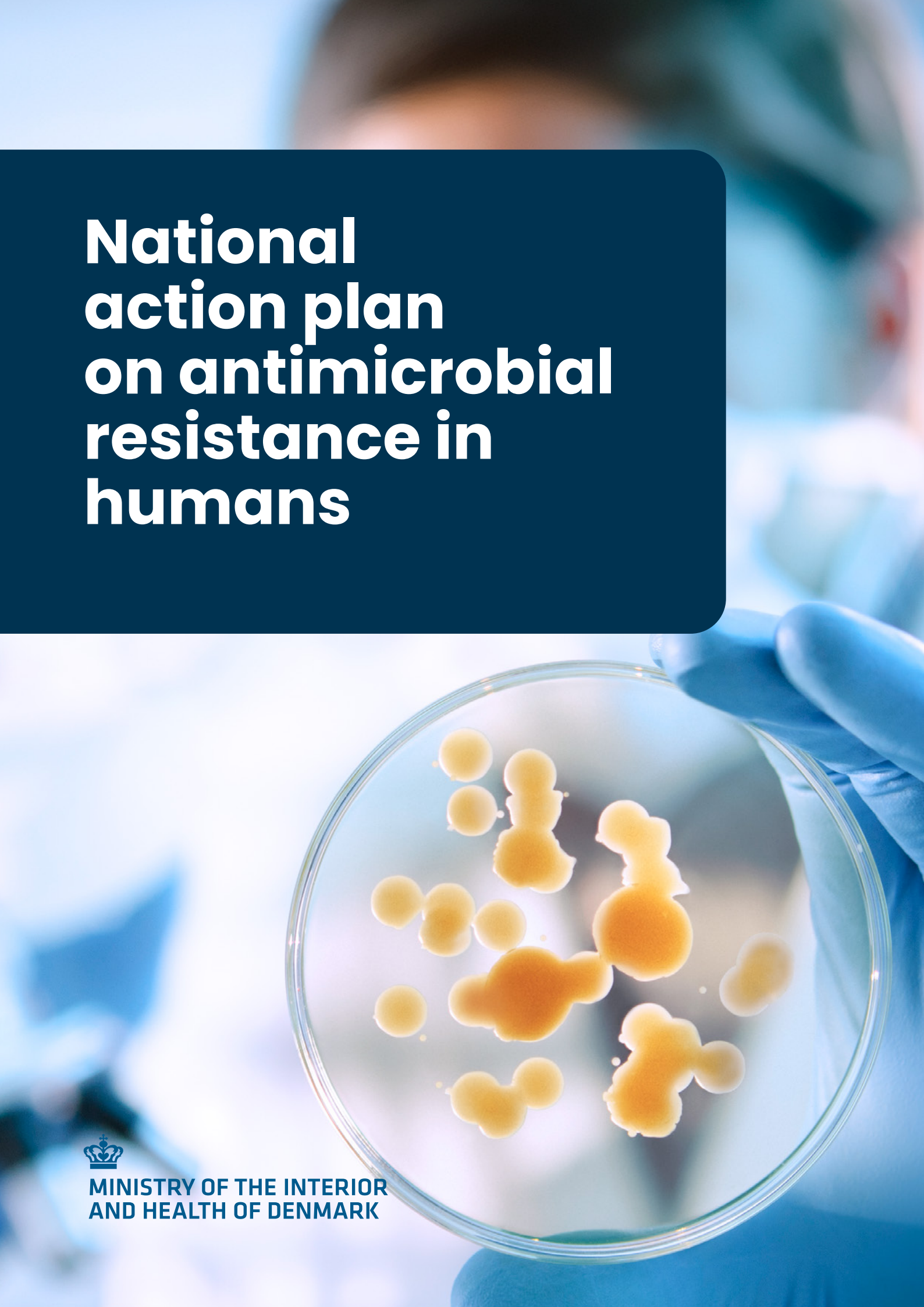
National action plan on antimicrobial resistance in humans



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Foreword

Antimicrobials, and especially antibiotics, save lives every day. They save lives by treating common pneumonia which, less than 100 years ago, would have been a death sentence for many. They save lives by protecting the most vulnerable members of our society, whose immune systems cannot defend themselves. They save lives by enabling us to carry out complex procedures such as organ transplantation.

But we cannot take for granted that the future will look the same. Microorganisms are in a constant race with medical science, developing defence mechanisms that make them resistant to antimicrobials. This is known as antimicrobial resistance, or simply AMR. Each time we use an antimicrobial drug, we fuel the risk of developing resistance. We therefore have to use them with particular care.

Failing to do so could have insurmountable consequences. In a world without effective antimicrobials, doctors would be unable to treat patients for commonly occurring infections. A patient with osteoarthritis would not be able to receive a hip replacement without putting themselves at risk. A person suffering from chronic illness would not be able to hug their grandchildren without fearing a potentially life-threatening infection. Common infections, such as pneumonia, can develop into more severe conditions if no effective antibiotics are available.

Fortunately, tireless efforts are already underway to prevent the development of resistance, even if many of us are unaware of it in our everyday lives. It is the general practitioner who makes a conscious effort to prescribe antibiotics only when needed. The microbiologist who analyses samples and keeps hospital colleagues up to date on the latest clinical knowledge. The social and healthcare assistant at the nursing home who protects residents from infection through meticulous attention to hygiene.

The major day-to-day effort in Denmark has been supported by the 2017 ***National action plan on antibiotics for humans,*** which outlined three ambitious goals to reduce antibiotic consumption in Denmark. The action plan has served as an important point of reference in the fight against antibiotic resistance and has contributed to Denmark's strong standing today compared to many other countries around the world.

But our work is far from over. We are fighting a global trend. Resistance is spreading more and more across the globe. In many places around the world, common infections have once again become life-threatening. The World Health Organization (WHO) estimates that, by 2050, AMR could be responsible for more deaths worldwide than cancer.

Denmark is not immune to this development. It is important to act in time and use every tool at our disposal. I am therefore pleased that the government (The Social Democratic Party, The Liberal Party and the Moderates) has reached an agreement with the Green Left, the Denmark Democrats, The Liberal Alliance, the Conservative People's Party, the Red-Green Alliance, the Social Liberal Party, the Alternative and the Danish People's Party on the ***National action plan on antimicrobial resistance in humans***. It strengthens and broadens the efforts to combat antimicrobial resistance with 21 initiatives across four priority areas and several cross-cutting efforts. The four priority areas are:

1. **Antimicrobial stewardship**
2. **Access to antimicrobials**
3. **Infection prevention and control**
4. **International engagement**

The action plan targets antimicrobial resistance in humans and focuses on the healthcare sector. However, combating AMR is based on interdependence between humans, animals, food and the environment. The government and the parties to the agreement recognise that the AMR challenge should be viewed from a One Health perspective, integrating health considerations across all sectors. The government has therefore launched an initiative to draft a new One Health strategy addressing antimicrobial resistance.

The initiatives in the action plan are fully financed for the period 2025–2028.

We must keep AMR on the political agenda by integrating AMR and its implications into other future healthcare plans.

I look forward to following the implementation of the action plan in collaboration with the parties behind the agreement, and I hope that, in addition to the concrete initiatives, it will help foster ongoing commitment both within the sector and internationally.

Sophie Løhde,
Minister of the Interior and Health

Background on antimicrobials and antimicrobial resistance (AMR)

What are antimicrobials?

- Antimicrobials kill or inhibit the growth of microorganisms and are important because they enable us to treat infections.
- Antimicrobials comprise several different types of medicinal products. The most well-known type is antibiotics, which are used to treat bacterial infections.
- However, there are also drugs for the treatment of fungi (antimycotics/antifungal agents), parasites (antiparasitics) and viruses (antivirals).
- Some are effective against only a few specific microorganisms and are therefore referred to as narrow-spectrum antimicrobials. Others are active against a wide range of microorganisms and are therefore classified as broad-spectrum antimicrobials.
- The use of broad-spectrum antimicrobials carries a higher risk of resistance development than the use of narrow-spectrum products, as they create a more intense selection pressure and thereby increase the likelihood that resistant microorganisms survive.
- It is generally recommended to use a narrow-spectrum antimicrobial rather than a broad-spectrum one, if both are equally effective.
- In certain cases, it may be necessary to use broad-spectrum antimicrobials, for example if a patient is seriously ill and treatment must be initiated before a specific pathogen can be identified.

What is antimicrobial resistance (AMR)?

- Microorganisms can, through random mutations, develop defence mechanisms that render antimicrobials less effective or completely ineffective. This is referred to as antimicrobial resistance (AMR).
- A microorganism that has developed such defence mechanisms is referred to as a resistant microorganism.
- The use of antimicrobials creates a selection pressure that favours microorganisms that have already developed antimicrobial resistance.
- This means that these microorganisms are more likely to survive and reproduce, thereby contributing to a higher overall prevalence of resistant microorganisms.
- All use of antimicrobials entails a risk of developing resistance. It is therefore essential that antimicrobials are only used when clinically appropriate.
- Antibiotic resistance represents the most pressing AMR challenge; however, resistance among fungi, parasites and viruses is an increasing concern.
- Infections involving resistant microorganisms are frequently more complex and challenging to treat than infections caused by susceptible strains. It consequently increases the risk of serious disease and death.
- It may be necessary to use alternative antimicrobials, which are associated with more severe adverse effects than the standard treatment options.
- Infections caused by resistant microorganisms place significant demands on infection control measures aimed at preventing transmission and thus impose a substantial burden on the healthcare system.
- In some rare instances, certain microorganisms exhibit resistance to such a wide range of antimicrobials that no treatment options are available.

The stories of Peter, Malene and Thorvald

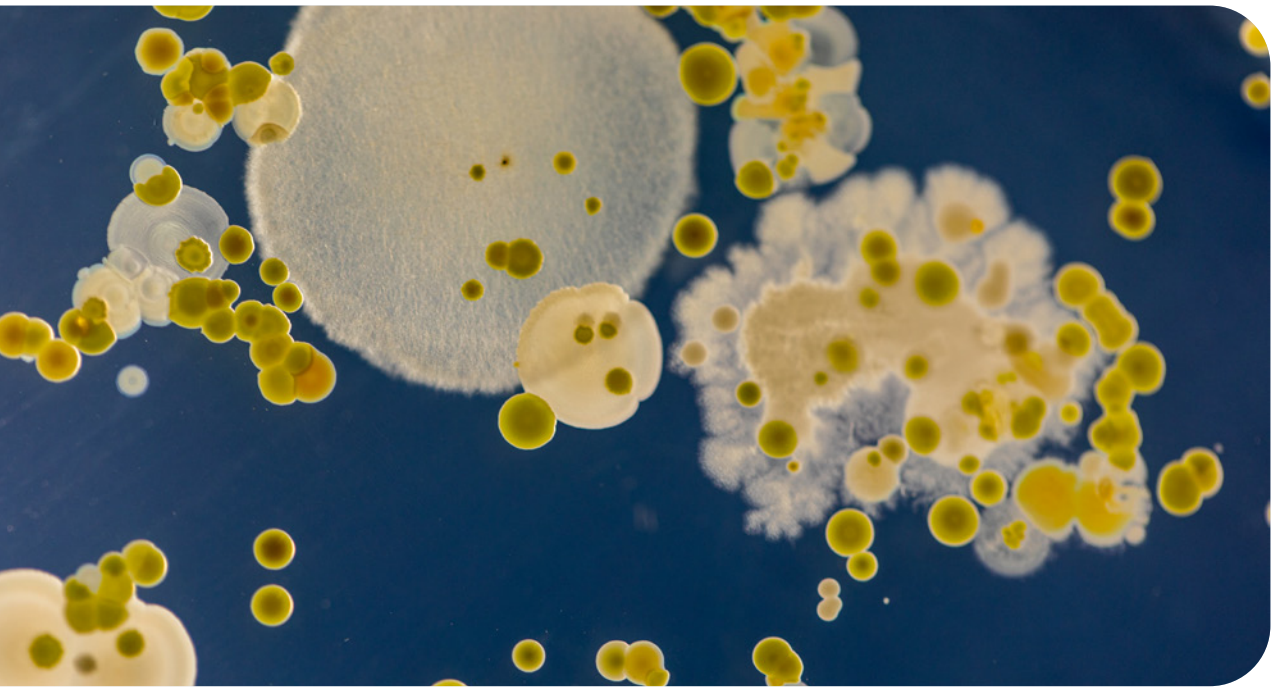
Peter, 67 years old, underwent heart valve surgery in 2015 and later required reoperation due to bleeding following the initial procedure. He was discharged three days post-surgery but, a few days later, developed a systemic infection that necessitated readmission. He remained hospitalised for a week before the doctors, with the help of various antibiotics, managed to bring the infection under control. According to Peter, the operation most likely saved his life. However, given the inherent risk of infection associated with the procedure, it would have been extremely hazardous to perform without the option of administering antibiotics.

Malene, 46 years old, is a kidney transplant recipient undergoing immuno-suppressive therapy, which makes her particularly vulnerable to infections. In 2024, she developed a urinary tract infection caused by resistant bacteria. As a result, the antibiotic treatment was more complex and required a longer duration than is typically the case. Consequently, her already declining renal function deteriorated further, resulting in loss of kidney function and the need for dialysis treatment. Although the treatment was ultimately effective, it had a substantial impact on Malene's health and quality of life. Kidney transplant recipients are particularly vulnerable to resistant bacteria and rely on prompt and effective antibiotic treatment in the event of infection.

Thorvald, 69 years old, has been living with chronic obstructive pulmonary disease (COPD) for over 15 years. As a result, he is at increased risk of pulmonary infections such as pneumonia and pleurisy. Prior to the COVID-19 pandemic, Thorvald would typically experience pneumonia between six and eight times a year. The intervals between infections have increased, but the infections themselves have become more severe. The most recent case of pneumonia took five weeks to bring under control. Like other patients with COPD, Thorvald is therefore heavily dependent on access to effective antibiotic therapy.

Source: Peter's story was obtained from the Danish Heart Foundation, Malene's from the Danish Kidney Association and Thorvald's from the Danish Lung Association.

The threat of antimicrobial resistance



Antimicrobials are important and often life-saving medicines used to treat infections caused by microorganisms such as bacteria, fungi or parasites. Stories like Peter's and Thorvald's highlight that antimicrobials form the cornerstone of our modern healthcare system and, by extension, our collective health. The most well-known type of antimicrobials is antibiotics, which are used to treat bacterial infections.

The use of antimicrobials is not without consequences. Microorganisms exposed to antimicrobials may, over time, develop defence mechanisms that enable them to withstand these drugs. Antimicrobial resistance occurs when microorganisms become resistant to the medicinal products used to eliminate them. All use of antimicrobials entails a risk of developing resistance.

Widespread resistance would mean that common infections such as urinary tract, skin or respiratory infections would become difficult or eventually impossible to treat. They could lead to serious illness and, in the worst-case scenario, death. Malene's story clearly illustrates the profound human consequences of antimicrobial resistance. Resistance also complicates the use of modern treatments that suppress the immune system, such as cancer therapy or organ transplantation. AMR will also increase the risks associated with routine procedures, such as hip replacements, as post-operative infections become more difficult to treat.

At the global level, antimicrobial resistance has been recognised as one of the greatest threats to public health, by, among others, the World Health Organization (WHO). It is estimated that one in five bacterial infections in the EU/EEA is currently caused by resistant bacteria, and that more than 35,000 people in Europe die each year as a result of infections with resistant bacteria. On a global scale, AMR is estimated to have caused more than 1.27 million deaths in 2019. It is estimated that AMR could potentially cause up to 10 million deaths by 2050 if action is not taken to counter its development.

Widespread resistance also has consequences for the wider economy. Resistance directly leads to increased costs in the healthcare system due to more expensive treatments, longer hospital stays and the need for specialised infection prevention and control measures. AMR also has indirect economic consequences for society, including increased sick leave due to prolonged illness.

Projections indicate that, in the coming years, up to 10 percent of healthcare expenditure on infectious diseases in OECD and EU countries will be spent on managing complications arising from antimicrobial resistance. According to the Center for Global Development, the global direct healthcare costs of AMR exceed DKK 470 billion annually, and this figure could rise to more than DKK 1,151 billion per year by 2050. Based on OECD calculations, antimicrobial resistance is currently associated with annual direct healthcare costs of DKK 400 million in Denmark.

Antimicrobial resistance from a One Health perspective

Antimicrobial resistance is not only a challenge for humans. Resistance is also present in micro-organisms in animals, plants and the environment that can spread to humans. The occurrence of resistance in microorganisms in humans is affected by the animals we come into contact with, the food we eat, and the environment we occupy.

Efforts to combat antimicrobial resistance in humans cannot stand alone. Collaboration is necessary across the human, veterinary, food and environmental sectors through a One Health approach that integrates the health of people, animals and the environment.

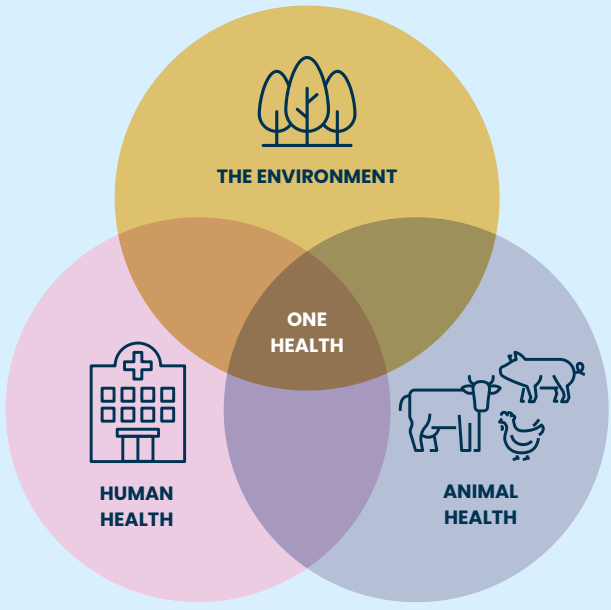
Extensive efforts are underway both within and across sectors to combat AMR. Denmark has a long-standing tradition of strategic One Health collaboration on AMR, with specific action plans implemented within each sector. The present action plan should be viewed in conjunction with the *National action plan on antimicrobial resistance in animals and food 2024–2027*, published by the Danish Veterinary and Food Administration in 2024. This action plan outlines four strategic priority areas in the veterinary and food sectors. Each focus area includes objectives supported by concrete measures and activities.

Since 1995, Denmark has had an integrated cross-sectoral surveillance of the use of antimicrobials and the prevalence of resistant bacteria in animals, food and humans through the DANMAP collaboration between Statens Serum Institut and the National Food Institute at the Technical University of Denmark. DANMAP issues an annual report detailing trends in antibiotic consumption and resistance prevalence and highlighting key developments in the Danish AMR landscape. The cross-sectoral collaboration in DANMAP is recognised internationally as a success story for the One Health approach.

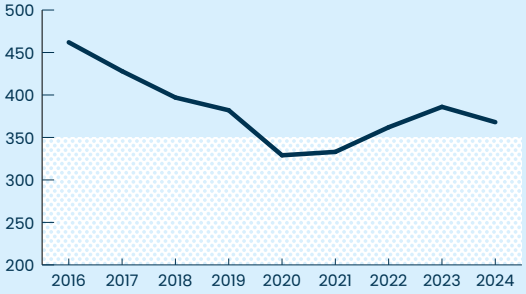
In 2017, the former Ministry of Environment and Food and the Ministry of Health and the Elderly developed a *One Health strategy to combat antibiotic resistance*. The strategy contains five objectives, all aimed at reducing antibiotic use and preventing the development of resistance in humans and animals alike.

The One Health strategy has been successful in setting the direction for Denmark's efforts to combat antibiotic resistance. The importance of a strong One Health approach will only continue to grow in the future.

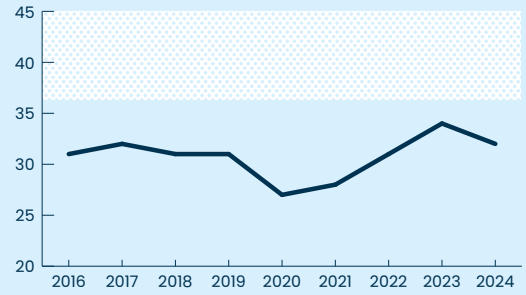
We are therefore taking the initiative to develop an updated One Health strategy to guide future efforts for combating antimicrobial resistance and promoting health for all.



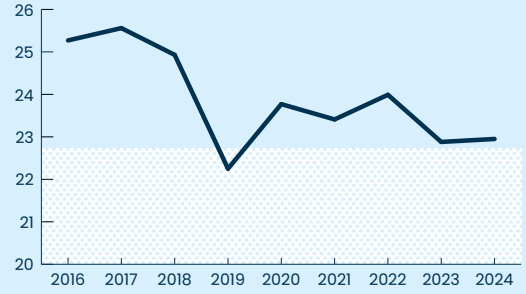
Since 2016, we have reduced the number of prescriptions in the primary care sector (measured as prescriptions per 1,000 inhabitants per year) and have nearly reached the target set in 2017.



A larger share of total antibiotic use in primary care (measured as the number of prescriptions per 1,000 inhabitants) now consists of the narrow-spectrum antibiotic penicillin V, but we have not yet reached the target.



We have reduced the use of critically important antibiotics (measured as DDDs per 100 bed-days) to a significantly lower level.

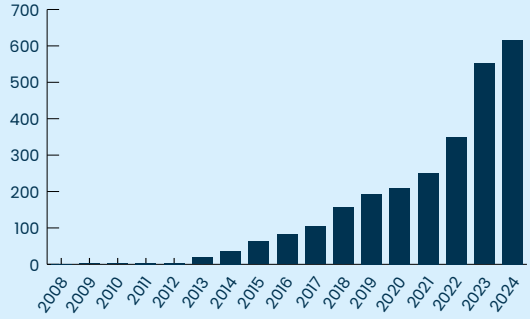


Source: Statens Serum Institut

The number of invasive cases of monitored bacterial species, in which a person is infected with bacteria, has increased by 25 percent from 2014 to 2024.

Source: Statens Serum Institut

In particular, the incidence of multidrug-resistant intestinal bacteria – carbapenemase-producing Enterobacterales (CPE) – has risen sharply, making them difficult, and in some cases impossible, to treat.



Source: Statens Serum Institut

And the frequency of antimicrobial shortages has increased significantly.

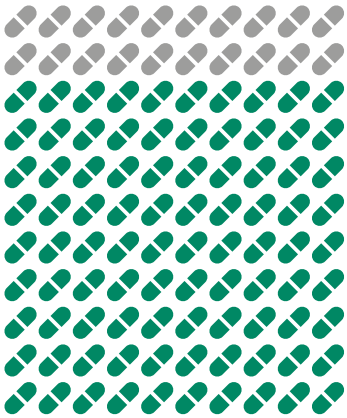
5.9

Average number of packs affected by supply shortages in 2011

52.4

Average number of packs affected by supply shortages in 2024

Source: The Association of Danish Pharmacies
Note: The annual average number of antibiotic packs (J01) affected by supply shortages is recorded for both full-line wholesalers on the first tariff day of each 14-day pricing period.



80.1%

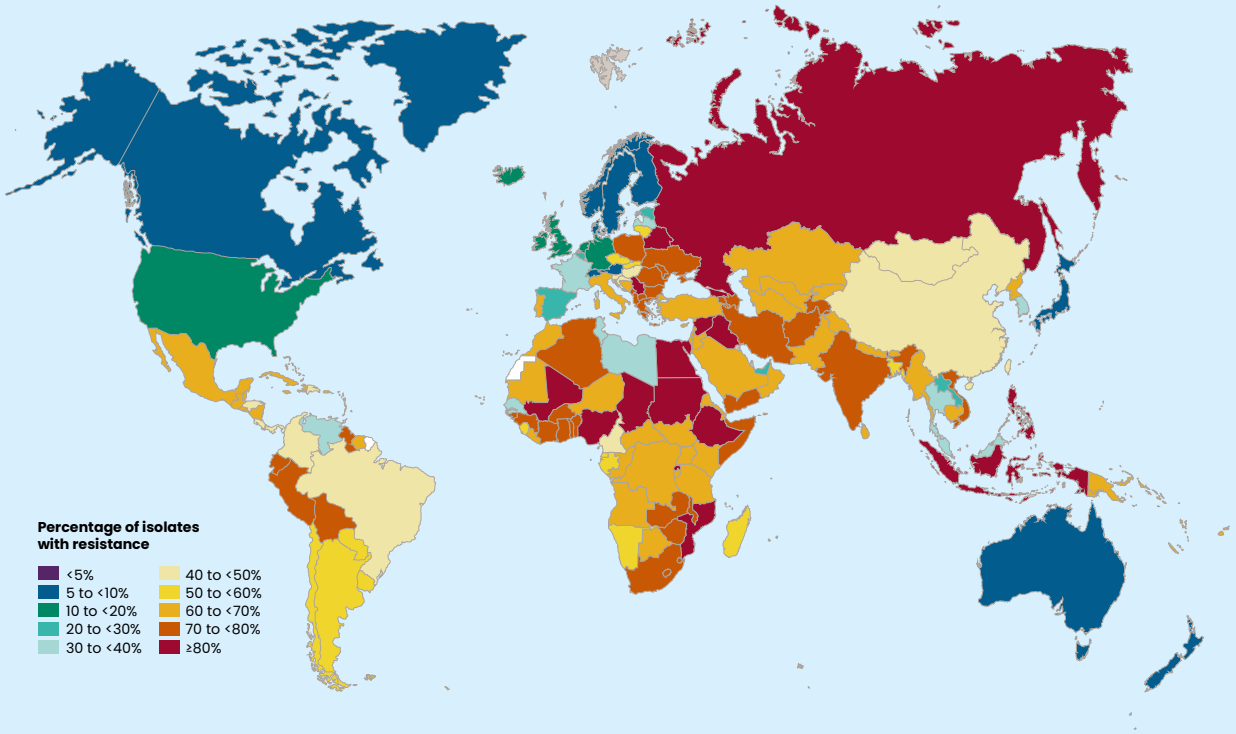
In 2023, 80.1 percent of total antibiotic consumption in Denmark consisted of antibiotics in the WHO's Access group, which carry the lowest risk of promoting resistance.

Denmark is therefore the EU country that, measured as a share of total consumption, is best at making use of antibiotics associated with the lowest risk of resistance development.

Note: Each icon represents one hundredth of Denmark's antibiotic consumption, measured in DDDs per 1,000 inhabitants per day in 2023, broken down according to the WHO's AWaRe classification into the Access group (green) and the remaining groups – Watch, Reserve, and Unclassified (grey).

Source: ESAC-Net

The resistance level for many microorganisms remains low in Denmark. However, in many other regions of the world, antimicrobial resistance already poses a major challenge.



Note: The map shows the distribution of K. pneumoniae isolates resistant to critically important third-generation cephalosporins.
Source: Global Research on Antimicrobial Resistance (GRAM)

Due to high global resistance levels, in 2019 AMR was estimated to have caused

1.27 million deaths

If no action is taken, by 2050 that number is expected to rise to over

10 million deaths

Source: WHO

Overview of priority areas, initiatives and objectives in the national action plan on antimicrobial resistance in humans

Antimicrobial stewardship

We must reduce the use of antimicrobials and prioritise the use of antimicrobials that carry a lower risk of resistance development.

1. Strengthened collaboration between hospitals and municipalities, general practitioners and practising specialists on antimicrobial resistance
2. Pilot project to strengthen point-of-care diagnostics
3. Assessment of prescription requirements for topical antimicrobials
4. Increased harmonisation of medicinal product packaging
5. Increased focus on antimicrobial resistance in primary care

Access to antimicrobials

We must work towards a more stable and improved supply of antimicrobials.

6. Increased European cooperation on innovative procurement models
7. Increased Nordic cooperation on the availability of narrow-spectrum antibiotics
8. Exemption from annual fees for antimicrobials

Cross-cutting initiatives

18. Establishment of a national AMR advisory group
19. Monitoring
20. Research on antimicrobial resistance
21. Awareness and information campaigns

Infection prevention and control

We must combat any increase and work towards a reduction in the amount of infections requiring treatment.

9. Enhanced training in hygiene and infection prevention and control
10. Health Technology Assessment (HTA) of pneumococcal vaccination
11. AMR as a parameter in vaccine assessment
12. Simplification of guidance materials
13. Elimination of administrative barriers to vaccines with conditional reimbursement

International engagement

We must strengthen our international involvement and contribution to global efforts to combat antimicrobial resistance.

14. Increased international engagement and cooperation on AMR
15. Appointment of a High-Level Representative (HLR)
16. Developing and implementing sustainable AMR solutions in low- and middle-income countries through ICARS
17. Support for global capacity building

New One Health Strategy on Antimicrobial Resistance

Photo: Danish Health Authority

Priority area 1:
Antimicrobial stewardship

Nina's story

Nina is a physician at the Department of Clinical Microbiology at Aalborg University Hospital. Nina is involved in both laboratory work and clinical consultations to help diagnose patients. Drawing on test results, she provides guidance to colleagues across hospitals in the region on the most suitable treatment for each patient.

While it remains relatively uncommon, Nina is encountering noticeably more patients who are ill due to highly resistant microorganisms than she did in the past. This means that she has to carry out more tests, which requires both time and resources. This may impact patients, as delays in identifying the appropriate treatment may contribute to a deterioration in their condition. Resistant micro-organisms frequently require treatment with broad-spectrum antibiotics, which may be associated with increased side effects for patients. At the same time, according to Nina, being placed in isolation is a distressing experience for patients, but it is a necessary measure to prevent microorganisms from spreading to other patients.

Source: Nina's story was obtained from the Danish Society for Clinical Microbiology.

We must protect our antimicrobials. Without action, stories like Nina's may become increasingly frequent. Excessive and unnecessary use of antimicrobials accelerates the development of resistance, ultimately diminishing their effectiveness against the micro-organisms they are designed to combat. It is therefore essential that we use antimicrobials only when necessary and when they will benefit the patient. This is also referred to as rational use of antimicrobials.

We are therefore committing to reducing the use of antimicrobials and prioritising antimicrobials associated with a lower risk of resistance development.

This serves not only the interest of society as a whole, but also those of each individual. Treatment with antimicrobials – particularly broad-spectrum ones – can have a significant impact on the body's normal microbiota. The microbiota plays a vital role in keeping the body healthy and in balance, and disruptions can make individuals more susceptible to illness.

A correct and timely diagnosis is essential to ensuring the rational use of antimicrobials. For example, broad-spectrum antibiotics are often used as a temporary measure in serious situations where the physician is unable to rule out a bacterial infection or accurately identify the pathogen. Accurate diagnostics are equally important in less serious infections. Accessible, accurate and rapid diagnostics make it possible to target treatment and avoid overuse of antibiotics.

The field of diagnostics is constantly evolving, yet existing diagnostic tools are often characterised as inadequate and slow. We will therefore explore the potential of scaling up new diagnostic tools through a research-based pilot project. The pilot project will be established through a public–private partnership with the aim of assessing the potential of new diagnostic tools to support rapid point-of-care diagnostics in the primary care sector, with a view to reducing antibiotic consumption.

The 'Fri for UVI' pilot project: Preventing urinary tract infections in nursing homes

Urinary tract infections (UTIs) pose a major challenge in many nursing homes, where many residents develop UTIs, and many others receive unnecessary antibiotic treatment for suspected infections.

Excessive use of antibiotics can cause side effects for the individual and increase the risk of resistance development at the societal level. Part of the overuse is due to the widespread reliance on urine dipsticks to diagnose urinary tract infections. Urine dipsticks can detect bacteria in the urine, but a positive result does not necessarily indicate a urinary tract infection. This is particularly relevant for older individuals, who often have a naturally higher bacterial presence in the urine.

Odense Municipality, Nyborg Municipality and the Department of Clinical Microbiology at Odense University Hospital therefore launched Fri for UVI, a pilot project aimed at preventing urinary tract infections and reducing the use of antibiotics for their treatment. The Department of Clinical Microbiology developed a short interactive training seminar in cross-sectoral collaboration with two selected nursing homes: Vindinge Landsbycenter and Blomsterdalen Nursing Home. The seminar aimed to promote a systematic focus on basic preventive measures and to clarify when the use of antibiotics is clinically appropriate. In addition, a decision support tool was developed for use by nursing home staff in their daily work to assess the risk of urinary tract infections.

All staff and management at the two nursing homes, affiliated general practitioners and key municipal representatives participated in the seminar training. The two participating nursing homes subsequently halved their use of antibiotics for the treatment of urinary tract infections, and the incidence of UTIs was reduced. The marked decrease in antibiotic consumption was partly attributable to the discontinuation of urine dipstick testing. The results of the pilot project have been so positive that Nyborg Municipality has decided to scale up the concept to all nursing homes in the municipality. Odense Municipality also has a plan to fully implement the concept in all municipal nursing homes.

Ensuring the rational use of antimicrobials is not an easy task. Nevertheless, several topical antimicrobials, such as creams for fungal infections, can be purchased over the counter without a prescription. However, they may pose a potential risk of resistance development if not used correctly. An assessment will therefore be initiated to assess whether there is a need to extend prescription requirements to additional topical antimicrobials and to examine the potential consequences of introducing such a measure.

In the future, the healthcare system in Denmark will also move closer to the citizens, allowing more healthcare services to be delivered outside of hospitals. This likewise applies to tasks related to infection prevention and control, as well as the rational use of antibiotics. However, much of the specialised expertise is located in hospitals. The action plan will help ensure that this expertise is accessible closer to citizens by strengthening collaboration between hospitals and municipalities, general practitioners and practising specialists, including through the forthcoming health councils. This is intended to ensure that the right national frameworks are in place to support effective local cross-sectoral collaboration, as seen, for example, in the ***Fri for UVI project***.

General practitioners play a key role in addressing antimicrobial resistance. For most people, the general practitioner is their first point of contact with the healthcare system, and general practitioners are responsible for prescribing approximately 75 percent of all antibiotics in Denmark. However, general practitioners do not have the same access to a specialised peer network with whom they can discuss antimicrobial resistance. We will activate the existing cluster networks under the Quality in General Practice (KiAP) initiative to create a framework for professional knowledge-sharing and data-driven quality development.

Antimicrobial stewardship is not solely about limiting the use of antimicrobials. They are both useful and necessary in many situations. But they must be used correctly. At the correct dosage and for the appropriate duration of treatment. We will therefore intensify ongoing efforts to adjust medicinal product packaging to align with modern and more restrictive treatment recommendations.

The national action plan will strengthen antimicrobial stewardship efforts by:

1. Strengthening cooperation between hospitals and municipalities, general practitioners and practising specialists to ensure access to guidance on infection prevention and control and the rational use of antibiotics, thereby making expert knowledge accessible closer to citizens.
2. Strengthening diagnostics through a research-based pilot project developed in a public–private partnership to generate knowledge on how rapid point-of-care diagnostics can be implemented in primary care.
3. Assessing the need for prescription requirements for topical antimicrobials currently available over the counter to promote rational use.
4. Adjusting the packaging of antimicrobials to ensure greater alignment with treatment guidelines and updated package leaflets.
5. Improving quality in general practice through a cluster package on the rational use of antimicrobials for use within quality clusters in general practice, ensuring that knowledge and experience on rational use are accessible to general practitioners.

Rational use of antimicrobials

According to the Danish Health Authority's guidance on antibiotic prescribing, rational use of antibiotics includes, among other things, the following:

- Antibiotics should only be used when they can prevent serious or life-threatening illness or significantly shorten the course of illness.
- Antibiotics should only be used when clinical and diagnostic findings provide at least a reasonable likelihood that the infection is caused by bacteria.
- The selected antibiotic should be as narrow-spectrum as possible, and the treatment duration should be kept to a minimum.
- If treatment with the selected antibiotic proves ineffective, the choice of antibiotic should be reassessed.

The fundamental principles of rational antibiotic use can also be applied to the rational use of other antimicrobials.

Photo: Danish Health Authority

Priority area 2:
Access to antimicrobials

Kristina's story

Kristina is a specialist in infectious diseases and works as a chief physician at Gødstrup Regional Hospital. Kristina contributes, among other things, to the development of treatment guidelines designed to help her colleagues choose the right antibiotic. The guidelines are instrumental in ensuring the rational use of antibiotics.

However, Kristina finds that antimicrobial shortages make it difficult to update the guidelines. She has been involved in updating multiple treatment guidelines intended to promote a shift from broad-spectrum antibiotics to more narrow-spectrum options. The challenge, however, is that there is an insufficient supply of the alternative antibiotics, creating a risk of exhausting existing medical stockpiles. As a result, the new treatment guidelines have to be put on hold. This may accelerate the development of resistance to some of the antibiotics we are trying to preserve, and, in the worst-case scenario, we risk losing their effectiveness in the future.

Source: Kristina's story was obtained from the Danish Medical Association.

Rational use of antimicrobials requires access to the appropriate medicines. Limited availability and antimicrobial shortages may lead clinicians to resort to less suitable alternatives, which potentially carry a greater risk of resistance development. This may mean that infections have to be treated with broad-spectrum antibiotics, thereby promoting resistance development.

Kristina's experiences clearly demonstrate how the availabilityof appropriate antimicrobials affect both patients and society.

We will therefore work to ensure a more stable and improved supply of antimicrobials.

Piperacillin/Tazobactam shortage

In 2016, an explosion occurred at a pharmaceutical factory in Jinan, China. The factory produced the majority of the active substances in the combination antibiotic piperacillin/tazobactam, which is widely used in Denmark to treat severe infections.

The explosion impacted global production to such an extent that Denmark temporarily faced major difficulties in the supply of the medicine. As a result, seriously ill patients in Denmark had to be treated with a broader-spectrum antibiotic, which may have contributed to the further development of antimicrobial resistance.

The incident highlights that antimicrobial shortages can significantly threaten efforts to combat antimicrobial resistance, and that ensuring access to antimicrobials is a global challenge requiring cross-border solutions.

The global supply of medicines is complex and involves many stages. Denmark cannot address these challenges alone. It is therefore important that we look to partners and enter into mutually beneficial agreements. In this context, the European Union's strategic autonomy plays a key role. The National Action Plan will include cross-border initiatives to strengthen access to antimicrobials, both at EU level and within the Nordic cooperation framework.

The market for antimicrobials is challenging. On the one hand, we want to ensure access to antimicrobials and support the development of new ones. However, at the same time, we must reduce our use of antimicrobials. This highlights the need for innovative and forward-thinking solutions. Sweden and the United Kingdom have successfully implemented pilot initiatives involving alternative reimbursement models, which have supported continued access to antimicrobials. Enhanced collaboration between countries can contribute to jointly supporting the necessary development and access to antimicrobials. We will work to further innovative, EU-wide solutions that can, for instance, create initiatives for pharmaceutical companies to supply the market or develop new antimicrobials.

There is already a well-established Nordic cooperation in the field of antimicrobial resistance. This cooperation must be preserved and strengthened. Unlike much of the world, the Nordic countries continue to use narrow-spectrum antibiotics, which are associated with a lower risk of resistance development. This also means that, from a global perspective, the total market for these medicines remains limited.

As part of the National Action Plan, we are working to participate in an innovative joint Nordic procurement scheme founded on a subscription-based model. This initiative is intended to support continued access to critical narrow-spectrum antibiotics in Denmark and across the Nordic region.

It is important to look beyond national borders. However, there are also initiatives that can be implemented at national level. Every year, several antimicrobials are removed from the Danish market, as they are no longer considered commercially viable in Denmark. This reduces our arsenal in the fight against infections and resistance. We are taking steps to eliminate the financial barrier posed by the annual marketing authorisation fee for systemically administered antibiotics, in order to help retain more antimicrobials on the market.

The national action plan will reinforce efforts to secure access to antimicrobials by:

6. Exploring the potential for participating in an innovative joint European procurement model to safeguard access to essential antibiotics.
7. Strengthening Nordic cooperation on the development of a joint procurement model to improve the availability of narrow-spectrum antibiotics that are particularly used in Denmark and the rest of the Nordic region.
8. Exempting antimicrobials from annual fees to remove unnecessary barriers to marketing and keep antimicrobials on the market in Denmark.

Subscription model for antimicrobials

In a subscription model, one or more countries enter into a contract with one or more manufacturers producing antimicrobials. The contract entails that the participating countries receive a supply guarantee in return for a fixed payment to the manufacturers. The aim of the model is to fully or partially decouple manufacturers' earnings from national consumption of antimicrobials.

The model is designed to ensure stable access to antimicrobials while avoiding incentives that may lead to overconsumption. There are several variants of the subscription model, which may differ in aspects such as payment size, the degree of decoupling, and the specific obligations of the manufacturers. Both Sweden and the United Kingdom have implemented subscription models based on initial pilot projects.

Priority area 3:
Infection prevention and control

The stories of Pia and Lykke

Pia works as a service assistant in the Emergency Department at Randers Hospital. There is a high turnover of patients in the department, which creates a significant risk of infection transmission. This means that Pia must place strong emphasis on infection prevention and control in her daily tasks. This can range from putting up signs in patient rooms to inform colleagues about the required personal protective equipment, to thoroughly cleaning the rooms in accordance with professional guidelines.

Lykke works as a social and healthcare assistant in home care in the Egevang district of Nyborg Municipality. Infection prevention and control also plays a significant role in her daily work. Lykke's service users live in their own homes, so she must exercise particular caution to avoid transmitting infections between households. It can be challenging, but she finds that simple practices such as hand disinfection and wearing gloves can help prevent infections in all situations.

Both Pia and Lykke report that their infection prevention and control efforts provide great value for service users by keeping them healthy, preventing hospital admissions and reducing the need for medication.

Source: Pia and Lykke's stories were obtained from FOA.

Resistant microorganisms, like other microorganisms, can spread as infections between people, which increases the prevalence of resistance. A high level of infections also leads to increased use of antimicrobials, which in turn contributes to a higher prevalence of antimicrobial resistance. One of our most effective weapons against antimicrobial resistance is therefore to prevent infections – such as urinary tract and respiratory infections – in the first place.

We commit to combating any upward trend and working towards a reduction in the level of infections requiring treatment.

A large part of the fight against the development of resistance takes place through daily hygiene and infection prevention and control efforts, such as those carried out by Pia and Lykke. The measures may seem simple. Handwashing. Thorough cleaning. Disinfection. However, preventing infections in practice requires knowledge and skills. As part of the National Action Plan, training in hygiene and infection prevention and control will be reinforced by the development of new educational materials covering hygiene, cleaning and infection prevention and control. The material will be incorporated into the social and healthcare assistant and service assistant training programmes and will also be freely accessible for use in workplaces by other staff groups working in close contact with service users. The objective is to enhance the knowledge base of new employees to enable their active participation in infection prevention and control efforts, while also upskilling both skilled and unskilled staff already in the workforce.

Extensive and complex guidance materials can make it difficult for staff to prioritise their efforts. We are therefore taking concrete steps to simplify and prioritise the existing guidance material in order to provide practical and usable guidance. The initiative will have a broad scope and will be based on the needs of the staff. The aim is to benefit service users through improved infection prevention and control efforts, while also easing the burden on staff by removing unnecessary administrative tasks.

Vaccines also play a key role in the effort to prevent infections and resistance. Vaccines prevent infections and reduce the need for treatment with antimicrobials. Vaccination against infections caused by bacteria – such as pneumococci – that are typically treated with antibiotics directly reduces antibiotic consumption. Other vaccines also reduce usage by preventing infections that may lead to secondary bacterial infections or situations where antibiotics are used as a precaution. This is intended to complement

Denmark's already well-functioning seasonal vaccination programme, which helps protect the most vulnerable members of society against COVID-19 and influenza. In 2024, the programme achieved coverage rates of 74.9 percent for COVID-19 vaccination and 75.7 percent for influenza vaccination among citizens aged 65 and over – the highest uptake in the Nordic region by a significant margin.

It is important that all decisions to include vaccines in a public programme have a solid basis in the best available scientific evidence. The Danish Health Authority therefore conducts scientific assessments of vaccines prior to any decision on their inclusion in a public programme. A Health Technology Assessment (HTA) of pneumococcal vaccination is therefore being initiated. During the COVID-19 pandemic, pneumococcal vaccination was offered as a measure to protect particularly vulnerable groups and ease the burden on the healthcare system. The assessment will, among other things, examine the benefits and advantages of offering the vaccine as part of a public programme.

When the Danish Health Authority assesses vaccines, several considerations are already taken into account, such as preventive potential and the severity of the disease. But there is potential in adopting a broader perspective. With the National Action Plan, we will therefore introduce the effect of vaccines on antimicrobial resistance as a parameter in future assessments conducted by the Danish Health Authority. This is intended to provide a broader perspective on vaccines and ensure a consistent focus on AMR, highlighting their value in preventing resistance.

Vaccines with conditional reimbursement

Some vaccines are offered with conditional reimbursement for clearly defined population groups who meet specific medical eligibility criteria. It is the physician who determines whether an individual belongs to one of the groups eligible for conditional reimbursement.

An effort to improve the use of vaccines to prevent the development of resistance does not only involve focusing on new vaccines. We must also consider how to make the best use of the vaccines that are already being offered. Many physicians are already aware of how vaccines can be used to prevent disease and the development of resistance. Unfortunately, they encounter administrative barriers when advising their patients about vaccines. Today, it is difficult for general practitioners to gain an overview of which of their patients might benefit from a vaccine offered with conditional reimbursement. We are therefore removing administrative and legal barriers, so that general practitioners can access information on relevant patients' vaccination status and, on that basis, offer vaccination. For patients, the initiative will contribute to a smoother vaccination process with fewer visits to the doctor. Overall, this can help ensure that vaccines benefit more vulnerable individuals.

The national action plan will reinforce infection prevention and control efforts by:

9. Strengthening training in hygiene and infection prevention and control by developing new educational materials on hygiene and infection prevention for use in social and healthcare assistant and service assistant training programmes, as well as in workplaces for other staff groups.
10. Conducting a Health Technology Assessment (HTA) of pneumococcal vaccination to provide a well-founded basis for decisions on a potential public vaccination programme.
11. Introducing antimicrobial resistance as a parameter in the Danish Health Authority's future professional assessments of vaccine effectiveness to ensure sustained focus on the potential of vaccines to prevent AMR.
12. Simplifying guidance materials to streamline and support staff in their infection prevention and control efforts, and to eliminate unnecessary administrative burdens.
13. Improving general practitioners' access to the Danish Vaccination Register (DDV) to enhance citizens' access to vaccines with conditional reimbursement.

Priority area 4:
International engagement

Dr Chanda's story

Dr Duncan Chanda is Director of Infectious Diseases at the University Teaching Hospital in Lusaka, the capital of Zambia, and has served as project lead on one of ICARS' 55 projects across 24 low- and middle-income countries. The purpose of the project was to reduce unnecessary use of antibiotics in patients with bloodstream and urinary tract infections. According to Dr Chanda, it was not uncommon prior to the project for a patient to receive three types of antibiotics, even though just one would have been sufficient.

In close collaboration with local staff such as Dr Chanda, ICARS contributed knowledge and practical tools to support decision-making on when antibiotics should be used. The project led to a significant reduction in antibiotic use, which, according to Dr Chanda, has benefited both individual patients and the wider community by reducing the development of resistance.

Source: Dr Chanda's story was obtained from ICARS.

Microorganisms do not respect national borders. They travel across countries with the help of people, animals, plants and food. At the same time, an increasing number of countries are facing growing challenges related to antimicrobial resistance.

Although Denmark has a low level of resistance compared to other countries, international trade and travel patterns present a risk of resistant bacteria entering the country. It is therefore also in Denmark's interest to assist other countries in combating antimicrobial resistance. Dr Chanda's story illustrates how development programmes targeting antimicrobial resistance can make a tangible difference in local communities.

We will therefore commit to strengthening Denmark's international engagement and contribution to global efforts against antimicrobial resistance.

We must do this both by supporting existing multilateral efforts relevant to AMR – such as the World Health Organization's ***End TB Strategy***, which aims to eradicate tuberculosis globally – and through bilateral cooperation, such as Denmark's strategic sector collaboration with Ukraine, which, among other goals, aims to strengthen Ukrainian authorities' efforts to combat antimicrobial resistance.

Denmark has held a leading position in the field of antimicrobial resistance for many years, for example through the joint human-animal surveillance programme under the DANMAP collaboration. We therefore have valuable experience and knowledge that can also benefit other countries. Denmark's expertise should be directed towards areas where the need is most acute and the consequences most severe. Accordingly, Denmark's international engagement will primarily target low- and middle-income countries. Efforts will also focus on initiatives within the European context, where geographical proximity and cross-border movement increase the risk of infection spread. Denmark's EU Presidency in the second half of 2025 will also serve as a lever to highlight the issue of antimicrobial resistance at the European level.

Building on the National Action Plan, Denmark will reinforce its international engagement and cooperation on antimicrobial resistance. The work will take place across a wide range of multilateral forums, such as the EU's Health Emergency Preparedness and Response Authority (HERA), the EU collaboration JAMRAI-2, the UN, the WHO, and through bilateral cooperation under the Ministry of the Interior and Health of Denmark's Strategic Sector Cooperation (SSC) with health authorities in a number of countries.

Denmark's engagement is supported by the appointment of a ***High-Level Representative*** tasked with representing Denmark in international AMR forums with a One Health approach, contributing Danish solutions, and helping to shape the international debate. This is intended to ensure that Denmark

continues to play a leading role in shaping the AMR agenda and is regarded as a reliable international partner.

As many collaborators as possible must be brought on board in the fight against antimicrobial resistance. In 2018, Denmark took the initiative to establish the International Centre for Antimicrobial Resistance Solutions (ICARS), with the aim of developing and implementing collaborative programmes on AMR with low- and middle-income countries. In 2021, ICARS transitioned to an independent, self-governing organisation. Denmark must continue to support the important work carried out by ICARS to ensure locally sustainable One Health solutions. In addition to the National Action Plan, the government has allocated DKK 280 million to ICARS via Denmark's development aid over a four-year period from 2027–2030, to support its future work and development.

Denmark will also increase its support for the WHO's global One Health AMR efforts through the DTU National Food Institute in its role as a WHO Collaborating Centre. The increased support is intended to assist the WHO in carrying out capacity-building activities in the AMR field, developing guidelines and tools to support the implementation of advanced genome sequencing methods, enhancing the capacity of national and international laboratories worldwide, and strengthening knowledge of and implementation of AMR surveillance.

The national action plan will reinforce efforts to promote international engagement by:

14. Actively applying Danish knowledge and experience to support initiatives to combat AMR in both bilateral and multilateral partnerships.
15. Appointing a *High-Level Representative* to promote Danish solutions, participate in international forums and influence the global AMR agenda.
16. Providing financial support to the International Centre for Antimicrobial Resistance (ICARS) to sustain its ongoing work with low- and middle-income countries in developing evidence-based and sustainable AMR solutions adapted to local contexts.
17. Supporting the scaling up of the DTU National Food Institute's engagement as a WHO Collaborating Centre to strengthen Danish research-based advisory capacity and global capacity building.

Cross-cutting initiatives

In addition to the four areas of action, the action plan includes a number of cross-cutting initiatives. They all aim to support the overall objective of the action plan: combating antimicrobial resistance.

AMR is not only a health issue but a societal issue. An initiative will therefore be launched to establish a cross-sectoral advisory group involving a wide range of stakeholders to ensure focus on implementation. It is important to include the perspectives of patients. Patient organisations should therefore be included in the advisory group as representatives of the patient perspective. The advisory group will be established in collaboration with the Danish AMR Alliance, which has already brought together a broad range of stakeholders in the field.

An important part of the follow-up is to monitor developments based on sound professional knowledge. Accordingly, the objectives set out in the action plan will be subject to ongoing monitoring. Monitoring will be anchored in the DANMAP surveillance programme, which publishes an annual status report tracking the use of antimicrobials and the occurrence of antimicrobial resistance. The report includes a number of recurring elements published each year, as well as a set of special analyses that vary from year to year.

It is essential that research on AMR continues to advance. We will therefore seek to stimulate advanced research in AMR that may lay the foundations for future AMR efforts and, ideally, contribute to the development of new antimicrobials. The EU's research and innovation framework programme, Horizon Europe, will play a central role in these efforts. DKK 231.5 million has been allocated from the 2025 research reserve to strengthen patient-centred, clinical and independent research, which may include research in AMR, as set out in "***Agreement on the research reserve, etc. (Nov. 2024)***".

However, generating new knowledge is not the only priority. We must also disseminate the substantial knowledge we already possess. The action plan will therefore also include awareness and information campaigns on AMR targeting both the general public and healthcare professionals.

The national action plan will reinforce cross-cutting efforts by:

18. Establishing a national AMR advisory group where stakeholders involved in the implementation of the action plan can meet and exchange experiences to support broad societal anchoring.
19. Continuously monitoring the objectives of the action plan to provide the necessary knowledge base for future decision-making in the AMR area.
20. Promoting further research in AMR to generate new knowledge that can form an important foundation for future efforts to combat antimicrobial resistance.
21. Designing awareness and information campaigns on AMR targeting both the public and healthcare professionals.

Financial overview of the national action plan on antimicrobial resistance in humans

The 2025 Finance Act allocates DKK 130 million to strengthen efforts against antimicrobial resistance in humans over a four-year period from 2025 to 2028. Funding is distributed as DKK 10 million in 2025, followed by DKK 40 million annually over the next three years.

In addition, the government is allocating DKK 280 million to ICARS through development aid over a four-year period from 2027 to 2030.

	DKK million 2025-pl	2025	2026	2027	2028
	Priority area 1 – Antimicrobial stewardship				
1.	Strengthened collaboration between hospitals and municipalities, general practitioners and practising specialists on antimicrobial resistance	0.4	5.2	10.0	10.0
2.	Pilot project to strengthen point-of-care diagnostics	-	2.4	2.4	3.8
3.	Assessment of prescription requirements for topical antimicrobials	1.1	-	-	-
4.	Enhanced harmonisation of pharmaceutical packaging	1.1	1.1	1.1	1.1
5.	Increased focus on antimicrobial resistance in primary care	0.9	3.0	1.2	-
	Priority area 2 – Access to antimicrobials				
6.	Increased European cooperation on innovative procurement models	-	-	-	-
7.	Increased Nordic cooperation on the availability of narrow-spectrum antibiotics	2.8	13.7	13.7	13.7
8.	Exemption from annual fees for antimicrobials	-	8.8	8.8	8.8
	Priority area 3 – Infection prevention and control				
9.	Enhanced training in hygiene and infection prevention and control	-	0.9	1.1	1.1
10.	Health Technology Assessment of pneumococcal vaccination	0.9	1.1	-	-
11.	AMR as a parameter in vaccine assessment	-	-	-	-
12.	Simplification of guidance materials	0.4	1.1	0.2	.
13.	Elimination of administrative barriers for vaccines with conditional reimbursement	-	-	-	-
	Priority area 4 – International engagement				
14.	Increased international engagement and cooperation on AMR	-	-	-	-
15.	Appointment of High-Level Representative (HLR)	0.5	1.0	1.0	1.0
16.	Dissemination of sustainable AMR solutions in low- and middle-income countries through ICARS	-	-	-	-
17.	Support for global capacity building	0.5	0.5	0.5	0.5
	Cross-sectoral initiatives				
18.	Establishment of a national AMR advisory group	-	-	-	-
19.	Monitoring	0.1	0.1	0.1	0.1
20.	Research on antimicrobial resistance	-	-	-	-
21.	Awareness and information campaigns	1.3	1.1	-	-
	Total	**10.0**	**40.0**	**40.0**	**40.0**

Note: Any differences in total figures are attributable to rounding in the table.
Source: Projections and calculations by the Ministry of the Interior and Health of Denmark.

Appendix: Overview of objectives and indicators in the national action plan on antimicrobial resistance in humans

National objectives on antimicrobial resistance

We must reduce the use of antimicrobials and prioritise the use of antimicrobials that carry a lower risk of resistance development	We must work towards a more stable and improved supply of antimicrobials.	We must combat any increase and work towards a reduction in the level of infections requiring treatment	We must strengthen Denmark's international involvement and contribution to global efforts to combat antimicrobial resistance
Indicators			
Number of dispensed antibiotic prescriptions in primary care ○	Number of market withdrawals of antimicrobials ○	Bacteraemias per 100,000 inhabitants ○	Denmark supports and collaborates with the authorities of other countries and international organisations in the fight against AMR ○
Use of Penicillin V and Mecillinam as a share of total antibiotic use in primary care, measured in prescriptions per 1,000 inhabitants ○	Number of new market registrations of antimicrobials ○	Incidence of bloodstream infections with carbapenem-resistant Klebsiella pneumoniae (per 100,000 inhabitants) ○	
Use of critically important antibiotics measured in DDDs per 100 hospital admissions ○		Incidence of bloodstream infections with methicillin-resistant Staphylococcus aureus (MRSA) (per 100,000 inhabitants) ○	
Share of total antibiotic consumption represented by the Access group ○		Incidence of bloodstream infections with third-generation cephalosporin-resistant Escherichia coli (per 100,000 inhabitants) ○	
Total antibiotic consumption in both primary care and the hospital sector, including care facilities (DDD per 1,000 inhabitants per day) ○			

Indicators

🟢 Stable or positive trend

🟡 Limited negative trend

🔴 Marked negative trend