RUTGERS
Global Tuberculosis Institute
NEW JERSEY MEDICAL SCHOOL

Infection Control

We are all connected by the air we breath

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Clinical Cases

- 55 year old ENT physician
- Long time smoker
- Weight loss
- Cough

- 22 year old female
- 38 weeks pregnant
- Cough and fever of a few days duration

Clinical Cases

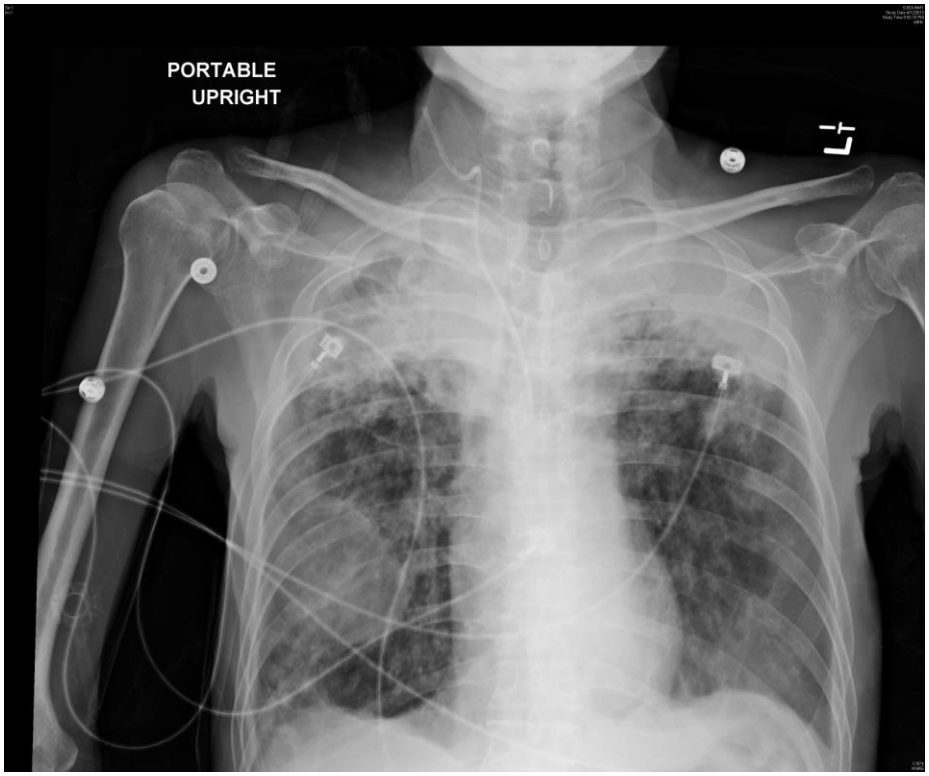
- 55 year old ENT physician
- Long time smoker
- Weight loss
- Cough
- Born in RI
- DX: lung cancer

- 22 year old female
- 38 weeks pregnant
- Cough and fever of a few days duration
- Born in Australia
- In US for College
- DX: Viral URI

Clinical Cases

- 55 year old ENT physician
- Long time smoker
- Weight loss
- Cough
- Born in India
- Mom died of TB
- +TST never treated

- 22 year old female
- 38 weeks pregnant
- Cough and fever of a few days duration
- Born in Guinea
- Immigrated 11 months ago
- Cared for in the private OB GYN setting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Hierarchy of Infection Control

Administrative Controls

Environmental Controls

Respiratory Protection

Fundamentals of Infection Control

- Administrative controls: reduce risk of exposure
- Environmental controls: prevent spread and reduce concentration of droplet nuclei
- Respiratory protection controls: further reduce risk of exposure to wearer only

TB-Infection Controls: Simplified

- Administrative: WHO?
  - Who is a TB suspect?
  - Who is at risk from exposure?
  - Who has infectious TB?
  - Who has drug resistant TB?
- Environmental: WHERE?
  - Where is optimal place to minimize risk?
- Personal Respiratory Protection: Special high-risk settings

ADMINISTRATIVE CONTROLS

Administrative Controls

- Administrative controls are the first and most important level of the hierarchy. These are management measures that are intended to reduce the risk or exposure to persons with infectious TB
  - Risk assessment
  - Infection prevention and control plan
  - Administrative support for the program implementation including quality assurance

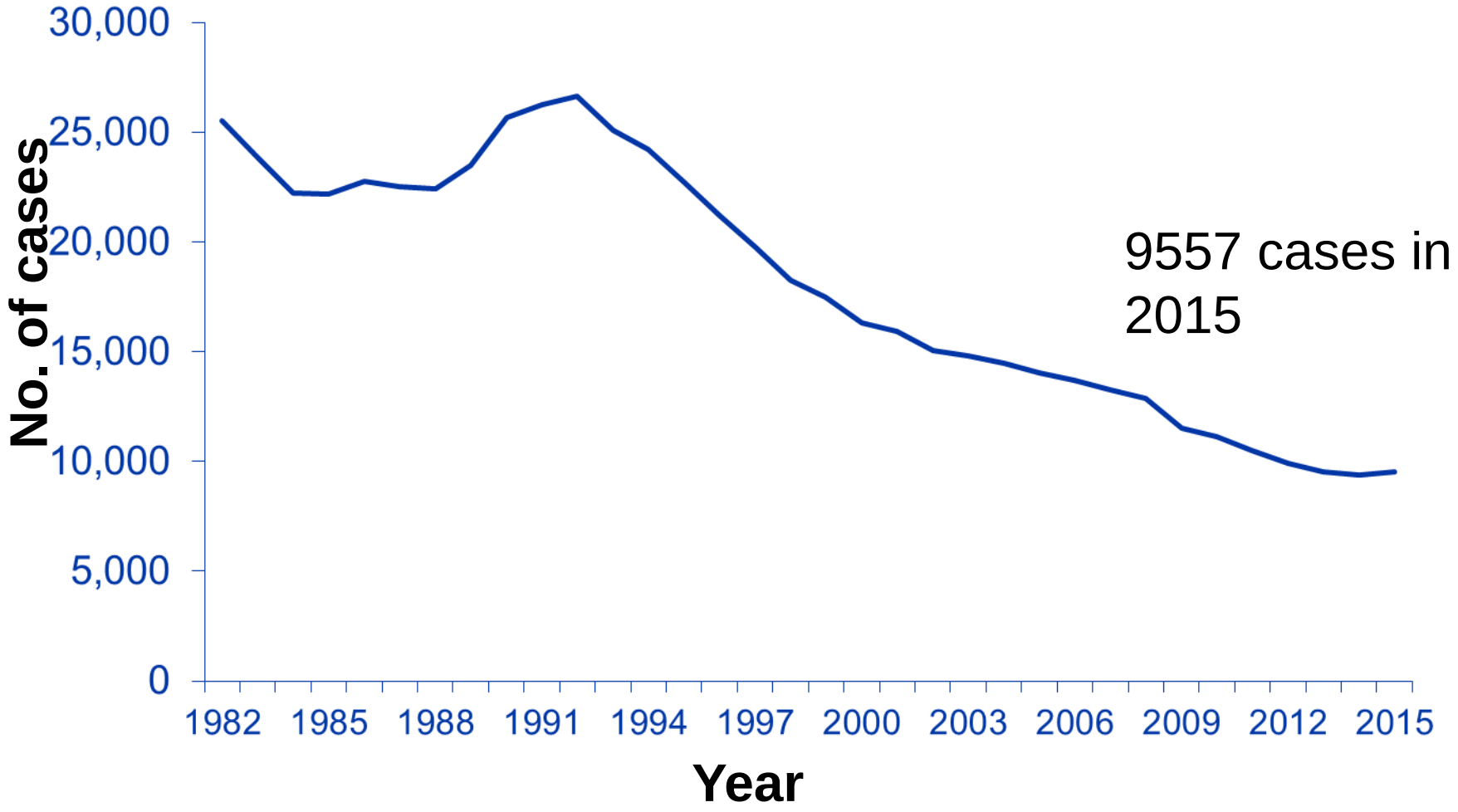
Administrative Controls

- Assigning someone the responsibility for TB infection control in the health care setting;
- Conducting a TB risk assessment of the setting;
- Developing and implementing a written TB infection-control plan;
- Ensuring the availability of recommended laboratory processing, testing, and reporting of results;
- Implementing effective work practices for managing patients who may have TB disease;
- Ensuring proper cleaning, sterilization, or disinfection of equipment that might be contaminated (e.g., endoscopes);
- Educating, training, and counseling health care workers, patients, and visitors about TB infection and TB disease;
- Testing and evaluating workers who are at risk for exposure to TB disease;
- Applying epidemiology-based prevention principles, including the use of setting-related TB infection-control data;
- Using posters and signs to remind patients and staff of proper cough etiquette (covering mouth when coughing) and respiratory hygiene; and
- Coordinating efforts between local or state health departments and high-risk health-care and congregate settings.

Prompt Triage
Think TB!

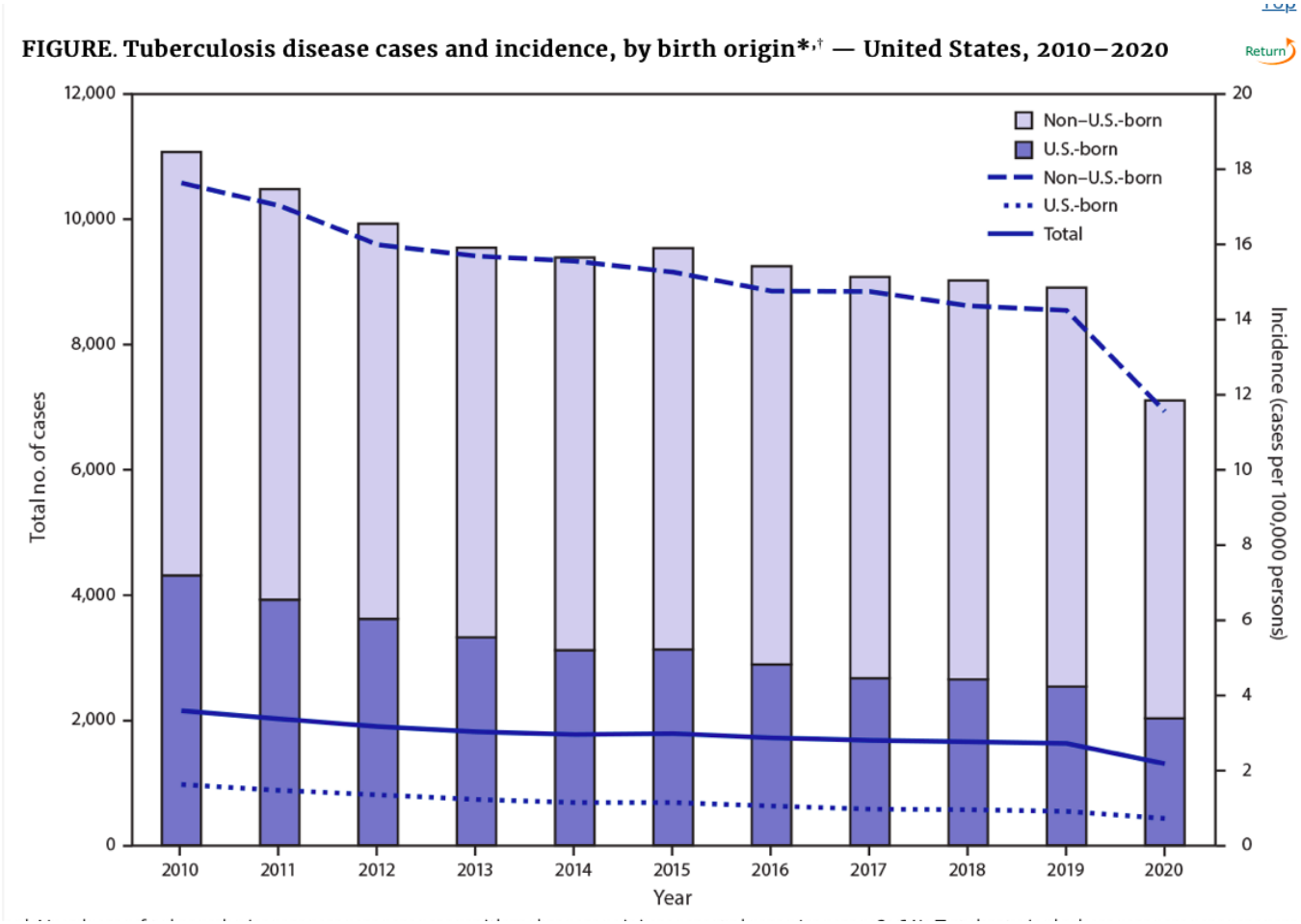
- Primary TB risk to HCPs is patient with undiagnosed or unrecognized infectious TB
- Promptly initiate AII precautions and manage or transfer patients with suspected or confirmed TB
  - Ask about and evaluate for TB
  - Check for signs and symptoms
  - Mask symptomatic patients
  - Separate immunocompromised patients

Reported Tuberculosis (TB) Cases United States, 1982–2015*



*As of June 9, 2016.

United States 2010-2020



7,163 (20% decline over 2019)

F-A-S-T

- Find cases Actively by cough surveillance and rapid molecular testing, Separate safely and Treat appropriately
- TB bacilli transmitted by unsuspected (untreated case)
- Instituted in variety of settings
  - Cough screening at entry to out-patient unit
  - Cough screening on wards
  - Cough screening at entry to HIV / ART unit
  - Cough hygiene instituted
  - Sputum specimens collected, tested, and results received
  - Prompt action after results received

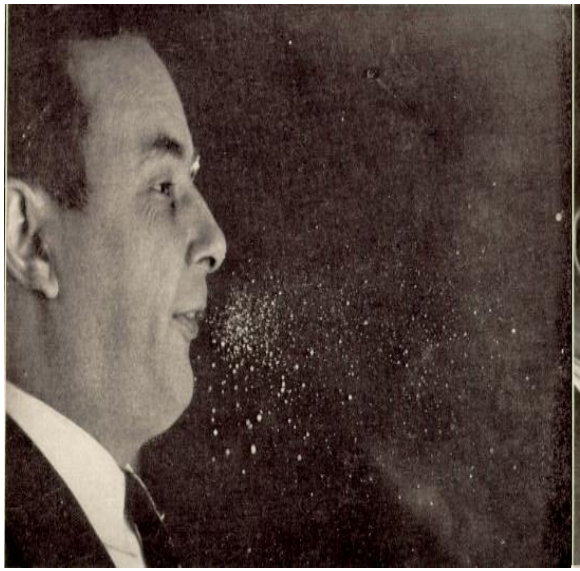
- Train in “TB Mindedness”
  - Take the targeted testing strategy to thinking TB in the appropriate setting
  - Education. Education. Education.
- Infection Control Plan
  - Who gets into isolation rooms
  - How to get people out of isolation rooms
- Surveillance Testing of Health Care Personnel
  - Intermittency of routine testing of health care personnel is determined by the risk of TB in that setting
  - Contact investigation with appropriate education/messaging for ”inadvertent” exposures
  - Be reasonable. Be Calm. Be the expert.

Surveillance Program (Pragmatic Approach)

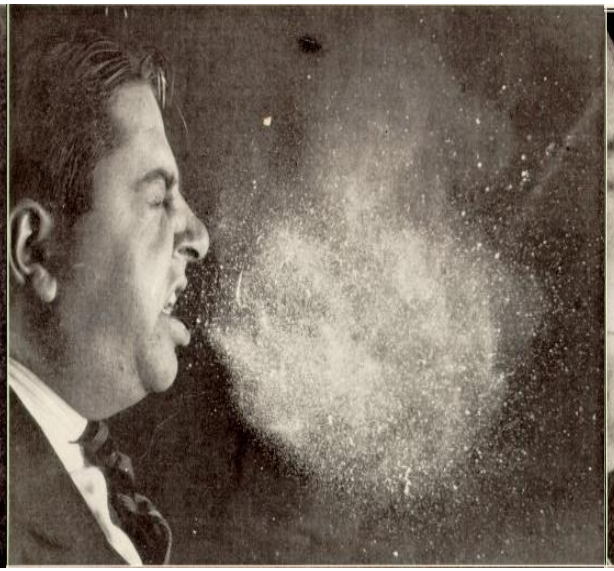
- Screen entry HCPs for TB Infection
  - Link to treatment
  - Infected untreated HCPs represent risk as well
- Practice concentric circle approach to inadvertent exposures
- Ongoing surveillance
  - Determined by burden of TB in the facility
  - Consider “Canary Approach”
    - ED staff, RT staff
    - Point of first contact staff

ENVIRONMENTAL CONTROLS

Sharing the air: aerosol generation



Speaking



Coughing

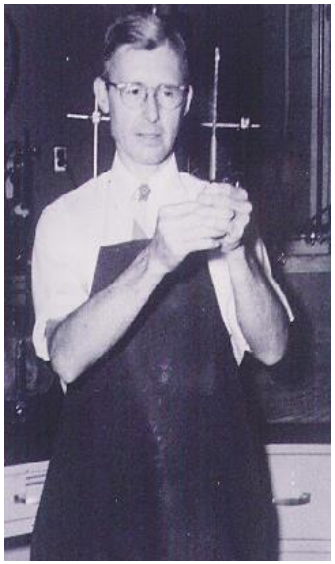
Sneezing

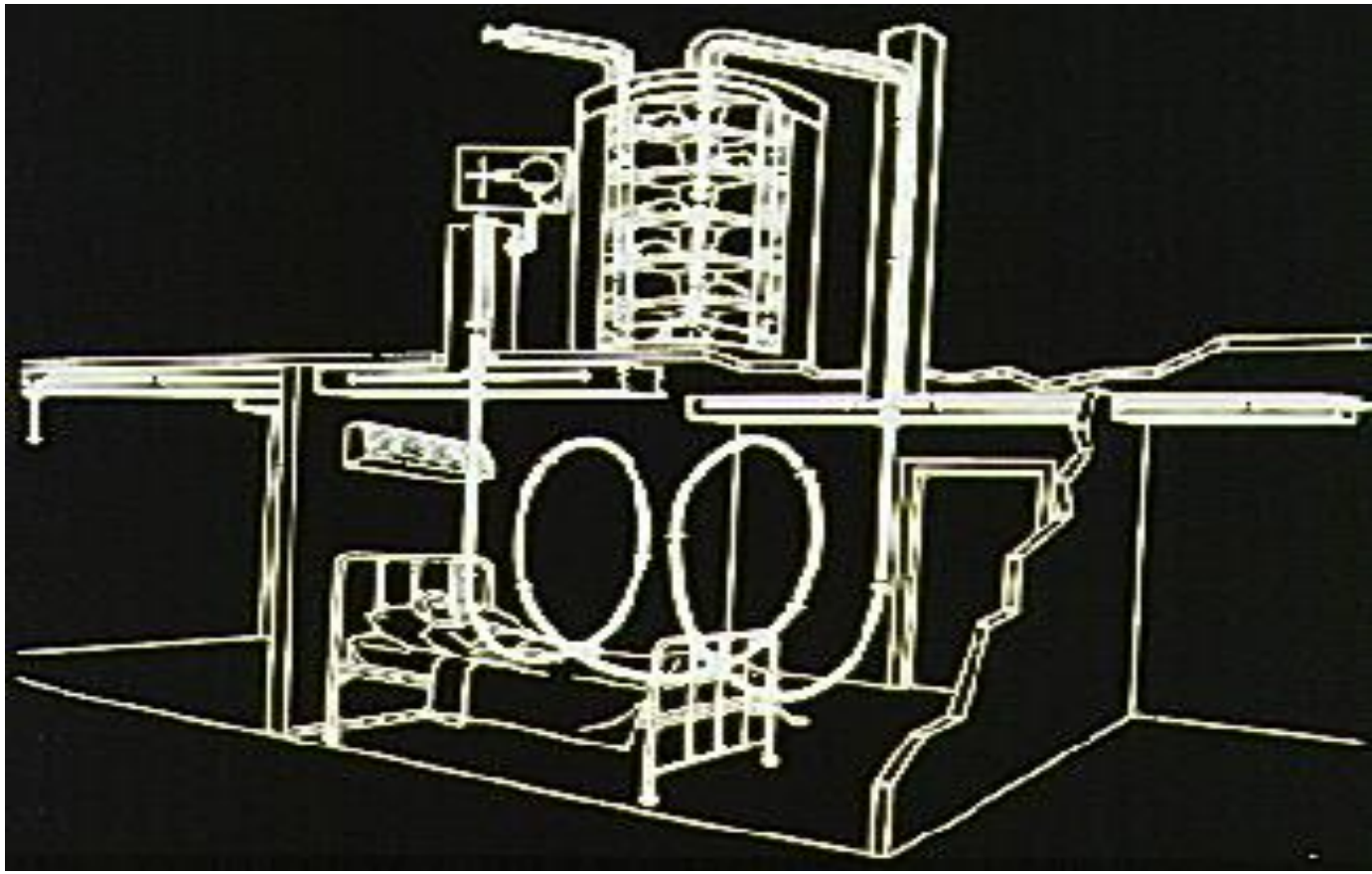
- Large droplets (>150 µm) fall onto ground
- Smaller droplets dry in air and become droplet nuclei
- Each droplet nuclei can carry 2-3 TB bacilli and can float and move with air for hours
- These droplet nuclei (3-5 µm) may be inhaled and end up in alveoli = *exposure*

What are determinants of *M. tb* transmission?

- *Source*:
  - *Number*, viability and virulence of organisms
  - *Coughing*?
  - Correct treatment?
- *Environmental factors*:
  - Room size and *ventilation*
- *Aerobiology*:
  - Temperature, humidity, oxygen, *radiation*
- *Source-host contact*:
  - Proximity, duration, frequency of contact
  - Cough hygiene?
- *Host*:
  - Age, *HIV status*, co-morbidities

Riley (Wells) experimental TB ward Baltimore, 1958 - 1962





Wells Riley Equation

$$\text{Risk of infection in susceptible host} \;\alpha\; \frac{\text{(No infectious particles) X (time in same airspace)}}{\text{Ventilation of airspace}}$$

Environmental Controls

- High income setting
  - Negative Pressure rooms
  - HEPA filters
  - UV Lights
- Low and middle income setting
  - Maximize natural ventilation and light

Natural Ventilation (NV) for Prevention of Airborne Contagion (1)

Escombe et al. PloS Med 2007; 4-e68:309-17

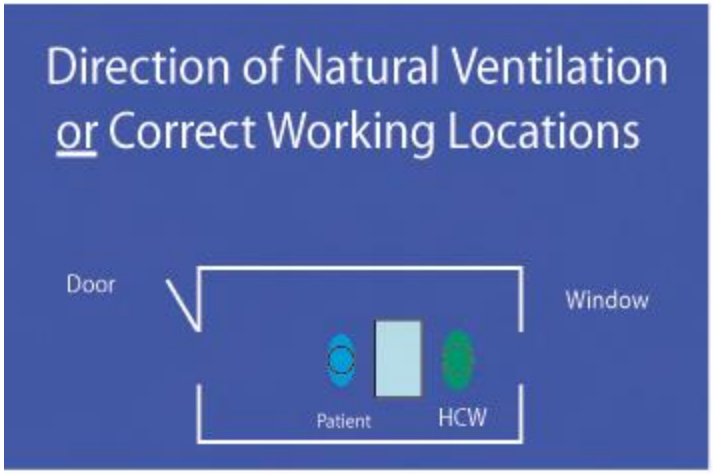
- Background
  - 8 hospitals, Lima, Peru
  - 70 naturally ventilated (NV) units in old and new hospitals
  - 12 negative pressure (NP) rooms
- Method
  - CO_2 tracer gas to determine number of air changes/hour (ACH)
  - Wells-Riley equation to predict chance of untreated TB patient infecting others

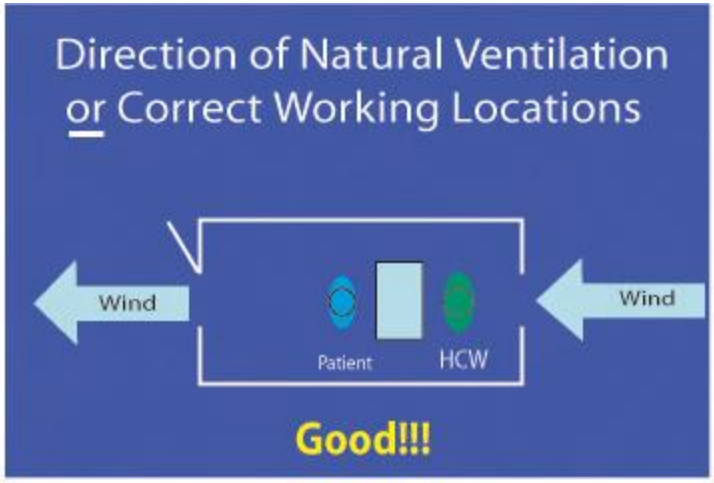
Natural Ventilation (NV) for Prevention of Airborne Contagion 2

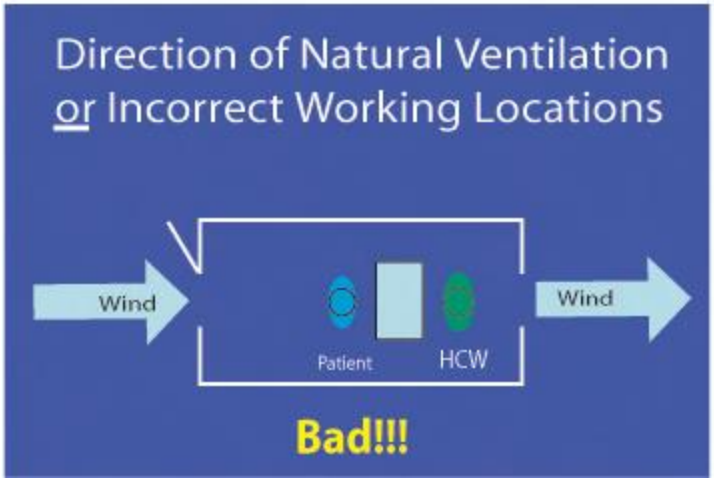
Escombe et al. PloS Medicine 2/2007

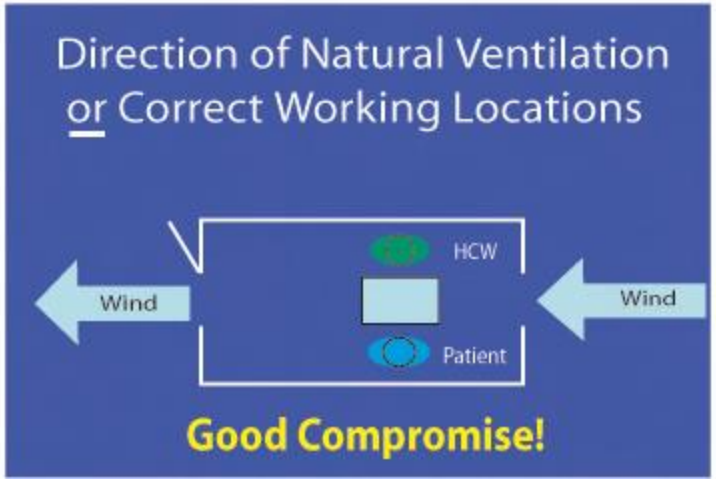
- Findings
  - NV = 28 ACH vs. NP = 12 ACH
  - NV **old hosp** (high ceilings, large windows) 40 ACH vs. 17 ACH in NV new hosp
  - Risk of untx'ed TB pt infecting others in 24 h if in:
    - Mechanically ventilated room: 39% infected
    - NV new hosp: 33% infected
    - NV old hosp: 11% infected
- Conclusion **NV works well**; rooms need to be designed to naturally achieve good air flow (casualty, OPD, waiting rooms)

Natural Ventilation in Consultation Room









Key Points

- Engineering controls (EC) are the 2nd priority in control measures AFTER administrative controls
  - But they are complementary
- Dilution ventilation is the most important EC
  - Protects HCPs, other patients, visitors
  - Has limits defined by technology, expense, comfort
- Negative pressure or directional airflow keeps contaminated air away from HCPs
- UVGI and filtration devices are adjuncts or back-ups for high-risk areas
  - Require maintenance
  - Need to consider cost-effectiveness

PERSONAL RESPIRATORY DEVICES

Personal Respiratory Protection

Respirator for Health Care Personnel

- Health care personnel wearing a respirator

- Respirators
  - Designed to filter out droplet nuclei from being inhaled by the health-care worker and other individuals
  - Should properly fit different face sizes and features
  - Should NOT be worn by the patient

Surgical Mask for Persons with Infectious TB Disease

- Infectious TB patient wearing a surgical mask

- Surgical masks
  - Designed to stop droplet nuclei from being spread (exhaled) by the patient
  - Should NOT be worn by the health care personnel

Personal Respiratory Protection

Respirator

- Can prevent inhalation of aerosolised droplet nuclei (5µm)
- To be used by HCP in contact with infectious TB patients
- Many different types; must be ***fit tested***; uncomfortable to wear for long periods of time
- Relatively expensive

Surgical Mask

- Used by infectious person to prevent respiratory secretions from becoming airborne
- Does ***not*** protect user from inhaling aerosols and droplet nuclei

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Questions?

…….And here's Patty

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Managing TB Inpatient & Outpatient Settings

Patricia Woods, RN, MSN
Global TB Institute

What Happens When a TB Case is Reported – Local HD Responsibilities

- Nurse Case Manager receives the report or phone call from ICP/MD
  - Responsible for the outcome of TB suspects/cases/contacts from initiation of treatment until discharge
  - Review report for medical information and accuracy
    - How infectious is the patient
    - Are they medically stable
    - Correct regimen
    - Barriers to discharge
      - Homeless
      - Vulnerable population in the home

What Happens When a TB Case is Reported - 2

- Outreach worker or nurse interviews the patient in the hospital after receiving the report
  - Reviews hospital records
  - Contact investigation is initiated
  - Home visit is made to verify address and contacts
  - Establishes plan for DOT upon discharge and medical supervision – clinic vs. private MD
  - Ensures patient has follow-up appointment and no interruption in treatment
  - Participates in discharge planning

Notification of Precautions to Protect Public Health

- A document that explains the appropriate precautions the patient needs to take while infectious is reviewed with the patient at the hospital or home

- It outlines the infection control measures with which the patient must adhere to in order to protect the public until rendered non-infectious

Notification of Infection Control Precautions

Patient's Name:_____ DOB: _____

The public health department has determined that your suspected or confirmed TB disease presents an imminent danger to the health of the public. As a result, you are instructed to adhere to the following infection control measures until you are informed by the public health department that it is no longer necessary.

In the hospital, you must:

- Remain in your assigned hospital room unless or until you are moved by hospital personnel.
- Cover your mouth and nose whenever coughing or sneezing.
- Take all medications as prescribed.

After hospital discharge, you must:

- Remain in your residence and/or outdoors on your residential property, except for trips approved by the public health nurse case manager. A respirator must be worn as deemed necessary by the nurse case manager.
- Cover your mouth and nose whenever coughing or sneezing.
- Keep all TB-related medical appointments and take all medications as prescribed.
- Attain prior approval from the public health nurse case manager for visitors entering the residence. Without prior approval, visitors must remain outdoors and may not enter the residence.
- Not visit homes of others, churches, schools, workplaces or other public or private places where you are in contact with others.
- Not use public transportation or taxis.

I acknowledge receipt of these conditions and recognize that failure to adhere with the conditions places the public at risk for transmission and may result in legal action against me.

Patient signature: _____ Date: _____

Witness name: _____

Witness signature: _____ Date: _____

Communication with Case Management and Public Health

- Infection prevention, case management and public health must work together in discharge planning
- Specific needs of the patient must be identified early on
- No two cases are the same
- Team must decide best plan of care after discharge for the patient

Discharge Planning

- Request appropriate notice prior to discharge
- Request not to have patient discharged on a Friday
- Ensure the criteria for discharge is met

Poll #1 - Does your state have regulations regarding discharging TB Patients into the community?

- Yes
- No
- Unsure

Recommended Criteria for Hospital Discharge

The Infectious Patient

- The patient has a stable residence that is validated by the TB nurse case manager

AND

- The residence is **not** shared by any person(s) who is a member of a vulnerable population unless the person(s) has been diagnosed with LTBI
  - Vulnerable population are those individuals who are immuno-compromised for any reason or <5 years of age

OR

- TB has been ruled out as the cause of the patient's illness

Recommended Criteria for Hospital Discharge - 2

- If the patient:
  - Is a resident of a congregate living facility
  - Is homeless
  - Reports a private residence that the TB nurse case manager has not verified as being valid or stable **OR**
  - Has a private residence where uninfected members of a vulnerable population reside

If any of the above conditions exist, the patient MUST meet one of the following criteria before discharge:

Recommended Criteria for Hospital Discharge - 3

- Have 3 consecutive sputum smears negative for AFB collected at least 8 hours apart
- Have at least one sputum culture negative *M.tb* after TB treatment has been initiated
- 2 Negative NAAT
- Had no sputum smears + for AFB, been on TB treatment for at least 2 weeks and no current respiratory symptoms
- Is granted an exception by the Health Department based on clinical evidence and patient interview if none of the above conditions have been met

Recommended Criteria for Hospital Discharge - 4

- If the infectious or potentially infectious patient does not meet the criteria for discharge or patient non-adherence/risk of flight has been documented during the hospitalization, discharge should be delayed

Immediate/Imminent Public Health Risk

- Definition: A patient with suspected or confirmed infectious or potentially infectious TB disease who does any of the following:
  - Threatens to leave hospital against medical advice (AMA)
  - Leaves hospital AMA
  - Verbalizes or demonstrates non adherence with infection control measures
  - Refuses to take medications as prescribed
  - Threatens to travel on public conveyance

Appropriate Discharge

Protects the community against transmission

- Patients can only be discharged while infectious with:
  - Stable residence
  - No vulnerable residents in household
  - Agreement to self isolate until non-infectious
- Otherwise, must be kept in an AII room until documented non-infectious
- Must coordinate discharge with TB nurse case manager

Infectious Patient Diagnosed Outpatient

- Prompt response by the NCM is needed to have the patient started on treatment and evaluate the household contacts

- A home or clinic visit should be initiated quickly to assess the patient

Poll #2 - If you found an infectious patient with TB in the community, would you have them admitted to the hospital?

- Yes
- No
- Unsure

TB Infection Control in the Home

Steps that Patients Can Take to Prevent the Further Transmission of TB in the Home	Precautions for Health-Care Workers to Take to Protect Themselves from Exposure to M. tuberculosis
• Cover their mouth and nose when coughing or sneezing • Sleep alone and not in a room with other household members • Refrain from having visitors in the home until they are noninfectious	• Instruct patients to cover their mouth and nose with a tissue when coughing or sneezing • Wear a respirator when visiting the home of a patient with infectious TB disease or when transporting a patient with infectious TB disease in a vehicle • Collect specimens in a well-ventilated area, away from other household members

Initial Visit with the Nurse

- Assessment should include:
  - Weight
  - Vitals
  - Assessment of symptoms
  - Medical history
  - Interview to establish infectious period
  - Assessment of living space and household contacts
    - Is there space to home isolate
  - Providing the patient with a surgical mask
  - Educate patient and family on TB and home infection control measures

Infectious Patient Diagnosed Outpatient

- Collect a sputum
  - If possible, collect outdoors or in an isolated area of the home
- Set up a clinic appointment as soon as possible
- Discuss DOT
- Set up evaluation of household contacts
- Evaluate for expanding the contact investigation to congregate setting (school, worksite)

Clinic Visit

- Instruct patient to come to clinic with a mask or provide one immediately once they arrive
- Isolate patient in a separate exam room away from other patients waiting for an appointment
- Make the appointment a priority to be seen as quickly as possible
- If a patient is very infectious try to schedule them as the last appointment to have less patients in the clinic
- Do not make the appointment during appointments of vulnerable populations (e.g., children, HIV)

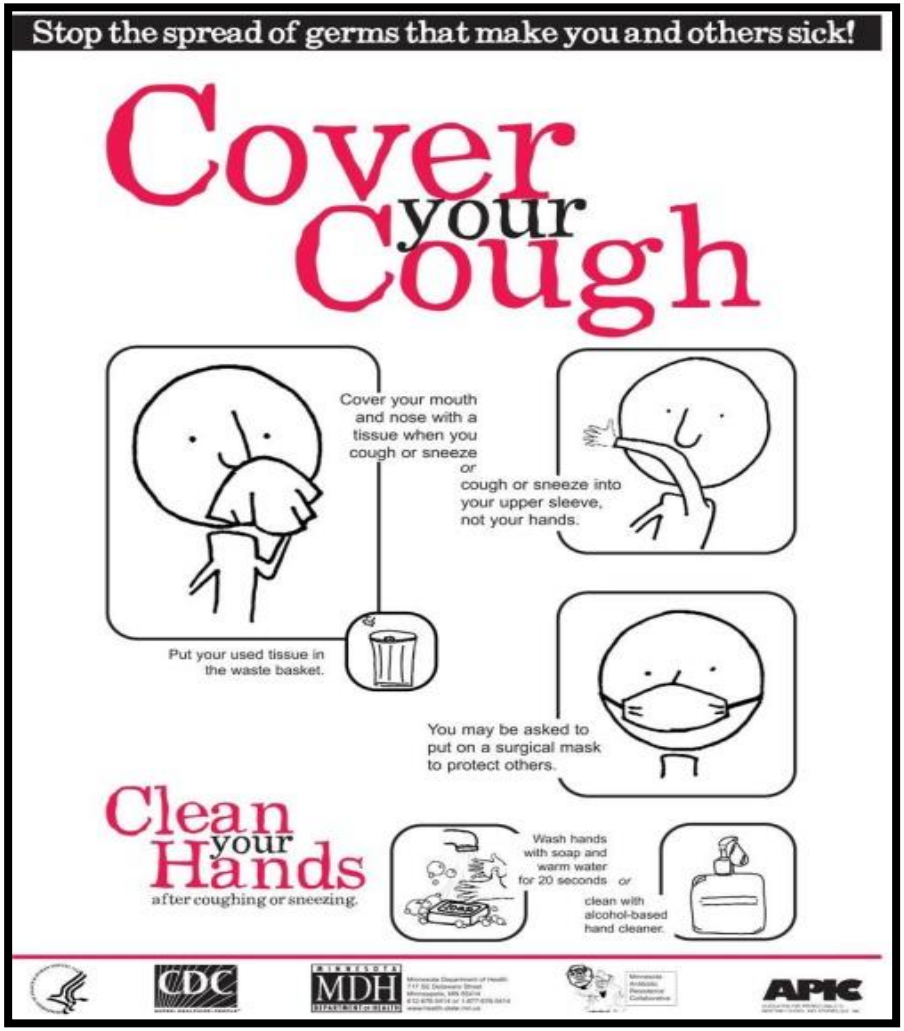
Monitor Patient

- Regularly collect sputum until three negative smears
- Regular monitor patient for symptom improvement
- Keep infection control measures in place until patient is no longer infectious

Think TB

- Assess all TB infection for TB disease
- “THINK TB!” - there should be a triage plan and if possible a separate room to place the patient
- Patient must be offered a surgical mask
- Precautions should be initiated for signs or symptoms of TB disease or if patient has known TB disease and has not completed anti-TB treatment
- Use signage in the waiting area of TB symptoms and cover your cough
- Train staff

‘Cover Your Cough!’



Think TB

- Health care workers must be trained to ask questions that will facilitate detection of persons who have suspected or confirmed TB infection

- The medical evaluation must be conducted in the patient's primary language using an interpreter if needed

- There should be 'red flags' or key words that raise the suspicion for TB

Think TB

Symptoms related to cough/respiratory tract

- Consider TB for any patient with symptoms of infection in the lung or airways
- Cough for > 3 weeks
- Bloody sputum of hemoptysis
- Hoarseness

Other signs, symptoms and factors

- Loss of appetite
- Unexplained weight loss
- Fever
- Fatigue
- Chest pain
- Travel history
- Homeless population
- Recent incarceration or residence in a group setting

Questions?