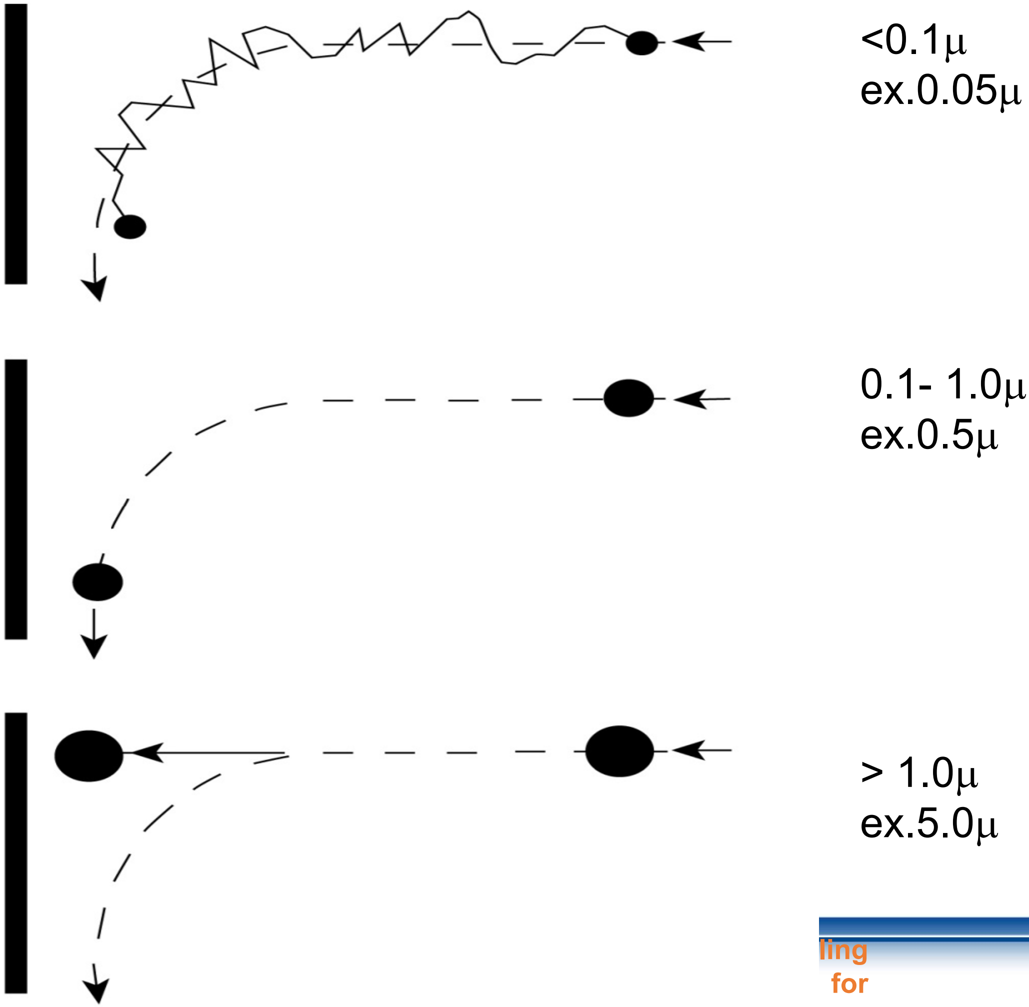
Luftrensere har de noen plass i smittevernet?

Egil Lingaas
Avdeling for smittevern
Oslo universitetssykehus

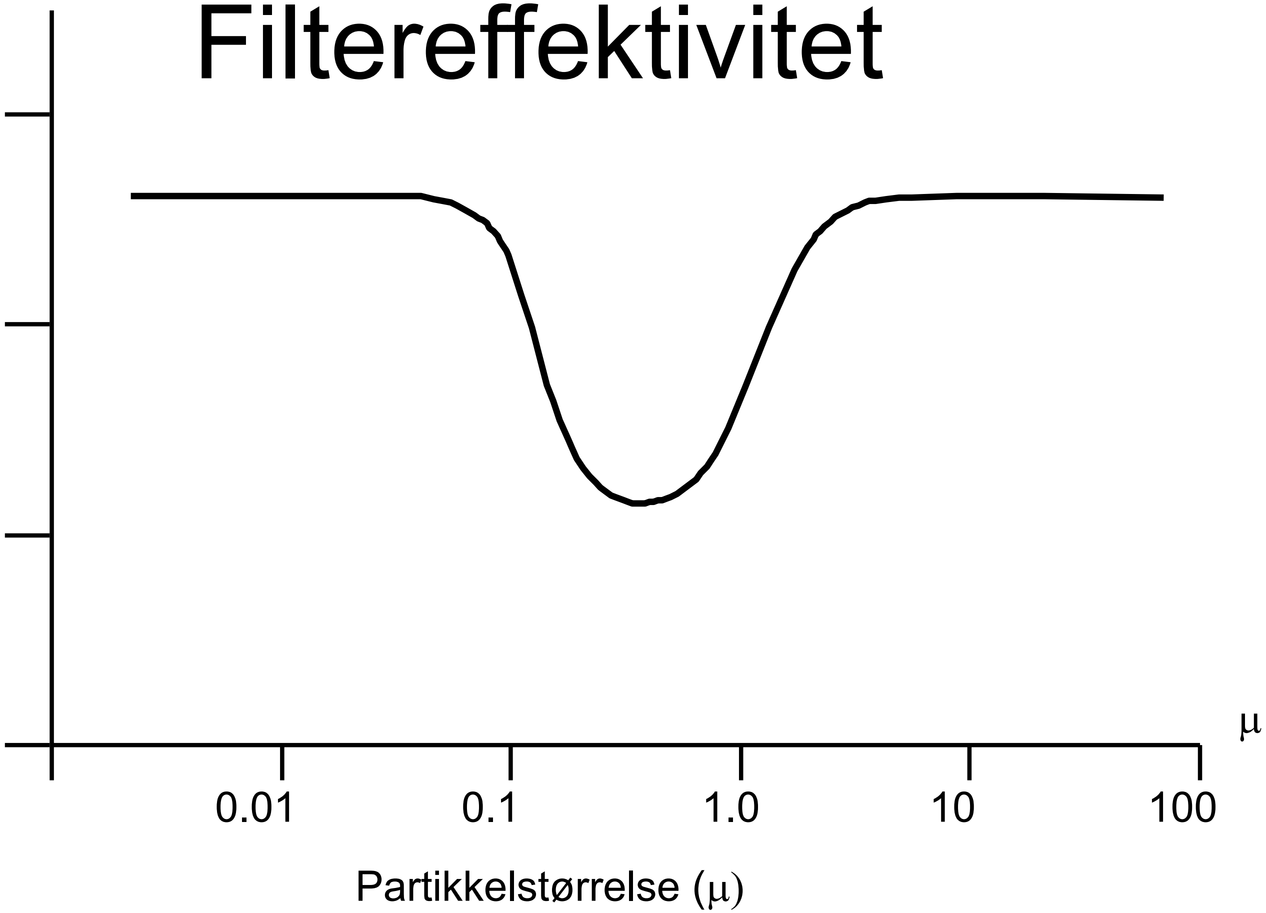
Ventilasjon av isolater

- 10 – 12 luftskiftinger per time for å beskytte personell og besøkende i isolatet
- Styrt luftretning
- Unngå kortslutninger
- Trykkgradient av størst betydning ved passasje inn og ut, men størst gradient er ikke nødvendigvis best

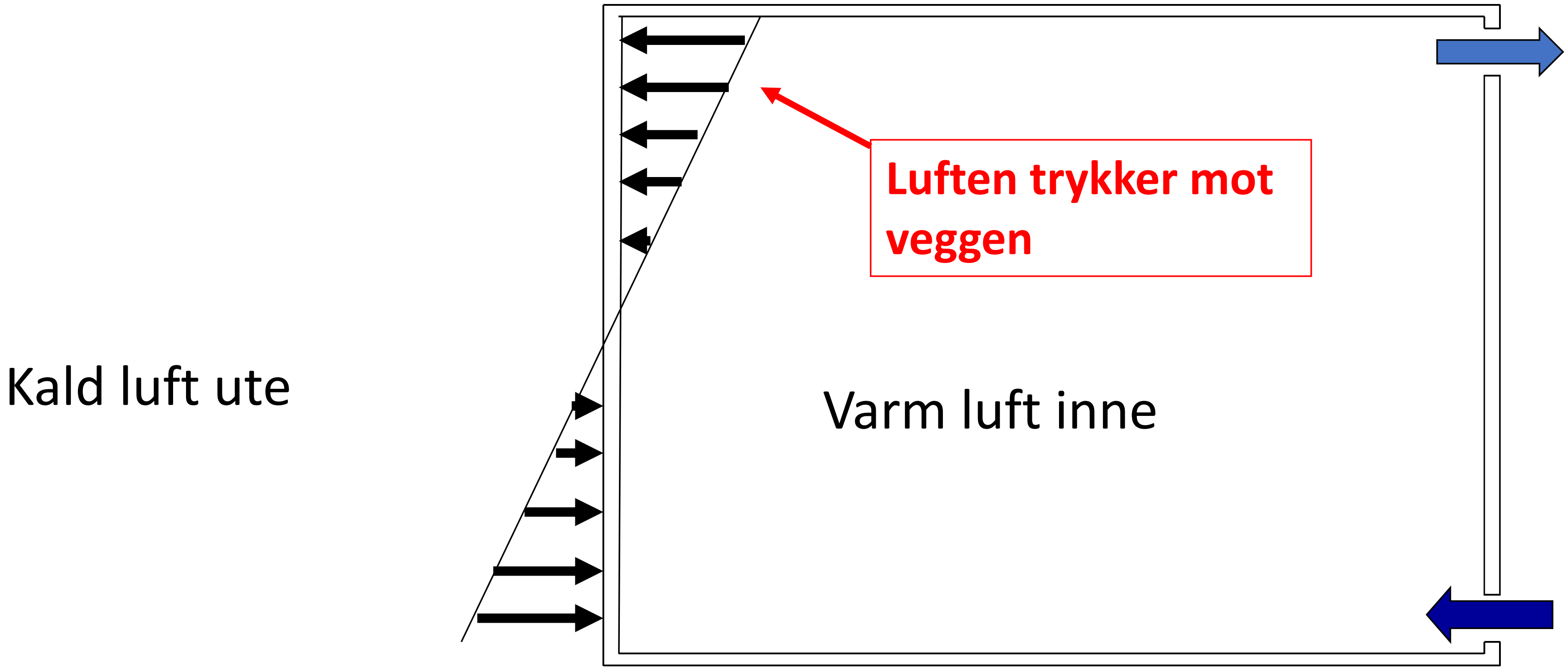
Bevegelse av partikler i luft



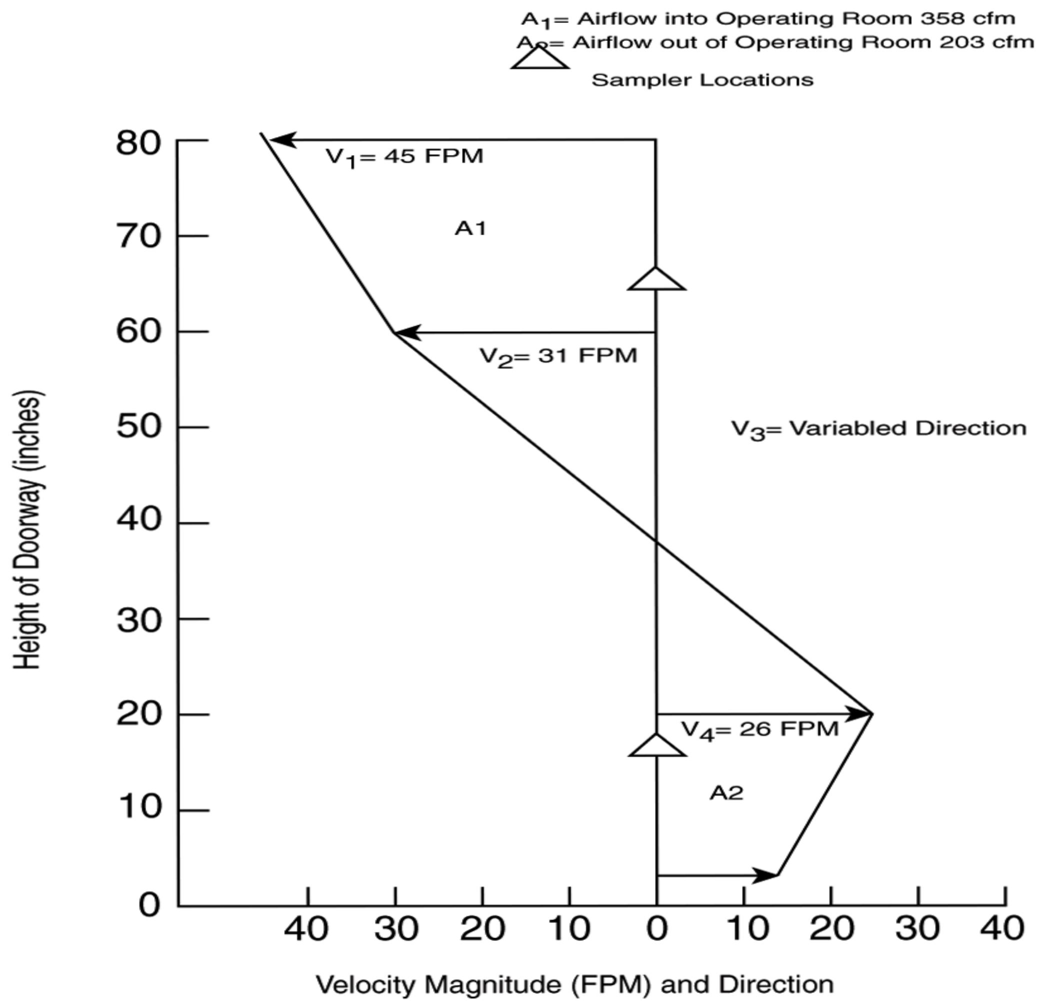
Filtereffektivitet



Naturlig ventilasjon



Operasjonsstue



Velocity Distribution through Operating Room Doorway (Room Not in Use)

Korridor

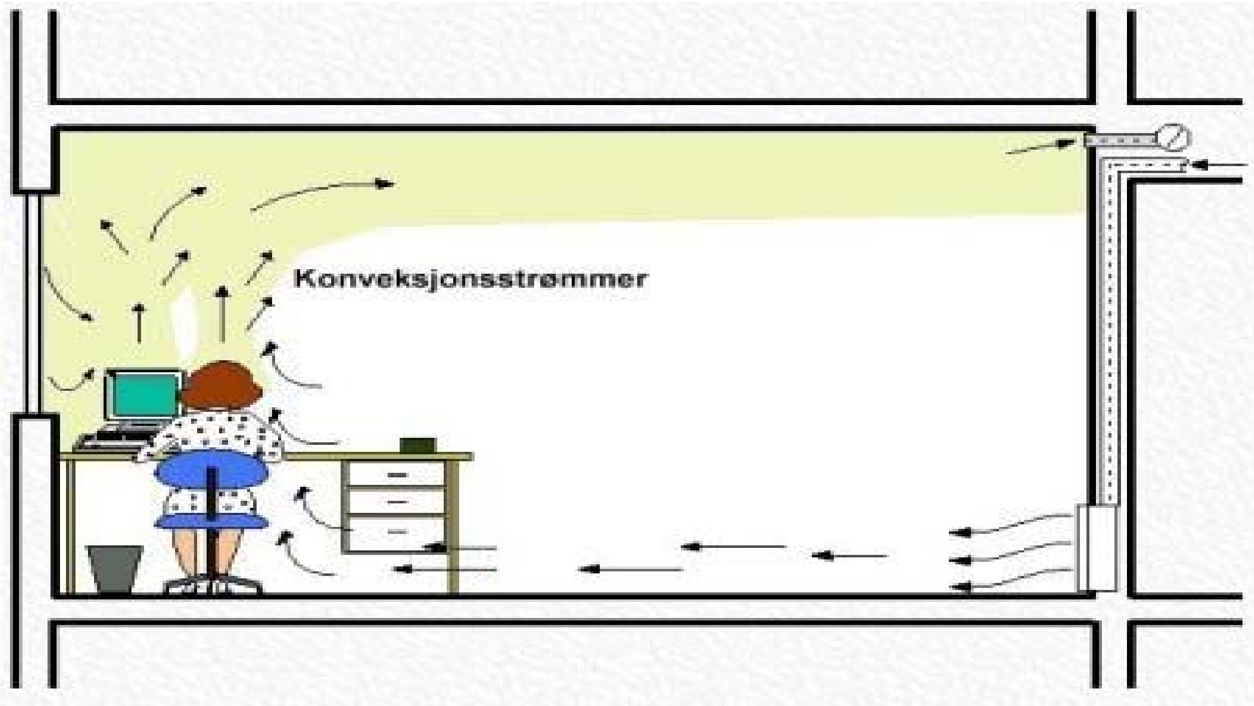
Fortrengningsventilasjon

Svakt underkjølt friskluft tilføres med lav hastighet inn ved gulvnivå mens varm og forurenset luft trekkes ut ved taknivå.

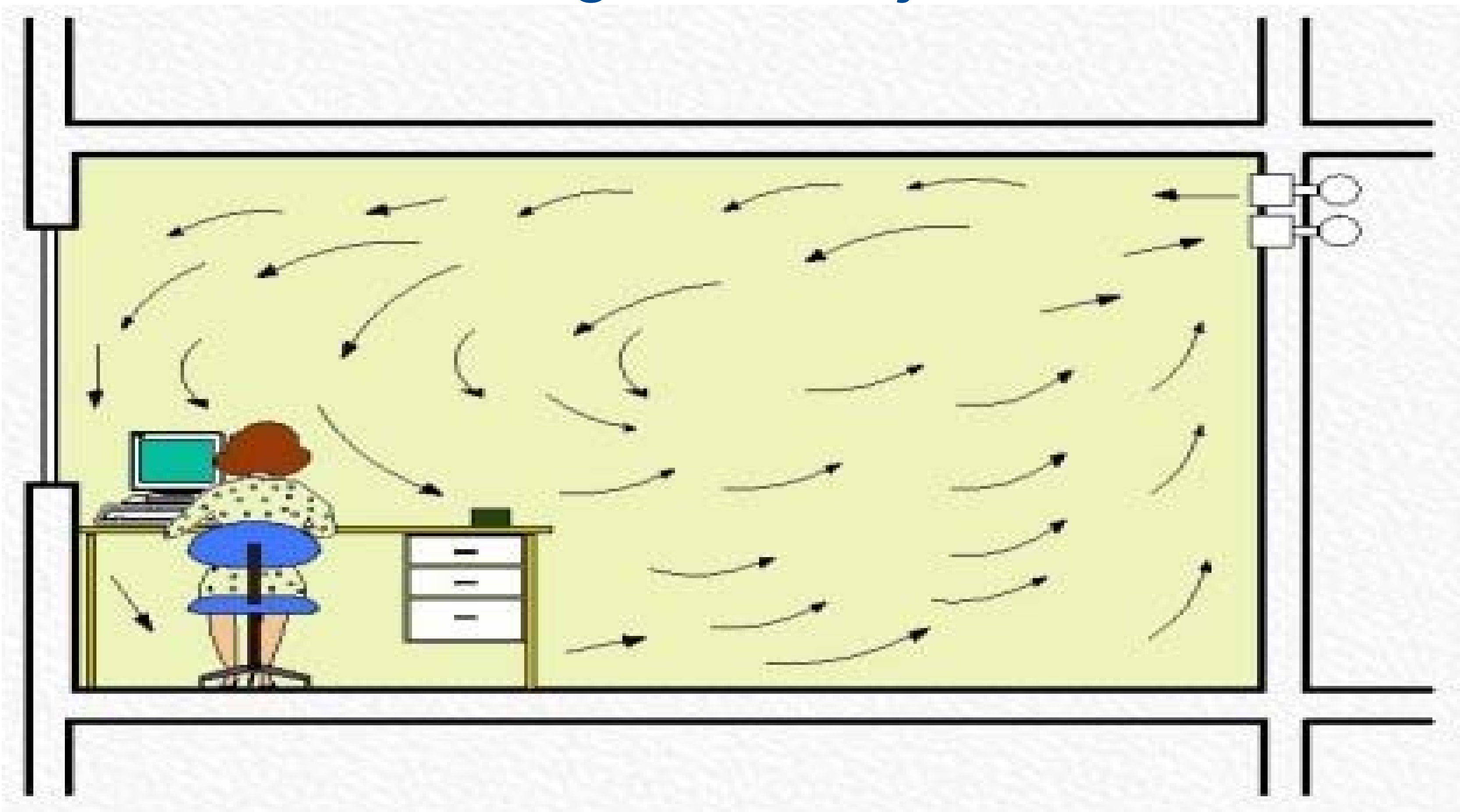
Når systemet er riktig dimensjonert, blir det skapt tilløp til sjiktning, og man oppnår kjølige og rene soner nær gulvnivå.

Effekten øker med økende takhøyde og bedret isolasjon.

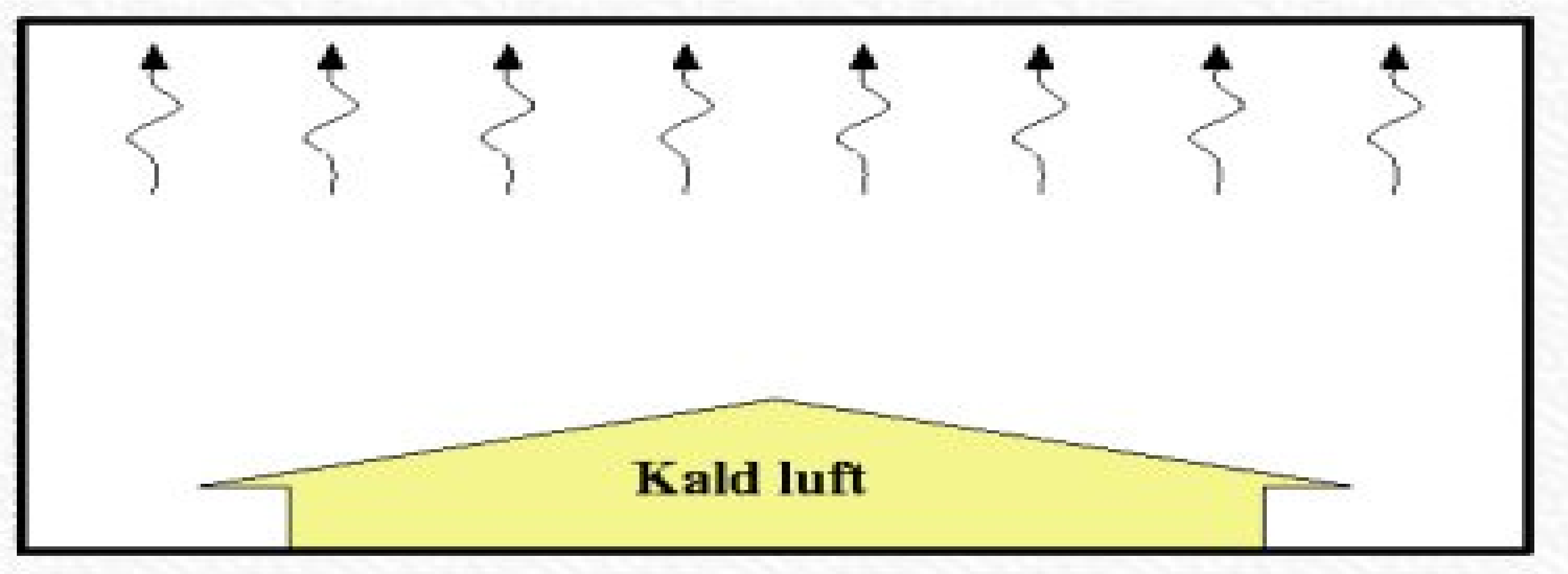
Fortrengningsventilasjon



Omrøringsventilasjon



Stempelstrøm



Vanlige teknologier for luftrensing

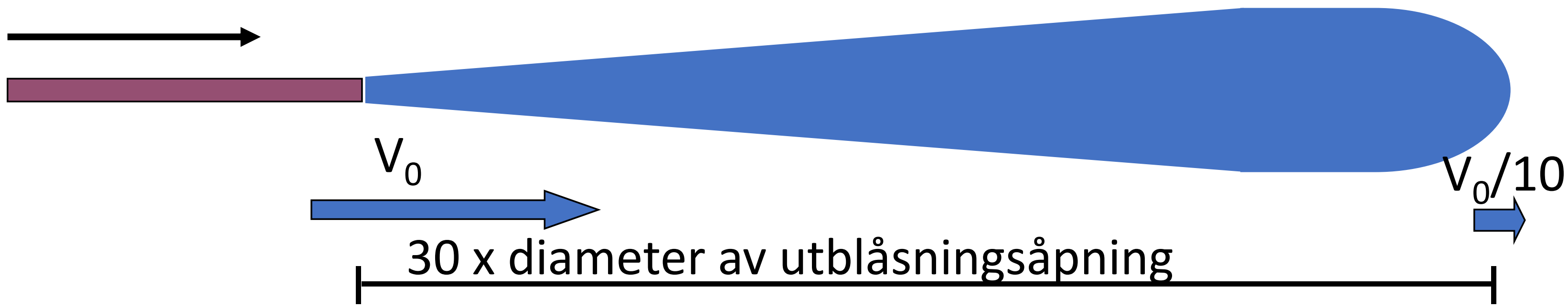
- Fortynning
- Styrt luftstrøm
- HEPA-filtrering
- HEPA-filtrering pluss UVC
- UVC
- Ionisering
- (Ozon)

Luftskift og fortynning

Luftskift per time	Antall minutter for reduksjon med		
	90 %	99 %	99,9 %
1	138	276	414
2	69	138	204
3	46	92	138
4	35	69	104
5	28	55	83
6	23	46	69
7	20	39	59
8	17	35	52
9	15	31	46
10	14	28	41
11	13	25	38
12	12	23	35
13	11	21	32
14	10	20	30
15	9	18	28
16	9	17	26
17	8	16	24
18	8	15	23
19	7	15	22
20	7	14	21
25	6	11	17
30	5	9	14
35	4	8	12
40	3	7	10
45	3	6	9
50	3	6	8

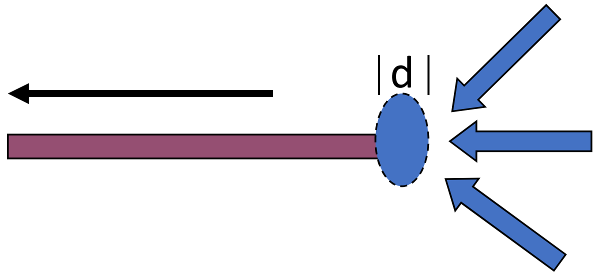
Lufthastighet ved utblåsing og avtrekk

Utblåsning:



10 % av luft-hastighet på utblåsings-punktet

Avtrekk:



10 % av luft-hastighet 1 diameter fra avtrekksåpning

Health Canada | Santé Canada | *Your health and safety… our priority.* | *Votre santé et votre sécurité… notre priorité.*

Ventilation and the Indoor Environment

Canada

ASHRAE Position Document on Infectious Aerosols

Approved by ASHRAE Board of Directors
April 14, 2020

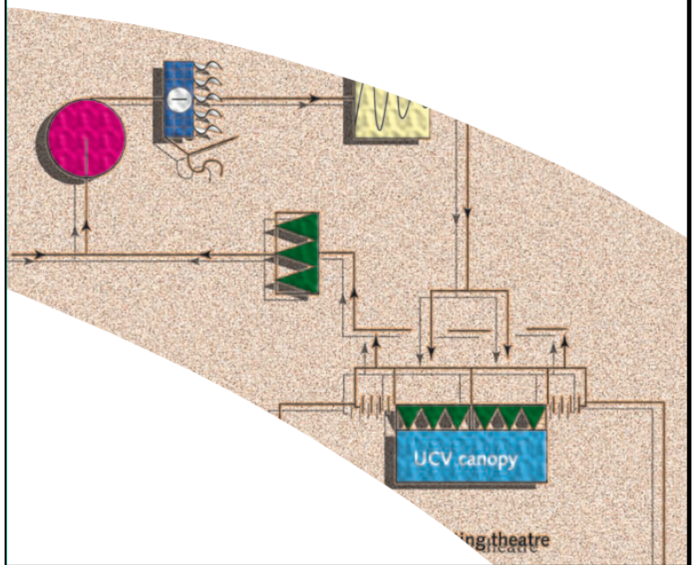
Expires
April 14, 2023

1791 Tullie Circle, NE • Atlanta, Georgia 30329-2305
404-636-8400 • fax: 404-321-5478 • www.ashrae.org

Department of Health

Heating and ventilation systems
Health Technical Memorandum 03-01: Specialised ventilation for healthcare premises

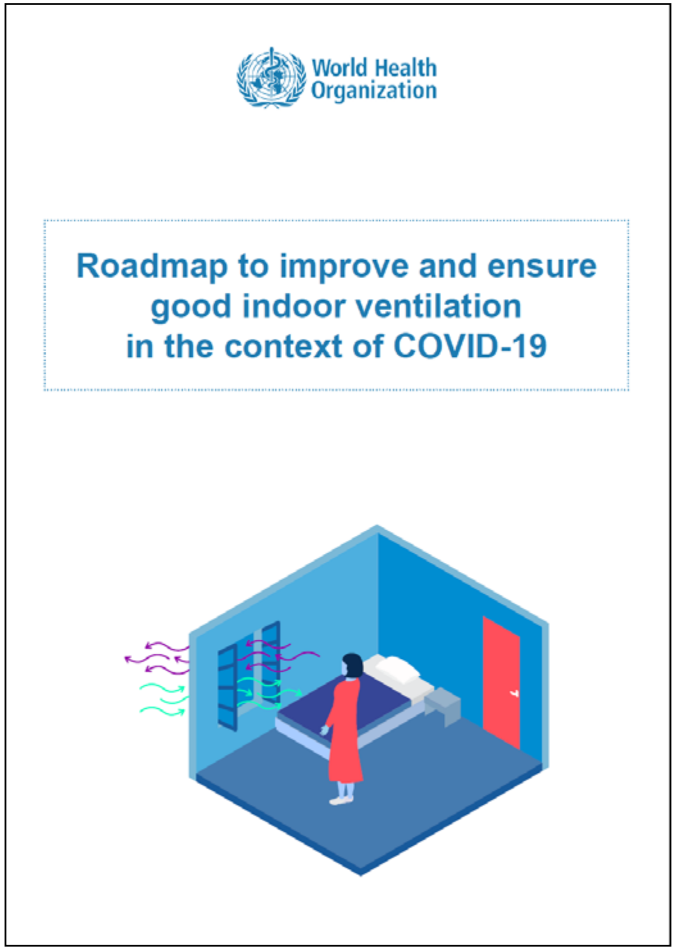
Part A: Design and validation



Department of Health

Heating and ventilation systems
Health Technical Memorandum 03-01: Specialised ventilation for healthcare premises

Part B: Operational management and performance verification


World Health Organization

Roadmap to improve and ensure good indoor ventilation in the context of COVID-19

6.1 Health care settings including quarantine facilities

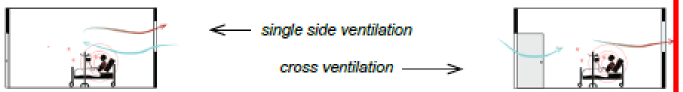
natural ventilation

Minimum requirements	Steps – key questions	Strategies
Ventilation rate minimum requirements *(32)*: • 160 L/s/patient or 12 ACH where AGP are performed • 60 L/s/patient or 6 ACH other	Does the ventilation rate meet WHO minimum requirements? To estimate the ventilation rate consult point 2.	

NO

\+ Assess the opening locations and opening surfaces considering potential new openings (add/modify window or door dimensions).

\+ Consider enabling cross ventilation rather than single-sided ventilation.
Note: Cross ventilation should not be implemented in these specific cases:
• within a room or ward for COVID-19 suspected cases where AGP may take place and when the exhaust air is not properly managed;
• when the airflow is moving from a less clean to a clean area.



→ If the system does not allow increasing ventilation to the recommended minimum per person requirement, consider reducing the maximum room occupancy to meet the L/s/patient standard.

\+ If no other (short-term) strategy can be adopted, consider using a stand-alone air cleaner with HEPA filters. Pay attention to the airflow direction (from clean to less clean areas) when positioning. The air cleaner should be positioned in the areas used by people and close to people, to provide the maximum possible treatment of the source(s) of infection. Stand-alone air cleaners should be operated continuously and air cleaner capacity should at least cover the gap between the minimum requirement and the measured ventilation rate – compare the device clean air delivery rate (CADR) (m³/hr) with the room ventilation rate.
Note: Consider that stand-alone air cleaners do not replace ventilation in any circumstance.

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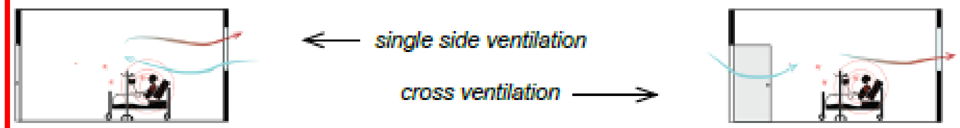

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Note: Consider that stand-alone air cleaners do not replace ventilation in any circumstance.

- Portable HEPA filtration units that combine a HEPA filter with a powered fan system are a preferred option for auxiliary air cleaning, especially in higher risk settings such as health clinics, vaccination and medical testing locations
- In choosing a portable HEPA unit, select a system that is appropriately sized for the area in which it will be installed. This determination is made based on the air flow through the unit, which is typically reported in cubic feet per minute (cfm). ons, workout rooms, or public waiting areas.

Faktorer med betydning for effekt

- Filtreringseffekt
- Lufthastighet/volum gjennom filteret
- Luftbevegelser i rommet
- Posisjonering av luftrenser i forhold til smittekilde (pasient) og smittemottaker (helsepersonell)
- Effektiviteten til ulike typer luftrensesystemer, inkludert systemer med HEPA and non-HEPA filtre, UVC og kombinasjoner er evaluert under ulike forhold og har vist eg å være variable

EFFICACY OF PORTABLE FILTRATION UNITS IN REDUCING AEROSOLIZED PARTICLES IN THE SIZE RANGE OF *MYCOBACTERIUM TUBERCULOSIS*

William A. Rutala, PhD, MPH; Suzanne M. Jones, MT(ASCP), MPH; John M. Worthington, MPH;

ABSTRACT

OBJECTIVE: To evaluate engineering control measures to prevent nosocomial transmission of diseases such as tuberculosis, we studied four portable high-efficiency air filtration units, including three high-efficiency particulate air (HEPA) filtration units, for their ability to remove aerosolized particles.

DESIGN: Studies were conducted in either a nonventilated aerosol chamber or in a hospital isolation room that met CDC guidelines for TB control (negative pressure, ≥6 air changes per hour, air exhausted directly to the outside). The rooms were challenged with aerosolized mineral oil in the size range of 0.3 to 5.0 μm at levels 10 to 20 times the normal airborne particle load in the room at baseline. Airborne particles were counted with a laser counter capable of simultaneously measuring sizes ≥0.3, ≥0.5, ≥1.0, and ≥5.0 μm. Experimental runs were conducted with the filtration units in the center or corner of the chamber or room, and the particle counter in the center of the room or at the exhaust vent.

RESULTS: Portable filtration units were effective in accelerating the removal of aerosolized submicron particles. In the nonventilated room, time required by the various portable filtration units for removal of 90% of aerosolized particles (≥0.3 μm) ranged from a low of 5 to 6 minutes to a high of 18 to 31 minutes, compared to the control (no filtration unit), >171 minutes. In the hospital room, individual filtration units removed 90% of aerosolized particles (≥0.3 μm) in times ranging from 5 to 8 minutes to 9 to 12 minutes, compared to the control (no filtration unit), 12 to 16 minutes. The location of the portable filtration unit (center versus corner) did not affect the clearance rate of airborne particles.

CONCLUSION: Our data indicate that portable filtration units can rapidly reduce levels of airborne particles similar in size to infectious droplet nuclei and, therefore, may aid in reducing the risk of tuberculosis exposure *(Infect Control Hosp Epidemiol* 1995;16:391-398).

Journal of Hospital Infection (2006) **63**, 47–54

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Reduction in MRSA environmental contamination with a portable HEPA-filtration unit

T.C. Boswell*, P.C. Fox

Department of Microbiology, Nottingham City Hospital, UK

Received 27 May 2005; accepted 22 November 2005
Available online 3 March 2006

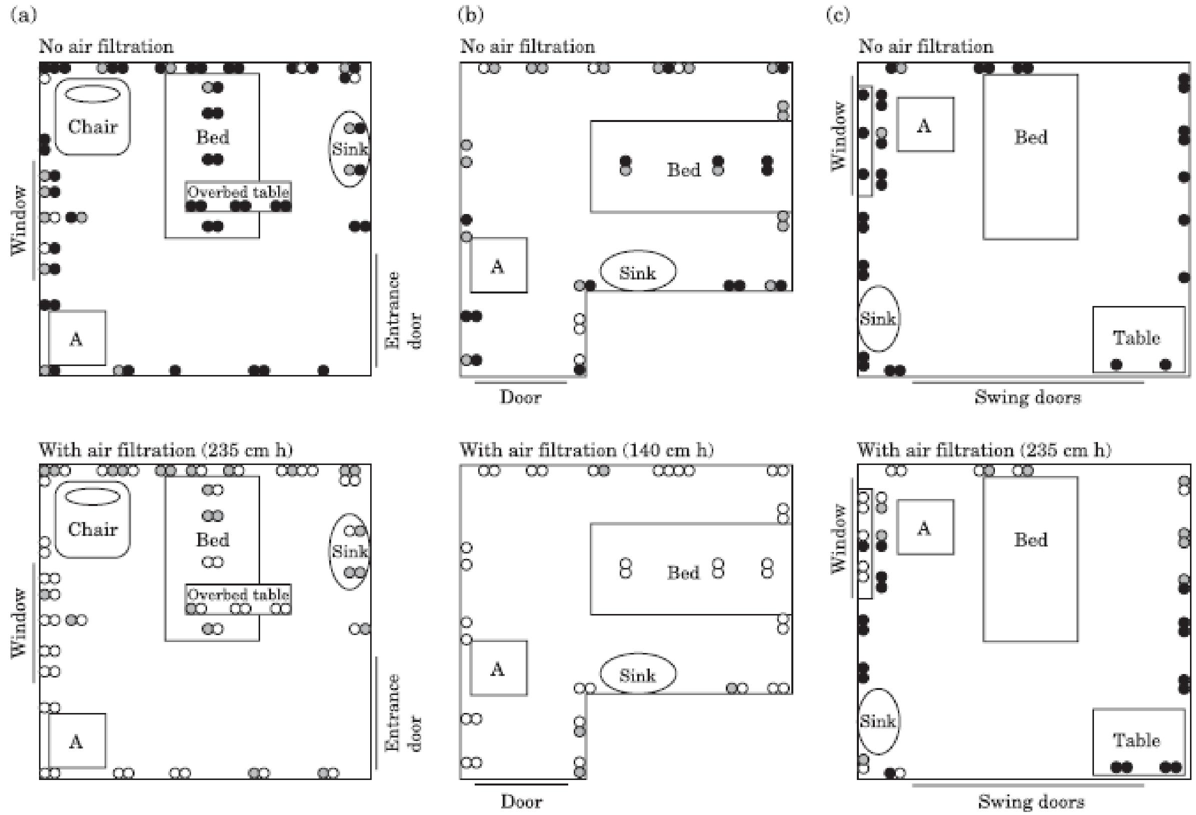


Figure 1 (a–c) Room schematics, position of settle plates and position of IQAir machine (A) are shown for Patients A–C, respectively. The results of the settle plates on the paired study days for each patient with and without IQAir filtration are combined. These are summarized as follows: open circle, settle plate with no methicillin-resistant *Staphylococcus aureus* (MRSA); grey circle, settle plate with 0.1–5.0 MRSA colony-forming units (cfu)/10-h exposure; black circle, settle plate with >5.0 MRSA cfu/10-h exposure. cm h, cubic metres per hour.

Luftfiltrering med 140 m^3/time (1 pasient) og 235 m^3 per time (2 pasienter) ga signifikant reduksjon av kontaminering i rommet sammenlignet med ingen luftfiltrering. (justert odds rato 0,037 og 0.099, P< 0,001)

Boswell J et al. JHI 2006

AJIC major articles

The impact of portable high-efficiency particulate air filters on the incidence of invasive aspergillosis in a large acute tertiary-care hospital

Zakir-Hussain Abdul Salam, MBBS, MS, MPH,[a] Rubiyah Binte Karlin, BHSc,[b] Moi Lin Ling, MBBS, FRCPA,[b] and Kok Soong Yang, MBBS, MMedPH[a]
Singapore

Salam Z-HA. AJIC 201038:e1-e7

Infection Control & Hospital Epidemiology (2021), 1–6
doi:10.1017/ice.2021.284

SHEA
The Society for Healthcare Epidemiology of America

Original Article

Use of portable air cleaners to reduce aerosol transmission on a hospital coronavirus disease 2019 (COVID-19) ward

Kristy L. Buising MD[1], Robyn Schofield PhD[2], Louis Irving MBBS[3], Melita Keywood PhD[4], Ashley Stevens[5], Nick Keogh[5], Grant Skidmore PhD[6], Imogen Wadlow PhD[7], Kevin Kevin PhD[7], Behzad Rismanchi PhD[8], Amanda J. Wheeler PhD[9], Ruhi S. Humphries PhD[4], Marion Kainer MPH[10], Jason Monty PhD[6], Forbes McGain PhD[11] and Caroline Marshall PhD[12]

[1]Victorian Infectious Diseases Service Royal Melbourne Hospital, Melbourne, Victoria, Australia, [2]Environmental Science Hub, University of Melbourne, Melbourne, Victoria, Australia, [3]Respiratory Medicine, Royal Melbourne Hospital, Melbourne, Victoria, Australia, [4]Oceans and Atmosphere, Commonwealth Scientific and Industrial Research Organization, Melbourne, Victoria, Australia, [5]Hospital Engineering, Royal Melbourne Hospital, Melbourne, Victoria, Australia, [6]Department of Mechanical Engineering, University of Melbourne, Melbourne, Victoria, Australia, [7]University of Melbourne, Melbourne, Victoria, Australia, [8]Department of Infrastructure Engineering, University of Melbourne, Melbourne, Victoria, Australia, [9]Mary MacKillop Institute for Health Research, Australian Catholic University, Melbourne, Victoria, Australia, [10]Infection Prevention Western Health, Melbourne, Victoria, Australia, [11]Intensive Care, Western Health, Melbourne, Victoria, Australia and [12]Infection Prevention and Surveillance Service, Royal Melbourne Hospital, Melbourne, Victoria, Australia

Buising KL et al. ICHE 2021

Aerosoler, måling med lukket dør:

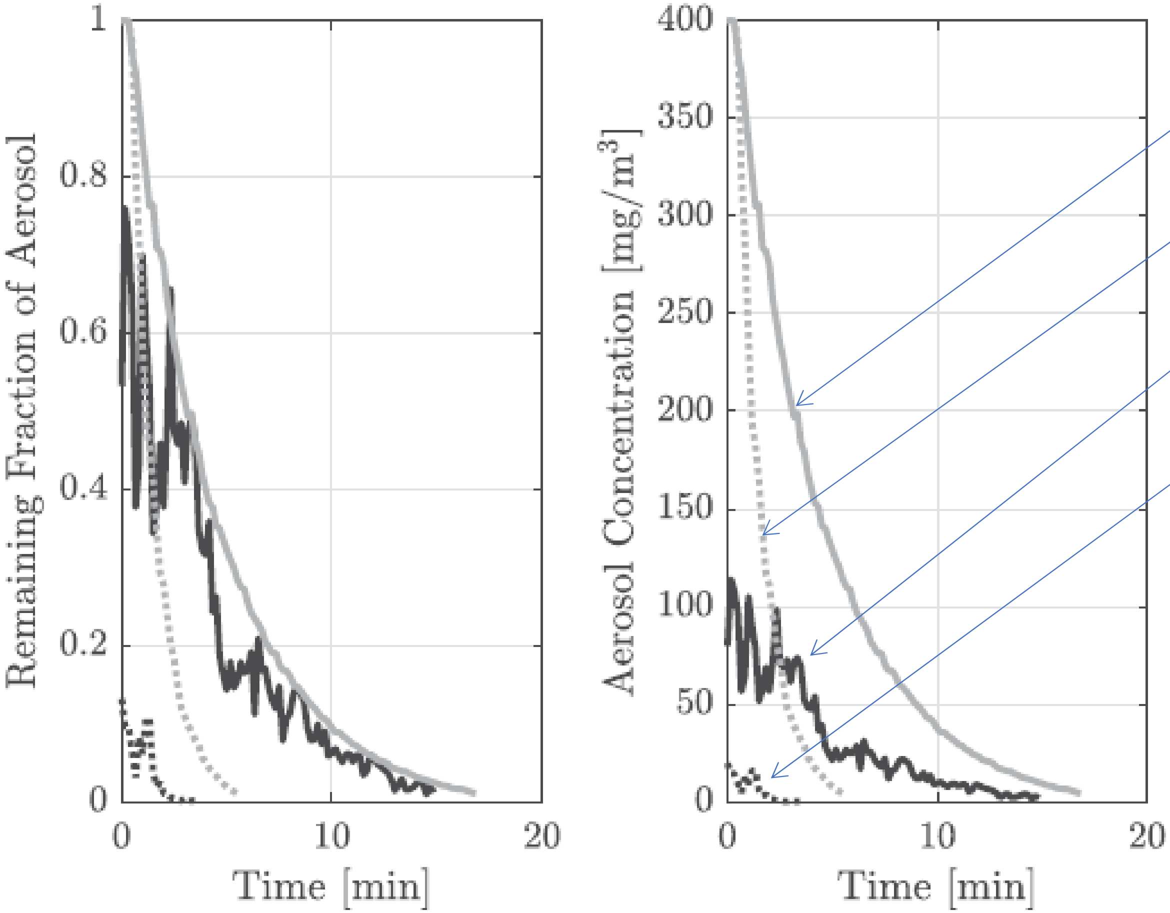
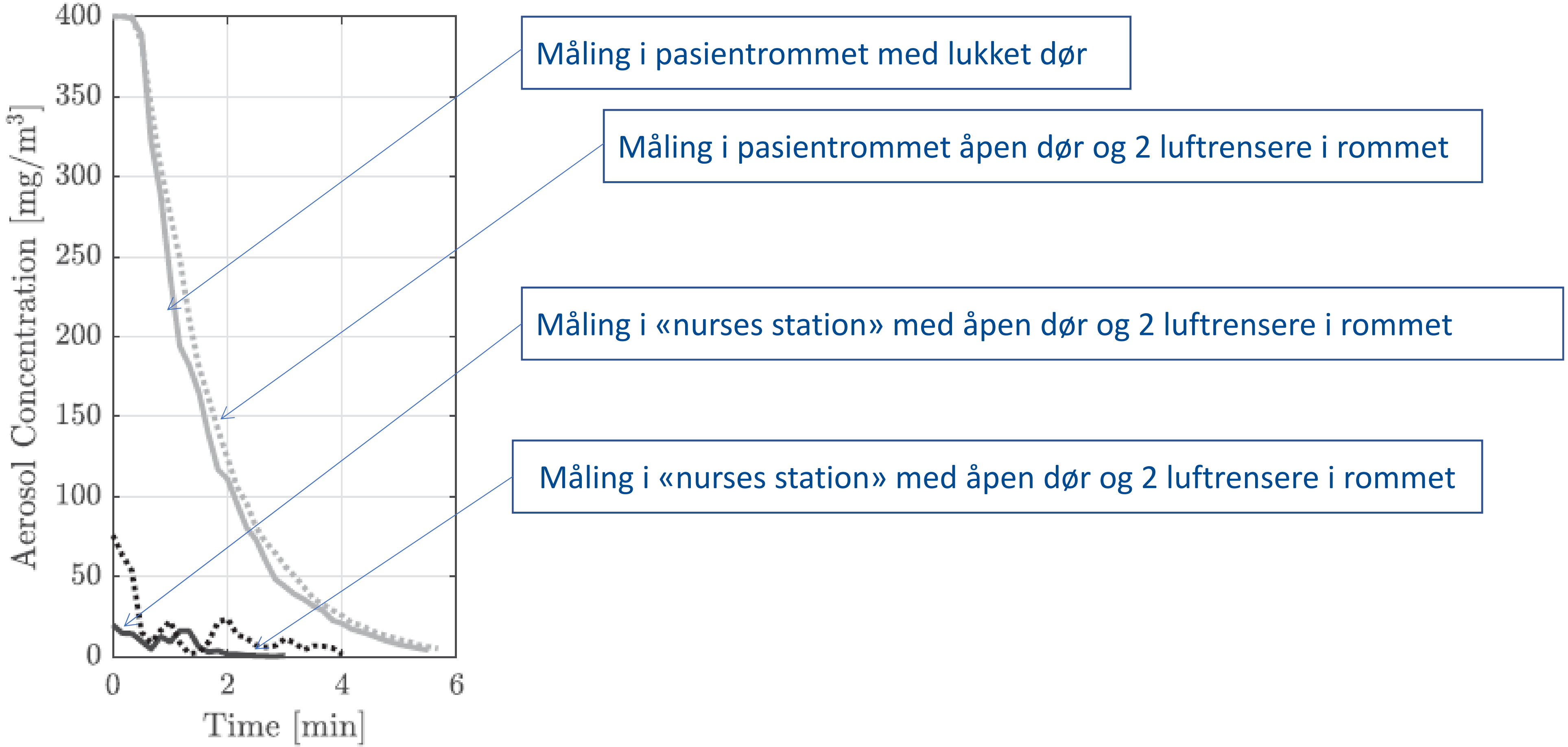


Fig. 1. The effect of no air cleaners versus 2 air cleaners on aerosol clearance and transmission of aerosols within a patient room with the door closed. The left image shows the values normalized to the saturation value of the sensor whereas right shows the measured value. Note. The grey solid line indicates measures taken within the standard patient room. Black solid line indicates measures taken at nurses' station. The grey dotted line indicates measures taken within the patient room with 2 air cleaners running. The black dotted line indicates measures taken at the nurses' station when the 2 air cleaners were in the patient room.

Aerosoler, måling med lukket dør:



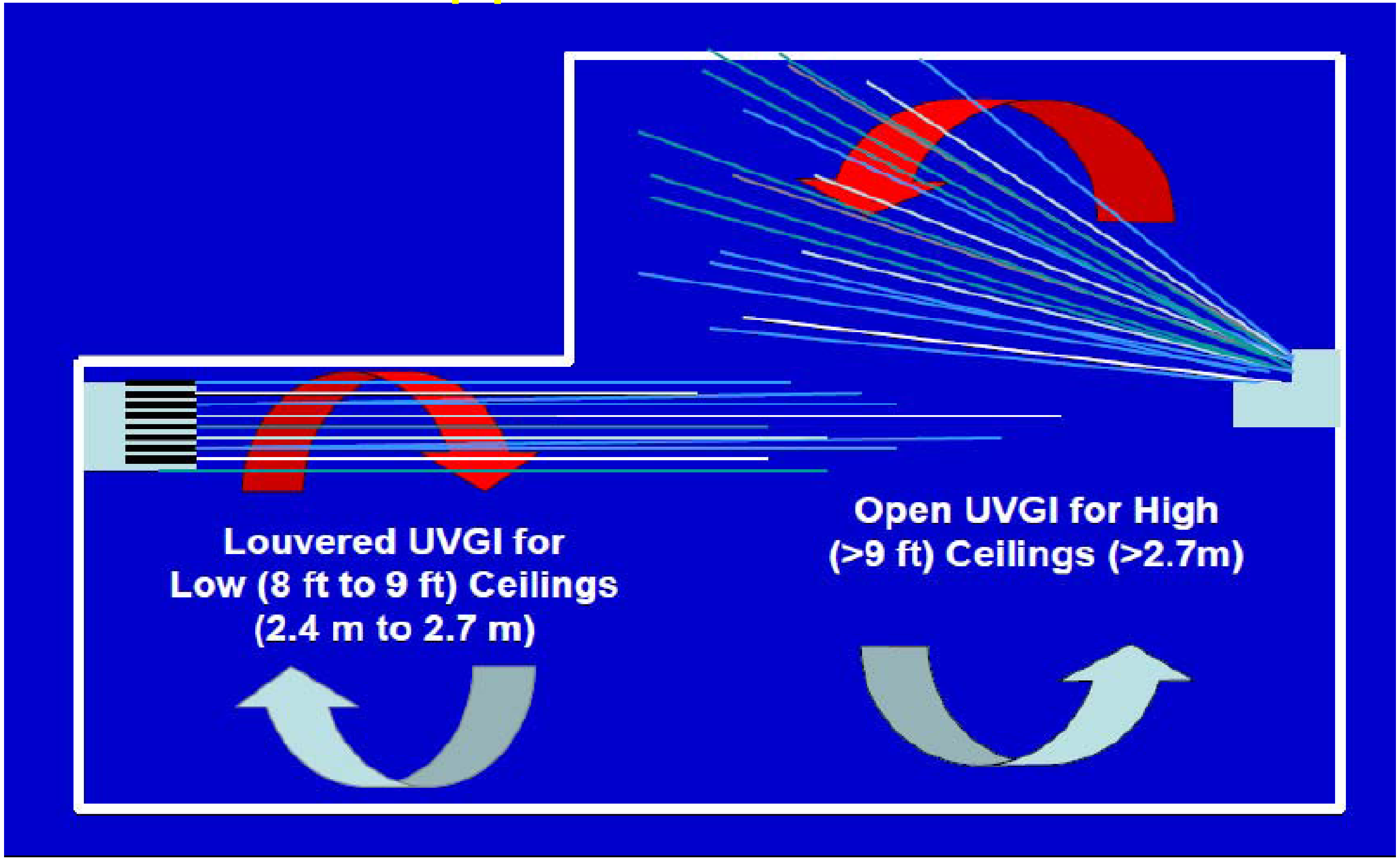
OPEN ACCESS Freely available online PLoS MEDICINE

Upper-Room Ultraviolet Light and Negative Air Ionization to Prevent Tuberculosis Transmission

A. Roderick Escombe[1,2,3*], David A. J. Moore[1,2,3,4,5], Robert H. Gilman[3,4,5], Marcos Navincopa[6,7], Eduardo Ticona[6], Bailey Mitchell[8], Catherine Noakes[9], Carlos Martínez[5], Patricia Sheen[4], Rocio Ramirez[7], Willi Quino[4], Armando Gonzalez[7], Jon S. Friedland[1,2], Carlton A. Evans[1,2,3,4,5]

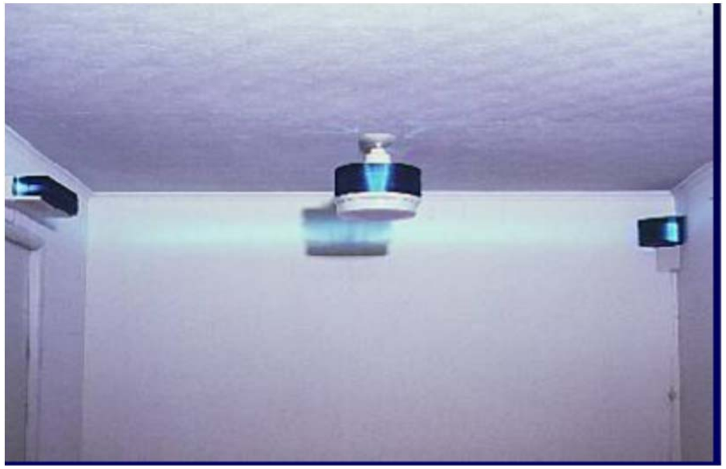
Escombe AR PlosMedicine 2009 6 (3) e1000043

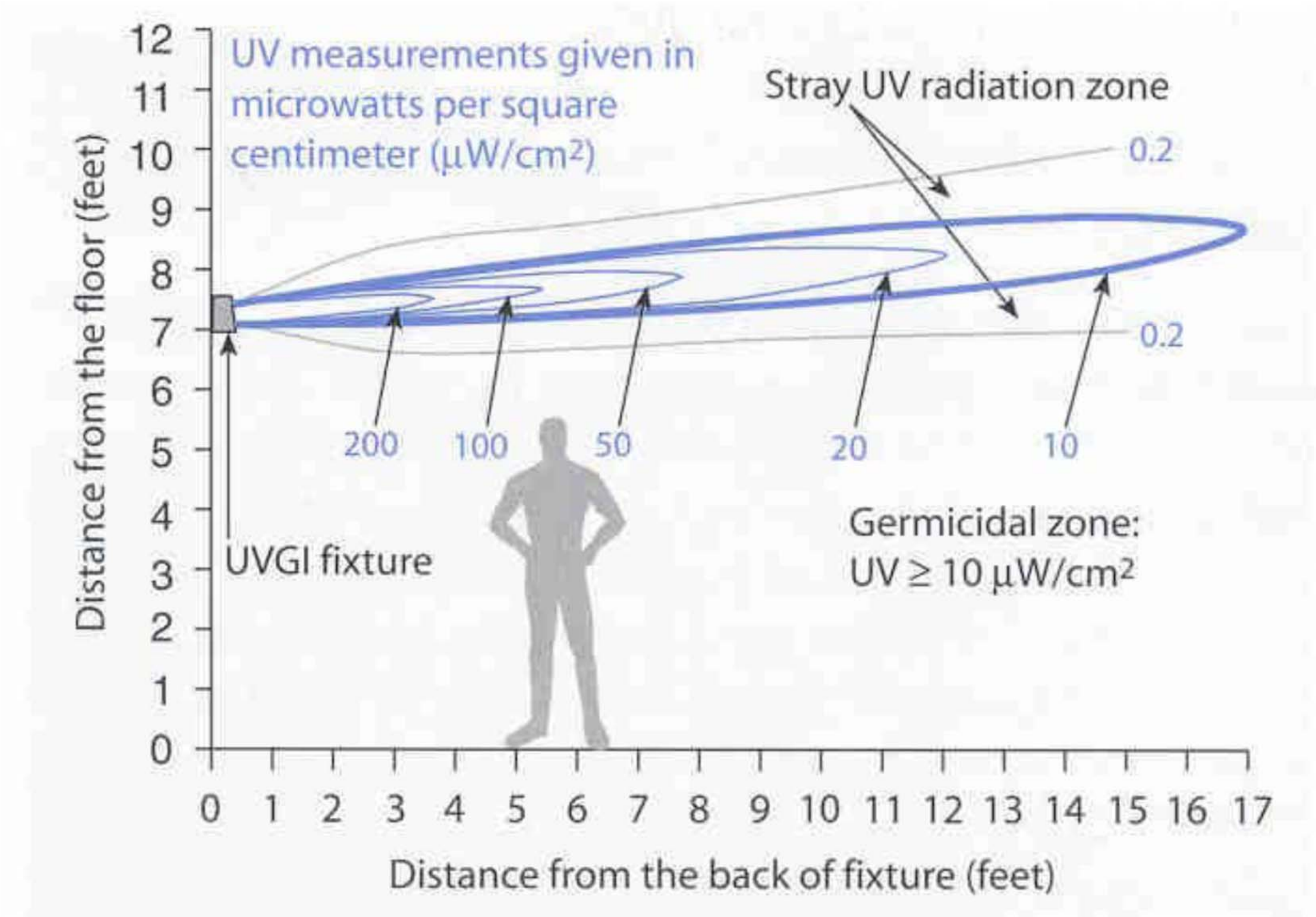
Upper room UVGI



WILLIAMS TV, JR. *AMERICAN**Jails*** JANUARY / FEBRUARY 2009

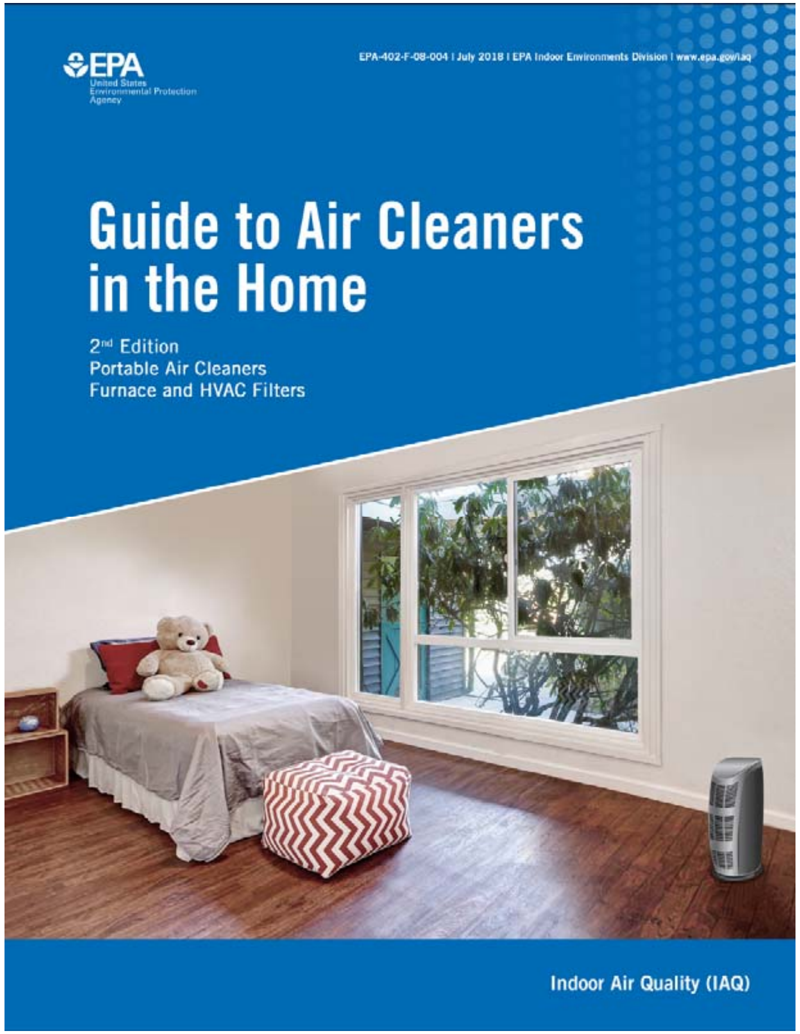
Upper room UVGI





Richard L. Vincent, St. Vincent's Hospital, Manhattan

Vladimir, Russland



Portable Air Cleaner Sizing for Particle Removal

Room area (square feet)	100	200	300	400	500	600
Minimum CADR (cfm)	65	130	195	260	325	390

Note this chart is for estimation purposes. The CADRs are calculated based on an 8-foot ceiling. If you have higher ceilings, you may want to select a portable air cleaner with a higher CADR.

CADR = clean air delivery rate

In-Depth Report

Expedient Methods for Surge Airborne Isolation within Healthcare Settings during Response to a Natural or Manmade Epidemic

Kenneth R. Mead, Ph.D., P.E.
Amy Feng, M.S.
Duane Hammond, M.S., P.E.
Stan Shulman, Ph.D.

Division of Applied Research and Technology
Engineering and Physical Hazards Branch
EPHB Report No. 301-05f

Veterans Administration Medical Center, Oklahoma City, Oklahoma
Central Kansas Medical Center, Great Bend, Kansas
St. Joseph Memorial Hospital, Larned, Kansas
INTEGRIS Baptist Medical Center, Oklahoma City, Oklahoma

April 2012

DEPARTMENT OF HEALTH AND HUMAN SERVICES
Centers for Disease Control and Prevention
National Institute for Occupational Safety and Health

Ventilated Headboards | NIOSH |

https://www.cdc.gov/niosh/topics/healthcare/engcontrolsolutions/ventilated-headboard.html

Workplace Safety and Health Topics

- Healthcare Workers
  - Infectious Agents
  - Chemical Hazards
  - Physical Hazards
  - Prevention Controls
    - Expedient Patient Isolation
    - Ventilated Headboard
  - Home Healthcare
  - Dentistry
  - Work Stress
  - Surveillance and Statistics
  - Emergency Preparedness and Response
  - Resources for Healthcare Workers

Related Topics

Antineoplastic Agents

Promoting productive workplaces through safety and health research / NIOSH

Ventilated Headboards

Engineering Controls To Reduce Airborne, Droplet and Contact Exposures During Epidemic/Pandemic Response

On This Page

Ventilated Headboard

Oftentimes, local and national protective guidance issued during a pandemic might call upon the use of airborne infection isolation rooms (AIIRs) for patients and/or specific patient procedures. Within U.S. hospitals, AIIRs are patient rooms with specific engineered features, intended to isolate and more-quickly remove potentially infectious patient aerosols. During a pandemic, the demand for AIIRs may exceed their availability. When this occurs, healthcare facilities may choose to use portable fan systems with high-efficiency particulate air (HEPA) filtration to establish surge AIIR capacity. Although there has been substantial research indicating potential shortcomings when HEPA fan/filter units are deployed incorrectly, there has historically been minimal guidance on how to deploy these units in a highly-protective fashion. The National Institute for Occupational Safety and Health (NIOSH) has developed the Ventilated Headboard, a novel and effective solution that isolates patients while protecting healthcare personnel from airborne infectious diseases. The latest version of the technology consists of lightweight, sturdy, and adjustable aluminum framing with a retractable plastic canopy. The ventilated headboard can be deployed in combination with HEPA fan/filter units to provide surge isolation capacity within a variety of environments, from traditional patient rooms to triage stations, emergency medical shelters, or even as emergency/temporary support options for displaced population shelters. For the

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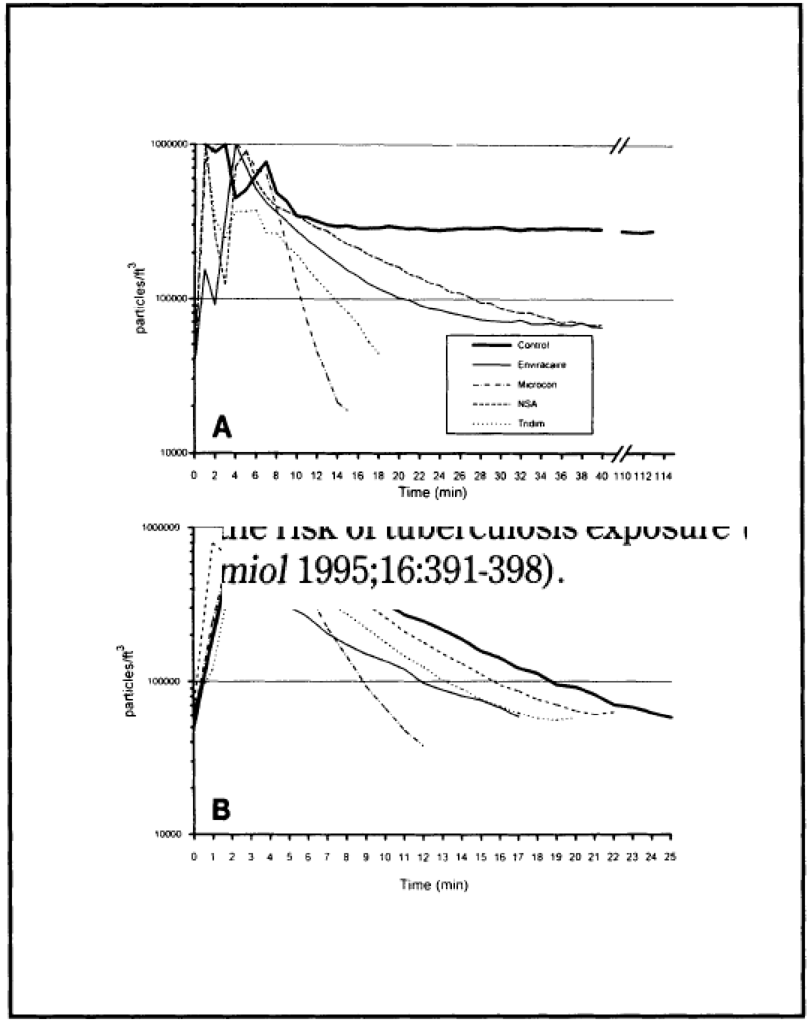
[Expedient Isolation Extruded Aluminum Assembly Instructions (cdc.gov)]



Rutala W. ICHE 1995;16:391