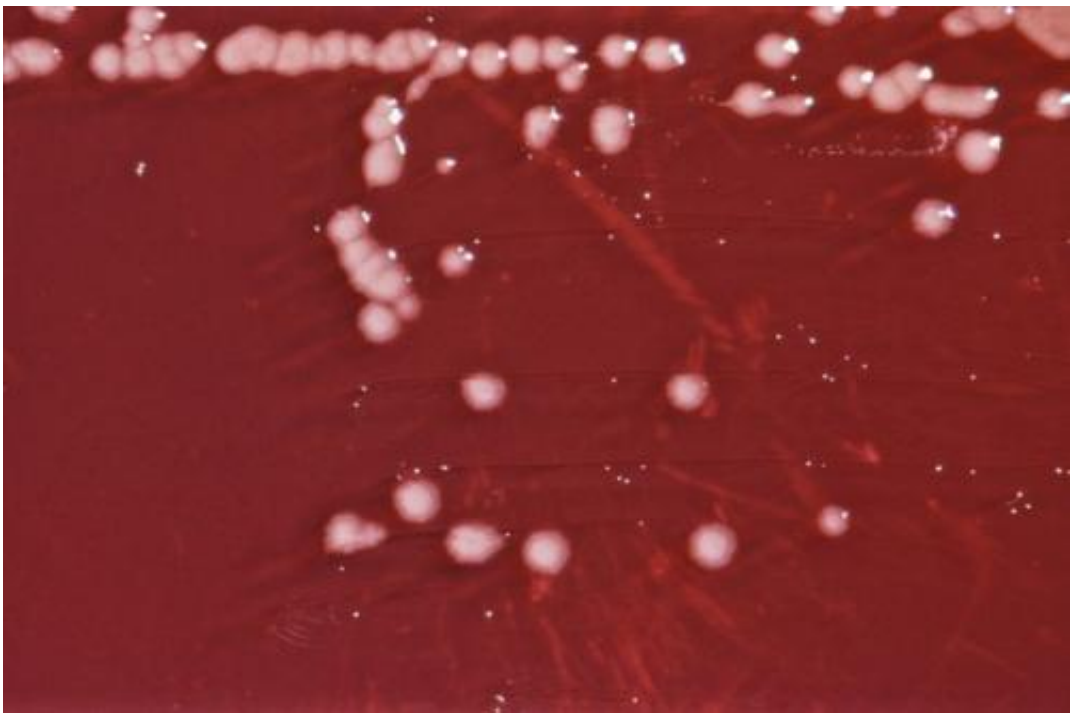
Study shows manure from cows not given antibiotics still causes increase in resistant bacteria in soil

October 7 2014, by Bob Yirka



Pseudomonas aeruginosa bacterial culture on an Xylose Lysine Sodium Deoxycholate (XLD) agar plate. Credit: CDC/public domain

(Phys.org) —A team of researchers working out of Yale University has found that soil treated with cow manure from cows that never received antibiotics, still had more resistant bacteria in it than soil treated with nonorganic fertilizer. In their paper published in *Proceedings of the*

National Academy of Sciences, the team describes their study and offers some theories regarding their results.

Giving livestock antibiotics has allowed farmers to produce a huge amount of meat in relatively small areas, increasing production and profits. But, some contend, it's also contributed to the problem of bacteria becoming more resistant to drugs dedicated to fighting infections in people. Some have also suggested that using manure from cows given antibiotics as a fertilizer, very likely makes the problem even worse. In this new effort, the researchers sought to find out if that is true.

It was a simple exercise, the team fertilized one patch of ground with manure from cows that never were given antibiotics, and another patch with a nitrogen based inorganic fertilizer. Two weeks later they came back and tested the soil for bacteria levels. To their surprise they found that the soil that had been treated with the manure still had a lot more resistant bacteria (those with genes that caused the production of the enzyme β-lactamases) in it than the patch that had been inorganically treated. Further testing revealed that the increase in antibiotic resistant bacteria came from the soil, not the cows. Thus, there was something about the presence of the manure that caused living organisms in the soil to behave differently.

The researchers can't say for sure why the manure caused more resistant bacteria to show up in the soil but suggest it's possible that heavy metals from the manure or other nutrients could make the soil friendlier to the types of resistant bacteria that are naturally in soils. Such bacteria have naturally developed resistance to antibacterial agents from fungi and even other bacteria. The researchers plan to continue their research to find out the true cause.

In the meantime, it's likely that those who have been suggesting that

manure from cows given antibacterial agents causes problems, will suggest that because "clean" manure also causes an increase in the amount of resistant bacteria, its likely cows given antibiotics would make the problem even worse.

More information: Bloom of resident antibiotic-resistant bacteria in soil following manure fertilization, *PNAS*, DOI: 10.1073/pnas.1409836111

Abstract

The increasing prevalence of antibiotic-resistant bacteria is a global threat to public health. Agricultural use of antibiotics is believed to contribute to the spread of antibiotic resistance, but the mechanisms by which many agricultural practices influence resistance remain obscure. Although manure from dairy farms is a common soil amendment in crop production, its impact on the soil microbiome and resistome is not known. To gain insight into this impact, we cultured bacteria from soil before and at 10 time points after application of manure from cows that had not received antibiotic treatment. Soil treated with manure contained a higher abundance of β-lactam–resistant bacteria than soil treated with inorganic fertilizer. Functional metagenomics identified β-lactam–resistance genes in treated and untreated soil, and indicated that the higher frequency of resistant bacteria in manure-amended soil was attributable to enrichment of resident soil bacteria that harbor β-lactamases. Quantitative PCR indicated that manure treatment enriched the blaCEP-04 gene, which is highly similar (96%) to a gene found previously in a Pseudomonas sp. Analysis of 16S rRNA genes indicated that the abundance of Pseudomonas spp. increased in manure-amended soil. Populations of other soil bacteria that commonly harbor β-lactamases, including Janthinobacterium sp. and Psychrobacter pulmonis, also increased in response to manure treatment. These results indicate that manure amendment induced a bloom of certain antibiotic-resistant bacteria in soil that was independent of antibiotic exposure of

the cows from which the manure was derived. Our data illustrate the unintended consequences that can result from agricultural practices, and demonstrate the need for empirical analysis of the agroecosystem.