How ASHRAE 170 is Applied to Healthcare Operations

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About Me

- Currently the Healthcare Life Safety Specialist at Barnes Jewish Hospital

- My background includes:
  - B.S. in Emergency Management with minors in Biology & Public Health
  - Safety & Risk Management at St. Louis Zoo
  - Emergency Preparedness at Barnes Jewish Hospital
  - Environmental Safety & Emergency Preparedness for SSM Health

Goal of the Presentation

- Provide an overview of ASHRAE 170 – 2008
- Discuss importance of understanding room type and function in order to understand how to best manage ventilation safety
- Explain basic requirements and parameters of the ventilation code
- Give examples of how building design code is working to keep up with infectious disease and public health concerns

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What is ASHRAE 170

- ASHRAE 170 is the Ventilation Code for Healthcare Facilities

- For deemed organizations, CMS requires compliance with the 2008 edition via NFPA 99 – 2011 edition (9.3.1.1)
  - Other organizations may be utilizing newer editions based on the edition of FGI used at time of construction or local/state building codes

- Other codes at play:
  - NFPA 99 is the Healthcare Facilities Code governing most major utility systems for healthcare facilities
  - FGI is the Facilities Guideline Institute Guidelines which provides design structure for new healthcare construction

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How we use ASHRAE 170

- Determine the type of room we need to ventilate
  - What function is occurring within?
  - What type of care is going to be provided within?
  - What type of person is going to be cared for within?
  - What type of supplies might be stored within?
- Match the type of room we need to ventilate to Table 7.1

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ASHRAE's Rosetta Stone

- Table 7.1 will answer 99% of your questions

- Translates from function to ventilation design standards by room type across almost 75 different types of rooms

  - Air exchanges
  - Temperature
  - Humidity
  - Pressure Relationship
  - Etc.

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What are the parameters described?

- Air exchanges: The process of replacing inside air with outside air
- Temperature: The setpoint range of degrees on the thermostat day to day
- Humidity: The amount of moisture in the air
- Pressure: The relationship in the direction of air travel from where you are standing created by changing the supply or return air in the room

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Design Not Necessarily Operations

- ASHRAE tells system designers and architects the parameters they must be able to consistently meet

- It only accounts for the HVAC system, not other factors
  - EX: Clinical needs of the patient, Surgeon/Staff preference or necessity

- It does not tell us the defining point of safe vs not safe
  - EX: At what point does an excursion threaten safety?

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TABLE 7-1 Design Parameters

Function of Space	Pressure Relationship to Adjacent Areas (n)	Minimum Outdoor ach	Minimum Total ach	All Room Air Exhausted Directly to Outdoors (j)	Air Recirculated by Means of Room Units (a)	RH (k), %	Design Temperature (l), °F/°C
SURGERY AND CRITICAL CARE							
Classes B and C operating rooms, (m), (n), (o)	Positive	4	20	N/R	No	30–60	68–75/20–24
Operating/surgical cystoscopic rooms, (m), (n) (o)	Positive	4	20	N/R	No	30–60	68–75/20–24
Delivery room (Caesarean) (m), (n), (o)	Positive	4	20	N/R	No	30–60	68–75/20–24
Substerile service area	N/R	2	6	N/R	No	N/R	N/R
Recovery room	N/R	2	6	N/R	No	30–60	70–75/21–24
Critical and intensive care	Positive	2	6	N/R	No	30–60	70–75/21–24
Wound intensive care (burn unit)	Positive	2	6	N/R	No	40–60	70–75/21–24
Newborn intensive care	Positive	2	6	N/R	No	30–60	70–75/21–24
Treatment room (p)	N/R	2	6	N/R	N/R	30–60	70–75/21–24
Trauma room (crisis or shock) (c)	Positive	3	15	N/R	No	30–60	70–75/21–24
Medical/anesthesia gas storage (r)	Negative	N/R	8	Yes	N/R	N/R	N/R
Laser eye room	Positive	3	15	N/R	No	30–60	70–75/21–24
ER waiting rooms (q)	Negative	2	12	Yes	N/R	max 65	70–75/21–24
Triage	Negative	2	12	Yes	N/R	max 60	70–75/21–24
ER decontamination	Negative	2	12	Yes	No	N/R	N/R
Radiology waiting rooms (q)	Negative	2	12	Yes	N/R	max 60	70–75/21–24
Class A Operating/Procedure room (o), (d)	Positive	3	15	N/R	No	30–60	70–75/21–24
INPATIENT NURSING							
Patient room (s)	N/R	2	6	N/R	N/R	max 60	70–75/21–24
Toilet room	Negative	N/R	10	Yes	No	N/R	N/R
Newborn nursery suite	N/R	2	6	N/R	No	30–60	72–78/22–26
Protective environment room (f), (n), (t)	Positive	2	12	N/R	No	max 60	70–75/21–24
AII room (e), (n), (u)	Negative	2	12	Yes	No	max 60	70–75/21–24
AII isolation anteroom (t) (u)	N/R	N/R	10	Yes	No	N/R	N/R
Labor/delivery/recovery/postpartum (LDRP) (s)	N/R	2	6	N/R	N/R	max 60	70–75/21–24
Labor/delivery/recovery (LDR) (s)	N/R	2	6	N/R	N/R	max 60	70–75/21–24

Note: N/R = no requirement

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Corridor	N/R	N/R	2	N/R	N/R	N/R	N/R
SKILLED NURSING FACILITY							
Resident room	N/R	2	2	N/R	N/R	N/R	70–75/21–24
Resident gathering/activity/dining	N/R	4	4	N/R	N/R	N/R	70–75/21–24
Physical therapy	Negative	2	6	N/R	N/R	N/R	70–75/21–24
Occupational therapy	N/R	2	6	N/R	N/R	N/R	70–75/21–24
Bathing room	Negative	N/R	10	Yes	N/R	N/R	70–75/21–24
RADIOLOGY (v)							
X-ray (diagnostic and treatment)	N/R	2	6	N/R	N/R	max 60	72–78/22–26
X-ray (surgery/critical care and catheterization)	Positive	3	15	N/R	No	max 60	70–75/21–24
Darkroom (g)	Negative	2	10	Yes	No	N/R	N/R
DIAGNOSTIC AND TREATMENT							
Bronchoscopy, sputum collection, and pentamidine administration (n)	Negative	2	12	Yes	No	N/R	68–73/20–23
Laboratory, general (v)	Negative	2	6	N/R	No	N/R	70–75/21–24
Laboratory, bacteriology (v)	Negative	2	6	Yes	No	N/R	70–75/21–24
Laboratory, biochemistry (v)	Negative	2	6	Yes	No	N/R	70–75/21–24
Laboratory, cytology (v)	Negative	2	6	Yes	No	N/R	70–75/21–24
Laboratory, glasswashing	Negative	2	10	Yes	No	N/R	N/R
Laboratory, histology (v)	Negative	2	6	Yes	No	N/R	70–75/21–24
Laboratory, microbiology (v)	Negative	2	6	Yes	No	N/R	70–75/21–24
Laboratory, nuclear medicine (v)	Negative	2	6	Yes	No	N/R	70–75/21–24
Laboratory, pathology (v)	Negative	2	6	Yes	No	N/R	70–75/21–24
Laboratory, serology (v)	Negative	2	6	Yes	No	N/R	70–75/21–24
Laboratory, sterilizing	Negative	2	10	Yes	No	N/R	70–75/21–24
Laboratory, media transfer (v)	Positive	2	4	N/R	No	N/R	70–75/21–24
Autopsy room (n)	Negative	2	12	Yes	No	N/R	68–75/20–24
Nonrefrigerated body-holding room (h)	Negative	N/R	10	Yes	No	N/R	70–75/21–24
Pharmacy (b)	Positive	2	4	N/R	N/R	N/R	N/R

Note: N/R = no requirement

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Examination room	N/R	2	6	N/R	N/R	max 60	70–75/21–24
Medication room	Positive	2	4	N/R	N/R	max 60	70–75/21–24
Endoscopy	Positive	2	15	N/R	No	30-60	68–73/20–23
Endoscope cleaning	Negative	2	10	Yes	No	N/R	N/R
Treatment room	N/R	2	6	N/R	N/R	max 60	70–75/21–24
Hydrotherapy	Negative	2	6	N/R	N/R	N/R	72–80/22–27
Physical therapy	Negative	2	6	N/R	N/R	Max 65	72–80/22–27
STERILIZING							
Sterilizer equipment room	Negative	N/R	10	Yes	No	N/R	N/R
CENTRAL MEDICAL AND SURGICAL SUPPLY							
Soiled or decontamination room	Negative	2	6	Yes	No	N/R	72–78/22–26
Clean workroom	Positive	2	4	N/R	No	max 60	72–78/22–26
Sterile storage	Positive	2	4	N/R	N/R	max 60	72–78/22–26
SERVICE							
Food preparation center (i)	N/R	2	10	N/R	No	N/R	72–78/22–26
Warewashing	Negative	N/R	10	Yes	No	N/R	N/R
Dietary storage	N/R	N/R	2	N/R	No	N/R	72–78/22–26
Laundry, general	Negative	2	10	Yes	No	N/R	N/R
Soiled linen sorting and storage	Negative	N/R	10	Yes	No	N/R	N/R
Clean linen storage	Positive	N/R	2	N/R	N/R	N/R	72–78/22–26
Linen and trash chute room	Negative	N/R	10	Yes	No	N/R	N/R
Bedpan room	Negative	N/R	10	Yes	No	N/R	N/R
Bathroom	Negative	N/R	10	Yes	No	N/R	72–78/22–26
Janitor's closet	Negative	N/R	10	Yes	No	N/R	N/R
SUPPORT SPACE							
Soiled workroom or soiled holding	Negative	2	10	Yes	No	N/R	N/R
Clean workroom or clean holding	Positive	2	4	N/R	N/R	N/R	N/R
Hazardous material storage	Negative	2	10	Yes	No	N/R	N/R

Note: N/R = no requirement

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Operating Room vs Procedure Room

- Essentially any surgical intervention or care permitted in OR
  - Ingrown toenail removal
  - Heart & lung Transplant
- OR requires restricted environment
  - Ex: “Red Line”
- Procedure Room can be outside surgical suite

operating room (OR)*: a room in the surgical suite that meets the requirements of a restricted area and is designated and equipped for performing surgical or other invasive procedures. An aseptic field is required for all procedures performed in an OR. Any form of anesthesia may be administered in an OR if proper anesthesia gas administration devices are present and waste anesthesia gas disposal systems are provided.

[. . .]

procedure room*: a room designated for the performance of procedures that do not meet the definition of “invasive procedure” and may be performed outside the restricted area of a surgical suite and may require the use of sterile instruments or supplies. Local anesthesia and minimal and moderate sedation may be administered in a procedure room, as long as special ventilation or waste anesthesia gas disposal systems are not required for anesthetic agents used in these rooms.

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Different Surgery Different Class

- Determine the level of patient sedation
- Understand “invasiveness” of procedure
  - Including potential complications
- Some procedures have their own designated room types
  - Ex: Bronchoscopy, C-section, etc.

classification of surgeries:

Class A surgery: provides minor surgical procedures performed under topical, local, or regional anesthesia without preoperative sedation. Excluded are intravenous, spinal, and epidural procedures, which are Class B or C surgeries.

Class B surgery: provides minor or major surgical procedures performed in conjunction with oral, parenteral, or intravenous sedation or performed with the patient under analgesic or dissociative drugs.

Class C surgery: provides major surgical procedures that require general or regional block anesthesia and/or support of vital bodily functions.

For more information on this method of classifying surgeries, see ACS (2000) in Informative Annex B: Bibliography.

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OR Design Features

- Code provides guidance on where supply and return vents should be located
- Code requires diffusers to be made such that they can be internally cleaned
- Radiant heat devices must be smooth panels

7.4 Surgery Rooms

7.4.1 Class B and C Operating Rooms. Operating rooms shall be maintained at a positive pressure with respect to all adjoining spaces at all times. A pressure differential shall be maintained at a value of at least +0.01 in. wc (2.5 Pa). Operating rooms shall be provided with primary supply diffusers that are designed as follows:

a. The airflow shall be unidirectional, downwards, and the *average velocity* of the diffusers shall be 25 to 35 cfm/ft^2 (127 L/s/m^2 to 178 L/s/m^2). The diffusers shall be concentrated to provide an airflow pattern over the patient and surgical team. (see Memarzadeh [2002] and Memarzadeh [2004] in Informative Annex B: Bibliography.)

b. The area of the primary supply diffuser array shall extend a minimum of 12 in. (305 mm) beyond the footprint of the surgical table on each side. No more than 30% of the primary supply diffuser array area shall be used for non-diffuser uses such as lights, gas columns, etc. Additional supply diffusers may be required to provide additional ventilation to the operating room to achieve the environmental requirements of Table 7-1 relating to temperature, humidity, etc.

The room shall be provided with at least two low sidewall return or exhaust grilles spaced at opposite corners or as far apart as possible, with the bottom of these grilles installed approximately 8 in. (203 mm) above the floor.

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Imaging Procedure Rooms

- IVR Rooms most common application
- Doesn't define the imaging techniques used
- Other departments could include:
  - Cath Labs
  - Interventional Pulmonology

invasive imaging procedure room: a room in which radiographic imaging is used and in which instruments or devices are inserted into patients through the skin or body orifice under sterile conditions for diagnosis and/or treatment.

7.4.3 Imaging Procedure Rooms. If invasive procedures occur in this type of room, ventilation shall be provided in accordance with the ventilation requirements for Class A surgery. If anesthetic gases are administered, ventilation shall be provided in accordance with the ventilation requirements for Class B or C surgery.

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Invasive Procedures

- FGI defines invasive procedure as
  - “A procedure that is performed in an aseptic surgical field and penetrates the protective surfaces of a patient’s body
    - (e.g., subcutaneous tissue, mucous membranes, cornea).”

  - “May fall into one or more of the following categories:
    - Requires entry into or opening of a sterile body cavity
      - (i.e., cranium, chest, abdomen, pelvis, joint spaces)
    - Involves insertion of an indwelling foreign body
    - Includes excision and grafting of burns that cover more than 20 percent of total body area
    - Does not begin as an open procedure but has a recognized measurable risk of requiring conversion to an open procedure”

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What is an AII Room?

- A negative pressure room intended for the isolation of patients capable of spreading airborne contaminants
- Table 7.1 requires:
  - 2 outdoor ach & 12 total ach
  - All air exhausted directly outdoors
  - Maximum 60% humidity
  - 70-75 degrees
- Must be on emergency power

airborne infection isolation (AII): the isolation of patients infected with organisms spread by airborne droplet nuclei less than 5 µm in diameter (see CDC [2003] in Informative Annex B: Bibliography). For the purposes of this standard, the abbreviation "AII" refers to the room that provides isolation.

airborne infection isolation room: a room that is designed according to the requirements of this standard and that is intended to provide *airborne infection isolation*.



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AII Room Requirements

- Table 6.1 requires 2 filter banks, one with a MERV rating of 7 and the second of MERV 14

- Visual means at the room to monitor and confirm pressure
  - Ex: Lamiflow

- Exhaust should be directly above the patient

7.2 Additional Room Specific Requirements

7.2.1 Airborne Infection Isolation (AII) Rooms. Ventilation for AII rooms shall meet the following requirements whenever an infectious patient occupies the room:

a. Each AII room shall comply with requirements of Tables 6-1, 6-2, and 7-1. AII rooms shall have a permanently installed device and/or mechanism to constantly monitor the differential air pressure between the room and adjacent spaces of the room when occupied by patients with an airborne infectious disease. A local visual means shall be provided to indicate whenever negative differential pressure is not maintained.

b. All air from the AII room shall be exhausted directly to the outdoors.

Exception: AII rooms that are retrofitted from standard patient rooms from which it is impractical to exhaust directly outdoors may be ventilated with recirculated air from the room's exhaust, provided that the air first passes through a HEPA (MERV 17) filter.

c. All exhaust air from the AII rooms, associated anterooms, and associated toilet rooms shall be discharged directly to the outdoors without mixing with exhaust air from any other non-AII room or exhaust system.

d. Exhaust air grilles or registers in the patient room shall be located directly above the patient bed on the ceiling or on the wall near the head of the bed unless it can be demonstrated that such a location is not practical.

e. The room envelope shall be sealed to limit leakage air flow at 0.01 in. wc (2.5 Pa) differential pressure across the envelope.

f. Differential pressure between AII rooms and adjacent spaces that have a different function shall be a minimum of –0.01 in. wc (–2.5 Pa).

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Protective Environment Rooms

- A positive pressure room intended for the isolation of patients needing protection from airborne contaminants

- 6.1.1 requires continuation of ventilation & pressure requirements on e-power.

7.2.2 Protective Environment (PE) Rooms. Ventilation for PE rooms shall meet the following requirements:

a. The room envelope shall be sealed to limit leakage air flow at 0.01 in. wc (2.5 Pa) differential pressure across the envelope.

b. Each PE room shall comply with the requirements of Tables 6-1, 6-2, and 7-1. PE rooms shall have a permanently installed device and/or mechanism to constantly monitor the differential air pressure between the room and adjacent spaces of the room when occupied by patients requiring a protective environment. A local visual means shall be provided to indicate whenever positive differential pressure is not maintained.

c. Air distribution patterns within the protective environment room shall conform to the following:
   - Supply air diffusers shall be above the patient bed, unless it can be demonstrated that such a location is not practical. Diffuser design shall limit air velocity at the patient bed to reduce patient discomfort. (See *ANSI/ASHRAE Standard 55-2004, Thermal Environmental Conditions for Human Occupancy,* in Informative Annex B: Bibliography.)
   - Return/exhaust grilles or registers shall be located near the patient room door.

d. Differential pressure between any dissimilar adjacent spaces shall be a minimum of +0.01 in. wc (+2.5 Pa).

e. PE rooms retrofitted from standard patient rooms may be ventilated with recirculated air, provided that air first passes through a HEPA filter and the room complies with parts "a" through "d" of this section.

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Protective Environment Rooms

- Table 6.1 requires 2 filter banks, one with a MERV rating of 7 and the second of MERV 17

- Visual means at the room to monitor and confirm pressure
  - Ex: Lamiflow

- Supply should be directly above the patient with exhaust/return by the door



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What is a Central Sterile Supply Room?

- Includes OR sterile core & clean side SPD
- Up to your organization to interpret
  - Does “Central” = Bulk?
- CMS Infection Control Hierarchy requires only that sterility is not compromised



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What is Clean vs Dirty vs Neutral?

- Clean items are ready for patient use
  - Ex: Dressings
- Soiled Items need cleaning before re-use or disposal
  - Ex: Used Linen
- Neutral is not a code term but can be a helpful way to think about certain items from a regulatory perspective
  - Ex: WOWs

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ASHRAE & Infectious Disease

- AII Rooms account for isolation of infectious patients

- Additional rooms account for isolation precautions
  - Emergency Department Waiting Rooms
  - Triage Rooms/Areas
  - ED Decontamination
  - Radiology Waiting Rooms

- Exception: Standard patient rooms are allowed to be retrofitted as AII without outdoor exhaust if we can exhaust the air through HEPA filters

Summary

- ASHRAE 170 gives you basic tools to make decisions but is most effective with cross functional input
- New technology, new standards of care, new pathogens demand new considerations of our infrastructure
- Regulations can be hard, but safety doesn’t have to be

Questions?

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