Excerpt from the Scientific Committee on Emerging and Newly Identified Health Risks

Assessment of the Antibiotic Resistance Effects of Biocides

(The SCENIHR adopted this opinion after public consultation on 19 January 2009)

Does current scientific evidence indicate that the use of certain active substances in biocidal products in various settings can contribute to the occurrence of antibiotic resistant bacteria, both in humans and in the environment?

Yes, current scientific evidence (including bacteriological, biochemical and genetic data) does indicate that the use or misuse of certain active substances in biocidal products in various settings may contribute to the increased occurrence of antibiotic resistant bacteria, both in humans and in the environment.

If yes, which types of areas of application create the highest risks for increasing antibiotic resistance?

Any application that encompasses the widespread regular use of biocides at sub-lethal concentrations maintains a continuous selective pressure and thus increases the risk of selecting resistant bacteria. This may occur in a number of uses including hospitals, food production and cosmetics manufacturing etc.

Antimicrobial molecules include antibiotics and biocides having a bactericidal/ bacteriostatic effect on bacteria.

Active substances:

The number of biocides in use is large. In the context of this mandate, biocides used for their surfactant properties, and for which the primary purpose is not their antimicrobial activity will not be considered.

Some of the components that are commonly found in household products are surface active agents (surfactants). Surfactants have an intrinsic antibacterial activity (anionic, non-ionic, organic acids [active against Gram-positive bacteria] and compounds with alkyl chains [active against both Gram positive and negative bacteria]) (Birnie et al. 2000)

Surface Active Agents (Surfactants)
Cationic agents (QACs)
Anionic agents
Nonionic agents
Amphoteric (ampholytic) agents

Antibiotic Resistance Effects of Biocides Type of antimicrobial (intrinsic potential for generating resistance)

Based on our current state of knowledge and literature based evidence from mainly in vitro studies, bacteria have been shown to be able to withstand biocide exposure. The mechanisms by which bacteria can escape damage from biocides are complex and multiple, and are governed by a number of factors inherent to the biocide (e.g. concentration, contact time etc.) and to the bacteria (e.g. type, metabolic activity). However, some biocides, because of the nature of their interaction with the bacteria, would be more prone to induce resistance/tolerance. This group of high-risk biocides contains the quaternary ammonium compounds, biguanides (i.e. surface active agents) and phenolics. Metallic salts, such as silver could also be added to this list based on practice-based evidence from the 1960s-1970s.

Highly reactive biocides such as oxidizing agents and alkylating agents would present a low risk when emerging bacterial resistance is concerned. This means that resistance is unlikely but not impossible. Examples of resistance to these biocides have been described, but they resulted mainly from an inappropriate usage of the biocide.

Finally, for a number of biocides used heavily in consumer products and in the food industry (e.g. isothiazolones, anilides, diamidines, inorganic acids and their esters, alcohols), there is little information available on emerging resistance/tolerance when bacteria are exposed to their in-use concentrations. However, because of the nature of their interaction with the bacterial cell and their antimicrobial efficacy, these biocides would have to be classified for the time being as being of a medium risk in terms of emerging bacterial resistance until they can be properly assessed.

Biocides are invaluable compounds that provide society with numerous benefits. They play an important role in the control of bacteria in a variety of applications. They are a precious resource that must be managed to avoid any loss in activity for as long as possible. Therefore, in order to preserve the role of biocides in infection control and hygiene, it is paramount to prevent the emergence of bacterial resistance and cross resistance through their appropriate and prudent use.

Considering the high uncertainty in the in vivo evaluation of the effects of biocides on the emergence of antibiotic resistance, reporting of production and use of biocides should be promoted.

Environmental monitoring programs for undesirable substances should include biocides.

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