**Genetically encoded nanosilver resistance in priority pathogen**

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**Introduction –** Nanosilver (NAg) with its broad spectrum antimicrobial efficacy has been used as alternative technologies to control microorganisms. The rapid rise of antibiotic resistance has led to the growing momentum of engineering and applications of the nanoparticle.[1,2] NAg has been incorporated not only in medical devices to fight infections, but also, worryingly in increasing arrays of consumer products. This indiscriminate use has led to an escalating concern that, just like antibiotics, bacteria will develop resistance to the nanoparticle.

**Fig. 1.** Rapid growth of nanosilver-resistant bacteria under toxic nanosilver exposure.

Image courtesy: Australasian Science.

**Results –** Our team has found that bacteria can develop resistance to NAg (Fig. 1). Bacteria can grow in an otherwise toxic concentrations of the nanoparticle, following prolonged exposures. Our recent work reports the ability of a WHO-listed priority pathogen to evolve genetic resistance to NAg.[4] Known for its high level of antibiotic resistance, the pathogen has been perceived to have no, or very low capacity for silver resistance. Indeed, we found that the bacterium is able to mutate its genes to adapt to the nanoparticle toxicity. These single letter DNA mutations on physiological genes are passed onto daughter cells, rendering a heritable resistance determinants that reduces the NAg efficacy.

**Conclusion –** With the now widespread use of NAg, research inquiries have detected release of toxic silver species in soil and natural waters, as well as, in human organs and tissues [1]. The observations of the development of heritable resistance traits in bacteria are relevant to wider microbial communities, presenting consequences of extensive microorganism exposure. The acquired resistance traits can spread even following discontinuation of the nanoparticle exposure.

**References**

[1]. (a) Gunawan, C., Marquis, C.P., Amal, R., Sotiriou, G.A., Rice, S.A., Harry, E.J. (2017) ACS Nano, 11, 3438-3445 (b) [http://www.nanowerk.com/nanotechnology-news/newsid=46282.php](http://www.nanowerk.com/nanotechnology-news/newsid%3D46282.php) (c) <https://phys.org/news/2017-03-rampant-antibacterial-nanosilver-resistance.html>

[2] Gunawan, C., Teoh, W.Y., Marquis, C.P., Lifia, J., Amal, R. (2009) Small, 5, 341-344; A.L. Chun (2009) Nature Nanotechnology Research Highlights doi: 10.1038/nnano.2009.18

[3] Faiz, M.B., Amal, R., Marquis, C.P., Harry, E.J., Sotiriou, G.A., Rice, S.A., Gunawan, C. (2018) Nanotoxicology, 12, 263-273

[4] (a) Gunawan, C., Teoh, W.Y., Marquis, C.P., Amal, R. (2013) Small, 9, 3554-3560 (b) <http://www.arc.gov.au/news-media/news/resilient-bacteria-adapt-nanosilver> (c) <http://www.sciencealert.com/bacteria-adapt-to-nanosilvers-sting>