**The Emergence of MCR-1, the Bacterial Super-Gene**

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**Physicians rely on a certain class of antibiotic known as colistin in order to eliminate infections in which the typical antibiotics have no effect. New research has surfaced claiming that a strain of *E coli* was found including a gene known as MCR-1. This gene is believed to be completely immune to the effects of colistin. Research has also found that the gene isn’t a mutation, in fact it is believed to be able to transfer from one strain to another. So far the reach of this gene isn’t too large, however given the right pathways researchers believe it could spread and cause detrimental effects to the medical field. If a gene that makes bacteria resistant to the strongest antibiotic used finds its way into too many strains, human beings could be facing a time where physicians no longer have a treatment for infections.**

**Introduction**

When physicians encounter a bacterial infection, there’s a hierarchy of antibiotics that they will use in order to eliminate it. Most infections caused by Gram-negative bacteria can be treated using normal antibiotics such as ceftazidime-avibactam, also known as Avycaz3. Although, there is always a chance that the bacteria the physician is looking to expel is a part of the small percentage of Gram-negative bacteria that require a stronger antibiotic, such as the polymyxin known as colistin, which is usually that last line of defense. In most cases colistin is enough to eliminate the infection, but because of chromosomal gene mutations, antibiotic resistant bacteria have always been a possibility. Luckily, strains that are resistant due to mutation do not usually last very long in the environment because they exhibit low fitness. Bacteria can also show a resistance to antibiotics by a specific plasmid-mediated route, which is a characteristic that allows bacteria to transfer the resistance to other strains. Until a recent study by Liu, et al. (2016) reported on a strain of *E coli* found in China, there was no real knowledge of a specific strain of bacteria that could pass the colistin resistance on from cell to cell via horizontal gene transfer, thus making the last line of infection defense useless and increasing the likelihood of the strain spreading.

**Recent Progress**

Within the last few years, a group of scientists have been performing routine surveillance on possible *E coli* antibacterial resistance in Chinese agricultural animals. While performing these routine checks all throughout China, they discovered an important increase in what looked to be colistin resistance. They randomly selected a strain of *E coli,* which they dubbed SHP45, from a pig farm in Shanghai to use for any additional testing. Given that this resistance could either be plasmid mediated or caused by genetic mutation2, the group in China set out to pinpoint exactly why this strain of *E coli* was resistant to the strongest form of antibiotics we can use.

 Due to the extremely low chance that they stumbled upon a mutated colistin resistant *E coli* strain, their initial guess was that the increased resistance was plasmid mediated2, meaning the source was outside of the bacteria’s DNA and able to replicate independently. Using a series of sequencing techniques, they were able to narrow down the culprit to a gene they eventually labeled *mcr*-1. They tested further and discovered that the mechanism necessary for the bacteria to be resistant to colistin could be transferred between two different strains of *E coli* through bacterial conjugation, and even between *E coli* and different bacteria (*Klebsiella pneumoniae* and *Pseudomonas aeruginosa*)3 via transformation, which further shows that the gene was plasmid mediated and not just a result of a random gene mutation.

 Liu and colleagues then sought to find the specific gene responsible for the colistin resistance. They did this by sequencing the plasmid pulled from SHP45 and identifying the function of the genes within it, eventually finding that a gene named *mcr-*1 was responsible for antimicrobial resistance2. After identifying the gene behind the resistance, the study took a step further and looked to determine how likely *mcr*-1 was to spread. Samples of *E coli* were taken from a variety of pigs and chickens both in a slaughterhouse and from a local market. Samples were also taken from inpatients with *E coli* caused infections. While the percentage of resistant strains taken from these samples was small (15%, 21%, and 1% for marketed meat, animals, and inpatients, respectively) the data showed that even though the strain was mostly active in animals it had already established some group in infected humans as well2.

**Discussion**

While the article previously discussed focused on the spread of *mcr*-1 in China, other papers have found evidence of the gene in travelers throughout other parts of Asia as well as Peru, Bolivia, and Columbia1. Ultimately, this strain has come into contact with at least three continents through these humans. This is just a small sample of the numerous travellers imaginable who could eventually come in contact with unknowingly infected people who came in contact with infected meat. While the sample size collected by Liu and colleagues (2016) was fairly small in comparison to the amount of meat consumed by China, the fact that *mcr*-1 was significantly more prevalent in the sampled meats than in infected inpatients is important in illustrating where the resistance began. For decades, agriculturalists have used colistin as an antimicrobial for the animals being raised for slaughter, which eventually led to some strain of *E coli* present on animals becoming resistant to the drug through survival of the fittest. Since the meat being treated was directly processed for consumption, it was only a matter of time before the strain made the jump from animals to humans3.

These results bring forward a very important question: Why are agriculturists still using so much colistin in their treatment of meats? Now that researchers understand where the strain started, the continuation of colistin use in veterinary practices will only increase the selection pressure on the *mcr-*1 strain, thus increasing its prevalence in marketed meats and ultimately contributing to a possible outbreak amongst humans. Without a ban on veterinary antibiotics that overlap with those that are used in humans, this may not be the last antibacterial resistance we see. As stated in the article by Liu et al. (2016), we cannot simply ignore the facts surrounding this strain. If left ignored, the negative effects could include the possible eradication of usable antibiotics. Doctors could one day be faced with infections that even the strongest colistin cannot eliminate.

**References**

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