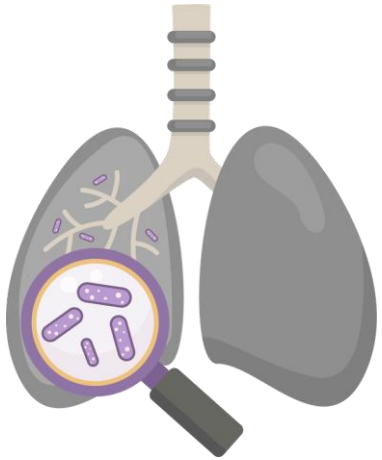
Block 5. Unit 32.



TUBERCULOSIS, MENINGITIS AND LEGIONELLOSIS

Infectious diseases of bacterial origin

Maria Llena Meler (maria.llena@uv.es)

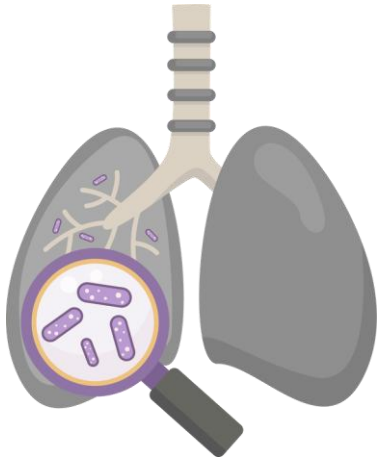
AECC PhD student, Autophagy and Onconutrition Lab, UV

Block 5. Unit 32.

Block V: PREVENTION OF COMMUNICABLE DISEASES

- Topic 30. Epidemiology of communicable diseases. Control and surveillance.
- Topic 31. Airborne diseases.
- **Topic 32. Tuberculosis and other bacterial infection diseases**
- Topic 33. Contact-transmitted diseases. Tetanus.
- Topic 34. Epidemiology and prevention of sexually transmitted diseases.
- Topic 35. Water- and foodborne diseases.
- Topic 36. Diseases covered by vaccination programs: epidemiological and preventive aspects.
- Topic 37. Epidemiology of Human Immunodeficiency Syndrome.
- Topic 38. Epidemiology of zoonoses and vector-borne diseases.
- Topic 39. Sanitation, disinfection, pest control, and rodent control.
- Topic 40. Hospital-acquired infections.

Block 5. Unit 32.



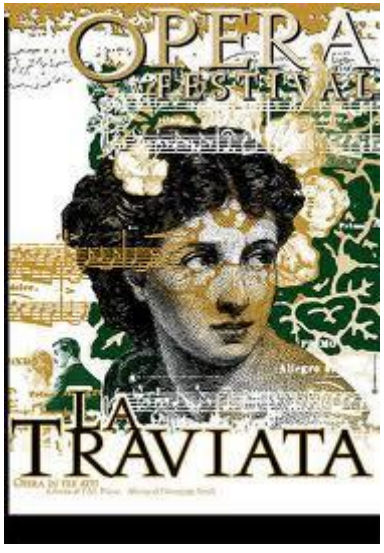
First ...
TUBERCULOSIS

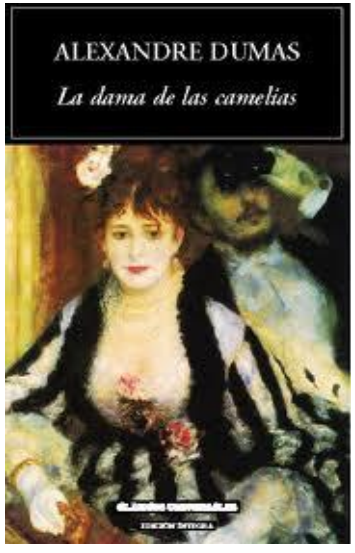
Maria Llena Meler (maria.llena@uv.es)

AECC PhD student, Autophagy and Onconutrition Lab, UV

Tuberculosis

Tuberculosis is responsible for high morbi-mortality in Europe.
Known as the "***Great White Plague",*** it accounted for a quarter of all deaths in the 15th and 16th centuries.

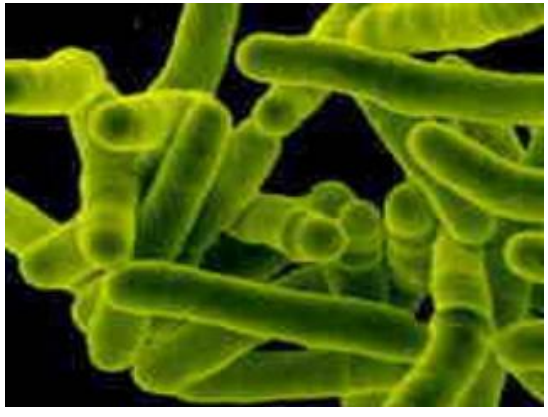




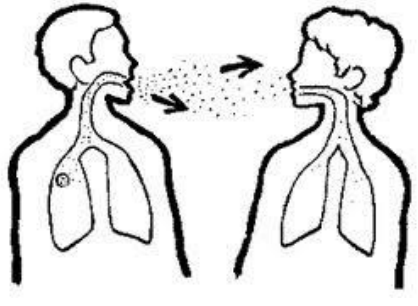
Tuberculosis

The disease is caused by *Mycobacterium tuberculosis* (also called Koch's bacillus)

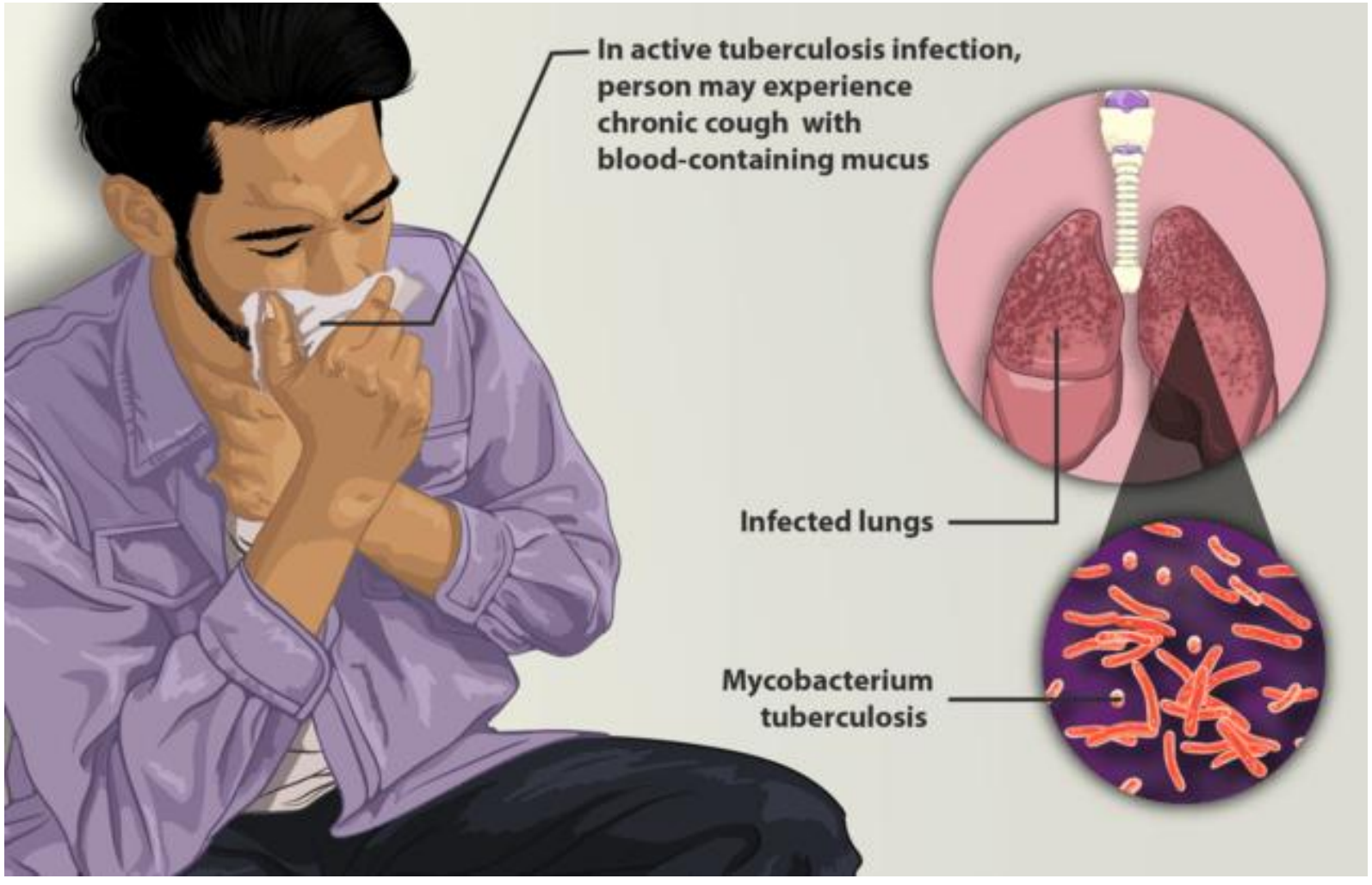
Robert Koch
(1843-1910)



It can be acquired by **inhaling droplets** from the cough or sneeze of an infected person.



Tuberculosis



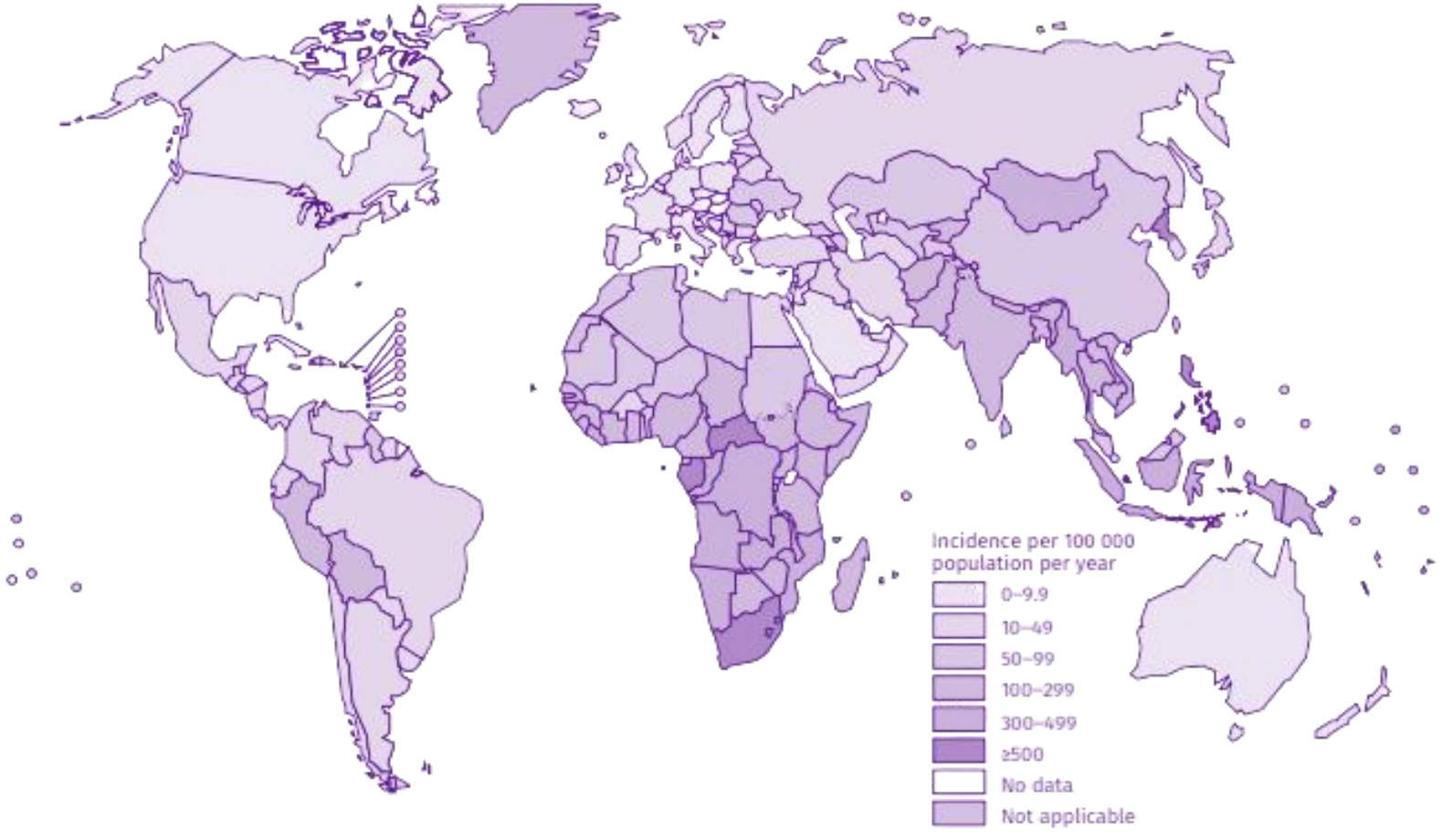
Tuberculosis

Several **TB epidemics** have been recorded throughout history, with **peaks** occurring:

- at the end of the 18th century in England,
- at the beginning of the 19th century in Western Europe, and
- at the end of the 19th century in Eastern Europe and North and South America.

In many regions of Asia and Africa, peak incidence has not yet been reached.

Tuberculosis



Estimated TB incidence rates

Tuberculosis

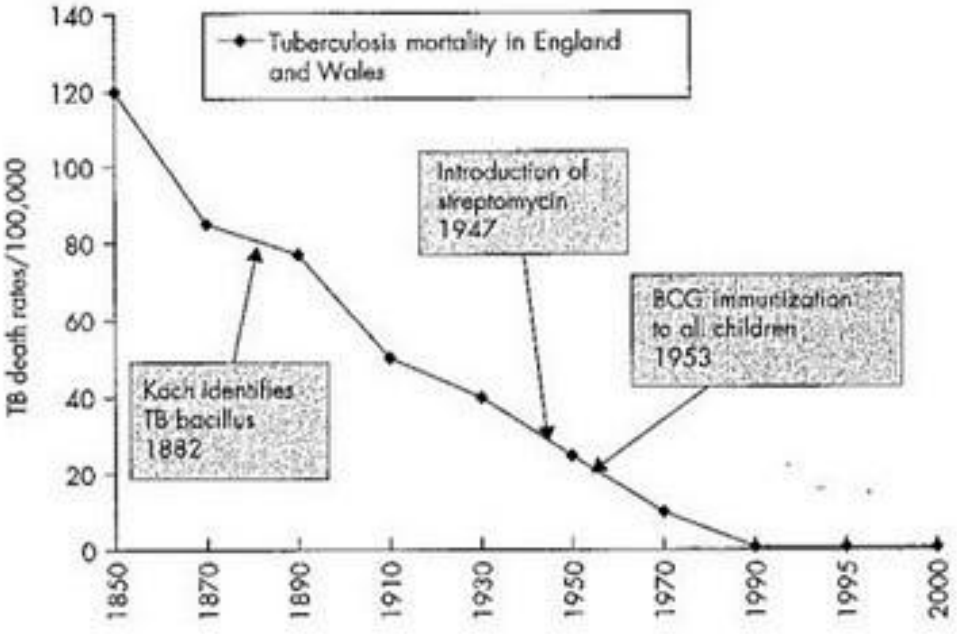
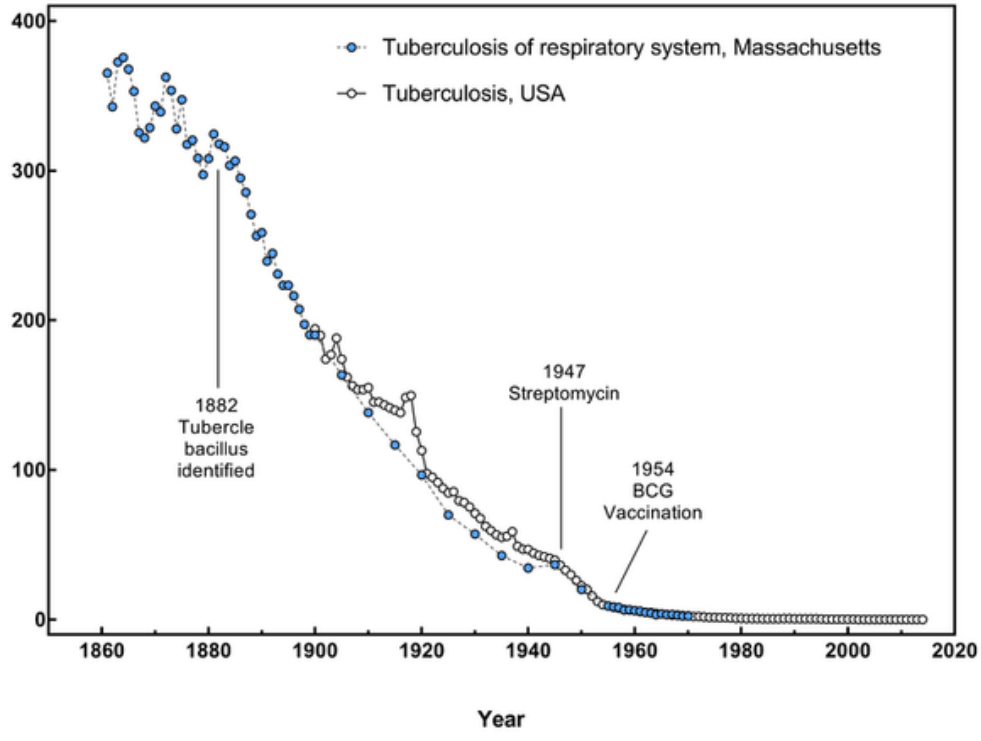


Figure 2–2 Tuberculosis mortality and medical interventions.
Source: Based on McKeown, Record, and Turner (1975).

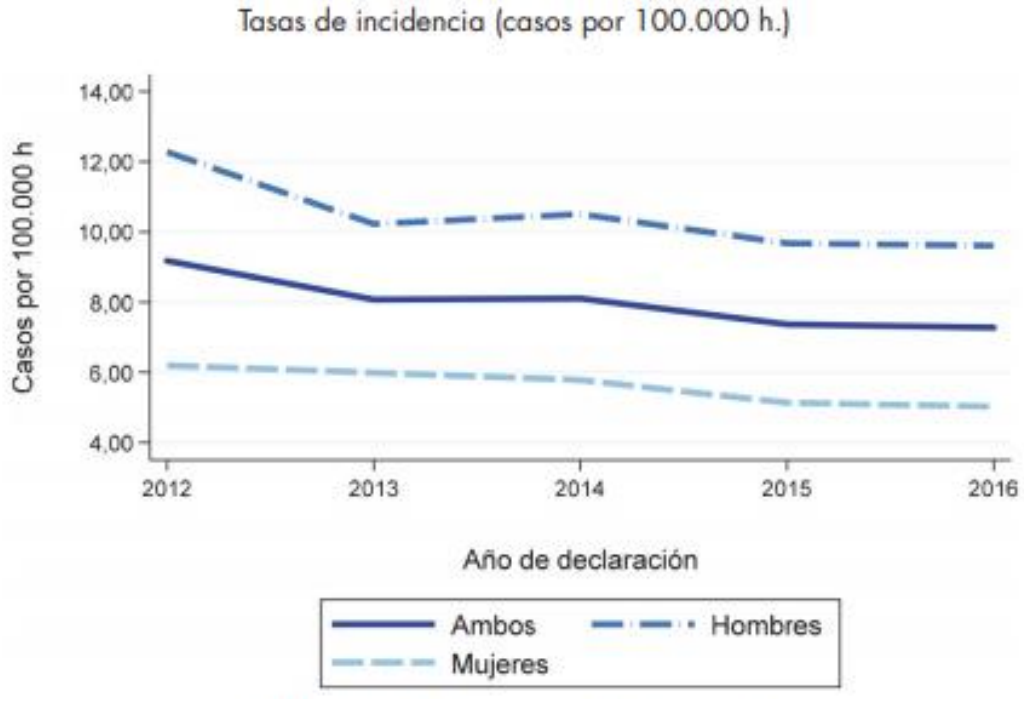


By Ljstalpers - Own work, CC BY-SA 4.0, https://commons.wikimedia.org/w/index.php?curid=54316893

Tuberculosis

TUBERCULOSIS IN SPAIN

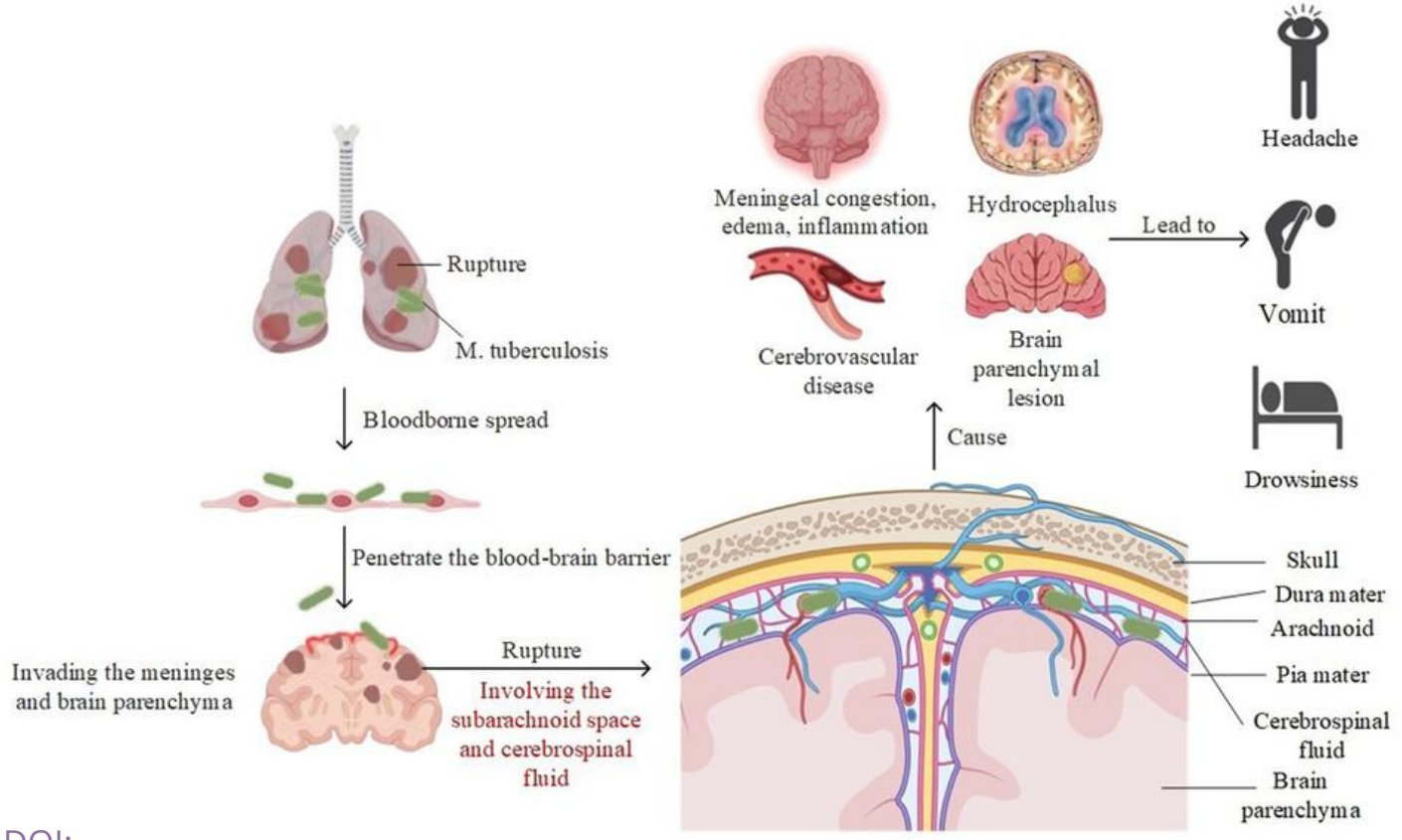
Pulmonary tuberculosis



Source: National Epidemiological Surveillance Network (RENAVE)

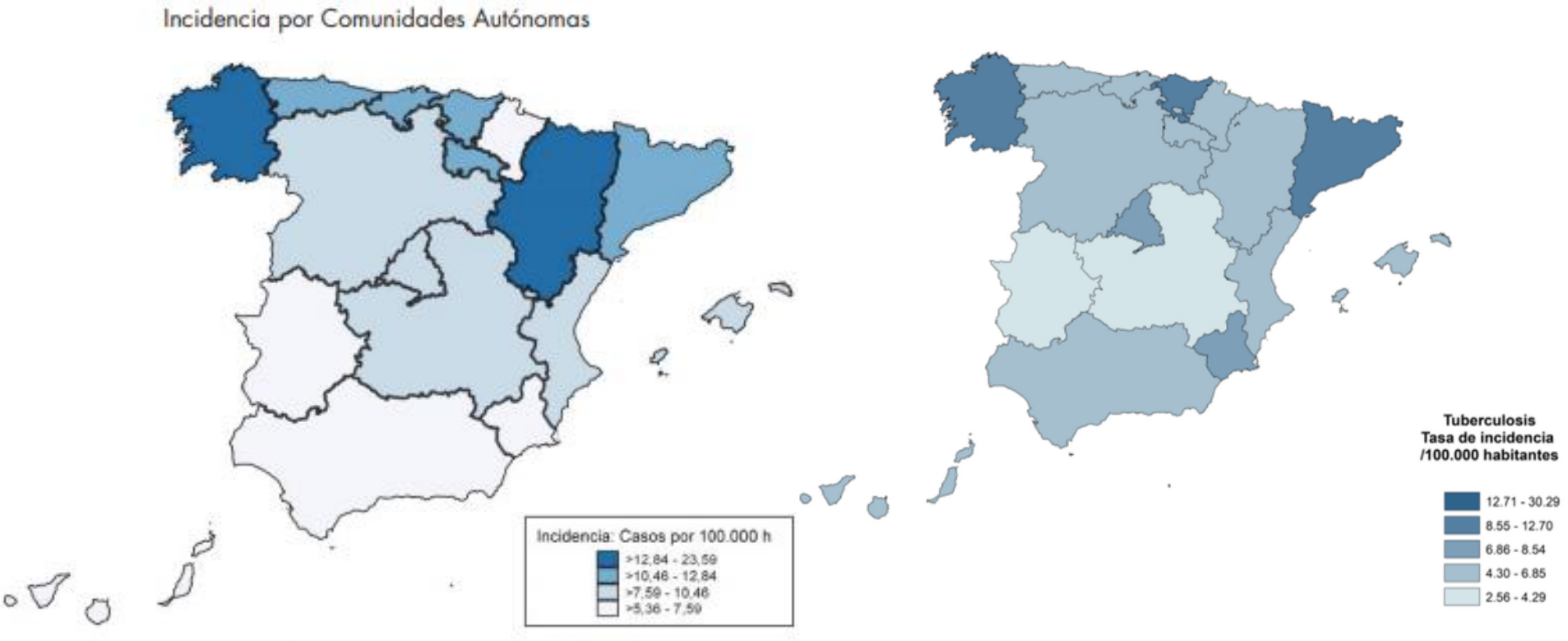
Tuberculosis meningitis

Sometimes the bacteria spread from the lungs to the brain and spine, causing **tuberculous meningitis** (though this is very rare).
Tuberculous meningitis appears in 1% of all tuberculosis patients and in 6% of those with some deficiency in the immune system.



DOI: 10.3389/fmicb.2023.1308149

Tuberculosis meningitis



201
6

202
2

Source: National Epidemiological Surveillance Network (RENAVE)

Mycobacterium tuberculosis

Mycobacterium tuberculosis is characterized by a slow rate of division.
Its growth depends on environmental conditions as it is sensitive to heat, sunlight and UV light.

The disease may cause periods of lethargy.

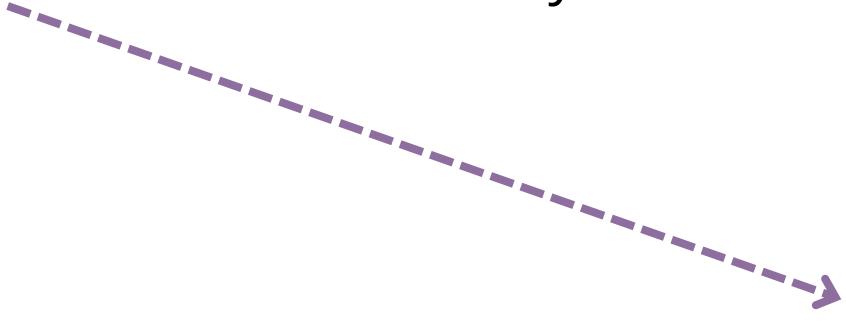
- *The most important reservoir* are infected human beings.
- *The source of infection* are infected human beings who develop the disease (healthy carriers are NOT a source of infection).

The most contagious patients are individuals

- with numerous bacillary forms in the sputum,*
- with an intense cough, and
- without respiratory isolation, mask protection, and treatment against tuberculosis during the first two weeks.

People at high risk of TB are individuals

1. who have recently been infected with TB, and
2. who have conditions that weaken the immune system.



***Sputum**, also known as phlegm, is a thick mucus produced in the lungs. It is different from saliva, as it contains cells and substances from the respiratory tract that help fight infections. Sputum is often collected for testing when a patient exhibits symptoms of respiratory infections, such as persistent cough, fever, or difficulty breathing.*

People at high risk of TB are individuals

1. who have recently been infected with TB, and

2. who have conditions that weaken the immune system.

- Individuals who have been in close contact with a person with infectious TB,
- those who have immigrated from regions of the world with high rates of TB,
- children < 5 years who have tested positive for TB,
- groups with high rates of TB transmission (the homeless, drug users who inject, individuals with HIV), and
- those who work or reside with anyone at high risk of becoming infected by TB in facilities or institutions such as hospitals, shelters, correctional centers, nursing homes, or residences for people with HIV.

People at high risk of TB are individuals

1. who have recently been infected with TB, and

2. **who have conditions that weaken the immune system.**

- individuals infected with HIV,
- those who engage in harmful substance abuse,
- those with silicosis,
- those with diabetes mellitus,
- those with severe kidney disease,
- those with a low body weight (IMC < 18 kg/m^2),
- those who have undergone an organ transplant,
- those with head or neck cancer,
- those undergoing certain medical treatments (e.g.. corticosteroids), and
- those receiving specialized treatments for rheumatoid arthritis or Crohn's disease.

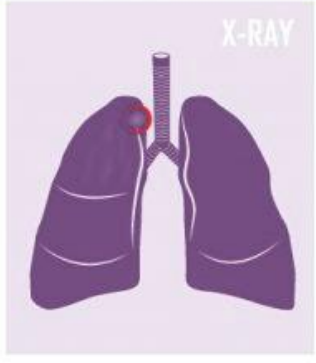
Factors that lead to tuberculosis endemia

- **HIV/AIDS:** HIV disables and destroys the cells responsible for anti-tuberculosis defense.
- **Multi-resistant tuberculosis:** when the bacteria are resistant to first-line anti-tuberculosis drugs (isoniazid and rifampicin).
- **Failure in tuberculosis control programs:** if cases are not cured or detected early, a high number of infectious cases may appear in the population.
- **Unfavorable socioeconomic conditions:** overcrowding and malnutrition, etc.
- **Population movements**

Tuberculosis

Vaccination

Medication



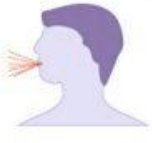
Mycobacterium tuberculosis

Chest pain

Signs and symptoms

Fever

Nights sweats

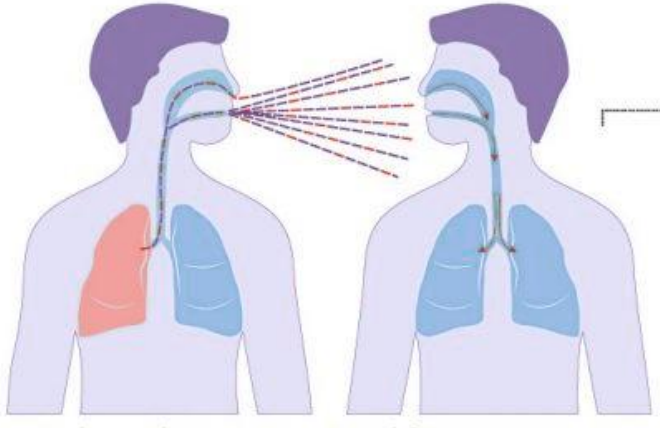


Cough

Weight loss

Loss of appetite

Fatigue



Tuberculosis transmitted from person via droplets from the lungs of people with active TB

Risk

HIV

Genetics

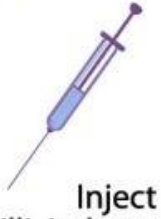
Smokers

Children

Elderly

Diabetes

Alcoholism



Inject illicit drugs

Control of Tuberculosis

1. Early detection and diagnosis

- Search for cases of tuberculosis.
- Diagnostic tests:
  - Tuberculin test (Mantoux). Skin test.
  - Interferon gamma release assay (IGRA). Blood test.

2. Treatment

- Association of drugs and correct administration for several months (to prevent resistance and avoid relapses)
- Directly Observed Treatment (DOT): for the homeless, prisoners, people who are multi-resistant, drug addicts, those with a history of abandoning treatment.

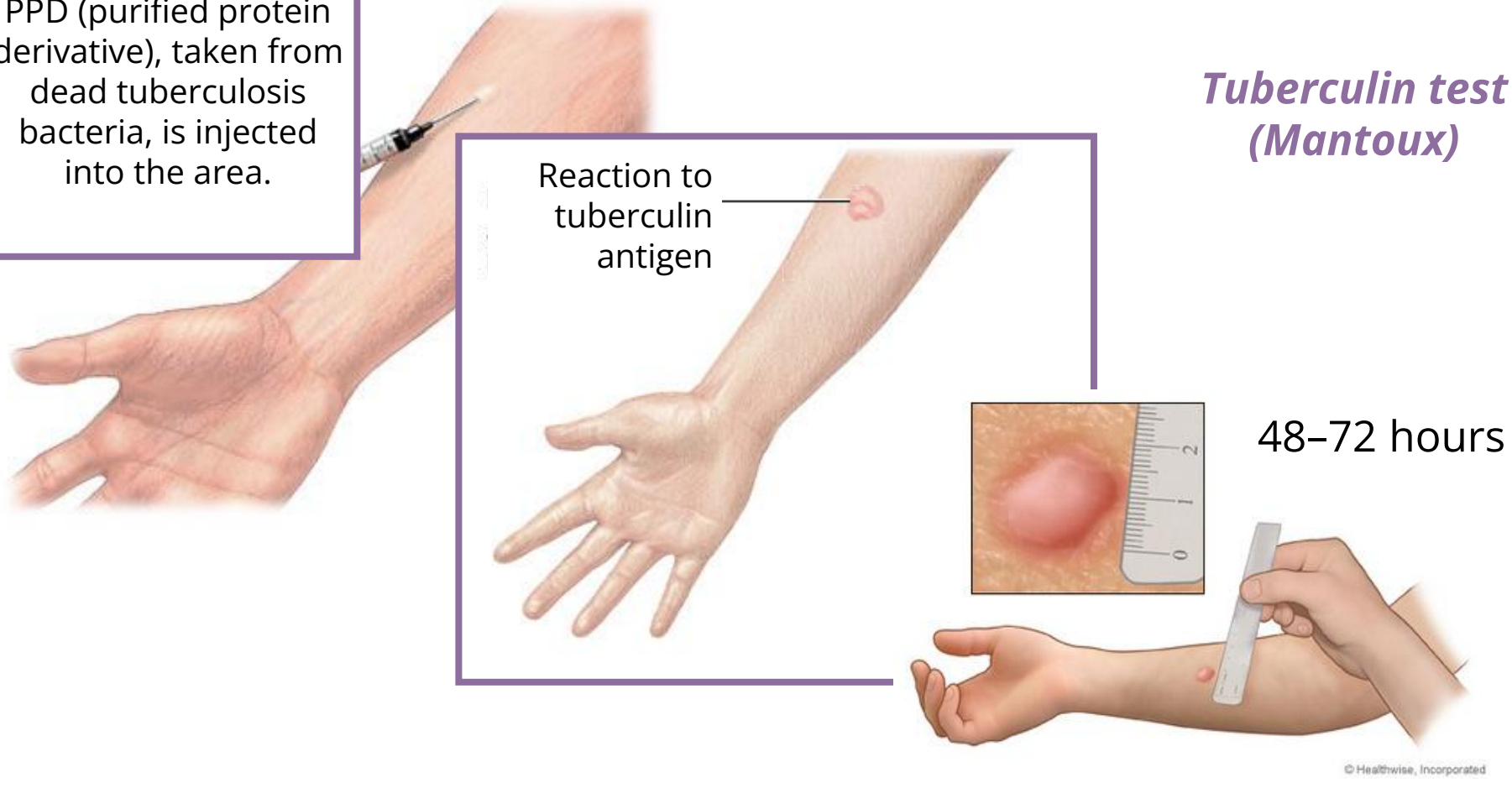
3. Surveillance

4. Study of contacts

- All cases diagnosed with TB, with priority given to cases of pulmonary TB with positive baciloscopy or positive sputum culture.

Control of Tuberculosis

PPD (purified protein derivative), taken from dead tuberculosis bacteria, is injected into the area.

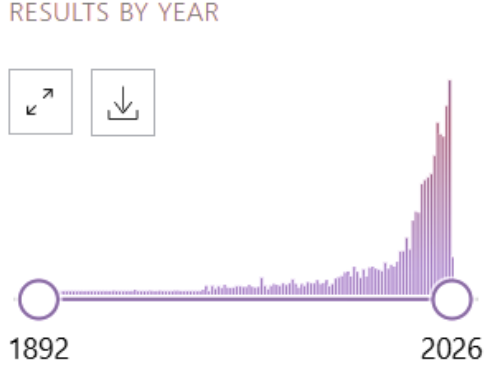


Tuberculin test (Mantoux)

48–72 hours

Tuberculosis and nutrition

Prolonged malnutrition exposes the body to easy invasion by infectious diseases; TB infection leads to or aggravates malnutrition.



(Tuberculosis) AND (nutrition)

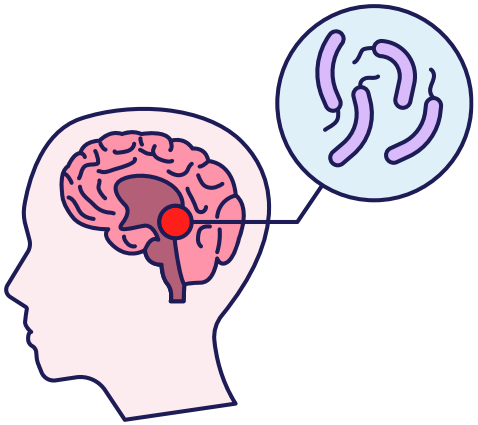
Malnutrition increases the **risk of developing active TB because undernutrition weakens immune defenses** needed to control *Mycobacterium tuberculosis*, making infection more likely to progress to disease (Jaganath & Mupere, 2012) (Sinha et al., 2018) (Gupta et al., 2009).

Children and people with severe acute malnutrition are **especially vulnerable**, with studies showing high TB prevalence among severely malnourished children and poorer outcomes without integrated care (Sathenahalli et al., 2015) (Vonasek et al., 2022).

Malnourished TB patients have **worse outcomes, including higher mortality, delayed recovery, and increased risk of treatment failure or relapse** (Seid & Ayele, 2020) (Xu et al., 2022) (Siraj et al., 2025).

TB can cause or worsen malnutrition through appetite loss, increased **energy needs, nutrient malabsorption, and chronic inflammation, leading to weight loss and wasting** (Gupta et al., 2009) (Padmapriyadarsini et al., 2016).

Block 5. Unit 32.

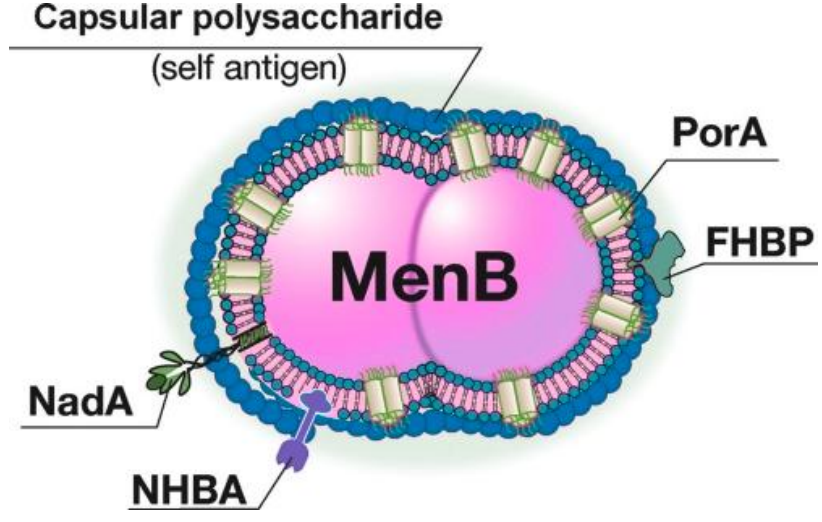


Second …
MENINGOCOCCAL DISEASE

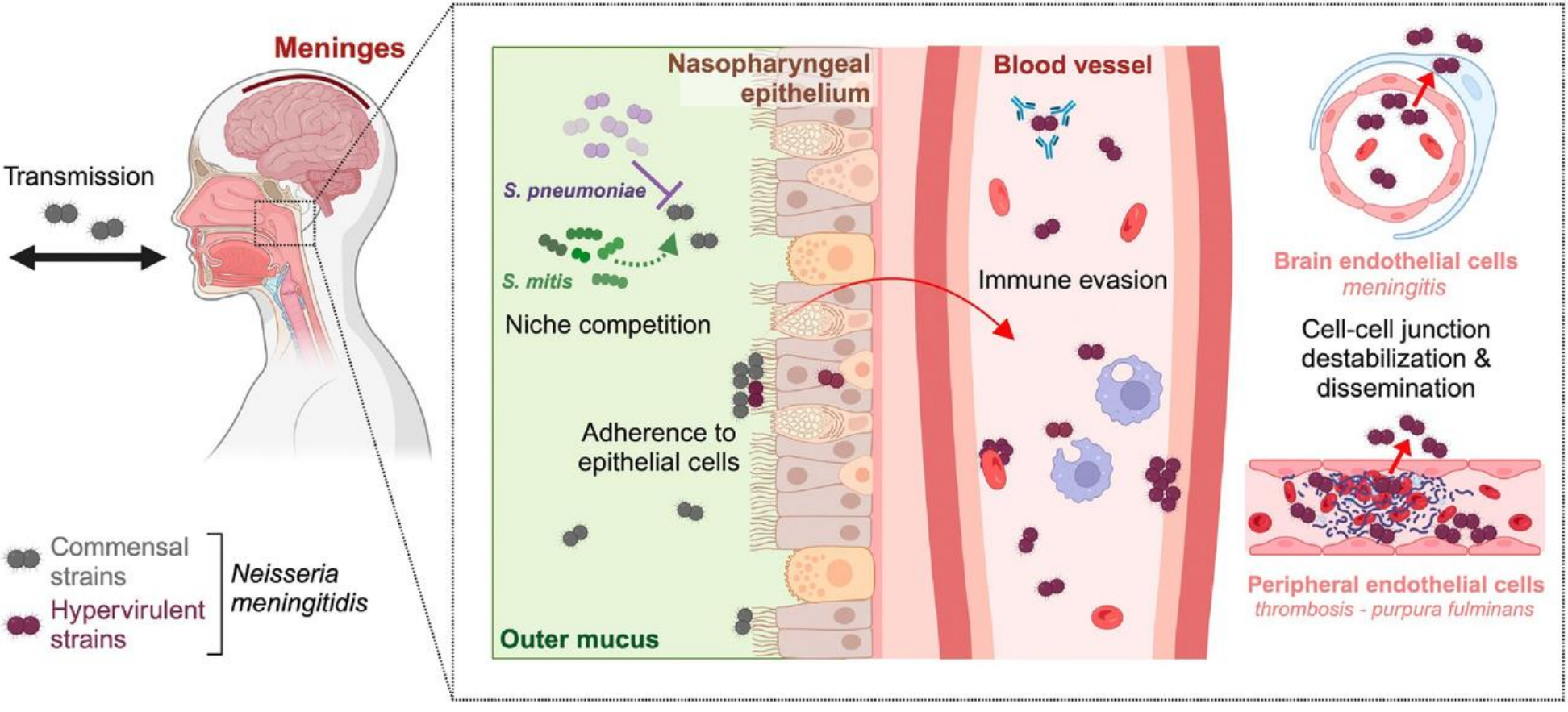
"Meningitis"

Meningococcal disease

- ***Neisseria meningitidis*** is a pathogen that lives in the rhinopharynx.
- It is extremely fragile outside the human organism.
- Serogroups: A, B, C, W and Y (B and C are the most frequent in Spain; A is the most frequent in Africa).
- **Clinical forms:**
  - Meningitis
  - Meningococcemia
  - Purpura Fulminans
  - Endotoxic shock
- **Transmission:** via droplets.



Meningococcal disease



DOI: 10.1016/j.tim.2025.01.001

Trends in Microbiology

Meningococcal disease

- Reservoir and source of infection: human beings

- **Carriers:** healthy individuals with the capacity to infect others.
  - Prevalence in the general population: <10%
  - Prevalence in children: <3%
  - Prevalence in adolescents and young adults: 30%

- **Factors associated with a higher prevalence of carriers:**
  - Overcrowding
  - Environmental exposure to tobacco smoke
  - Respiratory infections

Meningococcal disease

- Actions on the transmission mechanism:
  - Fomite washing
  - Ventilation
- Actions on the susceptible individual:
  - Chemoprophylaxis of close contacts (<24 hours from case onset).

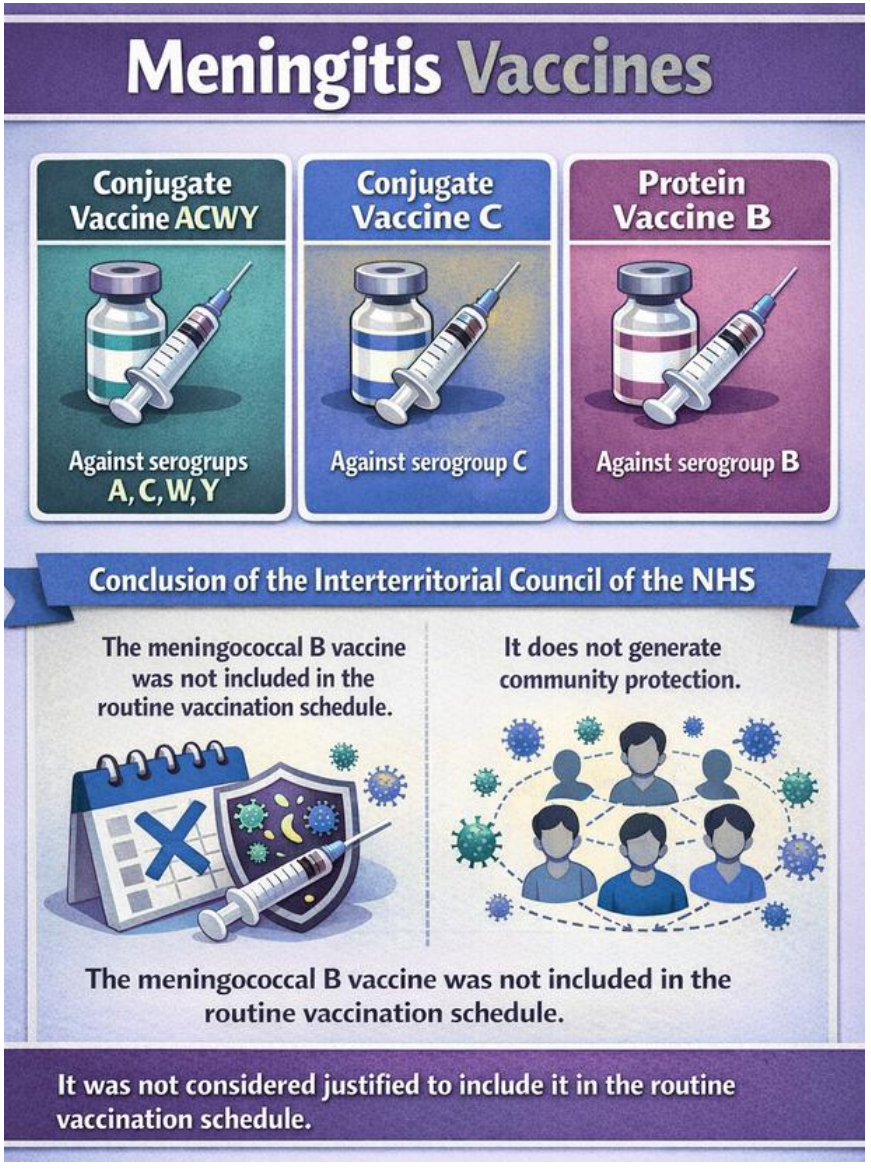
Outbreaks

- Outbreaks often cause social alarm.
- They can progress very quickly.
- Chemoprophylaxis is administered in a stepwise manner.
- Vaccination is recommended or updated.
- Closure of centers (schools, universities, etc.) is generally not necessary.
- Effective communication is required.

Three vaccines

1. Conjugate vaccine against **serogroups A, C, W, Y**
2. Conjugate vaccine against **serogroup C**
3. Protein vaccine against **serogroup B**

In the UK, the Interterritorial Council of the NHS concluded that including the meningococcal B vaccine in systematic vaccination schedules was not justified as it seems unable to generate community protection.



MenACWY Vaccine

- **Systematic** vaccination in the **adolescent population**: at 12 years of age, substitute MenC vaccination for the MenACWY vaccine. Duration of protection: at least up to 17–18 years.
- **Vaccination in children is not included at this time**. If a change in the trend of the disease is detected in childhood before community protection is established, including MenACWY vaccination in this population would be justified.

MenB Vaccine

- This vaccine is not included in the vaccination schedule.

Vaccination against meningococcal B and meningococcal serogroups A, C, W, and Y is recommended for the following **risk groups**:

- individuals with anatomical asplenia* or severe splenic dysfunction**
- those with complementary system deficiency,
- those with eculizumab (monoclonal Ab used in the treatment of paroxysmal nocturnal hemoglobinuria, hemolytic uremic syndrome and myasthenia gravis)
- those with HIV infection (ACWY vaccine).

*: ***Anatomical asplenia****: the absence of a spleen, usually due to surgical removal (splenectomy) or a congenital condition.*

****: Severe splenic dysfunction:*** *a condition in which the spleen is present but does not function properly, leading to reduced immune protection against certain infections.*

REMEMBER: The spleen stores, activates, and allows the proliferation of lymphocytes when it detects infections.

Block 5. Unit 32.

And finally for today: LEGIONELLA

A little history …

1976: An outbreak of pneumonia outbreak at a hotel in Philadelphia affected members of the American Legion celebrating their annual convention.

A total of 182 cases were recorded (with 34 deaths).

The causative bacterium was named *Legionella pneumophila.*

Outbreaks prior to 1957 have subsequently been identified.

Legionella = ambiental bacteria

Natural reservoir: surface waters (e.g., lakes, rivers, ponds), where it forms part of the bacterial flora.

Legionella is able to colonize urban **water supply systems** and be incorporated into **sanitary water systems** (hot or cold) and water-based installations (cooling towers, evaporative condensers, and ornamental fountains, etc.) .

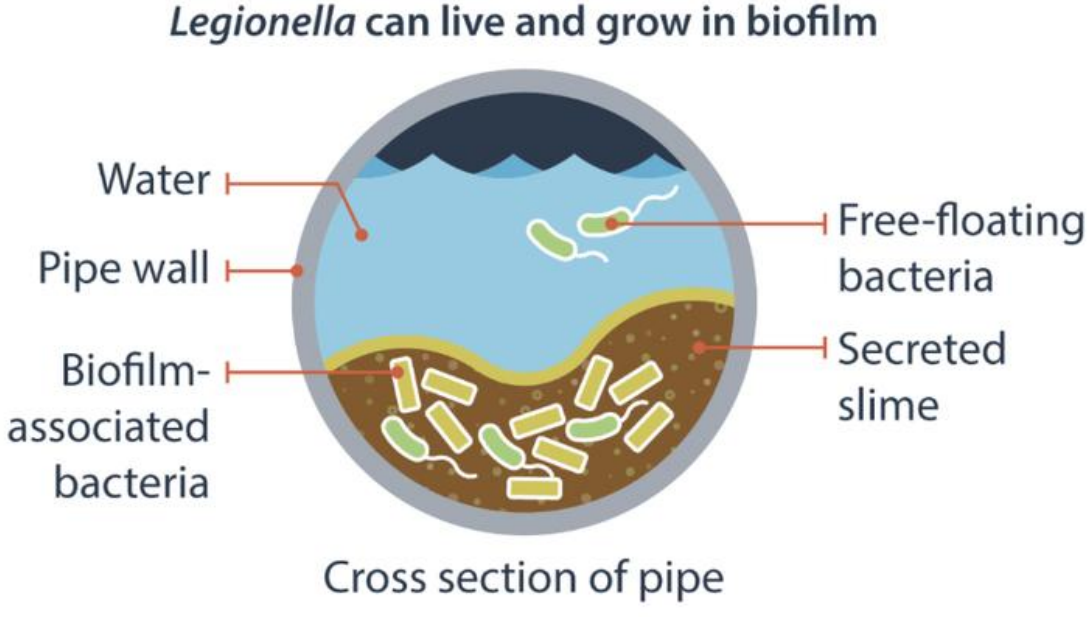
It has also been isolated in wetlands.

It has a worldwide distribution.

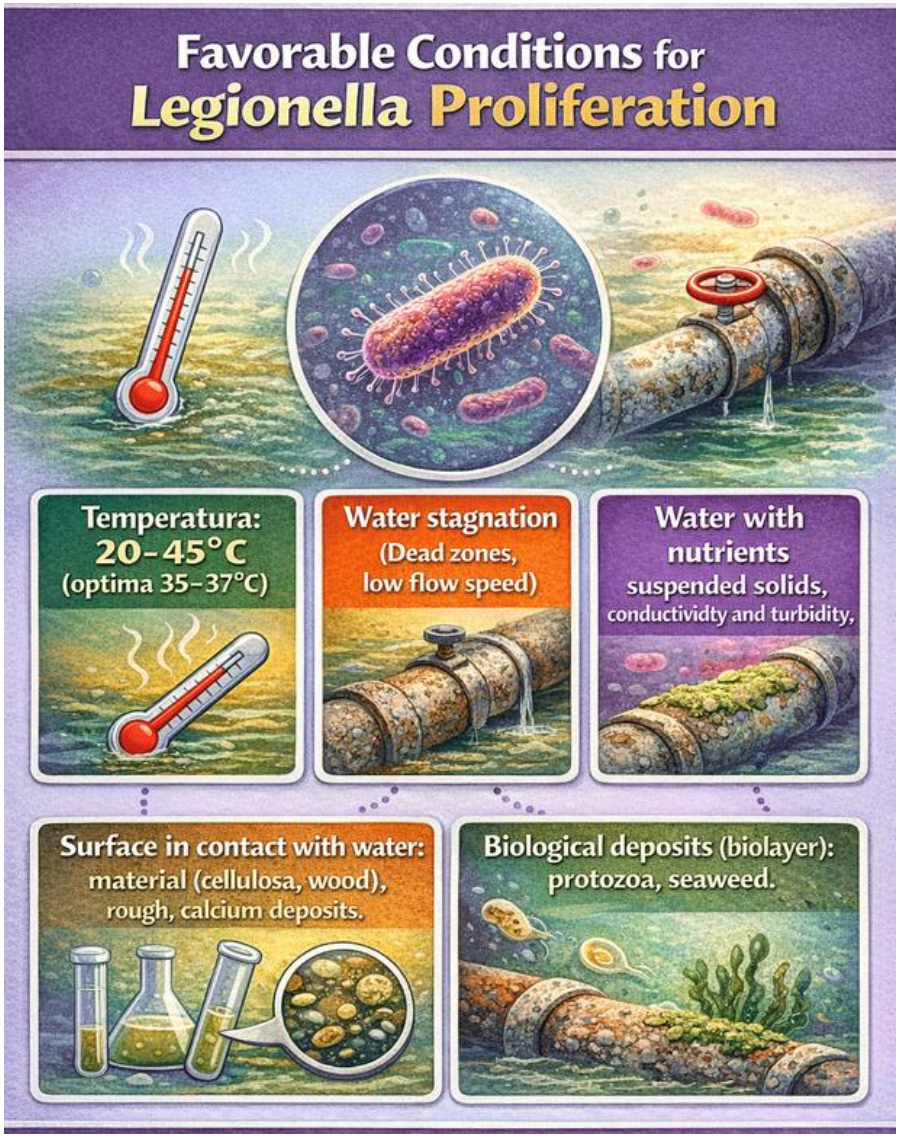
Legionella is able to survive in a wide range of physico-chemical conditions:

- it multiplies between 20ºC and 45ºC.
- it is destroyed at 70ºC.
- its optimal growth temperature is 35ºC–37ºC.

It multiplies inside various **free-living protozoa** (five genera of amoebas); in the free environment it is found as a component of complex *microbial biolayers*.



- **Temperature:** 20–45°C (optimal 35–37°C)
- **Water stagnation** (dead zones, low flow speed)
- **Water** with nutrients, suspended solids, conductivity and turbidity.
- **Surface in contact with water:** material (cellulose, wood), rough, calcium deposits, corrosion.
- **Biological deposits (biolayer):** protozoa, seaweed.



Transmission of Legionella

Airways: through the inhalation of **respirable aerosols or droplets** (less than 5 µm) containing *Legionella* and by microsuction of contaminated water.

The permanence of aerosols in the air is short (low resistance to desiccation and the effects of ultraviolet radiation).

Aerosols do not reach great distances (roughly 200m, though distances of up to 3 km and even 28 km have been recorded).

Conditions for infection

- The microorganism must have an entry way into the water supply facility.
- It must multiply in water until it reaches a sufficient number of microorganisms to be a risk to susceptible individuals.
- It must be able to disperse into the air as an aerosol from the system.
- Susceptible individuals should be exposed to aerosols with sufficient amounts of viable *Legionella pneumophila*.

Human infections

Clinical picture

Highly variable:

- Asymptomatic forms.
- Lung infection or pneumonia.
- Pontiac fever or acute self-limiting global syndrome.

- **Lethality:** < 5% (15–20% if adequate antibiotic treatment is not administered)

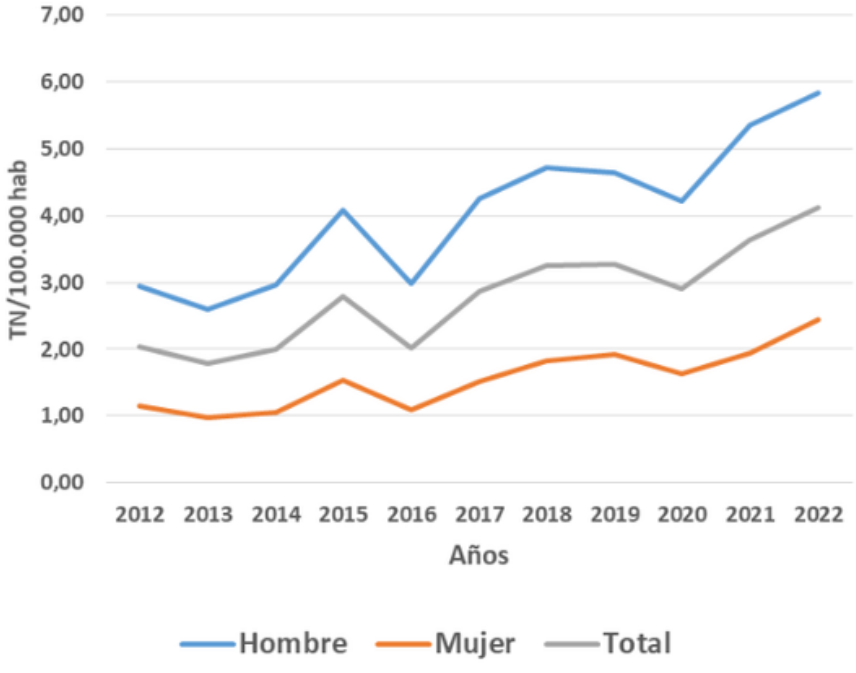
Diagnosis

- Isolation of the bacteria by **culture** of respiratory samples (sputum or bronchoscopy).
- **Serology** by indirect immunofluorescence (IIF).
- Detection in urine of **specific Ag** of *L. pneumophila* serogroup 1.
- **Direct immunofluorescence** (DIF).
- **PCR.**

Human infections

Legionellosis Surveillance, 2012-2022

Legionellosis notification rates per 100,000 inhabitants by year of symptoms onset and sex. Spain, 2012 to 2022.

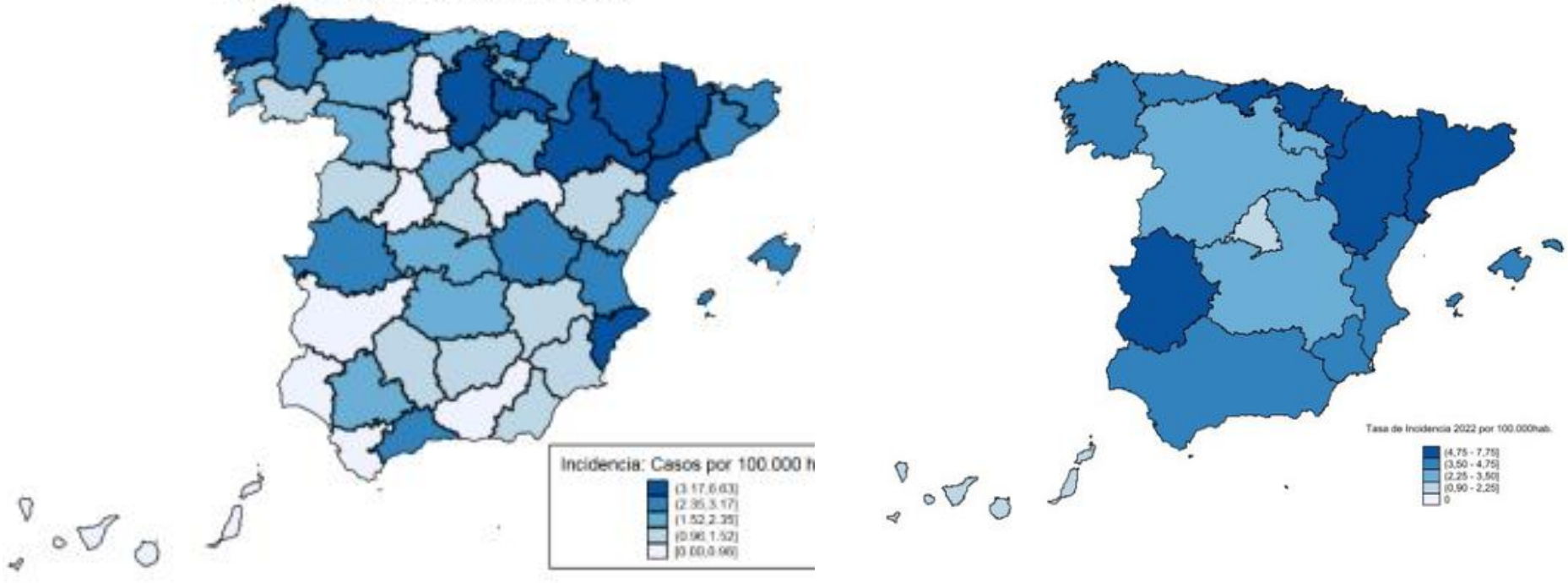


Source: National Epidemiological Surveillance Network (RENAVE)

Human infections

Legionellosis Surveillance, 2017 and 2022

Cumulative incidence by provinces



Source: National Epidemiological Surveillance Network (RENAVE)

Prevention and control of Legionella

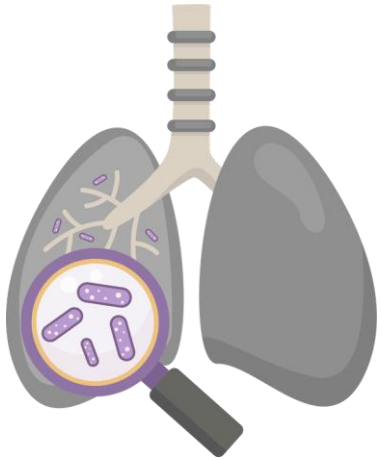
- Prevent *Legionella* from entering the facility.
- Prevent it from multiplying.
- Prevent aerosol from forming.
- Identify the infection and keep risk facilities under control.

U32. Summary Table

Haga clic en U32. Summary Table.pdf para ver el archivo.

https://aulavirtual.uv.es/mod/resource/view.php?id=3506789

Block 5. Unit 32.



TUBERCULOSIS, MENINGITIS AND LEGIONELLOSIS

Infectious diseases of bacterial origin

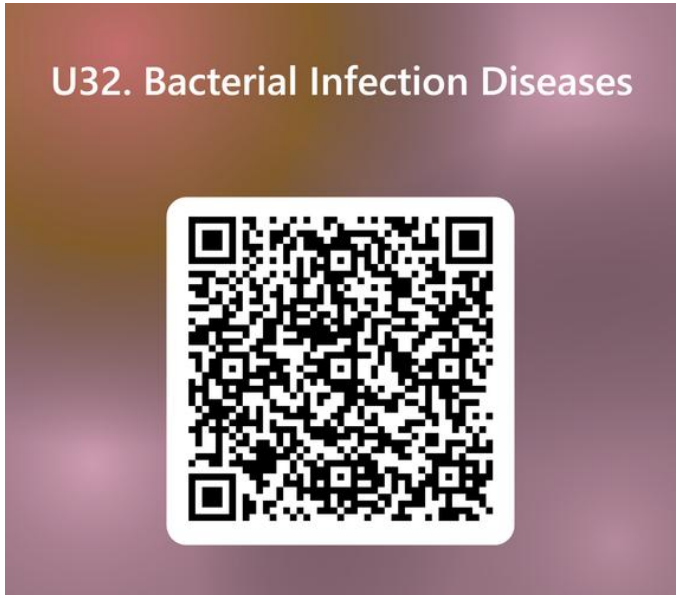
Maria Llena Meler (maria.llena@uv.es)

AECC PhD student, Autophagy and Onconutrition Lab, UV

Block 5. Unit 32.

TAKE A QUIZ

Infectious diseases of bacterial origin



Maria Llena Meler (maria.llena@uv.es)

AECC PhD student, Autophagy and Onconutrition Lab, UV