmed communicable disease.

## **METHODS**

A limited literature search was conducted on key resources including PubMed, The Cochrane Library, University of York Centre for Reviews and Dissemination (CRD) databases, ECRI Institute, Canadian and major international health technology agencies, as well as a focused Internet search. No methodological filters were applied to limit retrieval by publication type. Where possible, retrieval was limited to the human population. The search was also limited to English language documents published between January 1, 2010 and July 5, 2015. Internet links were provided, where available.

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The summary of findings was prepared from the abstracts of the relevant information. Please note that data contained in abstracts may not always be an accurate reflection of the data contained within the full article.

**SELECTION CRITERIA**

One reviewer screened citations and selected studies based on the inclusion criteria presented in Table 1.

<b>Table 1: Selection Criteria</b>	
<b>Population</b>	Patients with suspected or confirmed communicable disease
<b>Intervention</b>	Powered air purifying respirators (PAPR) (also referred to as ‘Controlled Air Purifying Respirators’)
<b>Comparator</b>	Q1 & 2: N95 respirator or any other active comparator (e.g., surgical mask); No infection control measure; No comparator Q3: No comparator
<b>Outcomes</b>	Q1: Clinical effectiveness outcomes including: infection prevention, infection transmission rates; Safety Q2: Cost-effectiveness outcomes Q3: Evidence-based guidelines regarding best practice for the use of PAPRs
<b>Study Designs</b>	Health technology assessment reports, systematic reviews, meta-analyses, randomized controlled trials, non-randomized studies, economic evaluations, and evidence-based guidelines.

**RESULTS**

Rapid Response reports are organized so that the higher quality evidence is presented first. Therefore, health technology assessment reports, systematic reviews, and meta-analyses are presented first. These are followed by randomized controlled trials, non-randomized studies, economic evaluations, and evidence-based guidelines.

One economic evaluation and one evidence-based guideline were identified regarding powered air purifying respirators used by healthcare workers when providing care for patients with suspected or confirmed communicable disease. No relevant health technology assessments, systematic reviews, meta-analyses, randomized controlled trials, or non-randomized studies were identified.

Additional references of potential interest are provided in the appendix.

**OVERALL SUMMARY OF FINDINGS**

One economic evaluation<sup>1</sup> examined the costs of stockpiling respiratory protection devices for use during an Influenza pandemic. Reusable half face respirators were reported to be more cost-effective than disposable N95 masks and the authors recommended against stockpiling powered air purifying respirators due to their cost.

One guideline<sup>2</sup> was identified regarding infection control practices for cystic fibrosis. The guideline recommends healthcare providers use N95 masks or powered air purifying respirators when caring for cystic fibrosis patients who are under airborne precautions for suspected, or confirmed, tuberculosis.

## REFERENCES SUMMARIZED

### Health Technology Assessments

No literature identified.

### Systematic Reviews and Meta-analyses

No literature identified.

### Randomized Controlled Trials

No literature identified.

### Non-Randomized Studies

No literature identified.

### Economic Evaluations

1. Baracco G, Eisert S, Eagan A, Radonovich L. Comparative cost of stockpiling various types of respiratory protective devices to protect the health care workforce during an influenza pandemic. *Disaster Med Public Health Prep.* 2015 Jun;9(3):313-8.  
[PubMed: PM25874891](#)

Specific guidance on the size and composition of respiratory protective device (RPD) stockpiles for use during a pandemic is lacking. **We explore the economic aspects of stockpiling various types and combinations of RPDs by adapting a pandemic model that estimates the impact of a severe pandemic on a defined population, the number of potential interactions between patients and health care personnel, and the potential number of health care personnel needed to fulfill those needs.** Our model calculates the number of the different types of RPDs that should be stockpiled and the consequent cost of purchase and storage, prorating this cost over the shelf life of the inventory. Compared with disposable N95 or powered air-purifying respirators, we show that stockpiling reusable elastomeric half-face respirators is the least costly approach. Disposable N95 respirators take up significantly more storage space, which increases relative costs. Reusing or extending the usable period of disposable devices may diminish some of these costs. We conclude that stockpiling a combination of disposable N95 and reusable half-face RPDs is the best approach to preparedness for most health care organizations. **We recommend against stockpiling powered air-purifying respirators as they are much more costly than alternative approaches.**

## Guidelines and Recommendations

2. Saiman L, Siegel JD, LiPuma JJ, Brown RF, Bryson EA, Chambers MJ, Downer VS, Fliege J, Hazle LA, Jain M, Marshall BC, O'Malley C, Pattee SR, Potter-Bynoe G, Reid S, Robinson KA, Sabadosa KA, Schmidt HJ, Tullis E, Webber J, Weber DJ. Infection prevention and control guideline for cystic fibrosis: 2013 update. 2014 Aug;35(Suppl 1):S1-S67  
[PubMed: PM25025126](#)  
NGC summary: <http://www.guideline.gov/content.aspx?f=rss&id=48772>  
See: 14.c

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**APPENDIX – FURTHER INFORMATION:**

**Previous CADTH Reports**

3. Respiratory precautions for protection from bioaerosols or infectious agents: a review of the clinical effectiveness and guidelines [Internet]. Ottawa (ON): CADTH; 2014 Aug 19. [cited 2015 Jul 15]. (Rapid Response report). Available from: <https://www.cadth.ca/sites/default/files/pdf/htis/dec-2014/RC0576%20Respirator%20Effectiveness%20final.pdf>
4. Wear compliance and donning/doffing of respiratory protection for bioaerosols or infectious agents: a review of the effectiveness, safety, and guidelines [Internet]. Ottawa (ON): CADTH; 2014 Aug 19. [cited 2015 Jul 15]. (Rapid Response report). Available from: <https://www.cadth.ca/sites/default/files/pdf/htis/dec-2014/RC0575%20Respirator%20Compliance%20final.pdf>

**Non-Randomized Studies**

*Simulation*

5. Watson CM, Duval-Arnould JM, McCrory MC, Froz S, Connors C, Perl TM, et al. Simulated pediatric resuscitation use for personal protective equipment adherence measurement and training during the 2009 influenza (H1N1) pandemic. *Jt Comm J Qual Patient Saf.* 2011 Nov;37(11):515-23. [PubMed: PM22132664](#)

*Impact on Speech*

6. Radonovich LJ Jr, Yanke R, Cheng J, Bender B. Diminished speech intelligibility associated with certain types of respirators worn by healthcare workers. *J Occup Environ Hyg.* 2010 Jan;7(1):63-70. [PubMed: PM19904661](#)

**Clinical Practice Guidelines – Methodology Not Specified**

7. Interim PPE guidelines for managing Ebola virus disease patients [Internet]. Brisbane (AU): Queensland Health; 2015 Apr. [cited 2015 Jul 15]. Available from: <https://www.health.qld.gov.au/publications/clinical-practice/guidelines-procedures/diseases-infection/ppe-guideline.pdf>  
*See: Additional considerations, pages 2-3*
8. Interim PPE guidelines for Retrieval Services Queensland staff managing patients with Ebola virus disease [Internet]. Brisbane (AU): Queensland Health; 2015 Jun. [cited 2015 Jul 15]. Available from: <https://www.health.qld.gov.au/publications/clinical-practice/guidelines-procedures/diseases-infection/ebola-rs-ppe-guideline.pdf>  
*See: PPE recommendations for RSQ staff managing patients with EVD, page 1*

9. Provincial Ebola Expert Working Group. Recommendations for donning (putting on) and doffing (taking off) personal protective equipment for health care workers during the management of confined cases of Ebola virus disease [Internet]. Victoria (BC): BC Ministry of Health; 2015 Feb. [cited 2015 Jul 15]. Available from: <http://www2.gov.bc.ca/assets/gov/health/about-bc-s-health-care-system/office-of-the-provincial-health-officer/donning-and-doffing-recommendations-higher-transmission-risk.pdf>  
See: *Option 2 [Powered Air Purifying Respirator (PAPR) with Coveralls, pages 7-8*
10. Provincial Ebola Expert Working Group. Recommendations for reprocessing of reusable personal protective equipment (PPE) for Ebola virus disease: standard operating procedures [Internet]. Victoria (BC): BC Ministry of Health; 2015 Jun 22. [cited 2015 Jul 15]. Available from: <http://www2.gov.bc.ca/assets/gov/health/about-bc-s-health-care-system/office-of-the-provincial-health-officer/ppe-ebola-standard-procedures.pdf>
11. Respiratory Protection – use and maintenance of powered air purifying respirators (PAPRs) [Internet]. Lincoln (NE): University of Nebraska-Lincoln; 2013 Feb. [cited 2015 Jul 15]. Available from: [http://ehs.unl.edu/sop/RPP\\_SOP\\_PAPR.pdf](http://ehs.unl.edu/sop/RPP_SOP_PAPR.pdf)
12. National Health and Medical Research Council (NHMRC). Australian guidelines for the prevention and control of infection in healthcare [Internet]. Canberra (AU): Commonwealth of Australia; 2010. [cited 2015 Jul 15]. Available from: [http://www.nhmrc.gov.au/files\\_nhmrc/publications/attachments/cd33\\_complete.pdf](http://www.nhmrc.gov.au/files_nhmrc/publications/attachments/cd33_complete.pdf)

#### Review Articles

13. Branch-Elliman W, Savor PC, McGeer A, Perl TM. Protecting the frontline: designing an infection prevention platform for preventing emerging respiratory viral illnesses in healthcare personnel. *Infect Control Hosp Epidemiol.* 2015 Mar;36(3):336-45.  
[PubMed: PM25695176](#)

#### Additional References

14. Board on Health Sciences Policy, Institute of Medicine. The use and effectiveness of powered air purifying respirators in health care: workshop summary. Washington (DC): National Academies Press (US); 2015 May 7.  
[PubMed: 25996018](#)
15. Respirator trusted-source information [Internet]. Atlanta (GA): Centers for Disease Control and Prevention; 2014 Dec. [cited 2015 Jul 15]. Available from: [http://www.cdc.gov/niosh/npptl/topics/respirators/disp\\_part/RespSource1quest3.html](http://www.cdc.gov/niosh/npptl/topics/respirators/disp_part/RespSource1quest3.html)
16. With strengthened guidelines for health care workers, the CDC ups its game against the deadly Ebola virus. *ED Manag.* 2014 Dec;26(12):133-6.  
[PubMed: PM25522493](#)
17. Tompkins BM, Kerchberger JP. Special article: personal protective equipment for care of pandemic influenza patients: a training workshop for the powered air purifying respirator. *Anesth Analg.* 2010 Oct;111(4):933-45.  
[PubMed: PM20810676](#)