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EDITORIAL

Antibiotic stewardship programs should include disinfectants and biocides

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Rising antimicrobial resistance (AMR) is considered a public health emergency since the practice of modern medicine is completely dependent on being able to treat infections with effective antibiotics [1]. The overuse and misuse of antibiotics over decades has been noted as the reason for AMR. Efforts to decrease the selection of AMR has led to carefully crafted antibiotic stewardship guidelines that are practiced in many countries but are not yet universal. Antibiotic usage in agriculture and animal farming is a cause of AMR. Although antibiotic use for animal growth promotion is inappropriate, it is essential to treat plant and animal infections.

During the COVID-19 pandemic, overwhelmed emergency room physicians, neglected to practice antibiotic stewardship and overused antibiotics, especially broad-spectrum ones like ceftriaxone, which were commonly administered with azithromycin, to patients hospitalized with COVID-19 [2]. Although it was known that these antibiotics were ineffective against SARS-CoV-2, it was believed that these antibiotics would decrease secondary bacterial pneumonia that occurs frequently after viral pneumonia as has been seen with influenza. The US Center for Disease for Disease Control and Prevention (CDC, Atlanta, Georgia, USA) has stated that after this overuse, isolation of resistant bacteria has increased in hospitals [3]. In addition to increased antibiotic usage during the COVID-19 pandemic, disinfectants and biocides were sprayed liberally in public areas and in homes. Post-pandemic, this practice of spraying and wiping clean with disinfectants, is now commonly used to re-assure individuals that they are protected from COVID-19.

In this Issue of the Journal of Antibiotics, Baig et al. have reviewed emerging resistance to antimicrobial agents resulting from the use of non-antibiotics, such as disinfectants, biocides, and preservatives [4]. It calls to attention the shared mechanisms of resistance between antibiotics and non-antibiotics and that it is yet another cause for the increasing numbers of antibiotic resistant microorganisms. This review is focused on bacteria, but resistant fungal pathogens are also likely to occur. The negative side of exposure to chemical disinfectants is that these products can also be selected for AMR. Many disinfectants such as triclosan, chlorhexidine and even chlorine can induce efflux pumps in bacteria which lower the susceptibility of these bacteria to these agents as well as to antibiotics [5]. Quaternary ammonium compounds are used as food preservatives and as surfactants in detergents. These compounds are also selected for AMR in pathogens like Enterobacterales, *Pseudomonas aeruginosa* and *Acinetobacter baumannii* that have been named by the WHO as priority pathogens. Bacteria expressing efflux pumps have a lower hurdle to acquire mutations or plasmids carrying higher levels of antibiotic resistance [6–9]. Owing to the increasing awareness of the ability of agents like triclosan to select for AMR, they are no longer recommended for use in hand-washing soaps [10]. Hypochlorite solutions are commonly used for disinfection, but bacteria that are not killed when exposed to non-lethal concentrations, can acquire efflux pump, and have decreased susceptibility. Solutions of isopropyl alcohol and ethyl alcohol are the most frequently recommended disinfectants, and these can be safely used [10].

In addition, to disinfectants, the review also describes the effect of heavy metals such as silver, zinc, and copper that are commonly used in pharmaceuticals, cosmetics, and equipment manufacture, on the selection of AMR organisms. As example, silver salts are commonly used in surgical bandages. Zinc lozenges are available over the counter in pharmacies to prevent the common cold. Heavy metal content of cosmetics has been studied by the US Food and Drug Administration (FDA) and most have been found in exceedingly small amounts [11]. However, their surveys

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showed that products such as eye shadows, blushes, and compact powders contained more heavy metals than other types of cosmetics.

Although the authors recommend additional regulations on the controlled use of these non-antibiotic products like disinfectants and biocides, it is appropriate to increase the education on their uses and extend stewardship programs to include disinfectants to decrease selection for resistant pathogens. The close relationship between microbial flora and humans and animals is essential for health and well-being. Microbes have evolved many means to protect them in harsh environmental conditions and from products that range from antibiotics to biocides to disinfectants. Bacteria will use whatever resistance mechanism they need to survive. The environment also has normal microflora and trying to create sterile public spaces may only invite disinfectant- and antibiotic-resistant organisms to occupy the space. The concept of One Health is key to slowing AMR and should extend beyond antibiotic stewardship to disinfectant stewardship also.

Compliance with ethical standards

Conflict of interest The author declares no competing interests.

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