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Prevalence, species, and antimicrobial resistance of *Acinetobacter* in surgical practice and laboratory dog husbandry room environments

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Acinetobacter is a bacteria found in the environment and clinical specimens, causing nosocomial infection and antimicrobial resistance (AMR) threats. This study examined the prevalence, species, and AMR characteristics of *Acinetobacter* isolated from surgical practice and the laboratory dog husbandry room environments (n = 235) at Rajamangala University of Technology Tawan-ok veterinary hospital during 2018-2019. The prevalence of *Acinetobacter* in the laboratory dog husbandry room and veterinary belongings were 2.55% and 0.43%, respectively. Species determination was *Acinetobacter hemolyticus* (2.13%) and *Acinetobacter baumannii* (0.43%) from environments in the laboratory dog husbandry room, and *Acinetobacter junii* (0.43%) from the shoes used in the surgical practice room. AMR was observed in both study environments and the specimens sent to the Veterinary Diagnostic Center. These isolates had a high resistant percentage to amoxicillin-clavulanic acid (84.62%), sulfamethoxazole-trimethoprim (61.54%), and cephalexin (53.85%) but were susceptible to imipenem. Compared to the isolates recovered from the clinical specimens, most isolates derived from environments exhibited multidrug resistance and shared correlated resistance patterns. These results highlight the need for sanitization in the dog husbandry room. Furthermore, the AMR results can be used as a preliminary baseline for studying AMR *Acinetobacter* contamination in animals and their environments.

Keywords: *Acinetobacter*; environment; antimicrobial resistance; dog

Introduction

Acinetobacter is gram-negative coccobacilli or short rods in the family Moraxellaceae [1], which can be found in water, soil, sewage, and foods, as well as in the skin and mucous membranes of humans and animals [2,3]. This group of bacteria recently has an impact on public health because they are considered as the source of antimicrobial resistance (AMR) and multidrug resistance (MDR), particularly for carbapenems, which cause difficulties in treatment and result in a high mortality rate [4]. Since 1988, *Acinetobacter* has comprised 10% of bacteria found frequently as nosocomial infections in the United States and worldwide [5].

In Thailand, the incidence of *Acinetobacter* infections in hospitals increased from 2%-4% to 10%-30% for the last decade, particularly in the ward unit [6]. The National Anti-microbial Resistant Surveillance Center Thailand also reported that

the resistance rates of *Acinetobacter* spp. to antimicrobial agents increased gradually during 2000-2020 [7]. In addition, *Acinetobacter* was found mostly as contamination on nurses' hands [8], and can be isolated from the soil, water, air, sink, urine bottle, bed, and respiratory equipment in hospitals [9,10]. Clinical specimens, such as urine, exudate, respiratory tract, and blood samples, are a major source of *Acinetobacter* infection [11,12]. Moreover, *Acinetobacter baumannii* is the main causative agent usually recovered from human clinical cases [6].

In addition to human hospitals, *Acinetobacter* can often be found in clinical specimens of animals [13]. Among several species, *A. baumannii* is important in animal hospitals underlying severe illnesses, such as canine pyoderma, urinary tract infection, and foal sepsis, as well as AMR infections [6,14]. Based on a study in Germany during 2000-2008 [15], MDR *A. baumannii* isolates recovered from veterinary hospitals and clinics were distinctly resistant to carbapenem groups, such as human cases [16].

Other species of *Acinetobacter*, which are not *A. baumannii* (non-baumannii *Acinetobacter*), including *Acinetobacter pittii*, *Acinetobacter calcoaceticus*, *Acinetobacter bereziniae*, *Acinetobacter hemolyticus*, *Acinetobacter johnsonii*, *Acinetobacter lwoffii*, *Acinetobacter schindleri*, *Acinetobacter radioresistens*, *Acinetobacter beijerinckii*, *Acinetobacter junii*, *Acinetobacter generi*, and *Acinetobacter ursingii* have also been reported in animals particularly in livestock, horses, and pets [13,17]. Some outstanding species, such as *A. hemolyticus*, were found in the general environment and tended to cause severe clinical cases concerned with the environment in hospitals. On the other hand, AMR, particularly carbapenems, was not determined clearly [18]. *A. junii* has been reported in calculi obstructions in the ureter [19]. As mentioned previously, *Acinetobacter* is found mainly in nature. Nevertheless, few studies have been conducted on the epidemiology and pathogenesis in the environment [2], leading to gaps of knowledge about the relationship of this bacteria in humans, animals, the environment, and the loss of AMR transferring pathways [14,16].

According to the gaps, this study focused on the prevalence of all *Acinetobacter* species and their AMR patterns recovered from surgical practice and laboratory dog husbandry room environments at the veterinary hospital, Rajamangala University of Technology Tawan-ok. Furthermore, the AMR patterns from the study environment were compared with the same bacterial group isolated from clinical specimens sent for analysis at Veterinary Diagnostic Center, Faculty of Veterinary Medicine, Rajamangala University of Technology Tawan-ok during 2016-2020. These results can be used as baseline data in the study of AMR *Acinetobacter* in animals, humans, and the environment.

Materials and Methods

Sample collection

This study was a descriptive research. Two hundred and thirty-five swabbed samples from the surgical practice and laboratory dog husbandry room at the veterinary hospital, Rajamangala University of Technology Tawan-ok, Chonburi province, Thailand, between January 2019 and March 2020. The samples were composed of four categories: laboratory dog husbandry room environment, such as floor under cages, the inner area of cages, dog beds, pet food cabinet, room floor, sewer pipe, sink, and storage area floor (n = 100); laboratory dogs, such as oral mucous membrane, anus, blood, saliva, leash, collar, feeding bowl, skin swab, and cotton containing alcohol used in skin scrub (n = 80); veterinary belongings, including shoes used in the surgical practice room, used syringe and needle (n = 35), and hands of people in contact with dogs (n = 20).

Acinetobacter isolation

All samples were taken for bacterial isolation and biochemical tests applied from previous studies [20-23]. Briefly, swabbed samples were cultured on tryptic soy broth (TSB) and incubated at 37°C and 44°C for 24 to 48 hours. The turbid TSB was then transferred to culture on MacConkey agar and incubated under the same conditions above. Subsequently, a single typical (pale pink or colorless) colony was transferred from MacConkey agar and identified by gram staining, motility, morphology, and oxidation/fermentation tests. Moreover, biochemical tests [21,24] were applied for species confirmation. The species of all confirmed *Acinetobacter* isolates were recorded and stored for further analysis.

Antimicrobial susceptibility testing

All *Acinetobacter* isolates were taken to determine the antimicrobial susceptibility test by the disc diffusion method of Kirby-Bauer [25] using data from previous studies [13-15,20] for selected antimicrobial discs. The antimicrobial-resistant percentages were then concluded and compared with *Acinetobacter* isolates derived from the clinical specimens of the Veterinary Diagnostic Center, which had been reported in 2016-2020.

Statistical analysis

Statistical analysis was applied to determine the prevalence of *Acinetobacter* derived from four categories (laboratory dogs husbandry room, laboratory dog, veterinarian belongings, and

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hands of people in contact with dogs) for the most variables. The analysis with the likelihood ratio test and Fisher's exact test, using R version 3.1.2 (R Foundation for Statistical Computing, Austria) were applied. The results were reported as the odds ratios (ORs) with the associated 95% confidence interval (CI), and a p-value < 0.05 was considered significant.

Results

Prevalence of *Acinetobacter* in environments

The overall prevalence of *Acinetobacter* in this study was 2.98% (7/235). Considering the categories, the prevalence in the environments of surgical practice and laboratory dog husbandry rooms were 2.55% (6/235), or 6.0% (6/100) in this category (OR, 8.55; 95% CI, 1.013-72.218; $p = 0.044$). The veterinary belongings had a 0.43% (1/235) prevalence, or 2.86% (1/35) in this category, while there was no positive sample for *Acinetobacter* in the laboratory dogs and hands of people in contact with dogs (Table 1). The laboratory dog husbandry room environment showed the highest prevalence, which was determined in the samples from the floor under cages, dogs beds, storage area floor, and inner area of the cages. Significantly, the prevalence in dogs beds was 20.0% (2/10) with OR, 11, which was higher than other factors in laboratory dog husbandry room environment. The odds of *Acinetobacter* prevalence in the floor under cages, storage area floor, the inner area of the cages, and the shoes used in the surgical practice room were 4.67, 4.06, 4.06, and 2.55, respectively, compared to other factors (Table 1).

Species of *Acinetobacter* isolates

All 235 swabbed samples were determined to be *Acinetobacter* for seven isolates, including five isolates of *A. hemolyticus* (2.13%, 5/235) recovered from the floor under cages (0.85%, 2/235), storage area floor (0.43%, 1/235), the inner area of cages (0.43%, 1/235), and dogs' bed (0.43%, 1/235). One isolate of *A. junii* (0.43%, 1/235) was recovered from shoes used in the surgical practice room, and one isolate of *A. baumannii* (0.43%, 1/235) was recovered from a dogs' bed (Fig. 1).

Antimicrobial susceptibility testing

Most *Acinetobacter* isolates recovered from the environments in surgical practice, the laboratory dog husbandry rooms (6/7), and clinical specimens of Veterinary Diagnostic Center (5/6) were resistant to amoxicillin-clavulanic acid at 84.62%. In con-

Table 1. Prevalence of *Acinetobacter*

Factor	Prevalence (%)	OR (95% CI)	*p*-value*
Environments in laboratory dog husbandry room	6.0 (6/100)	8.55 (1.013–72.218)	0.044*
Floor under cage	10.0 (2/20)	4.67 (0.845–25.779)	0.112
Room floor	0 (0/20)	0	0
Sewer pipe	0 (0/10)	0	0
Dogs bed	20.0 (2/10)	11 (1.845–65.566)	0.031*
Storage area's floor	10.0 (1/10)	4.06 (0.441–37.327)	0.265
Inner area of cage	10.00 (1/10)	4.06 (0.441–37.327)	0.265
Sink	0 (0/10)	0	0
Pet food cabinet	0 (0/10)	0	0
Laboratory dog	0 (0/80)	0	0
Saliva	0 (0/15)	0	0
Oral mucous membrane and anus	0 (0/15)	0	0
Blood	0 (0/10)	0	0
Leash and collar	0 (0/10)	0	0
Feeding bowl	0 (0/10)	0	0
Skin swab	0 (0/10)	0	0
Cotton contained alcohol used for skin scrub	0 (0/10)	0	0
Veterinary belongings	2.9 (1/35)	0.95 (0.111–8.149)	> 0.999
Shoes used in surgical practice room	6.7 (1/15)	2.55 (0.287–22.653)	0.374
Used syringe and needles	0 (0/20)	0	0
Hands of person contacted dog	0 (0/20)	0	0

OR, odds ratio; CI, confidence interval.
*Fisher exact test statistic at $p < 0.05$.

trast, the *A. hemolyticus* recovered from the storage area floor and *A. lwoffii* vdc2 from the Veterinary Diagnostic Center were resistant to sulfamethoxazole-trimethoprim. In addition, 61.54% of *Acinetobacter* isolates were resistant to this antimicrobial type, except for *A. hemolyticus* and *A. baumannii* recovered from the dog beds, and *A. lwoffii* vdc2 was susceptible to this drug (Table 2). Approximately 53.85% of the isolates recovered from the environments in surgical practice and laboratory dog husbandry room (4/7) and clinical specimens of Veterinary Diagnostic Center (3/6) were resistant to cephalexin, except *A. hemolyticus* recovered from storage area floor and dog beds, *A. junii* recovered from shoes used in the surgical practice room and *A. lwoffii* vdc2 (Table 2).

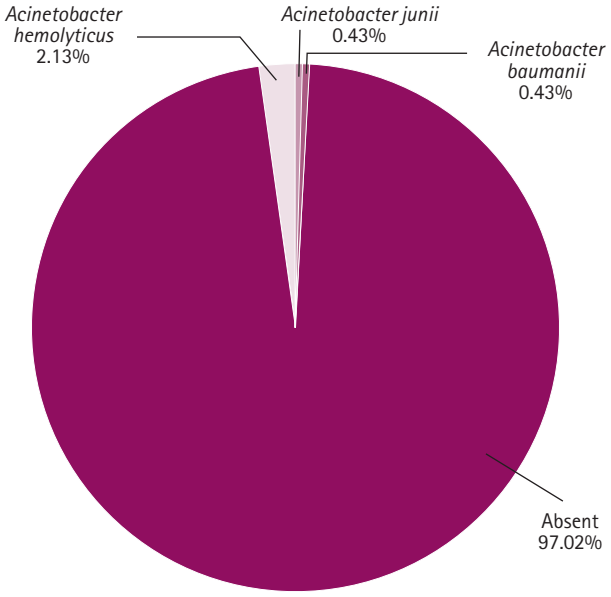

Fig. 1. Percentage of *Acinetobacter*'s species.

AMR patterns of *Acinetobacter*

The AMR patterns of *Acinetobacter* primarily found in this study were amoxicillin-clavulanic acid, cephalexin, and doxycycline (13.04%) of *A. hemolyticus* isolated from the inner area of cages, the floor under the cage, and vdc2, while amoxicillin-clavulanic acid and sulfamethoxazole-trimethoprim (13.04%) of *A. junii* recovered from the shoes used in the surgical practice room, *A. hemolyticus* vdc1 and *A. lwoffii* vdc1 (Table 3). Another pattern with a high percentage of resistance (13.04%) was clindamycin from *A. lwoffii* vdc1 and 2 and *A. hemolyticus* vdc1. Other MDR patterns found mainly in this study (8.70%) were amikacin, amoxicillin-clavulanic acid, cephalexin, and sulfamethoxazole-trimethoprim of *A. hemolyticus* recovered from the floor under the cages; amoxicillin-clavulanic acid, cephalexin, doxycycline, and sulfamethoxazole-trimethoprim of *A. hemolyticus* recovered from the inner area of cages and floor under cages; amoxicillin-clavulanic acid, cephalexin, and

Table 2. Susceptibility pattern of *Acinetobacter* isolates to antimicrobial agents

Acinetobacter isolates*	Antibiotic												
	AK	AMC	CL	CRO	DO	IMP	ENR	SXT	CN	S	DA	CAZ	NOR
Acinetobacter hemolyticus 1	S	S	S	S	S	S	S	R	-	-	-	-	-
A. hemolyticus 2	S	R	I	S	S	S	S	S	-	-	-	-	-
A. hemolyticus 3	S	R	R	S	R	S	I	R	-	-	-	-	-
A. hemolyticus 4	R	R	R	S	I	S	I	R	-	-	-	-	-
A. hemolyticus 5	R	R	R	S	R	S	S	R	-	-	-	-	-
Acinetobacter junii 1	S	R	S	S	S	S	S	R	-	-	-	-	-
Acinetobacter baumannii 1	S	R	R	R	I	S	R	S	-	-	-	-	-
Acinetobacter johnsonii vdc 1	S	R	R	-	S	-	S	R	-	-	-	-	-
Acinetobacter lwoffii vdc 1	S	R	-	-	I	-	S	R	-	-	R	-	-
A. lwoffii vdc 2	S	S	S	-	S	-	S	S	S	-	R	-	-
A. hemolyticus vdc 1	R	R	-	R	-	-	S	R	-	-	R	-	S
A. hemolyticus vdc 2	-	R	R	S	R	S	S	-	-	-	-	R	S
A. baumannii vdc 1	S	R	R	R	R	S	-	-	S	S	-	-	-
Percentage of resistance	23.08	84.62	53.85	23.08	30.77	0	7.69	61.54	0	0	23.08	7.69	0

AK, amikacin; AMC, amoxycillin-clavulanic acid; CL, cephalexin; CRO, ceftriaxone; DO, doxycycline; IMP, imipenem; ENR, enrofloxacin; SXT, sulfamethoxazole-trimethoprim; CN, gentamycin; S, streptomycin; DA, clindamycin; CAZ, ceftazidime; NOR, norfloxacin; R, resistant; I, intermediate; S, susceptible; -, did not test; 0, no resistance.

A. hemolyticus 1, isolate from storage area floor; *A. hemolyticus* 2, isolate from dogs bed; *A. hemolyticus 3*, isolate from inner area of cage; *A. hemolyticus* 4 and 5, isolate from floor under cage; *A. junii* 1, isolate from shoes used in surgical practice room; *A. baumannii* 1, isolate from dogs bed; vdc 1 and 2 of latter *Acinetobacter*, isolates were recovered from clinical specimens of veterinary diagnostic center.

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Table 3. Predominant resistance patterns (R-patterns) of *Acinetobacter* isolates

Predominant R-patterns (n)	*Acinetobacter* isolates*	Percentage
AK, AMC, CL, SXT (2)	*Acinetobacter hemolyticus* 4, *A. hemolyticus* 5	8.70
AMC, CL, DO, SXT (2)	*A. hemolyticus* 3, *A. hemolyticus* 5	8.70
AMC, CL, CRO (2)	*Acinetobacter baumannii* 1, *A. baumannii* vdc1	8.70
AMC, CL, SXT (2)	*A. hemolyticus* 4, *Acinetobacter johnsonii* vdc1	8.70
AMC, CL, DO (3)	*A. hemolyticus* 3, *A. hemolyticus* 4, *A. hemolyticus* vdc2	13.04
AMC, SXT (3)	*Acinetobacter junii* 1, *A. hemolyticus* vdc1, *A. lwoffii* vdc1	13.04
AK, CRO (1)	*A. hemolyticus* vdc1	4.35
DA (3)	*Acinetobacter lwoffii* vdc1, *A. lwoffii* vdc2, *A. hemolyticus* vdc1	13.04
AMC (1)	*A. hemolyticus* 2	4.35
DO (1)	*A. baumannii* vdc1	4.35
SXT (1)	*A. hemolyticus* 1	4.35
ENR (1)	*A. baumannii* 1	4.35
CAZ (1)	*A. hemolyticus* vdc2	4.35

AK, amikacin; AMC, amoxycillin-clavulanic acid; CL, cephalexin; SXT, sulfamethoxazole-trimethoprim; DO, doxycycline; CRO, ceftriaxone; DA, clindamycin; ENR, enrofloxacin; CAZ, ceftazidime.
A. hemolyticus 1, isolate from storage area floor; *A, hemolyticus* 2, isolate from dogs bed; *A. hemolyticus* 3, isolate from inner area of cage; *A. hemolyticus* 4 and 5, isolate from floor under cage; *A. junii* 1, isolate from shoes used in surgical practice room; *A. baumannii* 1, isolate from dogs bed; vdc1 and 2 of latter *Acinetobacter*, isolates were recovered from clinical specimens of veterinary diagnostic center.

ceftriaxone of *A. baumannii* isolated from dogs' bed and vdc1; amoxicillin-clavulanic acid, cephalexin, and sulfamethoxazole-trimethoprim of *A. hemolyticus* recovered from the floor under cages and *A. johnsoniii* vdc1 (Table 3). On the other hand, all *Acinetobacter* isolates recovered from the environments in surgical practice and laboratory dog husbandry room (7/7) and two isolates from Veterinary Diagnostic Center, including *A. hemolyticus* vdc2 and *A. baumannii* vdc1, were susceptible to imipenem (Table 2).

Discussion

Prevalence of *Acinetobacter* in environments

In this study, the prevalence of *Acinetobacter* in the laboratory dog husbandry rooms environment was 6.0% (Table 1), which was similar to a previous study. Uwingabiye et al. [12] reported that clinical specimens of hospitals showed a prevalence of 6.94%. According to the ORs in Table 1, the prevalence of *Acinetobacter* in the environment of laboratory dog husbandry rooms was 8.55 times higher than the other factors, including laboratory dogs, veterinary belongings, and people in contact with the dog's paws. The environment is an intermediate source of bacteria dissemination. Two reports stated that the healthcare environments could be accumulation and multiplication sources of *Acinetobacter* affecting patients [26,27]. In addition, the dog beds, which are closely in contact with animals, have 11 times the risk of *Acinetobacter* prevalence compared to other locations in the laboratory dog husbandry room (Table 1). This group of bacteria can survive in many environments and produce biofilms to protect their vegetative cells on both abiotic and biotic surfaces, particularly in *A. baumannii*, leading to prolonged survival and nosocomial infection [16,27]. This problem would be more severe if the healthcare settings have insufficient sanitization [27].

Unlike the prevalence of *A. baumannii* recovered from medical equipment, such as respiratory tubes and blood pressure monitors [28], the prevalence in veterinary belongings was only 2.9%. Hence, the highest prevalence was found only in shoes used in the surgical practice room, needles, and syringes but did not cover other veterinary belongings. Moreover, the laboratory dogs in this study were healthy and had no septicemia or severe clinical diseases [13,20]. Therefore, *Acinetobacter* was not detected in the needles and syringes. Although the shoes used in the surgical practice room had a prevalence of 6.7%, it was assumed that those shoes might have been a reservoir of *Acinetobacter* [2].

No positive *Acinetobacter* sample was found in the laboratory dogs, which contrasts with several reports. A study in Reunion Island of France claimed that pets (dogs and cats) were carriers of *A. baumannii* with a prevalence of 6.5% [29]. Black et al. [30] detected *Acinetobacter* in 7% in the clinical specimens from the canine intensive care unit and sent for bacterial culture and an-

timicrobial sensitivity test. On the other hand, some studies explained that healthy laboratory dogs without an immunocompromised state would have a primary line of body defense that could depress the multiplication of undesirable normal flora, such as *Acinetobacter* spp. [31,32].

Several studies reported that the hands of healthy people could be a multiplication source of *A. baumannii* spreading to patients, particularly with wounds or injuries on the skin [8,28], which is in contrast to the present study in that no *Acinetobacter* was found on staff hands. The reason, in this case, might be that people in contact with dogs had a strict handwashing regimen and recognized the importance of hygiene [14]. This suggests that the bacterial transferring pathway between dogs and humans or the environment and humans could be broken by hygiene and sanitation practices [14,20,33].

Species of *Acinetobacter* isolates

Three species of *Acinetobacter* were recovered in the environment of this study (Fig. 1). *A. hemolyticus* has been found in the environment, such as water and human skin [2]. Therefore, this species would be found on the floor under cages, storage area floor, the inner area of cages, and dog beds. The results suggest that dogs roaming outside the building transferred these bacteria from the environment into husbandry rooms. *A. junii* has been reported in viscous mud, sewage, water, soil, and human skin [2], including animals [17]. The determination of *A. junii* in shoes used in the surgical practice room might originate from sewage in environmental contamination. *A. baumannii* can be found in humans, animals, the environment, and medical equipment, including clinical specimens in hospitals and veterinary hospitals [12,13,15,23,28,33]. This species was isolated from dog beds, which were assumed to be contaminated.

Antimicrobial susceptibility testing

According to Table 2, the class of antimicrobials showing a high resistance percentage was the cephalosporin group, including amoxicillin-clavulanic acid (84.62%), cephalexin (53.85%), and ceftriaxone (23.08%). This group of antimicrobials is used frequently in clinics [34]. These results were correlated with previous studies reporting that approximately 90% of this bacteria recovered from clinical specimens and the hospital environment were resistant to both old generation and new broad-spectrum cephalosporins [11,20]. Moreover, 23.08% of *Acinetobacter* isolates in this study were also resistant to the aminoglycoside drug (amikacin). Recently, these two groups of antimicrobials tended to increase the level of resistance [20].

A. baumannii was considered the most outstanding species of MDR [23,29,33,35]. This species uses various resistant mechanisms to survive against β-lactams and carbapenems, particularly the production of β-lactamase or carbapenemases [13,36]. In agreement with this study, *A. baumannii* recovered from the dog beds and vdc1 were resistant to amoxicillin-clavulanic acid, cephalexin, and ceftriaxone (Table 3). As mentioned previously, this group of antibiotics is generally used for treatment in animal healthcare [34], which might increase the selection pressure of AMR in the environment leading to horizontal gene transfer [13,33,36]. Amikacin is usually selected to treat MDR *Acinetobacter* infections [13,28], but most of the *Acinetobacter* isolates in the present study were susceptible to this drug, except for *A. hemolyticus* recovered from the floor under the cage and vdc1 (Table 3). Only one isolate of *A. baumannii* recovered from dog beds in this study was resistant to enrofloxacin, which was the same as the study before. The researchers reported that a small percentage of *Acinetobacter* isolates were resistant to this drug [13]. Zordan et al. [15] reported that all MDR *A. baumannii* isolated from veterinary clinics in Germany were resistant to clindamycin. In contrast to the present study, only 13.04% of clindamycin resistance was detected (Table 3). Interestingly, several studies reported the accelerated trend of carbapenems resistance [7,13,16]. On the other hand, there was no resistance to imipenem or carbapenem. These results highlight the need for rational drug use in animal hospitals and livestock production to reduce AMR threats.

AMR patterns of *Acinetobacter*

This study identified five predominant MDR patterns of *Acinetobacter* (Table 3) that were resistant to at least three antimicrobial agent groups [37], representing approximately 45.5% of the related isolates. Several species isolated in the environment of this study as well as clinical cases from animal hospitals sent for analysis at the Veterinary Diagnostic Center, including *A. hemolyticus*, *A. baumannii*, *A. johnsoniii*, had MDR patterns. A previous study stated that *A. baumannii* was mostly found with the MDR patterns of *Acinetobacter* recovered from all clinical specimens in veterinary hospitals [13]. This contrasts with the present study showing that *A. hemolyticus* presented the highest frequency of MDR patterns. The MRD *Acinetobacter* determination in the hospital environment would relate to nosocomial infections and circulate in both human and animal intensive care units [16,35]. On the other hand, AMR gene transmission and resistant mechanisms of *Acinetobacter* should be considered for further study.

In conclusion, *Acinetobacter* is a gram-negative bacteria generally found in the environment and clinical specimens of hu-

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man and veterinary hospitals. In this study, the determination of this bacteria in the environments of laboratory dog husbandry room and veterinary belongings were *A. hemolyticus*, *A. junii*, and *A. baumannii*. The finding emphasizes the importance of sanitary management and cleaning the operating place and laboratory dog husbandry room to reduce the source of bacterial contamination. In addition, most antimicrobial-resistant patterns of the *Acinetobacter* isolates recovered from surgical practice, and laboratory dog husbandry rooms environments were MDR, which is in agreement with the isolates derived from the clinical specimens of the Veterinary Diagnostic Center. These MDR *Acinetobacter* determined the public health importance of the environment and its related clinical specimens.

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