

Table 7.2

Ventilation Requirements for Areas Affecting Patient Care in Hospitals and Outpatient Facilities<sup>1</sup>

Area designation	Air movement relationship to adjacent area <sup>2</sup>	Minimum air changes of outdoor air per hour <sup>3</sup>	Minimum total air changes per hour <sup>4,5</sup>	All air exhausted directly to outdoors <sup>6</sup>	Recirculated by means of room units <sup>7</sup>	Relative humidity <sup>8</sup> (%)	Design temperature <sup>9</sup> (degrees F/C)
<b>SURGERY AND CRITICAL CARE</b>							
Operating/surgical cystoscopic rooms <sup>10, 11</sup>	Out	3	15	--	No	30-60	68-73 (20–23) <sup>12</sup>
Delivery room <sup>10</sup>	Out	3	15	--	No	30-60	68-73 (20–23)
Recovery room <sup>10</sup>	--	2	6	--	No	30-60	70-75 (21–24)
Critical and intensive care	--	2	6	--	No	30-60	70-75 (21–24)
<del>Intermediate care--</del>	<del>2</del>	<del>6<sup>13</sup></del>	<del>--</del>	<del>--</del>	<del>--</del>	<del>--</del>	<del>70-75 (21–24)</del>
Newborn intensive care	--	2	6	--	No	30-60	72-78 (22-26)
Treatment room <sup>13,14</sup>	--	--	6	--	--	--	75 (24)
Trauma room <sup>13,14</sup>	Out	3	15	--	No	30-60	70-75 (21–24)
Anesthesia gas storage	In	--	8	Yes	--	--	--
<del>Gastrointestinal Endoscopy room<sup>15</sup></del>	<del>In/Out</del>	<del>2</del>	<del>6</del>	<del>--</del>	<del>No</del>	<del>30-60</del>	<del>68-73 (20–23)</del>
Bronchoscopy <sup>11</sup>	In	2	12	Yes	No	30-60	68-73 (20–23)
ER waiting rooms	In	2	12	Yes <sup>14,15,16, 17</sup>	--	--	70-75 (21-24)
Triage	In	2	12	Yes <sup>14,16</sup>	--	--	70-75 (21-24)
Radiology waiting rooms	In	2	12	Yes <sup>14,15,16, 17</sup>	--	--	70-75 (21-24)
Procedure room	Out	3	15	--	No	30-60	70-75 (21-24)
<del>Laser eye room</del>	<del>Out</del>	<del>3</del>	<del>15</del>	<del>--</del>	<del>No</del>	<del>30-60</del>	<del>70-75 (21-24)</del>
<del>X-ray (surgical/critical care and catheterization)</del>	<del>Out</del>	<del>3</del>	<del>15</del>	<del>--</del>	<del>No</del>	<del>30-60</del>	<del>70-75 (21–24)</del>
<b>NURSING</b>							
Patient room	--	2	6 <sup>16</sup> 6 <sup>13</sup>	--	--	--	70-75 (21–24)
Toilet room	In	--	10	Yes	--	--	--
Newborn nursery suite	--	2	6	--	No	30-60	72-78 (22-26)
Protective environment room <sup>11,17</sup>	Out	2	12	--	No	--	75 (24)
Airborne infection isolation room <sup>11,18</sup>	In	2	12	Yes <sup>15,17</sup>	No	--	75 (24)
Isolation alcove or anteroom <sup>17,18</sup>	In/Out	--	10	Yes	No	--	--
Labor/delivery/recovery	--	2	6 <sup>16,13</sup>	--	--	--	70-75 (21–24)
Labor/delivery/recovery/postpartum	--	2	6 <sup>16,13</sup>	--	--	--	70-75 (21–24)
Patient corridor	--	--	2	--	--	--	--
<b>ANCILLARY</b>							
<del>Radiology<sup>19,18</sup></del>	<del>Out</del>	<del>3</del>	<del>15</del>	<del>--</del>	<del>No</del>	<del>30-60</del>	<del>70-75 (21–24)</del>

X-ray (diagnostic & treatment)	--	--	6	--	--	--	75 (24)
Darkroom	In	--	10	Yes	No	--	--
Laboratory							
General <sup>19,18</sup>	--	--	6	--	--	--	75 (24)
Biochemistry <sup>19,18</sup>	OutIn	--	6	--Yes <sup>19</sup>	No	--	75 (24)
Cytology	In	--	6	Yes	No	--	75 (24)
Glass washing	In	--	10	Yes	--	--	--
Histology	In	--	6	Yes	No	--	75 (24)
Microbiology <sup>19,18</sup>	In	--	6	Yes	No	--	75 (24)
Nuclear medicine	In	--	6	Yes	No	--	75 (24)
Pathology	In	--	6	Yes	No	--	75 (24)
Serology	OutIn	--	6	--Yes <sup>21</sup>	No	--	75 (24)
Sterilizing	In	--	10	Yes	--	--	--
Autopsy room <sup>11</sup>	In	--	12	Yes	No	--	--
Nonrefrigerated body-holding room	In	--	10	Yes	--	--	70 (21)
Pharmacy	Out	--	4	--	--	--	--
<u>DIAGNOSTIC AND TREATMENT</u>							
Examination room	--	--	6	--	--	--	75 (24)
Medication room	Out	--	4	--	--	--	--
Treatment room	--	--	6	--	--	--	75 (24)
Physical therapy and hydrotherapy	In	--	6	--	--	--	75 (24)
Soiled workroom or soiled holding	In	--	10	Yes	No	--	--
Clean workroom or clean holding	Out	--	4	--	--	--	--
<u>STERILIZING AND SUPPLY</u>							
ETO-sterilizer room	In	--	10	Yes	No	30-60	75 (24)
Sterilizer equipment room	In	--	10	Yes	--	--	--
Central medical and surgical supply							
Soiled or decontamination room	In	--	6	Yes	No	--	68-73 (20-23)
Clean workroom	Out	--	4	--	No	30-60	75 (24)
Sterile storage	Out	--	4	--	--	(Max) 70	--
<u>SERVICE</u>							
Food preparation center <sup>20</sup>	--	--	10	--	No	--	--
Warewashing	In	--	10	Yes	No	--	--
Dietary day storage	In	--	2	--	--	--	--
Laundry, general	--	--	10	Yes	--	--	--
Soiled linen (sorting and storage)	In	--	10	Yes	No	--	--
Clean linen storage	Out	--	2	--	--	--	--
Soiled linen and trash chute room	In	--	10	Yes	No	--	--
Bedpan room	In	--	10	Yes	--	--	--
Bathroom	In	--	10	--	--	--	75 (24)
Janitor's closet	In	--	10	Yes	No	--	--

<sup>1</sup>The ventilation rates in this table cover ventilation for comfort, as well as for asepsis and odor control in areas of acute care hospitals that directly affect patient care and are determined based on healthcare facilities being predominantly "No Smoking" facilities. Where smoking may be allowed, ventilation rates will need adjustment. Areas where specific ventilation rates are not given in the table shall be ventilated in accordance with ASHRAE Standard 62, *Ventilation for Acceptable Indoor Air Quality*, and ASHRAE *Handbook—HVAC Applications*. Specialized patient care areas, including organ transplant units, burn units, specialty procedure rooms, etc., shall have additional ventilation provisions for air quality control as may be appropriate. OSHA standards and/or NIOSH criteria require special ventilation requirements for employee health and safety within healthcare facilities.

<sup>2</sup>Design of the ventilation system shall provide air movement which is generally from clean to less clean areas. If any form of variable air volume or load shedding system is used for energy conservation, it must not compromise the corridor-to-room pressure balancing relationships or the minimum air changes required by the table.

<sup>3</sup>To satisfy exhaust needs, replacement air from the outside is necessary. Table 7.2 does not attempt to describe specific amounts of outside air to be supplied to individual spaces except for certain areas such as those listed. Distribution of the outside air, added to the system to balance required exhaust, shall be as required by good engineering practice.

Minimum outside air quantities shall remain constant while the system is in operation. In variable volume systems, the minimum outside air setting on the air-handling unit shall be calculated using the ASHRAE 62 method.

<sup>4</sup>Number of air changes may be reduced when the room is unoccupied if provisions are made to ensure that the number of air changes indicated is reestablished any time the space is being utilized. Adjustments shall include provisions so that the direction of air movement shall remain the same when the number of air changes is reduced. Areas not indicated as having continuous directional control may have ventilation systems shut down when space is unoccupied and ventilation is not otherwise needed, if the maximum infiltration or exfiltration permitted in Note 2 is not exceeded and if adjacent pressure balancing relationships are not compromised. Air quantity calculations must account for filter loading such that the indicated air change rates are provided up until the time of filter change-out. The minimum total air change requirements for Table 7.2 shall be based on the supply air quantity in positive pressure rooms, and the exhaust air quantity in negative pressure rooms.

<sup>5</sup>Air change requirements indicated are minimum values. Higher values should be used when required to maintain indicated room conditions (temperature and humidity), based on the cooling load of the space (lights, equipment, people, exterior walls and windows, etc.).

<sup>6</sup>Air from areas with contamination and/or odor problems shall be exhausted to the outside and not recirculated to other areas. Note that individual circumstances may require special consideration for air exhaust to the outside, e.g., in intensive care units in which patients with pulmonary infection are treated, and rooms for burn patients.

\*<sup>7</sup>Recirculating room HVAC units refers to those local units that are used primarily for heating and cooling of air, and not disinfection of air. Because of cleaning difficulty and potential for buildup of contamination, recirculating room units shall not be used in areas marked "No." However, for airborne infection control, air may be recirculated within individual isolation rooms if HEPA filters are used. Isolation and intensive care unit rooms may be ventilated by reheat induction units in which only the primary air supplied from a central system passes through the reheat unit. Gravity-type heating or cooling units such as radiators or convectors shall not be used in operating rooms and other special care areas. See Appendix A for a description of recirculation units to be used in isolation rooms.

<sup>8</sup>The ranges listed are the minimum and maximum limits where control is specifically needed. The maximum and minimum limits are not intended to be independent of a space's associated temperature. The humidity is expected to be at the higher end of the range when the temperature is also at the higher end, and vice versa.

<sup>9</sup>Where temperature ranges are indicated, the systems shall be capable of maintaining the rooms at any point within the range during normal operation. A single figure indicates a heating or cooling capacity of at least the indicated temperature. This is usually applicable when patients may be undressed and require a warmer environment. Nothing in these guidelines shall be construed as precluding the use of temperatures lower than those noted when the patients' comfort and medical conditions make lower temperatures desirable. Unoccupied areas such as storage rooms shall have temperatures appropriate for the function intended.

<sup>10</sup>National Institute for Occupational Safety and Health (NIOSH) Criteria Documents regarding Occupational Exposure to Waste Anesthetic Gases and Vapors, and Control of Occupational Exposure to Nitrous Oxide indicate a need for both local exhaust (scavenging) systems and general ventilation of the areas in which the respective gases are utilized.

\*<sup>11</sup>Differential pressure shall be a minimum of 0.01" water gauge (2.5 Pa). If alarms are installed, allowances shall be made to prevent nuisance alarms of monitoring devices.

<sup>12</sup>Some surgeons may require room temperatures that are outside of the indicated range. All operating room design conditions shall be developed in consultation with surgeons, anesthesiologists, and nursing staff. See Figure 7.1 for a graphic representation of the indicated changes on a psychrometric chart. Shaded area is acceptable range.

<sup>13</sup>Total air changes per room for patient rooms, intermediate care, labor/delivery/recovery rooms, and labor/delivery/recovery/postpartum rooms may be reduced to 4 when supplemental heating and/or cooling systems (radiant heating and cooling, baseboard heating, etc.) are used.

<sup>14</sup>The term *trauma room* as used here is the operating room space in the emergency department or other trauma reception area that is used for emergency surgery. The first aid room and/or "emergency room" used for initial treatment of accident victims may be ventilated as noted for the "treatment room." Treatment rooms used for Bronchoscopy shall be treated as Bronchoscopy rooms. Treatment rooms used for cryosurgery procedures with nitrous oxide shall contain provisions for exhausting waste gases.

<sup>15</sup>This line item refers to the actual endoscopic procedure room, with the exception of rooms used for the specific endoscopic procedure of bronchoscopy. Any adjacent area utilized for cleaning of endoscopic equipment shall be maintained at a negative pressure with respect to the gastrointestinal endoscopy room and surrounding areas.

<sup>16</sup>In a ventilation system that recirculates air, HEPA filters can be used in lieu of exhausting the air from these spaces to the outside. In this application, the return air shall be passed through the HEPA filters before it is introduced into any other spaces.

<sup>17</sup>If it is not practical to exhaust the air from the airborne infection isolation room to the outside, the air may be returned through HEPA filters to the air-handling system exclusively serving the isolation room.

<sup>16</sup>Total air changes per room for patient rooms, labor/delivery/recovery rooms, and labor/delivery/recovery/postpartum rooms may be reduced to 4 when supplemental heating and/or cooling systems (radiant heating and cooling, baseboard heating, etc.) are used.

<sup>17</sup>The protective environment airflow design specifications protect the patient from common environmental airborne infectious microbes (i.e., Aspergillus spores). These special ventilation areas shall be designed to provide directed airflow from the cleanest patient care area to less clean areas. These rooms shall be protected with HEPA filters at 99.97 percent efficiency for a 0.3 µm sized particle in the supply airstream. These interrupting filters protect patient rooms from maintenance-derived release of environmental microbes from the ventilation system components. Recirculation HEPA filters can be used to increase the equivalent room air exchanges. Constant volume airflow is required for consistent ventilation for the protected environment. If the facility determines that airborne infection isolation is necessary for protective environment patients, an anteroom should be provided. Rooms with reversible airflow provisions for the purpose of switching between protective environment and airborne infection isolation functions are not acceptable.

<sup>18</sup>The infectious disease isolation room described in these guidelines is to be used for isolating the airborne spread of infectious diseases, such as measles, varicella, or tuberculosis. The design of airborne infection isolation (AII) rooms should include the provision for normal patient care during periods not requiring isolation precautions. Supplemental recirculating devices may be used in the patient room, to increase the equivalent room air exchanges; however, such recirculating devices do not provide the outside air requirements. Air may be recirculated within individual isolation rooms if HEPA filters are used. Rooms with reversible airflow provisions for the purpose of switching between protective environment and AII functions are not acceptable.

<sup>18</sup>When required, appropriate hoods and exhaust devices for the removal of noxious gases or chemical vapors shall be provided (see Sections 7.31.D14 and 7.31.D15 and NFPA 99).

<sup>20</sup>Food preparation centers shall have ventilation systems whose air supply mechanisms are interfaced appropriately with exhaust hood controls or relief vents so that exfiltration or infiltration to or from exit corridors does not compromise the exit corridor restrictions of NFPA 90A, the pressure requirements of NFPA 96, or the maximum defined in the table. The number of air changes may be reduced or varied to any extent required for odor control when the space is not in use. See Section 7.31.D1.p.

<sup>19</sup>The air movement relationships for laboratories apply between laboratory and adjacent non-laboratory spaces. Reference AIA and BMBL Guidelines.

<sup>A7</sup>Recirculating devices with HEPA filters may have potential uses in existing facilities as interim, supplemental environmental controls to meet requirements for the

control of airborne infectious agents. Limitations in design must be recognized. The design of either portable or fixed systems should prevent stagnation and short circuiting of airflow. The supply and exhaust locations should direct clean air to areas where health care workers are likely to work, across the infectious source, and then to the exhaust, so that the health care worker is not in position between the infectious source and the exhaust location. The design of such systems should also allow for easy access for scheduled preventative maintenance and cleaning.

<sup>A11</sup>The verification of airflow direction can include a simple visual method such as smoke trail, ball-in-tube, or flutterstrip. These devices will require a minimum differential air pressure to indicate airflow direction.

<sup>A15</sup>The gastrointestinal endoscopy room functions as a minor procedure room, and a positive pressure in the patient procedure room reduces the infiltration of contaminants from the corridor and adjacent areas. The space requiring negative pressure (to control odors due to cleaning agents) is actually the equipment cleaning area associated with the endoscopy room. Procedure rooms used for bronchoscopy are an exception, requiring negative pressure in the patient area. (See Table 7.2 Bronchoscopy.)

### Psychrometric Chart

