

Science AMA Series: We are Dr Anne Leonard and Dr William Gaze from the University of Exeter Medical School. We conduct research into antibiotic-resistance in coastal waters, and we're here today to talk about it. AMA!

ECEHH ¹ and r/Science AMAs¹

¹Affiliation not available

April 17, 2023

Abstract

Hi Reddit, We are Dr Anne Leonard and Dr William Gaze from the European Centre for Environment and Human Health (<http://www.ecehh.org/>), based at the University of Exeter Medical School. We are here to answer your questions on antibiotic-resistance in coastal waters. Bacteria that can survive in the presence of medicines (antibiotics) designed to kill them, are termed antibiotic-resistant bacteria, and are a growing threat to human wellbeing around the world. Infections caused by bacteria that survive treatment with antibiotics are difficult to cure, and can even kill people if effective antibiotics aren't available (<https://www.newscientist.com/article/2118046-woman-dies-from-infection-resistant-to-all-available-antibiotics/>) Understanding the various ways people come into contact with resistant bacteria can help develop effective strategies to control the spread of resistance. We recently published a study (Beach Bums) on resistant bacteria in coastal waters and the potential for their spread to water users. Finding that surfers, who swallow a lot of seawater when they surf, are at a much greater risk of having antibiotic-resistant bacteria in their guts compared to people who don't go in the sea indicates that coastal waters could be an important environment in which members of the community acquire resistant bacteria. We are looking forward to reading your questions and comments about antibiotic-resistance in the environment. EDIT: hi! Thanks to everyone who got in touch to ask us thought-provoking questions about the issue of antibiotic-resistance in the environment. We're going to sign out in a bit, but (time permitting) we will check back later to see if there are any more questions to answer.

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ECEHH [R/SCIENCE](#)

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CORRESPONDENCE:

DATE RECEIVED:
February 02, 2018

DOI:
10.15200/winn.151749.93056

ARCHIVED:
February 01, 2018

CITATION:
ECEHH , r/Science , Science
AMA Series: We are Dr Anne
Leonard and Dr William Gaze
from the University of Exeter

How many years do you believe we have till antibiotics are useless in humans?

[William_Harford](#)

Will Gaze - Hi William, some bacteria are already resistant to all known antibiotics and people are already dying from pan resistant infections. Thankfully this is still quite rare but is predicted to become more common. We don't know how long it will be until all antibiotics are useless but it could be a few decades if we cant find or make more new antibiotics. Hopefully we will never reach the point where all bacterial pathogens are pan resistant which is why a lot of research is focusing on drug discovery and the mechanisms by which bacteria acquire antibiotic resistance. Anne's work on environmental transmission in surfers is just one example of efforts to better understand this complex process.

Medical School. We conduct research into antibiotic-resistance in coastal waters, and we're here today to talk about it. AMA!, *The Winnower* 5:e151749.93056, 2018, DOI: [10.15200/winn.151749.93056](https://doi.org/10.15200/winn.151749.93056)

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First, thanks for your awesome work!

My question is: Do you think surfers should change their behaviour in any way to mitigate the effect that you've shown? For instance, after a particularly heavy rainfall is the water likely to be worse with all the run-off, and should surfers avoid going in?

[armitage_shank](#)

Thanks! We think that antibiotic-resistant bacteria are more common in seawater after heavy rainfall, as you rightly point out due to run-off, as well as untreated sewage being released from storm outfalls. Experts suggest that surfers and other water users avoid going in the sea about 2 days after heavy rainfall to reduce their exposure to antibiotic-resistant bacteria, as well as to other microorganisms carried in sewage that might make them unwell. Water users in England can look up water quality at their favourite beaches to see whether levels of bacteria are high, or if sewage pollution is likely to be a problem - this information is publically available via the Environment Agency bathing water quality website for over 400 beaches. The Safer Seas Service also provides live alerts on sewage spills for some beaches. Anne

Hi folks, is there a risk of this sort of exposure in other bodies of water - eg freshwater lakes and rivers?

[yamahahahaha](#)

Hi, we know that rivers are an important way by which microorganisms (including antibiotic-resistant bacteria) are transported from land to coastal waters. The type and abundance of resistant bacteria in the water will probably differ according to the sources of pollution upstream. Anne

Can you please enlighten us regarding few most important measures that can be taken to prevent the spread of such resistant strains

[luxatioerecta](#)

Will - in the context of water borne transmission there are several ways to prevent transmission. For risks associated with human sewage much depends on existing treatment infrastructure. For example 1 billion people in the world do not have access to a toilet so introducing sewage treatment of any kind would be beneficial. In countries where reasonably good treatment facilities exist additional tertiary treatment steps and UV and ozone treatment can be used but these are expensive. There may also be risks associated with antibiotic residues that humans excrete, alongside antimicrobial cleaning products used in the home, which may further increase resistance in the environment. For farm animal waste you can reduce antibiotic usage and faecal waste can be treated and/or prevented from entering streams and rivers.

How this is gonna affect agriculture?

[johntelles](#)

I think Anne is also answering this one but from my perspective ultimately we need to reduce reliance on antibiotics in farming particularly use as a growth promoter. Also antibiotic use enables intensive factory farming that is only possible because of preventative prophylactic usage of antibiotics, including those critical to treatment of disease in humans.

How this is gonna affect agriculture?

[johntelles](#)

Human health, animal health and environmental health are all connected, and this is especially true for antibiotic resistance because some of the types of bacteria that live in the environment can also live in (and harm) humans and animals. Not only this, but bacteria can share the genes that confer resistance to antibiotics with other bacteria (a process called horizontal gene transfer). This means that antibiotic-resistant bacteria in humans or in the environment do not necessarily stay there: resistant bacteria in livestock have found their way into the clinic and vice versa. While livestock may not acquire resistant bacteria from the sea directly, they might drink from streams affected by sewage pollution and containing resistant bacteria. Antibiotic resistance undoubtedly affects agriculture because we are also concerned with treating and preventing infections in livestock and crops to maintain the health and productivity of agricultural systems.

If antibiotics cease being an effective way to kill bacteria, is there any other option or will preventing others from being exposed be the only recourse?

[OnFloor4](#)

Will - reducing transmission, so better infection control and hygiene, is always important but there are other possibilities. Vaccines can be developed so that infections by certain pathogens are reduced, this is already a focus of much effort. Viruses that infect bacteria (bacteriophage or phage) have long been used to treat infections such as wound infections in certain parts of the world and there is renewed interest in phage therapy. A further approach is to actually intervene at a molecular or genetic level. One possible approach is to use CRISPR systems (bacterial immune mechanisms currently being used in human gene editing) located on mobile genetic elements to actually get rid of antibiotic resistance genes. Because bacterial DNA can move between even unrelated bacteria by horizontal gene transfer other mechanisms to block this transfer process are also being investigated.

I do both in silico design and vitro testing for new inhibitors for ESBL's that are mutated or we have no inhibitors for them. My PI said working on this is a waste of time since the products are not naturally found in nature and we have no hope of this drug going anywhere. I am still new to the academic research and drug development and was wondering if this is true for drug development? Assume this drug has good absorption , low toxicity and good selectivity. Thanks!

[miguel833](#)

There are likely to be many natural products that remain undiscovered and resistance mechanisms in environmental bacteria that are also unknown. We know that the original ESBL genes or their progenitors have come from environmental bacteria so I'm not sure that it's a waste of time. Can you be more specific?

Do you all see antibiotic resistance in vibrio in coastal waters becoming a significant threat to be both people and industry in the near future?

[PHealthy](#)

There is increasing concern about vibrios in coastal waters and although I personally don't know much about resistance in these organisms it is possible that environmental pollution could enable transfer of resistance genes or even select for resistance in polluted estuaries for example. One of my colleagues,

Michiel Vos, has recently isolated an emerging vibrio pathogen species from coastal UK waters. We are currently looking at resistance determinants in this and other vibrio species.

It may not be part of your group's research, but have you seen/aware of any similar effects for other antimicrobials, especially antifungals? Perhaps not terribly relevant for coastal waters, but for other bodies of water, I'd imagine there's quite a bit of dangerous fungi lying around?

[hslakaal](#)

The concern regarding fungal resistance lies with the huge amount of fungicides used in horticulture. The resistance mechanisms that these antifungals select for can be the same as those in human fungal pathogens.

Not sure if this is so much your area but I was told (in a UEMS lecture, #bleedgreen) that a major reason behind the development of bacteria with such a wide variety of resistances is the differences between front line antibiotics in different countries, for example vancomycin is not commonly used as a first line treatment over here but is in Japan. Have there been any attempts at stopping this by international organisations (like the WHO maybe?).

[antarcticelephants](#)

Different antibiotics are used in different amounts and for different purposes in different countries. For example colistin is used in animal production in China and India and resistance has emerged and spread to human pathogens in this way. There was supposed to be a division between antibiotics used in humans and animals but this has not really been implemented widely and sometimes a different compound may be used but still have the same mode of action so the resistance mechanisms are the same. There are coordinated efforts to reduce use of frontline human drugs in agriculture but this is hard to enforce. Now that AMR is on the international agenda hopefully regulation will continue to tighten, and we can already see this beginning to happen.

What's the predominant resistance mechanism you see in coastal water pathogenic bacteria?

[madkeepz](#)

All different types. Anne has recently been looking at resistance in E. coli in coastal waters using genome sequencing methods and we see many different types of resistance genes in this single species.

1. What part or system of the body is usually affected when antibiotic-resistance occur? What exactly happens to the person when there's an antibiotic resistance?
2. Is this kind of bacteria present everywhere? What reason/s made this research focus on coastal waters? And why not on other parts of the environment?

PS I really appreciate your time, effort and perseverance. Thank you for not giving up ☺

[Studentfrph_cz](#)

1. Infections caused by antibiotic-resistant bacteria can cause problems in any part of the body. They can affect the site of the original infection, and have the potential to spread if resistant bacteria get

into the bloodstream. There are many factors at play that might affect how the infection presents and progresses (e.g. age, comorbidities, etc.), but the issue with infections caused by resistant bacteria is that they take longer to treat, are more expensive to cure, and can cause long-term damage (and even death) during their course.

2. Antibiotic-resistant bacteria have been found in many different environments (including in the home, hospitals, food, etc.), and it is really important that we study the various ways people might acquire resistant bacteria so that certain high-risk pathways can be identified for intervention. The reason we chose to focus on coastal waters for our recently published paper (the Beach Bum Survey) is that seawater is frequently contaminated by faecal waste from humans and animals, and faecal waste carries bacteria, including clinically important antibiotic-resistant bacteria. Also, millions of people visit the sea, go in the water and enjoy activities which involve high levels of exposure to seawater and the resistant bacteria in it.

Will Gaze leads a research group which works on understanding the emergence and spread of antibiotic resistance in various natural environments: not just coastal waters.

Anne