Classification

- Family: Alcaligenaceae
- Genus: Bordetella
- Species:
  - *Bordetella pertussis*
  - *Bordetella parapertussis*
  - *Bordetella bronchiseptica*

General characteristics

- Small Gram-negative coccobacilli
- Strict aerobes
- Non-motile(*B.bronchiseptica* is motile)
- Capsulated
- Non-spore forming
- Piliated
- Colonize the respiratory tracts of mammals.

Virulence factors

- **Adhesins**
  - Filamentous haemagglutinin(FHA)
  - Fimbriae
  - Pertactin
- **Toxins**
  - Pertussis toxin(Ptx)
  - Adenylate cyclase(CyaA)-haemolysin
  - Dermonecrotic toxin
  - Tracheal cytotoxin

Virulence factors

- **Secretion systems**
  - Type III secretion system
  - Type IV secretion system

Clinical implications

- *Bordetella pertussis*
  - Causes **whooping cough**
- *Bordetella parapertussis*
  - Causes a milder form of whooping cough
- *Bordetella bronchiseptica*
  - Causes infections ranging from lethal pneumonia to asymptomatic respiratory carriage

Bordetella pertussis

1st isolated by **Bordet** and **Gengou** in 1906

A **strict human pathogen** with no known animal or environmental reservoir

Colonizes the cilia

Causes **whooping cough**; a highly contagious, acute respiratory illness of humans

- a relatively mild disease in adults

Has a significant mortality rate in infants

Transmission of disease occurs via respiratory droplets

Pathogenesis

- *B.pertussis* infects its host by colonizing lung epithelial cells
- **FHA** binds to sulfatides on cilia
- Once anchored, bacterium produces **tracheal cytotoxin** which stops the cilia from beating
- Prevents body from clearing debris from the lungs→body responds by sending the body into a **coughing fit**

Whooping cough

- Incubation period: 7-10 days

A. <u>Classic illness</u>

- Primary infection in unimmunized children
- Lasts 6-12 weeks or longer
- Occurs in 3 stages
    1. Catarrhal stage
    2. Paroxysmal stage
    3. Convalescent stage

Whooping cough: Classical illness

1. **Catarrhal stage**
   - Rhinorrhoeae
   - Lacrimation
   - Mild cough
- Over a 7- to 14-day period, the cough worsens in both frequency and degree.
- Temperature is normal or occasionally mildly elevated

Whooping cough: Classical illness

2. Paroxysmal stage

- Onset during the second week of illness
- Repeated coughing fits with 5 to 10 or more forceful coughs during a single expiration (a **paroxysm**)
- At the end of a paroxysm, there is a massive inspiratory effort during which the **classic whoop** occurs
- The paroxysmal stage lasts for 2 to 8 weeks and sometimes longer.

Whooping cough: Classical illness

3. Convalescent stage

- usually lasts for 1 to 2 weeks

Complications:

- Encephalitis, bronchopneumonia, mental retardation

B. Mild illness and asymptomatic infection

- Previously vaccinated children and adults
- Adults who had previously had *B.pertussis* infections.
- Include rhinorrhea, tearing, sneezing,
- Conjunctivitis, fever, sore throat, or cough of <2 weeks' duration

Clinical manifestations: *B.parapertussis* and *B.bronchiseptica*

- *B.parapertussis* infection in humans
  - unrecognized infection,
  - mild pertussis
  - classic pertussis- milder than *B.pertussis*
- *B. bronchiseptica* causes respiratory infections in many different mammals

Laboratory diagnosis

- Clinical- paroxysmal cough followed by whoop
- **Specimen**:
  - Nasopharyngeal swabs and aspirates
  - Respiratory droplets on a cough plate
  - **Gram stain**: Small Gram-negative coccobacilli

Laboratory diagnosis

Culture:

*Growth media enriched with blood

1. **Regan-Lowe agar**(charcoal agar) supplemented with 10% horse blood and cephalexin
2. **Bordet-Gengou agar**

- Incubate at 35˚C - 37˚C in humid aerobic conditions
- Slow growth: 2-4 days
- Examine cultures daily for 7 days

Laboratory diagnosis

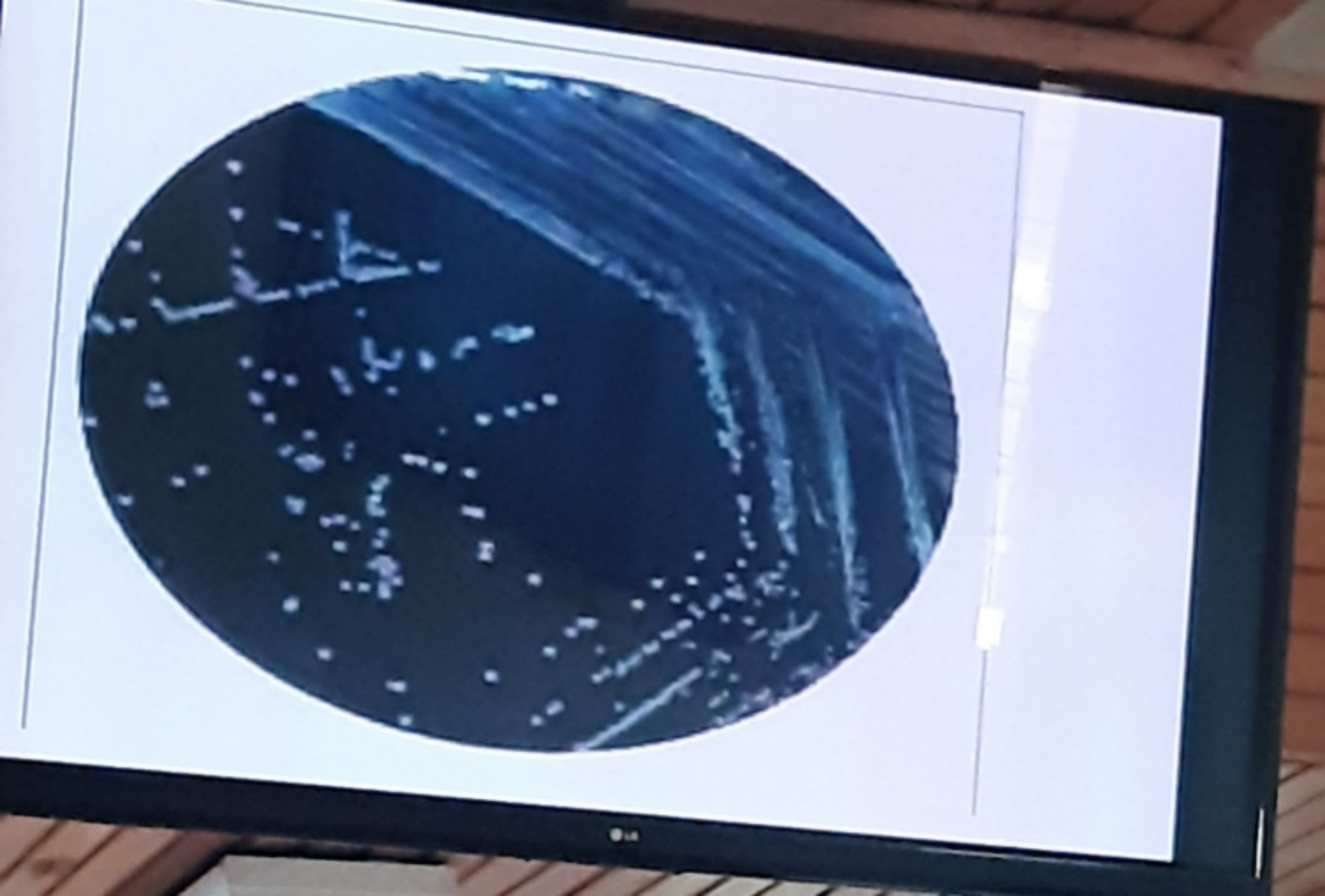
- Colonial morphology:
  - **Small pearly-grey, shiny(mercury-like), usually mucoid colonies.**
- *B.parapertussis* grows more rapidly and forms larger colonies than *B.pertussis*
- Biochemical tests

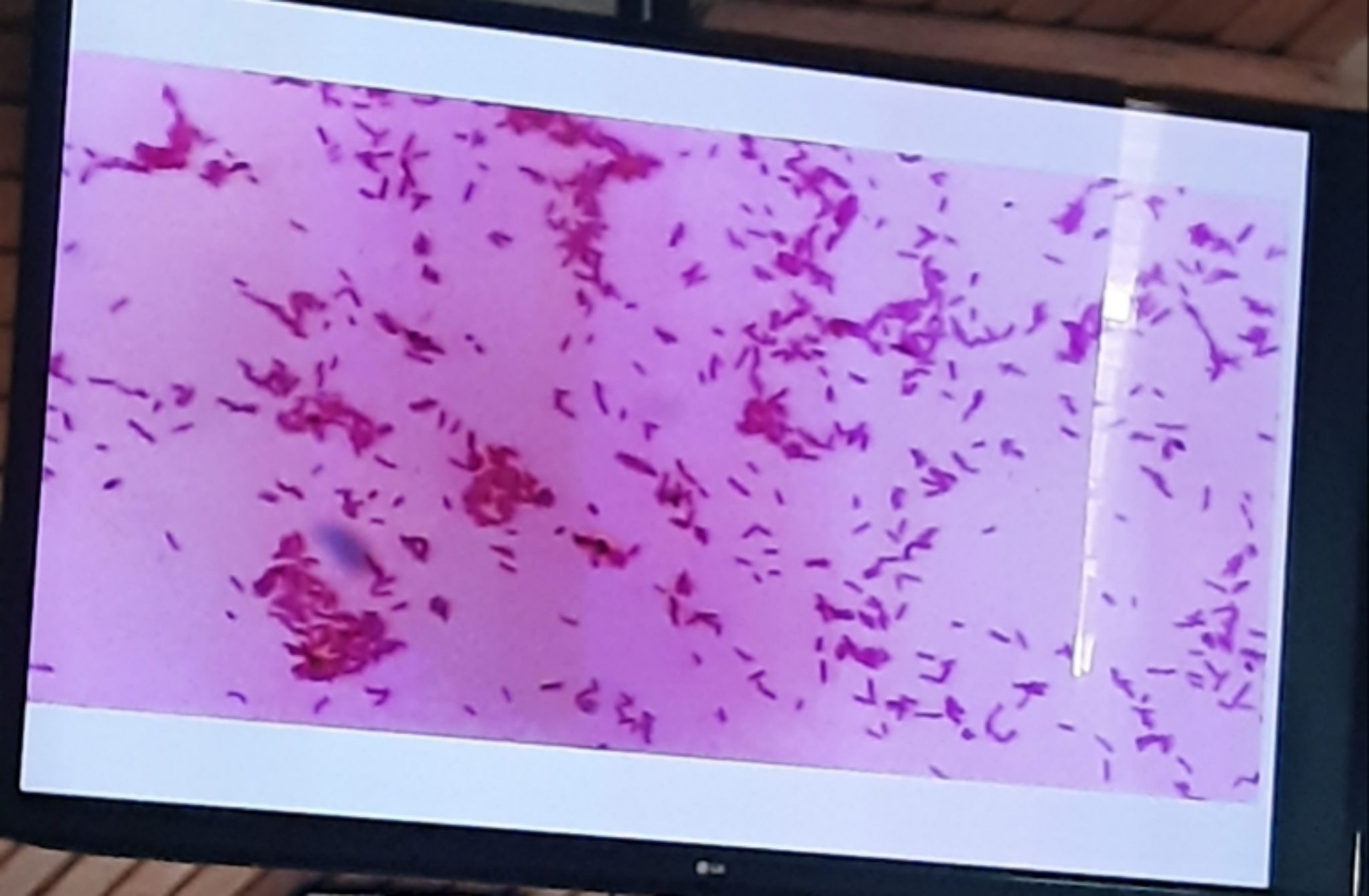
B.pertussis

- Urease negative, does not reduce nitrate, oxidase positive

B.parapertussis

- Urease positive(after 24 hours), oxidase negative





Laboratory diagnosis

- DFA(Direct Fluorescent antibody) test
  - Direct staining of nasopharyngeal secretions
  - can provide a rapid, presumptive diagnosis
  - low sensitivity and specificity
- ELISA
- PCR

Treatment and prevention

Treatment

- Azithromycin
- Erythromycin
- Chloramphenical
- Amoxycillin
- Ampicillin
- Kanamycin

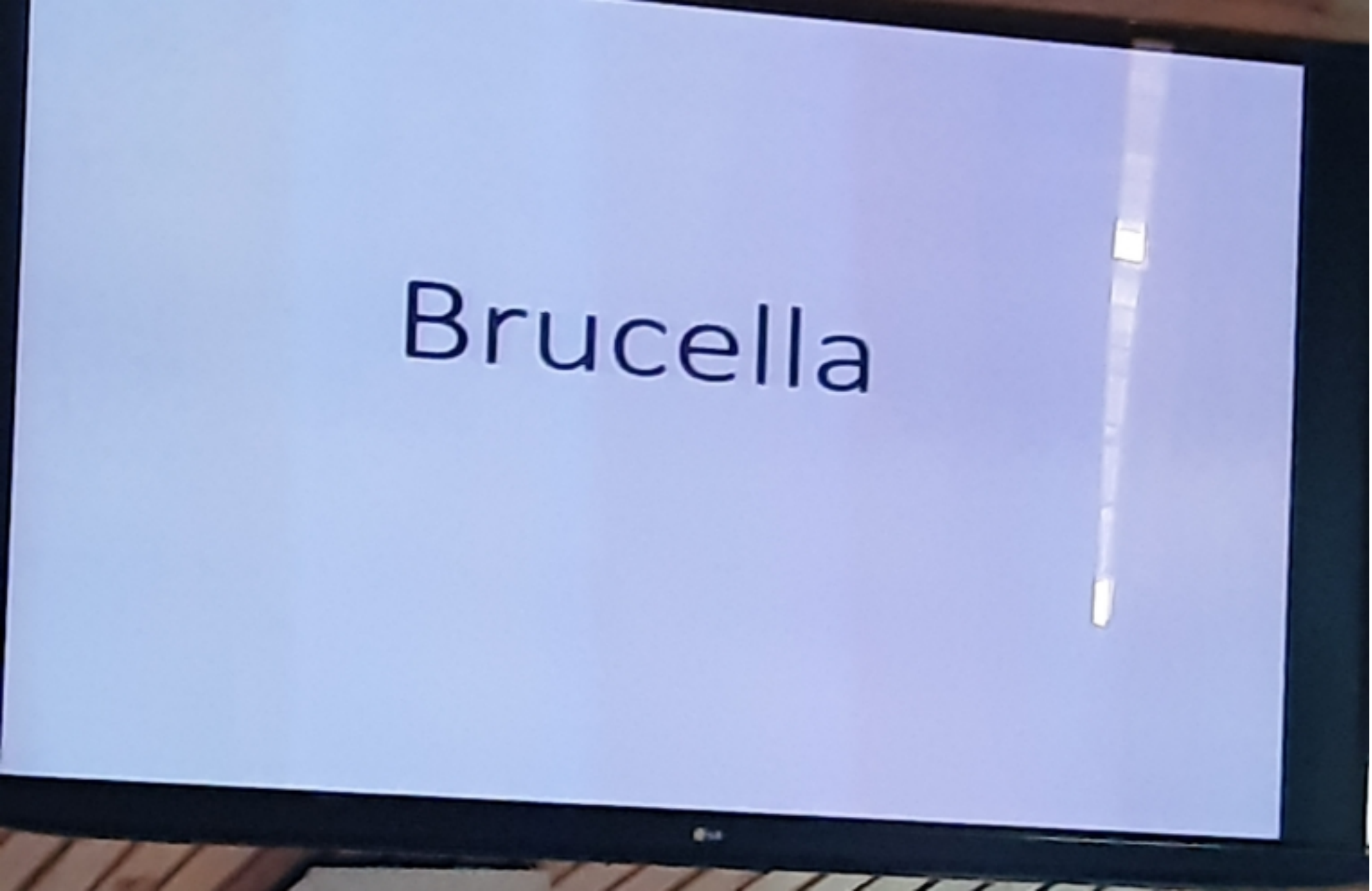
Prevention

- Early recognition and isolation of the patient to limit the spread
- Treatment
- Vaccination by pertussis vaccine

Pertussis vaccine

- 1st introduced in the late 1940s.
- Whole cell vaccine + diphtheria and tetanus toxoid (**DTwP**)
  - Significant reduction in cases
  - Side effects: high fever and febrile seizures
- Led to complete cessation in some countries: Japan, Sweden
- Pertussis outbreaks reported in unimmunized children.
- Acellular vaccines then developed (**DTaP**)
- DTaP replaced DTwP in developed countries
- Pertussis incidence is **rising** in countries aP vaccines have been introduced

Anti-Vaccine Movement Causes The Worst Whooping Cough Epidemic In 70 Years


Brucella

Classification

- Family: Brucellaceae
- Genus: Brucella
- Species
  - *B.melitensis*
  - *B.abortus*
  - *B.suis*
  - *B.ovis*
  - *B.neotomae*
  - *B.canis*
  - *B.ceti*
  - *B.pinnipedialis*
  - *B.microti*
  - *B.inopinata*

General Characteristics

- Pleomorphic Gram-negative bacilli(short or coccobacilli)
- Non-sporeforming
- Non-motile
- Non-capsulated
- Obligate aerobes
- Oxidase, catalase and urease positive.

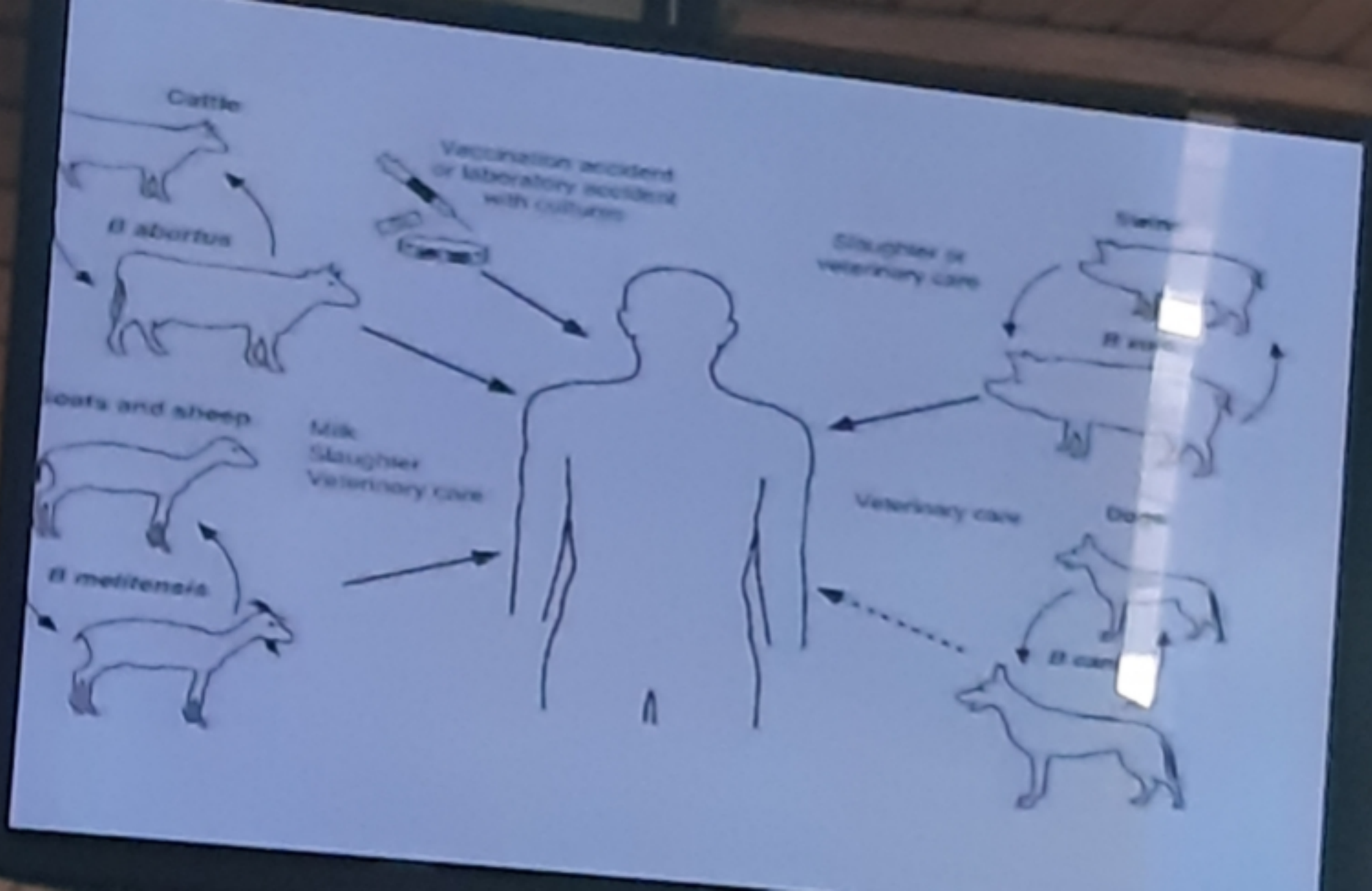
Epidemiology

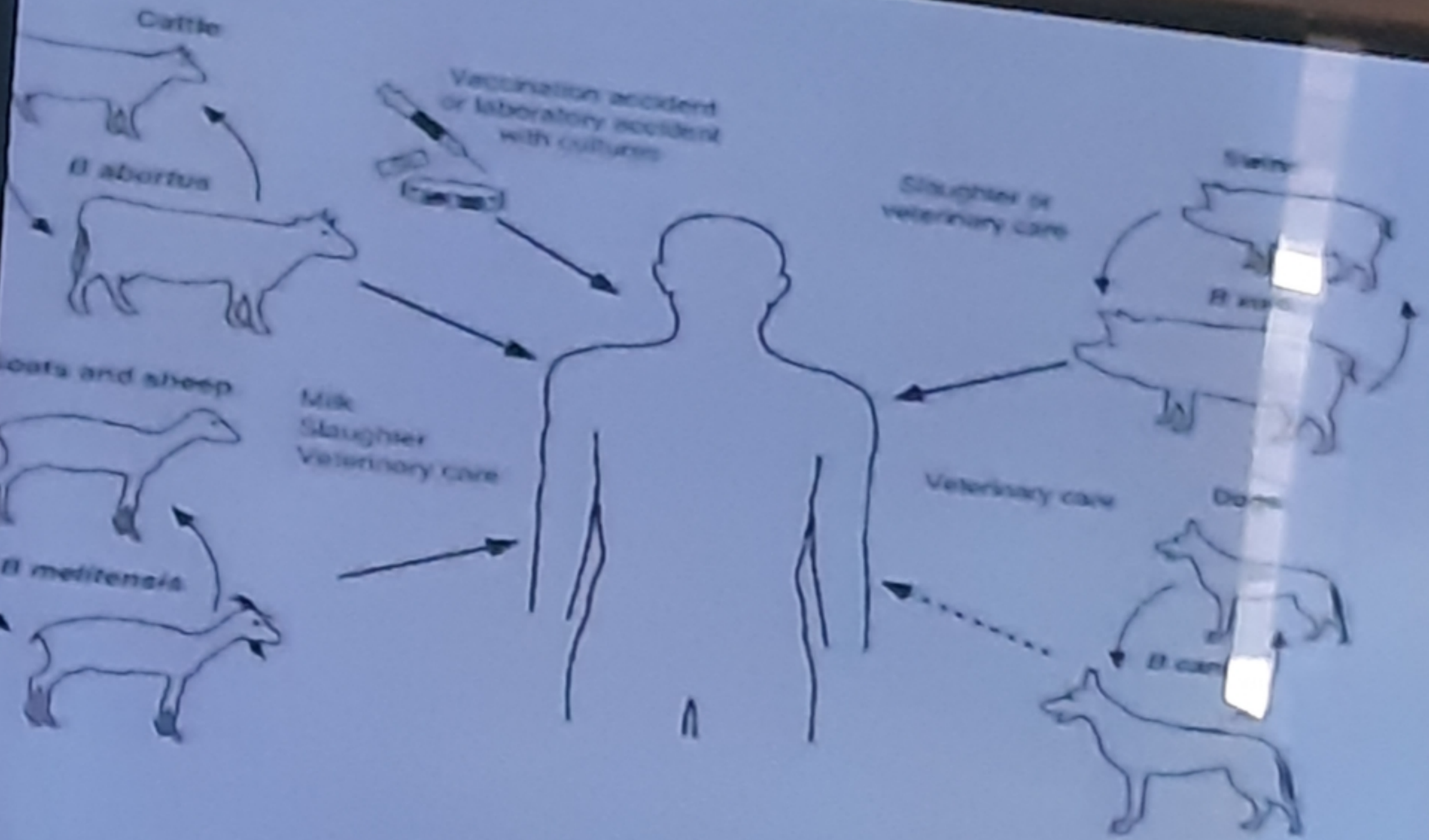
- Highly infectious species
- Cause infections in a wide variety of mammals
- **Zoonoses**
- Entry via:

1. Mucous membrane-droplets
2. Broken skin-Direct or indirect contact with infected animals
3. Ingestion

Epidemiology

- Ingestion relatively common compared to the rest
- *Brucella* species have a **low infectious dose** and are **capable of transmission via aerosols**
- *Brucella* is therefore classified as a potential **warfare threat agent**
- The *Brucella* species primarily considered to be pathogenic for humans:
  - ***B. melitensis***,
  - ***B. suis*** **(biovars 1, 3, and 4)**,
  - ***B. abortus***
  - *B. canis- sporadically*


Cattle
B abortus
Vaccination accident
or laboratory accident
with cultures
Slaughter or
veterinary care
Swine
B suis
Goats and sheep
Milk
Slaughter
Veterinary care
B melitensis
Veterinary care
Dogs
B canis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B melitensis
Veterinary care
Dogs
B canis

Pathogenesis

- **Facultative intracellular pathogen**
- Can survive and replicate in many types of host cells
- Prime targets= **macrophages**
- *Brucella* persist and replicate within phagocytic cells of the reticuloendothelial system
- Temporary fusion of the Brucella-containing vacuole(BCV) with the lysosome
- Subsequent exclusion of the lysosomal proteins

Pathogenesis

- *Brucella*-containing vacuole becomes associated with the endoplasmic reticulum(ER)
- Once inside this ER-associated compartment, the bacteria can establish chronic infection.

Clinical manifestations

Brucellosis or **undulant fever**

Manifestations vary in severity and signs and symptoms

A severely debilitating and disabling illness can result

Human brucellosis usually manifests as an

- **acute** (< 2 months)
- **subacute** (2-12 months) febrile illness
- **Chronic** (> 1 year) incapacitating disease with severe complications

Clinical manifestations

1. **Acute** illness
   - Fever, generalised malaise, headache, lymphadenopathy, hepatosplenomegaly
2. **Intermittent** waves of fever
3. **Chronic** illness with
   - possible internal organ damage

Complications

- Diverse depending on the specific site of infection
  - Osteoarticular (40%)
  - Genitourinary
  - gastrointestinal
  - nervous
  - cardiovascular
  - skin and mucous membranes
  - respiratory complications

Laboratory diagnosis

igh degree of clinical suspicion

listory of exposure to animals and exotic foods

ecimen:

- Blood or bone marrow(iliac crest)
- Infected tissue

rucellae are highly infectious (Hazard Risk Group 3
)

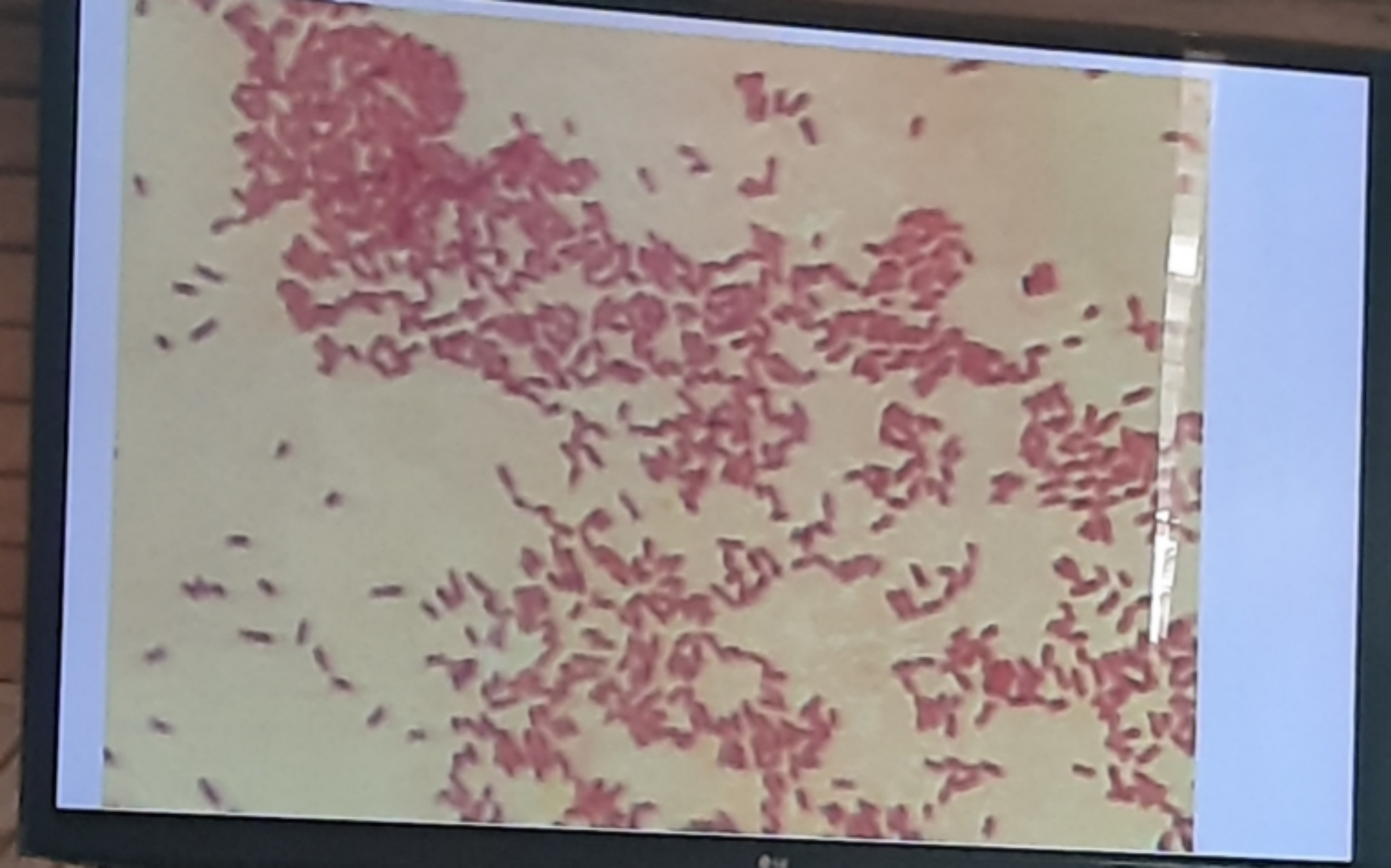
Laboratory diagnosis

Culture:

- Difficult to isolate.
- More likely to be isolated from the blood in acute brucellosis during times of fever
- Culture medium:
  - Tryptone soya(tryptic soy) diphasic medium=Castenada
- Aerobic(*_B.abortus_* requires a CO_2 enriched atmosphere)

Laboratory diagnosis

- 20-40˚C(optimum 37˚C)
- Cultures should be kept for 4 weeks
- Colonial morphology:
  - A variety of colonial forms: smooth, mucoid, rough
  - Colourless or grey



Laboratory diagnosis

erology

- Demonstration of IgM, IgG and IgA
  1. ELISA
  2. Standard tube agglutination test
  3. Modified tube agglutination test
  4. Brucellin skin test

Cross –reactions Gram-negative bacteria e.g. *V.cholerae, F.tularensis, Y.enterocolitica, E.coli, Salmonella* serovars

Molecular diagnosis

- PCR

Treatment, Prevention and Control

Treatment

- **Doxycycline** for 6/52 in combination with **Streptomycin** for 2-3 weeks or **Rifampin** for 6/52
- **Prevention and Control**
- Control of disease in animal hosts
- Effective heat treatment of dairy produce
- Hygienic precautions to prevent occupational exposure