EPIDEMIOLOGIC AND ANTIBIOTIC RESISTANCE PROFILE AND DETECTION OF *MECA* GENE IN *STAPHYLOCOCCUS* SPP. ISOLATES FROM DOG-OWNING VETERINARY STUDENTS

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ABSTRACT: The maintenance of pets as reservoirs of multiresistant bacteria and the transmission of microorganisms such as *Staphylococcus* spp. between animals and humans can affect the effectiveness of antimicrobials in human medicine. The aim of this study was to detect risk factors, evaluate the phenotypic profile of antimicrobial resistance and detect the *mecA* gene in *Staphylococcus* spp. isolated from the nasal cavity of students of veterinary medicine who own dogs. This is a field survey where 35 nasal swab samples were collected to isolate *Staphylococcus* spp. The antimicrobial resistance of the isolates and the classification according to the multidrug resistance profile (MDR) were determined. The presence of the *mecA* gene was investigated in isolates with resistance to oxacillin. In addition, the research subjects answered a questionnaire about behavior towards the dog and hygiene habits to identify risk variables for developing antimicrobial resistance. The antimicrobials tested were ampicillin, penicillin, oxacillin, cephalothin, clindamycin, gentamicin, erythromycin, enrofloxacin, and tetracycline. 92.9% of coagulase-positive staphylococci (CoPS) and 45% of coagulase-negative staphylococci (CoNS) were resistant to the beta-lactam class, and 28.6% of CoPS and 45% of CoNS showed MDR profile. Three isolates were classified as resistant to oxacillin, and the *mecA* gene was detected in 100% of these isolates. About half of the individuals used antimicrobials in the last 12 months (52.9%), and 75% used amoxicillin, which could

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explain the high antimicrobial resistance profile. Dog owners harbor *Staphylococcus* spp. with high resistance to beta-lactam antimicrobials and a multi-resistance profile, representing a unique One Health problem.
KEYWORDS: Pets; Epidemiology; Resistance Genes; One Health.

PERFIL EPIDEMIOLÓGICO E DE RESISTÊNCIA A ANTIBIÓTICOS E DETECÇÃO DO GENE *MECA* EM *STAPHYLOCOCCUS* SPP. ISOLADOS DE ESTUDANTES VETERINÁRIOS PROPRIETÁRIOS DE CÃES

RESUMO: A manutenção de pets como reservatórios de bactérias multirresistentes e a transmissão de microrganismos como *Staphylococcus* spp. entre animais e humanos podem afetar a eficácia de antimicrobianos na medicina humana. O objetivo deste estudo foi detectar fatores de risco, avaliar o perfil fenotípico de resistência antimicrobiana e detectar o gene *mecA* em *Staphylococcus* spp. isolados da cavidade nasal de estudantes de medicina veterinária proprietários de cães. Trata-se de pesquisa de campo onde 35 amostras de swab nasal foram coletadas para isolar *Staphylococcus* spp. A resistência antimicrobiana e a classificação segundo o perfil de multirresistência (MDR) dos isolados foram determinadas. A presença do gene *mecA* foi investigada em isolados resistentes à oxacilina. Os estudantes responderam a um questionário sobre comportamento em relação ao cão e hábitos de higiene para identificar variáveis de risco para o desenvolvimento de resistência antimicrobiana. Foram testados os antimicrobianos ampicilina, penicilina, oxacilina, cefalotina, clindamicina, gentamicina, eritromicina, enrofloxacina e tetraciclina. 92,9% dos estafilococos coagulase-positivos (CoPS) e 45% dos estafilococos coagulase-negativos (CoNS) foram resistentes à classe dos beta-lactâmicos e 28,6% CoPS e 45% CoNS apresentaram perfil MDR. Três isolados foram classificados como resistentes à oxacilina e o gene *mecA* foi detectado em 100% destes isolados. Mais da metade dos indivíduos fez uso de antimicrobiano nos últimos 12 meses (52,9%), 75% fizeram uso de amoxicilina, o que poderia explicar o alto perfil de resistência antimicrobiana. Os donos de cães abrigam *Staphylococcus* spp. com alta resistência aos antimicrobianos beta-lactâmicos e apresentam MDR, o que representa um problema de saúde única.
PALAVRAS-CHAVE: Pets; Epidemiologia; Genes de Resistência; Saúde Única.

PERFIL DE RESISTENCIA EPIDEMIOLÓGICA Y ANTIBIÓTICA Y DETECCIÓN DE GÉNERO *MECA* EN *STAPHYLOCOCCUS* SPP. ESTUDIANTES VETERINARIOS AISLADOS DE PERROS

RESUMEN: El mantenimiento de las mascotas como reservorios de bacterias multiresistentes y la transmisión de microorganismos como *Staphylococcus* spp. entre animales y seres humanos pueden afectar a la eficacia de los antimicrobianos en la medicina humana. El objetivo de este estudio fue detectar factores de riesgo, evaluar el perfil fenotípico de la resistencia antimicrobiana y detectar el gen meccaA en *Staphylococcus* spp. aislado de la cavidad nasal de estudiantes veterinarios dueños de perros. Se trata de una investigación de campo en la que se recogieron 35 muestras de hisopo nasal para aislar *Staphylococcus* spp. Se determinó la resistencia antimicrobiana y la clasificación de los aislados por perfil de multiresistencia (MDR). La presencia del gen de la mecaA se ha investigado en aislados resistentes a oxacilina. Los estudiantes respondieron a un cuestionario sobre comportamiento de perros y hábitos de higiene para identificar variables de riesgo para el desarrollo de resistencia antimicrobiana. Se han estudiado antimicrobianos como ampicilina, penicilina, oxacilina, cefalotina,

clindamicina, gentamicina, eritromicina, enrofloxacina y tetraciclina. El 92,9% de los estafilococos coagulasa-positivos (CoPS) y el 45% de los estafilococos coagulasa-negativos (CoNS) fueron resistentes a la clase beta-lactam y el 28,6% de los CoPS y el 45% de los CoNS tenían un perfil de MDR. Se clasificaron tres aislados como resistentes a la oxacilina y se detectó el gen de la mecaA en el 100% de estos aislamientos. Más de la mitad de los individuos utilizaron antimicrobianos en los últimos 12 meses (52,9%), el 75% utilizó amoxicilina, lo que podría explicar el alto perfil de resistencia antimicrobiana. Los dueños de perros albergan *Staphylococcus* spp. con alta resistencia a los antimicrobianos beta-lactámicos y tienen MDR, lo que representa un único problema de salud.
PALABRAS CLAVE: Mascotas; Epidemiología; Genes de Resistencia; Salud Única.

1. INTRODUCTION

Currently, the relationship between humans and pets is a driving factor in the growth of the pet market. Dogs take on a differentiated place since they commonly become family members in homes, satisfying human needs through their company, friendship, unconditional love, and affection (PRATA, 2022). However, this very close relationship between humans and animals can result in the unwanted sharing of antimicrobial-resistant or multidrug-resistant bacteria.

Staphylococcus spp. are gram-positive bacteria typically found in the upper respiratory tract and other epithelial surfaces of all warm-blooded animals (MARCO-FUENTES *et al*., 2022). However, *Staphylococcus aureus,* has been associated with severe infections in humans, such as pneumonia, meningitis, endocarditis, and septicemia (CHAI *et al*., 2021). Therefore, it is crucial to determine its resistance profile, mainly because antimicrobial resistance rates are increasing in both hospital and community settings, creating a favorable environment for the development of superbacteria (KLOS *et al*., 2023). The World Health Organization (WHO) has presented data with high levels of antimicrobial resistance for several bacterial infections in low-income and high-income countries, with *S. aureus* being one of the most commonly reported resistant bacteria (OPAS, 2018).

Studies evaluating the bacterial phenotypic resistance profile of isolates from different diseases of dogs and cats (ISHII *et al*., 2011; SILVA *et al*., 2014; OLIVEIRA *et al*., 2016; MARCO-FUENTES *et al*., 2022) have shown strains with resistance to most antimicrobials and many with a multidrug resistance profile. These results show the possibility of maintenance of multidrug-resistant bacteria and subsequent transmission of these microorganisms, such as *Staphylococcus* spp. between animals and humans and consequently, an impact on the effectiveness of these drugs in human medicine (LLOYD, 2007; YADAV; KAPLEY, 2021).

Coelho *et al*. (2007) reported that combining phenotypic and genotypic methods in identifying the antimicrobial resistance profile of *Staphylococcus* spp. of humans and animals allows a more accurate diagnosis and assists in establishing strategies for controlling the spread of resistant strains.

In bacteria of the genus *Staphylococcus*, resistance to antimicrobials, especially beta-lactams, may be associated with producing a penicillin-binding protein (PBP2a or PBP2') encoded by the *mecA* gene (MENDONÇA *et al*., 2012) and whose expression is constitutive or induced by beta-lactam antimicrobials such as oxacillin (LOWY, 2003).

Therefore, this study aimed to detect risk factors, evaluate the phenotypic antimicrobial resistance profile and detect the *mecA* gene in *Staphylococcus* spp. isolated from nasal swabs from dog-owning veterinary medicine students.

2. MATERIAL AND METHODS

2.1 Study Location

Sample collection was conducted in the municipality of Umuarama, located at 23º45'59"S and 53º19'30"W, in northwestern Paraná state, Brazil. Nasal swab samples were collected from dog-owning veterinary medicine students from a private University after approval by the Research Ethics Committee Involving Human Beings (CEPEH) under CAAE No. 71715417.5.0000.0109.

Initially, students were informed about the research project and answered an epidemiologic questionnaire containing questions about using antimicrobials in the last 12 months and hygienic habits. None of the students showed clinical signs of any illness.

2.2 Sampling

The samples were collected through a nasal swab from the students, considering the total number of veterinary medicine students (N = 181) in 2017 and the formula for determining the number of samples to obtain data for statistical analysis (RODRIGUES, 2002):

$n_0 = \frac{z^2.p.q}{(P-p)2}$ and $n = \frac{n0}{1+\frac{n0}{N}}$

Where,

n_0 - initial number; z - confidence level; p - value obtained from a previous study by others or an origin not known, is considered 50%; N - population size; q = 100 – p; P – p = precision determined by the researcher (15%).

Thus, 35 nasal swab samples were collected from the veterinary students. For sample collection, the swab was first moistened in the transport medium (Stuart). It was then introduced into the student's nose, with rotation, and inserted into the transport medium for further laboratory processing.

2.3 Isolation of Coagulase-Positive Staphylococci (CoPS) and Coagulase-Negative *Staphylococci* (CoNS)

The swab was processed at the Laboratory of Preventive Veterinary Medicine and Public Health of the Graduate Program in Animal Science with an Emphasis on Bioactive Products at Parana University (UNIPAR). The swab was removed from the transport medium and incubated in brain heart infusion medium (BHI) in an oven for 24 hours at 37 ºC. Afterward, the bacteria were streaked on mannitol agar and incubated at 37 ºC for 24 hours to isolate *Staphylococcus* spp. Each colony was submitted to analysis of the macroscopic, microscopic, catalase, and coagulase tests, allowing classification of coagulase-positive *Staphylococci* (CoPS) and coagulase-negative *Staphylococci* (CoNS).

2.4 Diffusion Susceptibility Test

The agar disc-diffusion method was used according to the recommendations of the Clinical and Laboratory Standards Institute (CLSI, 2018). The *Staphylococcus* spp. were tested for susceptibility to 10 antimicrobials: ampicillin (10 µg), penicillin (10 U), oxacillin (1 µg), cephalotin (30 µg), cefoxitin (30 µg), clindamycin (2 µg), gentamicin (10 µg), erythromycin (15 µg), enrofloxacin (5 µg) and tetracycline (30 µg).

Inhibition zone results were subsequently interpreted as sensitive (S) and resistant (R) according to the reference standard by Br-CAST (BrCAST, 2022), except for enrofloxacin which was interpreted according to CLSI (CLSI, 2018).

2.5 Detection of the *Mec*a Gene

The samples that were resistant to oxacillin had their DNA extracted with the aid of a commercial kit (Purelink Genomic DNA Kit - Invitrogen, Carlsbad, CA, USA), for carrying out PCR assays, according to Murakami et al. (1991) using the primers mecA1 (AAAATCGATGGTAAAGGTTGG) and mecA2 (AGTTCTGCAGTACCGGATTTG) at 5 µM. A Veriti™ 96-Well Thermal Cycler Applied Biosystems was used for PCR amplification. The amplification products were visualized by electrophoresis on 2% agarose gel stained with Gel Red (Uniscience, Osasco, São Paulo, BR), yielding a 533-bp band.

2.6 Determination of the Multidrug Resistance Profile - Multidrug Resistance (MDR)

Bacterial isolates were classified concerning their multidrug resistance (MDR) profile, defining MDR as not susceptible to at least one agent in at least three classes of antimicrobials (SWEENEY et al., 2018).

2.7 Statistical Analysis

The association between the variables (hygienic habits) and antimicrobial resistance profile or multidrug resistance of CoPS and CoNS was determined. The data were compared using the chi-square test with Yates correction or Fisher's exact test and calculating the odds ratio and 95% confidence interval using the statistical program SPSS v. 21.0 at the 5% significance level.

3. RESULTS

Thirty-five isolates of *Staphylococcus* spp. were obtained. Fourteen were identified as coagulase-positive staphylococci (CoPS) (Table 1) and 92.9% were resistant to the beta-lactams and macrolides antimicrobials. In addition, 28.6% presented a multi-resistance profile. The antimicrobials with the highest resistance profile were penicillin (PEN) and erythromycin (ERI), resistant to 14 strains of CoPS.

Table 1 - Rate of antimicrobials resistance of coagulase-positive Staphylococci (CoPS) strains (n=14) isolated from nasal swabs of veterinary medicine students dog owners.

ID	Course series	Antimicrobials to which the strain was resistant	MDR
1	2 nd serie	PEN, ERI	No
5	2 nd serie	PEN, ERI	No
9	2 nd serie	PEN, ERI	No
19	1 st serie	PEN, ERI	No
20	1 st serie	PEN, ERI, GEN	Yes
24	3 rd serie	OXA, PEN, ERI, GEN, TET	Yes
29	4 th serie	PEN, ERI	No
37	4 th serie	PEN, ERI, GEN, TET	Yes

38	4 th serie	PEN, ERI, TET	No
39	4 th serie	PEN, ERI	No
41	3 rd serie	PEN, ERI, TET	Yes
42	3 rd serie	AMP, PEN, ERI	No
43	3 rd serie	AMP, PEN, ERI	No
44	3 rd serie	AMP, PEN, ERI, TET	Yes
TOTAL	2 -1 st serie 3 -2 nd serie 5 -3 rd serie 4 -4 th serie	Beta-lactams (13/14; 92.9%) Quinolones (0/14; 0%) Macrolides (13/14; 92.9%) Lincosamides (0/14; 0%) Aminoglycosides (4/14; 28.6%) Tetracycline (4/14; 28.6%)	MDR (4/14; 28.6%)

MDR – Multidrug resistance; Beta-lactams class: AMP: Ampicillin; OXA: Oxacillin; PEN: Penicillin; CFL: Cephalothin; CFO: Cefoxitin. Quinolones: ENO: Enrofloxacin. Macrolides: ERI: Erythromycin. Lincosamides: CLI: Clindamycin. Aminoglycosides: GEN: Gentamicin. Tetrakinins: TET: Tetracycline
Source: Prepared by the authors.

The 20 strains of CoNS identified (Table 2) presented a lower resistance profile. That is, 45% were resistant to the beta-lactam and 40% to the macrolide antimicrobials. However, they showed a higher multidrug resistance profile (45%), emphasizing the same antimicrobials.

Table 2 - Rate of antimicrobials resistance of coagulase-negative Staphylococci (CoNS) strains (n=20) isolated from nasal swabs of veterinary medicine students dog owners.

ID	Course series	Antimicrobials to which the strain was resistant	MDR
2	2 nd serie	PEN, ERI, GEN, TET	Yes
3	2 nd serie	PEN, ERI, TET	Yes
4	2 nd serie	AMP, PEN, ERI, GEN, TET, CFO	Yes
7	2 nd serie	PEN, ERI	No
14	1 st serie	AMP, PEN, CFO	No
15	1 st serie	PEN, TET, CFO	No
16	1 st serie	PEN, GEN, TET, CFO	Yes
17	1 st serie	PEN, CLI, ERI, CFO	Yes
18	1 st serie	PEN, CFO	No
21	1 st serie	PEN, ENO, ERI, GEN, TET, CFO	Yes
23	3 rd serie	PEN, ERI, GEN, TET, CFO	Yes
25	3 rd serie	AMP, OXA , PEN, ENO, ERI, GEN, TET, CFO	Yes
30	4 th serie	PEN, ERI	No
31	4 th serie	PEN, ERI	No
32	4 th serie	PEN	No
33	4 th serie	PEN, ERI	No
34	4 th serie	OXA, PEN, GEN	No
35	4 th serie	PEN, ERI, TET, CFO	Yes
36	4 th serie	PEN, ERI, CFO	No
40	4 th serie	PEN, CFL	No
TOTAL	6 -1 st Serie 4 -2 nd Serie 2 -3 rd Serie 8 -4 th Serie	Beta-lactams (9/20; 45%) Quinolones (2/20; 10%) Macrolides (8/20; 40%) Lincosamides (1/20; 5%) Aminoglycosides (7/20; 35%) Tetracycline (9/20; 45%)	MDR (9/20; 45%)

MDR – Multidrug resistance; Beta-lactams class: AMP: Ampicillin; OXA: Oxacillin; PEN: Penicillin; CFL: Cephalothin; CFO: Cefoxitin. Quinolones: ENO: Enrofloxacin. Macrolides: ERI: Erythromycin. Lincosamides: CLI: Clindamycin. Aminoglycosides: GEN: Gentamicin. Tetrakinins: TET: Tetracycline.
Source: Prepared by the authors.

Concerning the use of antimicrobials in the last 12 months, 18 among 34 students (52.9%) (Table 3) reported the use of antimicrobials, and 12 (75%) used a beta-lactam antimicrobial (amoxicillin). One of the students did not answer this question.

Table 3 - Absolute (n) and relative (%) behavior of dog-owning veterinary medicine students (n = 34) in relation to the use of antimicrobials, hygiene habits and habits related to contact with animals.

Variable	**n (%)**	
	No	**Yes**
Did you use an antibiotic in the last 12 months?	16 (47.1%)	18 (52.9%)
Do you wash your hands before eating?	19 (55.9%)	15 (44.1%)
Are you in the habit of washing your hands after contact with animals?	20 (58.8%)	14 (41.2%)
Does the animal have access to outside?	14 (41.2%)	20 (58.8%)
Are you in the habit of sleeping with your pet?	22 (64.7%)	12 (35.3%)
Do you use PPE during a procedure with animals?	---	34 (100%)

PPE: personal protective equipment
Source: Prepared by the authors.

There was no association (P>0.05) between the presence of CoPS and CoNS strains with a multi-resistance profile and the variables related to the hygiene habits and behavior of students with their pets (Table 4).

In the molecular tests, the three samples classified as resistant to oxacillin and subjected to PCR were positive for the *mecA* gene.

Table 4 - Pet and hygiene habits of dog-owning veterinary medicine students and their relationship with multidrug resistance profile resistance.

Variable	**Answer**	**CoPS PMR**	**P value**	**CoNS PMR**	**P value***
Did you use an antibiotic in the last 12 months?	No Yes	2/9 (22.22%) 2/5 (40.0%)	0.5840	3/11(27.27%) 5/8 (62.5%)	0.1809
Do you wash your hands before eating?	No Always Sometimes	1/2 (50.0%) 0/4 (0%) 3/8 (37.5%)	0.4909	1/1 (100%) 3/8 (37.5%) 4/9 (44.44%)	1.000
Are you in the habit of washing your hands after contact with your pet?	No Yes	4/8 (50.0%) 0/6 (0%)	0.0849	5/10 (50.0%) 3/9 (33.3%)	0.6499
Are you in the habit of sleeping with your pet?	No Yes	3/8 (37.5%) 1/6 (16.7%)	0.5804	5/13(38.5%) 3/6 (50.0%)	1.000
Do you use PPE during a procedure with animals?	No Yes	2/9 (22.2%) 2/5 (40.0%)	0.5804	7/13(53.8%) 1/6 (16.7%)	0.1770

Questions with different numbers, not answered by the student; *Fisher's exact test. PPE: personal protective equipment.
Source: Prepared by the authors.

4. DISCUSSION

The results revealed high antimicrobial resistance profile, mainly for beta-lactam (penicillin) and macrolides (erythromycin) (Tables 1 and 2). The high resistance profile may be associated with using antimicrobials in the last 12 months by 52.9% of the students (Table 3), mainly amoxicillin (75%). According to Yadav and Kapley (2021), one of the factors associated with the emergence of antimicrobial resistance is related to antibiotic overuse. Klein *et al.* (2021) reported that from 2000 to 2015, the sale of medicines in 76 countries revealed a 65% increase in the use of antimicrobials.

Homologous genes found in pathogens, normal microbiota, and soil (WOOLHOUSE *et al*., 2015) indicate that the sharing of resistance between bacteria from animals, humans, and the environment may justify the increase in bacterial strains with profiles of resistance and multi-resistance, including those associated with the consumption of food contaminated with resistant bacteria (SERGELIDIS; ANGELIDIS, 2017).

Amoxicillin is the most prescribed antimicrobial in Brazil (LIMA *et al*., 2014; PAULA, 2014). In addition, Silva *et al.* (2013) reported that more than 70% of *S. aureus* (CoPS) and *S. epidermidis* (CoNS) isolates from the community or the hospital environment are resistant to penicillin, ampicillin and amoxicillin, corroborating the results found in the present study for penicillin.

Dobrachinski *et al.* (2022), studying employees of a Public Health unit in Bahia state, found that all samples of *S. aureus* (CoPS) isolated from the employees' nasal cavities were resistant to penicillin, as was observed in this study, in which 100% of the CoPS strains were resistant to penicillin.

Lin *et al.* (2018) verified that school environmental contamination with methicillin-resistant *Staphylococcus aureus* (MRSA) was positively associated with MRSA nasal carriage in elementary students. Although the present study did not assess MRSA strains, the fact that environmental contamination influenced the contamination of students demonstrates the sharing of antimicrobial-resistant microbiota.

Coelho *et al.* (2007), evaluating the resistance profile of *Staphylococcus* spp. from animals and humans, also observed a high resistance profile for antimicrobials of the beta-lactam class (ampicillin and penicillin), with a higher percentage for human samples (80.9%). Penicillin is among the most used antimicrobials in the small animal clinic (ARIAS; CARRILHO, 2012), which could explain the high antimicrobial resistance in this drug class in the *Staphylococcus* isolates tested.

Additionally, we highlight that the students of veterinary medicine subjects of this research conduct their practical activities with animals, including dogs, and can share resistant microorganisms with the animals. Coincidently, amoxicillin is one of the main antimicrobials prescribed in the small animal clinic for infections by gram-positive bacteria at the veterinary hospital where the students perform practical activities. In addition, the use of the combination of amoxicillin with clavulanate for respiratory infections and cephalexin for pets' skin infections caused by gram-positive bacteria was also mentioned by veterinarians working at that hospital.

Pereira and Cunha (2009) evaluated nasal colonization by *Staphylococcus* spp. resistant to oxacillin in nursing students and similarly observed a low profile of oxacillin resistance. However, resistance was only detected in CoNS (16.2%), differing from the present work in which an isolate resistant to oxacillin and with the *mecA* gene in CoPS was found.

The occurrence of the *mecA* gene was evaluated only in samples resistant to oxacillin, and the results showed that 100% (n=3) had the *mecA* gene. Similarly, Angel *et al.* (2019) found that of the 32 oxacillin-resistant *S. aureus* isolated from patients in two hospitals, 30 (93.8%) harbored the *mecA* gene. Mimica and Mendes (2007) reported that phenotypic resistance to oxacillin is highly variable and dependent on the expression of the *mecA* gene. However, Goering *et al.* (2019) reported that strains of *S. aureus* possessing the *mecA* gene but showing phenotypic susceptibility to oxacillin may become resistant after exposure to the antimicrobial, resulting in treatment failure.

In the present study, when the habits of dog-owning students (Table 3) were related to MDR profile, there was no significant association ($P>0.05$) between habits concerning hygiene and behavior with animals and MDR profile. However, this demonstrates that at some point in life, they were exposed to or showed habits explaining the high percentage of resistance to antimicrobials of the beta-lactam class. In addition, in analyzing the questionnaire answers of students about hygiene habits and habits related to contact with animals (Table 3), 100% made use of personal protective equipment (mainly gloves) during practical activities with animals, and only 35.3% had the habit of sleeping with their pet.

Among the CoPS isolated, 28.6% exhibited an MDR profile, similar to the data from Angel et al. (2019) in *S. aureus* isolates from urine, vagina, ear, and wound samples from patients in two hospitals.

Staphylococcus spp. do not live isolated on the skin or mucous surfaces of animals but are in very close contact with various other bacteria (WENDLANDT et al., 2013), enabling the sharing of resistance genes. In addition, the interruption of antimicrobial treatment when the patient sees improvement allows some bacteria to survive, which results in the recurrence of the disease, contributing to the growth of bacteria that survived, possibly including drug-resistant populations (ALLEL *et al*., 2023).

Strategies aimed at combating resistant pathogens are frequently based on international documents, such as from the FDA (Food and Drug Administration) and CDC (Centers for Disease Control and Prevention), that consider many resources and disease conditions not present in Brazil (COSTA; SILVA JÚNIOR, 2017). These hindrances and the fact that treatments guided by antibiogram results are rare limit the measures for control and prevention in Brazil (MENEZES *et al.*, 2006). Since the launch by WHO of the Global Action Plan on Antimicrobial Resistance in 2015 (ANVISA, 2018), the Brazilian government developed the National Plan for the Prevention and Control of Resistance to Antimicrobials in the Scope of One Health in 2018 (BRASIL, 2018), which includes, among other objectives, the training of professional managers who work in the areas of human, animal and environmental health concerning antimicrobial resistance, demonstrating the great importance of the theme.

5. CONCLUSIONS

Dog-owning students host *Staphylococcus* spp. with a high antibiotic resistance profile, mostly drugs of the beta-lactam class. In addition, the *Staphylococcus* isolates show a multidrug resistance profile, with the *mecA* gene present in 100% of the isolates resistant to oxacillin, proving to be an One health problem, as it may have been acquired from animals in your household. Further work is needed to verify the association between the resistance profile in strains of Staphylococcus spp. isolated from dogs and their respective owners.

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