

The Consequences of Withholding Noninvasive Ventilation During an Epidemic

The February issue of *RESPIRATORY CARE* published an article by Benditt, "Novel Uses of Noninvasive Ventilation,"¹ which included a discussion on the possible risk of using noninvasive ventilation (NIV) with infectious patients during an epidemic. The author presented epidemiological data describing the safe and effective use of NIV during the severe acute respiratory syndrome (SARS) epidemic in China, and some inconclusive data from the Canadian SARS experience. He then cited the bench study by Hui et al² as rationale for caregivers to be wary of ventilating infectious patients noninvasively. However, Hui et al used a mannequin that could not simulate aerosol dispersion when it is most likely to occur with a live patient (ie, during a cough or sneeze), and it did not compare dispersion between subjects who were on NIV versus others who were not. Moreover, the authors' finding that particle dispersion is likely to extend up to 0.5 m from the noninvasive interface seems irrelevant, since caregivers would need to use precautions in order to get that close to any infected patient, regardless of whether NIV was in use or not.

In the discussion that followed, concerning the American Association for Respiratory Care's recommendation to abandon NIV during an epidemic,³ Kacmarek correctly stated that it is easy to filter exhaled gases from an intubated patient on a conventional ventilator, and problematic to do so with a patient on NIV. However, that would not support Mehta's suggestion to intubate contagious patients rather than use NIV. While it may be safer to care for an intubated patient than one whose exhaled gases are unfiltered, there is no evidence to support that initiating NIV increases the risk of transmission, and for both ethical and practical reasons, we could not intubate patients during an epidemic for the purpose of filtering exhaled gases. Even during an epidemic, the only reason to intubate a patient should be to provide him/her with the support required. On the basis of available evidence, it seems unreasonable to reject an intervention (NIV) with demonstrable ben-

efits,⁴ especially at a time when every available option would be needed.

It is said that "Those who cannot remember the past are condemned to repeat it."⁵ During Toronto's SARS epidemic, Ontario's Ministry of Health issued a province-wide directive stipulating that NIV be avoided,⁶ and some hospitals banned using NIV for any acute respiratory illness.^{7,8} Given what is known about the complications of intubation,⁹ we should acknowledge that the broad application of restrictions on the use of NIV during the SARS epidemic may have been associated with a substantial number of avoidable deaths. Considering what is at stake during future epidemics, it is surprising that the potential scale of this flip side to SARS mortality has not been discussed by authors who have taken a retrospective look at the "Spring of Fear."¹⁰

John McCracken RRT

Department of Respiratory Therapy
Peterborough Regional Health Centre
Peterborough, Ontario, Canada
john.mccracken@sympatico.ca

Mr McCracken has disclosed no conflicts of interest.

REFERENCES

1. Benditt JO. Novel uses of noninvasive ventilation. *Respir Care* 2009;54(2):212-219.
2. Hui DS, Hall SD, Mathew TV, Chan MTV, Chow BK, Tsou JY, et al. Noninvasive positive pressure ventilation: an experimental model to assess air and particle dispersion. *Chest* 2006;130(3):730-740.
3. American Association of Respiratory Care. Guidelines for acquisition of ventilators to meet demands for pandemic flu and mass casualty incidents, addendum 2. January 30, 2008.
4. Keenan SP, Sinuff T, Cook DJ, Hill NS. Does noninvasive positive pressure ventilation improve outcome in acute hypoxemic respiratory failure? *Crit Care Med* 2004;32(12):2516-23.
5. George Santayana. The life of reason: the phases of human progress. Vol 1. Reason in common sense. 1906. <http://www.gutenberg.org/files/15000/15000-h/15000-h.htm>. Accessed August 9, 2009.

6. Ontario Ministry of Health. Directives to all Ontario acute care hospitals for high-risk procedures in critical care areas. Directive 03-06. Ontario: Ministry of Health; 2003.
7. Saint Jacques AJ. SARS outbreak in Canada: an expert interview with Randy Wax MD FRCPC. *Medscape Medical News*, April 14, 2003. <http://www.medscape.com/viewarticle/452303>. Accessed August 10, 2009.
8. University Health Network. Policy and procedure manual: respiratory therapy department. BiPAP/CPAP during SARS 04/03.
9. Girou E, Schortgen F, Delclaux C, Brun-Buisson C, Blot F, Lefort Y, et al. Association of noninvasive ventilation with nosocomial infections and survival in critically ill patients. *JAMA* 2000;284(18):2361-2367.
10. Campbell JA. SARS Commission final report: spring of fear, Volumes 1 and 2. December 2006.

The authors respond:

The letter by McCracken in response to the presentation and subsequent discussion at the 2008 Journal Conference concerning the use of NIV in pandemic respiratory infection raises several interesting issues.¹ He makes several explicit and implicit statements regarding the use of NIV in pandemic respiratory infections such as SARS.

First, he suggests that there is no direct evidence that NIV transmits respiratory infection through the dispersal of infectious particles into the environment. We agree. There is no direct evidence at this time that NIV use in this situation leads to an increase in the risk of infection to health-care providers or those in the immediate vicinity. However, there is bench evidence that aerosolized particles are expelled through the unfiltered NIV systems.^{2,3} In an additional and very recent investigation, Hui et al have shown,³ with a variety of NIV mask systems, that particles can be dispersed at a distance even farther than that stated in their original publication,² up to a distance of one meter from the mask. Thus, there is reasonable concern that this could happen in the clinical situation. Reasonable steps to reduce the risk of exposure of health-care workers to infection risk is paramount. In the executive summary of the Ontario, Canada, SARS Commission's final report, to which McCracken refers, the following paragraph summarizes this principle.

The point is not who is right and who is wrong about airborne transmission. The point is not science, but safety. Scientific knowledge changes constantly. Yesterday's scientific dogma is today's discarded fable. When it comes to worker safety in hospitals, we should not be driven by the scientific dogma of yesterday or even the scientific dogma of today. We should be driven by the precautionary principle that reasonable steps to reduce risk should not await scientific certainty.⁴

Second, the author indicates that withholding NIV in the SARS epidemic in Toronto, Canada, in 2003 was associated with an increase in the number of deaths due to complications of invasive ventilation. While we agree that avoidance of intubation is desirable in appropriate patients, we were unable to find any published evidence to support this statement. Countering this argument is the fact that a systematic review of NIV in the treatment of hypoxemic respiratory failure concluded that there was insufficient evidence to support the routine use of NIV in this disorder (of which SARS is a subset). In fact, a recent systematic review of NIV in hypoxemic respiratory fail-

ure in patients without chronic obstructive pulmonary disease and patients without cardiogenic pulmonary edema failed to support a mortality benefit.⁵

While we would all prefer to have more scientific information to guide us in the development of disaster-management protocols, we can only make the best and *safest* judgments with the data that are currently available. We therefore respectfully disagree with McCracken; on balance, the data do not support a safe role for NIV in the treatment of patients in the setting of pandemic respiratory infection.

Joshua O Benditt MD

Division of Pulmonary and
Critical Care Medicine
University of Washington
Seattle, Washington

Robert M Kacmarek PhD RRT

Department of Respiratory Care
Massachusetts General Hospital
Harvard Medical School
Boston, Massachusetts

Sangeeta Mehta MD

Division of Respirology
Mount Sinai Hospital
University of Toronto
Toronto, Ontario, Canada

Dr Kacmarek has disclosed relationships with Newport Medical, Hamilton, Covidien, and General Electric. Drs Benditt and Mehta have disclosed no conflicts of interest.

REFERENCES

1. Benditt JO. Novel uses of noninvasive ventilation. *Respir Care* 2009;54(2):212-219.
2. Hui DS, Hall SD, Mathew TV, Chan MTV, Chow BK, Tsou JY, et al. Noninvasive positive pressure ventilation: an experimental model to assess air and particle dispersion. *Chest* 2006;130(3):730-740.
3. Hui DS, Chow BK, Ng SS, Chu LC, Hall SD, Gin T, et al. Exhaled air dispersion distances during noninvasive ventilation via different Respironics face masks. *Chest* 2009; May 1 [Epub ahead of print].
4. Campbell JA. SARS Commission final report: spring of fear, Volumes 1 and 2. December 2006.
5. Keenan SP, Sinuff T, Cook DJ, Hill NS. Does noninvasive positive pressure ventilation improve outcome in acute hypoxemic respiratory failure? A systematic review. *Crit Care Med* 2004;32(12):2516-2523.

CORRECTION

In the article "The clinical impact of new long-term oxygen therapy technology" by Dunne PJ (*Respir Care* 2009;54[8]:1100-1111) the XPO₂ setting for Maximum F_IO₂ at 20 breaths/min should be setting 2 (not 5), as reported in reference 57; also, reference 57 should be among the sources for compiling this table. We regret this error.

Table 1. Performance Characteristics of Several Models of Portable Oxygen Concentrator

Model	Company	Weight (lb)	Maximum Oxygen Production (mL/min)	Flow Settings	Pulse Settings	Maximum Bolus Size (mL)	Maximum F _I O ₂ at 20 breaths/min
FreeStyle	AirSep, Buffalo, New York	6	480	NA	1-3	26	0.27 at setting 3
Inogen One	Inogen, Goleta, California	10	750	NA	1-5	26	0.29 at setting 5
XPO ₂	Invacare, Elyria, Ohio	7	900	NA	1-5	42	0.24 at setting 2
EverGo	Respironics, Murraysville, Pennsylvania	10	1,050	NA	1-6	36	0.32 at setting 6
Eclipse 2	SeQual Technologies, San Diego, California	17	3,000	0.5-3.0 L/min	1-6	96	0.42 at setting 6

F_IO₂ = fraction of inspired oxygen
NA = no data available
(Adapted from References 26, 28, and 57.)