Ventilation System Resiliency in Hospitals

39th Annual FPC Seminar + Expo

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LEARNING OBJECTIVES

1. Identify modifications potentials in existing hospital ventilation system that help to meet future pandemic challenges.
2. Explain how new ventilation systems can be designed to combat a future airborne pandemic.
3. Explain how use system testing to uncover opportunities for improving health and safety and lowering energy use and emissions
4. Describe how we can implement ventilation control strategies that will drive the biggest energy savings in hospitals

WHAT IS VENTILATION RESILIENCY?

Ventilation resiliency in hospitals refers to the capacity of a healthcare facility's ventilation systems to withstand and adapt to various challenges and disruptions while maintaining a safe and healthy environment for patients, staff, and visitors.

KEY ASPECTS OF VENTILATION RESILIENCY

- Redundancy
- Emergency Power Supply
- Contingency Plans
- Infectious Disease Preparedness
- Regular Maintenance and Inspections
- Monitoring and Alert Systems
- Design for Flexibility
- Education and Training

CODES VENTILATION HOSPITAL DESIGN

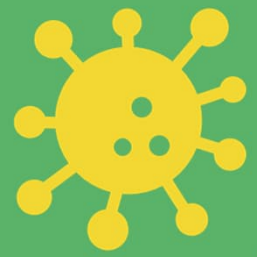
- FGI Guidelines
- ASHRAE Standard 170, "Ventilation of Health Care Facilities.
- ANSI/ASHRAE Standard 62: Ventilation for Acceptable Indoor Air Quality.
- CDC Guidelines
- Local Building Codes

Typical Ventilation Room Requirements

ROOMS	ROOM AIR CHANGES	FILTRATION	RECIRCULATION
PE Room	>12 ACH	99.97% (HEPA)	Allowed
Critical Care	>6 ACH	>90%	Allowed
Isolation (anteroom)	>10 ACH	>90%	Not Allowed
Operating Room	>15 ACH	>90%	Allowed

IMPORTANCE OF VENTILATION SYSTEMS IN HOSPITALS

Maintaining indoor air quality and preventing the spread of infectious diseases.



Dilute and remove airborne contaminants, such as viruses, bacteria, and fungi, from the air.

MOST IMPORTANT HVAC SYSTEMS FOR VENTILATION

- HVAC
- Air Handling Units
- Exhaust System
- Special Ventilation Systems
- Filtration
- Humidifiers
- Monitor & Control Systems

VENTILATION REDUNDANCY

Critical Areas should have back up systems

- Headered AHUs
- Redundant Air Handling Units
- Fan Arrays

Dedicated Exhaust Systems

- Isolation rooms & Labs
- Redundant Systems

Standby Power Generators

- Ventilation Systems should be on Generator

VENTILATION REDUNDANCY CONT'D

Dual Path Ventilation

- Two independent ventilation paths
- Backup in case of a failure in one path
- Controlled by automated dampers or valves to switch

Battery Backup for Controls & Sensors for Ventilation Systems

- Bridge Power Gaps
- During Transient Power Interruptions

Isolation Dampers

- Isolated Sections of Ventilation Systems
- In Case of Malfunction or Contamination

VENTILATION REDUNDANCY CONT'D

Remote Monitoring and Control

- Implementing a centralized monitoring and control
- Monitor the performance of ventilation systems
- Alerts can be set up to notify personnel

Maintenance and Testing

- Regular maintenance and testing
- During Transient Power Interruptions
- Scheduled inspections
- Performance testing
- Preventive maintenance

Air Quality Sensors

(Identify any areas with compromised ventilation)

- Installing air quality sensors
- In Case of Malfunction or Contamination
- Helps monitor indoor air quality

EMERGENCY POWER

Hospitals often have backup power sources (e.g., generators) to maintain essential services during power outages. Ensuring that ventilation systems are connected to these emergency power supplies is crucial to maintaining continuous airflow.

- Ensure you are meeting FGI Chapter 6 requirements as well as NFPA 99 and 101 requirements around emergency power requirements for ventilation of patient care spaces.

CONTINGENCY PLANS

Hospitals should have detailed contingency plans in place to address ventilation system failures or disruptions. These plans outline the actions to be taken to ensure patient safety and staff well-being during emergencies.

INFECTIOUS DISEASE AND PANDEMIC PREPAREDNESS

Ventilation resiliency becomes especially critical during infectious disease outbreaks, as airborne pathogens can spread rapidly. Hospitals may implement specific protocols and measures to manage ventilation in isolation rooms and areas with infected patients.

CHALLENGES FACED BY HOSPITALS DURING THE COVID-19 PANDEMIC

Many hospitals were not designed to handle the influx of COVID-19 patients	→ Leading to overcrowding and increased risk of transmission
Some hospitals struggled to maintain adequate ventilation	→ Inadequate ventilation results in risk of airborne transmission.

LESSONS LEARNED FROM THE COVID-19 PANDEMIC

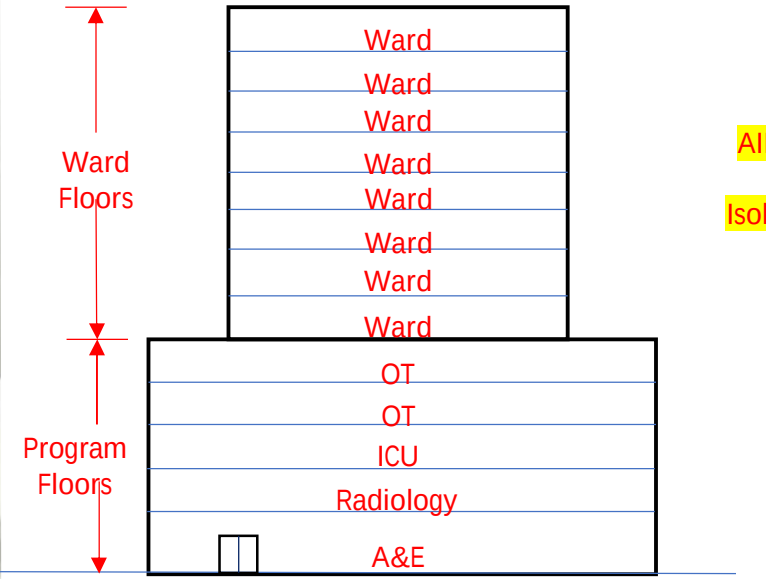
- Hospitals needs to prioritize ventilation system resiliency and flexibility.
- Hospitals should have backup ventilation systems in place in case of equipment failure or increased demand.
- Hospital administrators should work with engineers and HVAC experts to assess and improve their ventilation systems.

PANDEMIC DESIGN VENTILATION SYSTEM

100 % OA AHU System

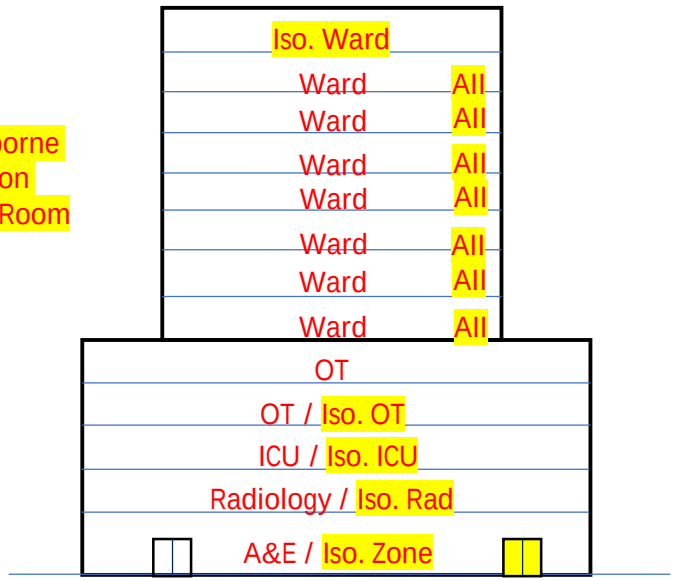
Compartmentalize ventilation zone design

LESSONS LEARNED FROM HONG KONG

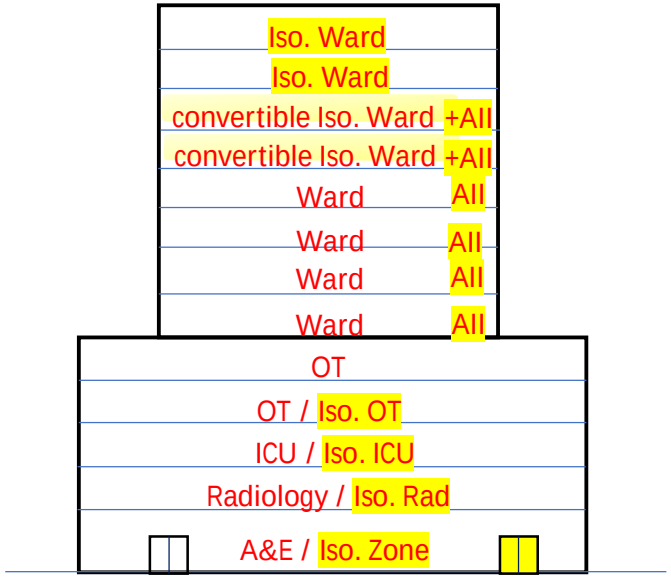


Before SARS
(prior 2003)
Isolation Beds
(total 90 beds in HK)

AII = Airborne Infection Isolation Room



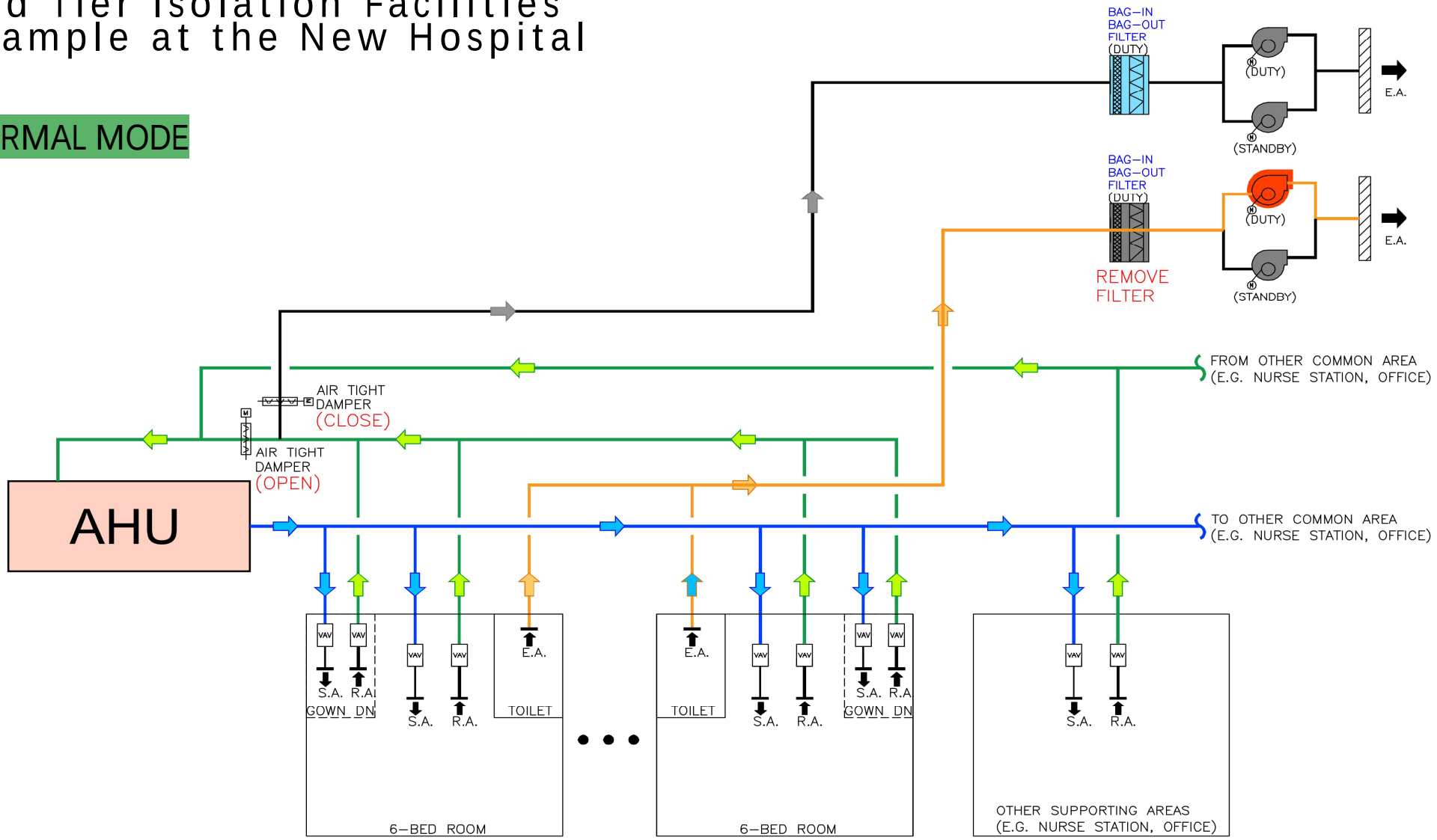
After SARS
(2004 - 2019)
Isolation Beds
(total 1,000+ beds in HK)



Future (post COVID-19)
(2020 & beyond)
Isolation Beds
(maybe 2,000+ beds in HK)

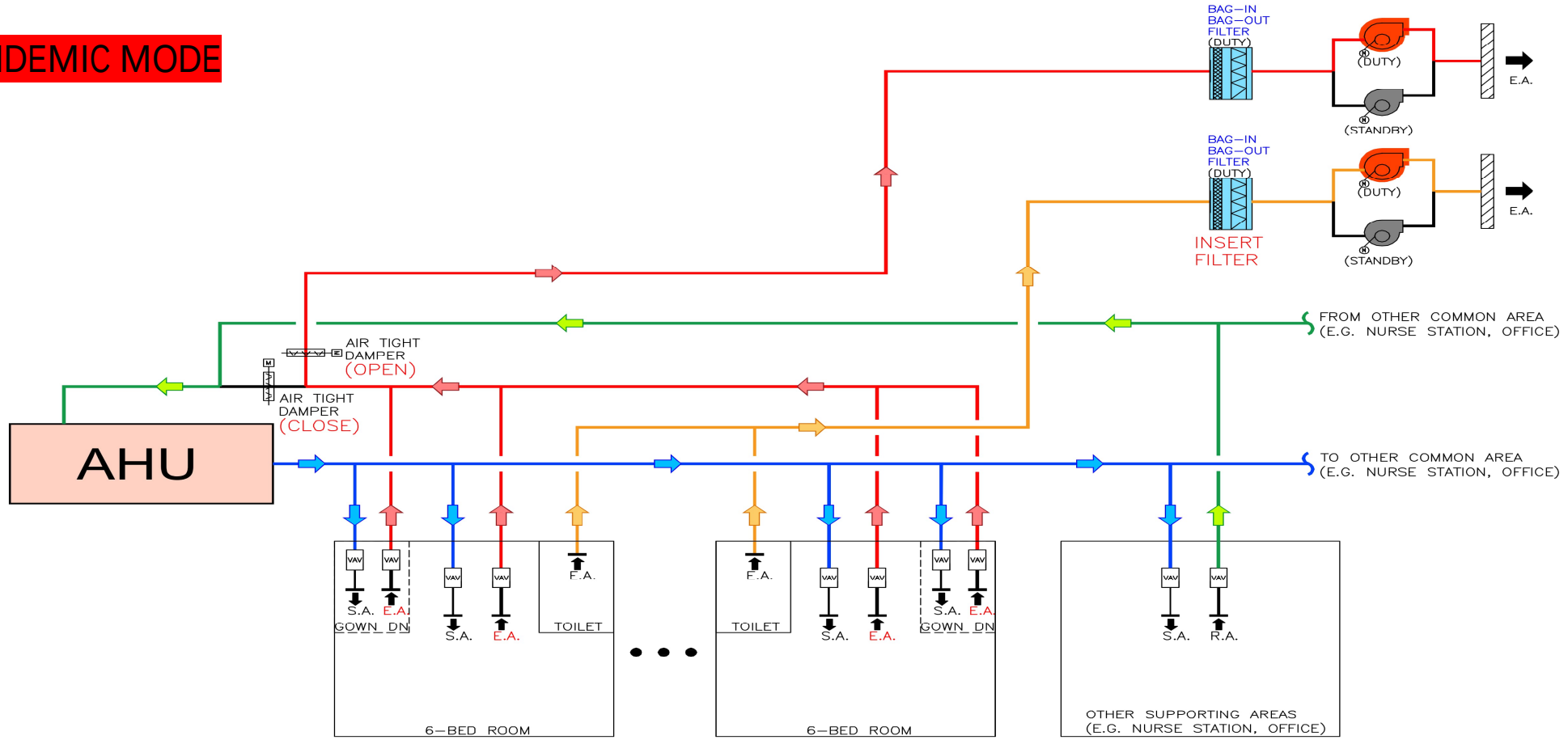
2nd Tier Isolation Facilities Example at the New Hospital

NORMAL MODE



2nd Tier Isolation Facilities
Example at the New Hospital

PANDEMIC MODE



STRATEGIES FOR IMPROVING VENTILATION SYSTEM

- Regular maintenance and inspection of ventilation systems to ensure they are functioning properly.
- Upgrading ventilation systems to meet modern standards and improve air filtration.
- Investing in new technologies, such as ultraviolet germicidal irradiation (UVGI) and high-efficiency particulate air (HEPA) filters.
- Developing emergency plans to quickly respond to outbreaks and other crises.

REGULAR MAINTENANCE AND INSPECTIONS:

Routine maintenance and inspections of ventilation systems are essential to identify and address potential issues before they become significant problems.

ROUTINE MAINTENANCE

Filter Replacement

- Regular Inspection
- More Frequent for Critical Areas

Cleaning

- Supply, Return & Exhaust Grilles
- Ductwork
- Air Handling Units
- Cooling coils & Heat Exchangers

Airflow Testing

- Verify airflow rates in critical spaces
- Verify pressurization of critical spaces

Calibration of Sensors & Controls

- Maintain calibration record

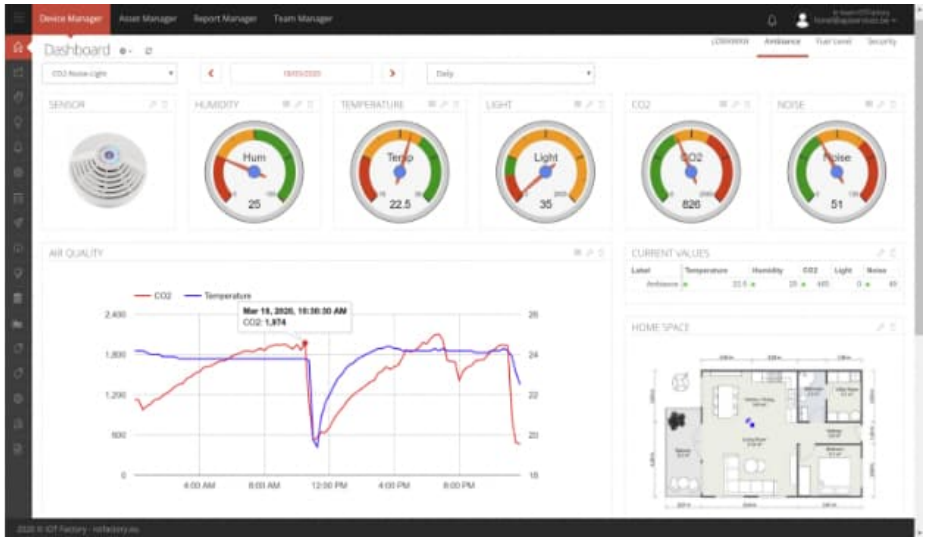
Fan & Motor Maintenance

- Check for signs of wear & tear
- Predictive maintenance systems

MONITORING AND ALERT SYSTEMS

Implementing real-time monitoring and alert systems for ventilation can help identify irregularities or malfunctions promptly, allowing for timely responses and corrective actions.

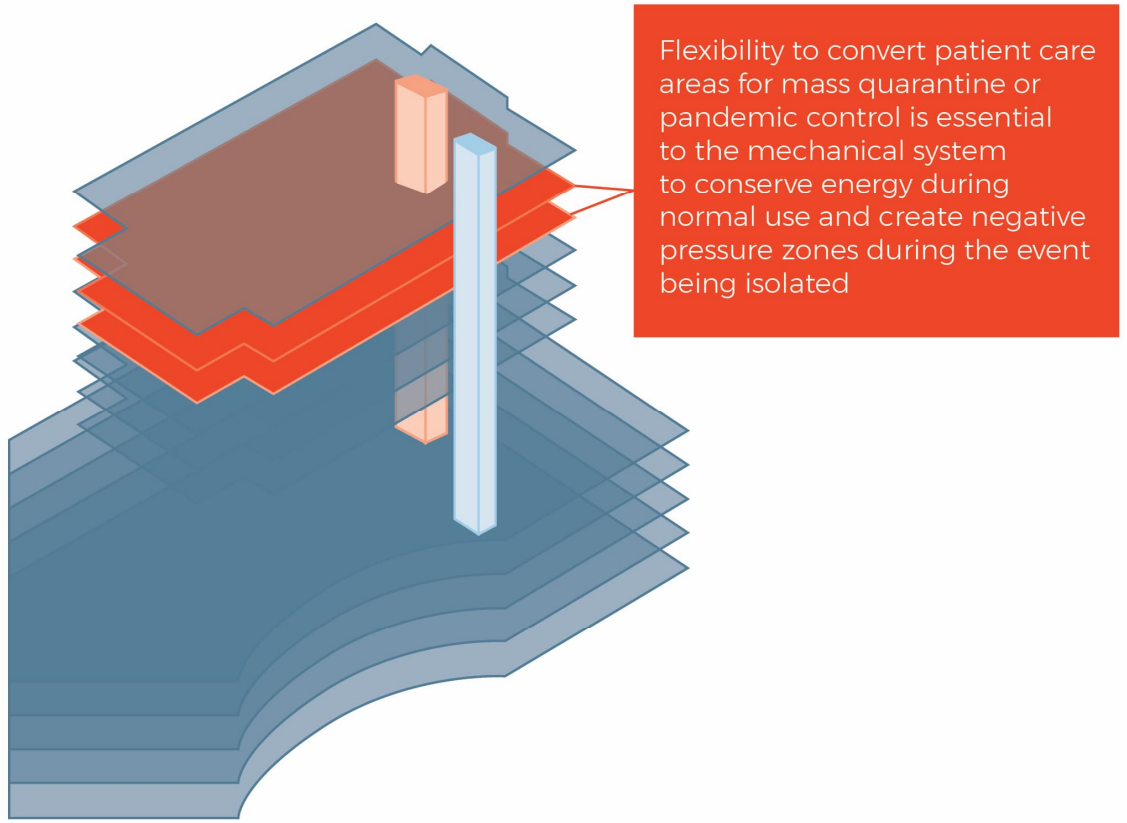
MONITORING & ALERT SYSTEMS



- BMS or BAS
- Environmental Monitoring Systems
- Differential Pressure Monitoring
- Airborne Particle Counters
- Energy Management Systems
- Remote Monitoring & Control
- Data Logging & Reporting
- Could-Based Solutions
- Integration in Electronic Health Records (EHR)

DESIGN FOR FLEXIBILITY

Hospitals should consider the flexibility of their ventilation systems during the design phase to accommodate changing healthcare needs, technology advancements, and future challenges.



EDUCATION AND TRAINING

Ensuring that hospital staff, especially facilities management and engineering personnel, receive appropriate training and education on ventilation systems' operation and emergency response procedures is crucial for effective resiliency.

EDUCATION & TRAINING

- Understanding Healthcare Env.
- Regulatory Compliance
- Infection Control
- Safety Protocols
- Equipment Familiarization
- Maintenance Procedures
- Calibration & Testing
- Documentation
- Emergency Preparedness
- Communication Plans
- Hands-On Training
- Assessment & Certification

A Checklist to get started for your Ventilation Resiliency

1	Does your facility conduct a Risk Assessment for the Ventilation System	Yes/No
2	Does your facility have a comprehensive inventory of all ventilation systems and equipment	Yes/No
3	Does your facet have all critical areas identified to ensure that their operation is maintained during disruptions	Yes/No
4	Does your facility ensure that the Critical Ventilation System are on Emergency Power	Yes/No
5	Does your faculty have a routine maintenance for ventilation systems & have records maintained	Yes/No
6	Does your facility have a contingency plans for various scenarios, including power outages and air quality issues	Yes/No
7	Does your facility have a system implemented for continuous monitoring and alarm systems for ventilation performance	Yes/No
8	Does your facility train hospital staff on emergency procedures related to ventilation resiliency	Yes/No
9	Does your facility have established clear communication protocols for reporting ventilation system issues and emergencies	Yes/No
10	Does your facility do Regularly test and monitor indoor air quality, especially in critical areas, to ensure patient and staff safety	Yes/No

0-4	Beginner
5-7	Intermediate
8-10	Advanced

Hospitals must prioritize ventilation system resiliency and flexibility to be better prepared for the next pandemic.

By investing in modern ventilation technologies and emergency preparedness

Questions

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