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Canadian Integrated Program for Antimicrobial Resistance Surveillance (CIPARS)

2007

FARM SURVEILLANCE PRELIMINARY RESULTS

... working towards the preservation of effective antimicrobials for humans and animals…

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Preamble

We are posting the preliminary findings for the calendar year 2007 for the CIPARS *Farm Surveillance* component. This is the first posting of antimicrobial use results from this component of CIPARS and is in addition to the previously posted 2007 Preliminary Results for: *Surveillance of Human Clinical Isolates, Abattoir Surveillance, Retail Meat Surveillance, Surveillance of Animal Clinical Isolates.* Additional results based on human and agri-food antimicrobial resistance and antimicrobial use data will be presented in the full 2007 CIPARS Annual Report.

CIPARS Farm Surveillance

The primary objectives of the *Farm Surveillance* component are: to establish an infrastructure to support a national surveillance program; to provide farm data regarding antimicrobial use and resistance among enteric bacteria; to investigate potential associations between antimicrobial use and resistance in the agri-food sector and finally, to provide quality data for future human health risk assessments. The swine industry was selected as the pilot commodity for surveillance infrastructure development because there is extensive implementation of the Canadian Quality Assurance (CQA®) program by the industry, there was the absence of a recent foreign animal disease outbreak and there was a similar initiative in swine in the United States (Collaboration in Animal Health and Food Safety Epidemiology). The Farm Surveillance component focuses on grower-finisher pigs in the five major pork producing provinces in Canada (Alberta, Saskatchewan, Manitoba, Ontario, and Québec). In each of the 5 participating provinces, the number of CIPARS sentinel sites is proportional to the national total of grower-finisher units. The Ministries of Agriculture in Alberta and Saskatchewan provided laboratory and financial support for additional sentinel sites in those provinces. The objective of this design was to provide nationally representative data for pigs immediately prior to entering the food processing chain.

Twenty-nine swine veterinarians from private and corporate practice have enrolled 108 client producers that are CQA® validated, produce more than 2000 market pigs per year, and are representative of the demographic and geographic distribution of herds in the veterinarian's swine practice. Criteria for exclusion were; herds that were regarded to be organic pertaining to animal husbandry, herds that were feeding edible residual material or herds that were pasture raised. The inclusion/exclusion criteria help ensure that the herds enrolled are representative of the majority of swine production in Canada.

Pooled fecal samples are collected from pens of close to market weight (>175 lbs) finisher pigs three times annually in each participating herd. The bacteria of interest are generic *E. coli, Enterococcus* and *Salmonella.*

Questionnaires are administered by herd veterinarians to collect ongoing antimicrobial use data for feed, water and injectables as well as demographic, management and production information.

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Antimicrobial Resistance

Salmonella

(n = 110)

Figure 1. Individual antimicrobial resistance in swine *Salmonella* isolates. *Farm Surveillance*, 2007.

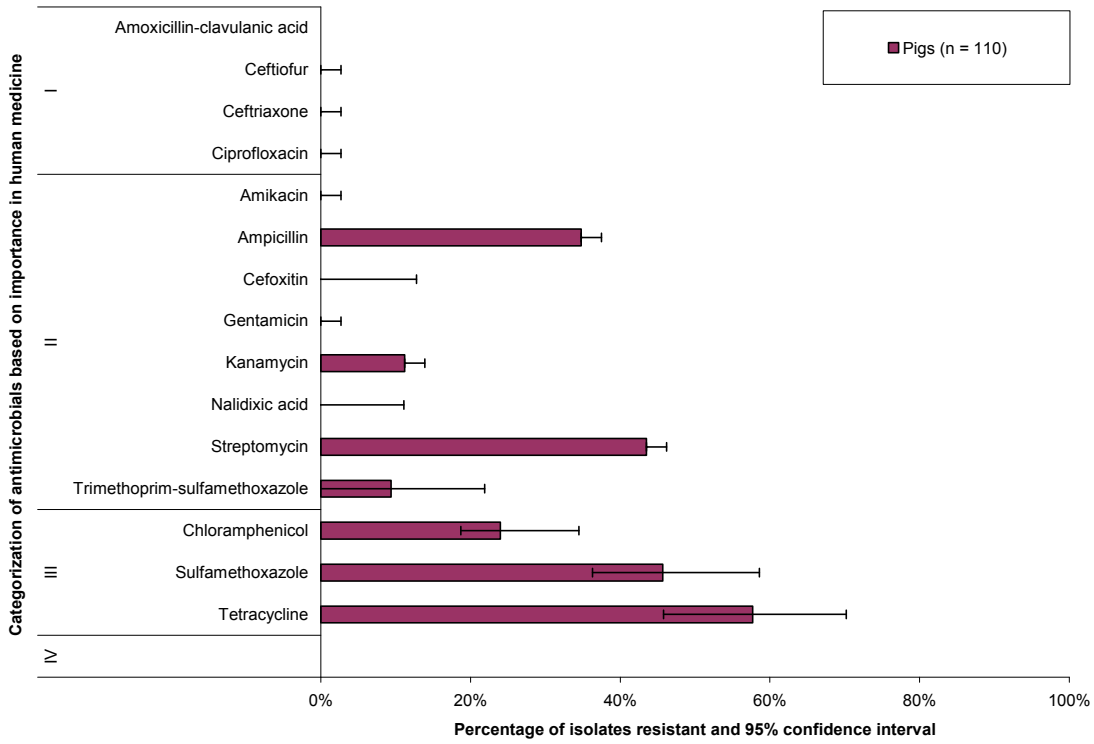


Table 1. Number of antimicrobials in resistance pattern of swine *Salmonella* isolates across serovars; *Farm Surveillance*, 2007.

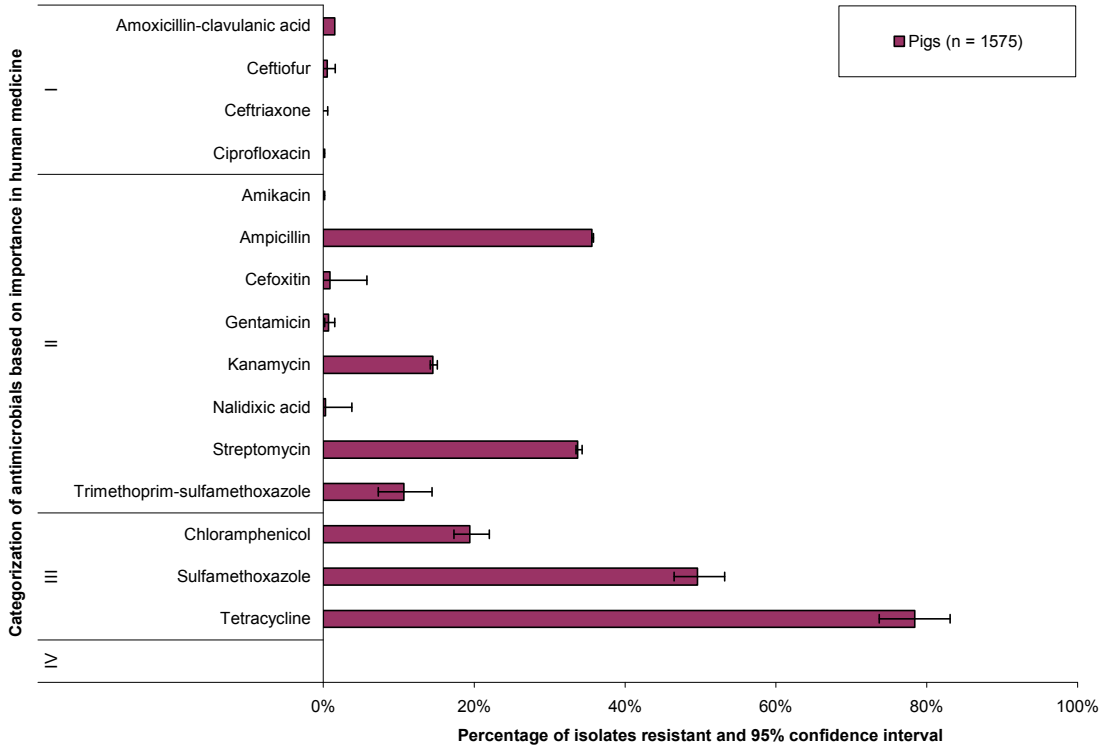
Serovar	n (% total)	Number of antimicrobials in resistance pattern			
		0	1 - 4	5 - 8	9 - 15
		Number of isolates			
Typhimurium var. 5-	22 (20.0)	4	8	10	0
Derby	21 (19.1)	7	13	1	0
Infantis	11 (10.0)	10	1	0	0
Typhimurium	10 (9.1)	1	3	6	0
I 4:i:-	7 (6.4)	0	3	4	0
California	4 (3.6)	2	2	0	0
Heidelberg	4 (3.6)	3	1	0	0
Brandenburg	3 (2.7)	0	2	1	0
Mbandaka	3 (2.7)	1	2	0	0
Orion	3 (2.7)	3	0	0	0
Less common serovars	22 (20.0)	18	1	3	0
Total	**110 (100)**	**49**	**36**	**25**	**0**

Serovars with less than 2% were classified as “Less common serovars".

Escherichia coli

(n = 1,575)

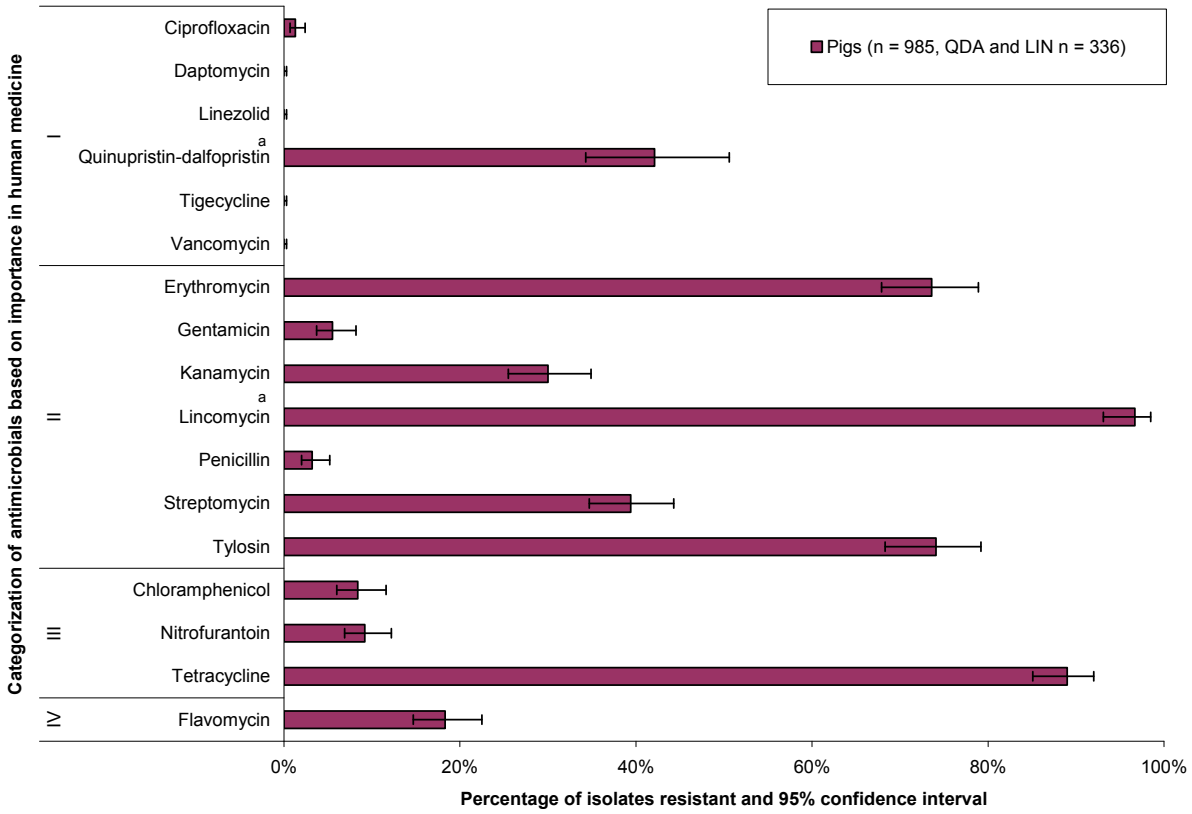
Figure 2. Individual antimicrobial resistance in swine *E. coli* isolates; *Farm Surveillance*, 2007.



Enterococcus

(n = 985)

Figure 3. Individual antimicrobial resistance in swine *Enterococcus* isolates; *Farm Surveillance*, 2007.



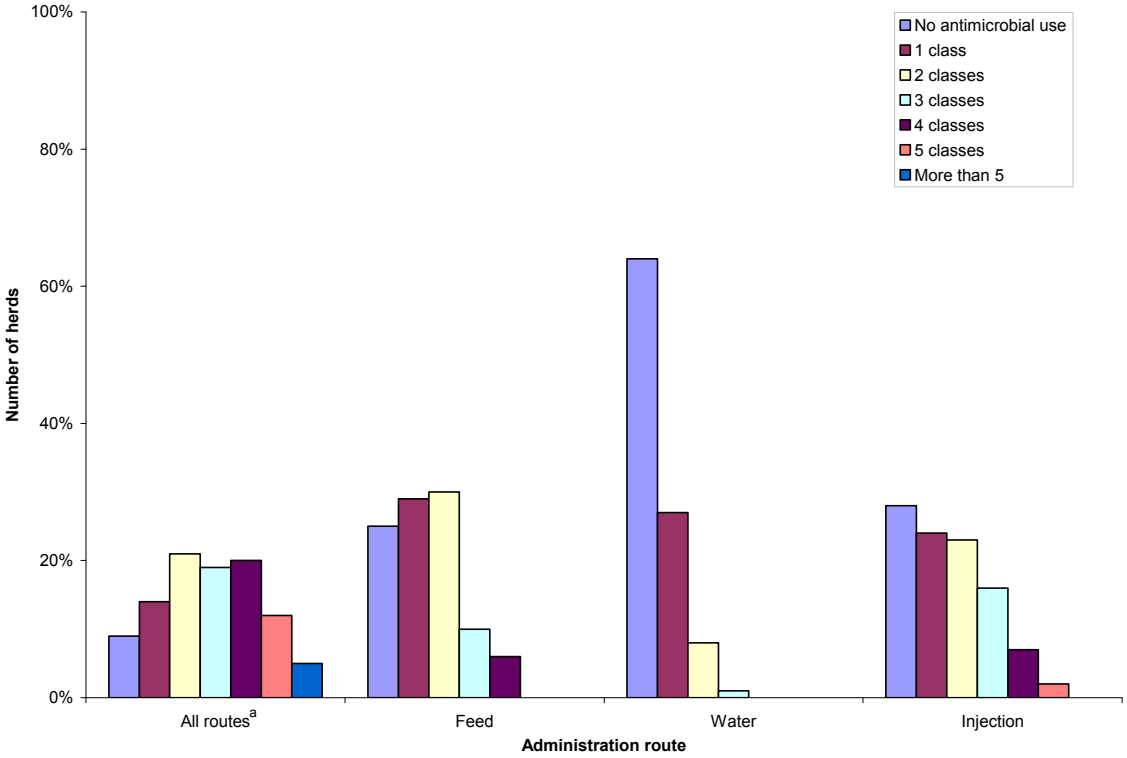
[a] Resistance to quinupristin-dalfopristin and lincomycin is not reported for *E. faecalis* because *E. faecalis* is intrinsically resistant to these antimicrobials.

Table 2. Number of antimicrobials in resistance pattern of swine *Enterococcus* isolates across species; *Farm Surveillance*, 2007.

Serovar	n (total)	Number of antimicrobials in resistance pattern			
		0	1 - 4	5 - 8	9 - 15
		Number of isolates			
E. faecalis	649 (65.9)	34	420	195	0
E. faecium	44 (4.5)	0	30	14	0
Enterococcus spp.	292 (29.6)	0	114	168	10
Total	**985 (100)**	**34**	**564**	**377**	**10**

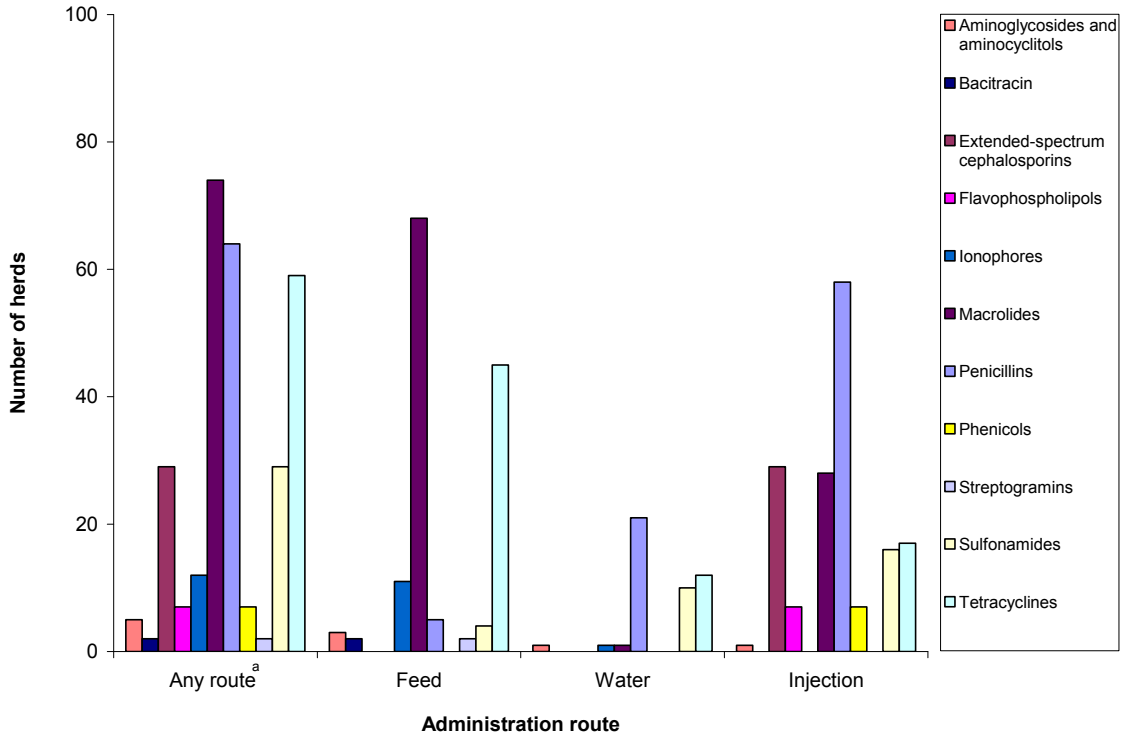
Antimicrobial Use

Figure 4. Number of sentinel swine herds with reported use of no antimicrobials, a single antimicrobial class, or multiple antimicrobial classes, by administration route (n = 100); *Farm Surveillance,* 2007.



[a] All routes: The sum of antimicrobial classes reportedly used in each herd, counting each class no more than once regardless of number of administration routes reported.

Figure 5. Number of sentinel swine herds with reported use of specific antimicrobial classes, by administration route (n = 100); *Farm Surveillance*, 2007.



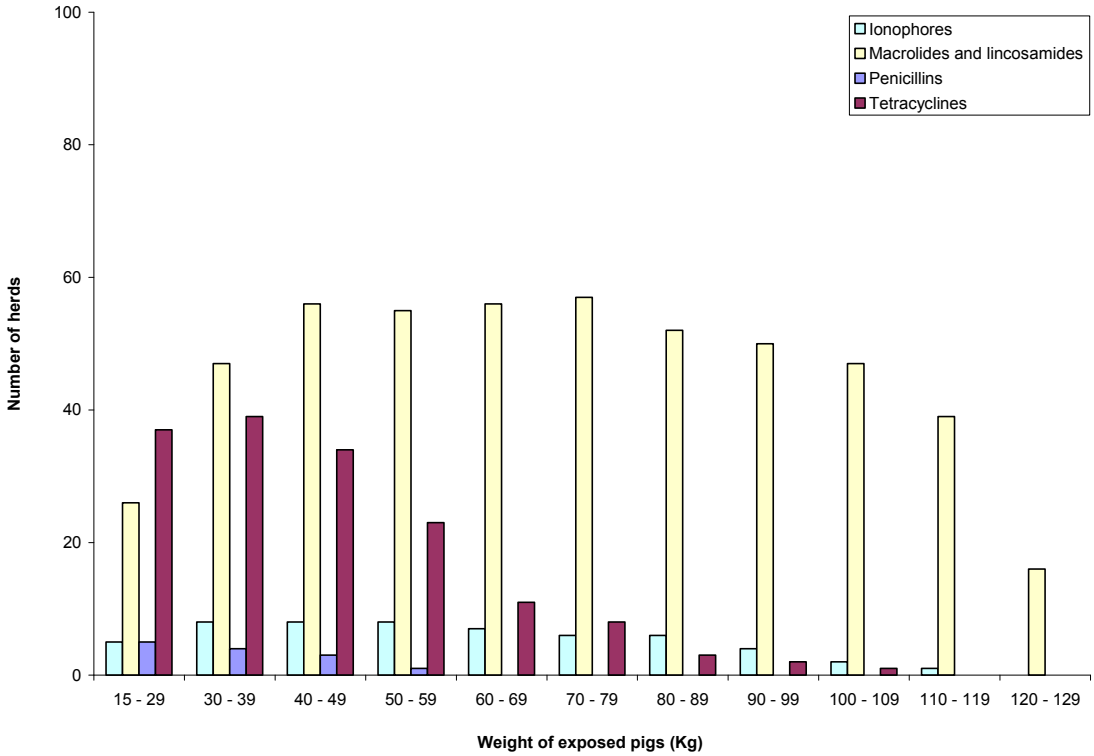
[a] Any route: Herds with reported use of an antimicrobial class by feed, water, injection, or any combination of these routes were counted as exposed.

Table 3. Number of sentinel swine herds with reported use of specific active antimicrobial ingredients, by administration route (n = 100); *Farm Surveillance*, 2007.

	Antimicrobial Class	Active ingredient	Administration route			
			Any route	Feed	Water	Injection
I	Extended spectrum cephalosporin	Ceftiofur	29			29
	Streptogramin	Virginiamycin	2	2		
II	Aminoglycoside	Neomycin	2	1	1	
	Macrolide and lincosamide	Erythromycin	1			1
		Lincomycin	42	34	1	13
		Tiamulins	9	7		2
		Tulathromycins	12			12
		Tylosins	52	46		10
	Penicillins	Amoxicillins	3		3	
		Ampicillins	9			9
		Penicillins G	63	5	14	58
		Phenoxymethyl penicillins	6		6	
	Sulfonamides	Trimethoprim-sulfadoxines	22		5	16
III	Aminoglycosides	Spectinomycins	3	2		1
	Bacitracin	Bacitracin	2	2		
	Phenicols	Florfenicols	7			7
	Sulphonamides	Sulfonamides (unspecified)	9	4	5	
	Tetracyclines	Chlortetracyclines	45	43	4	
		Oxytetracyclines	18	2		17
		Tetracyclines hydrochlorides	8		9	
IV	Flavophospholipols	Bambermycin	3	3		
	Ionophores	Salinomycin	12	11	1	

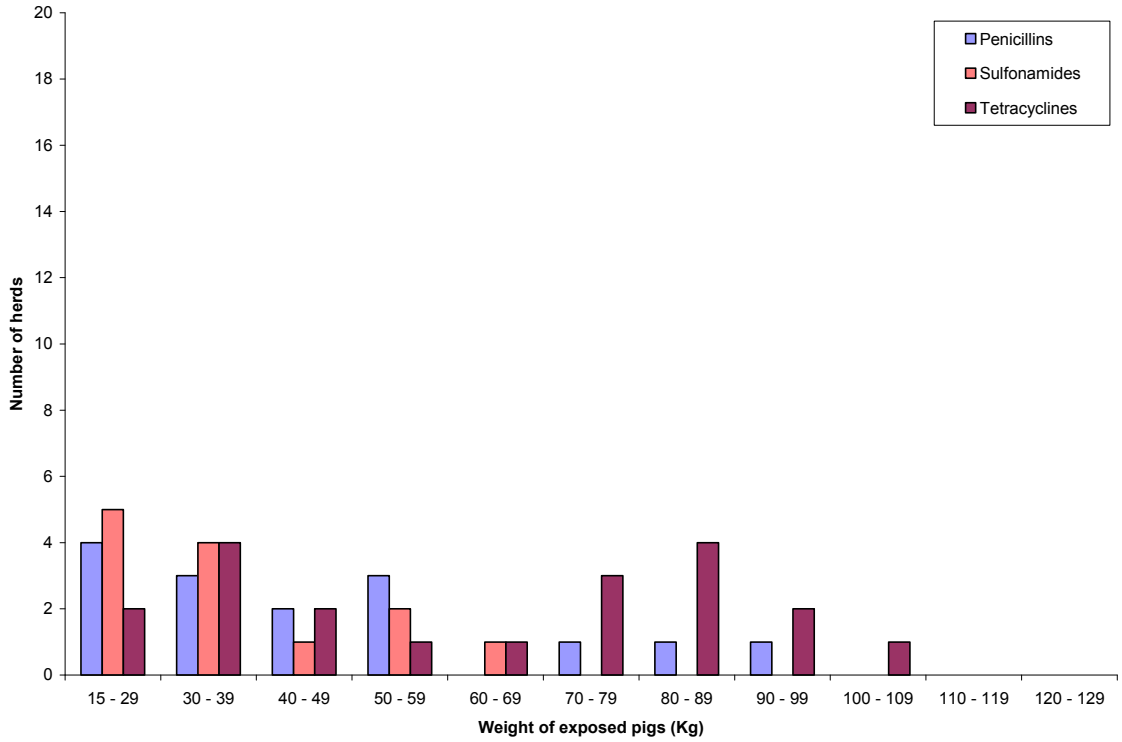
Roman numerals I to IV indicate the categories of antimicrobials based on importance in human medicine as outlined by the Veterinary Drugs Directorate. Any route: Herds with reported use of an antimicrobial class by feed, water, injection, or any combination of these routes were counted as exposed.

Figure 6. Number of sentinel swine herds with reported use of specific antimicrobial classes in feed, by weight category of pigs (n = 100); *Farm Surveillance*, 2007.



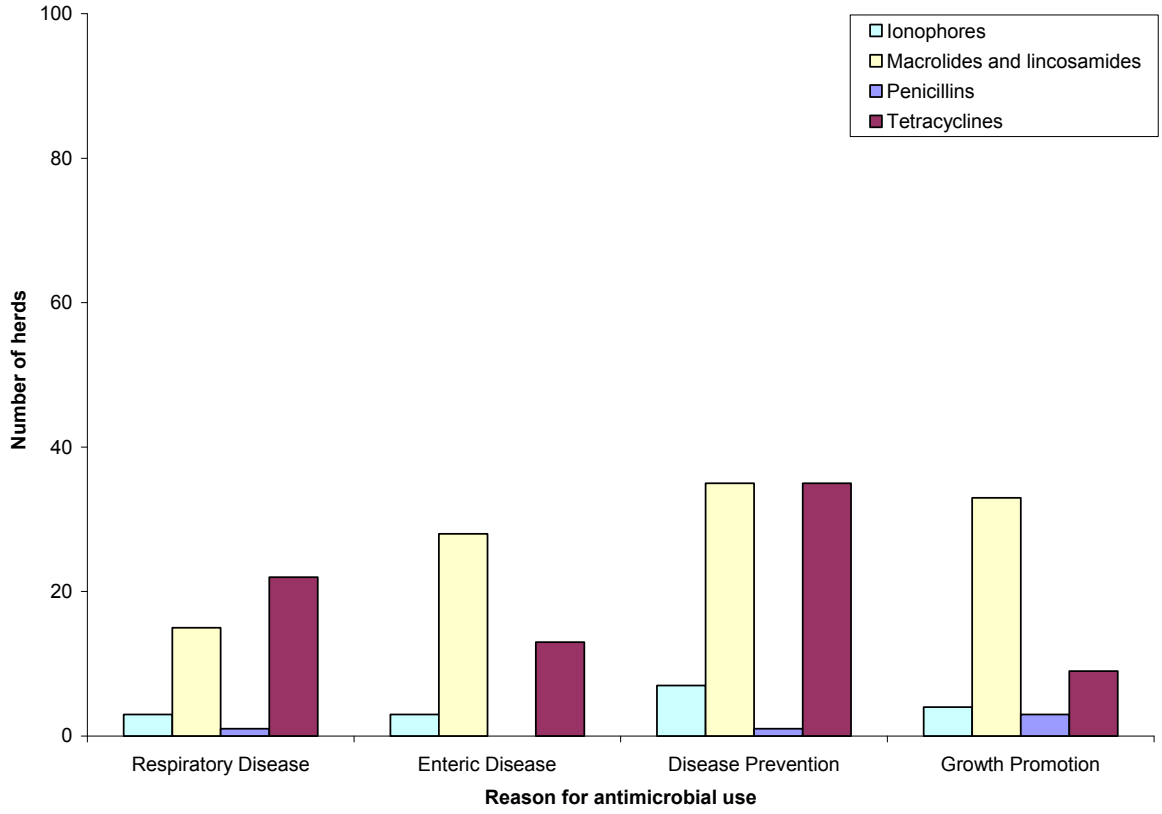
Data regarding antimicrobial classes used in feed in less than 5 herds are not presented.

Figure 7. Number of sentinel swine herds with reported use of specific antimicrobial classes in water, by weight category of pigs (n = 100); *Farm Surveillance,* 2007.



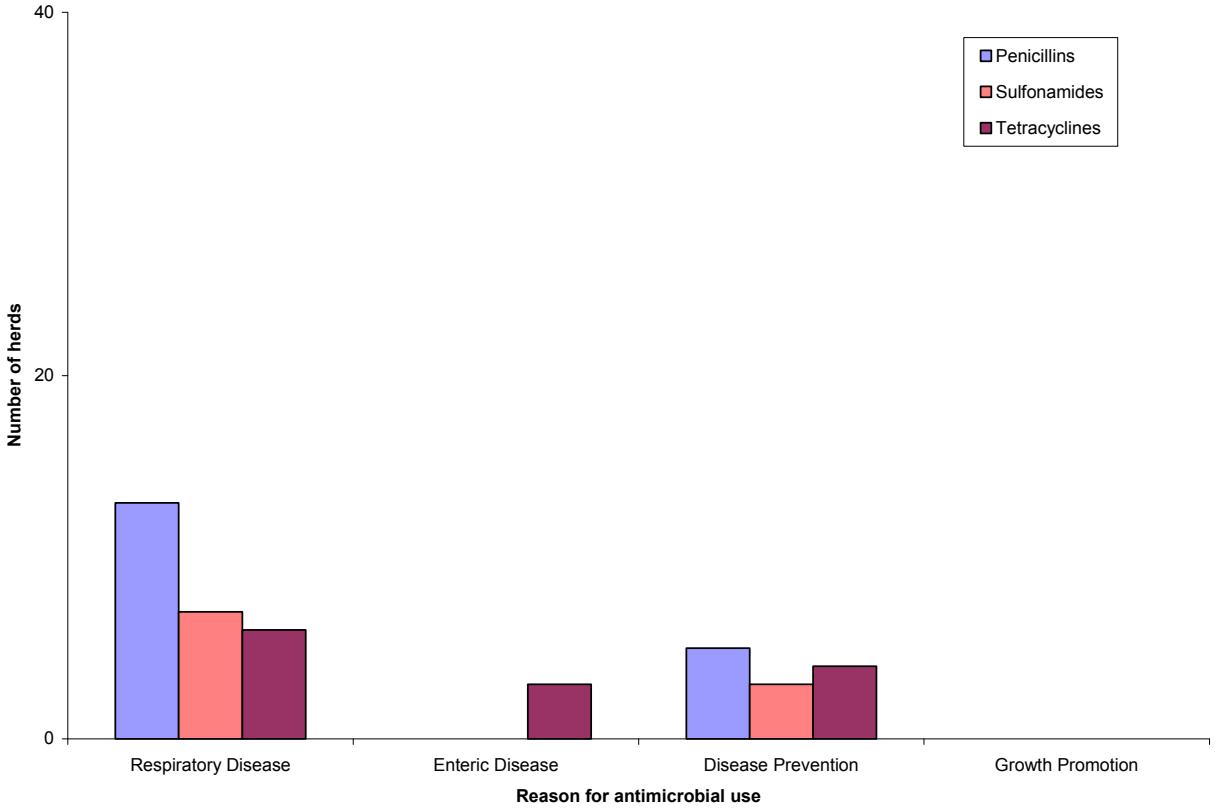
Data regarding antimicrobial classes used in water in less than 5 herds are not presented.

Figure 8. Number of sentinel swine herds with reported use of specific antimicrobial classes in feed, by reason for use (n = 100); *Farm Surveillance*, 2007.



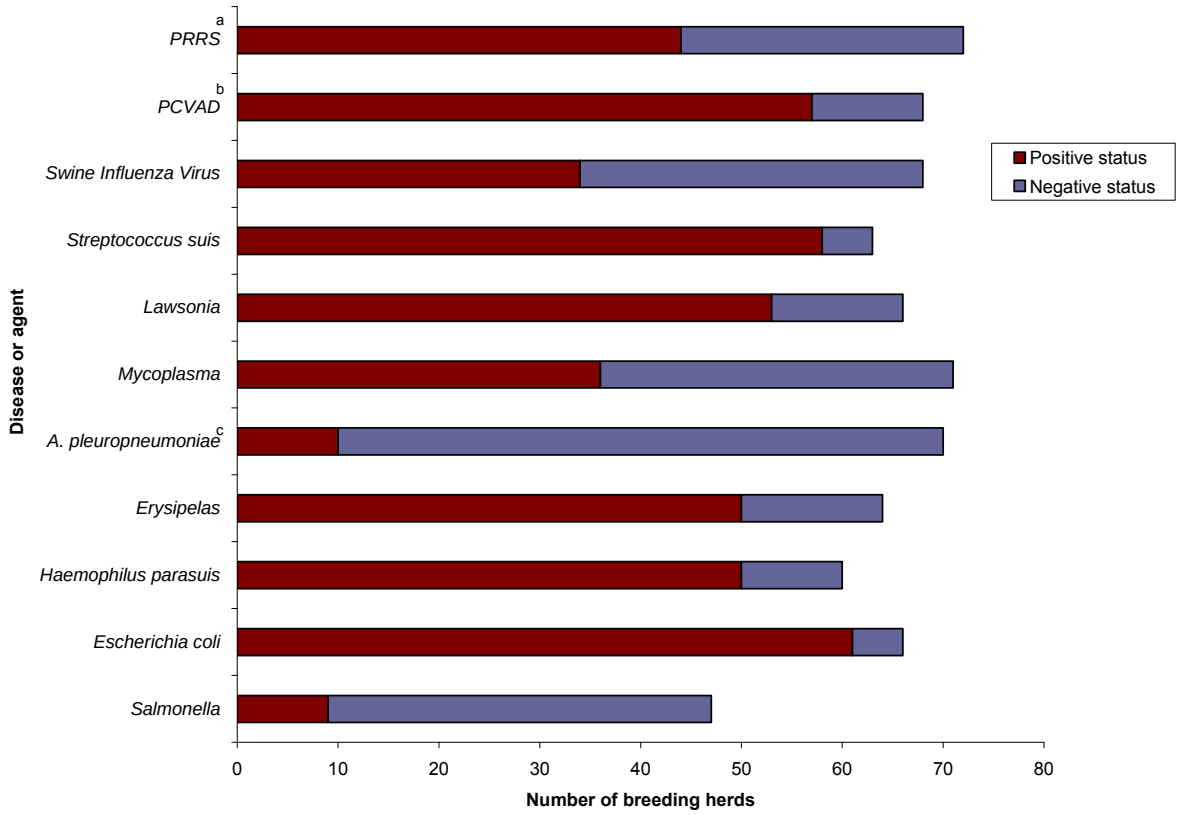
Data regarding antimicrobial classes used in feed in less than 5 herds are not presented.

Figure 9. Number of sentinel swine herds with reported use of specific antimicrobial classes in water, by reason for use (n = 100); *Farm Surveillance*, 2007.



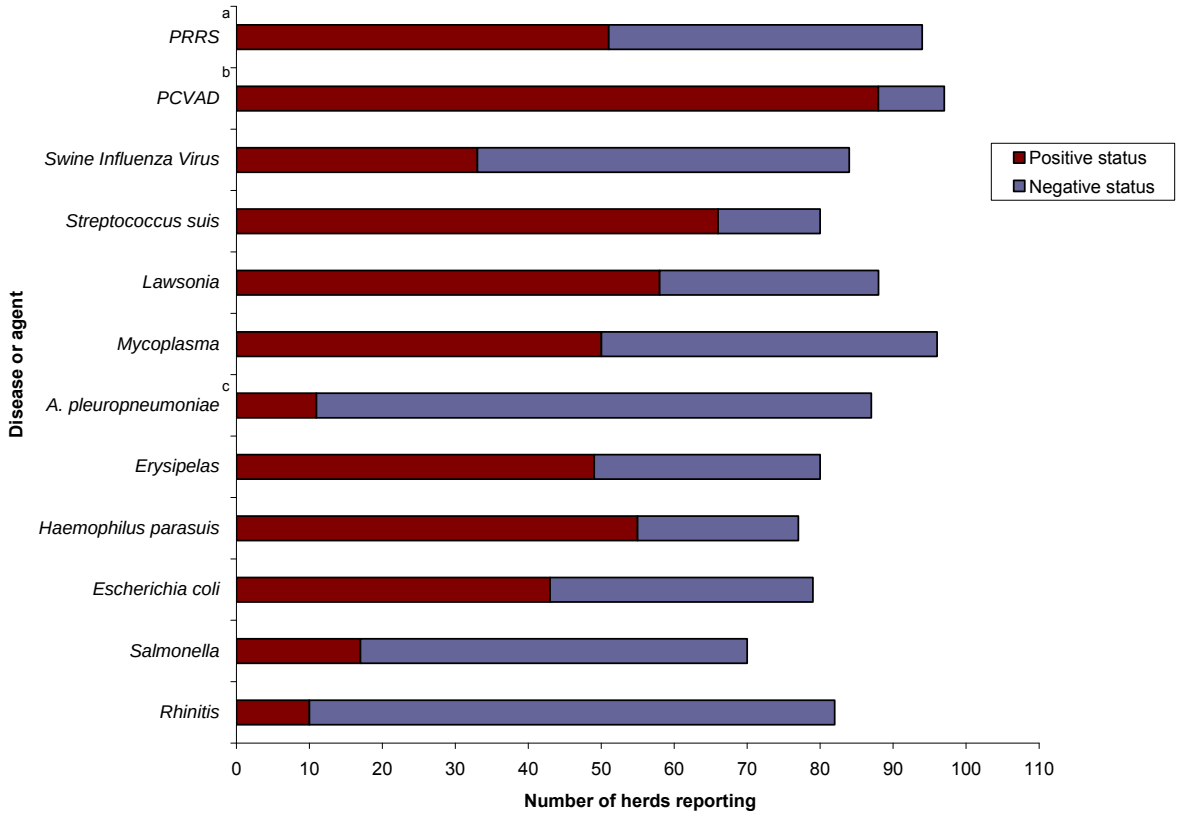
Data regarding antimicrobial classes used in water in less than 5 herds are not presented.

Figure 10. Number of breeding swine herds for which disease status (positive or negative) was reported, by disease; *Farm Surveillance*, 2007.



[a] PRRS: Porcine reproductive and respiratory syndrome
[b] PCVAD: Porcine circovirus-associated disease
[c] *Actinobacillus pleuropneumoniae*

Figure 11. Number of grower-finisher swine herds for which disease status (positive or negative) was reported, by disease; *Farm Surveillance*, 2007.



[a] PRRS: Porcine reproductive and respiratory syndrome
[b] PCVAD: Porcine circovirus-associated disease
[c] *Actinobacillus pleuropneumoniae*

Appendix

Additional Tables

Table A. 1. Distribution of MICs and antimicrobial resistance in swine *Salmonella* isolates; *Farm Surveillance*, 2007.

	Antimicrobial	n	MIC Percentiles		% R	Distribution (%) of MICs														
			MIC 50	MIC 90		≤ 0.015	0,03	0,06	0,12	0,25	0,5	1	2	4	8	16	32	64	128	256	> 256
I	Amoxicillin-clavulanic acid	110	≤ 1	16	0.0							64.5	6.4	1.8	15.5	11.8					
	Ceftiofur	110	1	1	0.0						19.1	78.2	2.7								
	Ceftriaxone	110	≤ 0.25	≤ 0.25	0.0					100.0											
	Ciprofloxacin	110	≤ 0.015	0.03	0.0	80.0	19.1	0.9													
II	Amikacin	110	1	2	0.0						10.0	60.0	27.3	2.7							
	Ampicillin	110	≤ 1	> 32	30.9							59.1	9.1	0.9			**0.9**	**30.0**			
	Cefoxitin	110	2	4	0.0							10.9	40.0	44.5	3.6	0.9					
	Gentamicin	110	≤ 0.25	0.50	0.0					54.5	44.5	0.9									
	Kanamycin	110	≤ 8	> 64	12.7										87.3				**12.7**		
	Nalidixic acid	110	4	4	0.0							0.9	20.9	72.7	5.5						
	Streptomycin	110	≤ 32	> 64	37.3												62.7	**13.6**	**23.6**		
	Trimethoprim-sulphamethoxazole	110	≤ 0.12	1	8.2				59.1	24.5	5.5	2.7			**8.2**						
III	Chloramphenicol	110	8	> 32	21.8									15.5	60.0	2.7		**21.8**			
	Sulfisoxazole	110	64	> 256	38.2											11.8	35.5	13.6	0.9		**38.2**
	Tetracycline	110	32	> 32	50.9									49.1				**9.1**	**41.8**		
IV																					

Roman numerals I to IV indicate the categorization of antimicrobials based on importance in human medicine as outlined by the Veterinary Drugs Directorate. The unshaded fields indicate the range tested for each antimicrobial in the plate configuration. Numbers in bold red fonts indicate the percentage of isolates resistant. Numbers at the right of the largest dilution are those isolates with growth in all wells within the tested range, indicating the actual minimum inhibitory concentration (MIC) is greater than that range of dilutions. The numbers in the smallest dilution of the range tested indicate isolates susceptible to this level or to lower concentration of the antimicrobial. Solid bars represent the resistance breakpoints. Dotted bars represent the susceptibility breakpoints.

Table A. 2. Distribution of MICs and antimicrobial resistance of swine *E. coli* isolates; *Farm Surveillance*, 2007.

	Antimicrobial	n	MIC Percentiles		% R	Distribution (%) of MICs														
			MIC 50	MIC 90		≤ 0.015	0,03	0,06	0,12	0,25	0,5	1	2	4	8	16	32	64	128	256	> 256
I	Amoxicillin-clavulanic acid	1575	4	8	1.4							4.1	28.0	38.5	26.8	1.2	**1.3**	**0.1**			
	Ceftiofur	1575	0.25	0.50	0.4				5.1	57.2	36.2	0.7	0.2	0.2	**0.2**	**0.3**					
	Ceftriaxone	1575	≤ 0.25	≤ 0.25	0.0					98.7	0.4	0.3		0.1	0.3	0.2					
	Ciprofloxacin	1575	≤ 0.015	≤ 0.015	0.0	98.4	1.3	0.1		0.2											
II	Amikacin	1575	2	4	0.0						2.5	29.0	57.7	9.7	1.1						
	Ampicillin	1575	2	> 32	35.1							14.1	36.8	11.9	1.6	0.6	**0.6**	**34.5**			
	Cefoxitin	1575	4	8	0.8						0.4	1.3	30.6	57.5	8.4	1.0	**0.2**	**0.6**			
	Gentamicin	1575	0.50	1	0.7					20.8	64.8	12.4	0.6	0.2	0.6	**0.4**	**0.3**				
	Kanamycin	1575	≤ 8	> 64	14.7										84.3	0.9	0.1	**0.6**	**14.2**		
	Nalidixic acid	1575	2	2	0.3						0.8	15.1	76.4	7.2	0.1	0.1	**0.1**	**0.2**			
	Streptomycin	1575	≤ 32	> 64	33.8												66.2	**16.0**	**17.8**		
	Trimethoprim-sulphamethoxazole	1575	≤ 0.12	> 4	10.9				53.7	27.2	7.2	0.8	0.3	**0.1**	**10.7**						
III	Chloramphenicol	1575	8	32	19.0								2.9	37.0	36.0	5.0	**10.2**	**8.8**			
	Sulfisoxazole	1575	64	> 256	49.6											44.4	4.6	1.3	0.1	0.1	**49.6**
	Tetracycline	1575	> 32	> 32	78.5									21.2	0.3	**0.3**	**4.0**	**74.2**			
IV																					

To interpret MIC distributions see Table A.1. footnote.

Table A. 3. Distribution of MICs and antimicrobial resistance of swine *Enterococcus* isolates; *Farm Surveillance*, 2007.

	Antimicrobial	Species	n	MIC percentile		% R	Distribution (%) of MICs																		
				MIC 50	MIC 90		≤ 0.015	0.03	0.06	0.12	0.25	0.5	1	2	4	8	16	32	64	128	256	512	1024	2048	> 2048
I	Ciprofloxacin	*E. faecalis*	649	1	2	0.5					0.2	5.9	71.3	22.2	0.3	0.2									
	Ciprofloxacin	*E. faecium*	44	1	4	15.9						15.9	43.2	25.0	13.6	2.3									
	Ciprofloxacin	*Enterococcus* spp.	292	0.5	2	1.0					9.9	46.9	32.2	9.9	0.3	0.7									
	Daptomycin	*E. faecalis*	649	1	1	0.0						19.4	72.3	7.7	0.3	0.3									
	Daptomycin	*E. faecium*	44	2	8	0.0						11.4	18.2	22.7	36.4	11.4									
	Daptomycin	*Enterococcus* spp.	292	1	4	0.0						32.2	26.7	28.8	12.0	0.3									
	Linezolid	*E. faecalis*	649	2	2	0.0						3.1	30.2	66.6	0.2										
	Linezolid	*E. faecium*	44	2	2	0.0						2.3	13.6	84.1											
	Linezolid	*Enterococcus* spp.	292	1	2	0.0						13.0	42.1	44.9											
	Quinupristin-dalfopristin[a]	*E. faecium*	44	2	8	27.3							20.5	52.3	15.9	9.1	2.3								
	Quinupristin-dalfopristin	*Enterococcus* spp.	292	2	8	47.3							20.9	31.8	27.4	18.2	1.7								
	Tigecycline	*E. faecalis*	300	0.25	0.25	0.0	53.8		1.2	20.8	22.3	1.8													
	Tigecycline	*E. faecium*	34	0.12	0.25	0.0	22.7		18.2	36.4	22.7														
	Tigecycline	*Enterococcus* spp.	143	0.12	0.25	0.0	51.0		8.6	24.0	15.8	0.7													
	Vancomycin	*E. faecalis*	649	1	2	0.0						5.5	74.7	19.4	0.3										
	Vancomycin	*E. faecium*	44	0.5	1	0.0						72.7	18.2	4.5	4.5										
	Vancomycin	*Enterococcus* spp.	292	0.5	2	0.0						57.9	26.0	7.9	4.1	4.1									
II	Erythromycin	*E. faecalis*	649	16	16	74.9						7.2	13.1	4.6	0.2	0.5	74.4								
	Erythromycin	*E. faecium*	44	2	16	38.6						20.5	22.7	18.2			38.6								
	Erythromycin	*Enterococcus* spp.	292	16	16	68.8						25.7	2.4	1.4	1.7	0.7	68.2								
	Gentamicin	*E. faecalis*	649	128	128	7.7													90.8	1.5	4.2	1.7	1.8		
	Gentamicin	*E. faecium*	44	128	128	0.0													100.0						
	Gentamicin	*Enterococcus* spp.	292	128	128	0.7													99.0	0.3	0.7				
	Kanamycin	*E. faecalis*	649	128	2048	32.4													66.4	0.6	0.6	0.3	32.0		
	Kanamycin	*E. faecium*	44	128	512	6.8													79.5	9.1	4.5		6.8		
	Kanamycin	*Enterococcus* spp.	292	128	2048	22.3													76.4	1.0	0.3	0.3	21.9		
	Lincomycin[a]	*E. faecium*	44	32	64	86.4							9.1	2.3	2.3		31.8	11.4	43.2						
	Lincomycin	*Enterococcus* spp.	292	64	64	97.3							1.7	0.7	0.3	1.0	11.0	7.2	78.1						
	Penicillin	*E. faecalis*	649	4	4	0.5						3.9	0.8	19.0	74.9	1.1	0.3	0.2							
	Penicillin	*E. faecium*	44	2	8	4.5						15.9	20.5	25.0	27.3	6.8	4.5								
	Penicillin	*Enterococcus* spp.	292	1	8	9.2						31.8	21.9	9.9	16.1	11.0	4.1	5.1							
	Streptomycin	*E. faecalis*	649	512	> 2048	44.5															55.5	1.7	15.6	27.3	
	Streptomycin	*E. faecium*	44	512	1024	11.4															88.6	2.3	4.5	4.5	
	Streptomycin	*Enterococcus* spp.	292	512	> 2048	30.1															69.9	7.9	8.6	13.7	
	Tylosin	*E. faecalis*	649	64	64	75.2					0.2	0.2	4.9	17.9	1.5	0.2		0.2	75.0						
	Tylosin	*E. faecium*	44	4	64	38.6							6.8	22.7	22.7	6.8	2.3		38.6						
	Tylosin	*Enterococcus* spp.	292	64	64	70.5					1.0	4.1	4.5	15.8	2.7	1.0	0.3	0.3	70.2						
III	Chloramphenicol	*E. faecalis*	649	8	32	10.2									7.1	78.1	4.6	2.6	7.6						
	Chloramphenicol	*E. faecium*	44	8	8	2.3									40.9	54.5	2.3		2.3						
	Chloramphenicol	*Enterococcus* spp.	292	8	8	5.1								1.7	41.4	50.0	1.7	3.1	2.1						
	Nitrofurantoin	*E. faecalis*	649	8	16	3.1								0.5	1.4	77.7	13.7	2.2	1.5	3.1					
	Nitrofurantoin	*E. faecium*	44	64	64	2.3									2.3	15.9	20.5	11.4	47.7	2.3					
	Nitrofurantoin	*Enterococcus* spp.	292	32	128	20.5								0.3	4.8	20.9	9.6	29.8	14.0	20.5					
	Tetracycline	*E. faecalis*	649	64	64	92.6									6.6	0.8	0.6	3.7	88.3						
	Tetracycline	*E. faecium*	44	4	64	38.6									61.4		4.5	2.3	31.8						
	Tetracycline	*Enterococcus* spp.	292	64	64	83.2									13.7	3.1	4.8	7.9	70.5						
IV	Flavomycin	*E. faecalis*	649	1	1	2.2							93.5	3.1	0.6	0.3	0.3	2.2							
	Flavomycin	*E. faecium*	44	32	32	72.7							13.6		4.5	6.8	2.3	72.7							
	Flavomycin	*Enterococcus* spp.	292	32	32	51.4							31.8	5.8	4.5	3.8	2.7	51.4							

To interpret MIC distributions see Table A.1. footnote.

[a] Resistance to quinupristin-dalfopristin and lincomycin is not reported for *E. faecalis* because *E. faecalis* is intrinsically resistant to these antimicrobials.