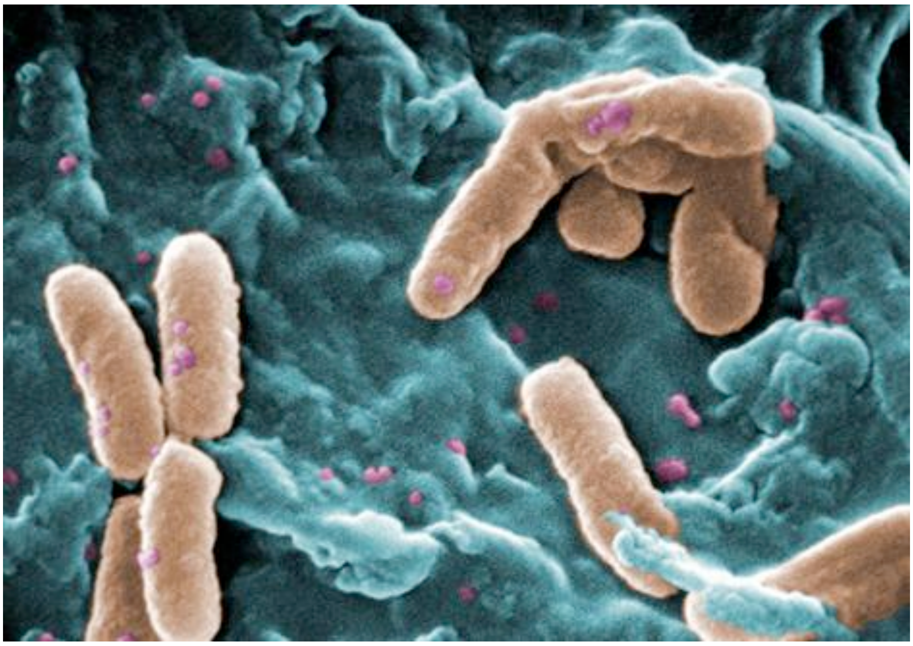
Slime cities & bacteria signals

Pete Wilton 23 Feb 09



Stuart West, who recently joined Oxford's Department of Zoology, has just published in Current Biology about his research into how bacteria cells interact.

I asked Stuart about what bacteria working together or cheating each other means for infection in humans:

OxSciBlog: What are the social interactions that go on between bacterial cells?
Stuart West: Bacteria cooperate to perform a wide range of functions. They secrete a number of factors out of the cell that then provide benefits to the local group - for example to scavenge nutrients, aid movement, overcome their host, kill and degrade prey, kill competitors and degrade antibiotics. They join together to form 'slime cities' (biofilms). Many of these behaviours are controlled by a social signalling system that has been termed 'quorum sensing' and which appears to switch on cooperative behaviours when they are most beneficial, which is when population densities are high.

OSB: How do these interactions affect the overall virulence of an infection?
SW: Hugely. These cooperative behaviours are crucial to the growth of bacteria and the damage that they do to their host. Indeed, many of these traits are also termed 'virulence factors'.

OSB: What is 'quorum sensing' and why is it important to understand it?
SW: Quorum sensing (QS) is the process where bacteria use small molecules diffusable molecules as signals which control other behaviours. The signal molecules are secreted out of the cell, and can then be taken up by the same cell or other cells nearby. This uptake has two effects.

First, it stimulates the production of many products that are realeased out into the environment, and which are 'public goods' that benefit the local bacteria. Second, it leads to an increase in production of the signalling molecules themselves. At high cell densities this leads to a positive feedback that markedley increases the production of factors released by the cell. The idea here is that QS turns on the production of these extracellular public goods when it is most useful to do so: at high densities.

From a pure science perspective, QS is interesting, because signalling and communication can be hard to explain from an evolutionary perspective, because they are exploitable by individuals that lie and cheat. From an applied perspective, QS is fundamental to the success and virulence of pathogenic bacteria.

OSB: How might your findings help in the search for new ways to combat infection?
SW: One way is that cheats that do not perform cooperative behaviors such as QS could be introduced into hosts to outcompete wild-type cooperators. As well as directly reducing virulence, this could drive down the bacterial population size, which may benefit other intervention strategies such as treatment with antibiotics. Another way is that other beneficial traits, such as antibiotic susceptibility, could also be hitch-hiked into infections by such cheats who do not perform QS or other social behaviours.

Stuart West is Professor of Evolutionary Biology at Oxford's Department of Zoology.

SEM of Pseudomonas bacteria studied by Stuart West. Credit: Janice Haney Carr

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