Antimicrobial resistance and food safety

Fact sheet

The use of antibiotics can make bacteria resistent to antibiotics: or insusceptible to antibiotics. Resistance can develop in the body of an animal or person who is given antibiotics. Resistant bacteria can spread through the environment or by direct contact with other animals or other people. Food is another potential source of contamination, for example, by eating meat from animals that carry resistant bacteria. It is not clear how much transmission is due to food. Consumers can reduce the risk of contamination through food by taking hygienic measures when preparing meals.

Antibiotic resistant bacteria can cause foodborne infections. These will not usually cause lasting problems as, in most people, foodborne infections usually fade away naturally. In exceptional cases, they may have more serious consequences. The physician may then decide that treatment with antibiotics is required. In the case of resistance, the prescribed antibiotic may be ineffective against the infection. This makes treatment more difficult.

As there are still many uncertainties about antimicrobial resistance in relation to diet, the Netherlands Nutrition Centre has consulted experts in this field in the Netherlands. This enabled us to determine the scope of the uncertainties involved, and to tailor our recommendations to consumers accordingly. This fact sheet gives details of the latest scientific situation regarding antimicrobial resistance and diet. It also shows what consumers can do to reduce, as far as possible, the risk of acquiring a bacterial contamination (including contamination by antibiotic resistant bacteria) through food.

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For whom is it relevant?

This fact sheet is suitable as a background document for anyone who wants further details about the relationship between antimicrobial resistance and food. This could include dieticians, healthcare professionals, and commercial establishments, such as retailers and the food industry. They can use this fact sheet to educate consumers about this issue.

What issues are involved?

Antimicrobial resistance means that a bacterium has become insusceptible to a particular antibiotic. As a result, that antibiotic is no longer able to kill the bacteria or to inhibit its growth. Figure 1 is a brief representation of how antimicrobial resistance develops. The presence of antibiotic resistant bacteria in people does not necessarily cause immediate problems. For instance, if the resistant bacterium is not pathogenic or if a foodborne infection caused by a resistant pathogen fades away naturally, then there is no need at all to treat people with an antibiotic. A problem only occurs in those cases where resistant pathogens are making people very ill. For example, when serious complications occur, the physician may determine that antibiotics are needed to cure the patient. In such cases, therefore, it is important to know to which antibiotics the pathogen is resistant.

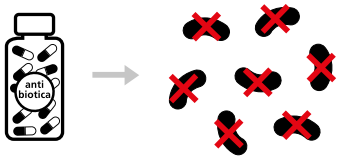
Pregnant women, young children, the elderly and those suffering from illnesses (or chronic illnesses) are groups that are at high risk of foodborne infections. This may be due to compromised immunity resulting from medical treatments, such as chemotherapy. Infections are more common in these high-risk groups.[1] Patients with infections caused by resistant pathogens spend longer in hospital and are at greater risk of dying than those infected by pathogens that are susceptible to antibiotics.[2]

Antibiotic resistance restricts treatment options, which is why the World Health Organization (WHO) has declared this issue a serious threat to public health.[2] The Minister of Health, Welfare and Sport and the State Secretary for Economic Affairs have also indicated in 2013 that policy will be intensified in the areas of antibiotic use and the prevention of resistance to antibiotics.[3]

Figure 1: How does antimicrobial resistance develop?

What are antibiotics?

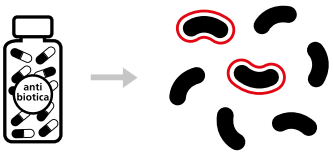
Antibiotics are medicines that kill bacteria or inhibit their growth.



How does antimicrobial resistance develop?

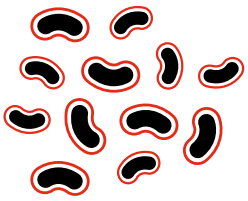
Bacteria can become resistant through the use of antibiotics.

Some bacteria adapt, becoming insusceptible to antibiotics.



The antibiotic kills all of the bacteria except for those that are resistant to antibiotics.

The resistant bacteria then have plenty of space in which to keep on growing.



Disease burden

The European project entitled 'Burden of resistance and disease in European nations' examined the burden of disease due to antimicrobial resistance in two species of resistant bacteria. This study showed that infections caused by antibiotic resistant bacteria impose an extra burden of disease. This is due to additional deaths and to extra bed days in the hospital. But the total burden of disease due to infections caused by bacteria that are susceptible to antibiotics is still much higher. That's because these infections are much more common than infections caused by resistant bacteria. This shows that there is still much to be gained, provided that there is a greater focus on preventive measures against infections in general. In specific terms, this means fewer foodborne infections in general, and less contamination with resistant bacteria.[4]

What do Dutch consumers think about this?

Consumers are not always clear about the degree of risk associated with antimicrobial resistance, the way in which this risk occurs, and whether or not they themselves can do anything about it.

Scientific situation

Healthy individuals can carry resistant bacteria without themselves becoming ill. It is only when a person becomes ill or is admitted to hospital, and antibiotics are used, that these resistant bacteria gain the upper hand and their presence is discovered. It is uncertain how long it will take to clear an individual of antibiotic resistant bacteria.[1]

Antibiotic resistant bacteria can spread just as easily as non-resistant bacteria. Accordingly, there are various routes by which people can come into contact with antibiotic resistant bacteria.[1] These different routes are shown in Figure 2. This is a particularly important issue in healthcare institutions. The spread of bacteria in such surroundings is very common.

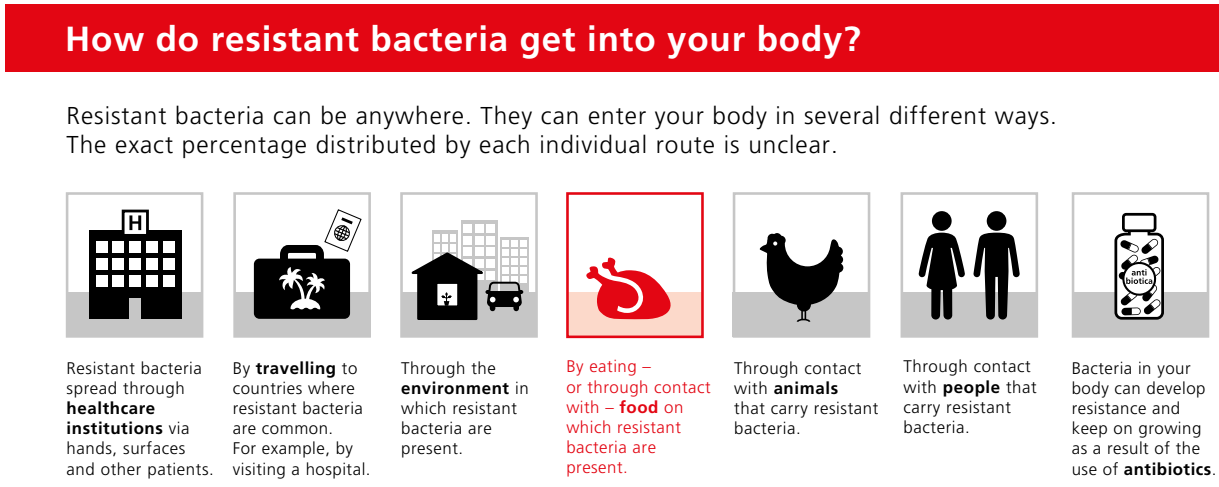
One of the routes by which resistance is transmitted to people is through food. However, the exact percentage associated with this route is still unclear. This area is currently the subject of a great deal of research. The presence of resistant pathogens in food means that people can acquire foodborne infections that are difficult to treat. The European Food Safety Authority (EFSA) and the European Centre for Disease Prevention and Control (ECDC) have concluded that the bacteria responsible for most foodborne infections (Salmonella and Campylobacter) have shown a marked increase in resistance to commonly used antibiotics. Fortunately there is very little resistance to those antibiotics that are used as a last resort when treating people. As a result, in most cases, there are currently still treatment options.[5,6]

Antibiotic use in the animal husbandry sector

As with people, it is sometimes necessary to treat animals with antibiotics. Cows with udder inflammations, for example. Or enclosures containing numerous sick animals, such as chickens, where the antibiotic in question is given to every animal in the building.

The use of antibiotics in the animal husbandry sector can cause bacteria to develop resistance to these

Figure 2: Contamination routes



drugs. People can also be exposed to resistant bacteria from these animals. Figure 3 shows how food can become contaminated with antibiotic resistant bacteria. Individuals can become contaminated by eating animal products or local fruit and vegetables. In addition, it is possible to become infected through direct contact with animals or contact with those working with these animals. As yet, nothing is known about how the presence of resistant bacteria in animals influences the occurrence of such bacteria in people.[1,6]

The Dutch animal husbandry sector used antibiotics more often than is the case in other countries. This has been the focus of considerable attention in recent years. The total sales of antibiotics in the Dutch livestock sector fell the last years (from 2009) by 60%. The initial evidence suggests that this decrease in the use of antibiotics has resulted in a fall in the number of resistant bacteria in animals. But this effect is not yet visible in all types of antibiotic resistance.[7] Nor is it yet clear whether this has led to fewer resistant bacteria in people.

Achieving a permanent reduction in the use of antibiotics in the livestock industry is a policy priority at the Ministry of Health, Welfare and Sport and the Ministry of Economic Affairs. Aside from a reduction, it is especially important for public health that antibiotics used as a last resort when treating people should not be used in animals at all.[3]

Different types of antimicrobial resistance

There are various types of antimicrobial resistance. In the most simple type of resistance, a specific bacterium is resistant to just one specific antibiotic. In multiple resistance, the bacterium is resistant to multiple groups of antibiotics. Bacteria that are resistant to several groups of antibiotics or to the most commonly used antibiotics, are referred to as Highly Resistant Microorganisms. This form of resistance is increasing. As a result, physicians are increasingly having to use "reserve antibiotics" (drugs that are kept in reserve for just this kind of infection).[1]

A 2011 advisory report by the Health Council of the Netherlands listed three groups of resistant bacteria that pose the biggest public health problem and that are linked to concerns about a possible causal relationship with the use of antibiotics in the animal husbandry sector.[8]

- ESBL (Extended Spectrum Beta-Lactamase) producing bacteria: ESBL is an enzyme that bacteria can synthesise. They can use it to inactivate antibiotics, such as penicillin.
- MRSA (Methicillin-resistant Staphylococcus aureus): MRSA is a variant of the bacterium Staphylococcus aureus, which many people carry without becoming ill. Under some circumstances it can become pathogenic, such as after an operation. For this reason MRSA is also known as the "hospital bacterium".
- VRE (Vancomycin-resistant Enterococcus): VRE is a variant of the bacterial genus Enterococcus. In severely ill patients, these bacteria can cause an infection. There is a risk that resistance will be transferred to other bacteria.

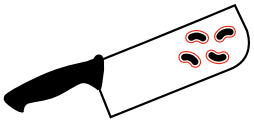
Recently there has been a focus on CPE (Carbapenemase-producing Enterobacteriaceae). CPE are bacteria that are resistant to specific antibiotics used in the treatment of life-threatening infections. Those antibiotics are known as Carbapenems. They are only used when no other antibiotics are effective. To date, very few studies have demonstrated the presence of carbapenem-resistant bacteria in animal husbandry. In 2014, Germany's Federal Institute for Risk Assessment demonstrated the presence of CPE in various samples from the animal husbandry sector.[9] In the Netherlands, this has not been found in animals or in animal products.[7] The issue of the possible presence of CPE in food is still very much under the spotlight.

Figure 3: Antibiotic resistant bacteria in food

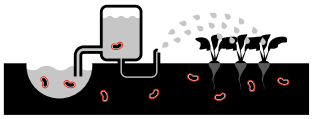
How do resistant bacteria get into food?

Resistant bacteria can get into food through a variety of routes. Two examples:

When animals are being slaughtered, resistant bacteria from their intestines can contaminate the meat.



Through the environment in which resistant bacteria are present.



Which foods are most often infected?

In 2012, the Netherlands Food and Consumer Product Safety Authority tested over 2,000 food samples for the presence of ESBLs and MRSA.

Approximately 1/6 of these samples contained ESBL. There are major differences between the various categories of food products in this regard. Almost all chicken is infected, while infections occur only sporadically in mussels and oysters. A number of ready-to-eat products, such as salads, fresh herbs and steak tartare, were also found to be infected.[6]

Researchers from various institutes collaborating in a large consortium (ESBLAT) have looked at the routes of transmission of ESBL. They concluded that the chance of ESBL contamination via livestock farming and eating meat is small. The transmission mainly occurs between humans.[10] Also people who eat meat frequently do not more often carry ESBLs compared to people who do not eat meat at all like vegetarians.[11]

MRSA is often found in meat such as chicken, beef, veal and pork. Yet consumers are unlikely to become infected with MRSA through eating meat, because these bacteria do not colonise the human gastrointestinal tract. Like other staphylococci, MRSA preferentially colonises the nose and the skin, where it is less likely to cause any harm. Nevertheless, antibiotic resistance can jump from one type of bacteria to another, by the exchange of genes. This occurs less often in MRSA than in ESBL.[6]

How can you prevent contamination with antibiotic-resistant bacteria?

Antibiotic resistant bacteria are common, making it almost impossible for consumers to avoid coming into contact with them. However, the risk of foodborne transmission can be minimised. There are various general hygiene recommendations on this topic (see Figure 4). By taking proper hygiene measures, consumers can reduce the risk of contamination with pathogenic bacteria, regardless of whether these are resistant or susceptible to antibiotics.

Looking to the future

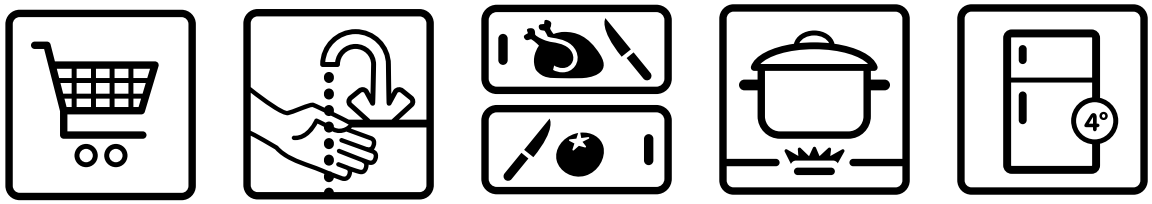
Antimicrobial resistance is a threat to public health. Physicians increasingly have to use antibiotics that are considered to be a "last resort", because the usual antibiotics are no longer effective. In Dutch hospitals, it is still highly unusual for patients to die from infections caused by resistant, untreatable bacteria. At the present time, effective antibiotics are still available to treat patients. At hospitals outside the Netherlands, however, untreatable infections are no longer exceptional. This is particularly the case in distant countries or in southern European countries such as Greece.[6]

All bacteria adapt quickly, and the pathogenic strains are no exception. When bacteria are exposed to antibiotics, resistant strains will develop and spread. While foodborne transmission certainly occurs, it has not yet been possible to estimate the level involved, as a proportion of all transmission.

Figure 4: Hygiene recommendations

What can you do?

You can reduce the risk of contamination by taking effective measures when preparing meals.



1 Buy

Make sure that raw meat and chicken are well wrapped, to ensure that other items of shopping are not contaminated by meat juices.

2 Wash

Always wash your hands before cooking, after touching raw meat and chicken, and after using the toilet. Always wash fruit and vegetables under running water.

3 Separate

Keep cooked food separate from raw food. Use separate cutting boards and kitchen utensils for meat and vegetables, to prevent pathogens from one product contaminating the other.

4 Cook

Cook meat and chicken thoroughly, to kill any pathogens that may be present.

5 Chill

Set your refrigerator to 4 degrees, to inhibit the growth of bacteria.

It is vital that antibiotics are used prudently in people and animals, to reduce the risk of resistance. There is an important role here for the food production chain, from farmer to supermarket, to reduce the presence of antibiotic-resistant bacteria in food. Consumers need to be aware of the risks involved, and of the fact that they themselves can also help to limit any further spread, by taking proper hygiene measures. It is important to communicate such details, as consumers are not yet sufficiently aware of them.

The difference between antibiotic residues and antibiotic resistance

There is a big difference between the risks associated with antibiotic residues in food and the risks associated with resistant bacteria. In contrast to what many consumers think, antibiotic residues are not an especially significant risk factor in the Netherlands. Statutory waiting periods have been established. Animals that have been treated with antibiotics may not be slaughtered or consumed during the subsequent period. The temporary consumption ban also applies to any products derived from such animals. Under the National Residue Monitoring Plan, random samples are taken from meat, fish, eggs and milk to check that they do not exceed the maximum permitted levels for veterinary drug residues, such as antibiotics. In the Netherlands, these statutory levels are seldom breached.

It is bacteria, not animals and people, that become resistant to antibiotics. If such resistant bacteria are present on the product, they can be transmitted to people. If these bacteria then make people ill, it is more difficult to treat these individuals using antibiotics.

The following experts were consulted in the course of drafting this document:

Dr. H.J.M. Aarts, Head of Food at the Centre for Zoonoses and Environmental Microbiology, National Institute for Public Health and the Environment
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Dr E.E. Stobberingh, medical microbiologist at the Centre for Infectious Disease Control (Clb), National Institute for Public Health and the Environment
Prof. dr. J.A. Wagenaar, professor of clinical infectiology at the Faculty of Veterinary Medicine, Utrecht University; senior researcher at the Central Veterinary Institute of Wageningen UR, and member of the Veterinary Medicines Authority (SDa) expert panel
Prof. dr. M.H. Zwietering, professor of food microbiology, Wageningen UR

References

1. *RIVM (National Institute of Public Health and the Environment) National Public Health Compass - Antimicrobial resistance -. Available at: www.volksgezondheidenzorg.info*
2. *WHO (World Health Organization). Antimicrobial resistance: global report on surveillance. Geneva, 2014*
3. *Central government. Everything is health ... The 2014-2016 National Prevention Programme. The Hague, October 2013*
4. *Kraker, MEA de. Burden of disease associated with antimicrobial resistance: studies on bloodstream infections and clinical outcomes in European hospitals. Dissertation University of Groningen (RUG). July 2012*
5. *EFSA (European Food Safety Authority and ECDC (European Centre for Disease Prevention and Control). The European Union Summary Report on antimicrobial resistance in zoonotic and indicator bacteria from humans, animals and food in 2012. EFSA Journal 2014; 12(3):3590, 336 pp., doi:10.2903/j.efsa.2014.3590. Parma. 2014*
6. *Netherlands Food and Consumer Product Safety Authority - Office for Risk Assessment & Research. Recommendation concerning the risks of ESBLs and MRSA in food. Recommendation made by the Director of the Office for Risk Assessment & Research to the Minister of Health, Welfare and Sport and the State Secretary for Economic Affairs. Utrecht, November 2013*
7. *Mevius, DJ, Dierikx, C, et al. MARAN 2014 – Monitoring of Antimicrobial Resistance and Antibiotic Usage in Animals in the Netherlands in 2013. Lelystad. June 2014*
8. *Health Council of the Netherlands. Antibiotics in food animal production and resistant bacteria in humans. Publication No. 2011/16. The Hague, August 2011*
9. *Bundesinstitut für Risikobewertung (Federal Institute for Risk Assessment) Antibiotikaresistenz: Carbapenemasebildende Keime in Nutztierbeständen. Information no. 002/2014. January 2014.*
10. *Dorado-García A. et al, Molecular relatedness of ESBL/AmpC-producing Escherichia coli from humans, animals, food and the environment: a pooled analysis. J Antimicrob Chemother. 2017 November 18.*
11. *C. Dierikx et al., Onderzoek naar ESBL-producerende bacteriën onder vegetariërs en niet-vegetariërs, Report 2017-0150, RIVM (Rijksinstituut voor Volksgezondheid en Milieu), Bilthoven, 2017*

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October 2014 - updatet June 2019