Administrative Controls

Paul A Jensen

US Centers for Disease Control and Prevention

http://www.who.int/gtb/publications/healthcare/PDF/WHO99-269.pdf

Copyright © World Health Organization (1999)

This document is not a formal publication of the World Health Organization (WHO) and all rights are reserved by the Organization. The document may, however, be freely reviewed, abstracted, reproduced, or translated in part, but not for sale or for use in conjunction with commercial purposes.

For authorisation to reproduce or translate the work in full, and for any use by commercial entities, applications and enquiries should be addressed to the Communicable Diseases Programme, Department of Control Prevention and Eradication, World Health Organization, Geneva, Switzerland, which will be glad to provide the latest information on any changes in the text, plans for new editions, and the reprints, regional adaptations and translations that are available.

The views expressed herein by named authors are solely the responsibility of those authors.

Printed in Italy
Design and printing: Jotto Associati s.a.s. - Biella - Italy

99/12760 - 1000

© World Health Organization
1999

TUBERCULOSIS INFECTION CONTROL IN THE ERA OF EXPANDING HIV CARE AND TREATMENT

Addendum to WHO *Guidelines for the Prevention of Tuberculosis in Health Care Facilities in Resource-Limited Settings, 1999*

Writing committee:

Centers for Disease Control and Prevention: Naomi Bock, Paul Jensen, Wanda Walton, Michael Iademarco, Bess Miller
World Health Organization: Alasdair Reid, Pierre-Yves Norval, Paul Nunn
The International Union Against TB and Lung Disease: Riitta Dlodlo

Acknowledgements
Mary Catlin, William Coggin, Elizabeth L. Corbett, Chris W. Green, Eric Ikoona, Saiyud Moolphate, Mary Nandili, Supalert Nedsuwan, Lisa Nelson, Jintana Ngamvithayapong-Yanai, Joseph Odhiambo, Pecharin Kaewrakmook, Naraworn Puraksa, Supaporn Trongsakul, Jeroen van Gorkom and Charles Wells reviewed these guidelines and provided useful comments.

INTERNATIONAL STANDARDS FOR

Tuberculosis Care

DIAGNOSIS TREATMENT PUBLIC HEALTH

MMWR
Morbidity and Mortality Weekly Report
Recommendations and Reports December 30, 2005 / Vol. 54 / No. RR-17

Guidelines for Preventing the Transmission of *Mycobacterium tuberculosis* in Health-Care Settings, 2005

http://www.cdc.gov/mmwr/PDF/rr/rr5417.pdf

INSIDE: Continuing Education Examination

DEPARTMENT OF HEALTH AND HUMAN SERVICES
CENTERS FOR DISEASE CONTROL AND PREVENTION

MMWR
Morbidity and Mortality Weekly Report
Recommendations and Reports July 7, 2006 / Vol. 55 / No. RR-9

Prevention and Control of Tuberculosis in Correctional and Detention Facilities: Recommendations from CDC

Endorsed by the Advisory Council for the Elimination of Tuberculosis, the National Commission on Correctional Health Care, and the American Correctional Association

http://www.cdc.gov/mmwr/PDF/rr/rr5509.pdf

INSIDE: Continuing Education Examination

DEPARTMENT OF HEALTH AND HUMAN SERVICES
CENTERS FOR DISEASE CONTROL AND PREVENTION

What is infection control?

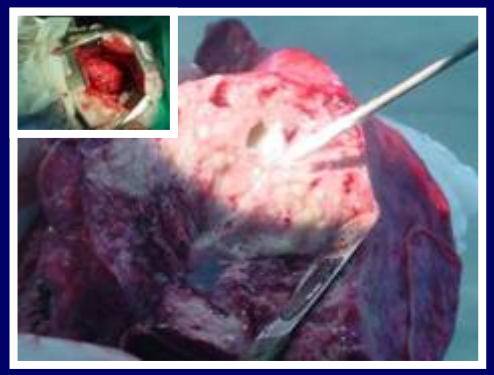
Prevention of TB transmission

Patient to:
- Worker
- Patient
- Visitor

Worker to:
- Worker
- Patient
- Visitor

Visitor to:
- Worker
- Patient
- Visitor

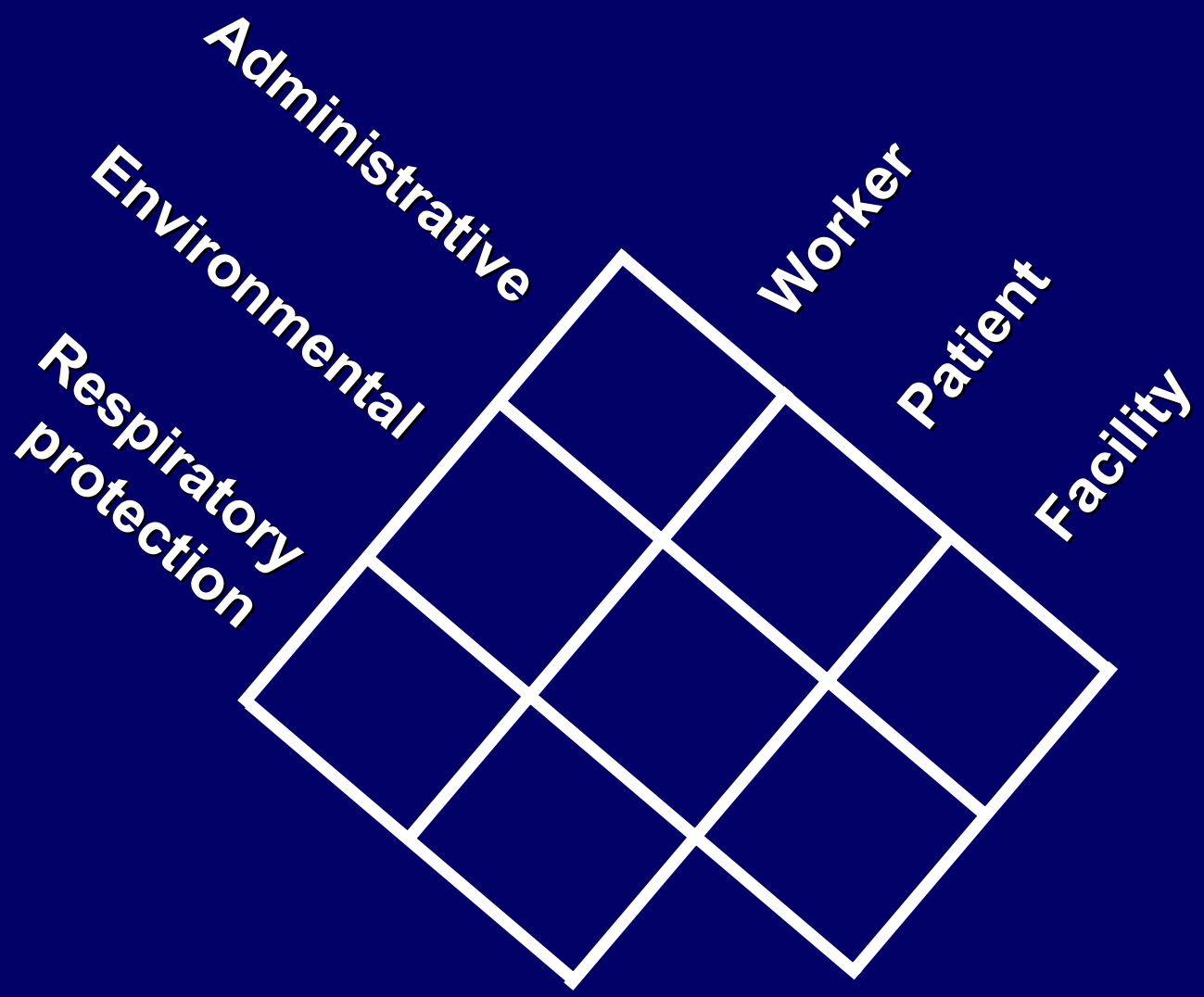
What is Infection Control?
How can we decrease the risk?



Hierarchy of Infection Controls

- Administrative controls to reduce risk of exposure, infection, and disease through policy and practice;
- Environmental (engineering) controls to reduce concentration of infectious bacilli in air in areas where contamination of air is likely; and
- Respiratory protection to protect personnel who must work in environments with contaminated air

Hierarchy of Infection Controls



Violent Sneeze

Number and size of organisms liberated

Wells 1934, Duguid 1945, Wells/Riley 1953, et al.

Number of organisms liberated:

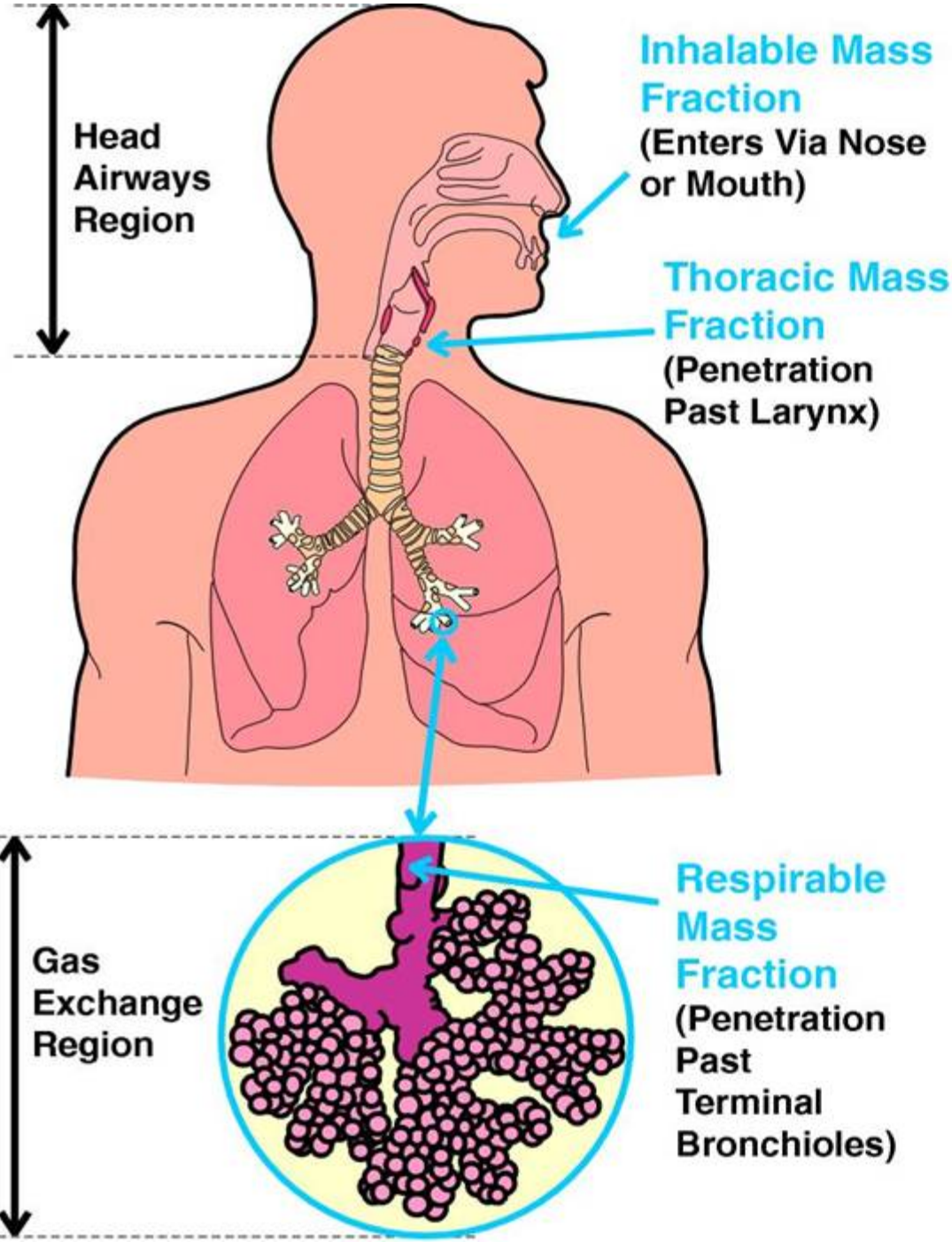
Talking	0 – 200
Coughing	0 – 3 500
Sneezing	4500 – 1 000 000
Bacteria bearing droplets	< Ø100 µm

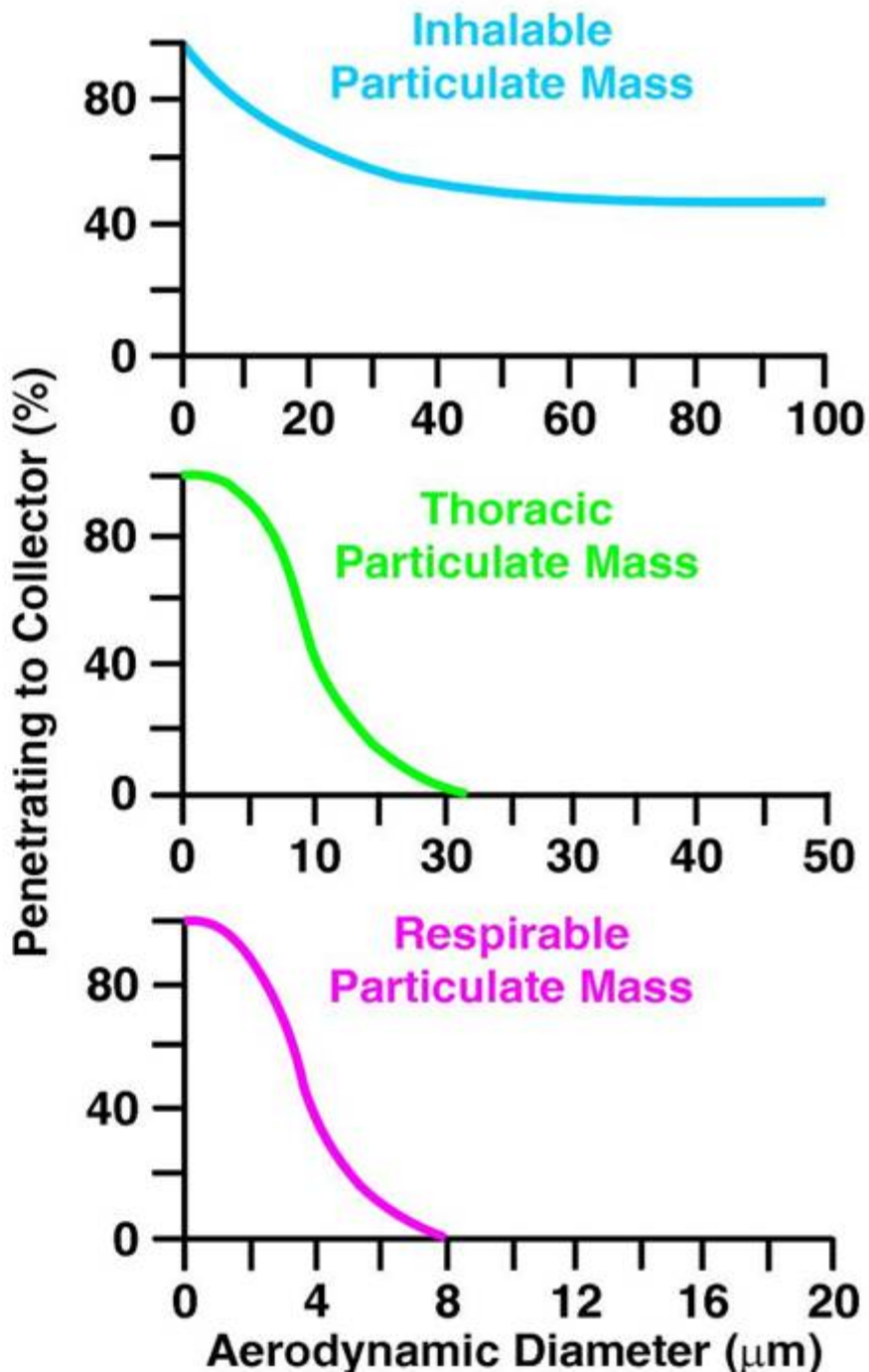
Size of droplets (function of air velocity):

Sneeze	~ 300 m/s
Ø100µm	~ 100 m/s
Ø10 µm	~ 75 %

Fate of droplets

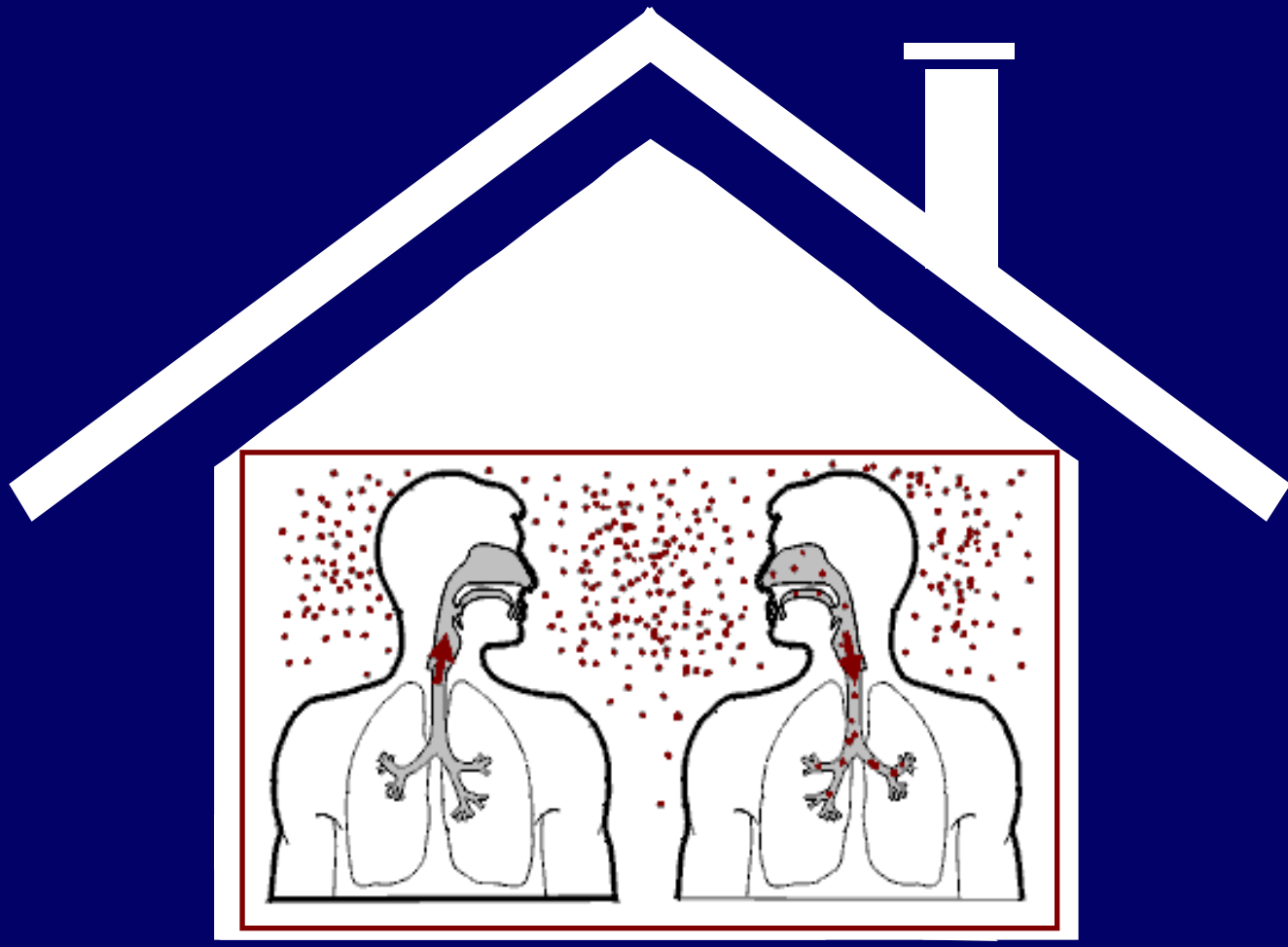
- *Large* droplets fall to ground or other horizontal surface relatively fast
- A 1.0 µm *Droplet Nucleus* will settle at a rate of 0.0035 cm/s or 3 m in 24 hours!
- The fate of the s*maller* droplets will depend on the relative humidity of the air in the space


Head
Airways
Region
Inhalable Mass
Fraction
(Enters Via Nose
or Mouth)
Thoracic Mass
Fraction
(Penetration
Past Larynx)
Gas
Exchange
Region
Respirable
Mass
Fraction
(Penetration
Past
Terminal
Bronchioles)


Inhalable
Particulate Mass
80
40
0
0
20
40
60
80
100
Thoracic
Particulate Mass
80
40
0
0
10
30
30
40
50
Respirable
Particulate Mass
80
40
0
0
4
8
12
16
20
Penetrating to Collector (%)
Aerodynamic Diameter (μm)

Risk of TB transmission

- Patient
- Recipient
- Institutional
- Bacterial

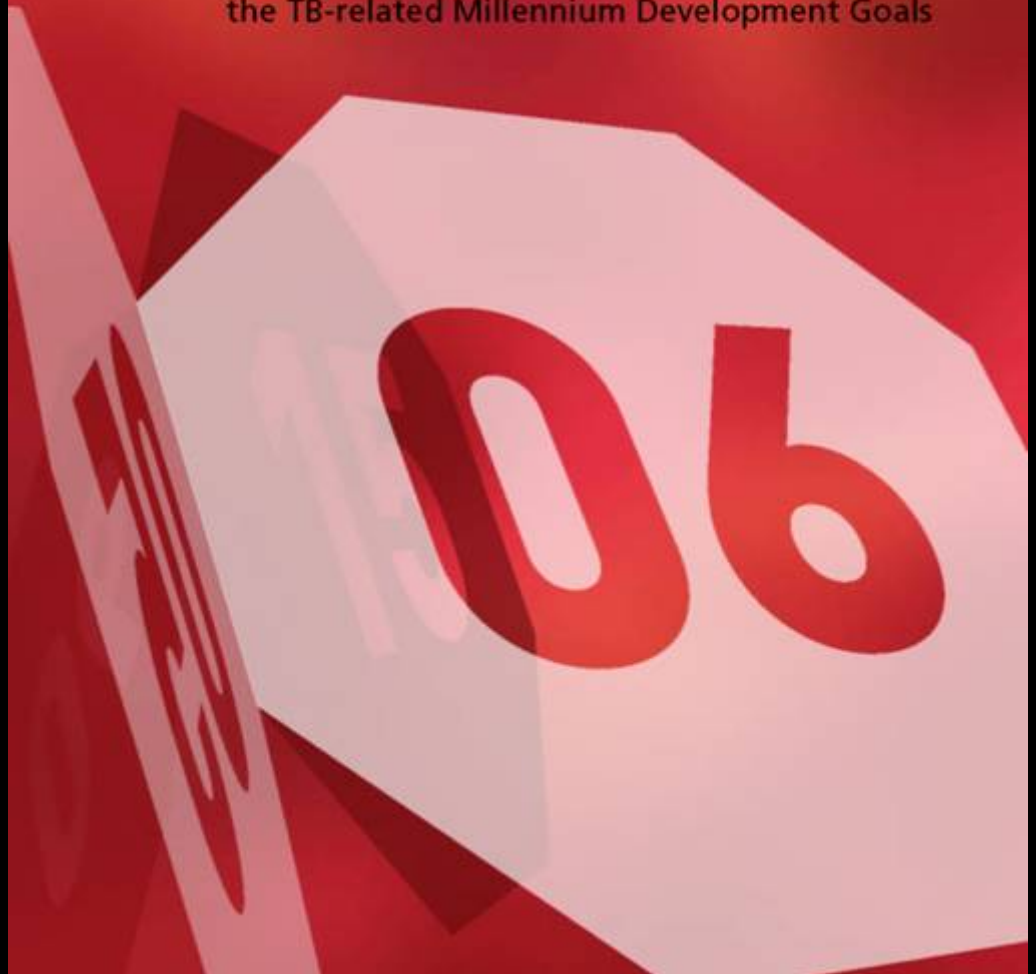


World Health Organization

Stop TB Partnership

THE STOP TB STRATEGY

Building on and enhancing DOTS to meet the TB-related Millennium Development Goals



Patient factors

- **Infectiousness: sputum smear, cavitation, force and frequency of cough***
- **Understanding of TB, cough etiquette***
- **Treatment***
- **Cough-inducing procedures**
- **Likelihood of TB (prior treatment, age, homelessness, contact of known case, etc.)**

Influence the number of infectious bacilli in room air*

Strategy for preventing institutional transmission of TB

- Identify each factor that contributes to transmission of TB in institutions
- Develop written plan that addresses these factors at each possible point of intervention
  - *Practical*
  - *Affordable*
  - *Comprehensive*
  - *Creative*

Strategy for preventing institutional transmission of TB

- Put the IC plan into practice
- Monitor and enforce infection control policies
- Evaluate and revise accordingly

Institutional factors

- Fixed characteristics (type, location, clients)
- Type and number of people served by institution (crowding)
- Resources available
- Policies, practices governing patient movement, housing
- Time lag until disease, infectiousness and drug resistance detected

Institutional factors

Recipient factors

- Closeness, duration, and frequency of contact*
- Adherence to infection control practices*
- Susceptibility (intrinsic or acquired)

**Influence dose of inhaled bacilli*

Recipient factors

Bacterial factors

- Intrinsic virulence of M(X)DR-TB bacilli is not thought to be greater than drug susceptible bacilli; however, . . .
- Patients with M(X)DR-TB may infect more people due to the prolonged period of infectiousness: chronic cases, defaulters, treatment failures, or re-treatment cases

Administrative controls

The most important means to protect health workers, patients, prisoners

What are Administrative Controls?

- Managerial or administrative measures to significantly reduce the risk of TB transmission by preventing the generation of droplet nuclei
- Procedures for implementing, monitoring, enforcing, evaluating, and revising infection control programs routinely

What is an Infection Control Plan?

- Assigning responsibility and authority
- Conducting risk assessment
- Developing comprehensive written policies and protocols
- Rapidly identifying TB cases, suspects, and high risk for M(X)DR-TB
- Separating patients with TB from those without disease
- Diagnosis, treatment, and monitoring

Implementation of IC

- Implement, monitor, and enforce IC plan
- Educate and train health workers to ensure good work practices
- Counsel and screen health workers and prisoners periodically
- Evaluate at least annually and revise plan as needed

Assignment of responsibility

- Responsibility and authority should be delegated to a specific person or team with a designated leader
- Should include expertise in:
  - Infection control
  - Epidemiology
  - Clinical
  - Microbiology
  - Engineering
  - Administration

Objectives of an IC Risk Assessment

- To evaluate the management of the TB control program (including IC) in a facility in order to reduce risk against infection
- Review existing TB infection control protocols and patient flows through the facility being evaluated

Objectives of an IC Risk Assessment

- Evaluate compliance with personal protection practices
- Evaluate facility environmental controls and maintenance practices, and determine their effectiveness in reducing or preventing the likelihood of TB transmission

IC Risk Assessment

Risk differs between:

- Geographic regions
- Facilities within same region
- Areas within same facility
- Occupational groups

Steps in assessing risk

- Community: number of TB cases and drug resistance patterns (new / re-treatment)
- Occurrence of TB and M(X)DR-TB in health workers
- In prisons (new cases in prisoners)

Steps in assessing risk (2)

- Facility (for each area):
  - Number of drug resistant cases
  - Patterns of drug resistance
  - HIV prevalence
  - Time from admission to determination of infectiousness to determination of drug resistance
  - Time to correct treatment
  - Time to clinical and bacteriological response

IC Risk Assessment

Assess risk for:

- Community overall
- Facility as a whole
- Areas within facility
- Occupational group

Base infection control plan on degree of risk: highest priority to interventions with most impact and lowest cost

- Medium and high risk areas: administrative controls
- High risk areas: environmental controls
- Health workers in high risk areas: respiratory protection

VCT and HIV-care settings

- THINK TB
- Screen clients by questionnaire
  - TB signs and symptoms
  - TB history
  - TB contact history
- Other infectious diseases

Five Steps for Patient Management to Prevent Transmission of TB in HIV Care Settings

Step	Action	Description
1	Screen	Early **recognition** of patients with suspected or confirmed TB disease is the first step in the protocol. It can be achieved by assigning a staff member to screen patients for prolonged duration of cough immediately after they arrive at the facility. Patients with cough of more than two weeks duration, or who report being under investigation or treatment for TB*, should not be allowed to wait in the line with other patients to enter, register, or get a card. Instead, they should be managed as outlined below.
2	Educate	Instructing the above mentioned persons identified through screening in **cough hygiene**. This includes instructing them to cover their noses and mouths when coughing or sneezing, and when possible providing face masks or tissues to assist them in covering their mouths.
3	Separate	Patients who are identified as TB suspects or cases by the screening questions must be **separated** from other patients and requested to wait in a separate well-ventilated waiting area, and provided with a surgical mask or tissues to cover their mouths and noses while waiting.
4	Provide HIV Services	Triaging symptomatic patients to the front of the line for the services they are seeking (e.g. voluntary HIV counseling and testing, medication refills), to quickly provide care and reduce the amount of time that others are exposed to them is recommended. In an integrated service delivery setting, if possible, the patient should receive the HIV services they are accessing before the TB investigation.
5	Investigate for TB or Refer	TB diagnostic tests should be done on site or, if not available onsite, the facility should have an established link with a TB diagnostic center to which symptomatic patients can be **referred.** Also, each facility should have a linkage with a TB treatment center to which those who are diagnosed with TB can be **referred.**

HOLA 6

Caring together for life
Khomanani

TB and HIV...

what health workers need to know

For TB patients

- Every TB patient should be referred for voluntary counselling and testing (VCT) for HIV.
- Look for other signs and symptoms of HIV: recurrent hospital admissions, severe weight loss, oral thrush, generally enlarged lymph nodes.
- Uncommon forms of TB may be a sign of HIV infection.
- If your TB patient has HIV, he or she should also be given **co-trimoxazole prophylaxis to prevent other bacterial infections** (see below).

For HIV-positive patients

- TB is the major cause of death among HIV-positive people in South Africa. TB can present without other signs and symptoms of HIV.
- All HIV-positive people should be screened regularly for TB. If active TB is excluded, and a TB skin test is positive, then patients should be put on **INH prophylaxis to prevent TB** (see below).
- TB may be smear negative, or present outside the lungs. One negative sputum test is not enough to exclude TB in HIV-positive people.
- If the patient is on ART, TB drugs can interact with these. Check the National ART Guidelines for details.

Co-trimoxazole prophylaxis

Dosage:
Adults: 960 mg daily

Children: Syrup 40/200 mg per 5 ml one dose daily
- less than 5 kg: 2.5 ml
- 5 - 10 kg: 5 ml
- 10 - 15 kg: 7.5 ml
- 15 - 22 kg: 10 ml or a 480 mg tablet
- more than 22 kg: 15 ml or 1½ 480 mg tablets

Duration: For HIV-positive adults and children older than 15 months, it should be given until immunity is restored i.e. CD4 greater than 200 cells/mm^3 (over 3 - 6 months) while the patient is on ART.

INH prophylaxis

Dosage: 5 mg/kg (up to a maximum of 300 mg) daily

Duration: Treat every day for 6 months.

Monitor for the following:
- adherence
- signs of TB
- jaundice (stop INH and refer immediately to a doctor)

TB can be cured. Whether the patient is HIV positive or negative, they take the same medication for the full 6 months.

Caring together for life
Khomanani
Brought to you by Government

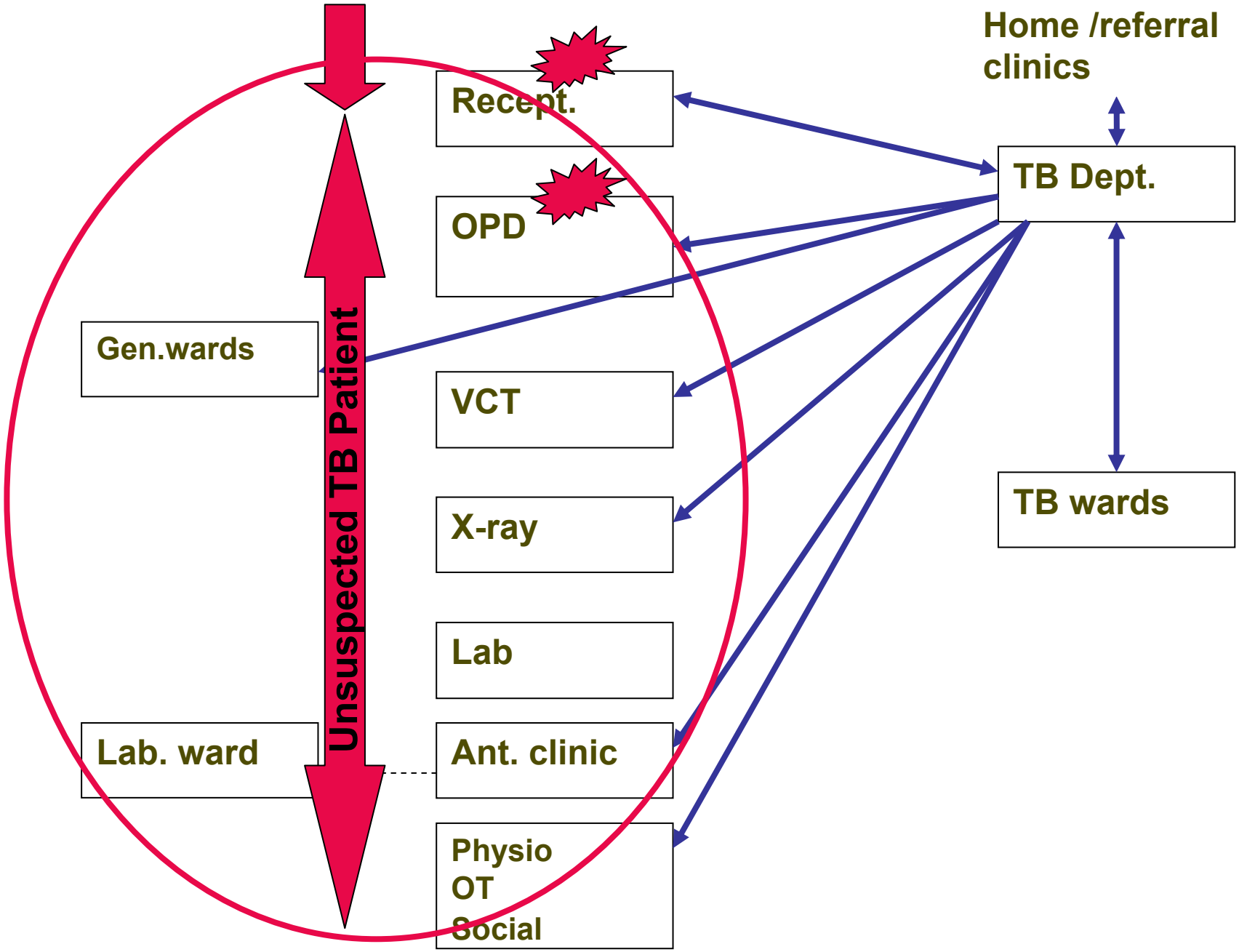
stop TB

Red Ribbon Resource Centre for free HIV/AIDS material (011) 880 0405
AIDS Helpline for more information 0800 012 322
www.aidsinfo.co.za

Path of the patient

- Inpatients
- Outpatients
- Functional procedures

Areas visited by TB patients, suspected or confirmed



Path of the specimen

- Collection location & procedures
- Storage
- Transportation
- Registration
- Storage
- Processing procedures
- Disposal procedures

Develop a comprehensive written plan

- Plan should be specific to each facility, area within facility, and group
- Based on level of risk
- Put plan and procedures in writing, easy to understand, and accessible
- Educate staff about the plan – organization, rationale and what is expected of them

Contents of written plan (1)

- Specify who has responsibility and authority
- Specify procedures for risk assessment
- Write out policies for:
  - Triage and evaluation of suspected cases
  - Transfer into and out of designated high-risk areas for TB patients or suspects
  - Monitoring infectiousness (frequency)

Contents of written plan (2)

- Write out policies for
  - Special precautions for high risk procedures and locations (sputum collection or induction, bronchoscopy, autopsy, waiting areas, surgery)
  - Maintaining and monitoring engineering controls
  - Respiratory protection program

Contents of written plan (3)

- Write out policies for
  - Educating personnel
  - Implementing the IC plan
  - Screening and management of health workers
  - Ongoing monitoring of the program
  - Annual evaluation of the IC program
  - Resolving problems

Triage and evaluation (1)

- Suspect TB in all patients from high risk groups
- Separate suspects from other patients, prisoners, vulnerable contacts
- Determine infectiousness and drug resistance as rapidly as possible
  - sputum smear, chest x-ray
  - culture and susceptibility testing

Triage and evaluation (2)

- If not M(X)DR-TB move out of highest risk area promptly

- If TB or M(X)DR-TB is confirmed, house in separate, dedicated respiratory isolation unit, if available

Special precautions for high risk areas and procedures

- TB and M(X)DR-TB departments
- Waiting areas and diagnostic departments before diagnosis
- Holding areas for prisoners before transfer
- Sputum collection rooms
- Laboratory
- Bronchoscopy
- Surgery (?)
- Autopsy (?)

Specialized wards for TB and M(X)DR-TB (and other high risk areas)

- Separate suspected or known M(X)DR-TB patients to minimize risk to others
- Environmental engineering measures to minimize viable bacilli in air in special wards

Education and training of staff

The key to infection control

- Issues about TB and M(X)DR-TB risk and prevention
- Principles and practices of infection control
- Seek active input and participation of staff

Education and training of staff

The key to infection control

- Responsibilities of health workers and what is expected of them
- Responsibilities of infection control team
- Responsibilities of the institution

Periodic screening of health workers and prisoners to detect disease at an early stage

- Each year for employees
- Twice yearly for prisoners
- Medical questionnaire
- Chest x-ray, Mantoux test, other tests
- Sputum exam if cough > 3 weeks
- Special consideration for employees or prisoners with increased individual risk

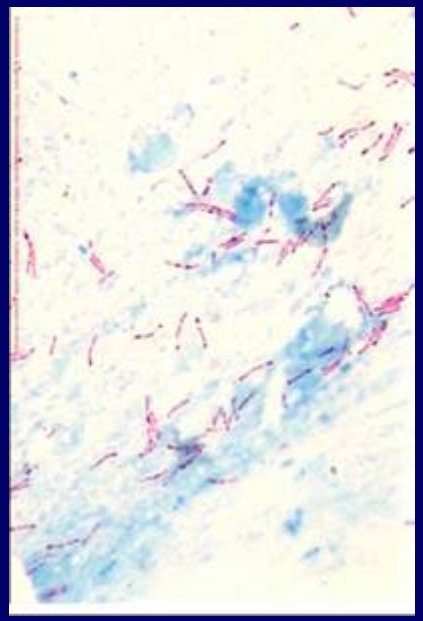
Special considerations

Health workers, patients, and prisoners with conditions that increase individual risk

- HIV
- Chest radiograph findings suggestive of previous TB
- M(X)DR TB
- Diabetes mellitus
- Corticosteroids and other immunosuppressive therapy
- Smoking
- Silica exposure

Evaluating the IC Program

- Repeat risk assessment
- Measure performance indicators
  - Determine time intervals from admission to:
    - Report of sputum results
    - Transfer into isolation unit
    - Report of culture and drug susceptibility results



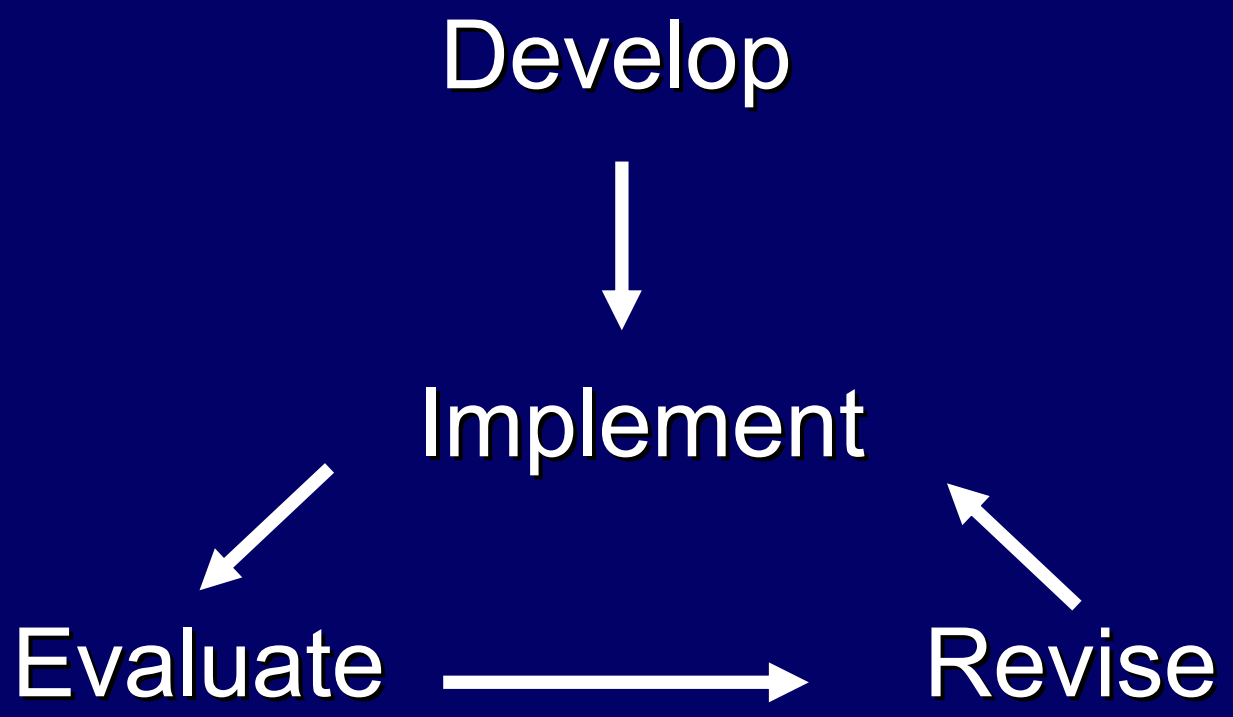
Evaluating the IC Program (2)

- Measure performance indicators
  - Appropriate transfer into / out of isolation
  - Procedures in isolation unit (doors, masks, etc.)
  - Appropriate treatment and monitoring
  - Maintenance of environmental (engineering) controls

Revise infection control program as needed

- Updated risk assessment
- Current performance indicators
- Input from health workers
- Resources available
- Problems encountered
- Re-educate health workers

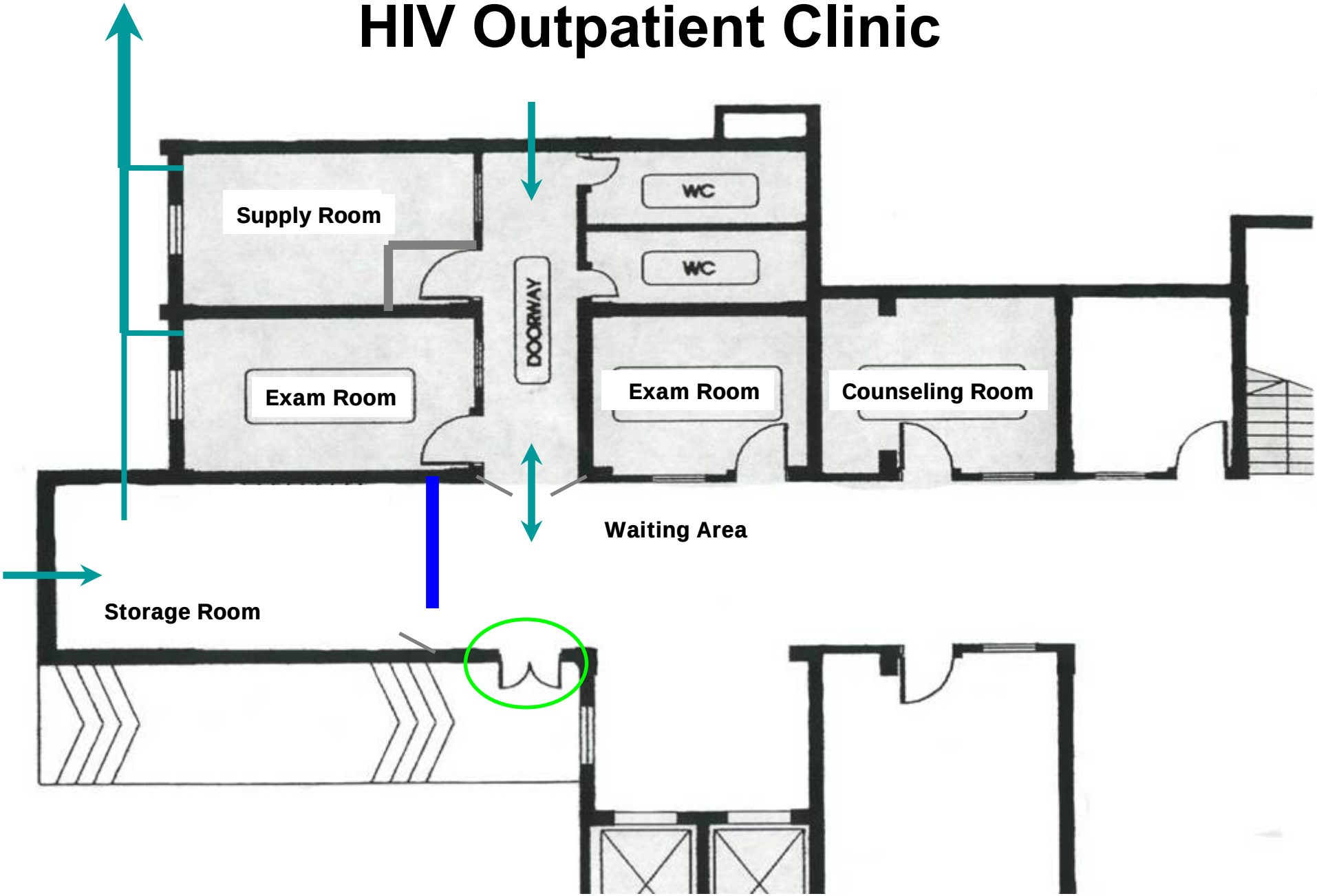
Lifecycle of IC Programs



Reorganization for Optimal Services (Functionality)

- Maximize infection control
- Minimize risk
- Maximize quality of patient services
- Minimize cost (capital and recurring)

HIV Outpatient Clinic



Summary and Review

- Quickly identify and separate sources of TB, and especially M(X)DR-TB from those at risk
- Examine practical opportunities and obstacles to prevent transmission for each institution, area and group

Summary and Review (2)

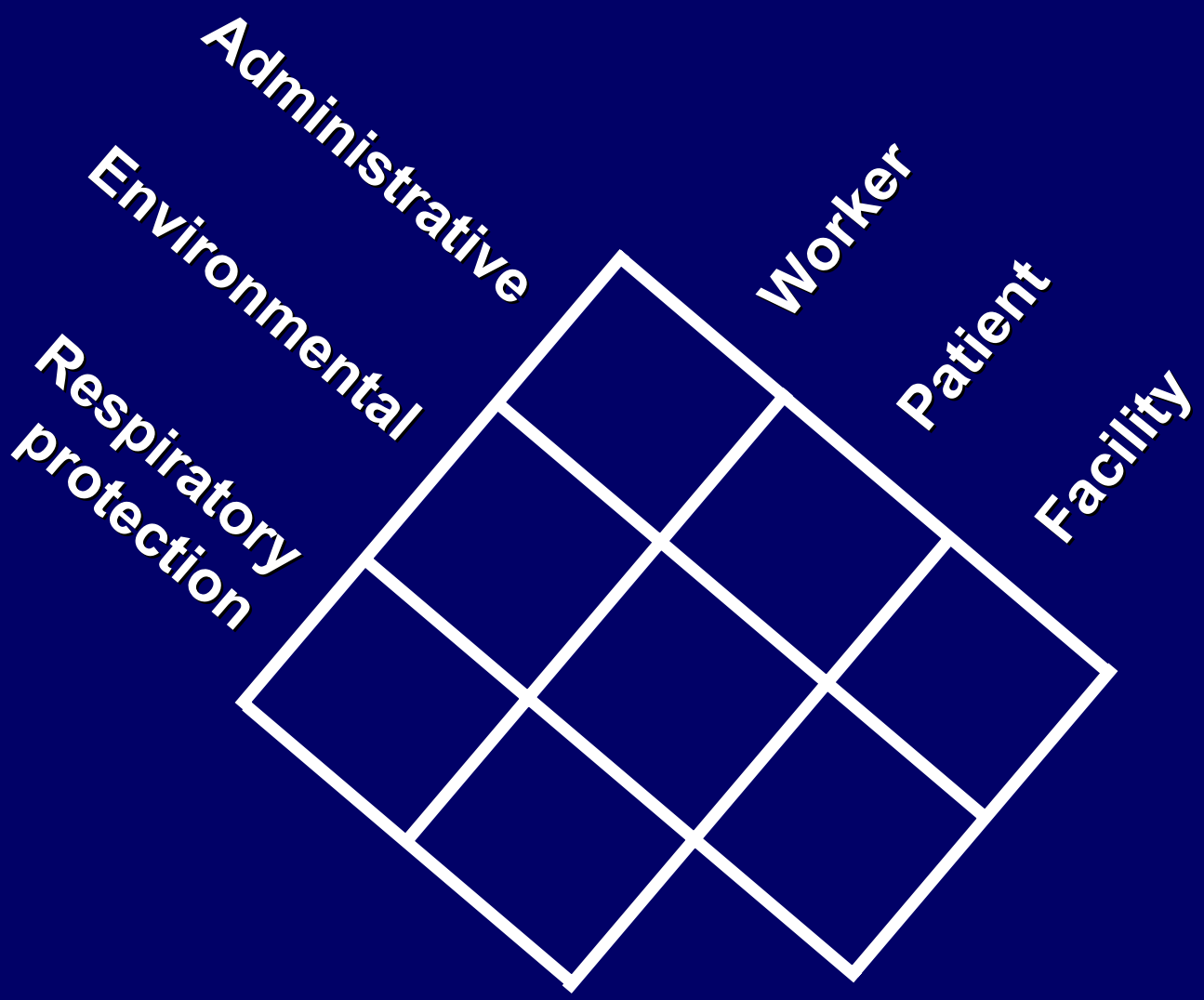
- Assign responsibility and authority
- Conduct risk assessment
- Develop a comprehensive written IC plan and policies for implementing it
- Implement, monitor, and enforce IC plan
- Educate, screen, and counsel health workers
- Evaluate and revise IC plan as needed

Environmental (Engineering) Controls

Paul A. Jensen

U.S. Centers for Disease Control and Prevention

Hierarchy of Infection Controls



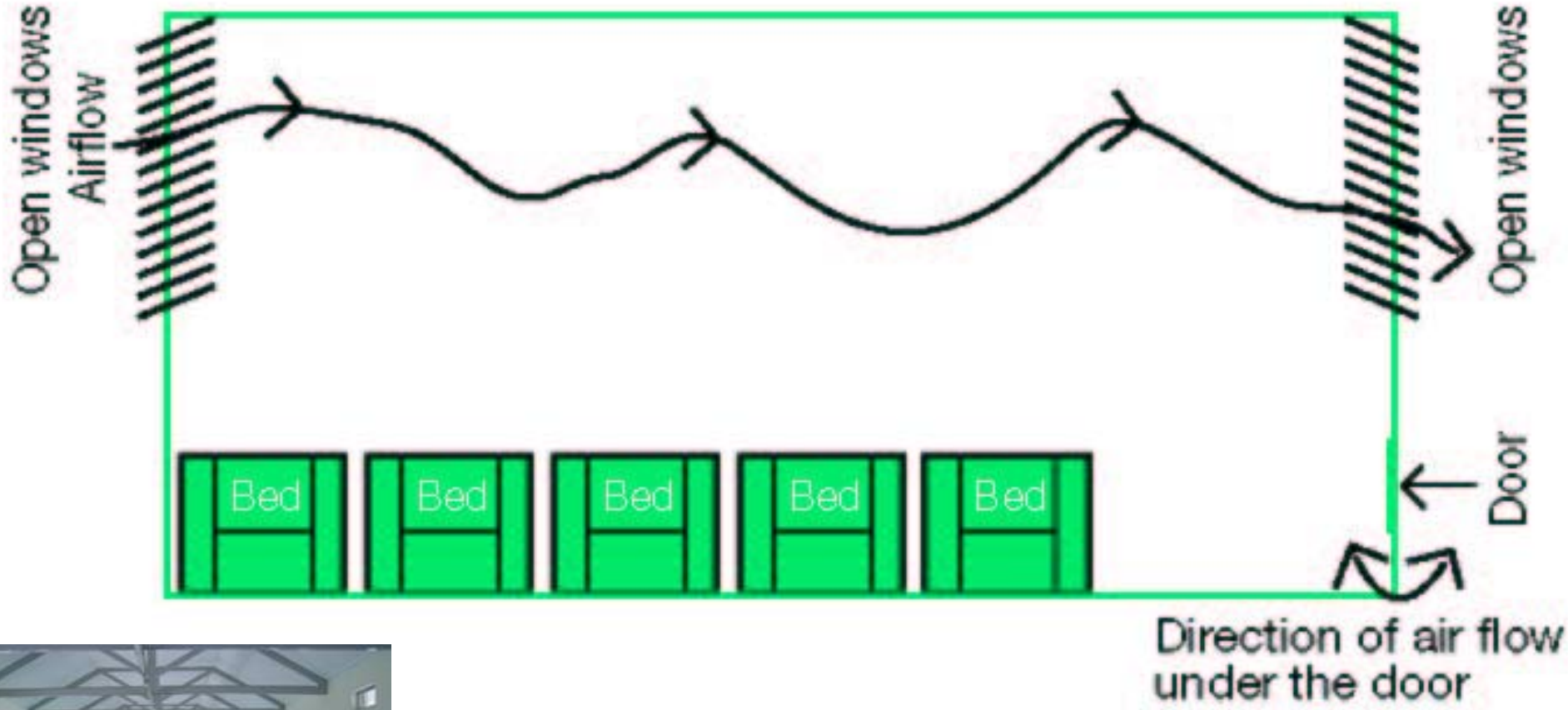
What is ventilation?

- Movement of air
- “Pushing” and/or “pulling” of particles and vapors
- Preferably in a controlled manner

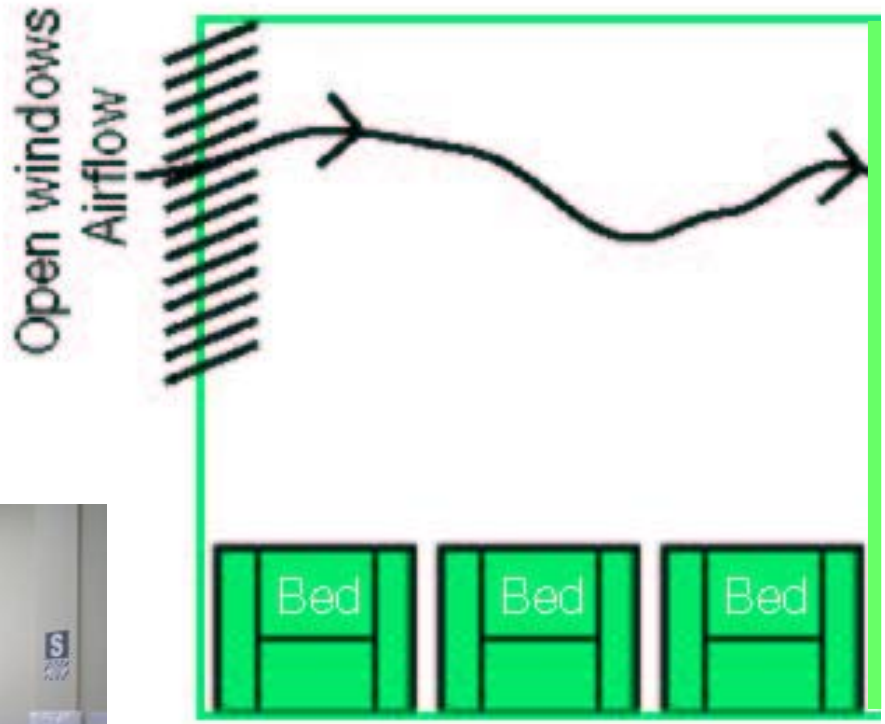
Ventilation control

- Types of ventilation
  - Natural
  - Local
  - General

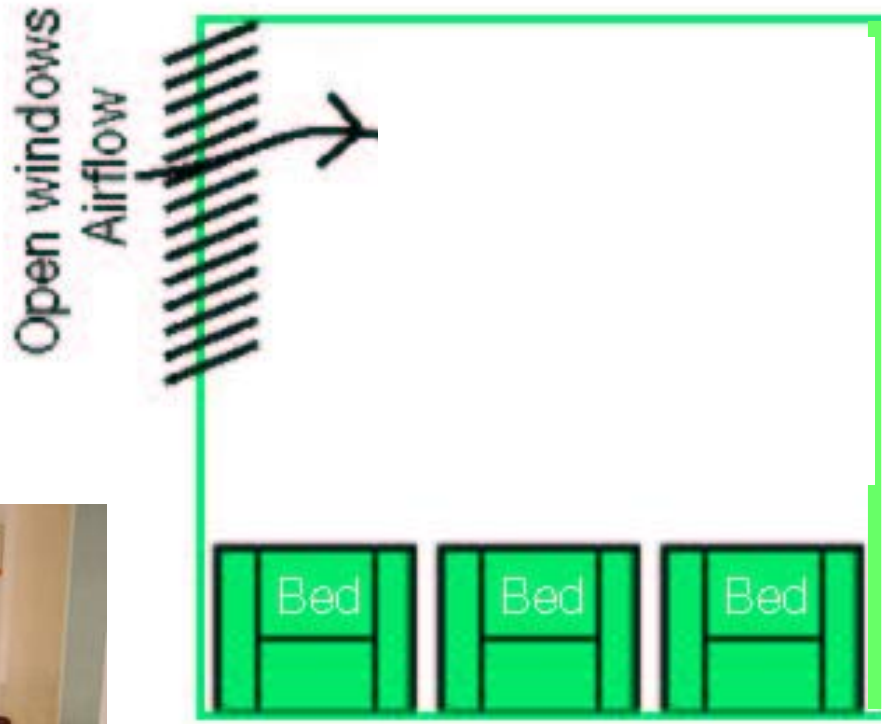
Natural Ventilation



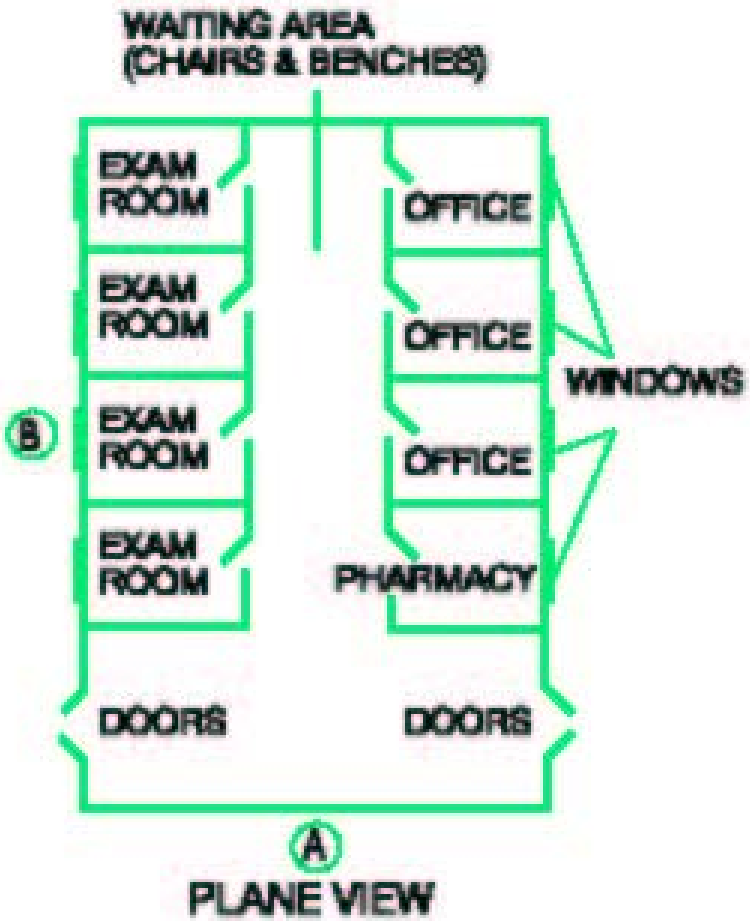
Natural Ventilation

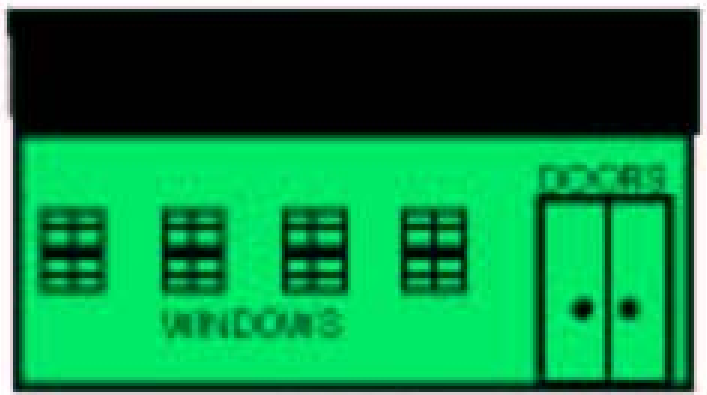


Natural Ventilation



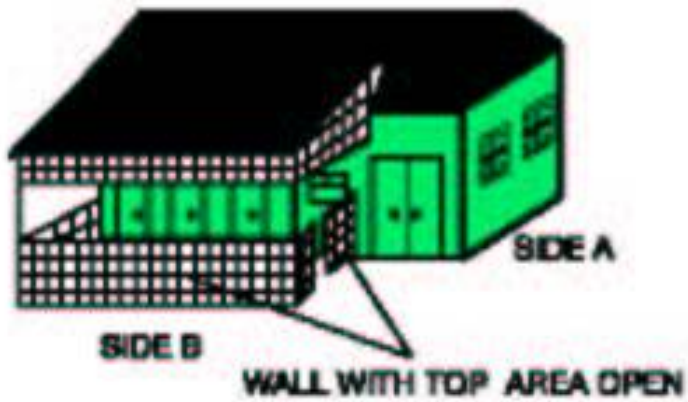
Natural Ventilation





SIDE B

Natural Ventilation



Do not block windows

Rod Escombe

Rod Escombe

Peru

Peru

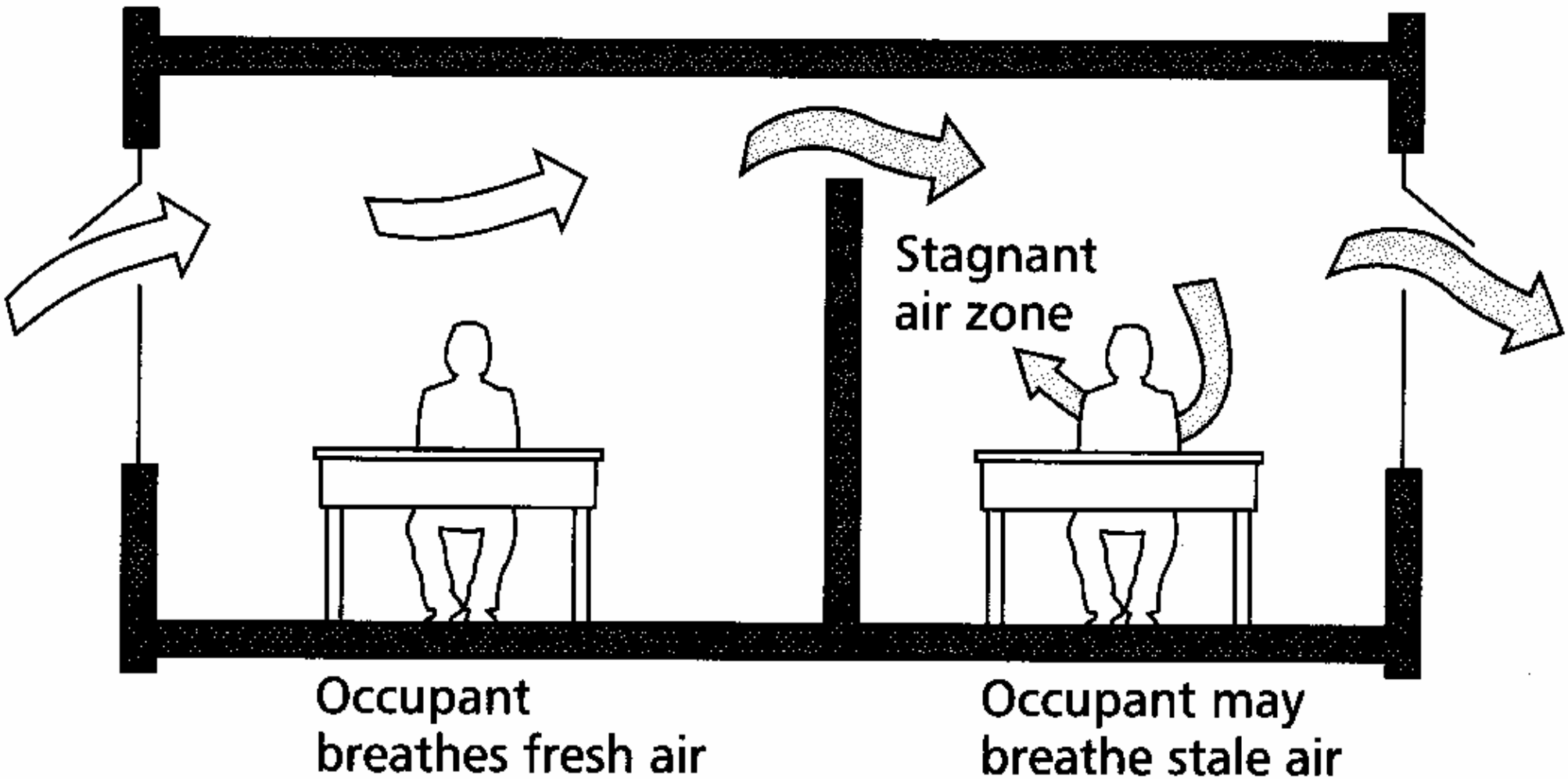


Figure 4.5 The effect of internal partitions on air flow

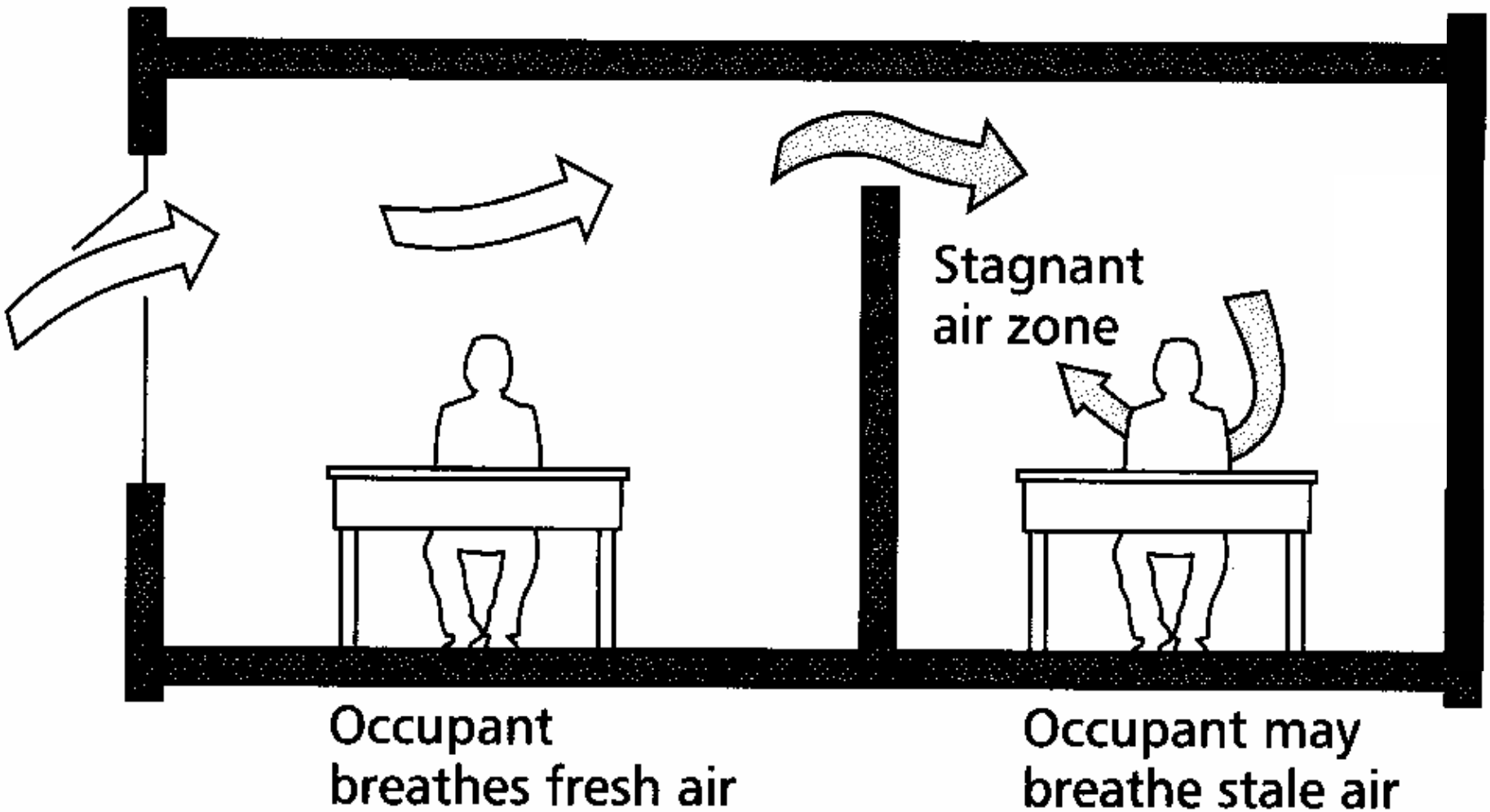


Figure 4.5 The effect of internal partitions on air flow

SALIDA
120
122
Stop
Tuffcare

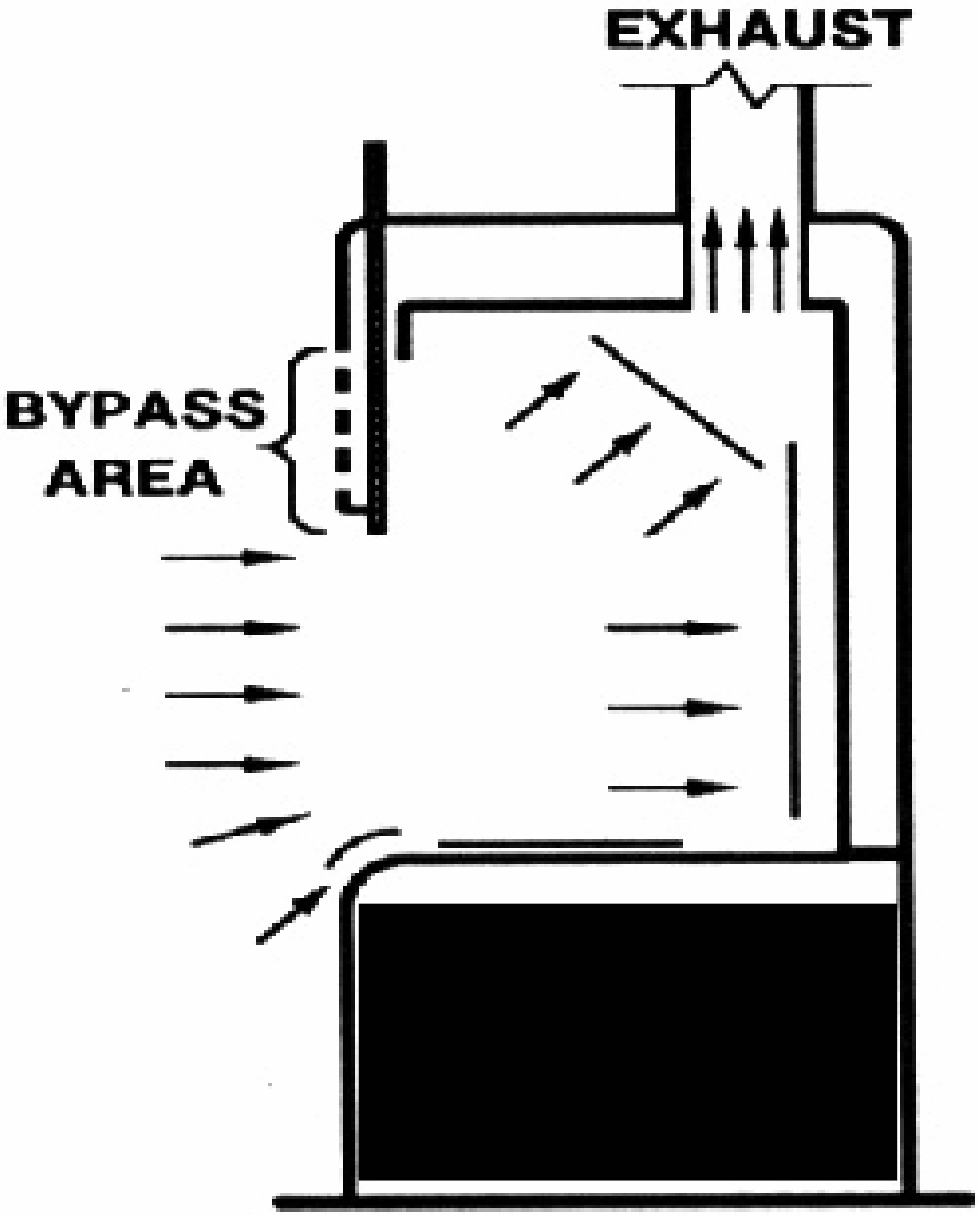
Jefatura
Servicio Social
2Do.Piso
ZONA
SALIDA

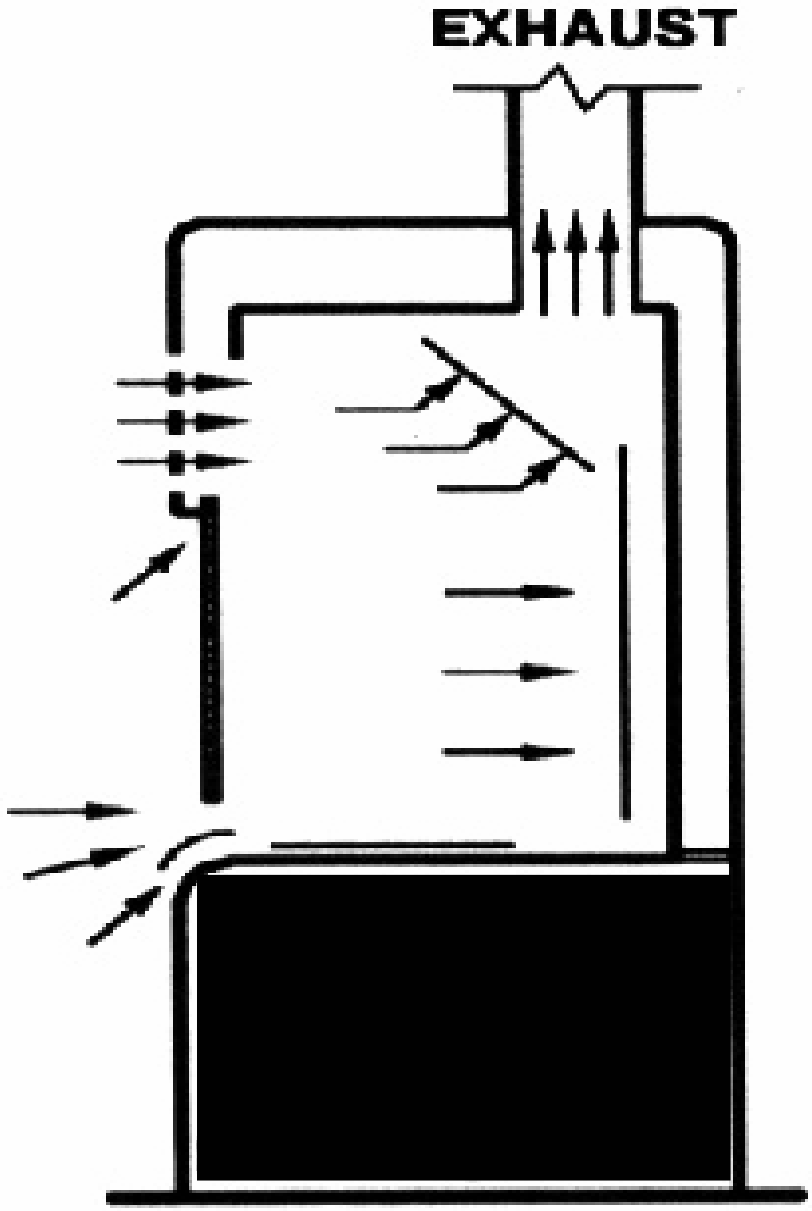
Local exhaust ventilation

- Source capture
  - Exterior hoods
  - Enclosing hoods

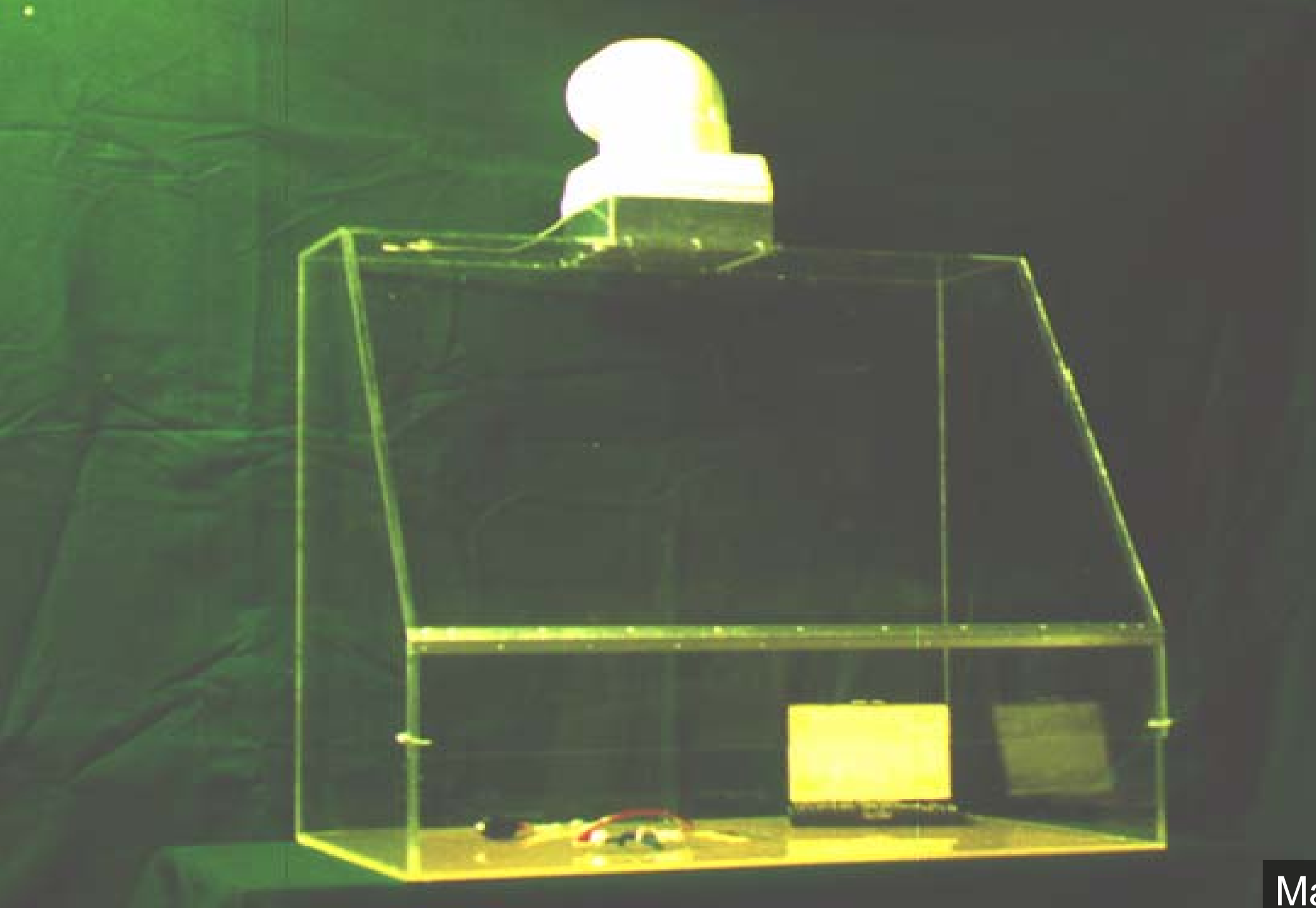
Laboratory

- Ventilated Cabinet
- Biological Safety Cabinet (BSC)
- Laminar Flow Cabinet

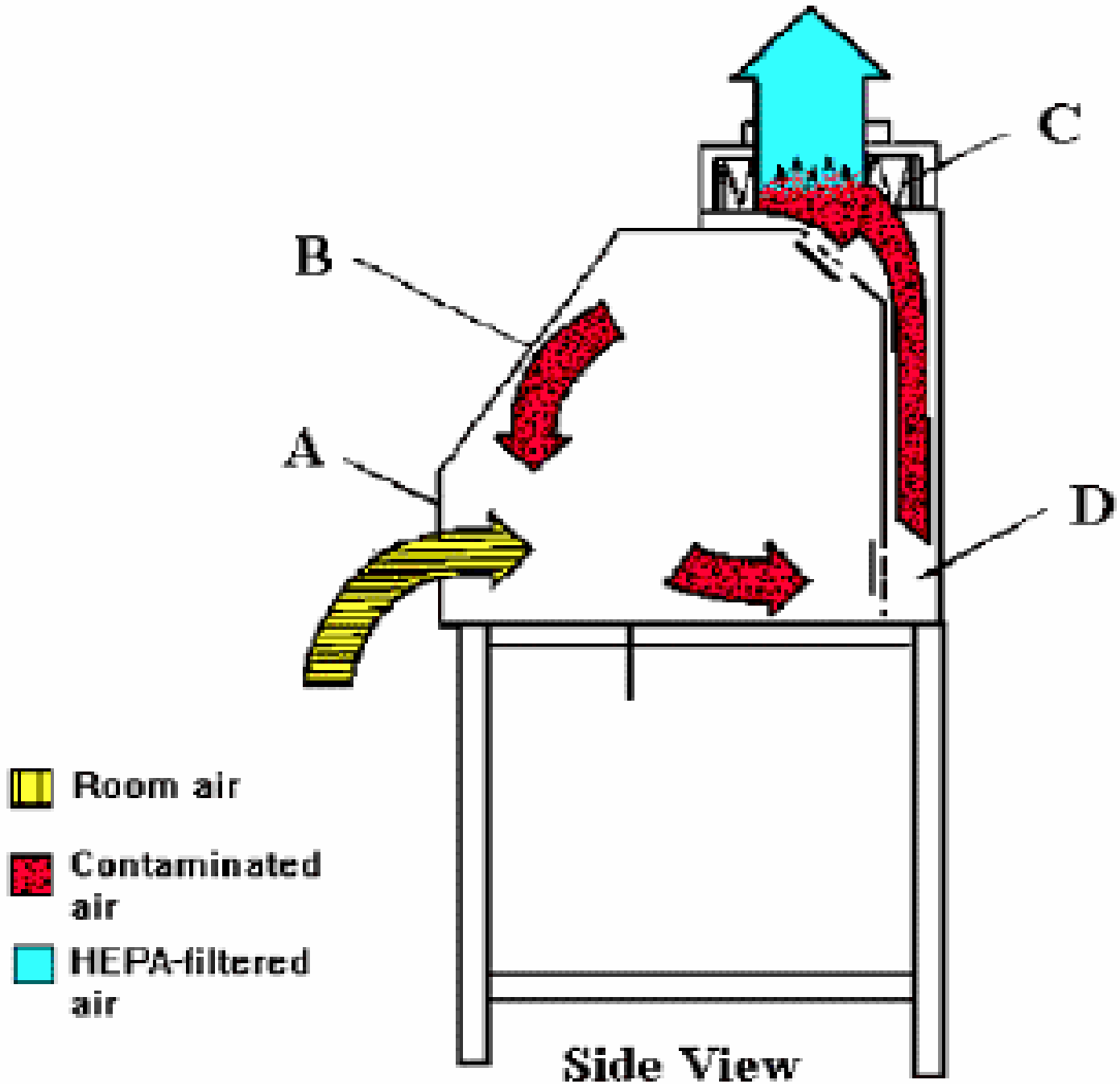




100% Exhaust 0.5 m/s



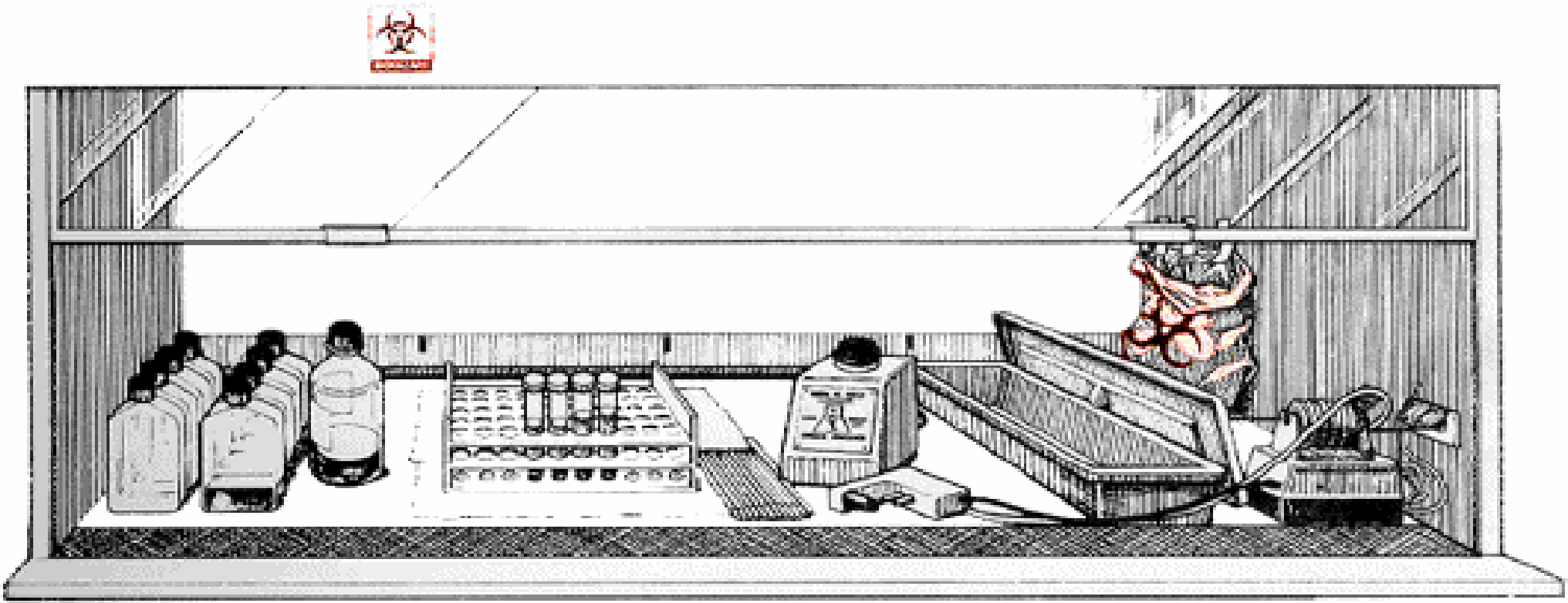
BSC Class I



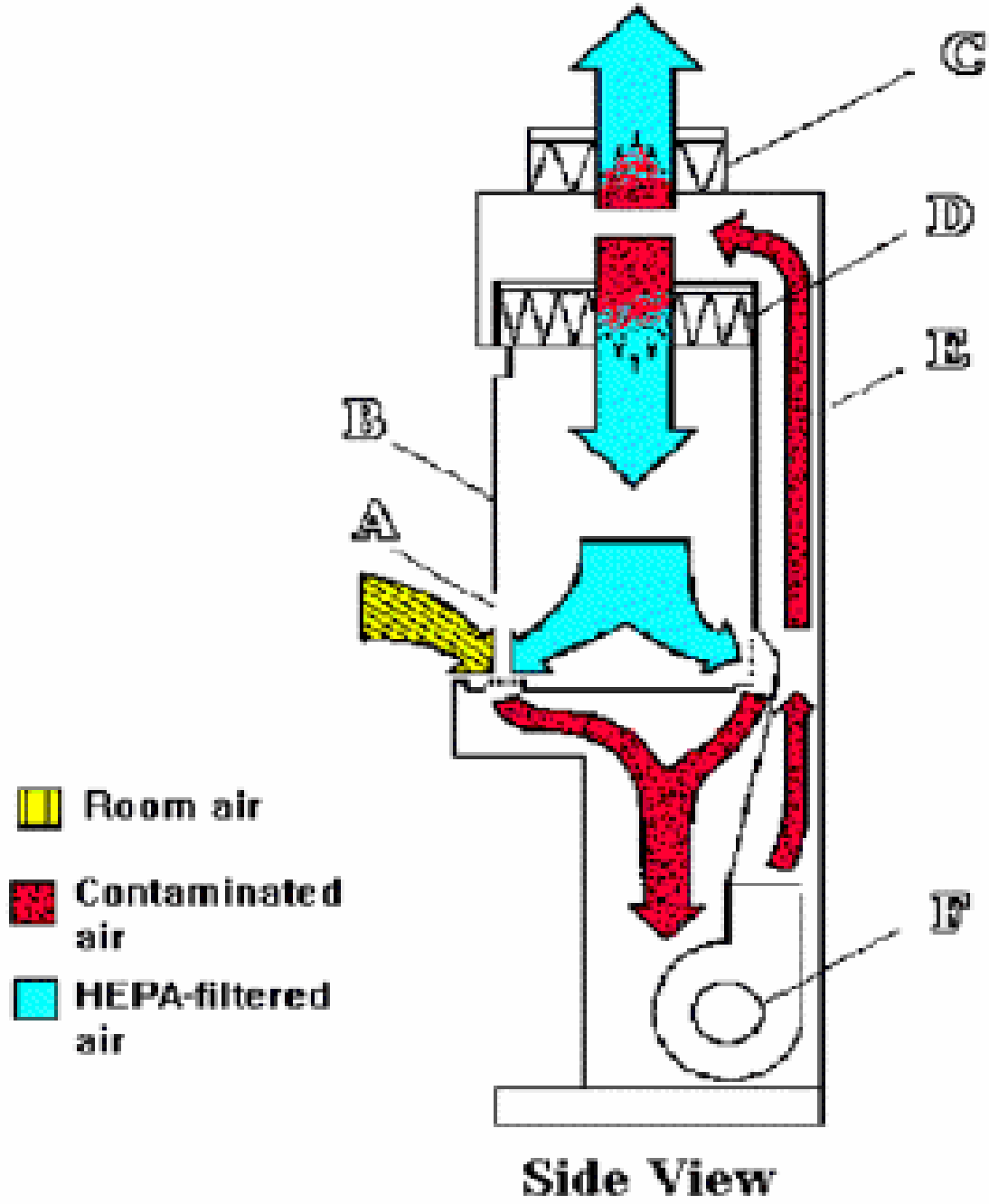
100% exhaust
~ 0.38 m/s

Russian Federation

Plan your work . . .
Work your plan



BSC
Class IIA



70% recirculation
0.38 m/s

Estonia

Sputum Induction

Russian Federation

Russian Federation

Russian Federation

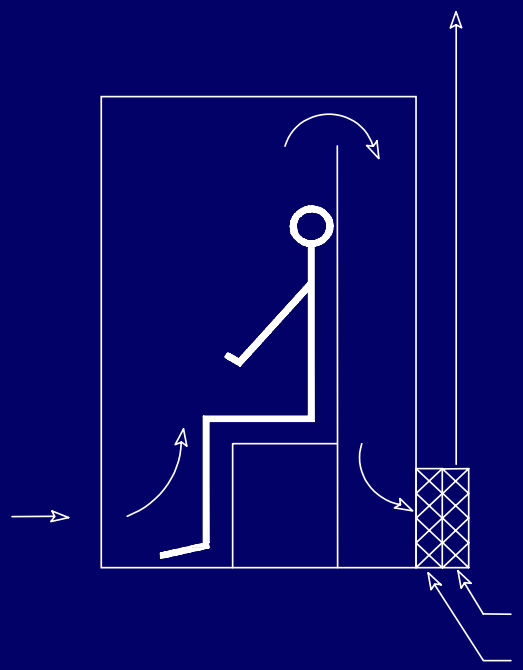
Russian Federation

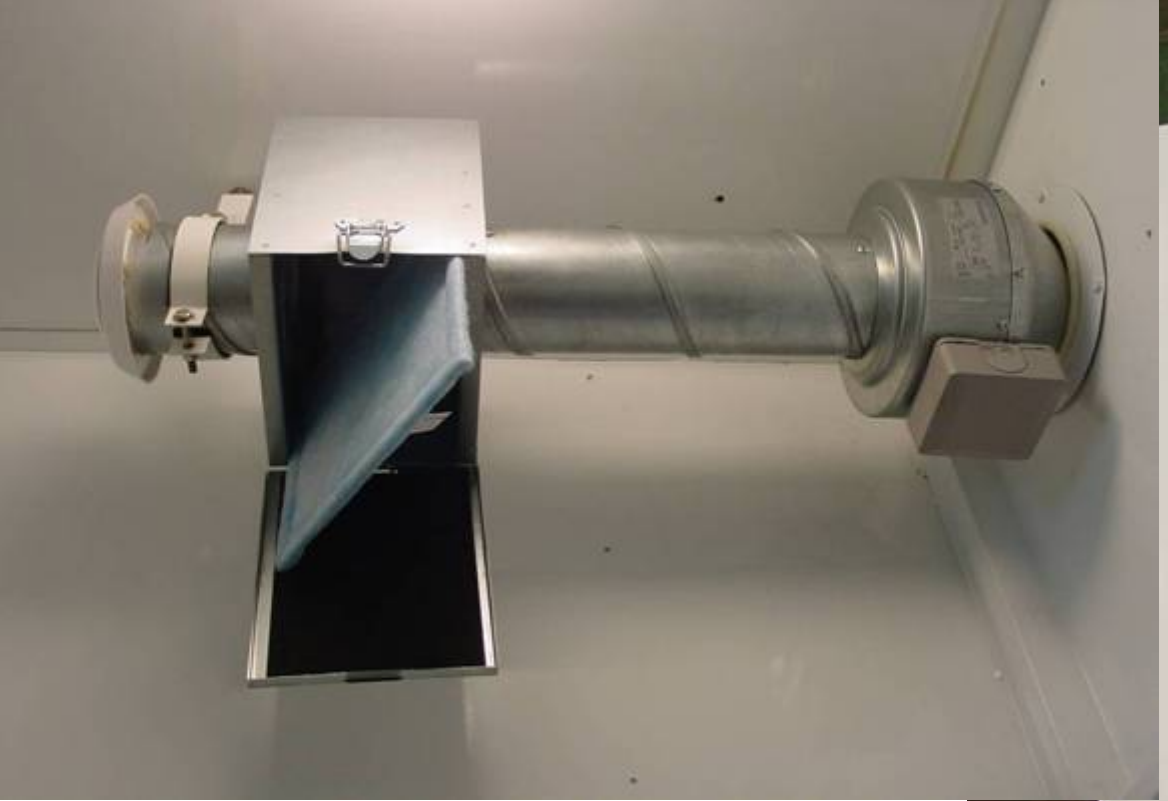
Russian Federation

Russian Federation

Enclosing hood / booth

- Encloses
- Treatment

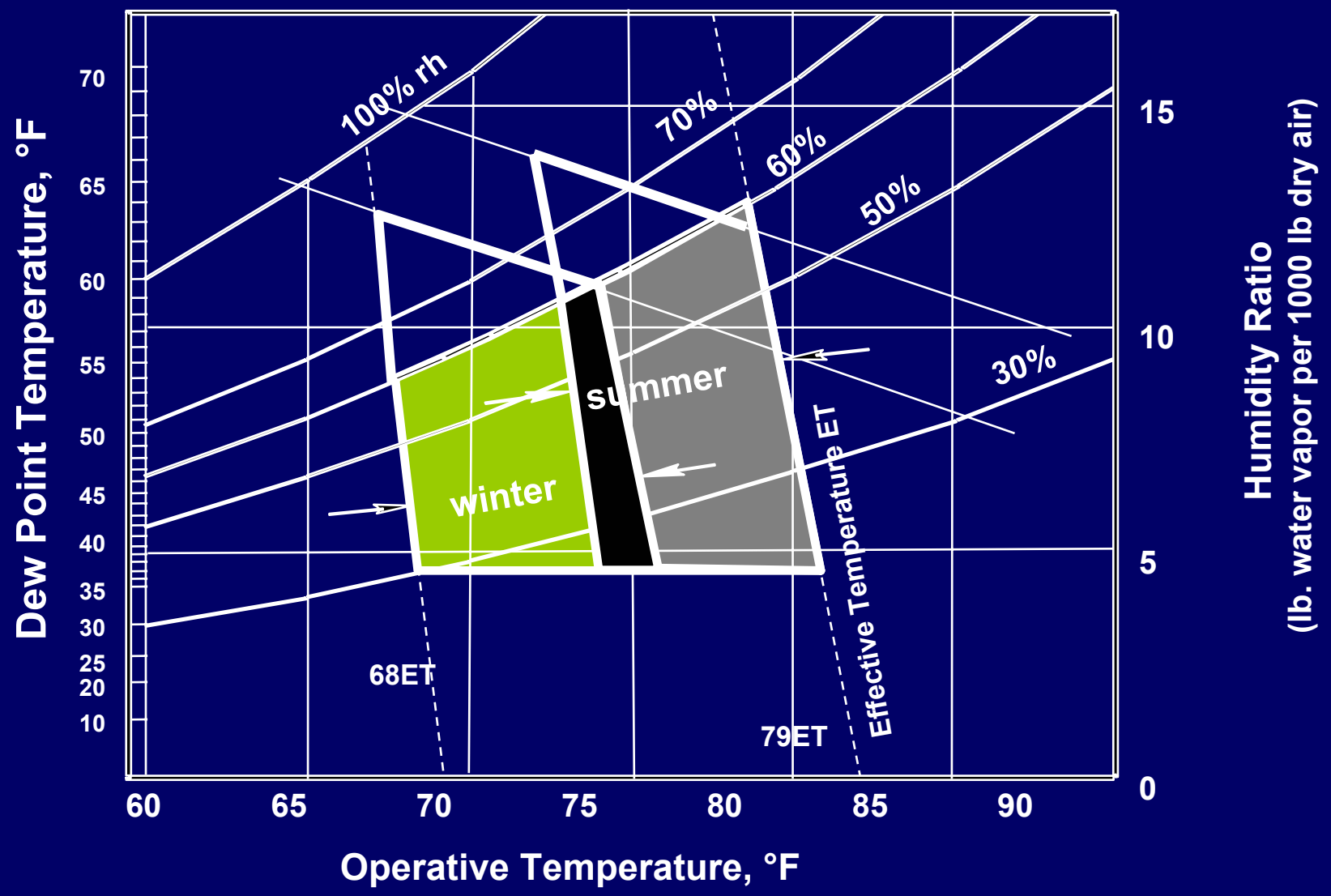




Russian Federation

Philippines

ASHRAE Comfort Zones



General ventilation airflows

- SABS/CEN
- ASHRAE/AIA
- Validation of airflow rates
- Operating room studies
- Applicability to control of Mycobacterium tuberculosis
- Use highest airflow feasible

Calculation of Air Changes per Hour

ACH = Flowrate/Room Volume

Flowrate = __ m^3/hour

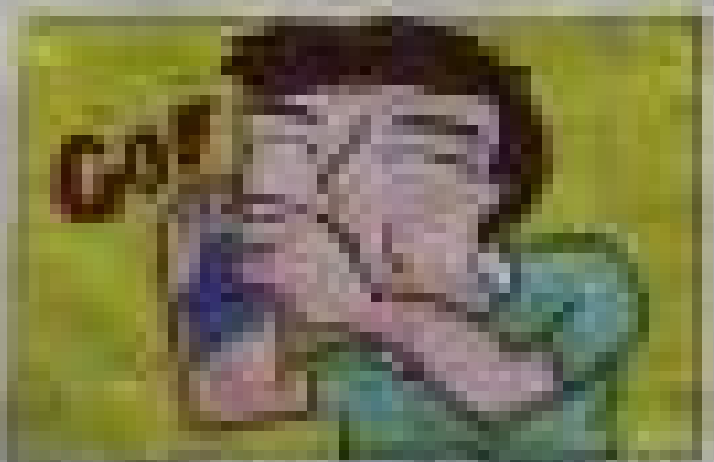
Room Volume = __ m^3

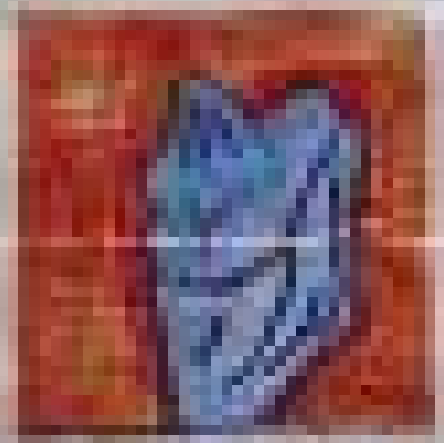
Dilution Ventilation

- Flow rate = Constant
- Exhaust > Supply

$$C_1/C_o = e^{-kt}$$

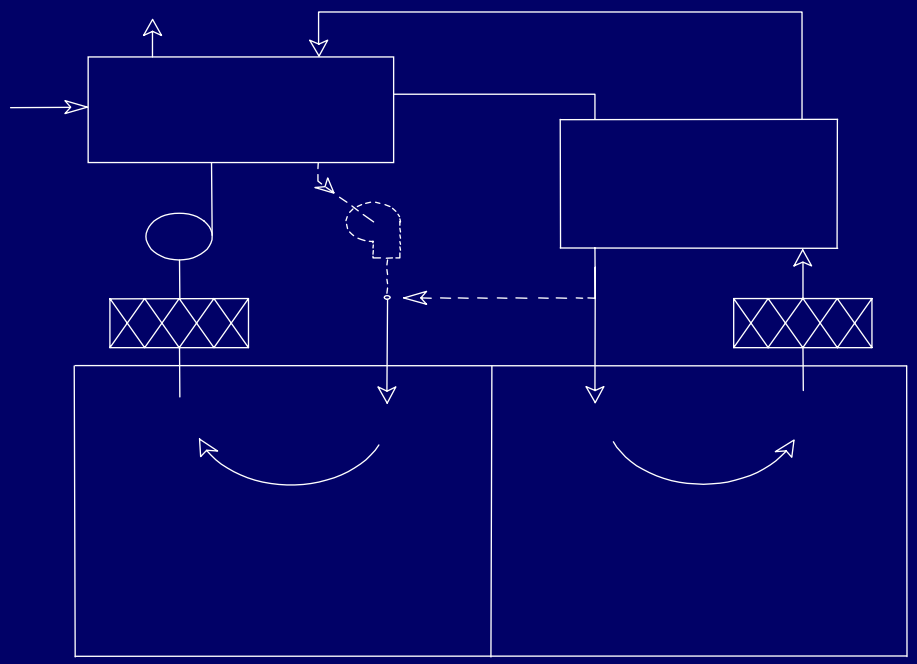
Where:	C_o	=	Initial concentration
	C_t	=	Concentration at time t
	k	=	Rate of removal in ACH (m^3/hour / m^3)
	t	=	Time (hours)





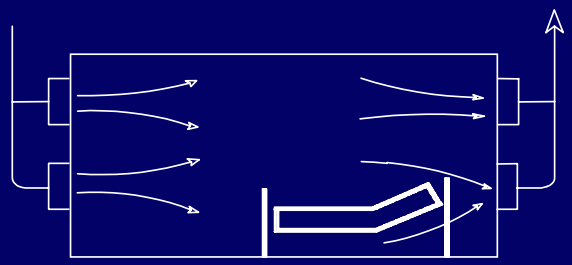
Examples of general ventilation

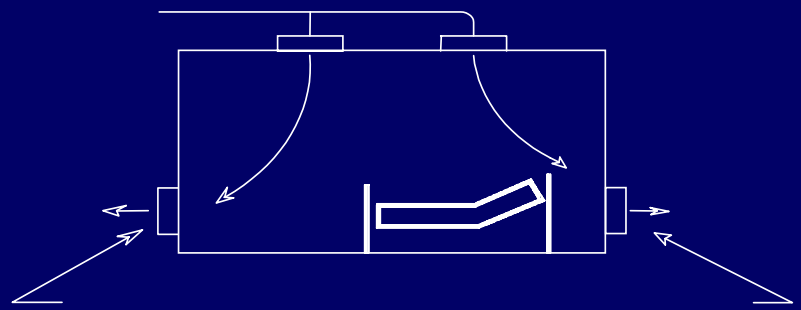
- Single pass
  - First choice
- Recalculating
  - HEPA filtration



Room air mixing and air flow

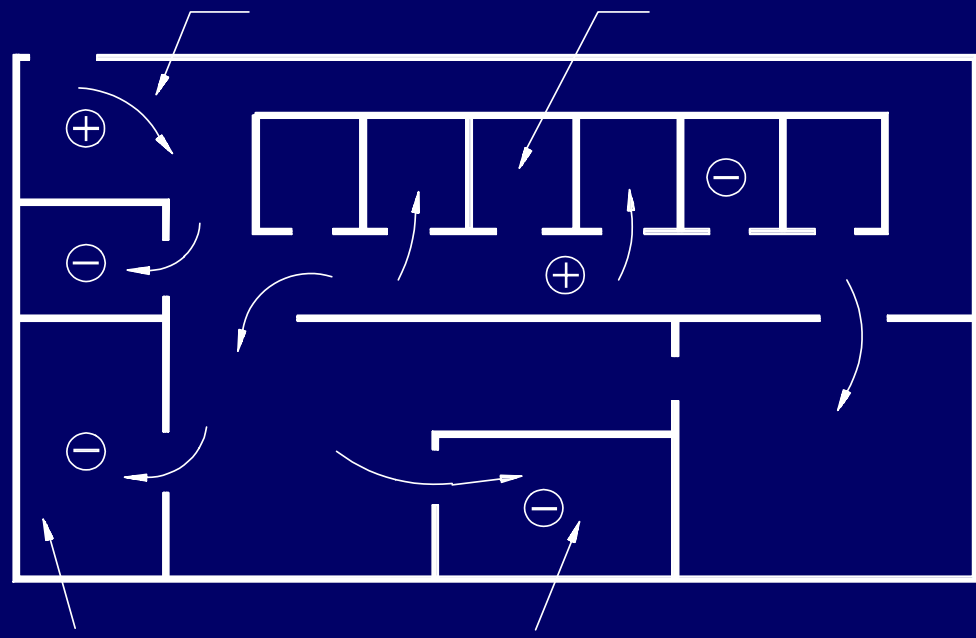
- Prevent air stagnation
- Prevent short circuiting
- Air direction
- Air temperature
- Space configuration
- Movement

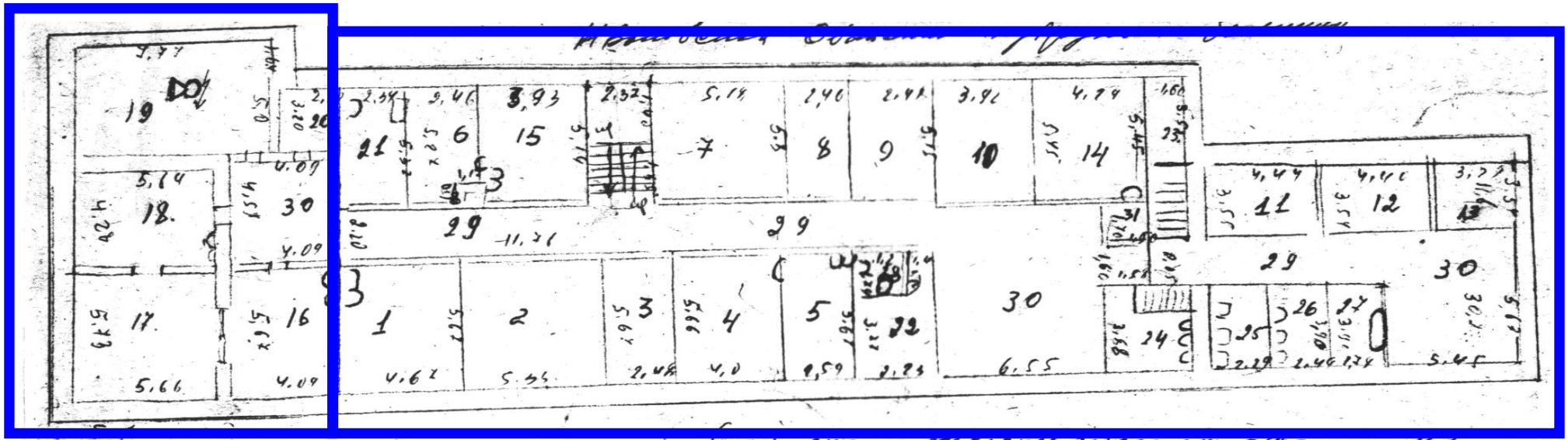




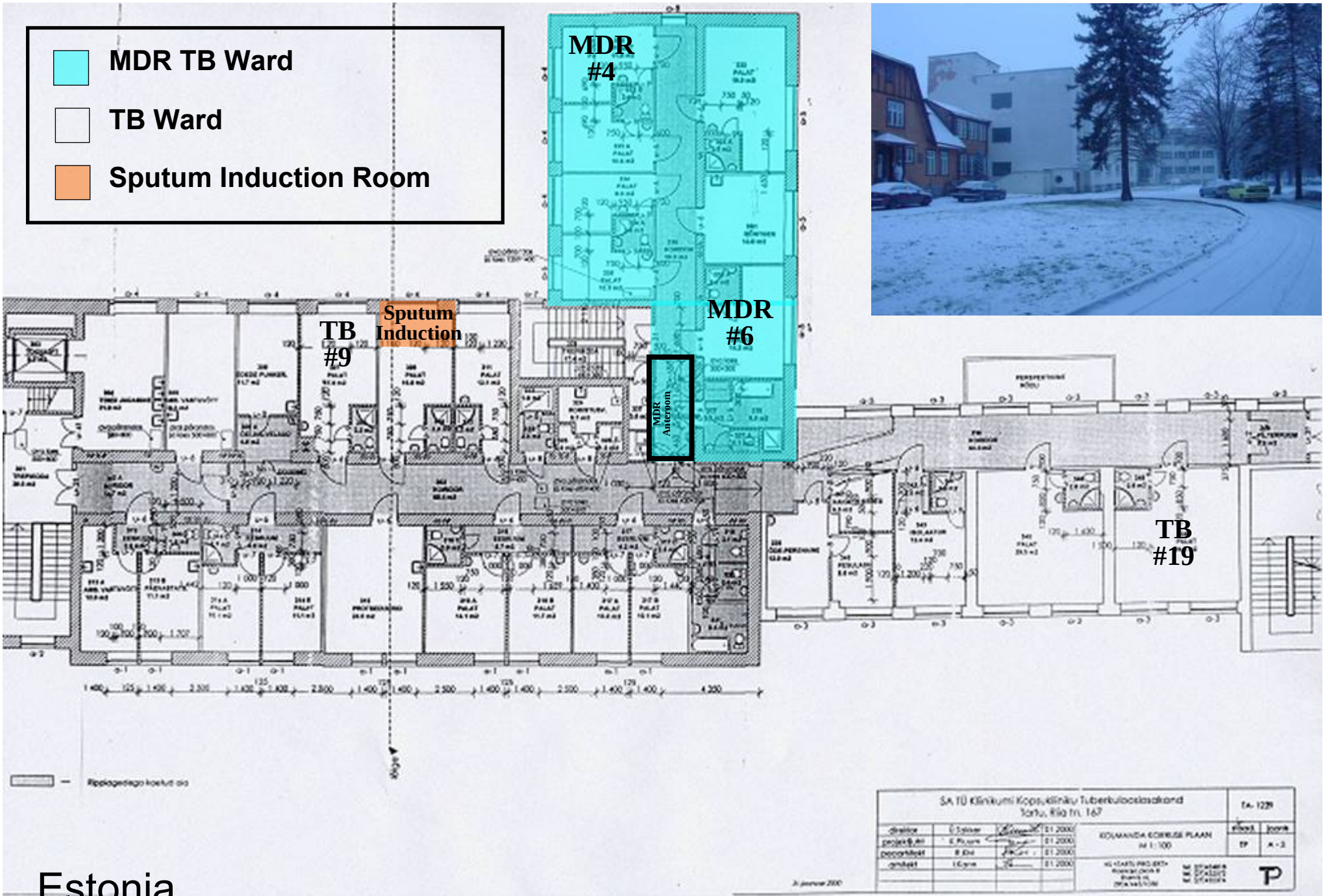
Facility airflow direction

- Clean to less clean
- Negative pressure

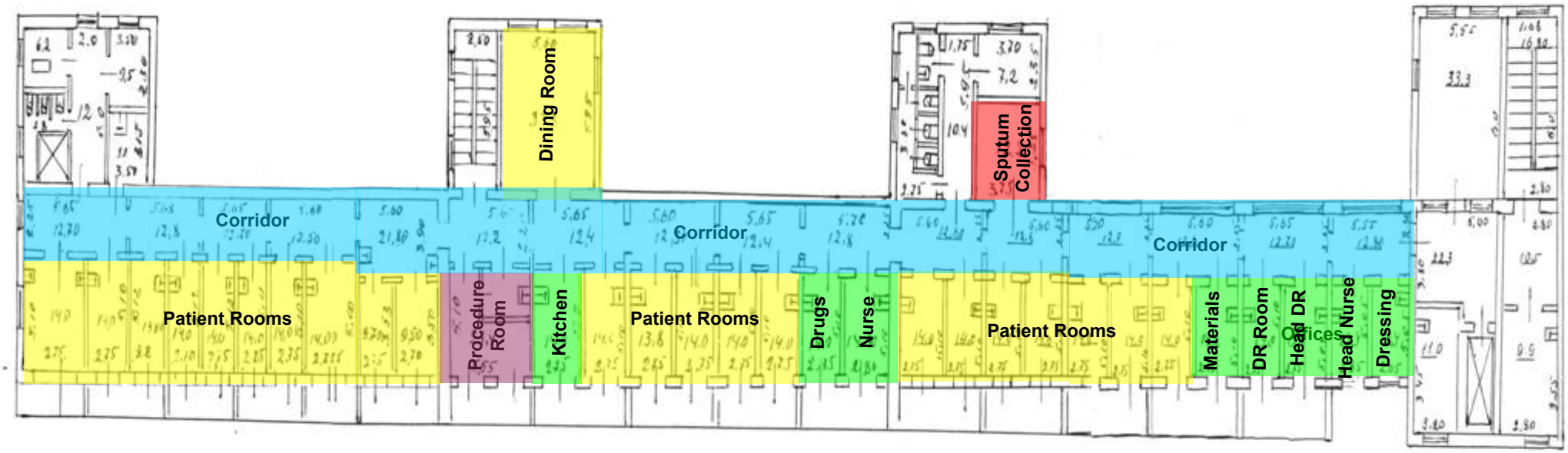




с 11 – 12 палаты
13 – кабинет старшей мед сестры
14 – Ординаторская
15 – Перевязочная
16 – Прививочный кабинет
17 – Кабинет врачебных инфекций
18 – Бронхологический кабинет
19 – Рентген кабинет
20 – Пультовая
21 – Фотолаборатория
22 – Комнаты отдыха мед персонала
23 – Комнаты отдыха дежурного врача
24 – Мужской туалет
25 – Женский туалет


MDR TB Ward
TB Ward
Sputum Induction Room
MDR #4
MDR #6
MDR Anteroom
TB #9
Sputum Induction
TB #19
Estonia

TB Dispensary



Russian Federation

TABLE 1. Air changes per hour (ACH) and time required for removal efficiencies of 99% and 99.9% of airborne contaminants*

	Minutes required for removal efficiency†	
ACH	**99%**	**99.9%**
2	138	207
4	69	104
6	46	69
12	23	35
15	18	28
20	7	14
50	3	6
400	<1	1

* This table can be used to estimate the time necessary to clear the air of airborne *Mycobacterium tuberculosis* after the source patient leaves the area or when aerosol-producing procedures are complete.

† Time in minutes to reduce the airborne concentration by 99% or 99.9%.

http://www.cdc.gov/mmwr/PDF/rr/rr5417.pdf

Russian Federation

Russian Federation

Russian Federation

Russian Federation

STOP!

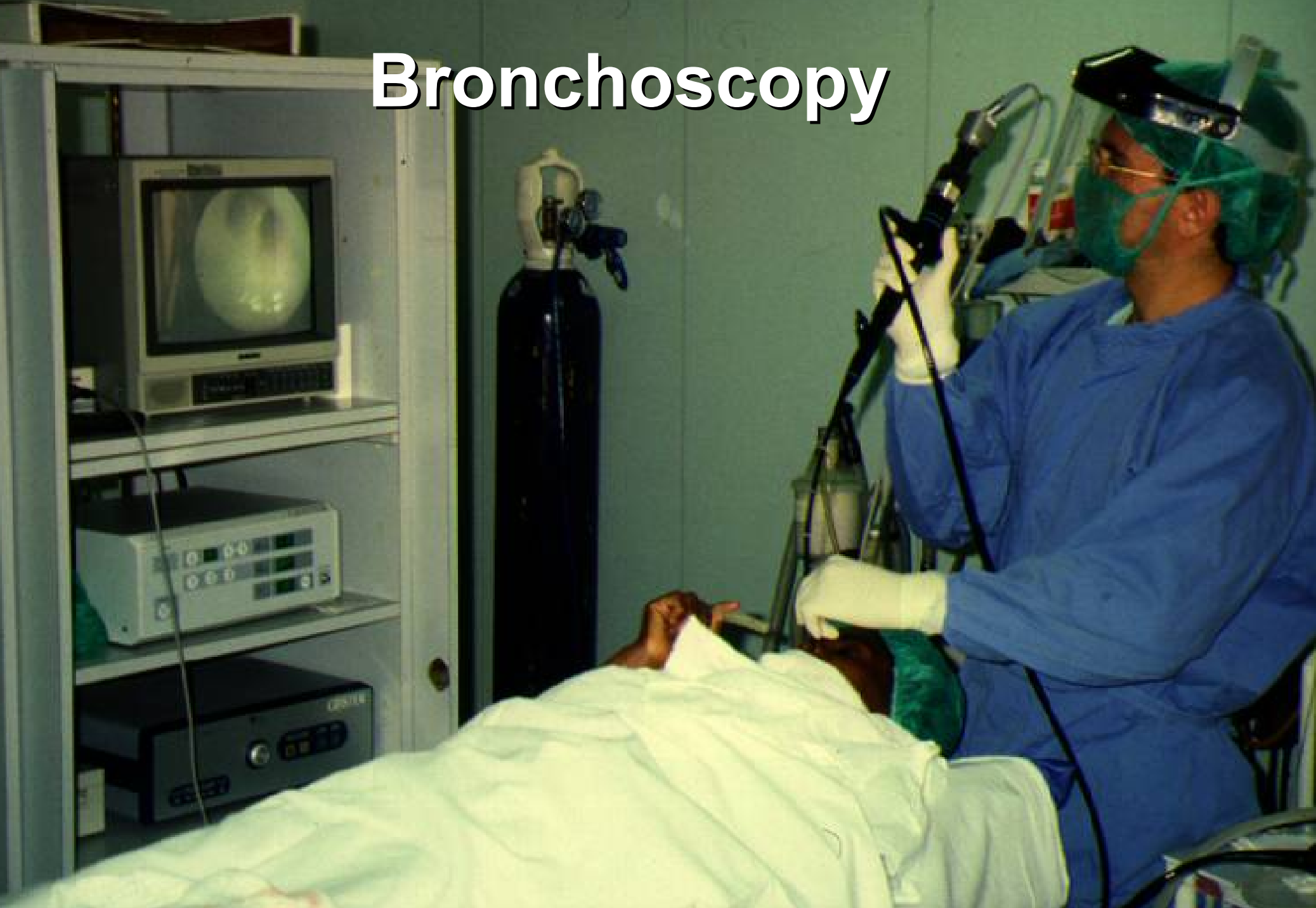
RESTRICTED AREA!

ASSIGNED STAFF ONLY

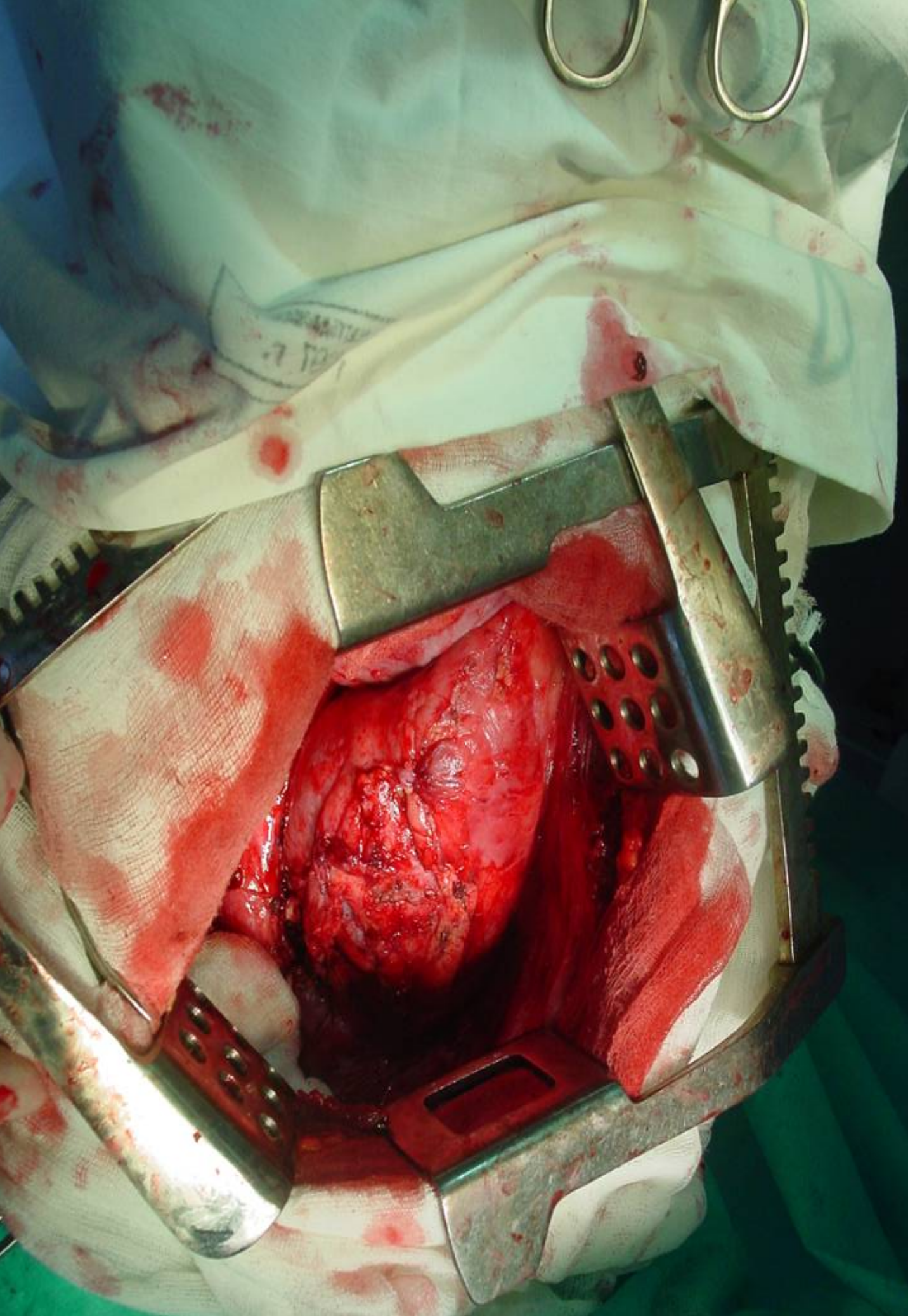
VISITORS NOT ALLOWED

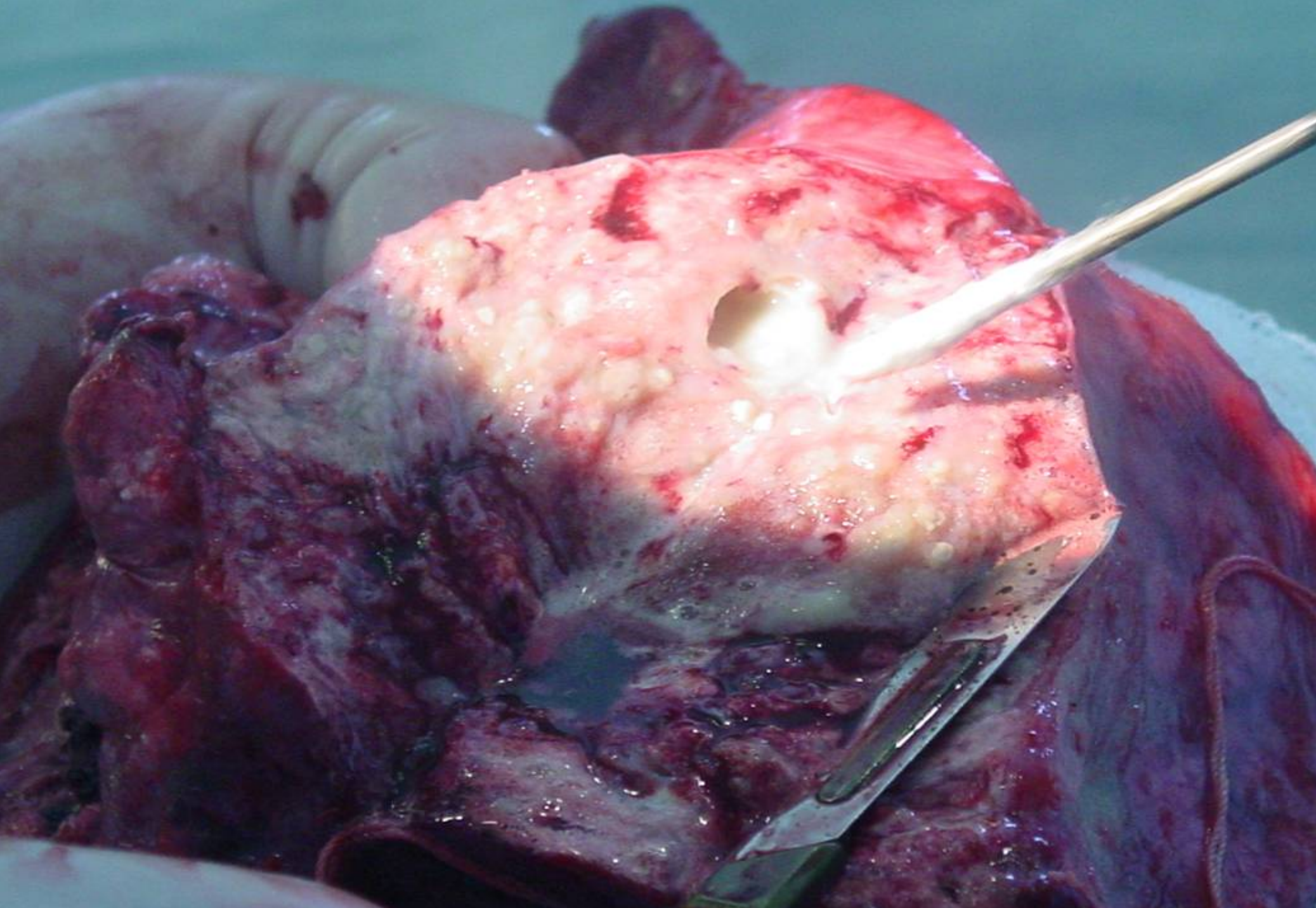
E-03

Bronchoscopy



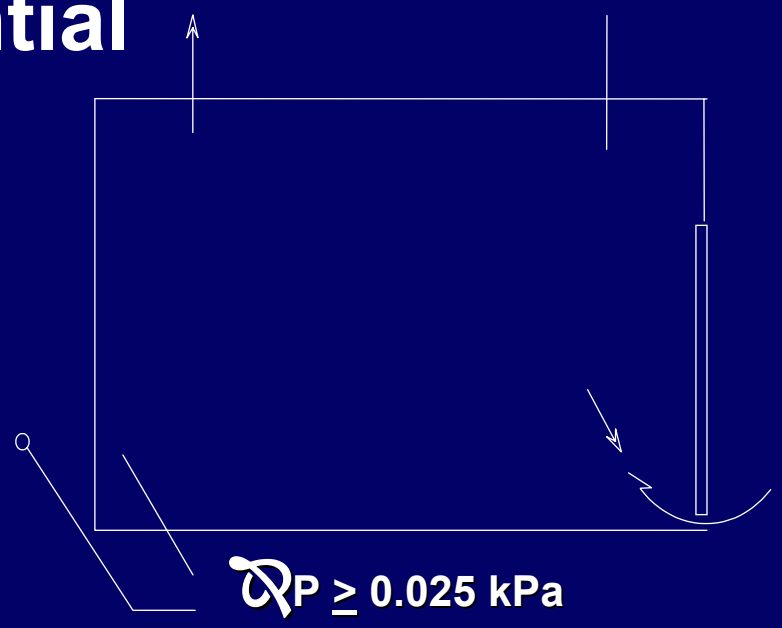
Bronchoscopy





Room negative pressure

- Higher to lower pressure
- Airflow into room
- 10% flow differential (85 m^3/h minimum)
- Pressure differential
- Keep doors and windows closed

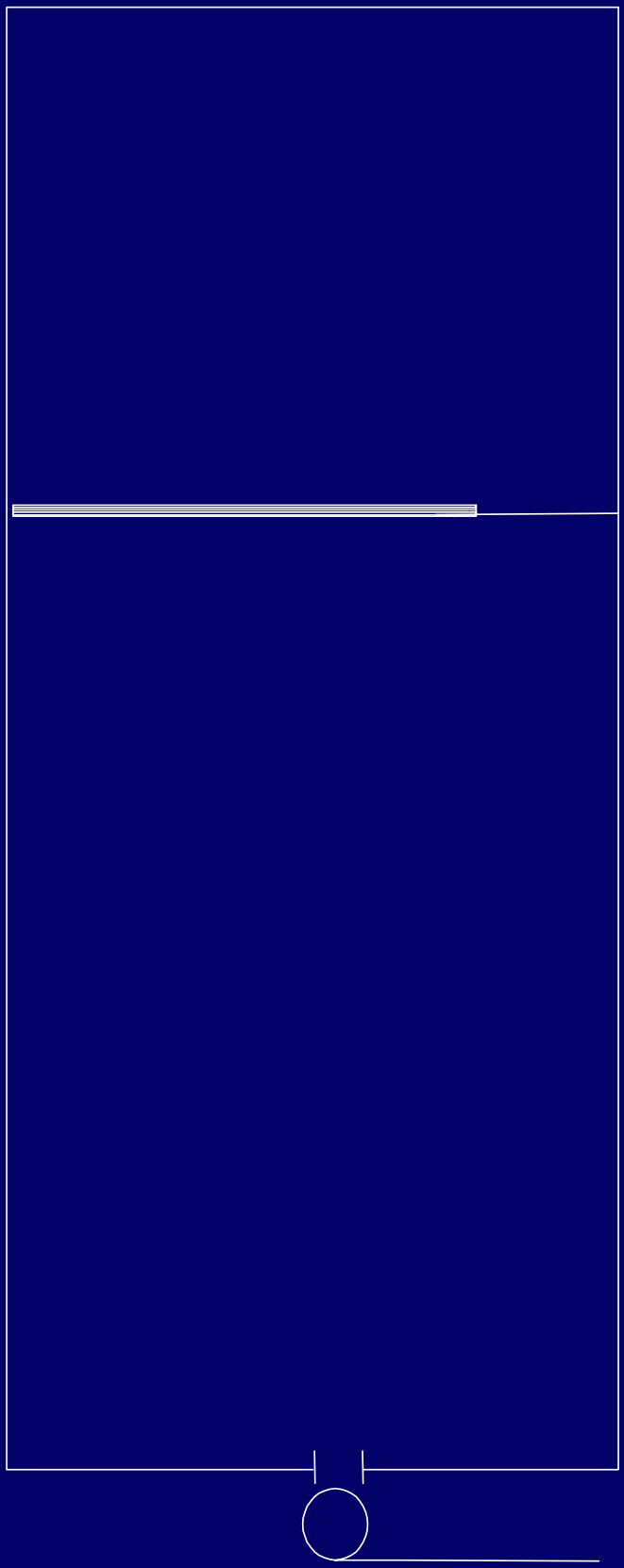


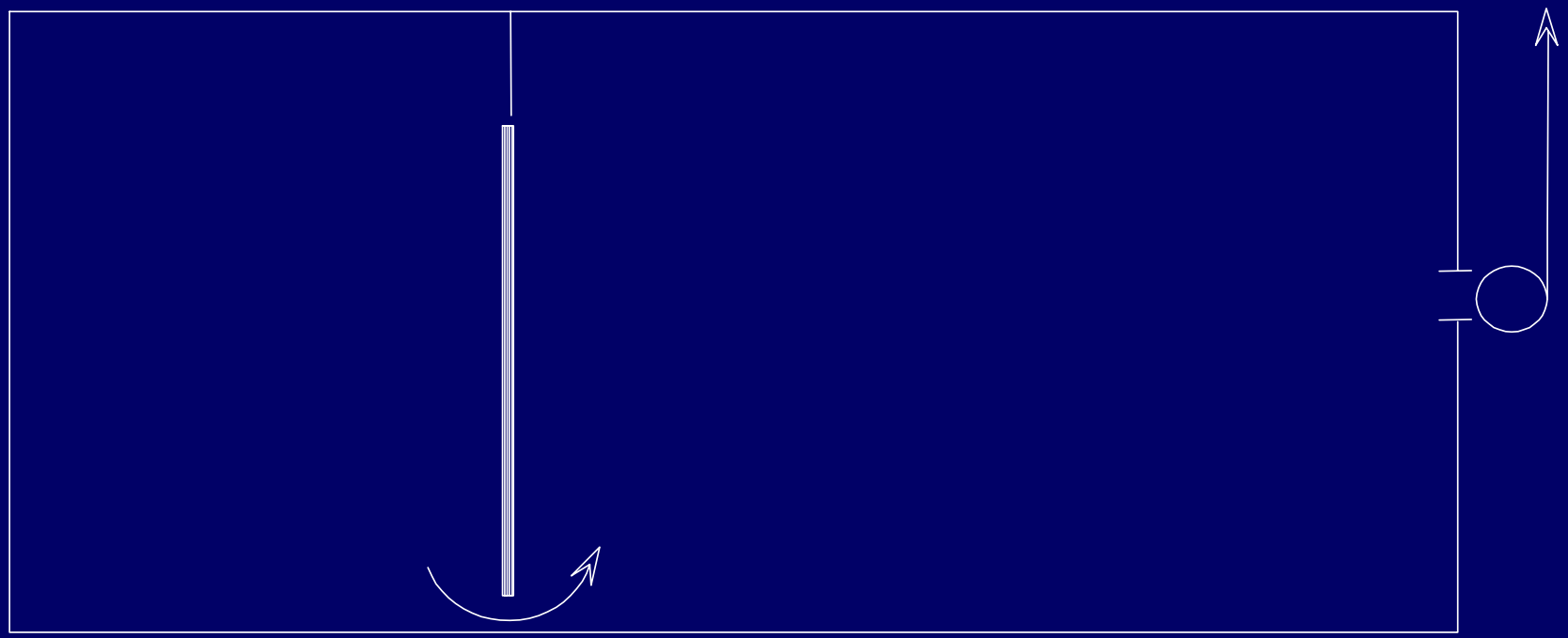
Engineering Control
Administrative Control

Laboratory

Alternative ventilation methods

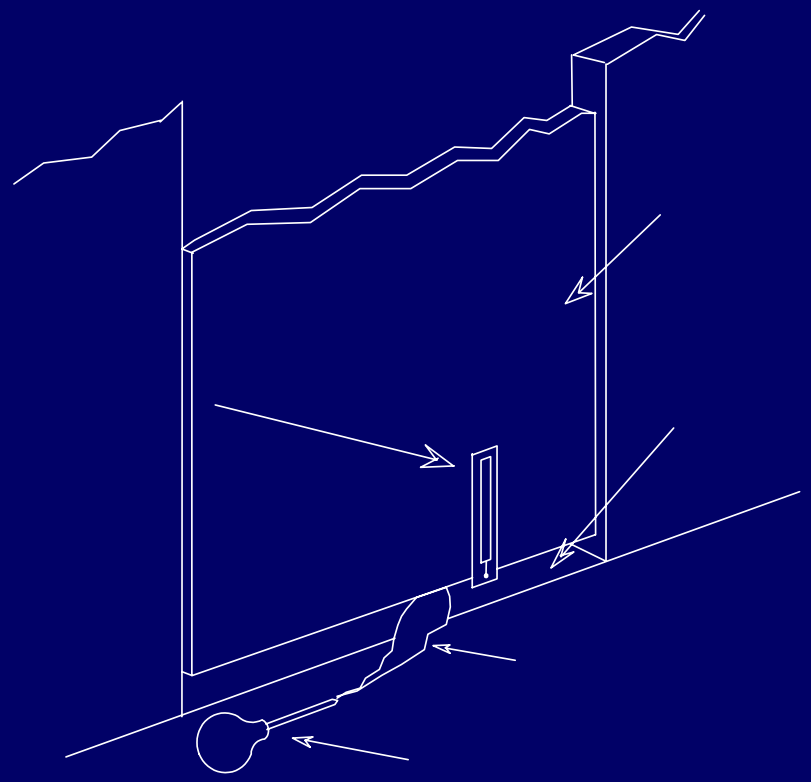
- Window exhaust fan
  - Effect on ventilation
  - Temporary measure





Negative pressure evaluation

- Smoke tube
- Velocity meter
- Pressure sensor



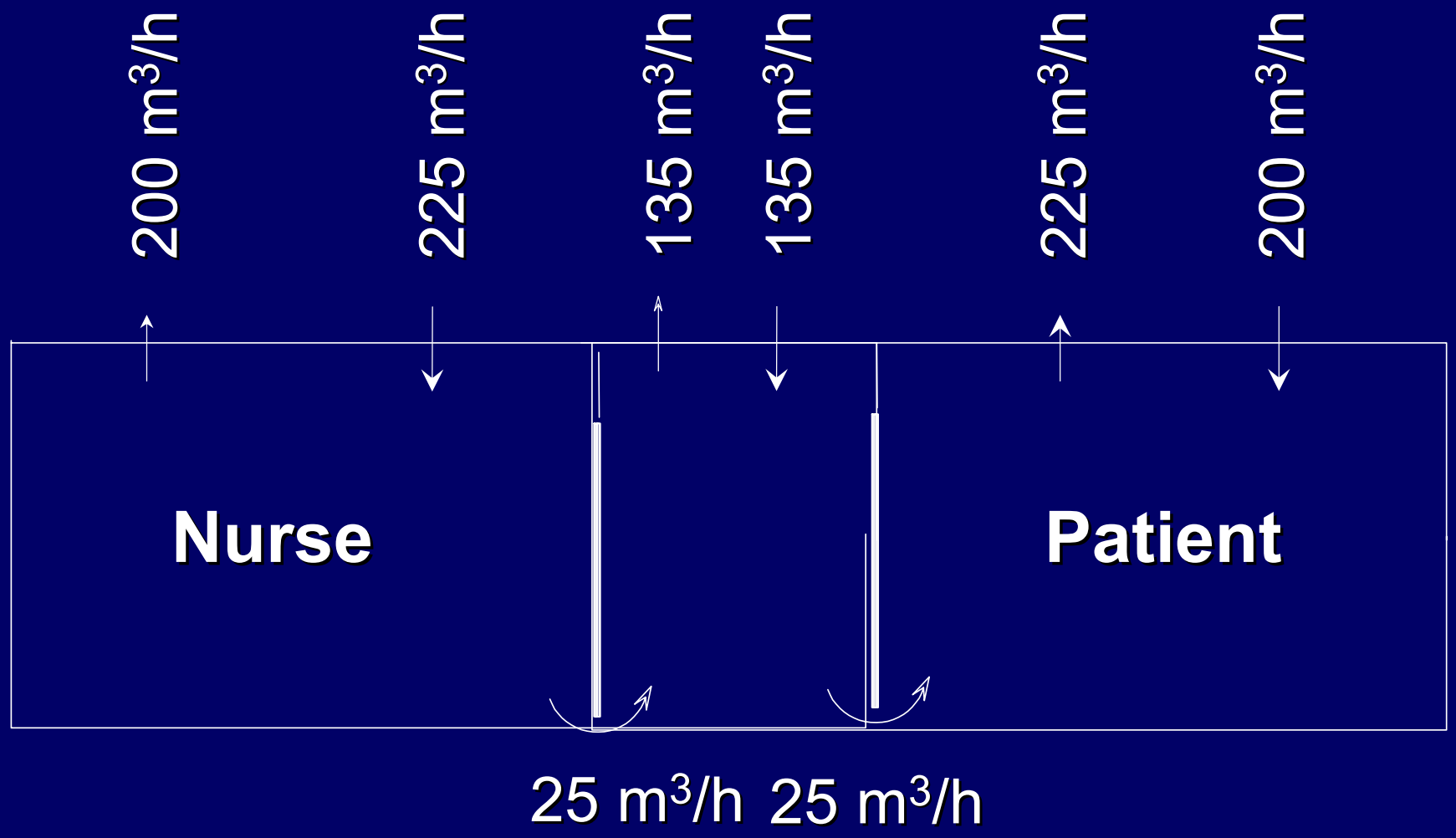
Room air migration

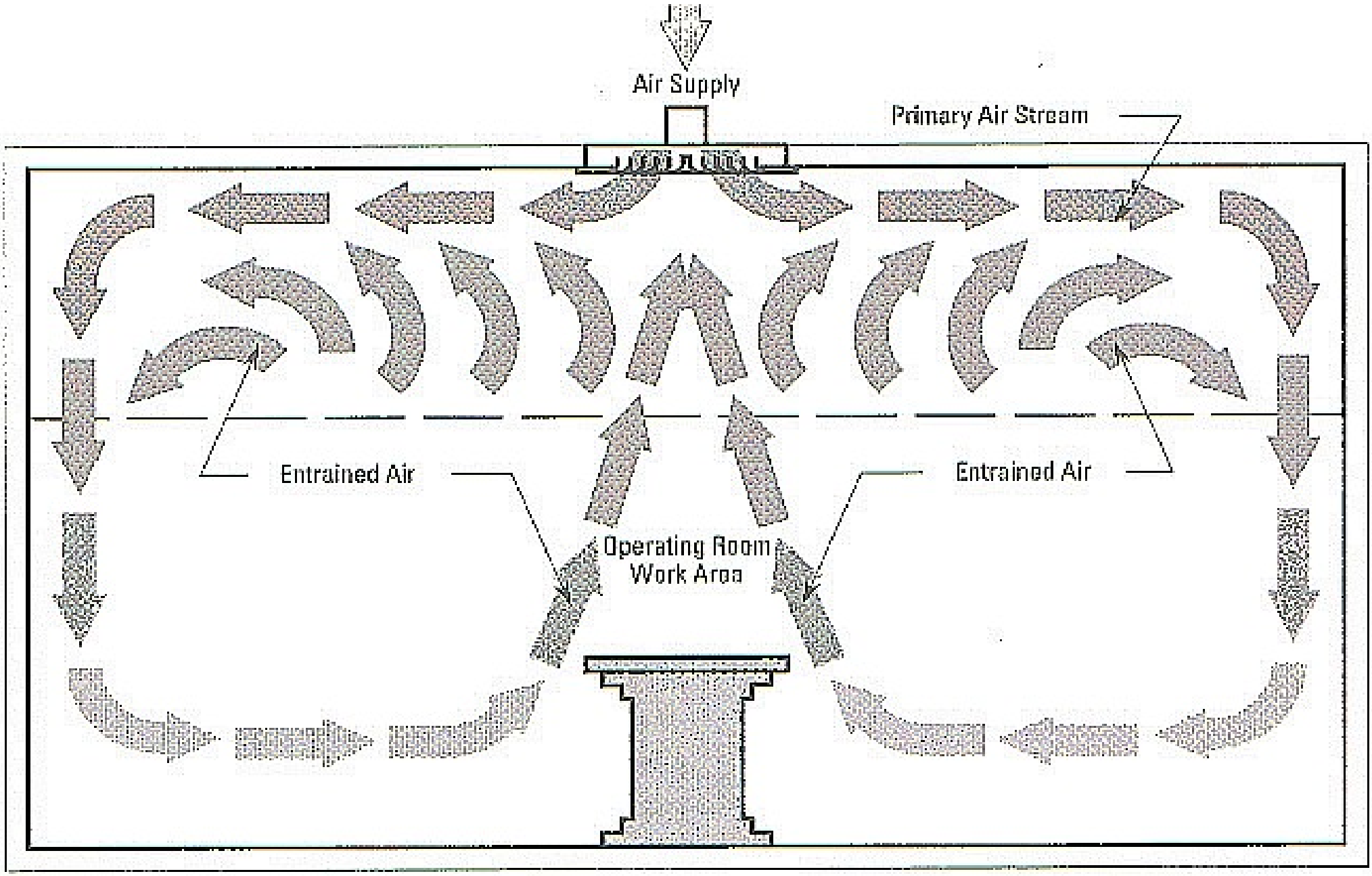
What is negative pressure?

What is differential flow?

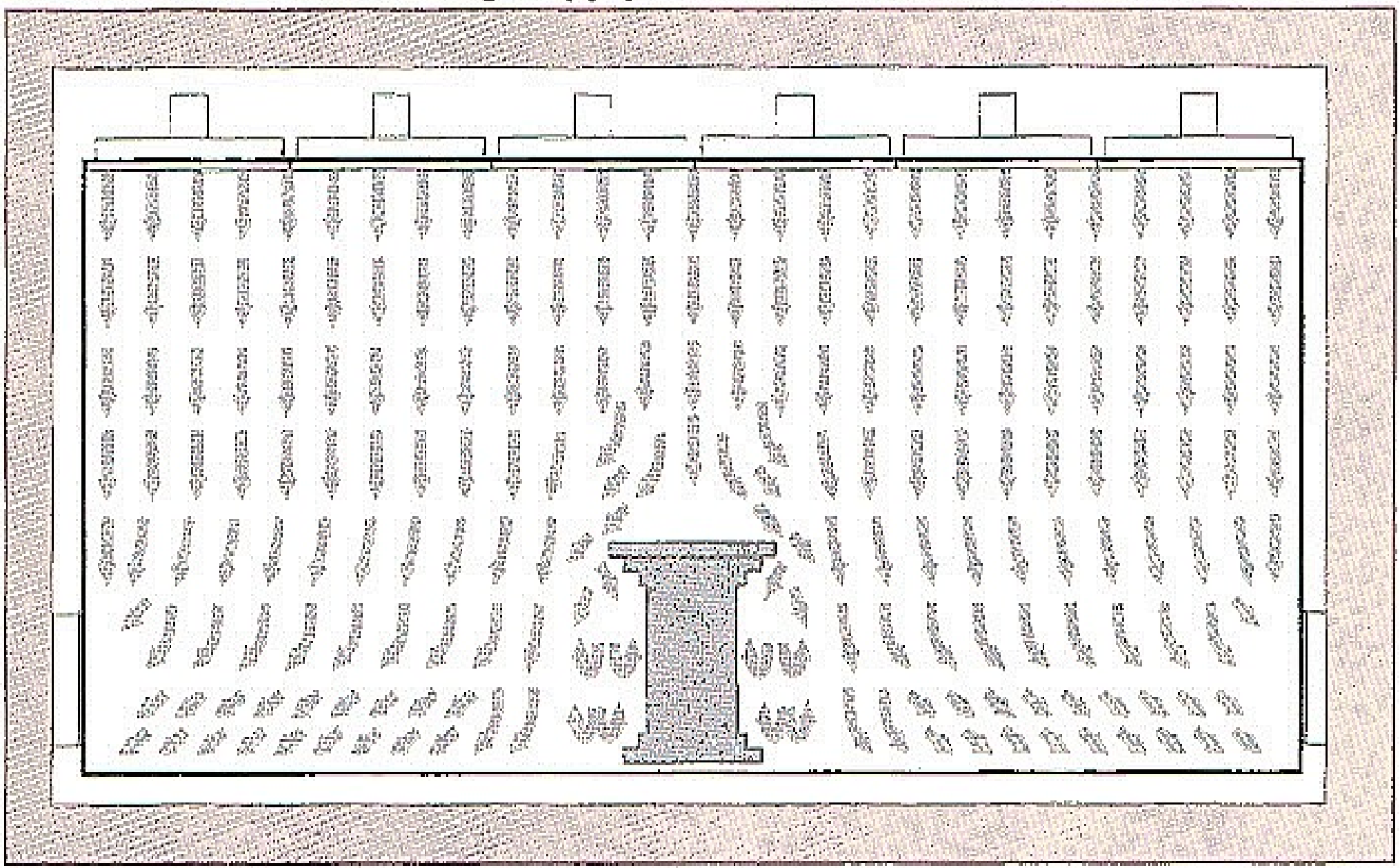
Differential Pressure vs. Differential Flow?

- Room dimensions: 3m x 5m x 2.5m
- Air flow (exhaust): 225 m^3/hour
- Air flow (supply): 200 m^3/hour


200 m3/h
225 m3/h
135 m3/h
135 m3/h
225 m3/h
200 m3/h
Nurse
Patient
25 m3/h
25 m3/h


Air Supply
Primary Air Stream
Entrained Air
Entrained Air
Operating Room
Work Area

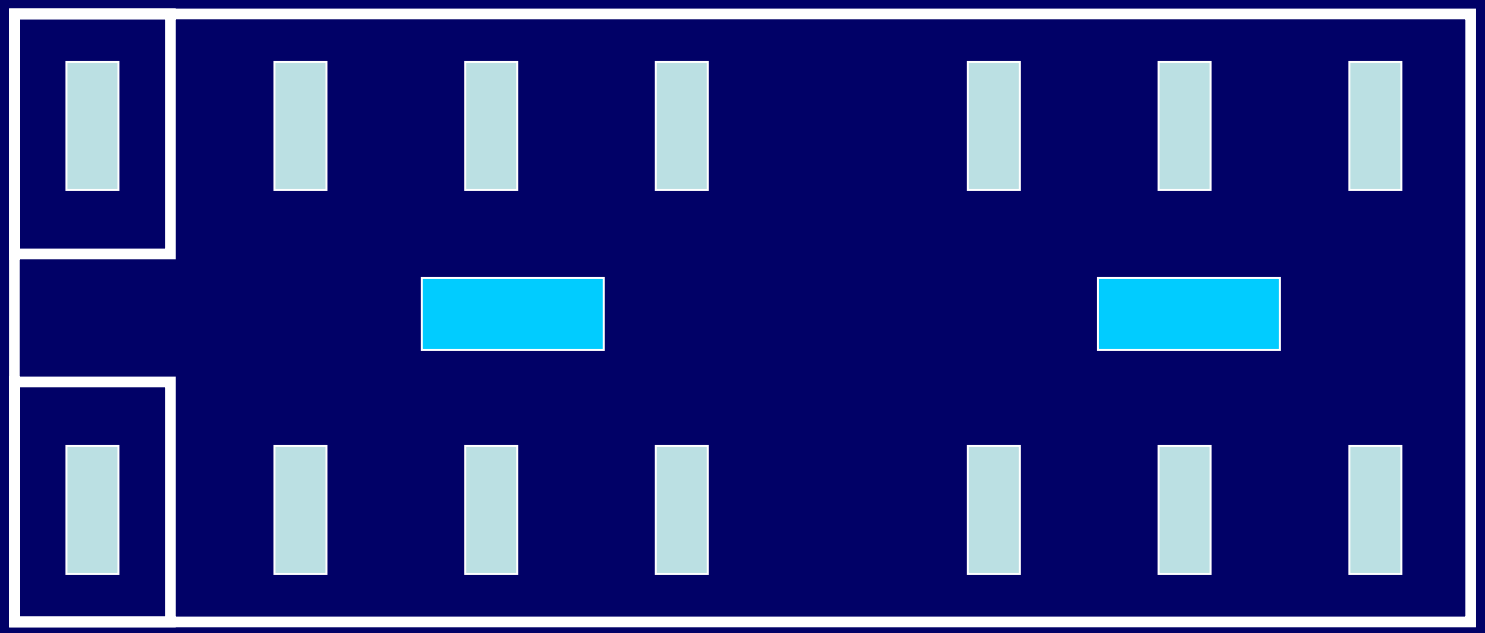
Laminar Flow - Full Ceiling Supply



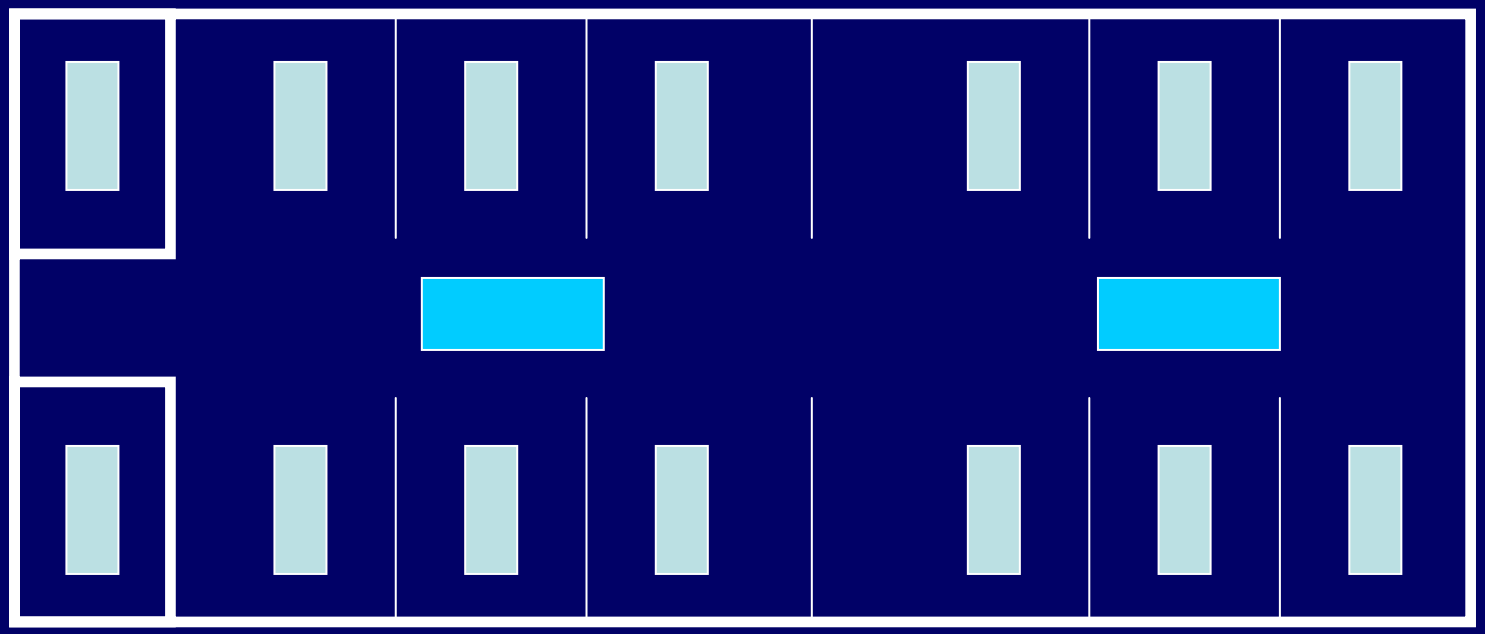
Intensive Care Units

- Open construction
- Semi-open construction

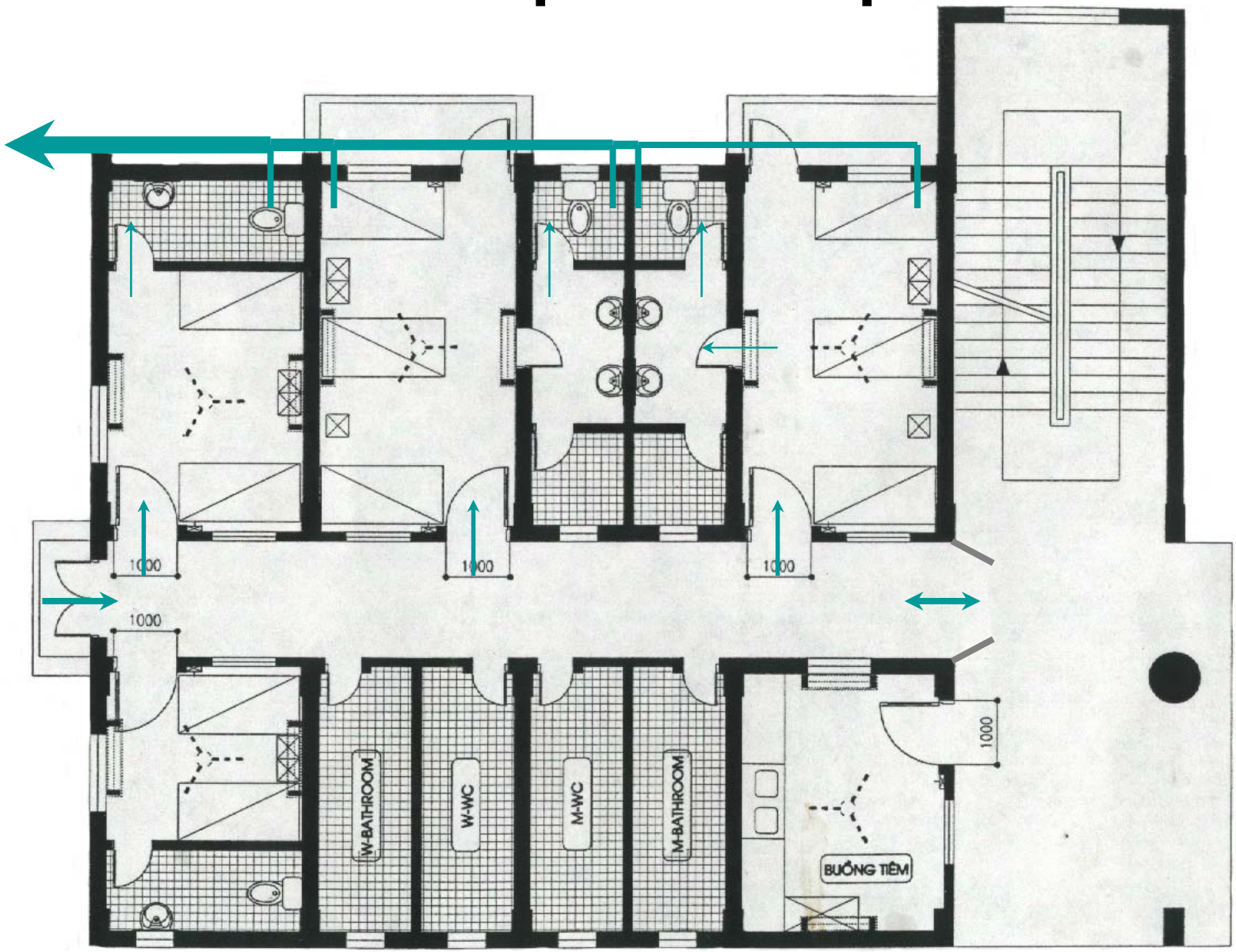
Intensive Care Units



Intensive Care Units



HIV/TB Inpatient Department



EFFECTIVE PERIOD AFTER STERILIZATION
THREE YEARS STERILIZATION DATE

Ventilation Measurement

FORPUS
WWW.FORPUS.LV
7808100

3M

Risk of Inadequate Maintenance

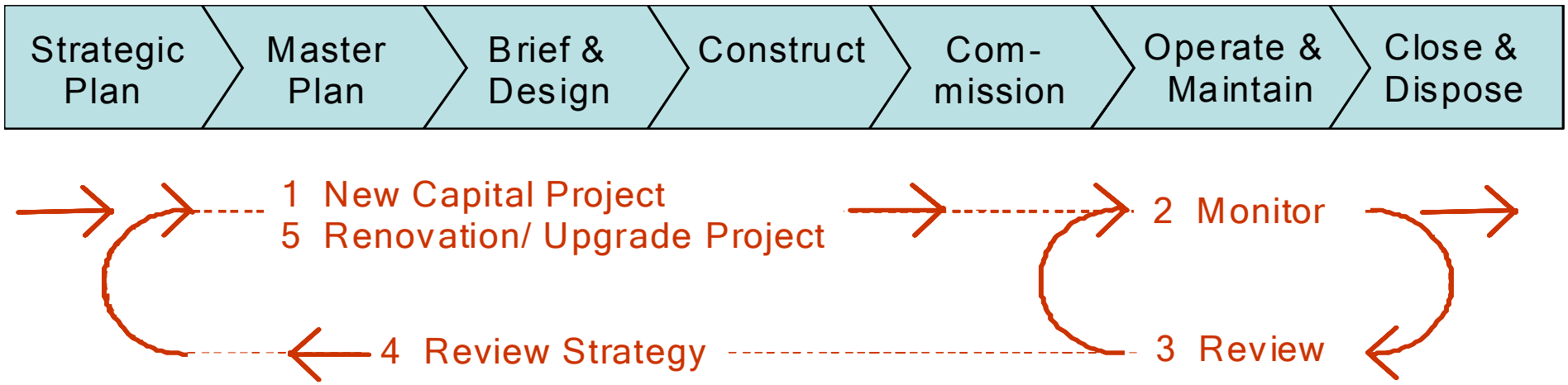
Engineering Services Maintenance

Risk of Inadequate Maintenance

Operational Maintenance:
Waste Management and Cleaning

Principles of Maintenance

Facilities Life-cycle

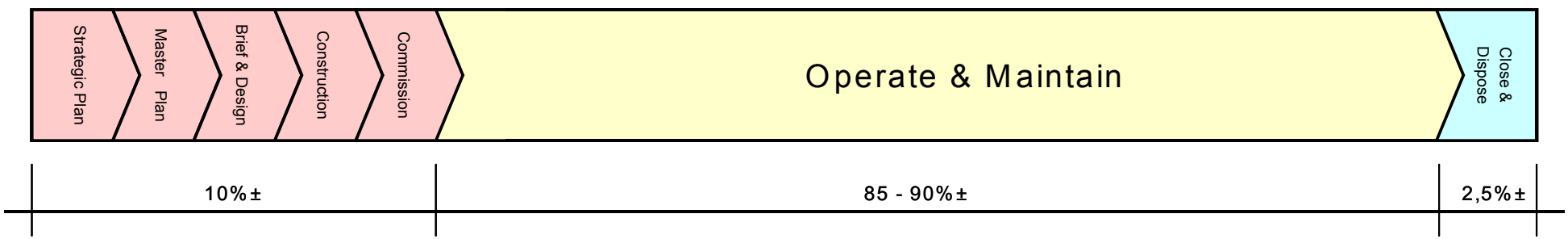


Principles of Maintenance

Facilities Life-cycle

- Assume building has lifespan of 60 years
- Say the initial construction cost is 10 million
- And you spend 4% of initial construction cost per year on maintenance, that is 400,000 per year!
- Then, you will spend 240% of the buildings initial construction cost over the next 60 years on maintenance alone, or 24 million, which is 2,4 times more than the initial building cost!

Facilities Life-cycle



Laboratory Exhaust

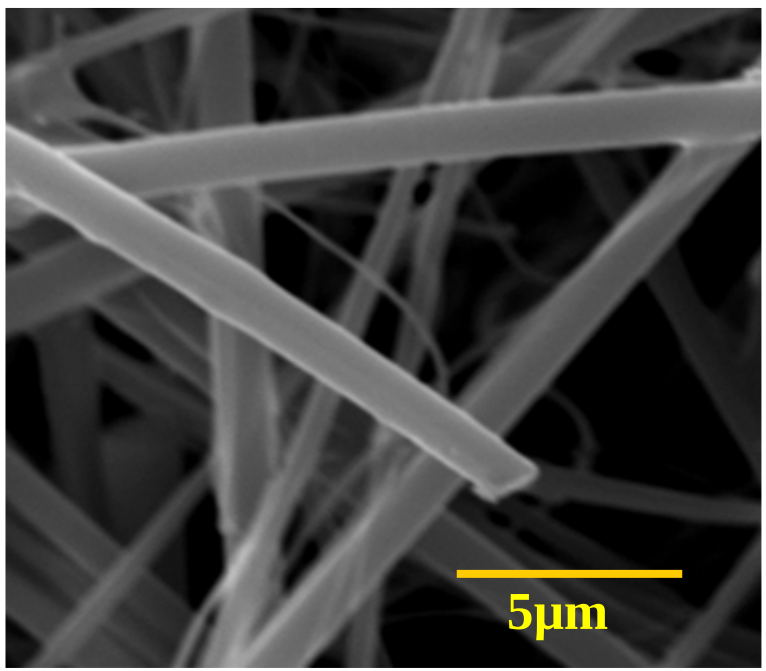
Filters

Filters

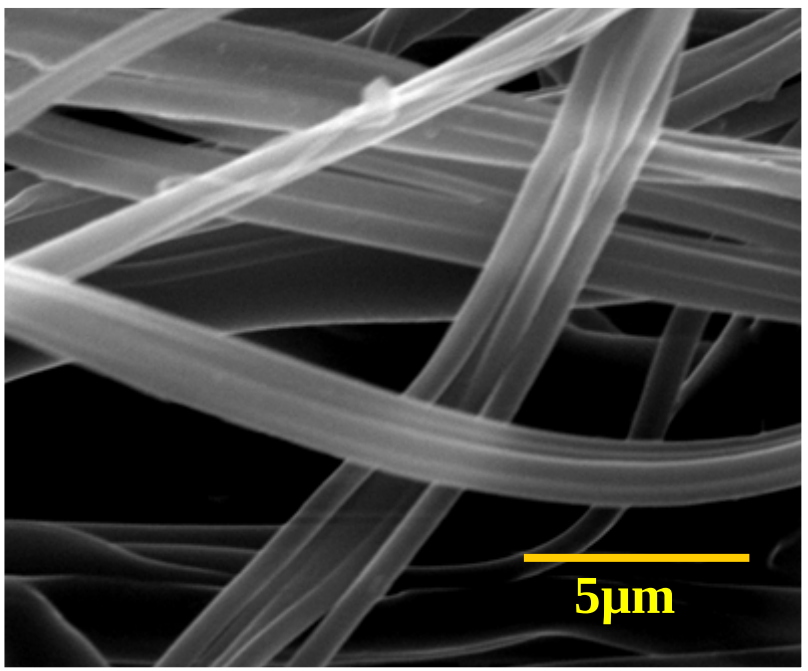
Filters

Ventilation Fibrous Filters

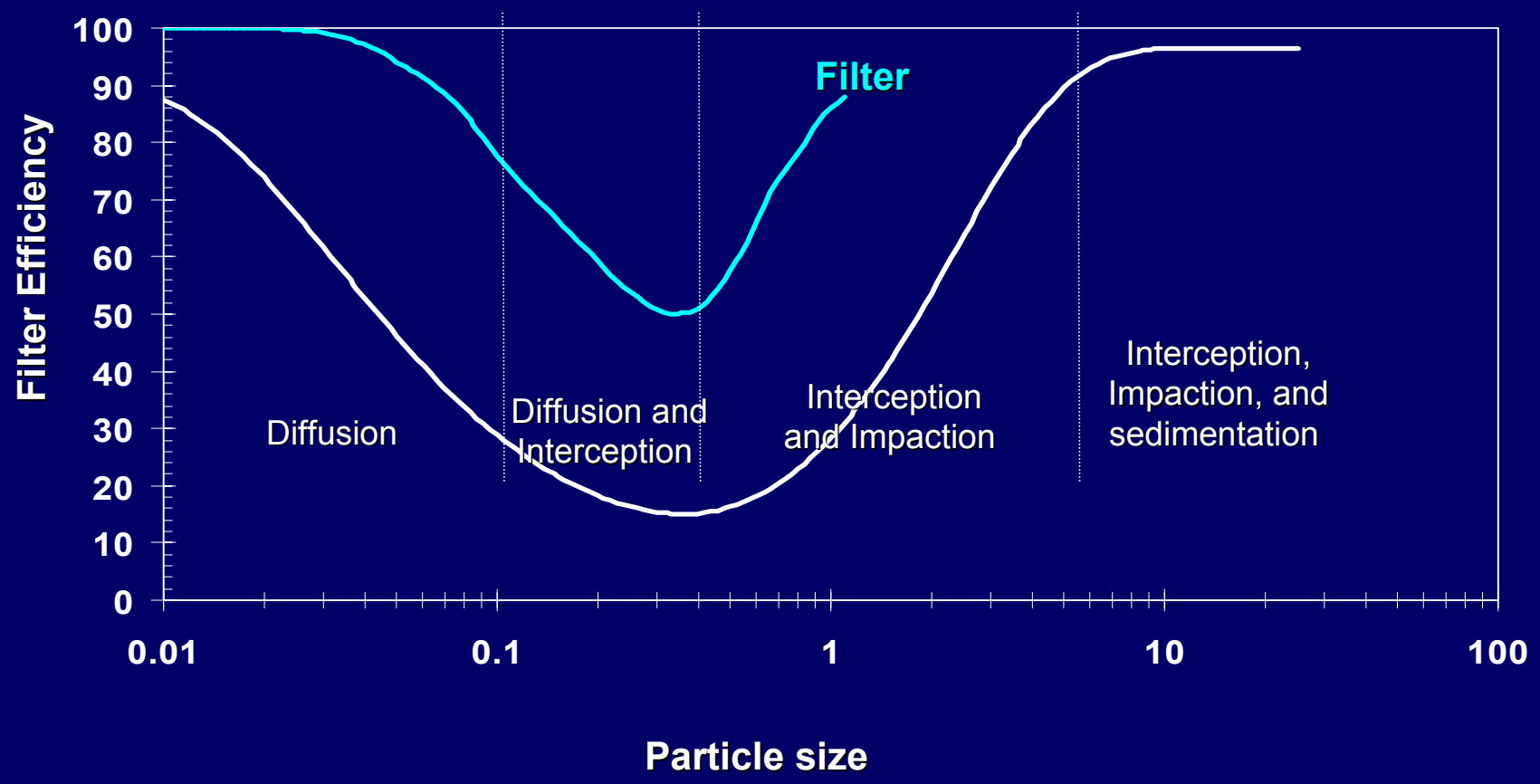
Glass Fiber



Polymeric



Pulmonary System versus Filter



CEN EN 779

Filter Class	Resistance PA	Arrestance Test (Am) %	Efficiency Test (Em) 0,4 µm %
G1	250	50 Am < 65	
G2	250	65 Am < 80	
G3	250	80 Am < 90	
G4	250	90 Am	
F5	450		40 Em < 60
F6	450		60 Em < 80
F7	450		80 Em < 90
F8	450		95 Em
F9	450		?

CEN EN 1822

Filter Class	Filtration	
	Efficiency (%)	Penetration (%)
H10	85	15
H11	95	5
H12	99,5	0,5
H13	99,95	0,05
H14	99,995	0,005
U15	99,999 5	0,000 5
U16	99,999 95	0,000 05
U17	99,999 995	0,000 006

ASHRAE 52

Standard 52.5 Minimum Efficiency Reporting Value	Approx. Std. 52.1 Results		Application Guidelines		
	Dust Spot Efficiency	Arrestance	Typical Controlled Contaminant	Typical Applications and Limitations	Typical Air Filter/Cleaner Type
8	30-35%	>90%	**3.0-10.0 µm Particle Size** Mold Spores Hair spray Fabric protector Dusting aids Cement dust Pudding mix Snuff Powdered milk	Commercial buildings Better residential Industrial workplace Paint booth inlet air	**Pleated Filters** – Disposable, extended surface, 25 to 125 mm (1 to 5 in.) thick with cotton-polyester blend media, cardboard frame. **Cartridge Filters** – Graded density viscous coated cube or pocket filters, synthetic media **Throwaway** – Disposable synthetic media panel filters.
7	25-30%	>90%			
6	<20%	85-90%			
5	<20%	80-85%			
4	<20%	75-80%	**>10.0 µm Particle Size** Pollen Spanish moss Dust mites Sanding dust Spray paint dust Textile fibers Carpet fibers	Minimum filtration Residential Window Air Conditioners	**Throwaway** – Disposable fiberglass or synthetic panel filters **Washable** – Aluminum mesh, latex coated animal hair, or foam rubber panel fibers **Electrostatic** – Self charging (passive) woven polycarbonate panel filter
3	<20%	70-75%			
2	<20%	65-70%			
1	<20%	<65%			

Standard 52.5 Minimum Efficiency Reporting Value	Approx. Std. 52.1 Results		Application Guidelines		
	Dust Spot Efficiency	Arrestance	Typical Controlled Contaminant	Typical Applications and Limitations	Typical Air Filter/Cleaner Type
20 19 18 17	n/a n/a n/a n/a	n/a n/a n/a n/a	**≤ 0.30 µm Particle Size** Virus (unattached) Carbon Dust Sea Salt All combustion Smoke Radon progeny	Cleanrooms Radioactive materials Pharmaceutical manufacturing Carcinogenetic materials Orthopedic surgery	**HEPA/ULPA Filters** ➢ 99.999% efficiency on 0.10-0.20 µm particles, IEST Type F ➢ 99.999% efficiency on 0.30 µm particles, IEST Type D ➢ 99.99% efficiency on 0.30 µm particulates, IEST Type C ➢ 99.97% efficiency on 0.30 µm particles, IEST Type A
16 15 14 13	n/a >95% 90-95% 80-90%	n/a n/a >98% >98%	**0.30-1.0 µm Particle Size** All bacteria Most tobacco smoke Droplet nuclei (sneeze) Cooking Oil Most smoke Insecticide dust Copier Toner Most face powder Most Pint Pigments	Hospital inpatient care General surgery Smoking lounges Superior commercial buildings	**Bag Filters** – Nonsupported (flexible) microfine fiberglass or synthetic media. 300 to 900 mm (12 to 36 in.) deep, 6 to 12 pockets **Box Filters** – Rigid style cartridge filters 150 to 300 mm (6 to 12 in.) deep may use lofted (air laid) or paper (wet laid) media.
12 11 10 9	70-75% 60-65% 50-55% 40-45%	>95% >95% >95% >90%	**1.0-3.0 µm Particle Size** Legionella Humidifier dust Lead dust Milled flour Coal dust Auto emissions Nebulizer drops Welding fumes	Superior residential Better commercial buildings Hospital laboratories	**Bag Filters** – Nonsupported (flexible) microfine fiberglass or synthetic media. 300 to 900 mm (12 to 36 in.) deep, 6 to 12 pockets **Box Filters** – Rigid style cartridge filters 150 to 300 mm (6 to 12 in.) deep may use lofted (air laid) or paper (wet laid) media.

What Needs to be Filtered?

- Any contaminated air that might be recirculated into the room or other rooms
- Any contaminated air that might be exhausted near:
    - Air intakes
    - People
    - Open windows

Maintenance of Filters

Change out is dependent on:

- Amount of loading
- Type of loading
- Environmental conditions
- Flow rate
- Type of filter
- Location in ventilation system

What if I don’t use Filters?

Keep exhaust away from:

- Windows
- People
- Air intakes

Where goes that air?

Room Air Cleaners

Room Air Cleaners

- Non-biological aerosols
  - Excellent
    - HEPA
    - ESP
    - Enhanced filter
  - Poor
    - Negative ion
    - Ozone
- Biological aerosols

Room Air Cleaners

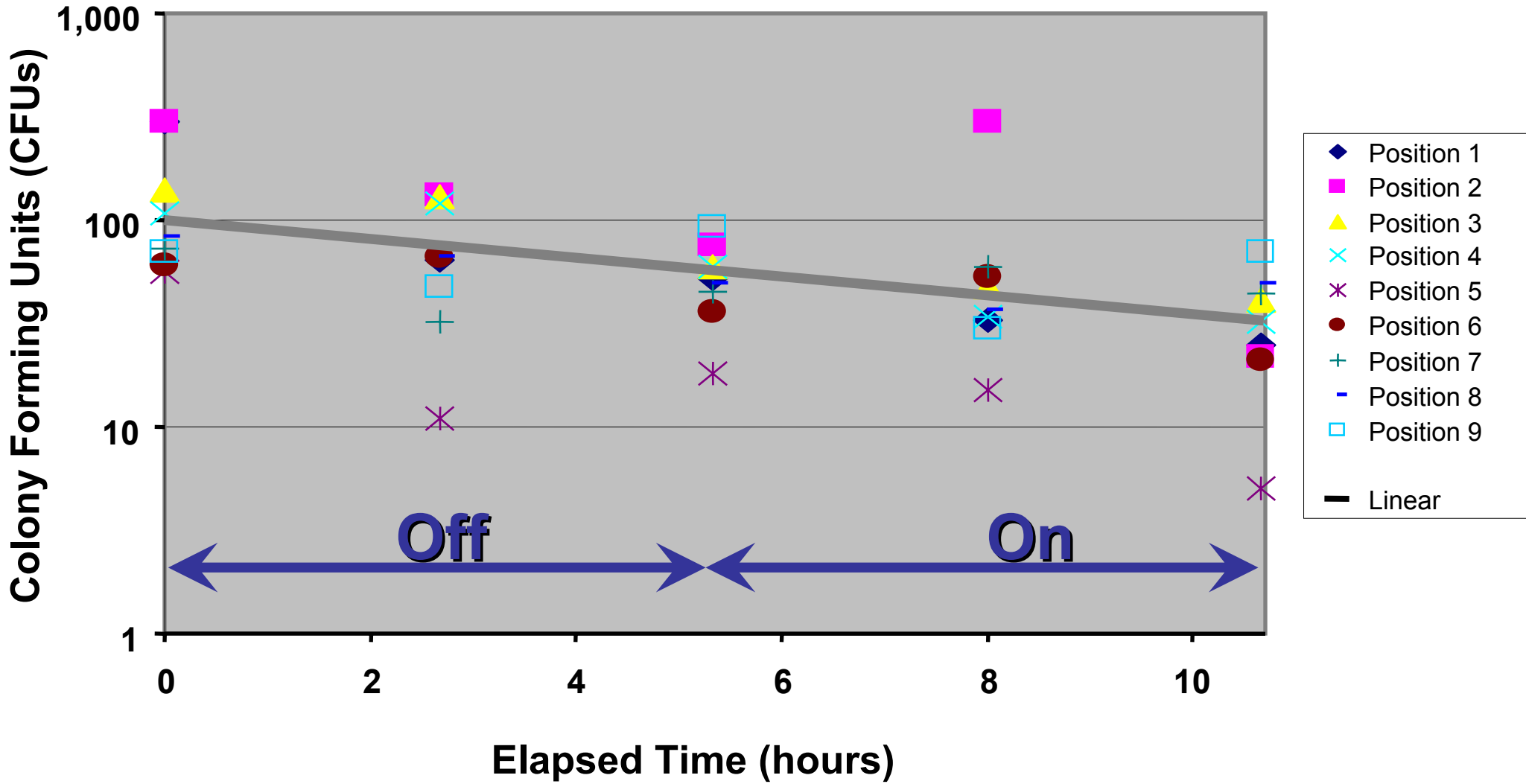
Estonia

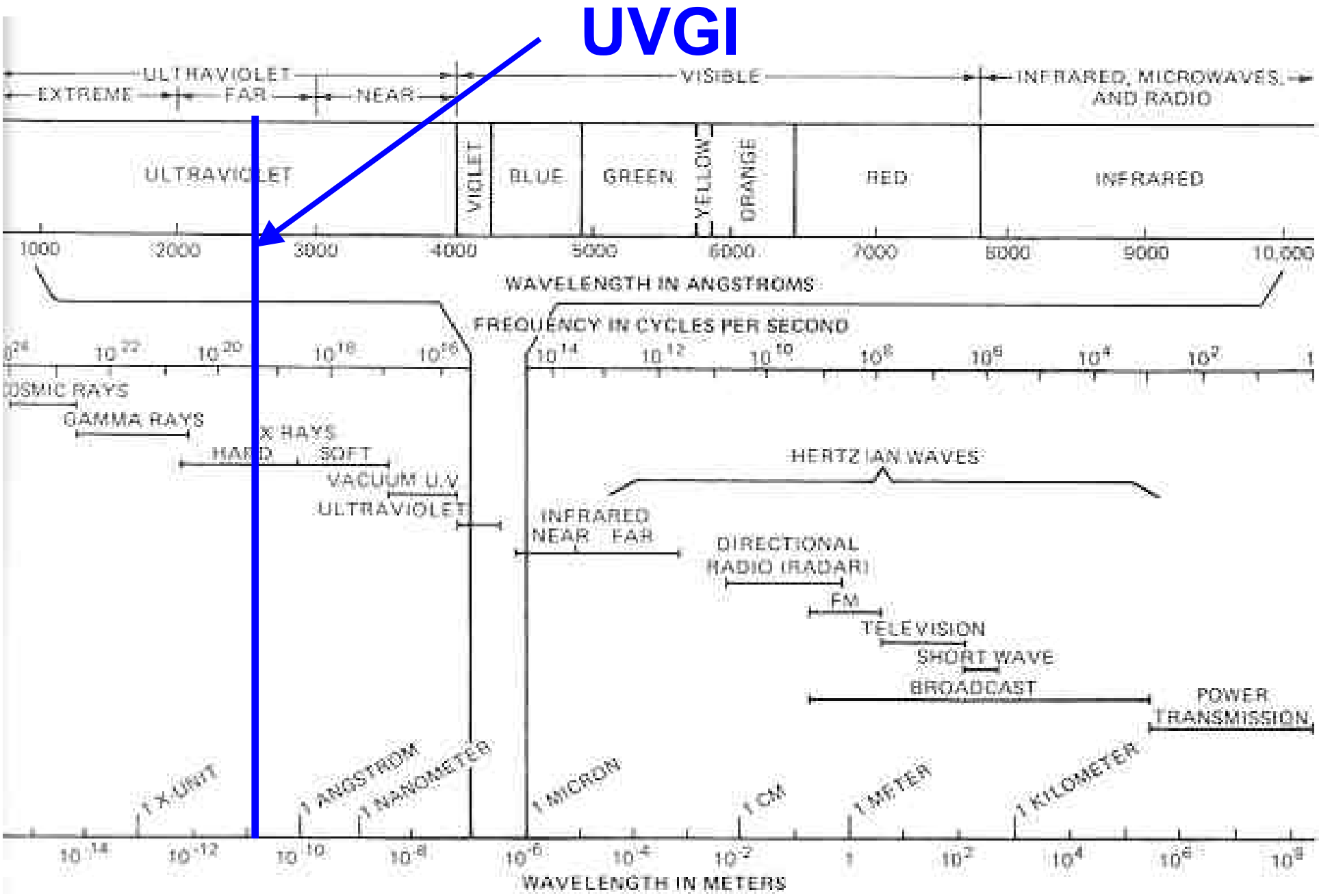
Estonia

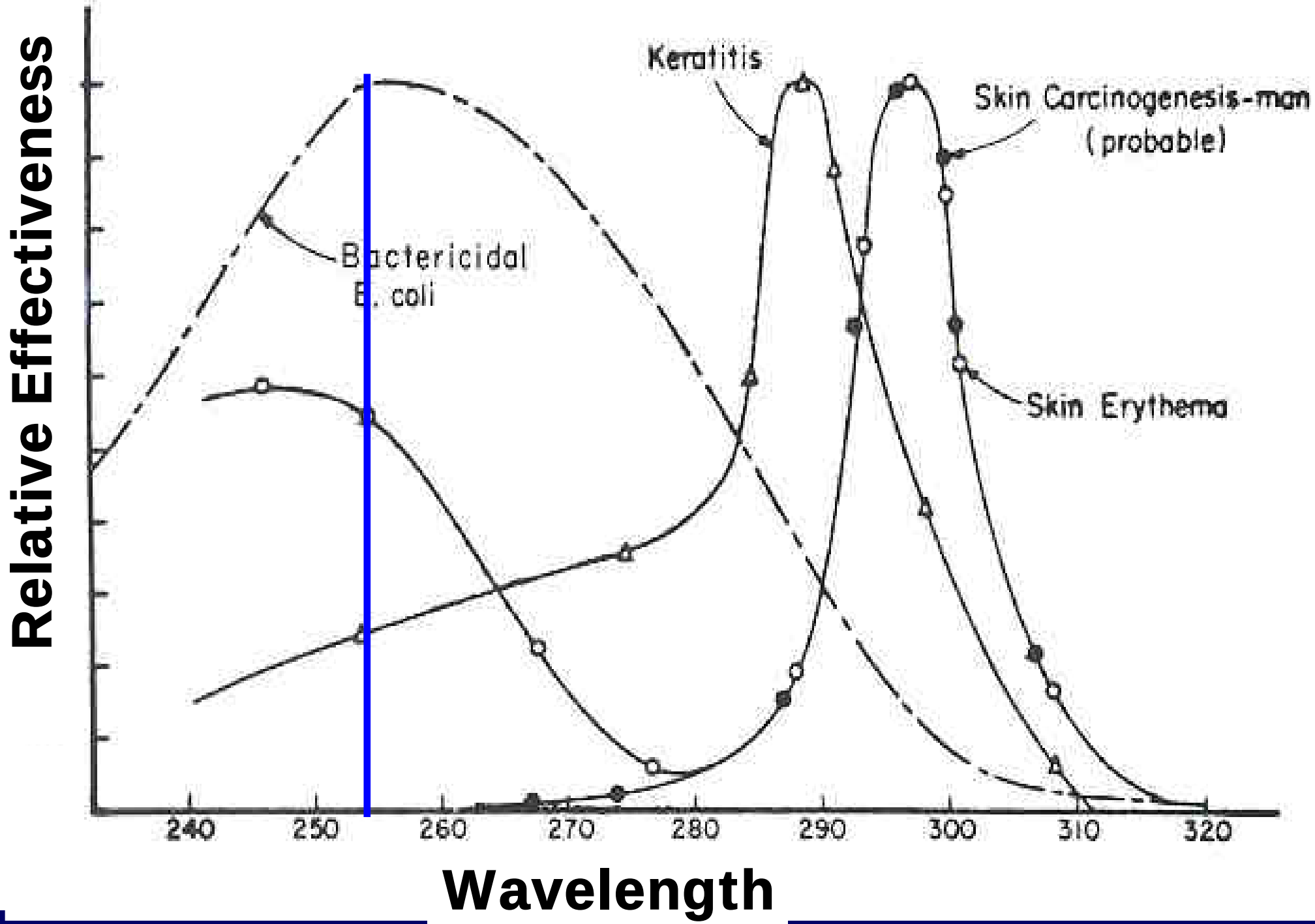
Estonia

Estonia

Evaluation of Room Air Cleaners




UVGI
ULTRAVIOLET
EXTREME
FAR
NEAR
VISIBLE
INFRARED, MICROWAVES, AND RADIO
ULTRAVIOLET
VIOLET
BLUE
GREEN
YELLOW
ORANGE
RED
INFRARED
1000
2000
3000
4000
5000
6000
7000
8000
9000
10,000
WAVELENGTH IN ANGSTROMS
FREQUENCY IN CYCLES PER SECOND
COSMIC RAYS
GAMMA RAYS
X RAYS
HARD
SOFT
VACUUM U.V
ULTRAVIOLET
INFRARED
NEAR
FAR
HERTZIAN WAVES
DIRECTIONAL RADIO (RADAR)
FM
TELEVISION
SHORT WAVE
BROADCAST
POWER TRANSMISSION
1 X UNIT
1 ANGSTROM
1 NANOMETER
1 MICRON
1 CM
1 METER
1 KILOMETER
WAVELENGTH IN METERS


Relative Effectiveness
Keratitis
Skin Carcinogenesis-man
(probable)
Bactericidal
E. coli
Skin Erythema
240
250
260
270
280
290
300
310
320
Wavelength

UVGI Occupational Exposure Limit

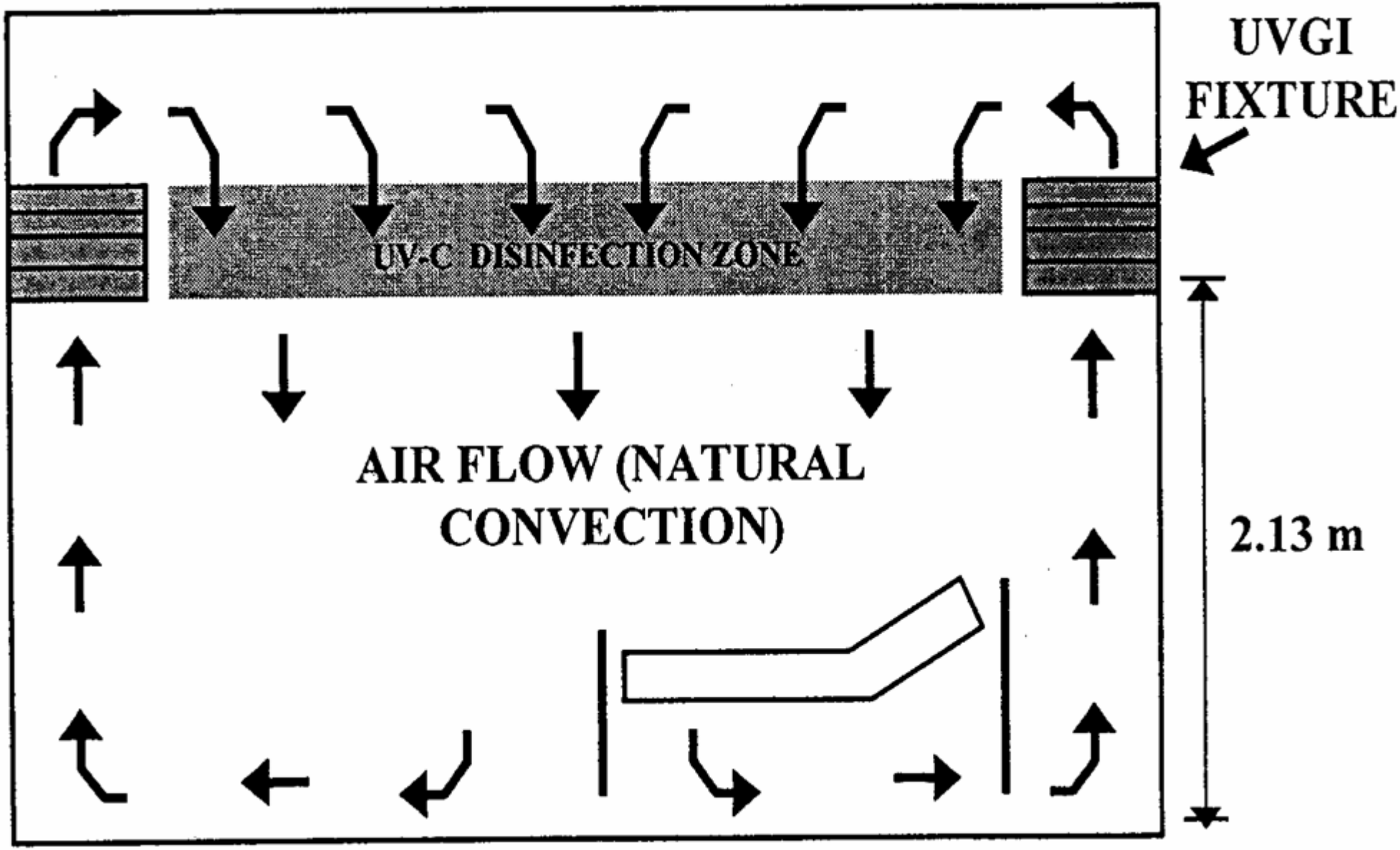
λ_{UVGI} = 254 nm

OEL = 3,000-6,000 $\mu J/cm^2$
for 8-hour exposure

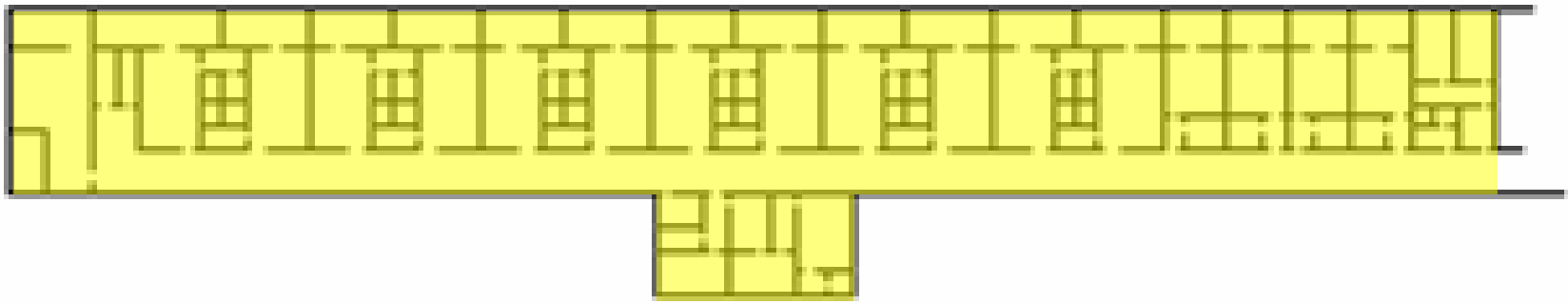
1 $\mu J/cm^2$ = 1 μW✌sec/cm^2

Background

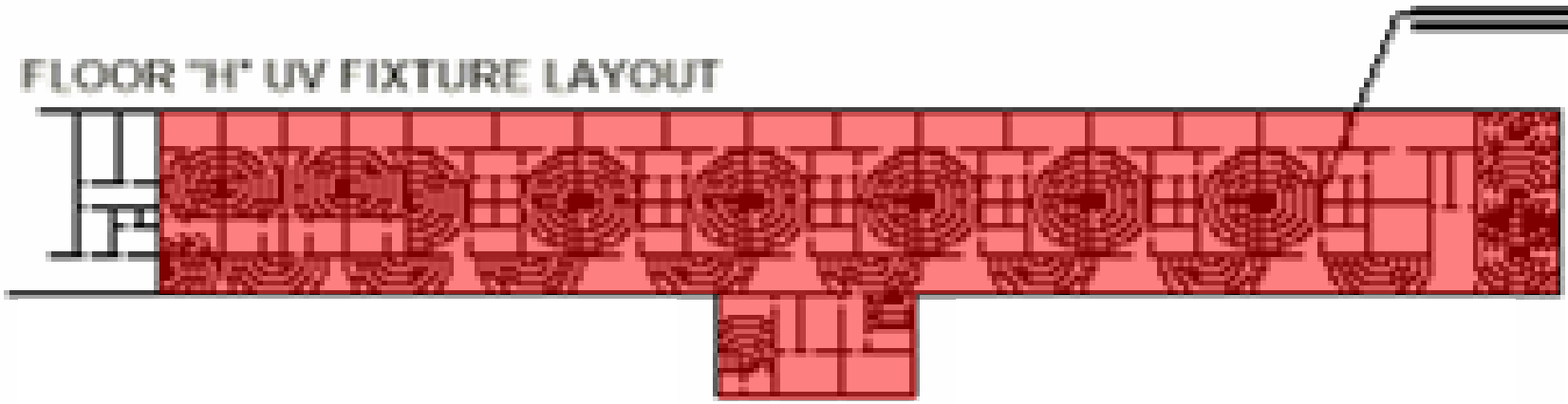
- Recommended as one approach to control spread of infectious diseases, TB in particular
- CDC researchers involved in evaluating occupational exposure to UVGI
    - Erythema
    - Photokeratitis


UVGI
FIXTURE
UV-C DISINFECTION ZONE
AIR FLOW (NATURAL
CONVECTION)
2.13 m

FLOOR "G" UV FIXTURE LAYOUT



FLOOR "H" UV FIXTURE LAYOUT



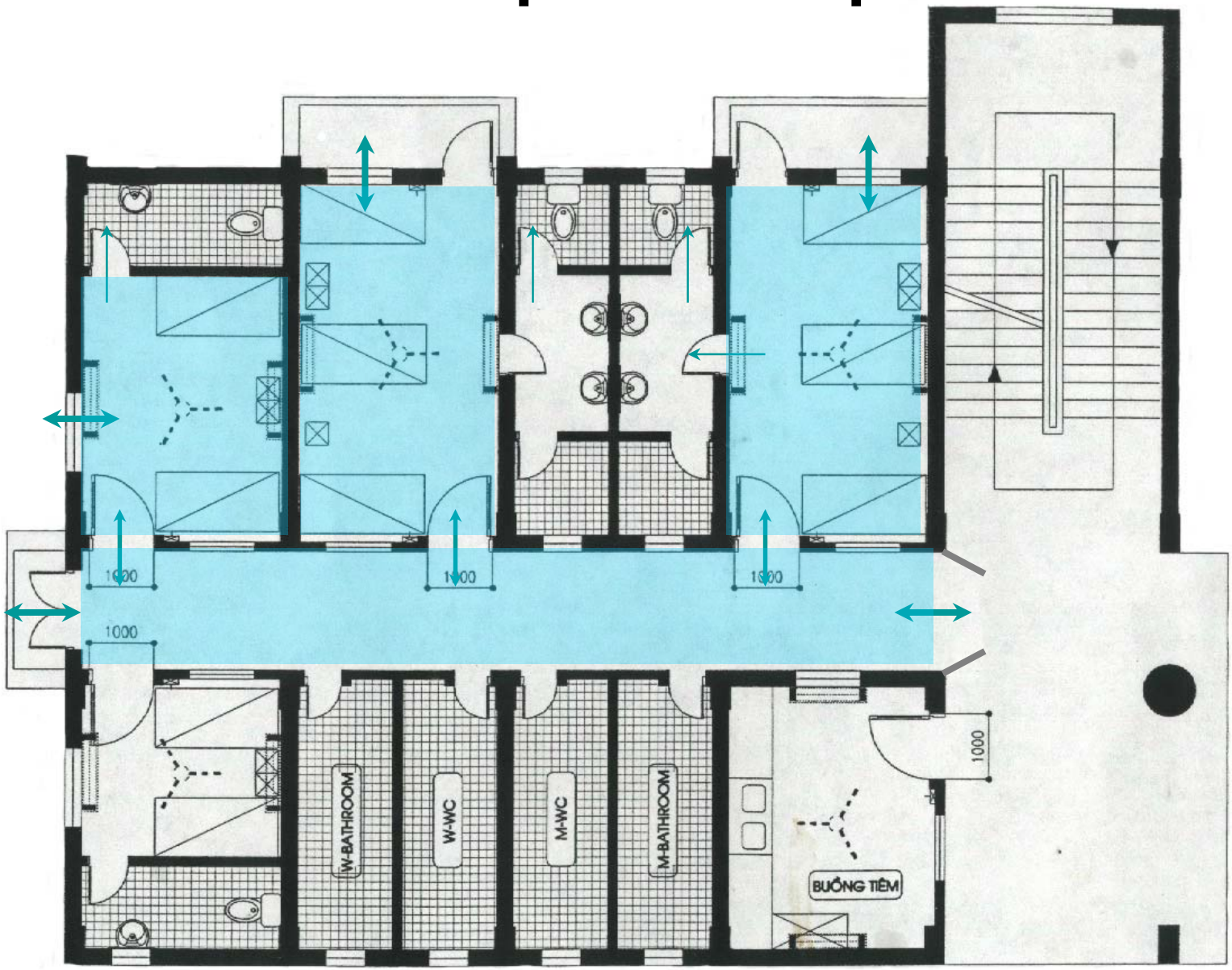
JULIA KUBITSHEK HOSPITAL, BELO HORIZONTE, BRAZIL

[redacted] LUMALIER

CAUTION
CUIDADO

10
711
712
713
714
715
716
717
MERLIN GERIN
multi 9
C60N
C2
24396
Q - OFF

HIV/TB Inpatient Department



Room Air Cleaner with UVGI

Study-TX
Study-TX
Study-TX
Study-TX
Study-CT
Study-IPs
Study-IPs

Routine Maintenance

Distance from UVGI	Before Cleaning	After Cleaning
1 m	100 $\mu W/cm^2$	190 $\mu W/cm^2$
2 m	15 $\mu W/cm^2$	28 $\mu W/cm^2$
3 m	13 $\mu W/cm^2$	26 $\mu W/cm^2$
4 m	10 $\mu W/cm^2$	18 $\mu W/cm^2$
5 m	7 $\mu W/cm^2$	12 $\mu W/cm^2$
6 m	5 $\mu W/cm^2$	7 $\mu W/cm^2$
7 m	4 $\mu W/cm^2$	4 $\mu W/cm^2$

Laboratory - 8 months – no record of cleaning

Routine Maintenance

Distance from UVGI	Before Cleaning	After 1st Cleaning	After 2nd Cleaning
1 m	30 $\mu W/cm^2$	10 $\mu W/cm^2$	100 $\mu W/cm^2$
2 m	20 $\mu W/cm^2$	10 $\mu W/cm^2$	31 $\mu W/cm^2$
3 m	19 $\mu W/cm^2$	11 $\mu W/cm^2$	25 $\mu W/cm^2$
4 m	13 $\mu W/cm^2$	9 $\mu W/cm^2$	15 $\mu W/cm^2$
5 m	9 $\mu W/cm^2$	6 $\mu W/cm^2$	10 $\mu W/cm^2$
6 m	7 $\mu W/cm^2$	5 $\mu W/cm^2$	7 $\mu W/cm^2$
7 m	4 $\mu W/cm^2$	5 $\mu W/cm^2$	6 $\mu W/cm^2$

Autoclave Room – Installed 1998, Measured 2001, No maintenance record

Measurement of UV Light

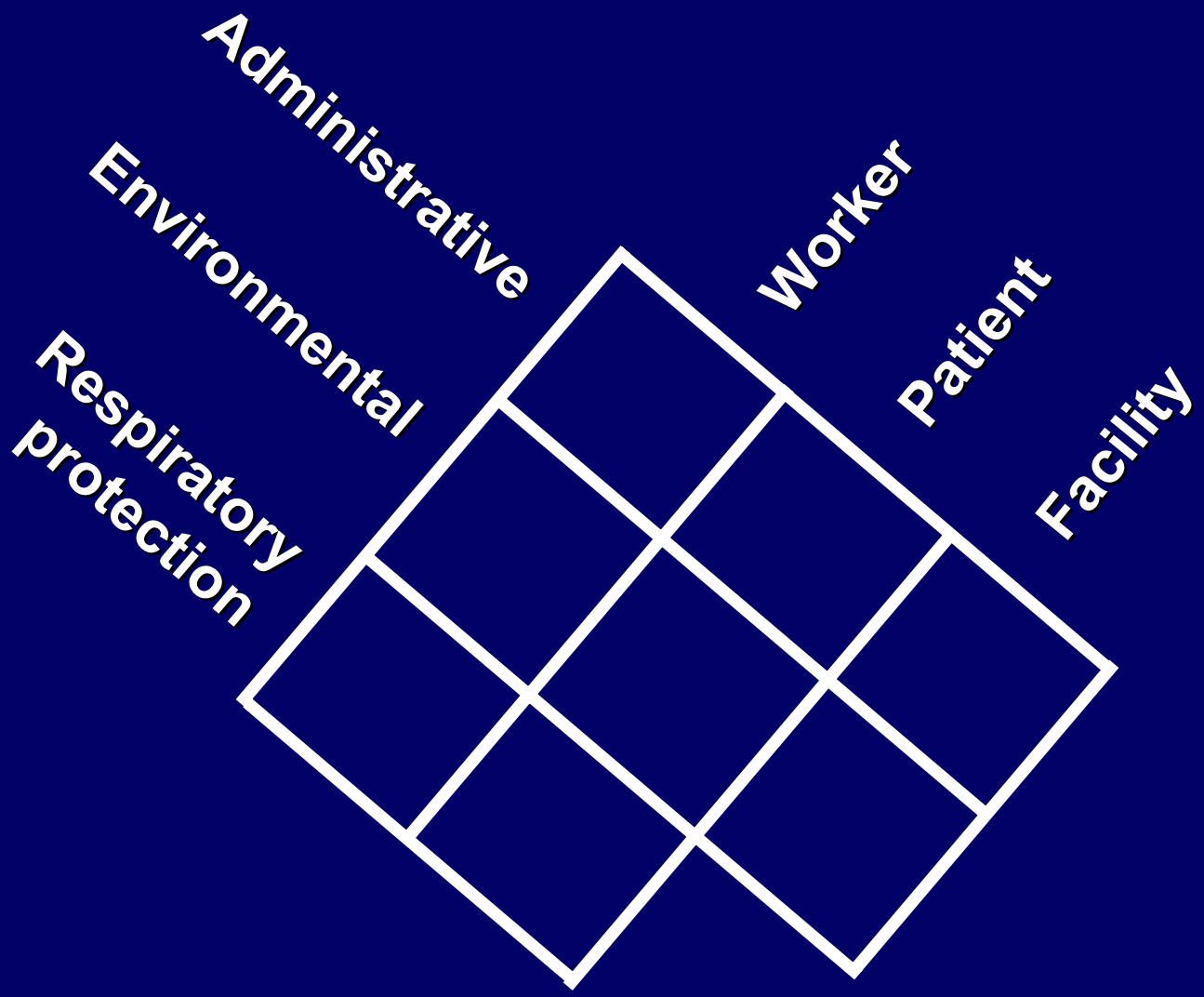
- UVGI measurement devices
  - International Light meter model 1400A with SEL240 detector, or
  - Gigahertz-Optik model X911 UVC meter with UV-3718-4 detector
- At eye level
- Maximum exposure limits
  - 6,000 μJ/cm2
  - 6,000 μW•sec/cm2
  - 0.2 μW/cm2 continuous for 8 hours

Peru

Respiratory Protection

Paul A Jensen
US Centers for Disease Control and Prevention

Hierarchy of Infection Controls



Personal protective equipment

Respirators vs. Masks

Surgical masks

Surgical masks

24
CANDLES
happy
birthday

Personal protective equipment

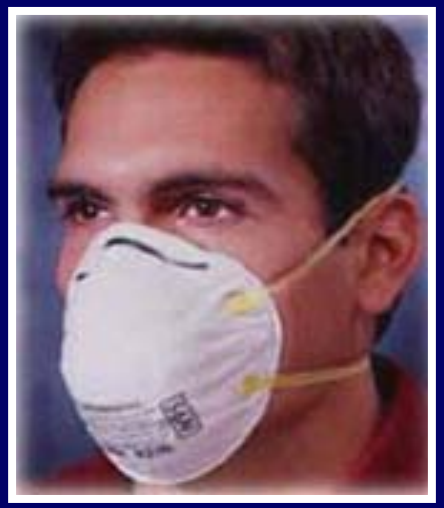
Masks (patients and HCWs for large droplets)
Respirators (HCWs)

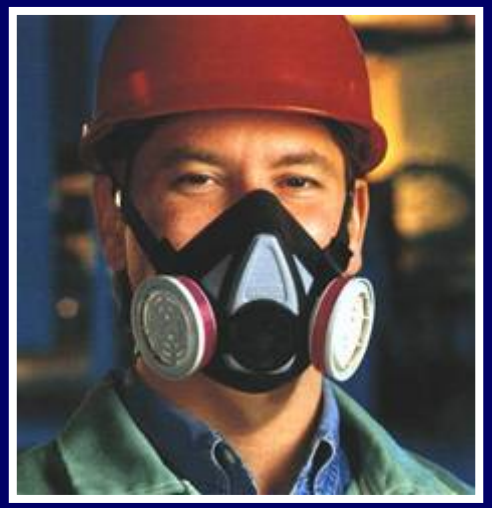
Negative pressure respirator

- A respirator in which the air pressure inside the facepiece is negative during inhalation with respect to the ambient air pressure outside the respirator

Air-purifying respirator (APR)

A respirator with an air-purifying filter, cartridge, or canister that removes specific air contaminants by passing ambient air through the air-purifying element





N95 respirators

- N95 disposable respirators are generally acceptable for most TB situations
- Higher level of protection may be prudent during high risk procedures
  - Sputum induction
  - Bronchoscopy
  - Autopsy

CEN respirators

- FFP2 or FFP3 disposable respirators are generally acceptable for most TB situations
- Higher level of protection may be prudent during high risk procedures
  - Sputum induction
  - Bronchoscopy
  - Autopsy

Respirator program elements

- Training
  - Medical evaluation
  - Fit testing
  - Selection
  - Use
  - Maintenance and care
- Program evaluation

Masque antipoussières 9320 (F)

Ce masque est conforme à la norme européenne EN149:2001 classe FFP2. Il protège contre les aérosols solides et liquides non-volatils uniquement. Il peut être utilisé pour des concentrations allant jusqu'à 10 fois la Valeur Moyenne d'Exposition (VME) (Valeur Limite Belge (VLB).

Notice de précautions d'emploi à l'intérieur.

Respiratore per polveri 9320 (I)

Questo respiratore a facciale filtrante è conforme ai requisiti previsti per la classe FFP2 dalla norma europea EN149:2001 e protegge l'utilizzatore da particelle solide e liquidi non volatili. Il respiratore può essere utilizzato per concentrazioni di contaminanti fino a 10 volte il loro valore limite ponderato (TLV): il fattore di protezione operativo (FPO) è 10 x TLV.

Vedere le istruzioni per l'uso all'interno.

Atemschutzmaske 9320 (D)

Diese filtrierende Halbmaske erfüllt die Anforderungen der EN149:2001 für die Partikelfilterklasse FFP2 und sollte ausschließlich zum Schutz vor Partikeln und nichtflüchtigen, flüssigen Aerosolen eingesetzt werden. Die Maske kann gegen Gefahrstoffkonzentrationen bis zum 10-fachen des Grenzwertes verwendet werden.

Siehe Gebrauchsanleitung.

Zerrecik Filtresi 9320 (TR)

Bu filtreler Avrupa Standardı EN149:2001, kategori FFP2'nin gerektirdiği koşullar'ın katı ya da uçucu olmayan sıvı zerreciklere karşı kullanılmalıdır. Bu maskeler kirleticilerin eşik sınır değerinin (ESD)10 katına kadar olan (10 x ESD) konsantrasyonlarına karşı etkili koruma sağlar.

Kullanım için talimatlara bakınız.

Mascarilla para Partículas 9320 (E)

Esta mascarilla autofiltrante cumple con los requisitos de la Norma Europea EN149:2001 en la categoría FFP2. Debe ser utilizada exclusivamente como protección frente a partículas sólidas y líquidas no volátiles. Esta mascarilla puede usarse en concentraciones hasta 10 veces el límite de exposición ocupacional (TLV, VLA, ...).

Lea instrucciones de ajuste y uso en el interior.

Máscara para Partículas 9320 (P)

Esta máscara cumpre com os requisitos da Norma Europeia EN149:2001, na categoria FFP2. Deve ser utilizada exclusivamente como protecção contra partículas sólidas e líquidas não voláteis. Esta máscara pode ser utilizada em concentrações até 10 vezes o limite de exposição ocupacional (ex: TLV).

Ver instruções de ajuste e de utilização no interior.

Made in UK

EXP DATE
30 / 04 / 06
Time 18 : 26

3M

NIOSH APPROVED N95 RESPIRATOR

Health Care N95 Particulate Respirator and Surgical Mask

Donning instructions (to be followed each time product is worn):

1 Cup the respirator in your hand with the nosepiece at fingertips, allowing the headbands to hang freely below hands.

2 Position the respirator under your chin with the nosepiece up.

3 Pull the top strap over your head so it rests high on the back of head.

4 Pull the bottom strap over your head and position it around neck below ears.

5 Using two hands, mold the nosepiece to the shape of your nose by pushing inward while moving fingertips down both sides of the nosepiece. Pinching the nosepiece using one hand may result in less effective respirator performance.

6 FACE FIT CHECK
The respirator seal should be checked before each use. To check fit, place both hands completely over the respirator and exhale. If air leaks around your nose, adjust the nosepiece as described in step 5. If air leaks at respirator edges, adjust the straps back along the sides of your head. Recheck.

NOTE: If you cannot achieve proper fit, do not enter the isolation or treatment area. See your supervisor.

Removal instructions:

1 Cup the respirator in your hand to maintain position on face. Pull bottom strap over head.

2 Still holding respirator in position, pull top strap over head.

3 Remove respirator from face and discard or store according to your facility's policy.

6000 Series Half-Mask Respirators

Fitting Instructions

Fitting instructions must be followed each time the respirator is worn.

1. Place the respirator over the mouth and nose, then pull the harness over the crown of the head.

2. Take the bottom straps in both hands, place them at the back of the neck and hook them together.

3. Tighten the top straps first by pulling on ends to achieve a comfortable and secure fit.

4. Tighten bottom straps using either front or rear adjustments. (Strap tension may be decreased by pushing out on back side of buckles).

5. Perform a positive and/or negative pressure fit check (see overleaf). The positive method is recommended.

WTC Fit Station

Sen. Jeffords and New York City Mayor Rudolph Giuliani, wearing protective gear, inspect the devastated World Trade Center.

South Africa

Russian Federation

Why fit testing?

- Ensure that each person receives an adequate fit while wearing a respirator
- Determine appropriate make/model
- Determine appropriate size
- Ensure proper seal between respirator and wearer

Fit testing

Uses a challenge agent to evaluate the fit of a respirator on an individual

Physical factors contributing to poor fitting respirators

- Weight loss/gain
- Facial scarring
- Changes in dental configuration (dentures)
- Facial hair
- Cosmetic surgery
- Excessive makeup
- Mood of worker (smiling/frowning)
- Body movements

Sources of facepiece leakage

- Through air-purifying element
- Through exhalation valve
- Around facepiece/skin interface

Qualitative fit tests

- A pass/fail fit test to assess the adequacy of respirator fit that relies on the individual's response to the test agent

Qualitative fit tests

- Began with US Bureau of Mines respirator certification program
- Coal dust test
  - Subject donned respirator
  - Coal dust blown into face of subject
  - Subject removed respirator
  - Respirator failed if dust streaks were noticed

Coal dust test

24 de marzo
Día Mundial de la TBC
Perú
¡EVÍTALA!
1
¡No quiero Comer!
2
¡NO quiero Comer!
3
¡No quiero Comer
Se puede Curar

TSI PortaCount® Plus

What can you do?

- Be proactive in fit test program
- Research and select well designed respirators
- Take care of your respirator
    - Decontamination
    - Cleaning
    - Storage
- Take care when reusing respirator – closely monitor service life
- Dispose of respirator if you question its performance

Selection of respirators

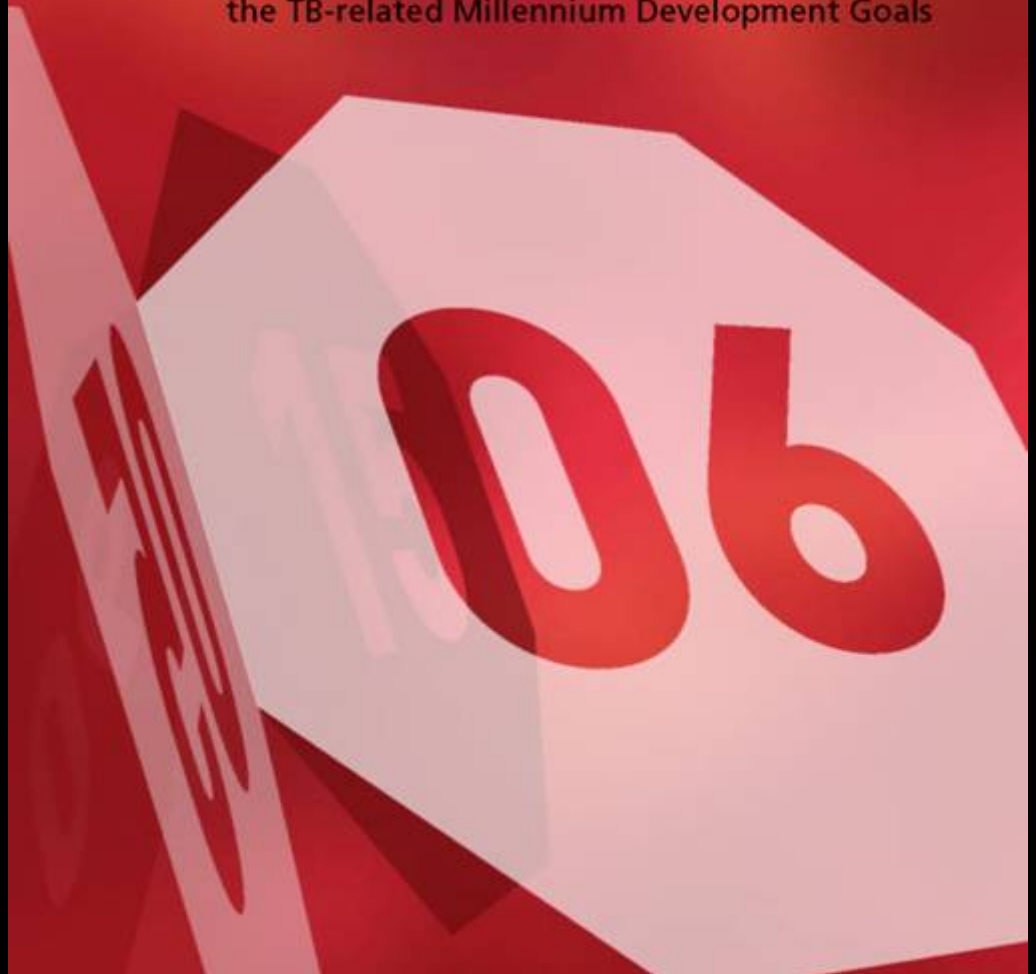
Selection of respirators

World Health Organization

Stop TB Partnership

THE STOP TB STRATEGY

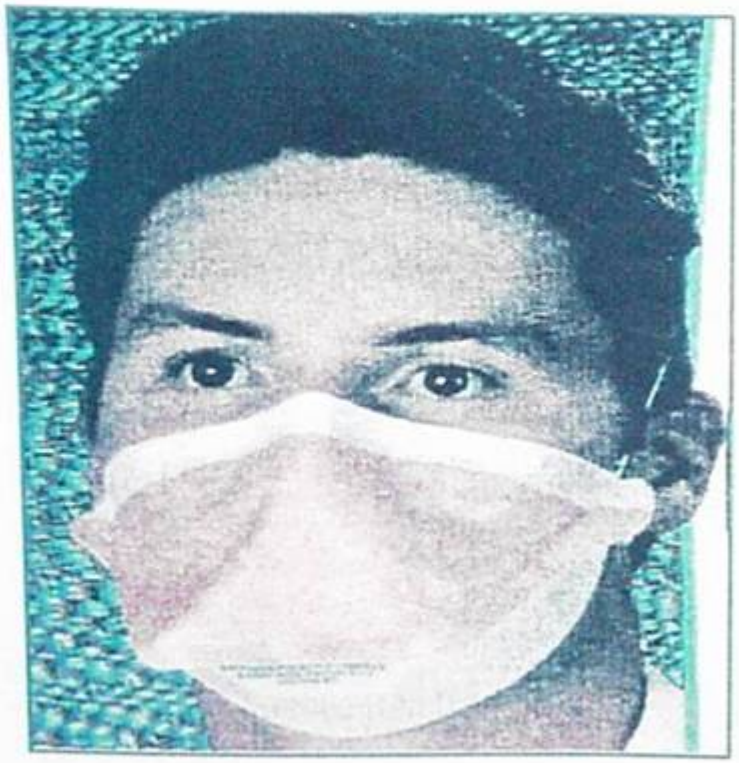
Building on and enhancing DOTS to meet the TB-related Millennium Development Goals



SALIDA
120
122
Stop
Tuffcare

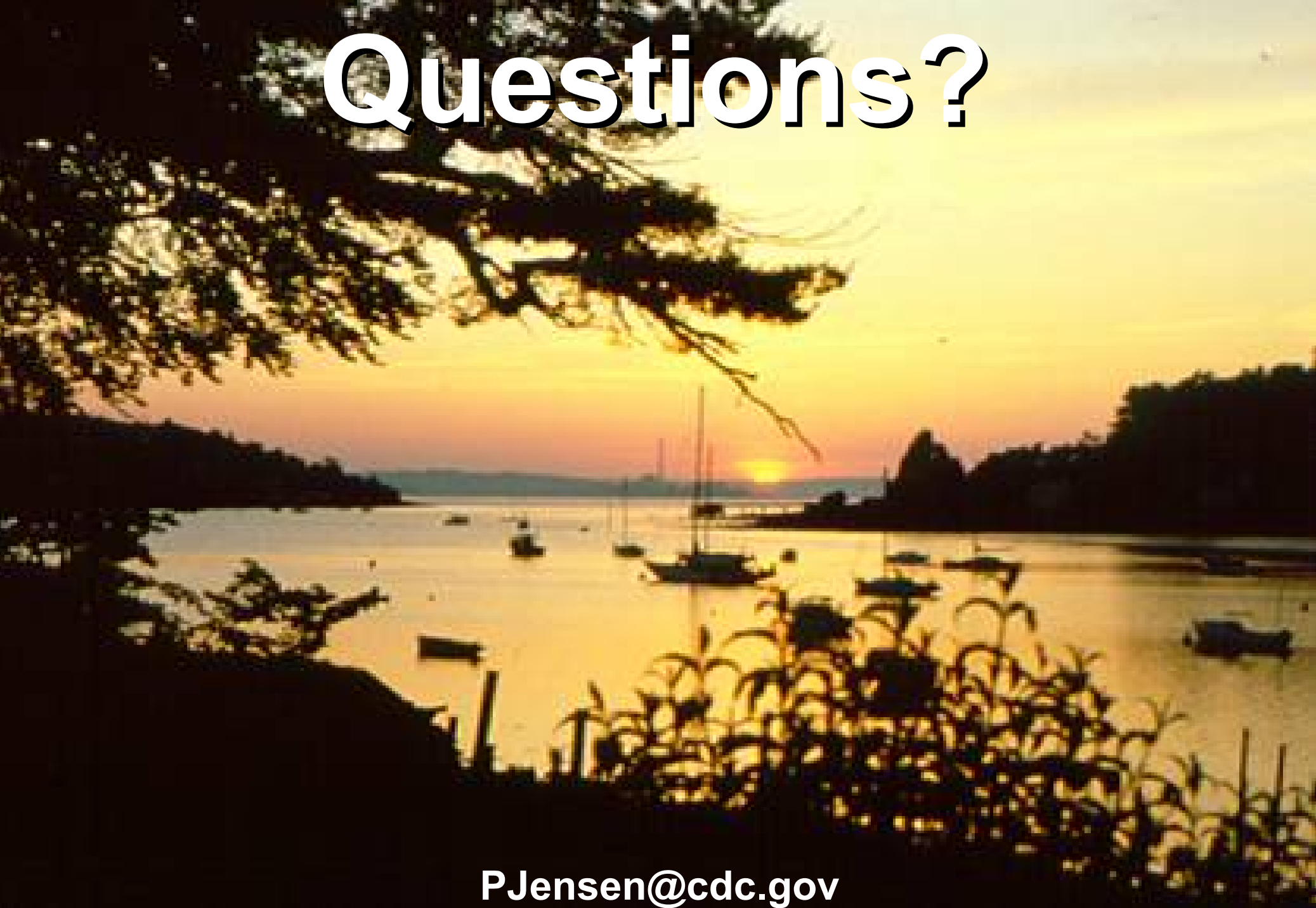
Precaução Respiratória por Aerossol

A disseminação aérea ocorre por via respiratória, através de aerossol disperso pelo ar.



- Quarto privativo - manter a porta fechada e a janela aberta.
- Máscara: filtro especial (vestir antes de entrar no quarto).
- Transporte: o paciente deve usar máscara cirúrgica.

HUCFF/UFRJ
Coordenação de Controle de Infecção Hospitalar



Questions?

PJensen@cdc.gov