

# nature REVIEWS

## NATURE REVIEWS MICROBIOLOGY

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Original design by Jane Walker

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Printed in Wales by Cambrian Printers on acid-free paper

Bacterial toxins were the first virulence factors to be identified and studied in detail. Indeed, these molecules represented the inspiration for those microbiologists who initially proposed the concept of the virulence factor. Since those early days, many bacterial toxins have been studied, and it is now clear that there is a staggering diversity in toxin properties and modes of action. In this issue of *Nature Reviews Microbiology*, two articles on quite different aspects of toxin biology emphasize the diversity and versatility of these fascinating molecules.

Since the discovery that *Helicobacter pylori* infection leads to gastric cancer, it has become increasingly clear that some bacteria and their toxins can contribute to carcinogenesis. The molecular mechanisms involved, however, remain unclear. Nevertheless, many bacteria that cause persistent infections produce toxins that specifically disrupt cellular signalling to perturb the regulation of cell growth or to induce inflammation, whereas others produce toxins that directly damage DNA. On page 343, Alistair Lax reviews the evidence — both epidemiological and molecular — for the oncogenic potential of these bacterial products.

A substantial fraction of the functional versatility that is attributed to bacterial toxins derives from their capacity to cause multiple cellular effects. By producing toxins with multifunctional properties, bacteria are able to use a single protein to produce a wide range of effects at different sites in the host, depending on which cell types and tissues are targeted. On page 320, Timothy Cover and Steven Blanke review the pleiotropic effects of the vacuolating cytotoxin (VacA) of *H. pylori* — the authors contend that this molecule is an important model for understanding the actions of multifunctional toxins that contribute to bacterial pathogenesis in numerous ways.



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