

# MRSA in dairy cattle

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# Staph aureus in dairy cows

- Mastitis is a major production disease of dairy cows and leads to high antibiotic use in dairy farms
- *S. aureus* is responsible for <10% but is a serious problem due to recurrent nature and high somatic cell counts



# Mechanisms of methicillin resistance

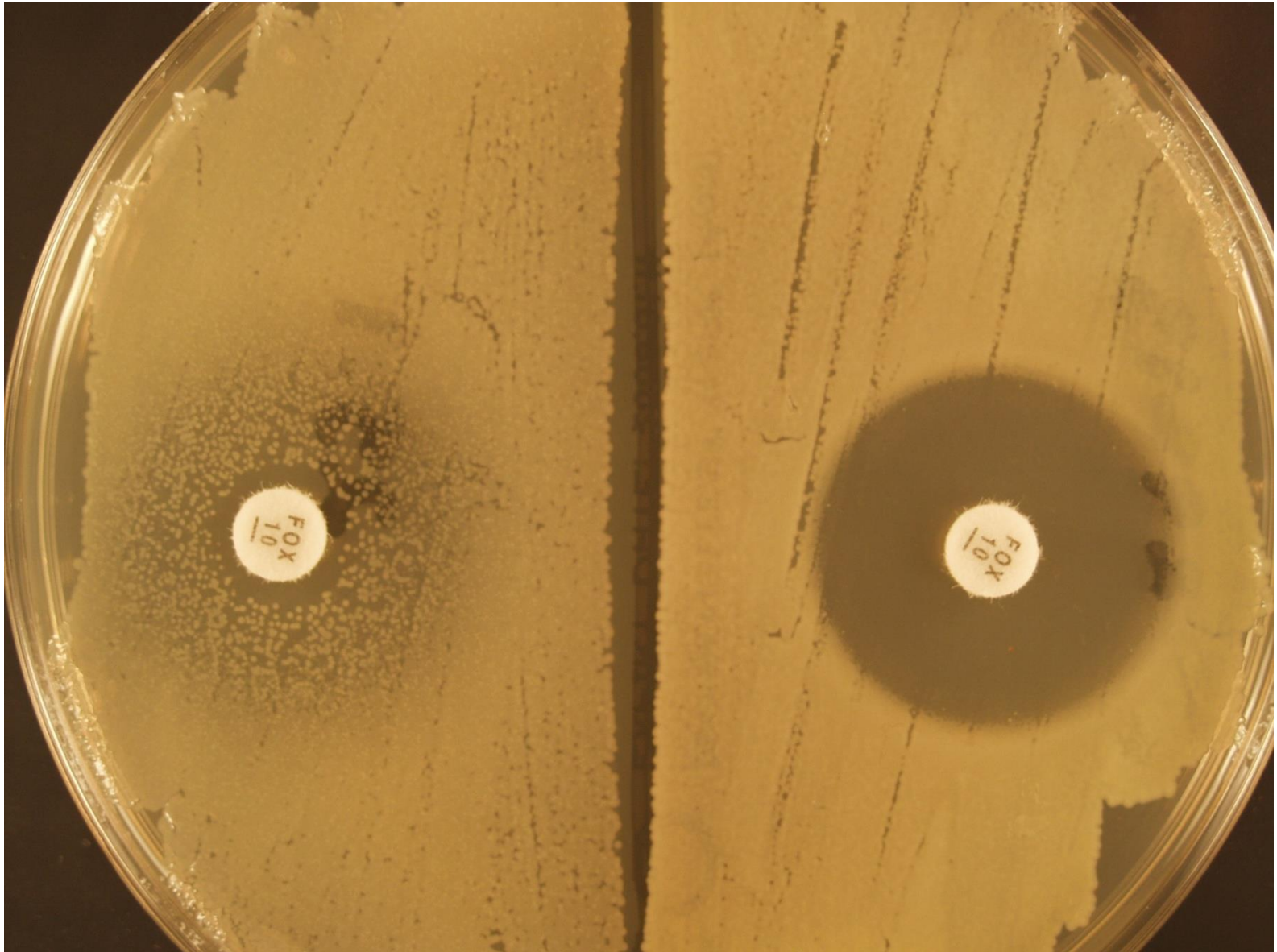
- Shortly after appearance of penicillin resistant strains emerged which produced penicillinase
- Shortly after introduction of penicillinase resistant beta-lactams antibiotics (new penicillin type drugs, such as methicillin) were developed, MRSA appeared (1961)
- Penicillins binds to cell wall synthetic enzyme and disables it
- Penicillin target is PBP2 (penicillin binding protein 2)
- MRSA produce a replacement PBP (PBP2a) encoded by a gene called *mecA*
  - *low affinity for penicillins, i.e. more resistant*

# MRSA ID agar (chromogenic)



**LGA251**

**MSSA**





# A new livestock associated MRSA

- Variant methicillin resistance gene, *mecC*
- First discovered in a dairy farm
- Subsequently found to have a wide distribution in man and animals

## Meticillin-resistant *Staphylococcus aureus* with a novel *mecA* homologue in human and bovine populations in the UK and Denmark: a descriptive study

Laura García-Álvarez, Matthew T G Holden, Heather Lindsay, Cerian R Webb, Derek F J Brown, Martin D Curran, Enid Walpole, Karen Brooks, Derek J Pickard, Christopher Teale, Julian Parkhill, Stephen D Bentley, Giles F Edwards, E Kirsty Girvan, Angela M Kearns, Bruno Pichon, Robert L R Hill, Anders Rhod Larsen, Robert L Skov, Sharon J Peacock, Duncan J Maskell, Mark A Holmes

## New form of MRSA found in cows' milk

By Jenny Hope  
Medical Correspondent

A NEW strain of MRSA has been found in cows' milk. The same strain of the superbug has also been discovered in patients being treated for wound infections. It is the first time any form of MRSA has been traced to dairy cattle in the UK. However, experts insist there is no overall threat to the safety of milk sold in shops. This is because any kind of MRSA in dairy products is destroyed by the heat used in the process of pasteurisation. Scientists warned that further research would be required to find out if humans were spreading the bug to cows or vice versa.

The discovery raises concern that intensive farming methods may be encouraging the emergence of new MRSA strains which are resistant to an ever-wider range of antibiotics. Organic farming lobby The Soil Association last night called for a complete ban on routine use of antibiotics in livestock because of fears they may promote drug-resistant bacteria.

Helen Browning of the Soil Association, said: "Under acute price pressure, dairy systems are becoming ever more antibiotic dependent. We need to get farmers off this treadmill, even if that means that milk has to cost a few pence more. That would be a very small price to pay for maintaining the efficacy

of these life-saving drugs. The MRSA strain was discovered by researchers at Cambridge University investigating mastitis, a serious disease in dairy cows. Dr Mark Holmes, a veterinary scientist who led the research, said they found a drug resistant form of MRSA which did not match existing strains. MRSA, or methicillin-resistant *Staphylococcus aureus*, is a usually harmless and common bacterium carried on the skin which can be deadly if it infects wounds. Checks found the mutated MRSA in 15 of 140 samples from 450 English dairy herds. Further research, confirmed the strain was also in humans, says a report published today in the journal *The Lancet Infectious Diseases* Samples from screening

tests and patients treated for MRSA wound infections revealed 12 instances of the strain from Scotland, 18 from England and 24 from Denmark. It was also identified in Ireland and Germany. The scientists also spotted a 'clustering' of human and cow samples that suggested transmission between them. Dr Holmer said: "Although there is circumstantial evidence that dairy cows are providing a reservoir of infection, it is still not known for certain if cows are infecting people, or people are infecting cows." MRSA infection is often found in hospital patients, but a drive to improve hygiene has dramatically cut the number of fatal cases. There were 1,250 in 2008 and 111 in 2010. Researchers

### COMMON BUG THAT CAN TURN INTO A KILLER

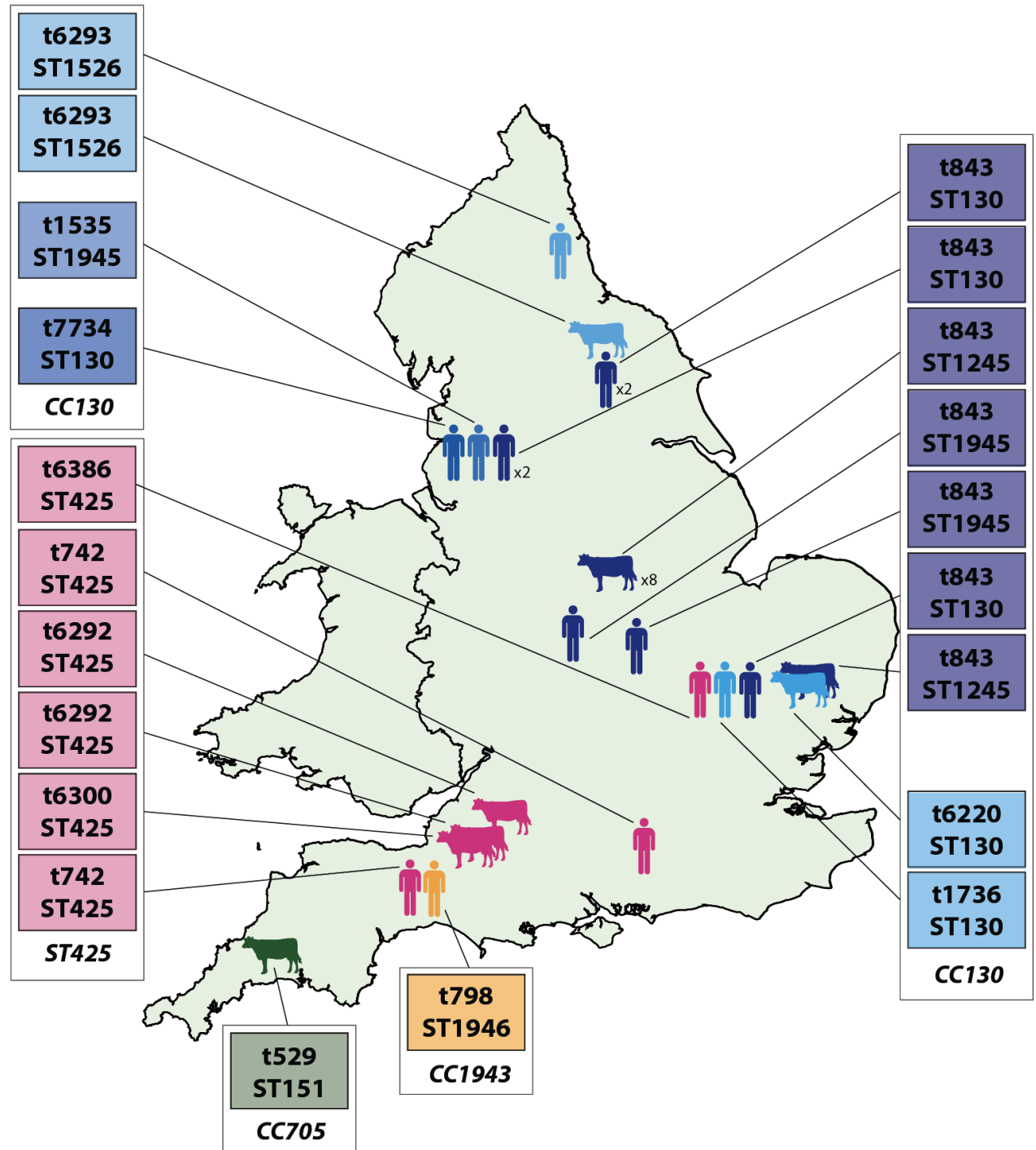
resistant to commonly-used antibiotics, in particular methicillin. These are known as methicillin-resistant *Staphylococcus aureus*—MRSA. In fact, methicillin is no longer manufactured but the term MRSA is still used to describe infections that do not respond to a range of antibiotics. Patients diagnosed with MRSA infections—whatever the strain—will be treated with antibiotics that the bacteria have not yet become resistant to.

have no information about the virulence of the new strain, which has so far not been linked to any deaths. It is treated with the same antibiotics used against normal MRSA. They said workers on dairy farms might be at higher risk of becoming carriers, but the food chain was unlikely to be affected. Unpasteurised milk can only be sold directly from farms in England, and bugs in unpasteurised cheeses struggle to survive the human digestive system. The Department of Health said it would review the issue.

A spokesman from the Food Standards Agency said: "The risk of contracting this strain of MRSA through milk is extremely low because the vast majority of cows' milk is pasteurised."

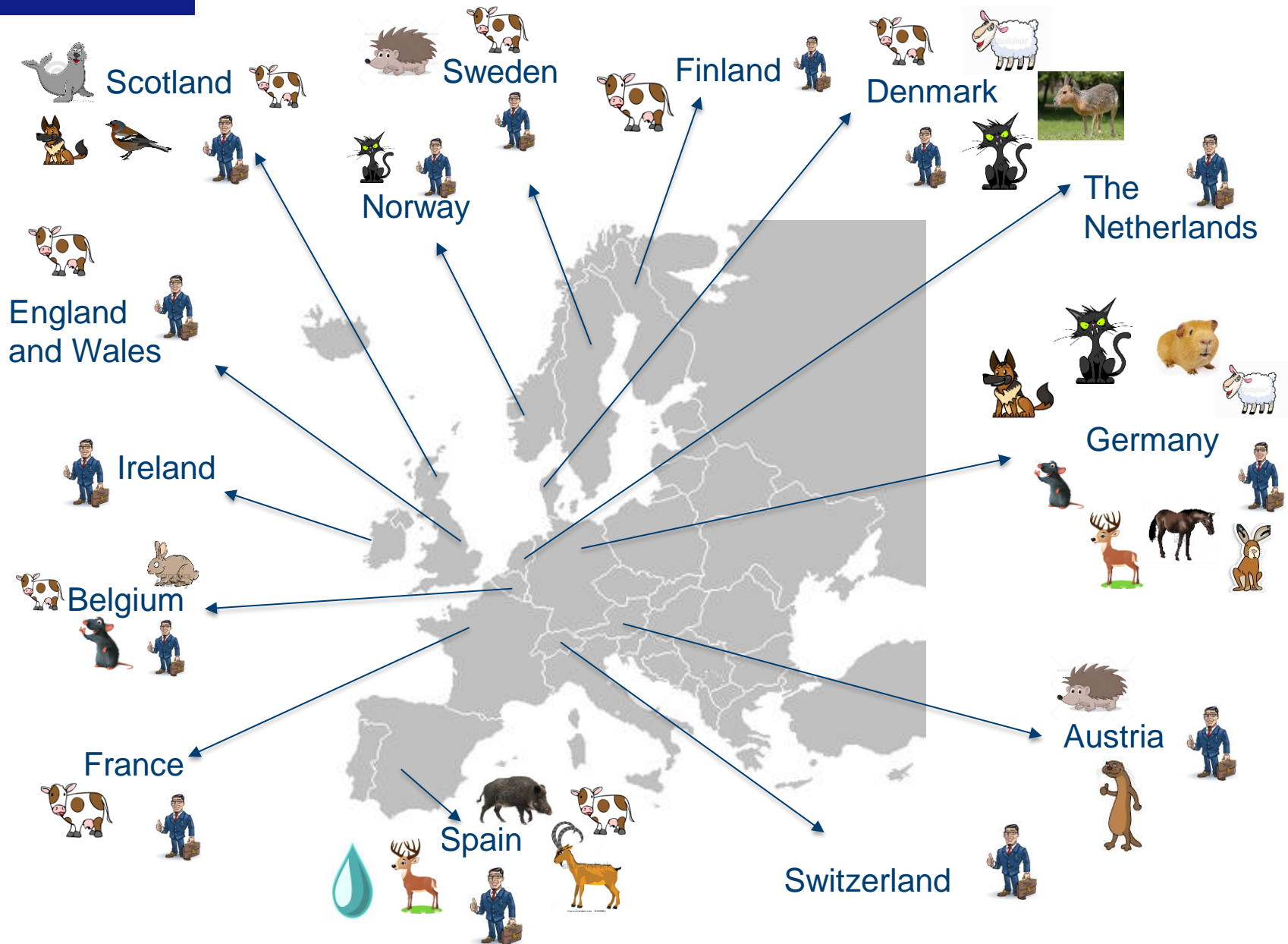
Two main lineages:  
CC130  
CC425

Both animal lineages prior to *mecC*





# *mecC-MRSA* found in multiple host species across Europe





# Outbreak investigations

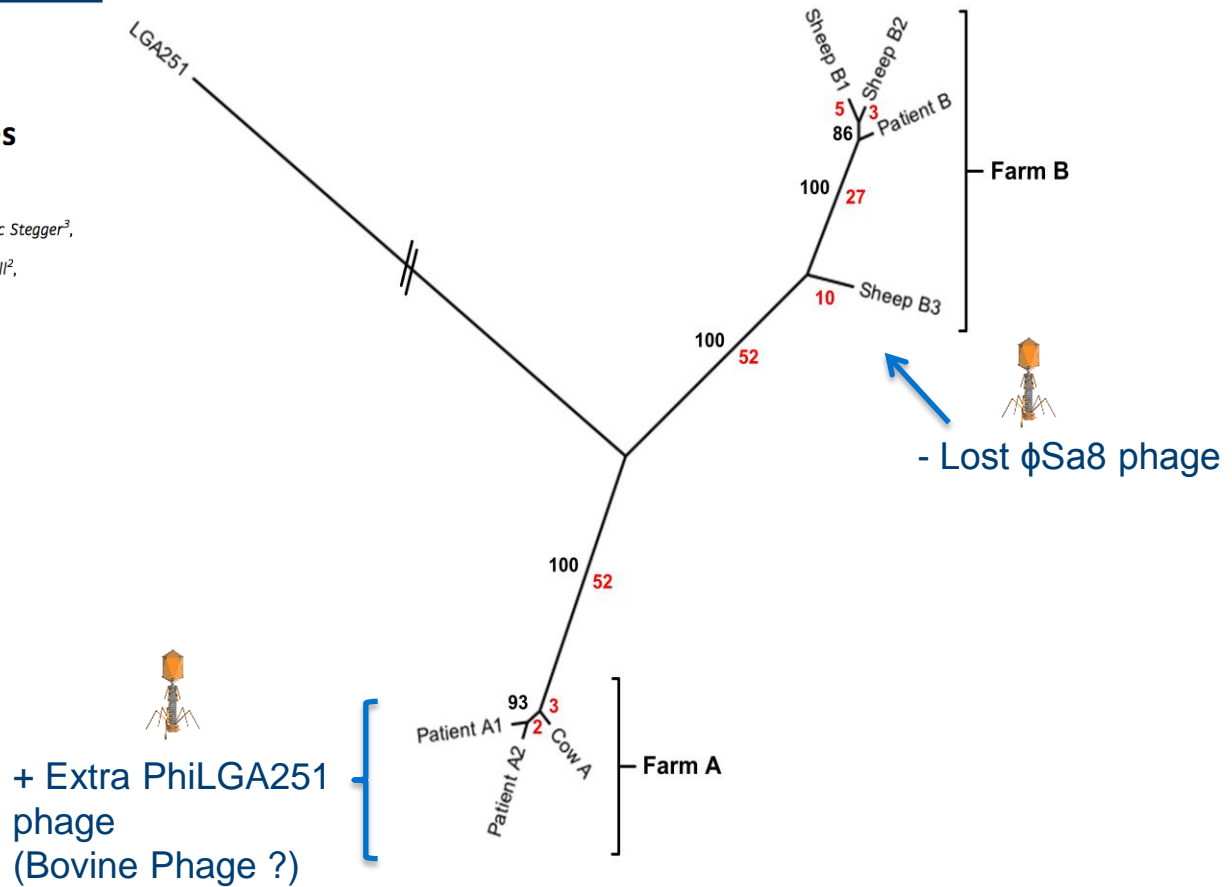
Report  
Zoonotic transmission of MRSA



EMBO  
Molecular Medicine

## Whole genome sequencing identifies zoonotic transmission of MRSA isolates with the novel *mecA* homologue *mecC*

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# Livestock associated MRSA: ST398

- First encountered in the Netherlands
- Unusual MRSA noticed in people from farms
- Subsequently found in farm animals
  - Pigs initially, but also veal calves, poultry & others
- Conventional *mecA* gene (the resistance gene)
- Few problems in farm animals but a problem in man
  - Provides reservoir of MRSA
  - Increases carriage rates (and disease) in risk population

# In UK first found in dairy farms

## RAPID COMMUNICATIONS

### First detection of livestock-associated meticillin-resistant *Staphylococcus aureus* CC398 in bulk tank milk in the United Kingdom, January to July 2012

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## Confirmation of LA-MRSA in pigs in the UK

WE wish to report the isolation of livestock-associated methicillin-resistant *Staphylococcus aureus* (LA-MRSA) from a postweaning piglet in Northern Ireland. While LA-MRSA is a relatively common finding in pigs in some EU countries (EFSA 2009a), we believe this to be the first reported isolation of LA-MRSA from a pig in the UK.

# ST398 & other MRSA in the UK dairy herd



**Blue ST398**  
Green CC22  
Red CC1

LA ST398 lineage:

$\phi$ Sa3 phage negative -  
contains *chp*, *scn* and *sak*  
(human virulence factors)

*lukF/S* negative

*tetM* positive



# Last month's results

- Preliminary results from 3 dairy farms
- Testing of individual cow samples
- Identification of MRSA and MSSA
- All clinically normal
- 2 farms were known to have had a mecC MRSA
- 1 farm was a negative control



# Conclusions

- Both ST398 and *mecC* MRSA provide examples of agricultural reservoirs of AMR that enter the human population
- It is highly likely that use of antimicrobials on farms provides a selective advantage to MRSA
  - Highly productive husbandry systems
  - Increased endemic infectious disease
  - Increased use of antibiotics
- LA-MRSA do not present a large threat to human or animal health at the moment ...

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