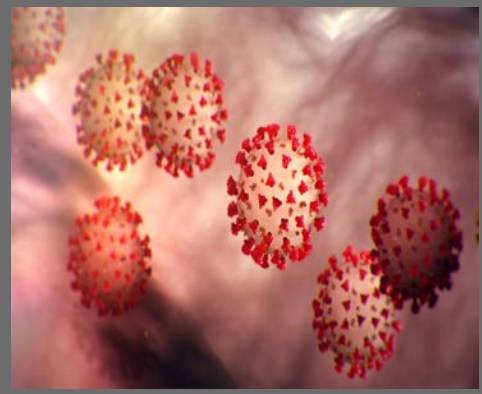

Infection Control and Facilities Design Needs for COVID-19

37th Annual AHCA Seminar
October 2021

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“Everything we do before a pandemic will seem alarmist. Everything we do after will seem inadequate”

Michael Leavitt
Nobel Prize-winning structural biology professor at Stanford

Overview

Discuss information obtained from the following:

CDC

South Korea

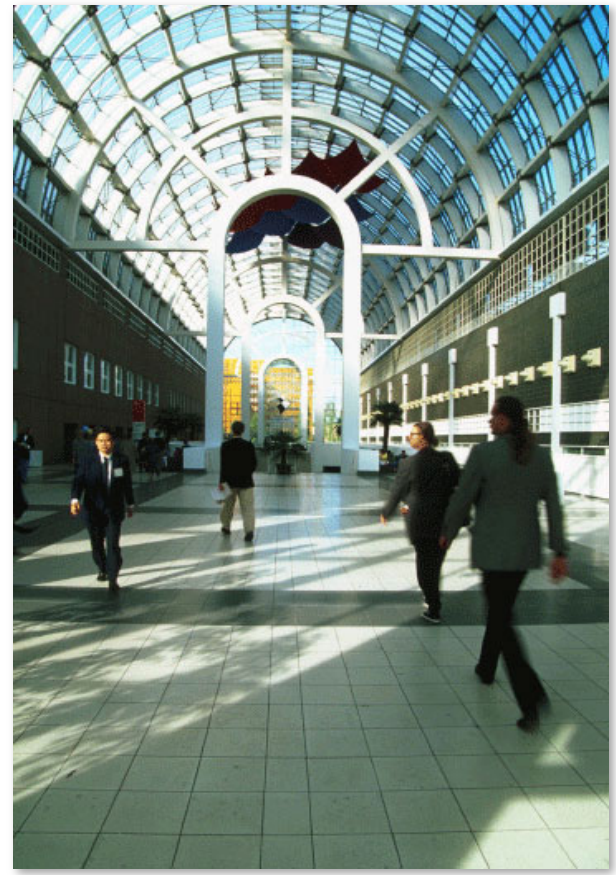
CMS

ASHE/ASHRAE

- ✓Notable Pandemics
- ✓Initial Response
- ✓Shortcomings
- ✓Where we are compared to 2020
- ✓HVAC guidelines ASHE Guidelines
- ✓Recovery Planning Efforts
- ✓What we Learned

HISTORY

- 1918 Flu [Spanish Flu]
- Hong Kong Flu (1968)
- SARS CoV (2002)
- H1N1 (2009) [Swine Flu]
- MERS CoV [Middle East Respiratory Syndrome] (2015)
- SARS-CoV-2 (COVID 19) (2019)

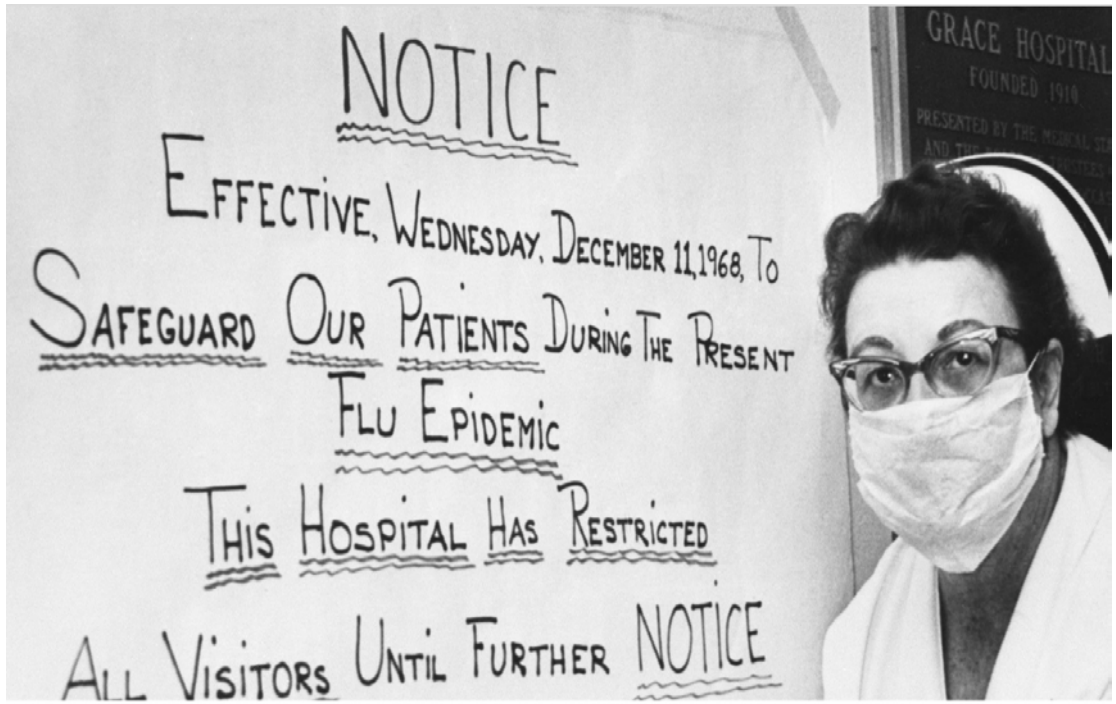


NOTABLE PANDEMICS

Disease	1918 (Spanish Flu)*	Asian Flu H2N2	Hong Kong Flu	SARS+ (CoV)	H1N1 ** (Swine Flu)	MERS^ (CoV)	COVID-19 SARS (CoV-2)
First detected	April 1918	February 1957	July 1968	Nov 2002	April 2009	Sept 2012	December 2019
Peak Second third wave	-Peak between Oct-Nov 1918 -Second peak in Feb 1919 -Third wave Spring 1919	Sept 1957 and October 1957 following school opening	Peak September 1968	Peak May 2003 SARS CoV-2: 2019 [virus responsible for COVID-19]	October 2009	Still occurring Peak 2014 Peak ROK [Republic of Korea] 2015	In process
Estimated End	End of 1919	End of 1958	End of 1969	July 2003	August 2010	Still occurring	-
Originated	US?	Chinese province of Guizhou	Hong Kong	China	US (California) (Mexico)	Arabian peninsula, Sandia Arabia	Wuhan, China
Age with highest Mortality Rate	<5; 20-40, >65	>65	>65	>45	<5 and >65	>50	All
Cause	H1N1	New influenza A (H2N2) virus	Influenza A (H3N2) virus (Swine-Avian originated)	SARS (CoV)	Novel influenza A (H1N1)pdm09 virus (Swine)	Camels, Bats	Bats (SARS Cov-2)
Cases (US)	Millions	500,000	5 mil	27	60 million	2	4.2 mil
Deaths (US)	675,000	70,000	100,000	0	12,000	0	680,000
Cases (Global)	500 million	500 million	20 million	8000	90 million	2500	214 mil
Deaths (Global)	50 million	2 million	1 million	774	285,000	866	4.7
Vaccine	No	Yes (Dec 1957)	Yes	No	Yes (Nov-2009)	No	Yes (2021)

Source: CDC (Centers for Disease Control and Prevention)
The "H" (hemagglutinin**) and the "N" (neuraminidases) are both proteins that are found on the outer shell or envelope of the virus
*In 2005 CDC synthesized and studied H1N1; vaccination was produced quickly in 2009
+SARS {Severe Acute Respiratory Syndrome]
^MERS [Middle East Respiratory Syndrome]

Hong Kong Flu (1968)



Restrictions on visits to Cleveland's Grace Hospital and others were among the measures taken to slow the spread of the Hong Kong flu in 1968. BETTMANN ARCHIVE

H1N1 [Novel influenza A flu infection] (2009)

Timeline

- ✓April 15, 2009 “first” patient detected in California.
- ✓April 18, 2009: Novel infection reported to WHO
- ✓April 27, 2009 Pandemic alert by WHO
- ✓April 28, 2009 FDA approves testing, CDC issues IC guidance
- ✓May 1, 2009 Domestic and global shipment of CDC tests to detect H1N1 begins
- ✓June 2009 summer camps canceled
- ✓July 2009 cases double compared to June 2009

H1N1 [Novel influenza A flu infection] (2009)

Timeline

- ✓ August 19, 2009 *CDC Guidance for Businesses* and accompanying toolkit posted to CDC.gov.
- ✓ Second wave of 2009 H1N1 influenza activity began in the U.S.
- ✓ October 5, 2009 First doses of H1N1 vaccine were given in the U.S
- ✓ October 24, 2009 Influenza activity reached its highest level with 48 of 50 states reported widespread activity
- ✓ December 18, 2009 First 100 million doses of 2009 H1N1 vaccine were available for ordering
- ✓ January 2010 Activity declined to levels below baseline, but persisted for several more months at lower levels.

December 2009

An H1N1 flu vaccination clinic was held in San Francisco in December 2009.

JUSTIN SULLIVAN/GETTY IMAGES

Why is this different?

- South Korea CDC response was excellent (compared to MERS) , then not so good. Why?
- Nursing Home population is most vulnerable (25% of deaths in New York state)
- All ages are affected
- PPE was not readily available
- Guidance and response requirements were not well understood or communicated
- Testing program not readily available

Initial Response

- Facilities tried to control intake and limit exposures
- Closing facilities and re-routing care was an issue
- Remote care was a good plan, but with no real process, was delayed
- Planning for screening and staffing was a challenge
- Development of ventilation plan for care areas was costly and there was disagreement as to what should be done.

Initial Response-ASHE, CDC and ASHRAE Guidance

CDC had develop response guideline documents similar to H1N1

ASHRAE-170 working group developed guidelines for ventilation (May 2020)

UF and others published papers of ventilation controls and potential for virus transmission

Organizations such as ASHE and APIC developed guidance

THIS IS WHERE WE WERE
May 6, 2020

- Some states are opening in phases
- Stay at home orders still in place
- No vaccination or treatment
- No method for widespread testing
- Supplies and PPE appear adequate in some areas of the country
- Ventilators are being provided
- Hospitals implement ventilation strategies to control virus transmission in the facility

American Hospital Association™
Advancing Health in America

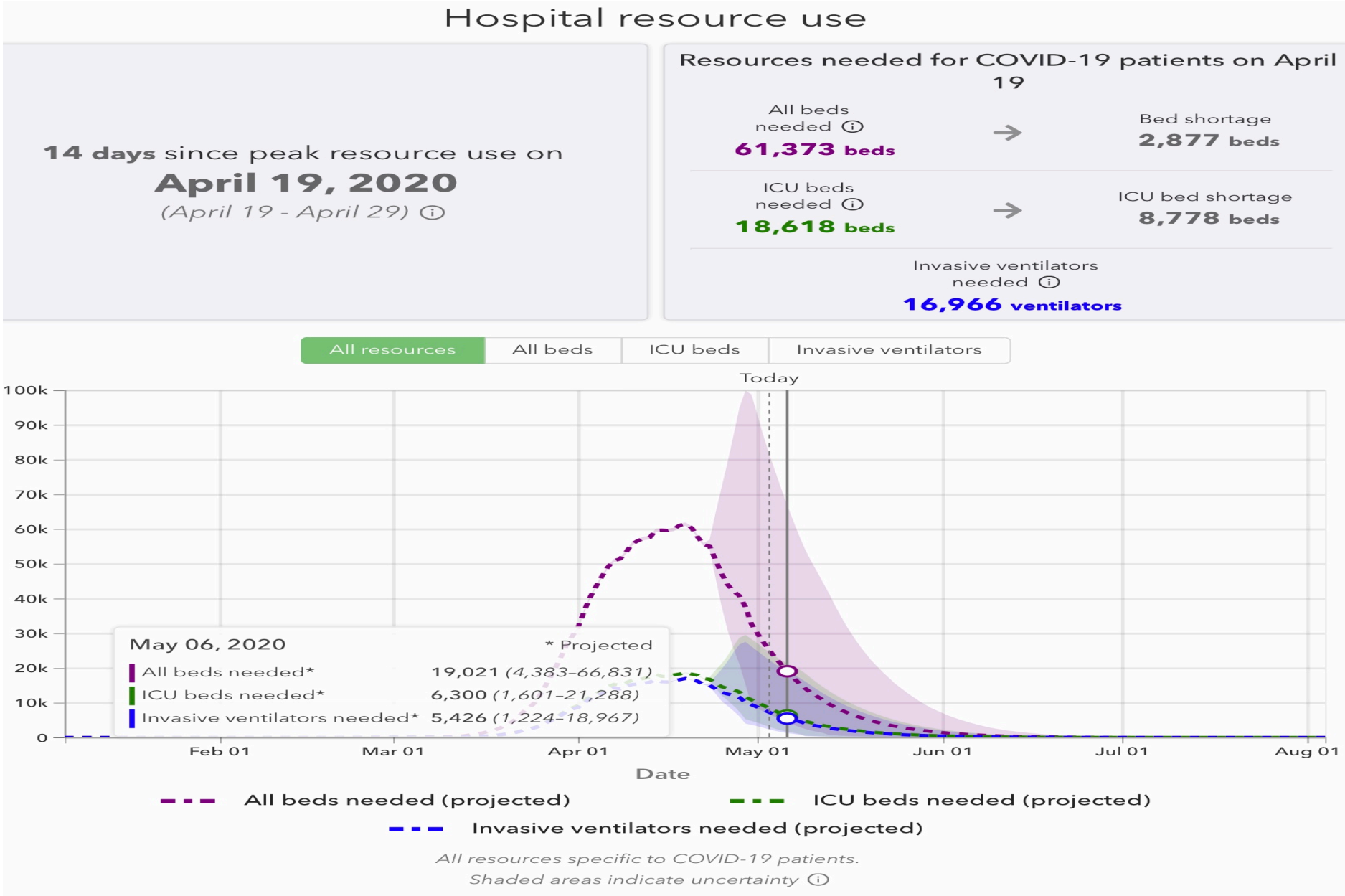
COVID-19

COVID-19 Models:
Forecasting the Pandemic's Spread

www.aha.org/covid19

AHA CENTER FOR HEALTH INNOVATION

American Hospital Association™
Advancing Health in America



Source: **UW-IHME** — *COVID-19 Forecasting Tool*
The University of Washington's Institute for Health Metrics and Evaluation forecasting tool

(Short Comings)

- Do we need to disinfect the HVAC system in units converted back from a COVID-19 unit?
- When we start non-elective surgery, what precautions are needed?
- How do we handle patient intake of positive and unknown?
- What kind of recovery efforts will be needed to utilize spaces for non-Covid-19 patients?

(Short Comings)

- No clear understanding of Infection transmission in hospitals between patient and staff
  - Barriers and common transmission concerns
- Infection transmission in hospitals occurs between patient and patient
  - Lack of PPE, reuse of PPE, gloves,
  - Staffing actions and use of PPE

Goal of Infection Control during HCI Event

- The goal of infection control is to protect patients from infection transmission in the healthcare facility.
- Infection control practices must protect staff and visitors for exposure to infectious diseases.

Applicable guidelines:

- CDC Guidelines for isolation precautions.
- OSHA ETS Covid-19
- ASHRAE 170-2021
- ASHE/ASHRAE Ventilation Guidelines

Accessable version: https://www.cdc.gov/infectioncontrol/guidelines/isolation/index.html

2007 Guideline for Isolation Precautions: Preventing Transmission of Infectious Agents in Healthcare Settings

Last update: July 2019

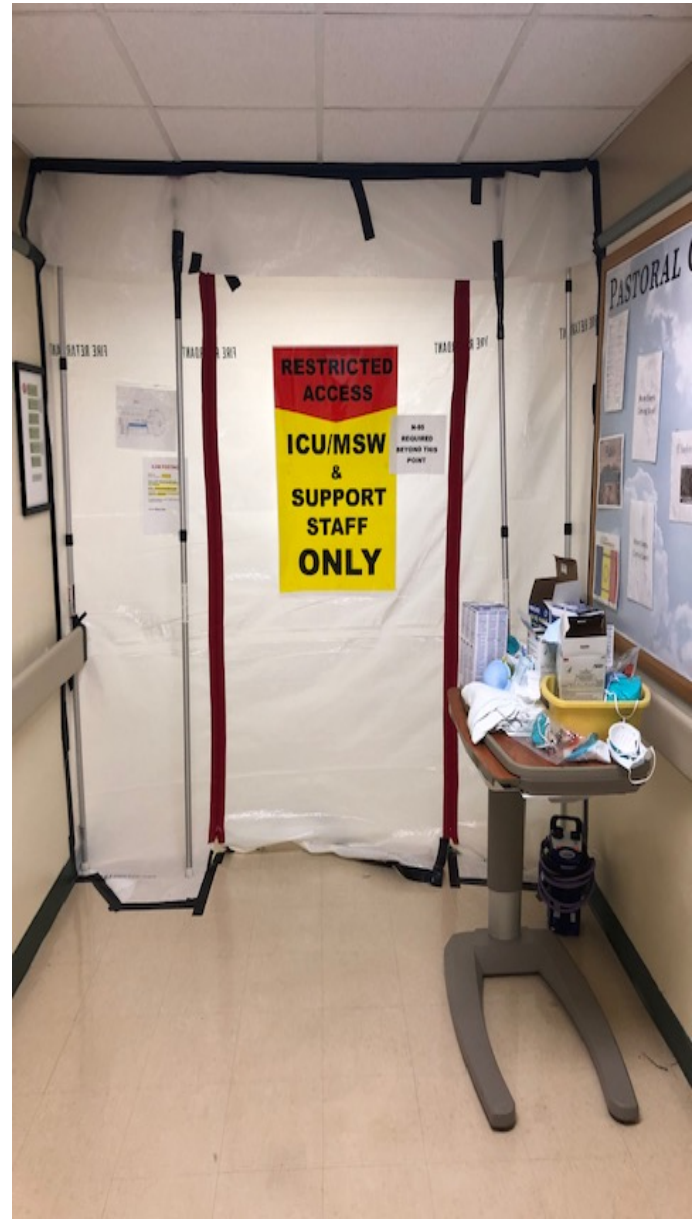
Jane D. Siegel, MD; Emily Rhinehart, RN MPH CIC; Marguerite Jackson, PhD; Linda Chiarello, RN MS; the Healthcare Infection Control Practices Advisory Committee

Acknowledgement: The authors and HICPAC gratefully acknowledge Dr. Larry Strausbaugh for his many contributions and valued guidance in the preparation of this guideline.

Suggested citation: Siegel JD, Rhinehart E, Jackson M, Chiarello L, and the Healthcare Infection Control Practices Advisory Committee, 2007 Guideline for Isolation Precautions: Preventing Transmission of Infectious Agents in Healthcare Settings https://www.cdc.gov/infectioncontrol/guidelines/isolation/index.html

Infection/Condition	Type of Precaution	Duration of Precaution	Precautions/Comments
Herpes zoster (varicella-zoster) (shingles) Disseminated disease in any patient Localized disease in immunocompromised patient until disseminated infection ruled out	Airborne + Contact + Standard	Duration of illness	Susceptible HCWs should not enter room if immune caregivers are available; no recommendation for protection of immune HCWs; no recommendation for type of protection (i.e. surgical mask or respirator) for susceptible HCWs.
Herpes zoster (varicella-zoster) (shingles) Localized in patient with intact immune system with lesions that can be contained/covered	Standard	Until lesions dry and crusted	Susceptible HCWs should not provide direct patient care when other immune caregivers are available.
Histoplasmosis	Standard		Not transmitted from person to person.
Human immunodeficiency virus (HIV)	Standard		Postexposure chemoprophylaxis for some blood exposures [866].
Human metapneumovirus	Contact + Standard	Duration of illness	HAI reported [1071], but route of transmission not established [823]. Assumed to be Contact transmission as for RSV since the viruses are closely related and have similar clinical manifestations and epidemiology. Wear masks according to Standard Precautions.
Impetigo	Contact + Standard	Until 24 hours after initiation of effective therapy	
Infectious mononucleosis	Standard		
Influenza Human (seasonal influenza)			See Prevention Strategies for Seasonal Influenza in Healthcare Settings (https://www.cdc.gov/flu/professionals/infectioncontrol/healthcaresettings.htm accessed September 2018). [Current version of this document may differ from original.] for current seasonal influenza guidance.
Influenza Avian (e.g., H5N1, H7, H9 strains)			See [This link is no longer active: www.cdc.gov/flu/avian/professional/infect-control.htm. Similar information may be found at Interim Guidance for Infection Control Within Healthcare Settings When Caring for Confirmed Cases, Probable Cases, and Cases Under Investigation for Infection with Novel Influenza A Viruses Associated with Severe Disease (https://www.cdc.gov/flu/avianflu/novel-flu-infection-control.htm accessed September 2018)] for current avian influenza guidance.
Influenza Pandemic Influenza (also a human influenza virus)	Droplet + Standard		See [This link is no longer active: http://www.pandemicflu.gov. Similar information may be found at Interim Guidance for Infection Control Within Healthcare Settings When Caring for Confirmed Cases, Probable Cases, and Cases Under Investigation for Infection with Novel Influenza A Viruses Associated with Severe Disease (https://www.cdc.gov/flu/avianflu/novel-flu-infection-control.htm accessed September 2018)] for current pandemic influenza guidance.
Kawasaki syndrome	Standard		Not an infectious condition.
Lassa fever (see Viral Hemorrhagic Fevers)			

Infection/Condition	Type of Precaution	Duration of Precaution	Precautions/Comments
Salmonellosis (see Gastroenteritis)			
Scabies	Contact + Standard	Until 24	
Scalded skin syndrome, staphylococcal	Contact + Standard	Duration of illness	See Staphylococcal Disease, scalded skin syndrome below.
Schistosomiasis (bilharziasis)	Standard		
Severe acute respiratory syndrome (SARS)	Airborne + Droplet + Contact + Standard	Duration of illness plus 10 days after resolution of fever, provided respiratory symptoms are absent or improving	Airborne preferred; Droplet if AIIR unavailable. N95 or higher respiratory protection; surgical mask if N95 unavailable; eye protection (goggles, face shield); aerosol-generating procedures and "supershedders" highest risk for transmission via small droplet nuclei and large droplets [93, 94, 96]. Vigilant environmental disinfection (see [This link is no longer active: www.cdc.gov/ncidod/sars]. Similar information may be found at CDC Severe Acute Respiratory Syndrome (SARS) (https://www.cdc.gov/sars/index.html accessed September 2018).)
Shigellosis (see Gastroenteritis)			
Smallpox (variola; see Vaccinia for management of vaccinated persons)	Airborne + Contact + Standard	Duration of illness	Until all scabs have crusted and separated (3-4 weeks). Non-vaccinated HCWs should not provide care when immune HCWs are available; N95 or higher respiratory protection for susceptible and successfully vaccinated individuals; postexposure vaccine within 4 days of exposure protective [108, 129, 1038-1040].
Sporotrichosis	Standard		
Spirillum minor disease (rat-bite fever)	Standard		Not transmitted from person to person.
Staphylococcal disease (*S. aureus*) Skin, wound, or burn Major	Contact + Standard	Duration of illness	Until drainage stops or can be contained by dressing.
Staphylococcal disease (*S. aureus*) Skin, wound, or burn Minor or limited	Standard		If dressing covers and contains drainage adequately.
Staphylococcal disease (*S. aureus*) Enterocolitis	Standard		Use Contact Precautions for diapered or incontinent children for duration of illness.
Staphylococcal disease (*S. aureus*) Multidrug-resistant (see Multidrug-Resistant Organisms)			
Staphylococcal disease (*S. aureus*) Pneumonia	Standard		
Staphylococcal disease (*S. aureus*) Scalded skin syndrome	Contact + Standard	Duration of illness	Consider healthcare personnel as potential source of nursery, NICU outbreak [1095].
Staphylococcal disease (*S. aureus*) Toxic shock syndrome	Standard		



ASHE/ASHRAE

Current/Updated Health Care Facilities Ventilation Controls and Guidelines for Management of Patients with Suspected or Confirmed SARS-CoV-2 (COVID-19)

February 4, 2021

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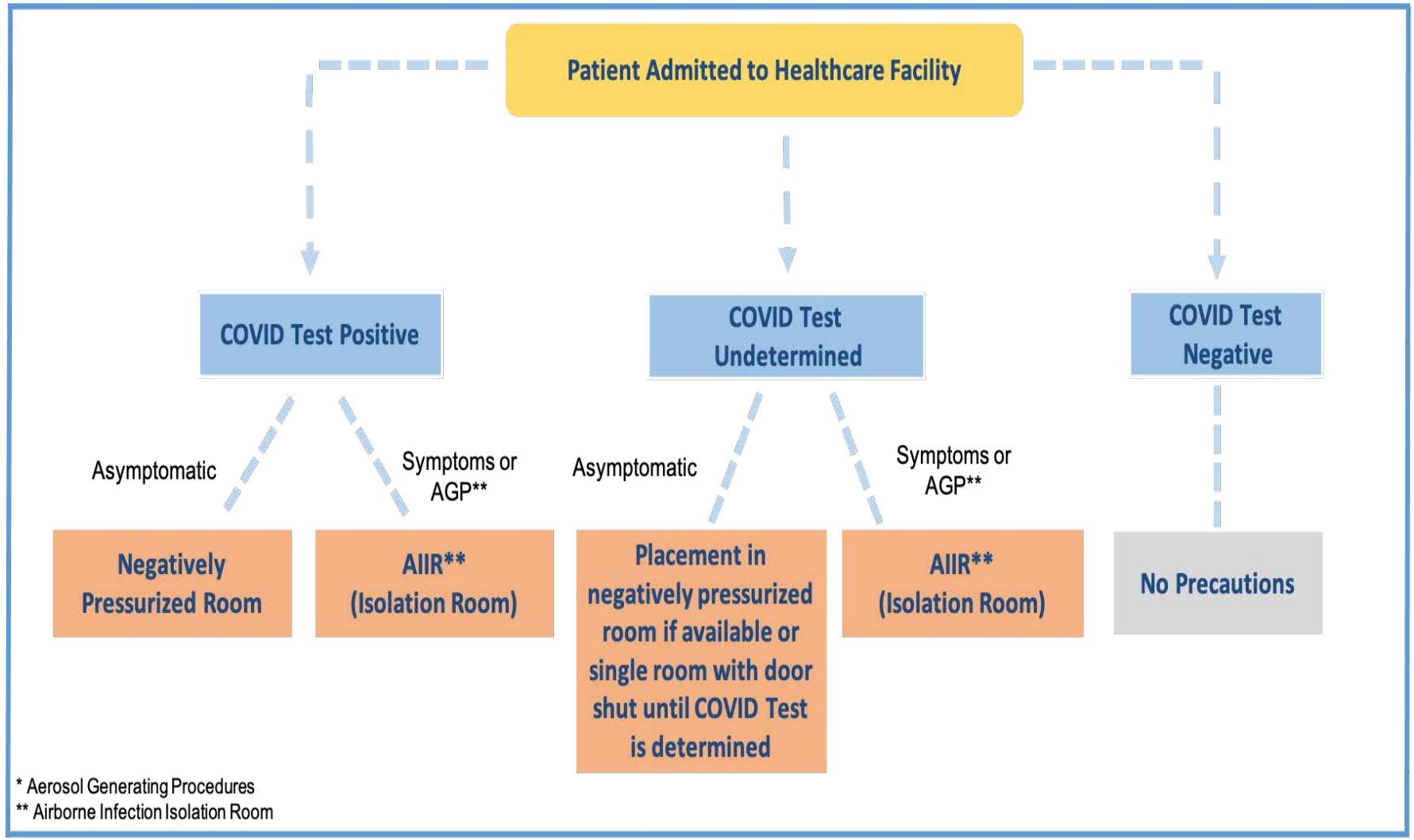
Ventilation Controls for Infection Control

Environmental conditions and ventilation of spaces with suspect COVID-19 patients

- Screening stations
- Emergency departments and acute care areas

Requirements for management of COVID-19 positive patients

- Dedicated wards
- Individual patient rooms
- Operating and procedure rooms
- Isolation rooms (AII rooms)
- Temporary isolation room (AIIR) options
- Temporary negative pressure patient room options
- Temporary unit conversion options


Patient Admitted to Healthcare Facility
COVID Test Positive
COVID Test Undetermined
COVID Test Negative
Asymptomatic
Symptoms or AGP**
Asymptomatic
Symptoms or AGP**
Negatively Pressurized Room
AIIR** (Isolation Room)
Placement in negatively pressurized room if available or single room with door shut until COVID Test is determined
AIIR** (Isolation Room)
No Precautions
* Aerosol Generating Procedures
** Airborne Infection Isolation Room

Decision Analysis-Patient Placement

Patient is positive for COVID-19, no symptoms, located on Labor and Delivery in single room?

Neutral-Negatively pressurized room

Patients is positive for COVID-19, no symptoms, in ED or Lab

Neutral-Negatively pressurized room

Patient is positive for COVID-19, with SYMPTOMS, no aerosol procedures performed at this time-IF AVAILABLE

AIIR

Patient is positive for COVID-19, no symptoms, having aerosol generating procedure.

AIIR

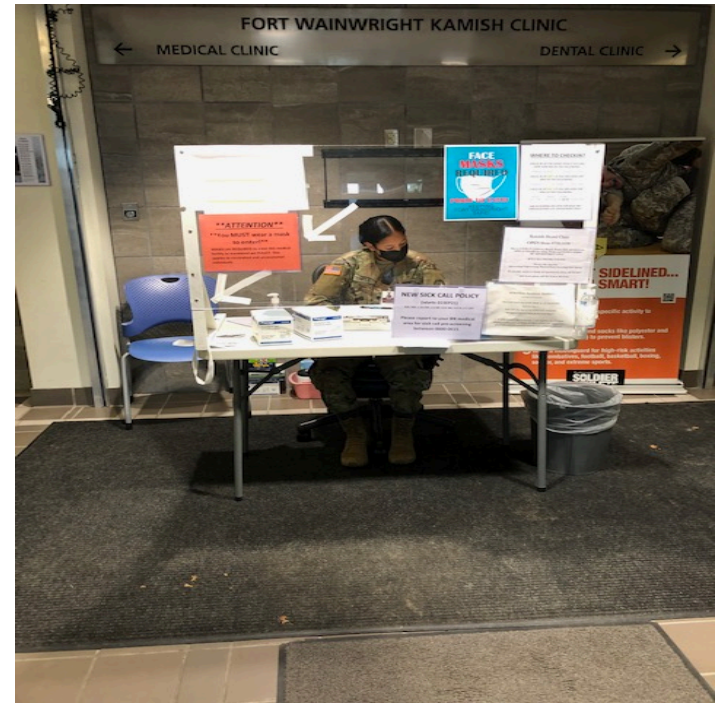
Group of patients on a ward, all COVID-19 positive, no symptoms.

Neutral-Negatively pressurized room for each

Unit must meet requirements for dedicated unit

Screening Stations- suspect COVID-19 patients

HVAC systems meet ASHRAE/ASHE standard 170-2017 and ASHRAE standard 62.1 guidelines. No additional measures for ventilation control are recommended.



Screening Stations- suspect COVID-19 patients

When screening stations are outdoors, natural ventilation appears to provide protection against airborne SARS-CoV-2

Nasopharyngeal swabbing of symptomatic patients is considered an aerosol-generating procedure even if done outdoors, thus proper wearing of PPE is required.

Emergency departments and acute care-suspect COVID-19 patients

- Known positive for COVID-19 , no symptoms: Negative pressurization room that meets ASHRAE/ASHE Standard 170-2017 guidelines for the area of treatment. If room is not available, then a room with the door closed and dedicated bathroom.

- Known positive for COVID-19, with active symptoms or requiring aerosol-generating treatment or procedure: AIIRs meeting ASHRAE/ASHE Standard 170-2017 and CDC guidelines (see AII rooms or AIIR).

Dedicated Wards and Individual Rooms

Additional considerations beyond use of ASHRAE/ASHE standard 170-2017 and ASHRAE standard 62.1 guidelines are recommended and include:

- Increasing outside air intake to maximum allowable level to enhance mixing and elimination of recirculating air
- Improving filtration efficiencies, if practical
- Provide negative pressure to patient rooms, if possible
- Run systems continuously and eliminate economized function
- Disabling demand-controlled ventilation (DCV) provisions

Dedicated Wards and Individual Rooms

To limit staff exposure and conserve PPE consider dedicated COVID-19 Patient Wards:

- Consider designating entire units for COVID-19 patients separate from units designated for persons under investigation (PUIs).
- The ward or unit that is used to house COVID-19 patients (rule-out or confirmed) should be designed to provide neutral-negative pressurization to the entire area to meet appropriate ASHRAE/ASHE 170-2017 guidelines for the unit/area except for those spaces. HEPA filtration is recommended for the space, however if not practical, the use of employee respiratory protection must be required while in the work areas.

Surgery and Procedure Rooms

- Operating and procedure rooms remain positively pressurized in order to minimize surgical site infection risk. Ventilation design following ASHRAE/ASHE standard 170-2017 guidelines appear adequate for the control of airborne spread of SARS-CoV-2 (COVID-19) in operating rooms, procedure rooms, and adjacent areas.
- Terminal Cleaning should be performed only after the necessary number of air changes has occurred to remove potentially infections particles.

Surgery and Procedure Rooms

- Control practices should be implemented after intubation and extubation occurs. These practices include, but are not limited to, the following:
  - Limiting entrance into the room for a set period of time after intubation
  - Pausing for a number of room air exchanges after extabation
  - Only essential staff should be in the OR during procedures.
- Airway procedures should be performed in accordance with Anesthesia Patient Safety Foundation (APSF) guidelines.

Airborne Infection Isolation Rooms (AIIR)

AII rooms are designed to prevent the spread of droplet nuclei expelled by a patient with disease. AII rooms must be designed to have the following characteristics:

- Negative pressure relative to the adjacent area and other parts of the facility. Negative pressurization must be at least -0.01 inches of water (H_2O) for newly constructed rooms, or -0.001 H_2O for rooms constructed before 2005.

- Air cannot escape to other parts of the facility when the door is closed and the ventilation system is operating properly.

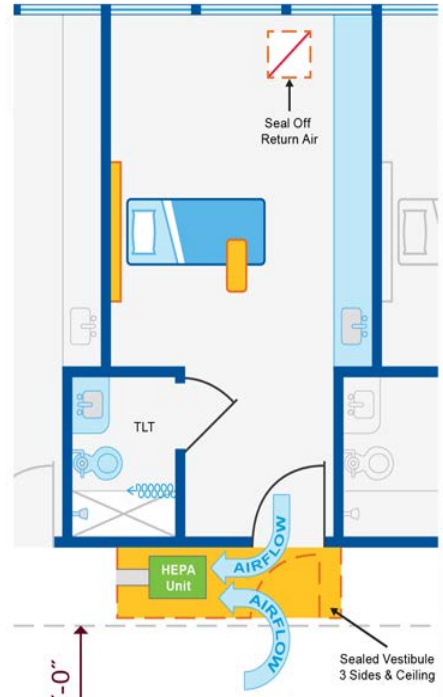
Airborne Infection Isolation Rooms (AIIR)

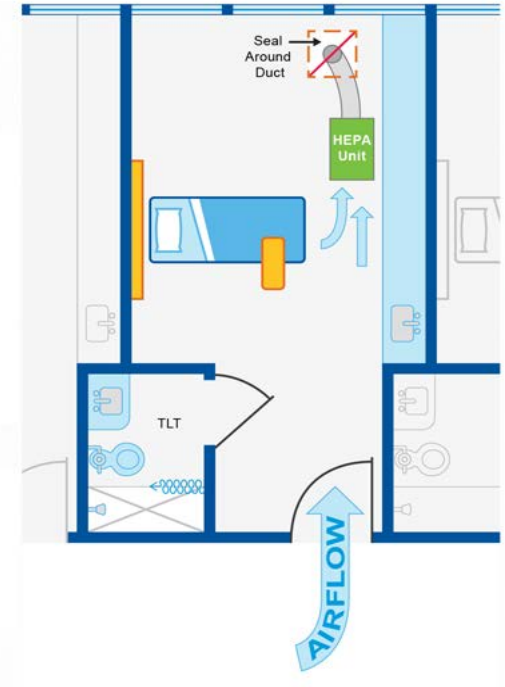
- Air from AII room should be exhausted directly to the outdoors, where the droplet nuclei will be diluted in the outdoor air, or passed through a special high efficiency air (HEPA) filter that removes most (99.97%) of the droplet nuclei before it is returned to the general circulation.

- AII rooms must have 12 ACH (air changes per hour) for newly constructed rooms, or 6 ACH for rooms constructed before 2005.

Temporary Isolation Room (AIIRs) and Negative Rooms

Set-up of temporary rooms to meet AII criteria can be a challenge. In order to be able to designate and use a room as an AIIR the room will need to meet all of the requirements listed in ASHRAE/ASHE 170, 2017 edition.





Temporary Isolation Room (AIIRs) and Wards [negative]

Temporary Isolation Room (AIIRs) and Wards [negative]

Pressure Checks-AIIR

OSHA and the CDC require monthly verification by physical testing (smoke or other device) to ensure that the room is negatively pressurized. Daily when in use.

Reference: *Occupational Safety and Health Administration (OSHA) directive CPL 02-02-078, 06/30.2015 and Centers for Disease Control and Prevention (CDC), Guidelines for Preventing the Transmission of Mycobacterium tuberculosis in Health-Care Settings, 2005, MMWR December 30, 2005/ Vol. 54/ No. RR-17.*

HVAC systems, demand control, and multiple zone VAV

HVAC system design must meet current ventilation rates and parameters for ASHRAE/ASHE Standard 170-2017 in healthcare facilities and ASHRAE standard 62.1 requirements in all non-healthcare areas.

The demand mode and use of zone VAV controls should be disabled in order to allow for constant flow and air exchange. Verify that systems are providing maximum air intake from outdoor source and exchange based on design.

Other HVAC considerations

- UVGI (ultraviolet germicidal irradiation)
- Seasonal variations: effects of temperature and relative humidity
- Room temperature and humidity
- CLERANCE AIR FLOW for removal of contaminate (SEE NEXT PAGE)

Airborne Contaminant Removal

Table B.1. Air changes/hour (ACH) and time required for airborne-contaminant removal by efficiency

+ Denotes frequently cited ACH for patient-care areas.

§ Values were derived from the formula:

$t2 - t1 = - [\ln (C2 / C1) / (Q / V)] \times 60$, with $t1 = 0$

where

The number of air changes per hour and time and efficiency.		
ACH § ¶	Time (mins.) required for removal 99% efficiency	Time (mins.) required for removal 99.9% efficiency
2	1	207
4	69	104
6+	46	69
8	35	52
10+	28	41
12+	23	35
15+	18	28
20	14	21
50	6	8

Staff Protection-Facility Storage Needs

Clinical staff must follow current OSHA and CDC guidelines for personal protection while working in the healthcare environment with suspect or confirmed COVID-19 patients. Currently, the following guidelines for protection include, but are not limited to, the following:

Ensure that masking practices and face covering practices are followed at all times in the healthcare environment.

- Use of N95 or higher respiratory protection for worker activities in rooms caring for positive COVID-19 patients.
- Use N95, or preferred higher (HEPA) respiratory protection for worker activities in rooms caring for positive COVID-19 during aerosol generating procedures.

Staff Protection-Facilities Management

Workers in areas within 25 feet of hazardous exhaust vents (not-HEPA filtered)

- Employee protection must be developed for working near hazardous exhaust. Workers entering and working on the roof in the area of isolation room exhaust discharge must wear the following:
    - N95 or higher respiratory protection when on the roof and when within 25 feet of exhaust ventilation systems.

Facilities workers maintaining HVAC systems and changing filter material:

- Employee protection must be defined for workers servicing and maintaining HVAC systems associated with COVID-19 care areas. Work including air hander unit maintenance and filter changes must have defined protection, such as, but not limited to:
- Use of personal protective clothing or disposable coveralls
- Use of HEPA respiratory protection
- Eye protection, such as goggles or face shield to prevent touching of mucus membranes

Distancing and Ventilation in Common Areas

- HVAC system design must meet current ventilation rates and parameters for ASHRAE/ASHE Standard 170-2017 in healthcare facilities and ASHRAE standard 62.1 requirements in all non-healthcare areas.

What We Learned

- ✓Improved facility design (for when HCI event happens again)
- ✓Initial response planning and recovery

  Six Sections
  - Specific Facility Management Issues
  - Pre-Recovery Planning
  - Immediate Needs
  - Short Term Needs
  - Long-Term Needs
  - The New Normal

GUIDANCE [Facilities Needed]

Planning for surge and normal operations
Need occupational health guidance
Staffing needs and resources centers
Development of testing centers
Development of vaccination centers
Need to re-think our response actions

What should the hospital of the future look like?

- Have future design be to have methods to increase outside air to all spaces. Purge
- Have future design be to have all hospital spaces with true HEPA filtered air or MER 13
- Have current and future spaces for distancing and barrier protection from visitors and patients
- Have patient rooms and wards with dedicated exhaust systems in order to create on demand negative pressure. <CLEARANCE AIR FLOW for removal of contaminate>

What should the hospital of the future look like?

- Have defined surge plans
- Have remote care methodologies defined and tested routinely
- Should future design be based on infectious agents and potential for spread?
  - Based on organism type
  - Potential for aerosolization
  - Ward design by phase Low to High potential for spread

Questions

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