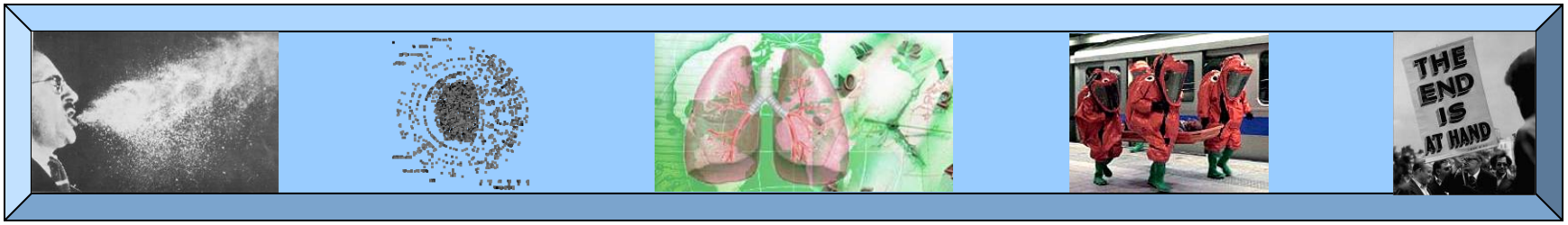
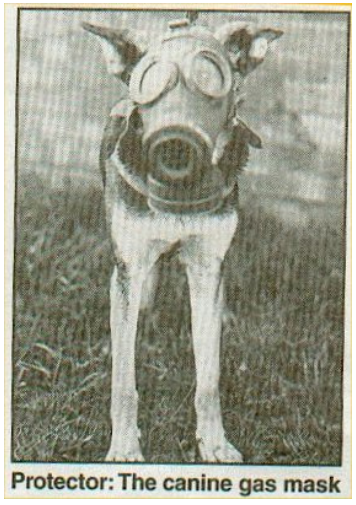


Environmental Controls for droplet and airborne transmissible pandemic disease containment


Protector: The canine gas mask

Presenter: David Lutz

Director of Marketing
Mintie Inc.

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Disclosures-Disclaimer

- David Lutz works for Mintie Technologies
- Mintie is a provider of Portable Airborne Particulate Containment and Filtration solutions.
  - Construction and Maintenance
  - Patient Isolation
  - Pandemic Preparedness

- David works with many Epidemiologists, IPs and Facility Engineers but is not one himself

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PCAST Report

- 30-50% of US could contract A/H1N1
- 30-90,000 potential mortalities
- 1.8 million potential hospital admissions

- Based on the assumption A/H1N1 does not become more severe

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Surge Capacity Issues

- Environmental Controls:
  - Limited number of private rooms and even fewer true AIIRs
    - U.S. GAO report, 2000: >50% hospitals have ≤ 4 AIIRs/100 staffed beds
    - Smaller facilities may have 1-2, or no AIIRs
    - 38.3% of Hospitals do not have an AIIR (2004 AHA)
  - Existing HVAC - Very limited capability to isolate sections of a facility

- Patient-Related Factors:
  - Likely will be unaware/ignore federal hospital designation and will present at their usual hospital
  - Expect a significant proportion of the surge to be "worried but well"
    - Are there alternative sites for them?
  - Endemic needs of the population, e.g. heart attack, injury, etc., will require judicious use of emergency care services
    - ER can be overwhelmed by surge

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A/H1N1 Prep Nurse Survey

- **Nurses sited inadequate isolation of A/H1N1 patients in a quarter of hospitals**

- **At 49% of facilities, nurses say they have not been adequately trained to identify and care for infected patients**

California Nurses Association/National Nurses Organizing Committee
http://www.calnurses.org/media-center/press-releases/2009/august/
many-hospitals-are-not-ready-for-h1n1-nurse-survey-shows-deficiencies-in-hospital-swine-flu-readiness.html

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Objectives

- Review regulations / guidelines
- Identify locations requiring containment
- Discuss environmental control options

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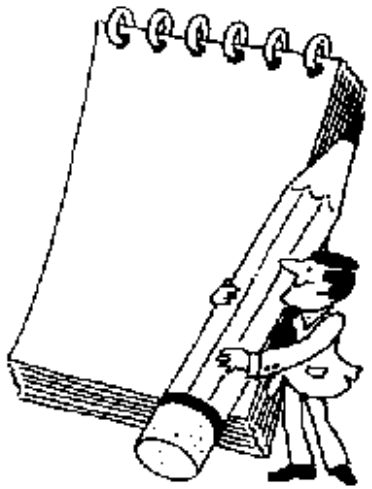
Agenda

- Tools for Responding to Pandemics
- Recommendations and Guidelines
- Containment Locations
- Environmental Control Solutions
- Recap
- Questions



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Pandemic Response Tools

- Anti-Viral drugs
  - Reactive
  - Influenza focused
  - Vulnerable to resistance

- Vaccines
  - Proactive
  - Strain specific
  - Production lead time
  - Pre exposure application

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Pandemic Response Tools

- Administrative
  - Reduce opportunities for exposure

- Environmental / PPE
  - Proactive
  - Non disease specific
  - Reduces exposure risk
  - Location oriented (environmental)

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CDC/HICPAC Guideline

- Tier 1 - Standard Precautions: Implemented for all patient care.
  - Hand hygiene; PPE; Respiratory Hygiene; Patient placement (e.g. single occupancy room vs ward); Safe injection practices
- Tier 2 -Transmission-based Precautions: documented or suspected infection or colonization with highly transmissible or epidemiologically-important pathogens.
  - Contact
  - Droplet
  - Airborne

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

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Modes of Transmission

- Contact:
  - Direct = microbe transferred directly from patient to caregiver; example: scabies
  - Indirect = transfer of germs via intermediate object or person; caregiver picks up germs from contaminated surface and transfers to the patient, example: methicillin-resistant *S. aureus* (MRSA)

- Droplet: microbe in respiratory droplets produced by cough or sneeze; droplets travel 3-6 feet; examples: influenza, SARS-CoV

- Airborne: germ in respirable droplet nuclei becomes airborne and can travel long distance and be inhaled deep into lung; examples: *Mycobacterium tuberculosis, Aspergillus spp.*

“5 microns” Rule Overturned

- Diameter related to unique pathogenesis of pulmonary *Mycobacterium tuberculosis* infection
  - Terminal alveolar deposition
  - “Obligate” inhalational transmission via droplet nuclei
- However, we know that:
  - Much larger particles can float and are inhaled.
  - Most inhaled particles are not infectious.
  - Most respiratory pathogens do not require terminal alveolar deposition, but infect the upper respiratory mucosa.
  - “Opportunistic” inhalational transmission? [e.g. SARS-CoV]

Source: Michael Bell, MD – Exec. Secretary, Healthcare Infection Control Practices

Advisory Committee (HICPAC), CDC

Droplet & Airborne

Joint Commission

- Infection Prevention and Control **IC.01.06.01**
  - The hospital describes, **in writing**, how it will respond to an influx of potentially infectious patients. **D*** [IC.01.06.01.04]
    - Note: One acceptable response is to decide not to accept patients.
  - If the hospital decides to accept an influx, then the hospital describes **in writing** its methods for managing these patients over an extended period of time. **D*** [IC.01.06.01.05]
  - EP 6. When the hospital determines it is necessary, the hospital activates its response to an influx of potentially infectious patients. [IC.01.06.01.06]

D = document required

Joint Commission

- Emergency Management (EM) 03.01.03
  - As an emergency response exercise, the hospital activates its Emergency Operations Plan twice a year at each site included in the plan. [EM.03.01.03.01]
  - For each site of the hospital that offers emergency services or is a community-designated disaster receiving station, at least one of the hospital's two emergency response exercises includes an influx of simulated patients. [EM.03.01.03.02]
    - Note 1: Tabletop sessions, though useful, cannot serve for this portion of the exercise.
  - For each site of the hospital that offers emergency services of is a community designated disaster receiving station, at least one of the hospital's two emergency response exercises includes an escalating event in which the local community is unable to support the hospital. [EM.03.01.03.03]
    - Note 1: This portion of the emergency response exercise can be conducted separately or in conjunction with EM 03.01.03, EPs 2 and 4

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CMS

- EMITALA
  - Intended to prevent patient dumping
  - Complaint based system
  - Does not prevent on campus redirection
  - Medical Screening Exam ≠ Full triage
- Waiver
  - President and HHS Secretary take action
  - State & Hospital emergency plans activated

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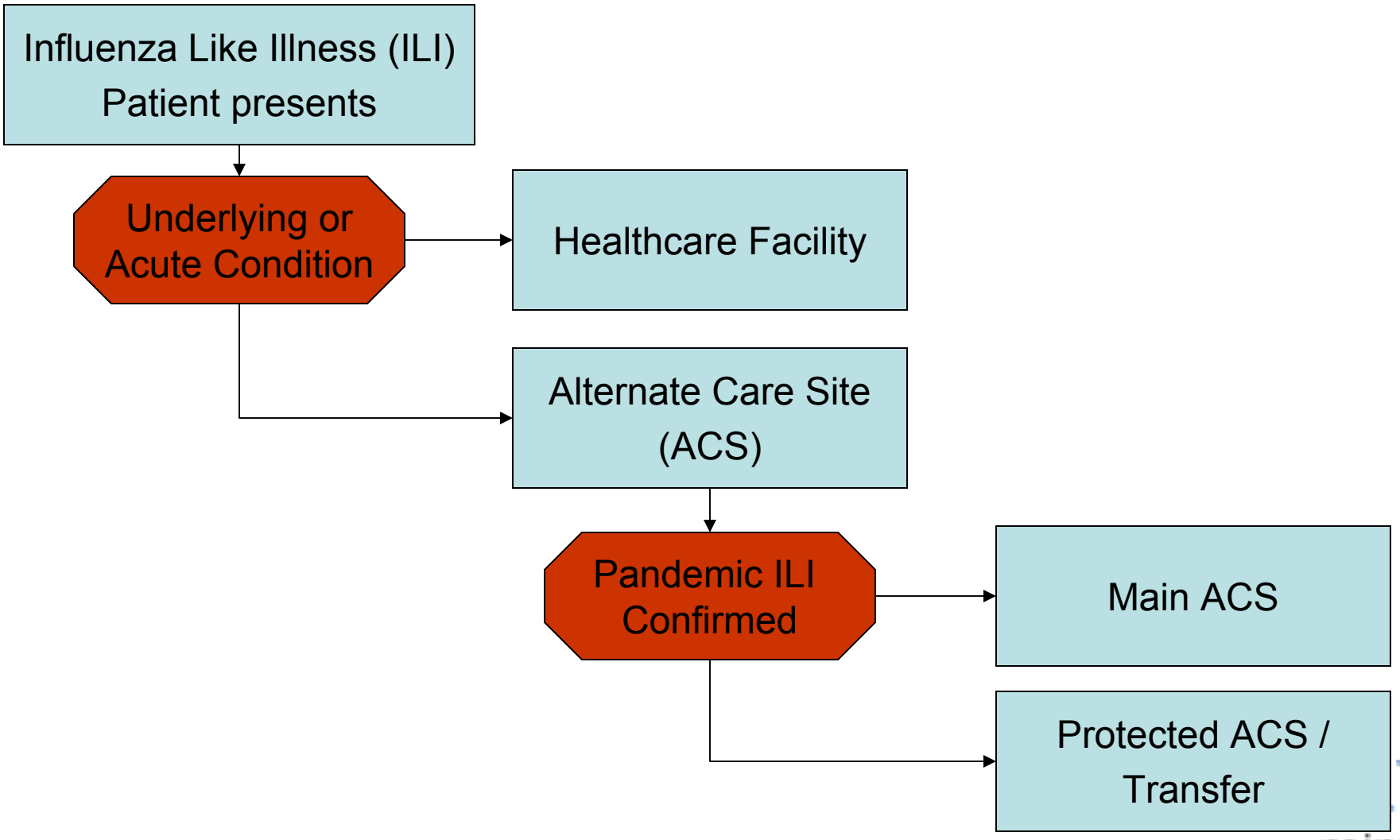
Patient Assessment



Patient Types

- ILI patients presenting at ER
  - 1) Need to be at Main Facility
  - 2) End up at Main Facility

- ILI patients presenting / redirected to ACS
  - 3) Pandemic disease patients
  - 4) Non-pandemic disease patients
    - Seasonal
    - Other
    - Worried Well

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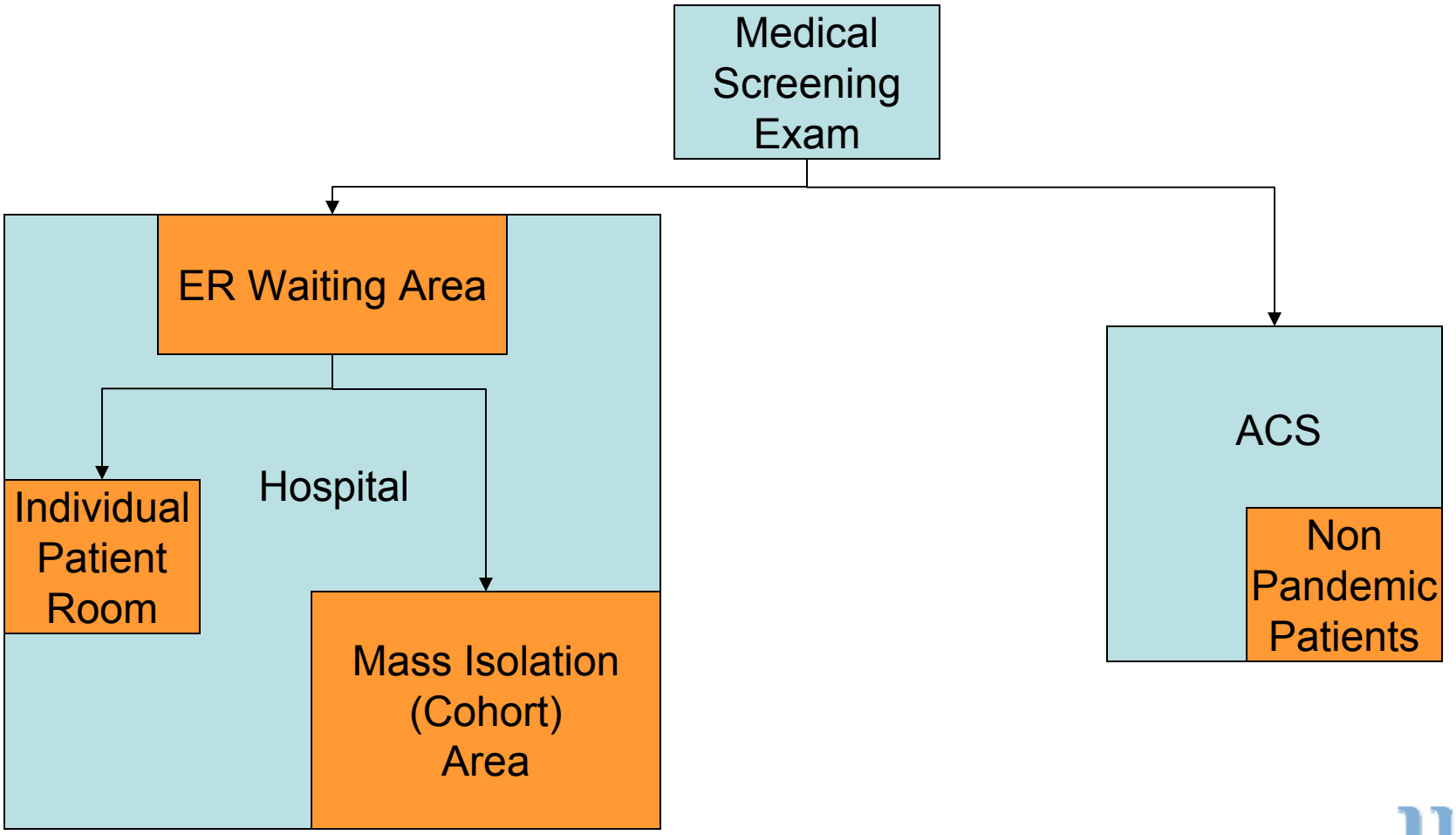
Containment Locations



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Containment Options

- ER
- Individual Patient Room
- Mass Isolation (Cohort) Area
- ACS

Reputable Manufacturer

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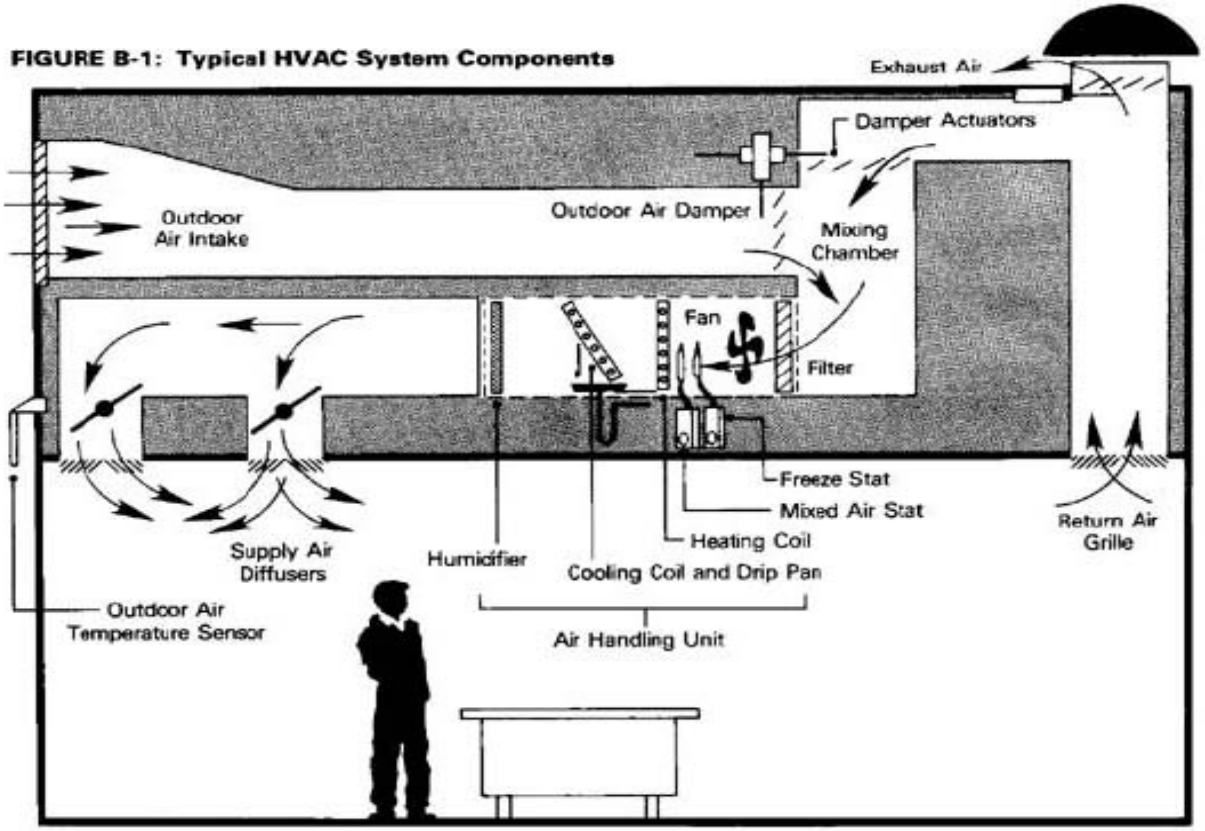
HVAC Systems



- Does not provide containment
- Dilution Ventilation, Exhaust Ventilation
- Supply only option

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Emergency Room

Emergency Room

- Freestanding NAM
- HEPA Filtered
- 99.99% Effective @ 3µ
- Visible Reminder
- Social Distancing
  - ILI area
- Make Available
  - Surgical Masks
  - Hand wash dispensers

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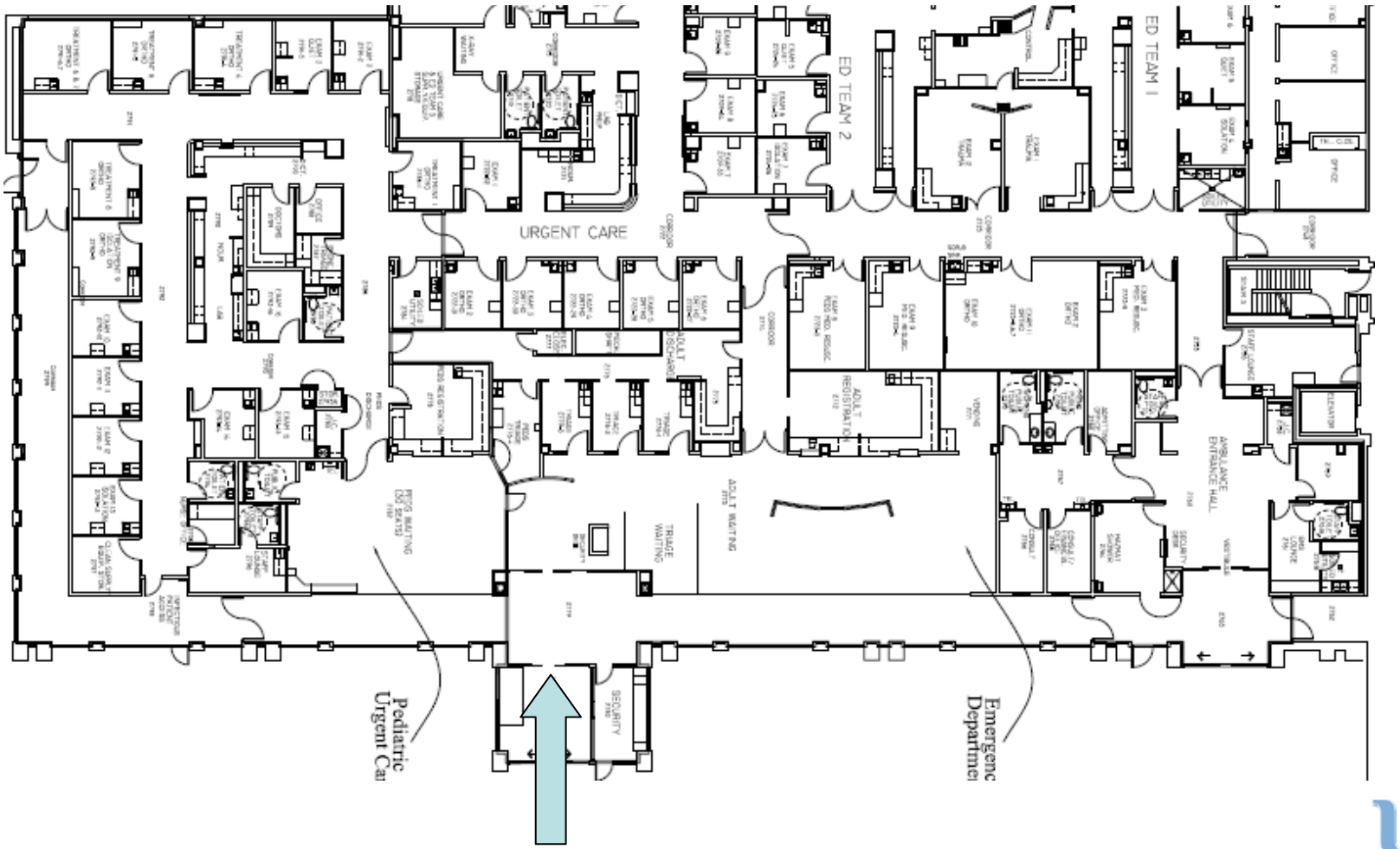
ER Layout & Patient Flow



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Surge Plan Elements

- Administrative Strategies:
  - Respiratory hygiene / cough etiquette
  - Spatial separation, e.g febrile respiratory illness (FRI) in waiting areas
  - Detection & response activation; follow emergency operations & disaster plans + hospital incident command

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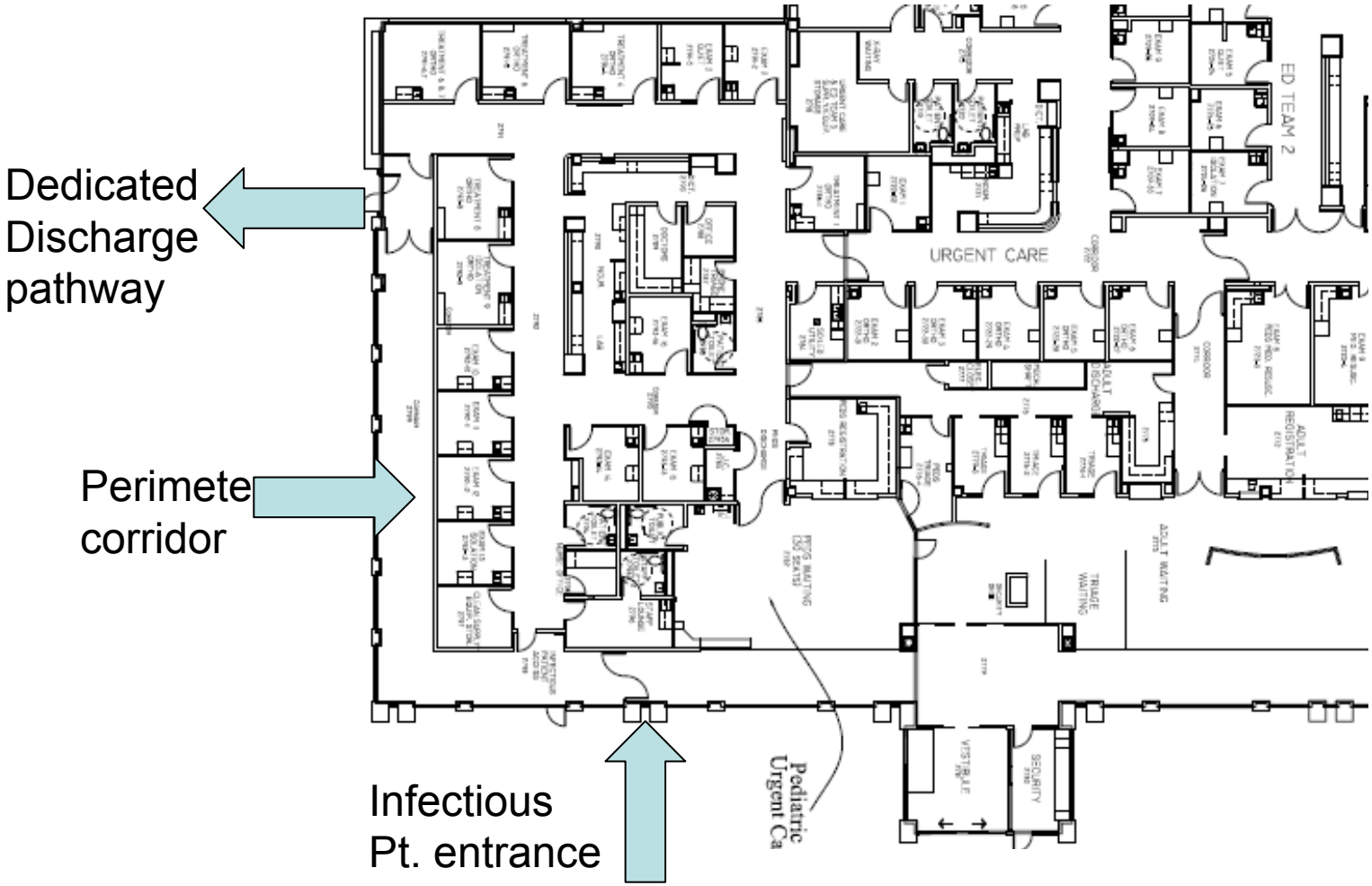
Response Phases

Response Phase	Trigger threshold	Interventions
1	Between 5 - 20 patients; similar symptoms present over matter of hours	•Notices placed •Check resp. hyg. supplies •Empty Pediatric waiting (glass-enclosed) •Move current patients to fast track •New triage station at “infectious patient entrance” •Notify Pt Resource Mgr (aka “bed manager” •Dedicated discharge pathway; infect. pts.

Surge Response Planning



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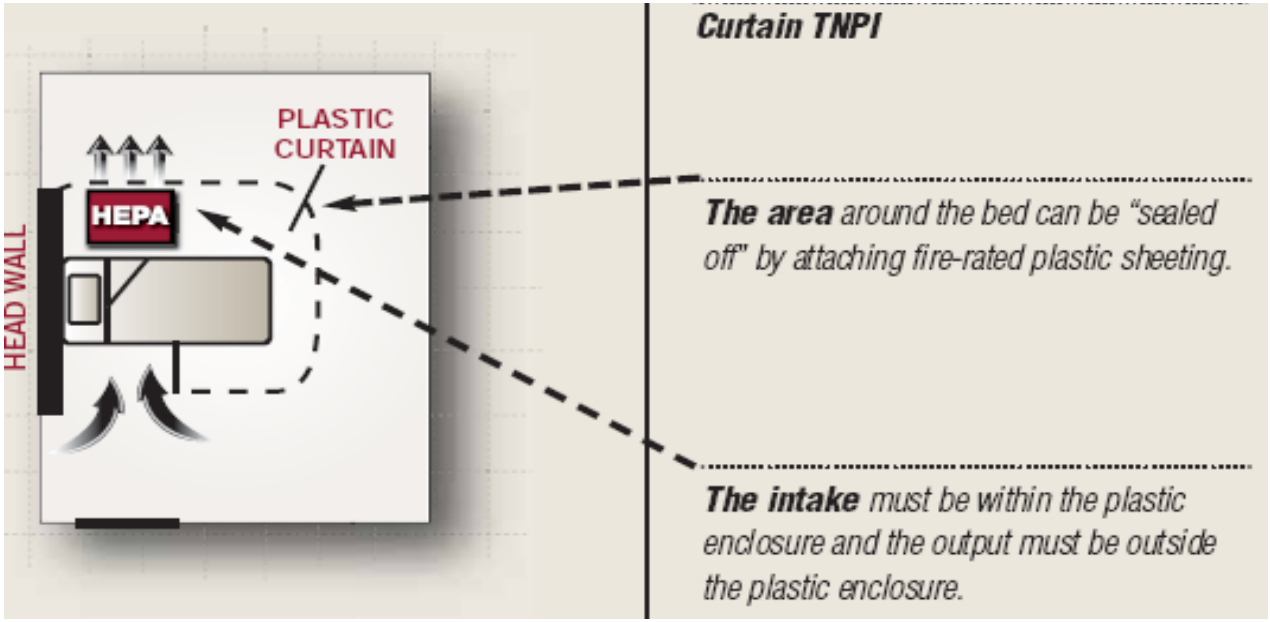
Response Phases, cont.

Response Phase	Trigger threshold	Interventions
2	≥ 20 patients; similar symptoms – hours to days Total capacity = 52 patient surge	•Incident command activated •Deploy environmental containment equipment at perimeter corridor •PRM assess (Med. PCU + MICU) & expedite transfers /discharges •Suspend elective care •Surge staffing plan activated •Regional collaboration activated

Individual Patient Room

Freestanding HEPA

- Does not provide containment (to corridor)
- Noise in room
- Poles and plastic sheeting are unreliable



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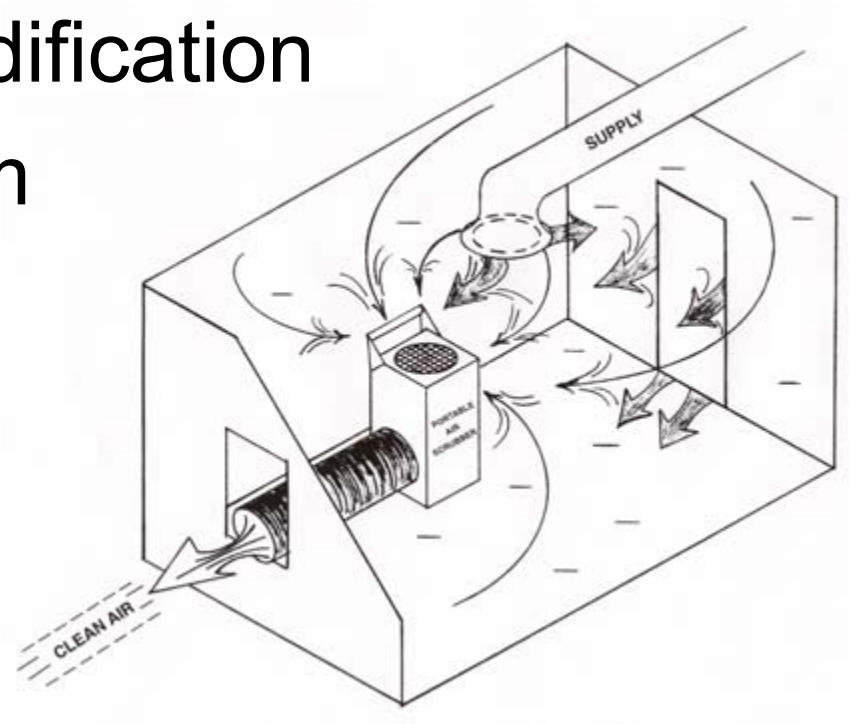
Window/Exhaust Conversion

- Requires Room Modification
- Tied to specific room
- Breaches Building
- Unbalances HVAC
- Weather exposure
- Noise in room



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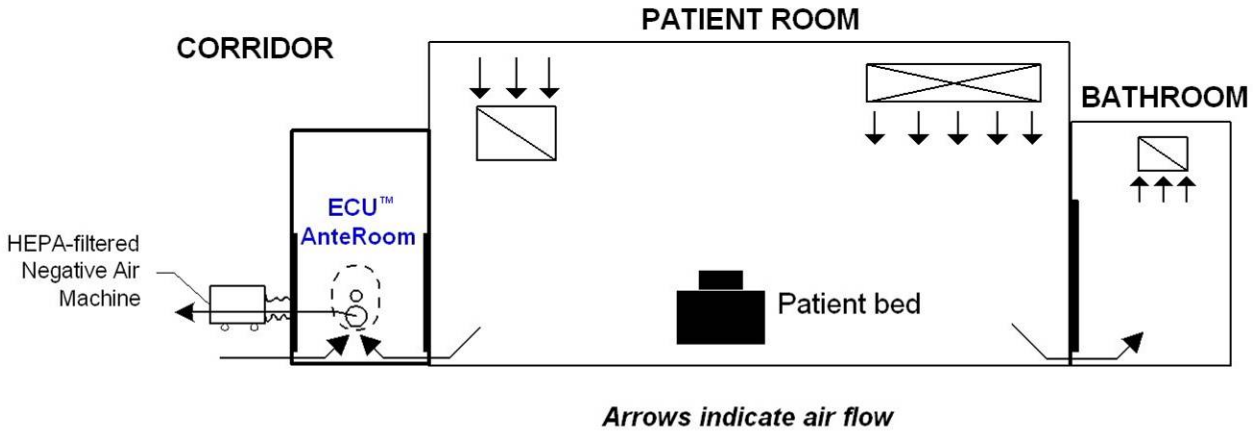
Portable Anteroom

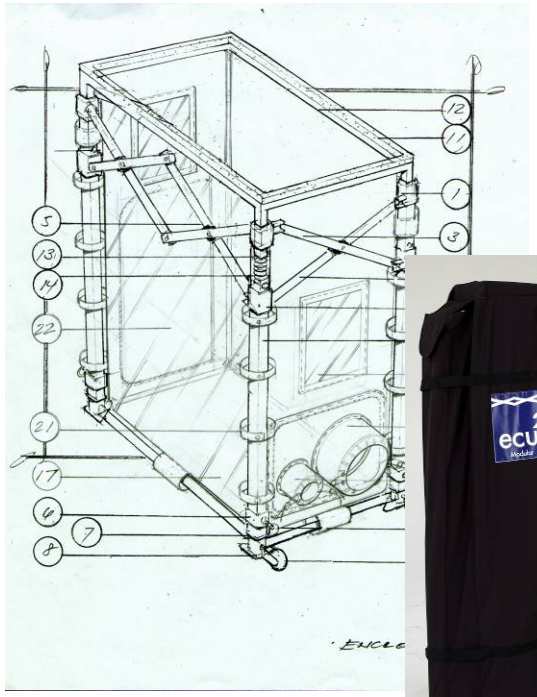
- Physical / Pressure Containment
- AIIR equivalent isolation
- NAM outside room
- No Building Modification
- Visual reminder



Arrows indicate air flow

Portable Anteroom

- External Frame
- Set up
  - Quick, Easy
  - 1 Person
- Few Pieces
- Convenient to
  - Store
  - Move
- Scalable



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Operating Room

Operating Room

- Freestanding NAM
  - Loud
  - Disrupted Airflow
  - Less efficient filtration
- Anteroom
  - Quieter
  - Directional Airflow
  - More efficient filtration

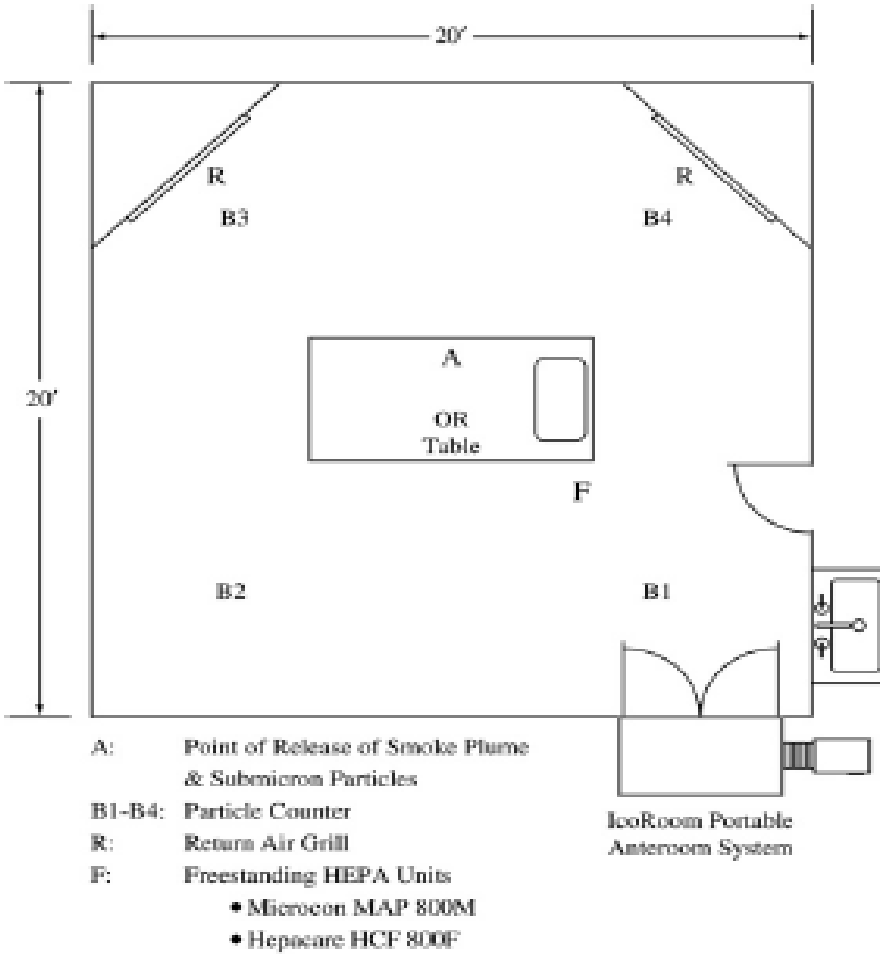

Fig 1. Configuration of operating room and location of sampling locations and equipment.

Pilot study of directional airflow and containment of airborne particles in the size of *Mycobacterium tuberculosis* in an operating room. Olmsted RN. Am J Infect Control 2008;36:260-7

Anteroom Efficiency

- Submicron Particle release
  - Baseline concentration = 6,468 particles / cu. Ft [p/cu.ft] (before particle release)
  - Initial quantity = 500,000 p/cu.ft.
  - 5 min. = 303,701
  - 10 min. = 116,664
  - 20 min = 28,034
- Removal efficiency after 20 minutes = 94.5%

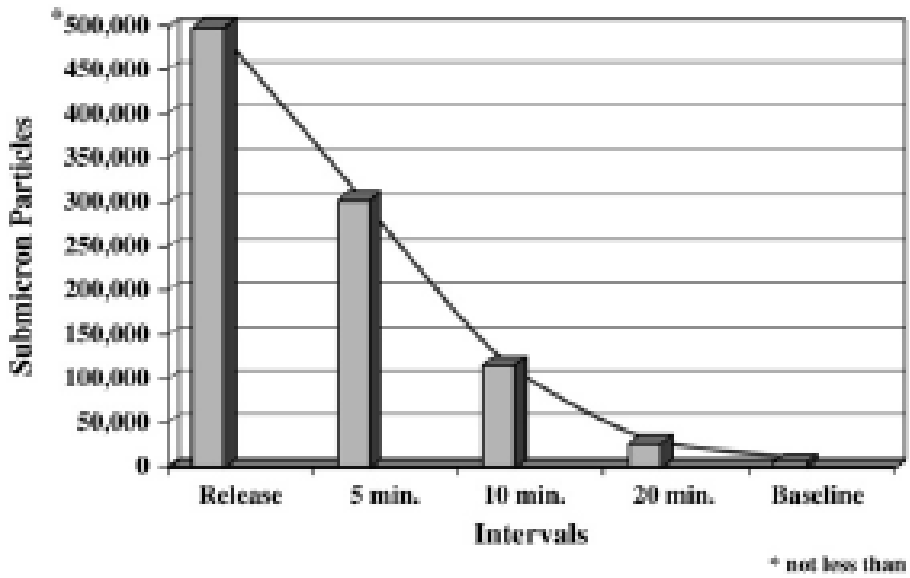

Fig 2. Efficiency of removal of submicron particles (particles/ft^3) from operating room with portable anteroom-HEPA unit device.

Particles: poly-alpha olefin (PAO); final conc. = 500,000 particles / cubic foot

Pilot study of directional airflow and containment of airborne particles in the size of *Mycobacterium tuberculosis* in an operating room. Olmsted RN. Am J Infect Control 2008;36:260-7

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Mass Isolation

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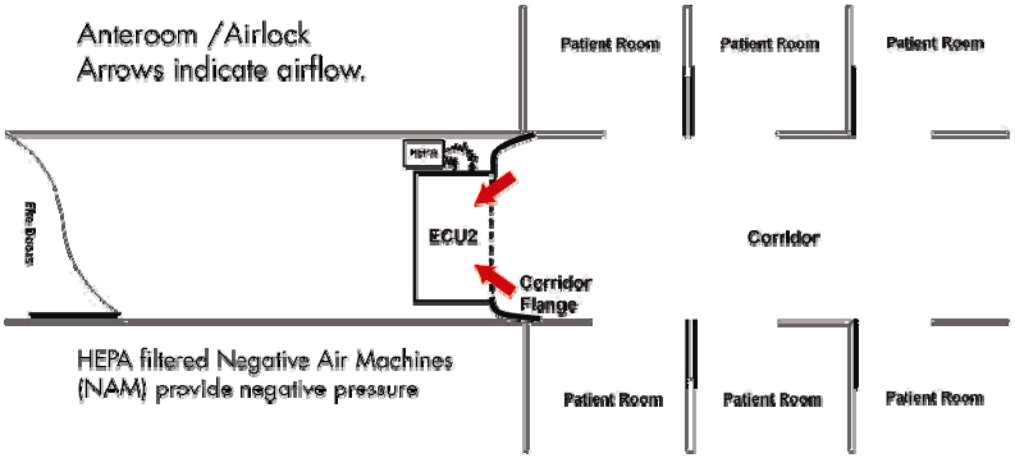
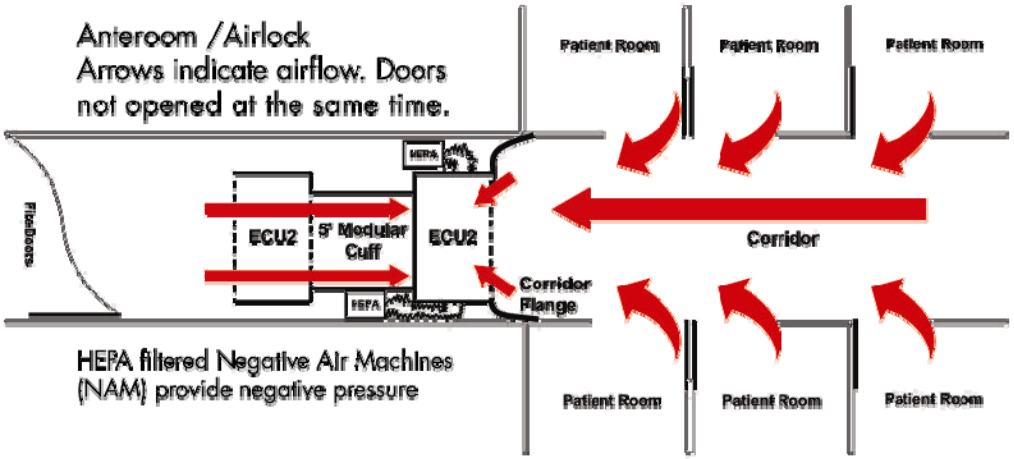
Mass Isolation - Droplet

- Physical barrier separation
- Negative pressure at entrances
- Visual alert of contained area
  - Staff PPE Reminder
  - Prevents Patient Wander



Mass Isolation – Airborne

- Physical barrier separation
- Negative pressure separation
- Extended space for gurneys, etc.
- Easily Expanded



Alternate Care Sites (ACS)

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Mobile Hospitals

- Provide “full” hospital capability
- State/region owned
- Planned as regional response
- Operated by Mobile Field Medical Teams (consistent with FEMA resource typed definition)
- Take time to deploy
- Very expensive

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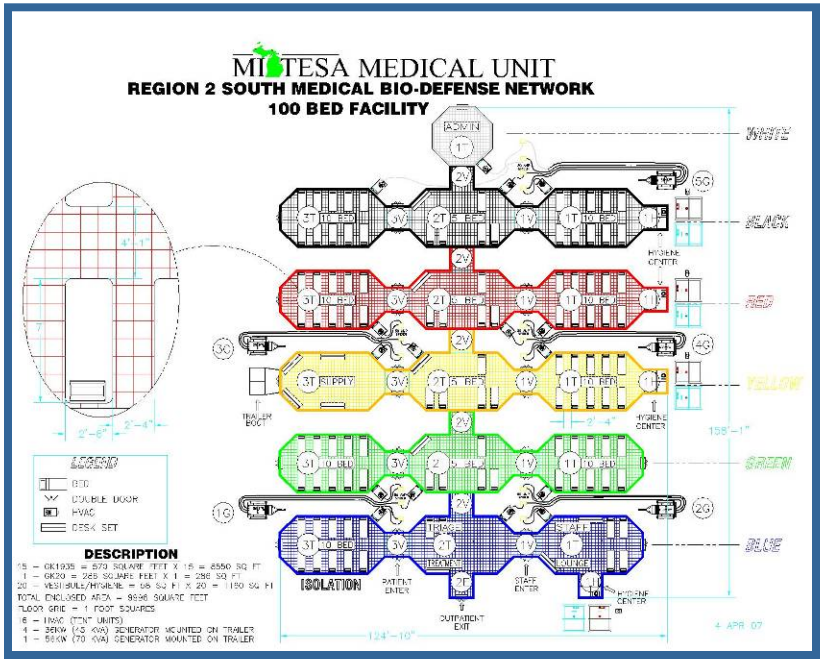
Mobile Hospital

- Michigan Transportable Emergency Surge Assistance (MI-TESA) Medical Unit
  - Michigan has purchased two interoperable mobile medical facilities from Western Shelter Systems that have the capability to join as a statewide 140-bed mobile medical facility.
  - The MI-TESA Medical Units will be operated by Mobile Field Medical Teams (consistent with the FEMA resource typed definition) under the guidance of the Regional Medical Coordination Centers.

Mobile Hospital



MI TESA Medical Unit
40-Bed
Mobile surge facility in Southwest Michigan (Region 5)

MI TESA Medical Unit
100-Bed
Mobile surge facility in Southeast Michigan (Region 2S)

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Mobile Hospital

4,500 Sf. Disaster Med. Facility

10-Bed Ward

ICU Bed

- Oriented on disaster response
- Internal separate isolation area

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Other ACS

- Medical Office Buildings (MOB)
- Schools
- Gyms
- Hotels

- Individual Patient Room Solutions
  - Protective Environment (~neutropenic)

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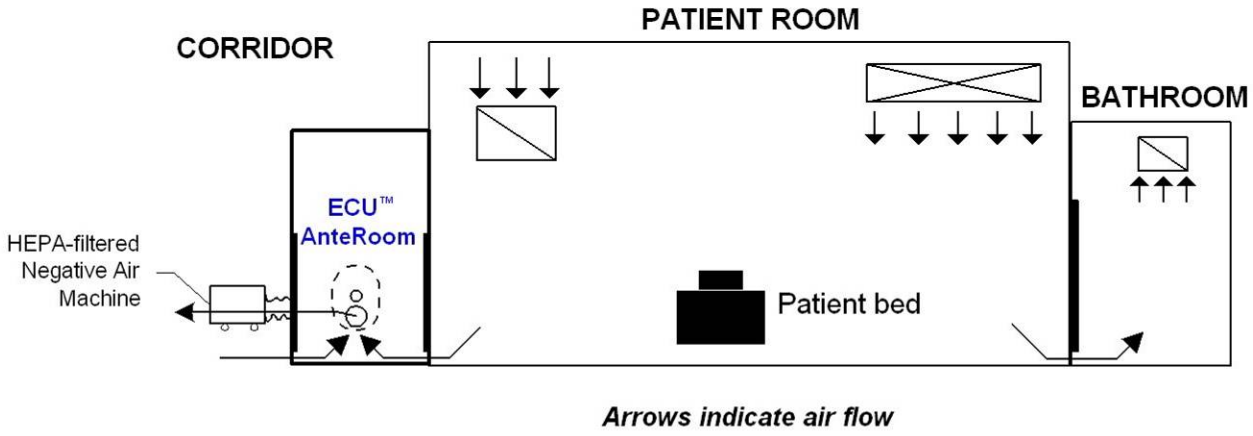
Portable Anteroom

- Physical / Pressure **Isolation**
- **Protective Environment**
- NAM outside room
- No Building Modification
- Visual reminder



Arrows indicate air flow

Key Points

- Identify Isolation Areas
- Determine how to redirect to ACS
- Evaluate HVAC
- Temporary Environmental Controls
  - Easy to set-up
  - Easy to use
  - Scaleable
  - Portable

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Thank You

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