

# Swedish Strategy to Combat Antibiotic Resistance

2020–2023



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# Foreword

Antibiotics save lives. Thanks to antibiotics we have become accustomed to being able to treat even very serious infectious diseases caused by bacteria. Medical procedures that pose an increased risk of infection, such as transplants, advanced cancer therapy and care of premature infants, are dependent on effective antibiotics. Modern medicine would have been largely impossible without these medicines. Antibiotics are also important to cure diseases in animals and to ensure food security.

However, the use of antibiotics causes bacteria to develop resistance. In the longer term, this leads to a loss of effective antibiotics. In addition, the development of new antibiotics by the big pharmaceutical companies has come to a halt. No new class of antibiotics has reached the market in a long time. The antibiotics that already exist must therefore be used responsibly in order to curb the development of resist-

ance, and we must continue to work preventively to tackle infectious diseases.

Antibiotic resistance affects all countries and is one of the greatest health threats of our age. It is a momentous global issue that concerns us all, but low-income countries are particularly at risk. Limited access to clean water and sanitation, medicines and health-care impact morbidity and mortality rates for infectious diseases. Most deaths from pneumonia among children under the age of five are due to a lack of access to effective antibiotics.

In the food chain, antibiotic resistance is a threat to animal health and animal welfare, to food safety, trade and economic development. Excessive use of antibiotics in animal production increases the risk of spread of resistant bacteria. Swedish animal production is characterized by high animal welfare standards and

preventive animal health efforts. Close collaboration between the state, animal producers and academia contributes to the relatively low incidence of infectious diseases and to the very low use of antibiotics in animals compared with other countries. Sweden has shown that it is possible to reduce the use of antibiotics in animal production radically without any loss of production. This makes us an important model for the rest of the world.

There is a growing realisation that the use of antimicrobial agents in crop cultivation speeds up the development of resistance. In addition, emissions of antimicrobial substances to the environment can lead to the development and spread of antibiotic resistance and can have an adverse impact on ecosystems.

As a result of long-term, productive efforts, the resistance situation in Sweden is more favoura-

ble than in many other countries. However, here too there is a risk of critical levels of antibiotic resistance being reached over the next few years. To curb the development of resistance, antibiotics must be used even more responsibly.

At the same time, we must invest in research and innovation. Knowledge is needed in several areas, above all to devise new treatment options and diagnostic methods. New insights into human behaviour and attitudes can allow us to promote preventive work even more than we do today. Research initiatives are an investment in our future.

The whole of society needs to be involved. It is important that there is public awareness of the consequences of increased antibiotic resistance. To enable global ways forward to be found, the

issue must be raised to the level of heads of state and government and the international organisations, headed by the UN.

The Swedish Government accords high priority to the issue of antibiotic resistance. The overarching objective of the Swedish Strategy to Combat Antibiotic Resistance is to preserve the possibility of effective treatment of bacterial infections in humans and animals. Finding new ways of preventing and treating infectious diseases is ultimately a matter of our future welfare.

The strategy represents a roadmap for efforts to tackle antibiotic resistance. Swedish society should be well equipped to deal with increased occurrence of resistant bacteria and other microorganisms. Sweden should continue to pursue the issue of antibiotic resistance at the international and EU levels.

Swedish efforts should continue to be based on a broad, cross-sectoral One Health perspective, involving multiple areas such as human and animal health, the environment, research, education, trade and international development cooperation.

We cannot wait, we must act now.

*Lena Hallengren,  
Minister for Health and Social Affairs*

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Minister for Higher Education  
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Development Cooperation*

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Minister for Environment and Climate*

Overarching goal

Preserve the possibility  
of effective treatment  
of bacterial infections in  
humans and animals.

# Introduction

Bacteria that are resistant to antibiotics pose an increasing threat to health and food production across the world. Like other bacteria, resistant bacteria can be transmitted between people, animals and foods, and be spread in our environment. This means that multiple sectors, such as human and animal health, the environment, research, education, trade and international development cooperation must be involved to combat antibiotic resistance in what is known as a One Health approach.

Resistance to antimicrobial agents in general, which include antibiotics, is a global problem. Antibiotic resistance is particularly challenging, however, as bacterial infections are very common among humans and animals world-wide. Furthermore, in the Swedish context, infections treated with antimicrobial agents other than antibiotics are more uncommon in relative terms.

Infectious diseases caused by resistant bacteria bring suffering to those affected. Their consequences can be serious, including increased mortality, prolonged illness and a reduced ability to use antibiotics to protect patients in surgery or other medical treatments, such as cancer therapy. Animals can also contract infections that are difficult to treat due to resistant bacteria, which causes suffering, loss of production and reduced profitability in the agricultural sector. This poses a threat to food safety and to food security world-wide. Resistant bacteria can spread quickly in animal populations, which can pose a risk of further spread to both humans and animals. Antibiotic resistance leads to increased costs in the health-care system and in society at large.

Few new antibiotics are currently being developed, and treatment options are failing to keep pace with the increasing bacterial resistance to existing drugs. However, even developing new antibiotics to a greater extent would not be sufficient to keep up with the development of resistance as it looks today. If the overarching goal of the strategy is to be attained, a long-term, sustainable approach to preventive efforts, the management of infectious diseases and the use of antibiotics is therefore needed.

This strategy is intended to form the basis of Swedish efforts to curb the development and spread of antibiotic resistance and to prevent and manage its consequences. Swedish efforts to combat antibiotic resistance at the national, EU and international levels need to be long-term and sustainable and be based on effective initiatives in all relevant areas.

Sweden should continue to show leadership in international efforts, in line with the Swedish Policy for Global Development, global commitments made under the 2030 Agenda for Sustainable Development and EU activities.

The strategy is based on ongoing Swedish efforts to combat antibiotic resistance, on the global action plan on antimicrobial resistance adopted by the WHO<sup>1</sup> Member States, the FAO<sup>2</sup> action plan, the OIE<sup>3</sup> strategy and on other relevant plans and strategies such as the EU Action Plan against Antimicrobial Resistance, the IACG<sup>4</sup> recommendations and the joint work plan of the Tripartite<sup>5</sup>.

The present strategy is an update of the previous Swedish strategy (2016–2019). The update has been made in line with how circumstances for efforts to combat antibiotic resistance have changed in recent years in Sweden, in the EU and at the international level. It is based on developments in several areas, in particular internationally with increased engagement within the UN system. The strategy applies until the end of 2023 and maintains the long-term focus, its overarching goal continuing to be to preserve the possibility of effective treatment of bacterial infections in humans and animals. It comprises the same seven objectives as previously, in which the Government has identified important factors in attaining the overarching goal.

1. World Health Organisation
2. UN Food and Agriculture Organisation
3. World Organisation for Animal Health
4. UN Inter-Agency Coordination Group on Antimicrobial Resistance
5. WHO, OIE and FAO

# Objective 1: Increased knowledge through enhanced surveillance

This objective signifies that

- access to data on antibiotic resistance and the sale and use of antibiotics and other antimicrobial agents in all sectors, as well as data on healthcare-associated infections and the emission of antibiotics to the environment is improved
- the outcome and cost-effectiveness of various measures is evaluated, using continuous data collection.

It is necessary to continuously collect data on the occurrence of resistant bacteria and use of antibiotics. This makes it possible to analyse trends over time, identify significant changes indicating spread of resistant bacteria, communicate findings and take action at an early stage. Changes in patterns of resistance may prompt updates to treatment recommendations. Surveillance also allows the monitoring and evaluation of measures taken, as part of systematic efforts for improvement. Using comparable resistance data from different sectors, makes it possible to map transmission routes and identify risk factors that are of significance to the problem of resistance.

More efficient use of existing data sources necessitates improved technical means for the exchange and sharing of information. It is important, for example, to be able to link an antibiotic prescription to the preceding diagnosis in order to monitor and influence the compliance of treatment

recommendations by prescribers (for example doctors and veterinarians). There is a long tradition and a high level of expertise in surveillance in Sweden, but the current systems should be improved and developed further to become more integrated and resource-efficient, and to be capable of adaptation to new challenges.

## The Government expects

- appropriate data to be collected from relevant sectors that guide the work at local, regional and national levels, as well as in the EU and globally
- Sweden to employ effective systems for early detection, collation, analysis and reporting of antibiotic resistance and healthcare-associated infections
- the ability to systematically monitor the long-term trends regarding infections in humans and animals, the resistance situation and sale and use of antibiotics to be maintained, coordinated and developed

- possibilities for exchange of information between IT systems and analytical tools to be developed further to increase the benefit of existing data sources
- relevant IT systems to make data available on reasons for prescribing, and compliance with treatment recommendations in all sectors and the results to be fed back to relevant organisations.

Access to high-quality data enables organisations to make improvements pertaining to antibiotic resistance.

## Objective 2: Continued strong preventive measures

This objective signifies that

- effective measures are taken to prevent infections and infection transmission and to minimise the spread of multi-resistant bacteria
- emissions of antibiotics and antimicrobial substances to the environment are minimised.

The favourable resistance situation in Sweden in international terms does not permit complacency. Resistance is growing here as well, albeit more slowly than elsewhere. We must continue to be acutely aware of the importance of preventive measures so that the situation does not deteriorate. Humans and animals that are healthy or receive good quality care have less of a need for antibiotics. Preventive efforts such as vaccination programmes and prevention of sexually transmitted infections, reduce both the use of antibiotics and the consequences of the development of resistance.

Healthcare-associated infections are the most common type of medical adverse event, and a number of these infections are caused by resistant bacteria. Health and social care settings are particularly conducive to the development and spread of antibiotic resistance, both because of the high level of antibiotic use and because of transmission to patients with increased susceptibility to infection. This, in turn, means that these patients are at greater risk of

serious complications. Infection prevention and control measures and practices are fundamental in curbing infections and spread of infection in health and social care and in veterinary care.

The resistance situation in Swedish food producing animals is relatively good from an international point of view, and bacteria with notifiable resistance are generally uncommon in Swedish animals. Vaccination, control and monitoring programmes are of fundamental importance in preventing infections. The need for antibiotics in animals is reduced through efficient disease control, good farm management, biosecurity and sound animal husbandry. Safe international trade in both living animals and animal products is particularly important. This also reduces the risk of resistant bacteria spreading to other animals, to foods, to the environment and to humans.

The emission of antibiotics and other antimicrobial agents to the environment can contribute to increased resistance. Although

knowledge of the development and spread of antibiotic resistance in the environment is incomplete, there is sufficient knowledge today for action to be taken. Advanced treatment of wastewater is one way of reducing the dispersal of antibiotics, resistant bacteria and other antimicrobial agents to the environment. Minimising emissions from the manufacturing of antibiotics and other antimicrobial agents can also contribute to reduced dispersal to the environment.

### **The Government expects**

- a high level of compliance with vaccination, monitoring and health programmes to be maintained to promote human and animal health and consequently reduce the need for antibiotics
- personnel in relevant organisations to have and apply knowledge of antibiotic resistance, infection transmission and the importance of a high level of compliance with basic hygiene practices as part of systematic and evidence-based infection prevention efforts



- regions and municipalities to have access to expertise on hygiene in healthcare settings so that good hygiene standards can be maintained
- relevant actors in animal production, veterinary medicine and the food chain to have access to expertise on hygiene and infection prevention and control in order to ensure good animal health and safe food
- personnel in relevant organisations to observe a high level of vigilance, use rapid diagnostic techniques and apply established procedures and guidelines to prevent, detect and halt the spread of infectious disease
- technology to be installed in wastewater treatment plants for the treatment of pharmaceutical residues and other persistent substances
- public procurement to be used as a strategic tool to attain the goals of the strategy, for example by setting requirements for animal welfare, responsible use of antibiotics and reduced environmental impact of antibiotics.

# Objective 3: Responsible use of antibiotics

This objective signifies that

- antibiotics and other antimicrobial agents are used and managed in a responsible and environmentally friendly manner.

Antibiotics are one of our most important classes of medicines, which if used correctly save many lives and safeguard food production. Increased use of antibiotics, however, leads to increased development of resistance. If antibiotics are used incorrectly, for example when they are not needed, at an inappropriate dosage, or if antibiotics with an unjustifiably broad antibacterial spectrum are used, the development of resistance is promoted unnecessarily. It is therefore important that antibiotics and other antimicrobial agents are used only when they are of benefit, that the right type of antibiotic is used and that treatment recommendations are developed, kept up to date and followed. To reduce the growth of resistance, antibiotics must also be used responsibly in animal husbandry. The Swedish Board of Agriculture regulations govern the use in animals of drugs that are particularly important for the treatment of humans.

Data on compliance with treatment recommendations must be fed back to healthcare organisations to ensure that antibiotics are prescribed responsibly. It is also important to be able to monitor that antibiotic prescription does not decrease to such an extent



that complications increase as a result of untreated or mistreated infections.

Shortages in the availability of antibiotics in the short and long term may pose serious obstacles to the responsible use of antibiotics. This is a problem that also exists in wealthier countries, including Sweden. If there is a shortage of recommended first-line drugs, there is a risk of alternatives being prescribed that are more expensive, have more adverse side effects or are worse from the point of view of resistance development. It is therefore important that access to recommended first-line drugs is guaranteed. More knowledge is also

needed on how the efficacy of older antibiotics can be optimised and preserved. The increasing activity of online sales of pharmaceuticals poses challenges in guaranteeing the same safety and quality as in sale at a physical pharmacy. Diagnosis, treatment and contact tracing of infectious diseases must attain the same high level of quality in both physical and digital healthcare consultations.

There is a risk that the widespread, and in many cases unnecessary, use of antimicrobial agents in everyday products could contribute to the emergence and spread of resistant bacteria.

**The Government expects**

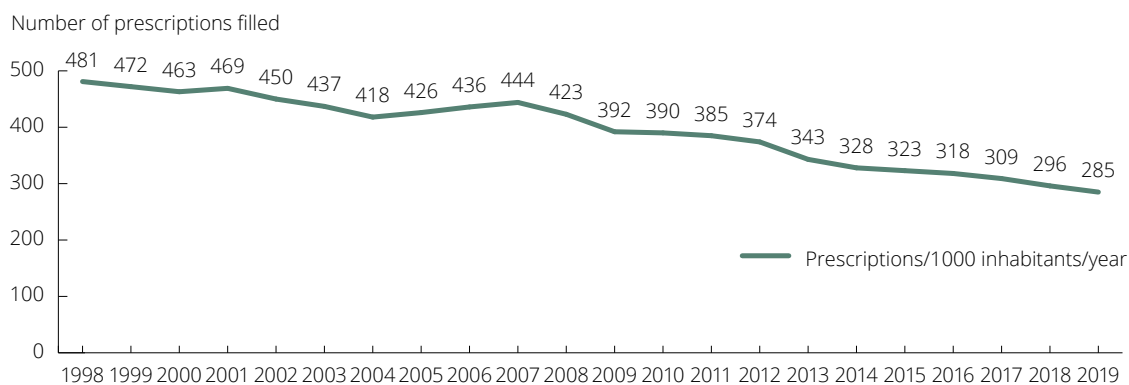
- antibiotics to continue only to be used after being prescribed by professionals who are authorised to prescribe antibiotics
- recommendations on diagnostics and management of common infections to be kept up-to-date and harmonised as far as possible and applied in day-to-day work in the healthcare system and in veterinary care
- quality-assured and adequate diagnostics with the shortest response time possible to underlie the prescribing of antibiotics, regardless of the form of care, in order to avoid un-

necessary and incorrect treatment and to enable follow-up

- data on compliance with treatment recommendations to be used by relevant staff, for example prescribers, managers in healthcare organisations and purchasers, to support improvement efforts both in the healthcare system and in veterinary care
- access to both new and older antibiotics to be guaranteed on the Swedish market
- antibiotics that are not used to be returned to pharmacies and disposed of in an environmentally correct manner

Responsible manufacturing and use of antibiotics and other antimicrobial agents, as well as correct waste management, reduce the risk of antibiotic resistance developing and spreading in the environment.

- antimicrobial agents to be used in a responsible and evidence-based manner in different types of consumer products
- data to be available regarding reasons for prescribing of medicines in veterinary medicine in order to enable checking or supervision of compliance with treatment recommendations.



**Figure 1.** Number of out patient care antibiotic prescriptions filled in Sweden 1998–2019. Systemic use J01 excl. methenamine. Source: The Swedish eHealth Agency

# Objective 4: Increased knowledge for preventing and managing bacterial infections and antibiotic resistance with new methods

This objective signifies that

- greater knowledge of infectious diseases contributes to new antibiotics, other treatment options, diagnostic methods and vaccines being developed
- increased knowledge about the emergence and spread of resistance contributes to the optimised use of new and existing antibiotics and to the problem of resistance being prevented and limited.

A contributory cause of the seriousness of the problem of resistance is that the development of new antibiotics and other treatment options has slowed. Many pharmaceutical companies have closed down their development of antibiotics. This is due to several factors, including low profitability, but also the scientific difficulty of finding new angles of attack. To enable the development of new treatments and preventive measures, research is required into how bacteria cause infections and into their epidemiology and the course of disease. Equally, research is needed to be able to optimise and preserve the effectiveness of existing antibiotics for as long as possible. The development of cost-effective methods for better diagnostics and determination of resistance could reduce the incorrect use of antibiotics in healthcare and veterinary care.

There is furthermore a need for new knowledge to be able to estimate the disease burden and costs

of resistance-related health and social care. Estimates of the costs and benefits of antibiotic use and resistance in both animal production and healthcare should be used to justify further improvements at the national and international levels. It is very important to be able to measure the effects of actions taken and calculate the economic consequences of resistance. There is also a need for greater knowledge of how attitudes and behaviour can be influenced to promote responsible use of antibiotics and of how the organisation of healthcare systems, animal production, global trade and tourism affect the spread of antibiotic resistance between bacteria, humans, animals and the environment.

These challenges cannot be solved by individual nations; they require coordinated international cooperation spanning multiple sectors, also including low-income countries and their particular circumstances. The EU is an important

platform in international research cooperation for Sweden.

## The Government expects

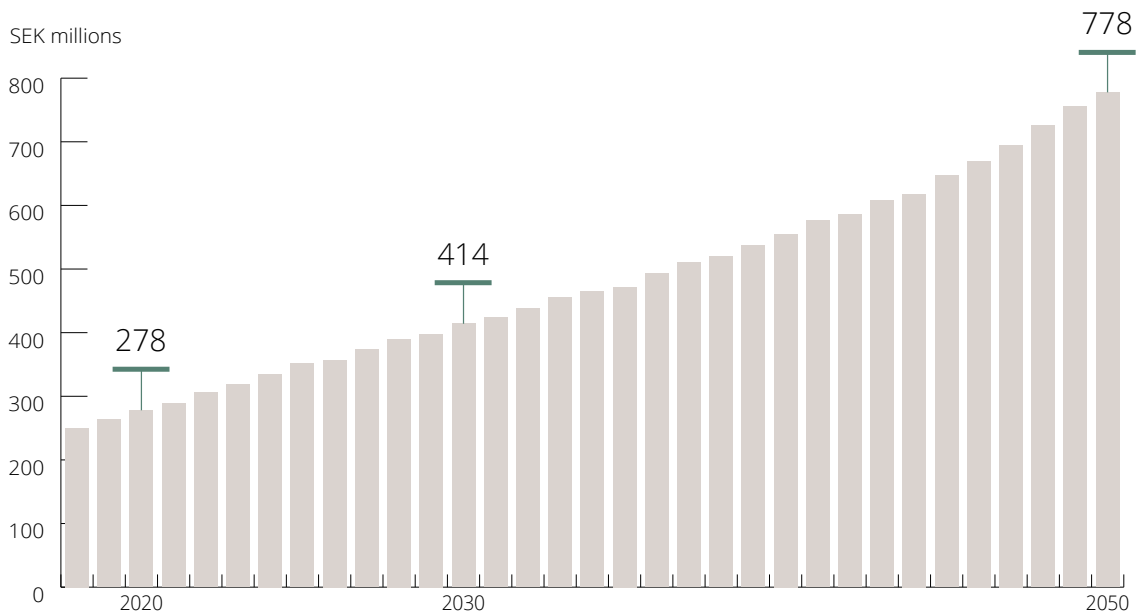
- research concerned with antibiotic resistance to be pursued and long-term research initiatives to be taken under the National Research Programme on Antibiotic Resistance
- initiatives to be taken to bridge the gap between basic research and the commercialisation or other application of research findings
- existing diagnostics and treatments to be developed and optimised in line with the needs and priorities of healthcare organisations
- Sweden to take part in international research cooperation in the field of antibiotic resistance and related areas
- universities, government agencies, the healthcare sector and



trade and industry to collaborate at the national, EU and international levels to identify and eliminate knowledge gaps

- Sweden to contribute to the development of knowledge on new business models and financial control systems to improve

the availability of antibiotics and encourage the development of new antibiotics and other treatment options.



**Figure 2.** Estimated cost for health care and loss of production due to notifiable antibiotic resistance.  
Source: Public Health Agency of Sweden

# Objective 5: Improved awareness and understanding in society of antibiotic resistance and countermeasures

This objective signifies that

- good knowledge and awareness exist among all relevant parties, including the general public, of measures to prevent the spread of infections and of the risks of resistance development due to the use of antibiotics
- the knowledge is implemented as behaviour that promotes containment of antibiotic resistance.

In Sweden, where antibiotics are available on prescription only, prescribers have a heavy responsibility for responsible use. Public knowledge and expectations may, however, influence decisions on prescribing antibiotics. Acute awareness of why it is important that antibiotics are used only when they are of benefit, used correctly and used after being prescribed by an authorised prescriber is therefore essential in building a sustainable approach to antibiotics in society. Likewise, reducing the spread of infectious diseases and consequently the need for antibiotics relies on acute awareness of the importance of good hygiene and preventive measures. It is also important that consumers are given the opportunity to make informed and conscious choices. For example, origin labelling on certain foods can contribute to enabling consumers to choose meat from countries with responsible use of antibiotics in animal production.

It is beneficial that many parties in Sweden are working to disseminate

knowledge about antibiotic resistance and preventive measures through their channels and networks. At the same time, it is important that the information is coordinated in each sector and between the sectors, so that the general public receive the same message from all parties involved and that the communication leads to the desired behaviour.

## The Government expects

- the general public to have good knowledge of approaches that can prevent the spread of infection and promote responsible use of antibiotics
- staff in health and social care, dentistry and the animal and food sector to have good knowledge of the issue of resistance, antibiotics and antimicrobial agents, infection prevention and control practices and the One Health concept
- management of relevant organisations and other decision-makers to have good knowledge of possible initiatives to be taken

in their sectors with the aim of counteracting increasing antibiotic resistance

- patients and animal keepers to have good knowledge of the importance of using antibiotics as prescribed following contact with the healthcare system or a veterinarian
- consumers to be aware that food from producers who work to achieve good animal health and use antibiotics only when they are really needed contributes to counteracting the spread of resistant bacteria in society
- relevant parties to collaborate to develop and disseminate updated and tailored information about antibiotics and antibiotic resistance, general hygiene and other preventive measures
- antibiotic resistance, infection prevention and control and healthcare hygiene to be included in relevant basic education and professional training



# Objective 6: Supporting structures and systems

This objective signifies that

- supporting structures and systems are in place and in use, as well as that activities regarding antibiotic resistance are followed up and the lessons learnt are acted upon
- efforts are carried out in a coherent, efficient and strategic manner on the basis of the roles of the various parties involved.

Efforts to prevent and manage antibiotic resistance spans several sectors and parties. Distinct systems and structures for support and collaboration are important, for example to utilize the accumulated knowledge that exists among the various stakeholders involved and to identify knowledge gaps. Such processes can facilitate the evidence-based approach in healthcare organisations and also, where necessary, generate new evidence. Coordination enables resources to be used more efficiently, duplication of work to be avoided and coordinated messages to be communicated. Several groupings involved with efforts to combat antibiotic resistance have been formed within the Swedish national system for knowledge management in healthcare, such as the national working groups for Strama<sup>6</sup> and for infection prevention and control. For the animal sector there are groupings with similar objectives such as Strama VL (Veterinary and Food) and the Swedish Veterinary Association for Infection Prevention and Control. There is an interdepartmental working group on the issue of

antibiotic resistance in the Government Offices of Sweden. The National Research Programme for Antibiotic Resistance is another supporting structure that contributes to coordinating research and increasing the dissemination and impact of research results.

Successful efforts to combat antibiotic resistance build on initiatives targeting individuals and on the development of supporting structures in healthcare organisations. For example, established systems for the follow-up of antibiotic use and compliance with treatment recommendations can influence how and when antibiotics are prescribed. This also applies to veterinary medicine. The long-term impact of efforts to tackle antibiotic resistance can also be promoted by broader approaches to involve stakeholders at all levels of society, in accordance with current public health policy.

#### The Government expects

- a national collaborative function with relevant government agencies and other stakeholders to coordinate overarching national efforts

- Strama, a national working group within the Swedish national system for knowledge management in healthcare, to support national efforts of the entities responsible for healthcare and to coordinate the regional Strama groups in working towards prudent and responsible use of antibiotics
- Strama VL (Veterinary and Food) to continue to provide knowledge-based support to various stakeholders in the veterinary and food sectors
- regional health authorities, healthcare providers and management of relevant organizations to create the necessary conditions for responsible use of antibiotics and reduced spread of infection
- the Knowledge Centre for Pharmaceuticals in the Environment at the Medical Products Agency to collate and disseminate knowledge on the development and spread of antibiotic resistance in the environment, as well as the risks to the environment and to human and animal health.

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6. Swedish Strategic Programme Against Antibiotic Resistance

# Objective 7: Leadership within the EU and international cooperation

This objective signifies that

- Sweden continues to show international leadership in efforts to tackle antimicrobial resistance and urges responsible use of antimicrobial agents around the world.

Antibiotic resistance and other antimicrobial resistance (AMR) is a global problem that requires all countries to contribute to its solution. Large international organisations such as WHO<sup>7</sup>, FAO<sup>8</sup>, OIE<sup>9</sup> and UNEP<sup>10</sup> are platforms for these efforts. The political will to address the threat posed by AMR has increased in recent years in more and more countries, and substantial progress has been made in international efforts. The global action plan adopted by the WHO Member States in 2015 emphasises the importance of having an explicit One Health perspective in tackling AMR. FAO has developed its own action plan to support the food and agriculture sectors in particular in implementing the global action plan. OIE has prepared a strategy to support Member Countries on AMR related efforts and responsible use of antimicrobial agents in animal production. Other international organisations such as UNICEF<sup>11</sup> are also active in the field of AMR.

The high-level meeting on AMR at the UN General Assembly in 2016 led to the formation of the UN Interagency Coordination Group on AMR (IACG), which in 2019 presented recommendations to the Secretary-General of the UN on measures that need to be taken for a more effective global response to AMR. Sweden has been promoting these efforts in several ways, for instance through the alliance of health ministers known as the Alliance of Champions. Despite considerable progress, international lobbying is still needed to keep the issue high on the international agenda and raise awareness in all sectors concerned.

Progress is also being made in the EU in efforts to tackle antibiotic resistance. In 2017 the European Commission adopted a cross-sectoral action plan with the objectives that the EU should become a best practise region in activities to tackle AMR, to boost research, development and innovation and further shape the global agenda in the context of AMR. Sweden has been proactive in the negotiations ahead of the recent EU Regulation on Veterinary Medicinal Products and in

Antibiotic resistance and other antimicrobial resistance are a global and cross-sectoral threat to health that necessitates input from the whole international community.

preparing Council conclusions on AMR.

The Nordic region leads the way in several aspects of the issue of antibiotic resistance, and the use of antibiotics here is low in comparison with other countries. As well as cooperation in the EU, joint Nordic efforts take place through the Nordic Council of Ministers.

Sweden currently has a favourable situation with regard to antibiotic resistance in international terms, but this can change quickly due to the way resistance develops and spreads internationally, through travel and trade. Circumstances differ between countries with regard to tackling the problem of resistance, and inadequate access to antibiotics is perhaps the most pressing problem in low-income countries. Lack of sufficient data often impedes an overview of

7. World Health Organisation  
8. UN Food and Agriculture Organisation  
9. World Organisation for Animal Health  
10. UN Environment Programme  
11. UN Children's Fund

the resistance situation and consequently of what initiatives need to be taken. There is a risk of antibiotic resistance undermining some of the progress that has been made through the Sustainable Development Goals, as infectious diseases are more common in low-income countries. Worse living conditions such as lack of access to clean water, sanitation, healthcare and antibiotics are some of the causes. In addition, measures to reduce antibiotic resistance tend not to reach the poorest people. The consequences of antibiotic resistance also make their presence felt in the area of sexual and reproductive health and rights, which is a priority for Swedish development cooperation. Maternal and child mortality, infections in newborn infants and gonorrhoea are some of the problem areas at risk of being exacerbated by increased antibiotic resistance. Agriculture is relatively more important in low-income countries than in high-income countries. Adverse effects of antibiotic resistance in food production therefore pose a threat to the goal of abolishing hunger and several other goals in the 2030 Agenda for Sustainable Development.

Sweden should contribute to other countries' efforts on reducing the development of resistance and curbing spread. Sweden's relatively good resistance situation is due in part to assiduous work over a long period of time, which has generated a high level of expertise on antibiotic resistance in demand internationally.

Antibiotic resistance can spread across borders through international trade with animals. Healthy animals are an overarching goal in Swedish animal production. Strategies based on improving animal

health and animal welfare lead to reduced spread of infectious diseases, reduced use of antibiotics and greater profitability. Preventive animal health measures and low levels of antibiotic use in animal production result in a favourable resistance situation. It is also important from the point of view of competition that other countries take similar measures to those already implemented in Sweden, so that animal producers who make continuous efforts to keep their use of antibiotics down are not put at a disadvantage.

Knowledge of the economic and social impact of antibiotic use and antibiotic resistance is increasing globally. Analyses, models and knowledge raise the level of understanding of the problem and are needed as an incentive for change. For example, in a study funded by Sweden, the OECD has shown that the costs of phasing out the use of antibiotics as growth promoters in livestock are relatively low in high-income countries.

Knowledge of the role of the environment in the development and spread of antibiotic resistance and what effects can occur in the environment is also increasing. To prevent emissions of antibiotic residues to the environment, there is a need for emissions from manufacturing to be minimised, for people throughout the world to have access to clean water and sanitation and for discarded antibiotics to be collected and managed in an environmentally sound way.

It is positive and entirely necessary that increasing attention is paid to the threat of resistance internationally. It is economically favourable to address the problems of resistance, but resources are also required to monitor,

coordinate, drive and take part in various initiatives. By channelling resources through the large international organisations, the EU and the cooperation between the Nordic countries, we can improve the impact of our resources. The importance of international cooperation and coordination in the area of research is highlighted under Objective 4 in the present strategy. Swedish international efforts should be made in multilateral processes, in the EU and in bilateral contacts and cooperation. The global commitments made under the UN system and under the 2030 Agenda, as well as the Swedish Policy for Global Development, represent key frameworks.

#### The Government expects

- Sweden to continue to support WHO, FAO, OIE and UNEP in efforts to tackle AMR, in accordance with the global action plan on AMR and equivalent documents in the agriculture and food sectors
- Sweden to press for the expansion, development and use of harmonised global surveillance systems for antibiotic resistance and antibiotic use in humans and animals and, where appropriate, also for foods and the environment. This can take place in cooperation with WHO, FAO, OIE, Codex Alimentarius<sup>12</sup> and UNEP, among others
- Sweden actively to push the issue of antibiotic resistance in the EU and to cooperate with other EU Member States, the

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12. Codex, or Codex Alimentarius Commission (CAC), is a programme for food standards formed in the early 1960s by the UN bodies FAO and WHO for the purpose of drafting international rules – standards – for food safety, fair practices in food handling and free trade in food at a global level.

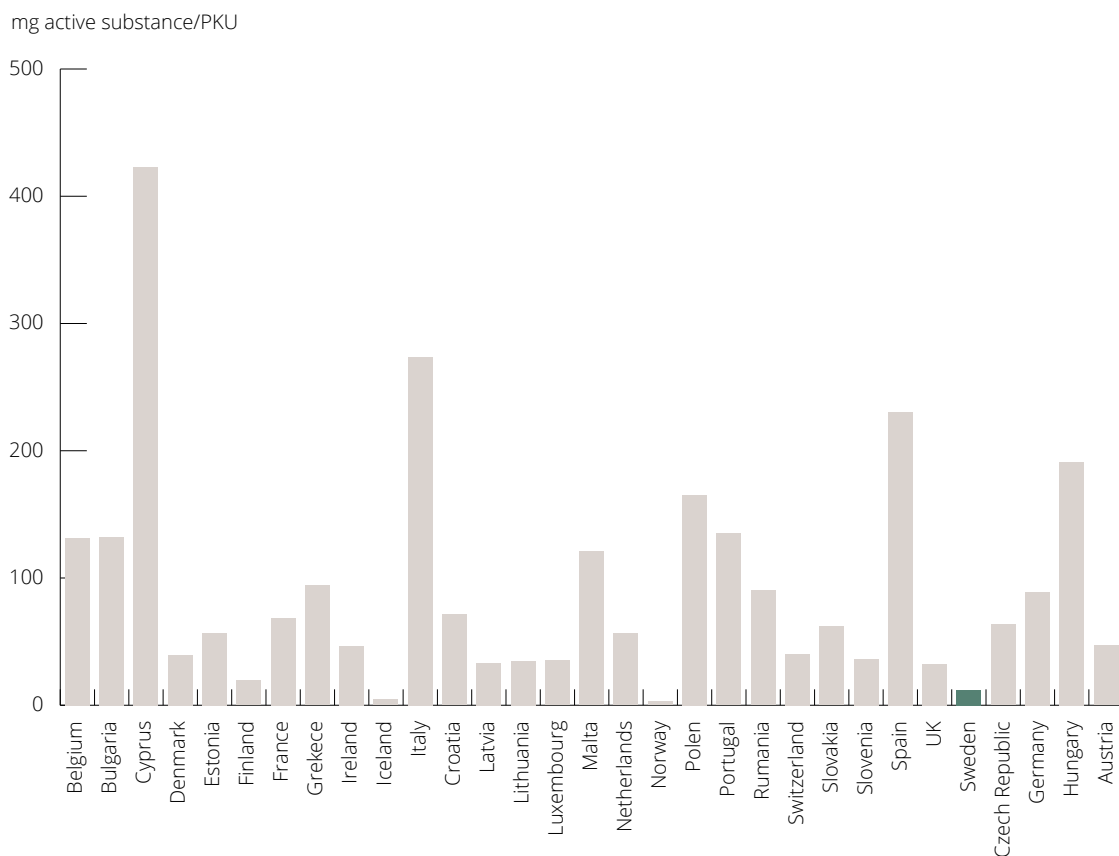
European Commission and the EU agencies on the implementation of the EU Action Plan against AMR; Sweden to be a driving force in relevant negotiations on new EU regulations, recommendations and guidelines linked to AMR and reduced environmental impact; Sweden to urge the EU to pursue issues relevant to AMR at the global level

- Sweden to continue to build alliances with other countries to pursue the AMR issue at a high political level with the aim of highlighting important overarching issues from a One Health perspective; Sweden to take part in Nordic cooperation on AMR
- Sweden to contribute to a movement towards more sus-

tainable agriculture and production systems, and to support a global phase-out of the use of antibiotics as growth promoters in animal production and of other routine use of antibiotics in groups of animals

- Sweden to urge effective cooperation on responsible use of antibiotics in animal production under EU free trade agreements to counteract antibiotic resistance
- Sweden to share knowledge and experience with other countries from a One Health perspective, paying particular attention to the needs of low-income countries; Sweden also to make use of experience from other countries in international cooperation and learn from how others operate

- Sweden to push for environmental data to form part of the basis for the approval process of antibiotics and be made available to governmental agencies and other relevant stakeholders. The data should be used for the assessment of environmental risks of development and spread of antibiotic resistance
- Sweden to push for the development of regulations to steer towards minimised emissions of antibiotics to the environment in pharmaceutical production
- Sweden to continue to address issues relating to antibiotic resistance in international forums such as the OECD and the Global Health Security Agenda, as well as through bilateral agreements with other countries.



**Figure 3.** Sales of antibiotics for food-producing animals 2017 expressed as mg of active substance per Population Correction Unit (PCU). PCU corresponds approximately to the total weight of live animals within a country, expressed in kilograms. Source: European Medicines Agency



# Sweden as a model

## Preventive measures

Swedish preventive efforts to combat antibiotic resistance are based on the idea that low infection pressure in society leads to a healthy population and healthy animals needing less antibiotics. Lower consumption of antibiotics in turn leads to reduced development of antibiotic resistance. Effective infection prevention and control programmes such as good healthcare hygiene and other preventive measures, reduce the spread of infectious diseases in society and in health and social care. Two examples are the Swedish child vaccination programme, one of the most successful of its kind, and the regulations on basic hygiene routines applicable to all health and social care staff. A corresponding approach with vaccination programmes, infection prevention and control programmes and rules for hygiene procedures is used to keep animals healthy in Sweden.

## Surveillance of antibiotic resistance and use

Microbiological diagnostics and surveillance were expanded at an early stage in Sweden, which was important in drawing attention to the problem of antibiotic resistance. The discovery of rapidly increasing resistance among pneumococci had a great impact, leading to initiatives being taken to prevent the spread of resistance and limit unnecessary use of antibiotics.

Surveillance is essential in order to draw up and evaluate relevant

measures against antibiotic resistance and is the basis for recommendations on the treatment of infectious diseases. Diagnostics with routine taking of samples forms the basis of surveillance in the Swedish healthcare system. This, combined with automated, daily collation of laboratory results, produces clinically relevant resistance data.

Sweden also has a programme for surveillance of antibiotic resistance in bacteria from animals and in food. The Swedish National Veterinary Institute and the Public Health Agency of Sweden are tasked with monitoring antibiotic resistance, which is done in collaboration with the Swedish Board of Agriculture and the Swedish National Food Agency. Samples are also taken through the annual residue control program to detect antibiotic residues in food producing animals that may have entered the food chain before the withdrawal period has expired.

A high level of awareness of the problem of antibiotic resistance among relevant professions and industries, managements of healthcare organisations, the general public and decision-makers is an important element in efforts towards responsible use of antibiotics. The results from surveillance of resistance and antibiotic use in humans and animals are presented annually in a joint report by the Swedish National Veterinary Institute and the Public Health Agency of Sweden.

Particular communication initiatives are also carried out through other channels. In the European Eurobarometer survey in 2018, the Swedish public scored highly for knowledge concerning antibiotics and antibiotic resistance.

Sweden has been proactive in the development of global surveillance of antibiotic resistance. The Public Health Agency of Sweden supports the expansion of the Global Antimicrobial Resistance Surveillance System through its WHO Collaborating Centre.

The antibiotic resistance situation in Sweden is relatively favourable in international terms, largely due to consistent and purposeful efforts having been pursued over a long period of time in relevant sectors. Resistance to first-line treatment of urinary tract infections is uncommon, and the rate of methicillin-resistant *Staphylococcus aureus* (MRSA) is among the lowest in the EU. The serious type of resistance ESBL-CARBA, for which few treatment options remain, has not yet been detected in animals in Sweden, and the number of cases in humans is very low. In general, however, antibiotic resistance in health and social care is also on the rise here, indicating a need for strong countermeasures to continue in accordance with this Strategy.

Responsible use of antibiotics  
The use of antibiotics in Sweden is low by international comparison, and in addition consists

largely of narrow-spectrum drugs that are less likely to drive resistance. The interdisciplinary organization Strama has promoted responsible use of antibiotics since it was formed in 1995. The Strama model is based on peer-to-peer feedback to prescribers, in particular how their prescribing relates to established treatment recommendations and set targets. The model is well established locally and represents a cornerstone in Swedish efforts to tackle antibiotic resistance. The Public Health Agency of Sweden is tasked with working to ensure that the possibility of using antibiotics effectively in humans and animals is maintained. The National Veterinary Institute likewise has a remit to take action to ensure responsible use of antibiotics in the veterinary and food sector through Strama VI.

Evidence-based national treatment recommendations provide important support to physicians and veterinarians as well as a reference point to follow up prescription. Prescribing targets that are developed in consideration of current treatment recommendations and the possibility of follow-up can be a useful tool in efforts to combat antibiotic resistance. An example is the national ‘250 target’ in primary care (fewer than 250 antibiotic prescriptions issued per 1,000 inhabitants per year), which was introduced in 2009. Two regions achieved the target in 2018, and the national average fell in the same year to

below 300. As a result, the number of antibiotic prescriptions filled annually fell by around one million between 2009 and 2017, without any adverse health consequences being observed.

Sales of antibiotics for animals have decreased steadily in Sweden over the past 30 years. In 2018 a total of 10,042 kilograms of active substance of different antibiotics for veterinary use were sold, representing a decrease of around 70% since the start of the 1980s. The resistance situation among animals in Sweden is favourable, and some resistance with relevance for human health is decreasing. ESBL resistance among broiler chickens, for example, dropped sharply from 34% in 2017 to 17% in 2018. Notifiable resistant bacteria are generally uncommon in Swedish animals.

Effectively regulated sale of antibiotics both for veterinary and human use fosters responsible use of antibiotics. As a result of close cooperation between government agencies and the livestock industry, Sweden became the first country in the world to prohibit the use of antibiotics for growth-promoting purposes in 1986. Sweden also contributed strongly to the introduction of a corresponding ban in the EU in 2006. Today there is broad consensus among Swedish animal health organisations, animal health professionals and animal keepers on responsible use of antibiotics. In addition, the Swedish Board of Agriculture has

developed regulations on the use of antibiotics in animals.

Many different measures are required to deal with emissions of antibiotics to the environment. In addition to work in progress to promote responsible use of antibiotics, the Government in 2018 launched a three-year programme to install advanced wastewater treatment. The aim is to reduce emissions of pharmaceutical residues, including antibiotics, from wastewater treatment plants. The Government has also set up a Knowledge Centre for Pharmaceuticals in the Environment at the Medical Products Agency.

#### Cross-sectoral collaboration and research

The Swedish Strategy to Combat Antibiotic Resistance points the way for activities in the area and facilitates coordination of Swedish stakeholders to maximize contributions in the same direction.

A national collaborative function currently comprising 25 government agencies and other organisations coordinates national efforts against antibiotic resistance since 2012. This collaborative function operates according to a national action plan based on the Swedish Strategy. The Public Health Agency of Sweden and the Swedish Board of Agriculture chair the collaborative function, which hosts the sector-wide communication platform ‘Save Antibiotics’, and an annual Antibiotics Forum, in which a broad group of stake-

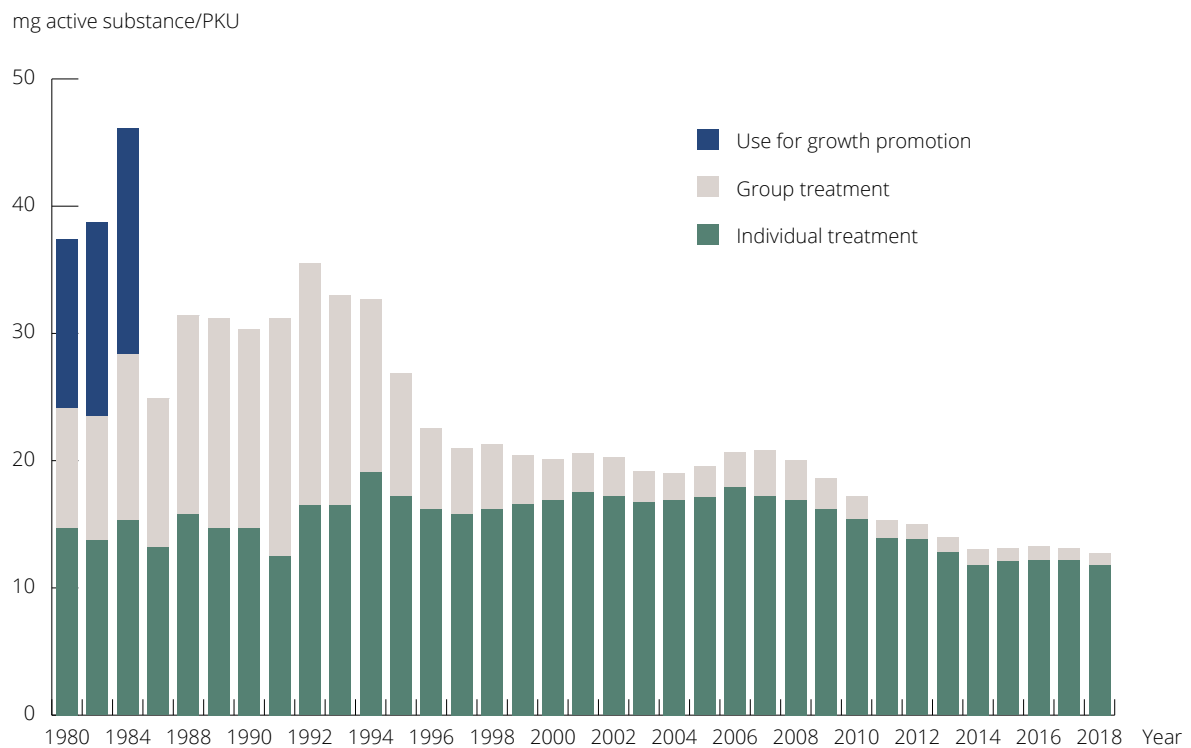
holders meet. One Health has long been an established approach in Sweden, and the first national action plan against antibiotic resistance in 2000 was already cross-sectoral.

There is close contact and good collaboration in the efforts done at national government agencies and at the level of regions, county councils and local authorities, ensuring endorsement and the best possible conditions for appropriate use of knowledge and evidence-based initiatives. Both the acquisition and implementation

of new knowledge depend on well-functioning organisations, such as Strama groups, clinical microbiology laboratories, infection prevention and control units and pharmaceutical committees.

Antibiotic resistance has been a priority research issue in Sweden for many years. In the 2016 Research Bill, the Government launched a National Research Programme on Antibiotic Resistance. The research programme takes a broad, interdisciplinary and cross-sectoral perspective and is focused on both basic and

applied research. Sweden was also one of the initiators of the international research cooperation Joint Programming Initiative on Antimicrobial Resistance (JPIAMR) that was launched in 2010. Ever since, Sweden has played a leading role in this cooperation, in part through the secretariat being located at the Swedish Research Council. Sweden is also a member of the Global AMR R&D Hub, a collaboration platform for research policy issues in the area of resistance.



**Figure 4.** Sales of antibiotics for food-producing animals in Sweden expressed as mg of active substance per Population Correction Unit (PCU). PCU corresponds approximately to the total weight of live animals within a country, expressed in kilograms. Data for 2010–2015 is not complete due to drop out. Source: Swedres-Svarm 2018

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