ISSN: 2697-3391
Vol. 7 No. 1.1, pp. 102 – 116, February 2024

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# Bacterias comunes identificadas en heridas de perros domésticos con mordeduras por congénere y su resistencia a los antibióticos

*Most common bacteria identified in wounds of dogs with congener bites and their resistance to antibiotics.*

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**Scientific and Technological Research Article**
Sent: 11/15/2023
Revised: 13/12/2023
Accepted: 19/01/2024
Published:06/02/2024
DOI: **https://doi.org/10.33262/anatomiadigital.v7i1.1.2924**

Please quote: Yugcha Valladares, WA, & Villamarín Barragán, DR (2024). Common bacteria identified in wounds of domestic dogs with bites by congeners and their resistance to antibiotics. Digital Anatomy, 7(1.1), 102-116.https://doi.org/10.33262/anatomiadigital.v7i1.1.2924

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The journal is published by Editorial Ciencia Digital (a prestigious publisher registered with the Ecuadorian Book Chamber with membership number 663).www.celibro.org.ec

ISSN: 2697-3391
Vol. 7 No. 1.1, pp. 102 – 116, February 2024

www.anatomiadigital.org

**Palabras claves:**
Mordeduras, resistencia bacteriana, Antibióticos, cultivos bacterianos, congéneres

**Resumen**

**Introducción.** La interacción social entre perros, tanto en entornos domésticos como comunitarios, puede dar lugar a episodios de agresión, manifestándose ocasionalmente a través de mordeduras. Estas situaciones no solo implican riesgos de lesiones físicas, sino que también introducen un elemento crítico y cada vez más inquietante: la resistencia bacteriana a los antibióticos. Este problema cobra relevancia, especialmente al considerar el aumento constante de la resistencia bacteriana en el contexto de las mordeduras entre congéneres, planteando la necesidad urgente de abordar esta preocupación de manera adecuada. En este escenario, los cultivos bacterianos y los antibiogramas emergen como herramientas esenciales para la identificación de los microorganismos presentes en las mordeduras caninas, así como para la evaluación de la resistencia antimicrobiana. Elementos que desempeñan un papel crucial al proporcionar una base precisa para el tratamiento de las lesiones resultantes de las mordeduras. Consecuentemente a través de esta investigación, se busca identificar las principales bacterias presentes en las heridas causadas por mordeduras entre congéneres y analizar la resistencia bacteriana asociada. Además, se pretende resaltar la importancia de la información derivada de los cultivos y antibiogramas en la formulación de estrategias terapéuticas más precisas y específicas. Con este enfoque, se busca contribuir al desarrollo de prácticas médicas más informadas y efectivas en el tratamiento de las consecuencias bacterianas de las interacciones sociales entre perros. **Objetivo.** Identificar las bacterias más comunes encontradas en las heridas por mordeduras y su resistencia frente a los antibióticos. **Metodología.** Esta investigación adopta un enfoque descriptivo de naturaleza no experimental y se llevó a cabo en perros con mordeduras por congénere que buscaron atención en la clínica veterinaria CanVet, ubicada en la ciudad de Latacunga, durante el periodo de junio a octubre de 2023. Durante este lapso, se atendieron un total de 17 perros domésticos, con edades comprendidas entre 1 y 10 años, quienes presentaban heridas en diversas áreas del cuerpo. Se aplicaron procedimientos asépticos en la zona perilesional, seguidos de la toma de muestras mediante hisopos estériles.

Anatomía Digital

ISSN: 2697-3391
Vol. 7 No. 1.1, pp. 102 – 116, February 2024

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Estas muestras fueron posteriormente enviadas para realizar cultivos y antibiogramas, como parte del protocolo de investigación. **Resultados.** En este trabajo se identificaron bacterias del género estafilococos s.p, aureus y proteus (53%) como las bacterias más frecuentes en heridas de perros domésticos por mordeduras de congéneres, así también se determinó un 47 % de muestras en las cuales no existió desarrollo bacteriano. Se puede dimensionar un mayor caso de resistencias hacia penicilina (67%) y clindamicina (56%). Así como también hay heridas que no presentan desarrollo bacteriano. **Conclusión.**

Existen bacterias con resistencia a varios antibióticos por lo cual es relevante realizar estudios de cultivo y antibiograma para elaborar la terapia adecuada. **Área de estudio:** microbiología, cirugía.—**Tipo de estudio:** Revisión Bibliográfica.

**Keywords:**
Bites, bacterial resistance, Antibiotics, bacterial cultures, congeners

**Abstract**

**Introduction.**Social interaction between dogs, both in domestic and community environments, can lead to episodes of aggression, occasionally manifesting through bites. These situations not only involve risks of physical injury, but also introduce a critical and increasingly disturbing element: bacterial resistance to antibiotics. This issue becomes relevant, especially when considering the constant increase in bacterial resistance in the context of inter-conspecific bites, raising the urgent need to adequately address this concern. In this scenario, bacterial cultures and antibiograms emerge as essential tools for the identification of microorganisms present in canine bites, as well as for the evaluation of antimicrobial resistance. Elements that play a crucial role in providing an accurate basis for the treatment of injuries resulting from bites. Consequently, through this research, we seek to identify the main bacteria present in wounds caused by bites between conspecifics and analyze the associated bacterial resistance. Furthermore, it is intended to highlight the importance of information derived from cultures and antibiograms in the formulation of more precise and specific therapeutic strategies. With this approach, we seek to contribute to the development of more informed and effective medical practices in the treatment of the bacterial

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ISSN: 2697-3391
Vol. 7 No. 1.1, pp. 102 – 116, February 2024

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consequences of social interactions between dogs. objective. Identify the most common bacteria found in bite wounds and their resistance to antibiotics. Methodology. This research adopts a descriptive approach of a non-experimental nature and was carried out on dogs with specific bites that sought care at the CanVet veterinary clinic, located in the city of Latacunga, during the period from June to October 2023. During this period, A total of 17 domestic dogs were treated, aged between 1 and 10 years, who had wounds in various areas of the body. Aseptic procedures were applied to the perilesional area, followed by sampling using sterile swabs. These samples were subsequently sent for cultures and antibiograms, as part of the research protocol. Results. In this work, bacteria of the genus staphylococcus sp, aureus and proteus (53%) were identified as the most frequent bacteria in wounds of domestic dogs due to bites from conspecifics, and 47% of samples in which there was no bacterial development were also determined. A greater case of resistance to penicillin (67%) and clindamycin (56%) can be estimated. Just as there are wounds that do not present bacterial development. Conclusion. There are bacteria with resistance to several antibiotics, which is why it is relevant to perform culture studies and antibiograms to develop the appropriate therapy. Study area: microbiology, surgery. Type of study: Bibliographic Review.

## Introduction

Antimicrobial agents are the main therapeutic tool for controlling bacterial infections in humans and animals. However, since the beginning of their use, it has been known that bacteria possess mechanisms to resist the action of these agents.(1)

Acquired and transmissible resistance mechanisms are the most important and consist fundamentally of the production of bacterial enzymes that inactivate antibiotics or the appearance of modifications that prevent the drug from reaching the target site or the alteration of the target site itself. A bacterial strain can develop several resistance mechanisms against one or many antibiotics and in the same way an antibiotic can be inactivated by different mechanisms by different bacterial species.(2)

In order to destroy or inhibit microorganisms, antibiotics must cross the surface barrier of the bacteria and then attach to their target, that is, to one of the biochemical structures or mechanisms that are necessary for the bacteria to multiply or survive. The mechanisms

of action of antibiotics are diverse and sometimes multiple, but they all operate at one of the following points: preventing the synthesis of nucleic acids, proteins or the cell wall or altering the cell membrane of the bacteria on which they act. (2)

Bacterial resistance is one of the most worrying public health problems in the world. In Latin America, as in impoverished countries in other regions, it has become a major threat. Undoubtedly, the misuse and abuse of antibiotics are the direct cause, but it is very important to recognize bacterial resistance as a multi-causal problem of enormous complexity.(3)

Although antibiotic resistance is an alarming situation in both humans and veterinary medicine, the proportion of the resistant state present in companion animals has not been extensively investigated.(3)

The skin has a bacterial flora that is made up of saprophytic microorganisms whose population remains latent and in permanent mutualism, but there is also another corresponding to transient microorganisms that can reach the injured skin from the superficial mucous membranes of the animal or from the environment, generating an imbalance that allows the proliferation of opportunistic microorganisms and the establishment of the infection.(4)

Normal resident flora of canine skin may also include coagulase-negative staphylococci, streptococci, Micrococcus spp., and Aanetobacter spp. Transient bacteria on canine skin include Bacillus spp., Corynebacterium spp., Escherichia coli, Proteus mirabilis, and Pseudomonas spp. These organisms may play a role as secondary pathogens.(5)

Aggression: This is the most common behavioural disorder in dogs (Manteca X., 2003). It is the one that causes the most problems with humans, and in some cases, it is a public health problem by compromising human health. Aggression can be directed towards other dogs, female or male, and towards other species such as felines or humans, as a response to failures in the socialisation period. In the case of humans, it can be directed towards children, or there may be no differences due to age. (6)

A bite is a wound or puncture made by the teeth or any part of the mouth of a living organism. Animal and human bites represent a major health problem in the world, as they are associated with high morbidity and, in isolated cases, mortality.(7)

Bite wounds are among the most serious injuries seen in small animal practice, accounting for 10-15% of all veterinary trauma cases. Canine teeth are designed for tissue penetration, the incisors for grasping and the molars/premolars for cutting tissue. The curved canine teeth of large dogs are capable of deep penetration, while the smaller, straighter canine teeth of domestic cats can penetrate directly into tissue, leaving a relatively small cutaneous opening. The jaws of larger dogs, in particular, can generate

marked crushing (up to 450 psi) and shearing forces, and canine teeth can tear and lacerate skin, hypodermis, and underlying musculature.(8)

If infection is present, wound cultures (aerobic or anaerobic) are recommended to select the most appropriate antibiotics, especially in the septic patient. Culture of an acute, noninfected bite wound is unhelpful in determining possible infecting organisms. Specimens from deep within the wound, obtained by aspiration or incision, drainage, and exploration of the area, should be submitted for culture. Aspiration of lymph nodes or areas of cellulitis may also be used to obtain more accurate culture specimens. Cultures from more superficial specimens are more likely to include contaminants that will lead to misleading results. The most accurate source for culture of infected wounds is tissue samples from the abscess wall.(8)

Bite wounds can range from simple local injuries to those affecting muscles, blood vessels, organs and bones, often leading to complex treatments including surgery and hospitalisation. These wounds present a phenomenon known as the “iceberg effect”, which can hide the true severity of the injury and require more invasive management to prevent complications, although these are common. Comprehensive patient management is essential for an adequate resolution of the pathology and depends on various factors, such as the time in which the wounds are treated (known as the “golden period”), which is crucial to prevent contaminated wounds from becoming colonised or infected wounds.(9)

Dog bites can cause bacterial infections in people and other animals, especially those that are not treated properly. These infections can be serious and, in some cases, can lead to complications such as sepsis and septic shock.(10)

Resistance to Staphylococcus

Bacteria of the genus Staphylococcus are natural inhabitants of the skin and intestinal microflora in animals and humans, however many species are opportunistic pathogens that can cause serious diseases of the skin or any cavity or tissue of the body. 33 The coagulase-positive species are considered to be the most important in veterinary medicine and correspond to Staphylococcus aureus, Staphylococcus intermedius, Staphylococcus hyicus and Staphylococcus schleiferi. Staphylococcus aureus is the predominant pathogen in humans while Staphylococcus intermedius and Staphylococcus schleiferi are the most important in dogs. Currently, a significant number of staphylococcal species that cause disease in humans and animals have shown some degree of resistance.(11)

Bacterial culture is a laboratory technique used to identify the bacteria present in a sample, such as an infected wound or a blood sample. During culture, the sample is placed in a culture medium that provides nutrients for the bacteria. If bacteria are present in the

sample, they will grow in the culture medium, allowing for their identification and characterization. Bacterial culture can be useful in determining which bacteria are present in a dog bite and which antibiotics are effective against them.(12)

Antibiograms are the study of the sensitivity to antimicrobials of the different bacteria isolated in biological samples. They have two fundamental objectives: to guide the clinician in choosing the best individual treatment, and to monitor the evolution of bacterial resistance in order to review the antimicrobial spectrum and to be able to update empirical treatments.(13)

## Methodology

This study used a cross-sectional observational design. Data collection was performed at a single time point, analyzing wounds from domestic dogs with bites from conspecifics to identify the bacteria present and assess their antibiotic resistance. This design allowed for a snapshot of bacterial diversity and its resistance profile in the context of canine bites.

The research was descriptive in nature, as it sought to characterize the bacterial composition in the wounds and describe the corresponding antibiotic resistance. This approach will allow obtaining a detailed view of the microbiota present in the lesions and understanding the extent of antibiotic resistance in dogs affected by bites from congeners.

The level of research was exploratory, since little-explored aspects of bacterial resistance in the specific context of canine bites were addressed. Exploratory research will facilitate the identification of new variables and the generation of hypotheses for future, more specific research.

The research modality was field-based, involving direct sampling of wounds from affected dogs in natural environments. This will ensure direct applicability of the results to real clinical situations and provide valuable information on bacterial resistance under practical conditions.

This research design, type, level and modality have been strategically selected to provide a comprehensive understanding of the bacteria present in dog wounds with bites from conspecifics and their antibiotic resistance, thus contributing to the formulation of more informed therapeutic strategies in the field of veterinary care.

The research was carried out on dogs that came to the CanVet veterinary clinic in the city of Latacunga, from June to October. In total, 17 domestic dogs between 1 and 10 years old were admitted, presenting wounds caused by bites in various areas of their bodies. To carry out the evaluation, informed consent was obtained from the owners of the participating dogs, ensuring the confidentiality of the information and their ethical treatment.

ISSN: 2697-3391
Vol. 7 No. 1.1, pp. 102 – 116, February 2024

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Detailed clinical data were collected, including the dog's medical history, bite severity, previous treatments and any pre-existing medical conditions. These data were used to provide context for the microbiological findings. Samples were obtained from the wounds using sterile swabs. Precautions were taken to avoid external contamination, and physical characteristics of the wounds will be recorded. Sampling was carried out under aseptic conditions to preserve microbiological integrity.

The samples were sent to be cultured in a private human medicine laboratory with a turnaround time of 72 hours.

This combination of methods and techniques provides a detailed understanding of the bacteria present in dog wounds with bites from conspecifics and their resistance to antibiotics, thus allowing a comprehensive and rigorous approach to research.

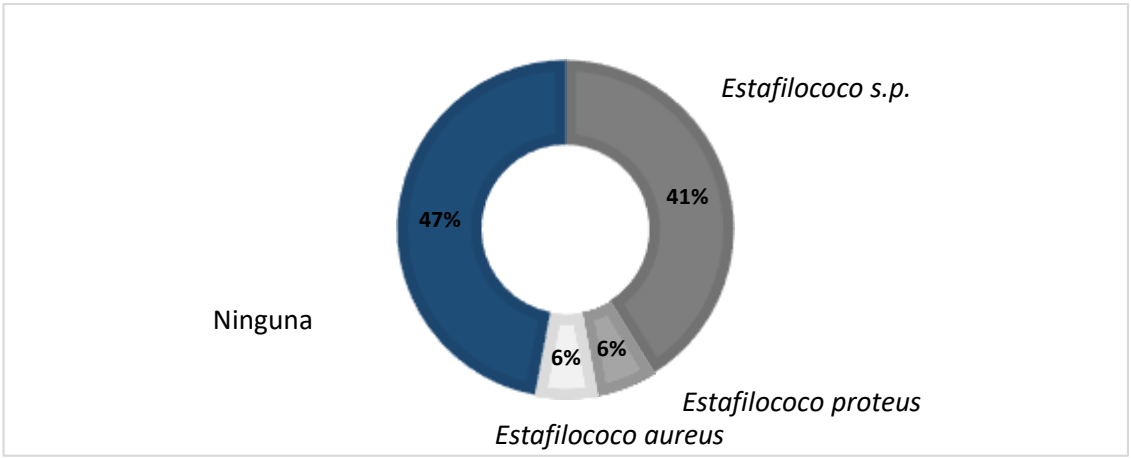


**Figure 1.**Most Common Bacteria Identified in Wounds of Domestic Dogs with Congener Bites

Within the broad spectrum of the most common aerobic bacteria found in canine bites to humans are those of the Staphylococcus and Pasteurella genera (Concha Tiznado, et al 2020). The prevalence found in this study identified 53% of cases positive for bacteria of the Staphylococcus genus and 47% of cases could not identify any aerobic bacteria in the wounds as seen in Figure 1. Within the types of Staphylococcus found, one specific case (6%) of Staphylococcus aureus and another case (6%) of Staphylococcus proteus could be identified. The remaining 7 cases (41%) maintain a generic classification of Staphylococcus sp. It is necessary to consider that the presence of the type of bacteria and severity of the wound will depend on the location where the bites occur (Mosocoso, et al, 2020). Assuming a probability of 0.5, this prevalence would not be highly significant (p=0.882).

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ISSN: 2697-3391
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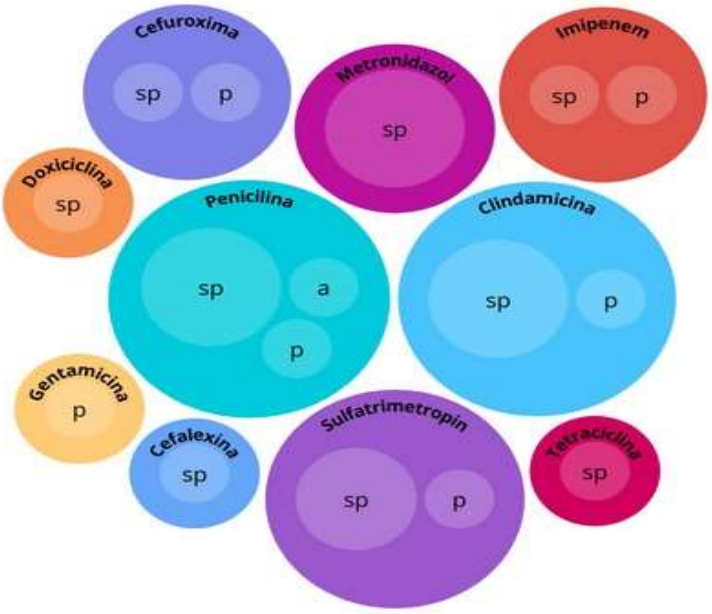


**Figure 2.**Spectrum of Antimicrobial Resistance to the Main Antibiotics Used in Canine Bite Treatments.

In Figure 2 we observe the spectrum of antimicrobial resistance in proportion to the first-line antibiotics used within veterinary clinics and hospitals, where according toConcha Tiznado, et al (2020) recommend the main use of:Amoxicillin/Clavulanic Acid; Clindamycin + Trimethoprim/Sulfamethoxazole; Third Generation Cephalosporin + Clindamycin and/or Trimethoprim/Sulfamethoxazole and Penicillin + Clindamycin. No specific evidence for an effect was found in this study.on a species of Staphylococcus; however, a greater case of resistance can be seen towards Penicillin (67%), followed by Clindamycin (56%), Sulfatrimethoprim (44%) and Metronidazole (44%); these 4 products being the most resistant. There is also resistance to Cefuroxime (22%), Ipipenem (22%), Cephalexin (11%), Tetracyclines (11%), Gentamicin (11%) and Doxycillin (11%). It is important to highlight that of the 10 products that were evaluated, all presented at least one case of resistance.

**Table 1.**Antimicrobial Resistance and Multi-Resistance to the Main Antibiotics Used in Canine Bite Treatments.

| Multi-resistance (n) | Prevalence | Antibiotic |
|---|---|---|
| Resistance (1) | 18% | Penicillin |
| | | Metronidazole |
| | | Clindamycin |
| Resistance (2) | 6% | Penicillin-Cephalexin |
| Resistance (3) | 6% | Penicillin-Gentamicin-Metronidazole |

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ISSN: 2697-3391
Vol. 7 No. 1.1, pp. 102 – 116, February 2024
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| | | |
|---|---|---|
| Resistance (4) | 12% | Penicillin-Clindamycin-Cefuroxime-Sulfatrimethoprim |
| | | Clindamycin-Sulfatrimethoprim-Metronidazole-Doxycycline |
| Resistance (5) | 6% | Penicillin - Clindamycin - Sulfatrimethoprim - Metronidazole - Tetracycline |
| Resistance (6) | 6% | Penicillin-Clindamycin-Cefuroxime-Sulfatrimethoprim-Gentamicin-Doxycycline |

In canine bites, a greater number of cases of resistance to Amoxicillin/Clavulanic Acid or Dicloxacillin have been reported (Cadima Terrazas and Calderón López, 2011), corroborated by Hayes, et al (2020) who explains that this problem is increasing and the spectrum of resistance is broadening in a general and specific way in cases of*Staphylococcus spp*Of the total number of resistance cases (53%), the groups were resistant to one or more antibiotics, with the largest number of cases of multi-resistance to 6 products: Penicillin-Clindamycin-Cefuroxime-Sulfatrimethoprim-Gentamicin-Doxycycline. 18% presented resistance to only one product, and this product was different for each of the cases. Penicillin is the antibiotic present in all cases of resistance (1 to 6 products). Clindamycin is resistant to one case and is part of the group of multi-resistant to 4,5 and 6 antibiotics. The cases of resistance and multi-resistance are shown in Table 1.

## Discussion

Where Staphylococcus aureus was isolated in most cases, Pasteurella multocida in 4 cases, both were isolated in 2 cases and in 10 cases none of the 40 samples was isolated. Concluding that S aureus and P multocida constitute the most frequent aerobic germs in wounds caused by animal bites. Both antibiotics, Amoxicillin/Clavulanic Acid and Dicloxacillin are proportionally effective in controlling infections.(14)

In another study published in 2012, the subgingival microbiota in dogs and its sensitivity to antimicrobials were investigated in canine patients with spontaneously occurring periodontal disease, who should undergo treatment in the Surgery Service of the Veterinary Medicine School Hospital (HEMV) and in the Dentistry and Maxillofacial Surgery Service, Faculty of Veterinary Sciences, UBA. Where 105 isolates were obtained, 79 corresponding to genera of aerobic and facultative anaerobic bacteria

(Staphylococcus spp., Streptococcus spp., Micrococcus spp., Bacillus spp., Proteus spp., Escherichia spp., Alcaligenes spp. and Pseudomonas spp.) and 28 to genera of strict anaerobic bacteria (Porphyromonas spp., Fusobacterium spp., Prevotella spp., Peptostreptococcus spp. and Bacteroides spp.).(15)

In a study published in 2018, the sensitivity and resistance of bacteria to antibiotics in dermatopathies was measured. Results were obtained from 100 canines with dermatopathies. It was determined that the etiological agents identified in the skin of canines are S. aureus, S. epidermidis, S. intermedius, Streptococcus spp., Escherichia coli., Pseudomona aeruginosa and Proteus spp., with Staphylococcus aureus being the most prevalent microorganism.(16)

In a 2023 study, where a case of a dog bite by a congener was presented, the evolution of a case of generalized systemic infection due to a bite from a domestic dog is described, which was successfully treated and discharged in 28 days. Adequate preparation of the wound using various methods, dressings and constant instillation systems of antiseptic solutions that promote healing in an optimal environment, as well as the application of VAC negative pressure therapy, allowed the case to be resolved in 28 days. In which a blood culture was performed to determine the use of elective antibiotic therapy, demonstrating the importance of these studies for the proper and responsible management of these drugs.(9)

The data provided in Figure 2 demonstrate the relationship between bites by conspecifics and bacterial resistance, demonstrating the importance of performing cultures and antibiograms for making decisions on antibiotic therapy. This knowledge can have direct applications in veterinary practice, contributing to more effective strategies for the treatment of wounds in the context of bites between dogs.

## Conclusions

- The results of the research reveal a high prevalence of bacteria of the genus Staphylococcus sp., aureus and Proteus in wounds of domestic dogs caused by bites from congeners. This finding suggests that these bacteria are common in this type of injuries.
- A significant problem of antibiotic resistance was found, especially towards penicillin (67%) and clindamycin (56%). This information is crucial for the appropriate choice of antibiotic treatments, highlighting the importance of considering bacterial resistance when planning therapy. Consequently, it is inferred that individualization of antibiotic treatment is imperative, given the variability in resistance to different antimicrobials between patients and the wounds analyzed.

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## Conflict of interest

The authors declare that there is no conflict of interest in relation to the submitted article.

## Authors' contribution statement

The article must be accompanied by a note, which expresses the contribution of each author to the study carried out.

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