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LETTER TO THE EDITOR

# Is Fecal Carriage of Extended-Spectrum-β-Lactamase-Producing *Escherichia coli* in Urban Rats a Risk for Public Health?

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Brown rats (*Rattus norvegicus*) are synanthropic and inhabit urban infrastructures. Therefore, they might be involved in transmission pathways of zoonotic bacteria, including multiresistant "superbugs" like extended-spectrum beta-lactamase-producing (ESBL) *Escherichia coli* (1). According to our previous data, ESBL *E. coli* organisms are apparently present in the feces of urban brown rats from Europe (2, 3). As in these studies, however, nonselective media were used; they were not adequate to estimate an approximate rate of ESBL *E. coli* colonization of the gut of rats.

Thus, it is still necessary to determine the importance of the gut of urban rats as a reservoir for ESBL *E. coli* to verify if previous findings of ESBL *E. coli* might have been a coincidence, which would suggest a low relevance for the transmission of these bacteria by rats.

In 2010, we screened a total number of 56 brown rats for ESBL *E. coli* by plating fecal contents using selective CHROMagar (Mast Diagnostica, Reinfeld, Germany) supplemented with cefotaxime (4 μg/ml). The animals were obtained from 19 different sampling spots covering the inner-city area of Berlin (Germany). They were trapped during pest control procedures either in buildings and public areas like parks and streets ($n = 47$) or in sewer tunnels close to the wastewater discharge of a university hospital ($n = 9$). *E. coli* isolates with confirmed ESBL production according to a Clinical and Laboratory Standards Institute (CLSI) document (4) were further analyzed for (i) their phenotypic resistance to several antimicrobials by agar disc diffusion, (ii) their possession of antimicrobial resistance genes via PCR, and (iii) their phylogenetic background via multilocus sequence typing (MLST) and structure analysis. Their clonal relatedness was examined by means of pulsed-field gel electrophoresis (PFGE). All tests were performed using protocols described previously (3). Overall, 16% of the rats examined carried an ESBL *E. coli* strain. The detected rates not only were significantly higher than those reported for rats from China and Senegal (0.5% to 4%) (5–7) but also exceeded those that have been recently reported for healthy individuals from comparable urban settings (5% to 8%) (8–11). On the other hand, they were similar to the prevalence of ESBL *E. coli* in hospitalized patients or their household contacts (12% to 16%) (12). In particular, the high number of ESBL *E. coli* isolates determined among sewer rats, which were trapped near the wastewater discharge of a large hospital, might be an indication for high ESBL *E. coli* levels in the outflow and for a permanent transmission of these bacteria from clinical environments to the rat population. This may also explain the high diversity of ESBL-producing bacteria that have been found in a recent study in urban river sediments (13).

The most prevalent ESBL gene detected among the rat isolates was $bla_{CTX-M-1}$ (87.5%) (Fig. 1), which is common in human and livestock samples in Europe (14). All ESBL *E. coli* isolates harbored transferable large resistance plasmids of >100 kb belonging to inc/rep probe type FIA or FIB. Most of the isolates showed combined resistance to other antimicrobial classes, including fluoroquinolones, tetracyclines, and aminoglycosides (Fig. 1). Multilocus sequence types (STs) included ST10 (ST complex 10), ST410, and ST90 (both ST complex 23), and these are well-known STs frequently associated with an ESBL phenotype also in human and veterinary clinical isolates (14). ST90 ESBL *E. coli* strains representing a single clone could be traced via PFGE in three different animals over a period of 2 months (Fig. 1). This clone initially appeared in two animals captured in the same sampling spot in the sewage system within 2 weeks of each other. Six weeks later, it was recovered from a third animal in a nearby apartment (distance, 700 m), which the rat possibly entered through the toilet drain. This finding points toward a spread of ESBL *E. coli* from the sewage system to human infrastructures by rats, which might present an important vector within those cycles. The potential dissemination of different types of ESBL *E. coli* isolates by rats is further exemplified by one animal (no. 6) (Fig. 1) which carried two different strains. These varied in sequence type (ST10 versus ST34) and ESBL type (CTX-M-1 versus SHV-12). Furthermore, rats from the sewer tunnels carried ESBL *E. coli* isolates twice more often (33%) than did the total rat population sampled (16%). This may reflect a bias due to the small number of animals available from the sewage system ($n = 9$), which is a result of the legally restricted access to the sewage system in Berlin. We also observed that the rats tended to avoid the traps after one of their conspecifics had been captured. It must be conceded that the study is based on a limited number of animals. This is due to difficulties in rat sampling, which somehow reflects the obstacles leading to constricted pest control. Nevertheless, our results reveal that urban rats might be of importance with regard to public health, as they carry high rates of ESBL *E. coli* strains that have genotypes and ESBL types resembling those that currently circulate in human patients and thus have to be considered zoonotic. Urban areas are assumed to be populated by hundreds of thousands of rats (15,

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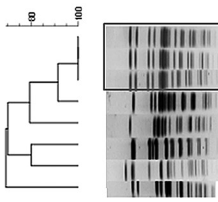

| Strain no. | Animal no. | Strain origin (date for clones) | ECOR group | ESBL type | Sequence type (ST) | Other resistance genes | Phenotypic resistance |
|---|---|---|---|---|---|---|---|
| IMT24151 | 48 | Building Berlin-Mitte 22.10.2010 | AxB1 | CTX-M1 | 90 | tet(A), strB, aacC4, aadA1-like | AMP, CTX, CAM,GEN,ENRO |
| IMT24166 | 42 | Sewage tunnel Berlin-Mitte 09.09.2010 | AxB1 | CTX-M1 | 90 | tet(A), strB, aacC4, aadA1-like | AMP, CTX,CAM, GEN, ENRO |
| IMT24169 | 41 | Sewage tunnel Berlin-Mitte 27.08.2010 | AxB1 | CTX-M1 | 90 | tet(A), strB, aacC4, aadA1-like | AMP, CTX,CAM, GEN, ENRO |
| IMT21905 | 35 | Building Berlin-Wedding 03.05.2010 | A | CTX-M1 | 2607 | tet(A), sul2 | AMP, CTX,TET,SXT |
| IMT21222 | 27 | Building Berlin-Wedding 28.04.2010 | AxB1 | CTX-M1 | 1284 | bla OXA-1, sul1, sul2, tet(A), tet(B), strB, aadA1-like, acc(6′)-Ib | AMP, CTX, TET,GEN, ENRO, SXT |
| IMT21151 | 06 | Sewage tunnel Berlin-Mitte 06.04.2010 | B1 | SHV-12 | 410 | blaTEM-1, blaSHV-1, tet(A), sul1, sul2, strB, aadA1-like, acc(6′)-Ib | AMP, CTX,TET,ENRO,SXT |
| IMT24154 | 49 | Building Berlin-Mitte 22.10.2010 | A | CTX-M1 | 10 | tet(A), tet(B), strB, aacC4 | AMP, CTX, TET |
| IMT21148 | 06 | Sewage tunnel Berlin-Mitte 06.04.2010 | A | CTX-M1 | 34 | blaOXA-1, tet(A), acc(6′)-Ib | AMP, CTX,TET,ENRO,SXT |

**FIG 1** Genotypic and phenotypic characteristics of ESBL-producing *E. coli* isolates from urban rats based on a dendrogram using XbaI-generated PFGE profiles (Bionumerics 6.5.; Applied Maths, Sint-Martens-Latem, Belgium). The data marked in gray are based on a similarity index of 100% for three *E. coli* strains representing a clone originating from three different animals, two different locations, and three different time points. Phylogenetic groups were determined by the software Structure 2.3.X, based on the concatenated sequences of the seven housekeeping genes used for MLST (http://pritch.bsd.uchicago.edu/structure.html).

16). Rat feces are therefore considered to be omnipresent and are most likely a permanent environmental source of zoonotic and multiresistant bacteria. There is an urgent need for holistic approaches comprising humans, animals, and the environment to explore putative transmission cycles of multiresistant ESBL *E. coli* strains in the future.

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