

Evolutionary management of drug resistance

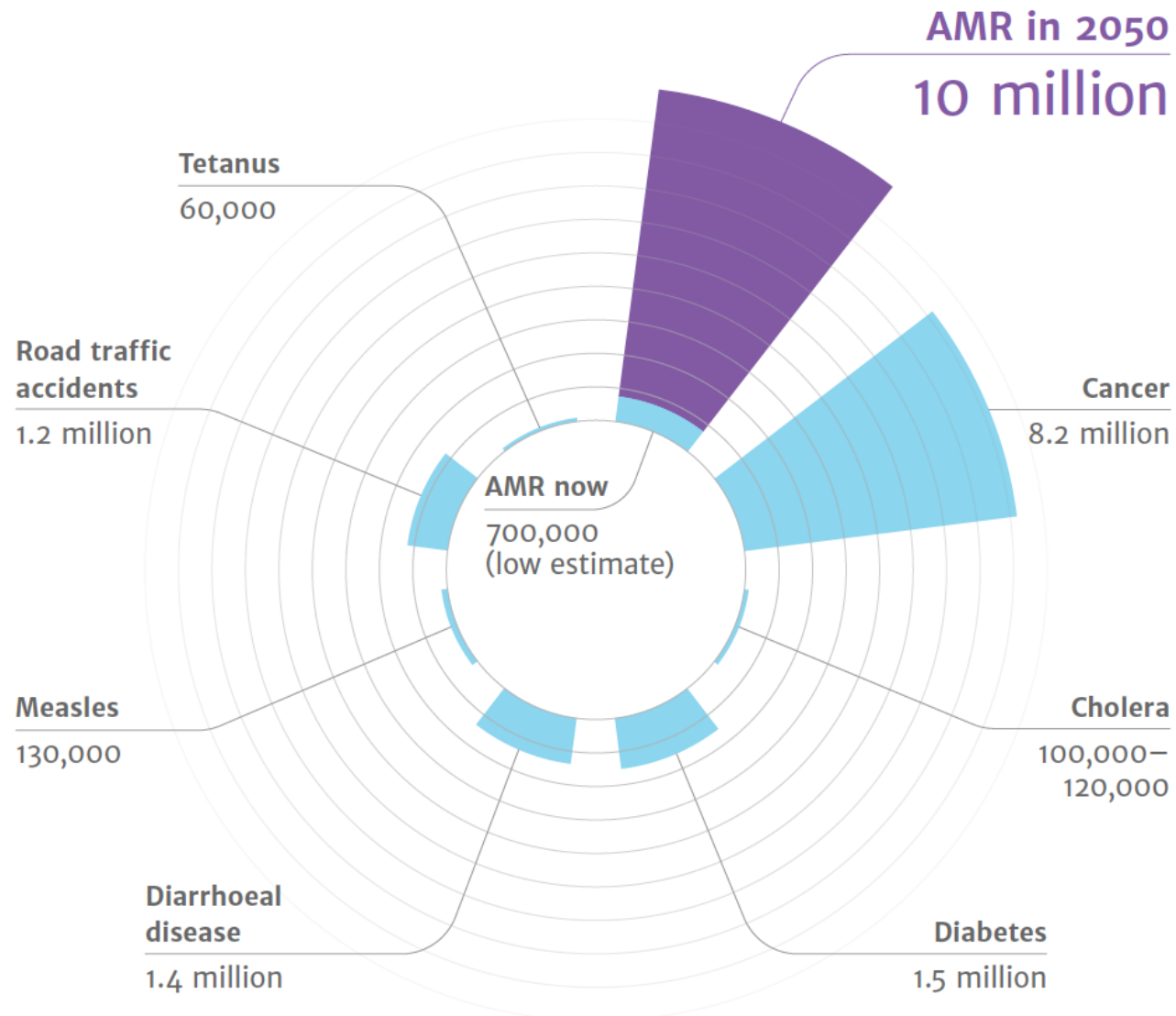
Jens Rolff



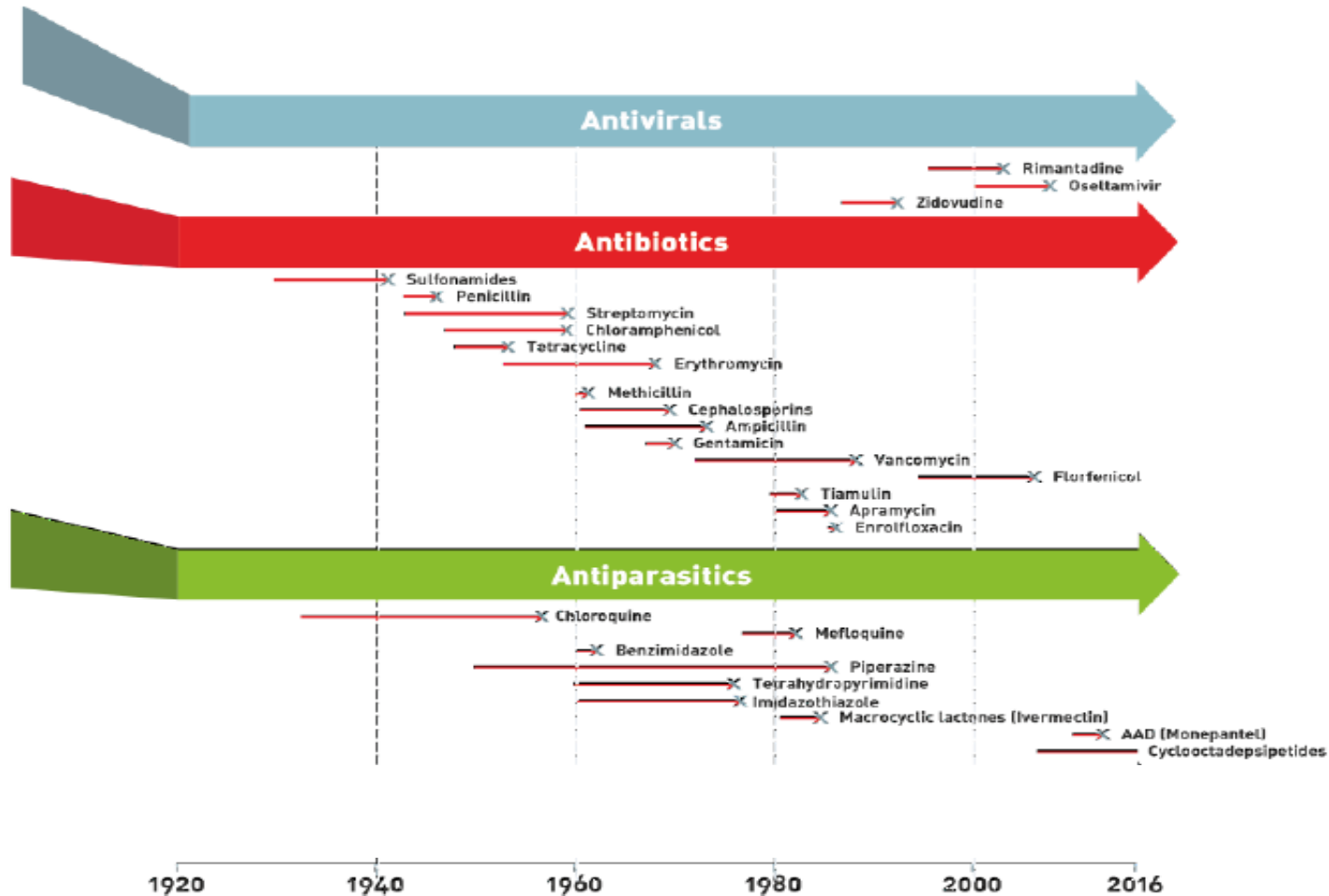
The end of antibiotics? Health chief warns we will soon have to treat the sick with 'fresh air and sunshine'

- The UK's chief medical officer has warned of 'post-antibiotic' era

Post-antibiotic era?



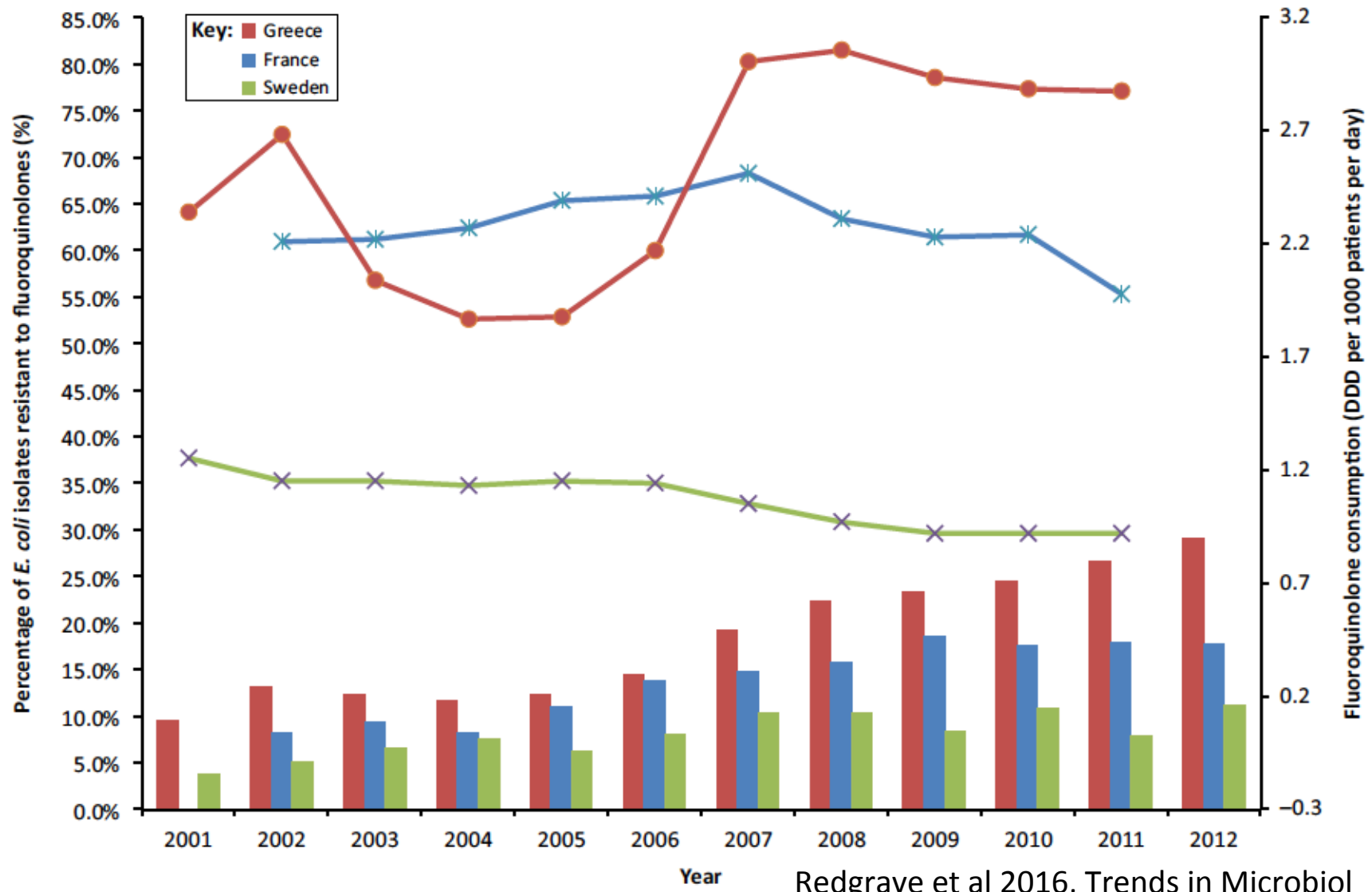
Resistance evolves readily



after Kennedy and Read 2017, modified by Greco, Samson-Himmelstjerna

What now?

Prudent use helps



Redgrave et al 2016, Trends in Microbiol

Prudent use works
New antibiotics work
But not sufficient

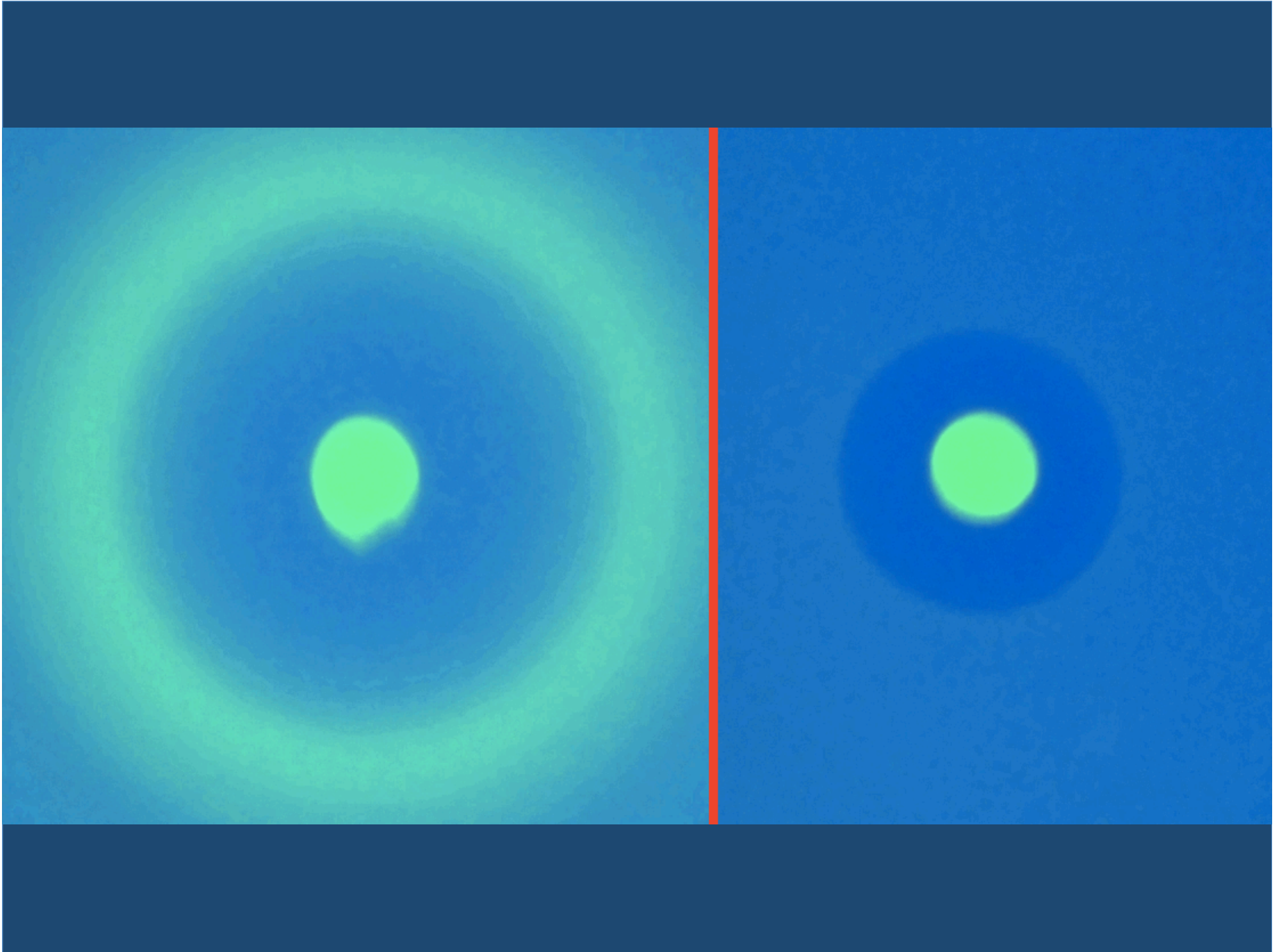
Insects as inspiration?



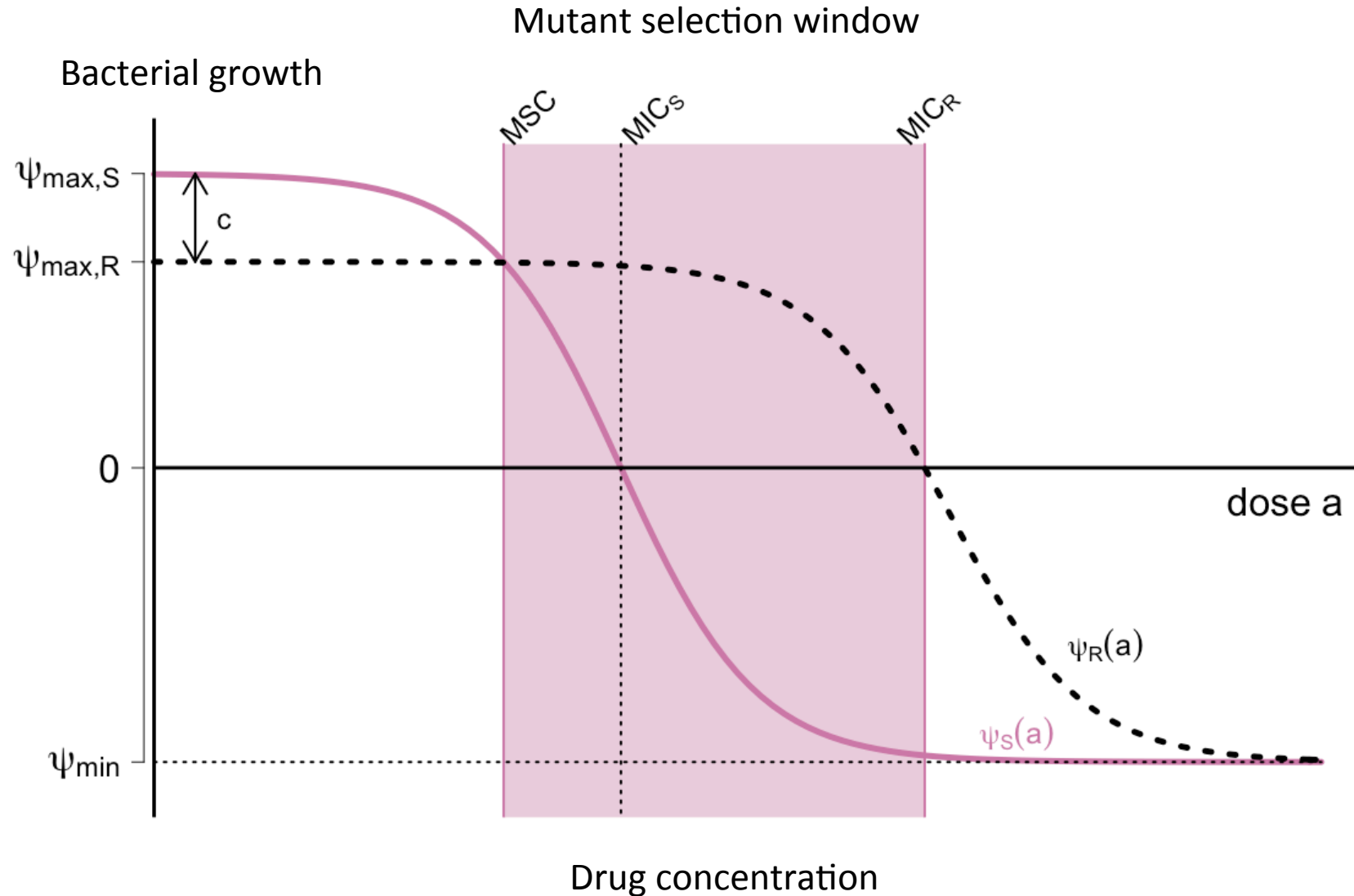
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Mealworm beetle (*Tenebrio molitor*)

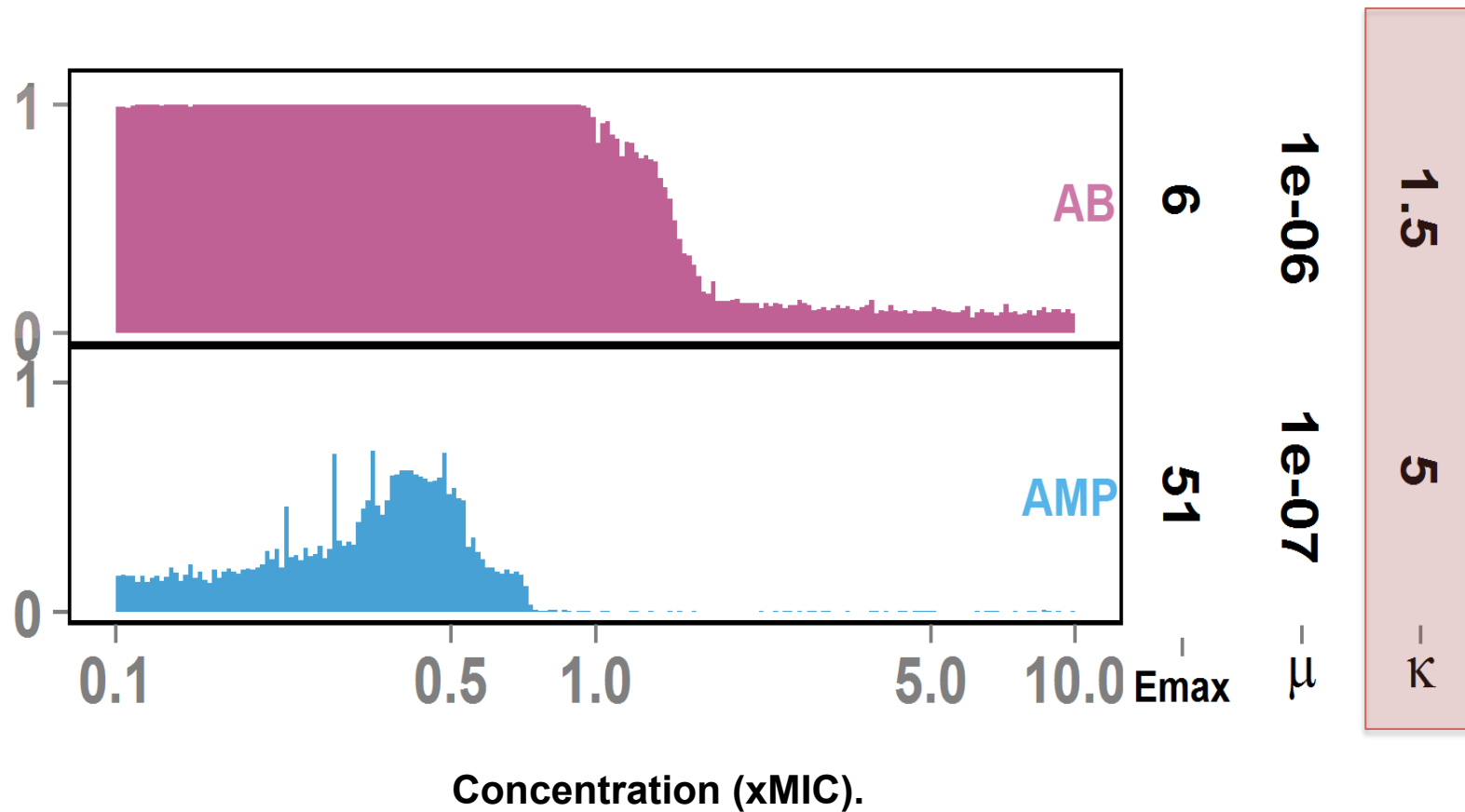


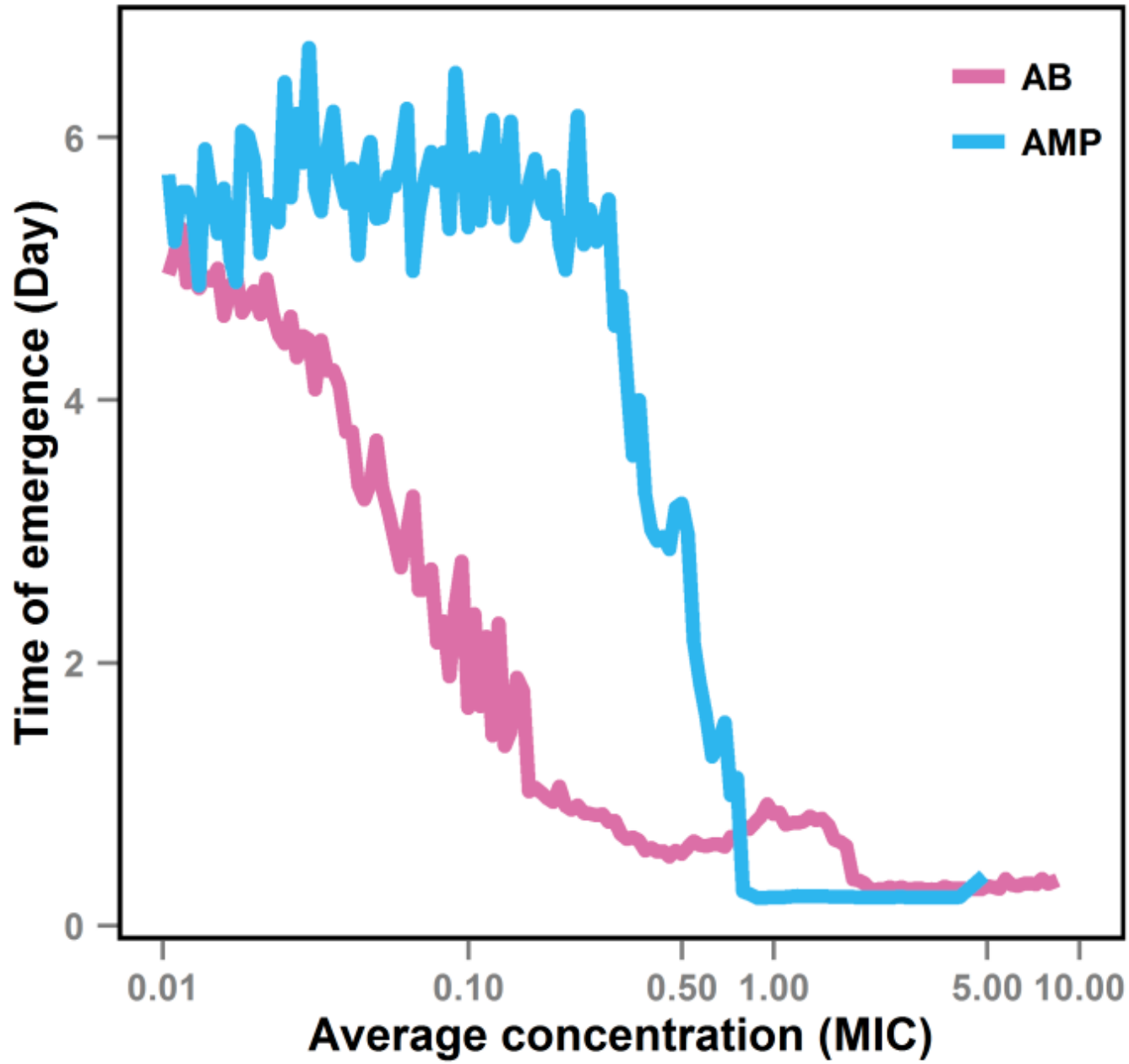


Pharmacodynamic interlude



Probability of resistance evolution





Outlook

Proactive - reactive

Discovery

Introduction

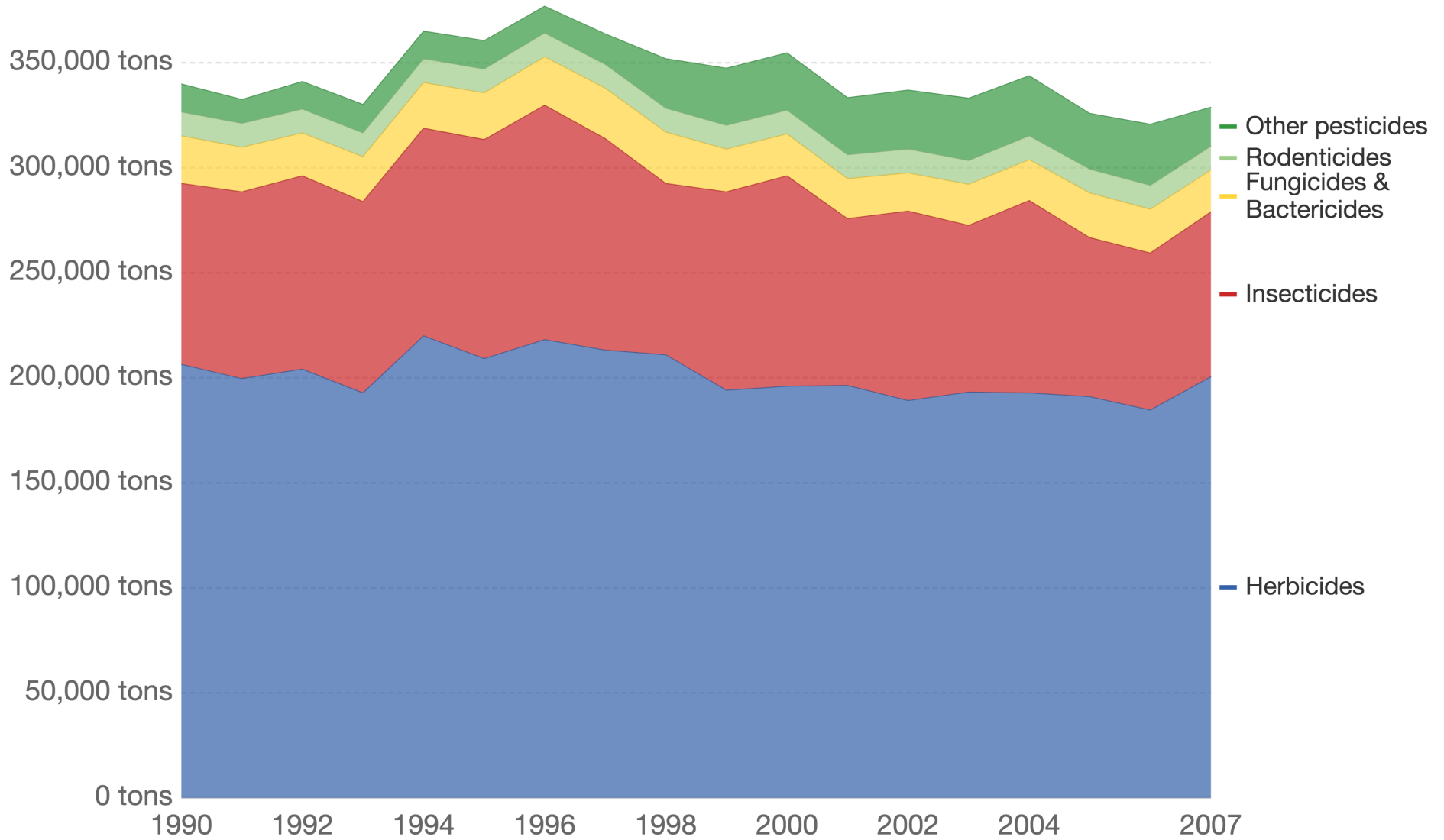


Resistance evolves

time

Pesticide breakdown by type, United States

Pesticide use, broken down by product type, measured in tonnes of active ingredient.



Source: UN Food and Agricultural Organization (FAO)

OurWorldInData.org/fertilizer-and-pesticides/ • CC BY-SA

Everyday Evolution Revealed in Flu Shots

By Allison MacLachlan, National Institutes of Health | October 6, 2011 03:14pm ET

f 130

51



MORE ▾

in cooperation with

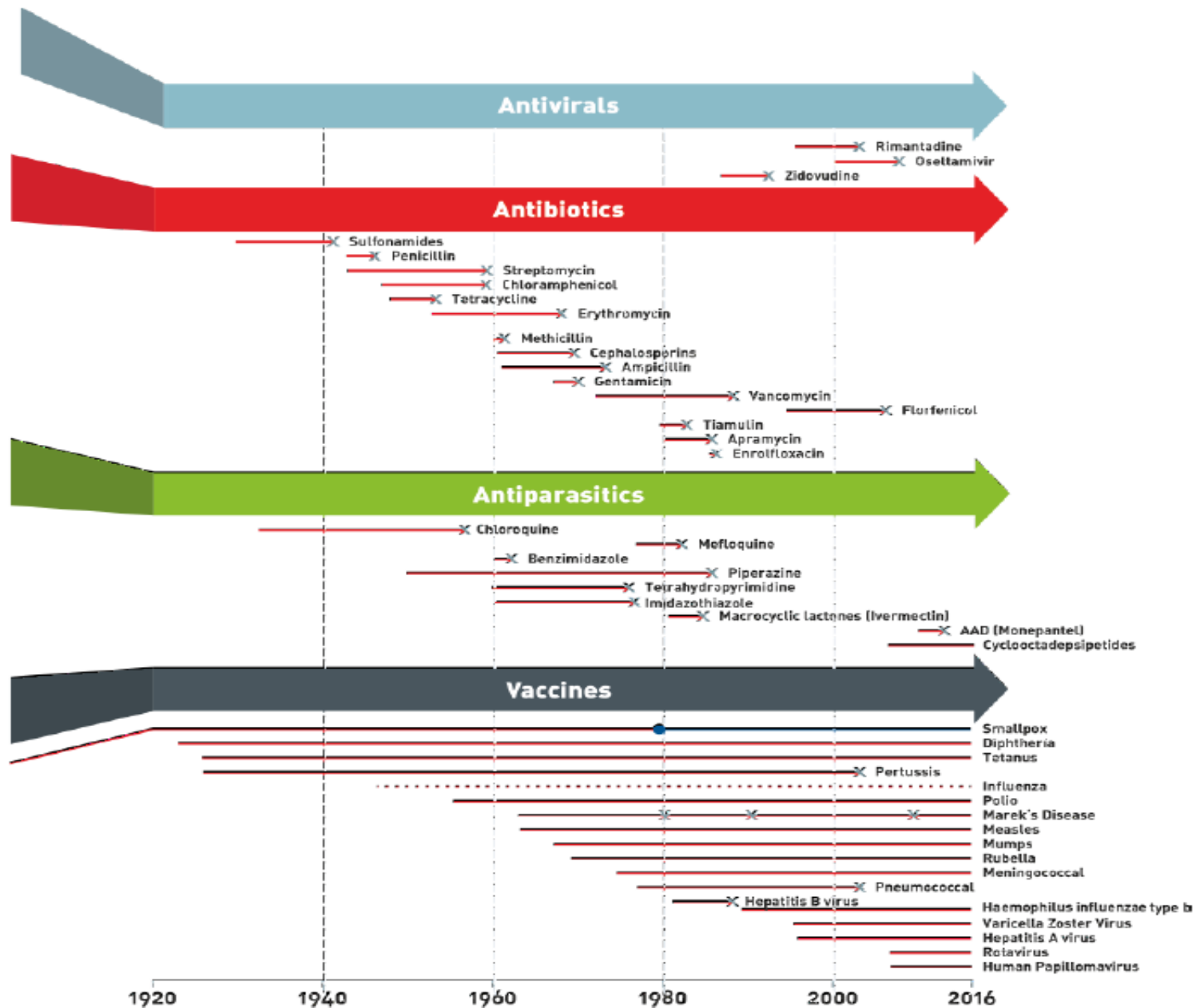


National Institute of
General Medical Sciences



Flu viruses replicate quickly, so the helpful antibodies you may have developed to a previous year's strain often can't attach to this year's viruses. In other words, viruses evolve and so must the vaccines.

Credit: CDC



after Kennedy and Read 2017, modified by Greco, Samson-Himmelstjerna

Thank you

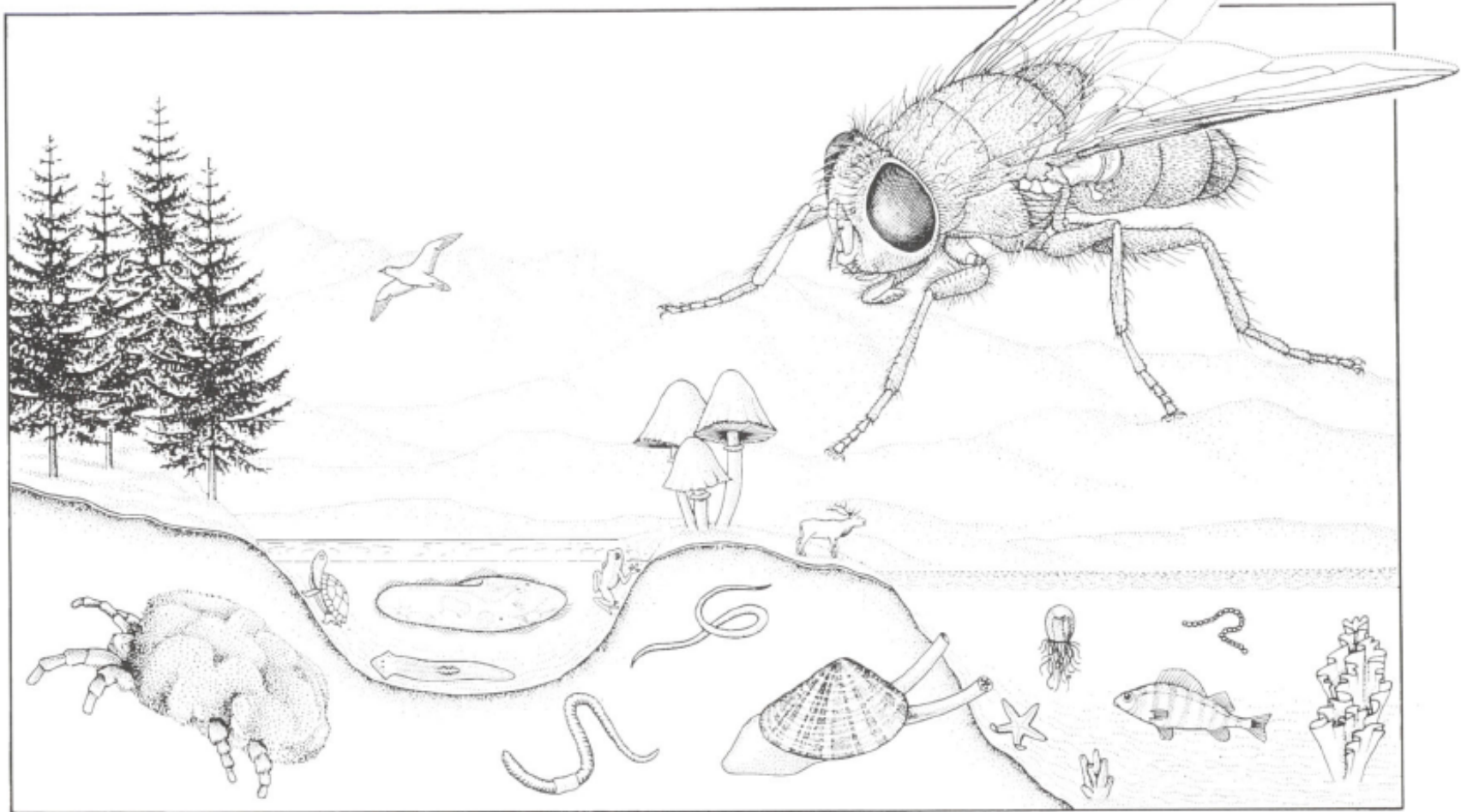


Desiree Baeder, Roland Regoes

ETH zürich



DFG



Ecological immunologyexamines the causes and consequences of variation in immune function in the context of evolution and of ecology
Rolf and Siva-Jothy 2003

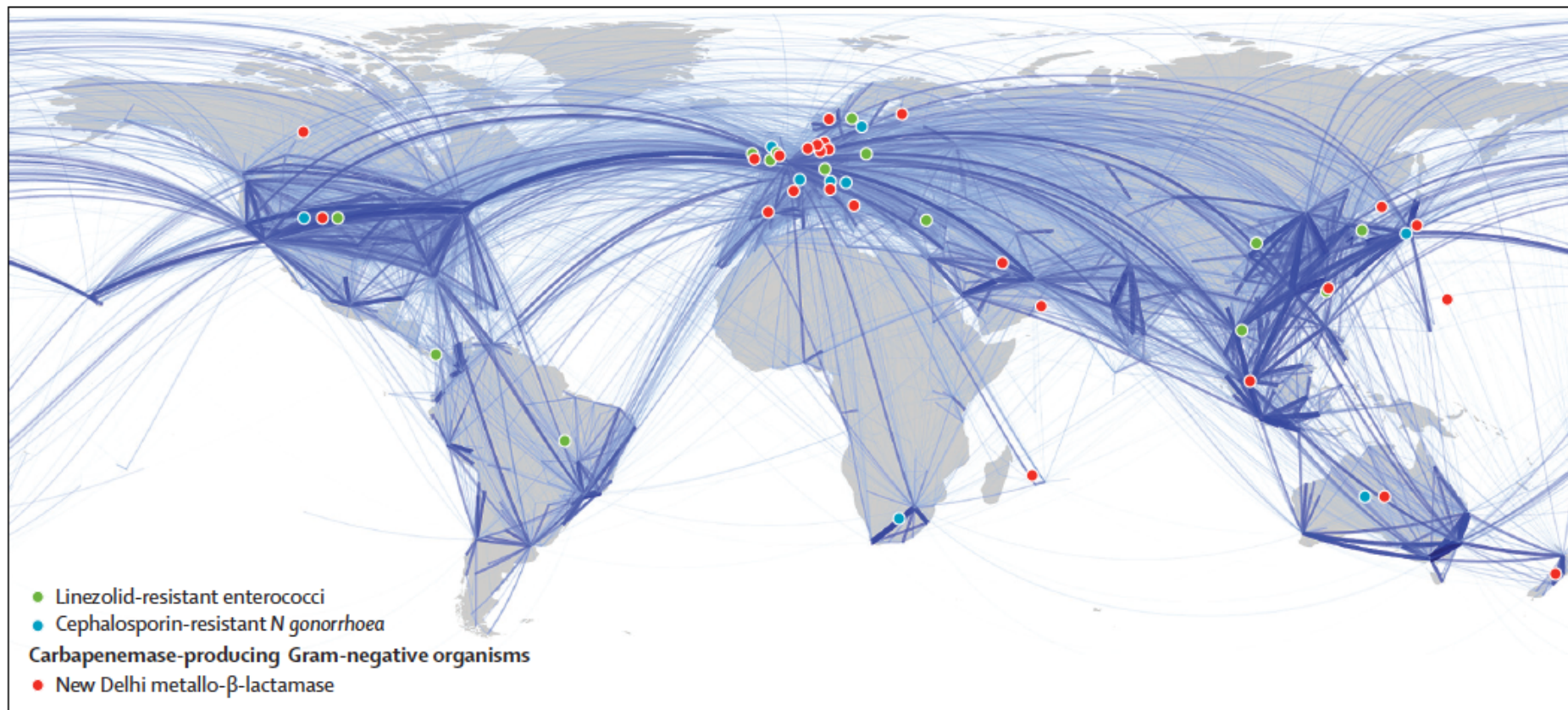


Figure 2: Worldwide travel routes and emergence of antimicrobial resistance

Although extended-spectrum β -lactamase-producing *Enterobacteriaceae* and MRSA are now nearly ubiquitous, certain novel types of resistance, among both Gram-negative and Gram-positive organisms, are of particular concern. The mechanisms of human-to-human transmission for these organisms are likely to be complex, but include association with travel. Data shown includes NDM-positive bacteria from patients with an epidemiological link to the Indian subcontinent,⁵² linezolid-resistant enterococci,⁵³ and reported cefixime/ceftriaxone treatment failures for *Neisseria gonorrhoea*.⁵⁴ Flight path data developed by Dr Jonathan Read and Professor Tom Solomon, based on the number of commercial flight bookings made (number of travellers might be higher).



The evolving threat of antimicrobial resistance

Options for action





500.000.000 years

~300.000

~80

~2-3