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Antimicrobial susceptibility testing by Australian veterinary diagnostic laboratories

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Background The national strategy for tackling antimicrobial resistance highlights the need for antimicrobial stewardship in veterinary practice and for surveillance of antimicrobial susceptibility in veterinary pathogens. Diagnostic laboratories have an important role in facilitating both of these processes, but it is unclear whether data from veterinary diagnostic laboratories are similar enough to allow for compilation and if there is consistent promotion of appropriate antimicrobial use embedded in the approaches of different laboratories to susceptibility testing.

Methods A cross-sectional study of antimicrobial susceptibility testing and reporting procedures by Australian veterinary diagnostic laboratories was conducted in 2017 using an online questionnaire. All 18 veterinary diagnostic laboratories in Australia completed the questionnaire.

Results Kirby-Bauer disc diffusion was the method predominantly used for antimicrobial susceptibility testing and was used to evaluate 86% of all isolates, although two different protocols were used across the 18 laboratories (CLSI 15/18, CDS 3/18). Minimum inhibitory concentrations were never reported by 61% of laboratories. Common isolates were consistently reported on across all species, except for gram-negative isolates in pigs, for which there was some variation in the approach to reporting. There was considerable diversity in the panels of antimicrobials used for susceptibility testing on common isolates and no consistency was apparent between laboratories for any bacterial species.

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Conclusion We recommend that nationally agreed and consistent antimicrobial panels for routine susceptibility testing should be developed and a uniform set of guidelines should be adopted by veterinary diagnostic laboratories in Australia.

Keywords antimicrobial resistance; antimicrobial stewardship, diagnostic laboratories; microbiology; susceptibility testing

Abbreviations AMR, antimicrobial resistance; CDS, calibrated dichotomous sensitivity; CLSI, Clinical Laboratory Standards Institute; EUCAST, European Committee on Antimicrobial Susceptibility Testing; MIC, minimum inhibitory concentration

Antimicrobial resistance (AMR) of animal origin has been implicated in the development of AMR in humans.¹⁻⁶ Both global⁷ and national strategies⁸ for tackling AMR have called for improved antimicrobial stewardship in animal health and for the monitoring of antimicrobial susceptibility patterns. However, surveillance of resistant veterinary pathogens is limited in Australia because of a lack of resources and heavy reliance on passive surveillance of clinical specimens. Moreover, comparative studies require strict quality control procedures to ensure data are uniform. It is unclear if data from veterinary diagnostic laboratories are similar enough to allow national compilation.

Antimicrobial stewardship is a term used to describe the implementation of processes to ensure the appropriate use of antimicrobials in animals and people, with the goal of reducing the driving factor (antimicrobial use) for AMR.⁸ Many antimicrobial stewardship programs call for an increase in the use of culture and susceptibility testing, to improve appropriate antimicrobial use in medical⁹ and veterinary¹⁰ clinical practice.

Previous research has shown that antimicrobial susceptibility results obtained from veterinary diagnostic laboratories are rarely scrutinised by veterinarians in clinical veterinary practice.¹¹ In addition, reporting of sensitivity patterns may lead to changes in antimicrobial selection by veterinarians in practice, so there is a need for these to be consistent between diagnostic laboratories. Variability in testing methodology and data storage have been identified as barriers to the use of veterinary diagnostic laboratory data for AMR surveillance in the USA.¹²

The aim of this study was to investigate laboratory procedures that may contribute to antimicrobial selection by veterinarians in Australia and to evaluate whether a lack of consistency in procedures could affect the compilation of data that may contribute to an effective AMR surveillance system.

Materials and methods

A cross-sectional study of antimicrobial susceptibility testing and reporting procedures by Australian veterinary diagnostic laboratories was conducted in 2017. The source population consisted of the 18 veterinary diagnostic laboratory organisations providing services for veterinary clinical specimens in Australia in 2017.

A letter of invitation was sent to a microbiologist at each laboratory. Questionnaire responses were collected and managed using REDCap electronic data capture tools.¹³ The questionnaire comprised five sections (Supplementary File 1). The initial section asked for information on the frequency with which different methods of assessing antimicrobial susceptibility were used and the standards that were used to perform this testing (e.g. Clinical and Laboratory Standards Institute [CLSI], calibrated dichotomous sensitivity [CDS], European Committee on Antimicrobial Susceptibility Testing [EUCAST]). The second section asked which

organisms were never tested for susceptibility. Section three asked respondents to nominate the three most frequently isolated pathogens for dogs, cats, horses, cattle and pigs, and to nominate the antimicrobials that were routinely included in susceptibility testing performed on these pathogens. Section four asked about the approach used by the laboratory to identify methicillin-resistant *Staphylococcus* species, to detect extended-spectrum beta-lactamase-producing *Enterobacteriaceae* and to detect vancomycin-resistant *Enterococcus* species. Finally, respondents were asked to nominate if and when antimicrobial susceptibility testing was performed but not reported to the clinician submitting the request for diagnostic services. The survey was pretested with two independent laboratory personnel. The survey took 15–20 min to complete. Minimal changes were made to the survey following the initial testing. Data were downloaded from the survey software to spreadsheets and processed with Microsoft Office Excel 2016. The respondents had to indicate that they routinely performed culture and susceptibility testing on each species to be included in the analysis for that species. Descriptive statistics were computed, with percentages being reported as a proportion of the total laboratories responding to each animal species section. This research was approved by the University of Melbourne Faculty of Veterinary and Agricultural Science Human Ethics Advisory Group under approval no. 1749375.2.

Results

All of the veterinary diagnostic laboratory organisations operating in Australia in 2017 were recruited into this study and all completed the survey. Of these 18 facilities, 12 routinely processed dog and cat isolates, 13 routinely processed equine isolates, 14 routinely processed bovine isolates and 9 routinely processed porcine isolates.

The Kirby-Bauer disc diffusion method was the method predominantly used for susceptibility testing. The disc diffusion method was used by all laboratories, with an average across the laboratories of 86% of all isolates tested using this method. Broth dilution methods were used by eight laboratories, with an average across these laboratories of 8% of all isolates tested using this method. The Etest® method was used by five laboratories, with an average across the laboratories of 6% of all isolates tested using this method. Agar dilution methods were used by three laboratories, with an average across the laboratories of less than 1% of all isolates tested using this method. Genotyping for AMR genes was rarely used, with a detection assay for the *mecA* gene in *Staphylococcus* isolates only offered if requested by a clinician or researcher. Laboratories were typically reporting the susceptible–intermediate–resistant interpretation for disc diffusion results (14/18), with others reporting zone diameters (4/18). Minimum inhibitory concentrations (MICs) were never routinely reported by any laboratory and were not reported at all by most laboratories (11/18), with the remainder reporting MICs only when they were requested by clinicians (7/18). The CLSI guidelines were used by 83% (15/18) of laboratories, with the remainder using the CDS test method. Reasons for not performing susceptibility testing included isolation of fastidious organisms (8/18), anaerobic organisms (7/18) and organisms with predictable susceptibility patterns (3/18).

The most commonly isolated pathogens for each species were relatively consistent between laboratories for all species, except for pigs, where there was diversity, predominantly among gram-negative isolates (Table 1). One laboratory did not report gram-positive equine isolates, so this laboratory was excluded for that section.

To further analyse the patterns of antimicrobial susceptibility testing, the data were compared when more than half of the laboratories were routinely culturing and testing isolates of a specific bacterial species. There was considerable diversity in the panels of antimicrobials used in susceptibility testing for the common isolates, with no consistency detected between laboratories in any animal or bacterial species (Supplementary File 2). Canine *Streptococcus* spp. isolates were tested for amoxycillin, ampicillin or penicillin susceptibility by 64% (7/11) of laboratories reporting these isolates. Equine and bovine *Streptococcus* spp. isolates were frequently tested for susceptibility to 3rd-generation cephalosporins (11/12 laboratories and 7/14 laboratories, respectively). Susceptibility testing for vancomycin was rare for all bacterial isolates and animal species, except for *Enterococcus* isolates from dogs and cats. Susceptibility testing for antimicrobials that are not permitted to be used in food-producing animals was uncommon and when susceptibility testing was performed it was for identification purposes, or to monitor for resistance, and was not reported to clinicians. Other reasons for not reporting susceptibility data included when the susceptibility test was performed for research purposes. Routine susceptibility testing for antimicrobials with a high-importance rating (as defined by the Australian Strategic Advisory Group on Antimicrobial Resistance¹⁴) was generally uncommon, except for fluoroquinolones, 3rd-generation cephalosporins and amikacin. Susceptibility to imipenem was infrequently reported in any species. Testing for amikacin, piperacillin and ticarcillin-clavulanate was uncommon in dog and cat isolates. Sensitivity to vancomycin was rarely assessed, except for *Enterococcus* spp. isolates. Ticarcillin-clavulanate was only reported for *Escherichia coli* in dogs (5/12) and cats (5/12) and for *Pseudomonas* isolates in dogs (6/12). Fluoroquinolone susceptibility was commonly assessed for *Staphylococcus* spp. (12/12), *E. coli* (11/12), *Pseudomonas* spp. (11/12) and *Proteus* spp. (9/9) isolates in laboratories frequently isolating these pathogens from dogs and for *Staphylococcus* spp. (11/12), *Streptococcus* spp. (6/7), *Enterococcus* spp. (7/9), *E. coli* (10/12), *Pseudomonas* spp. (6/6) and *Proteus* spp. (6/6) isolates in laboratories frequently isolating these pathogens from cats. Susceptibility to 3rd-generation cephalosporins was commonly assessed for *Pseudomonas* spp. isolates (10/12), *Staphylococcus* spp. (9/12), *E. coli* (9/12), *Proteus* spp. (7/9) and *Streptococcus* spp. (4/11) in laboratories frequently isolating these pathogens from dogs, and *Staphylococcus* spp. (7/12), *Streptococcus* spp. (6/7), *Enterococcus* spp. (4/9), *E. coli* (8/12), *Pseudomonas* spp. (3/6) and *Proteus* spp. (5/6) isolates in laboratories frequently isolating these pathogens from cats. Piperacillin susceptibility was never tested for in equine isolates and testing for vancomycin, imipenem and ticarcillin-clavulanate susceptibility was reported to be rare. Susceptibility to 3rd-generation cephalosporins was commonly assessed for *Streptococcus* spp. (11/12), *Staphylococcus* spp. (9/11), *E. coli* (11/13) and *Pseudomonas* spp. (5/9) isolates in laboratories frequently isolating these pathogens from horses. Fluoroquinolone susceptibility testing was also common for *Streptococcus* spp. (8/12), *Staphylococcus* spp. (8/11), *E. coli* (10/11) and *Pseudomonas* spp. (7/9) isolates from horses. Amikacin susceptibility testing was commonly reported for *Streptococcus* spp. (5/12), *Staphylococcus* spp. (6/11), *E. coli* (8/11) and *Pseudomonas* spp. (5/9) isolates from horses. In cattle, the only antimicrobials with a high-importance rating for which susceptibility were reported were 3rd-generation cephalosporins, for *Staphylococcus* spp. (5/12), *Streptococcus* spp. (7/13), *E. coli* (6/11), *Pasteurella* spp. (4/6) and *Salmonella* spp. (2/6). Similarly for pig isolates, 3rd-generation

cephalosporins were the only antimicrobials with a high-importance rating for which susceptibility was reported and this was done infrequently and only for *Staphylococcus* spp. (2/6), *E. coli* (1/5) and *Trueperella pyogenes* (2/5).

Discussion

This is the first survey to investigate the antimicrobial susceptibility testing procedures of Australian veterinary diagnostic laboratories and has quantified the variety of testing procedures and antimicrobial panels that are currently being used. Veterinary diagnostic laboratories have been identified internationally as a vital source of data for monitoring antimicrobial susceptibility¹² and the Office International des Epizooties (OIE) Ad Hoc Group of Experts on Antimicrobial Resistance has called for standardisation of susceptibility testing and harmonisation of the antimicrobials used in susceptibility testing to enable international comparison of data.¹⁵ Standardisation is also required to allow for national compilation of data. However, there are limitations to the use of these data for surveillance, as clinical isolates might be expected to have higher levels of resistance resulting from the selective effect of recent exposure to antimicrobials than isolates collected from sentinel animals.

This survey showed that there was no uniformity in the practice of susceptibility testing, with two laboratory standards being used commonly (CLSI and CDS) and a range of other methods used for specific circumstances. A number of different susceptibility testing methods are also used in the human medical laboratory sector.¹⁶ Although a national approval system for laboratories does not exist, the National Association of Testing Authorities, Australia accredits veterinary diagnostic laboratories for a range of services; 9 of the 18 veterinary laboratories are accredited for antimicrobial susceptibility testing (to the standard ISO/IEC 17025:2005:20.11.02).¹⁷ Such accreditation requires participation in regular proficiency testing. Non-accredited laboratories may also participate in these programs, although the extent to which the laboratories that are not accredited for antimicrobial testing participate in proficiency testing is unknown.

Ideally, a national surveillance system would be based on MICs, as this allows for subtle shifts in susceptibility to be detected, rather than a dichotomous system of sensitive versus resistant. Of concern is that this study showed that many (11 of 18) veterinary diagnostic laboratories currently do not perform any MIC testing. This is a significant barrier that will be difficult to overcome, given the costs involved in acquiring appropriate equipment and the barrier that the cost of culture and susceptibility testing to animal owners poses to greater utilisation of susceptibility testing.¹¹ An additional barrier is that of susceptibility breakpoints. There are relatively few validated veterinary breakpoints and many interpretations of susceptibility are based on extrapolation from human breakpoints. Although the CLSI guidelines recommend that the laboratory should inform veterinarians of the source of the breakpoints, this is rarely done. In addition, there is substantial variation between the breakpoints set by CDS and CLSI, making comparison, and interpretation, difficult. Substantial variability was also found in the range of antimicrobials used in susceptibility testing for individual bacterial species. Consensus on standard panels is clearly needed. Veterinary diagnostic laboratories also have a significant role in antimicrobial stewardship, because veterinarians rely on susceptibility reports to guide antimicrobial selection. Previous research identified that Australian veterinarians rarely consulted laboratory microbiologists

about culture and susceptibility results, even when these results were unexpected.¹¹ In this study, testing and reporting of susceptibility to three antimicrobials with a high-importance rating was common: for 3rd-generation cephalosporins in all species, fluoroquinolones in dogs, cats and horses, and amikacin in horses. Beta-haemolytic *Streptococcus* spp. isolates were the most commonly reported *Streptococcus* spp. isolates for dogs and horses, and these are uniformly sensitive to penicillins.^{18,19} Reporting of 3rd-generation cephalosporin susceptibility for beta-haemolytic *Streptococcus* spp. isolates in dogs and horses may lead practitioners to choose these drugs over antimicrobials with a low-importance rating, such as amoxicillin or penicillin. Injudicious antimicrobial susceptibility reporting has resulted in inappropriate use of antimicrobials in human medicine.²⁰ Selective reporting has been used safely in a human hospital¹⁵ and is recommended by EUCAST.²¹ A similar selective approach to reporting should be implemented in veterinary medicine.

Testing for susceptibility to fluoroquinolones was common for horse, dog and cat isolates, particularly for gram-negative isolates and *Staphylococcus* species. This may reflect the widespread use of fluoroquinolones in general practice in Australia,²³ but may also be encouraging this use. Testing for susceptibility to amikacin was common for equine isolates. Amikacin should be reserved for cases of documented gentamicin resistance, which appears to be uncommon in Australia.²⁴ A further concern this survey raised was the low frequency with which many laboratories included appropriate narrow-spectrum agents in their susceptibility panels. *Pasteurella* spp. are commonly susceptible to penicillin, but the antimicrobials most commonly included in testing panels for *Pasteurella* spp. were the broad-spectrum antimicrobials, trimethoprim-sulfonamide and tetracycline, and antimicrobials with high-importance rating (i.e. 3rd-generation cephalosporins) and only 50% of laboratories included penicillin in their panels for these species. Susceptibility to antimicrobials with a high-importance rating should only be reported if the organism is resistant to all agents with a low- or medium-importance rating, or if specifically requested by clinicians. In addition, narrow-spectrum antimicrobials should be preferred over broad-spectrum antimicrobials. Some surprising pathogens were listed among the three most commonly isolated organisms in some species; for example, *Brucella* spp. in horses. This may reflect the low number of samples subjected to susceptibility testing by some laboratories serving the equine sector or may reflect regional differences in equine diseases.

In conclusion, this survey identified several barriers to the use of veterinary diagnostic laboratory data for AMR surveillance and antimicrobial stewardship. Standardisation of laboratory methods should be considered and standard panels of antimicrobials for susceptibility testing for common isolates need to be generated and adopted.

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Conflicts of interest and sources of funding

The authors declare no conflicts of interest for the work presented here.

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Supporting information

Additional Supporting Information can be found in the online version of this article at the publisher's website:

Supplementary File 1. Details of the questionnaire.

Supplementary File 2. Antimicrobials commonly used included in susceptibility testing for different pathogens.

Table 1. Most commonly isolated pathogens for each animal species included in the survey

		Canine	Feline	Equine	Bovine	Porcine
Gram-positive	<i>Staphylococcus</i> spp.	12/12	12/12	11/12	12/14	6/9
	<i>Streptococcus</i> spp.	11/12	7/12	12/12	13/14	7/9
	<i>Enterococcus</i> spp.	9/12	9/12	3/12	2/14	5/9
	<i>Corynebacterium</i> spp.	1/12	1/12	2/12	1/14	2/9
	<i>Clostridium</i> spp.		1/12	1/12	5/14	
	<i>Rhodococcus</i> spp.					
	<i>Trueperella pyogenes</i>					
	<i>Erysipelothrix</i> spp.					
Gram-negative	<i>Pseudomonas</i> spp.	12/12	6/12	9/13	1/14	1/9
	<i>Escherichia coli</i>	12/12	12/12	11/13	11/14	5/9
	<i>Proteus</i> spp.	9/12	6/12	1/13	6/14	4/9
	<i>Pasteurella</i> spp.	2/12	4/12	1/13	2/14	1/9
	Other <i>Enterobacteriaceae</i>	1/12	1/12	5/13	6/14	1/9
	<i>Serratia</i> spp.		1/12	1/13	3/14	4/9
	<i>Salmonella</i> spp.		1/12	2/13	2/14	1/9
	<i>Klebsiella</i> spp.		1/12	1/13	1/14	1/9
	<i>Actinobacillus</i> spp.				1/14	
	<i>Brucella</i> spp.					
	<i>Mannheimia haemolytica</i>					
	<i>Enterobacter</i> spp.					
	<i>Yersinia</i> spp.					
	<i>Moraxella bovis</i>					
	<i>Haemophilus</i> spp.					

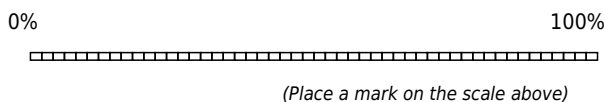
Data are shown as: the number of laboratories reporting that these bacterial species were among the three most common species isolated from this animal species/the number of laboratories that commonly receive samples from this animal species.

Antimicrobial susceptibility testing by Australian veterinary diagnostic laboratories

LY Hardefeldt, M Marendia, H Crabb, MA Stevenson, JR Gilkerson, H Billman-Jacobe and GF Browning
Supplementary File 1:

Laboratory AMS 2017

How frequently do you use the disk diffusion method for testing susceptibility to antimicrobials?

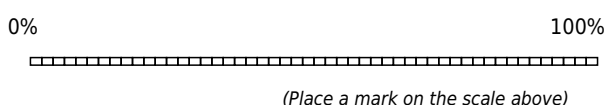


Which method do you use to measure the zone of inhibition?

- Manual (callipers, ruler)
- Automated (e.g. Sirscan)
- Other

Please specify

How frequently do you use the broth dilution method for determining MIC and susceptibility to antimicrobials?

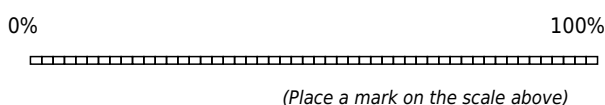


Which method of broth dilution are you using?

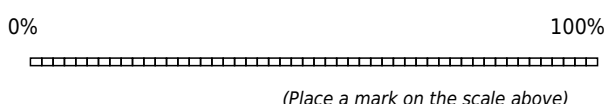
- Manual
- Automated (e.g. Vitek, Sensititre, Phoenix)
- Other

Please specify

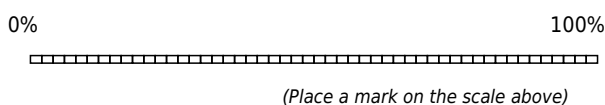
How frequently do you use the E-test method for determining MIC and susceptibility to antimicrobials?



How frequently do you use the agar dilution method for determining MIC and susceptibility to antimicrobials?



How frequently do you use automated AST methods for determining MIC and susceptibility to antimicrobials?



Specify in which situations you use genotype testing for antimicrobial resistance genes (e.g. PCR)?

Do you report MICs routinely?

- Never
- When requested
- For some species
- Always

Please give details

Which methodology and clinical interpretative criteria do you use?

- CLSI
- CDS
- EUCAST
- Other

Please give details _____

Are there any organisms for which you never do antimicrobial sensitivity testing?

- Yes
 No

Please give details _____

Which species do you process antimicrobial culture and susceptibility testing for?

- Canine
 Feline
 Equine
 Bovine
 Porcine

ANTIMICROBIAL SENSITIVITY TESTING IN GRAM POSITIVE CANINE ISOLATES

Which are the 3 most common gram positive organisms you culture in dogs? _____

For the 3 organisms listed above, please indicate which antimicrobials are tested for sensitivity Please answer based on the order in which you have listed the organisms above.

	Gram positive organism 1	Gram positive organism 2	Gram positive organism 3
Amoxicillin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Amoxicillin-clavulanic acid	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ampicillin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Amikacin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cefovecin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cefoxitin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ceftazidime	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ceftiofur	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cephalexin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cephalothin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cephazolin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Chloramphenicol	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ciprofloxacin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Clarithromycin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Clindamycin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Doxycycline	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Enrofloxacin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Erythromycin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Fusic acid	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Gentamicin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Imipenim	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Marbofloxacin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Neomycin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Nitrofurantoin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Oxacillin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Penicillin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Piperacillin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Polymyxin B	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Rifampicin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Tetracycline	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ticarcillin-clavulanate	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Trimethoprim sulphonamide	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Vancomycin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

ANTIMICROBIAL SENSITIVITY TESTING IN GRAM NEGATIVE CANINE ISOLATES

What are the 3 most common gram negative organisms you culture in dogs?

From your list of 3 organisms above, please indicate your usual selection of antimicrobials that are tested for sensitivity to those pathogens.

	Gram negative organism 1	Gram negative organism 2	Gram negative organism 3
Amoxicillin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Amoxicillin-clavulanic acid	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ampicillin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Amikacin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cefovecin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cefoxitin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ceftazidime	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ceftiofur	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cephalexin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cephalothin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cephazolin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Chloramphenicol	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ciprofloxacin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Clarithromycin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Clindamycin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Doxycycline	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Enrofloxacin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Erythromycin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Fusic acid	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Gentamicin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Imipenim	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Marbofloxacin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Neomycin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Nitrofurantoin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Oxacillin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Penicillin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Piperacillin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Polymyxin B	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Rifampicin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Tetracycline	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ticarcillin-clavulanate	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Trimethoprim sulphonamide	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Vancomycin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

ANTIMICROBIAL SENSITIVITY TESTING IN GRAM POSITIVE FELINE ISOLATES

Which are the 3 most common gram positive organisms you culture in cats? _____

For the 3 organisms listed above, please indicate which antimicrobials are tested for sensitivity.

	Gram positive organism 1	Gram positive organism 2	Gram positive organism 3
Amoxicillin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Amoxicillin-clavulanic acid	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ampicillin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Amikacin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cefovecin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cefoxitin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ceftazidime	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ceftiofur	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cephalexin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cephalothin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cephazolin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Chloramphenicol	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ciprofloxacin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Clarithromycin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Clindamycin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Doxycycline	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Enrofloxacin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Erythromycin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Fusic acid	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Gentamicin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Imipenim	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Marbofloxacin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Neomycin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Nitrofurantoin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Oxacillin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Penicillin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Piperacillin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Polymyxin B	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Rifampicin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Tetracycline	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ticarcillin-clavulanate	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Trimethoprim sulphonamide	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Vancomycin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

ANTIMICROBIAL SENSITIVITY TESTING IN GRAM NEGATIVE FELINE ISOLATES

What are the 3 most common gram negative organisms you culture in cats? _____

From your list of 3 organisms above, please indicate your usual selection of antimicrobials that are tested for sensitivity to those pathogens.

	Gram negative organism 1	Gram negative organism 2	Gram negative organism 3
Amoxicillin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Amoxicillin-clavulanic acid	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ampicillin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Amikacin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cefovecin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cefoxitin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ceftazidime	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ceftiofur	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cephalexin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cephalothin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cephazolin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Chloramphenicol	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ciprofloxacin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Clarithromycin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Clindamycin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Doxycycline	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Enrofloxacin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Erythromycin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Fusic acid	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Gentamicin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Imipenim	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Marbofloxacin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Neomycin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Nitrofurantoin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Oxacillin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Penicillin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Piperacillin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Polymyxin B	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Rifampicin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Tetracycline	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ticarcillin-clavulanate	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Trimethoprim sulphonamide	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Vancomycin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

ANTIMICROBIAL SENSITIVITY TESTING IN GRAM POSITIVE EQUINE ISOLATES

Which are the 3 most common gram positive organisms you culture in horses? _____

For the 3 organisms listed above, please indicate which antimicrobials are tested for sensitivity.

	Gram positive organism 1	Gram positive organism 2	Gram positive organism 3
Amoxicillin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Amoxicillin-clavulanic acid	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ampicillin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Amikacin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cefoxitin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ceftazidime	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ceftiofur	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cephalexin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cephalothin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cephazolin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Chloramphenicol	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ciprofloxacin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Clarithromycin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Clindamycin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Doxycycline	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Enrofloxacin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Erythromycin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Fusic acid	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Gentamicin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Imipenim	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Marbofloxacin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Neomycin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Nitrofurantoin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Oxacillin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Penicillin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Piperacillin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Polymyxin B	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Rifampicin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Tetracycline	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ticarcillin-clavulanate	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Trimethoprim sulphonamide	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Vancomycin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

ANTIMICROBIAL SENSITIVITY TESTING IN GRAM NEGATIVE EQUINE ISOLATES

What are the 3 most common gram negative organisms you culture in horses? _____

From your list of 3 organisms above, please indicate your usual selection of antimicrobials that are tested for sensitivity to those pathogens.

	Gram negative organism 1	Gram negative organism 2	Gram negative organism 3
Amoxicillin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Amoxicillin-clavulanic acid	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ampicillin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Amikacin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cefoxitin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ceftazidime	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ceftiofur	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cephalexin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cephalothin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cephazolin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Chloramphenicol	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ciprofloxacin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Clarithromycin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Clindamycin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Doxycycline	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Enrofloxacin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Erythromycin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Fusic acid	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Gentamicin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Imipenim	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Marbofloxacin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Neomycin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Nitrofurantoin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Oxacillin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Penicillin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Piperacillin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Polymyxin B	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Rifampicin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Tetracycline	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ticarcillin-clavulanate	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Trimethoprim sulphonamide	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Vancomycin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

ANTIMICROBIAL SENSITIVITY TESTING IN GRAM POSITIVE BOVINE ISOLATES

Which are the 3 most common gram positive organisms you culture in cattle?

For the 3 organisms listed above, please indicate which antimicrobials are tested for sensitivity.

	Gram positive organism 1	Gram positive organism 2	Gram positive organism 3
Amoxicillin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Amoxicillin-clavulanic acid	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ampicillin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Amikacin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cefoxitin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ceftazidime	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ceftiofur	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cephalexin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cephalothin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cephazolin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Chloramphenicol	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ciprofloxacin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Clarithromycin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Clindamycin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Doxycycline	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Enrofloxacin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Erythromycin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Fusic acid	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Gentamicin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Imipenim	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Marbofloxacin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Neomycin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Nitrofurantoin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Oxacillin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Penicillin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Piperacillin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Polymyxin B	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Rifampicin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Tetracycline	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ticarcillin-clavulanate	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Trimethoprim sulphonamide	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Vancomycin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

ANTIMICROBIAL SENSITIVITY TESTING IN GRAM NEGATIVE BOVINE ISOLATES

What are the 3 most common gram negative organisms you culture in cattle? _____

From your list of 3 organisms above, please indicate your usual selection of antimicrobials that are tested for sensitivity to those pathogens.

	Gram negative organism 1	Gram negative organism 2	Gram negative organism 3
Amoxicillin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Amoxicillin-clavulanic acid	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ampicillin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Amikacin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cefoxitin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ceftazidime	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ceftiofur	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cephalexin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cephalothin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cephazolin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Chloramphenicol	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ciprofloxacin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Clarithromycin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Clindamycin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Doxycycline	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Enrofloxacin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Erythromycin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Fusic acid	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Gentamicin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Imipenim	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Marbofloxacin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Neomycin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Nitrofurantoin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Oxacillin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Penicillin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Piperacillin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Polymyxin B	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Rifampicin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Tetracycline	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ticarcillin-clavulanate	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Trimethoprim sulphonamide	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Vancomycin

ANTIMICROBIAL SENSITIVITY TESTING IN GRAM POSITIVE PORCINE ISOLATES

Which are the 3 most common gram positive organisms you culture in pigs? _____

For the 3 organisms listed above, please indicate which antimicrobials are tested for sensitivity.

	Gram positive organism 1	Gram positive organism 2	Gram positive organism 3
Amoxicillin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Amoxicillin-clavulanic acid	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ampicillin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Amikacin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cefoxitin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ceftazidime	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ceftiofur	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cephalexin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cephalothin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cephazolin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Chloramphenicol	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ciprofloxacin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Clarithromycin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Clindamycin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Doxycycline	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Enrofloxacin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Erythromycin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Fusic acid	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Gentamicin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Imipenim	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Marbofloxacin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Neomycin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Nitrofurantoin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Oxacillin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Penicillin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Piperacillin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Polymyxin B	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Rifampicin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Tetracycline	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ticarcillin-clavulanate	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Trimethoprim sulphonamide	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Vancomycin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

ANTIMICROBIAL SENSITIVITY TESTING IN GRAM NEGATIVE PORCINE ISOLATES

What are the 3 most common gram negative organisms you culture in pigs? _____

From your list of 3 organisms above, please indicate your usual selection of antimicrobials that are tested for sensitivity to those pathogens.

	Gram negative organism 1	Gram negative organism 2	Gram negative organism 3
Amoxicillin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Amoxicillin-clavulanic acid	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ampicillin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Amikacin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cefoxitin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ceftazidime	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ceftiofur	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cephalexin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cephalothin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cephazolin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Chloramphenicol	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ciprofloxacin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Clarithromycin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Clindamycin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Doxycycline	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Enrofloxacin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Erythromycin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Fusic acid	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Gentamicin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Imipenim	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Marbofloxacin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Neomycin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Nitrofurantoin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Oxacillin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Penicillin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Piperacillin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Polymyxin B	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Rifampicin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Tetracycline	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ticarcillin-clavulanate	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Trimethoprim sulphonamide	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Vancomycin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

FINAL QUESTIONS

Do you systematically look for MRSA in Staphylococcus aureus isolates?

- Yes
 No

Using which method?

Do you systematically look for ESBL resistance in Gram negative isolates?

- Yes
 No

Using which method?

Do you systematically look for VRE among Enterococcus spp isolates?

- Yes
 No

Using which method?

For dogs and cats do you do any susceptibility testing on isolates that is NOT reported to the veterinarian submitting the sample?

- Yes
 No

Why do you perform these and not report them?

For horses do you do any susceptibility testing on isolates that is NOT reported to the veterinarian submitting the sample?

- Yes
 No

Why do you perform these and not report them?

For cattle do you do any susceptibility testing on isolates that is NOT reported to the veterinarian submitting the sample?

- Yes
 No

Why do you perform these and not report them?

For pigs do you do any susceptibility testing on isolates that is NOT reported to the veterinarian submitting the sample?

- Yes
 No

Why do you perform these and not report them?

How do you report susceptibility testing to veterinarians?

- Clinical interpretation (S, I, R)
 Zone diameters or MICs

Do you make any comment about drug efficacy if the clinical interpretation is "intermediate"?

- Yes
 No

Antimicrobial susceptibility testing by Australian veterinary diagnostic laboratories

LY Hardefeldt, M Marena, H Crabb, MA Stevenson, JR Gilkerson, H Billman-Jacobe and GF Browning

Supplementary File 2. Antimicrobials commonly used included in susceptibility testing for different pathogens

Species	Isolate	Antimicrobials included in susceptibility testing by >90% of laboratories
Canine	<i>Staphylococcus</i> spp.	Amoxycillin-clavulanate
		Clindamycin
	<i>Streptococcus</i> spp.	Fluoroquinolones
		Tetracycline
	<i>Enterococcus</i> spp.	Trimethoprim-sulphonamide
		Tetracyclines
	<i>E. coli</i>	Ampicillin or amoxycillin
		Amoxycillin-clavulanate
		Fluoroquinolones
		Gentamicin
<i>Pseudomonas</i> spp.	Tetracyclines	
	Trimethoprim-sulphonamide	
	3 rd generation cephalosporins	
	Fluoroquinolones	
<i>Proteus</i> spp.	Gentamicin	
	Ampicillin or amoxycillin	
	Amoxycillin-clavulanate	
	Fluoroquinolones	
	Gentamicin	
Feline	<i>Staphylococcus</i> spp.	Trimethoprim-sulphonamide
		Amoxycillin-clavulanate
		Clindamycin
		Fluoroquinolones
		Tetracycline
	<i>Streptococcus</i> spp.	Fluoroquinolones
		Tetracyclines
		Trimethoprim-sulphonamide
	<i>Enterococcus</i> spp.	Ampicillin or amoxycillin
		Amoxycillin-clavulanate
		Fluoroquinolones
		Tetracyclines
	<i>E. coli</i>	Ampicillin or amoxycillin
		Amoxycillin-clavulanate
		Fluoroquinolones
Gentamicin		
Tetracyclines		
Trimethoprim-sulphonamide		
<i>Pseudomonas</i> spp.	Fluoroquinolones	
	3 rd generation cephalosporins	
<i>Proteus</i> spp.	Ampicillin or amoxycillin	

		Amoxicillin-clavulanate Fluoroquinolones Gentamicin Tetracyclines Trimethoprim-sulphonamide
Equine	<i>Streptococcus</i> spp.	3 rd generation cephalosporins Penicillin Tetracycline Trimethoprim-sulphonamide
	<i>Staphylococcus</i> spp.	3 rd generation cephalosporins Gentamicin Penicillin Tetracycline Trimethoprim-sulphonamide
	<i>E. coli</i>	3 rd generation cephalosporins Enrofloxacin Gentamicin Tetracycline Trimethoprim-sulphonamide
	<i>Pseudomonas</i> spp.	Enrofloxacin Gentamicin Trimethoprim-sulphonamide
Bovine	<i>Staphylococcus</i> spp.	Penicillin Tetracycline Trimethoprim-sulphonamide
	<i>Streptococcus</i> spp.	Penicillin Tetracycline
	<i>Pasteurella</i> spp.	3 rd generation cephalosporins Amoxicillin or ampicillin Neomycin Tetracycline Trimethoprim sulphonamide
	<i>E. coli</i>	Amoxicillin or ampicillin Neomycin Tetracycline Trimethoprim-sulphonamide
	<i>Salmonella</i> spp.	Amoxicillin or ampicillin Neomycin Tetracycline Trimethoprim-sulphonamide
Porcine	<i>Streptococcus</i> spp.	Penicillin Tetracycline
	<i>Staphylococcus</i> spp.	Penicillin Tetracycline Trimethoprim-sulphonamide
	<i>Trueperella pyogenes</i>	Penicillin Tetracycline Trimethoprim-sulphonamide
	<i>E. coli</i>	Amoxicillin or ampicillin Tetracycline Trimethoprim-sulphonamide

