

# New gene that makes common bacteria resistant to last-line antibiotic found in animals and patients in China

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A new gene (*mcr-1*) that enables bacteria to be highly resistant to polymyxins, the last line of antibiotic defence we have left, is widespread in Enterobacteriaceae taken from pigs and patients in south China, including strains with epidemic potential, according to new research published in *The Lancet Infectious Diseases*.

The *mcr-1* gene was found on plasmids, mobile DNA that can be easily copied and transferred between different bacteria, suggesting an alarming potential to spread and diversify between different bacterial populations.

"These are extremely worrying results. The polymyxins (colistin and polymyxin B) were the last class of antibiotics in which resistance was incapable of spreading from cell to cell. Until now, colistin resistance resulted from chromosomal mutations, making the resistance mechanism unstable and incapable of spreading to other bacteria," explains author Professor Jian-Hua Liu from South China Agricultural University in Guangzhou, China.

"Our results reveal the emergence of the first polymyxin resistance gene that is readily passed between common bacteria such as *Escherichia coli* and *Klebsiella pneumoniae*, suggesting that the progression from extensive drug resistance to pandrug resistance is inevitable."

During routine testing of food animals for antimicrobial resistance in China, Liu and colleagues isolated an *E. coli* strain (SHP45) from a pig on an intensive pig farm in Shanghai that showed resistance to colistin that could be transferred to another strain. This prompted the researchers to collect bacteria samples from pigs at slaughter across four provinces, and from pork and chicken sold in 30 open markets and 27

supermarkets across Guangzhou between 2011 and 2014. They also analysed bacteria samples from patients presenting with infections to two hospitals in Guangdong and Zhejiang provinces. Samples were tested for antibiotic susceptibility and the *mcr-1* gene using polymerase chain reaction (PCR) and sequencing.

The researchers found a high prevalence of the *mcr-1* gene in *E. coli* isolates from animal (166 of 804) and raw meat samples (78 of 523). Worryingly, the proportion of positive samples increased from year to year (table 2). *mcr-1* was also found in 16 *E. coli* and *K. pneumoniae* isolates taken from 1322 hospitalised patients.

Importantly, the transfer rate (rate at which the *mcr-1* gene is copied and transferred between different bacteria) was very high between *E. coli* strains. Moreover, the researchers found that the *mcr-1* gene has the potential to spread into other epidemic pathogenic bacterial species such as *K. pneumoniae* and *Pseudomonas aeruginosa*, which can cause a variety of diseases from pneumonia to serious blood infections, suggesting that *mcr-1* is likely to spread rapidly into human pathogens.

"Because of the relatively low proportion of positive samples taken from humans compared with animals, it is likely that *mcr-1* mediated colistin resistance originated in animals and subsequently spread to humans," says co-author Professor Jianzhong Shen from China Agricultural University in Beijing, China. "The selective pressure imposed by increasingly heavy use of colistin in agriculture in China could have led to the acquisition of *mcr-1* by *E. coli*."

China is one of the world's largest users and producers of colistin for agriculture and veterinary use. Worldwide, the demand for colistin in



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