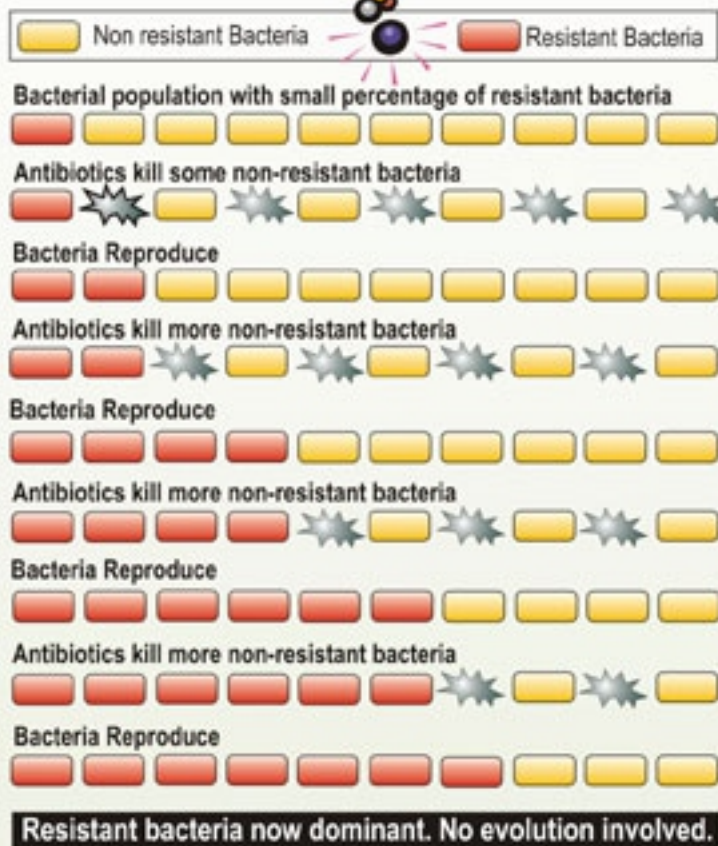


## The Rise of Resistance



childhood pneumonias surveyed by the Pneumococcal Molecular Epidemiology Network (USA) were caused by one strain of pneumococcus, named Spain 23-F. (Ref. 6)

This is natural selection at work, but it is not evolution. Resistant strains have thrived in preference to others because they were already able to cope in hostile (to the bacteria) environments. The bacteria have not changed from one kind into another.

### Acquired Resistance by Gene Transfer

Many bacteria carry the genes for resistance on small pieces of DNA called plasmids. These can be passed to other bacteria. As far as can be proven, bacteria have always had plasmids. They did not evolve after the medical use of antibiotics. Plasmids have been found in bacteria kept in cultures begun in the 19th century which have never been exposed to antibiotics. They have also been found in bacteria found frozen in Arctic ice cores believed to be 3,500 to 7,100 years old. (Ref. 7)

The discovery of the gene exchange process has helped explain the rapid spread of antibiotic resistance among bacteria, and at the same time proved that gaining resistance is not the result of evolution. For example: microbiologists at the University of Illinois Urbana (USA), studied bacteria that live only inside the human digestive system and found they contained genes for

antibiotic resistance, even though the humans the bacteria were residing in were not taking antibiotics. The resident bacteria had gained these by swapping genes with food borne bacteria that were carrying genes for resistance. (Ref. 8) Resistant bacteria occur in food because of widespread antibiotic use in farming as well as in medicine. This has killed many non-resistant organisms in the general environment and left only the already resistant forms to reproduce and spread resistance genes to other bacteria, wherever they meet. No evolution is involved.

Bacterial gene swapping explains why antibiotic resistance has become so widespread among many species of bacteria. However, bacteria that have acquired resistance by gene transfer remain the same species of bacteria. The genetic information needed for antibiotic resistance has not evolved; it has simply been redistributed.

Bacteria are also able to transfer genes from their main chromosome to plasmids, but, again, this is not evolution just another form of redistribution. Furthermore, it didn't happen because of human use of antibiotics. Molecular biologists at University of Rochester, New York, studied a gene for penicillin resistance in *Salmonella* (bacteria that cause food poisoning) and concluded that the gene had existed for millions of years and had moved from chromosome to plasmid three times. (Ref9)

After the bacteria have acquired resistance genes, natural selection then acts on them and the newly resistant bacteria survive and thrive in an environment containing antibiotics. If the environment becomes free of antibiotics some bacteria off-load plasmids because the extra genetic material is not useful but requires metabolic energy to maintain. They then become non-resistant bacteria, but this is not evolution either.

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