guidelines. Moreover, many horse wounds heal by supportive therapy without antibiotics. Finally, the hypothesis for MRSA being selected by the use of cefquinome in those horses cannot be excluded.

In this study, two CCs with no geographical clustering were characterized. Indeed, three MRSA strains belonged to CC130, the most prevalent CC among mecC-positive MRSA in animals, whereas the fourth one belonged to ST49, which was recently described in mecC-positive humans. Among the CC130 isolates, two different STs (ST1245 and ST130) and three divergent—though related—spa types were found. This finding might be due either to microevolutions of a common ancestor or to successive introduction of distinct strains.

Considering the nosocomial and zoonotic potential of MRSA isolated from horses, equine veterinarians and riders should pay specific attention to hygiene measures in both veterinary clinics and equestrian centres in order to limit MRSA spread. Prudent and responsible use of antibiotics by veterinarians is also of major importance to avoid selection and dissemination of such resistant strains.

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Transparency declarations
None to declare.

References
Six colistin-resistant *E. coli* were isolated from humans, four from pigs and none from goats (Table 1). All of the isolates displayed resistance to amoxicillin and trimethoprim/sulfamethoxazole (Table 1). We did not isolate an *E. coli* strain that was only resistant to colistin, which may be due to the medium’s composition.

All six of the *E. coli* isolated from humans and two from pigs belonged to novel STs (Table 1). The remaining colistin-resistant *E. coli* from pigs, ST93 and ST117 (an emerging avian pathogenic *E. coli*), were both known zoonotic pathogenic strains. Interestingly, two colistin-resistant *E. coli*—one from a human (LH1, from a 15-year-old boy, the only household member screened) and one from a pig (P10)—both belonged to the same novel ST and displayed the same virulence and PFGE patterns (Figure S1, available as Supplementary data at JAC Online). Further investigation showed that the pig belonged to the boy’s family and the boy (with no recent history of antibiotic usage) normally feeds the pig without wearing any protective equipment such as boots. This observation indicates a possible horizontal transmission from pig to human. The colistin-resistant *E. coli* LH1 (from the human) had additional resistance to aminoglycosides and intermediate resistance to ciprofloxacin and was positive for *aadA22* and *aac(6’)-Ib-cr*. *E. coli* LH1 produced a transconjugant resistant to kanamycin, indicating that it has further acquired a mobile element bearing aminoglycoside resistance genes. Of these 10 colistin-resistant *E. coli* isolates, 4 (3 from humans and 1 from a pig) were classified as potential ExPEC (Figure S1).

Lastly, no known mutations associated with colistin resistance were observed in *pmrAB*, *phoPQ* and *mgrB* from eight of the isolates, which could indicate the participation of other unknown gene(s) in polymyxin resistance in *E. coli*. However, two of the *E. coli* (LH57 and LH140) had a unique missense mutation of E375K in PhoQ. In silico analysis using PROVEAN software (http://provean.jcvi.org/seq_submit.php) predicted the mutation as deleterious and it may thus contribute to resistance by affecting the activity of PhoQ. Moreover, mutations in PmrAB, another two-component system, have been linked to colistin resistance in *E. coli* from animals.8 Daily subculturing of three colistin-resistant *E. coli* (LH1, LH57 and P10) in colistin-free Mueller–Hinton medium up to 30 passages resulted in one (P10) colistin-susceptible revertant (6 to 0.094 mg/L) at the 18th passage, indicating that colistin resistance is reversible in some *E. coli* strains and more stable in others.

Polymyxins, mostly in combination with other antibiotics in the form of premixes, are heavily used by farmers in South-East Asia.2,9 The unregulated use of polymyxins in animal farming could significantly contribute to the emergence of colistin resistance among zoonotic bacterial pathogens and such pathogens could find their way to humans. This is because antimicrobial drug use is regarded as the most powerful factor contributing to the emergence, selection and spread of antibiotic-resistant microorganisms and genes in animals and humans.10

### Table 1. Antibiotic resistance patterns and STs of colistin-resistant *E. coli* isolated from humans and pigs

<table>
<thead>
<tr>
<th>Antibiotic</th>
<th><strong>E. coli isolate (ST)</strong></th>
<th><strong>humans</strong></th>
<th><strong>pigs</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>LH30</strong> (ST4012&lt;sup&gt;a&lt;/sup&gt;)</td>
<td>R(4)</td>
<td>R(4)</td>
<td>R(4)</td>
</tr>
<tr>
<td><strong>LH57</strong> (ST3997&lt;sup&gt;a&lt;/sup&gt;)</td>
<td>R(4)</td>
<td>R(4)</td>
<td>R(4)</td>
</tr>
<tr>
<td><strong>LH1</strong> (ST4015&lt;sup&gt;a&lt;/sup&gt;)</td>
<td>R(6)</td>
<td>R(8)</td>
<td>R(6)</td>
</tr>
<tr>
<td><strong>LH121</strong> (ST4013&lt;sup&gt;a&lt;/sup&gt;)</td>
<td>R(6)</td>
<td>R(8)</td>
<td>R(6)</td>
</tr>
<tr>
<td><strong>LH140</strong> (ST3997&lt;sup&gt;a&lt;/sup&gt;)</td>
<td>R(6)</td>
<td>R(8)</td>
<td>R(6)</td>
</tr>
<tr>
<td><strong>LH257</strong> (ST4014&lt;sup&gt;a&lt;/sup&gt;)</td>
<td>R(6)</td>
<td>R(8)</td>
<td>R(6)</td>
</tr>
<tr>
<td><strong>P10</strong> (ST4015&lt;sup&gt;a&lt;/sup&gt;)</td>
<td>R(6)</td>
<td>R(8)</td>
<td>R(6)</td>
</tr>
<tr>
<td><strong>P6</strong> (ST4014&lt;sup&gt;a&lt;/sup&gt;)</td>
<td>R(6)</td>
<td>R(8)</td>
<td>R(6)</td>
</tr>
</tbody>
</table>

**AMX** | R | R | R | R | R | R |
**AMC** | I | I | I | I | I | I |
**CRO** | S | S | S | S | S | S |
**CTX** | S | S | S | S | S | S |
**ATM** | S | S | S | S | S | S |
**FOX** | S | S | S | S | S | S |
**TIM** | S | S | S | S | S | S |
**IPM** | S | S | S | S | S | S |
**TOB** | R | R | R | R | R | R |
**GEN** | R | R | R | R | R | R |
**AMK** | I | I | I | I | I | I |
**KAN** | S | S | S | S | S | S |
**CIP** | S | S | S | S | S | S |
**OFX** | S | S | S | S | S | S |
**SXT** | S | S | S | S | S | S |


<sup>a</sup>Novel ST.

<sup>b</sup>Broth microdilution method.

<sup>c</sup>Ettest.
immediate priority, the use of the same classes of antibiotics used in human medicine, such as colistin, in animal production, should be restricted. Moreover, colistin has been reclassified as ‘critically important’ for human medicine (www.who.int/foodsafety/publications/antimicrobials-third/en/).

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Transparency declarations
None to declare.

Supplementary data
Figure S1 is available as Supplementary data at JAC Online (http://jac.oxfordjournals.org/).

References