

Infection Control Manual		
	Policy Name	Plant Engineering and Maintenance
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	Responsible for Content	Hospital Epidemiology

I. Description

Describes the infection control guidelines for maintaining the physical environment of the hospital.

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II. Rationale

Proper maintenance of the ventilation and physical facilities is essential to help reduce the risk of infections associated with the physical environment.

III. Policy

A. Personnel

1. Personnel should adhere to guidelines established by the hospital Occupational Health Service (OHS) (see policy entitled [“Infection Control and Screening Program – OHS”](#)).
2. Personnel must be prompt in reporting any exposures to blood or other potentially infectious material (e.g., needlesticks, mucous membrane or non-intact skin) by calling the **Needlestick Hotline** at 984-974-4480.
3. Occupationally-exposed personnel must be familiar with the [Exposure Control Plan for Bloodborne Pathogens](#) and the [TB Control Plan](#). When it is necessary to come in contact with patient's body fluids (e.g., repairing sewer lines, toilets), personal protective equipment (e.g., gloves, gowns and/or goggles) must be worn. If disposable latex gloves are inadequate to protect from blood exposure, utility gloves may be used to protect hands from blood and other potentially infectious materials. Hands must be washed after gloves are removed. Reusable utility gloves will be decontaminated using an EPA-registered disinfectant if the integrity of the gloves is not compromised. However, they must be discarded if they are cracked, peeling, torn, punctured, or exhibit other signs of deterioration or when their ability to function as a barrier is compromised.

4. Isolation Precautions

- a. All personnel will follow the [Isolation Precautions Policy](#) and any instructions addressed on the isolation precaution sign posted outside the patient's room.
- b. Equipment (pliers, wrenches, hammers, etc.) must be disinfected with the hospital's EPA-registered disinfectant (i.e., Metriguard) after use in an isolation precautions room and when visibly soiled.

B. Maintenance of Buildings

1. All surfaces (floors, walls, and ceilings) require inspection and repair when necessary in order to maintain smooth, dry and cleanable surfaces. Water leaks or water soaked walls can become reservoirs for fungus.
2. Any openings or breaks in the walls, foundations, window frames, etc. require repair to preserve a clean environment.
3. UNC Health Care employees will report need for repairs to their supervisors. Supervisor (or designee) will contact Plant Engineering.

C. Equipment and Repairs

1. Water Treatment

a. Domestic Potable Water Primary Treatment

- i. The domestic potable water supply is treated, disinfected, tested and approved as safe by public water supplier (Orange Water and Sewer Authority, Town of Hillsborough) using a combination of physical and chemical processes in accordance with state and federal regulations.

b. Domestic Potable Water Secondary Treatment

- i. The domestic potable water supply (cold and hot) to the Bone Marrow Transplant Unit (BMTU) on 1st Floor Neurosciences Hospital in Chapel Hill will be served by a secondary treatment system (copper silver ionization). The system will be maintained in accordance with Manufacturer's recommendations including weekly readings by Plant Engineering, monthly water sample testing by the Manufacturer for copper and silver ion levels, and, if needed, monthly adjustments to the system by Plant Engineering as directed by the Manufacturer.

c. Domestic Potable Hot Water

- i. Domestic hot water systems will utilize recirculation pumping and piping technology to maintain continuous flow in hot water distribution loops.
- ii. Water heaters will be of the instantaneous low-volume type or tank type with recirculation.

d. Cooling Towers and Condenser Water

- i. Cooling tower condenser water will be chemically-treated with inhibitors, dispersants and biocides in accordance with industry/vendor best practice standards to protect against fouling, corrosion, scale and microbiological growth. Water quality parameters and chemical feeds will be controlled, monitored, adjusted, and maintained by automated water treatment controllers and chemical treatment vendor technicians.
- ii. Cooling towers will be cleaned once annually and disinfected twice annually in accordance with industry/vendor best practice standards.

- iii. Cooling tower condenser water makeup will be either by domestic potable water supply or by reclaimed water, both of which are treated by the public water supplier using a combination of physical and chemical processes in accordance with state and federal regulations.
- e. Humidifiers in Central Air Handling
 - i. Steam for central air-handler humidification will be provided either by local steam generators fed directly by a domestic potable water supply or by central plant steam that has been treated with amines in accordance with industry/vendor best practice standards.
- 2. Ventilation system
 - a. Air filters will be monitored as indicated in Appendix 2 which details the requirements and monitoring for filters, pressures and air changes. From an infection control perspective, temperature and relative humidity monitoring is not necessary so long as temperature and relative humidity are not excessive (temperature >90°F, relative humidity >80% for longer than 48 hours).
 - b. Disposable filters are never cleaned or reused.
 - c. All roughing filter beds will be visually inspected every 3 months to ensure that unfiltered air does not bypass the filters because of leaks around the filter frames or holes in the filters. N-95 respirators (fit-testing required) are available to staff for use when filters are changed.
 - d. Air exchange rates and the air pressure differential between patient rooms and the adjacent corridor will be checked as requested by the Hospital Epidemiology Department. Rooms used for isolation of tuberculosis patients will be monitored annually (see Appendix 2). The results will be kept on file by Plant Engineering for a period of 3 years and a copy of annual monitoring results will be sent to Hospital Epidemiology. Rooms of patients on Airborne Precautions are monitored by the nursing staff at least daily using the "tissue test."
 - e. To preclude bypass of unfiltered air, all hospital windows and outside doors will remain closed.
 - f. When cleaning dust from behind vent covers in patient rooms, use a damp cloth or HEPA-filtered vacuum cleaner. This cleaning should only be done when the patient is not in the room, with the door closed. The room should remain unoccupied for 30 minutes, if possible.
- 3. Ice Machines
 - a. Only ice machines that dispense ice directly into portable containers at the touch of a control will be purchased.
 - b. Ice machines will be inspected, cleaned and repaired, if necessary, on a regular maintenance schedule (i.e., annually for single-use dispenser machines and ice chest machines). (Refer to Appendix 1)
- 4. Automatic sensor sinks

Will not be installed in bone marrow transplant unit and the Burn ICU patient rooms.
- 5. Other Equipment and Repairs
 - a. Perform routine inspection and servicing of all plumbing, heating, refrigeration, steam supplies, electrical and air-conditioning systems. Maintenance records will be prepared

on all routine inspections and servicing and will be kept on file for 3 years. Inspection and monitoring of these systems are summarized in Appendix 2.

- b. The computerized tube system is maintained and cleaned as per hospital policy. The McLendon Labs and Plant Engineering have separate functions in ensuring the maintenance of this system. Please refer to specific departmental procedures for Plant Engineering and UNCHC Operational Policies and Procedures for further details. Staff should comply with the guidelines for decontaminating specimen spills in the tube system (see [Plant Engineering Policy: PE 0044 "Usage of the Computerized Tube System"](#)).

6. Ceilings and Leaks

- a. Plant Engineering/Maintenance Department occasionally must enter ceilings to perform repairs or maintenance. This process involves removal of ceiling tiles to gain access to the ceiling crawl space. Removal of such tiles has been documented as a risk factor for the acquisition of infection with fungal spores (i.e., *Aspergillus* sp., *Mucor* sp.) by immunocompromised patients. Such acquisition may lead to serious pulmonary and/or systemic infection. Hospital employees, unless on immunosuppressive medication, are at no increased risk. Investigations at UNC Hospitals have shown that removing our ceiling tiles leads to an increased number of fungal spores in the immediate environment. When ceiling tiles must be moved, Hospital Epidemiology recommends certain precautions (see Appendix 3). For more information, refer to Policy EHS 0050 ["Safety and Infection Control Management Plan for Construction, Renovation, and Modernization Projects."](#)
- b. When Plant Engineering/Maintenance staff find stains suggestive of leaks (e.g., ceiling tiles, walls), they should investigate the reason for the stain, correct the leak as needed, and ensure there are no wet structural materials or mold (hidden or visible) resulting from the leak. If mold is found, contact Environmental Health and Safety and Hospital Epidemiology and develop a clean-up plan. Stains on ceiling tiles or other areas should only be painted or tiles replaced after this investigation has been done and the leak corrected. Carpeting that remains wet after 72 hours will be replaced. Carpet that is soiled by sewage spills should be replaced regardless of the time it remains wet.
- c. Hospital Epidemiology and Environmental Health and Safety should be notified by Plant Engineering / Maintenance about any leak that is recurrent and/or associated with mold in adjacent areas.
- d. Water intrusion/leaks will be managed in accordance with CDC Environmental Infection Control Guidelines available on the CDC website.

7. Sinks

- a. Aerators on scrub sink faucets are to be replaced annually as part of a scheduled preventative maintenance program.
- b. Aerators on sink faucets in ICUs are to be replaced annually as part of a scheduled preventative maintenance program

8. Decorative Water Fountains/Water Walls

- a. Decorative water fountains/water walls are prohibited in the indoor environment.

D. Hospital Renovations/Construction

- 1. All renovations/construction plans involving the health care system will be reviewed by Hospital Epidemiology to maintain the air quality in the hospital and to ensure appropriate considerations have been made to infection control issues. The procedure details are

provided in the EHS Policy: "Safety and Infection Control Management Plan for Construction, Renovation, and Modernization Projects."

- a. To preclude exposure to medically important mycotic agents (e.g., *Aspergillus*) which are associated with dust, all renovations and repair procedures must be carefully reviewed and patient care areas must be protected from construction areas by an effective barrier system. When new construction or renovation is planned at UNC Health Care, the Plant Engineering office will invite Hospital Epidemiology to the preconstruction conference for all in-house and contract construction. Plant Engineering will be responsible for initiating the risk assessment form that will be forwarded to Hospital Epidemiology for approval prior to construction.
- b. Contract and Hospital employees cannot conduct renovation or new construction until the plan and risk assessment is approved by Hospital Epidemiology.
- c. Inspections of the construction/renovation sites are conducted by Hospital Epidemiology staff regularly (e.g. every 2 weeks) and as needed during new construction or renovation to ensure the precautions needed to preclude patient exposure to medically important mycotic agents have been implemented and maintained.
- d. Walkoff mats will be placed at construction/renovation site entrances and will be replaced as needed to prevent tracking dust. Wet towels may be used if they are replaced daily and affixed so they do not pose a trip hazard.
- e. Portable HEPA units will be used in some renovation/construction areas to minimize the likelihood of air contamination. Portable HEPA unit air filters will be replaced when resistance to air flow has increased as indicated by visual inspection.
- f. All new construction or renovation can be terminated immediately if the Hospital Epidemiology staff believes there is an infection risk associated with such activities.

E. Education

Infection control education, including required OSHA education for Bloodborne Pathogens and TB, is required at least annually.

F. Implementation

The implementation and enforcement of this policy is the responsibility of the Director of Plant Engineering.

IV. References

Centers for Disease Control and Prevention. Guidelines for Environmental Infection Control in Health-Care Facilities. 2003.

V. Reviewed/Approved by

Hospital Infection Control Committee

VI. Original Policy Date and Revisions

Revised on Aug 2004, Sept 2006, May 2009, Aug 2011, Aug 2013, Feb 2014, Feb 2017, Oct 2017_{rev}

Appendix 1: Sanitary Care and Maintenance of Ice Chests and Ice Machines

Ice may become contaminated from use of impure water, contamination of ice-making machines, or from improper storage or handling of ice. CDC has conducted an investigation demonstrating that ice contaminating syringes used to obtain specimens for blood gas determinations caused a series of bacteremias in an ICU (N Engl J Med 292:1099-1102, 1975), and there is a published report of contaminated ice causing another outbreak of nosocomial infection (Lancet 2:620-623, 1968).

The following procedures should be followed to reduce the likelihood of contamination of ice chests (ice storage compartments) and ice machines:

1. Ice machines that dispense ice directly into portable containers at the touch of a control provide a more sanitary method to store and obtain ice than use of ice chests, but such ice machines may be more expensive to purchase and to operate.
2. All ice handlers should be taught the following precautions:
 - Wash hands frequently.
 - Hold scoop used with ice chest by handle; do not touch bowl surface with hands.
 - Do not handle ice with hands.
 - Do not return unused ice to an ice storage chest.
 - Keep access doors to chests closed except when removing ice.
3. Ice scoops used should be smooth and impervious and kept on a keeper chain short enough so the scoop cannot touch the floor. Scoops should be kept on an uncovered stainless steel, impervious plastic, or fiberglass tray on top of the chest when not in use. The tray and the scoop should be run through a dishwasher or sterilized daily.
4. Remove all extraneous equipment and items from around or on the ice chests and machines; if possible, limit access to ice chests.
5. Clean ice storage compartments on a preset schedule; weekly to monthly cleaning of open chests is suggested; less frequent cleaning may be possible with ice dispensing machines. Cleaning should be carried out with a fresh soap or detergent solution after disconnecting the unit, removing and discarding all ice, and allowing the chest to warm to room temperature. Use clean rags or disposable wipes to scrub all surfaces. Pay particular attention to door tracks, guides, and gaskets. After cleaning, rinse all surfaces of the compartment with potable water, rinse it again with a 100-ppm (mg/l) solution of hypochlorite, allow it to dry, and then return the unit to service.
6. At least on an annual schedule, disconnect ice-making machines, discard all ice, and disassemble removable parts of the machine. Thoroughly clean the machines and the parts. Check for the need of possible repair of any portion of the machine. Insure the presence of an air gap at all inlets for potable water. Inspect for insect or rodent infestation under the unit, and treat if necessary. Check the gasket around the ice chest door (open compartment models) for cleanliness and evidence of possible leakage or dripping of contaminants into the ice chest. Clean the ice storage compartment

as in (5) above. Place a 50-ppm solution of hypochlorite in the ice machine for at least four hours or a 100-ppm solution for at least two hours. Circulate the solution throughout the entire ice-making and storing system according to the manufacturer's recommended cleaning and sanitizing procedures. Remove the disinfecting solution, flush the system with potable water, allow the ice compartment to dry, and then return the unit to service.

Neither routine microbiologic sampling of ice or ice machines is recommended. Sampling could be carried out if it were desired to use the data obtained to develop best schedules for cleaning open ice chests under existing hospital conditions. To sample, remove and melt ice aseptically and do quantitative plate counts (or use membrane-filter technique) on the resulting water; possible pathogens should be identified if present. If laboratory service to conduct such evaluations is not readily available, ice melted in a sterile container might be submitted to the local health department in their water-sampling bottles to determine whether or not coliform contamination is present. Sampling for microbial contamination on ice scoops could be conducted very occasionally for educational purposes.

Bacterial Diseases Division
Bureau of Epidemiology
Center for Disease Control
Atlanta, Georgia
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Revised slightly and reprinted July 1976; revised October 1979; reprinted May 1982, April 19

Appendix 2: Summary of Air Quality Systems Management - UNC Health Care Plant Engineering^A

Area Designation	Air movement relationship to adjacent area	Minimum total air changes per hour UNC Hospitals	All air directly exhausted to outdoors	Filtering System	Monitoring	Plant Engineering schedule for verification and documentation**
Hospitals Ventilation Systems	NA	NA	Variable depending upon area	Filter bed #1 – MERV 7 Filter bed # 2 – MERV 14	Operation of fans continuously monitored (alarmed). PM program for HVAC.	Filter bed #1 are visually inspected every 12 weeks and replaced as needed. Filter bed #2 are visually inspected annually and changed as needed. HEPA filters are inspected every 5 years and changed as needed.
Protective precautions rooms BMTU1st floor NSH and 5C07 in Children's Hospital 5C08 Children's Hospital 5C17, 5C18, 5C19 (with portable HEPA), and 5C20 PICU: 2C11, 2C12, 2C14, 2C15	Continuous positive pressure May be either positive or negative pressure Positive pressure mode. Positive pressure mode.	9 air changes per hour (ACH)	NO	HEPA filtration MERV 17	PM program for HVAC.	ACH verified and documented annually by PE
Airborne Isolation Rooms (i.e., TB) (see <u>Listing of Airborne Isolation Rooms</u>)	Continuous negative pressure	6-12 ACH*	YES		Monitored daily (when used for isolation) by nursing staff using tissue test and documented in the patient's medical record. PM program for HVAC.	ACH verified and documented annually

Area Designation	Air movement relationship to adjacent area	Minimum total air changes per hour UNC Hospitals	All air directly exhausted to outdoors	Filtering System	Monitoring	Plant Engineering schedule for verification and documentation**
Negative Pressure Rooms (i.e., other airborne diseases such as chickenpox)	Continuous negative pressure	6 ACH	NO		Monitored daily (when used for isolation) by nursing staff using tissue test and documented in the patient's medical record, PM program for HVAC.	ACH verified and documented annually
Operating Rooms, 2nd and 4th Floors of Main Hospital, Labor and Delivery Operating Rooms and Children's Hospitals, Chapel Hill,	Continuous positive pressure	15 ACH	NO	MERV 17	PM program for HVAC. Temperature and humidity history recorded in HVAC control system. Temperature, humidity, and pressure monitored by clinical department.	ACH verified and documented annually
Operating Rooms, Hillsborough Hospital	Continuous positive pressure	20 ACH	NO	MERV 17	PM program for HVAC. Temperature and humidity history recorded in HVAC control system. Temperature and humidity monitored by clinical department. Pressure monitored by Plant Engineering.	ACH verified and documented annually
Operating Rooms, Ambulatory Surgery Center (ASC) at ACC	Continuous positive pressure	20 ACH	NO	MERV 17	PM program for HVAC by UNC Facilities Services. Temperature and humidity history recorded in HVAC control system by UNC Facilities Services. Temperature, humidity, pressure monitored by clinical department.	ACH verified and documented annually

Plant Engineering and Maintenance

Area Designation	Air movement relationship to adjacent area	Minimum total air changes per hour UNC Hospitals	All air directly exhausted to outdoors	Filtering System	Monitoring	Plant Engineering schedule for verification and documentation**
Bronchoscopy Rooms: 6 th Floor Main Hospital and 2 nd Floor Children's Hospital	Continuous negative pressures	12 ACH*	YES		PM program for HVAC.	ACH verified and documented annually
Central Sterile Processing Sterilizer Equipment Room, Chapel Hill	Continuous negative pressure	10 ACH*	YES		PM program for HVAC. Temperature and humidity history recorded in HVAC control system. Temperature, humidity, and pressure monitored by clinical department.	ACH verified and documented annually.
Central Sterile Processing Sterilizer Equipment Room, Hillsborough	Continuous negative pressure	10 ACH*	YES		Temperature and humidity history recorded in HVAC control system. Temperature and humidity monitored by clinical department. Pressure monitored by Plant Engineering.	ACH verified and documented annually.
Central Sterile Processing Sterilizer Equipment Room, ASC	Continuous negative pressure	10 ACH*	YES		PM program for HVAC by UNC Facilities Services. Temperature and humidity history recorded in HVAC control system by UNC Facilities Services. Temperature, humidity, pressure monitored by clinical department.	ACH verified and documented annually.

Plant Engineering and Maintenance

Area Designation	Air movement relationship to adjacent area	Minimum total air changes per hour UNC Hospitals	All air directly exhausted to outdoors	Filtering System	Monitoring	Plant Engineering schedule for verification and documentation**
Central Processing Sterile Storage Room, Chapel Hill	Continuous positive pressure	4 ACH*	NO		PM program for HVAC. Temperature and humidity history recorded in HVAC control system. Temperature, humidity, and pressure monitored by clinical department.	ACH verified and documented within 3 years.
Central Processing Sterile Storage Room, Hillsborough	Continuous positive pressure	4 ACH*	NO		Temperature and humidity history recorded in HVAC control system. Temperature and humidity monitored by clinical department. Pressure monitored by Plant Engineering.	ACH verified and documented within 3 years.
Central Processing Sterile Storage Room, ASC	Continuous positive pressure	4 ACH*	NO		PM program for HVAC by UNC Facilities Services. Temperature and humidity history recorded in HVAC control system by UNC Facilities Services. Temperature, humidity, pressure monitored by clinical department.	ACH verified and documented within 3 years.
Central Processing Decontamination Room, Chapel Hill	Continuous negative pressure	6 ACH*	YES		PM program for HVAC. Temperature and humidity history recorded in HVAC control system. Temperature, humidity, and pressure monitored by clinical department.	ACH verified and documented annually.

Plant Engineering and Maintenance

Area Designation	Air movement relationship to adjacent area	Minimum total air changes per hour UNC Hospitals	All air directly exhausted to outdoors	Filtering System	Monitoring	Plant Engineering schedule for verification and documentation**
Central Processing Decontamination Room, Hillsborough	Continuous negative pressure	6 ACH*	YES		Temperature and humidity history recorded in HVAC control system. Temperature and humidity monitored by clinical department. Pressure monitored by Plant Engineering.	ACH verified and documented annually.
Central Processing Decontamination Room, ASC	Continuous negative pressure	6 ACH*	YES		PM program for HVAC by UNC Facilities Services. Temperature and humidity history recorded in HVAC control system by UNC Facilities Services. Temperature, humidity, pressure monitored by clinical department.	ACH verified and documented annually.
Pediatric Cardiac Catherization Lab	Continuous positive pressure	8 ACH (if used as OR, portable HEPA used during surgery).	NO	MERV 7 and 14	PM program for HVAC	ACH verified and documented annually
Labs Surgical Pathology TB Microbiology Area	Continuous negative pressure	6 ACH*	YES	NA	PM program for HVAC.	ACH verified and documented within 3 years.

A – Hospital Epidemiology and Plant Engineering will review data for all rooms listed on an annual basis. A report will be submitted to HICC for approval upon review.

* Ventilation recommendations from AIA

** Documentation should remain on file for 3 years.

Appendix 3: Precautions for Patients in Clinical Areas Where Ceiling Work is Planned

Plant Engineering/Maintenance Department occasionally must enter ceilings to perform repairs or maintenance. This process involves removal of ceiling tiles to gain access to the ceiling crawl space. The removal of such tiles has been documented as a risk factor for the acquisition of infection with fungal spores (i.e., *Aspergillus* sp., *Mucor* sp.) by immunocompromised patients*. Such acquisition may lead to serious pulmonary and/or systemic infection. Hospital employees, unless on immunosuppressive medication, are at no increased risk. Investigations at UNC Hospitals have shown that removing our ceiling tiles leads to an increased number of fungal spores in the immediate environment. All individuals opening a ceiling must do so in accordance with these guidelines and the UNC Health Care System's Ceiling Opening Policy which is summarized below. In the highest risk areas (see below), Plant Engineering will speak with the area Managers (and Hospital Epidemiology as needed) and will assess the need for plastic barriers prior to beginning the work.

- If the project is of long duration (i.e., >1 hour), more than 5 2x2 tiles in a patient area will be removed, and/or destruction of materials is likely to cause dispersal of dust/debris, a plastic barrier or cube will be required.
- The infection prevention measures for ceiling access provided to the contractors by Plant Engineering and used by Plant Engineering and Nurse Managers include:
 1. Immediately prior to beginning ceiling work in a patient care area, the individual conducting the work should consult the charge nurse, so she/he can assess the potential impact of the work on immunocompromised patients in the area and ensure that patients are in their rooms and doors are closed.
 2. No patients should be housed in rooms where work is being conducted or ceiling tiles have been removed in the patient's room.
 3. During the period in which tiles have been removed and work is being done, all immunocompromised patients should wear a tight-fitting surgical mask that covers the mouth and nose *when in the area of the ceiling opening*.
 4. Thorough cleaning following all work should be done by Environmental Services before patients are allowed to remove their masks.
 5. Depending on the details of the project, a plastic barrier or cube may be required.

**Highest risk areas: Any inpatient area housing immuno-compromised patients (i.e., BMTU, all ICUs, burn floor [5 East], solid organ transplant floors [CTSU, 5WST, ISCU], Oncology [4ONC], Pediatric Oncology [5CH,]), Step-down Units, Cardiac Cath Lab, VIR, Dialysis, Central Processing, Negative pressure isolation rooms, Operating rooms, PACU, Transplant Clinic, BMTU Clinic, Pharmacies, Oncology clinics, Microbiology Lab, HPC Lab, and infusion areas.*