AIRING IT OUT
VENTILATION COMPLIANCE

MSL
DEDICATED HEALTHCARE PARTNERS

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WHY IS VENTILATION COMPLIANCE AN ISSUE?

Top Joint Commission HAP Findings in 2015

#1. 62% - EC.02.06.01 The hospital establishes and maintains a safe, functional environment. *(58% CAH)*

- **(EP 13)** The hospital maintains ventilation, temperature, and humidity levels suitable for the care, treatment, and services provided.

WHY IS VENTILATION COMPLIANCE AN ISSUE?

Top Joint Commission HAP Findings in 2015

#2. 59% - IC.02.02.01 The hospital reduces the risk of infections associated with medical equipment, devices, and supplies. *(60% CAH)*

- **(EP 4)** The hospital implements infection prevention and control activities when storing medical equipment, devices and supplies.

WHY IS VENTILATION COMPLIANCE AN ISSUE?

Top Joint Commission HAP Findings in 2015

#3. 58% - EC.02.05.01 The hospital manages risks associated with its utility systems. *(67% CAH)*

- (EP 15) In areas designed to control airborne contaminants (such as biological agents, gases, fumes, dust), the ventilation system provides appropriate pressure relationships, air-exchange rates and filtration efficiencies.

TOP 3 TJC HAP & CAH FINDINGS – 2015

- Incorrect pressure differential in just one (1) space will cause a "Condition Level Deficiency"
- Building tour is now conducted on 1st day of survey to give organizations a chance to correct pressure differential problems.
- Surveyor allowed to reduce CLD finding to a "Standard Level Deficiency" (SLD) finding.

SO WHAT IS THE REAL ISSUE?

- Hospital Acquired Infections
  - Over 99,000 deaths per year
  - Cost for treating nosocomial infections is approximately $5 billion a year
  - **Estimated that 5% are construction, renovation, maintenance oriented**

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THE ISSUE

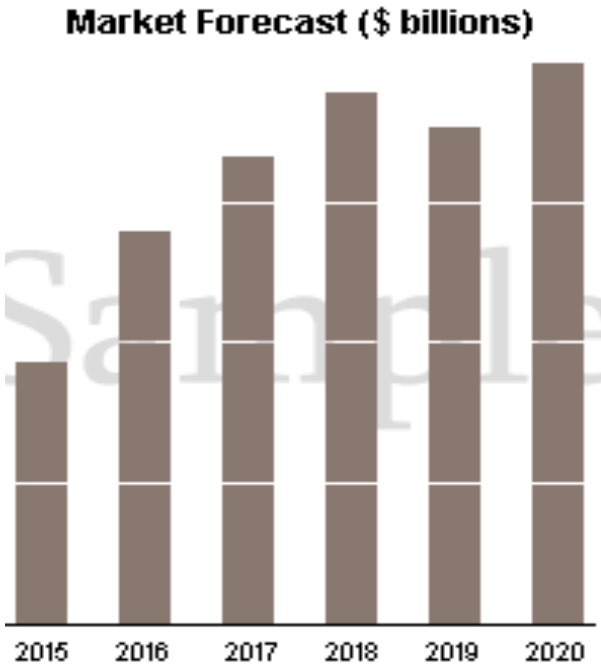
By JESSICA FIRGER CBS NEWS *March 26, 2014, 5:39 PM*

In U.S., hospital-acquired infections run rampant

Each year, in the United States, thousands of patients seek medical care at both inpatient and outpatient facilities, but emerge from routine, urgent or surgical care with an additional -- and sometime untreatable -- life-threatening illness. On an average day, 1 in 25 patients has at least one infection contracted from a hospital visit, according to the Centers for Disease Control and Prevention.

HOW DOES IT AFFECT US?

Market forecasts show the long term industry outlook & Commercial & Institutional Building Construction future growth trends. The following five-year forecast utilizes advanced econometric techniques that project both short-term and long-term market growth outlook. The industry outlook can be used to set a strategy applicable to economic realities.



ARE YOU RESPONSIBLE FOR CONSTRUCTION?

"Let me introduce you to our low-bid contractor"

ASPERGILLOSIS

- The CDC now says of aspergillosis: "Nosocomial infection of aspergillosis may be associated with dust exposure during building renovation or construction."
- The death rate for immune-suppressed patients who become colonized with aspergillus or develop invasive aspergillosis, is between 40% and 90%.

IF WE are RESPONSIBLE for 5% of HAI DEATHS:

- According to the AHA, there are 902,202 staffed beds in the U.S.
- With 100,000 HAI deaths per year there are 0.11 deaths per staffed bed each year
- A 200 bed hospital would have 22 deaths of which at least 1 (5%) was due to construction or maintenance

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What if that 1 patient was your mother?

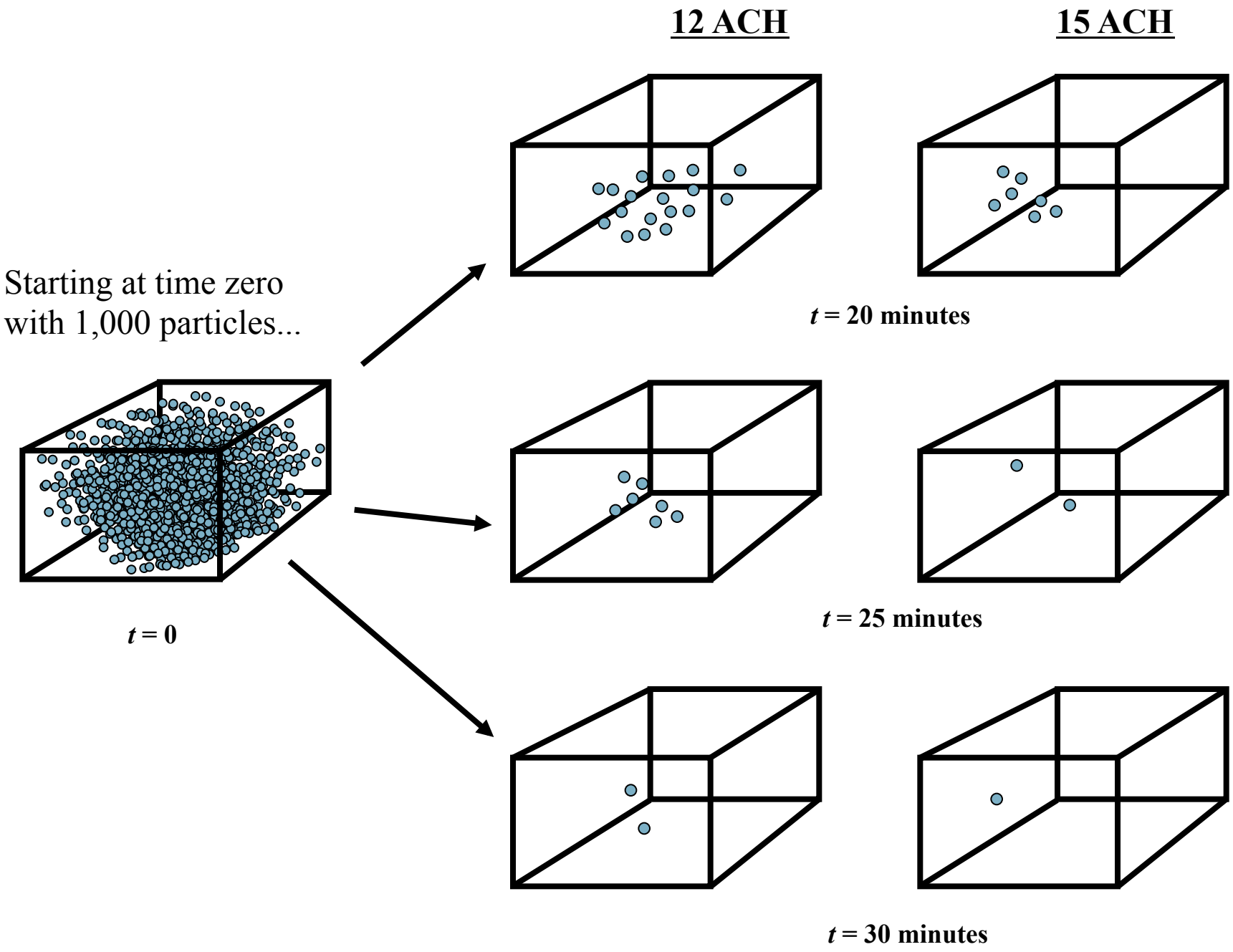
Or your child?

SO LETS TALK ABOUT VENTILATION

- Supply Air – Conditioned outside air blended with return and filtered before discharge in occupied space.
- Exhaust System - Removes air from occupied space and discharged from building
- Air Changes per Hour (ACH) - Number of times/hour room volume of air is replaced by “clean” supply air
- Clean/Sterile rooms based on total supply air for ACH
- Dirty rooms based on total exhaust air for ACH

VENTILATION RATE (Air Change Rates)

- 1 ACH (air change) is equivalent to the cubic feet of air within the room. Therefore, 12 ACH dilutes a room air by turning it over 12 times every hour.
- Although proper ventilation will not eliminate all contaminated droplet nuclei in isolation rooms, it will greatly reduce the statistical risk of transmitting disease in hospitals and essentially eliminate transmission when utilized with correct Infection Control procedures.


12 ACH
15 ACH
Starting at time zero
with 1,000 particles...
t = 20 minutes
t = 25 minutes
t = 0
t = 30 minutes

VENTILATION RATE - Calculating CFM for specific Air Change Rates

- Assume 12 x 15 room with 8 foot ceiling the room volume is 12 x 15 x 8 = 1440 cu. ft.
- 12 ACH would require the following air flow:

  12 x 1440 = 17,280 cu. ft./hr. divided by 60 minutes = 288 CFM
- 15 ACH would require the following air flow:

  15 x 1440 = 21,600 cu. ft./hr. divided by 60 minutes = 360 CFM

VENTILATION RATE – Calculating Air Change Rates (ACH) from CFM

- Same 1440 cu. ft. room
- ACH = CFM x 60 / room volume
- If Supply air CFM is 288:

  ACH = 288 CFM x 60 / 1440 = 12 ACH
- However if Supply air rebalanced to 360 CFM:

  ACH = 360 CFM x 60 / 1440 = 15 ACH
- Is this a positive or negative pressure room?

Ventilation - Wait time upon discharge of Isolation Patient

- It is critical that the patient room remain “isolated” for a fixed period of time upon the discharge of an isolation patient to allow the air exchange rate to “purge” the room. Most organizations require personal protection to be worn by workers entering the room for at least 1-hour after patient discharge.
- Rooms where a patient has been tested and found NOT to be infectious may be immediately utilized without protection.

REGULATION – what rooms to monitor?

Surveyors will ask for:

- Temperature and humidity records
  - Action taken when out of range
- Monitoring of air exchange rates and pressure differentials
- They will check pressure differential with tissue test
- Must have 100 percent correct pressure differentials
- Failure can lead to CMS condition level deficiency

REGULATION – AREAS TO MONITOR

- OR
- C-Section Rooms
- Sterile Processing (dirty, clean, & storage)
- Endoscopy & Scope Cleaning
- Ultrasound Probe Cleaning
- Sub-sterile Storage
- Isolation rooms
- Pharmacy
- Lab
- **All areas listed in FGI Guidelines Table 7-1** (ASHRAE Standard 170)

TJC WILL USE FGI 2010 IN THE ABSENCE OF ANOTHER STANDARD

2010 FGI Guidelines

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

So we are all on the same page…

- If hospital was built in 1990 with 12 ORs which have not received major renovation and we added 8 more ORs in an expansion designed last year. What should my Air Change Rates be for Old and New ORs?
- Old – 1987 AIA Guidelines = 15 ACPH
- New – 2010 FGI Guidelines = 20 ACPH

1987 AIA Guidelines

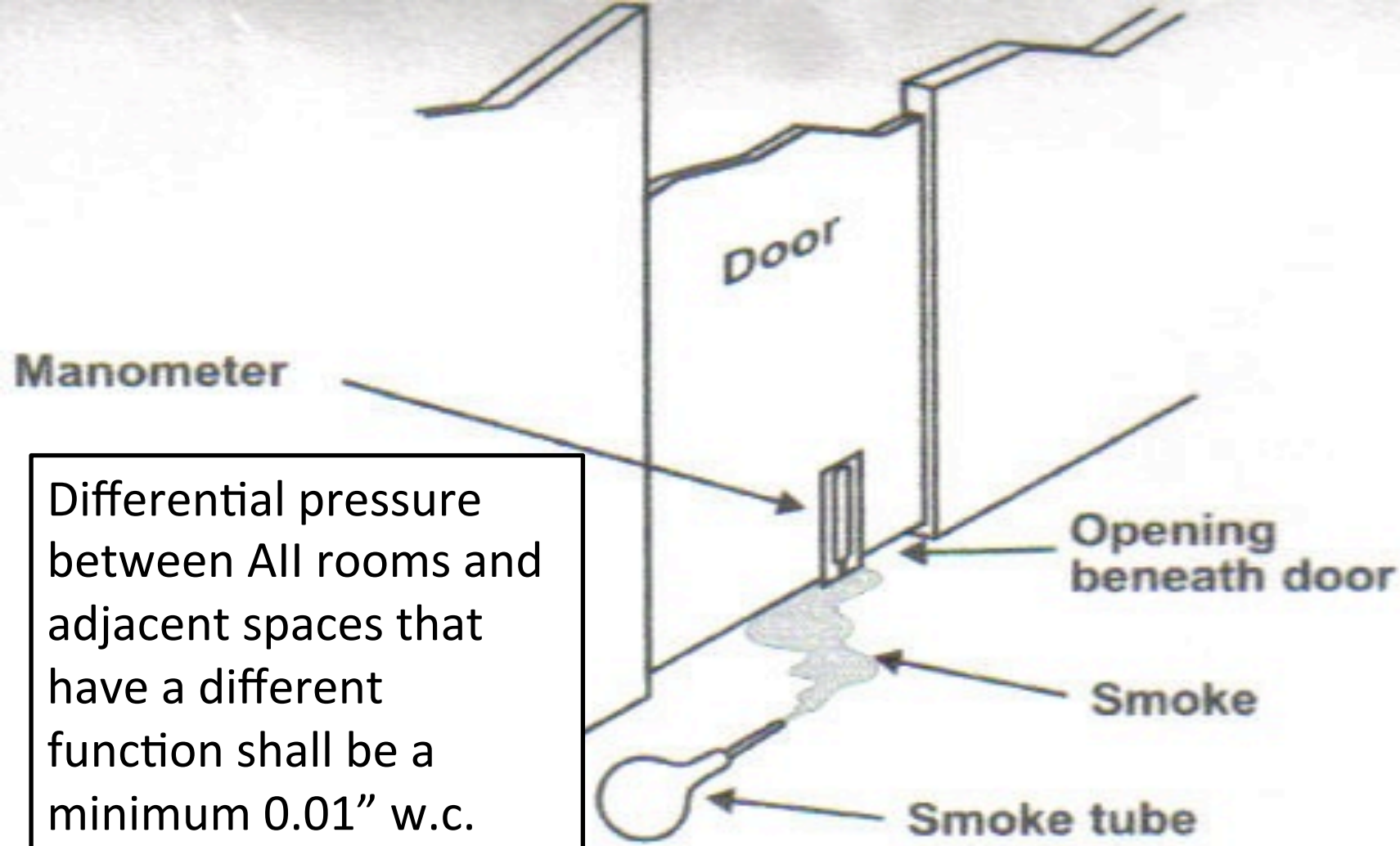
Table 7.2

Ventilation Requirements for Areas Affecting Patient Care in Hospitals and Outpatient Facilities[1]

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

SURVEY PROCESS (per TJC)

- Tissue test: only to be used as a pre-screening tool to evaluate if further investigation needs to occur
  - To perform the flutter test take a tissue and let it hang just off the floor near the bottom edge of a door
  - If the tissue indicates incorrect air flow, stabilize the area by closing doors & windows and re-test
  - If the organization presents a Testing & Balancing report the following questions should be asked
    - when was the balancing done (seasonal issues)
    - are any specific requirements (such as keeping a door closed) needed to achieve satisfactory results



Differential pressure between All rooms and adjacent spaces that have a different function shall be a minimum 0.01” w.c.
FGI 2010 Guidelines

Smoke in = Negative pressure

Smoke out = Positive pressure

SURVEY PROCESS

- EC.02.05.01 EP 15 will generate a CLD (conditional level)
  - If the organization can repair the ***process*** that led to non-compliance, LSCS (Life Safety Code Surveyor) may review
  - Following LSCS review, the LSCS may contact the Central Office to discuss the ***possibility*** of reducing the CLD to SLD (standard level), with no change to the finding
  - Resolution should include the area affected by the equipment identified as non-compliant, not just the identified room/area
    - i.e. ensure zone is balanced
    - Is there an ongoing process to assess

ENGINEERING CONTROLS

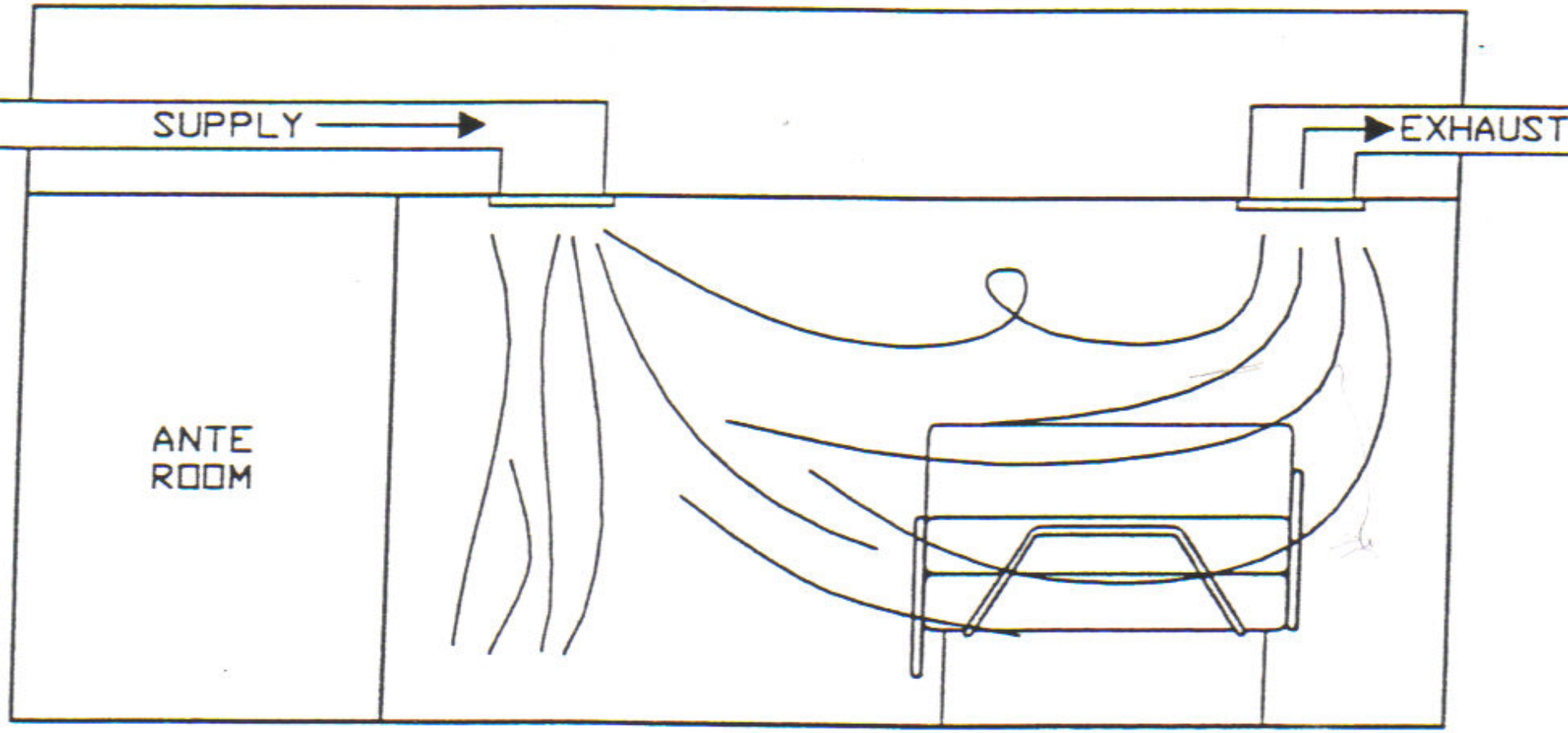
Part of the hierarchy established as a means of determining how to implement feasible and effective control of occupational hazards:

- Elimination
- Substitution
- **Engineering controls**
- Administrative controls
- Personal protective equipment

Engineering controls for Airborne Infectious Isolation (AII) rooms

- Use of negative pressure rooms.
- Use of ventilation rates (minimum 6 air changes per hour (ACH) for existing facilities & 12 ACH for new construction (c. 2001).
- Air from negative pressure rooms exhausted directly to the outside When the recirculation of air from AII rooms is unavoidable, HEPA filters should be installed in the exhaust duct leading to the general ventilation system.

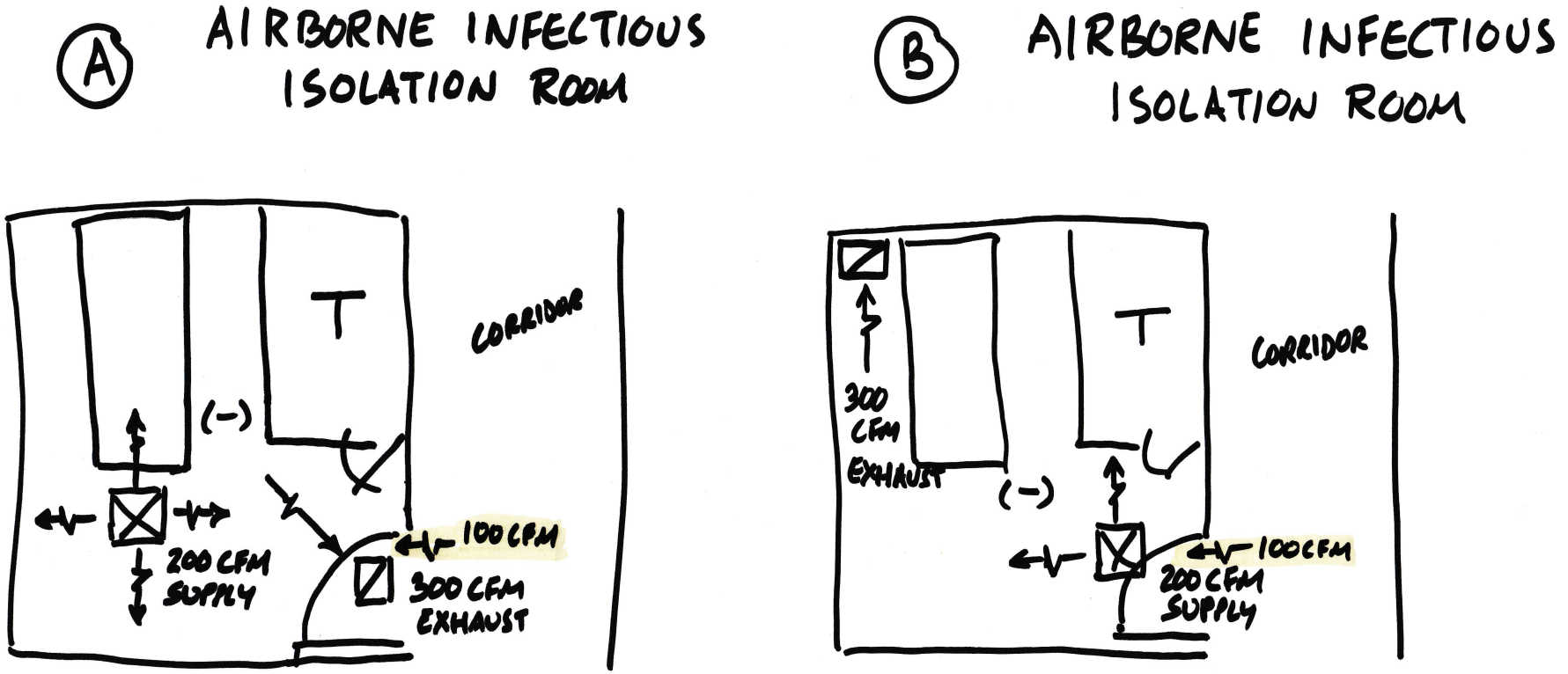
Ventilation - Single Pass Air System



Isolation room exhausting all air to atmosphere

Which Airborne Infectious Isolation Room would you want?

Both are negative pressure by 100 CFM



Health System -

VENTILATION TESTING
Positive Pressure Rooms

Date: _____

Technician: _____

Item #	Room/Area Tested	Design Range		Temp/RH	Test Frequency		Original Design				Results		Annual Test Results				
		Temp. (°F)	RH (%)	Monitored by:	Tissue or Smoke Test	Air Flows	AIA/FGI Edition	ACPH	AIA/FGI 2010 Edition	Room Volume (cu.ft.)	PASS	FAIL	Supply Air total CFM	Return / Exh total CFM	Actual ACPH	Room Pressure	Comments
1	OR Room 1 B1-1	68-75	20-60	OR	D	A	1981	12	20	4907							
2	OR Room 2 B1-1	68-75	20-60	OR	D	A	1981	12	20	4866							
3	OR Room 3 B1-1	68-75	20-60	OR	D	A	1981	12	20	3883							
4	OR Room 4 B1-1	68-75	20-60	OR	D	A	1981	12	20	3880							
5	OR Room 5 B1-1	68-75	20-60	OR	D	A	1981	12	20	3880							
6	OR Room 6 B1-1	68-75	20-60	OR	D	A	1981	12	20	3880							
7	OR Room 7 B1-1	68-75	20-60	OR	D	A	1981	12	20	3120							
8	OR Room 8 B1-1	68-75	20-60	OR	D	A	1981	12	20	4703							
9	OR Room 9 B1-1	68-75	20-60	OR	D	A	1997	15	20	6786							
10	OR Room 10 B1-1	68-75	20-60	OR	D	A	1997	15	20	6786							
11	IR Lab 1 B8-1	70-75	20-60	IR Lab	W	A	1997	12	15	3500							
12	IR Lab 2 B8-1	70-75	20-60	IR Lab	W	A	1997	12	15	3600							
13	Cath Lab 1 RCN-4 (Storage)	70-75	20-60	Cath Lab	W	A	1987	12	15	3990							
14	Cath Lab 2 RCN-4	70-75	20-60	Cath Lab	W	A	1987	12	15	3900							
15	Cath Lab 3 RCN-4	70-75	20-60	Cath Lab	W	A	1992	15	15	4285							
16	Cath Lab 4 RCN-4	70-75	20-60	Cath Lab	W	A	2001	15	15	3849							
17	Cath Lab 5 RCN-4	70-75	20-60	Cath Lab	W	A	2001	15	15	4446							
18	Pharm IV Room B8-3	68	20-60	Pharmacy	M	A	USP797	30	N/R	3460							
19	C-Section 1 RCN-2	70-75	20-60	OB	D	A	1997	15	20	3071							
20	C-Section 2 RCN-2	70-75	20-60	OB	D	A	1997	15	20	3090							
21	Room 620 B1-6	70-75	N/R	N/A	M	A	1992	6	12	1760							
22	Room 621 B1-6	70-75	N/R	N/A	M	A	1992	6	12	1760							
23	Room 622 B1-6	70-75	N/R	N/A	M	A	1992	6	12	1760							
24	Room 623 B1-6	70-75	N/R	N/A	M	A	1992	6	12	1760							
25	Room 624 B1-6	70-75	N/R	N/A	M	A	1992	6	12	1632							
26	Room 625 B1-6	70-75	N/R	N/A	M	A	1992	6	12	1760							
27	Room 626 B1-6	70-75	N/R	N/A	M	A	1992	6	12	1760							
28	Room 627 B1-6	70-75	N/R	N/A	M	A	1992	6	12								
29	OR Core Sterile Storage	68-75	N/R	OR	D	N/A	1981	4	4								
30	OR Store Room 8	68-75	N/R	OR	A	N/A	1981	4	4								
31	TEE/Scope Room	72-78	N/R	OR	A	N/A	1981	4	4								
32	Track Shelving	72-78	N/R	OR	A	N/A	1981	4	4								
33	Endo Scope Storage	72-78	N/R	Endoscopy	A	N/A	1981	4	4								
34	Cath Middle Storage Room	72-78	N/R	N/A	A	N/A	1997	4	4								
35	Cath Inventory Storage	72-78	N/R	N/A	A	N/A	1997	4	4								
36	NICU	70-75	30-60	N/A	A	N/A	1997	6	6								
37	CCU Suite	70-75	30-60	N/A	A	N/A	1997	6	6								
38	ICU	70-75	30-60	N/A	A	N/A	1997	6	6								
39	CS Prep and Pack	75	30-60	CS	D	N/A	2001	4	4								
40	CS Sterile Storage	N/R	Max 70	CS	D	N/A	2001	4	4								

Health System -

VENTILATION TESTING
Positive Pressure Rooms

Date: _____

Technician: _____

Item #	Room/Area Tested	Design Range		Temp/RH	Test Frequency		Original Design				Results		Annual Test Results				
		Temp. (°F)	RH (%)	Monitored by:	Tissue or Smoke Test	Air Flows	AIA/FGI Edition	ACPH	AIA/FGI 2010 Edition	Room Volume (cu.ft.)	PASS	FAIL	Supply Air total CFM	Return / Exh total CFM	Actual ACPH	Room Pressure	Comments
	Clean Utility Rooms	NR	NR	NA	A	NA	Misc.	4	4								
41	Emergency WB-319G	NR	NR	NA	A	NA	Misc.	4	4								
42	Emergency WB-356	NR	NR	NA	A	NA	Misc.	4	4								
43	CT 3 81-100A	NR	NR	NA	A	NA	Misc.	4	4								
44	PACU 81-105F	NR	NR	NA	A	NA	Misc.	4	4								
45	5th fl S 81-538B	NR	NR	NA	A	NA	Misc.	4	4								
46	5th fl S 81-544	NR	NR	NA	A	NA	Misc.	4	4								
47	6th fl S 81-644	NR	NR	NA	A	NA	Misc.	4	4								
48	7th fl S 81-784	NR	NR	NA	A	NA	Misc.	4	4								
49	7th fl S 81-747A	NR	NR	NA	A	NA	Misc.	4	4								
50	8th fl S 81-837	NR	NR	NA	A	NA	Misc.	4	4								
51	8th fl S 81-847	NR	NR	NA	A	NA	Misc.	4	4								
52	Radiology 69-125	NR	NR	NA	A	NA	Misc.	4	4								
53	Radiology 69-119E	NR	NR	NA	A	NA	Misc.	4	4								
54	Hospitality 69-229	NR	NR	NA	A	NA	Misc.	4	4								
55	Neurophys JCM-234	NR	NR	NA	A	NA	Misc.	4	4								
56	Respiratory JCM-317	NR	NR	NA	A	NA	Misc.	4	4								
57	Rad Onc 84-40	NR	NR	NA	A	NA	Misc.	4	4								
58	Hskpg 84-51	NR	NR	NA	A	NA	Misc.	4	4								
59	Endo 84-203B5	NR	NR	NA	A	NA	Misc.	4	4								
60	Hemodialysis 84-210G	NR	NR	NA	A	NA	Misc.	4	4								
61	Bari Clinic 84-443	NR	NR	NA	A	NA	Misc.	4	4								
62	ICU B-418	NR	NR	NA	A	NA	Misc.	4	4								
63	FSC RCN-228J	NR	NR	NA	A	NA	Misc.	4	4								
64	FSC RCN-248C	NR	NR	NA	A	NA	Misc.	4	4								
65	FSC RCN-228F	NR	NR	NA	A	NA	Misc.	4	4								
66	OP Rehab RCN-321C	NR	NR	NA	A	NA	Misc.	4	4								
67	Rehab RCN-358	NR	NR	NA	A	NA	Misc.	4	4								
68	Rehab RCN-373	NR	NR	NA	A	NA	Misc.	4	4								
69	CCU RCN-485	NR	NR	NA	A	NA	Misc.	4	4								
70	Heart 1st RCN-445A	NR	NR	NA	A	NA	Misc.	4	4								
71	PAR RCN-465	NR	NR	NA	A	NA	Misc.	4	4								
72	APU RN-555E	NR	NR	NA	A	NA	Misc.	4	4								
73	CIAS RCN-560D	NR	NR	NA	A	NA	Misc.	4	4								
74	YTU RCN-559B	NR	NR	NA	A	NA	Misc.	4	4								

A Annual
ACPH Air changes per hour
NR = No requirement
NA = Not applicable

Health System

VENTILATION TESTING
Negative Pressure Rooms

Date: _____
Technician: _____

Item #	Room/Area Tested	Test Frequency		Original Design		AIA/FGI 2010 Edition	Room Volume (cu.ft.)	Results		Annual Test Results				Comments
		Tissue or Smoke Test	Air Flows	AIA/FGI Edition	ACPH			PASS	FAIL	Supply Air total CFM	Return / Exh total CFM	Actual ACPH	Room Pressure	
1	Room 823 81-8	M	A	1981	6	12	1856							
2	Room 812 81-8	M	A	1981	6	12	1440							
3	Room 809 81-8	M	A	1981	6	12	1632							
4	Room 712 81-7	M	A	1981	6	12	1440							
5	Room 724 81-7	M	A	1981	6	12	1632							
6	Room 812 81-8	M	A	1981	6	12	1440							
7	Room 510 81-5	M	A	1981	6	12	1870							
8	Room 455 Bridge-4	M	A	1997	12	12	2977							
9	Room 456 Bridge-4	M	A	1997	12	12	2736							
10	Room 459 Bridge-4	M	A	1997	12	12	2856							
11	Room 460 Bridge-4	M	A	1997	12	12	2977							
12	Room 476 RCN-4	M	A	1997	12	12	2255							
13	Room 240 RCN-2	M	A	1997	6	12	1520							
14	Room 241 RCN-2	M	A	1997	6	12	2888							
15	NICU STA-9 RCN-2	M	A	1997	6	12	1280							
16	NICU STA-10 RCN-2	M	A	1997	6	12	1200							
17	Endo-Flouro 1 84-2	A	N/A	1981	6(-)	15(+)	1836							
18	Endo-Flouro 2 84-2	A	N/A	1981	6(-)	15(+)	2142							
19	Endo-Flouro 3 84-2	A	N/A	1981	6(-)	15(+)	2048							
36	Endoscope Cleaning Room 84-2	A	A	1981	10	10	569							
20	ER Exam 8 WB-3	M	A	2001	12	12	1174							
21	ER Exam 9 WB-3	M	A	2001	12	12	1174							
22	ER Exam 10 WB-3	M	A	2001	12	12	1174							
23	ER Exam 11 WB-3	M	A	2001	12	12	1174							
24	Radiation Oncology Mold Room	A	N/A	1992	N/A	N/A								
25	Ultrasound S Cleaning Room 68-1	A	N/A	1997	6	6	788							
26	Ultrasound N Cleaning Room RCN-4	A	N/A	1997	6	6	642							
27	OR Medivator Room	A	N/A	2006	10	10								
28	ER Decontamination Room	M	A	2001	12	12	964							
29	CS Decontamination Room	M	N/A	1981	6	6								
30	Morgue	A	N/A	2001	12	12								
31	Nuclear Med - Spect Rm 1 68-2	SA	SA	1992	N/A	10								
32	Nuclear Med - Spect Rm 2 68-2	SA	SA	1992	N/A	10								
33	Laundry - soiled linen/sorting	A	N/A	1981	N/A	10								
34	Hazardous materials storage	A	N/A	1981	10	10								

Health System

VENTILATION TESTING
Negative Pressure Rooms

Date: _____
Technician: _____

Item #	Room/Area Tested	Test Frequency		Original Design		AIA/FGI 2010 Edition	Room Volume (cu.ft.)	Results		Annual Test Results				Comments
		Tissue or Smoke Test	Air Flows	AIA/FGI Edition	ACPH			PASS	FAIL	Supply Air total CFM	Return / Exh total CFM	Actual ACPH	Room Pressure	
	Soiled Utility Rooms	A	N/A	misc.	6	10								
35	Emergency WB-350	A	N/A	misc.	6	10								
36	Emergency WB-319F	A	N/A	misc.	6	10								
37	CT B1-100L	A	N/A	misc.	6	10								
38	OR B1-105B	A	N/A	misc.	6	10								
39	PACU B1-105C	A	N/A	misc.	6	10								
40	CS B1-316E	A	N/A	misc.	6	10								
41	5th Fl S B1-539C	A	N/A	misc.	6	10								
42	6th Fl S B1-645	A	N/A	misc.	6	10								
43	7th Fl S B1-738	A	N/A	misc.	6	10								
44	8th Fl S B1-845	A	N/A	misc.	6	10								
45	Radiology 69-119H	A	N/A	misc.	6	10								
46	Hospitality 69-228	A	N/A	misc.	6	10								
47	Nuc Med 69-210G	A	N/A	misc.	6	10								
48	Neurophys JCM-232	A	N/A	misc.	6	10								
49	Respiratory JCM-315	A	N/A	misc.	6	10								
50	Laundry SL-23	A	N/A	misc.	6	10								
51	Rad Onc B4-35	A	N/A	misc.	6	10								
52	Hemo B4-210F	A	N/A	misc.	6	10								
53	Bari Clinic B4-439	A	N/A	misc.	6	10								
54	Brain & Spine B-380	A	N/A	misc.	6	10								
55	ICU B-408	A	N/A	misc.	6	10								
56	FBC RCN-248A	A	N/A	misc.	6	10								
57	FBC RCN-228M	A	N/A	misc.	6	10								
58	Rehab RCN-304	A	N/A	misc.	6	10								
59	Rehab RCN-373B	A	N/A	misc.	6	10								
60	CCU RCN-487E	A	N/A	misc.	6	10								
61	Heart Inst. RCN-445B	A	N/A	misc.	6	10								
62	Heart Inst. RCN-462F	A	N/A	misc.	6	10								
63	Heart Inst. RCN-480A	A	N/A	misc.	6	10								
64	PAR RCN-467T	A	N/A	misc.	6	10								
65	APU RCN-555G	A	N/A	misc.	6	10								
66	CIAS RCN-560C	A	N/A	misc.	6	10								
67	YPU RCN-599A	A	N/A	misc.	6	10								

A = Annual | SA = Semi-Annual | M = Monthly | ACPH = Air Changes Per Hour

Airborne Infectious Isolation Patient in Surgical Suites:

- When possible, postpone non-urgent procedures until the patient is determined to be noninfectious.
- When surgery cannot be postponed.. it should be the last case of the day to allow maximum time available for removal of airborne contamination.
- Consider using additional air-cleaning technologies, such as HEPA filtration or UVGI.
- Place a bacterial filter on the patient's endotracheal tube to reduce the risk of contaminating ventilator or anesthesia equipment.
- Health care workers must wear personal protection, including N95 disposable respirator.

SO HOW CRITICAL IS VENTILATION IN SURGERY?

- Air changes are needed to “purge” rooms of airborne infectious agents.
- Air pressure differentials (positive or negative rooms) are needed to “contain” infectious agents.
- Temperature and/or relative humidity control may be necessary for the items (or people) stored or in the room.
- What about air velocity or particle counts?

SURGICAL SITE INFECTIONS

- The CDC reports over 99,000 deaths per year resulting from healthcare associated infections (HAIs).
- According to the U.S. Department of Health and Human Services (HHS), it is estimated that of the more than 290,000 incidences of surgical site infection (SSI) annually, more than 13,000 people die each year due to infections acquired during surgical procedures.

SURGICAL SITE INFECTIONS

- Clinical trials carried out in Britain, Europe, and the US have confirmed that between 80% and 90% of bacterial contaminants found in the wound after surgery come from colony forming units (cfu) present in the air of the operating theatre.
- With respect to bacteria transmitted to the surgical site through the air, squames (or skin scales) are the primary source of transmission

SEMICONDUCTOR INDUSTRY VS HEALTHCARE

- An interesting parallel can be drawn between the control of these airborne contaminants in operating rooms (ORs) and semiconductor manufacturing cleanroom

FIGURE 1 (LEFT) Typical gowning protocol in a Class 10 cleanroom. FIGURE 2 (RIGHT) Typical gowning protocol in a hospital operating room. Exposed skin is obvious and can be contrasted to semiconductor gowning shown in *Figure 1*.

3 BASIC DESIGNS FOR SURGICAL AIR DELIVERY

- Air curtain (AC) - a laminar flow diffuser array over the surgical table with a high velocity slot diffuser at the perimeter of the sterile field
- Multi-diffuser array (MDA) – multiple diffusers that are set into an array in the ceiling
- Single-large diffuser (SLD) – supplies air from a single, large diffuser that concentrates the air delivery in a controlled air field over the surgical table and reduces these turbulent zones.

SURGICAL AIR SUPPLY AND "SQUAMES"

- Particle trace analysis of the MDA design compared to SLD reveals that SLD performs much better in terms of pulling contaminants away from the surgical site.
- It's not likely that doctors, nurses and other OR personnel will wear full coverage clothing to prevent release of squames into the OR as done in the semiconductor industry. Therefore, the role of airflow velocity in maintaining a sterile field becomes even more critical for ORs.

SO WHAT'S NEXT?

- What is missing for ORs is an aerobiological standard conceptually similar to that used in manufacturing cleanrooms.
- Semiconductor manufacturing cleanrooms are generally installed taking maximum advantage of factory fabrication in a controlled environment to reduce on-site contamination, construction timelines, labor, and the coordination of trades

SO WHAT'S NEXT?

- Modular, all inclusive ceiling systems that centralize the design and installation of all services and components, including electrical, lighting, medical gases, boom mounts, duct connections, etc. in optimal locations.
- 1/6 the installation time of typical OR ceiling construction.
- SLD design ensures uniform airflow where airborne contaminants are directed away from OR personnel.
- Operating Rooms required to meet ISO requirements?

Central Sterile Layout - *FGI Guidelines 2010 edition*

- Physically separated soiled and clean work rooms.
  - Soiled Work Room: with work surface, sink, washer/sterilizer decontaminators (not to have direct contact with the OR).
  - Clean assembly /work room: with hand washing station, sufficient workspace and equipment
- Self-closing door or pass through is acceptable between soiled and clean work rooms.
- Storage - may be within the clean assembly/ workroom in a permanently designated space, provisions for humidity, temperature, and ventilation.

Central Sterile Layout - facility issues

Understand:
FGI Guidelines
vs.
AAMI Guidelines

Ventilation Requirements for Functional Areas

Functional Areas	Airflow	Min. # air exchanges/hr AAMI/ANSI ST-79	Min.# air exchanges/hr AIA (2001)	Min. # air exchanges/hr AIA(2010)	All air exhausted directly to the outdoors?
Soiled/ Decontamination	Negative(in)	10	6	6	Yes
Sterilizer equipment access	Negative(in)	10	10	10	Yes
Sterilizer loading/ unloading	Positive (out)	10	---	4	Yes
Restrooms/ Housekeeping	Negative (in)	10	10	10	Yes
Preparation and Packaging	Positive (out)	10 (down-draft type)	4	4	No
Textile pack room	Positive(out)	10 (down-draft type)	---		No
Clean/sterile storage	Positive(out)	4 (down-draft type)	4	4	No

Temperature	**(AAMI Guidelines)**	**AIA(2001)**	**AIA(2010)**
General work areas	68-73 deg. F (20-23 deg. C)	75 deg. F	72-78 deg. F
Decontamination	60-65 deg. F (16-18 deg. C)	68-73 deg. F	72-78 deg. F
Sterilization equipment access room	75-85 deg. F (24-29 deg. C)	no requirements	no requirements
Sterile storage/support areas	75 deg. max. (max24 deg. C)	75 deg. F	72-78 deg. F
Relative Humidity	**(AAMI Guidelines)**		
all work areas except Sterile Storage	30-60%	30-60%	max. 60%
Decontamination	30-60%	no requirements	no requirements
prep/packaging	Ideal is 50% not less than 35% RH	30-60%	max. 60%
Sterile Storage	should not exceed 70%	max. 70%	max. 60%

Monitor and document temperature and humidity levels daily in all areas of department

AAMI = Association for the Advancement of Medical Instrumentation; AIA = American Institute of Architects (now Facility Guidelines Institute)

Temperature: **60 – 65°F**
Humidity: **30 – 60%**

Decontamination

Month: _____
Year: _____

1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31	Signature: _____			

Log sent to Maintenance monthly for monitoring purposes. Maintenance will note corrective actions.

ANSI/AAMI ST79 Comprehensive guide to steam utilization and sterility assistance in health care facilities, Section 3-Design Considerations 3.3.6.5 Temperature, 3.3.6.6. Relative Humidity Pg. 25:

Temperature 60°-65° F; Relative Humidity 30-60%

Endoscopy Scope Processing Room

- May be one room, dedicated to Endo equipment processing
  - Sized for amount of equipment processed
  - Work flow from soiled to clean - clean should not be exposed to soiled - 3ft min clearance clean to soiled at all times; droplet contamination a concern
  - Work surface and sink
  - Hand washing station
  - Sufficient workspace, utilities and equipment
- Ventilation must be negative air pressure to surrounding areas with minimum 10 ach (2 fresh, outside); direct exhaust, NO requirements for temperature or humidity

Endoscopy Scope Storage Room

- Storage
  - May be a cabinet in the endoscopy processing room
    - Cabinet must have doors and ventilation openings
    - Cabinet must be at least 3ft from potential droplet contamination
    - Consider route from processor to the cabinet to ensure it does not cross through soiled processing
  - Storage may be in a separate room
- Inventory of Scopes - Recommended practice is to include scopes in the Medical Equipment Inventory

TJC Endoscopy Waiver

ASHRAE voted in July 2013 to move endoscopy ***procedure*** rooms from positive to N/A. FGI is planning on releasing this in the November publication of the 2014 FGI Guidelines.

Therefore, if an organization had made a documented decision based on risk assessment to no longer monitor endoscopy procedure rooms as per the 2013 ASHRAE action, we would accept this.

If the organization has not made a **documented** decision, the room should be evaluated as per the below table and construction date.

No change to bronchoscopy procedure rooms.

Guidelines Ventilation Table: Endoscopy & Bronchoscopy

Edition	Endoscopy				Bronchoscopy	
	Procedure		Processing (Cleaning)		Procedure	
	Pressure	Direct Exhaust	Pressure	Direct Exhaust	Pressure	Direct Exhaust
2014 (pending)	N/A	N/A	Negative (-)	YES	Negative (-)	YES
2010	Positive (+)	N/A	Negative (-)	YES	Negative (-)	YES
2006	Neutral	N/A	Negative (-)	YES	Negative (-)	YES
2001	Negative (-)	N/A	N/A	N/A	Negative (-)	YES
1996/1997	N/A	N/A	N/A	N/A	Negative (-)	YES
1992/1993	N/A	N/A	N/A	N/A	N/A	N/A
1987	N/A	N/A	N/A	N/A	N/A	N/A
1979	N/A	N/A	N/A	N/A	N/A	N/A

FGI Guidelines – 2010 edition

The following operations and maintenance procedures are recommended for health care facilities.

- A1.1 Operating Rooms
  - Each operating room should be tested for positive pressure semi-annually or on an effective preventative maintenance schedule. When HEPA filters are present within the diffuser of operating rooms, the filter should be replaced based on pressure drop.

FGI Guidelines – 2010 edition

- A1.2 Protective Environment (PE) Rooms
  - PE rooms should remain under positive pressure with respect to all adjoining rooms whenever an immune-compromised patient is present. PE rooms should be tested for positive pressure daily when an immune-compromised patient is present. When HEPA filters are present within the diffuser of protective environment rooms, the filter should be replaced based on pressure drop.

FGI Guidelines – 2010 edition

- **6.4 Filtration.** Filter banks shall be provided in accordance with Table 6-1. Each filter bank with an efficiency of greater than MERV 12 shall be provided with an installed manometer or differential pressure measuring device.
- **6.4.1 First Filtration Bank** shall be placed upstream of the heating and cooling coils such that all mixed air is filtered.
- **6.4.2 Second Filtration Bank** shall be downstream of all wet air cooling coils and the supply fan. All second filter banks shall have sealing interface surfaces.

FGI Guidelines – 2010 edition

TABLE 6-1 Minimum Filter Efficiencies

Space Designation (According to Function)	Filter Bank Number 1 (MERV)[a]	Filter Bank Numb (MERV)[a]
lasses B and C surgery; inpatient and ambulatory diagnostic and therapeutic radiology; inpatient delivery and recovery spaces	7	14
ient care, treatment, and diagnosis, and those spaces providing direct service or clean supplies and clean processing (except as noted below); AII (rooms)	7	14
Protective environment rooms (PE)	7	17 (HEPA)[c]
Laboratories; Class A surgery and associated semi-restricted spaces	13[b]	N/R*
ninistrative; bulk storage; soiled holding spaces; food preparation spaces; and laundries	7	N/R
All other outpatient spaces	7	N/R
Skilled nursing facilities	7	N/R

= not required

DOCUMENTATION

- PM Records
  - Filter replacement
  - Record differential pressure when appropriate
- Air Flows (design & actual)
  - Supply, Return/Exhaust CFM
  - Air Changes
  - Differential Pressures
- Temperature & Humidity
  - If BAS used, ensure user notification & document actions taken

SHARE THE RESULTS

- Infection Control Practitioner
- Department Directors
- Summarize deficiencies and actions taken
- Avoid engineering terms and ensure that clinical staff understand how it works
- Keep everyone focused on the goal of preventing hospital-acquired illness

QUESTIONS?

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MSL

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so you can be by theirs™