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Clinical impact of antimicrobial resistance in animals

'It is interesting to contemplate an entangled bank, clothed with many plants of many kinds, with birds singing on the bushes, with various insects flitting about, and with worms crawling through the damp earth, and to reflect that these elaborately constructed forms, so different from each other, and dependent upon each other in so complex a manner, have all been produced by laws acting around us... Thus, from the war of nature, from famine and death, the most exalted object which we are capable of conceiving, namely, the production of the higher animals, directly follows. There is grandeur in this view of life, with its several powers, having been originally breathed into a few forms or into one; and that, whilst this planet has gone cycling on according to the fixed law of gravity, from so simple a beginning endless forms most beautiful and most wonderful have been, and are being, evolved.'
Charles Darwin, 1859 (2)

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Summary
It is almost impossible to imagine veterinary medicine today without the use of antimicrobials. Shortly after their discovery, antimicrobials found their way into the veterinary world. They have brought many benefits for the health and welfare of both animals and people, such as the lessening of pain and suffering, reduction in shedding of (zoonotic) bacteria and the containment of potentially large-scale epidemics. Indirectly, they also contribute to food security, protection of livelihoods and animal resources, and poverty alleviation. Given the broad range of animal species under veterinary care and the enormous variety of infectious agents, a complete range of antimicrobials is needed in veterinary medicine. Losing products, either through the occurrence of resistance or through a prohibition on their use, will have serious consequences for the health and welfare of all animals. It will also seriously affect people who depend on these animals. It is a great challenge to everyone involved to stop the growing trend of antimicrobial resistance and to safeguard the effectiveness of antimicrobials for the future. Transparent and responsible use of antimicrobials, together with continuous monitoring and surveillance of the occurrence of resistance, are key elements of any strategy. The current situation also urges us to re-think unsustainable practices and to work on the development of alternatives, in the interests of the health and welfare of both animals and people.

Keywords
Animal – Antimicrobial – Clinical impact – One Health – Resistance – Responsible use.

History

Long ago, people were already aware of the fact that various diseases could be transferred from one person to another and from one animal to another. Outbreaks of transmissible diseases, such as bubonic plague, could have an enormous impact and severely reduce a country's population. In the veterinary world, the recently eradicated rinderpest (officially declared eliminated in May 2011) was a notoriously fatal disease of cattle which often led to poverty and famine in the countryside. Whereas, in former days, many people considered such outbreaks as inevitable acts of God, others started to understand that measures could be taken to mitigate these risks. Even without much understanding of the pathogenesis of disease, they

discovered that the isolation of sick animals and a ban on their movement could be effective in stopping the spread of transmissible diseases.

Another phenomenon that has been recognised down the ages, although, for most of that time, no one had any idea of the underlying mechanism, is that certain disorders can be treated by applying specific substances or materials. Big advances in the understanding and treatment of transmissible diseases were made towards the end of the 19th Century. The development of microbiology and the growing awareness that microorganisms were responsible for causing transmissible diseases significantly enhanced the development of modern medicines. A major breakthrough came in 1928, when the Scottish physician and bacteriologist, Alexander Fleming, observed that a mould – *Penicillium notatum* – that had contaminated a *Staphylococcus* culture had killed the bacteria (4). Although Fleming immediately realised, after isolating the active substance, which he called penicillin, that this discovery held great potential as a medicine, it took until 1940 before the large-scale production and use of penicillin as a medicine became feasible.

Survival of the fittest

At almost the same time as penicillin was discovered, it became evident that not all staphylococci are sensitive to penicillin. Some of them are less affected and survive, thanks to their ability to produce an enzyme that destroys penicillin (1): penicillinase.

Since 1859, and the publication of Charles Darwin's most famous book, *On the origin of species by means of natural selection, or the preservation of favoured races in the struggle for life*, we have known that natural selection is the driving force behind the development of the enormous variety of living creatures in the world. In the 1869 edition of the book, Darwin summarised the evolutionary process as the 'survival of the fittest', using an expression coined a few years earlier by Herbert Spencer (9). In the course of the evolutionary process, organisms acquire genetically transferable tools and mechanisms, which render them and their offspring better adapted to the conditions under which they live; they become better equipped to compete with other individuals and species. One specific way to compete with pathogenic bacteria is to produce substances that damage these bacteria, hamper their growth or destroy them. The ability to produce penicillinase, as described above, can be considered a further step in the continuing competition for the 'survival of the fittest'.

In fact, antibiotic resistance is a very old phenomenon. Recent research has shown that 30,000-year-old DNA samples already contained genes encoding for resistance against different classes of antimicrobial substances (3). Whereas the development and occurrence of genes for resistance seem to have taken place independently from the use of antimicrobials, the selection and multiplication of resistant strains is greatly enhanced by the exposure of bacteria to antimicrobials.

Veterinary use of antimicrobials

Since the discovery of penicillin, much research has been targeted at the identification and isolation of more antimicrobial substances, and at almost the same time as they entered the medical world, these substances also found their way into veterinary treatment. Many different families and classes of antibiotic substances are used to control or prevent bacterial infections in a wide range of animal species, including food-producing and working animals, as well as animals kept for recreation or companionship, both terrestrial and aquatic. The availability of antimicrobials has also greatly enhanced the possibility of surgical intervention. It was also discovered that antimicrobials, even in low dosages, can stimulate growth and feed conversion.

Without doubt, the introduction of antimicrobials into veterinary medicine had and still has an enormous impact on the health and welfare of animal species. Bacterial infections causing pain and suffering and leading to tissue damage, organ dysfunction, weight loss and loss of productivity can now be effectively controlled. Other benefits include (8):

– ensuring the production of foods of animal origin

– a reduction in shedding and spread of (zoonotic) bacteria

– containment of potentially large-scale epidemics

– the protection of people's livelihoods and animal resources, and the alleviation of poverty.

Taking into account the broad range of bacterial diseases that occur in a wide variety of animal species – terrestrial animals as well as aquatic animals, carnivores and herbivores, ruminants and non-ruminants, food-producing animals and those kept for companionship and recreational purposes – a wide range of antimicrobials is indicated for veterinary use. Many of these antimicrobials are considered to be highly important or even critically important for veterinary medicine. Following the recommendation of the Second Joint Expert Workshop on Non-Human Antimicrobial Usage and Antimicrobial Resistance, organised by the Food and Agriculture Organization of the United Nations (FAO), World Organisation for Animal Health (OIE) and World Health Organization (WHO) (6), the OIE (in collaboration with its Member Countries, various international organisations and

the OIE Collaborating Centre for Veterinary Drugs) developed an overview of vital antimicrobials, which was unanimously adopted at the OIE General Session of May 2007 (10). The list comprises active substances, categorised for ten groups of animal species: avian, bee, bovine, caprine, camel, equine, rabbit, ovine, fish and swine. They are divided into 'veterinary critically important', 'veterinary highly important' or 'veterinary important' antimicrobials. The list does not include antimicrobial substances that are important for companion animals, e.g. dogs, cats, reptiles, etc. However, many of these substances can be categorised as equally important for these creatures (Table I).

From the overview, it is clear that veterinary practice cannot afford to lose any of these important antimicrobials. The indications for using some of them may be very specific; nevertheless, losing any of them as an effective medicine or no longer having them available for veterinary purposes will have very direct consequences for animals, their owners and society at large.

For the animals, the direct consequences will be prolonged pain and suffering, seriously affecting their welfare. In serious cases, tissue and organ damage may cause irreversible loss of function, or lead to the death of the animal. For the owners and livestock-keepers, the damage is both emotional and socio-economic, depending on the species and the purpose for which the animal was kept. Many animal owners, especially of companion animals and horses, are very attached to their animals. Suffering from an infectious disease will not only make the animal unfit for the purpose for which it was kept but, equally, cause considerable emotional distress to its owner.

For production animals and those kept for other economic reasons, infectious diseases can have very adverse effects on the performance of the animals and the financial returns of the smallholding, through decreased feed conversion rates, reduced production and growth and higher mortality, all of which cause financial loss. In intensive production systems, and certainly where margins are low, the financial effects of an infectious disease outbreak can be very serious.

However, the impact can be just as devastating on small farms. In many developing countries, the majority of the population depend on agriculture and the loss of a few goats, a donkey or a cow can be a disaster for the community. Not only may they incur direct financial losses but they may also, for example, have less milk to feed their family or lose the ability to transport wood and water or plough the land. In a recent study published by the FAO (7), it is estimated that roughly one-third of the edible food produced for human consumption gets lost or wasted. In low-income countries, it is mainly lost during the early and middle stages of the food chain. For example, in sub-Saharan Africa, relatively high losses (over 50% of the total loss) occur in the agricultural production phase. These huge losses are due primarily to high animal mortality, caused by such common diseases as pneumonia, digestive disease and parasites in breeding livestock.

An increased occurrence of antimicrobial resistance also risks becoming a self-reinforcing phenomenon. If certain bacteria become more difficult to treat with the regular first-line antimicrobials, there will be a tendency to use newer antimicrobials that are more effective. For example, under certain conditions, *Escherichia coli* infections in broilers and *Pasteurella* infections in calves do not always respond satisfactorily to the traditional antimicrobials. In a number of cases, they are now being treated with more advanced substances. Although this may be beneficial in these particular cases and for these particular animals, in the long run, we run the risk of extending the range of antimicrobials that are no longer effective. The occurrence of multi-resistance may also increase. It is estimated that around 60% of Belgian broilers are contaminated with extended-spectrum beta-lactamase-producing bacteria and that around 35% of the Belgian broilers carry bacteria that are resistant to third-generation cephalosporins.

Infection prevention

Although antimicrobials are essential tools for ensuring the health and welfare of animals and people, this does not mean that they are the only solution to preventing and controlling bacterial infections. In cases where a pathogen has reached an animal or herd, the use of an antimicrobial might be the preferred option. However, it would have been greatly preferable if the contamination and infection could have been prevented altogether.

Nowadays, especially, with such large numbers of animals and people being transported around the globe, biosecurity and hygiene measures are essential to stop the spread of bacteria. Both the entrance into a herd, as well as the exit, should be carefully controlled. With relatively simple measures, huge results can be achieved. Even where a measure does not seem to have been completely effective, this does not mean that it is worthless. Every reduction in the risk of introducing a pathogen is better than no reduction at all.

The critical control moments are those in which direct and indirect contacts take place between animals. Contacts with new animals, either in a herd or at a gathering place, as well as contacts with stray animals, wildlife and rodents, all carry the risk of a direct transmission of micro-organisms. Indirect transmission can also easily occur, through transport and other tools or machinery, or by visitors – professional and non-professional – entering

Table I
Summary list of antimicrobials of veterinary importance, developed by the World Organisation for Animal Health

Antimicrobial agent	Classification and use
Aminoglycosides	Veterinary Critically Important Antimicrobials *Used for: avian, bee, bovine, caprine, camel, equine, rabbit, ovine, fish and swine species* The wide range of applications and the nature of the diseases treated make aminoglycosides extremely important for veterinary medicine. Aminoglycosides are of importance in septicaemias; digestive, respiratory and urinary diseases Gentamicin is indicated for *Pseudomonas aeruginosa* infections with few alternatives Spectinomycin is used only in animals. Few economic alternatives are available Rifampicin is critically important in equines for the treatment of *Rhodococcus equi* infections in foals
Cephalosporins	Veterinary Critically Important Antimicrobials *Used for: avian, bee, bovine, caprine, equine, rabbit, ovine, fish and swine species* Cephalosporins are used in the treatment of septicaemias, respiratory infections and mastitis. Alternatives are limited in efficacy through either inadequate spectrum or presence of antimicrobial resistance
Fosfomycin	Veterinary Highly Important Antimicrobials *Used for: avian, bovine, fish and swine species* This antimicrobial is authorised only in a few countries. It has a limited number of alternatives in some fish infections It is critically important for fish
Fusidic acid	Veterinary Important Antimicrobials *Used for: bovine and equine species* Fusidic acid is used in the treatment of ophthalmic diseases in cattle and horses
Ionophores	Veterinary Highly Important Antimicrobials *Used for avian, bovine, caprine, rabbit and ovine species* Ionophores are essential for animal health because they are used to control intestinal parasitic coccidiosis (*Eimeria* spp.) where there are few or no alternatives available. Ionophores are used only in animals and they are critically important in poultry
Lincosamides	Veterinary Highly Important Antimicrobials *Used for: avian, bee, bovine, caprine, ovine, fish and swine species* Lincosamides are essential in the treatment of mycoplasmal pneumonia, infectious arthritis and haemorrhagic enteritis of pigs
Macrolides	Veterinary Critically Important Antimicrobials *Used for: avian, bee, bovine, caprine, equine, rabbit, ovine, fish and swine species* Macrolides are used to treat *Mycoplasma* infections in pigs and poultry, haemorrhagic digestive disease in pigs and liver abscesses (*Fusobacterium necrophorum*) in cattle, where they have very few alternatives. Macrolides are also used for respiratory infections in cattle
Novobiocin	Veterinary Important Antimicrobials *Used for: bovine, caprine, ovine and fish species* Novobiocin is used in the treatment of mastitis in the form of intramammary creams and in sepsis of fish. Novobiocin is only used in animals
Orthosomycins	Veterinary Important Antimicrobials *Used for: avian and rabbit species* Avilamycin is used for digestive diseases of poultry and rabbits: avilamycin is used to treat necrotic enteritis in chickens where available. This antimicrobial class is used only in animals
Penicillins	Veterinary Critically Important Antimicrobials *Used for: avian, bovine, caprine, camel, equine, rabbit, ovine, fish and swine species* Penicillins are used in the treatment of septicaemias, respiratory and urinary tract infections. They are very important in the treatment of many diseases in a broad range of animal species. Few economical alternatives are available
Phenicols	Veterinary Critically Important Antimicrobials *Used for: avian, bovine, caprine, equine, rabbit, ovine, fish and swine species* Phenicols are of particular importance in treating some fish diseases, in which there are no or very few treatment alternatives. Phenicols also represent a useful alternative in respiratory infections of cattle, swine and poultry. Phenicols, and in particular florfenicol, are used to treat pasteurellosis in cattle and pigs species

Table I (cont.)
Summary list of antimicrobials of veterinary importance, developed by the World Organisation for Animal Health

Antimicrobial agent	Classification and use
Pleuromutilins	Veterinary Highly Important Antimicrobials *Used for: avian, caprine, rabbit, ovine, and swine species* Pleuromutilins are used exclusively in animals. The class of pleuromutilins is essential against respiratory infections in pigs and poultry. This family is critically important against swine dysentery (*Brachyspira hyodysenteriae*) because there are no alternatives in many regions
Polypeptides	Veterinary Highly Important Antimicrobials *Used for: avian, bee, bovine, caprine, equine, rabbit, ovine and swine species* Bacitracin is used against necrotic enteritis in poultry where available. Polypeptides are indicated in septicaemias, colibacillosis, salmonellosis, and urinary infections. Cyclic polypeptides are widely used against Gram-negative digestive infections
Quinolones	Veterinary Critically Important Antimicrobials *Used for: avian, bee, bovine, caprine, equine, rabbit, ovine, fish and swine species* Quinolones of the first and second generations are used in septicaemias and in infections such as colibacillosis, which cause serious losses in poultry, cattle, swine, fish and other species Fluoroquinolones have no equally efficacious alternative in the treatment of chronic respiratory disease in poultry (*Escherichia coli*)
Quinoxalines	Veterinary Important Antimicrobials *Used for: swine species* Quinoxalines (carbadox) are used for digestive disease of pigs (e.g. swine dysentery)
Sulphonamides	Veterinary Critically Important Antimicrobials *Used for: avian, bovine, caprine, equine, rabbit, ovine, fish and swine species* Several sulphonamides alone or in combination with diaminopyramidines are essential because of diseases covered (bacterial, coccidial and protozoal infections), and use in multiple animal species This is essential for treatment of cattle, pigs, sheep, poultry, fish or other species. Few economical alternatives are available
Streptogramins	Veterinary Important Antimicrobials *Used for: avian, bovine, ovine and swine species* Virginiamycin is an important antimicrobial in the prevention of necrotic enteritis (*Clostridium perfringens*)
Tetracyclines	Veterinary Critically Important Antimicrobials *Used for: avian, bee, bovine, caprine, camel, equine, rabbit, ovine, fish and swine species* Tetracyclines are very important in the treatment of many bacterial and chlamydial diseases in a broad range of animal species. There are no alternatives to tetracyclines in the treatment of animals against heartwater (*Ehrlichia ruminantium*) and anaplasmosis (*Anaplasma marginale*) Few economical alternatives are available

Source: World Organisation for Animal Health (10)

a farm. In cases where many animals are kept closely together, it is useful to have hygiene barriers between smaller groups of animals.

Complementary actions can also be taken to help animals cope with potentially pathogenic bacteria without becoming sick. Adequate husbandry techniques and welfare conditions will support the animal's own defence mechanisms for dealing with infectious agents. Housing systems should provide the animals with that is suited to the climate. Animals should have enough light and space, and adequate feed and clean drinking water should be available. Any items which could injure an animal should be removed. The production level should be appropriate for the animals' capabilities. Neglecting any of these requirements will easily make the animal more susceptible to various kinds of disease. Selecting breeding animals for the capacity of their immune system and their ability to eliminate pathogens is essential to keep future generations healthy. It helps to counterbalance the effects of an unbalanced selection for other qualities, such as production or behavioural factors.

Another important way to stop the development of clinical disease is through the use of vaccines. Stimulating the animal's immune system through vaccination helps to protect it against infection and clinical illness, and stops or reduces shedding of the pathogen. When enough animals in a population are vaccinated, the spread of a pathogen through the population can be stopped. Vaccination zones can be useful for containing a pathogen within a certain area. Whereas, in general, vaccinations provide very

specific protection against a specific pathogen, stopping that pathogen will also help to prevent the occurrence of a wider range of secondary infections.

Early diagnosis

If an animal or group of animals becomes infected, it is crucial to recognise this as early as possible in order to limit the spread of the infection and the development of clinical illness. The earlier a diagnosis is made, the better the prognosis will be for the animal, and the sooner an infection is contained, the fewer animals that will become sick and require treatment. Good stockmanship lies at the heart of early detection: knowing when the animals are not thriving, carrying out further examinations and consulting a veterinary professional as soon as possible. Depending on the characteristics of the disease, it is important that the relevant information can be rapidly forwarded to stakeholders and authorities, at the local, national and international levels, where this is needed. Adequate systems to provide veterinary services, including monitoring, surveillance, reporting and intervention, are indispensable for preventing outbreaks of transmissible diseases.

Once it is suspected that an animal is suffering from an infection that requires antibiotics, a further refinement of the diagnosis by a skilled veterinarian, identifying the pathogen and its sensitivity to antimicrobials, will make selecting the appropriate treatment a great deal easier. It is very important that diagnostic tests are readily available to help veterinarians make informed decisions. In countries with insufficient numbers of veterinarians, collaboration with a well-trained veterinary technician is especially desirable.

Prophylactic use of antimicrobials

In human health care, most of the attention is focused on the individual patient and their health status. In veterinary medicine, however – with the exception of companion animals and horses – much more attention is paid to groups of animals. This is especially true for production animals, which are generally kept in groups; it is essential to look at the herd or flock and indeed all animals on a smallholding.

Obviously, the individuals within these groups often have comparable genetic constitutions, may belong to the same age group, are housed in similar conditions and share the same feed, etc. and thus have an equal risk of becoming infected with the same pathogens. Once a pathogen has found its way into a group of animals and started to multiply, it is almost impossible to stop it circulating throughout the whole group. It is not the individual, but the group it belongs to, which is considered the epidemiological unit. All the animals of a unit are considered as having the same health status. Since animals often stay together as a group – in contrast to humans, who may depart in many different directions after having visited the same site – it is efficient to approach them as a group; not only in terms of workload but also with regard to the results achieved. Disease outbreaks will be less severe and more rapidly brought under control when treatment is started at an early stage, even before the onset of clinical signs. The impact of the disease on the health and welfare of the animals as well as on the performance of the farm will be considerably lessened.

However, in this context, it should also be noted that, for various reasons, antimicrobials are being used in situations where other, more sustainable measures should be chosen. In general, animals should be able to cope with the conditions in which they are kept. Animal husbandry systems where the use of antimicrobials has become the rule, rather than the exception, are not sustainable and should be eliminated. For example, the routine (prophylactic) use of antimicrobials to make up for inadequate housing conditions must be banned.

Shortage of effective antimicrobials

Table I clearly shows that most of the available antimicrobials are important for specific indications in the target animal species. Losing these antimicrobials for veterinary use or decreasing their effectiveness will immediately result in losing important opportunities to intervene effectively in the course of bacterial infection in animals. The consequences will be an increase in animal pain and suffering, more tissue and organ damage, increased loss of function, greater spread of the (zoonotic) disease agent, increased risk of large-scale outbreaks, greater risk of people losing their livelihoods and of loss of animal resources, and an increase in poverty.

A directly related point of concern is the fact that the development and authorisation of new antimicrobials for veterinary use always lags behind the need for new treatments. The high investments needed for the research, development and marketing of a new antimicrobial, combined with a high level of uncertainty as to whether companies will gain a reasonable return on their investment, make the development of new antimicrobials fairly unattractive for pharmaceutical companies. Further

initiatives are needed to stimulate the development of new substances. At the same time, further research is needed into the development of alternatives to antimicrobials.

Controlling antimicrobial resistance

A key element in trying to prevent the development of resistance in effective antimicrobials is the collection of data about their use, together with data on the occurrence of resistance. Without sufficient data that can be analysed and compared over time and place, any action taken is more or less like the proverbial shot in the dark.

Equally important is the responsible use of antimicrobials. Reliable and transparent authorisation of medicinal products, proper diagnosis and prescription, evaluation of treatment results, restricted distribution channels and accurate record-keeping are the basic elements of responsible use.

In the interests of the responsible use of antimicrobials, veterinary antimicrobials should be used under veterinary supervision only. Regular, close veterinary involvement is essential for informed advice on the effective use of antimicrobials. Regardless of the distribution system, the use of antimicrobials should be subject to appropriate professional veterinary advice. Codes of good veterinary practice, quality assurance programmes, herd health control and surveillance programmes, and educational programmes should all promote the responsible and prudent use of antimicrobials (12).

The OIE *Terrestrial Animal Health Code* (the *Terrestrial Code*), which sets the standards for the improvement of animal health and welfare and veterinary public health worldwide, includes a chapter on the responsible and prudent use of antimicrobial agents in veterinary medicine (11). It gives clear descriptions of the responsibilities that regulatory authorities, the veterinary pharmaceutical industry, wholesale and retail distributors, veterinarians and food-animal producers must all meet with regard to the prudent use of antimicrobials.

In addition, the Codex Alimentarius Commission 'Code of Practice to minimize and contain antimicrobial resistance' recommends that, for food-producing animals, antimicrobials should only be prescribed by a veterinarian or suitably trained person, licensed in accordance with national legislation. Moreover, antimicrobials should only be supplied through licensed/authorised distribution systems and administered to animals by a veterinarian or under the supervision of a veterinarian or some other suitably trained and authorised person (5). The same recommendations apply for companion animals.

It is the responsibility of the veterinarian to choose the antimicrobial product, based on his/her informed professional judgement, and balancing the risks and benefits for humans and animals. Ideally, when treating a disease, the antimicrobial sensitivity of the causal organism should be ascertained before therapy is started.

In disease outbreaks involving high rates of mortality, or where there are signs of rapid transmission of disease among contact animals, treatment may be started on the basis of clinical diagnosis. Even so, the antimicrobial sensitivity of the suspected causal organism should, where possible, be determined so that, if treatment fails, the regimen can be changed in light of the results of sensitivity testing.

Conclusion

The clinical impact of antimicrobial resistance on animals is potentially very high. Given the broad range of animal species under veterinary care and the enormous variety of infectious agents, a complete range of antimicrobials is needed in veterinary medicine. Losing products, either through the occurrence of resistance or through a prohibition on their use, will have serious consequences for the health and welfare of animals. It will also seriously affect those people who depend on these animals.

The current situation, as pathogens become increasingly resistant to antimicrobials, is thus a grave threat for veterinary medicine and for the health and welfare of animals and humans. It is a great challenge to everyone involved to stop the growing trend of antimicrobial resistance and to safeguard the effectiveness of antimicrobials for the future. However, such a challenge also offers us an opportunity to re-think risky, unsustainable practices and to work on the development of alternatives, in the interests of the health and welfare of both animals and people.

Impact clinique de l'antibiorésistance chez les animaux

J. Vaarten

Résumé
On ne saurait concevoir aujourd'hui la médecine vétérinaire sans les antibiotiques. Dès leur découverte, les antibiotiques ont trouvé des applications dans le monde vétérinaire. Ils ont apporté de nombreux bénéfices à la santé et au bien-être des animaux et des hommes, parmi lesquels l'atténuation de la douleur et de la souffrance, la réduction des quantités de bactéries (zoonotiques) excrétées et la maîtrise d'épidémies ayant un potentiel de propagation à grande échelle. Ils contribuent aussi indirectement à la sécurité de l'approvisionnement alimentaire, à la sauvegarde des moyens de subsistance et des ressources animales et à la lutte contre la pauvreté. Compte tenu du large éventail d'espèces animales faisant l'objet de soins vétérinaires et de l'immense variété d'agents pathogènes pouvant les affecter, la médecine vétérinaire a besoin d'utiliser une gamme étendue d'antibiotiques afin de couvrir le spectre complet de pathogènes. L'impossibilité d'utiliser certains produits, du fait de l'apparition de résistances ou parce que leur utilisation a été interdite aura de graves conséquences pour la santé et le bien-être de tous les animaux. Elle aura également de graves répercussions pour les individus dont la subsistance ou le revenu dépendent de ces animaux. Inverser la tendance de l'antibiorésistance et préserver l'efficacité future des antibiotiques constituent un immense défi pour toutes les personnes concernées. L'utilisation transparente et responsable des antibiotiques, parallèlement à l'exercice d'un contrôle et d'une surveillance continus de l'apparition des résistances sont des éléments clés de toute stratégie en la matière. La situation actuelle exige également que nous reconsidérions certaines pratiques qui s'avèrent intenables sur le long terme et que nous réfléchissions à l'élaboration de solutions alternatives, dans l'intérêt de la santé et du bien-être des animaux comme de l'homme.

Mots-clés
Animal – Antibiotique – Impact clinique – Résistance – Une seule santé – Utilisation responsable.

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Consecuencias clínicas de la resistencia a los agentes antimicrobianos en los animales

J. Vaarten

Resumen
Hoy en día resulta casi imposible imaginar la medicina veterinaria sin los agentes antimicrobianos. Estos fármacos hicieron su entrada en el universo veterinario poco después de ser descubiertos, y desde entonces han traído consigo muchos beneficios para la salud y el bienestar de personas y animales, disminuyendo los niveles de dolor y sufrimiento, reduciendo la excreción de bacterias (zoonóticas) o conteniendo epidemias capaces de extenderse a gran escala. También han contribuido indirectamente a la seguridad alimentaria, a la protección de los medios de vida y los recursos animales y al alivio de la pobreza. Dada la gran variedad de agentes infecciosos que existen, así como las muchas y muy diversas especies animales de que se ocupa la medicina veterinaria, esta necesita todo un arsenal de antimicrobianos. La pérdida de

productos, ya sea por la aparición de resistencias o por la prohibición de utilizarlos, tendrá graves consecuencias para la salud y el bienestar de todos los animales, sin olvidar a las personas que dependen de ellos para vivir. Atajar la creciente aparición de resistencias a los antimicrobianos y proteger la eficacia de esos fármacos en el futuro constituye, para todos los interesados, una ímproba tarea. Toda estrategia en la materia debe incorporar como elemento clave el uso transparente y responsable de estos fármacos, así como una constante labor de seguimiento y vigilancia de la aparición de resistencias. En la situación actual también urge que nos replanteemos ciertas prácticas insostenibles y trabajemos para dar con alternativas, en aras de la salud y el bienestar tanto de los animales como de las personas.

Palabras clave
Agente antimicrobiano – Animal – Consecuencia clínica – Resistencia – Una sola salud – Uso responsable.

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