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FACULTY OF LIFE SCIENCES UNIVERSITY OF COPENHAGEN



# Transmission of MRSA CC398 strains between pig farms related by trade of animals

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Background: Purchasing pigs from a positive farm may be an important risk factor for acquisition of MRSA CC398 in the recipient farms (Broens et al., 2010).

Objective: to provide conclusive molecular evidence that MRSA CC398 is transmitted vertically through the pig production chain by trade of MRSA-positive animals. Our hypothesis was that PFGE profiles found in the recipient farms would also be present in the corresponding supplying farms.

<u>Methods</u>: Six chains (group of farms related to each other by trade of animals) were included in the retrospective study (Chains F, G, P, I, Q, R). Two farms were included the prospective study (Farm 1 and Farm 2) where newly purchased gilts were sampled before entering the farm. Pools of samples from inside the farms and samples from these farms from 2009 were also included (Farm isolates). MRSA isolates from farms linked by commercial trade of pigs were typed using the PFGE protocol by Bosch et al., 2010, a highly discriminatory method allowing differentiation between different lineages of MRSA CC398 (van Wamel et al., 2010). GelCompar II software was used for the cluster analysis and *spa* types were assigned following the protocol by Harmsen et al., 2003. The study was structured in two parts: a retrospective study (isolates from the study by Broens et al., 2010) and a prospective study (isolates from Denmark).

<u>Results</u>: The results of the retrospective study and the prospective study are presented in Figures 1 and 2, respectively. In most but not all cases, MRSA transmission by trade was supported by PFGE analysis.

Chain	Was the strain present at all production levels?	Observations
F	Yes	One strain being transmitted.
Ρ	Yes	Two strains being transmitted.
Q	Yes	A second strain linked to Chain R
R	Yes	One strain being trasnmitted.
G	No	Only one isolate/level included.
	No	Only one isolate/level included.

Dice (Opt 0.10%) (Tol 1.0%-1.0%) (H>0.0% S>0.0%) [0.0% – 100%]

1 No Farm isolates (from 2009 and 2011) cluster, but not with Gilt isolates.   2 Yes One strain being transmitted.   Dice (Opt 0.10%) (Tol 1.0%-1.0%) (H>0.0% S>0.0%) [0.0%-100.0%]   Farm Description Year spa type	Farm	Was the strain present a all production levels?	t Observat	ions					
Dice (Opt 0.10%) (Tol 1.0%-1.0%) (H>0.0% S>0.0%) [0.0%-100.0%]	1	No							
	2	Yes	One strai	One strain being transmitted.					
		0 10%) (Tol 1 0%_1 0%) (HS0 0% SS0 0%) [0 0%_	100.0%1						
	Dice (Opt	®		<b>Farm</b> Farm 1	<b>Description</b> Farm isolate	<b>Year</b> 2011	<b>spa typ</b> t034		
Earm 1 Farm isolate 2011 t034	Dice (Opt			Farm 1	- Farm isolate	2011	t034		
Farm 1 Farm isolate 2011 t034   Farm 1 Farm 1 Farm isolate 2011 t034   Farm 1 Farm 1 Farm isolate 2011 t034	Dice (Opt			Farm 1 Farm 1 Farm 1	Farm isolate Farm isolate Farm isolate	2011 2011 2011	t034 t034 t034		

			Chain	Farm type	<i>spa</i> type	Farm ID
	11 111	1 1 5 8 5	Q	Breeder/Farrower	t011	9
	11 111 11	1111	R	Breeder/Farrower	t011	11
	11 11 11	1111	R	Finisher	t011	12
	11 11 11	1111	F	Breeder	t108	1
	11 11 1	1111	F	Breeder/Farrower	t943	2
	11 11 1	11111	F	Breeder/Farrower	t2503	2
	11 41 41	1111	F	Finisher	t108	3
			F	Finisher	t943	3
	11 11 1	11111	F	Finisher	t2503	3
	11 11 11	11111	G	Breeder	t108	13
	11 11 1	11111	Р	Breeder/Farrower	t108	4
		1110	Р	Finisher	t108	5
		1110	Р	Breeder/Farrower	t108	4
		1110	Ι	Farrower	t108	7
		11111	Р	Breeder/Farrower	t011	4
	11 1 11 1 11	1110	Р	Breeder/Farrower	t011	4
	11 1 11 1 80	8 8 3 8 3	Р	Finisher	t011	5
1		110	Q	Breeder/Farrower	t011	8
		1144	Q	Finisher	t011	10
		110	G	Finisher	t011	14
		110	1	Breeder	t011	6

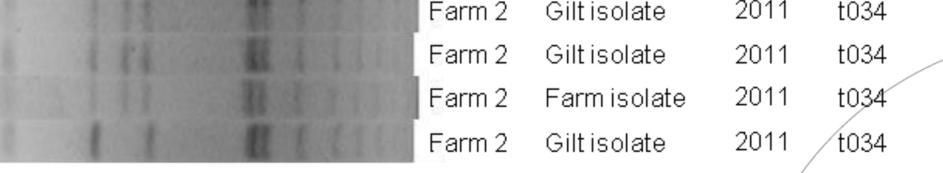
Figure 1. Genetic diversity of 21 MRSA CC398 isolates from 6 pig farms and their

	A CONTRACTOR OF	Contract in	1 anni 10 onato	2000	
		Farm 1	Farm isolate	2009	t034
		Farm 1	Giltisolate	2011	t034
		Farm 1	Giltisolate	2011	t034
	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	Earm 1	Giltisolate	2011	t034
		Farm 1	Giltisolate	2011	t034
		Earm 1	Giltisolate	2011	t034
		Earm 1	Giltisolate	2011	t034
	1.	Farm 1	Giltisolate	2011	t034
		Farm 1	Giltisolate	2011	t011
		Farm 2	Giltisolate	2011	t034
		Farm 2	Giltisolate	2011	t034
	·	Farm 2	Giltisolate	2011	t034
		Farm 2	Farm isolate	2009	t034
		Farm 2	Farm isolate	2009	t034
		Farm 2	Giltisolate	2011	t034
		Farm 2	Giltisolate	2011	t034
		Farm 2	Giltisolate	2011	t034
		Farm 2	Giltisolate	2011	t034
		Farm 2	Giltisolate	2011	t034
		Farm 2	Giltisolate	2011	t034
		Farm 2	Giltisolate	2011	t034
		Farm 2	Giltisolate	2011	t034
		Farm 2	Giltisolate	2011	t034
		Farm 2	Giltisolate	2011	t034
		Earm 2	Giltisolate	2011	t034
		Farm 2	Giltisolate	2011	t034
		Earm 2	Giltisolate	2011	t034
	A REAL PROPERTY AND A REAL	Earm 2	Gilticolato	2011	±034

corresponding gilts or pigs suppliers in Holland. Production Chain (F, G, I, P, Q, R), *spa* type and Farm identification (ID) (1-14) and are provided for each strain.

### **CONCLUSIONS**

- 1. MRSA CC398 strains can be transmitted through pig trading, which is important for the development of intervention strategies (Chains F, P, Q, R and Farm 2).
- 2. Alternative transmission pathways may exist (there are identical strains among farms not related by trade, for example Chains Q and R).
- 3. Association between PFGE profiles and *spa* types was not consistent (Figure 1).



2009

t034

Earm 1 Farm isolate

Figure 2. Genetic diversity of 36 MRSA CC398 isolates from 2 Danish pig farms and purchased gilts sampled before entering the farm. Farm isolates were isolated in this study and in another study conducted at the same farms in 2009.

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