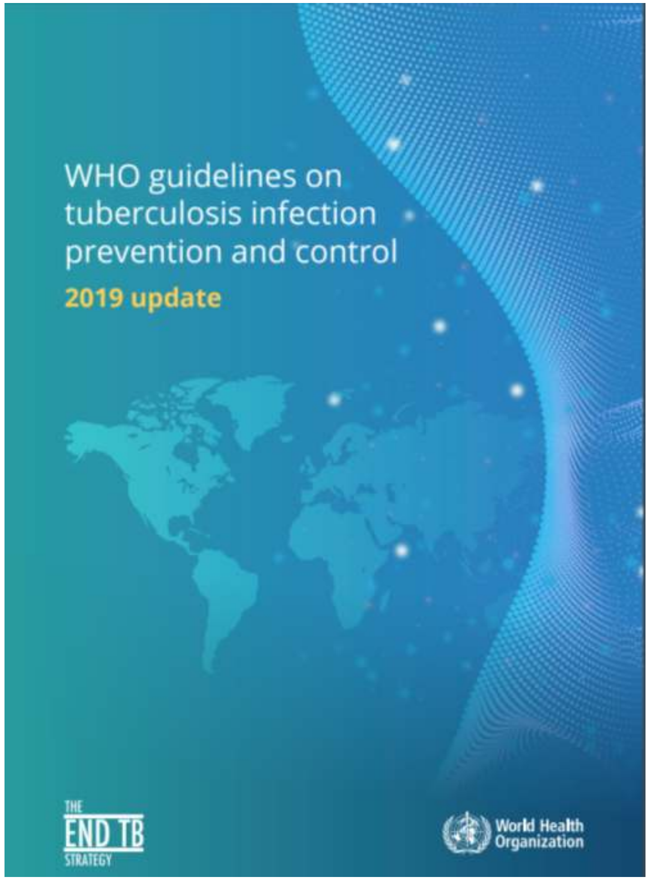
Administrative Measures to Control Airborne Infections Transmission

Grigory Volchenkov

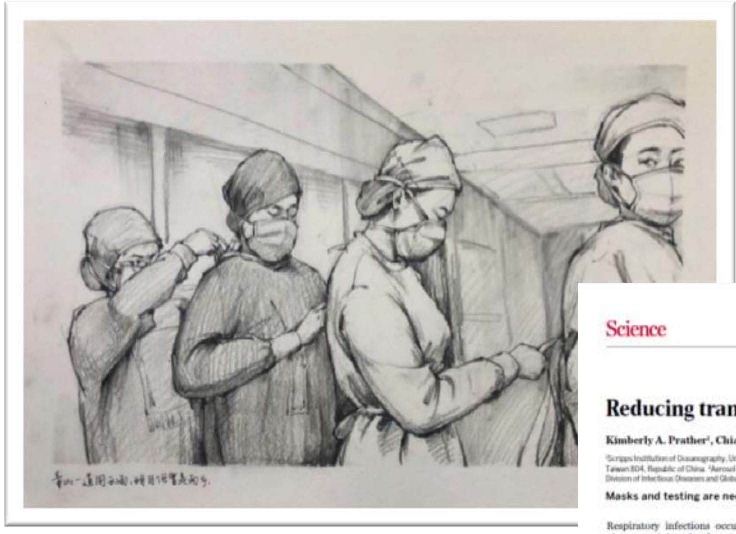
Vladimir, Russia

WHO guidelines on tuberculosis infection prevention and control. 2019 update

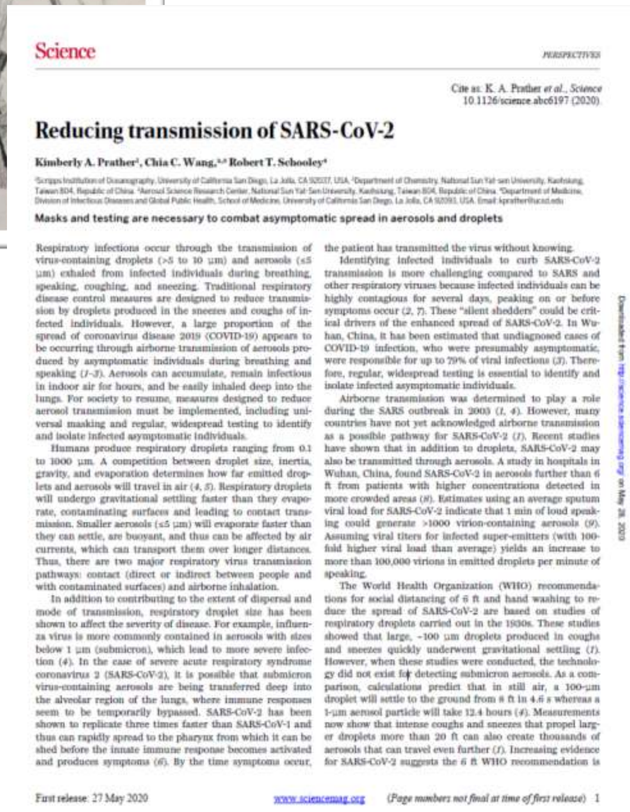
- Integrated package of IPC interventions to prevent *M. tuberculosis* transmission.
- updated, evidence-informed recommendations outlining a public health approach within the clinical and programmatic management of TB
- hierarchy of infection control as a systematic and complex approach for strengthening IPC and reducing the risk of *M. tuberculosis* transmission.



COVID-19 and Bioaerosols



Nurses getting ready to go to work with COVID19 patients
Daughter of Yuhong Liu (ETTi), February 2020



Science PERSPECTIVES

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Reducing transmission of SARS-CoV-2

Kimberly A. Prather[1], Chia C. Wang,[2,3] Robert T. Schooley[4]

Masks and testing are necessary to combat asymptomatic spread in aerosols and droplets

Respiratory infections occur through the transmission of virus-containing droplets (>5 to 10 μm) and aerosols (≤5 μm) exhaled from infected individuals during breathing, speaking, coughing, and sneezing. Traditional respiratory disease control measures are designed to reduce transmission by droplets produced in the sneezes and coughs of infected individuals. ...

the patient has transmitted the virus without knowing.

Identifying infected individuals to curb SARS-CoV-2 transmission is more challenging compared to SARS and other respiratory viruses because infected individuals can be highly contagious for several days, peaking on or before symptoms occur (2, 7). These "silent shedders" could be critical drivers of the enhanced spread of SARS-CoV-2. ...

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Opinion

VIEWPOINT

Airborne Spread of SARS-CoV-2 and a Potential Role for Air Disinfection

Edward A. Nardell, MD, Brigham and Women's Hospital, Division of Global Health Equity, Harvard Medical School, Boston, Massachusetts.

On April 2, 2020, expert consultation from the National Academies of Sciences, Engineering, and Medicine to the White House Office of Science and Technology Policy concluded that available studies are consistent with the potential aerosol spread of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), not only through coughing and sneezing, but by normal breathing. ...

Management of the current crisis and preparation for future respiratory viral pathogens should include consideration of the use of upper-room GUV to help mitigate airborne transmission.

PREPAREDNESS MATTERS

Administrative Controls

Recommendation 1: Triage of people with TB signs and symptoms, or with TB disease, is recommended to reduce *M. tuberculosis* transmission to health workers (including community health workers), persons attending health care facilities or other persons in settings with a high risk of transmission.

Recommendation 2: Respiratory separation / isolation of people with presumed or demonstrated infectious TB is recommended to reduce *M. tuberculosis* transmission to health workers or other persons attending health care facilities.

Recommendation 3: Prompt initiation of effective TB treatment of people with TB disease is recommended to reduce *M. tuberculosis* transmission to health workers, persons attending health care facilities or other persons in settings with a high risk of transmission.

Recommendation 4: Respiratory hygiene (including cough etiquette) in people with presumed or confirmed TB is recommended to reduce *M. tuberculosis* transmission to health workers, persons attending health care facilities or other persons in settings with a high risk of transmission.

Environmental Controls

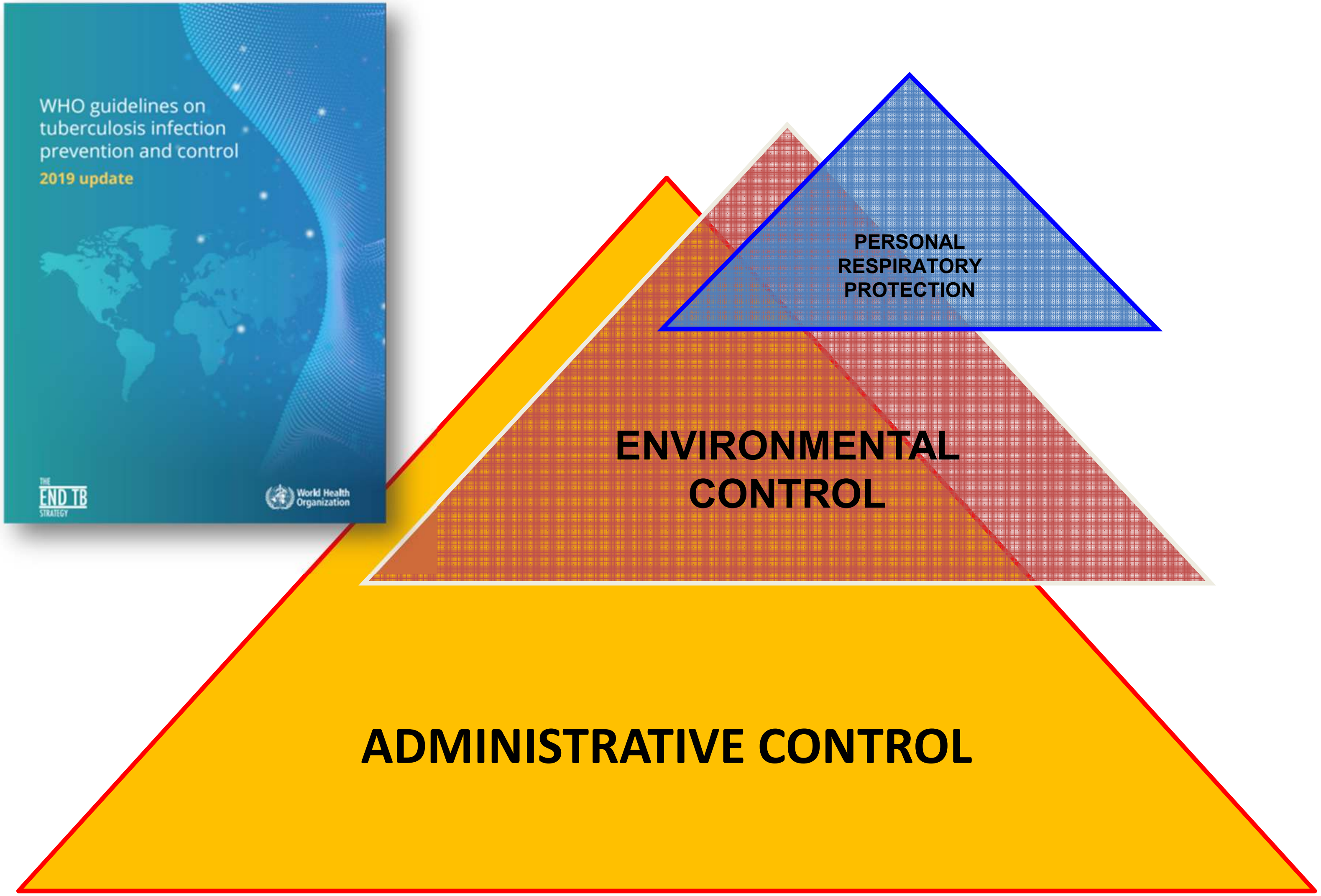
Recommendation 5: Upper-room germicidal ultraviolet (GUV) systems are recommended to reduce *M. tuberculosis* transmission to health workers, persons attending health care facilities or other persons in settings with a high risk of transmission.

Recommendation 6: Ventilation systems (including natural, mixed-mode, mechanical ventilation and recirculated air through high-efficiency particulate air [HEPA] filters) are recommended to reduce *M. tuberculosis* transmission to health workers, persons attending health care facilities or other persons in settings with a high risk of transmission.

Personal Respiratory Protection

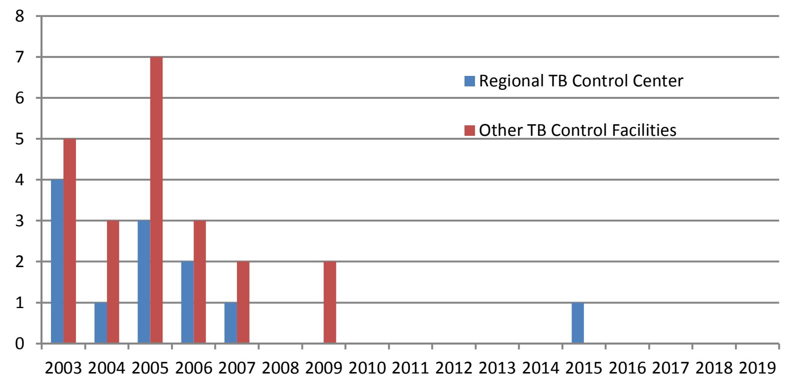
Recommendation 7: Particulate respirators, within the framework of a respiratory protection programme, are recommended to reduce *M. tuberculosis* transmission to health workers, persons attending health care facilities or other persons in settings with a high risk of transmission.

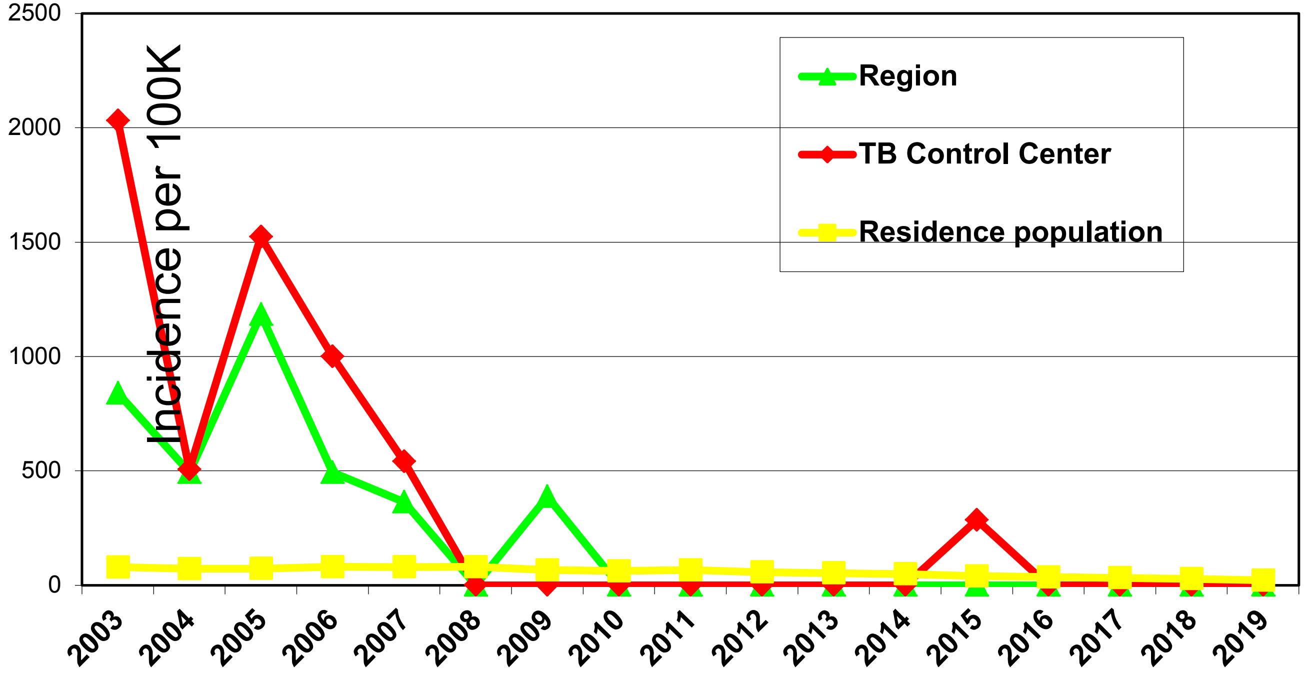
TB (Airborne) Infection Control Hierarchy



Occupational TB incidence among HCWs of TB control facilities

Vladimir region, Russia





Occupational TB risk for Emergency Hospital Staff

	Total staff amount	Active TB cases notified*	Annual TB notification rate per 100K**	Relative risk of occupational TB
Doctors	106	2	157,2	6,3
Nurses	236	8	282,5	11,4
Auxiliary HCWs	114	0	0,0	0,0
Others	94	0	0,0	0,0
Total	550	10	151,5	6,1

* - in 2002 – 2013 (12 years)

** - TB notification rate for Vladimir city residents in 2013 – 27,3 per 100K.

Potential HIGH risk Airborne Transmitters

- Undetected, undiagnosed coughing patients
- Respiratory patients which do not receive EFFECTIVE treatment
  - Treatment delay, interruption, default
  - Ineffective treatment regimen
- For TB: most sensitive and available contagiousness indicator – sputum smear microscopy - before effective treatment initiation!

Effect of Chemotherapy on Transmission

1929 - 2015

- Rouillon A, Perdrizet S, Parrot R. Transmission of tubercle bacilli:

The effects of chemotherapy. Tubercle 1976; 57:279-299.

– Sputum smear and culture positivity correlate with transmission before but not on therapy

– Discordance between effect of treatment on culture and smear

– Evidence that smear and culture positive TB patients on therapy do not infect close contacts.

"There is an ever-increasing amount of evidence in support of the idea that abolition of the patient's infectiousness – a different matter from 'cure,' which takes months and from negative results of bacteriological examinations, direct and culture, which may take weeks – is very probably obtained after less than 2 weeks of treatment".

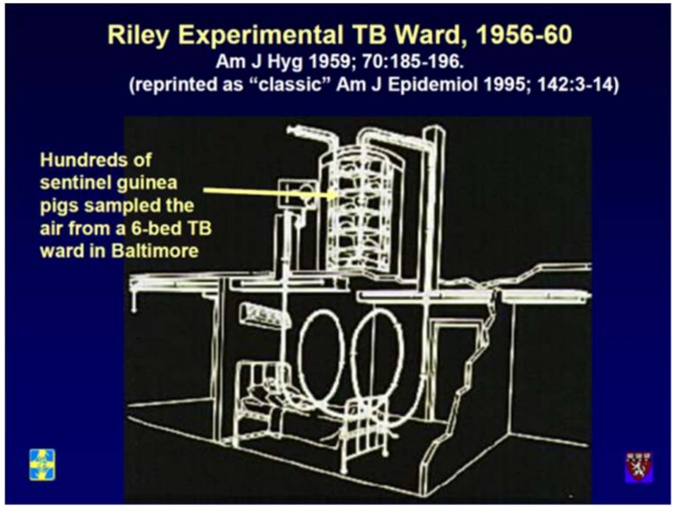
"These facts seem to indicate very rapid and powerful action by the drugs on infectivity…"

"The future reduction of transmission will essentially depend on the maintenance of an adequate system ensuring the early diagnosis and correct treatment of cases, which will inevitably continue to appear among the already infected portion of the population. "

Richard L. Riley и William F. Wells

(1959 – 1962 – 1974)

"The treated patients were admitted to the ward at the time treatment was initiated and were generally removed before the sputum became completely negative. Hence the decrease in infectiousness preceded the elimination of the organisms from the sputum, indicating that the effect was prompt as well as striking."



Courtesy of Edward Nardell

Dramatic reduction of transmission risk after EFFECTIVE treatment initiation

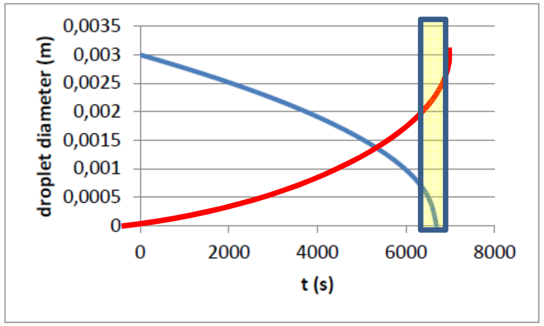


Figure 6: Variation of droplet diameter over time.

TB drugs concentration

$$C = m / V$$

$$V = 4/3\, \pi R^3$$

R_3 = 5 µm

R_2 = 10 µm

R_1 = 100 µm

where: *C* - drug concentration in a droplet (particle);

m – drug mass;

V – particle volume;

R – particle radius.

Water evaporation effect on drug concentration in a droplet:

- in particle #2 - **1000** times higher, than in #1
- in particle #3 - **8000** times higher, than in #1

INITIATION OF EFFECTIVE THERAPY RAPIDLY STOPS TB TRANSMISSION

F-A-S-T

A refocused, intensified, administrative tuberculosis transmission control strategy

Find cases **A**ctively by cough surveillance and rapid molecular sputum testing, **S**eparate safely, and **T**reat effectively based on rapid drug susceptibility testing (DST).

Four underlying principles:

1) TB is spread in institutions predominantly by coughing patients with unsuspected TB or unsuspected drug resistance,
2) most potentially infectious patients can be identified by cough surveillance,
3) coughing TB patients most likely to be infectious can be diagnosed using rapid molecular sputum tests, including drug resistance (Xpert MTB/RIF)

4) by dramatically reducing the duration of institutional exposure through effective treatment, transmission among patients and to health care workers will be reduced proportionately

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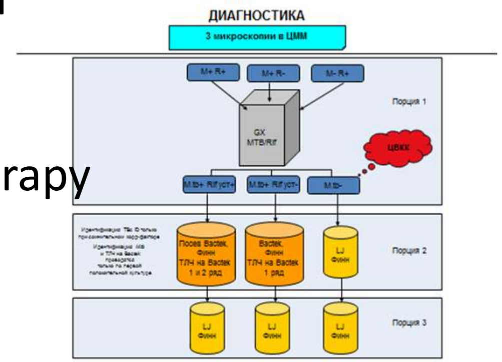
Harvard School of Public Health, Harvard Medical School

CONCLUSIONS

- Considerable portion of Airborne Infections Transmission takes place from undetected, undiagnosed patients
- Case finding with rapid testing to identify *M. tuberculosis* or other *Airborne pathogen* and its drug susceptibility, if available, should be the first priority, followed by:
  - Prompt and effective Airborne Isolation
  - Effective therapy rapidly ends TB transmission long before smear microscopy and culture conversion

KEY ADMINISTRATIVE MEASURES

- Education and training
- Active screening for all patients, visitors and staff
- Airborne transmission risk assessment and facility zoning based on risk level
- Use of surgical masks or valveless respirators for all
- Separation of patients, visitors and staff flows
- Hospitalization criteria revision for TB and other Airborne Infections patients
- Reconstruction and restructuring of the facilities based on Airborne IPC principles to ensure staff and inmates safety and Airborne transmission risk reduction
- Introduction of diagnostic algorithms including rapid molecular testing to identify *M. tuberculosis, SARS-CoV-2* and drug susceptibility
- Immediate initiation of AIRBORNE isolation and EFFECTIVE therapy based on rapid testing and DST results



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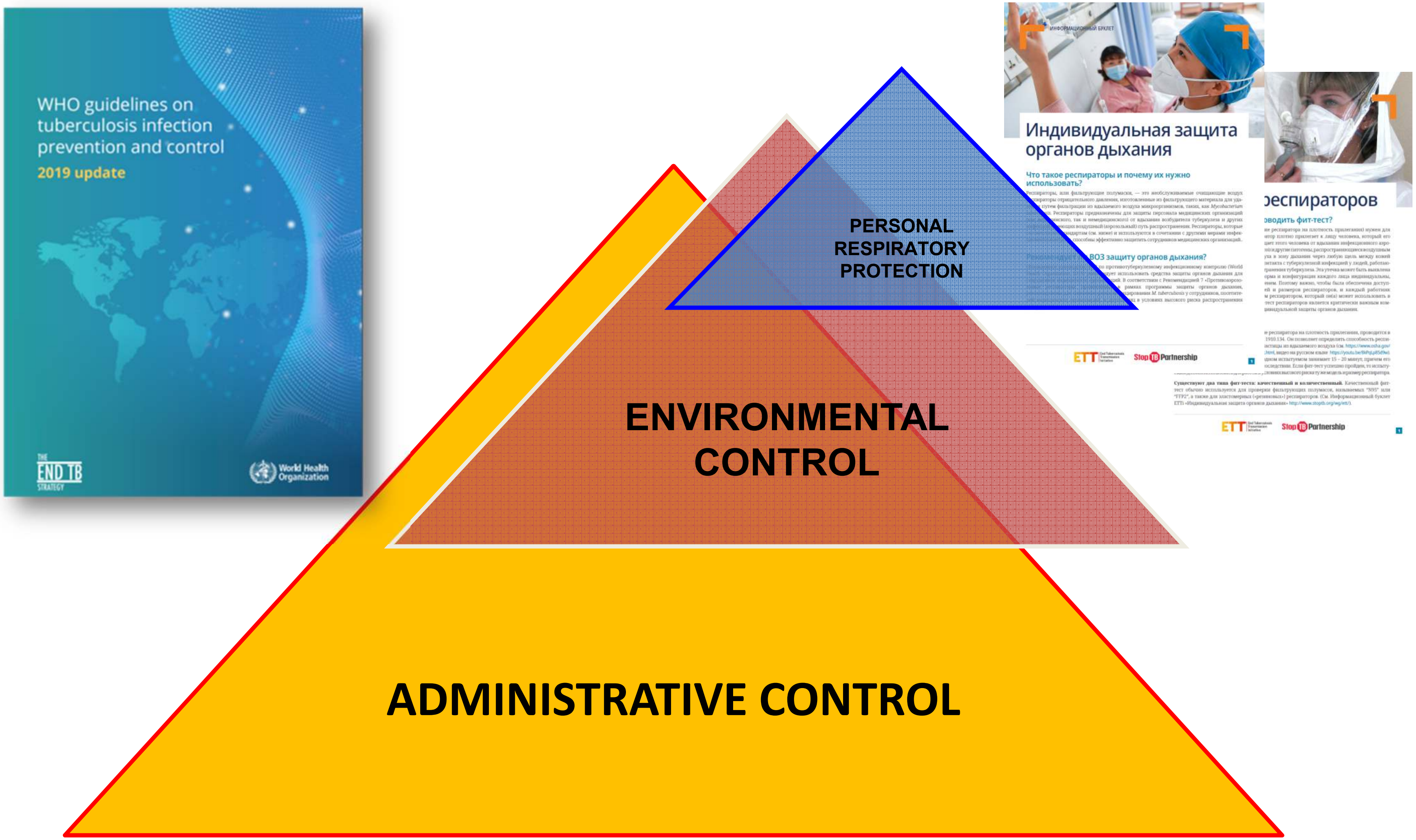

THINK SAFE AIR

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http://www.stoptb.org/wg/ett/resources.asp