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# Correspondence

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## Transport of daptomycin resistance genes between animals and humans as a possible mechanism for development of *de novo* daptomycin resistance in enterococci

To the Editor

Zoonoses that can be transmitted from livestock to humans have increasingly been reported [1]. Geenen *et al*. determined the prevalence of livestock-associated methicillin-resistant *Staphylococcus aureus* (MRSA) on Dutch broiler farms and in people living and/or working on these farms and concluded that people in contact with live broilers are at risk for MRSA carriage worldwide [2]. Another emerging infection that may be associated with livestock is daptomycin non-susceptible *Enterococcus* (DNSE) [3].

Arias *et al*. described mutations that set the genetic basis for *in vivo* daptomycin resistance in enterococci that were exposed to daptomycin [4]. These mutations may have originated from recombination between adjacent repetitive nucleotide sequences [4]. However, little is known about the mechanisms of development of daptomycin resistance in patients without prior exposure to daptomycin (*de novo* DNSE) [5].

The genes encoding antibiotic resistance may derive from commensal bacteria that constitute a reservoir of resistance genes for pathogenic bacteria [6]. The level of resistance encountered in commensal bacteria may be a good indicator for selection pressure by antibiotic use and for resistance problems to be expected in pathogens [6].

Antibiotic use for animal growth promotion may hasten the appearance of antibiotic-resistant bacteria that, like zoonotic bacteria, might contaminate meat products and reach the intestinal tract of humans [6, 7]. Antimicrobial usage in animals has a major role in the selection of bacterial resistance and the transport of resistance genes via the food chain to humans [6, 7]. These resistant bacteria can transfer their antibiotic resistance genes, located on mobile genetic elements, to other bacteria, including human enterococci [6, 7].

Enterococci are members of the gastrointestinal tract consortium in humans and most other organisms [8, 9]. Acquired resistance in *Enterococcus* spp. is mediated by transferable transposons or plasmids encoding resistance cassettes [8, 9]. Multidrug-resistant enterococci can be found in food and animal species [8, 9]. Previous studies have shown that food and animal species other than *E. faecium* and *E. faecalis* can efficiently transfer antibiotic resistance to human strains in inter-specific matings [8, 9]. Of note, vancomycin-resistant enterococci emerged in farm animals in Europe, but became widespread in US hospitals within just a few years [8, 9]. The potential development of environmental reservoirs of antibiotic resistance in farmland is a concern [7, 8]. Thus, a possible mechanism of resistance in daptomycin-resistant enterococci could be the transfer of antibiotic resistance genes encountered in animal products [5]. In addition, the daptomycin-resistant enterococci may have developed in animals with the original daptomycin-resistant strains being passed to humans via the food chain [5].

In a recent study, *Enterococcus* spp. were frequently isolated from beef products (up to 62%) and up to 25% of these isolates were resistant to daptomycin [9]. Of note, in a recent series of nine patients with *de novo* DNSE infections, three (33·3%) patients had a history of prior exposure to livestock and four (44·4%) patients reported frequent ingestion of beef [5]. Clonal spread was not detected in this series, suggesting a large role of gene transfer in the dissemination of antibiotic resistance [5]. We have also reported cases of DNSE *E. gallinarum*, which are common intestinal commensal bacteria in poultry [3, 5, 10]. Interestingly, in our recent cohort of 11 patients with DNSE isolated from the urinary tract, all three *de novo* DNSE isolates in the urine were *E. faecalis* (T. Kelesidis *et al*. unpublished data).

The importance of *E. faecalis* as a reservoir of resistance genes and their potential transfer to humans through consumption of contaminated undercooked meat, which can be a reservoir for DNSE isolates [5, 9] has recently been validated [1]. However, these observations need to be validated in further studies and their significance remains unclear. The origin of *de novo* community-acquired DNSE urinary isolates remains to be determined.

To safeguard public health, the selection and dissemination of resistant bacteria from animals should be controlled. It is possible that transport of gene elements of daptomycin resistance from food and animal *Enterococcus* spp. to human strains is a mechanism of development of *de novo* daptomycin resistance in enterococci. The findings from Geenen *et al*. indicate that people worldwide in contact with live broilers are at risk for MRSA carriage [2] and it should also be investigated whether such epidemiological exposures place these subjects at increased risk for DNSE carriage.

## Declaration of Interest

None.

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