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Microbiology

Antibiotic-resistant bacteria in East and West London public settings

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ABSTRACT

High-frequency touched surfaces in public settings in London were found to have multidrug resistant staphylococci. They pose a risk to public health as they can transfer their antibiotic-resistant genes to more severe infectious bacteria.

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The discovery of antibiotics made many bacterial infections easily curable. However, today the world is facing a 'post-antibiotic era' crisis as bacteria are rapidly evolving new ways to resist antibiotics. Yearly, 700, 000 deaths are caused by bacterial infections that are untreatable with currently available antibiotics. This number could reach 10 million by 2050 if no global actions are taken to prevent it.

Antibiotic resistance has always been present in the environment before its mass production. However, the overuse of antibiotics resulted in an increase in antibiotic-resistant bacteria, many being resistant to multiple drugs. For bacteria to survive in areas with high antibiotic usage, they have to adapt. The bacterial isolates that do not adapt (sensitive ones) simply die, but those that have been selected (resistant ones) survive. Antibiotic-resistant bacteria are commonly found in areas of high usage of antibiotics, e.g., hospitals and animal farming, but can spread to other areas via people or food.

Staphylococci, a group of bacteria commonly found on human skin, have the potential to adapt quickly and become antibiotic-resistant. These bacteria are generally harmless but can cause infections if an opportunity presents itself. These infections can range from simple skin infection (e.g., boils) to more severe infections, including sepsis and meningitis. Although the majority of staphylococci infections are treatable, more and more of them are becoming challenging to treat due to these bacteria developing resistance to multiple antibiotics. This includes well-

known superbug methicillin-resistant *S. aureus* (MRSA), which has been associated with healthcare, farm animals, and the environment.

Many studies have focused their research on multidrug-resistant staphylococci in hospitals. Still, little is known about the levels of antibiotic resistance in the environment, e.g., general public settings. In our study, we collected samples from high frequency touched surfaces in public settings. This included areas that were considered general public settings (shopping centres and trains stations) and public areas in hospital (reception areas, corridors and washrooms) from East and West London. From each area, we swabbed 50 high frequency touched surfaces (door handles, stair rails, toilet flusher, etc.). We determined the bacterial species and tested their resistance to 11 different antibiotics. We further investigate 49 isolates by sequencing their entire genome to identify the whole arsenal of antibiotic resistance genes they may have.

Of 600 isolates that we recovered, 281 were multidrug-resistant and belonged to 11 different staphylococci species. Penicillin was the most common antibiotic that the strains were resistant to, followed by fusidic acid and erythromycin. We were able to determine that there was a higher abundance of multidrug-resistant staphylococci in East London in comparison to West London. We also observed a higher abundance of multidrug-resistant staphylococci in public areas in hospital areas compared to general public settings. Forty-nine staphylococci isolates that we sequenced had 24 different genes responsible for antibiotic resistance.

These results show that high-frequency touched surfaces in public settings areas in East and West London harbour high levels of multidrug-resistant staphylococci belonging to different species. Multidrug-resistant staphylococci can spread to varying surfaces via hand contact, which can further spread to members of the public. The high abundance of antibiotic-resistant bacteria in East London (compared with West London) may be due to higher population density in East London. As for the higher abundance of multidrug-resistant bacteria in public areas in hospitals (then the general public setting) is undoubtedly due to higher usage of antibiotics.

Staphylococci species that were found in our study are unlikely to cause severe infections in most people. However, they still pose a risk to those who are immunocompromised. Also, antibiotic resistance genes can transfer across to human pathogens enabling them to resist multiple antibiotics. Therefore, further research is necessary to understand the levels of multidrug-resistant bacteria in public settings and the risk they may pose to the general public health. As these results were only a snapshot of a small area, it still not fully understood how widespread antibiotic-resistant bacteria are in the public setting environments.