



Standard Treatment Guidelines (STG) for Large Animal, Bangladesh

*A guideline for the prevention, control and treatment
of important bacterial, mycoplasmal, rickettsial and
protozoal diseases in large animals*

First Edition, 2025

Department of Livestock Service (DLS)
Ministry of Fisheries and Livestock (MoFL), Bangladesh





Standard Treatment Guidelines (STG) for Large Animal, Bangladesh

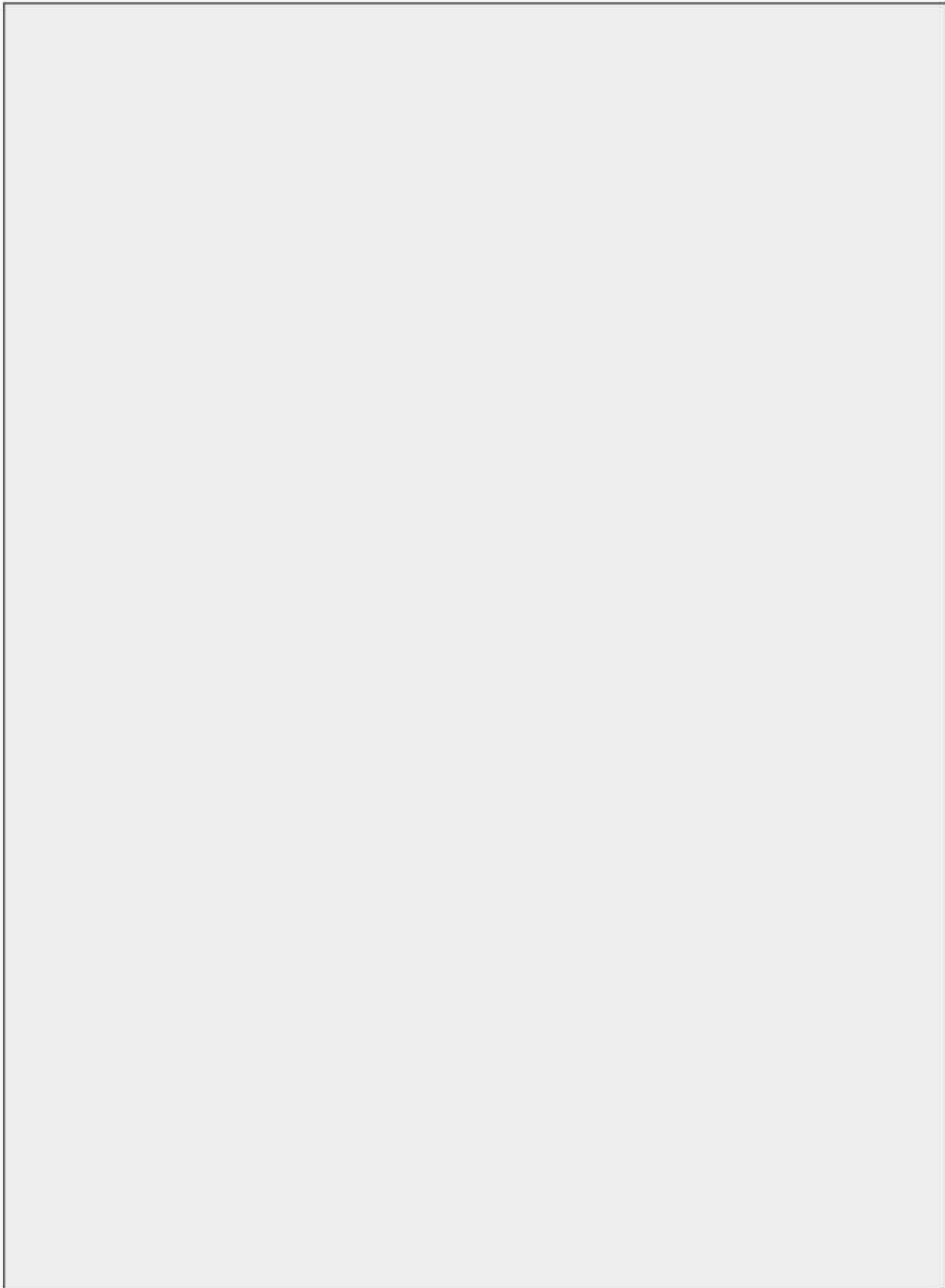
*A guideline for the prevention, control and treatment
of important bacterial, mycoplasmal, rickettsial and
protozoal diseases in large animals*

First Edition, 2025

Department of Livestock Service (DLS)
Ministry of Fisheries and Livestock (MoFL), Bangladesh



The
Fleming
Fund





Director General,

Department of Livestock Services (DLS),
Krishi Khamar Sarak, Farmgate, Dhaka
Bangladesh

MESSAGE

Antimicrobial resistance (AMR) is a silent threat to humans, animals, plants and the environment. Scientists considering it as another pandemic after COVID-19 and will affects us all. To curb it effectively, all sectors must work together and to encourage the prudent use of antimicrobials, with a focus on preventive measures. Strengthening biosecurity in animal farms and food industry premises, ensuring access to quality vaccines, clean water, sanitation and hygiene, implementing best practices in food and agriculture production including marketing systems, and ensuring the proper waste management in animal farms are crucial to reducing the need for antimicrobial usage (AMU) and minimizing the emergence and transmission of AMR.

I am proud to share that Bangladesh is a pioneer country where One Health (OH) in action on AMR and AMU is evident. The DLS, DoF, DGHS, DGDA with the Technical Assistance Services (TAS) from the FAO and WHO have been working together since the last 6 years to carry out activities under the National AMR Containment Plan. A Standard Treatment Guidelines (STG) on antibiotic use on important infectious diseases of Bangladesh has been formulated by the Communicable Disease Control (CDC), Directorate General of Health Services, Ministry of Health and Family Welfare. The Department of Livestock Services (DLS) has been working with the FAO and the Bangladesh AMR Response Alliance (BARA) and endorsed the **“Standard Treatment Guidelines (STG) for Poultry, Bangladesh”** in 2022. Then as a continuation of achieving the target of NAP for ARC, it was mandatory to develop **“Standard Treatment Guidelines (STG) for large animals”**. Accordingly, during the 6th sectoral working group meeting for animal health at the DLS conference room, it was decided that FAO would support DLS to develop the STGs for large animals.

Hence, I appreciate and thank to the members of the national review committee consisting of government (DLS) and private sector subject matter experts, International contributors, FAO Country Team Leader and his team working on AMR and the BARA members for contributing in the **“Standard Treatment Guidelines (STG) for large animals”**. The DLS is again acknowledging the generous financial support from USAID and Fleming Fund UK on AMR and AMU in Bangladesh.

I do strongly believe that this book will be a guiding document for the large animal practitioners of the country for safe and sustainable production of food of poultry-origin and a reduced risk of developing AMR.

I feel proud to be a part of this document and wish for its wide circulation.

Dr. Md. Abu Sufiun

Director General

PREAMBLE

These guidelines have been prepared through several processes and technical consultative workshops among DLS, DGHS, FAO and WHO.

The FAO organized a One Health AMU guideline development workshop on 13-14 August 2017 in collaboration with the Department of Livestock Services (DLS) and Communicable Disease Control (CDC), Directorate General of Health Services (DGHS). Collectively, the five participating microbiology laboratories shared culture and sensitivity results from over 10,500 recent clinical samples to a common database. Using a tool (algorithm for guiding antimicrobial usage in veterinary medicine) an antibiogram was developed. Antibiotics were then evaluated by the overall likelihood of sensitivity pattern to the pathogens captured in each body system based on the culture and sensitivity test results.

In parallel, a group of veterinarians specializing in poultry medicine and AMR, extracted data from published articles on AMR in poultry in Bangladesh to determine the status of resistance against common poultry pathogens, and reviewed the literature of recommended treatment guidelines for important bacterial infections in poultry. They also prioritized 10 important bacterial poultry diseases. The information generated was then further tailored by an international FAO poultry health expert to develop the draft AMU guidelines for poultry treatment which was also reviewed by the FAO HQ experts.

Then, two consecutive workshops were conducted to finalize the One Health AMU guidelines for both human medicine and poultry medicine. The workshop was held on 20-21 January 2018 with leading human health clinical practitioners and microbiologists, an infectious disease clinical specialist from WHO HQ, and facilitation from FAO Bangladesh. The first workshop on 20 January 2018 resulted in a finalization of AMU guidelines (BARA "Manush") for common human infections modeled on the AWaRe-based usage guidelines developed under the WHO Essential Medicines List programme as well as a harmonized SOPs for conducting culture and sensitivity testing and reporting results at microbiology laboratories. On the next day, FAO with the poultry veterinarians from both public and private sectors finalized the poultry AMU guidelines (BARA "Murgi") for Bangladesh. The two AMU guidelines were prepared by the BARA community and served as the basis for subsequent training and outreach.

After COVID-19 pandemics, one National Technical Advisor-Antimicrobial stewardship was recruited. He collected recent local AST data from different public and private microbiology labs from all over Bangladesh, and AST data from some big poultry entrepreneurs including other research projects. Based on these data, finally two antibiograms; one for human health and other for poultry were updated to forge revision of BARA AMU guidelines. Accordingly, BARA AMU

guidelines (BARA “Murgi” and “Manush”) were revised via a technical consultative workshop held on 29-30 August 2022.

During the last AMR multisectoral livestock meeting, it was decided that the DLS will form a committee to review the updated BARA “Murgi”. In collaboration with the FAO, the committee reviewed and then recommended it to be endorsed by the DLS. Finally, the “**Standard Treatment Guidelines (STG) for poultry, Bangladesh**” has been endorsed.

Then as a continuation of achieving the target of NAP for ARC, it was mandatory to develop “Standard Treatment Guidelines (STG) for large animals”. Accordingly, during the 6th sectoral working group meeting for animal health at the DLS conference room, it was decided that FAO would support DLS to develop the “Standard Treatment Guidelines (STG) for large animals”. In response to that decision, a small technical working group was formed by the nominated DLS officials by DG DLS, large animal experts & practitioners from the private sector and few foreign experts. There were three meetings held on 14, 15 and 22 December 2022 at FAO ECTAD conference room to make the first draft of the guidelines. Then another technical consultative workshop was held on 25 January 2023 with a larger group of experts from DLS and other stakeholders in Dhaka. All the experts reviewed the document disease by disease via panel discussions and notes were taken.

After incorporating all the feedback noted during the technical consultative workshop FAO then shared a google document to all the stakeholders involved in the above-mentioned process and addressed their final inputs.

In collaboration with the FAO, the joint DLS and private sector committee initially reviewed and recommended it to be endorsed by the DLS. Finally, the “**Standard Treatment Guidelines (STG) for large animals**” has been endorsed.

This is a living document that will be updated from time to time based on user’s feedback, recent antibiograms and other necessities. Therefore, the STG should be oriented to the practitioners via workshop/training.

ACKNOWLEDGEMENTS

The Department of Livestock Services (DLS) greatly appreciate the technical support services (TAS) of the Food and Agriculture Organization (FAO) of the United Nations, Bangladesh AMR Response Alliance (BARA) and the private sector large animal experts during the development of the Standard Treatment Guidelines (STG) for large animal. The DLS expresses gratitude to the Fleming Fund and USAID for the financial support. It is anticipated that the guidelines will be very useful as tools for veterinary professionals towards prudent use of antibiotics in large animal practice.

We would like to give special thanks to Dr. Eric Brum, Country Team Leader, FAO ECTAD for technical overview, Dr. Md. Habibur Rahman, National Technical Advisor-One Health Training and Outreach, Dr. Taifur Rahman, National Technical Advisor-Epidemiology, and Rahman Khan, Senior IT Associate, FAO Bangladesh for both technical and editorial support in the document. It is also mentioned that FAO will print these guidelines for the veterinary prescribers of the country and the DLS offices as a reference copy.

The DLS also wishes to acknowledge the members of the National Review Committee consisting of government (DLS) and private sector subject matter experts from country and abroad for their valuable inputs and guidance to the document.

Table-1: National Review Committee (Not according to seniority; as per formed committee in 2023)

Sl #	Name	Designation
1	Dr. Md. Reajul Huq	Director (Administration), DLS-HQ, Dhaka
2	Dr. Malay Kumar Sur	Director (Planning), DLS-HQ, Dhaka
3	Dr. Md. Abu Sufian	Director, Accounts, Budget and Audit, DLS-HQ, Dhaka
4	Dr. Md. Shahinur Alam	Director, Extension, DLS-HQ, Dhaka
5	Dr. Md. Rejaul Karim	Director (in-charge), CVH, DLS
6	Dr. Pallab Kumar Dutta	Deputy Director (HRD), DLS-HQ, Dhaka
7	Dr. TABM Muzaffar Goni Osmani	Deputy Director, Epidemiology Unit, DLS-HQ, Dhaka
8	Dr. Md. Nazmul Haque	Deputy Director (Animal health), DLS-HQ, Dhaka
9	Dr. Md. Nurul Alam	District Livestock Officer, DLO Office, Barishal
10	Dr. Md. Nure Alam	Upazila Livestock Officer, Nasirnagar, Brahmanbaria
11	Dr. Faisal Talukdar	Upazila Livestock Officer (LR), Epidemiology Unit, DLS-HQ, Dhaka
12	Dr. Layla Yasmin	Upazila Livestock Officer, Netrokona sadar

SI #	Name	Designation
13	Dr. Mohammad Golam Morshed	Upazila Livestock Officer (ULO), Dhanbari, Tangail
14	Dr. Shormin Akter	Veterinary Surgeon (VS), Kotowali, Chattogram
15	Dr. Md. Ibrahim Khalil	Scientific Officer, Field Disease Investigation Laboratory (FDIL), Barishal
16	Dr. Farhad Hossain	Dairy consultant and former Director, CVH, DLS
17	Dr. Maqsubul Hassan Howlader	Chief veterinary consultant, LD veterinary hospital Uttara, Dhaka and former Chief Veterinary Officer, CVH, DLS
10	Dr. Md. Mizanur Rahman	Professor, Department of Medicine and Surgery, Faculty of Veterinary Medicine, Chattogram Veterinary and Animal Sciences University and Coordinator of Udder Health Bangladesh, Chattogram
19	Dr. Md Ridoan Pasha	Assistant Professor, Department of Physiology, Biochemistry and Pharmacology, Faculty of Veterinary Medicine, Chattogram Veterinary and Animal Sciences University
20	Dr. Delowar Hossain	Assistant Professor, Medicine and Public Health, Sher-e-Bangla Agricultural University
21	Dr. Eric Brum	Country Team Leader, FAO ECTAD, Bangladesh
22	Dr. Md. Habibur Rahman	National Technical Advisor-One Health Training and Outreach, FAO ECTAD, Bangladesh

Table-2: International contributors (Not according to seniority)

SI #	Name	Designation
1	Dr. Eugene White	Associate Professor, Department of Ambulatory Medicine and Theriogenology, Tufts University Cummings School of Veterinary Medicine, USA
2	Dr. Ylva Persson	State Veterinarian, National Veterinary Institute (SVA)/Associate Professor, Swedish University of Agricultural Sciences (SLU), Sweden
3	Prof Susanna Sternberg Lewerin	Senior Lecturer, Swedish University of Agricultural Sciences (SLU), Sweden
4	Dr. Aziz Siddiqui	Assistant Clinical Professor, South Dakota State University, Former Teaching Professor, University of Wisconsin System and Former Director, Quality Control and Production Technology, Accelerated Genetics, USA

Table-3: Review Committee for Endorsement (Not according to seniority)

Sl #	Name	Designation
1	Dr. Md. Shahinur Alam	CSO (Ectoparasitology), LRI, DLS, Dhaka
2	Dr. Pallab Kumar Dutta	Deputy Director (LR), Attachment: Trade Section, DLS, Farmgate, Dhaka
3	Dr. Md. Shahadat Hossain	ULO, (LR), Attachment: Planning & Evaluation Cell, DLS, Farmgate, Dhaka
4	Dr. Sukesh Chandra Badhy	ULO, (LR), Attachment: CDIL, DLS, Dhaka
5	Dr. Md. Sohel Rana	Senior Scientific Officer, DLS, Dhaka
6	Dr. Faisal Talukdar	ULO (LR), Attachment: Epidemiology unit in DLS, Farmgate, Dhaka
7	Dr. Md. Habibur Rahman	National Technical Advisor, FAO ECTAD
8	Dr. Mohammad Taifur Rahman	National Technical Advisor, FAO ECTAD
9	Mr. Rahman Khan	Senior IT Associate, FAO ECTAD
10	Mr. Mahbubur Rahman	Programme Assistant, FAO ECTAD

Disclaimer

These guidelines form an acceptable basis for management of large animal diseases, but there may be sound clinical reasons for different therapy in specific situations. The complexity of clinical practice requires that, in all cases, users understand the individual clinical situation and exercise independent professional judgement. Particularly in complicated situations, these guidelines are not a substitute for seeking appropriate advice.

These guidelines do not include comprehensive information about medicines, some of which may be important: usually contraindications and precautions for the recommended medicines are not included. Responsible use requires that the prescriber is familiar with these matters.

Guiding principles

The following document lists some of the commonly occurring bacterial, mycoplasmal and protozoal diseases in large animals in Bangladesh with guidelines for prevention, control and treatment. Many of these diseases are the result of an infection overcoming the host's natural defenses in part as a consequence of poor management practices. Poor management practices can include poor hygiene, insufficient biosecurity, inadequate nutrition and poor environmental management.

Antimicrobials should be used only when there is a confirmed disease and when the use is narrowly focused on the disease agent. Use of broad-spectrum antibiotics may give short-term gains but only lead to problems further down the track. Some diseases can only be controlled by management changes as antibiotics will only give a short-term reprieve by antibiotic and the problem may well return once the antimicrobials are discontinued.

Any treatment of disease should be accompanied by an exhaustive problem analysis and examination of farm hygiene and biosecurity. Advice should include suggestions for improvements of hygiene and biosecurity that are then monitored.

The issues of correct diagnosis, disease prevention, prophylactic use of antimicrobials and withdrawal periods must be taken into account by the veterinarian.

1. Diagnosis

a. Correct history taking and diagnosis

Diagnosis should follow a logical process of information collection and analysis. If the clinical signs are not clear, do not give a broad spectrum in the hope that by killing everything you will solve the problem. Take a sample, send it to the lab and find out what the causative agent is; if there is a delay in the result, start using the narrow spectrum antibiotic for the most likely pathogen.

- b. The choice of the correct antimicrobial is an important part of being a veterinarian. The ideal drug is one to which the pathogen is susceptible, reaches effective concentration at the site of infection, is non-toxic to the host, requires minimal stress to the animal, and is inexpensive. Therefore, use the AWaRE classification and suggestions in this guideline. Drugs in the ACCESS group should be the first attempt to be used for livestock and when there is clear evidence of situation demands, use the WATCH group of drugs sparingly and according to the recommendation. Follow up visits to the farm ensure that the antibiotic is working (or not) shows the farmer that you are professional and that you have his interests at heart.

2. Prevention of disease

a. Biosecurity and hygiene

Many farms have poor biosecurity. The movement of equipment, personnel and vermin must be controlled if diseases are to be avoided. Minimum biosecurity would include:

Movement control – with signposts preventing entry of unauthorized people:

- An office at the entrance to the farm to control movement and remove the need for people to go into the productive part of the farm

- Preventing feed and manure trucks from entering the production area, disinfection of trucks
- Dedicated footwear for the productive areas
- Cleaning and disinfection and control of movement of equipment around the farm and between sheds

Hygiene:

- Foot baths or designated footwear at the entrance to each shed
- Regular cleaning of all farm equipment with dry and wet cleaning and disinfection – in particular cleaning feeding and drinking utensils daily.
- Thoroughly clean and disinfect sheds and equipment between batches and respect rest periods.
- Burn or bury carcasses of dead animals

Management:

- All hygiene and movement control activities should be well signposted and enforced by management
- Farm records, especially daily mortality, will alert the farmer to a developing problem.

b. Vaccination Prevent diseases through a vaccination programme

3. Use of prophylactics

Prophylactic use of antimicrobials is not recommended as it is an excuse for poor farm management. Do not give antimicrobials as preventative treatment “just in case” a problem occurs.

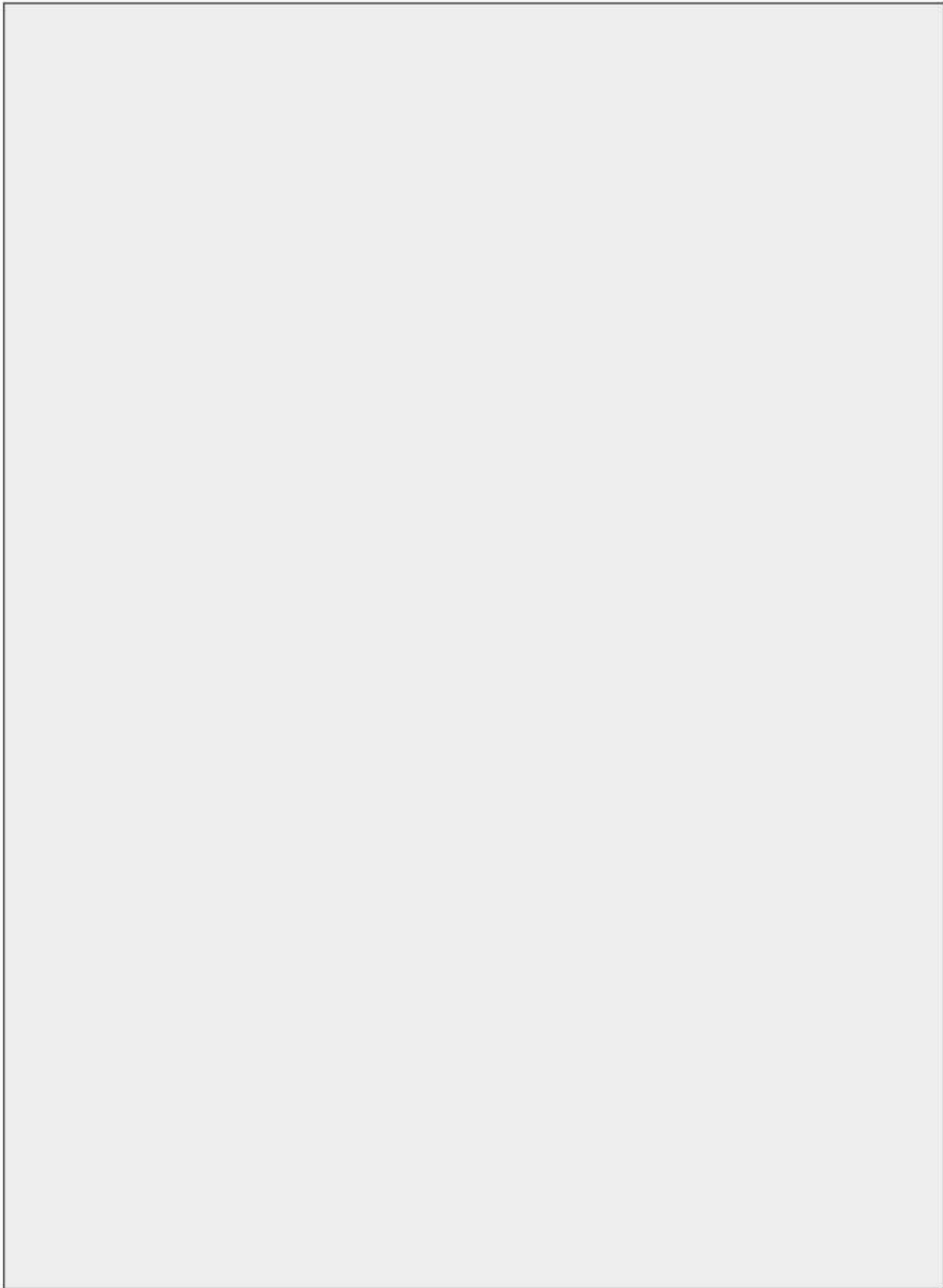
4. Withdrawal period

Withdrawal periods are required so that meat and milk are not sold during the treatment period when levels of antibiotics are high. The withdrawal period is different for each antibiotic and these needs to be checked by the veterinarian and discussed with the farmer.

The cow dung will have high levels of antibiotics following treatment and this should be considered before it is used for other agricultural activities. Breakdown of some antibiotics in the cow dung, such as ciprofloxacin, can be very slow.

Table of Contents

A1 Common diseases of the respiratory system	01
A1.1 Contagious Bovine Pleuropneumonia (CBPP) and Contagious Caprine Pleuropneumonia (CCPP)	01
A1.2 Haemorrhagic Septicaemia (HS)/Pasteurellosis/Shipping fever	05
A1.3 Tuberculosis	07
A1.4 Glanders	12
A2 Common diseases of the digestive system	15
A2.1 Balantidiasis	15
A2.2 Calf scour	17
A2.3 Enterotoxaemia	24
A3 Common diseases of the reproductive system	26
A3.1 Metritis	26
A3.2 Trichomoniasis	32
A3.3 Brucellosis	34
A3.4 Mastitis	37
A4 Common diseases of the Central Nervous System	46
A4.1 Listeriosis (Circling Disease)	46
A4.2 Tetanus	49
A5 Common diseases of the Urinary System	52
A5.1 Leptospirosis	52
A5.2 Contagious Bovine Pyelonephritis	56
A6 Common diseases of the Muscular System	60
A6.1 Blackleg/Black quarter	60
A6.2 Actinobacillosis (Wooden tongue)	64
A7 Common diseases of the Musculo-skeletal System	66
A7.1 Actinomycosis (Lumpy jaw)	66
A7.2 Arthritis	68
A7.3 Navel ill	71
A8 Common diseases of the Circulatory System	74
A8.1 Babesiosis	74
A8.2 Anaplasmosis	78
A8.3 Theileriosis	82
A8.4 Anthrax	87
A9 Common diseases of the Integumentary System	89
A9.1 Foot Rot	89
A9.2 Myiasis	92
A9.3 Malignant edema	94
A9.4 Dermatophylosis	96
A10 Common diseases of the Ophthalmic System	99
A10.1 Pinkeye	99
A11 Common Surgical Affections	101
A11.1 Clean cut surgeries (Cesarian Section, Hernia, Gid Disease, Castration, Amputation, Fracture)	101
A11.2 Septic wound (Abscess, Gangrene etc.)	102
A12 References	104
A13 References table for dose of antimicrobial agents and their withdrawal period (WP)	106
A14: AWaRe categorization	111
A15: Clinical mastitis decision tree	112
A16: Pregnancy category rating	113



Commonly occurring bacterial, mycoplasmal, rickettsial and protozoal diseases in large animals in Bangladesh along with the guidelines for prevention, control and treatment

A1 Common diseases of the respiratory system

A1.1 Contagious Bovine Pleuropneumonia (CBPP) and Contagious Caprine Pleuropneumonia (CCPP)

It is a highly infectious disease of cattle and goat affecting mainly lungs and occasionally joints and caused by *Mycoplasma* sp. and characterized by acute lobar pneumonia and pleurisy.

Etiology

- o Cattle: *Mycoplasma mycoides subsp mycoides*; **Gram-positive**
- o Goat: *Mycoplasma capricolum subsp capripneumoniae*; **Gram-positive**

Susceptible species

- o Cattle, goat, sheep

Epidemiology

- o All most worldwide
- o All age groups; severe infection in young age

Transmission

- o Droplet inhalation and contact with sick animals

Clinical signs

- o Fever (105°C)
- o Respiratory rate increase and coughing after exercise
- o In severe condition, grunting respiration, pleuritic friction rub sound in auscultation (mild form of snoring) and later stage fluke sound and moist crackles
- o Pain on percussion on the thoracic region
- o Abducted elbow
- o Extended neck and open mouth breathing
- o Arched back
- o Frothy discharge



Figure 1: The head and neck are extended and the elbows are abducted because of dyspnea (3), Prominent intermandibular edema during the final stage of acute disease (4), Frothy and stringy saliva accumulates around the mouth (5). Photo courtesy: Di Teodoro, G., Marruchella, G., Di Provvido, A., D'Angelo, A.R., Orsini, G., Di Giuseppe, P., Sacchini, F. and Scacchia, M., 2020. Contagious bovine pleuropneumonia: a comprehensive overview. *Veterinary Pathology*, 57(4), pp.476-489.

Necropsy findings

- o The pleural cavity may contain large quantities of yellowish-brown fluid with pieces of fibrin resulting in thickening of pleura.
- o Consolidation of the lungs with a typically marbled appearance is characteristic.



Figure 2: Copious amounts of pleural effusion are present, along with abundant fibrin on the pleura of the left lung (6), Massive deposition of fibrin on the visceral pleura, resembling the appearance of an "omelette" (7). Photo courtesy: Di Teodoro, G., Marruchella, G., Di Provvido, A., D'Angelo, A.R., Orsini, G., Di Giuseppe, P., Sacchini, F. and Scacchia, M., 2020. Contagious bovine pleuropneumonia: a comprehensive overview. *Veterinary Pathology*, 57(4), pp.476-489.

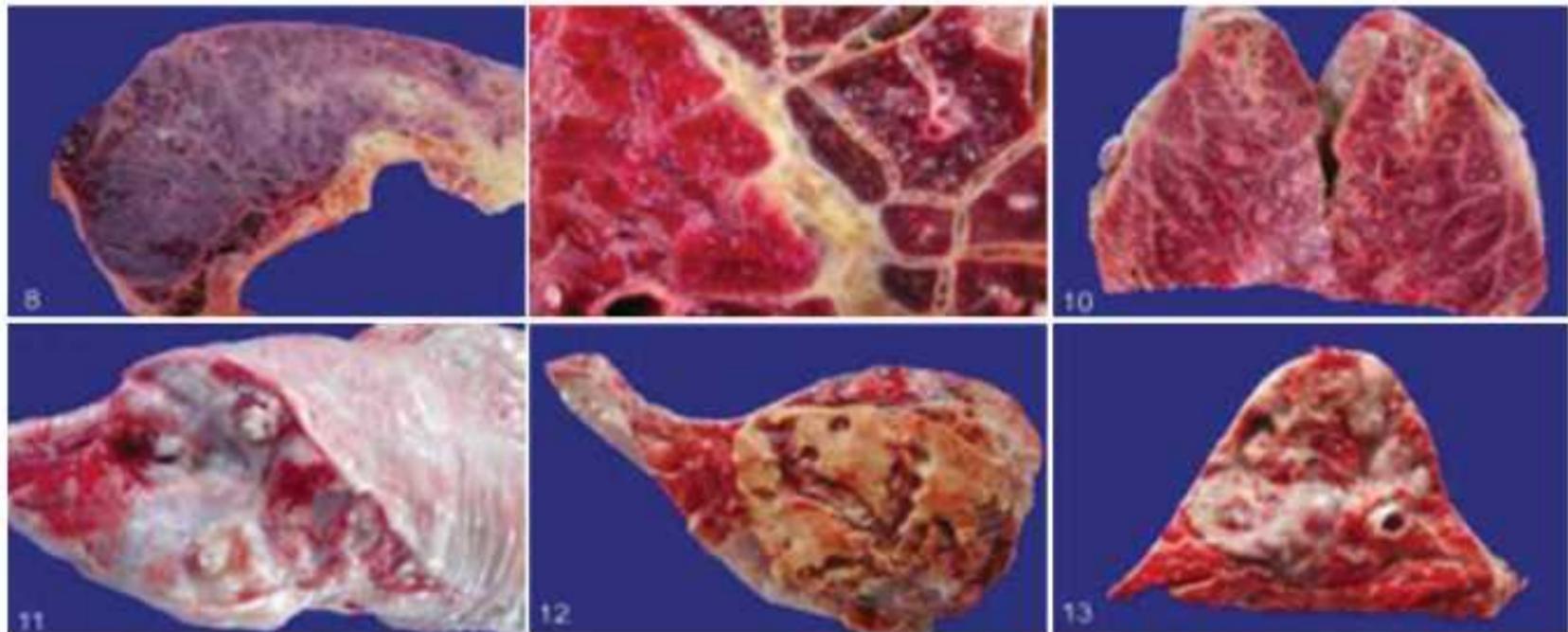


Figure 3: Acute contagious bovine pleuropneumonia (CBPP), lung, cattle. Diffuse red hepatization of the lung parenchyma; the lobules and interlobular septa both appear hemorrhagic. The pleura is covered by fibrin (8), Acute CBPP, lung, cattle. Healthy lobules are contrasted with those in varying stages of hepatization (red-to-grey). The lobules are sharply separated by distended and edematous interlobular septa, giving a "marbled" appearance of the lung (9), Subacute CBPP, lung, cattle. At least initially, the lung architecture (lobules, septa, bronchi and vessels) is still recognizable within this extensive area of necrosis (10), Chronic CBPP, lung, cattle. Small and large sequestra consist of a necrotic core surrounded by a fibrotic capsule (11-12), Chronic CBPP, lung, cattle. The sequestrum is replaced by scar tissue (13). Photo courtesy: Di Teodoro, G., Marruchella, G., Di Provvido, A., D'Angelo, A.R., Orsini, G., Di Giuseppe, P., Sacchini, F. and Scacchia, M., 2020. Contagious bovine pleuropneumonia: a comprehensive overview. *Veterinary Pathology*, 57(4), pp.476-489.

Diagnosis

- o Diagnosis based on clinical history, clinical signs, physical examination and PM findings

Table-3: Differential diagnosis

Disease	Point of differentiation
Hemorrhagic septicemia	Edema of the neck and brisket regions Increased breath sounds over ventral aspects of lungs History of stress (e.g. weaning or transportation etc.)
Lung abscess	Individual animal affected History of pneumonia with no response to treatment. Chronic coughing with epistaxis and hemoptysis
Tuberculosis	Gradual emaciation Intermittent moist coughing with dyspnea, dry painful coughing Tubercular nodules are degenerative cheese-like lesions, often calcified.

Treatment

- o There is official conventional wisdom in the past held that treatment of clinical cases of CBPP or CCPP with antimicrobials is counterproductive to contain the disease because it gives rise to persistent infection and may produce symptomless carrier animals. But experienced veterinarians suggested use of antimicrobial to reduce disease transmission, marked decrease in the disease occurrence, morbidity, and mortality rates in affected herds.

Medication

For cattle

First choice

- o Tylosin tartrate 10mg per kg body weight IM twice daily for 3-5 days. Withdrawal period: Milk 96 hours and meat 35.
- OR
- o Oxytetracycline 10mg per kg body weight IM once daily for 5 days (Cattle). Withdrawal period: Milk 96 hours and meat 18-28 days.

Second choice

- o Florfenicol 20mg per kg body weight IM once every two days for 2 times. Withdrawal period: Milk-not recommended for milking cow and meat 28 days if IM, 38 days if SC.
- OR
- o Tilmicosin 10 mg per kg body weight SC single dose. Withdrawal period: Milk- No withdrawal time established for milk.

For sheep/goat

First choice

- o Tylosin tartrate 10mg per kg body weight IM twice daily for 3-5 days. Withdrawal period: Milk 96 hours and meat 35 days.
- OR
- o Oxytetracycline 15mg per kg body weight IM once daily for 5 days. Withdrawal period: Milk 96 hours and meat 18-28 days.

Second choice

- o Florfenicol 20mg per kg body weight IM once every two days for 2 times. Withdrawal period: Milk-not recommended for milking cow and meat 28 days if IM, 38 days if SC.
- OR
- o Tilmicosin 10 mg per kg body weight SC single dose. Withdrawal period: Milk- No withdrawal time established for milk; if injected intramammary to lactating cows, discard milk for a minimum of 82 days and meat 28 days.

Supportive treatment

- o Bronchodilator, NSAID etc. as per clinical symptoms

Prevention and control

- o Management procedures
 - Difficult to control
 - Affected animal should be under quarantine or isolation
 - Slaughter if possible
 - Infected animal should be culled
 - Newly introduced animals should be under quarantine
 - Management must be hygienic

A1.2 Haemorrhagic Septicaemia (HS)/Pasteurellosis/Shipping fever

It is an acute septicemic disease characterized by fever, depression and the signs of pneumonia, pleuritis, pericarditis and arthritis.

Etiology

- o *Pasteurella multocida*
- o **Gram-negative**, coccobacilli, bipolar organism

Susceptible species

- o Cattle, Sheep, Goat, Buffalo and Horse

Epidemiology

- o Worldwide distribution
- o Normal commensal on the mucosa of the upper respiratory tract.
- o Buffalo, Cattle, Goat, Sheep is mostly susceptible
- o Morbidity: 35% and Mortality: 5-10%
- o Sudden transport and confinement (poor ventilation) are the major risk factor

Transmission

- o Animal to animal through fomites or droplets

Clinical signs and lesions

- o Acute fever (106-107°F)
- o Bronchopneumonia: Moist coughing and severe grunting sound during respiration (specially buffalo)
- o Dyspnea
- o Sudden painful swelling around throat, dewlaps and brisket region (Buffalo)
- o Swollen lymphnode (Note: Any septicaemia & viremic disease: lymphnode is swollen)
- o Nasal discharge and frothy salivation



Figure 4: Clinical cases of HS affected buffaloes (a, depressed animal; b, congested mucous membrane; c, hypersalivation and d, oedema in submandibular, cervical region towards brisket). Photo courtesy: Weerathunga¹, M.W.D.C., Ubeyratne, J.K.H. and Nadheer¹, M.A., 2017. An outbreak of Haemorrhagic septicaemia in the navithanveli veterinary range in Ampara District, Sri Lanka. Sri Lanka Veterinary Journal, 64(2).

Diagnosis

- o Clinical diagnosis based on history and clinical signs and PM findings
- o Laboratory diagnosis based on culture and blood tests (Giemsa or methylene blue staining)
- o Molecular: PCR

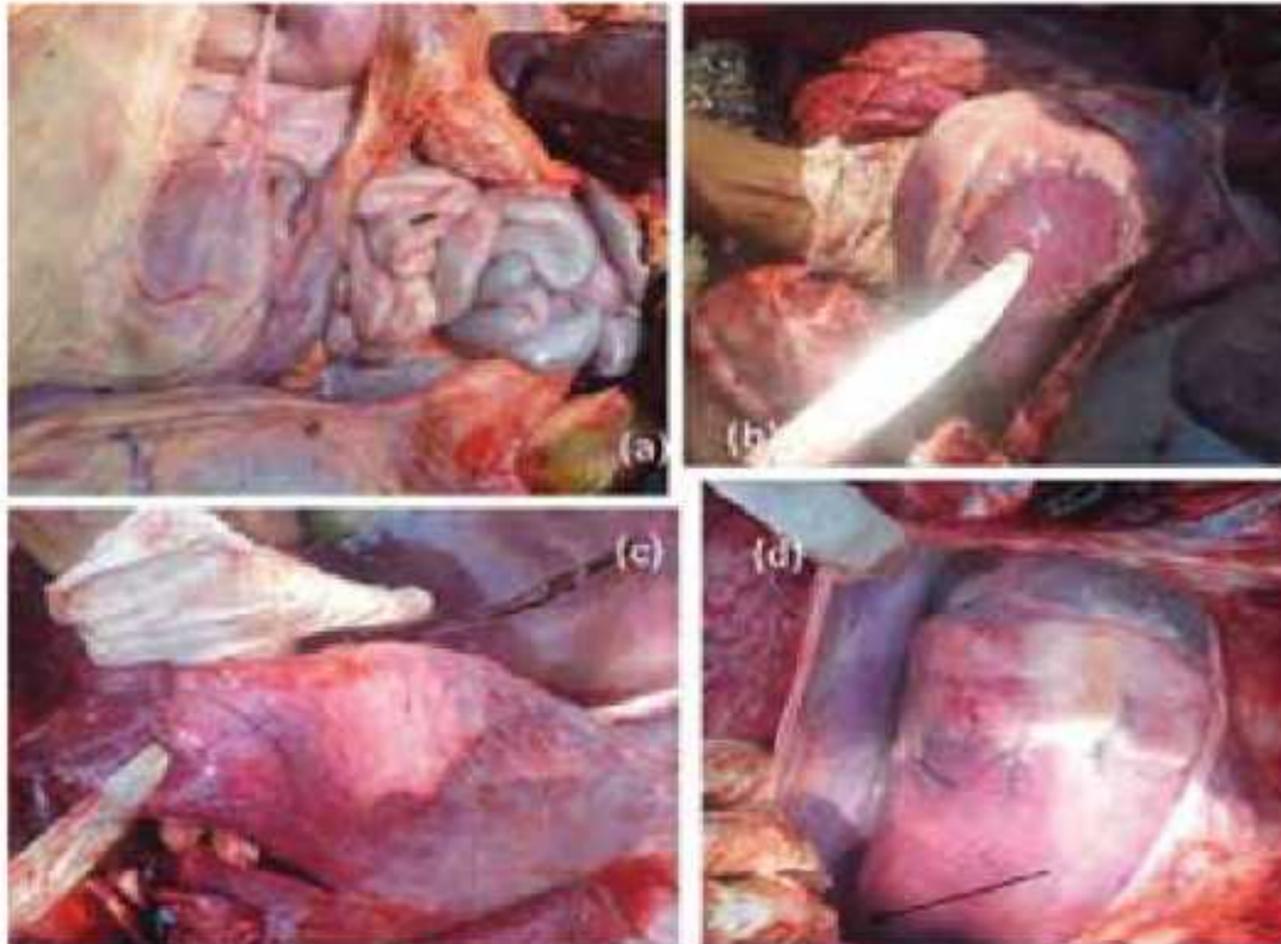


Figure 5: Necropsy findings (a, haemorrhages at the serosal surface of intestine; b, petechial haemorrhages on cardiac parenchyma; c, congested lung and d, pericardial effusion). Photo courtesy: Weerathunga¹, M.W.D.C., Ubeyratne, J.K.H. and Nadheer¹, M.A., 2017. An outbreak of Haemorrhagic septicaemia in the navithanveli veterinary range in Ampara District, Sri Lanka. Sri Lanka Veterinary Journal, 64(2).

Table-4: Differential diagnosis

Disease	Point of differentiation
Fascioliasis	Anemia, no fever, edematous swelling in intermandibular space
PPR	Diarrhea, stomatitis

Treatment

- o During HS outbreaks, any patient with a fever should be treated with intravenous antimicrobials as soon as possible to quickly obtain systemic bactericidal antimicrobial concentrations.
- o Various sulfonamides, tetracyclines, penicillin, gentamicin, kanamycin, ceftiofur, enrofloxacin, tilmicosin, and chloramphenicol have been used effectively to treat HS.

Medication

First choice

- o Oxytetracycline 10mg per kg body weight IM once daily for 5 days (Cattle). Withdrawal period: Milk 96 hours and meat 18-28 days.
OR
- o Florfenicol 20mg per kg body weight IM once every two days for 2 times. Withdrawal period: Milk-not recommended for milking cow and meat 28 days if IM, 38 days if SC.

Second choice

- o Trimethoprim-sulfonamide 25 mg per kg body weight IM/IV once daily for 5-7 days. Withdrawal period: Milk 96 hours and meat 10 days.

Supportive treatment:

- o Antihistaminic and SAIDs

Prevention and control

- o Management procedures
 - Reduce all types of stress
- o Vaccination
 - Vaccines are most commonly used for prevention and control of the disease.

A1.3 Tuberculosis

Tuberculosis is an infectious zoonotic disease, caused by certain pathogenic acid-fast organisms of the genus *Mycobacterium* and is usually characterized by the formation of nodular granuloma known as tubercles.

Etiology

- o Gram-positive, acid-fast bacteria, highly aerobic
- o Cattle, Buffalo and goat-*Mycobacterium bovis*, *Mycobacterium tuberculosis*
- o Horse-*Mycobacterium bovis*, *Mycobacterium avium*, *Mycobacterium tuberculosis*
- o Bird, Pig, Sheep-*Mycobacterium avium*

Susceptible species

- o Cattle, Sheep, Goat, Pig, Buffalo and Horse

Epidemiology

- o All part of the world
- o Young animal less susceptible
- o Over crowd (through droplet), Intensive farming, Cross breed susceptible than indigenous cattle

Transmission

- o Source of infection-Infected animal and carrier animals
- o Transmitted by droplet and feed alteration, sputum, feces (6-8-week persistence) and urine, earthworm, vaginal-uterine discharge, semen, open lymph nodes, coitus etc.

Clinical signs

- o Progressive emaciation
- o Intermittent moist coughing with dyspnea, dry painful coughing
- o Low grade and fluctuating fever
- o Lymph node-swollen lymph node, rupture, draining of pus
- o Skin-nodule of various size

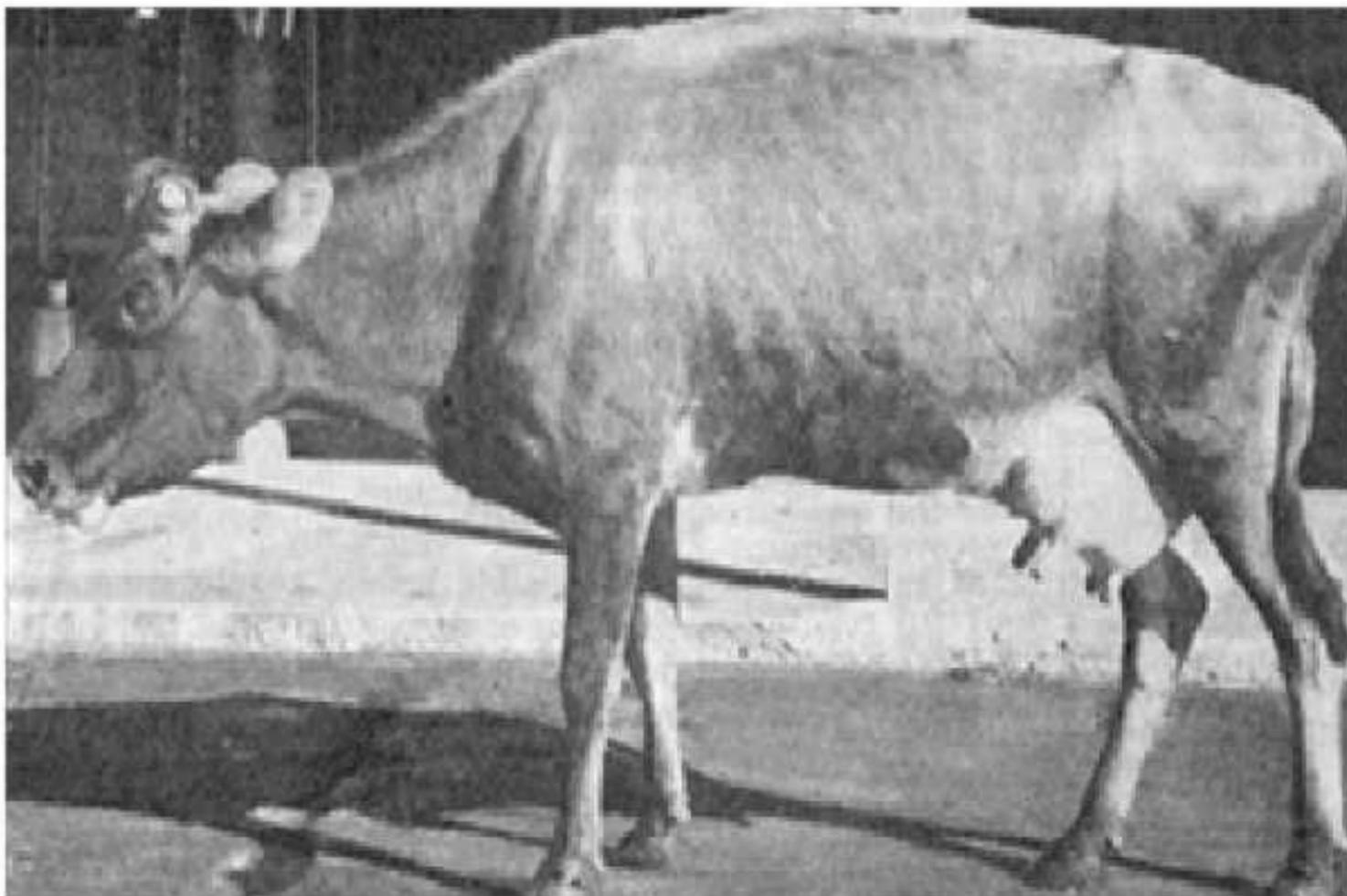


Figure 6: Cow in the last stage of tuberculosis become weak and emaciated
Photo courtesy: <https://teara.govt.nz/en/photograph/17448/tuberculosis-in-cattle>

Necropsy findings



Figure 7: A small tuberculous granuloma in the lung of a goat. The lesion is subpleural and easy to identify. Photo courtesy: Domingo, M., Vidal, E.N.R.I.C. and Marco, A., 2014. Pathology of bovine tuberculosis. Research in veterinary science, 97, pp.S20-S29.



Figure 8: Chronic lymph node tuberculosis in a cow. A mediastinic lymph node fully occupied by lesions showing confluent granulomas with caseous necrosis and mineralisation. Photo courtesy: Domingo, M., Vidal, E.N.R.I.C. and Marco, A., 2014. Pathology of bovine tuberculosis. Research in veterinary science, 97, pp.S20-S29.



Figure 9: Miliary generalised tuberculosis on the peritoneal serosa (tuberculous “pearls”). Photo courtesy: Domingo, M., Vidal, E.N.R.I.C. and Marco, A., 2014. Pathology of bovine tuberculosis. Research in veterinary science, 97, pp.S20-S29.



Figure 10: Miliary tuberculosis in the lung of a goat. A. Lateral view of the right lung after removal of the right chest wall. Multiple, small, confluent granulomas can be found throughout the lung. Photo courtesy: Domingo, M., Vidal, E.N.R.I.C. and Marco, A., 2014. Pathology of bovine tuberculosis. Research in veterinary science, 97, pp.S20-S29.

Diagnosis

- o Clinical diagnosis based on history, clinical signs and PM findings
- o Laboratory diagnosis
 - Field diagnosis or herd diagnosis- through PPD (purified protein derivatives; Tuberculin test)-1mg/ml
 - Ziehl- Neelsen technique (ZN)
 - Molecular techniques-PCR

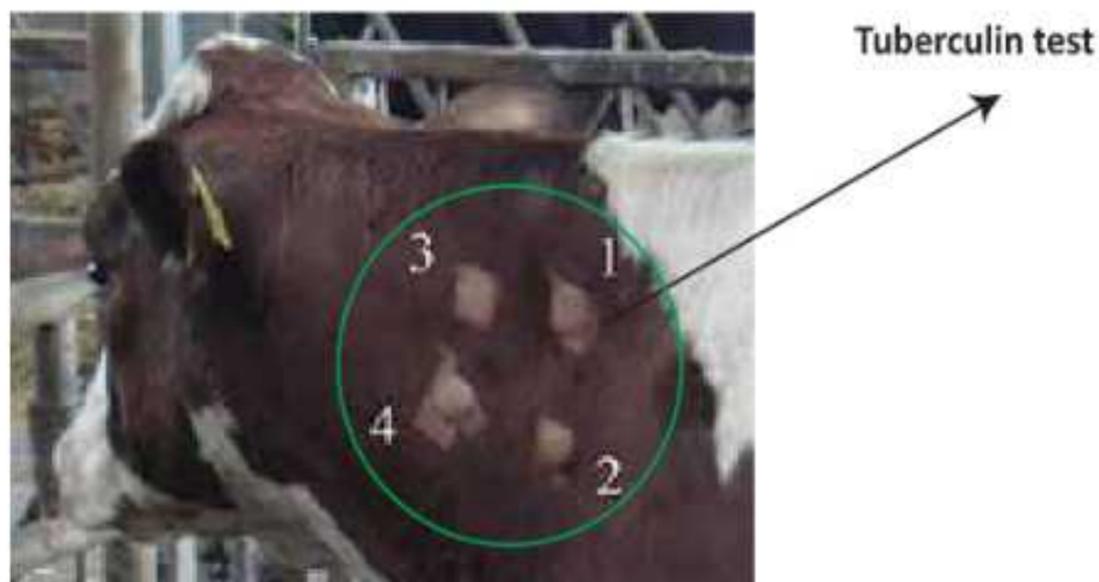


Figure 11: Injection sites with reactions, showing injection/measurement sequence, 1–4 (on each side of the neck), for bovine tuberculin PPD assay. Photo courtesy: Duignan, A., Kenny, K., Bakker, D. and Good, M., 2019. Tuberculin PPD potency assays in naturally infected tuberculous cattle as a quality control measure in the Irish Bovine Tuberculosis eradication programme. *Frontiers in Veterinary Science*, 6, p.328.

Table-5: Differential diagnosis

Disease name	Point of differentiation
Paratuberculosis	chronic diarrhea (not responsive to treatment), corrugated rectal wall.

Treatment

- o Test and condemn the animal if test positive because treatment is not cost effective and it is zoonotic disease.

Prevention and control

- o Management procedures
 - Hygienic measurement
 - Isolation and quarantine of sick animals until test positive
 - Farm personnel test for TB

A1.4 Glanders

Glanders is a contagious bacterial disease affecting primarily Equidae.

Etiology

- o *Burkholderia mallei*
- o A clonal **Gram-negative** facultative intracellular obligate pathogen

Susceptible species

- o Horse, Mule and Donkey

Epidemiology

- o The organism is susceptible to heat, light, and disinfectants; survival in a contaminated area is limited to 1–2 months. Humid, wet conditions favor survival.

Transmission

- o Ingesting food or water contaminated with nasal discharges of carrier animals
- o Contact with harness components

Clinical signs

Nasal form

- o High fever (106 °F)
- o Laboured breathing with a cough.
- o Yellow-green, thick, mucopurulent nasal discharge, possible ocular discharge also
- o Nodules in the nasal mucosa, which burst and become ulcerated. These ulcers spread in the upper respiratory tract and form star-shaped scars.



Figure 12: Mucopurulent nasal discharge in a horse with glanders. Photo courtesy: <https://www.rossdales.com/assets/files/Glanders.pdf>

Pulmonary form

- o Fever, laboured breathing with a persistent dry cough
- o Progressive loss of body condition

Cutaneous form (Farcy)

- o Enlargement of lymph nodes.
- o Nodules appear under the skin along the course of lymphatics of the legs, ribs and belly.
- o Upon rupturing, these also excrete an infectious, purulent discharge.
- o Leads to persistent ulcers connected along tortuous, thickened lymphatic vessels.



Figure 13: Dry, glanderous skin ulcers on the left lower jaw and limb of a horse with glanders. Photo courtesy: <https://www.rossdales.com/assets/files/Glanders.pdf> and Khan, I., Wieler, L.H., Melzer, F., Elschner, M.C., Muhammad, G., Ali, S., Sprague, L.D., Neubauer, H. and Saqib, M., 2013. Glanders in animals: a review on epidemiology, clinical presentation, diagnosis and countermeasures. *Transboundary and emerging diseases*, 60(3), pp.204-221.

Necropsy findings

- o Lung lesions in the form of nodules become calcified and discharge their contents spreading the disease to the upper respiratory tract.
- o Occasionally, lesions will also form in the liver, spleen and kidneys.



Figure 14: Nodules and ulcers in the nasal conchae in a horse with glanders at post-mortem and A granulomatous lesion in the lip of a donkey. Photo courtesy: <https://www.rossdales.com/assets/files/Glanders.pdf> and Mendllson, R.W., 1950. Glanders. US Armed Forces Med J., 1(7), pp.781-4.

Diagnosis

- o Clinical diagnosis based on history, clinical signs and PM findings
- o Laboratory diagnosis (Gram staining)
- o Molecular: PCR

Table-6: Differential Diagnosis

Disease name	Point of differentiation
Strangles	Soft coughing Slight and painful swelling between mandible Pharyngitis and Laryngitis

Treatment

- o Detection and isolation of confirmed cases
- o Treatment is contraindicated. However, in instances in which high value animals are treated.

Medication

First choice

- o Enrofloxacin 8mg per kg body weight IV once daily with trimethoprim-sulfadiazine 32mg per KG body weight IV once daily for 7 days. Followed by enrofloxacin 4mg per kg body weight IV once daily with trimethoprim-sulfadiazine 16mg per KG body weight IV once daily for 14 days. Withdrawal period for enrofloxacin: Milk-not recommended for milking cow and meat 28 days. Withdrawal period for trimethoprim-sulfadiazine: Withdrawal period: Milk 96 hours and meat 10 days.

AND

- o Doxycycline 6mg per kg body weight orally twice daily for 9 weeks. Withdrawal period: data not available.

Prevention and control

- o Management procedures
 - Prevention and control of glanders depend on early detection and isolation of affected animals, as well as complete quarantine and rigorous disinfection of the area involved.
 - Successful control is dependent on efforts to establish awareness among horse and donkey owners in remote areas, in addition to provision of funds to cull affected animals.
- o Vaccination
 - No vaccine

A2 Common diseases of the digestive system

A2.1 Balantidiasis

Balantidiasis is protozoal disease in dairy animals characterized by chronic diarrhea.

Etiology

- o *Balantidium coli*, a largest ciliate **protozoon**

Susceptible species

- o Cattle, Buffalo, Pig and Horse

Epidemiology

- o Worldwide, mostly prevalent in subtropical and tropical regions
- o Poor sanitary condition and drinking of contaminated water are the risk factor
- o Pig is the primary reservoir host

Transmission

- o Oral-fecal route

Clinical signs

- o Loose straw color watery feces, persistent fetid diarrhea with dehydration
- o Chronic form: intermittent diarrhea, weight loss or muscular weakness

Diagnosis

- o Diagnosis based on clinical history, clinical signs.
- o Laboratory diagnosis (identifying the trophozoites and cysts of *Balantidium coli* from feces, intestinal scrapings and in wet mounts of fresh feces)



Figure 15: Cyst of *B. coli* (400X). Photo courtesy: Paul, T.R., Begum, N., Shahiduzzaman, M., Hossain, M.S., Labony, S.S. and Dey, A.R., 2019. Balantidiasis, a zoonotic protozoan infection, in cattle and domestic pigs. Bangladesh Journal of Veterinary Medicine (BJVM), 17(1), pp.31-37.

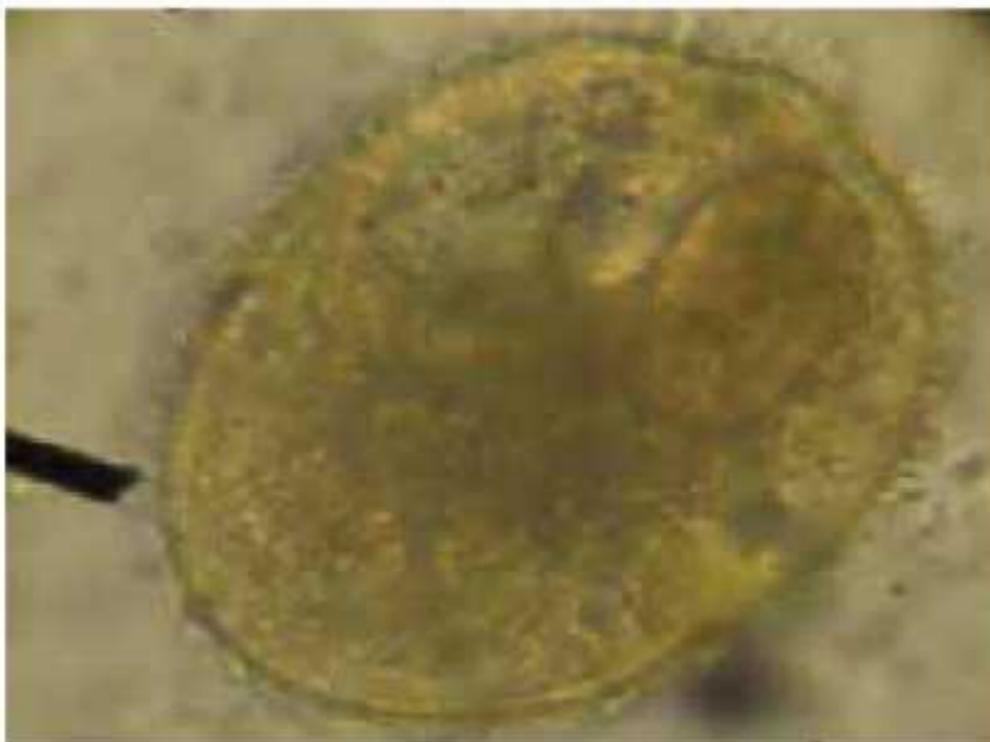


Figure 16: Trophozoite of *B. coli* (400X). A bean-shaped macronucleus is visible in right-top of trophozoite. Photo courtesy: Paul, T.R., Begum, N., Shahiduzzaman, M., Hossain, M.S., Labony, S.S. and Dey, A.R., 2019. Balantidiasis, a zoonotic protozoan infection, in cattle and domestic pigs. Bangladesh Journal of Veterinary Medicine (BJVM), 17(1), pp.31-37.

Table-7: Differential diagnosis

Disease name	Point of differentiation
Para TB	Chronic diarrhea (not responsive to treatment), corrugated rectal wall.
Intestinal schistosomiasis	Scanty feces and always lifting of tail (feces voiding approach) detection of parasite eggs by intestinal wall biopsy Topographical factor may influence the infestation

Treatment

- o Supportive treatment such as electrolytes should be given at body temperature and sick animals should be kept under a heat lamp to maintain body temperature.
- o Specific treatment will be given to animals against the protozoa.

Medication

First choice

- o 1% copper sulfate solution 10ml per kg body weight orally single dose.
OR
- o Metronidazole 10mg per kg body weight IV twice daily for 7 days. Withdrawal period: No data found.

Second choice

- o Oxytetracycline 10mg per kg body weight IV once daily for 5 days (Cattle). Withdrawal period: Milk 96 hours and meat 18-28 days.

Prevention and control

- o Management procedures (biosecurity)
 - Poor sanitary condition
 - Avoid contaminated water for drinking

A2.2 Calf scour

Calf scour is the most important disease of neonatal calves caused by Rotavirus, Coronavirus, E. coli and characterized by diarrhea and death.

Etiology

Infectious scour

Bacteria-Enterotoxigenic E. coli (**Gram-negative**), Salmonella spp (**Gram-negative**), Clostridium perfringens Types A, B & C (**anaerobe**)

Protozoa- *Eimeria* spp., *Cryptosporidium parvum*, *Giardia* spp.

Virus- Coronavirus, Rota virus, Bovine viral diarrhea virus

Non-infectious scour

Irregular feeding, Cold Milk feeding, improperly dissolved Milk replacer, Over feeding of milk, Stressors.

Susceptible species

- o Cattle, Sheep and Goat

Table-8: Epidemiology

Types of agents	Agents	Age affected
Bacteria	Enterotoxigenic <i>E. coli</i>	1-5 days
	<i>Salmonella sp.</i>	4-28 days and older
	<i>Clostridium perfringens</i> Types A, B & C	1-15 days and older
Protozoa	<i>Eimeria spp.</i>	>21 days
	<i>Cryptosporidium parvum</i>	5-20 days
	<i>Giardia spp.</i>	>15 days
Virus	Coronavirus	5-30 days
	Rota virus	4-14 days
	Bovine viral diarrhea virus	6-24 months old

Transmission

- o Oral-fecal route

Clinical signs

- o Diarrhea (loose, pasty, foul smelling, watery, containing blood, mucus), dehydration, acidosis and/or septicemia
- o Decreased suckling reflex
- o Fever or hypothermia (low body temperature).



Figure 17: Diarrheal fecal matting on a neonatal calf with cryptosporidiosis. Photo courtesy: <https://www.merckvetmanual.com/digestive-system/cryptosporidiosis/cryptosporidiosis-in-animals>



Figure 18: Yellowish, watery, and mustard feces from a calf with cryptosporidiosis. Photo courtesy: <https://www.merckvetmanual.com/digestive-system/cryptosporidiosis/cryptosporidiosis-in-animals>



Figure 19: Blood in the feces is one symptom in a calf with coccidiosis. Photo courtesy: <https://www.morningagclips.com/coccidiosis-affecting-young-calves-2/>

Diagnosis

- o Diagnosis based on clinical history, clinical signs, physical examination (skin fold test) and laboratory diagnosis (fecal microscopic examination and culture)

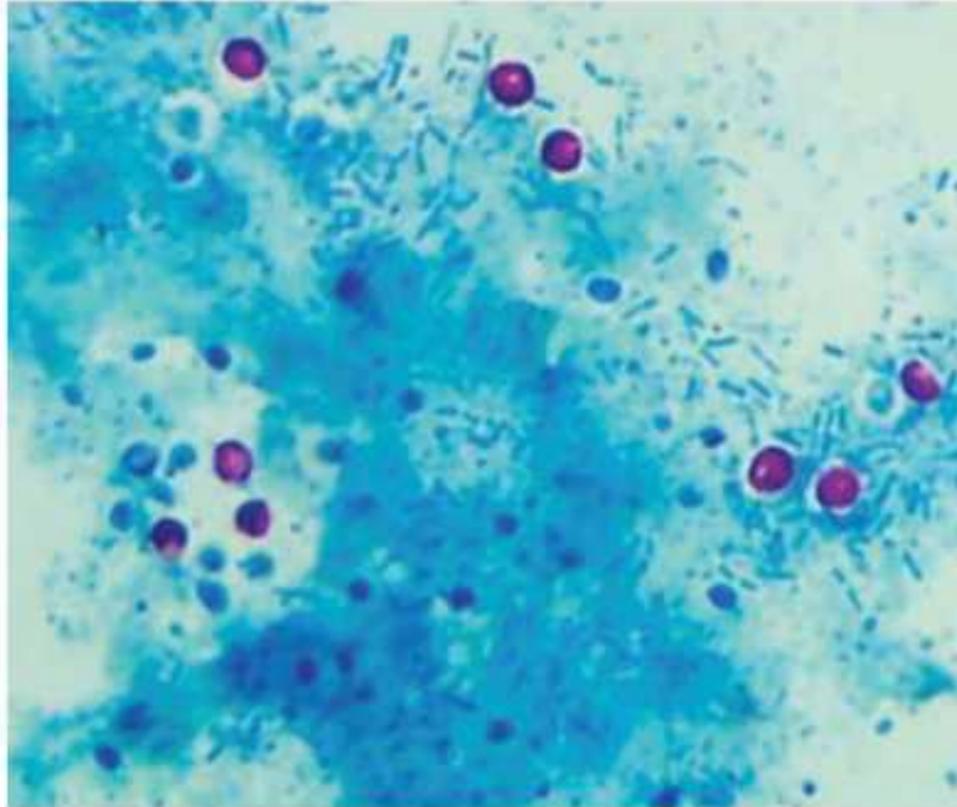


Figure 20: *C. parvum* oocysts (red spherules) in a Ziehl-Neelsen-stained fecal smear. Photo courtesy: <https://www.merckvetmanual.com/digestive-system/cryptosporidiosis/cryptosporidiosis-in-animals>Fig

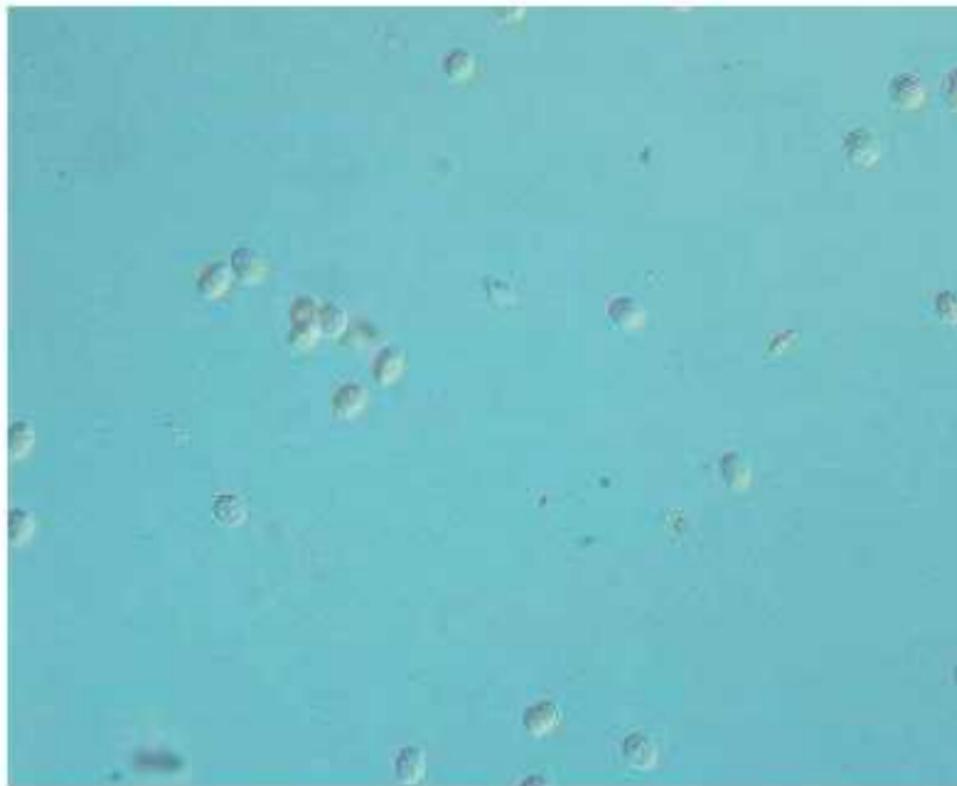


Figure 21: *Giardia* spp. cysts in a fecal sample (1000X).

Photo courtesy:

<https://www.merckvetmanual.com/digestive-system/giardiasis-giardia/giardiasis-in-animals?query=giardiasis>

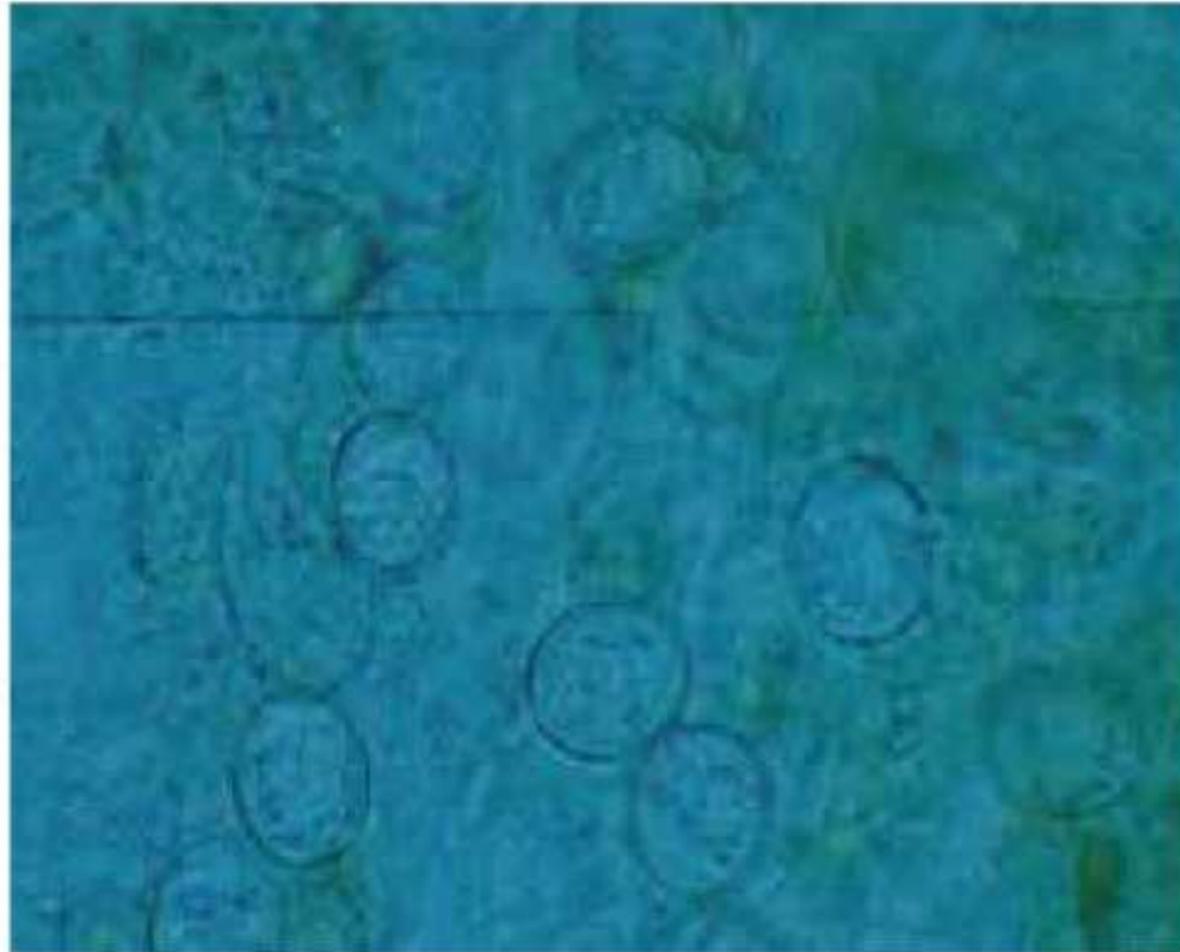


Figure 22: Oocysts of Eimeria spp. in a fecal smear from a calf. Photo courtesy: <https://www.merckvetmanual.com/digestive-system/coccidiosis/overview-of-coccidiosis-in-animals>

Table-9: Differential diagnosis

Types of agents	Agents	Age affected	Points of differentiation
Bacteria	Enterotoxigenic <i>E. coli</i>	1-5 days	Profuse diarrhoea (pale yellow to white color) and rapidly become depressed and recumbent
	Salmonella sp.	4-28 days and older	Foul smelling pasty feces containing blood, fibrin, and copious amounts of mucus, potential death
	Clostridium perfringens Types A, B & C	1-15 days and older	Bloody diarrhea, abdominal pain and Sudden death
Protozoa	Eimeria spp.	>3 weeks	Foul smelling diarrhea, feces containing mucus, tenesmus, severe straining and perineal region mottled with feces and soil; after stressful events
	Cryptosporidium parvum	5-20 days	Persistent diarrhea that does not respond to treatment; watery, brown to green feces
Virus	Coronavirus	5-30 days	Profuse amounts of feces containing mucus
	Rota virus	4-14 days	
	Bovine viral diarrheal virus	6-24 months old	

Treatment

- o Supportive treatment will be given to virus causing calf scour.
- o Electrolytes should be given at body temperature and sick calves should be kept under a heat lamp to maintain body temperature.
- o Specific treatment will be given to bacterial and protozoal causing calf scour.

Table-10: Medication

Types of agents	Agents	Medication
Bacteria	Enterotoxigenic <i>E. coli</i>	First choice:
	<i>Salmonella sp.</i>	<p>Trimethoprim-sulfonamide combinations 25mg per kg BW IV/IM once daily for 5-7 days. Withdrawal period: Milk 96 hours and meat 10 days.</p> <p>OR</p> <p>Amoxicillin 10-15 per kg BW IM/PO twice daily for 5-7 days. Withdrawal period: Milk 96 hours and meat 25 days.</p> <p>OR</p> <p>Amoxicillin plus clavulanic acid 12.5mg per kg BW twice daily for 3-5 days. Withdrawal period: Milk 96 hours and meat 25 days.</p> <p>OR</p> <p>Ampicillin 10-15 per kg BW IM/PO twice daily for 5-7 days. Withdrawal period: Milk 48 hours and meat 6 days.</p> <p>Second choice:</p> <p>Ceftiofur hydrochloride 1.1-2.2mg per kg BW IM once daily for 3-5 days. Withdrawal period: Milk 0 days and meat 3 days.</p> <p>OR</p> <p>Enrofloxacin 2.5-5mg per kg body weight IV/IM/SC/PO once daily for 3-5 days. Withdrawal period: Milk-not recommended for milking cow and meat 28 days.</p> <p>OR</p> <p>Neomycin 10mg per kg body weight IV/IM/SC/PO once daily for 3-5 days. Withdrawal period: Milk-not recommended for milking cow and meat 1 days.</p>

Types of agents	Agents	Medication
	<i>C. perfringens</i> Types A, B & C	<p>First choice:</p> <p>Penicillin 10,000-40,000 IU per kg BW IM once daily for 3-5 days. Withdrawal period: Milk 96 hours and meat 10-21 days.</p> <p>Second choice:</p> <p>Amoxicillin 10mg per kg BW IM/PO twice daily for 3-5 days, Withdrawal period: Milk 96 hours and meat 25 days.</p> <p>OR</p> <p>Amoxicillin plus clavulanic acid 12.5mg per kg BW twice daily for 5-7 days. Withdrawal period: Milk 96 hours and meat 25 days.</p>
Protozoa	<i>Eimeria spp.</i>	<p>First choice:</p> <p>Amprolium</p> <p><i>Calves:</i> 10mg per kg BW orally once daily for 5 days <i>Calves:</i> 5mg per kg BW in feed once daily for 21 days <i>Lambs:</i> 50mg per kg BW in feed once daily for 21 days Withdrawal period: Milk: No data found and meat 24 hours,</p> <p>Second choice:</p> <p>Sulfadimidine (sulfamethazine)</p> <p><i>Calves and lambs:</i> 140mg per kg BW orally once daily for 3 days <i>Calves:</i> 35mg per kg BW in feed once daily for 15 days <i>Lambs:</i> 25mg per kg BW in feed once daily for 7 days Withdrawal period: Milk- not recommended for daily cows more than 20 months of age and meat 8-18 days.</p>
	<i>C. parvum</i>	<p>First choice:</p> <p>Erythromycin 2.2-4.4 mg per kg BW IM once daily for 5-7 days. Withdrawal period: Milk 72 hours and meat 14 days.</p> <p>Second choice:</p> <p>Paromomycin sulfate 100 mg per kg orally once daily for 11 days from the second day of age. Withdrawal period: No data found.</p>

Supportive treatment

- o Less severe cases (6% of BW loss)
- o Electrolytes therapy containing sodium, potassium, glucose, glycine or alanine and bicarbonate by stomach tube or bucket nipple.

- o Milk should not be withheld for >24 hours
- o Dehydrated calves (8% of BW loss)
- o Sodium bicarbonate 7.5% in isotonic saline at 100ml per kg BW over 4-6 hours (initial dose)
- o A combination of sodium bicarbonate and Balanced Electrolytes Saline, 5-8ml/kg/hr for IV for next 20 hours (maintenance dose). Add 100ml of 7.5% Sodium bicarbonate in 250ml of isotonic saline, remove 100ml that will be stable for 48hrs;
<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10692481/#:~:text=We%20found%20that%20100%20mL,for%20up%20to%2048%20hours>)
- o Dexamethasone @20-200µgm/kg BW IM or 10-30mg/calf with 25gm of glucose
- o Alteration of ration

Prevention and control

- o Management procedures (biosecurity)
 - Keeping the environment meticulously clean
 - Removing the calf from the calving environment immediately (if possible)
 - Colostrum at least 3L within the first 6 hours of life.
 - Isolate and treat any sick calves immediately.
 - Cleanliness of pens including feeders, water, passageways, pen dividers etc.
 - Attention to detail, consistency and routines help ensure a healthy calf rearing system.

A2.3 Enterotoxaemia

Clostridial enteric disease in domestic animals is most frequently caused by gram positive *Clostridium perfringens*. This organism is located in the intestinal tract and its toxin absorbed in the blood and produces the disease that is why it is called enterotoxaemia. There are 05 types of *Cl. Perfringens* and the characteristic lesions or disease by the specific type present in the gut.

Table-11: Etiology

Etiology	Responsible for	Toxin produce	Susceptible species	Clinical signs and lesions
<i>Clostridium perfringens</i> Type A (anaerobe)	Yellow lamb disease	alpha	Lamb, calves	Lamb- depressed, icteric, anemic and hemoglobinuria, dyspneic, hard pale mucous membrane Calves-acute onset of abdominal tympany or bloat, colic, anorexia, depression with or without diarrhea or sudden death

Etiology	Responsible for	Toxin produce	Susceptible species	Clinical signs and lesions
Clostridium perfringens Type B (anaerobe)	Lamb dysentery	Alpha, beta, epsilon	Lamb, calves	Listlessness, unwilling ness to suckle, abdominal pain followed by fetid diarrhea.
Clostridium perfringens Type C (anaerobe)	Struck or Romney Marsh disease		Adult sheep, lambs, calves, kids and piglets	Diarrhea, dysentery, colic, sudden death
Clostridium perfringens Type D (anaerobe)	Overeating disease /Pulpy kidney disease		Sheep, goat, lambs, calves	Lambs and calves- the disease is per acute and the animal is found dead Goat-severe persistent diarrhea lasting for several days
Clostridium perfringens Type E (anaerobe)			lambs, calves	Diarrhea, dysentery, colic, sudden death

Epidemiology:

- o Cattle and buffalo sporadically infected but most of the new borne affected by the disease.
- o Spore of the organism transmits through ingestion of contaminated feed and water

Diagnosis

- o Enterotoxaemia should be suspected if sudden death occurs in apparently healthy young animals or other animals on full feed.
- o A presumptive diagnosis can be made if stained smears of fresh intestinal contents reveal large number of gram-positive rods.
- o Isolation and identification of Cl. perfringens Type and specific toxins is needed for definitive diagnosis

Treatment

- o Treatment of chronic form of type D enterotoxaemia in goats may be successful.
- o Antitoxin and antibiotic should be administrated to all potentially susceptible individuals.
- o Intravenous infusion of normal saline

Medication

First choice

- o Procaine penicillin 44,000 IU per kg body weight IM once daily for 7 days. Withdrawal period: Milk 96 hours and meat 10-21 days.

Second choice

- o Long acting Oxytetracycline 20 mg per kg body weight IM single dose, repeat after 48-72 hours. Withdrawal period: Milk 96 hours and meat 18-28 days.

Prevention and control

- o Balance food should maintain for animal feeding
- o Excess feeding should be avoided.

A3 Common diseases of the reproductive system

A3.1 Metritis

A common disease of dairy cattle. Metritis is an inflammation of all layers (endometrium, myometrium, and serosa) of the uterus during the postpartum period.

Etiology

- o The bacterial population is mixed and consists of both aerobic and anaerobic gram-negative and gram-positive organisms.
- o The most common organisms associated with metritis are *Arcanobacterium (Actinomyces) pyogenes* (**gram-positive**), *Fusobacterium necrophorum* (**anaerobe**), *Bacteroides melaninogenicus* (**anaerobe**), *Escherichia coli* (**gram-negative**), and *Staphylococcus aureus* (**gram-positive**).
- o *Bacteroides decreaseschemotaxis* (**anaerobe**)- inhibiting phagocytosis by neutrophils allowing *A. pyogenes* to persist.
- o Occasionally, *Clostridium* spp (**anaerobe**) infects the uterus and causes a gangrenous metritis.

Susceptible species

- o Ruminants commonly dairy cattle are more susceptible.

Epidemiology

- o Worldwide, in hot, warmer climates the incidence of metritis may be higher due to the effect of heat stress
- o Fat or over conditioned animals, retained fetal membranes, dystocia, twins, abortion, weather are common risk factors
- o Unsanitary calving conditions and traumatic obstetrical manipulation can also predispose the cow to uterine infections
- o Prevalence
- o The postpartum incidence of metritis varies among reports and with the definition criteria used for diagnosis.
- o A mean of 17% with a range of 8.8% to 24% has been reported. About one-half of the cows with an abnormal parturition (dystocia, retained fetal membranes, twins) can be expected to develop metritis.

Clinical signs and lesions

- o Cows with metritis usually go off feed
- o Produce less milk
- o Delay in days to first service
- o Lower conception rates
- o Increased days open



Figure 26: Vaginal discharge scoring system, early postpartum cows: discharge 1 (clear).

Photo courtesy: <https://www.msdivetmanual.com/reproductive-system/uterine-diseases-in-production-animals/metritis-in-production-animals>

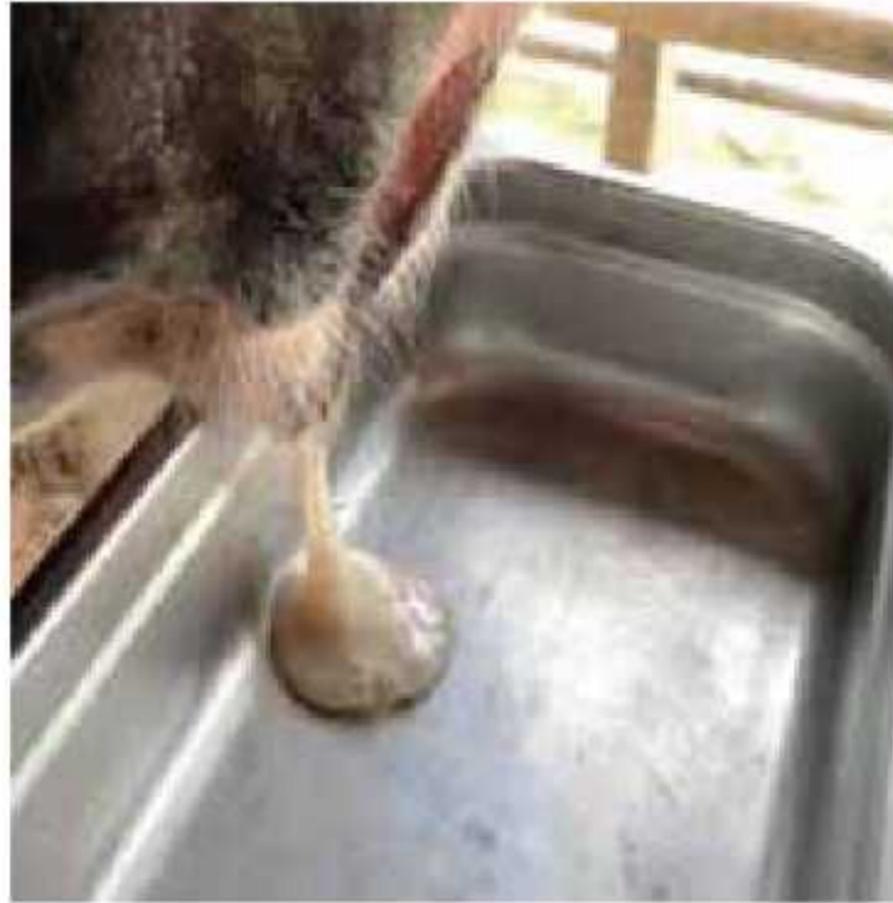


Figure 27: Vaginal discharge scoring system, early postpartum cows: discharge 2 (cloudy, with a speck of pus). Photo courtesy: <https://www.msdevetmanual.com/reproductive-system/uterine-diseases-in-production-animals/metritis-in-production-animals>

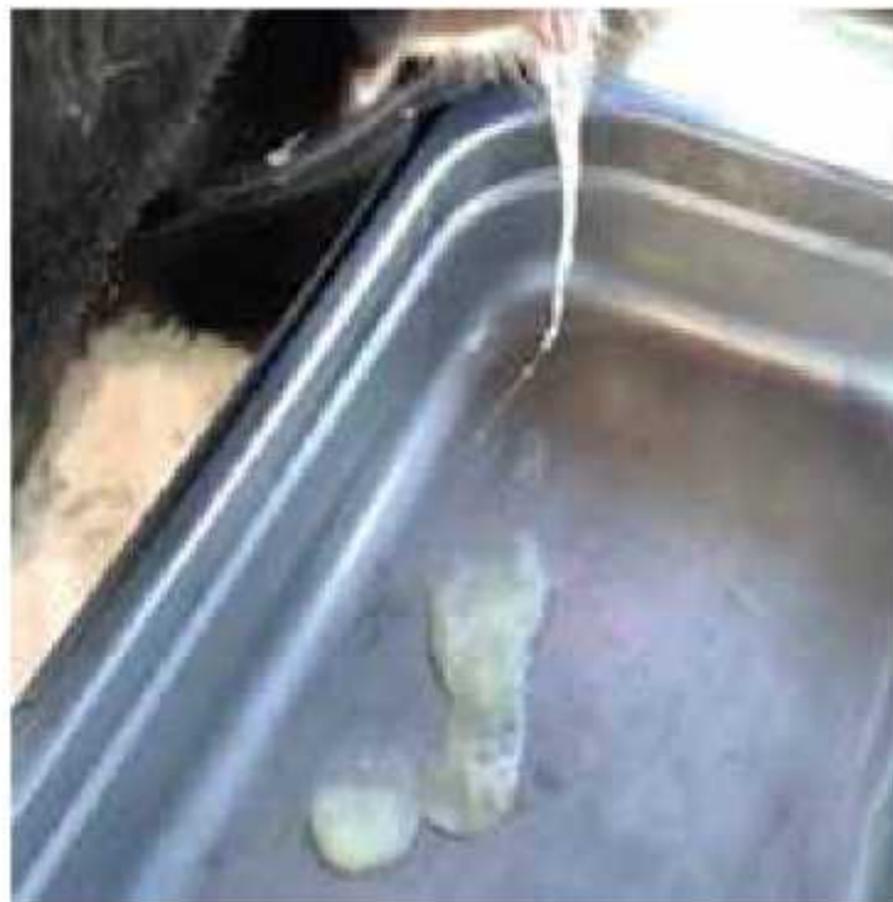


Figure 28: Vaginal discharge scoring system, early postpartum cows: discharge 3 (purulent). Photo courtesy: <https://www.msdevetmanual.com/reproductive-system/uterine-diseases-in-production-animals/metritis-in-production-animals>



Figure 29: Vaginal discharge scoring system, early postpartum cows: discharge 4 (bloody and purulent). Photo courtesy: <https://www.msdivetmanual.com/reproductive-system/uterine-diseases-in-production-animals/metritis-in-production-animals>



Figure 30: Vaginal discharge scoring system, early postpartum cows: discharge 5 (reddish-brownish, watery, and fetid). Photo courtesy: <https://www.msdivetmanual.com/reproductive-system/uterine-diseases-in-production-animals/metritis-in-production-animals>

Necropsy findings

- o Necropsy findings in cows that die from toxic or septic metritis: peritonitis; friable, gangrenous uterus

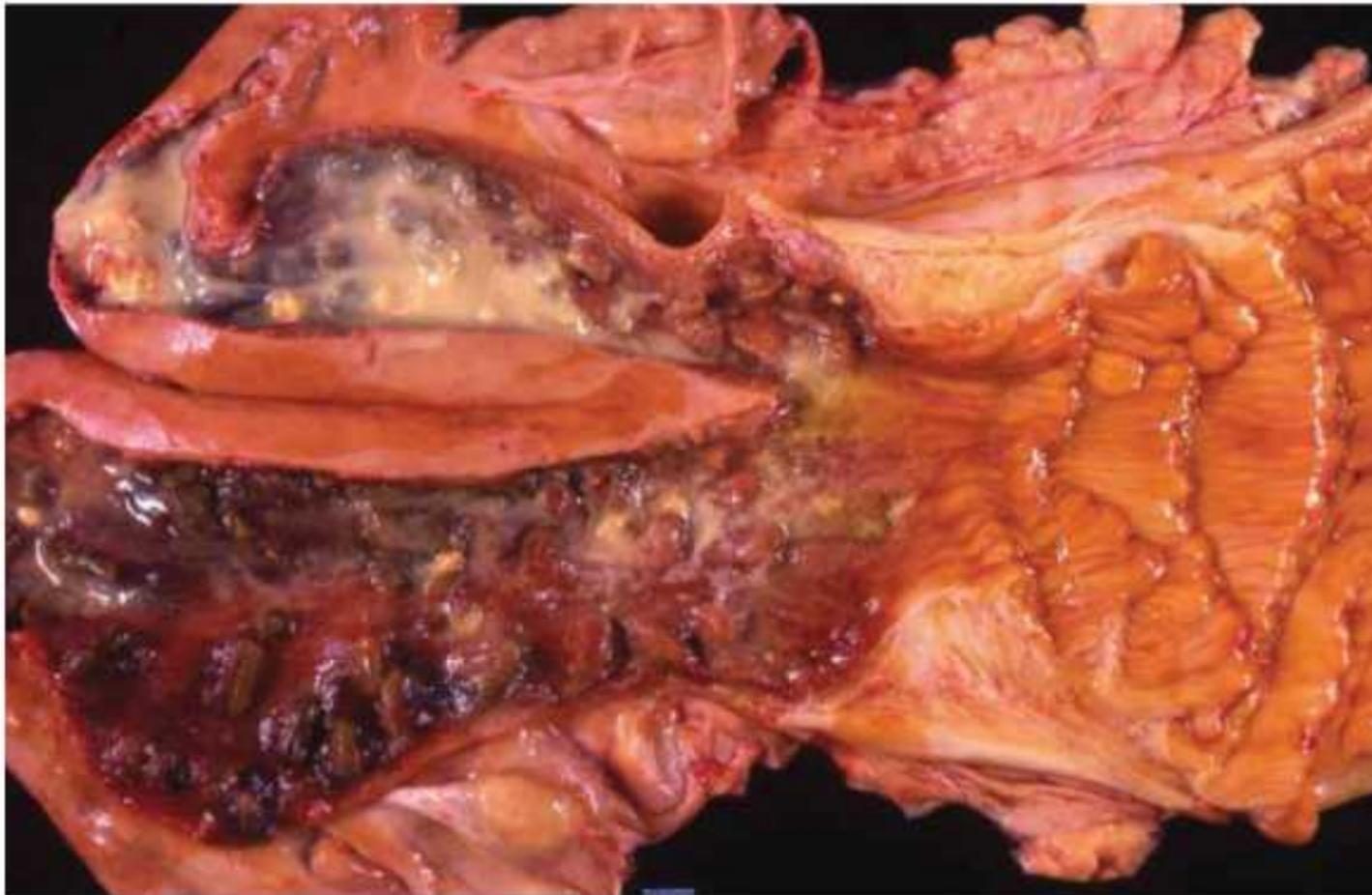


Figure 31: Pus in the uterus is a common finding in cows with endometritis but is not present in all cases. Photo courtesy: <https://www.nadis.org.uk/disease-a-z/cattle/fertility-in-dairy-herds/part-7-uterine-infection/>

Diagnosis

- o Based on history, clinical signs and PM findings
- o A vaginal examination with a speculum can be used to characterize the type of exudates from the uterus.

Treatment

- o Because of the differences in diagnostic criteria and the lack of controlled studies, treatment of this condition remains controversial among clinicians.
- o Most cases of metritis do not require inpatient medical management and can be successfully treated and managed medically on the farm.
- o Therapy generally includes antibiotics (systemic and or intrauterine) and hormonal and supportive treatment for hypocalcemia or ketosis.
- o Fluid and electrolyte replacement therapy may be indicated in cows with septic or toxic metritis.

Medication

First choice

- o Procaine G penicillin 22,000 IU per kg body weight IM once daily for 5 days. Withdrawal period: Milk 96 hours and meat 10-21 days.
OR
- o Ampicillin trihydrate 11 mg per kg body weight IM once daily for 5 days. Withdrawal period: Milk 48 hours and meat 6 days.

Second choice

- o Ceftiofur hydrochloride 2.2mg per kg BW IM once daily for 3-5 days. Withdrawal period: Milk 0 days and meat 3 days.
OR
- o Metronidazole 10mg per kg body weight IV twice daily for 7 days. Withdrawal period: No data found.

Supportive treatment

- o Lugol's iodine
- o Fluid therapy should be administered
- o Metritic cows with ketosis: 50% dextrose (500 mL, IV slowly; may be repeated in several hours or on successive days as needed)
- o Metritic cows with dehydration: 7.2% hypertonic saline (500 mL, IV, as needed judged on clinical condition of patient; provide adequate access to drinking water during administration)
- o Anti-inflammatory treatment may be provided
- o On organic dairy farms: Povidone-iodine (200 mL diluted in 2 L of distilled water) and essential oil based on carvacrol (3.75 mL diluted in 117 mL of distilled water).

Prevention and control

- o Management procedures (biosecurity)
 - The control of endometritis includes providing adequate comfort, sanitary, and nutritional management during the transition period to minimize the risk of calving and postpartum health disorders associated with predisposing factors. Some nutraceuticals, such as chromium propionate, have been associated with reduced incidence of endometritis.
- o Vaccination
 - Not available

A3.2 Trichomoniasis

Trichomoniasis is a venereal disease of cattle characterized primarily by early fetal death and infertility, resulting in extended calving intervals.

Etiology

- o The causative protozoan of trichomoniasis, *Tritrichomonas foetus*.

Susceptible species

- o Cattle

Epidemiology

- o Worldwide
- o Natural insemination is the common risk factor
- o Prevalence
- o Bulls: 11.9%. Higher in *Bos taurus*

Transmission

- o *T. foetus* is found in the genital tracts of cattle. When cows are bred naturally by an infected bull, 30%–90% become infected.
- o Bulls of all ages can remain infected indefinitely, but this is less likely in younger males.
- o By contrast, most cows are free of infection within 3 months after breeding.
- o Transmission can also occur when the semen from infected bulls is used for artificial insemination.

Clinical signs and lesions

- o The most common sign: Infertility caused by embryonic death.
- o This results in repeat breeding and attending stock persons often note cows in heat when they should be pregnant.
- o These include cows with pyometra, endometritis, or a mummified fetus.
- o Fetal death and abortions can also occur but are not as common as losses earlier in gestation.



Figure 32: Trichomoniasis infection in a pregnant cow will adversely impact the fetus.

Photo courtesy: <https://www.producer.com/livestock/trichomoniasis-is-a-tricky-illness-to-manage/>

Diagnosis

- o Based on history, clinical signs and PM findings
- o Diagnosis is confirmed by culture of T. foetus

Table-12: Differential Diagnosis

Disease	Point of differentiation		
	Abortion rate	Time of abortion (on gestation month)	Condition of placenta
Brucellosis	High, up to 90% in susceptible herds	5 months +	Severe placentitis, thickened placenta with surface exudate
Neosporosis	Sporadic or outbreaks common (20%–40%)	3–8 months of gestation (mean 5.5 months)	No characteristic gross lesions in placenta Parasite may be present
Vibriosis (Campylobacter fetus subsp. venerealis)	Low, up to 5%, may be up to 20%	4-6 months	Semiopaque, little thickening, Petechiae, localized avascularity and edema
Leptospirosis	25%–30%	Abortions may occur Throughout gestation; Late, 6 months +	Avascular placenta, atonic yellow-brown cotyledons, brown gelatinous edema between allantois and amnion
Infectious bovine rhinotracheitis	Variable	Most in second half of gestation	No significant gross lesions
Mycoses (Aspergillus, Absidia)	Unknown. 6%–7% of all abortions encountered	3–7 months	Necrosis of maternal cotyledon, adherence of necrotic material to chorionic cotyledon causes soft, yellow, cushion-like structure Small yellow, raised, leathery lesions on intercotyledonary areas
Listeriosis	Low, rare abortion storms related with poorly fermented silage	About 7 months	No obvious gross lesions
Epizootic bovine abortion	Abortion storms may occur, usually in heifers and newly introduced cattle High, 30%–40%	Third trimester abortion or birth of premature weak calves	No obvious gross lesions
Bovine viral diarrhea (BVD)	Less than 10%	Any time during Gestation. Most common in first trimester	No obvious gross lesions
Trichomoniasis (Trichomonas foetus)	Moderate, 5%–30%	Primarily first 5 months	Flocculent material and clear, serous fluid in uterine exudate

Treatment

- o Bull should not be used for breeding purposes.
- o Control is by culling infected bulls.
- o Females will self-cure within a few months. Cow should give consecutive 3 breeding rest.

Prevention and control

- o Management procedures (biosecurity)
 - Control consists of eliminating the infection by culling all bulls and replacing them with virgin bulls or by testing and culling positive bulls.
 - Reinfection is prevented by exposing only the uninfected (clean) bulls to uninfected (clean) cows.
 - Caution must be exercised to ensure that cows and heifers are not exposed to potentially infected bulls on the common grazing pasture.
- o Vaccination
 - Vaccines developed for use in cows were not highly effective, especially in the absence of other control measures.

A3.3 Brucellosis

Brucellosis is an infectious disease of animal and human characterized by abortions, retained placenta, weak kids, mastitis and infertility.

Etiology

- o *Brucella melitensis*, *Brucella abortus* (less frequent case), *Brucella ovis*, *Brucella melitensis* (Sheep), Gram-negative bacteria

Susceptible species

- o Cattle, Goat, Sheep and Horse

Epidemiology

- o Worldwide, Common in Australia, New Zealand, North & South America, Europe, Sporadic in Indian subcontinent like Bangladesh, India, Pakistan and also in Middle east
- o Pubertal animal (after puberty)
- o *Brucella ovis* is more in male than in female, *Brucella melitensis* & *Brucella abortus* are more in female than in male
- o Prevalence: In Bangladesh Cattle: 2.66%, Buffalo: 2.87%, Goat: 3.15% & Sheep: 2.31%

Transmission

- o Semen, Homosexual activity (Sniff & lick) are the source of infection
- o Transmission via infected soil (due to the bacteria survive few months in the soil)

Clinical signs and lesions

- o Uterus: Ulcerative endometritis led to abortion
- o Placenta: Necrotic change in cotyledon led to retained placenta
- o Fetus: Consolidation of lungs, abomasitis * Abortion/Weak kids
- o Joint: Arthritis- Joint become swollen, hot & painful, Lameness, recumbancy
- o Fever: Dull, depressed, anorexia
- o Udder: Udder become hot and painful
- o Milk may be blood stained
- o Mastitis
- o Epididymis: Epididymitis (more in Sheep)



Figure 33: Cattle usually become infected with brucellosis by licking or eating infected afterbirth, eating infected feed or grass, or drinking infected water.

Photo courtesy: <https://www.farmersweekly.co.za/animals/cattle/brucellosis-in-cattle/>



Figure 34: Contagious abortion. Photo courtesy:
<https://veepro.nl/animal-health/brucellosis-in-cattle-contagious-abortion-bangs-disease/>

Diagnosis

- o Based on history, clinical signs and PM findings
- o Laboratory diagnosis: Culture: Blood cultures in tryptose broth, bone marrow cultures. The growth of brucellae is extremely slow (they can take up to two months to grow) and the culture poses a risk to laboratory personnel due to high infectivity of brucellae.
- o Molecular test: PCR
- o Serological test: ELISA, CFT, Serum agglutination test
- o Field diagnosis: Rose Bengal dye test
- o Negative reaction: total absence of agglutination → the serum is negative.
- o Positive reaction: even minimal agglutination → the serum is positive.

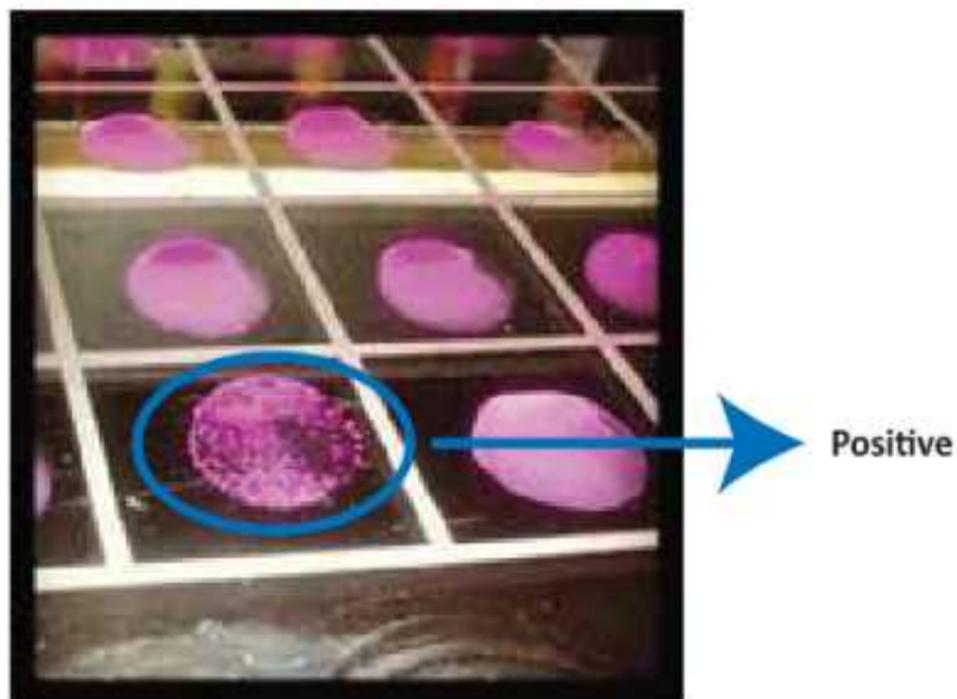


Figure 35: Agglutination in Rose Bengal dye test positive.
Photo courtesy: <https://microbiologie-clinique.com/rose-bengal-test.html>

Table-13: Differential Diagnosis

Disease name	Point of differentiation
Leptospirosis	Abortion at late 6 months
Trichomoniasis	Abortion at 2-4 months
Vibriosis (<i>Campylobacter foetus</i>)	Abortion at 5-6 months
Listeriosis	Abortion at about 7 months of pregnancy

Treatment

- o Condemned of the carcass
- o Spontaneous recoveries occur among all species and the percentages vary.

Prevention and control

- o Management procedures (biosecurity)
 - Test and slaughter of reservoir of infection
 - Herd must be tested at regular intervals until two or three successive tests
 - Isolation and Quarantine
 - Hygienic measures
 - Proper disposal of aborted fetus
 - Disinfection of contaminated areas
- o Vaccination
 - Application the strain 19 vaccine of *B. abortus* in female young calves age at 3-8 months

A3.4 Mastitis

Mastitis is an inflammation of the mammary gland characterized by physical, chemical and microbiological changes in milk and physical and pathological changes in udder.

Etiology

- o About 136 organisms were isolated from mastitis

Table-14: Etiology

Types of agents	Agents
Bacteria	<p>Gram-positive</p> <p>Staphylococcus aureus (CP) Non-aureus staphylococcus (TSOP) Streptococcus agalactiae (CP) Streptococcus dysgalactiae (EP) Streptococcus uberis (EP) Corynebacterium bovis (CP) Corynebacterium pyogenes (CP) Mycobacterium spp.</p> <p>Gram-negative</p> <p>Escherichia coli (EP) Klebsiella spp. (EP) Enterobacter spp. (EP) Salmonella spp. (EP) Pseudomonas spp. Yersinia spp.</p>
Fungus	<p>Aspergillus spp. Candida spp.</p>
Mycoplasma	<p>Mycoplasma bovis (CP)</p>
Virus	<p>FMD Pox virus Vesicular stomatitis virus</p>

*CP= Contagious pathogens, TSOP= Teat skin opportunistic pathogens, EP= Environmental pathogens

Susceptible species

- o Cattle, Buffalo, Sheep, Goat, Pig, Horse

Epidemiology

- o Worldwide
- o More prevalent in the intensive farming system due to contact and confined housing and environment
- o Exotic and cross bred high yielding cows are more susceptible
- o More prevalent in first lactation and after 4th lactation stage
- o More chance in hand milking than machine milking
- o High protein-rich diet is a risk factor
- o Genetic factors
- o Poor hygiene in housing and during milking

Transmission

- o Invasion through teat orifice.
- o Through milker's hands and poor hygiene and sanitation in farms

Table-15: Clinical signs

Subclinical mastitis	Clinical mastitis	
No visible signs	Grade-1 mastitis (mild)	Changes in milk (curd like, yellow, brown fluid with flakes and clots)
	Grade-2 mastitis (moderate)	Changes in milk (curd like, yellow, brown fluid with flakes and clots) and udder (swollen, hot and painful)
	Grade-3 mastitis (severe)	Changes in milk (curd like, yellow, brown fluid with flakes and clots), udder (swollen, hot, painful and gangrene) and body (fever, anorexia, dullness, depression, recumbency)

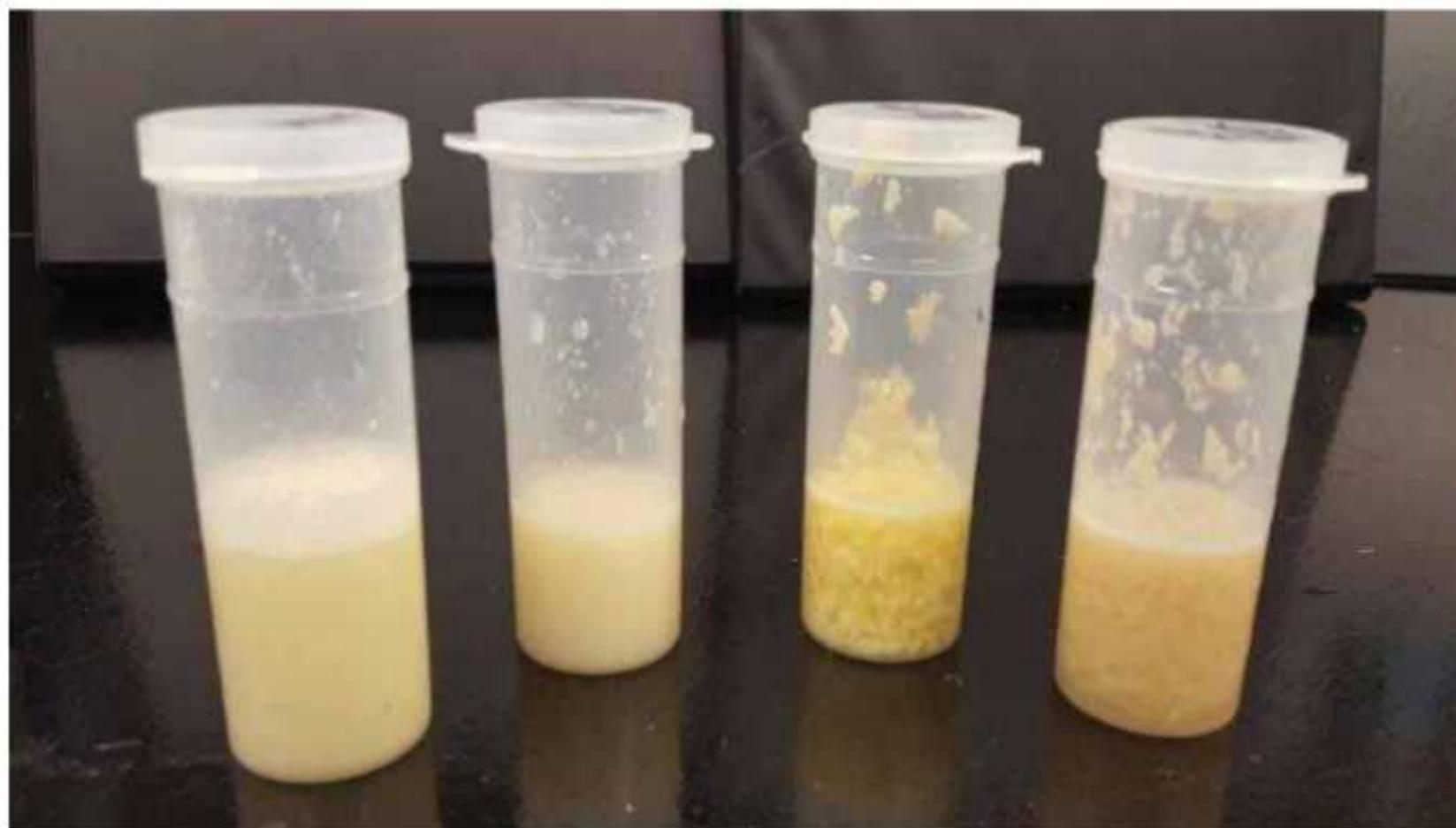


Figure 36: Abnormal milk from cases of mild clinical mastitis. Note changes in color and presence of fibrin clots. Photo courtesy: <https://www.msdivetmanual.com/reproductive-system/mastitis-in-large-animals/mastitis-in-cattle>



Figure 37: Swelling of udder in sheep.

Photo courtesy: <https://u.osu.edu/sheep/2018/01/23/mastitis-in-small-ruminants/>



Figure 38: Severe case of clinical mastitis in cow. Photo courtesy: Ribeiro, M.G., & Link, A., 2014. A fatal case of mastitis caused by *Klebsiella pneumoniae* in bovine.

Chronic mastitis

- o Painless
- o udder become hard and firm
- o Yellowish or greenish or oilsh colored milk

Gangrenous mastitis

- o Bluish or blackish color udder
- o Blood-stained milk
- o Cold to touch



Figure 39: Difference between normal milk and milk from gangrenous mastitis.
Photo courtesy: <https://u.osu.edu/sheep/2018/01/23/mastitis-in-small-ruminants/>



Figure 40: Gangrenous mastitis in a goat.
Photo courtesy: <https://u.osu.edu/sheep/2018/01/23/mastitis-in-small-ruminants/>



Figure 41: Gangrenous mastitis in a cow. Photo courtesy: <https://www.msdtvetmanual.com/reproductive-system/mastitis-in-large-animals/mastitis-in-cattle>

Diagnosis

- o Diagnosis based on epidemiological data, clinical history, clinical signs, physical examination and field screening test (strip cup test, California mastitis test, Surf field mastitis test and Somatic cell count)
- o Laboratory diagnosis: Culture and antibiotics sensitivity test (CS)



Figure 42: California mastitis test. Photo courtesy: Udder Health Bangladesh, www.uhb.org.bd



Figure 43: Somatic cell count. Photo courtesy: Udder Health Bangladesh, www.uhb.org.bd

Table-16: Differential Diagnosis

Disease	Point of differentiation
Udder edema	Normal temperature and no pain in palpation Skin of udder is tight and finger pressure leaves a depression (pits on pressure)

Treatment

- o More than hundred pathogens are responsible for causing clinical mastitis. So, CS test must be done before antibiotics treatment.
- o In the meantime, we must give supportive treatment to cows. We should not give any antibiotics except supportive therapy if there is no growth of bacteria in culture from infected quarter milk.
- o But during cases of serious clinical mastitis in lactating cows and in dry cows, are serious problems for the field veterinarian. In that situation, urgent treatment is needed and not possible to wait for the results of laboratory tests to guide the selection of the most appropriate antibiotic.
- o Empirical treatment may start based on clinical findings, season of the year; and management practices. Once the laboratory test results at hand, the treatment should be evaluated and modified according to CS test results.

Medication

For Gram-positive bacteria: (more than 80% pathogens are Gram-positive bacteria)

Penicillin sensitive Staphylococcus and other bacteria:

First choice

Procaine penicillin 10,000-40,000 IU per kg body weight IM/IMM once daily for 3-5 days.

Withdrawal period: Milk 96 hours and meat 10-21 days.

Penicillin resistance Staphylococcus (MRSA) and other bacteria:

Treatment according to antibiograms such as

Amoxicillin 10-15mg per kg body weight IM twice daily for 3-5 days. Withdrawal period: Milk 96 hours and meat 25 days.

OR

Gentamycin 2.2-6.6mg per kg body weight IM, twice daily for 3-5 days. Withdrawal period: Milk 0 days and meat 3 days.

Second choice

Treatment according to antibiograms such as

Ceftiofur hydrochloride 1.1-2.2mg per kg BW IMM once daily for 3-5 days. Withdrawal period: Milk 0 days and meat 3 days.

Dry cow therapy: Herds experiencing a high incidence of clinical mastitis in recently calved heifers, intramammary infusion with Cloxacillin (200mg)- First choice or Cephapirin (200mg) 7 days before expected parturition is highly effective. Withdrawal period (Cloxacillin): Milk 48 hours and meat 10 days. Withdrawal period (Cephapirin): No data found.

Note: Decision tree attached in the A-14

For Gram Negative bacteria and no bacterial growth: Only Supportive treatment

For fungus and mycoplasma: Culling the cow from the farm.

Supportive treatment

- o Frequent stripping and milking from the infected quarters
- o Hormonal therapy (Oxytocin @10-20IU IM) to complete let down milk from the infected quarters
- o Fluid therapy (Severe mastitis)
- o Application of cold water to the infected quarters
- o Non-steroidal anti-inflammatory drugs (NSAIDs) to reduce the swelling
- o Astringents over udder tissues to reduce the swelling
- o Dexamethasone @0.2-2mg per kg body weight to prevent the fibrosis (Chronic Mastitis)
- o Fermentation by MgSO₄ for becoming foamy and reduce hard (Chronic Mastitis)
- o Use of probiotic and prebiotics (SCM)
- o Vitamin and minerals (Selenium and vitamin E)

Route of administration

Mild and moderate cases: intramammary infusion (IMM); Severe cases and or Staphylococcus aureus identified; both IM and IMM

Procedure of intramammary infusion

- Clean and dry the teats.
- Dip teats in an effective germicidal product. Allow 30 seconds' contact time before wiping teats with an individual disposable towel (one towel per cow, use one corner of the towel for each teat).
- Thoroughly clean and disinfect each teat end with cotton soaked in 70% alcohol. Use a separate piece of cotton for each teat.
- Prepare teats on the far side of the udder first, followed by teats on the near side.
- Treat quarters in reverse order: near side first, far side last.
- Insert only the tip of the cannula into the teat end (partial insertion). Do not allow the sterile cannula to touch anything before infusion.
- Dip teats in a germicidal product after treatment.
- Identify treated cows and remove them from the milking herd to prevent antimicrobials from entering the milk supply.

Prevention and control

Principles of control

- Eliminate existing infections
- Prevent new infections
- Regular cleaning and disinfecting of the floor of shed and drying of the floor
- Monitor udder health status
- Vaccination will be recommended

Components of a mastitis control program

- Use proper milking management methods. Personal hygiene of the milkman before milking.
- Proper installation, function, and maintenance of milking equipment
- Dipping of teats with disinfectant.
- Dry cow management (dry off 60 days before parturition).
- Appropriate therapy of mastitis during lactation
- Culling chronically infected cows
- Maintenance of an appropriate environment
- Good record keeping
- Monitoring udder health status
- Periodic review of the udder health management program
- Setting goals for udder health status

A4 Common diseases of the Central Nervous System

A4.1 Listeriosis (Circling Disease)

The most common clinical manifestation of listeriosis is a localized ascending asymmetric infection of the brain stem of ruminants by *Listeria monocytogenes*. The resultant meningoencephalitis damages the origins of cranial nerves V, VII, and VIII in the brain stem, resulting in unilateral facial paresis or paralysis, head tilt, loss of sensation, depression, and recumbency. Diagnosis in ruminants is based on typical neurologic clinical signs. Treatment with high dosages of antimicrobials may be effective if given early in the course of infection.

Etiology

- o *Listeria monocytogenes* is a small, motile, **gram-positive**, nonspore-forming

Susceptible species

- o Cattle, Buffalo, Sheep, Goat

Epidemiology

- o Listeriosis is seen worldwide, more frequently in temperate and colder climates.
- o Feedlot or housed ruminants, less acidic pH of spoiled silage, young ruminants before the rumen is functional, pregnancy are common risk factors
- o Wide range of animals, humans and birds.
- o All material from suspected clinical cases of listeriosis carries the risk of zoonotic infection and should be handled with caution.
- o Aborted fetuses and necropsy of septicemic animals present the greatest hazard.
- o Humans have developed fatal meningitis, sepsis, and papular exanthema on the arms after handling aborted material.
- o Pregnant animals and women should be protected from infection because of danger to the fetus, with possible abortion, stillbirth, and infection of neonates.

Transmission

- o *Listeria monocytogenes* is present in fish, crustaceans, insects, sewage, water, silage and other feedstuffs, milk, cheese, meconium, feces, and soil.
- o The natural reservoirs of *L. monocytogenes* appear to be soil and mammalian GI tracts, both of which contaminate vegetation.
- o Infections acquired via ingestion.

Clinical signs and lesions

- o Septicemia in neonatal ruminants and monogastric animals, and septicemia with myocardial or hepatic necrosis.
- o Encephalitis and meningoencephalitis in adult ruminants,
- o Abortion and perinatal mortality in all species,

- o Anorexia, disorientation, depression, ipsilateral weakness, trigeminal and facial nerve paralysis, and less commonly, circling (vestibulocochlear nucleus), excitement, and recumbency



Figure 44: Sheep affected by neurolisteriosis presenting with head tilt, chewing and swallowing difficulties, drooping ear, eyelid and lip.

Photo courtesy: Walland, J., Lauper, J., Frey, J., Imhof, R., Stephan, R., Seuberlich, T. and Oevermann, A., 2015. *Listeria monocytogenes* infection in ruminants: is there a link to the environment, food and human health? A review. *Schweizer Archiv für Tierheilkunde*, 157(6), pp.319-328.



Figure 45: Sheep in early stage of encephalitic listeriosis, the animal started moving in circles with deviated head and neck.

Photo courtesy: Ismael, A.B., Masoud, E.S.E.S. and El-Nabtityc, S.M., 2009. Potential Clinical Role of Propolis in Treatment of Clinical Ovine and Caprine Listeriosis. *Vet. Med. J*, 57(4), pp.11-22.



Figure 46: Sheep in late stage of encephalitic listeriosis, the animal was unable to eat due to facial and tongue paralysis and became recumbent.

Photo courtesy: Ismael, A.B., Masoud, E.S.E.S. and El-Nabtityc, S.M., 2009. Potential Clinical Role of Propolis in Treatment of Clinical Ovine and Caprine Listeriosis. *Vet. Med. J*, 57(4), pp.11-22.

Diagnosis

- o Suspected based on clinical signs of asymmetric brain-stem dysfunction with depression
- o Confirmed by means of bacterial culture or immunofluorescence assay
- o Samples of lumbosacral CSF can be collected with the patient under local anesthesia. In cases of listeriosis, the CSF has an increased protein concentration (0.6–2 g/L [normal 0.3 g/L]) and a mild pleocytosis composed of large mononuclear cells.

Table-17: Differential Diagnosis

Disease	Point of differentiation
Pregnancy toxemia	Only in small ruminants
Ketosis	High yielding cattle
Polio-encephalomalacia	Blindness, head pressing, aimless walking, ataxia, recumbency
GID disease	Circling disease of small ruminants.

Treatment

- o Recovery from listeriosis depends on early, aggressive antimicrobial treatment.
- o High doses are required because of the difficulty in achieving minimum bactericidal concentrations in the brain.
- o The survival rate with treatment is lower in cattle exhibiting recumbency, excitement, and a weak or absent menace reflex.

Medication

First choice

- o Procaine G penicillin 200,000 IU per kg body weight IV as an initial loading dose followed by Procaine G penicillin 44,000-66,000 IU per kg body weight IM once daily for 10–14 days. Withdrawal period: Milk 96 hours and meat 10-21 days.

Second choice

- o Oxytetracycline 20mg per kg body weight IV once daily for 10-14 days. Withdrawal period: Milk 96 hours and meat 18-28 days.

Supportive treatment

- o Vit B1 supplement
- o NSAID
- o SAID in severe condition

Prevention and control

- o Management procedures (biosecurity)
 - Change of diet specially silage
 - Improving silage quality

A4.2 Tetanus

A common disease of large animal. Tetanus is an infection caused by bacteria called *Clostridium tetani*. When these bacteria enter the body, they produce a toxin that causes painful muscle contractions. Another name for tetanus is “lockjaw”.

Etiology

- o *Clostridium tetani* (**anaerobe**)
- o *C. tetani*, an anaerobe with terminal, spherical spores, is found in soil, especially cultivated soil, and intestinal tracts.

Susceptible species

- o Cattle, Horse, Goat, Lamb

Epidemiology

- o Worldwide
- o Soil, especially cultivated soil, and intestinal tract are common risk factors

Transmission

- o In most cases, it is introduced into the tissues through wounds, particularly deep puncture wounds, that provide a suitable anaerobic environment.
- o In lambs, however, and sometimes in other species, tetanus often follows docking or castration.
- o Sometimes, the point of entry cannot be found because the wound itself may be minor or healed.
- o Tetanus often follows docking or castration.

Clinical signs and lesions

- o Localized stiffness, often involving the masseter muscles and muscles of the neck, the hind limbs
- o Lock jaw
- o Increased heart rate, rapid breathing, and congestion of mucous membranes.
- o In horses, the ears are erect, the tail stiff and extended, the anterior nares dilated, and the third eyelid prolapsed. Walking, turning, and backing are difficult.



Figure 47: Clinical appearance: rigidity of the body (a); opisthotonus (b); trismus, steepening in the ears, foaming at the mouth (c); inability to stand, steepening in the ears and tail (d); infected and necrotic umbilical cord (e). Photo courtesy: Altuğ, N., Yüksek, N., Karasu, A., İlhan, F., Ceylan, E., Ekin, İ.H. and Arslan, S., 2017. Diagnosis and treatment of umbilical cord-derived tetanus in neonatal calves. Turkish Journal of Veterinary & Animal Sciences, 41(3), pp.317-322.

Diagnosis

- o Based on clinical sign & symptoms
- o Toxin presence confirmed by PCR assay of wound tissue.

Table-18: Differential Diagnosis

Disease	Point of differentiation
Strychnine poisoning	Uncommon in farm animals History- if occur then affect all animals Gut content examination
Grass tetany	History: Mainly occur in lactating animals, Deficiency of Mg Responsive to Mg therapy
Milk fever	Mainly in lactating animals or just after parturition Responsive to Ca therapy
Rabies	Dog bite history Paralysis
Acute laminitis	No convulsion No tetany No response to external stimuli No prolapse of third eyelid
Polioencephalomalacia	No prolapse of third eyelid Leg muscle rigidity but not severe like tetanus Response to Vit B1 therapy @10mg/Kg
Cerebrospinal meningitis	Rigidity to neck Hyperesthesia to touch, sound and movement Immobility rather than excitement No prolapse of third eyelid

Treatment

- o Antibiotic given to stop the multiplication of bacteria Penicillin
- o Ig and ATS
- o Fluid therapy
- o Muscle relaxants

Medication

First choice

High dose Penicillin 44,000 IU per Kg body weight IM once daily for 5-7 days. Withdrawal period: Milk 96 hours and meat 10-21 days.

Second choice

- o Oxytetracycline 15mg per kg body weight IM/IV once daily for 5-7 days. Withdrawal period: Milk 96 hours and meat 18-28 days.

Supportive treatment

- o Tranquilizers, or sedatives should be administered
- o Dextrose saline
- o Advice: Keep the animal in cum and quiet, dark place with comfortable bedding

Prevention and control

- o Management procedures (biosecurity)
 - Hygienic management
 - Early intervention, including wound cleaning, boosting immunity, parenteral antitoxin administration, and muscle relaxants
 - The horse should be placed in a quiet, darkened box stall with feeding and watering devices high enough to allow use without lowering the head.
- o Vaccination
 - Tetanous Toxoid (TT vaccine)

A5 Common diseases of the Urinary System

A5.1 Leptospirosis

Leptospirosis is a common zoonosis acquired by exposure to body fluids, to tissues of infected animals, or to contaminated soil or fresh water. Leptospirosis is a potentially re-emerging, epidemic disease creates a public health problem. It causes an acute, severe, septicemic infection leading to death following multi-organ failure.

Etiology

- o *Leptospira spp*, **Gram-negative** spirochete

Susceptible species

- o Cattle, Sheep, Goat, Buffalo and Horse

Epidemiology

- o Worldwide in distribution.
- o The disease is highly prevalent in India in animals and human beings.
- o Sub-clinical infection - abortion storm, still births and birth of weak calves, infertility, increased culling rate, agalactia, milk drop syndrome (*L. hardjo*) and death rate in - cattle, sheep and horses causes heavy economic losses.

- o Survival of *Leptospira spp* is favored by moisture and moderately warm temperatures; survival is brief in dry soil or at temperatures < 10°C or >34°C.
- o Rodents are the main reservoirs for pathogenic *Leptospira spp*.
- o Predisposing factors
 - o Organism is susceptible to dryness & pH <6 or >8 inhibits the survival.
 - o Temperature < 7-10 °C / >34-36 °C is sensitive to inactivate the organism.
 - o Moisture and dampness increase the incidence of leptospirosis.
 - o In high rainfall area *L. hardjo* and in low rainfall areas *L. pomona* is prevalent.
 - o There is a direct correlation exists between incidence and rainfall
 - o Stagnant water preserves more organism than the flowing water.

Transmission

- o *Transmission among maintenance hosts is often direct and involves contact with infected urine, placental fluids, or milk.*
- o *In addition, the infection can be transmitted venereally or transplacentally.*
- o *Infection of incidental hosts is more commonly indirect, by contact with areas contaminated with urine of subclinically affected maintenance hosts that shed *Leptospira* in their urine.*
- o *Rat is a peri-domiciliary mammal excrete *Leptospira spp* in urine.*
- o *Human contact with contaminated soil and infected materials able to contract the infection.*
- o *Through licking of urine, penetration via abraded/injured skin, mucous membrane and eyes infection mostly occurs in dogs.*
- o *Natural and artificial insemination would spread the infection.*

Clinical signs and lesions

- o *Abortions, weakened offspring, or blood-tinged milk.*
- o *Subclinical infections are common, particularly in the maintenance host. In incidental hosts, leptospirosis is an acute, systemic, often febrile illness characterized by renal or hepatic damage.*
- o *There may be effects on other body systems resulting in clinical problems such as uveitis, pancreatitis, bleeding, hemolytic anemia, muscle pain, or respiratory disease.*
- o *Persistence of the organism in the uterus may result in fetal infection, with subsequent abortion, stillbirth, birth of weak neonates, or birth of healthy but infected offspring.*



Figure 48: Leptospirosis is a common cause of abortion in dairy and beef herds.

Photo courtesy: NADIS (The National Animal Disease Information Service) <https://www.nadis.org.uk/disease-a-z/cattle/leptospirosis-in-cattle/>

Necropsy findings

- o Necropsy showed a marked yellowing pigmentation in all mucosal body openings and in the subcutaneous tissue, fat and muscles. There were also isolated petechia in the kidneys and the bladder contained red-tinged urine

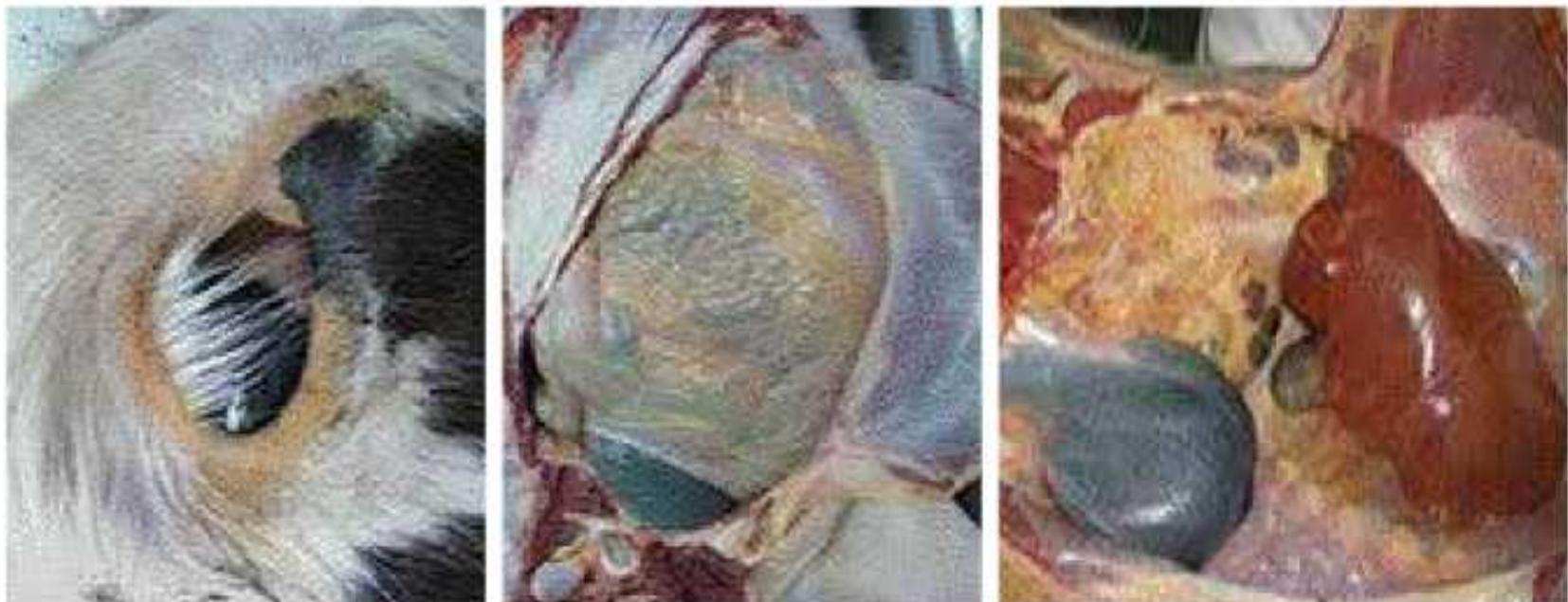


Figure 49: Calf with clinical sign and pathological findings consistent with *Leptospira* infection.

Photo courtesy: Salgado, M., Otto, B., Moroni, M., Sandoval, E., Reinhardt, G., Boqvist, S., Encina, C. and Muñoz-Zanzi, C., 2015. Isolation of *Leptospira interrogans* serovar Hardjoprajitno from a calf with clinical leptospirosis in Chile. *BMC veterinary research*, 11(1), pp.1-4.

Diagnosis

- o Clinical evaluation
- o Diagnosis of *Leptospira* spp. by dark field microscopy
- o Bacterial culture (Gold standard diagnostic method)
- o Combination of serologic testing to detect antibodies and PCR assay to detect organisms.
- o The microscopic agglutination test (MAT) is the most frequently used serologic test to diagnose leptospirosis.
- o An ELISA to diagnose canine leptospirosis is offered by a commercial laboratory

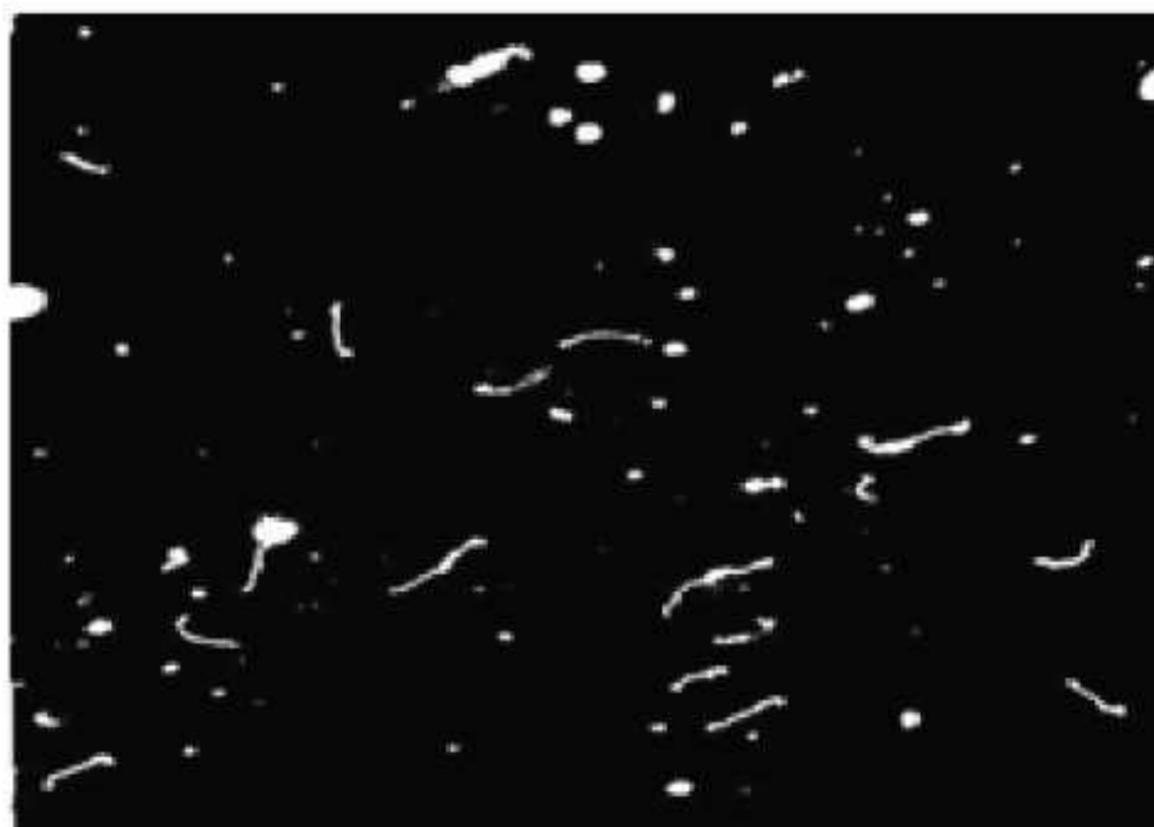


Figure 50: *Leptospira* spp in dark field microscopy (100x) increased.

Photo courtesy: Microbiology Laboratory, Unesp Brazil Dr. Márcia Marinho /2011, Ref: Marinho, M., 2012. Leptospirosis: Epidemiologic Factors, Pathophysiological and Immunopathogenic. Current Topics in Tropical Medicine, p.43.

Table-19: Differential Diagnosis

Disease name	Point of differentiation
Post parturient hemoglobinuria	Where fever is absent, milk is normal, and disease occurs mostly 4-6 weeks after parturition.
Bacillary haemoglobinuria	Where abortions are absent, and milk is normal.
Anaplasmosis	Does not reveal hemoglobinuria and tick history is evident.
Babesiosis	Where milk is normal, and animals have history of presence of ticks.
Chronic copper poisoning	Where body temperature and milk remain normal

Treatment

- o It is necessary that treatment is resorted before the liver or kidney is damaged.
- o The animals can be treated with streptomycin and if organisms are present in urine, it is to be given double doses.
- o Antimicrobial treatment reportedly prevents abortions and other reproductive problems.

Medication

First choice

- o Streptomycin 10mg per kg body weight IM once daily for 3-5 days. Withdrawal period: Milk 48 hours and meat 12 days.

Second choice

- o Oxytetracycline 11mg per kg body weight IM/IV once daily for 5-7 days. Withdrawal period: Milk 96 hours and meat 18-28 days.
OR
- o Ceftiofur hydrochloride 1.1-2.2mg per kg BW IM once daily for 3-5 days. Withdrawal period: Milk 0 days and meat 3 days.

Prevention and control

- o Management procedures (biosecurity)
 - Avoidance of exposure to free-ranging wildlife and domestic animals that may be maintenance hosts for *Leptospira* is difficult because rodents, found in rural and urban environments.
 - Considering the correction of environmental/management factors, subdivision of animals into smaller batches, soil sealing, and regular cleaning of milking sectors have been demonstrated to significantly reduce the exposure of animals to leptospire.
- o Vaccination
 - The cornerstone of leptospirosis prevention is vaccination with polyvalent inactivated vaccines

A5.2 Contagious Bovine Pyelonephritis

Bovine cystitis is a disease of cattle characterized by ascending bacterial infection and inflammation of the urinary tract, with clinical signs including pyuria, hematuria, and stranguria. Some infected animals show signs including decreased appetite and abdominal pain.

Etiology

- o *Corynebacterium renale* (**Gram-positive**) group of bacteria, including *C. renale* (Type I), *C. pilosum* (Type II), and *C. cystitidis* (Type III),

- o *E. coli* (**Gram-negative**)
- o *Staphylococcus spp* (**Gram-positive**)
- o *Proteus spp* (**Gram-negative**)
- o *Streptococcus spp* (**Gram-positive**)
- o *Trueperella pyogenes* (**Gram-positive**) (formerly *Arcanobacterium* or *Corynebacterium*).
- o Other opportunistic and environmental bacteria may be involved as well.

Susceptible species

- o Cattle

Epidemiology

- o Risk factors:
 - o Cystitis and pyelonephritis are most often seen after parturition.
 - o Multiparous cows are at highest risk.
 - o Cystitis and pyelonephritis are rare in male cattle.
 - o The stresses of parturition, peak lactation, and a high-protein diet (which increases the pH of the urine and is therefore conducive to colonization of the urinary tract by *Corynebacterium spp*) are all contributing factors.
- o Prevalence: low (< 1%–2%).

Transmission

- o *From environment: The most common causative bacteria are ubiquitous in the environment and are common inhabitants of the vagina and prepuce. Pyelonephritis develops from an ascending infection from the bladder.*
- o *Catheterization of the bladder with nonsterile catheters may facilitate transmission of Corynebacterium spp from cow to cow*

Clinical signs

- o *The first clinical sign may be the passage of blood-stained urine in an otherwise healthy cow.*
- o *As the infection proceeds up the ureters, causing inflammation and subsequent involvement of the kidney, the animal exhibits discomfort manifest by frequent attempts to urinate, anorexia, a slight fever, loss of production, colic with restlessness, tail switching, polyuria, hematuria, or pyuria.*
- o *In chronic cases, the animal may show colic, diarrhea, polyuria, polydipsia, stranguria, and anemia.*
- o *As the disease progresses, the bladder becomes thickened and inflamed.*
- o *The ureters become thickened and dilated with a purulent exudate.*
- o *The involved kidneys develop multiple small abscesses on the surface that may extend into the cortex and medulla.*



Figure 51: Large blood clot protruding from the vulva of a cow with acute pyelonephritis. The visible clot was part of a larger clot occluding the urethra, causing the animal to show signs of colic.
Photo courtesy: <https://veteriankey.com/urinary-tract-diseases/>



Figure 52: Hematuria and pyuria in a bull with *C. renale* pyelonephritis.
Photo courtesy: <https://veteriankey.com/urinary-tract-diseases/>

Necropsy findings

- o Pyelonephritis and a markedly smaller, fibrotic right kidney.

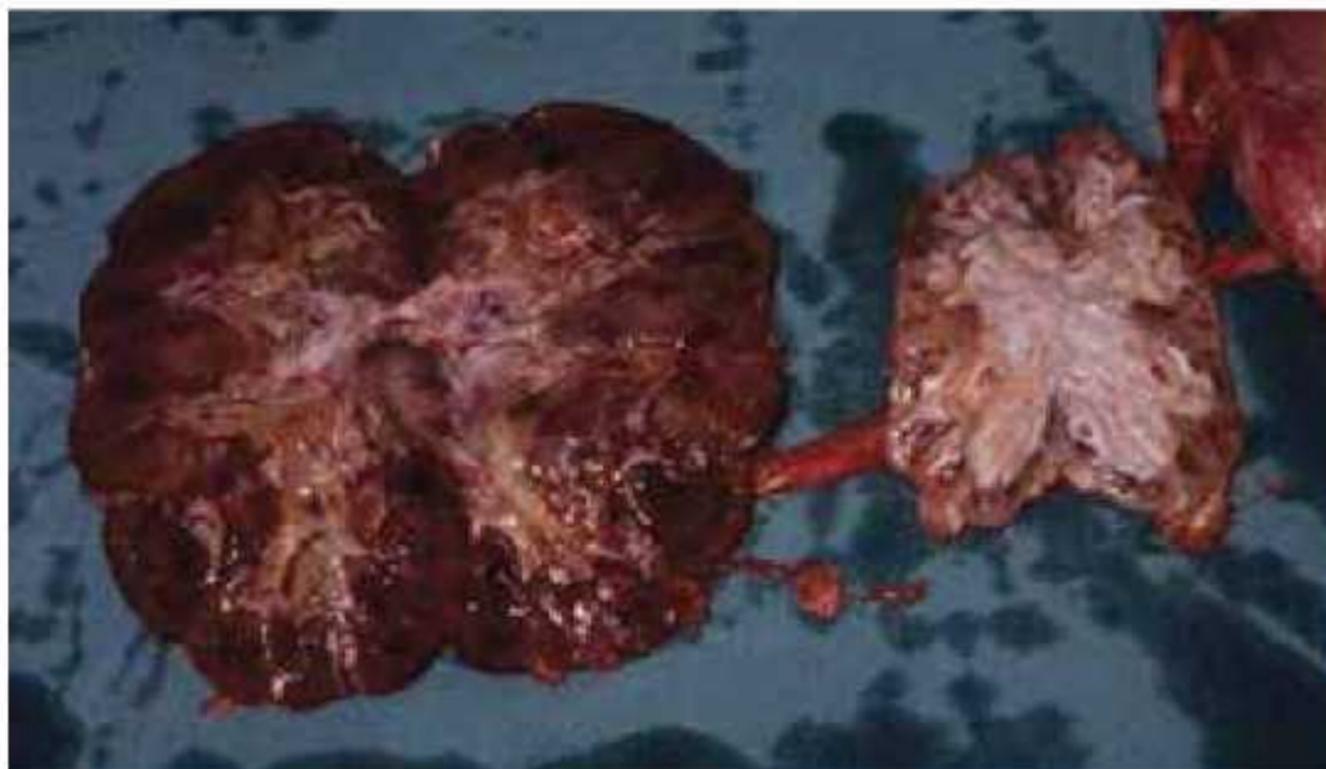


Figure 53: Necropsy of the kidneys of adult cow with chronic (right) and acute (left) pyelonephritis (left) in an adult cow. The cut sections reveal chronic pyelonephritis and a markedly smaller, fibrotic right kidney. Photo courtesy:

<https://www.msdsvetmanual.com/urinary-system/infectious-diseases-of-the-urinary-system-in-large-animals/bovine-cystitis-and-pyelonephritis>

Diagnosis

- o Diagnosis of bovine cystitis and pyelonephritis is based on clinical signs
- o History: hematuria; a history of recent parturition
- o Clinical examination: palpation of the left kidney for enlargement, loss of lobulation, and pain;
- o ultrasonographic inspection of the kidneys, ureters, and bladder;
- o microscopic examination of the urine for WBCs and bacteria;
- o dipstick screening for proteinuria and hematuria;
- o Catheterization of the bladder, and culture and susceptibility testing of bacterial isolates

Table-20: Differential Diagnosis

Disease/ condition	Differentiating points
Urolithiasis	Anuria
Cystitis or Embolic nephritis	Difficult to differentiate except USG

Treatment

- o Prolonged antimicrobial treatment; consider changing urine pH via diet
- o Unilateral nephrectomy in nonresponsive cases that involve only one kidney
- o Early diagnosis and prompt, sustained treatment are needed for a successful recovery from bovine cystitis and pyelonephritis.

Medication

For *Corynebacterium spp*:

First choice

- o Procaine G penicillin 22,000 IU per kg body weight IM twice daily for 5 days. Withdrawal period: Milk 96 hours and meat 10-21 days.
- OR
- o Trimethoprim-sulfadoxine 16 mg combined/kg, IM/IV, twice a day for ≥ 3 weeks. Withdrawal period: Milk 96 hours and meat 10 days.

For *E. coli*:

First choice

- o Gentamicin 2.2 mg per kg body weight IM twice daily for ≥ 3 weeks. Withdrawal period: Milk 10 days and meat 180 days.

Second choice

- o Ceftiofur 1.1-2.2mg per kg body weight IM/SC once daily for 3-5 days. Withdrawal period: Milk 0 days and meat 3 days.

Prevention and control

- o Management procedures (biosecurity)
 - Shed hygiene must be maintained

A6 Common diseases of the Muscular System

A6.1 Blackleg/Black quarter

Blackleg is an acute febrile disease primarily affecting cattle and sheep, with worldwide occurrence.

Etiology

- o *Clostridium chauvoei* (feseri), spore-forming, rod-shaped bacterium.
- o An **anaerobic**, soilborne bacterium and is almost always lethal.

Susceptible species

- o Cattle, Sheep, Goat and Buffalo

Epidemiology

- o The disease incidence shows a seasonal pattern, with peak incidences observed during the warmer period of the year.
- o In general, several animals of a herd or flock are affected within a short period of time. The disease is enzootic in particular areas, especially when they are subject to flooding.
- o The case-fatality rate in blackleg approaches 100%.
- o There appears to be an increased disease incidence in years of high rainfall, which has been explained by increased anaerobiosis in water-saturated soils in combination with enhanced pasture growth stimulating feed intake of pastured cattle.
- o Outbreaks of blackleg in cattle have occurred following excavation of soil, which suggests that
- o disturbance of the soil may expose and activate latent spores.
- o In the field, risk factors include rapidly growing cattle and a high plane of nutrition.

Transmission

- o The spores are normally found in soil and are highly resistant to environmental changes and disinfectants and persist in soil for many years.
- o Whereas in cattle the disease usually occurs without a history of trauma, in sheep, skin wounds from shearing, docking, and vulvar or vaginal lacerations from parturition or the fresh navel at birth are the most common routes through which *C. chauvoei* penetrates and infects muscle tissue to cause clinical disease.

Clinical signs

- o Lameness and pronounced swelling of upper limb in cattle
- o A stiff gait, and the sheep is disinclined to move because of severe lameness in one limb or, more commonly, in several limbs
- o High temperature (41° C; 106° F) and pulse rate (100 to 120/min)
- o High case-fatality rate and may be found dead
- o Histologically, blackleg cases feature myonecrosis, edema, emphysema, and an unimpressive neutrophilic cellulitis.
- o Severe toxemia
- o The clinical syndrome in horses is not well defined. Pectoral edema, stiff gait, and incoordination are recorded

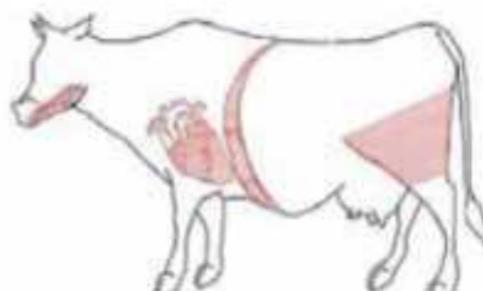


Figure 54: Most commonly affected sites in blackleg cases.

Photo courtesy: https://www.researchgate.net/figure/Gross-lesions-of-blackleg-in-cattle-A-Most-commonly-affected-sites-in-blackleg-cases_fig4_317495822

Necropsy findings

- o Myositis
- o Dark, rancid odor
- o Sanguineous fluid containing bubbles of gas
- o Metallic sheen on the cut surface
- o Myonecrosis of skeletal or cardiac muscles



Figure 55: Pathological and anatomical changes in cattle with blackleg: (A) foamy, bloody liquid from the eyes; (B) haemorrhagic-necrotic myositis; (C) gross hemorrhage in the heart; (D) hemorrhage in the serous membrane of a scar.

Photo courtesy: <https://www.frontiersin.org/articles/10.3389/fvets.2022.872386/full>

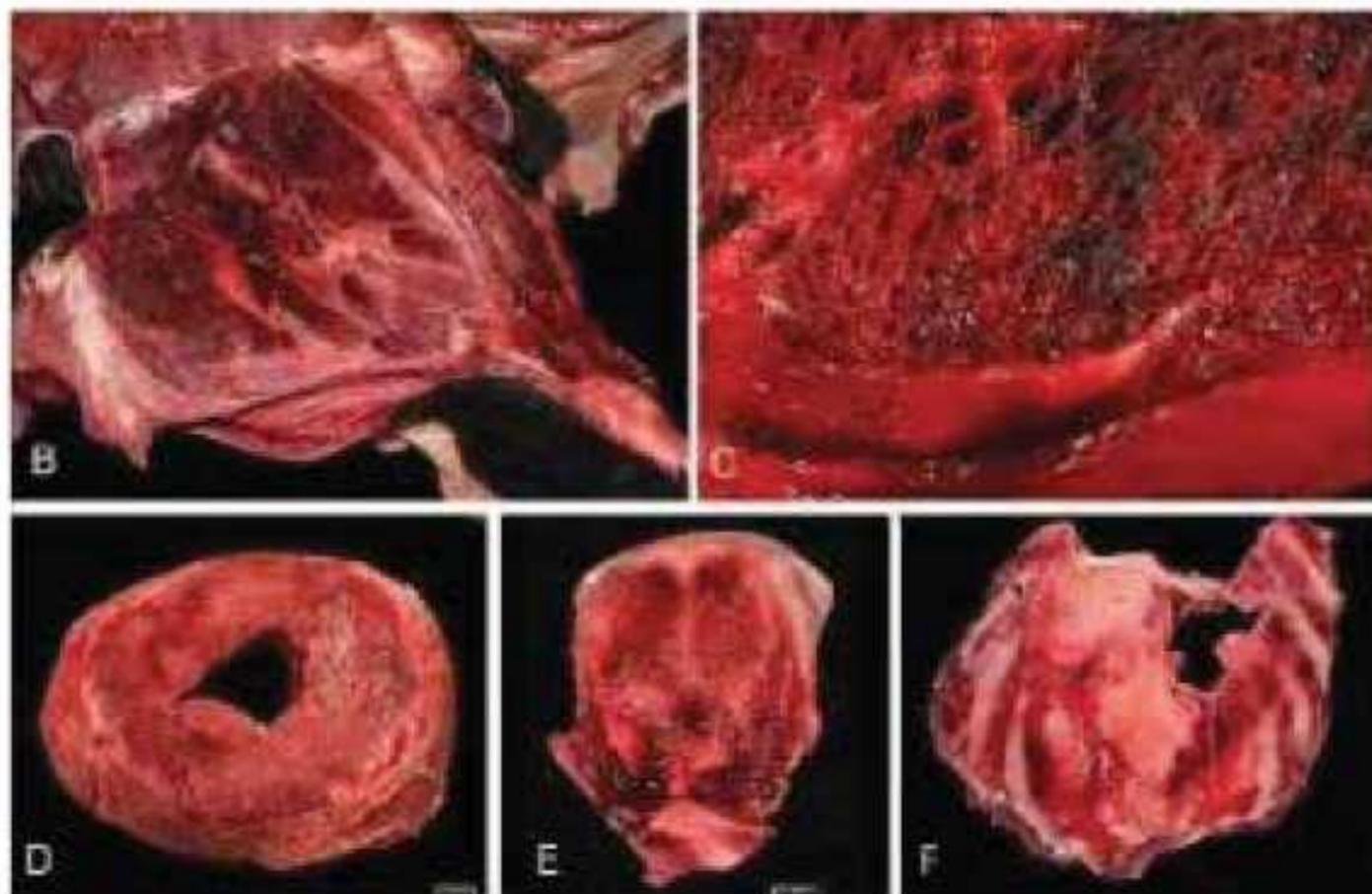


Figure 56: Gross lesions of blackleg in cattle. B. Classic blackleg necrohemorrhagic myositis in the hindlimb. C. Necrohemorrhagic myositis in hindlimb skeletal muscle with prominent emphysema. D. Necrohemorrhagic myocarditis and fibrinous epicarditis. E. Necrohemorrhagic glossitis primarily affecting the ventral portions of the tongue. F. Necrohemorrhagic myositis of the diaphragm with rib impressions. Photo courtesy: https://www.researchgate.net/figure/Gross-lesions-of-blackleg-in-cattle-A-Most-commonly-affected-sites-in-blackleg-cases_fig4_317495822

Diagnosis

- o Clinical evaluation
- o Fluorescent antibody identification of *C. chauvoei* in lesion.

Table-21: Differential Diagnosis

Disease name	Point of differentiation
Malignant edema	No gas production in muscle
Bacillary hemoglobinuria	Anemia, free and clotted blood in intestinal lumen
Acute lead poisoning	Sudden death but no lesion in muscle like BQ

Treatment

- o Treatment of affected animals with antibiotic and surgical debridement of the lesion, including fasciotomy, is indicated if the animal is not moribund.
- o Penicillin G (IV) is preferable in early stage of the disease followed by procaine penicillin
- o Recovery rates are low because of the extensive nature of the lesions.
- o Blackleg antiserum is unlikely to be of much value in treatment unless very large doses are given.

Medication

First choice

- o Penicillin 44,000 IU per Kg body weight IM once daily for 5-7 days. Withdrawal period: Milk 96 hours and meat 10-21 days.

AND

- o Penicillin G 40,000 IU per Kg body weight IV once daily as initial dose followed by Procaine Penicillin 44,000 IU per Kg body weight IM once daily for 5-7 days for 5-7 days. Withdrawal period: Milk 96 hours and meat 10-21 days.

Prevention and control

- o In both sheep and cattle, it is advisable to use a combined vaccine containing at least *C. chauvoei*, *C. septicum*, and *C. novyi*, where these organisms occur in the area and cause clostridial myositis.
- o But in Bangladesh only vaccines containing *C. chauvoei* are available.
- o In an outbreak, all unaffected animals should be vaccinated immediately and injected with penicillin intramuscularly. Penicillin 44,000 IU per kg body weight IM once daily for 3 days.

A6.2 Actinobacillosis (Wooden tongue)

Wooden tongue is a well-defined disease of the soft tissues of the mouth region in adult cattle.

Etiology

- o Actinobacillus lignieresii, Gram negative, coccobacilli

Susceptible species

- o Cattle, Buffalo, Sheep, Horses

Epidemiology

- o Infection through abrasion of oral mucosa or skin.
- o Sporadic disease but outbreaks in which herd/flock predisposing factors are present
- o There is a higher prevalence of this disease in cattle in areas of copper deficiency.

Clinical signs

- o Difficulty in prehension of food.
- o Inflammation and abscessation of tongue and draining lymph nodes in cattle and of lips in sheep
- o Nodular/proliferative skin lesions most common on head, neck, or lower limbs.



Figure 57: A cow with swollen tongue in Actinobacillosis,
Photo courtesy: https://www.wlj.net/top_headlines/wooden-tongue-in-cattle-can-lead-to-weight-loss/article_a22af7ce-0fc5-11eb-b8f7-23e7d08af8bb.html

Diagnosis

- o Clinical signs, culture and lesions.
- o Pus from the abscesses may show club-like spicules of calcium phosphate, giving the appearance of sulfur granules < 1 mm in diameter.

Table-22: Differential Diagnosis

Disease	Point of differentiation
Lumpy jaw	Painless, excessive swelling of the maxilla and mandible may cause dyspnea. The swellings are very hard, immovable and painful to the touch.
Tetanus	Lock jaw and wooden horse like appearance

Treatment

- o Sodium iodide is the treatment of choice in ruminant actinobacillosis
- o Systemic antibacterial agents, such as penicillin, ampicillin, florfenicol, and tetracyclines may be effective and are primarily recommended in severe cases of actinobacillosis

Medication

First choice

- o Streptomycin 10mg per kg body weight IM once daily for 3-5 days. Withdrawal period: Milk 48 hours and meat 12 days.
OR
- o Florfenicol 20mg per kg body weight IM once every two days for 2 times. Withdrawal period: Milk-not recommended for milking cow and meat 28 days if IM, 38 days if SC.
OR
- o Procaine penicillin 44,000 IU per kg body weight IM once every 7 days. Withdrawal period: Milk 96 hours and meat 10-21 days.

Second choice

- o Oxytetracycline 10 mg per kg body weight IM once daily for 7 days. Withdrawal period: Milk 96 hours and meat 18-28 days.
OR
- o Oxytetracycline long-acting 20 mg kg body weight IM single dose, repeat after 72 hours. Withdrawal period: Milk 96 hours and meat 18-28 days.

Supportive treatment

- o Sodium-iodide (as 10% or 20% solution) (70 mg per kg body weight IV, repeated after 7-10 days)
- o Potassium-iodide (6-10 g per animal orally once daily for 10 days)

Prevention and control

- o Wooden tongue is prevented primarily by avoiding coarse feed or feed particles
- o Isolation or disposal of animals with discharging lesions

A7 Common diseases of the Musculo-skeletal System

A7.1 Actinomycosis (Lumpy jaw)

Lumpy jaw is a localized, chronic, progressive, granulomatous abscess that most frequently involves the mandible, the maxillae, or other bony tissues in the head.

Etiology

- o *Actinomyces bovis*
- o Gram-positive, anaerobic bacteria.

Susceptible species

- o Cattle, Buffalo, Swine, Horses, Goats

Epidemiology

- o Worldwide distribution
- o Organism is a common inhabitant of the bovine mouth.

Clinical signs and lesions

- o Painless, bony swelling that appears on the mandible or maxilla
- o The swellings are very hard, immovable and painful to the touch.
- o They usually break through the skin and discharge through one or more openings
- o The discharge of pus is small in amount and consists of sticky, honey-like fluid containing minute, hard, yellow-white granules.
- o Excessive swelling of the maxilla may cause dyspnea.



Figure 58: Cow with actinomycosis of the left mandible, Photo courtesy: Radostits, O.M., Gay, C., Hinchcliff, K.W. and Constable, P.D. eds., 2006. *Veterinary Medicine E-Book: A textbook of the diseases of cattle, horses, sheep, pigs and goats.* Elsevier Health Sciences. pp 570.



Figure 59: Cow with actinomycosis of the left mandible with a draining tract, Cow with actinomycosis of the left mandible, Photo courtesy: Radostits, O.M., Gay, C., Hinchcliff, K.W. and Constable, P.D. eds., 2006. *Veterinary Medicine E-Book: A textbook of the diseases of cattle, horses, sheep, pigs and goats.* Elsevier Health Sciences. pp 570.

Diagnosis

- o Presumptive diagnosis of actinomycosis is often based on history and clinical signs.
- o The diagnosis can be confirmed by culture of the organism from the lesion
- o Gram stain of purulent material will reveal gram-positive, club-shaped rods and filaments (sulfur granules).

Table-23: Differential Diagnosis

Disease	Point of differentiation
Wooden tongue	Swollen tongue and nodular skin lesions
Tetanus	Stiffness of limb and history if deep injury
Localized abscess of the mandibular region	Abscess in mandibular region and drainage of pus
Firbous osteodystrophy	Rubbery jaw syndrome

Treatment

- o The goal of treatment for actinomycosis is to kill the bacteria and stop the spread of the lesion.
- o The causal agent is gram positive organism so choice of drug should be penicillin derived antibiotic
- o Other supportive treatment should be given as per clinical symptoms

Medication

First choice

- o Procaine penicillin 44,000 IU per kg body weight IM once daily for 7 days. Withdrawal period: Milk 96 hours and meat 10-21 days.
OR
- o Oxytetracycline 10 mg per kg body weight IM once daily for 7 days. Withdrawal period: Milk 96 hours and meat 18-28 days.
OR
- o Oxytetracycline long-acting 20 mg kg body weight IM single dose and repeat after 72 hours, Withdrawal period: Milk 96 hours and meat 18-28 days.

Second choice

- o Florfenicol 20 mg per kg body weight IM/SC once daily for 5-7 days. Withdrawal period: Milk-not recommended for milking cow and meat 28 days if IM, 38 days if SC.

Supportive treatment

- o Sodium-iodide (as 10% or 20% solution) (70 mg per kg body weight IV, repeated after 7-10 days)
- o Potassium-iodide (6-10 g per animal orally once daily for 10 days)

Prevention and control

- o Avoiding of coarse feed or feed particle that might damage the mucosal epithelium.

A7.2 Arthritis

Inflammation of the joint is called arthritis. Actually, arthritis is the inflammation of the synovial membrane and articular surfaces of the joint.

Etiology

- o Streptococcus spp (Gram-positive), Staphylococcus spp (Gram-positive), Chlamydia spp (atypical), E.coli (Gram-negative), Salmonella spp (Gram-negative), Mycoplasma spp (atypical)

Susceptible species

- o Cattle, Buffalo, Swine, Horses, Goats

Epidemiology

- o Worldwide distribution
- o Most commonly in young via naval infection

Clinical signs and lesions

- o Acute – sudden onset, severe pain, very lame, sore to touch, swelling and heat in joint
- o Chronic – continuous pain, recumbence, joint may be visibly swollen but normal appearance, pain may be evidence only when animal stands on joint



Figure 60: A) A calf suffering from chronic septic arthritis. (B) The calf's subcutaneous carpal bursa with an encrusted area in a dorso-medial position along the carpus. (C) Removal of the encrusted material after euthanasia revealed purulent secretion. (D) Preparation of the carpal joint for swab sampling. Photo courtesy: Jost, A. and Sickinger, M., 2021. *Helicobacter* associated with septic arthritis and bursitis in calves—a case report. *BMC Veterinary Research*, 17(1), pp. 1-6.

Diagnosis

- o Based on clinicopathological examination
- o Radiography is a useful adjunct for diagnosis

Treatment

- o Successful treatment in the early stages of synovitis will minimize or avoid changes in articular cartilage and bone and healing will result.
- o The antibiotics which are known to perfuse into the joint in therapeutic concentration include penicillin, tetracycline, streptomycin, neomycin, gentamicin and kanamycin

Medication

For Streptococcus spp, Staphylococcus spp:

First choice

- o Procaine G penicillin 20,000 IU per kg body weight IM once daily for 5-7 days. Withdrawal period: Milk 96 hours and meat 10-21 days.
OR
- o Ampicillin 10-15mg per kg body weight PO/IM twice daily for 5-7 days. Withdrawal period: Milk 48 hours and meat 6 days.
OR
- o Amoxicillin 10-15mg per kg body weight PO/IM twice daily for 5-7 days. Withdrawal period: Milk 96 hours and meat 25 days.

Second choice

- o Ceftiofur 1.1-2.2mg per kg body weight IM/SC once daily for 3-5 days. Withdrawal period: Milk 0 days and meat 3 days.

For E. coli, Salmonella spp:

First choice

- o Gentamicin 2.2-6.6 mg per kg body weight IM once/twice daily for 5-7 days. Withdrawal period: Milk 5 days and meat 180 days.
OR
- o Trimethoprim-sulfonamide 25 mg per kg body weight IM/IV once daily for 5-7 days. Withdrawal period: Milk 96 hours and meat 10 days.

Second choice

- o Ceftiofur 1.1-2.2mg per kg body weight IM/SC once daily for 3-5 days. Withdrawal period: Milk 0 days and meat 3 days.

For Chlamydia spp, Mycoplasma spp:

First choice

- o Oxytetracycline 10mg per kg body weight IM/IV once daily for 5 days (Cattle). Withdrawal period: Milk 3 days and meat 21 days.
OR
- o Florfenicol 20mg per kg body weight IM once every two days for 2 times. Withdrawal period: Milk-not recommended for milking cow and meat 28 days if IM, 38 days if SC.

Supportive treatment

- o SAIDs
- o NSAIDs
- o Management corrections in calf shed

Prevention and control

- o Sufficient colostrum should be given newly borne baby

A7.3 Navel ill

Navel ill or joint ill is a condition characterized by inflammation, as a result of infection, in the umbilicus and its associated structures. It occurs commonly in neonatal farm animals and appears to be particularly common in calves delivered in dirty environments.

Etiology

- o Streptococcus spp (Gram-positive), Staphylococcus spp (Gram-positive), E.coli (Gram-negative), Proteus spp (Gram-negative)

Susceptible species

- o Cattle, Buffalo, Swine, Goats

Epidemiology

- o The occurrence of navel ill in the age of <30 days was noted higher compared to the age of ≥30 days.
- o Male calves were highly susceptible compared to females.
- o In cross breed individuals, the occurrence was higher in regard of indigenous calves.
- o The occurrence of the illness in summer (March-June) was more common in comparison to both rainy and winter seasons.

Transmission

- o The infection can be transmitted through contamination of umbilicus of calve by feces, uterine discharge from infected dams, soils and bedding of contaminated pens.
- o Predisposing factors: This problem mainly develops due to the poor hygiene conditions at calving and dirty umbilicus.

Clinical signs

- o The umbilicus is typically hot, painful, and moist.
- o The calf is dull and reluctant to suck and may stand with an arched back.
- o It is essential to determine whether the bacterial infection has spread further into the peritoneal cavity, liver and bloodstream with possible localization in joints and the brain.

- o In older calves the umbilical infection may be limited to an abscess at the navel.
- o Spread of infection from the umbilicus into the peritoneal cavity leading to septic peritonitis causes rapid deterioration in the calf's condition, abdominal distension caused by gut stasis, and death within 2-3 days.
- o The umbilicus is typically hot, painful, and moist.
- o Potential for spread further into the peritoneal cavity, liver and bloodstream with possible localization in joints and the brain.



Figure 61: Umbilical infection with large abscess at the navel in calf,
 Photo courtesy: <https://www.nadis.org.uk/disease-a-z/cattle/joint-ill-navel-ill-of-calves/>



Figure 62: Umbilical abscesses with needle aspiration of pus,
 Photo courtesy: <https://www.nadis.org.uk/disease-a-z/cattle/joint-ill-navel-ill-of-calves/>

Diagnosis

- o Diagnosis is based upon a thorough clinical examination taking care to check for other focal bacterial infections.
- o Ultrasonography is useful to investigate involvement of the umbilical vessels and urachus, and to differentiate a hernia from an umbilical abscess.

Table-24: Differential diagnoses

Disease	Point of differentiation
Umbilical hernia	Diagnosed by finding the swelling caused by the hernia on a physical examination specially palpation.

Treatment

- o Penicillin for 5-7 days remains the antibiotic of choice for umbilical infections.
- o Other antibiotics may be prescribed by a veterinary surgeon for calves with meningitis and polyarthritis following septicemia.
- o Umbilical abscesses can be lanced after needle aspirate or ultrasonography, then flushed daily for three to five days.

Medication

For *Streptococcus* spp, *Staphylococcus* spp:

First choice

- o Procaine G penicillin 20,000 IU per kg body weight IM once daily for 5-7 days. Withdrawal period: Milk 96 hours and meat 10-21 days.
OR
- o Ampicillin 10-15mg per kg body weight PO/IM twice daily for 5-7 days. Withdrawal period: Milk 48 hours and meat 6 days.
OR
- o Amoxicillin 10-15mg per kg body weight PO/IM twice daily for 5-7 days. Withdrawal period: Milk 96 hours and meat 25 days.

Second choice

- o Ceftiofur 1.1-2.2mg per kg body weight IM/SC once daily for 3-5 days. Withdrawal period: Milk 0 days and meat 3 days.

For E. coli:

First choice

- o Gentamicin 2.2-6.6 mg per kg body weight IM once/twice daily for 5-7 days. Withdrawal period: Milk 5 days and meat 180 days.

OR

- o Trimethoprim-sulfonamide 25 mg per kg body weight IM/IV once daily for 5-7 days. Withdrawal period: Milk 96 hours and meat 10 days.

Second choice

- o Ceftiofur 1.1-2.2mg per kg body weight IM/SC once daily for 3-5 days. Withdrawal period: Milk 0 days and meat 3 days.

For Proteus spp:

First choice

- o Oxytetracycline 10mg per kg body weight IM/IV once daily for 5 days (Cattle). Withdrawal period: Milk 96 hours and meat 18-28 days.

Prevention and control

- o Maintain strict hygiene in the calving environment.
- o Calf should be kept separated from dam and bottle fed
- o Treat the umbilical remnant at birth, and 2-4 hours later with iodine where possible.
- o Ensure adequate and timely colostrum ingestion (good quality colostrum during the first 6 hours of life but preferably within the first two hours).

A8 Common diseases of the Circulatory System

A8.1 Babesiosis

It is a tick borne hemo-protozoan infectious disease of domestic animals and men caused by genus *Babesia* spp. and characterized by fever, hemoglobinemia and hemoglobinuria.

Etiology

- o Cattle and Buffalo: *Babesia* (*B.*) *bovis*, *B. bigemina*, *B. divergens*, *B. major*
- o Sheep and Goat: *B. ovis*, *B. motasi*
- o Horse: *B. equi*, *B. caballi*

Susceptible species

- o Cattle, Buffalo, Sheep, Goat and Horse

Epidemiology

- o Distribution: Worldwide especially tropical and sub-tropical region (Asia, Africa, North Central America, Australia)

- o Age
 - o Subclinical infection: <6 months of age
 - o Clinical infection: 6 months to 5 years
 - o Usually uncommon: >5 years
- o Breed: Exotic breed are more susceptible than local breed
- o Season: More prevalence in summer season

Transmission: by ticks

- o Trans-stadial transmission
- o Trans-ovarian transmission
- o Vertical transmission
- o Iatrogenic transmission
- o Sometimes intra-uterine transmission

Clinical signs

Acute form

- o High fever (106°F)
- o Hemoglobinuria (Dark red to brown color urine (coffee color) and sometimes frothy)
- o Brick red conjunctiva and soon change to paler and severe anemia, jaundice in terminal stage
- o Cerebral babesiosis: Hyperesthesia, circling, ataxia, nystagmus, head pressing, aggression, convulsion
- o Bull: temporary infertility and sometimes diarrhea; pregnant cow: may abortion

Sub-acute form

- o Mild fever
- o Hemoglobinuria may be absent



Figure 63: Clinical signs of babesiosis in naturally infected cow showing icteric vaginal mucous membrane (A) and dark red to brown urine (B),

Photo courtesy: Hashem, M., Neamat-Allah, A.N. and Gheith, M.A., 2018. A study on bovine babesiosis and treatment with reference to hematobiochemical and molecular diagnosis. *Slovenian Veterinary Research*, 55(Suppl 20), pp.165-173.

Lesions

- o Jaundice and pale tissues
- o Thin, watery blood
- o Enlargement of the spleen, which has a soft, pulpy consistency
- o Gross enlargement and dark-brown discoloration of the liver.
- o The gallbladder is distended, with thick, granular bile
- o Kidneys are enlarged and dark; and the bladder contains red-brown urine.

Diagnosis

- o Diagnosis based on clinical history, clinical signs and laboratory diagnosis
- o Laboratory diagnosis: Peripheral blood collection ☒ Thin and thick smear ☒ Giemsa stain ☒ Piroplasm found (confirmatory)

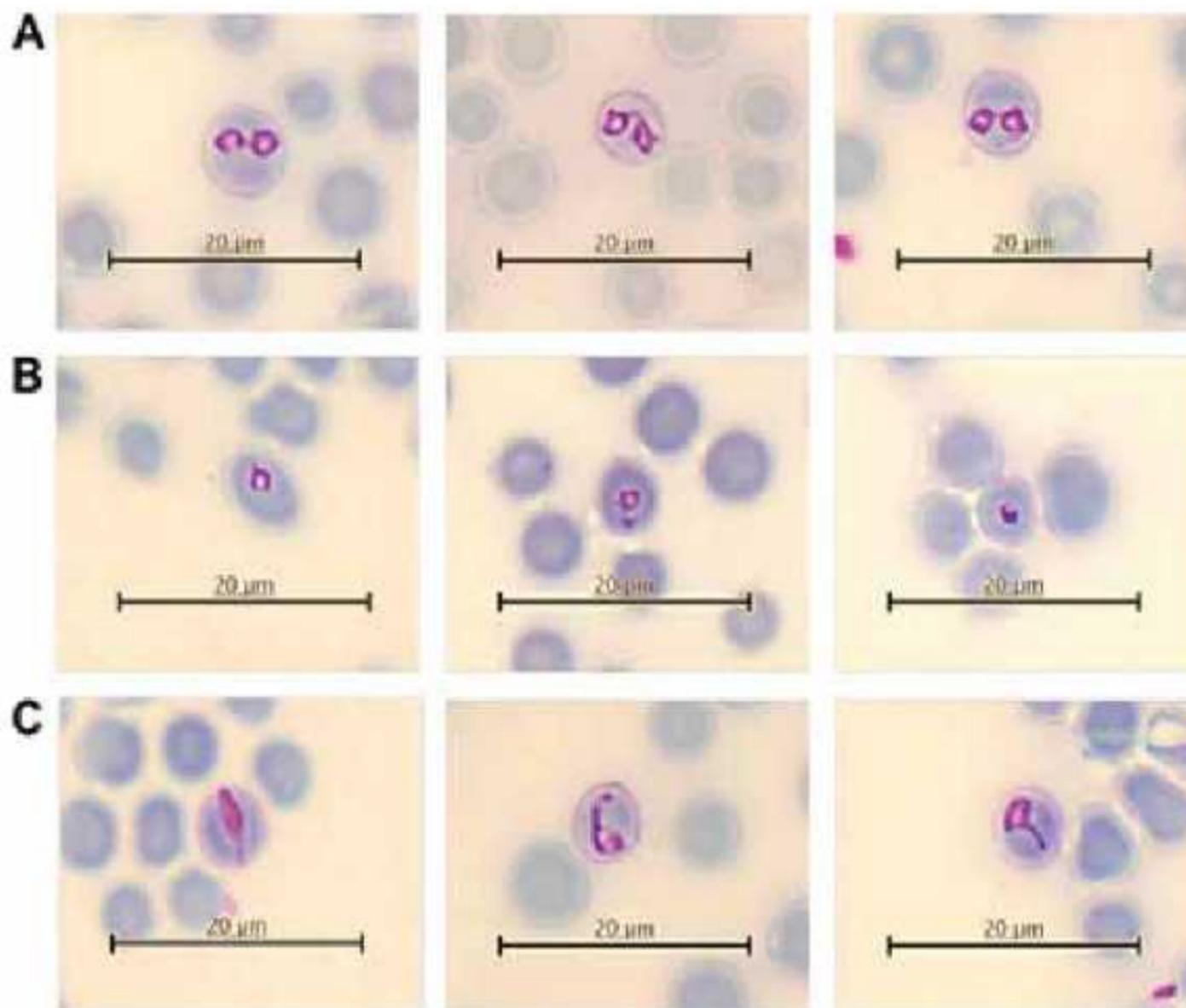


Figure 64: Giemsa-stained blood smear of naturally infected cow showing intra-erythrocytic Paired Pyriform (Pear-shape) (A), ring forms (B), and elongated and irregularly shaped single forms (C) of *Babesia* spp.

Photo courtesy: Sivakumar, T., Tuvshintulga, B., Zhyldyz, A., Kothalawala, H., Yapa, P.R., Kanagaratnam, R., Vimalakumar, S.C., Abeysekera, T.S., Weerasingha, A.S., Yamagishi, J. and Igarashi, I., 2018. Genetic analysis of *Babesia* isolates from cattle with clinical babesiosis in Sri Lanka. *Journal of clinical microbiology*, 56(11), pp.e00895-18.

Table-25: Differential Diagnosis

Diseases	Differentiating signs
Anaplasmosis	Normal urine Intermittent fever
Theileriosis	Grossly visible swollen lymph nodes Liver biopsy: Schizonts (Koch blue bodies) may find in lymphocytes
Post parturient hemoglobinuria	Caused by deficiency of phosphorus Occurs just immediate after parturition No fever
Leptospirosis	Strom of abortion (Late) Occurs only in this form of the disease in calves kept in unsanitary conditions that are wet underfoot Dark field microscope: spirochaete is present
Bacillary hemoglobinuria	Abdominal pain due to liver damage Deep red brown color urine but no cells Concurrent Fasciola infection in coproscopic examination Blood test: Increase SGPT level in blood
Chronic copper poisoning	Sudden blindness Death usually in 24-48 hours Response to treatment

Treatment

- o Primary treatment is aimed at killing the protozoa in the sick animals. Drugs such as diminazene aceturate (cattle) and imidocarb dipropionate (sheep) are mainly used against *Babesia spp.*
- o Oxytetracycline has been used extensively, but its use in acutely sick animals has been discontinued.

Medication

First choice:

- o Diminazene aceturate 3-5mg per kg body weight (Cattle), 5mg per kg body weight (Horse) IM once daily for two successive days. Withdrawal period: Milk 3 days and meat 20 days.
- OR
- o Imidocarb di-propionate 1-2mg per kg body weight (Cattle) SC (IM less preferable) single dose and repeat the dose after 7 days; 4.4mg per kg body weight (Horse) IM, 72 hours interval for 4 times. Withdrawal period: Milk 3 days and meat 21 days.
- o In case of outbreak, Imidocarb di-propionate 3mg per kg body weight SC, once daily for 4 weeks. Withdrawal period: Milk 3 days and meat 21 days.

Supportive treatment: Antipyretic drug, Hematinic drug and intravenous infusion (saline)

Prevention and control

- o Isolation and quarantine
- o *Very difficult to eradicate from enzootic country due to*
 - o Wide range of vectors carry the infection
 - o Long period of infectivity in carriers
 - o Presence of carrier in wild population
- o *Tick control*
 - o Very difficult to control if wild animals present
 - o Acaricides can be used against vectors

A8.2 Anaplasmosis

It is a vector borne infectious disease of ruminants characterized by variable degree of pyrexia, progressive emaciation, anemia and constipation.

Etiology

Small, coccobacilli, obligatory intracellular **Rickettsia**

- o Cattle and wild ruminants: *Anaplasma (A.) marginale*, *A. caudatum*
- o Cattle (mild disease): *A. phagocytophilum*, *A. centrale*
- o Sheep and Goat: *A. ovis*, *A. marginale*, *A. phagocytophilum*
- o Horse: *A. phagocytophilum*

Susceptible species

- o Cattle, Buffalo, Sheep, Goat, Horse and Wild Ruminants

Epidemiology

- o Distribution: Worldwide but most common in tropical region.
- o Age
 - o More in adult (6 months-3 years) than young
 - o Subclinical form: 3 months-3 years
 - o Per acute form: After 3 years
- o Breed: More in exotic than local breed
- o Coat color: Red and black coat is more susceptible than white coat color.
- o Source of infection: Infected animals and carrier animals

Transmission

- o Hematophagous insect transmission
- o Mechanical Vector: Blood sucking flies (*Tabanus and Stomoxys spp.*) and Mosquito- upto 2 years they can transmit the organism

- o *Biological vector: 20 species of tick under 7 genera can transmit the disease i.e. Boophilus, Ornithodoros, Dermacentor, Rhipicephalus, Ixodes, Hyalomma, and Argas spp.) - They transmit by trans-stadial transmission and trans-ovarial transmission*
- o Carrier animal
- o Iatrogenic transmission: Surgical instruments, Dehorning, Castration, Ear tagging, Hypodermic needles, Embryo transplantation, Blood transfusion
- o Transplacental transmission

Clinical signs

Per-acute case

- o Animal may die within several hours
- o Sudden onset of fever
- o Severe dyspnea
- o Anemia
- o Affected animal are hyper-excited and tend to attack the attendants.
- o Abortion in pregnant animal

Acute case

- o Initially fever
- o Anemia initially characterized by increase heart and respiratory rate
- o Pale mucus membrane
- o Muscle weakness and tremor
- o Jaundice
- o No hemoglobinuria
- o Gastro-intestinal atony ☒ Constipation, dehydration
- o Sometimes lymph nodes may swell

Nervous symptoms

- o Restlessness
- o Aggressive

Chronic case

- o Emaciated and infertility in bull
- o Temperature become normal or sub-normal before death

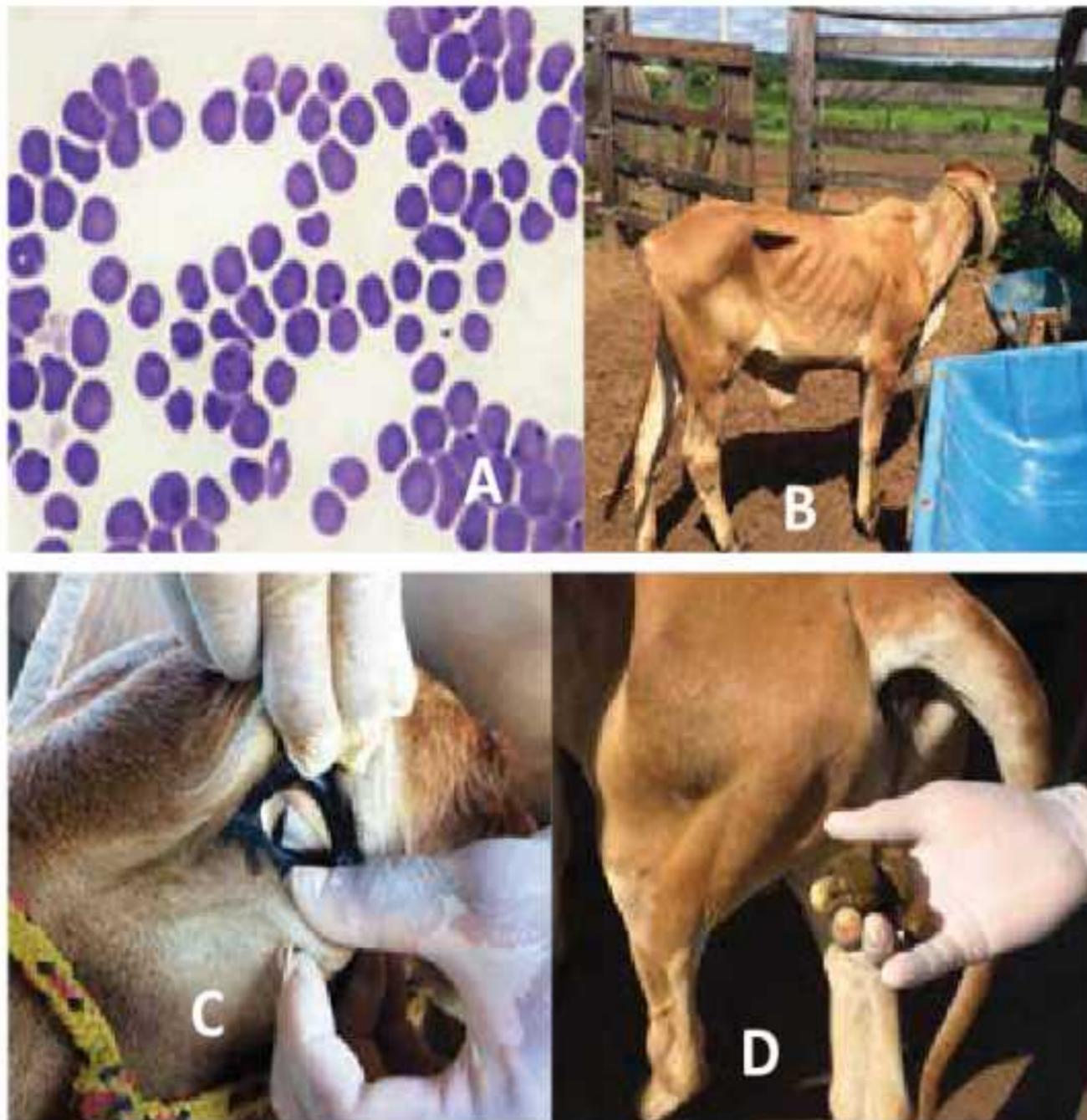


Figure 65: Giemsa-stained blood smear with presence of *A. marginale* corpuscles (A), Cattle showing apathy and severe weight loss (B), Cattle with pale left ocular mucosa (C), Cattle with recently obtained rectal-shaped stools (D).

Photo courtesy: Lima, D.H., Vinhote, W., Ubiali, D.G., Soares, P.C., Cordeiro, M.D., Silva, J.B., Fonseca, A.H. and Barbosa, J.D., 2019. Experimental infection by *Anaplasma marginale* in buffaloes and cattle: clinical, hematological, molecular and pathological aspects. *Pesquisa Veterinária Brasileira*, 39, pp.700-709.

Lesions

- o Enlarged spleen, up to 4 to 5 times the normal size with subcapsular hemorrhages

Diagnosis

- o Diagnosis based on clinical history, clinical signs and laboratory diagnosis
- o Laboratory diagnosis: Peripheral blood collection ⊕ Thin or thick smear ⊕ Giemsa stain (requires only 1 hour) ⊕ Erythrocyte with parasite or Diff quick staining (requires only 15 seconds)

Table-26: Differential diagnosis

Disease	Differentiating signs
Babesiosis	Hemoglobinuria Coffee color urine Diarrhea may present but in case of anaplasmosis, constipation may present
Theileriosis	Lymph nodes swollen or enlarged more than anaplasmosis, can observe from distant. Liver biopsy smear: Schizonts (Koch blue bodies) found in lymphocytes
Bacillary hemoglobinuria	Abdominal pain due to liver damage Concurrent Fasciola infection in coproscopic examination Blood test: Increase SGPT level in blood
Leptospirosis	Strome of abortion (Late) Occurs only in this form of the disease in calves kept in unsanitary conditions that are wet underfoot. Dark field microscope: spirochaete is present
Epi-erythrozoonesis	Organism found in blood Hind limb weakness/ paralysis common in affected animal
Trypanosomiasis	Progressive weight loss and anemia Epidemiological history: Vector Tsetse fly present in that region
Post parturient hemoglobinuria	Occurs just immediate after parturition Metabolic disease due to P deficiency No fever Blood test: Less P in blood serum

Treatment

- o The best results against anaplasmosis come after treating with oxytetracyclines in animals.
- o Supportive therapy may be necessary in pyrexia, dehydration and anemia

Medication

Cattle

First choice:

- o Long acting oxytetracycline 20mg per kg body weight IM single dose, repeat after 48-72 hours. Withdrawal period: Milk 96 hours and meat 18-28 days.

AND

- o Imidocarb di-propionate 3-5mg per kg body weight SC in case of Sheep/Goat, single dose and repeat after 7 days. Withdrawal period: Milk 3 days and meat 21 days.

Horse

First choice:

- o Oxytetracycline 7mg per kg body weight IV once daily for 5 to 7 days. Withdrawal period: Milk 96 hours and meat 18-28 days.

Supportive treatment:

Antipyretic drug, Hematinic drug and intravenous infusion (saline), sedative drugs

Prevention and control

- o Serological diagnosis
- o Isolation and quarantine
- o *Very difficult to eradicate from enzootic country due to*
 - o Wide range of vectors carry the infection
 - o Long period of infectivity in carriers
 - o Presence of carrier in wild population
 - o Chemoprophylaxis with oxytetracycline (LA) 20mg per kg body weight IM, 2-3 weeks interval (at risk season). Withdrawal period: Milk 96 hours and meat 18-28 days.
- o *Tick control*
 - o Very difficult to control if wild animals present
 - o Acaricides can be used against vectors

A8.3 Theileriosis

It is a tick borne hemo-protozoan disease characterized by fever, lymph node enlargement, hemoglobinuria, anemia and jaundice.

Table-27: Etiology

Disease	Distribution	Causal agent Cattle	Vector
Cattle			
Tropical theileriosis/ Mediterranean coast fever	Mediterranean countries, Indo-china	Theileria (T.) annulata	Hyalomma anatolicum
Oriental theileriosis	Asia	T. orientalis	Haemaphysalis spp.
Benign theileriosis	Worldwide	T. buffeli	Haemaphysalis spp., Amblyomma spp.
Sheep and Goats			
Malignant ovine theileriosis	North Africa, Middle East, India	T. hirci, T. ovis	Hyalomma spp., Haemophysalis spp.
Benign theileriosis	Worldwide	T. ovis	Rhipicephalus spp.
Horse			
Equine theileriosis	Worldwide	T. equi	Boophilus microplus, Rhipicephalus spp., Hyalomma spp.

Susceptible species

- o Cattle, Domestic Buffalo, Sheep, Goat and Horse

Epidemiology

- o Widely distributed to North Africa, Mediterranean coastal area, Middle East, Asia.
- o All age group of exotic, cross breed and young indigenous calves.
- o Adult indigenous zebu cattle are often subclinical- act as a carrier
- o Summer and rainy season.

Transmission

- o Several species of tick such as *Hyalomma* spp., *Haemaphysalis* spp. etc.

Clinical signs

- o Fever- 104 to 107°F (continuous or intermittent- fever remain 5 to 20 days)
- o Generalized swelling of superficial lymph nodes
- o Diarrhea (mucous or blood come out through feces)
- o Anemia followed by hemoglobinuria, jaundice, weakness and prostration.
- o Cerebral theileriosis/ circling disease
 - o Muscle twisting
 - o Paddling movement of leg
 - o High stepping gait
 - o Pressing of head against fixed objects
 - o Convulsion, tremor, profuse salivation



Figure 66: Cow infected with *T. annulata* showing debilitated condition.

Photo courtesy: <https://www.cabidigitallibrary.org/doi/10.1079/cabicompendium.62110>



Figure 67: Swollen lymph node draining site of inoculation of sporozoites of *T. parva*.
Photo courtesy: <https://www.cabidigitallibrary.org/doi/10.1079/cabicompendium.62110>



Figure 68: Enlarged prescapular lymph node.
Photo courtesy: https://nivedi.res.in/Nadres_v2/theileriosis.php



Figure 69: Enlarged premolar lymph node. Photo courtesy: Sarma, K., Prasad, H., Das, G., Behera, P., Behera, S.K., Rajesh, J.B. and Borthakur, S.K., 2016. Theileriasis in crossbred cows and its therapeutic management: first report from Lushai hill district of Mizoram. *Journal of Parasitic Diseases*, 40(3), pp.605-610.

Lesions

- o Massive pulmonary edema, hyperemia, and emphysema, along with hydrothorax and hydropericardium.
- o Copious froth is present in the airways.
- o Carcass is emaciated, and hemorrhages are evident in a variety of tissues and organs.
- o Enlargement of the liver, lymph nodes, and spleen and ulceration of abomasum and intestines.

Diagnosis

- o Diagnosis based on clinical history, clinical signs, physical examination and laboratory diagnosis
- o Physical examination: Palpation of superficial lymph nodes (prescapular and prefemoral lymph nodes)
- o Laboratory diagnosis: Liver biopsy smear ⊗ Giemsa stain ⊗ Schizonts (Koch blue bodies) found in lymphocytes

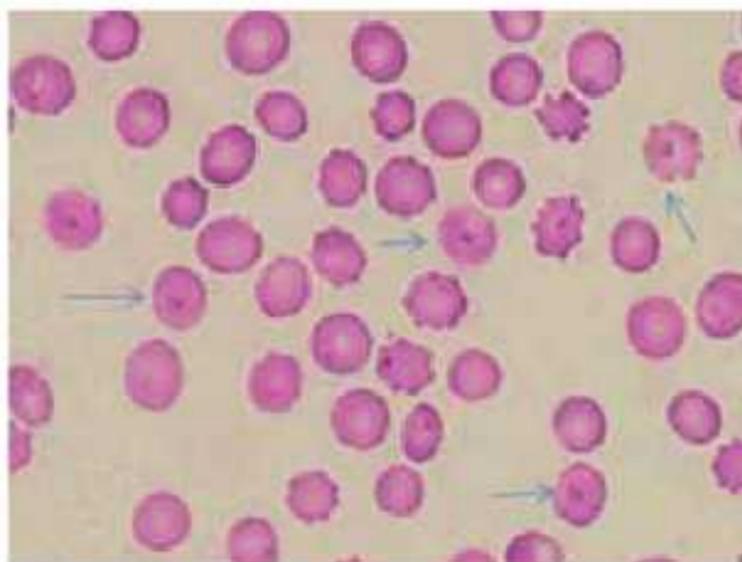


Figure 70: Piroplasmic form of *T. annulata* using Giemsa staining method. Photo courtesy: Yousef, S.G., El-Balkemy, F.A., El-Shazly, Y.A. and El-Damaty, H.M., 2020. Clinical picture and haemogram profile associated with *Theileria annulata* infection in cattle before and after therapeutic intervention. *Adv. Anim. Vet. Sci*, 8(3), pp.290-296.

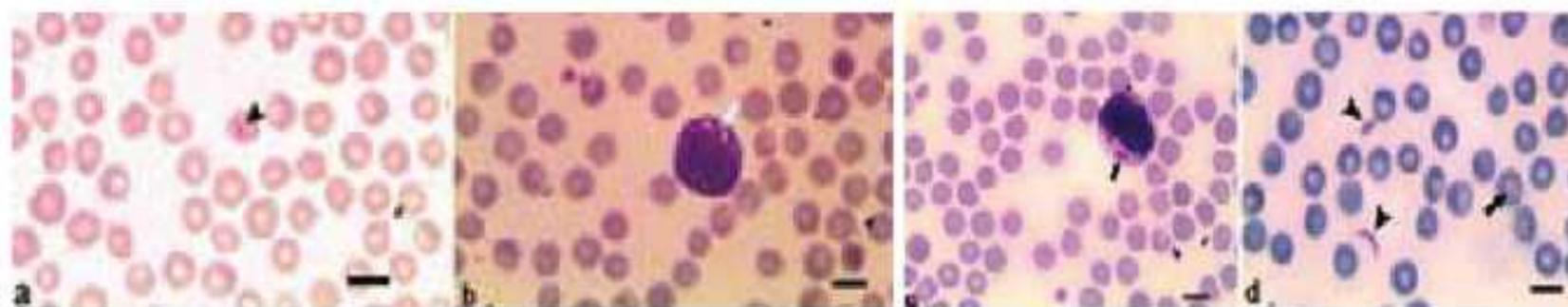


Figure 71: Giemsa-stained smears from sheep infected with *T. ovis*. Merozoites inside RBCs of infected animals (a), Schizogony stage of *T. ovis* inside the infected lymphocytes (b), Macroschizont of *T. ovis* in lymphocytes (c), Merozoites of *T. ovis* (arrow) (arrowheads). Photo courtesy: Hussein, N.M., Mohammed, E.S., Hassan, A.A. and El-Dakhly, K.M., 2017. Distribution pattern of Babesia and *Theileria* species in sheep in Qena Province, Upper Egypt. *Archives of Parasitology*, 1(1), pp.1-4.

Table-28: Differential diagnosis

Disease	Differentiating signs
Babesiosis	Hemoglobinuria Coffee color urine Diarrhea is present but in case of anaplasmosis constipation
Anaplasmosis	Normal urine Intermittent fever
Nagana disease	Edema in throat and abdomen, intercurrent infection by bacteria, virus
Surra disease	Edema especially genital area in the horse
Malignant catarrhal fever	Herpes virus Peripheral (centripetal) corneal opacity

Treatment

- o Two recent drugs are introduced with having much higher success rate such as halofuginone lactate and parvaquone. But recovered animals may become carriers unless the correct dose is used.
- o Tetracyclines were the recommended treatment for many years, but they have only moderate efficacy.
- o Supportive therapy may be necessary.

Medication

First choice:

- o Parvaquone 10mg per kg body weight IM single dose, repeat after 48 hours. Withdrawal period: No data found
- OR
- o Buparvaquone 2.5mg per kg body weight deep IM single dose, repeat after 48 hours. Withdrawal period: No data found
- OR
- o Halofuginone lactate 1-2mg per kg body weight orally, mix with 100 ml drinking water single dose, repeat after 48 hours. Withdrawal period: No data found
- AND
- o Oxytetracycline 20mg per kg body weight IM single dose, repeat after 48-72 hours. Withdrawal period: Milk 96 hours and meat 18-28 days.

Supportive treatment

Antipyretic drug, Hematinic drug and intravenous infusion (saline), sedative drugs

Prevention and control

- o Serological diagnosis
- o Isolation and quarantine
- o **Very difficult to eradicate from enzootic country due to**
 - o Wide range of vectors carry the infection
 - o Long period of infectivity in carriers
 - o Chemoprophylaxis with oxytetracycline (LA) 20mg per kg BW IM, 2-3 weeks interval (at risk reason) or preferably parvaquone 10mg per kg BW IM given at the same time
- o **Tick control**
 - o Very difficult to control if wild animals present
 - o Acaricides can be used against vectors at 3-weeks intervals

A8.4 Anthrax

Anthrax is a noncontagious zoonotic disease caused by the spore-forming bacteria. Anthrax primarily affects domestic and wild herbivores.

Etiology

- o *Bacillus anthracis* (Gram-positive)

Susceptible species

- o Cattle, Sheep, Goats and Buffalo

Epidemiology

- o Most common in agricultural regions with neutral or alkaline nature of soil.
- o Usually associated with drought, flooding, or soil disturbance
- o Sporadic cases may keep soil contaminated.
- o Birds seem to resistant to anthrax.

Transmission

- o Carcasses, contaminated materials, and environmental contamination.

Clinical signs

Per-acute form

- o Animals are usually found dead without any noticeable signs.
- o The disease course is only 1-2 hours and there may be pyrexia, depression, muscle tremor, dyspnea congestion of mucosae and petechiae.

Acute form

- o Abrupt onset of fever followed by anorexia, ruminal stasis, abdominal pain, haematuria.
- o Blood tinged diarrhoea and bloating.
- o Pregnant animal may abort, milk may be blood tinged and milk production decreases.
- o Oedematous swelling in the region of throat, sternum, perineum and flanks
- o Death occurs within 1 to 3 days after onset.



Figure 72: A cow that died on anthrax with close-up of the head with bloody discharge from the eyes and left nostril (A) and rear view with bloody anus and vagina (B).

Diagnosis

- o Clinical evaluation
- o Laboratory examinations: Diagnosis of anthrax based only on clinical signs is difficult. Confirmatory laboratory testing should be attempted if anthrax is suspected.
 - o Bacterial culture
 - o PCR assay
 - o Fluorescent antibody
 - o Fixed blood smears stained with Loeffler's or MacFadecan stains can be used.

Table-29: Differential Diagnosis

Disease name	Point of differentiation
Black quarter	Crepitating sound on palpation and lameness
Lightning stroke/Electrocution	Burning of hair
Babesiosis	Anemia, Coffee color urine
Acute lead poisoning	Nervous sign, single animal affected
Snake bite	Fang mark, local swelling and Blood

Treatment

It is per acute disease, death without clinical signs

- o Early treatment and vigorous implementation of a preventive program are essential to reduce losses.
- o Treatment of subclinical affected animals (post exposure prophylaxis),
- o In addition to treatment and vaccination, specific control procedures are necessary to contain the disease and prevent its spread.

Medication

First choice

- o Procaine Penicillin 22,000 IU per Kg body weight IM once daily for 5-7 days. Withdrawal period: Milk 96 hours and meat 10-21 days.
OR
- o Procaine G penicillin 20,000 IU per Kg body weight IM once daily for 5-7 days. Withdrawal period: Milk 96 hours and meat 10-21 days.

Second choice

- o Oxytetracycline 10mg per kg body weight IM once daily for 5 days (Cattle). Withdrawal period: Milk 96 hours and meat 18-28 days.

Prevention and control

- o Anthrax is controlled through vaccination programs; 1ml S/C in cattle and 0.5 ml S/C in goat/sheep
- o Rapid detection and reporting
- o Quarantine animal and
- o Burning or burial of suspect and confirmed cases.

A9 Common diseases of the Integumentary System

A9.1 Foot Rot

Interdigital phlegmon (foot rot) is an acute or subacute necrotizing infection of the inter-digital skin in ruminants such as-cattle that extends into the underlying tissues and results in diffuse digital swelling and lameness.

Etiology

- o *Fusobacterium necrophorum* (anaerobe)
- o *Prevotella levii* (anaerobe)

Susceptible species

- o Cattle, Goat, Ruminants

Epidemiology

- o Worldwide distribution
- o More common in younger animals but found in all age groups
- o Trauma to the inter-digital skin
- o Constant moisture in foot

Transmission

- o Wound or injury

Clinical signs

- o Sporadic occurrence of lameness with swelling around the coronary band
- o Swollen, painful foot with necrotic, foul-smelling inter-digital lesion



Figure 73: Extensive skin inflammation, damaged horn in the interdigital space in cattle. Photo courtesy: <https://www.canadiancattlemen.ca/vet-advice/foot-rot-in-cattle-2/>

Diagnosis

- o Acute to per acute onset of lameness, symmetrical swelling around the coronary band and in the inter-digital space
- o Usually only found on one foot and is more common on rear feet
- o Pyrexia and decreased feed intake are commonly seen in both beef and dairy cattle and decreased milk production is common in dairy cattle.

- o Microbiological culture is seldom used due to the time and expense involved in culturing anaerobic organisms.
- o In herd outbreaks, culture may be useful to confirm the presence of *F. necrophorum*.

Necropsy findings

- o Necrotizing, usually caseous, necrosis of the inter-digital skin with a characteristic foul odor and swelling of the foot around the coronary band
- o Extensive inflammation of the skin and underlying tissues

Table-30: Differential Diagnosis

Disease name	Point of differentiation
Septic arthritis	A sequel to sole ulcer, white line abscess, or vertical fissure. Usually swelling of only one digit observed
Digital dermatitis	Wart like lesion in interdigital space

Treatment

- o Hoof trimmers will commonly treat lesions with a topical antimicrobial and wrap the foot with a bandage.
- o Sometimes it is necessary to remove the inter-digital fat pad to facilitate healing of the inter-digital skin.
- o If bandages are applied, they should be removed after 3–4 days.
- o Affected cattle should be given the full course of parenteral antimicrobials and be monitored for improvement and clinical cure.

Medication

First choice

- o Procaine penicillin 44,000 IU per kg body weight IM once daily for 7 days. Withdrawal period: Milk 96 hours and meat 10-21 days.
OR
- o Ampicillin 10mg per kg body weight PO/IM twice daily for 5-7 days. Withdrawal period: Milk 48 hours and meat 6 days.

Second choice

- o Oxytetracycline 10mg per kg body weight IM once daily for 5 days (Cattle). Withdrawal period: Milk 96 hours and meat 18-28 days.
OR
- o Procaine penicillin 44,000 IU per kg body weight IM once daily for 7 days. Withdrawal period: Milk 96 hours and meat 10-21 days.

AND

- o Streptomycin 10mg per kg body weight IM once daily for 3-5 days. Withdrawal period: Milk 48 hours and meat 12 days.

Prevention and control

- o Management procedures
- o Footbaths with antiseptic solutions are commonly used on dairies to prevent new cases of infectious foot diseases including inter-digital phlegm on.
- o Commonly used footbath compounds are CuSO₄ or ZnSO₄ (5%–10%) or formalin (3%–5%).
- o Footbaths require good management to be effective since contamination of the footbath solution with feces and urine will render the solution ineffective.
- o It is commonly recommended that the footbath be drained, cleaned, and refilled after every 100–300 animal.

A9.2 Myiasis

A common disease of Sheep, Goat and Ruminants. Invasion of living or dead tissue by larvae of dipteran flies causes myiasis in livestock. Myiasis can be facultative or obligatory. There are two types, such as (1) Obligator myiasis: fly larvae are completely parasitic and will die without a host and (2) Facultative myiasis: fly larvae are free-living but can adapt themselves to a parasitic dependence on a host under the right circumstances.

Etiology

- o Blowflies-Traumatic or cutaneous myiasis- Calliphoridae spp.
- o There are eight major flies affecting cattle: face flies (*Musca autumnalis*), houseflies (*Musca domestica*), horn flies (*Haematobia irritans*), horseflies (*Hybontia* spp. and ***Tabanus*** spp.), deerflies (*Chrysops* spp.), heel flies (*Hypoderma lineatum* and *H. bovis*), screwworms (*Cochliomyia hominivorax*).
- o Blackflies (family Simuliidae) produce a salivary toxin.
- o Can be vectors for other diseases.

Susceptible species

- o Sheep, Goat, Cattle, all ruminants

Epidemiology

- o Blowfly strike is seasonal, with peak occurrence during warm, humid periods
- o Obligatory myiasis-causing flies lay their eggs only on fresh wounds. These include wounds created by procedures such as castration, dehorning, and docking.

- o Sites such as the navel of newborns, perineum, vagina, and wounds from tick bites also are susceptible to invasion.
- o Lush pastures and parasitic gastroenteritis predispose to cutaneous myiasis because of perineal soiling.
- o Hot, humid weather favors development of the flies.
- o Flies are attracted to wet fleece, areas affected by fleece rot, foot rot, and perineum soiled by feces or urine staining.
- o Geo-graphical distribution: Worldwide, depending on dipteran species and environment; Africa, Asia, North America, and Australia
- o Prevalence

Transmission

- o Wound or injury

Clinical signs

- o Animals show signs of restlessness and may bite at affected areas.
- o Affected areas produce a foul-smelling odor with exudates, and the mature larvae are usually observed on the lesions.
- o Annoyance/irritation (all flies)
- o Weight loss
- o Decreased feed intake
- o Decreased milk production
- o The body temperature rises to around 41°C. Pulse and respiratory rates increase in concert with the development of toxemia.



Figure 74: Early stage of myiasis with larva,
Photo courtesy: <https://www.cabidigitallibrary.org/doi/10.1079/cabicompendium.120994>

Diagnosis

- o Larvae from dipteran flies can be differentiated based on morphology. Formalin-fixed samples must be submitted for identification.
- o Predisposing factors such as foot rot, fleece rot, tick bites, and diarrhea can be easily differentiated from cutaneous myiasis.

Treatment

- o Ivermectin and organophosphates is effective in killing *Chrysomia bezziana* larvae in cutaneous myiasis
- o Surgical: surgical removal of warbles
- o Apply liquid larvicidal insecticide to the struck area, and thoroughly saturate a wide margin of surrounding wool
- o Wet but do not remove the wool covering the wound. The wool takes up insecticide and dries out once the maggots are dead. Thus, the treated wool provides a protective covering against further strike, and against sunburn

Medication

First choice

- o Ivermectin 0.2 mg per kg body weight SC single dose, repeat after 14 days. Withdrawal period: Milk 40 hours and meat 35 days. AND/OR
- o Procaine penicillin 44,000 IU per kg body weight IM once daily for 7 days. Withdrawal period: Milk 96 hours and meat 10-21 days. OR
- o Lincomycin 5-10mg per Kg body weight IV once/twice daily for 5-7 days. Withdrawal period: Milk 96 hours and meat 7 days.

Supportive treatment

- o Regular dressing

Prevention and control

- o Management procedures in farm shed
- o Measures should be taken according to the organ affected
- o Wound-control measures
- o Fly-control measure
- o Prevention of fleece rot, foot rot, and diarrhea

A9.3 Malignant edema

Malignant edema is an often-fatal wound infection caused by one of the several Clostridial spp.

Etiology

- o *Clostridium septicum* (**anaerobe**), *C. perfringens* (anaerobe), *C. sordellii* (**anaerobe**), *C. novyi* (**anaerobe**), *C. chauvoei* (**anaerobe**)

Susceptible species

- o Sheep, Goat, Cattle, all ruminants

Epidemiology

- o The disease occurs sporadically affecting individual animals.
- o Worldwide
- o All ages

Transmission

- o In most cases a wound (deep punctured) is the portal of entry.

Clinical signs

- o Acute onset with fever and toxemia
- o Inflammation and swelling at site of a wound, with heat, edema, pain on palpation, and usually subcutaneous emphysema



Figure 75: Clostridial gas gangrene due to *C novyi* myositis,

Photo courtesy: <https://www.msdivetmanual.com/generalized-conditions/clostridial-diseases/malignant-edema-in-animals>

Diagnosis

- o Tentative diagnosis can be made on the history and characteristic clinical signs
- o Bacteriological isolation and identification of the causative organism

Table-31: Differential Diagnosis

Disease name	Point of differentiation
Blackleg	The disease is differentiated from blackleg by the absence of typical muscle involvement and the presence of wounds

Treatment

- o Specific treatment requires the administration of high doses of penicillin
- o Antitoxin aids in controlling the toxemia but is expensive and must be given very early in the course of the disease.
- o An NSAID and supportive therapy are recommended
- o Local treatment consists of surgical incision to provide drainage, along with irrigation with hydrogen peroxide

Medication

First choice

- o Penicillin G 40,000 IU per Kg body weight IV once daily for 5-7 days. Withdrawal period: Milk 96 hours and meat 10-21 days.

Second choice

- o Lincomycin 5-10mg per Kg body weight IV once/twice daily for 5-7 days. Withdrawal period: Milk 96 hours and meat 7 days.

Prevention and control

- o Proper carcass disposal helps to prevent soil contamination
- o Vaccines are most commonly used for prevention and control of BQ.
- o LRI produce BQ vaccine – per vial (100ml)
- o First dose at more than 3months of age and repeat yearly
- o Large animal: 5ml, S/C-ly; Small animal: 2ml, S/C-ly

A9.4 Dermatophylosis

Common pustular/crusting disease of ruminants.

Etiology

- o *Dermatophilus congolensis*; gram-positive, non-acid-fast, facultative anaerobic actinomycete

Susceptible species

- o Sheep, Goat, Cattle, Buffalo, Horse, Camels.

Epidemiology

- o Worldwide distribution
- o Most important predisposing factors are chronic wetting (rain, snow) and maceration of the skin and micro trauma to the skin as organism is thought not to be able to invade healthy skin.
- o Outbreaks most common after periods of heavy rain and/or high humidity.

Transmission

- o Mechanical transmission of the organism can occur via flies and ectoparasites, in animal-to-animal contact, and during dipping practices.
- o Dried scabs from infected animals are important potential sources of infection for susceptible animals and for reinfection.

Clinical signs

- o Formation of pustule
- o Hair of the affected area is erected
- o Greasy or creamy discharge
- o Matted hair (paint brush type)
- o Scab formation
- o Hair loss with scab
- o Lesion found in mouth, neck, leg, udder, back region etc



Figure 76: Extensive skin lesions in dermatophilosis, Photo courtesy:
<https://www.nadis.org.uk/disease-a-z/sheep/non-parasitic-skin-conditions-in-sheep/>

Table-32: Differential Diagnosis

Disease name	Point of differentiation
Dermatophytosis	Roughly circular about 3-4 cm in diameter, raised above the skin. Scaling patches of hair loss with grey-white crust but with no itching; suppuration may occur.
Scabies	Diagnosis by taking skin scrapping upto bleeding and see live mite under microscope
Contageous ecthyma	Presence of hyperemia and small pustules around the mouth and muzzle

Treatment

Medication

For sheep

First choice

- o Procaine penicillin 70,000 IU per kg body weight IM once daily for 3 days. Withdrawal period: Milk 96 hours and meat 10-21 days.
- OR
- o Streptomycin 70mg per kg body weight IM once daily for 3 days. Withdrawal period: Milk 48 hours and meat 12 days.

Second choice

- o Erythromycin 10mg per kg body weight IM once daily for 3-5 days. Withdrawal period: Milk 72 hours and meat 14 days.
- OR
- o Oxytetracycline (LA) 20mg per kg body weight IM single dose, repeat after 48-72 hours. Withdrawal period: Milk 96 hours and meat 18-28 days.

For cattle

First choice

- o Procaine penicillin 22,000 IU per kg body weight IM once daily for 3 days. Withdrawal period: Milk 96 hours and meat 10-21 days.

Second choice

- o Oxytetracycline (LA) 20mg per kg body weight IM single dose, repeat after 48-72 hours. Withdrawal period: Milk 96 hours and meat 18-28 days.

For horse

First choice

- o Procaine penicillin 20,000 IU per kg body weight IM once daily for 3 days. Withdrawal period: Milk 96 hours and meat 10-21 days.

AND

Streptomycin 10mg per kg body weight IM once daily for 3 days. Withdrawal period: Milk 48 hours and meat 12 days.

Prevention and control

- o Provide shelter from rain.
- o Protect animals from fly-strike and ticks.

A10 Common diseases of the Ophthalmic System

A10.1 Pinkeye

A common disease of cattle, sheep and goats. Infectious keratoconjunctivitis is a common ocular condition characterized by blepharospasm, conjunctivitis, lacrimation, and varying degrees of corneal opacity and ulceration. In severe cases, ocular rupture leading to blindness can result.

Etiology

- o *Moraxella bovis* (**Gram-negative**), *Mycoplasma conjunctivae* (**anaerobe**), *Moraxella ovis* (**Gram-negative**), *Chlamydia pecorum* (**Gram-negative atypical**), *Listeria monocytogenes* (**Gram-positive**)

Susceptible species

- o Cattle, Sheep, Goat

Epidemiology

- o Worldwide
- o Flies, dust, mechanical irritation, ultraviolet solar irradiation, recent shipping, attendance at shows/sales/auctions are common risk factors
- o Outbreaks are most often associated with warmer times of year due to the increased fly infestation

Transmission

- o Animal to animal
- o Vector borne (by flies)

Clinical signs

- o The earliest clinical signs are photophobia, blepharospasm, and epiphora
- o The ocular discharge may become mucopurulent
- o Conjunctivitis, with or without varying degrees of keratitis, is usually present.

- o In sheep and goats, concurrent polyarthritis may be present in association with *C. pecorum* infections
- o Most corneal ulcers in cattle with IBK heal without loss of vision; however, corneal rupture and permanent blindness can occur in the most severe cases



Figure 77: Extensive lacrimation and blepharospasm and the centrally located corneal ulcer with keratitis and conjunctivitis,

Photo courtesy: Radostits, O.M., Gay, C., Hinchcliff, K.W. and Constable, P.D. eds., 2006. Veterinary Medicine E-Book: A textbook of the diseases of cattle, horses, sheep, pigs and goats. Elsevier Health Sciences. pp 1699.

Diagnosis

- o Clinical signs and microbial culture

Table-33: Differential Diagnosis

Disease name	Point of differentiation
Traumatic conjunctivitis	Presence of foreign matter in the eye or the conjunctival sac or evidence of a physical injury
Thelaziasis	Worm will be found in the eye.

Treatment

- o Local treatment is preferred. Topical benzathine cloxacillin ointment and antiseptic sprays are currently approved treatments.
- o Subconjunctival injection with Procaine-penicillin is also preferred.
- o Systemic NSAID treatment (eg, flunixin meglumine) may also provide relief.

Medication

For *Moraxella bovis*

- o Oxytetracycline long-acting 20 mg kg body weight IM single dose, repeat after 48 hours. Withdrawal period: Milk 96 hours and meat 18-28 days.

OR

- o Florfenicol 20 mg kg body weight SC single dose, repeat after 48 hours. Withdrawal period: Milk-not recommended for milking cow and meat 28 days if IM, 38 days if SC.

OR

- o Tilmicosin 5 mg per kg body weight SC, single dose. Withdrawal period: Milk-not recommended for milking cow and meat 28 days if IM, 38 days if SC.

For *Mycoplasma conjunctivae*

- o Oxytetracycline long-acting 20 mg kg body weight IM single dose, repeat after 48 hours. Withdrawal period: Milk 96 hours and meat 18-28 days.

OR

- o Florfenicol 20 mg kg body weight SC single dose, repeat after 48 hours. Withdrawal period: Milk-not recommended for milking cow and meat 28 days if IM, 38 days if SC.

Prevention and control

- o Management procedures
 - o Addressing risk factors is an important aspect of disease control.
 - o For IBK in cattle, vaccination is controversial, but anecdotal reports suggest benefits.

A11 Common Surgical Affections

A11.1 Clean cut surgeries (Cesarian Section, Hernia, Gid Disease, Castration, Amputation, Fracture)

Treatment

- o For topical wound or surgical opening in the skin, asepsis and antisepsis are necessary. Mild antiseptic solutions should be used for this purpose.
- o Povidone iodine (0.1-1%) has higher concentration of free iodine, which has high bactericidal activity.
- o Chlorhexidine 0.05 per cent is more effective as sporicidal, very effective in dirty wounds, especially with clostridial spores.
- o Sodium hypochlorite 0.5% solution release chlorine and oxygen in tissues, kills bacteria and liquefies tissues.

Medication

- o If proper asepsis is maintained, no antibiotic is required.
- o For topical site, Ointment of bacitracin, neomycin and polymyxin and gentamicin solution can be used
- o If the surgery is performed in an open and contaminated environment and systemic infection is found or can be expected, parenteral antibiotic treatment should be started as early as possible.
- o Procaine penicillin 22,000 IU per kg body weight IM once daily for 3-5days. Withdrawal period: Milk 96 hours and meat 10-21 days.

OR

- o Long acting Oxytetracycline 20mg per kg body weight IM single dose, repeat after 48-72 hours. Withdrawal period: Milk 96 hours and meat 18-28 days.

OR

- o Florfenicol 20mg per kg body weight IM once every two days for 2 times. Withdrawal period: Milk-not recommended for milking cow and meat 28 days if IM, 38 days if SC.

Prevention and control

- o Management procedures
 - o Keep the bandages intact
 - o Check the sutures
 - o Keep the animal in a dry and clean place (As much clean and dry as possible)

A11.2 Septic wound (Abscess, Gangrene etc.)

Treatment

- o Drainage or amputation or debridement of the affected portion is necessary.
- o Normal saline can be used for primary cleaning of the affected site. Mild antiseptic solution should be used after that.
- o Povidone iodine (0.1-1%) has higher concentration of free iodine, which has high bactericidal activity.
- o Chlorhexidine 0.05% is more effective as sporicidal, very effective in dirty wounds, especially with clostridial spores.
- o Sodium hypochlorite 0.5% solution releases chlorine and oxygen in tissues, kills bacteria and liquefies tissues.

Medication

- o Antibiotic treatment may vary upon the surgical condition.

For gangrene

- o Procaine penicillin 22,000 IU per kg body weight IM once daily for 3-5 days. Withdrawal period: Milk 96 hours and meat 10-21 days.

For abscess

- o Lipophilic antibiotic like Florfenicol 20mg per kg body weight IM once every two days for 2 times. Withdrawal period: Milk-not recommended for milking cow and meat 28 days if IM, 38 days if SC.

For mild infection case

- o Long acting Oxytetracycline 20mg per kg body weight IM single dose, repeat after 48-72 hours. Withdrawal period: Milk 96 hours and meat 18-28 days.

Supportive treatment

- o Systemic NSAID treatment (eg, flunixin meglumine) may also provide relief.
- o Fluid therapy is suggested in septic shock.

Prevention and control

- o Management procedures
- o Keep the bandages intact
- o Check the sutures
- o Keep the animal in a dry and clean place (As much clean and dry as possible)

A12 References

1. *Cattle Medicine- Philip R Scott, Colin D Penny, Alastair I Macrae*
2. *Handbook on Field Veterinary Surgery- M.M.S. Zama, H.P. Aithal, A.M. Pawde*
3. Lalman, D. and Kirkpatrick, J.G., 2003. Pinkeye in cattle: Infectious Bovine Keratoconjunctivitis (IBK). Oklahoma Cooperative Extension Service.
4. Rae, D.O., Chenoweth, P.J., Genho, P.C., McIntosh, A.D., Crosby, C.E. and Moore, S.A., 1999. Prevalence of *Tritrichomonas fetus* in a bull population and effect on production in a large cow-calf enterprise. *Journal of the American Veterinary Medical Association*, 214(7), pp.1051-1055.
5. *Veterinary Practitioner's Guide by Md.Abdus Samad*
6. *Blackwell's Five-Minute Veterinary Consult, Ruminant*
7. Kazi Kamaruddin et al. *Handbook of livestock and poultry disease in SAARC countries*. Page 72-74.
8. Abdus samad. *Veterinary practitioners guide*.246-247
9. MA Samad. *Animal husbandry and veterinary science*. Vol-2. 1222.
10. <https://www.msmanuals.com/professional>
11. Singhal, V., Singh, R., Yadav, A. and Agrawal, R., 2019. Prevalence of balantidiasis among diarrhoeic adult dairy animals of north west himalayan region and its impact on hemato-biochemical and mineral profile.
12. Hassan, N., Randhawa, C.S., Singh, S. and Narang, D., 2017. Chronic diarrhea and therapeutic trial with metronidazole in *Balantidium coli* infected cattle and buffaloes. *IJLR*, 7(7), pp.4-81.
13. Paul, T.R., Begum, N., Shahiduzzaman, M., Hossain, M.S., Labony, S.S. and Dey, A.R., 2019. Balantidiasis, a zoonotic protozoan infection, in cattle and domestic pigs. *Bangladesh Journal of Veterinary Medicine (BJVM)*, 17(1), pp.31-37.
14. Radostits, O.M., Gay, C.C., Hinchcliff, K.W. and Constable, P.D., 2007. A textbook of the diseases of cattle, horses, sheep, pigs and goats. *Veterinary medicine*, 10, pp.2045-2050.
15. Plumb, D.C., 2018. *Plumb's veterinary drug handbook: Desk*. John Wiley & Sons.
16. Aiello, S.E., Moses, M.A. and Allen, D.G. eds., 2016. *The Merck veterinary manual* (p. 3325). White Station, NJ, USA: Merck & Company, Incorporated.
17. Paul, T.R., Begum, N., Shahiduzzaman, M., Hossain, M.S., Labony, S.S. and Dey, A.R., 2019. Balantidiasis, a zoonotic protozoan infection, in cattle and domestic pigs. *Bangladesh Journal of Veterinary Medicine (BJVM)*, 17(1), pp.31-37.
18. <https://www.merckvetmanual.com/digestive-system/cryptosporidiosis/cryptosporidiosis-in-animals>
19. <https://www.merckvetmanual.com/digestive-system/coccidiosis/overview-of-coccidiosis-in-animals>
20. <https://www.merckvetmanual.com/digestive-system/giardiasis-giardia/giardiasis-in-animals?query=giardiasis>
21. <https://www.msmanual.com/reproductive-system/mastitis-in-large-animals/mastitis-in-cattle>
22. <https://u.osu.edu/sheep/2018/01/23/mastitis-in-small-ruminants/>
23. <https://www.cabidigitallibrary.org/doi/10.1079/cabicompendium.62110>
24. Sarma, K., Prasad, H., Das, G., Behera, P., Behera, S.K., Rajesh, J.B. and Borthakur, S.K., 2016. Theileriasis in crossbred cows and its therapeutic management: first report from Lushai hill district of Mizoram. *Journal of Parasitic Diseases*, 40(3), pp.605-610.

25. Yousef, S.G., El-Balkemy, F.A., El-Shazly, Y.A. and El-Damaty, H.M., 2020. Clinical picture and haemogram profile associated with *Theileria annulata* infection in cattle before and after therapeutic intervention. *Adv. Anim. Vet. Sci*, 8(3), pp.290-296.
26. Hussein, N.M., Mohammed, E.S., Hassan, A.A. and El-Dakhly, K.M., 2017. Distribution pattern of *Babesia* and *Theileria* species in sheep in Qena Province, Upper Egypt. *Archives of Parasitology*, 1(1), pp.1-4.
27. Di Teodoro, G., Marruchella, G., Di Provvido, A., D'Angelo, A.R., Orsini, G., Di Giuseppe, P., Sacchini, F. and Scacchia, M., 2020. Contagious bovine pleuropneumonia: a comprehensive overview. *Veterinary Pathology*, 57(4), pp.476-489.
28. Hashem, M., Neamat-Allah, A.N. and Gheith, M.A., 2018. A study on bovine babesiosis and treatment with reference to hematobiochemical and molecular diagnosis. *Slovenian Veterinary Research*, 55(Suppl 20), pp.165-173.
29. Sivakumar, T., Tuvshintulga, B., Zhyldyz, A., Kothalawala, H., Yapa, P.R., Kanagaratnam, R., Vimalakumar, S.C., Abeysekera, T.S., Weerasingha, A.S., Yamagishi, J. and Igarashi, I., 2018. Genetic analysis of *Babesia* isolates from cattle with clinical babesiosis in Sri Lanka. *Journal of clinical microbiology*, 56(11), pp.e00895-18.
30. Lima, D.H., Vinhote, W., Ubiali, D.G., Soares, P.C., Cordeiro, M.D., Silva, J.B., Fonseca, A.H. and Barbosa, J.D., 2019. Experimental infection by *Anaplasma marginale* in buffaloes and cattle: clinical, hematological, molecular and pathological aspects. *Pesquisa Veterinária Brasileira*, 39, pp.700-709.
31. Udder Health Bangladesh, www.uhb.org.bd
32. Guardabassi, L., Jensen, L.B. and Kruse, H. eds., 2008. *Guide to antimicrobial use in animals* (pp. 143-160). Oxford, UK: Blackwell Pub.
33. <https://www.msdtvetmanual.com/generalized-conditions/leptospirosis/leptospirosis-in-animals-overview?query=leptospirosis>
34. *Prevention and treatment of leptospirosis* Charles N Edwards and Paul N Levett Pages 293-298 | Published online: 10 Jan 2014
35. *VETERINARY MEDICINE, A Textbook of the Diseases of Cattle, Horses, Sheep, Pigs, and Goats; online version 11th edition* (book page 1430; PDF page 1478)

A13 References table for dose of antimicrobial agents and their withdrawal period (WP)

Antimicrobial agent	Reference for dose	Reference for WP
Amoxicillin	<p>Radostits, O.M., Gay, C., Hinchcliff, K.W. and Constable, P.D. eds., 2006. Veterinary Medicine E-Book: A textbook of the diseases of cattle, horses, sheep, pigs and goats. Elsevier Health Sciences. Page: 1942</p> <p>Guardabassi, L., Jensen, L.B. and Kruse, H. eds., 2008. Guide to antimicrobial use in animals. Page: 133, 143-160 and 168. Oxford, UK: Blackwell Pub</p>	Papich, M.G., 2016. Saunders handbook of veterinary drugs. In. Elsevier. Page: 112
Amoxicillin plus clavulanic acid	<p>Radostits, O.M., Gay, C., Hinchcliff, K.W. and Constable, P.D. eds., 2006. Veterinary Medicine E-Book: A textbook of the diseases of cattle, horses, sheep, pigs and goats. Elsevier Health Sciences. Page: 1942</p>	Papich, M.G., 2016. Saunders handbook of veterinary drugs. In. Elsevier. Page: 112
Ampicillin	<p>Radostits, O.M., Gay, C., Hinchcliff, K.W. and Constable, P.D. eds., 2006. Veterinary Medicine E-Book: A textbook of the diseases of cattle, horses, sheep, pigs and goats. Elsevier Health Sciences. Page: 673, 1942</p> <p>Guardabassi, L., Jensen, L.B. and Kruse, H. eds., 2008. Guide to antimicrobial use in animals Page: 168. Oxford, UK: Blackwell Pub</p> <p>https://www.msdsvetmanual.com/reproductive-system/uterine-diseases-in-production-animals/metritis-in-production-animals</p>	Papich, M.G., 2016. Saunders handbook of veterinary drugs. In. Elsevier. Page: 120, 121
Amprolium	<p>https://www.msdsvetmanual.com/digestive-system/coccidiosis/coccidiosis-of-cattle#:~:text=Su lfaquinoxaline%20(13%20mg%2Fkg%2C,after%20arrival%20at%20a%20feedlot</p>	Papich, M.G., 2016. Saunders handbook of veterinary drugs. In. Elsevier. Page: 124
Buparvaquone	<p>Radostits, O.M., Gay, C., Hinchcliff, K.W. and Constable, P.D. eds., 2006. Veterinary Medicine E-Book: A textbook of the diseases of cattle, horses, sheep, pigs and goats. Elsevier Health Sciences. Page: 2195</p>	No data found
Ceftiofur hydrochloride	<p>Papich, M.G., 2016. Saunders handbook of veterinary drugs. In: Elsevier. Page: 242</p> <p>https://www.msdsvetmanual.com/reproductive-system/uterine-diseases-in-production-animals/metritis-in-production-animals</p>	Papich, M.G., 2016. Saunders handbook of veterinary drugs. In: Elsevier. Page: 242

Antimicrobial agent	Reference for dose	Reference for WP
Cephapirin	Radostits, O.M., Gay, C., Hinchcliff, K.W. and Constable, P.D. eds., 2006. Veterinary Medicine E-Book: A textbook of the diseases of cattle, horses, sheep, pigs and goats. Elsevier Health Sciences. Page: 1975	No data found
Cloxacillin	Radostits, O.M., Gay, C., Hinchcliff, K.W. and Constable, P.D. eds., 2006. Veterinary Medicine E-Book: A textbook of the diseases of cattle, horses, sheep, pigs and goats. Elsevier Health Sciences. Page: 1975	Papich, M.G., 2016. Saunders handbook of veterinary drugs. In: Elsevier. Page: 295
Diminazene aceturate	Radostits, O.M., Gay, C., Hinchcliff, K.W. and Constable, P.D. eds., 2006. Veterinary Medicine E-Book: A textbook of the diseases of cattle, horses, sheep, pigs and goats. Elsevier Health Sciences. Page: 836-847	World Health Organization, 1998. Residues of some veterinary drugs in animals and foods. FAO Food and Nutrition Paper, 39
Doxycycline	Radostits, O.M., Gay, C., Hinchcliff, K.W. and Constable, P.D. eds., 2006. Veterinary Medicine E-Book: A textbook of the diseases of cattle, horses, sheep, pigs and goats. Elsevier Health Sciences. Page: 1067	Papich, M.G., 2015. Saunders handbook of veterinary drugs-e-book: small and large animal. Elsevier Health Sciences. Page: 418
Enrofloxacin	Radostits, O.M., Gay, C., Hinchcliff, K.W. and Constable, P.D. eds., 2006. Veterinary Medicine E-Book: A textbook of the diseases of cattle, horses, sheep, pigs and goats. Elsevier Health Sciences. Page: 1067, 1942	Papich, M.G., 2015. Saunders handbook of veterinary drugs-e-book: small and large animal. Elsevier Health Sciences. Page: 434
Erythromycin	Elitok, B., Elitok, Ö.M. and Pulat, H., 2005. Efficacy of azithromycin dihydrate in treatment of cryptosporidiosis in naturally infected dairy calves. Journal of veterinary internal medicine, 19(4), Page: 590-593	Papich, M.G., 2016. Saunders handbook of veterinary drugs. In: Elsevier. Page: 447
Florfenicol	Radostits, O.M., Gay, C., Hinchcliff, K.W. and Constable, P.D. eds., 2006. Veterinary Medicine E-Book: A textbook of the diseases of cattle, horses, sheep, pigs and goats. Elsevier Health Sciences. Page: 570-571, 969, 1698, 1701 Papich, M.G., 2015. Saunders handbook of veterinary drugs-e-book: small and large animal. Elsevier Health Sciences. Page: 482	Papich, M.G., 2015. Saunders handbook of veterinary drugs-e-book: small and large animal. Elsevier Health Sciences. Page: 482

Antimicrobial agent	Reference for dose	Reference for WP
Gentamycin	Guardabassi, L., Jensen, L.B. and Kruse, H. eds., 2008. Guide to antimicrobial use in animals. Page: 143-160, 168. Oxford, UK: Blackwell Pub	Papich, M.G., 2016. Saunders handbook of veterinary drugs. In. Elsevier. Page: 515
Halofuginone lactate	Radostits, O.M., Gay, C., Hinchcliff, K.W. and Constable, P.D. eds., 2006. Veterinary Medicine E-Book: A textbook of the diseases of cattle, horses, sheep, pigs and goats. Elsevier Health Sciences. Page: 2195	No data found
Imidocarb di-propionate	Radostits, O.M., Gay, C., Hinchcliff, K.W. and Constable, P.D. eds., 2006. Veterinary Medicine E-Book: A textbook of the diseases of cattle, horses, sheep, pigs and goats. Elsevier Health Sciences. Page: 806-816, 836-847	https://www.hpra.ie/img/uploaded/swedocuments/LicenceSPC_10980-001-001_25082009020418.pdf
Ivermectin	Radostits, O.M., Gay, C., Hinchcliff, K.W. and Constable, P.D. eds., 2006. Veterinary Medicine E-Book: A textbook of the diseases of cattle, horses, sheep, pigs and goats. Elsevier Health Sciences. Page: 1665	Papich, M.G., 2016. Saunders handbook of veterinary drugs. In. Elsevier. Page: 602
Lincomycin	Papich, M.G., 2016. Saunders handbook of veterinary drugs. In. Elsevier. Page: 638	Papich, M.G., 2016. Saunders handbook of veterinary drugs. In. Elsevier. Page: 639
Metronidazole	Hassan, N., Randhawa, C.S., Singh, S. and Narang, D., 2017. Chronic diarrhea and therapeutic trial with metronidazole in Balantidium coli infected cattle and buffaloes. IJLR, 7(7), Page: 4-81 Stephens, L.R. and Slee, K.J., 1987. Metronidazole for the treatment of bovine pyometra. Australian veterinary journal, 64(11), Page: 343-346	Papich, M.G., 2016. Saunders handbook of veterinary drugs. In. Elsevier. Page: 736
Neomycin	Radostits, O.M., Gay, C., Hinchcliff, K.W. and Constable, P.D. eds., 2006. Veterinary Medicine E-Book: A textbook of the diseases of cattle, horses, sheep, pigs and goats. Elsevier Health Sciences. Page: 1942	Papich, M.G., 2015. Saunders handbook of veterinary drugs-e-book: small and large animal. Elsevier Health Sciences. Page: 779
Oxytetracycline	Radostits, O.M., Gay, C., Hinchcliff, K.W. and Constable, P.D. eds., 2006. Veterinary Medicine E-Book: A textbook of the diseases of cattle, horses, sheep, pigs and goats. Elsevier Health Sciences. Page: 570-571, 673, 806-816, 969, 1410, 1698, 1701, 2059, 2195	Papich, M.G., 2016. Saunders handbook of veterinary drugs. In. Elsevier. Page: 825

Antimicrobial agent	Reference for dose	Reference for WP
	<p>Giguère, S., Prescott, J.F. and Dowling, P.M. eds., 2013. Antimicrobial therapy in veterinary medicine. John Wiley & Sons. Page:498</p> <p>Guardabassi, L., Jensen, L.B. and Kruse, H. eds., 2008. Guide to antimicrobial use in animals. Oxford, UK: Blackwell Pub. Page:168</p> <p>Papich, M.G., 2016. Saunders handbook of veterinary drugs. In. Elsevier. Page: 825</p>	<p>https://www.hpra.ie/img/uploaded/swedocuments/LicenceSPC_10980-001-001_25082009020418.pdf</p>
Paromomycin sulfate	<p>Aydogdu, U., Isik, N., Ekici, O.D., Yildiz, R., Sen, I. and Coskun, A., 2018. Comparison of the effectiveness of halofuginone lactate and paromomycin in the treatment of calves naturally infected with <i>Cryptosporidium parvum</i>. <i>Acta Scientiae Veterinariae</i>, 46, Page: 9-9</p>	<p>Papich, M.G., 2016. Saunders handbook of veterinary drugs. In. Elsevier. Page: 840</p>
Parvaquone	<p>Radostits, O.M., Gay, C., Hinchcliff, K.W. and Constable, P.D. eds., 2006. <i>Veterinary Medicine E-Book: A textbook of the diseases of cattle, horses, sheep, pigs and goats</i>. Elsevier Health Sciences. Page: 2195</p>	<p>No data found</p>
Penicillin	<p>Guardabassi, L., Jensen, L.B. and Kruse, H. eds., 2008. <i>Guide to antimicrobial use in animals</i>. Page: 133. Oxford, UK: Blackwell Pub</p> <p>Radostits, O.M., Gay, C., Hinchcliff, K.W. and Constable, P.D. eds., 2006. <i>Veterinary Medicine E-Book: A textbook of the diseases of cattle, horses, sheep, pigs and goats</i>. Elsevier Health Sciences. Page: 1410, 1477-1478</p> <p>Papich, M.G., 2016. <i>Saunders handbook of veterinary drugs</i>. In. Elsevier. Page: 846</p>	<p>Papich, M.G., 2016. <i>Saunders handbook of veterinary drugs</i>. In. Elsevier. Page: 846</p>
Procaine penicillin	<p>Giguère, S., Prescott, J.F. and Dowling, P.M. eds., 2013. <i>Antimicrobial therapy in veterinary medicine</i>. Page: 492-518. John Wiley & Sons</p> <p>Radostits, O.M., Gay, C., Hinchcliff, K.W. and Constable, P.D. eds., 2006. <i>Veterinary Medicine E-Book: A textbook of the diseases of cattle, horses, sheep, pigs and goats</i>. Elsevier Health Sciences. Page: 570-571, 673, 1621, 2059,</p> <p>Papich, M.G., 2016. <i>Saunders handbook of veterinary drugs</i>. In. Elsevier. Page: 845</p>	<p>Papich, M.G., 2016. <i>Saunders handbook of veterinary drugs</i>. In. Elsevier. Page: 846</p>

Antimicrobial agent	Reference for dose	Reference for WP
Procaine G penicillin	<p>https://www.msdtvetmanual.com/reproductive-system/uterine-diseases-in-production-animals/metritis-in-production-animals</p> <p>Plumb, D.C., 2018. Plumb's veterinary drug handbook: Desk. John Wiley & Sons. Page: 703</p> <p>Papich, M.G., 2016. Saunders handbook of veterinary drugs. In. Elsevier. Page: 846</p> <p>Guardabassi, L., Jensen, L.B. and Kruse, H. eds., 2008. Guide to antimicrobial use in animals. Page: 169. Oxford, UK: Blackwell Pub</p> <p>Radostits, O.M., Gay, C., Hinchcliff, K.W. and Constable, P.D. eds., 2006. Veterinary Medicine E-Book: A textbook of the diseases of cattle, horses, sheep, pigs and goats. Elsevier Health Sciences. Page: 2059</p>	Papich, M.G., 2016. Saunders handbook of veterinary drugs. In. Elsevier. Page: 846
Streptomycin	<p>https://www.fao.org/fileadmin/user_upload/vetdrug/docs/41-7-dihydrostreptomycin_streptomycin.pdf</p> <p>Radostits, O.M., Gay, C., Hinchcliff, K.W. and Constable, P.D. eds., 2006. Veterinary Medicine E-Book: A textbook of the diseases of cattle, horses, sheep, pigs and goats. Elsevier Health Sciences. Page: 1621</p>	https://www.hpra.ie/img/uploaded/swedocuments/LicenseSPC_10019-149-001_23082013153031.pdf
Sulfadimidine (sulfamethazine)	https://www.msdtvetmanual.com/digestive-system/coccidiosis/coccidiosis-of-cattle#:~:text=Su lfaquinoxaline%20(13%20mg%2Fkg%2C,after% 20arrival%20at%20a%20feedlot	Papich, M.G., 2016. Saunders handbook of veterinary drugs. In. Elsevier. Page: 1021
Tilmicosin	Radostits, O.M., Gay, C., Hinchcliff, K.W. and Constable, P.D. eds., 2006. Veterinary Medicine E-Book: A textbook of the diseases of cattle, horses, sheep, pigs and goats. Elsevier Health Sciences. Page: 969, 1698	Papich, M.G., 2015. Saunders handbook of veterinary drugs -e-book: small and large animal. Elsevier Health Sciences. Page: 482 and 1068
Trimethoprim-sulfadoxine	Papich, M.G., 2016. Saunders handbook of veterinary drugs. In. Elsevier. Page: 1104	Papich, M.G., 2016. Saunders handbook of veterinary drugs. In. Elsevier. Page: 1107
Trimethoprim-sulfonamide	<p>Guardabassi, L., Jensen, L.B. and Kruse, H. eds., 2008. Guide to antimicrobial use in animals. Page: 169. Oxford, UK: Blackwell Pub</p> <p>Radostits, O.M., Gay, C., Hinchcliff, K.W. and Constable, P.D. eds., 2006. Veterinary Medicine E-Book: A textbook of the diseases of cattle, horses, sheep, pigs and goats. Elsevier Health Sciences. Page: 1942</p>	Papich, M.G., 2016. Saunders handbook of veterinary drugs. In. Elsevier. Page: 1107
Tylosin tartrate	Guardabassi, L., Jensen, L.B. and Kruse, H. eds., 2008. Guide to antimicrobial use in animals. Oxford, UK: Blackwell Pub. Page: 168	https://www.hpra.ie/img/uploaded/swedocuments/LicenseSPC_10980-005-001_26082009020028.pdf

A14: AWaRe categorization

AWaRe

Categorization

(Access, Watch, Reserve)

Classification of Antibiotics 2023

Access	Watch	Reserve
<p>1st generation cephalosporins: cefadroxil cefalexin (both) cefazolin cefradine</p> <p>Aminocyclitols: spectinomycin</p> <p>Aminoglycosides: amikacin (both) gentamicin (both) plazomicin (vet) paromomycin (vet)</p> <p>Amphenicals: chloramphenicol florfenicol (vet)</p> <p>Beta-lactam/beta-lactamase-inhibitor: amoxicillin/clavulanic acid (both)</p> <p>Imidazoles: metronidazole (both) ornidazole secnidazole tinidazole</p> <p>Lincosamides: clindamycin</p> <p>Nitrofurans derivatives: nitrofurantoin</p> <p>Penicillins: amoxicillin (both) ampicillin (both) benzathine-benzylpenicillin benzylpenicillin cloxacillin (both) dicloxacillin flucloxacillin phenoxymethylpenicillin pivmecillinam procaine-benzylpenicillin</p> <p>Sulfonamides (vet): sulfadimethoxine sulfasquinoxaline sulphadiazine</p> <p>Sulfonamide-trimethoprim-combinations: sulfadiazine/trimethoprim (vet) sulfamethoxazole/trimethoprim (both)</p> <p>Tetracyclines: doxycycline (both) tetracycline (both) chlortetracycline (vet)</p> <p>Others: pleuromutilins (vet) polypeptides (vet) pyrimidine (vet)</p>	<p>2nd-generation cephalosporins: cefador cefuroxime</p> <p>3rd generation cephalosporins: cefdinir ceftriaxone cefepime cefotaxime cefopodoxime-proxetil ceftazidime ceftibuten ceftiofur (vet) ceftiofur (vet)</p> <p>Anti-pseudomonal Beta-lactam/beta-lactamase-inhibitor: piperacillin/tazobactam</p> <p>Aminoglycosides: kanamycin oral streptomycin (both) tobramycin (vet) neomycin (vet)</p> <p>Fluoroquinolones: ciprofloxacin (both) danofloxacin (vet) gatifloxacin gemifloxacin levofloxacin (both) moxifloxacin ofloxacin pefloxacin (vet) sparfloxacin norfloxacin (vet) oxofloxacin (both) marbofloxacin (vet)</p> <p>Glycopeptides: teicoplanin vancomycin</p> <p>Lincosamides: lincosycin (vet)</p> <p>Macrolides: azithromycin (both) clarithromycin erythromycin (both) rosithromycin tylosin (vet) tilmicosin (vet) spisamycin (vet)</p> <p>Rifamycins: rifampicin rifaximin</p> <p>Steroid antibacterials: fusidic-acid</p> <p>Tetracyclines: lymecycline minocycline oral oxytetracycline (both)</p>	<p>3rd Generation Cephalosporins: ceftriaxone/avibactam</p> <p>4th-generation Cephalosporins: cefepime cefquinome (vet)</p> <p>5th generation cephalosporins: ceftaroline-fosamil ceftolozane-tazobactam</p> <p>Aminoglycosides: plazomicin</p> <p>Carbapenems: ertapenem meropenem meropenem/vaborbactam imipenem + cilastatin</p> <p>Glycylcyclines: tigecycline</p> <p>Glycopeptides: dalbavancin oritavancin telavancin</p> <p>Lipopeptides: daptomycin</p> <p>Monobactams: aztreonam casimersonam</p> <p>Polymyxins: colistin polymyxin B</p> <p>Oxazolidinones: linezolid tedizolid</p> <p>Penems: faropenem</p> <p>Phacophins: fosfomicin</p> <p>Pleuromutilins: lefamulin</p> <p>Streptogramins: dalopristin/quinupristin</p> <p>Tetracyclines: eravacycline minocycline iv omadacycline</p> <p>Trimethoprim-derivatives: iclaprim</p>

A16: Pregnancy category rating

Pregnancy Category Rating	Evidence Of Risk	Antibiotics	Anthelmintics and others
A	No risk in human studies, no risk in animals in any pregnancy stage.	<ul style="list-style-type: none"> ● Neomycin 	
B	No risk in animals in studies, no well controlled study in human.	<ul style="list-style-type: none"> ● Procaine Penicillin ● Benzyl Penicillin ● Amoxicillin ● Amoxicillin-Clavulanic Acid ● Ampicillin ● Cloxacillin ● Lincomycin ● Metronidazole ● Erythromycin ● Tylosin 	
C	Risk not ruled out; Animal reproduction studies have shown an adverse effect on the fetus and there are no adequate and well-controlled studies in humans, but potential benefits may warrant use of the drug in pregnant women despite potential risks.		<ul style="list-style-type: none"> ● Ivermectin
D	Positive evidence of risk; There is positive evidence of human fetal risk based on adverse reaction data from studies in humans, but potential benefits may warrant use of the drug in pregnant women despite potential risks.	<ul style="list-style-type: none"> ● Gentamycin ● Streptomycin ● Doxycycline ● Tetracycline ● Oxytetracycline 	
X	Contraindicated in pregnancy; Studies in animals or humans have demonstrated fetal abnormalities and the risks involved in use of the drug in pregnant women clearly outweigh potential benefits.		
N	The FDA has not yet classified the drug into a specified pregnancy category.	<ul style="list-style-type: none"> ● Enrofloxacin ● Florfenicol ● Tilimicosin 	<ul style="list-style-type: none"> ● Amprolium ● Diminazine Acetaurate ● Imidocarb Dipropionate ● Buparvaquone



The
Fleming
Fund