



Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.

Respiratory Hygiene in the Emergency Department

Authors: Richard E. Rothman, MD, PhD, Charlene B. Irvin, MD, Gregory J. Moran, MD, Lauren Sauer, BA, Ylisabyth S. Bradshaw, DO, MS, Robert B. Fry, Jr, MD, Elaine B. Josephine, MD, Holly K. Ledyard, MD, and Jon Mark Hirshon, MD, MPH. From the Public Health Committee of the American College of Emergency Physicians

Supervising Editors: David A. Talan, MD, and Michael L. Callahan, MD

Reprinted from *Annals of Emergency Medicine*, 48, Rothman RE, Irvin CB, Moran GJ, Sauer L, Bradshaw YS, Fry RB Jr, et al, Respiratory hygiene in the emergency department, 570-82. Copyright 2006 with permission from the American College of Emergency Physicians.

Richard E. Rothman and Lauren Sauer, from the Department of Emergency Medicine, The Johns Hopkins University, Baltimore, MD.

Charlene B. Irvin, from the Department of Emergency Medicine, St. John Hospital and Medical Center, Wayne State University School of Medicine, Detroit, MI.

Gregory J. Moran, from the Department of Emergency Medicine and Division of Infectious Diseases, Olive View—University of California, Los Angeles Medical Center, Los Angeles, CA.

Ylisabyth S. Bradshaw, from the Department of Public Health and Family Medicine, Tufts University School of Medicine, Boston, MA.

Robert B. Fry, Jr, from the Department of Emergency Medicine, Wadley Regional Medical Center, Texarkana, TX.

Elaine B. Josephine, from the Department of Emergency Medicine, Our Lady of Mercy Medical Center, Bronx, NY; and the Department of Emergency Medicine, St. Luke's—Roosevelt Hospital Center, New York, NY.

Holly K. Ledyard, from the Department of Emergency Medicine, University of Cincinnati Hospital, Cincinnati, OH.

Jon Mark Hirshon, from the Department of Emergency Medicine, and Department of Epidemiology and Preventive Medicine, University of Maryland School of Medicine, Baltimore, MD.

For correspondence, write: Richard E. Rothman, MD, PhD, 5801 Smith Avenue, Davis Building, Suite 3220, Baltimore, MD 21209; 410-614-5933, fax 410-502-8881; E-mail: rrothman@jhmi.edu.

J Emerg Nurs 2007;33:119-34.

Available online 23 August 2006.

0196-0644/\$32.00

Copyright © 2006 by the American College of Emergency Physicians.

doi: [10.1016/j.jen.2007.01.013](https://doi.org/10.1016/j.jen.2007.01.013)

The emergency department (ED) is an essential component of the public health response plan for control of acute respiratory infectious threats. Effective respiratory hygiene in the ED is imperative to limit the spread of dangerous respiratory pathogens, including influenza, severe acute respiratory syndrome, avian influenza, and bioterrorism agents, particularly given that these agents may not be immediately identifiable. Sustaining effective respiratory control measures is especially challenging in the ED because of patient crowding, inadequate staffing and resources, and ever-increasing numbers of immunocompromised patients. Threat of contagion exists not only for ED patients but also for visitors, health care workers, and inpatient populations. Potential physical sites for respiratory disease transmission extend from out-of-hospital care, to triage, waiting room, ED treatment area, and the hospital at large. This article presents a summary of the most current information available in the literature about respiratory hygiene in the ED, including administrative, patient, and legal issues. Wherever possible, specific recommendations and references to practical information from the Centers for Disease Control and Prevention are provided. The "Administrative Issues" section describes coordination with public health departments, procedures for effective facility planning, and measures for health care worker protection (education, staffing optimization, and vaccination). The patient care section addresses the potentially infected ED patient, including emergency medical services concerns, triage planning, and patient transport. "Legal Issues" discusses the interplay between public safety and patient privacy. Emergency physicians play a critical role in early identification, treatment, and containment of potentially lethal respiratory pathogens. This brief synopsis should help clinicians and administrators understand, develop, and implement appropriate policies and procedures to address respiratory hygiene in the ED.

Introduction

Respiratory tract infections are common presentations among emergency department (ED) patients, some of whom may present an infectious risk. Unfortunately, definitive identification of the offending agent is generally not possible at the initial ED visit. Potential respiratory agents that the 21st century emergency physician must consider include the traditional respiratory pathogens and also emerging (eg, severe acute respiratory syndrome [SARS]), highly virulent (eg, avian influenza virus), resistant, and even bioterrorism-related agents. Thus, within the ED there is a potentially dangerous mixture of infections with serious possible public health consequences. Threat of contagion exists for uninfected patients (in the ED, the hospital at large, and the community) and health care personnel (including ED physicians). Through implementation of the most up-to-date guidelines, health care personnel can aid in minimizing respiratory infection transmission and protect patients and other hospital personnel from infection.

The potential risk for respiratory infection–related morbidity and mortality is compounded in the ED because of the increasing number of immunocompromised ED patients. Populations at increased risk include organ transplant patients,¹ HIV-infected patients, and postchemotherapy patients, all of whom are living longer because of improved lifesaving therapies.² Crowded and understaffed EDs further elevate risk of contagion and possible public health disasters. Two potentially lethal infections that are transmitted by the respiratory route, which most emergency physicians are familiar with, are *Neisseria meningitidis* (which causes meningococcemia) and *Mycobacterium tuberculosis*. These agents are relatively uncommon, however, in most US EDs, and as recently as 2003, the Centers for Disease Control and Prevention (CDC) reported that health care facility environments are rarely implicated in respiratory pathogen transmission (except in cases of immunocompromised patients). Case reports of transmission of SARS among hospital workers from that year resulted in heightened awareness of the need for increased attention to respiratory precautions. For example, according to Lau et al,³ 44% of SARS cases (68/156 cases) at the Prince of Wales Hospital in Hong Kong occurred in hospital workers who did not take special protective measures during the SARS outbreak. Another study found that failure

of providers to recognize risk, implement strict isolation measures, and diagnose disease was responsible for the majority of nosocomial cases of SARS in Hong Kong (with the vast majority of cases occurring among physicians and nurses).⁴ Internationally, health care worker infection has proven to account for up to 42% of SARS cases in Canada and approximately 25% of cases in Hong Kong.^{4,5} These findings provide compelling data that hospital workers are at significant risk of contracting respiratory infections and establish an imperative for initiating broad-scale infection control measures.

The participation of emergency physicians and nurses is critical for effective responsiveness to respiratory threats in hospitals. ED personnel represent a critical link in the chain of communication and response, along the continuum from the community to the inpatient unit. Policies should anticipate responses to the complex spectrum of possible respiratory illnesses, from highly transmissible and unexpected emerging global diseases such as SARS to yearly influenza epidemics. Lessons from the terrorist attacks on September 11, 2001, and other recent disasters emphasize the importance of integrating the public health system with both medical and mental health services, with close attention to capacity management and surge planning. Organizational systems thus require that disaster and public health planning at regional and state levels produce systems that integrate the ED (the likely focal point for patients with acute respiratory infections) with hospital and regional response plans and resources.^{6,7}

The purpose of this report is to summarize, from both the peer-reviewed literature and public health sources (eg, from the CDC), information most relevant to ED respiratory infection control. Specific and current recommendations and guidelines are provided, along with evidence supporting specific respiratory infection control measures, when available. The review is divided into 3 sections, addressing administrative, patient-related, and legal issues, with some unavoidable overlap occurring. Administrative topics include public health coordination, facility planning, and health care worker issues. The patient-related portion covers patient flow from out-of-hospital and triage to waiting room and ED treatment areas, with inclusion of a discussion of patient education and patient transport. The legal section summarizes federal and local laws pertinent to respiratory hygiene. Because SARS represents the

most recent significant respiratory pathogenic threat, many of the successes and challenges about respiratory infection control reference studies from the SARS outbreak. While this research is SARS specific, lessons that may be generalizable about infection control are provided. Further, although an all-inclusive discussion about respiratory hygiene is impossible, this summary provides the most relevant and practical information for the practicing emergency physician, with specific references provided for particular topics to allow more detailed review.

BACKGROUND

According to a recent national ED-based survey, acute respiratory infections are the leading ED “illness-related” diagnosis.⁸ Another recent study from the pediatric literature reported that acute respiratory illnesses are the second leading category of adolescent diagnosis from ED visits among virtually every age group (except women aged 18 to 21 years).⁹ The significant influx of patients expected during an outbreak (such as SARS or avian influenza) would result in an even greater proportion of ED patient visits for respiratory-related complaints.

The CDC has developed several specific guidelines about infection control in hospitals, with the most recent updates issued in November 2004.^{10,11} The recommendations are graded according to levels of supporting evidence, as defined in Figure 1. Precautionary measures are divided into standard precautions (Figure 2) to be followed in care of all patients and transmission-based precautions to be used in addition to standard precautions according to the route of pathogen transmission. Transmission-based precautions include contact precautions for agents with potential transmission by direct or indirect contact; droplet precautions for agents with potential transmission by coughing, sneezing, talking, or performance of procedures (Figure 3); and airborne precautions for agents with potential transmission by dissemination of either airborne droplet nuclei or evaporated droplets that remain suspended in the air for long periods (Figure 4). Airborne transmission is relevant for small infectious particles that are 5 μm or smaller.

Administrative Issues

Administrative issues surrounding respiratory hygiene apply to the entire health care facility. Emergency physicians

Recommendations Rated According to the Following Categories

Category IA. Strongly recommended for implementation and strongly supported by well-designed experimental, clinical, or epidemiologic studies.

Category IB. Strongly recommended for implementation and supported by certain experimental, clinical, or epidemiologic studies and a strong theoretic rationale.

Category IC. Required by state or federal regulation or representing an established association standard. (Note: Abbreviations for governing agencies and regulatory citations are listed where appropriate. Recommendations from regulations adopted at state levels are also noted. Recommendations from AIA guidelines cite the appropriate sections of the standards.)

Category II. Suggested for implementation and supported by suggestive clinical or epidemiologic studies or a theoretic rationale.

Unresolved issue. No recommendation is offered. No consensus or insufficient evidence exists about efficacy.

FIGURE 1

Rating categories applying to Figures 2-4.

should take a lead role in development and implementation of policies because the ED serves as the initial entry point for many patients. Policies to address routine respiratory pathogens (eg, tuberculosis [TB] and influenza A), emerging pathogens (eg, SARS or avian influenza), and bioterrorist agents are necessary. The CDC has provided detailed recommendations about health care facility response preparedness for a SARS outbreak (available online at <http://www.cdc.gov/ncidod/sars/guidance/C/recommended.htm>). Although these may not all be generalized to every new respiratory threat, the principles described in the reference can guide institutional preparation for any large-scale respiratory pathogen threat. Similar readiness plans for bioterrorism preparedness have been devised and published conjointly by the CDC and the Association of Professionals in Infection Control and Epidemiology.¹²

Public Health Coordination

SURGE CAPACITY PLANS

All health care facilities should have policies and procedures in place for respiratory infection control practice

Standard precaution (IB) applies to all patients receiving care in hospitals regardless of their diagnosis or presumed infection status.

1. Handwashing. Wash hands after touching blood, bodily fluids, secretions, excretions, and contaminated items, whether or not gloves are worn, and between patient contacts; IB.
2. Gloves. Clean nonsterile gloves to be worn when touching blood, bodily fluids, secretions, excretions, contaminated items, mucous membranes, and nonintact skin; IB.
3. Mask, eye protection, face shield. Wear during procedures and patient care activities that are likely to generate splashes or sprays of blood, bodily fluids, secretions, and excretions; IB.
4. Gown (clean, nonsterile). Use during procedures and patient care activities that are likely to generate splashes or sprays of bodily substances; IB.
5. Patient care equipment. Handle used patient care equipment soiled with patients' fluids in a manner that prevents skin and mucous membrane exposure, contamination of clothing, or transfer of microorganisms to other patients and environments; IB.
6. Environmental control. Ensure hospital has adequate procedures for routine cleaning of patient care or patient contact surfaces; IB.
7. Linen. Handle and process used linen in a manner that prevents skin and mucous membrane exposures or transfer of microorganisms to other patients and environments; IB.
8. Occupational health and blood-borne pathogens.
 - a. Use appropriate procedures when using sharp instruments; IB.
 - b. Use mouthpieces, resuscitation bags, or other ventilation devices as alternate to mouth-to-mouth resuscitation methods in areas in which the need of resuscitation is predictable; IB.
9. Patient placement. Place patient who contaminates the environment or who does not have appropriate hygiene or environmental control in a private room; IB.

FIGURE 2

Summary and level of supporting evidence for standard precautions (see Figure 1 for definitions of levels of grading); available at: http://www.cdc.gov/ncidod/hip/isolat/std_prec_excerpt.htm.

Droplet precautions (IB) are applied in addition to standard precautions for patients known or suspected to be infected with microorganisms transmitted by droplets (larger than 5 μm that can be generated during coughing, sneezing, talking, or the performance of procedures).

1. Patient Placement (IB)
 - a. Place patient in private room.
 - b. If private room not available, place with other patients with same microorganism (cohort).
 - c. If private room and cohorting not achievable, maintain spatial separation of at least 3 feet between the infected patient and other patients and visitors.
 - d. Special air handling and ventilation are not necessary and door may remain open.
2. Mask (IB)
In addition to wearing a mask as outlined under "Standard Precautions," wear a mask when working within 3 feet of the patient.
3. Patient Transport (IB)
Limit transport to essential purposes only. If transport is necessary, mask the patient if possible.

FIGURE 3

Summary and level of supporting evidence for droplet precautions (see Figure 1 for definitions of levels of grading); available at: http://www.cdc.gov/ncidod/hip/isolat/droplet_prec_excerpt.htm.

with specific operational plans for handling a large influx of potentially infectious patients in the event of a significant outbreak.¹³ When patient influx exceeds institutional capacity, plans should designate alternative triage and treatment areas either outdoors or in other nearby large-capacity facilities.¹⁴ Although plans may designate patient care areas that exceed hospital capacity, staffing issues may limit the ability to actually use these areas in a real event. Community isolation and treatment facilities may also be activated; a prototype for such a facility was developed by the CDC for SARS. In general, community facilities will likely house and treat patients with milder disease, with the public health department coordinating these procedures and venues. Community isolation facilities (eg, motels, hotels) should have rooms that are equipped with private bathrooms, as well as receptacles to dispose of soiled linen and contaminated waste. Personnel who work at the facility should also have N-95 respirators available, as well as disposable gowns and gloves. In general, patients at these facilities will be expected to care for themselves.¹⁵

Airborne precautions (IB) are applied in addition to standard precautions for patients known or suspected to be infected with microorganisms transmitted by airborne droplet nuclei (evaporated droplets containing microorganisms that remain suspended in the air and that can be widely dispersed by air currents within a room or over a long distance).

1. Patient placement (IB)
 - a. Monitored negative air pressure in relation to the surrounding areas
 - b. Six to 12 air changes/hour
 - c. Appropriate discharge of air outdoors or HEPA filtration of room air before recirculation
 - d. Door kept shut
 - e. Cohorting of patients with infection with same microorganism
2. Respiratory protection (IB)
 - a. Wear respiratory (N95 respirator) when entering room of patient with possible/known TB.
 - b. Susceptible persons should not enter the room of patients known/suspected to have measles or varicella if other immune caregivers are available. If susceptible persons must enter, they should wear respiratory protection (N95 respirator). Immune persons entering need not wear respiratory protection.
3. Patient Transport (IB)

Limit movement and transport to essential purposes only. Minimize patient dispersal of droplet nuclei by placing a surgical mask on the patient, if possible.

FIGURE 4

Summary and level of supporting evidence for airborne precautions (see Figure 1 for definitions of levels of grading); available at: http://www.cdc.gov/ncidod/dhpi/isolat/airborne_prec_excerpt.htm.

Other hospital infection-control procedures may involve cohorting potentially infectious patients (if isolation beds are not available), as well as rapidly discharging appropriate inpatients and canceling elective procedures to alleviate strain on hospital resources.

Preemptive planning and knowledge of health care facility (and ED) resource availability are critical components of preparedness. Lack of resource planning was cited as a significant factor that contributed to the spread of SARS in Southeast Asia and Toronto.¹⁶ Unfortunately, few recent data exist describing the availability of isolation facilities in US EDs. A 1995 study found that less than 20% of EDs had negative-pressure isolation rooms.¹⁷ In a recent press release from November 2005, American College of Emergency Physicians leaders warned that there

is an urgent need for increased ED and hospital planning, specifically citing lack of adequate surge capacity, isolation facilities, and staff to treat the large increase in the number of patients that may result from an influenza pandemic.¹⁸ Depending on the circumstances of the outbreak, public health officials may recommend keeping suspected non-critical infectious patients at home. The CDC's guidelines for home isolation for SARS and pandemic influenza serve as prototypes.^{19,20} Alternatively, specific health care facilities may be designated as referral centers for suspected cases.¹⁵ Although the public health department will ultimately be responsible for coordinating implementation of these types of large-scale overcapacity plans, emergency physicians need to understand the types of options available. ED physician participation in policy development will be critical in providing practical guidance for ED patient care and operations.

CONTACT TRACING

Policies to support rapid identification of patients with suspected respiratory infections that have serious public health consequences (eg, SARS, avian influenza) should include mechanisms for definitive diagnostic testing and immediate reporting to the local health department. The hospital laboratory should be advised to take appropriate precautions with specimens and coordinate specialized testing with local or state health department laboratories.

In a suspected outbreak with potential epidemic risk, procedures for contact tracing must be instituted. Effective communications mechanisms between EDs and health departments are required to allow contact tracing of potentially exposed patients, visitors, and health care workers who live in the community. Contact tracing involves either active or passive monitoring. Active monitoring consists of direct public health contact (telephone or in person), for example, once a day for exposed persons to assess for symptoms and address any needs. Passive monitoring relies on the affected person's contacting the health authorities if symptoms develop. Methods of monitoring depend on the exposure risk and capacity of the public health infrastructure. Regardless of the type of monitoring recommended, all individuals in contact with a potentially infectious person need to be advised of symptoms and what to do if symptoms develop. Additionally, persons with high-risk exposures may require activity restrictions. Although the

public health department would be responsible for the contact tracing process, emergency physicians need to understand these basic principles because they will likely be called on to work closely with public health departments and provide information about persons who are infected or exposed while in the ED. Telephone numbers for the local health department should be readily available in all EDs.

COMMUNICATION

Policies should include clear designations of specific persons within the hospital who are responsible for communication with public health officials (eg, hospital infection control officer) and dissemination of up-to-date information to health care staff (eg, hospital chief executive officer). Policies need to include processes for initiating communication with key public health officials after hours and on weekends and guidance about when communication should be initiated. Potential community contacts should be identified in advance and be capable of effectively communicating needs and concerns of the public.⁶

Facility Planning

INFECTION CONTAINMENT TECHNOLOGY

Although proper patient care is the main priority within the ED, the burden of protecting uninfected individuals from communicable illnesses is critical for minimizing spread of disease and the influx of new cases. The “hierarchy of control technologies” consists of (in order of effectiveness) engineering controls, administrative and work practice controls, and use of personal protective equipment. Consistent application of these principles demonstrated success in limiting TB resurgence more than a decade ago and, more recently, the spread of SARS.²¹ Understanding the hierarchy allows comprehensive planning, clear implementation, and appropriate local adaptations. The most effective practices from each category should be implemented according to characteristics of the responsible agent. For instances in which the infectious agent is unknown, the most restrictive isolation methods available should be instituted. Emergency physicians’ preparedness thus requires understanding of institutional resource availability and capacity and early initiation of infectious disease or public health consultation if a new outbreak is suspected or institutional capacity is at risk of being overwhelmed.

Problems with limited isolation resources in the ED or inpatient setting are usually best addressed in the short term by use of cohorting strategies.

ENGINEERING CONTROLS

Engineering controls provide passive protection for health care workers, visitors, and patients. Measures include use of isolation rooms (including negative pressure), filtration devices, and physical separation (eg, closing doors or cohorting). [Figure 5](#) summarizes recommendations (and supporting level of evidence) published by the National Institute for Occupational Safety and Health that are specific for maintaining airborne infection isolation rooms.

Negative pressure isolation systems prevent contaminated air from traveling to other areas of the ED or hospital, which is the most efficient method for early containment of infectious respiratory pathogens because airflow from either single rooms or small units can be controlled. However, when the organism load is extremely high, negative-pressure units may not be 100% effective, because they leave live pathogen in the air or on surfaces.²²⁻²⁵ Increased efficacy can be realized by supplementing negative-pressure isolation systems with a high efficiency particulate air (HEPA) filtration system.

HEPA filtration systems supplement negative-pressure systems, removing fungi and bacteria greater than 0.1 μm from the atmosphere. These can be installed in ventilation ducts but are also available as portable units. Addition of ultraviolet lights allows killing of spores and active organisms. All HEPA filters must be properly installed and maintained according to the manufacturer’s instructions to ensure satisfactory decontamination.^{25,26}

Closing doors and cohorting of patients are recommended if no proper isolation room is available. Such methods proved effective in Hong Kong in early 2003, when SARS patients were cohorted into 3 separate observation wards, with no subsequent secondary transmission reported.^{27,28} Unfortunately, if not done properly, cohorting in open wards may contribute to increased infection, as was seen in the early Toronto SARS experience.²⁷ Thus, it should be recognized that although possibly beneficial as an adjunctive measure when resources are scarce, physical separation and cohorting do not guarantee protection. Accordingly, health care workers should use proper infection controls when visiting patients in rooms, including droplet

Airborne infection isolation rooms (AIIR)

1. Maintain continuous negative air pressure (IB, IC)
2. Ensure rooms are well sealed (IB, IC)
3. Self-closing doors (IC)
4. Ventilate so that ≥ 12 air changes/h for new AIIR (≥ 6 ACH for existing AIIR)
5. Direct exhaust air outside (IC)
6. Install incoming air HEPA filters (IB, IC)

FIGURE 5

Recommendations about air handling systems in health care facilities from Guidelines for environmental infection control in health-care facilities: recommendations of CDC and the Health Care Infection Control Practices Advisory Committee. *MMWR Morb Mortal Wkly Rep.* 2003;52:5-13, n0.rr10. Available at: <http://www.cdc.gov/MMWR/preview/MMWRhtml/rr5210a1.htm>.

precautions and, if indicated, personal Occupation Safety and Health Administration (OSHA)-approved respirators.

ADMINISTRATIVE AND WORK PRACTICE CONTROLS

Administration of effective infection containment requires written policies and procedures and is the “second tier” in the hierarchy of infection control. Operational policies should include explicit criteria for suspecting disease, restricting contact with patients suspected of having infection, controlling transport and high-risk procedures, quarantining of patients and contacts, contact tracing, implementing methods for disinfection, and monitoring of isolation procedures.²¹ Procedural policies should address need for supplemental staff, education and training for health care workers, medical surveillance of exposed health care workers, and communication with public health officials and the general public.²¹ Rapid implementation of these policies is the key to infection control in an outbreak scenario and proved critically important in controlling SARS.²⁹ Although SARS specific, the CDC’s checklist for SARS Preparedness in Health Care Facilities¹⁶ provides a prototype of the types of policies and procedures that should be considered in the event of any bioterrorism-related or emerging communicable respiratory outbreak.

In the aftermath of an infectious outbreak, postevent analysis should be conducted to determine which management efforts were effective and which were not from the

hospital’s and community’s perspective. Representatives of all affected departments and organizations should be included, and appropriate revisions should be incorporated into policies. Health care worker surveillance should also attend to posttraumatic stress assessment and treatment, as indicated.³⁰

PERSONAL PROTECTIVE EQUIPMENT

Personal protective equipment, including gloves, gown, masks, and respirators, provides barrier protection, preventing skin and mucous membrane exposures. Although these resources offer protection to individuals by reducing likelihood of direct contact, they are categorized as the third hierarchy level because they do not eliminate the pathogen and may have limited effectiveness because of problems such as variable health care worker adherence, potential for equipment failure, and inadequate equipment availability. The 2 CDC- and OSHA-approved personal air filtration systems are N95 masks and powered air-purifying respirators. N95 masks are simple and inexpensive but require individual fit-testing. Powered air-purifying respirators offer the advantage of nearly universal fit but are far more expensive and cumbersome to use. Both devices require medical evaluation and clearance for safe use. Personal protective equipment should be used by all health care workers in outbreak settings when patients with potentially contagious respiratory infections are treated.

Health Care Workers

EDUCATION

Proper education of health care workers about respiratory hygiene practice is critical for effective infection control. Written policies and procedures for education and training of health care workers should be developed at the institutional level. Education topics should include infection control precautions, criteria for suspecting disease at first contact and methods for restricting contact with patients suspected of having infection, limiting and controlling patient transport, and minimizing exposure during high-risk procedures. Additional educational topics for ED providers and administrators include criteria and procedures for quarantining of contacts, protocols for disinfection and for monitoring isolation, and methods for maintaining medical surveillance of exposed health care workers.²¹

STAFFING ISSUES

Providing adequate hospital staffing is important in any disaster, and personnel issues particular to infectious disasters must be given consideration in developing hospital and ED plans. All health care facilities should have policies and procedures for mobilizing and reassigning staff to more critical areas in the event of a disaster. Because health care staff may be reluctant to come to work if they believe they are at risk of contracting an infectious illness, it is critical that the facility planning measures be reviewed in advance, with contingencies and backups in place. Health care workers (particularly those working in front-line ED settings) should also be given priority for receiving vaccines or prophylactic antimicrobials, when appropriate. Offering additional incentives to staff to come to work may also be required in certain situations.

Infectious outbreaks create the additional problem that health care workers themselves may become ill. Plans for respiratory outbreaks should include regular evaluation of health care workers for infectious signs or symptoms, criteria for removing health care workers from patient care, and criteria for quarantine (either at home or in the workplace). Health care workers' desire for a workplace quarantine option was demonstrated during the SARS outbreak, in which individuals did not want to subject family members to an increased risk of infection.

VACCINATION AND CHEMOPROPHYLAXIS RECOMMENDATION

Although the CDC provides recommendations for influenza vaccination among health care workers,³¹ there are no uniform recommendations for health care worker vaccination for all potential respiratory pathogens. In light of this, the influenza recommendations not only serve to guide planning for annual influenza epidemics but also may provide a template for other vaccine-preventable pathogens. Research has demonstrated that influenza vaccination of health care workers contributes to a substantial decrease in patient mortality,³² which has led some experts to call for mandatory vaccination of health care workers.³³ The CDC provides specific recommendations about when to provide chemoprophylaxis for influenza,³⁴ which may be used as a template and adapted to other pathogens when guidelines are developed for new and emerging pathogens for which vaccines are available. Vaccination plans for certain agents (eg, anthrax and smallpox) are controversial. Currently,

preexposure anthrax vaccine is not recommended for health care workers. After the terrorist attacks of 2001, the US government developed a smallpox vaccination plan that included "formation of smallpox response teams" at each institution. Emergency physician volunteers participated as critical members of the team. Although controversy still exists in the emergency medicine community about these recommendations,³⁵ they remain. Because the threat of a true smallpox event remains low, however, routine vaccination for all health care workers for smallpox is not recommended by the Advisory Committee on Immunization Practice.³⁶ Facilities should create a priority list for employee smallpox vaccination in the event of an outbreak, and emergency staff should be included.

Patient Issues

Concerns about the potential spread of respiratory pathogens begin at the point of entry into the health care system and continue to the inpatient setting. Emergency physicians need to be aware of the potential for infection, illness, and transmissibility in a variety of potentially high-risk environments, including (1) emergency medical services (EMS) and triage settings (in which historical and clinical information may be limited and risk underestimated), (2) during performance of "high-risk" invasive airway procedures, and (3) during patient transport to the various inpatient units throughout the hospital.

EMS Issues

The CDC provides specific recommendations for EMS transport of SARS patients.³⁷ Although specific EMS recommendations do not exist for each of the transmissible respiratory threats, the general principles outlined in the SARS directives are applicable to the transport of any patient with a suspected serious and contagious life-threatening respiratory infection³⁷ and include the following: (1) potentially contagious patients should be transported with as few EMS personnel as possible, (2) family members should not be allowed to ride with patients in the ambulance, (3) EMS personnel traveling with a patient suspected of having infection should wear proper personal protective equipment, including isolation gown, double gloves, facemask, and N95 or higher-grade respirator (eg, N99, 100, a powered air-purifying respirator), (4) patients should wear

a surgical mask if feasible and, if not, use tissues to cover their mouth or nose during coughing or sneezing; and (5) patients should be transported in a vehicle that has separate ventilation systems and compartments for patient and driver, whenever possible. Finally, advanced ED notification is advised to facilitate prearrival planning to limit exposure of other individuals. EMS personal protective equipment should be handled as medical waste, and EMS vehicles should be decontaminated before transporting another patient.³⁸

ED Triage and Waiting Room

The importance of implementing effective triage and ED-based diagnostic strategies is underscored by experience with highly transmissible respiratory infections such as TB and SARS. Several hospital- and ED-based studies provide data that demonstrate that lack of either provider education or adherence to institutional guidelines or inadequate diagnostic evaluation of patients at risk results in increased risk of disease transmission.^{3,5,16,17,39} Underscoring this is the findings from one epidemiologic outbreak of SARS in Toronto that found that 36% of new infections in the hospital occurred in health care workers, with the highest rates in those working in EDs and ICUs.⁵

Both the World Health Organization and the CDC provide general recommendations for handling of patients with suspected respiratory infections that include having triage staff adhere to proper hand hygiene procedures and donning face masks and eye protection.^{40,41} If SARS or TB is suspected, health care workers in EDs should don an N-95, 99, or 100 respirator.⁴² The degree of vigilance that should be applied to screening for respiratory infections depends on the current risk level, with the most up-to-date regional risk information based on surveillance data provided on a CDC Web site.^{43,44} For example, there are 3 basic risk levels that apply to SARS: (1) no current SARS transmission anywhere in the world, (2) active SARS transmission in limited geographic areas, and (3) SARS transmission within the community in which one is practicing. In the absence of person-to-person transmission of SARS worldwide, the goal of domestic surveillance is to maximize early detection of cases while minimizing unnecessary laboratory testing and social disruption. In the absence of known transmission worldwide, the overall likelihood that a person in the United States with fever and respiratory

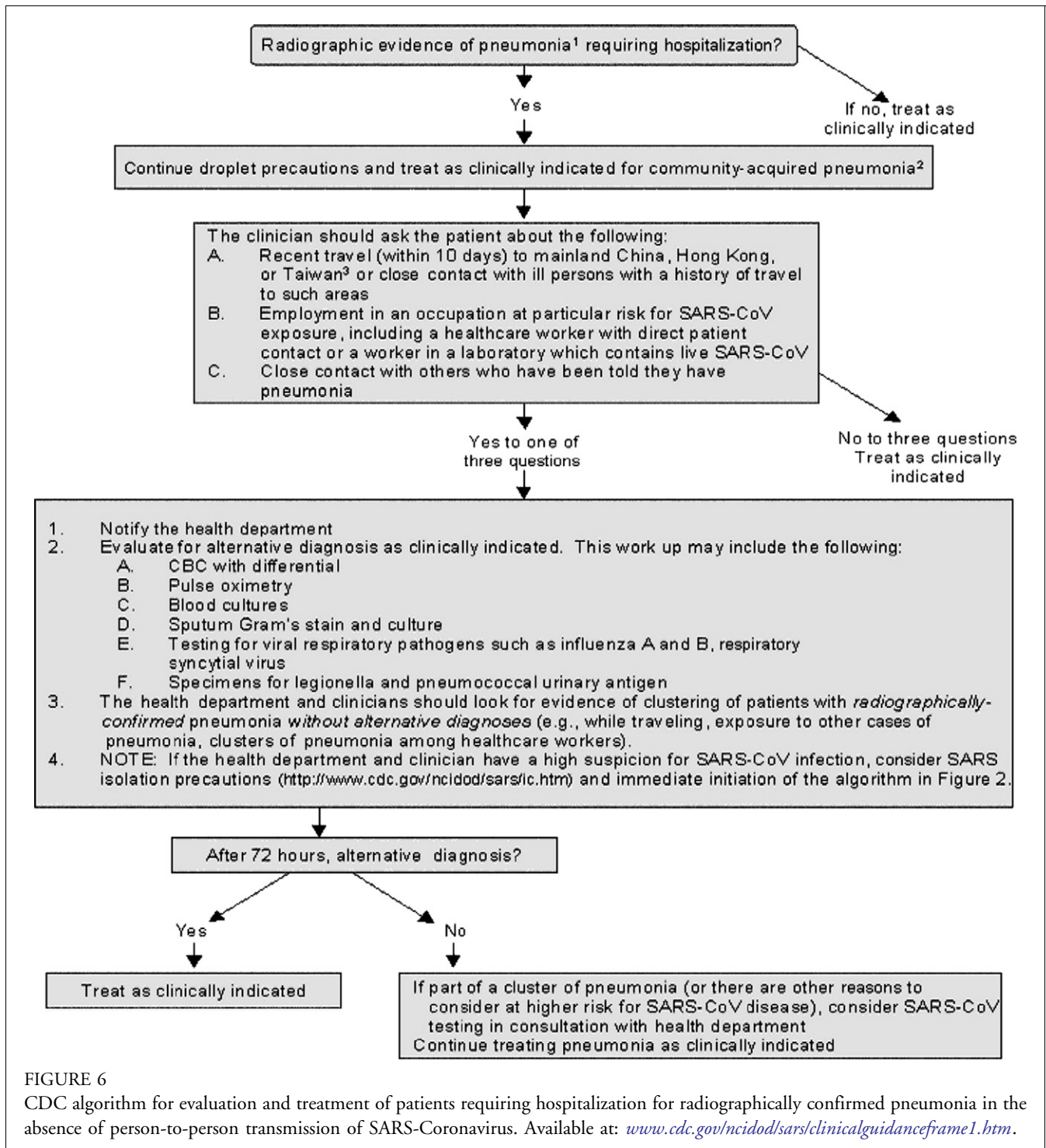
symptoms will have SARS is exceedingly low.⁴⁵ If SARS transmission is present in limited geographic areas, screening should focus on identifying persons with possible geographic exposures. When person-to-person SARS transmission is present in the community, everyone with fever or respiratory symptoms should be screened for SARS.

In an outbreak scenario (eg, SARS, avian influenza, or TB), explicit written criteria should be provided to triage personnel to allow rapid isolation of patients who may be harboring a highly contagious infection. The CDC has issued specific screening tools to be used for rapid detection and isolation of possible SARS patients, depending on the absence or presence of person-to-person transmission in the world (Figures 6 and 7). Various similar ED-based triage guidelines for specific agents (eg, TB, influenza and avian influenza)^{13,17,34} that include use of early radiography have been developed, and the CDC Web site (available online at <http://www.cdc.gov>) should be consulted for the most up-to-date recommendations, as well as the current threat level of SARS.⁴⁴ From the ED perspective, development of decision guidelines may be based on the characteristics of the epidemic and may require development and modification in real time. An excellent example is provided by an ED in Singapore, in which a triage tool, developed throughout a 1-year period, yielded a false-negative rate for SARS case identification of 0.28%.^{46,47}

The CDC recommends that tissues and masks be made readily available for all symptomatic patients who enter the ED or hospital doors (to cover their mouths and noses) and that sinks or handwashing stations be accessible for all patients in waiting rooms and triage areas.¹³ During periods of increased respiratory infections (eg, influenza season), separation of symptomatic and asymptomatic patients in waiting rooms and triage areas is advised, and surgical masks should be distributed to all patients with active respiratory symptoms. When it is not feasible to set up separate waiting areas in the ED, symptomatic patients should be encouraged to sit at least 3 feet away from other patients in the waiting room. According to the CDC, this practice is supported by level IB evidence.

Patient Education

The CDC recommends that visual education be provided at all patient entrances to EDs during periods of heightened respiratory alert. Visual alerts (including signs, pamphlets,



and other general education measures about respiratory hygiene) are proven measures that can decrease disease transmission.¹³ It is recommended that visual alerts be present in several languages (depending on the region of the

country and population served) and be provided at an appropriate reading level to allow for comprehension by the majority of the population. Content of educational material should include a general description of standard

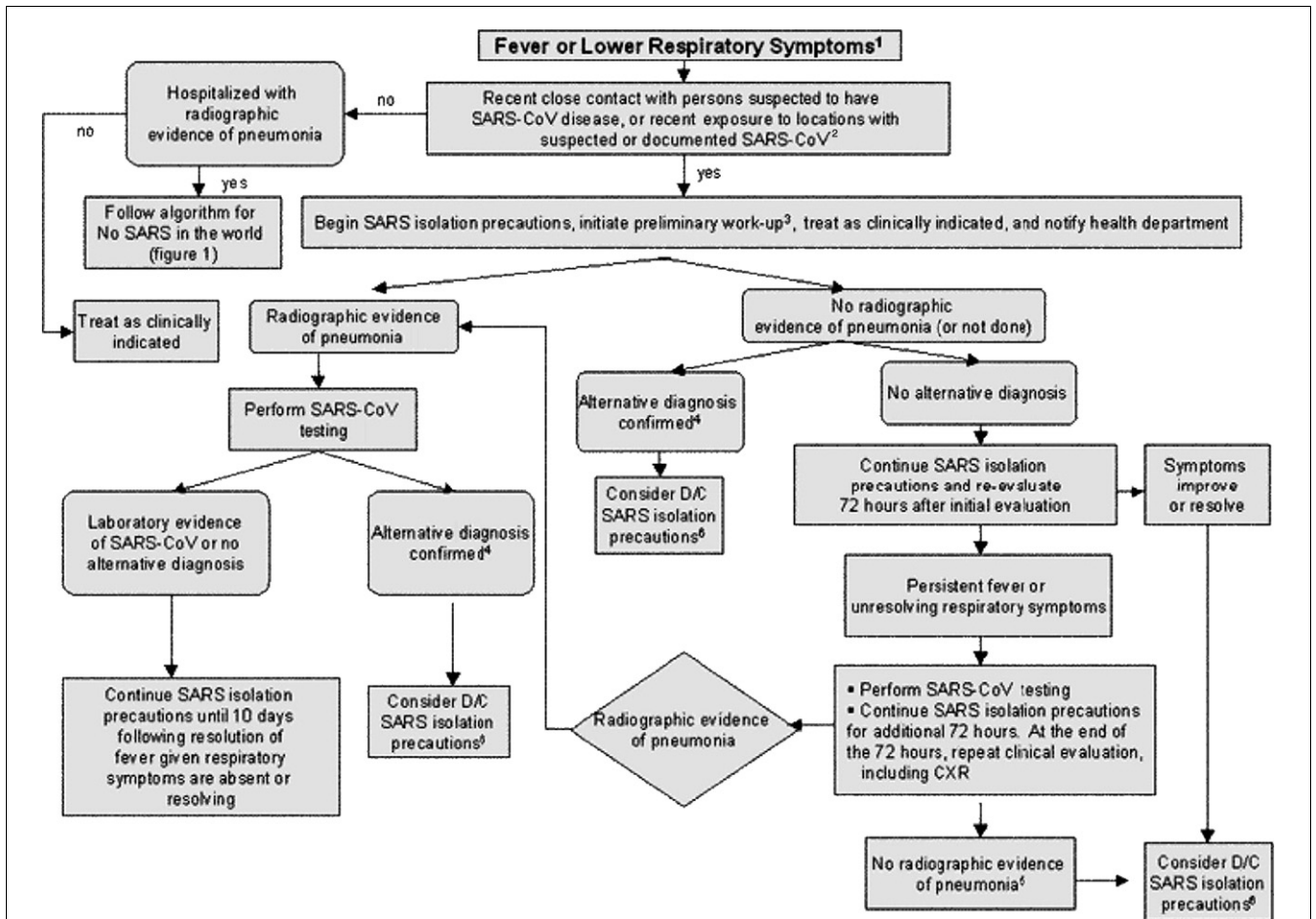


FIGURE 7
 CDC algorithm for management of fever or respiratory symptoms when SARS-CoV person-to-person transmission is occurring.
 Available at: <http://www.cdc.gov/ncidod/sars/clinicalguidanceframe2.htm>.

respiratory hygiene methods, including handwashing, use of disposable tissues for covering mouth and nose, and staying at least 3 feet away from persons with symptoms.

ED Treatment Area

Although proper patient care is the main priority within the ED, protecting uninfected patients from communicable illnesses is also important. Early isolation decreases the likelihood of person-to-person transmission. Patients with a suspected but unidentified communicable respiratory infection should be placed in an environment with the highest level of protection available until definitive identification of the offending pathogen can be made or the possibility of a public health threat can be safely ruled out.

Laboratory diagnosis of respiratory contagious pathogens represents a critical step in decisionmaking about the need for isolation, treatment, and disposition. Unfortunately, from the standpoint of the emergency physician, most current criterion-standard laboratory assays rely on serologic or culture methodologies often requiring days to weeks for definitive reporting. Even when alternative nonculture-based methodologies are available (eg, Acid-fast bacillus smear results for TB), reliable confirmation requires multiple sample procurement during a period of several days. For this reason, decisionmaking about patient care relies on clinical suspicion, which includes current knowledge of the community likelihood of a respiratory infectious event, risk status of the patient, and patient presenting signs and symptoms, which are often nonspecific.

As described under “ED Triage and Waiting Room,” clinical guidelines may be used as well for assistance.

Rapid diagnostic assays for contagious respiratory pathogens hold great promise with regard to assisting ED physicians in treatment of patients with suspected respiratory contagious pathogens. Although significant molecular advancements have recently been made in design and evaluation of rapid molecular-based methods, most notably using polymerase chain reaction techniques, few have reached the status of standard of care for point-of-care use. Rapid diagnostic assays for influenza are available, but none has adequate sensitivity or specificity to allow recommendation for definitive care in ED settings.⁴⁸

HIGH-RISK AIRWAY PROCEDURES

Interventional airway procedures in the ED (including use of nebulized therapy and endotracheal intubation) increase risk for airborne transmission of disease because they result in release of high pathogen loads.⁴⁹ Although most procedures can be done in the ED, the US Department of Health and Human Services recommends that in outbreak settings, aerosol-generating procedures (eg, nebulized medications or bilevel positive air pressure) be avoided as much as possible.⁵⁰ When essential for patient care, health care workers involved in these procedures should use N95 respirators or powered air-purifying respirators, along with gloves and gowns. After the procedure is completed, personal protective equipment should be removed and safely discarded to avoid contaminating the health care worker or the environment.⁵¹ Specific detailed recommendations about intubation suggest that added measures be taken to reduce unnecessary exposure to health care workers, including reducing the number of health care workers present and adequately sedating or paralyzing the patient to reduce the possibility of a cough.⁵² All high-risk procedures should be performed only by highly experienced staff.

TRANSPORT ISSUES

It is recommended that patient transport and movement from the room be limited to essential purposes only. When transport out of the room occurs, masks should be worn by the patient to reduce the opportunity for transmission to patients and staff and reduce environmental contamination. Further, health care workers in the area to which the patient is to be taken should be notified in advance.⁵³

Legal Issues

There is a forceful interplay between the health and well-being of the public in general and an individual's rights, which is set within a complex and often confusing legal field.⁵⁴ This affects emergency practitioners and health care facilities concerning respiratory infections primarily in 2 ways: (1) through the need to notify appropriate public health authorities of reportable infectious diseases, and (2) through the requirement to isolate ill patients and quarantine sick contacts.

The CDC is recognized as the lead federal agency for protecting the health of the public and has various federal responsibilities in this regard, including investigations of unusual diseases and federal quarantine authority.⁵⁵ According to Title 42 United States Code Section 264, the surgeon general, with the approval of the secretary, is authorized to make and enforce regulations to prevent the introduction, transmission, or spread of communicable diseases. However, the current legal framework of public health oversight and response in the United States is a complex mix of state and federal laws. Thus, the specific requirements for any practitioner, ED, or hospital vary according to the local and state laws.^{56,57} The federal government has oversight of importation of infectious diseases and overall quarantine authority, but the individual states generally have the primary authority and responsibility of responding to public health problems within their jurisdiction, such as investigating a cluster of TB cases and isolating infectious individuals. States also have the responsibility of addressing their own public health emergencies.

The interface between law, medicine, and public health requires the balancing of many potentially competing interests, especially individual human rights versus the need to protect the public's health. There is significant background and legal precedent on this topic.⁵⁸ It is best for institutions to have an existing relationship with local or state public health officials to ensure ongoing bidirectional communication in times of urgency or emergency. As in any emergency, adequate preparedness, coupled with clear communication, allows for coordinated response.

DISEASE REPORTING

The list of reportable diseases is established by each state or territory, though the CDC has recommended specific case

definitions for infectious conditions that could fall under public health surveillance.⁵⁷ Timeliness and mechanism for reporting also vary for different diseases. For example, a case of smallpox requires an immediate telephone call, whereas cases of gonorrhea may be reported in a weekly written report. Although this reporting activity may be mandated, it raises important legal and ethical issues about the balance between the duty to report and an individual's right to privacy.

QUARANTINE AND ISOLATION

The surgeon general is responsible for controlling, directing, and managing all United States quarantine stations, which includes isolation for people who are ill and quarantine for people exposed but not ill. In April 2003, SARS was added to the list of diseases for which quarantine is authorized (other diseases included are cholera, diphtheria, TB, plague, smallpox, yellow fever, and viral hemorrhagic fever). A lesson from SARS quarantines in Singapore is the capacity of a highly contagious infection to cause a rapid pandemic. The implications of quarantining a population or individuals for the length of the incubation time (or the length of the illness if patient is infected) are numerous. Quarantining a large population involves significant commitment of resources. To overcome the legal obstacles of a major quarantine, a plan must be in place well in advance of an outbreak. As part of the public health infrastructure, ED health care workers may be called on to participate in various infection containment strategies, including quarantining of individuals or vaccinating large segments of the population.

OSHA

One other important legal aspect relates to occupational safety. OSHA has a number of rules and regulations designed to protect the health and safety of health care workers. OSHA's jurisdiction includes all health care facilities. Health care workers in EDs should be aware that rules and regulations related to respiratory hygiene are legally mandated and must be implemented in hospitals in accordance with current guidelines, as described elsewhere.

Future Research

The increasing likelihood that a highly contagious respiratory outbreak such as pandemic influenza will be seen

soon, coupled with recognition of the presence of significant gaps between experimental and theoretic advances in both technologic and methodologic approaches to infection control (versus true ED preparedness), has created the need for further research.

Rapid point-of-care diagnostics hold great potential for improving triage, treatment, and disposition planning. Future research will need to bridge the divide between the numerous point-of-care assays that are under development and the need to have a reliable, easy-to-use test that is adequately sensitive and specific for clinical decision-making. Although such development will likely take several years of investigation, 2 such diagnostics in early phases of development include a polymerase chain reaction–based respiratory pathogen panel⁵⁹ and a mass spectrophotometry platform that can rapidly evaluate polymerase chain reaction products to identify any potential new emerging threat.⁶⁰

There are also multiple practical issues related to ED evaluation requiring study, including development of more effective clinical decision guidelines for isolation and diagnosis and determination of the impact and best practice methods for care in ambient settings. The effectiveness of ED air filtration techniques also remains unclear, and educational research in this area is required. The numerous ethical, legal, and practical challenges associated with isolation and quarantining of patients will also require further study, with emphasis on ED-specific questions such as the role of EDs in care of “routine” emergencies, development of ED surge capacity, and optimization of methods for coordination of EDs with the public health sector.

One other area of research that is gaining increased attention and has particular relevance for EDs involves surveillance methods for tracking respiratory illnesses. Current approaches that involve ED-based researchers include syndromic surveillance based on ED complaints,⁶¹ evaluation of the efficacy of increased diagnostic testing in EDs,⁶² and tracking of ED prescriptions.⁶³ These new areas of research will likely grow rapidly as the threat of respiratory infections becomes more prevalent.

Summary

This review serves as a brief synopsis of the issues surrounding respiratory hygiene as they relate to the ED. Protecting patients and staff is a difficult task in the ED

because cases of contagious respiratory infections are often not immediately identifiable. This report focuses on the development of appropriate policies relating to patients with potential transmissible respiratory pathogens. Education of key individuals, along with rapid dissemination of accurate information, is necessary to support these policies and will be instrumental in ensuring effective implementation. Emergency physicians will continue to be pivotal in the development of these policies by maintaining active administrative and leadership positions in hospitals, and advancing understanding of the critical role they play in the early identification, treatment, and containment of these potentially lethal respiratory pathogens.²⁵

Acknowledgment

The ACEP Public Health Committee is grateful to Ms. Margaret Montgomery and Ms. Julie Dill for their time and assistance in preparation of this manuscript.

REFERENCES

- Kotloff RM, Ahya VN, Crawford SW. Pulmonary complications of solid organ and hematopoietic stem cell transplantation. *Am J Respir Crit Care Med* 2004;170:22-48.
- Belleza WG, Browne B. Pulmonary considerations in the immunocompromised patient. *Emerg Med Clin North Am* 2003;21:499-531, x-xi.
- Lau JT, Fung KS, Wong TW, et al. SARS transmission among hospital workers in Hong Kong. *Emerg Infect Dis* 2004;10:280-6.
- Ho AS, Sung JJ, Chan-Yeung M. An outbreak of severe acute respiratory syndrome among hospital workers in a community hospital in Hong Kong. *Ann Intern Med* 2003;139:564-7.
- Varia M, Wilson S, Sarwal S, et al. Investigation of a nosocomial outbreak of severe respiratory syndrome (SARS) in Toronto, Canada. *CMAJ* 2003;169:285-92.
- Klitzman S, Freudenberg N. Implications of the World Trade Center attack for the public health and health care infrastructures. *Am J Public Health* 2003;93:400-6.
- Mann NC, MacKenzie E, Anderson C. Public health preparedness for mass-casualty events: a 2002 state-by-state assessment. *Prehosp Disaster Med* 2004;19:245-55.
- McCaig LF, Burt CW. *National Hospital Ambulatory Medical Care Survey: 2001 Emergency Department Summary: Advance Data from Vital and Health Statistics; No. 335*. Hyattsville, MD: National Center for Health Statistics; 2003. Available at: <http://www.cdc.gov/nchs/data/ad/ad335.pdf>. Accessed February 3, 2006.
- Ziv A, Boulet JR, Slap GB. Emergency department utilization by adolescents in the United States. *Pediatrics* 1998;101:987-94.
- Bolyard EA, Tablan OC, Williams WW, et al. Guideline for infection control in health care personnel, 1998. *Am J Infect Control* 1998;26:289-354.
- Garner JS. Hospital Infection Control Practices Advisory Committee: guideline for isolation precautions in hospitals. *Infect Control Hosp Epidemiol* 1996;17:53-80. Available at: http://www.cdc.gov/ncidod/dhqp/gl_isolation.html. Accessed January 30, 2006.
- Association of Professionals in Infection Control Bioterrorism Task Force. Bioterrorism readiness plan: a template for health care facilities. *Surg Serv Manage* 1999;5:43-54. Available at: <http://www.ssmonline.org/SSMOnlineMedia/Documents/CDC.pdf>. Accessed February 3, 2006.
- Centers for Disease Control and Prevention. Public health guidance for community level preparedness and response to severe acute respiratory syndrome (SARS): version 2: supplement C: preparedness and response in health care facilities. Available at: http://www.guideline.gov/summary/summary.aspx?doc_id=4588&nbr=003378&string=Public+AND+health+AND+guidance+AND+community-level+AND+preparednesswww.cdc.gov/fluprofessionals/infectioncontrol/resphygiene.htm. Accessed January 30, 2006.
- Chien LC, Yeh WB, Chang HT. Lessons from Taiwan. *CMAJ* 2003;169:277.
- Centers for Disease Control and Prevention. Public health guidance for community-level preparedness and response to severe acute respiratory syndrome (SARS) core document: supplement C: preparedness and response in health care facilities. Available at: <http://www.cdc.gov/ncidod/sars/guidance/core/index.htm> or <http://www.cdc.gov/ncidod/sars/guidance/Cpdf/c.pdf>. Accessed February 3, 2006.
- Hawryluck L, Lapinsky SE, Stewart TE. Clinical review: SARS: lessons in disaster management. *Crit Care* 2005;9:384-9.
- Moran GJ, Fuchs MA, Jarvis WR, et al. Tuberculosis infection-control practices in United States emergency departments. *Ann Emerg Med* 1995;26:283-9.
- American College of Emergency Physicians. Emergency physicians say federal pandemic influenza plan doesn't address nation's lack of surge capacity and isolation beds [press release]. Available at: <http://www.acep.org/webportal/Newsroom/NR/general/2005/110905.htm>. Accessed February 3, 2006.
- Centers for Disease Control and Prevention. Fact sheet on isolation and quarantine. Available at: <http://www.cdc.gov/ncidod/sars/isolationquarantine.htm>. Accessed February 3, 2006.
- Centers for Disease Control and Prevention. Questions and answers on the executive order adding potentially pandemic influenza viruses to the list of quarantinable diseases. Available at: http://www.cdc.gov/ncidod/dq/qa_influenza_amendment_to_eo_13295.htm. Accessed February 3, 2006.
- Thorne CD, Khozin S, McDiarmid MA. Using the hierarchy of control technologies to improve healthcare facility infection control: lessons from severe acute respiratory syndrome. *J Occup Environ Med* 2004;46:613-22.
- Centers for Disease Control and Prevention. Guidelines for preventing the transmission of tuberculosis in health-care facilities, 1994. *MMWR Morb Mortal Wkly Rep* 1994;43:1-132.
- Esswein EJ, Kiefer M, Wallingford K, et al. Environmental and occupational health response to SARS, Taiwan, 2003. *Emerg Infect Dis* 2004;10:1187-94. Available at: <http://www.cdc.gov/ncidod/EID/vol10no7/03-0728.htm>. Accessed January 30, 2006.
- Mead K, Johnson D. An evaluation of portable high-efficiency particulate air filtration for expedient patient isolation in epidemic and emergency response. *Ann Emerg Med* 2004;44:635-45.
- Centers for Disease Control and Prevention. Public health guidance for community-level preparedness and response to severe

- acute respiratory syndrome (SARS), version 2, supplement I: infection control in healthcare, home, and community settings. Available at: <http://www.cdc.gov/ncidod/sars/guidance/I/index.htm>. Accessed January 30, 2006.
26. Centers for Disease Control and Prevention. Infection control. In: *Core Curriculum on Tuberculosis: What the Clinician Should Know*. 4th ed. Atlanta, GA: Centers for Disease Control and Prevention; 2000. Available at: <http://www.cdc.gov/nchstp/tb/pubs/corecurr/Chapter1/Tableofcontents.htm>. Accessed February 3, 2006.
 27. Borgundvaag B, Ovens H, Goldman B, et al. SARS outbreak in the Greater Toronto area: the emergency department experience. *CMAJ* 2004;171:23.
 28. Tan YM, Chow PK, Tan BH, et al. Management of inpatients exposed to an outbreak of severe acute respiratory syndrome (SARS). *J Hosp Infect* 2004;58:210-5.
 29. Tham KY. An emergency department response to severe acute respiratory syndrome: a prototype response to bioterrorism. *Ann Emerg Med* 2004;43:6-14.
 30. Tham KY, Tan YH, Loh OH, et al. Psychiatric morbidity among emergency department doctors and nurses after the SARS outbreak. *Ann Acad Med* 2004;33:S78-S79.
 31. Centers for Disease Control and Prevention. Updated interim influenza vaccination recommendations: 2004-2005 influenza season. Available at: <http://www.cdc.gov/flu/protect/whoshouldget.htm>. Accessed January 30, 2006.
 32. Carman WF, Elder AG, Wallace LA, et al. Effects of influenza vaccination of health-care workers on mortality of elderly people in long-term care: a randomised controlled trial. *Lancet* 2000;355:93-7.
 33. Poland GA, Tosh P, Jacobson RM. Requiring influenza vaccination for health care workers: seven truths we must accept. *Vaccine* 2005;23:2251-5.
 34. Centers for Disease Control and Prevention. Infection control guidance for the prevention and control of influenza in acute-care facilities. Available at: <http://www.cdc.gov/flu/professionals/infectioncontrol/healthcarefacilities.htm>. Accessed February 3, 2006.
 35. Kwon N, Raven MC, Chiang WK, et al. Emergency physicians' perspectives on smallpox vaccination. *Acad Emerg Med* 2003;10:599-605.
 36. Advisory Committee on Immunization Practices. Advisory Committee on Immunization Practices (ACIP) statement on smallpox preparedness and vaccination. Available at: <http://www.bt.cdc.gov/agent/smallpox/vaccination/acipjun2003.asp>. Accessed February 3, 2006.
 37. Centers for Disease Control and Prevention. Interim guidance: ground emergency medical transport for severe acute respiratory syndrome patients. Available at: <http://www.cdc.gov/ncidod/sars/guidance/I/prehospital.htm>. Accessed January 30, 2006.
 38. Silverman A, Simor A, Loutfy MR. Toronto emergency medical services and SARS [letter]. *Emerg Infect Dis* [serial on the Internet] September 2004. Available at: <http://www.cdc.gov/ncidod/EID/vol10no9/04-0170.htm>. Accessed February 3, 2006.
 39. Moran GJ, McCabe F, Morgan MT, et al. Delayed recognition and infection control for tuberculosis patients in the emergency department. *Ann Emerg Med* 1995;26:290-5.
 40. Centers for Disease Control and Prevention (CDC). Public health guidance for community-level preparedness and response to severe acute respiratory syndrome (SARS), version 2, supplement I, section III: infection control in healthcare facilities. Available at: <http://www.cdc.gov/ncidod/sars/guidance/I/healthcare.htm>.
 41. World Health Organization. Hospital infection control guidance for severe acute respiratory syndrome (SARS). Available at: <http://www.who.int/csr/sars/infectioncontrol/en>.
 42. Chen YC, Huang LM, Chan CC, et al. SARS in hospital emergency room. *Emerg Infect Dis* 2004;10:782-8.
 43. National Center for Infectious Diseases Respiratory and Enteric Viruses Branch. Surveillance summaries and additional information. Available at: <http://www.cdc.gov/ncidod/dvrd/revb/nrevss/summ.htm>.
 44. Centers for Disease Control and Prevention. In the absence of SARS transmission worldwide: guidance for surveillance, clinical and laboratory evaluation, and reporting, version 2. Available at: <http://www.cdc.gov/ncidod/sars/absenceofsars.htm>. Accessed January 30, 2006.
 45. Centers for Disease Control and Prevention. Health Alert Network. Available at: <http://www.phppo.cdc.gov/HAN>. Accessed February 17, 2006.
 46. Foo CL, Tham KY, Seow E. Evolution of an emergency department screening questionnaire for severe acute respiratory syndrome. *Acad Emerg Med* 2004;11:156-61.
 47. Kline JA. Crash course in decision making. *Acad Emerg Med* 2004;11:179-80.
 48. Stein J, Louie J, Flanders S, et al. Performance characteristics of clinical diagnosis, a clinical decision rule, and a rapid influenza test in the detection of influenza infection in a community sample of adults. *Ann Emerg Med* 2005;46:412-29.
 49. Centers for Disease Control and Prevention. Cluster of severe acute respiratory syndrome cases among protected health-care workers: Toronto, Canada, April 2003. *MMWR Morb Mortal Wkly Rep* 2003;52:433-6. Available at: <http://www.cdc.gov/mmwr/preview/mmwrhtml/mm5219a1.htm>. Accessed January 30, 2006.
 50. US Department of Health and Human Services. HHS pandemic influenza plan: supplement 4: infection control: personal protective equipment for special circumstances. Available at: <http://www.hhs.gov/pandemicflu/plan/sup4.html>. Accessed January 30, 2006.
 51. US Department of Health and Human Services. HHS Pandemic Influenza Plan. Supplement 4 Infection Control. Part IV.D. Occupational Health Issues. Available at: <http://www.hhs.gov/pandemicflu/plan/sup4.html#occ>. Accessed January 30, 2006.
 52. Prevention. In: Kamps BS, Hoffman C, eds. *SARS Reference* [e-book]. Flying Publisher; 2006. Available at: <http://www.sarsreference.com/sarsref/prevent.htm>. Accessed February 3, 2006.
 53. Hospital Infection Control Practices Advisory Committee. Guideline for isolation precautions in hospitals, part II: recommendations for isolation precautions in hospitals. Available at: http://www.cdc.gov/ncidod/dhqp/gl_isolation_ptII.html. Accessed January 30, 2006.
 54. Center for Law and the Public's Health at Johns Hopkins and Georgetown Universities. Core legal competencies for public health professionals. Available at: <http://www.publichealthlaw.net/Training/TrainingPDFs/PHLCompetencies.pdf>. Accessed January 30, 2006.
 55. Centers for Disease Control and Prevention. About CDC. Available at: <http://www.cdc.gov/aboutcdc.htm>.
 56. Maryland Department of Health and Mental Hygiene. Provider disease list and reporting instructions. Available at: http://www.edcp.org/pdf/ReportableDisease_HCCP_20040223.pdf.
 57. Centers for Disease Control and Prevention. Case definitions for infectious conditions under public health surveillance. *MMWR Morb Mortal Wkly Rep* 1997;46:1-55, rv. 10.

58. Gostin LO, ed. *Public Health Law and Ethics: A Reader* (California, Milbank Books on Health and the Public, 4). University of California Press; 2002.
59. Briese T, Palacios G, Kokoris M, et al. Diagnostic system for rapid and sensitive differential detection of pathogens. *Emerg Infect Dis* 2005;11:310-3.
60. Ecker DJ, Sampath R, Blyn LB, et al. Rapid identification and strain-typing of respiratory pathogens for epidemic surveillance. *Proc Natl Acad Sci U S A* 2005;102:8012-7.
61. Barthell EN, Aronsky D, Cochrane DG, et al. The Frontlines of Medicine Project progress report: standardized communication of emergency department triage data for syndromic surveillance. *Ann Emerg Med* 2004;44:247-52.
62. Yang S, Rothman RE. PCR-based diagnostics for infectious diseases: uses, limitations, and future applications in acute-care settings. *Lancet Infect Dis* 2004;4:337-48.
63. Miller B, Kassenbourg H, Dunsmuier W, et al. Syndromic surveillance using emergency department data. *J Urban Health* 2003;80:i117-i123.