Scientists create first viable mathematical model of a key anti-Salmonella defense system

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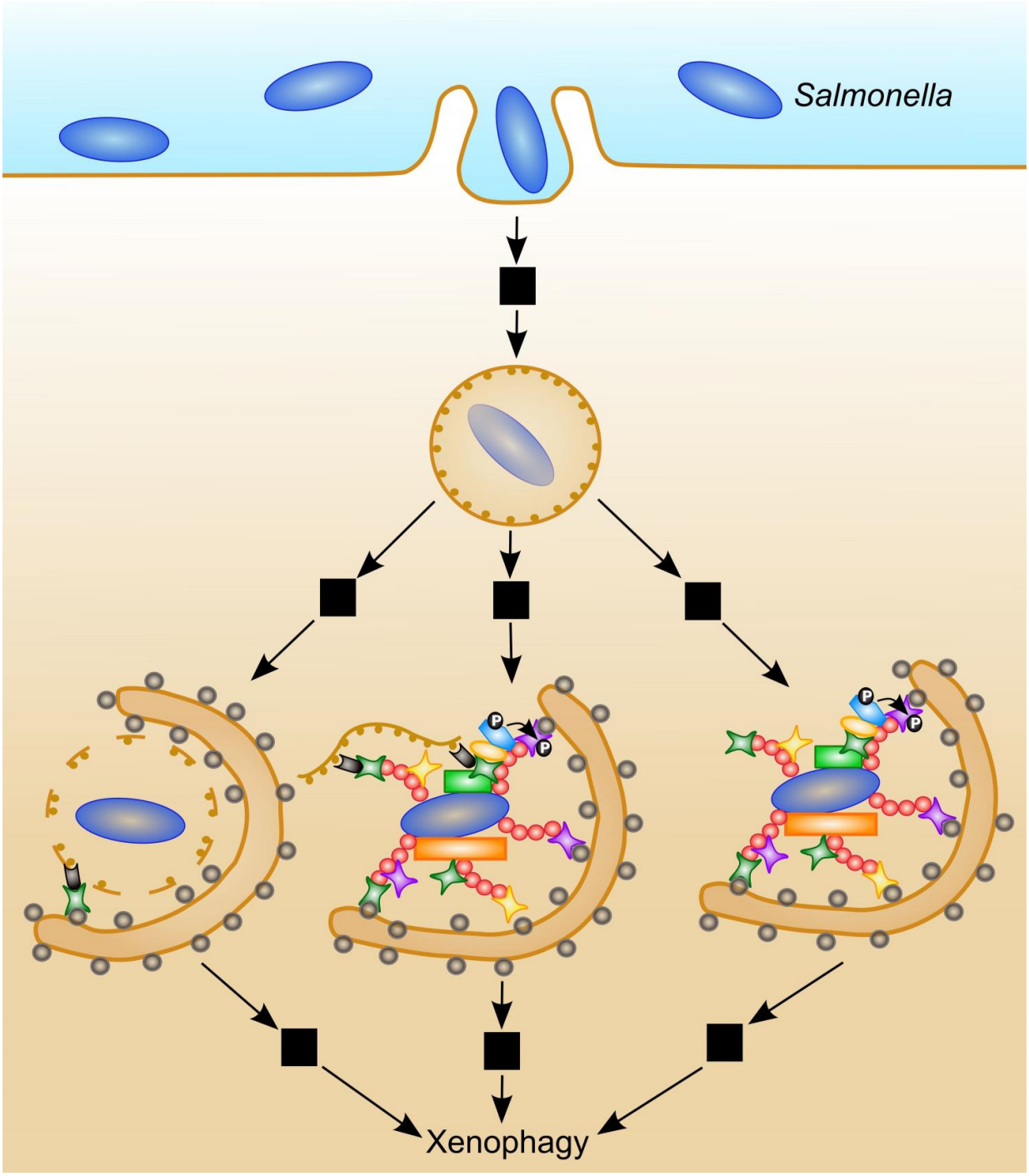

Mathematical model of a key anti-*Salmonella* defense system, a process called xenophagy. Credit: Scheidel et al.

Scientists have created the first validated mathematical model of an important cellular defense mechanism against the bacterium *Salmonella*, according to a new study in *PLOS Computational Biology*.

Worldwide, *Salmonella* is responsible for millions of infections and thousands of deaths every year. When *Salmonella* enters a human cell under certain conditions, a process called xenophagy may target the bacterium for destruction. Understanding how cells defend against *Salmonella* is essential to develop new treatments, but xenophagy is not yet well-understood.

In the new study, "wet lab" scientist Ivan Dikic and the bioinformatics team of Ina Koch at Goethe University Frankfurt used existing knowledge of molecular interactions, combined with a computer science technique called Petri nets, to build a mathematical model of xenophagy.

To test the model, the researchers investigated what would happen when several proteins in the xenophagy process were virtually perturbed—a technique known as in silico knockout. The results of this computer-based perturbation were consistent with data from lab experiments in which the same proteins were perturbed, confirming that the model accurately reproduces known parts of the xenophagy process.

The scientists also proposed a potential new mechanism for one of the proteins involved in the xenophagy process. This and other hypotheses suggested by further in silico knockout investigations could be tested in lab experiments.

"The in silico knockouts formulate hypotheses for future experimental studies towards a better understanding of the cellular antibacterial defense and towards a better treatment of illnesses caused by *Salmonella* infection," says study first author Jennifer Scheidel.

More information: Scheidel J, Amstein L, Ackermann J, Dikic I, Koch I (2016) In Silico Knockout Studies of Xenophagic Capturing of Salmonella. *PLoS Comput Biol* 12(12): e1005200. DOI: 10.1371/journal.pcbi.1005200