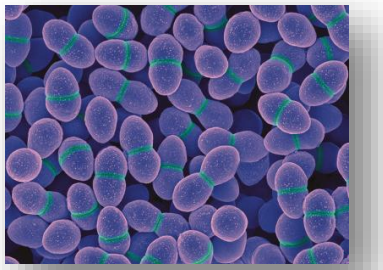
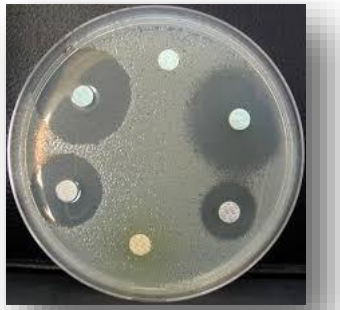
Antimicrobial susceptibility of equine clinical isolates from France (2006-2016)

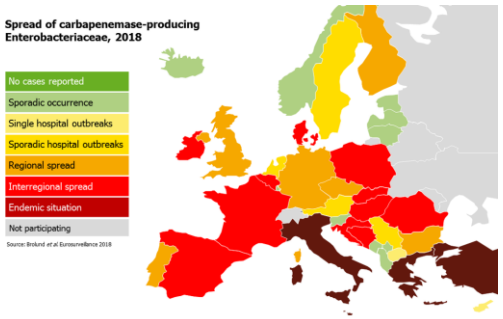




Pr Jean-Christophe GIARD

June 21th 2019

Overuse and misuse of antimicrobials
(Treatments, growth factors, prophilaxy…)



Emergence of MDR strains
Major public health problem
possible transmission Animals – Humans

ONE HEALTH
Global approach of interphase Humans-Animals-Environment

ONE HEALTH

Situation in the equine industry?

Normandy
115,000 horses
6,400 enterprises

Unité de Recherche Risques Microbiens
UR2RM

+

Analysis and Research
Food, Animals, Environment
Research field: **Equine infections**
(Dr Albertine Leon)

Hospital
Research field:
mechanisms of
antimicrobial resistances
(Pr J-C Giard)

Pipeline

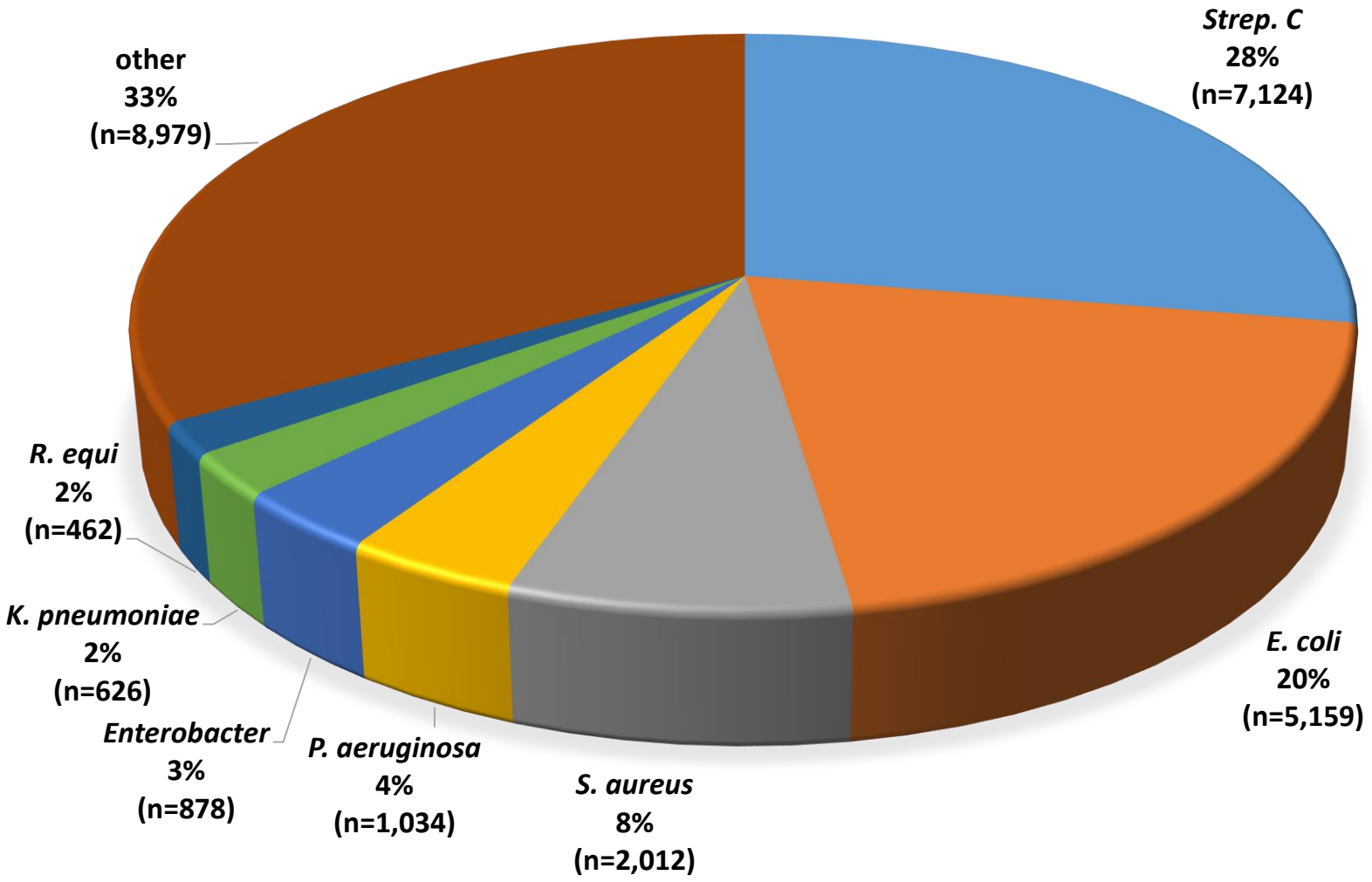
2006 – 2016
25,813 isolates* from all regions of France
From 1,895 (2016) to 3,058 (2012) per year

Identification
(API, VITEK, MALDI-TOF)

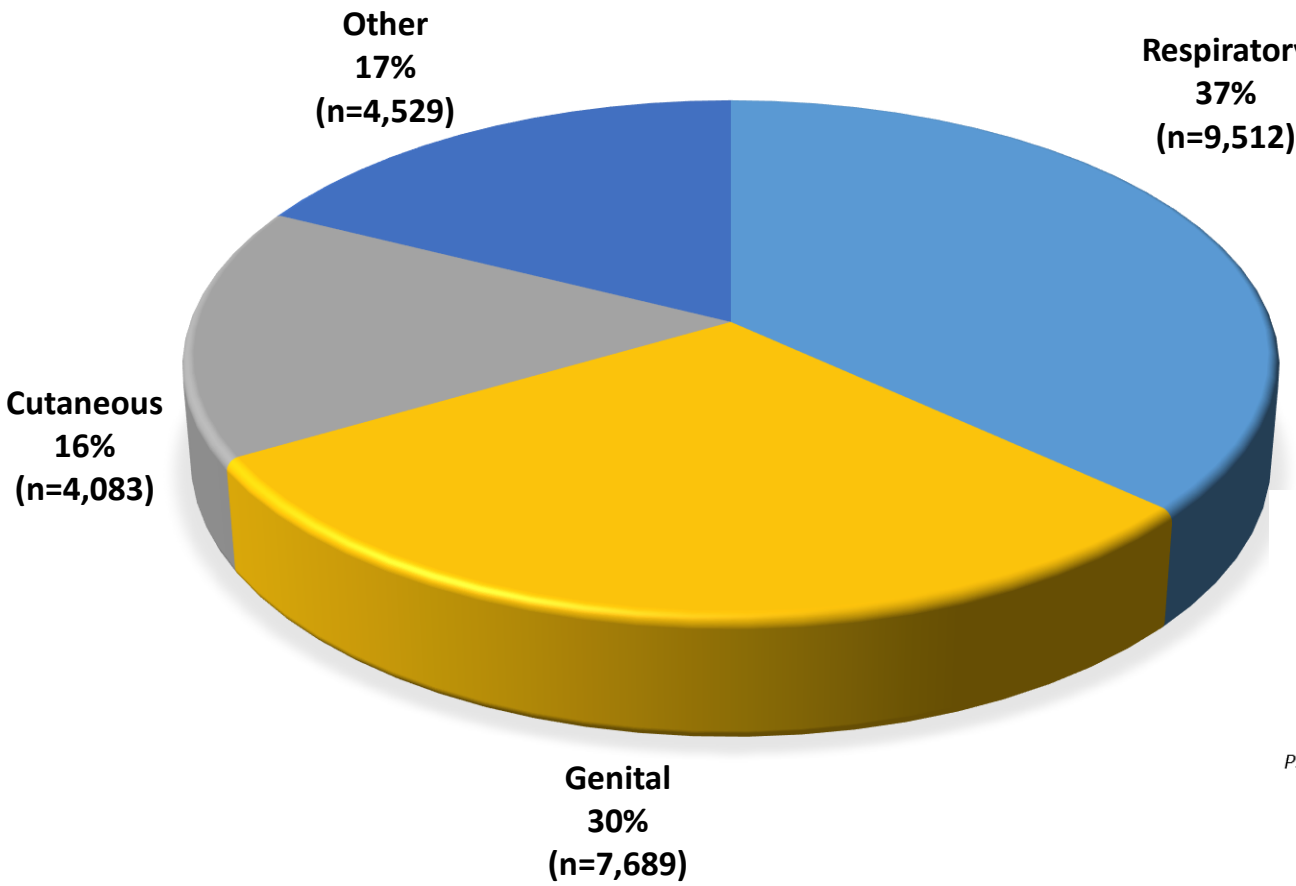
Antimicrobial susceptibility testing
(EUCAST recommendations)

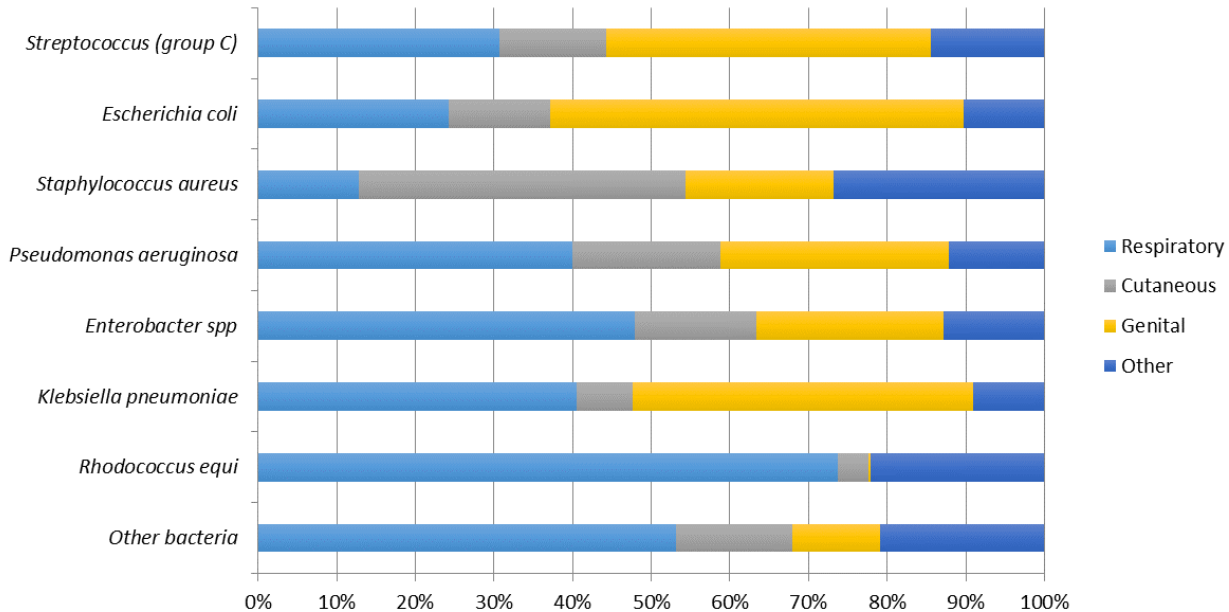
* Recovered from horses with suspected bacterial infection (with no prior antimicrobial treatment)

What pathogens were found?



From what origins?





Group C Streptococci

Antibiotic category		% of resistant *Streptococcus* (group C)										
	Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
	Number of strains (n)	383	464	554	627	671	703	811	680	768	771	692
Penicillins	PEN	0.0	0.4	0.2	0.0	0.0	0.1	0.1	0.0	0.1	0.0	0.1
	AMP/AMOX	0.0	0.2	0.2	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.7
	OXA	NT	NT	NT	NT	NT	NT	0.1	0.0	0.1	0.0	0.1
	AMC	0.0	0.2	0.2	0.0	0.0	0.1	0.2	0.0	0.0	0.0	0.7
Cephalosporins 3rd 4th	CEF	0.0	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4
	CEQ	0.0	0.0	0.2	0.0	0.0	0.0	0.2	0.1	0.0	0.0	0.1
Aminoglycosides	STR^{HC}	7.0	7.3	6.1	5.9	7.0	6.4	4.9	5.9	3.4	6.2	5.5
	KAN^{HC}	NT	NT	NT	NT	NT	NT	4.7	5.3	3.6	6.9	5.3
	GEN^{HC}	1.0	2.4	1.6	0.8	2.7	2.7	2.3	1.8	1.2	0.8	0.6
Tetracyclines	TET/OT**	22.2	33.4*	33.8	34.0	25.8*	44.1*	45.3	75.7*	61.5*	63.9	82.1*
Macrolides	ERY	8.6	14.4*	5.6*	13.2*	6.7*	9.1*	6.0	6.5	6.6	8.8	11.1
Rifampicin	RIF**	0.5	1.1	0.5	0.6	0.4	1.0	0.1*	0.0	0.3	0.4	15.5*
Sulphonamides	SUL/SXT**	1.0	6.0*	14.8*	1.4*	0.6	1.6	23.1*	0.1*	1.0*	0.0*	4.8*

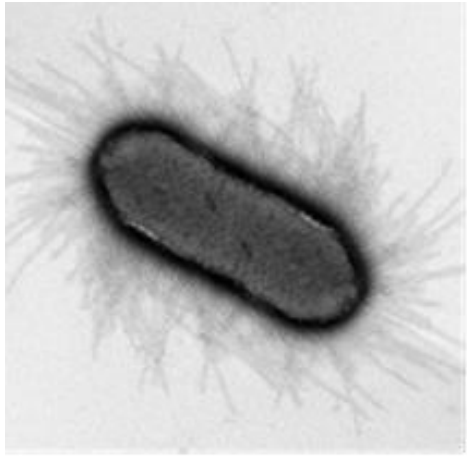
R≤10% 10<R≤30% 30<R≤50% R>50%

S. equi subsp. *zooepidemicus*
S. equi subsp. *equi* (respiratory tract, strangles)

Mainly from genital and respiratory origins

Penicillins remained active
High % of **Tetracyclines** resistances (from genital origin)
Natural low level of resistance to **Aminoglycosides** (high concentration discs used)

Escherichia coli



Gastro-intestinal disorders
Urinary tract infections
Septicemia

Antibiotic category		% of resistant *Escherichia coli*										
	Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
	Number of strains (n)	350	419	479	521	467	528	577	490	491	493	344
Penicillins	AMP/AMX	40.6	33.9	54.1*	56.6	31.3*	52.5*	62.7*	55.7*	39.7*	40.0	39.5
	AMC	28.9	23.6	48.6*	53.0	25.1*	43.6*	45.4	46.1	32.8*	34.9	31.4
Cephalosporins 3rd 4th	CEF	3.4	6.7*	8.6	8.6	8.8	10.8	10.2	9.8	11.2	6.7*	6.1
	CEQ**	1.4	6.0*	8.4	8.3	7.9	10.6	9.9	9.2	11.0	6.9*	5.8
Aminoglycosides	STR**	77.1	81.9	88.3	94.8*	90.4*	63.6*	76.1*	65.1*	59.3	36.1	33.1
	KAN	NT	NT	NT	NT	NT	NT	25.3	24.9	21.4	8.9	9.0
	GEN	5.7	8.1*	9.4	11.5	10.5	15.9*	11.8	11.6	10.4	6.9	6.1
	AMK**	3.4	3.8	2.7	3.8	3.4	0.6*	0.5	1.6	1.0	0.4	0.0
Tetracyclines	TET/OT	21.4	20.8	22.8	26.3	24.0	23.9	24.1	20.4	21.4	24.5	20.6
Sulphonamides	SUL/SXT**	24.6	26.7	27.1	28.4	26.1	29.2	62.7*	25.1*	30.1	28.2	31.4
Quinolones/Fluoroquinolones	NAL	NT	NT	NT	NT	NT	NT	7.1	10.0	8.1	6.7	4.9
	FLU**	7.7	17.2*	6.1	7.7	8.1	7.8	6.1	6.3	6.5	6.1	4.9
	ENO	4.0	5.0	5.0	4.6	6.0	6.3	5.9	5.5	6.1	5.3	3.2
	MAR	3.4	3.8	3.5	3.8	4.3	4.9	4.7	3.5	5.1	3.7	2.9

R≤10% 10<R≤30% 30<R≤50% R>50%

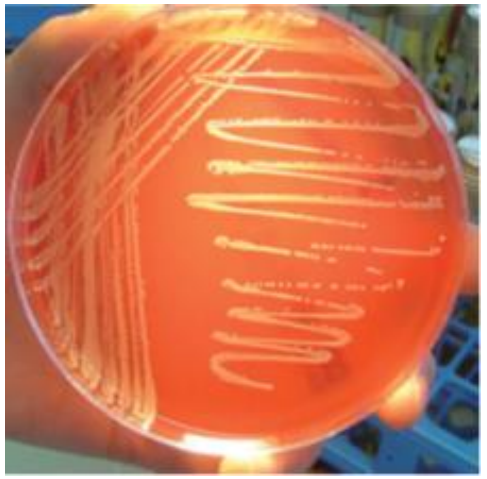
Mainly from genital origin (51%)

Around 40% of resistance to **Amoxicilline**
High level of resistance to **Streptomycin** but decreased in 2015 and 2016
Less than 12% resistant to **Cephalosporins** and **Quinolones**

Staphylococcus aureus

Antibiotic category		% of resistant *Staphylococcus aureus*										
	Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
	Number of strains (n)	114	163	198	190	226	253	185	178	180	186	139
Penicillins	PEN	55.3	35.6*	46.5*	41.6	32.3	32.8	44.3*	42.1	39.4	44.1	43.9
	AMP/AMX	55.3	35.6*	46.5*	41.6	32.3	32.8	44.3*	42.1	38.9	44.1	43.2
	OXA	NR	NR	NR	NR	NR	NR	23.8	13.5*	13.9	16.7	15.8
	AMC**	5.3	1.8	12.6*	14.2	12.4	15.8	23.8*	13.5	13.9	16.7	15.8
Cephalosporins 2nd 3rd 4th	FOX**	NT	NT	NT	NT	NT	NT	30.8	17.4	13.9	18.3	17.3
	CEF**	0.9	2.5	11.1*	13.2	11.5	16.2	24.3*	13.5*	13.9	16.7	15.8
	CEQ**	1.8	4.3	9.1	12.1	11.5	15.8	24.3*	13.5*	13.9	16.7	15.1
Aminoglycosides	STR**	38.6	31.3	57.6*	65.3	43.4*	27.3*	25.9	15.2*	15.0	19.4	20.9
	KAN	NT	NT	NT	NT	NT	NT	24.3	18.5	19.4	25.8	23.0
	GEN**	10.5	7.4	15.2*	18.4	15.0	21.3	23.2	18.5	18.9	25.3	21.6
	AMK	10.5	7.4	15.7	18.4	15.0	21.3	0.0	0.0	0.0	0.0	0.0
Tetracyclines	TET/OT**	18.4	8.6*	18.7*	18.4	17.3	16.6	28.1*	20.2	22.8	29.6	27.3
Macrolides	ERY**	6.1	5.5	12.6*	10.5	6.2	5.9	7.0	3.4	6.1	4.8	5.8
Rifampicin	RIF**	4.4	4.3	11.1*	7.4	5.8	10.3	7.6	2.8*	2.8	2.7	2.9
Sulphonamides	SUL/SXT	0.9	4.3	11.1	7.9	4.9	4.7	9.2	5.1	3.3	2.2	6.5*
Fluoroquinolones	ENO**	0.0	1.2	2.5	2.6	2.7	4.0	8.6*	4.5	5.6	3.8	1.4
	MAR**	0.0	0.6	0.5	1.1	1.3	2.8	2.2	1.1	3.9	2.7	1.4

R≤10% 10<R≤30% 30<R≤50% R>50%

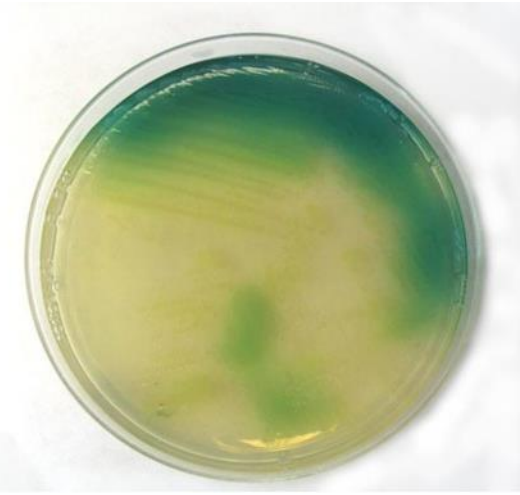


Major cause of nosocomial and community infections

Mainly from cutanous origin (41%)

High level of resistance to **Penicilline** or **Ampicilline**
MRSA (Cefoxitin or Oxacillin R) around 17% (except in 2012)
Decrease of **Streptomycin** resistance after 2010
Less than 30% of resistance to the other antimicrobials

Pseudomonas aeruginosa



Major opportunistic pathogen
Endometritis in mares

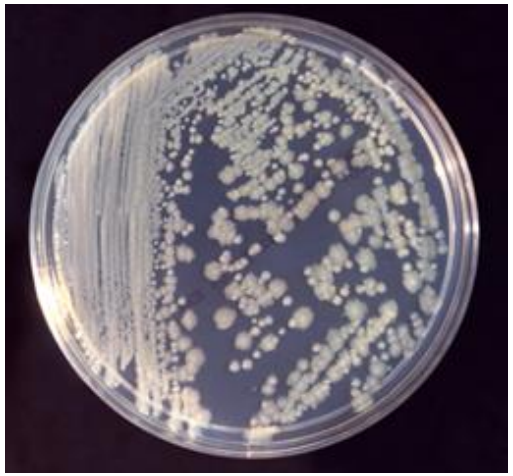
	% of resistant *Pseudomonas aeruginosa*											
Antibiotic category	**Year**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
	Number of strains (n)	**50**	**93**	**75**	**102**	**90**	**127**	**153**	**94**	**95**	**96**	**59**
Cephalosporin 4th	CEQ**	44.0	52.7	34.7*	41.2	34.4	33.1	43.8	46.8	50.5	21.9*	11.9
Aminoglycosides	GEN	14.0	12.9	36.0*	44.1	20.0*	51.2*	58.8	35.1*	20.0*	3.1*	10.2
	AMK**	10.0	7.5	6.7	14.7	6.7	8.7	8.5	10.6	1.1*	1.0	0.0
Fluoroquinolones	MAR	2.0	2.2	2.7	14.7*	8.9	6.3	24.2*	9.6*	3.2	3.1	1.7

R≤10% 10<R≤30% 30<R≤50% R>50%

Mainly from respiratory origin (40%)

Only 4 antimicrobials clinically relevant were tested
Favorable evolution of sensitivity to these compounds

Enterobacter spp.



Causative agent of nosocomial infections
Pneumonia, septicemia, urinary tract and wound infections

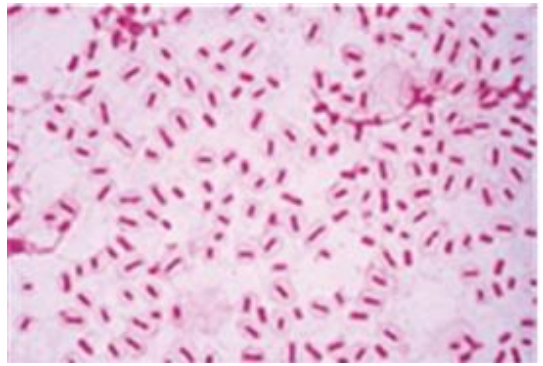
F		% of resistant *Enterobacter spp*										
Antibiotic category		**Year**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
		Number of strains (n)	**59**	**113**	**103**	**95**	**80**	**75**	**110**	**75**	**69**	**61**	**38**
Cephalosporins	**3rd**	CEF	6.8	18.6	18.4	20.0	10.0	18.7	28.2	12.0*	8.7	16.4	15.8
	4th	CEQ	3.4	8.0	9.7	7.4	8.8*	8.0	11.8*	8.0	1.4	8.2	13.2
Aminoglycosides		STR**	32.2	39.8	62.1*	64.2	47.5	33.3	50.0	29.3	18.8	26.2	23.7
		KAN**	NT	NT	NT	NT	NT	NT	37.3	16.0*	10.1	23.0	18.4
		GEN	3.4	17.7*	23.3	18.9	20.0	24.0	35.5	16.0*	8.7	18.0	18.4
		AMK	1.7	4.4	3.9	9.5	5.0	9.3	8.2	0.0*	1.4	6.6	5.3
Tetracyclines		TET/OT**	10.2	19.5	43.7*	40.0	37.5	26.7	56.4*	38.7*	43.5*	16.4	21.1
Sulphonamides		SUL/SXT	5.1	23.0*	21.4	18.9	18.8	20.0	43.6*	16.0	15.9	19.7	21.1
Quinolones/Fluoroquinolones		NAL	NT	NT	NT	NT	NT	NT	23.6	20.0	20.3	18.0	21.1
		FLU**	23.7	37.2	33.0	23.2	20.0	21.3	24.5	18.7	18.8	18.0	21.1
		ENO	1.7	19.5*	14.6	13.7	10.0	14.7	20.0	10.7	8.7	14.8	7.9
		MAR	0.0	0.9	2.9	0.0	0.0	2.7	1.8	2.7	0.0	4.9	2.6

R≤10% | 10<R≤30% | 30<R≤50% | R>50%

Mainly from respiratory origin (48%)

High level of **Streptomycin** resistance between 2006 and 2012. Significant decrease thereafter.
High level of **Tetracycline** resistance between until 2014. Significant decrease thereafter.

Klebsiella pneumoniae



Opportunistic pathogen
Metritis, infertility, pneumonia

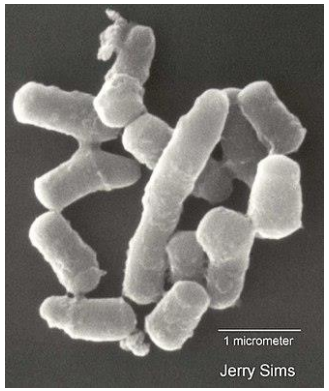
Antibiotic category		% of resistant *Klebsiella pneumoniae*										
		Year	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
		Number of strains (n)	**55**	**47**	**63**	**58**	**64**	**61**	**66**	**62**	**62**	**57**	**31**
Penicillins		AMC**	18.2	23.4	14.3	24.1	14.1	8.2	10.6	9.7	9.7	7.0	12.9
Cephalosporins	**3rd**	CEF	9.1	6.4	3.2	10.3	7.8	1.6	6.1	4.8	1.6	7.0	9.7
	4th	CEQ	5.5	4.3	1.6	1.7	6.3	1.6	4.5	3.2	1.6	7.0	9.7
Aminoglycosides		STR**	40.0	29.8	61.9*	72.4	56.3	23.0*	21.2	25.8	19.4	26.3	29.0
		KAN	NT	NT	NT	NT	NT	NT	6.1	1.6	0.0	3.5	3.2
		GEN	9.1	10.6	3.2	3.4	4.7	3.3	9.1	3.2	0.0	3.5	6.5
		AMK	0.0	0.0	0.0	0.0	0.0	0.0	1.5	0.0	0.0	0.0	0.0
Tetracyclines		TET/OTC	12.7	10.6	30.2*	41.4	15.6*	16.4	27.3	27.4	24.2	12.3	25.8
Sulphonamides		SUL/SXT**	18.2	12.8	3.2	10.3	9.4	8.2	21.2	11.3	12.9	19.3	32.3
Quinolones/Fluoroquinolones		NAL	NT	NT	NT	NT	NT	NT	13.6	32.3*	12.9*	5.3	19.4*
		FLU	3.6	12.8	1.6*	13.8*	7.8	3.3	9.1	8.1	6.5	3.5	12.9
		ENO**	1.8	2.1	0.0	3.4	1.6	0.0	9.1*	3.2	4.8	3.5	9.7
		MAR	0.0	0.0	0.0	0.0	1.6	0.0	6.1	0.0	1.6	0.0	3.2

R≤10% | 10<R≤30% | 30<R≤50% | R>50%

Mainly from genital origin (43%)

Evolution similar to *Enterobacter* spp.

Rhodococcus equi



Facultative intracellular pathogen
Severe pneumonia in foals

	% of resistant *Rhodococcus equi*											
Antibiotic category	**Year**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
	Number of strains (n)	**22**	**36**	**50**	**42**	**61**	**70**	**53**	**43**	**45**	**33**	**7**
Macrolides	ERY**	13.6	0.0*	0.0	4.8	1.6	1.4	1.9	0.0	0.0	0.0	0.0
Rifampicin	RIF	0.0	0.0	2.0	0.0	0.0	4.3	1.9	0.0	0.0	9.1	0.0

R≤10% 10<R≤30% 30<R≤50% R>50%

Rare resistances
No guideline available

Percentage of bacteria resistant to three or more antimicrobial classes

	Streptococcus (group C)	*Staphylococcus aureus*	*E. coli*	*Enterobacter spp*	*Klebsiella pneumoniae*
2006	**20.4**	**43.0**	**34.0**	**20.3**	**18.2**
2007	**14.0**	**24.5**	**39.6**	**31.9**	**17.0**
2008	**12.3**	**38.4**	**34.2**	**45.6**	**23.8**
2009	**11.6**	**41.1**	**38.8**	**41.1**	**39.7**
2010	**6.3**	**27.0**	**33.4**	**36.3**	**21.9**
2011	**9.0**	**27.3**	**34.1**	**26.7**	**21.3**
2012	**13.8**	**27.6**	**31.4**	**50.9**	**22.7**
2013	**6.8**	**18.0**	**24.3**	**24.0**	**35.5**
2014	**6.4**	**20.0**	**23.6**	**24.6**	**22.6**
2015	**7.5**	**25.3**	**22.5**	**26.2**	**21.1**
2016	**10.7**	**24.5**	**22.7**	**26.3**	**38.7**

High level of MDR!
Streptococci remained relatively susceptible
Decrease after 2012 (*S. aureus*, *E. coli*, *Enterobacter*) and **stabilisation**.
Careful to *klebsiella*

Take home messages

Large scale study (more than 25,000 isolates)

Study during **11 years**

The most important panorama of the antimicrobial susceptibility in equine field

No therapeutic problem to fight **Streptococci** or ***Rhodococcus***

MRSA: Stable since 2013 (17%)

Few choises to treat ***Pseudomonas aeruginosa*** infections but the evolution seems favorable

E. coli: 40% resistant to Amoxicillin, less than 10% were resistant to C3G or C4G (ESBL or CPE?)
« criticaly important drugs »
Close supervision is necessary to avoid a therapeutic impasse

Majority of ***Enterobacter*** spp. remained susceptible to Amikacine and Marbofloxacine

MDR: Myth or reality?

May be YES, may be NOT!

Half empty glass
Allways too much MDR

Half full glass
Stable or favorable evolution
Impact of the French National ECOANTIBIO Plan (2012-2016)

New ECOANTIBIO^2 Plan (2017-2021)

Avoid empirical practices

Need to support veterinary antimicrobial stewardship

Observe hygiene measures

Dr Albertine Leon
Dr Rachel Duchesne
Sophie Castagnet
Dr Sandrine Petry
Pr Vincent Cattoir

Dr Anne Dhalluin
Marion Aubourg

Thank you for your attention

Accepted Manuscript: R. Duchesne *et al.* J Glob Antimicrob Resist. 2019