

**New York State Department of Health
Environmental Control Measures for
Airborne Infection Isolation Surge Capacity Planning
in Health Care Facilities for
Smallpox, SARS or Other Infections
Potentially Transmitted via Airborne Droplet Nuclei
December 18, 2003**

This Environmental Control Measures guideline has been developed to assist infection control and plant management/engineering staff in health care facilities prepare for a natural or terrorist event involving an infectious agent capable of being transmitted via airborne droplet nuclei (smallpox, SARS, *M. tuberculosis*, etc.). Although the epidemiology and transmission of SARS has not been fully elucidated, current CDC recommendations call for airborne infection isolation precautions when caring for suspected SARS cases, in addition to standard and contact precautions, to ensure the greatest degree of safety for patients, healthcare workers and the community.

The control of communicable disease outbreaks (natural or intentional) requires prompt identification, appropriate isolation and treatment of affected individuals, strict adherence to infection control measures, monitoring and evaluation of control measures and ongoing education and training of staff. The focus of this document, environmental control measures, is only one component of the hierarchy of control measures. Therefore, these measures should be integrated into the facility's overall infection control and disaster response plans.

Goals/Objectives

1. Provide environmental control measure guidelines to assist healthcare facilities prepare for a bioterrorist event or naturally occurring outbreak involving a large number of persons requiring airborne infection isolation.
2. Ensure the provision of essential healthcare services while minimizing the risk of transmission to others, especially in acute care facilities where individuals at greatest risk of severe morbidity and mortality receive care.

Definitions of an Airborne Infection Isolation Room and Unit

Throughout this document, an **Airborne Infection Isolation Room (AIIR)** is defined as a patient room meeting the following criteria^{1,2}:

- Private room,
- Negative directional airflow from common areas into the room,
- A minimum of 6-12 air exchanges per hour [supplement with high efficiency particulate air (HEPA) filtration system or ultraviolet germicidal irradiation (UV), if insufficient dilutional ventilation]; and
- Direct exhaust to the outside of the building ≥ 25 feet from an air intake or exhaust through a HEPA filtration system.

An **Airborne Infection Isolation Unit (AII Unit)** is defined as a separate, dedicated area to care for patients suspected or confirmed to have an infection capable of being transmitted via airborne droplet nuclei. See the section entitled **Surge Capacity Planning for Airborne Infection Isolation – Establishment of Airborne Infection Isolation (AII) Unit** for environmental control measures to establish these units.

STEPS ALL FACILITIES SHOULD TAKE IN PREPARING TO RESPOND EFFECTIVELY TO AN AIRBORNE COMMUNICABLE DISEASE CASE OR OUTBREAK

I. Perform a Facility Assessment (Building Survey)³⁻⁵

Assumptions regarding current facility design:

- Most buildings are designed to supply a combination of fresh and recirculated air
- Most buildings have multiple heating, ventilating and air conditioning (HVAC) zones with each zone having an air handler and duct system
- Isolation of zones requires full-height walls or barriers between each zone and its adjacent zones, including hallway/entry doors
- Elevators, stairwells and hallways can affect airflow and dispersion of contaminated air to other zones
- Construction or renovation can affect air flow patterns

1. Assess the current ventilation system(s) of the facility
 - A. Determine and document the number and location of the different HVAC zones and their air handling units
 - B. Determine and document areas served by each zone/system
 - C. Document smoke compartments [based upon physical barriers (e.g., doors) and ventilation (e.g., dampers)]
 - D. Document location of air intakes, exhausts, and switches for each system/zone/compartment
 - E. Determine areas with smoke purge fans and record the location of controls or switches, if applicable
 - F. Ensure all systems are functioning as designed and/or document current functioning of each zone/system including checking the integrity of all ducts
2. Identify all AIIRs throughout the facility [emergency department (ED), inpatient, etc.] and ensure they are functioning properly
 - A. Create and maintain a current list of all AIIRs
 - B. Monitor each room with smoke test (or other visible method) daily when in use for airborne isolation, regardless of the presence of a continuous monitoring system or device
 - C. Monitor monthly with smoke (or other visible method) when not in use for airborne isolation
 - D. Maintain a record of all monitoring

II. Surge Capacity Planning for Airborne Infection Isolation – Establishment of Airborne Infection Isolation (AII) Units

Using the information compiled in the facility assessment, infection control and plant management/engineering should identify an area or areas that can be quickly converted to cohort patients with the same infectious agent. If the infectious agent has the potential to be transmitted by airborne droplet nuclei, the areas for cohorting need to have negative directional airflow relative to other areas and air should be directly exhausted to the outside and not recirculated to other areas. Develop contingency plans for increasing numbers of patients requiring isolation.

1. Identify units, floors, wings or buildings with separate air handling systems, separate HVAC zones, or smoke compartments to create an AII Unit
 - A. Identify areas where air will not recirculate to other parts of the facility
 - B. Identify areas that can be physically separated from other patient care areas
 - 1) Consider smoke compartments that are physically separated with doors or areas in which a temporary barrier can be constructed to minimize the migration of air to other patient areas
 - 2) Select areas with no flow through traffic
 - C. The directional air flow on the units should be able to remain negative relative to other patient care areas or areas with potential exposure to others
 - D. The air from the units should be directly exhausted to outside of the building more than 25 feet from an air intake or pass through a HEPA filtration system and not recirculated to other areas
 - E. If the above criteria cannot be met, consider portable HEPA units, UV units or other mechanisms to achieve supplemental air disinfection
 - F. Ideally, the isolation units would contain all private rooms
2. If there is not a unit, floor, wing or building with a separate air handling system/zone/smoke compartment, evaluate HVAC control options to minimize spread of an infectious agent. Consider the following environmental control measures that can be implemented in the event of a surge in cases requiring airborne infection isolation:
 - A. Decrease supply or increase exhaust to modify directional air flow on unit or in rooms
 - B. Minimize proportion of air that is recirculated
 - C. Increase filter efficiency
 - 1) HEPA filtration – high efficiency particulate air filtration (99.97% @ 0.3 microns) but consider the following concerns with HEPA:
 1. May adversely affect directional air flow due to increased resistance
 2. Increased static resistance can result in increased load on motor/fan units
 3. Increased energy consumption
 4. Increased likelihood of motor/fan failure/burnout
 5. Cost to design or retrofit the entire air handling system
 6. Proper installation, maintenance and monitoring are critical

- 2) Consider filters with higher minimum efficiency reporting value (MERV) rating. [e.g. MERV \geq 13]
- D. Create a physical separation from other patient units
- 1) Establish negative air flow on the designated unit
 1. Consider use of portable or fixed HEPA units vented to the outside
 2. Venting portable HEPA units to the outside through corridor windows may be able to create negative directional air flow from the hallways on the unit to the outside
 3. Venting HEPA units to the outside through window/wall in patient rooms may be able to create negative directional air flow in the patient rooms relative to the corridor
 4. Use exhaust fans in windows, if HEPA units are not available, and if there is no potential for air re-entry or exposure to persons outside the window
 - 2) Consider effect of stairwells and elevators
 1. Weather strips can minimize uncontrolled air infiltration
 - 3) Consider use of facility's smoke-purge systems, if feasible
 - 4) Document optimal HVAC control settings for normal use and the steps necessary to modify the system(s) in the event of an emergency
 - 5) Ensure staff are trained to properly maintain the system(s) under normal conditions and to modify the system(s) in the event of an emergency
 - 6) Document and ensure that there is an effective communication plan between clinical staff, infection control and plant management/engineering to initiate system modifications
 - 7) Hold drills to ensure effective communication and to measure the effects on the AII Unit and other building systems and areas
 - 8) Evaluate building operations after any system modification to ensure there is not a detrimental effect on building systems or the building occupants**

Please note:

NYSDOH Bureau of Architectural and Engineering Facility Planning (BAEFP) will allow temporary modification to existing facilities without prior approval to respond to a biologic event or outbreak. Permanent changes or modifications (renovation and new construction) must comply with the American Institute of Architects/Facility Guideline Institute (AIA/FGI) guidelines as required by NYSDOH code.

III. Emergency Department Guidelines

- 1) Place signs at all entrances to minimize exposure in all outpatient waiting areas
 - a) Provide directions for patients with febrile rash or febrile respiratory conditions to mask and report symptoms immediately to triage staff
 - b) Ensure surgical masks, tissues, and alcohol-based handrubs are readily available for symptomatic patients, including at the entrance near the signs

- i) Mask patients and family members/friends, if symptomatic to prevent aerosolization of infectious particles
 - ii) Have tissues, waste containers and alcohol-based hand rubs available in waiting areas
- c) Promptly mask and triage patients with febrile rash or febrile respiratory illness and place in pre-designated AIIR or other appropriate room (see below)
- d) Limit visitors or other persons accompanying the patient
- 2) Registration areas should have barriers (e.g., plexiglass) to separate patients from each other and staff
- 3) Waiting areas
 - a) Separate persons with febrile rash or febrile respiratory illnesses from others
 - b) Establish air flow patterns that will minimize exposure, if possible
 - i) For example, directional/downward airflow pattern
 - c) Enhance dilutional ventilation (increased air exchanges) while maintaining appropriate directional air flow, if feasible
 - i) Increased air mixing may pose an additional risk if not diluted and directed properly.
 - ii) Do not increase air mixing if it will increase exposure to others
 - d) If air is recirculated, consider supplemental HEPA or enhanced filtration to decrease airborne contaminants (proper installation and maintenance of filtration systems are critical) or supplemental ultraviolet germicidal irradiation for air disinfection (UVGI) (proper installation, maintenance and monitoring are critical for the safe use of UVGI)
- 4) Triage area
 - a) Have N95 respirators immediately available for staff
 - i) Ensure staff have been fit-tested
 - ii) Ensure appropriate sizes and type of respirators are available
 - b) Have surgical masks, tissues and alcohol-based handrubs immediately available
- 5) Patient care areas
 - a) Identify AIIR rooms and ensure they are functioning properly
 - i) Establish priority criteria for placement in bonafide AIIRs based on risk of transmission
 - (1) Suspected diagnosis
 - (2) Exposure history
 - (3) Extent/severity of symptoms
 - (4) Aerosol-generating procedures
 - b) Develop plans for overflow/surge in number of patients requiring isolation
 - i) Identify supplemental rooms
 - (1) AIIR on other units
 - (a) Use precautions during transport
 - (b) Notify unit prior to arrival of patient
 - (c) Minimize contact with others during transport
 - (2) Private rooms with doors closed
 - (a) Supplement dilutional ventilation with portable HEPA or UVGI, if available

- (b) If none of the above are available, consider window fans exhausting air to the outside, while ensuring no potential air re-entry or exposure to persons outside
- (3) Pre-identify a separate area near the emergency department or in an alternate setting that can be quickly converted to provide for triage, surge capacity and cohorting of individuals with febrile rash or febrile respiratory conditions
 - (a) Establish a system to initiate cohorting
 - (b) Establish criteria for instituting cohorting
 - (c) **Educate and perform a drill to ensure frontline healthcare providers can implement the system**
- c) Identify areas and procedures for storage, donning, and removal of PPE
 - i) Ensure appropriate PPE is immediately available for staff
 - ii) Ensure PPE can be appropriately discarded after use or if reusable (e.g., power air supplied respirators) protocols are in place to ensure safe decontamination and reprocessing
 - iii) Ensure hand hygiene can be performed immediately after removal of PPE
- d) If aerosol-generating procedures (e.g., sputum induction, intubation, positive pressure oxygen, bronchoscopy, etc.) are medically necessary for patients in the emergency department, perform them in a special booth or hood with local exhaust ventilation or in a room that meets the criteria for airborne infection isolation
- e) Limit patient movement to medically essential procedures only
 - i) Notify unit where procedure is to take place prior to transport
 - ii) Utilize precautions during transfer and during procedure
- f) Ensure appropriate cleaning and disinfection of medical equipment and environmental surfaces in immediate patient vicinity after patient leaves, as well as transport equipment (stretcher or wheelchair)

IV. Guidelines for the Inpatient Setting

1. Identify AIIR rooms on all patient units
 - A. Ensure clinical staff know the location of all AIIRs
 - B. Ensure appropriate staff have the authority to place suspect or confirmed cases on appropriate isolation precautions
2. Establish priority criteria for placement in bonafide AIIRs based on risk of transmission
 - A. Suspected diagnosis
 - B. Exposure history
 - C. Extent/severity of symptoms
 - D. Aerosol-generating procedures
3. Develop plans for overflow/surge in the number of cases requiring airborne infection isolation
 - A. Consider use of AIIRs on other units
 - B. If insufficient AIIRs, consider use private rooms with doors closed
 - 1) Use portable HEPA, if available
 - 2) Use exhaust fan blowing out to achieve negative directional airflow if there is not a potential for air re-entry or direct exposure to others (pedestrians etc.)

- C. If the number or location of AIIRs is not sufficient or appropriate, cohort patients with the same infectious agent in a designated unit, floor, wing or building (Dedicated AII Unit)
 - 1) Ensure appropriate administrative and clinical staff have the authority to initiate cohorting and/or establish the AII Unit when needed
 - 2) Ensure policies and procedures are in place to establish the AII Unit
 - 3) Train and drill clinical staff on protocols for establishing the AII Unit
 - 4) Ensure plant management/engineering staff are trained to implement the necessary engineering modifications
- D. Identify areas and procedures for storage, donning, and removal of PPE
 - 1) Ensure appropriate PPE is immediately available for staff
 - 2) Ensure PPE can be appropriately discarded after use or if reusable (e.g., power air supplied respirators) protocols are in place to ensure safe decontamination and reprocessing
 - 3) Ensure hand hygiene can be performed immediately after removal of PPE
- 4. Ensure appropriate environmental conditions for high risk aerosol-generating procedures are available
 - A. Perform in a room that meets the criteria of an AIIR or if AIIR is unavailable, in a special booth or hood with local exhaust ventilation
 - B. Ensure appropriate PPE is available for staff
- 5. Develop admission and discharge policies/procedures for use during mass events
 - A. Discontinue elective admissions
 - B. Establish referral systems for patients depending upon level of care required
 - 1) Establish written memoranda of understanding (MOU) with long term care, homecare or other facilities capable of providing alternate care for patients
 - 2) Coordinate triage plan with local/state health departments, regional resource centers (for facilities outside of New York City) and local emergency managers
- 6. Ensure that systems for prompt reporting to and communication with state and local health department are in place
 - A. During outbreaks of severe, highly contagious diseases, local health departments should be notified when infectious patients are discharged to the community or moved between hospitals, counties, states or other countries
 - B. Collaborate with local and state health departments to improve hospital bioterrorism and outbreak preparedness

V. References:

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4. NIOSH. Guidance for protecting building environments from airborne, chemical, biological, or radiological attacks. DHHS (NIOSH) Pub No. 2002-139.
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