Chemotherapy:

It is the treatment of diseases by using chemicals that are called *Chemotherapeutic Agents*, these agents includes Antiseptics and Disinfectants, Antimicrobials, Antibiotics, Antifungal.

A. Antiseptics and Disinfectants:

a. Cleansers: (Surfactants, Detergents):
Cleansers remove dirt and contaminating microorganisms by solubilization and physical means. Cleaning of an area with cleansers before antiseptic application increase the efficacy of antiseptics. Cleansers are of three types

- **Anionic Cleansers** e.g Soaps
- **Cationic Cleaners** e.g *Quaternary Ammonium Compounds* (QACs) widely used as a disinfectant. It is fungicidal, bactericidal and virucidal against lipophilic viruses but not sporicidal. Benzalkonium Chloride (QACs) the first commercially available QAC has been shown to cause chemical burns when used undiluted.
- **Nonionic Cleansers**.

b. Antiseptics:
It is a chemical agent which reduces microbial population on Skin and other living tissue.

c. Disinfectants:
Chemical agent which eliminate many or all pathogenic organism, excluding spores from an inanimate object.

- **Antiseptics and Disinfectants**
  - **Alcohols**: They kill microbes by solubilizing the lipid membrane and by denaturizing membrane cellular proteins. 70 % *ethyl-alcohol* and 50 % *isopropyl alcohol* are used. Alcohols have excellent antibacterial activity but not recommended for high level disinfection or chemical sterilization.

  - **Halogens**: Elemental iodine has activity against Gram –ve, Gram +ve bacteria, there spores, Fungi and Viruses. It exerts lethal effect by diffusing the cell wall and interfering with metabolic reactions and by disrupting proteins and nucleic acid structural synthesis. Iodine is insoluble in water that why Tincture of iodine is prepared in Alcohol. 1-2 % *iodine* solution in 70 % *ethyl-alcohol* (used in 1839 in French Civil War) about 90 % bacteria are killed.
**Chlorhexidin:**
It is a synthetic cationic compound with better activity against Gram +ve than Gram –ve ones. It kills the bacteria by disrupting the cell membrane and precipitating the cell contents. Chlorhexidin is available in detergent base as 4 % solution or as 2 % liquid foam. It is widely used as a pre-surgical antiseptic, Wounds flush, and Teats dip. It used as disinfectant is not been described.

**Aldehydes:**
Two related aldehyde disinfectants are formaldehyde and glutraldehyde (GLT). Formalin the aqueous form is 37 % formaldehyde. The caustic nature of both aldehydes makes them inappropriate for antiseptic use and in fact protective gloves and mask should be worn when using them for disinfection. It is irritating to mucus membranes of eyes and nose. Formaldehyde is slow disinfectant and requires 6-12 hours contact time but GLT require 2 minutes contact time for vegetative bacteria, 10 minutes for fungi and 3 hours for spores when used as a 2 % aqueous alkaline solution.

**Hydrogen Per-Oxide (H2O2):**
It has bactericidal, virucidal, and fungicidal activity. Some consider that it is more effective against bacterial spores as compare to the vegetative form of bacteria. It is not suitable for routine wounds care. However it is considered a stable and effective disinfectant.

**Phenols:**
Carbolic Acid is the oldest example of an antiseptic compound. However due to sever local and systemic toxicity, it is no longer appropriate for use as an antiseptic. The agent acts as a cytoplasmic poison by penetrating and disrupting the microbial cell walls. Sodium o-phenylphenol is effective against Mycobacteria, Staphylococci, Pseudomonas, Fungi, lipophilic Viruses, Ascarids, Strongyles and Tichurids. Cresols are substituted Phenols and are more bactericidal and less toxic and caustic than phenols.

**Gases:**
Gases are used primarily as disinfectants for large spaces and for sterilization of sensitive surgical equipments. Ethylene oxide (C2H4O) is a water soluble flammable gas used for gas sterilization. Mixing of the C2H4O with CO2 or fluorocarbons reduces its flammability. Ethylene oxide is used to kill bacteria, fungi, viruses and spores. Formaldehyde gas inactivates viruses, bacteria, fungi and bacteria spores. It activity depend on Relative Humidity (RH). It is used for fumigation of poultry houses, Hatcheries and Egg store rooms. Propiolactone, Methylbromide and propylene oxide are also used as a gas disinfectants.

**Carbolic Acid:**
It is used as 1 %, 2½ % and 5 % solutions. 5 % is indicated for instruments, site of operations and septic wounds and 2 % for recently practical wound and 1 % for mucous membranes.

**Per-Chloride of Mercury:**
Following solution kill most of the bacteria.

<table>
<thead>
<tr>
<th>Component</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sublimate</td>
<td>1 part</td>
</tr>
<tr>
<td>Tartaric acid</td>
<td>5 part</td>
</tr>
<tr>
<td>Boiled water</td>
<td>1000 part</td>
</tr>
</tbody>
</table>

Solution of 1 in 5000 to 1 in 3000 is used for mucous membranes like vagina and uterus. Another preparation is; Per-chloride of mercury 1 part and Glycerin 500 or 1000 part is also used.

**Bincodide of Mercury:**
1 in 10,000 or 20,000 solution is suitable for uterine and eye mucousa, wounds, hands and instruments.
• **Chloride of Zinc:**
  In 5 % solution destroys most of the spores but it is caustic in nature. 10 % solution is used for very septic wounds and sinuses.

• **Dakin’s solution:**
  Preparation:
  Dissolve 140 gm of dry sodium carbonate (Na2CO3) or 400 gm of crystals, 200 gm of Chloride of lime of good quality in 10 liters of ordinary water. The mixture is shaken and at the end of ½ an hour the clear liquid is siphoned, then filtered and 40 gm of Boric Acid is added. It is used as a cold but not be used with alcohols.

• **Hypochlorous acid:**
  Name “Cusol” has been given in Great Brittan.
  Preparation:
  Liquor Calcis Chlorinata (filtered) 12 ounces
  Saturated solution of Boric Acid 22 ounces
  Water 56 ounces
  It is cheap, nonirritant, and very effective but not suitable for immersion of equipments.

• **Potassium Per-Megnate:**
  It is used in proportion of 1 in 1000 distilled water. 10 % solution is used for septic wounds.

• **Iodoform:**
  It is antiseptic and analgesic in nature. Preparations which are used are given as below;
  1. Iodoform 7 or 10 parts
     Ether 100 parts
  2. Iodoform 10 parts
     Glycerin 100 parts
  3. Iodoform 1 or 2 parts
     Vaseline 10 parts
  4. Bismuth Sub-Nitrate 1 part
     Iodoform 2 parts
     Liquid parafin sufficient to make a paste
  No.4 is known as BIPP (bismuth iodoform paraffin paste) and widely used for applying on deep wounds.

• **Formaline:**
  It is 40 % aqueous solution of formaldehyde. Diluted with 400 or 500 parts of water is useful for disinfection and accidental wounds.

• **Chinosol:**
  A yellow crystalline powder derived from coal tar and if used as a ½ grains to the ounce of water is a powerful antiseptic.

• **Nitrate of Silver (AgNO3):**
  In the form of stick is very powerful caustic and solution of 2 to 4 grains to the ounce is a good astringent eye lotion.

• **Boric Acid:**
  It is powder has been used as a wound dressing. It is slightly an irritant. A saturated solution is smoothing and antiseptic for inflamed mucous surfaces, it is used for antisepsis of eye.
- **Antiseptic Dyes:**
  Acriflavine (acridine dye) and Gention violet (aniline) are used as a local antiseptics. Acriflavine is used in a concentration of 1:500 or 1:1000 for local wounds irrigation where 1% solution of Gention violet prepared in 10% alcohol is applied to burns, eczema and wounds.

- **Jeyes Fluid (Creolene):**
  It is a coal tar preparation, miscible with water and alcohol, and employed as an antiseptic and disinfectant. \( \frac{1}{2} \text{ to } 1 \% \) and 3% solutions are used.

- **Lysol:**
  Its solution is soapy in nature. 1 to 2% solution is used for antiseptic and disinfection purpose.

- **Chloride of Sodium (NaCl):**
  Boiled water containing 9 gm NaCl per liter of water is suitable for washing out serous cavities. A 5-8% solution has aseptic properties.

- **Magnesium Chloride:**
  12 in 1000 solution applied as a lotion thrice daily or used in the form of moist compresses for antiseptic purpose.

- **Heat:**
  Moist heat is more efficient in destroying bacteria than dry heat. Steam at 212°F kills most pathogenic microbes while a dry heat of temperature 290° to 330°F is required for this. Boiling water containing 1% \( \text{Na}_2\text{CO}_3 \) for 10 minutes is sufficient for destruction of the most of microorganisms but does not give security against spores.

- **Antiseptics and Disinfectants uses in Veterinary Practice:**
  Antiseptics are used as a skin cleanser in the form of soaps and detergents, Treatment of wounds in the form of wounds scrubs and antiseptic solutions and Teat antiseptics in the form of teat dips. While disinfectants are used for disinfection of food areas, feeding and watering utensils, dairy parlors and milking equipments, stocking yards, livestock production areas, equine facilities, hospitals, clinics, surgery and medication equipments, poultry houses, hatcheries and eggs store rooms, Zoo and aquaculture disinfection.
### Antimicrobials and Antibiotics:

#### Classification of Antimicrobials and Antibiotics

<table>
<thead>
<tr>
<th>Agent</th>
<th>Spectrum of Activity</th>
<th>Action against Mirobes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sulfonamides</td>
<td>Broad</td>
<td>Bacteriostatic</td>
</tr>
<tr>
<td>Sulfathiazoled</td>
<td></td>
<td></td>
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<tr>
<td>Sulfathiazole</td>
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<tr>
<td>Sulfamethoxazole</td>
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<tr>
<td>Sulfamethazine</td>
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<tr>
<td>Sulfadiazine</td>
<td></td>
<td></td>
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<tr>
<td>Sulfadoxin</td>
<td></td>
<td></td>
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<tr>
<td>Sulfamethazine</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sulfadimethazine</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sulfachlorpyridazine</td>
<td></td>
<td></td>
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<tr>
<td>Sulfaquinoxaline</td>
<td></td>
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<tr>
<td>Sulfamethazine(Sulfadimazine)</td>
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</tr>
</tbody>
</table>

#### Sulfonamides:

**Members:**

- Sulfanilamide
- Sulfamethoxazole
- Sulfamethazine
- Sulfadiazine
- Sulfadoxin
- Sulfamethazine
- Sulfadimethazine
- Sulfachlorpyridazine
- Sulfaquinoxaline
- Sulfamethazine(Sulfadimazine)

**Mode of Action:** Compete with Para Amino Benzoic Acid (PABA) for the catalytic site of the enzyme dihydropteroate synthetase and thereby inhabiting the conversion of PABA to folic acid by bacterial cell.

**Spectrum of activity:** Broad Spectrum

**Indications:**

Infections of Central Nervous System (CNS), Gastro Intestinal Tract (GIT), Respiratory Tract (RT), Urinary Tract (UT), and Reproductive Diseases (RD)

**Toxicity:**

- Crystalluria, Keratoconjunctivitis, Hepatic Necrosis, Hypoprothrombinaemia, Aplastic Anaemia,
- Thrombocytopenia, Iodiosyncracy reactions, Carcinogenesis.
**Beta-Lactam Antibiotics:**

- **(Pancillins, Cephalosporin, Pencillin+Clavunic acid):**

**Mode of action of Beta-Lactam Antibiotics:**

Prevent bacterial cell wall synthesis and disrupting bacterial cell wall integrity.

**Spectrum of Activity:** Pencillins have Variable spectrum while Cephalosporin is broad spectrum

- **Pencillin:**

<table>
<thead>
<tr>
<th>Natural Pancillins</th>
<th>Amino Pencillins</th>
<th>Pencillinase resistant Pencillins</th>
<th>Extended spectrum Pencillins</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pencillin G</td>
<td>Amoxicillin</td>
<td>Clavacillin</td>
<td>Azlocillin</td>
</tr>
<tr>
<td>Pencillin V</td>
<td>Ampicillin</td>
<td>Dicloxacillin</td>
<td>Carbenicillin</td>
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<tr>
<td></td>
<td></td>
<td>Methicillin</td>
<td>Mezlocillin</td>
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<td></td>
<td></td>
<td>Nafcillin</td>
<td>Piperacillin</td>
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<tr>
<td></td>
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<td>Oxacillin</td>
<td>Ticaricillin</td>
</tr>
</tbody>
</table>

**Mode of Action:**

Prevent bacterial cell wall synthesis by preventing cross linkage between peptidoglycane due to the catalytic effect of enzymes Pencillin Binding Proteins (PBPs) and disrupting bacterial cell wall integrity.

**Indications:**

Mastitis, UTI, Anthrax, Lumpy jaw, Tetanus, Leptospirosis, RTI, Meteritis, Meningitis, Listeriosis etc.

**Toxicity:**

- Allergic Reactions (Hypersensitivity), Acute Anaphylaxis reaction, Collapse, Hypersalivation and Shaking,
- Vomiting, Urticaria, Fever, Anaemia, Anorexia, Vomiting and Diarrhea in oral administration.

- **Cephalosporins:**

**Members:**

<table>
<thead>
<tr>
<th>First Generation</th>
<th>Second Generation</th>
<th>Third Generation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cefadroxil</td>
<td>Cefaclor</td>
<td>Cefixime</td>
</tr>
<tr>
<td>Cefazolin</td>
<td>Cefamandole</td>
<td>Cefoperazone</td>
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<tr>
<td>Cephalexin</td>
<td>Cefmetazole</td>
<td>Cefotetray</td>
</tr>
<tr>
<td>Cephalothin</td>
<td>Cefonicid</td>
<td>Cefotaxime</td>
</tr>
<tr>
<td>Cephapirin</td>
<td>Ceforanide</td>
<td>Cefpodoxime</td>
</tr>
<tr>
<td>Cephradin (Velosef®)</td>
<td>Cefotetan</td>
<td>Ceftazidime</td>
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<tr>
<td></td>
<td></td>
<td>Ceftiofur (Axinil®)</td>
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<tr>
<td></td>
<td></td>
<td>Ceftriaxone</td>
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<tr>
<td></td>
<td></td>
<td>Cefixime</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Moxalactam</td>
</tr>
</tbody>
</table>

**Indications:**

URTI, UTI, skin and soft tissues infections, systemic infections by Gram +ve and Gram –ve bacteria and life threatening infections before specific organism identified.

**Toxicity:**

Hypersensitivty, Vomiting and Diarrhea
Neutropenia, Thrombocytopenia, Agranulocutosis and Hepatopathy and Nephropathy when prolong use is continued.

- **Pencillin + Clavulanic Acid:** *(Amoxicillin + Clavulanic Acid)*

**Members:**

- (Tab Augmantin®)
- (Tab Co-Amoxiclav®)

Amoxicillin is combined with Clavulanic Acid in the ratio 4 : 1 and this preparation is used for oral administration.

**Indication:**

Combination of Pencillin and Clavulanic Acid is indicated in Skin and Enteric infections.
**Tetracycline:**

**Members:**
- Tetracycline
- Oxytetracycline (OTC)
- Chlortetracycline
- Doxycycline
- Menocycline

**Mode of Action:**
Interfere with bacterial protein synthesis by binding with 30S ribosomal subunit of the susceptible bacteria.

**Spectrum of Activity:** Broad Spectrum

**Indications:**
As due to broad spectrum of activity tetracyclines are indicated in variety of diseases caused by Bacteria, Protozoans and Rickettsia. It is indicated in mix infections like bronchopneumonia, enteritis, metritis, mastitis, urinary tract infections, prostatitis and pyodermatitis. It inhibit the growth of protozoal shizonts, that why it is also indicated in treatment of protozoal diseases like Babesiosis and Theleriosis in combination of antiprotozoal drugs. It is also indicated in canine Ehrlicosis.

**Toxicity:**
- Nearly safe antibiotic but may cause irritation when administered intramuscularly (IM) and GIT upsets and Hepatotoxicity when used in large quantitiy.
- Chelation with blood Ca when administered intravenously (IV) causes collapse of the animal.
- Tooth mottling (discoloration) is due to chelation of OTC with Ca. Use of Doxicycline is fatal in horses. Photo-toxicity and Super infection occur in human.

**Aminoglycosides:**

**Members:**
- Gentamicin
- Lividomicin
- Propikacin
- Amikacin
- Butikacin
- Ribostamicin
- Kanamycin
- Butirocin
- Sagamicin
- Apramicin
- Dibekacin
- Seldomicin
- Tobramycin
- Fortimicin
- Sisomicin
- Neomycin
- Netilamicin
- Sorbitin
- Dihydrostreptomycin
- Paromomycin
- Streptomycin

**Mode of Action:**
It binds with 30S subunit of microbial ribosome and inhabits translation process of the bacterial cell.

**Spectrum of Activity:** Broad Spectrum

**Indications:**
Still considered to be the drug of choice for treating serious aerobic Gram –ve infections in the Vet; Medicine.

- **Streptomycin:** Tuberculosis, Brucellosis, Glander and Mastitis (intramammary administration). It has synergistic effect when combined with Procaine Pencillin.
- **Gentamicin:** Indicated in UTI, RTI, Eye Infections, Metritis, Otitis and Soft tissues infections. Dose @ 5 mg/kg BW twice a day at first day and than once daily.
- **Neomycin:** UTI, Skin, Eye and Ear infections, White Scour in calves, Mastitis and Dermatitis. Dose @ 10 mg/kg BW orally and 2.5 mg/kg BW parentally.

**Toxicity:** Ototoxic and Nephrotoxic
**Chloramphenicol:**

**Members:**
- Thiamphenicol
- Florfenicol

**Mode of Action:**
They inhibit protein synthesis of bacterial cell by interfering the peptidyl transferase activity at 50 S subunit of bacterial ribosome.

**Spectrum of Activity:** Broad Spectrum

**Indications:**
RTI, CNS, Eye and Joints infections also recommended to use in exotic animals especially Reptiles and Amphabians, 15 species of birds were studied after IM administration of Chloramphenicol @ 50 mg/kg BW, the concentration was effective and adequate to treat susceptible bacteria for 8-12 hours but not recommended in Pegions, Macaws and Conures. However oral administration is not recommended in birds due to poor absorption of the drug.

**Toxicity:** Diarrhea, Anorexia, and decreased feed consumption are observed.

**Floroquinolones:**

**Members:**
- Enrofloxacin
- Ciprofloxacin
- Orbifloxacin
- Marbofloxacin

**Mechanism of Action:**
It has bactericidal effect because of inhabiting Bacterial DNA replication and transcription by inhabition the activity of DNA gyrase.

**Spectrum of Activity:** Broad spectrum
It has good activity against Gram –ve bacteria but Gram +ve are variably susceptible.

**Indications:**
- **Dogs and Cats:**
  It is indicated to treat Infections of the skin, soft tissues, oral cavity, urinary tract, external and internal ears, wounds, respiratory tract and bones, Ehrlicosis, Ricketsial, Mycoplasm and Mycobacterial infections
- **Horses:**
  It is used to treat the Joint infections, Endometeritis, Pneumonia, Pleuropneumonia, and Orthopedic infections.
- **Bovines:**
  Respiratory diseses.
- **Pet and Poultry Birds:**
  E.coli, Mycoplasma, Staphylococcus and Pasturella infections. Experiences suggests that Enroflaxacin can decrease clinical signs but not eliminate the infections (Flamer 1998), Therefore floroquinolones are not recommended for mass medication of Pet birds and Doxicycline is still the drug of choice for this indication.

**Toxicity:**
- CNS (seizures) effect when extra label administration is done.
- Ocular problems in cats are observed.
- Arthropathy, Tendinitis and Tendon rapture are observed in young animals.
**Macrolides**

**Members:**
- Erythromycin
- Tylosin
- Roxithromycin
- Erythromycylamine
- Tilmicosin
- Dirithromycin
- Azithromycin
- Clariyhromycin
- Sipramycin
- Flurithromycin

**Mode of Action:**
The antibacterial action of macrolides is due to inhibition of protein synthesis by binding to 50 S subunit of bacterial ribosome.

**Spectrum of Activity:** Narrow Spectrum mainly effective against Gram +ve bacteria.

**Indications:** Used to treat Gram +ve infections.

**Toxicity:**
Erythromycin: More side effects are observed in Human population as compare to animals, but regurgitation and vomiting are observed in dogs when orally administration is done. In horses diarrhea is observed.

**Lincosamides:**

**Members**
- Lincomycin
- Clindamycin

**Mode of Actions:**
Inhibit synthesis of proteins by bacterial cells by binding to 50 subunit of microbial ribosome.

**Spectrum of Activity:** Broad Spectrum

**Indications:**
- **Lincomycin:**
  It is used to treat Gram +ve aerobic and anaerobic infections.
  **Dogs & Cats:** Infections of skin, bones and URT dose @ 22 mg/kg BW every 12 hours orally.
  **Broilers:** Used as feed additives to increase the rate of weight gain and improve feed efficiency in addition to treat enteritis @ 2 g/ton of lincomycin to feed.
  **Sheep & Goats:** For the treatment of RTI.

- **Clindamycin:**
  It is 20 % more potent than lincomycin, and has been used to treat wounds, abscesses, osteomyelitis, and peri-odontal diseases.
  **Cats:** It can be used to treat Toxoplasmosis
  **Dogs:** It can be used to treat post-traumatic osteomyelitis @ 11 mg/kg orally twice daily for 28 day, also effective for the treatment of superficial pyoderma. It should be given @ 11 mg/kg IV for every 12 hours.

**Toxicity:**
GIT problems e.g Diarrhea, Vomiting and loose Stool in dogs and cats. Enteritis and Enterocolitis is also observed.
Other Antibiotics:

Rifampin:
It is used to treat equine diseases of Gram +ve organisms. Diseases produced by Staphylococcus, Streptococcus, Rhodococcus, Brucella, Mycobacterium and Chlamydia are treated efficiently by Rifampin.

Mode of Action:
It exerts the bacterial cell and forms stable complexes with the beta subunit of DNA dependent RNA-Polymerases and inhabit RNA-Synthesis.

Toxicity:
It induces Hepatitis in dogs. Teratogenic in nature and reported to turn the urine red.

Nitrofurans:
Over 3500 nitrofurans have been synthesized with only a handful being useful in animal chemotherapy.

- Furazolidone:
  Mode of Action:
  It is Bacteriostatic in nature. It blocks oxidative de-carboxylation of pyruvate to Acetyl-CoA.
  Spectrum of Activity: Encompasses Gram +ve and Gram –ve and some protozoans but they are more effective against Gram –ve bacteria.

  Indications:
  It is mostly used in topical preparations of Eye, Ear, Mucous memberanes, and Skin.
  Toxicity: It is mutagenesis, effect is observed in mammalian cells (Mc Calla 1983), as Carcinogenic and Mammary tumor is produced.

C. AntiFungal

A. Members:
1. Griseofulvin
2. Flucytosine
3. Amphotericin-B
4. Azole antifungal drugs
   i. Ketoconazole
   ii. Enilconazole
   iii. Clotrimazole [Clozox 10 gm (Clotrimazole 10 mg/gm of topical cream)]
   iv. Itraconazole
   v. Fluconazole
5. Terbinafine
6. Polyene fungicidal antibiotics
   i. Natamycin
   ii. Nystatin
<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Griseofulvin</th>
<th>Amphotericin-B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mechanism of action</td>
<td>In fungal cell it disrupts mitotic spindles by interacting with polymerized</td>
<td>Action on fungus involves more than one mechanism of action but the more major action is binding with ergosterol in the fungal plasma cell membrane and making it more permeable that leads to cell death.</td>
</tr>
<tr>
<td></td>
<td>microtubules, thus causing mitotic arrest at Metaphase.</td>
<td></td>
</tr>
<tr>
<td>Spectrum of activity</td>
<td>Microsporum, Trichophyton and Epidermophyton and no activity against other fungi or yeast.</td>
<td>More strains of fungi of Veterinary interest are inhibited by Amphotericin-B. Sensitive fungus are H.capsulatum, C.neoformans, C.immitis, B.dermatitis, Candidia spp; and Aspergillus spp:</td>
</tr>
<tr>
<td>Clinical use</td>
<td>To treat Dermatophytosis and Ring worms infections</td>
<td>To treat canine Histoplasmosis and Blastomycosis.</td>
</tr>
<tr>
<td>Side effects</td>
<td>Problematic in cats cause leukopnia, anaemia, ataxia, bone marrow hypoplasia and teratogenic in cats.</td>
<td>Nephrotoxicit, phlebitis, fever, nausea and vomiting is observed.</td>
</tr>
</tbody>
</table>

**Azole antifungal drugs:**

1. **Ketoconazole**
   - Activity: It is active against yeast and dimorphic fungi like candidia, malassezia (pityrosporum), C.immitis, B.dermatitids and most of Dermophytes.
   - Toxicity: Nausea, anorexia and vomiting are observed.

2. **Enilconazole**
3. **Clotrimazole**
4. **Itraconazole**
5. **Fluconazole**

**Mechanism of Action:**
All Azole exerts there antifungal effect on the cell membrane of the fungus cell by inhibiting the synthesis of primary sterol of the fungal cell membrane that is *ergosterol*, changes membrane fluidity and interferes with barrier function of membrane and with membrane bound enzymes.

- **Ketoconazole:**
  - Activity:
    - It is active against yeast and dimorphic fungi like candidia, malassezia (pityrosporum), C.immitis, B.dermatitids and most of Dermophytes.
  - Toxicity: Nausea, anorexia and vomiting are observed.

- **Itraconazole:**
  - Activity:
    - It is active against Microsporum, Trichophyton, Candidia, Malassezia, Sporothrix, Aspergillus, Histoplasma, Cryptococcus and Blastomyces.
  - Indication: Dermatophytosis in cats. Occular and Systemic Blastomycosis in dogs and Aspergillosis in caged birds.
  - Toxicity: It is probably better tolerated in dogs and cats but some adverse effect are observed that are produced include anorexia in dogs. Anorexia, vomiting and hepatic toxicities in cats.

- **Enilconazole (Imazalil):**
  - It is used for topical treatment of dermatophyte infections in cats, dogs and horses (@ 10 % solution are diluted 5:1 to form an emulsion), and nasal aspergollosis in dogs.
Polyene fungicidal antibiotics

1. Natamycin
2. Nystatin

- Nystatin:
  Mechanism of action:
  It effects on the cell membrane permeability of the fungus cell by combining with ergosterol.
  Activity:
  It is active against Candidia, Malassezia, Cryptococcus and Dermatophytes.
  Indications:
  Equine meteritis, Canine otitis, Bovine fungal Mastitis and avian crop mycosis (Thrush).