NOTTINGHAM TRENT UNIVERSITY

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Week 4
Antibiotic Usage In Animals

Booklet analysing and comparing antibiotic use in animals within the United Kingdom (UK) and Uganda.

Booklet Content:

This booklet analyses and compares antibiotic usage in animals within the United Kingdom (UK) and Uganda.

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Most common animals in the UK - domestic pets and livestock:

UK domestic pets:

- **Dogs are the most commonly owned pet within UK households** (Bedord, 2021).
- In 2020 till May 2021, pet ownership reportedly increased by 18% when compared to the years 2019 and 2020.
    - Likely reason for this would be the coronavirus pandemic and people's need for home comfort and company.

Table 1. Data taken from Bedford (2021) showing a 2020 survey on pet ownership in the UK.

Domestic animal	Percentage of households
Any pet	59%
Dogs	33%
Cats	27%
Birds (indoor)	2%
Rabbits	2%
Hamsters	1.7%
Guinea pigs	1.2%
Domestic fowl	1.1%
Tortoises and turtles	1%
Horses and ponies	1%
Snakes	0.8%
Pigeons	0.8%
Lizards	0.7%
Gerbils	0.6%
Rats	0.3%
Frogs and toads	0.2%
Ferrets	0.1%

- (*) stated that 51% of UK adults own a pet, according to data from 2020.
    - 26% of the UK adults reported owning a dog within a population of 10.1 million pet dogs.
    - 24% of the UK adults have a cat within a population of 10.9 million pet cats.

Farming animals and livestock: globally:

Livestock = any domesticated, land-living animal raised to provide resources (i.e, meat, milk, eggs and feathers). They are also animals providing services such as transportation (e.g. cows and horses).

- Livestock are raised on small local trade scales and in massive industrial operations supplying international markets.
- Its distribution is highest in eastern Asia, northern Africa and the Southeast region of the United States.
    - E.g. sheep prefer grasses near the ground and hence thrive in lusher grasslands and pastures, like New Zealand (Esri's StoryMaps team, 2021)

From a **global perspective**, the **most common livestock animals** are:

1. Chickens.
2. Cattle.
3. Sheep.
4. Ducks.
5. Goats.
6. Pigs.

Global livestock production is the largest user of agricultural land. Therefore, it accompanies many **animal welfare issues caused by livestock production** such as:

- **Lameness in dairy cattle.**
    - Caused by infectious diseases, poor nutrition, poorly-designed cubicles.
        - NOT ALL LAMENESS CASES REQUIRE ANTIBIOTICS...only infectious lesions.
- **Keel damage in laying hens.**
    - Keel bone fractures involve hens with broken keel bones preventing their quality of movement, flight and egg production.
    - Keel damage results from poor handling of animals, poor nutrition and genetics.
    - 36% of hens from furnished cages in the UK had reported associated keel bone fractures.
- **Castration in pigs.**
    - Removal of male pig testes to avoid boar taint in meat of mature male pigs.
    - Advantages also include reduction in male pig aggression.
    - Disadvantages include pain and accessible sites of infection… therefore, a risk factor for antibiotic overuse.
- **Farmed fish welfare.**
    - RSPCA (Royal Society for the Prevention of Cruelty to Animals) have identified that fish are not being transported and slaughtered humanely (RSPCA, 2021).
        - Fish are also capable of actions like humans such as memories and learning actions from other fish species.
    - **Aquaculture (fish farming)** is an overlooked source of antimicrobial resistance (AMR).
        - Aquaculture is often associated with fish being kept in horrific aquatic ecosystems and environments. This can lead to disease outbreaks.
            - E.g. *Saprolegnia parasitica* (fungal-like organism) eats dead organisms. They become deadly parasites that necrotize the flesh of stressed animals such as salmon and cause disease Saprolegniasis (McKee, 2020).
        - Antibiotics are heavily administered to deal with disease outbreaks.

Farming animals and livestock: UK:

The **Department for Environment Food and Rural Affairs** (DEFRA) releases annually detailed **statistics of the agricultural industry in the UK showing UK land areas and livestock numbers**: (Department for Environment, Food and Rural Affairs, 2021).

- Land use/ the total Utilised Agricultural Area (UAA) is inclusive of grassland, croppable area and other land (e.g. grassland).
- Cattle and calves breeding for dairy and beef production.
- Pig breeding and pig fattening.
- Sheep and lamb breeding.
- Poultry (chickens and other poultry like ducks and turkey).
- Other livestock like goats, farmed deer and horses.

Table 2. Showing the reported 2018-2020 farming statistics of UK land areas and livestock numbers according to the Department for Environment Food and Rural Affairs. Red represents a decrease in reported numbers from the previous annual recorded data; green represents an increase in reported numbers from the previous annual recorded data and orange represents no change in data from the previous annual recorded data.

	Units of measurement	**2018**	**2019**	**2020**
UAA	UAA as a proportion of the total UK area, in thousand hectares.	17, 361	**17, 532**	**17, 369**
Cattle and calves	Total cattle and calves in thousands.	9, 891	**9, 739**	**9, 615**
Pigs	Total pigs in thousands.	5, 012	**5, 078**	**5, 055**
Sheep and lambs	Total sheep and lambs in thousands.	33, 781	**33, 580**	**32, 697**
Poultry	Total poultry in thousands.	188, 960	**187, 072**	**181, 957**
Other livestock - goats	Total goats in thousands.	108	**111**	**112**
Other livestock - farmed deer	Total farmed deer in thousands.	34	**38**	**37**
Other livestock - horses	Total horses in thousands.	250	**250**	**235**

The Veterinary Medicines Directorate (2020) published their 2019 UK-VARSS (UK Veterinary Antibiotic Resistance and Sales Surveillance Report) summarising:

- **In 2019, 232.2 tonnes of antibiotics were sold in the UK.**
    - 12.4 tonnes were prescribed to dogs and cats.
    - 96.4 tonnes were prescribed to pigs and poultry, 12 tonnes for cattle, 3.1 tonnes for fish.
- Most sold antibiotic classes were tetracyclines (32% of sold antibiotics) followed by beta-lactams (26% of sold antibiotics).

Most common animals in Uganda - domestic pets and livestock:

Uganda's natural environment provides a good grazing climate for livestock such as cattle, goats, poultry, pigs and sheep with indigenous breeds dominating most livestock reared for both small holdings and larger scale industrial farming. Cattle and poultry are the most kept species, with their production valued at USD 8.7 and USD 0.9 million per year respectively. It was reported that approximately 3.9 million households own livestock (UBOS, 2017).

- **Cattle**; Uganda has an estimated number of over **14 million cattle**. They are the commonest livestock animals reared by the different farmers across the country. Indigenous cattle breeds are most reared in the country and the rest being the exotic breeds. An estimated 90% of the total cattle is kept under pastoral and mixed smallholder farming systems. Commercial beef ranching accounts for only 10 % of the total cattle. The cattle sector contributes over 40 percent to the value of livestock production and to about 7 percent to the value of agricultural production (UBOS, 2017). Most cattle are kept in a region known as the 'Cattle Corridor', which extends diagonally across Uganda from the pastoralist Ankole area in the Southwest to the Karamoja region in the Northeast (Egeru et al., 2014). The Karamoja region located in the Northwestern part of the country has the highest number of cattle mainly because pastoralism is the main form of livelihood for the locals there (Gradé et al., 2009).

Figure . A picture showing cattle on a grazing field.

- **Poultry;** There are over **47.6 million** poultry in Uganda, 85% percent of these being are indigenous breeds. 37.4 million of the country's total poultry are used for meat production. The most common species kept are the **chicken, turkeys** and **ducks**. The poultry sector contributes 4.3 percent to the total value of agricultural production. The major chicken production systems in Uganda: the free-range, the semi-intensive and the intensive production systems. About 40% of all households keep chickens, largely in free-range systems.

- **Small ruminants;** these comprise mainly **Goats** (approximately 16 million), **sheep** (approximately 4.5 million)
- **Pigs**(approximately 4.1 million).

- The main **pets** kept in homesteads are mainly **cats and dogs**.Both were estimated at 0.65 Million during the previous National Animal Census in 2008. In most cases dogs are for security reasons while cats are kept to feed on rats and mice pests in some homesteads. There is a relatively large number of these that are stray and are always observed moving in villages. These are usually not vaccinated and in some unfortunate cases attack people and spread disease causing germs of mainly rabies for the dogs.

Figure 2. A picture showing dogs brought to a vaccination outreach done by the Makerere University One Health Club.

It is important to note that Uganda's livestock is at a high risk of less production due to a variety of factors such as Antimicrobial Resistance, Limited veterinary and paraveterinary personnel, climate changes and poor enforcement of the guiding laws and regulations.

Most used antibiotics in animals in the UK:

Most frequently used antibiotics in veterinary medicine globally:

Table 3. Examples of frequently used antibiotics in animals. Bactericidal = agent kills bacteria. Bacteriostatic = agent prevents bacterial growth.

Antibiotic type	Example	Source	Effect	Mode of action	Limitations
Aminoglycosides	Gentamicin	*Streptomyces spp.* *Micromonospora spp.*	Bactericidal	Inhibits protein synthesis	Not effective against anaerobic bacteria Toxic, so is limited to severe infections
Beta-lactam antibiotics	Penicillins	Penicillin: *penicillium chrysogenum*	Bactericidal	Inhibits cell wall synthesis	Do not work against all bacteria
Chloramphenicol	Chloromycetin	*Streptomyces venezuelae*	Bacteriostatic	Inhibits protein synthesis	Vomiting and diarrhea in animals
Fluoroquinolones	Ciprofloxacin	4-quinolone molecule	Bactericidal	Inhibits nucleic acid synthesis	Prohibited in some countries
Glycopeptides	Vancomycin Avoparcin	Species of actinomycetes.	Bactericidal	Inhibits cells wall synthesis	Can causes aggregation of blood platelets
Lincosamides	Lincomycin	*Streptomyces lincolnensis* subspecies. *lincolnensis*	Bactericidal or bacteriostatic	Inhibits protein synthesis	Not used in horses.
Macrolides	Erythromycin Tylosin	*Saccharopolyspora erythaea* (Erythromycin) *Streptomyces fradiae* (Tylosin)	Bacteriostatic	Inhibits protein synthesis	Can be fatal in parent horses
Polymixins	Polymixin B Polymixin E	Bacillus polymyxa	Bactericidal	Inhibits cell membrane function	Not absorbed from GI tract
Tetracyclines	Chlortetracycline	*Streptomyces spp.*	Bacteriostatic	Inhibits protein synthesis	N/A

Applications in veterinary medicine (University of Minnesota, n.d.):

- **Aminoglycosides** - severe infections.
- **Beta-lactam antibiotics**:
    - Ruminants (cattle, sheep, antelopes, deer, giraffe…) - e.g. listeriosis.
    - Horses - e.g. foal pneumonia.
    - Dogs and cats - e.g. streptococcal and clostridial infections, UTI (urinary tract infection).
    - Poultry - e.g. ulcerative enteritis.
- **Chloramphenicol** - anaerobic infections e.g. salmonellosis.
- **Fluoroquinolones**:
    - Ruminants - e.g. respiratory disease.
    - Horses - e.g. infections prone to AMR.
    - Dogs and cats - e.g. wound infections.
- **Glycopeptides** - Vancomycin is a drug used as a last resort. Avoparcin is used for growth promotion in chickens and pigs.
- **Lincosamides**: used against anaerobes.
    - Cattle - used as intramammary infusion in mastitis.
    - Horses - no uses.
    - Dogs and cats - infections with anaerobes and Gram-positive cocci.
    - Poultry - for the control of mycoplasmosis.
- **Macrolides**:
    - Erythromycin - used against *Campylobacter jejuni.* It can be used as a Penicillin alternative.
    - Tylosin - used against *Mycoplasma* infections.
- **Polymyxins**:
    - Cattle - used against salmonellosis in calves.
    - Horses - used against bacterial keratitis/ mastitis caused by *Klebsiella spp.*
    - Dogs and cats - used against skin infections.
- **Tetracyclines** - treatment of borreliosis and brucellosis (often combined with streptomycin).

Most common antibiotics used on domestic pet in the UK:

Top antibiotics for dogs (Ware, n.d.)

- **Amoxicillin/Clavulanate** - used to treat a broad spectrum of bacterial infections, including skin infections, infections in the respiratory system, gastrointestinal infections, and genitourinary infections.
- **Gentamicin** - treat dogs with eye infections, ear infections, and pneumonia. It is prescribed with an anti-inflammatory drug to reduce redness and swelling.
- **Chloramphenicol** - has a level of pH safe enough to pass through a dog's body. It is great for treating a dog with bacterial infections in the organs.
- **Sulfamethoxazole** - treat urinary-tract infections in dogs. However, it can cause stress on the gastrointestinal system and as a result can cause nausea, vomiting, diarrhea, and loss of appetite. Hydration is required alongside this medication.
- **Tetracycline** - treat a variety of bacterial infections because it prevents proteins from synthesizing. It is used whenever another antibiotic has proven ineffective.

Top antibiotics for cats:

- **Amoxicillin** - prescribed by veterinarians to treat bacterial infections in cats. It is effective against a variety of problems from skin infections to gastrointestinal infections.
- **Cephalexin** - used to treat urinary tract infections, skin and soft tissue bacterial infections, infections in the bones, and respiratory tract infections.Popular due to minimal side effects.
- **Clindamycin** - used to treat toxoplasmosis, but is also good for treating bacterial infections in cat's skin, mouth, or bones. It is used to treat kittens as it is well tolerated and fast-acting.
- **Enrofloxacin** - this is a fluoroquinolone antibiotic. It is prescribed to treat infections of the urinary tract, skin, prostate, lungs, gastrointestinal system, and liver.
- **Metronidazole** - used to treat cats with periodontal disease. It is also effective against gastrointestinal infections.

<u>Most common farming and livestock antibiotics used in the UK:</u>

Tetracyclines, penicillin, streptomycin and bactrican are common additives in animal feed for livestock and poultry.

Today, the **most frequently used antibiotics in farming, livestock and poultry** are chlortetracycline, procaine penicillin, oxytetracycline, tylosin, bacitracin, neomycin sulfate, streptomycin, erythromycin, lincomycin, oleandomycin, virginiamycin, and bambermycins.

2-50 grams of antibiotics are added to animal feed to better the conversion of feed to animal products, increase growth rate and lower mortality rate.

- Antibiotic dosage increases to 50-200 grams per ton when there is a rampant spread of disease for example.
- **Overuse in antibiotics** in animal agriculture, specifically already healthy animals, has brought about **antimicrobial resistance (AMR).**

Benefits of antibiotics in animal feed (Ai et al. 2014):

- Increase efficiency and growth rate.
- Treat clinically sick animals and prevent/ reduce the incidence of infectious disease.
- In chicken feed, tetracycline and penicillin show substantial improvement in egg production, feed efficiency and hatchability but show no significant effect on mortality.
- In particular, chlortetracycline, oxytetracycline and penicillin also show improved growth rate.

Risk of antibiotics in animal feed: spread of bacteria:

- Animals that have been fed antibiotics over a period of time retain strains of bacteria resistant to antibiotics.
- Through interaction, the resistant bacteria are transmitted to other animals and form colonisation of antibiotic resistant bacteria.
- Bacteria flourish in the intestinal flora of animals and muscle. Animal faeces contain resistant bacteria.
- Bacteria can pass to humans via exposure of humans to resistant bacteria in farms and slaughterhouses.
    - Humans clean faeces (contain bacteria).
    - During the cleaning process, humans can pass the bacteria to their body, hands and mouth.
- Humans can transmit the bacteria through many mediums (physical contact, aerosol and bodily fluids).

Antibiotic side effects, risk groups and resistance:

Antibiotics should be reserved for animals that urgently require them.

Antibiotic side effects for animals can include:

- Diarrhoea and/ or vomiting.
- Swellings and/ or rashes.
- Low energy/ lethargy.
- Reduced appetite.

Animal **risk groups** for antibiotics:

- Very young.
- Elderly.
- Animals with illnesses.
- Pregnant animals.

Preventing antimicrobial resistance (AMR) in animals (PDSA, 2021):

- Provide the correct dose of antibiotic to the animal at the correct time.
- Always complete an animal's antibiotic course, even if the animal is recovering.
- Only give veterinarian prescribed antibiotics to animals.
    - Wrong antibiotic → worsening of condition.
- Return any unused antibiotics to the veterinary practices.
    - Discarding them into the environment brings about resistance.

Human vs animal antibiotic usage:

Table 2. Comparison table of the most common antibiotic in the UK, their usage in animals and humans and its resistance consequences. Information courtesy of Turner (2011).

Antibiotic type	**Animal usage**	**Human usage**	**Consequences**
Fluoroquinolones	Treat respiratory and alimentary tract infections in pigs and poultry. E.g. Enrofloxacin	Treat severe *Salmonella* and *Campylobacter* infections. E.g. Ciprofloxacin	Enrofloxacin as a prophylactic for chickens has brought about resistance to Ciprofloxacin.
Cephalosporins	Treat bacterial infections, by injection, in cattle and pigs. E.g. Ceftiofur	Treat severe *Salmonella* infections in young children. E.g. Cefoxtaime, ceftriaxone	Ceftiofur use has caused resistance to 3rd generation cephalosporins.
Macrolides	Promotes growth in pigs and chickens. E.g. Spiramycin, tylosin	Treat respiratory infections and food-borne infections (e.g. *Campylobacter*). E.g. Erythromycin	The bacteria can easily develop resistance to tylosin and erythromycin.

Most used antibiotics in animals in Uganda:

Antibiotics on farms and large scale livestock industries in Uganda are used for prevention, treatment and vaccination purposes. They can also be used for growth promotion in food producing animals. They are mainly used for treating bacterial infections that affect animals.

Some of the **common bacterial infections** affecting livestock in Uganda include:-

- Contagious bovine pleuropneumonia; Common in cattle and caused by Mycoplasma mycoides
- Clinical and subclinical mastitis; Common in dairy cattle and caused by a wide range of bacteria such as Staphylococcus aureus, Esherichia coli and even some Klebsiella and Pseudomonas species.
- Fowl typhoid: Common in poultry and caused by Salmonella Gallinarum
- Metritis: common in pigs, cattle, goats and sheep caused by Esherichia coli.

Generally the **choice of antibiotics** used is influenced by the the following reasons:-

- Animal species.
- Purpose of farming (commercial or industrial or domestic).
- Lack of clear and enforced legislative framework or policies on the use of antibiotics.
- The size and socioeconomic status of the population, specifically the farmers.

Access to antibiotics:

Ideally, antibiotics and all other veterinary drugs are supposed to be from an authorised veterinary drug store, pharmacy or a para veterinary shop after diagnosis of the animal's condition. However, In Uganda's veterinary sector, it is a common practice for antibiotics to be sold over the counter despite having regulations prohibiting this.There are over 200 antimicrobials sold in the country which are used to treat animal related diseases and infections(Mikecz et al., 2020).

The antibacterials can be administered through the animal feeds or in the drinking water. Common examples of antibacterial groups used include Tetracyclines and penicillins.

- Tetracyclines are broad-spectrum antimicrobials, which are widely used in animal husbandry for both prevention and treatment of diseases and for growth promotion in food-producing animals. The most commonly used is oxytetracycline. This is generally cheap and can easily be accessed over the counter in most pharmacies in the country.
- Penicillins are another group of antimicrobials that have been found to be commonly used among cattle owners within the country. They are a type of β-lactam antibiotic, which is sometimes combined with streptomycin (Penstrep) and are also available over-the-counter just like Tetracyclines. Penicillins are less expensive compared to tetracycline and are used by rural farmers

There are also cases of animals being given human medicines. These are mainly antibiotics such as amoxicillin, chloramphenicol, ciprofloxacin and tetracycline and paracetamol which are used to treat fever, lethargy, coughs and diarrhea mainly in poultry. Unfortunately HIV/AIDs drugs, Antiretroviral (ARV) treatment is also in some cases used to fatten pigs.

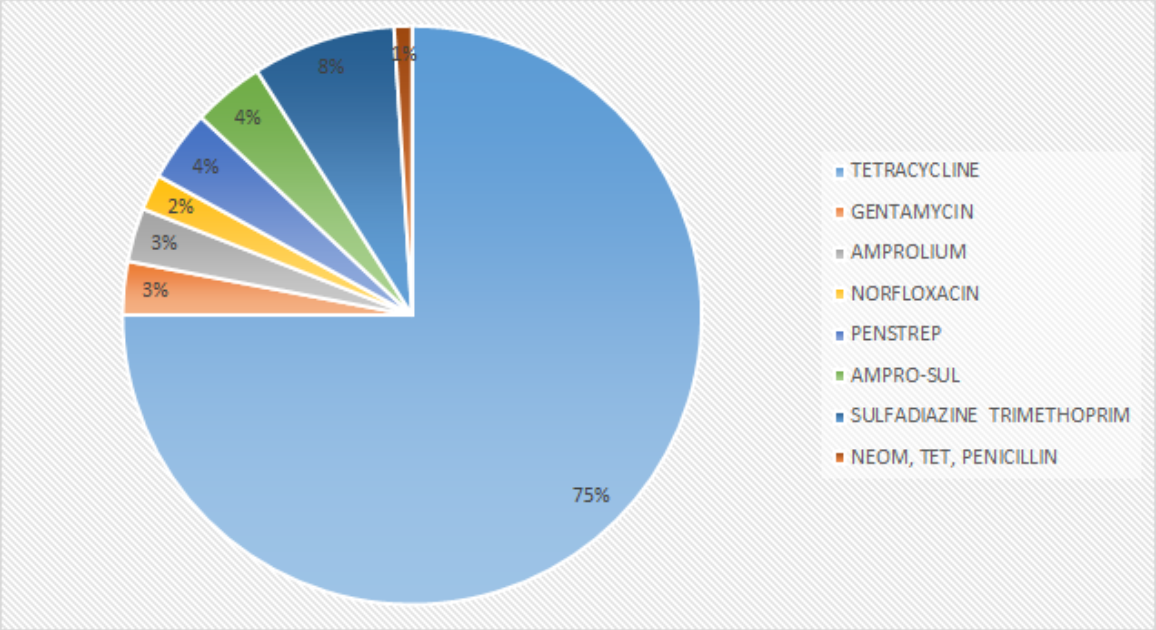

Figure 3. A pie chart showing the most used antimicrobials by farmers in Uganda.(Nayiga, 2020)

Figure 4. A picture of a Vet Student at Makerere University administering an Antibiotic to a cow.

Table 3. A summary of the most used antibiotics, their indications and recommended volume when administering.

Antibiotic classes for animal use	Antibiotic	Indication	Recommended volume to be used.
Tetracyclines	Oxytetracycline	Oxytetracycline is used to treat infections of the respiratory tract (pneumonia), urinary tract, soft tissues, and skin. It treats a wide spectrum of bacteria except that resistance is common among gram-negative bacilli of enteric origin and staphylococci. In cattle it treats bovine respiratory disease and Brucellosis. In pigs it treats pneumonia. In small ruminants it treats *Rickettsia* spp. and *Ehrlichia* spp. infections	A single dosage of 9 mg of Oxytetracycline Injection per 450g of body weight administered intramuscularly or subcutaneously to the animal for a specified period of time.
Penicillins	Penstrep	It is indicated for respiratory, uterine, alimentary tract infections, metritis, mastitis among others in cattle, pigs, sheep and goats.	Administered as an injection. 1ml per 25kg body weight usually for 3-4 days.
	Dihydrostreptomycin sulphate and procaine penicillin.	These are indicated for use in cases of treatment of mixed infections involving both Gram Negative and Gram positive bacteria for cattle, sheep and pigs.	An injection containing an aqueous suspension of 250mg dihydrostreptomycin sulphate and 200mg of procaine penicillin per ml.

Withdrawal periods for avoidance of antibiotic residues in the UK:

What is a withdrawal period?

- A legally defined period of time that is observed after the last administration of a veterinary medicine (e.g. antibiotic) has been given.
- This should be done prior to the animal or its produce entering the food chain (NOAH, 2016a)

What are antibiotic residues?

- These are metabolites found in trace amounts in any edible portion of the animal product after antibiotic administration (Menkem, Ngangom, Tamunjoh and Boyom, 2019).
- Some residues which are unfit for human consumption may remain in meat, milk and eggs as a result of using antibiotics in treating disease and in animal production.

What may happen if these residues exceed the acceptable maximum residue limit?

- They could contribute to development of antibiotic resistance in animals and humans.

Why have antibiotics been used in animals?

- Necessary to **prevent and treat disease** causing bacterial infections in animals.
- To improve the performance growth and feed efficiency, allowing for the synchronization of the reproductive cycle and breeding performance.

Why is the withdrawal period important?

- Makes the residues negligible or no longer detected in foods.
- **Safeguards humans** from exposure to foods with added antibiotics.

To minimise harmful residual effects, withdrawal periods must be observed.

What happens upon failure to respect this withdrawal period?

- Potential threat to be directly toxic in humans.
- Antibiotic residues, even at low levels, may result in increased antibiotic exposure, altering the microflora.This may:
    - Cause disease.
    - Lead to the development of resistant strains that are immune to antibiotic therapy.

Table 5. The Maximum Residues Limit (MRL) in mg/kg for antibiotics.

Antibiotics	Chicken	Pork	Beef
Ampicillin	-	0.01	0.01
Amoxycillin	-	-	0.01
Tetracycline	0.25	0.25	0.25
Oxytetracycline	0.1	0.1	0.1
Chlortetracycline	1.0	0.1	0.1
Streptomycin	N. D	-	-
Gentamicin	-	0.1	0.1
Neomycin	0.25	0.25	0.25
Spiramycin	0.2	0.025	0.025
Tylosin	0.2	0.2	0.2
Erythromycin	0.12	0.1	N. D

Note: N. D means Not determined (Menkem, Ngangom, Tamunjoh and Boyom, 2019).

What is the Maximum Residues Limits (MRL)?

- Residues of pharmacologically active substances, excipients or degradation products and their metabolites, remaining in foodstuffs that have been obtained from animals treated with a veterinary medicinal product.

Withdrawal periods for avoidance of antibiotic residues in Uganda:

Farm animals treated with antibiotics can be held for a specific period until all residues are depleted to safe levels before animal tissue can be used as food for human consumption. This period is termed as **withdrawal period.**
Withdrawal periods ensure foods do not contain pharmacologically active substances in excess of maximum residue limit.
Antibiotic residues result from failure to eliminate drugs from edible portions of animals because of insufficient time allowed between last treatment and slaughter of the animal.
Antibiotic residues can lead to allergy, cancer and antibiotic resistance in humans. Withdrawal periods should be observed to reduce risk to public health.
Significant drug residues are those above the acceptable limit of 30 micrograms per kg body weight.

Veterinary residues in meat, eggs, eggs may be produced by illegal use of antibiotics, use of mislabeled feed and use of feed unintentionally cross contaminated with antibiotics.
In Uganda, tetracycline and penicillin residues have been found in beef over time. Sulfonamide residues have also been found in eggs of layers.
A study in 2005 in Kampala district about use of sulfonamides in layers and sulfonamide residues in commercial eggs showed that 95% of farmers did not observe the withdrawal period and 98.3% of the samples had detectable sulfonamide levels.

Table 6. Showing antibiotics with their withdrawal periods in beef, eggs, poultry and milk.

Antibiotic agent	Beef	Milk	Eggs	Broiler
Tylosin	28 days	3 days		
Oxytetracycline			0	7 days
Gentamicin	7 days	2 days		
Doxycycline				7 days
Penistrep	10 days			
Amoxicillin + Colistin				7 days
Trimethoprim + Sulphadiazine			10 days	12 days
Amprolium			3 days	3 days

Some farmers in Uganda do not observe withdrawal periods despite knowing the importance. This is due to poverty which creates an urgent need for money and a fear of losing investments.
There is no existing insurance policy for farmers. Farmers therefore fear to make losses from pouring away milk and eggs due to observance of withdrawal periods.

Regulations of antibiotic usage in animals in the UK:

Veterinary Medicines Directorate (VMD):

- Responsible for the regulations pertaining to veterinary medicines.
- An executive agency of the Department of Environment, Food and Rural Affairs (Defra). VMD contributes to Defra objectives to **protect public health** and meet high standards of **animal welfare** (Veterinary Medicines Directorate, 2021).
- Helps the Food Standards Agency protect and improve the **safety of foods** for human consumption.
- It is the policy lead for the government on antibiotic resistance in animal health (Veterinary Medicines Directorate, 2016).
- Committed to the UK five year strategy on **minimising antibiotic resistance**. This involves reducing the development of antibiotic resistance and protecting animal and human health and welfare.

Why is it important to regulate the antibiotics we currently have? Laws can ensure:

1) The antibiotics available for use in animals are of consistent and high quality.
2) The reduction of potentially ineffective, fake or illegal products.
3) Accurate information is accessible by prescribers and users of antibiotics.
4) Access to vital antibiotics is subject to effective, professionally guided stewardship.

Who controls the laws relating to the manufacture, authorisation and distribution of veterinary medicines in all European member states?

- The European Commission's Veterinary Medicinal Products Directive.
- This directive provides the basis for the UK's Veterinary Medicines Regulations (VMR), which sets out the country's national controls.

Responsible use of antibiotics:

Antibiotics are vital medicines which can be used to treat bacterial infections in animals. It is important to use antibiotics responsibly as to:

- Prevent the increase in antimicrobial resistance (AMR).
- Ensure the continued availability and effectiveness of these vital medicines.

Responsible Use of Medicines in Agriculture Alliance (RUMA):

The animal health sector supports important initiatives promoting best practice in animal medicine.

This alliance was established in the UK in 1997 to promote:

- High standards in food safety and animal health.
- Welfare in the livestock industry.

It is an independent, non-profit group with membership from a multitude of different organisations representing all stages of the food chain from 'farm to fork' (NOAH, 2016).

RUMA has played an important role in:

- Developing a series of guidelines for **responsible use of antibiotics** in livestock.
- These guidelines are tailored for farmers and veterinary surgeons in addition to being tailored for poultry, pig, cattle, sheep and fish farming.
- Creating guidelines that hold the guiding principles of **disease control.**

How to reduce the need for antibiotic usage in farms:

Develop and implement herd and flock health plans with a veterinary surgeon.

When making health plans, it is important to consider individual factors such as the farm and animal health history whilst also focusing on preventative health measures.
This includes:

- Good biosecurity.
- Good hygiene.
- Good nutrition.
- Reduced stress.

Furthermore, vaccines can be used as a key preventative health tool.
Vaccines can:

- Reduce the incidence or severity of disease.
- Reduce the need to treat bacterial infections in animals with antibiotics, by **preventing the bacterial infection** from occuring in the first place.

Antibiotic Guardian and 'One Health':

Antibiotics are important for maintaining/ protecting the health and welfare of humans and animals.
It is therefore imperative to ensure:

- Responsible use of this medicine.
- A range of antibiotics are available and effective for use in treatment in animals and humans.

The 'Antibiotic Guardian' initiative:

- Developed by Public Health England (PHE) in collaboration with:
    - Department of Health's Expert Advisory Committee on Antimicrobial Resistance and Healthcare Associated Infections (ARHAI).
    - Department for Environment Food and Rural Affairs (DEFRA).
    - Devolved Administrations and professional bodies/organisations.
- Key message: **Use antibiotics responsibly.** (This message is widely acknowledged by both human and veterinary medical professions.)

The ‘One Health’ initiative:

- Invites everyone to make a pledge about how they will make better use of antibiotics and become ‘Antibiotics Guardians’.
- Pledges designed to reflect how these different communities can best play their part. The communities include:
    - Pet and horse owners.
    - Students.
    - Educators.
    - Formers.
    - Veterinary & medical communities.
    - Professional organizations.

Key principles for antibiotic use in animals:

- Only a veterinary surgeon can prescribe antibiotics to animals in need of them.
    - Antibiotics must be **prescribed appropriately.**
    - People must directly follow the instructions given by the Veterinary surgeon upon receiving the prescribed antibiotics.
    - The **correct dose** of antibiotic for the entire duration of treatment of the animal’s bacterial infection.
    - As each prescription must be delivered in full, antibiotics must only be used on the animal’s on the prescription.

- These measures ensure:
    - Animals receive the optimal dose of antibiotics.
    - Animals receive the antibiotic for the required amount of time to inhibit/ kill the bacteria causing the infection/disease.

- The effectiveness of the antibiotic treatment and the survival of resistant bacteria can be due to:
    - Reduced treatment duration.
    - Reduced dose of the prescribed antibiotic.

- Summary:
    - Safeguarding current antibiotics as vital medicine for animal and human health is the priority for all those involved in prescribing and using antibiotics.
    - Both the animal and human medicine sectors have developed initiatives and issued guidance to achieve common goals.
    - Future aspirations: Collaboration and coordination of resources and knowledge needed for further development and forward momentum of responsible use initiatives.

National Office of Animal Health (NOAH):

- Representative of the UK animal medicine industry (NOAH, 2016).
- Aim: To promote the benefits of safe, effective, quality medicines for the health and welfare of all animals.

Regulations of antibiotic usage in animals in Uganda:

Antibiotics are used in animals to enhance growth rates, health of birds, feeding efficiency, egg production and for therapeutic reasons to reduce incidence of diseases
In Uganda, some producers and veterinarians use these drugs with minimal controls therefore need for regulations on their use to avoid antimicrobial resistance and prevent residues from occuring in animal products.
Regulations help to preserve efficacy of antibiotics, avoid misuse, overdosing and underdosing thereby preventing antibiotic resistance.

Several regulatory bodies exist like the Ministry of Agriculture,Animal Industry and Fisheries, Uganda National Bureau of Standards, National Environment Management Authority, Uganda Beef Producers Association, Dairy Development Authority. These regulate milk, meat, egg products and sale and disposal of antibiotics used in animals
Uganda has had a policy on veterinary drugs for nearly 2 decades. It mentions monitoring drug residues in foods of animal origin, safe use of veterinary drugs as a major area of focus.

The Ministry of Agriculture, Animal Industry and Fisheries has developed a veterinary drug list and treatment guidelines for use of antibiotics on the farm.

Restricting the sale of antibiotics through licensed veterinary drug shops has been done by the National Drug Authority.

Also veterinary professionals are regulated under Veterinary Surgeons Act 1958. There is a Uganda Veterinary Board with a registrar who registers qualified veterinary services and a license is given to them.

Training programs for veterinary service providers and licensing of personnel allowed to handle and administer drugs.National programs have been put in place to train veterinary surgeons on appropriate use of antibiotics.

The public has been made aware and cautious of the meat, milk and eggs and withdrawal periods Therefore they do not buy buy these products where antibiotics are suspected

Promoting livestock vaccination and other good husbandry practices that prevent occurrence of diseases that require antibiotics. Vaccination reduces incidence and severity of disease thereby reducing need for antibiotics.

Promoting public awareness and education to monitor safe and responsible use of antibiotics by farmers. Farmers are encouraged to follow instructions and prescriptions by veterinary surgeons and avoid overdosing animals with antibiotics

Farmers should use antibiotics for only prescribed purposes and report treatment failures promptly and also adhere to guidance of vet professionals on prescription, dosage and withdrawal period

Livestock and Animal Product traders should desist from adulteration of animal products, use of antibiotics for preservation and observe withdrawal periods

Uganda is part of Global Antibiotic Resistance Partnership (GARP) which balances treatment access and Antibiotic resistance.GARP develops strategies to address AMR and aims to reduce demand and promote appropriate use of antibiotics in animals.

There are 2 primary legislations to livestock antimicrobial resistance: National Drug Policy and Authority Act and Public Health Act. The major findings are

- No person shall import , manufacture a drug without approval of National drug authority
- No person shall mix, compound or dispense any drug unless they are a registered veterinary officer
- Under the Public Health Act, medical officers of health make rules regarding inspection of dairy stock and animals intended for human consumption, milk shops, and examine samples of milk and meat.

The above regulations are enforced through milk inspection before sale, surveillance to generate evidence and knowledge to identify emerging Antimicrobial Resistance (AMR) ssues and informing best practices for slowing down AMR.
There is a Dairy Development Authority (DDA) that carries out milk inspection to ensure its safety before use. They have mobile vans that are able to go to farms, milk collection centers, factories to collect samples some of which are transported to laboratories for testing or tested onsite if kits are available. Antibiotic levels too are tested. These help find out if withdrawal periods were observed

As far as veterinary diagnostic services are concerned, there are 16 veterinary diagnostic laboratories in the country of which only three are able to carry out antimicrobial susceptibility tests. Even at these facilities, there are often shortages of media and reagents and they are done without laboratory evaluation for the need to use particular antibiotics. Therefore, there is a great need to improve both human and infrastructure capacity for a more effective antibiotic management programme in agriculture.

Despite the policies, implementation has not been adequate due to lack of laboratories and personnel to periodically enforce policy.
Also antibiotics are used interchangeably. Human antibiotics are sometimes used to treat animals and animals can be used to treat humans with wounds.
In Uganda, anyone can rear animals domestically and sell off products without restrictions. People can also access antibiotics in these vet drug shops and do self medication on their animals, poultry at home. This promotes misuse, overdose, underdose of antibiotics.

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