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CONCISE COMMUNICATION

Transmission of Bacterial Infections to Healthcare Workers during Intubation and Respiratory Care of Patients with Severe Pneumonia

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Exposure of healthcare workers to patients with rapidly fatal infections invariably raises concerns regarding the risk of occupational acquisition. We describe acquisition of *Streptococcus pyogenes* by 2 nurses from a patient with fatal pneumonia and review previously reported cases of transmission of bacterial pathogens from patients with pneumonia to healthcare workers.

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Large outbreaks of severe acute respiratory syndrome (SARS) in healthcare settings, as well as the potential for pandemic influenza, highlight the threat of transmission of respiratory pathogens to healthcare workers (HCWs).^{1,2} Aerosol-generating procedures (eg, endotracheal intubation or suctioning) increase the risk of HCW infection substantially.¹ Even outside the setting of SARS or influenza, patients with life-threatening pneumonia raise concerns for HCWs regarding the potential for acquisition of pathogenic organisms. In this report, we describe suspected transmission of *Streptococcus pyogenes* from a patient with severe pneumonia to HCWs and review published cases of transmission of bacterial infections to HCWs that occurred during care of patients with pneumonia.

CASE REPORT

A 71-year-old man presented to the hospital complaining of respiratory distress. A chest radiograph showed right lower lobe consolidation. He was admitted to the hospital with a presumptive diagnosis of community-acquired pneumonia. His general condition quickly worsened, leading to asystolic cardiac arrest. A physician and 3 nurses in the ward immediately initiated cardiopulmonary resuscitation. Although the physician who performed endotracheal intubation wore a surgical mask, all nurses assisting in this procedure and subsequent endotracheal suctioning did not wear a mask (because

of a low perceived risk of acquisition of pathogens). Despite their efforts, the patient was dead 4 hours after his arrival in the hospital.

A sputum sample from the patient was cultured, and the isolate found was identified as *S. pyogenes*. As a result of our investigation into HCWs who had had contact with the patient, we recognized that 2 of the 3 nurses involved in the resuscitation had sore throat and fever. Therefore, we obtained throat swab samples from the 14 HCWs who had had any contact with the patient. *S. pyogenes* was recovered from cultures of the throat samples from the 2 symptomatic nurses; the throat swab samples of the remaining 12 HCWs were negative for *S. pyogenes*. The genotype of the isolates from the symptomatic nurses and the index patient was determined to be *emm* type 1 by means of sequencing of the *emm* gene, and all isolates showed an identical pattern in pulsed-field gel electrophoresis. Both infected nurses lacked any regular contact with children. The infected nurses were given amoxicillin with no clinical sequelae.

DISCUSSION

We describe the presumed transmission of *S. pyogenes* from a patient with fatal pneumonia to HCWs. Most likely, transmission occurred while HCWs performed resuscitation and placement of endotracheal tubes without wearing a mask. Given this occurrence, we reviewed previously published literature in which transmission of bacterial infections to HCWs as a result of the respiratory care of patients with severe pneumonia has been documented. Healthcare-associated transmission of the respiratory viruses *Mycobacterium tuberculosis*, *Bordetella pertussis*, and *Corynebacterium diphtheriae* is well documented. To our knowledge, transmission of infection to HCWs following care of patients with severe pneumonia has been documented with only a small number of other bacterial pathogens—*S. pyogenes*, *Neisseria meningitidis*, *Acinetobacter baumannii*, and possibly *Haemophilus influenzae* (Table).

There are several cases in which transmission of *S. pyogenes* to HCWs has been described,^{3-5,9,10} including a number in which the acquisition was from patients with respiratory infection. Daneman et al reported 20 hospital outbreaks in a prospective study that involved a 9-year period of surveillance for invasive *S. pyogenes* infections in Ontario, Canada.⁹ They found 6 cases of secondary transmission to HCWs in 13 outbreaks in which the colonization status of HCWs was investigated. Four of these 6 outbreaks included patients with respiratory infection (eg, pneumonia or tracheostomy site infection) as a possible source of the transmission.

Patients with pneumonia due to *S. pyogenes* have also been

TABLE. Published Cases of Healthcare Worker (HCW) Acquisition of Bacterial Pathogens from Patients with Severe Pneumonia

Reference	Pathogen	Infected HCW(s)	Possible risky procedure(s)	HCW(s) wore mask
[3]	<i>Streptococcus pyogenes</i>	2 nurses	Respiratory care in ICU	No
[4]	<i>S. pyogenes</i>	6 nurses (3 definitive and 3 possible cases)	Unknown	Unknown
[5]	<i>S. pyogenes</i>	24 HCWs in ED or ICU	Intubation and respiratory care in ED or ICU	No, 16; unknown, 8
PR	<i>S. pyogenes</i>	2 nurses	Resuscitation and assistance in intubation	No
[6]	<i>Neisseria meningitidis</i>	1 nurse	Unspecified care of patient with meningococcal pneumonia	Unknown
[7]	<i>Haemophilus influenzae</i>	1 physiotherapist	Physiotherapy for patient in ICU	Unknown
[8]	<i>Acinetobacter baumannii</i>	1 nurse	Respiratory care including endotracheal suctioning in ICU	No

NOTE. ED, emergency department; ICU, intensive care unit; PR, present report.

involved in 3 other reports of occupational acquisition by HCWs.³⁻⁵ The largest outbreak among HCWs, in which 24 HCWs were infected from a single patient, was reported by Kakis et al.⁵ All 16 HCWs who responded to the authors' questionnaire answered that they had cared for the patient without wearing a surgical mask.⁵

Numerous cases of laboratory-acquired and healthcare-acquired *N. meningitidis* infection have been described, but, to our knowledge, just a single case report exists of HCW acquisition during care of a patient with meningococcal pneumonia.⁶ In this case, a nurse died of meningococcal meningitis after caring for a patient who was admitted to the intensive care unit with meningococcal pneumonia. It is not known whether the nurse wore a mask while caring for the patient.

A single case of presumed transmission of *H. influenzae* type b from an intensive care unit patient with pneumonia to a HCW has been described.⁷ A physical therapist caring for the patient became ill with pharyngitis, fever, and rigors. *H. influenzae* type b with the same biotype was isolated from culture samples of the physical therapist's blood. Molecular typing was not performed, so it is impossible to be certain that there was truly acquisition by the HCW from the patient.

The report does not comment on use of a face mask or other precautions.

Recently, occupational transmission of multidrug-resistant *A. baumannii* to a HCW was also reported.⁸ The HCW developed severe *Acinetobacter* pneumonia (necessitating mechanical ventilation) after providing respiratory care including endotracheal suctioning to a patient with *A. baumannii* in the sputum. She was reported not to have worn a mask while providing respiratory care. Genotypically, her isolate and the patient's isolate were identical.

Our case and these published cases have common backgrounds and can suggest important lessons. First, transmission of bacterial pathogens from patients with severe pneumonia to HCWs is extremely rare. We can find no documented reports of patient-to-HCW transmission of the most common cause of community-acquired pneumonia, *Streptococcus pneumoniae*. Second, HCWs who acquired infection from patients did not comply with standard precautions (Table). Current Centers for Disease Control and Prevention guidelines recommend protection of the eyes, nose, and mouth, in addition to the wearing of a gown and gloves, during the performance of aerosol-generating procedures

Standard precautions	Use of face masks, eye protection, gown and gloves during procedures such as intubation and suctioning of the respiratory tract
Additional precautions	Droplet precautions for the first 24 hours of antimicrobial therapy for patients with pneumonia due to <i>Neisseria meningitidis</i> or <i>Streptococcus pyogenes</i> Airborne precautions for patients with fever, cough, and upper lobe changes (if HIV negative) until diagnosis clarified
Chemoprophylaxis	After exposure to respiratory secretions of patients with <i>N. meningitidis</i>

FIGURE. Prevention strategies for healthcare workers who encounter patients with severe pneumonia recommended in Siegel et al.³ HIV, human immunodeficiency virus.

such as endotracheal intubation and open suctioning of the respiratory tract.²

Should additional precautions (eg, droplet or airborne precautions) be used for care of patients with severe pneumonia? Droplet precautions are indicated during the first 24 hours of antimicrobial therapy in patients with *N. meningitidis* or *S. pyogenes* infections.² However, apart from suggestive evidence from Gram stain of respiratory secretions, it is typically impossible to be certain of these diagnoses within 24 hours of the patient's presentation at the hospital. Transmission-based precautions are sometimes used when conditions carry a sufficiently high risk to warrant their use empirically while the results of confirmatory tests are pending.² For example, the presence of cough, fever, and upper lobe infiltrate mandates use of airborne precautions in addition to contact precautions, because of the risk of tuberculosis.² At the present time, given the lack of adherence to standard precautions in documented cases of infections acquired by HCWs, there is insufficient data to recommend that additional precautions be routinely used in the care of patients with severe pneumonia (Figure).

Further study should focus on adherence, determinants of adherence, and evaluation of strategies and interventions to enhance adherence to standard precautions. Such studies could allow practical recommendations to be made that would facilitate increased adherence to these measures. In addition, it would be appropriate to perform well-conducted prospective studies to assess the true risks of acquisition by HCWs of pathogenic bacteria from patients with severe pneumonia. In the meantime, adherence to standard precautions is the most important means of prevention of patient-to-HCW transmission of bacteria that cause severe pneumonia.

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