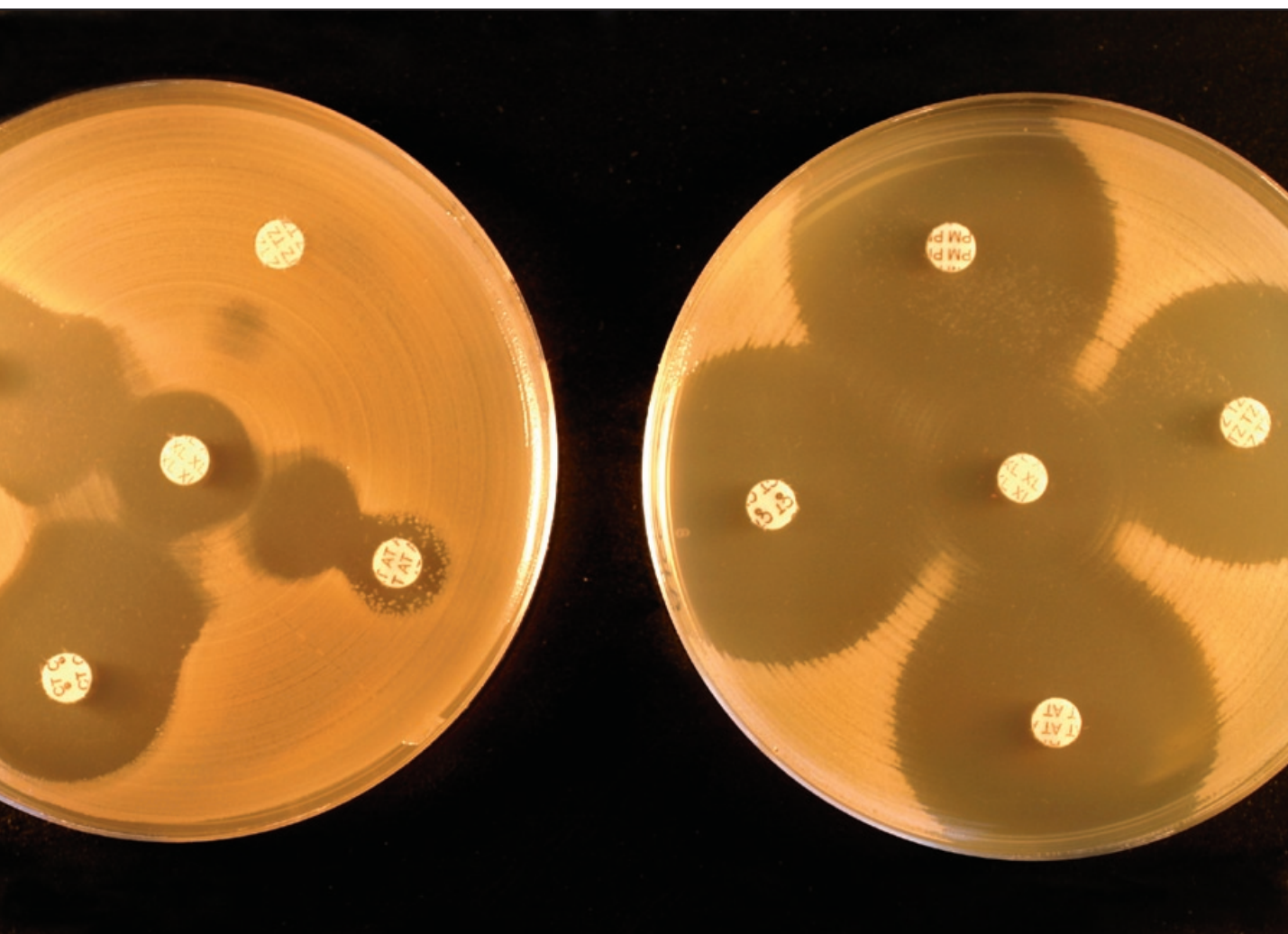NORWEGIAN MINISTRIES

Strategy

National strategy for prevention of infections in the health service and antibiotic resistance (2008–2012)

NORWEGIAN MINISTRIES

Strategy

National strategy for prevention of infections in the health service and antibiotic resistance (2008–2012)

Foreword

Infections that occur as a result of stays in health care institutions cause the patients increased suffering and in some cases death, and they also result in high costs for the health service. The risk of these infections is difficult to eradicate completely. The causes of infections are complex. New methods of diagnosis, nursing and treatment can give rise to an increased risk of infection. The average age of the patients is higher than previously, and the number of patients who have a weakened immune system is increasing. More advanced methods of treatment have been introduced, and antibiotic resistance poses a growing problem. Infections in patients also carry a risk that the health service staff may be infected.

Increased occurence of resistant microbes (antibiotic resistance) is due to higher consumption of antibiotics and increased spread of resistant microbes. Internationally, we have seen a considerable rise in the occurence of resistant pathogenic microbes in animals and people. This trend is also occurring in Norway, but the problem is not yet as serious here as in most other countries.

Modern antibiotic treatment amounted to a revolution in the fight against serious communicable diseases among people and animals. This situation may now be threatened. It is important to retain antibiotics as effective medicines in order to preserve good animal and human health and ensure safe and healthy food. In order to succeed in this, it is necessary to counteract the trend toward increased resistance by continuing the efforts to reduce the unnecessary use of antibiotics and to utilise the right antibiotics in a correct way when treatment is necessary.

Better control of communicable diseases and better use of antibiotics are often two sides of the same coin. The most extensive infections often occur with antibiotic-resistant bacteria. The efforts to control communicable diseases are important for both reducing these infections and counteracting the development of resistance. Much of the effort to prevent ant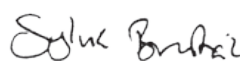ibiotic resistance and infections has been made by different groups of staff. An important objective of a new strategy is to encourage closer cooperation among and integration of all units in the health services for people and animals.

This strategy is a result of cooperation among five Norwegian ministries: the Ministry of Labour and Social Inclusion, the Ministry of Fisheries and Coastal Affairs, the Ministry of Agriculture and Food, the Ministry of the Environment and the Ministry of Health and Care Services. The strategy includes relevant measures in many sectors and at various levels that should enable us to continue to maintain a favourable situation in Norway.
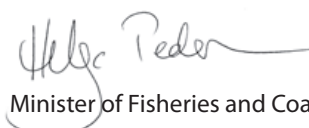
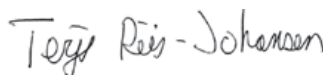Oslo, Norway, 9 June 2008

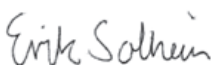Minister of Labour and Social Inclusion

Minister of Health and Care Services

Minister of Fisheries and Coastal Affairs

Minister of Agriculture and Food

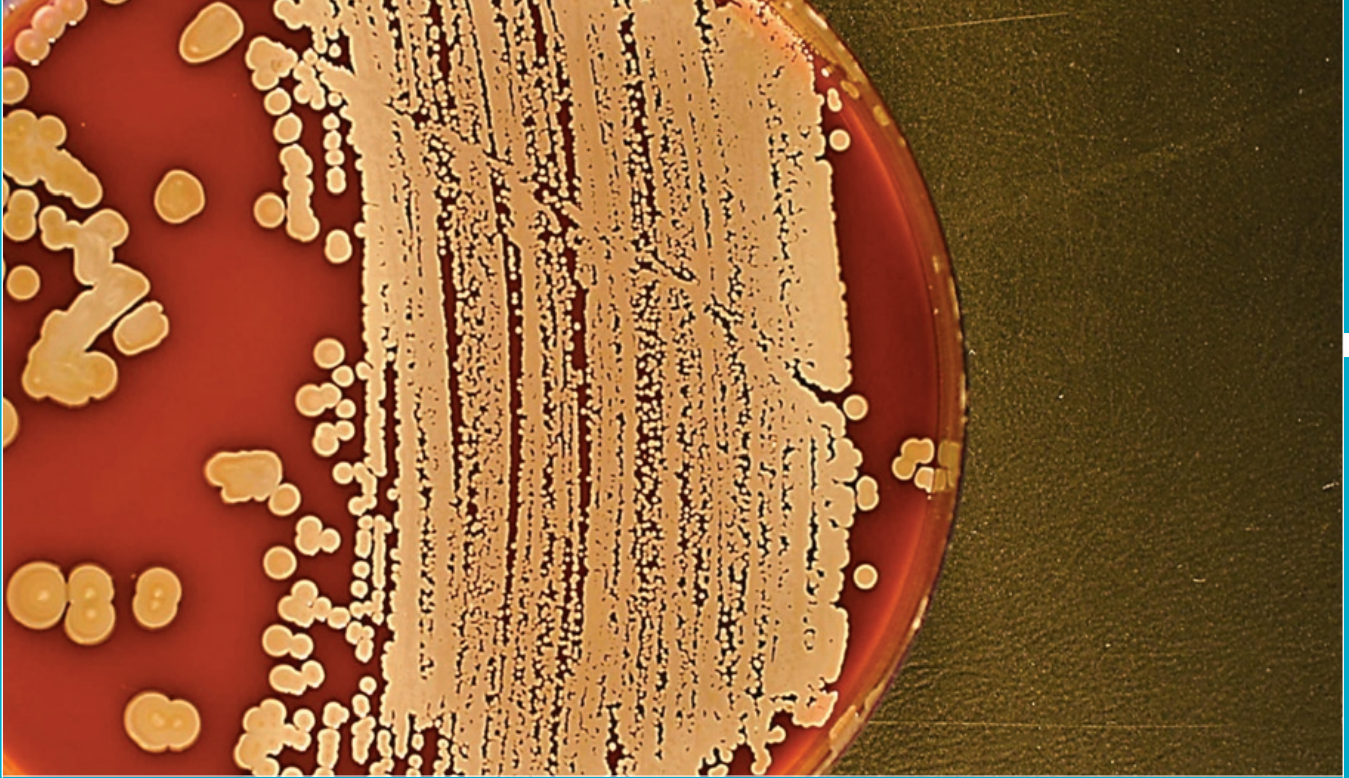Minister of the Environment and International Development

Content

Appendix – Description of the facts for the strategy

1. Introduction and background

1.1. Background

During treatment in the health service, and especially in hospitals, there is always a certain risk of becoming infected and getting an infection. Based on studies of the prevalence of hospital infections in Norway, it is estimated that 50,000 patients who are admitted each year to hospitals will contract a hospital infection. This inflicts unnecessary suffering on the patients and increased costs on society. It is estimated that infection lengthens a patient's hospital stay by four days on the average, i.e. a total of 200,000 days. The direct costs related to this are substantial for the health trusts. In addition, we must also include sickness benefits, lost earnings, loss of production, etc. Infections are also a steadily increasing problem in the health service outside of hospitals. It is not possible to completely eradicate the risk of these infections. However, there is evidence for claiming that 20-30% of the infections can be prevented by effective efforts to control communicable diseases. In addition to preventing suffering and death, this may free up considerable capacity in the health service for other high priority tasks. The effectiveness of preventive measures will depend to a great extent on interaction, e.g. among the different levels of the health service.

Antibiotics have helped reduce the spread of, sequelae of and death from infectious diseases. The usefulness of antibiotics is reduced when the infectious agents have changed their genetic material so that they can resist attacks from antibiotics. The resistant infectious agents may eventually become predominant while the non-resistant infectious agents will die out. An increasing occurence of resistant infectious agents is probably due to several factors such as increased consumption of antibiotics, the use of more broad-spectrum antibiotics and deficient hospital hygiene.

Antibiotic resistance may have serious consequences: it can become more difficult to choose the right antibiotic in situations where it is not possible to examine the infectious agents first, and we can more often be forced to use antibiotics that are more expensive and may have more side effects. In the worst case, some infectious diseases may become incurable because antibiotics no longer have any effect. Internationally, we have seen an accelerating increase in the occurence of resistant pathogenic infectious agents in animals and people. This trend is also occurring in Norway, but the problem is not yet as serious here as in most other places. Nevertheless, doctors and veterinarians daily encounter antibiotic resistance, which causes problems in the treatment of their patients. Resistance from otherwise harmless bacteria can spread to bacteria that cause disease to animals and people. Resistant bacteria can also spread from animals to people through food products. Prevention and limitation of antibiotic resistance is therefore an

important target area in order to ensure safe food for the consumers.

Since 2000, the authorities' efforts to combat antibiotic resistance and prevent infections in the health service have been followed up through *Tiltaksplan for å motvirke antibiotikaresistens 2000–2004 (*Action plan to prevent antibiotic resistance 2004–2004) and *Handlingsplan for å forebygge sykehusinfeksjoner 2004–2006* (Action plan to prevent hospital infections 2004–2006). Both of these plans were pioneering efforts, in a European context as well, and they have helped make the situation in these areas in Norway relatively favourable compared with other countries.

Although Norway has come a long way in the struggle to prevent infections in the health service and antibiotic resistance, this is a battle that must be fought continuously. Plans have been made to join these two target areas with a new common

1.2. Organisation of the work

The Norwegian Institute of Public Health was given the task of coordinating the preparation of a draft for a new, common plan. The ministries in the steering committee for the antibiotic plan and their subordinate agencies were invited to provide input. In the preparation of the draft, the Norwegian Institute of Public Health has also made use of the results from the evaluation and experience-sharing conferences related to the previous plans and research regarding antibiotic resistance and the control of communicable diseases in the health service. In addition, the Norwegian Institute of Public Health has made use of its networks in professional circles, e.g. Antibiotika-komiteen (the Antibiotic Committee).

The interministerial steering committee, consisting of representatives from the Ministry of Labour and Social Inclusion, the Ministry of Fisheries and Coastal Affairs, the Ministry of Agriculture and Food, the Ministry of the Environment and the Ministry of Health and Care Services, has had the task of completing the effort to formulate this new strategy after the draft has been submitted to professionals for comments.

1.3. Content

This strategy continues and improves the efforts that have been carried out through the two previous

action plans. In chapter four, three national goals for this strategy are presented. These three goals are further divided into a total of 31 sub-targets with relevant measures where the participants responsible for follow-up are specified. The participant who has the main responsibility for the follow-up is listed in bold type.

This is followed by a fact section in the form of an appendix, which gives a more detailed description of the key participants in the follow-up, the regulatory framework and a status description of the current situation in these areas in Norway and internationally. Together with the experiences from the two previous plans, this fact section forms the basis for the strategy's organisation and relevant measures.

1.4. Definitions

Antibiotics – natural substances that are produced by microbes and that inhibit the growth of or kill other microbes.

Chemotherapeutic agents are artificially produced substances with the same properties.

The word **antimicrobial agent** has been defined as any substance – natural, semi-synthetic or synthetic – that kills or inhibits the growth of a microbe and simultaneously does little or no harm to the individual who is given the substance. For the sake of simplicity here, we will use the term antibiotic to refer to both true antibiotics and chemotherapeutic agents.

Antibiotic resistance – the ability of infectious agents to resist antibiotics. For the sake of simplicity, the term resistance is often used synonymously, and the concept is also used in this context with regard to resistance against antivirals.

Infectious agent – e.g. viruses, bacteria, fungi and protozoa (single cell animals) that have the ability to cause disease. Sometimes the word **microbe** is used synonymously.

1.5. Roles, responsibility and relevant regulations

The strategy's goals and measures affect many sectors of society and involve participants at all administrative levels. The strategy mainly involves

the five ministries that share joint responsibility for it along with their subordinate agencies and enterprises, also including the regional and local levels (the County Governor and/or the Board of Health in the counties and the municipalities). Relevant participants and their roles are described in more detail in the accompanying fact section, cf. chapter 1 of the Appendix.

The strategy is also supported by an extensive body of regulations that set constraints for stakeholders' and services' obligations relative to the sub-targets in this action plan, also including supervision to ensure that the regulations are being complied with.

The most important Acts in this context are:
- the Act relating to control of communicable diseases (the Communicable Disease Control Act)
- the Act relating to food production and food safety etc. (the Food Act)
- the Act relating to veterinarians and other animal health personnel (the Animal Health Personnel Act)
- the Act relating to working environment, working hours and employment protection, etc. (the Working Environment Act)

Relevant regulations, including acts and regulations, are described in more detail in the accompanying fact section, cf. chapter 1 of the Appendix.

1.6. Follow-up

The strategy is a tool for improving and coordinating the efforts in the sectors represented by the five ministries. Arrangements have been made for the continuation of the efforts of the steering committee that has had the task of completing the job of formulating the new plan. Important tasks for the steering committee in the ongoing work will include evaluating the continuous follow-up of the plan and establishing a reporting system with respect to preparing status reports. Also in this context and during the plan period, the steering committee must evaluate whether an external evaluation should be carried out toward the end of the period.

The strategy will mainly be followed up within the existing allocations that the five ministries have at their disposal, using relevant management tools, subsidy schemes and parliamentary documents.

The list below provides an overview of the abbreviations used for the participants referred to in the sections pertaining to measures in chapter 4.

The Norwegian Ministry of Labour and Social Inclusion	AID
The Norwegian Ministry of Fisheries and Coastal Affairs	FKD
The Norwegian Ministry of Health and Care Services	HOD
The Norwegian Ministry of Agriculture and Food	LMD
The Norwegian Ministry of the Environment	MD
The Norwegian Labour Inspection Authority	AT
The Norwegian Food Safety Authority	MT
The Norwegian Institute of Public Health	FHI
The Norwegian Directorate of Health	Hdir
The Norwegian Knowledge Centre for the Health Services	NKH
The Norwegian Board of Health Supervision	Htil
The Norwegian Medicines Agency	SLV
The National Veterinary Institute	VI
The Norwegian Directorate for Nature Management	DN
The Norwegian Pollution Control Authority	SFT
The regional health authorities	RHF
The Pharmaceutical Trust	SA
The University Hospital of Northern Norway	UNN
The municipality	K
The municipal health service	KHT
Antibiotikakomiteen (The Antibiotic Committee)	AK
Lederforum for medisinsk mikrobiologiske avdelinger (Executive forum for medical microbiological departments)	LMM
The Norwegian Surveillance Programme for Antimicrobial Resistance	NORM
The Antibiotic Centre for Primary Care	ASP
Antibiotikasenteret for spesialisthelsetjenesten (The Antibiotic Centre for Specialist Health Care)	AFS
Regional competence centres for hospital hygiene	RKS

2. Current status

The national system for surveillance infections in the health service is implemented through two systems:

- *The Norwegian surveillance system for infections in the hospital service (NOIS)*, which has its basis in the NOIS regulations and measures the frequency (the incidence) of infections. NOIS uses surveillance periods where certain patient groups are to be monitored.
- *Prevalence surveys*, which are one-day counts in health care institutions of the number of admitted patients and the percentage of them that have an infection. The aim of the prevalence surveys is to obtain a rough overview of the burden of infections acquired in hospitals and health care institutions for the elderly and of which infections are predominant and to follow trends over a period of time.

Prevalence surveillance was last conducted on 24 October 2007. A total of 10,167 patients from hospitals were included. 639 infections were registered. The national occurence of hospital infections was thus 6.3%. The occurence of hospital infections in Norway has been quite stable in recent years, including the distribution of the various types of infections.

The prevalence surveys in health care institutions for the elderly were last conducted in week 42 of 2007. A total of 19,480 residents of 401 institutions were included. 1,413 health-service-acquired infections were registered. This gives a national prevalence of 7.3%. Urinary tract infections occurred most frequently and constituted 53% of the infections. Skin and lower respiratory tract infections each constituted 21% of the infections.

Through NOIS, infections after surgical intervention were registered in 38 hospitals in 2006. 92% of all patients who were operated on during the surveillance period were followed up for 30 days after the operation, and this is a very high percentage compared with other countries that are taking part in European cooperation on this surveillance. The study included 3,693 operations and 241 infections were registered. The percentage of operated patients who developed an infection within 30 days after surgery varied among the different surgical interventions. Only 15.4 % of the infections were diagnosed prior to discharge, but this also varied among the different interventions. The total incidence rate for 2006 was 6.5%; in 2005 it was 6.0%.

The control of communicable diseases in the health service is based on the so-called hospital hygiene standard measures. These are a set of basic hygiene rules that apply to all personnel and all patients. Perhaps the most important measure is hand hygiene. In the previous plan period, the Norwegian Institute of Public Health in collaboration with the hospitals implemented a change from hand washing

with soap and water to alcohol based hand disinfection alcohol as the predominant method of hand hygiene.

With regard to food-borne infections (*Salmonella* and *Campylobacter)*, more resistance has been noted for infections acquired abroad than for infections acquired in Norway. These strains of bacteria are often resistant to many types of antibiotics (multi-resistant). Among bacteria from Norwegian animals, antibiotic resistance is still not very extensive. For dogs, however, multi-resistance is common among staphylococci from skin infections.

In Norway, the national surveillance of antibiotic resistance is organised along four different axes:

- the Norwegian surveillance programme for antimicrobial resistance (NORM) is based on a standardised microbiological survey and reporting of specific microbes in specific periods of time.
- the European Antimicrobial Resistance Surveillance System (EARSS) is based on results drawn from the computer systems of various laboratories. About ten Norwegian laboratories report to EARSS.
- the Norwegian Surveillance System for Communicable Diseases (MSIS) receives reports about every case of infection and colonisation by specific antibiotic-resistant types of bacteria.
- the Norwegian surveillance programme for antimicrobial resistance in bacteria from feed, food and animals (NORM-VET) is based on centralised analysis of pathogenic bacteria and indicator bacteria from feed, food and animals.

The different axes illustrate the resistance epidemiology from different points of view, and they complement each other.

The total consumption of antibacterial agents has been relatively stable since the beginning of the 1990s. The total sale of antibiotics for systemic use in the last two years, however, has shown an annual increase of around 5-6 % measured in doses. In 2006, sales amounted to 19 DDD per 1000 inhabitants per day. The main increase is in the penicillin group and methenamine (Hiprex). Sales of tetracyclines, macrolides and quinolones are also increasing, while sales of sulfonamides and trimethoprim are decreasing.

In 2006, sales of antibacterial agents to hospitals constituted about 8% of total sales registered in the Norwegian Drug Wholesaler Database. Penicillins account for 48% of the sales in hospitals measured in DDD, followed by cephalosporines (22%), quinolones (7%) and metronidazole (6%). These are estimates because it is not currently possible to distinguish hospital institutions in the Norwegian Drug Wholesaler Database, nor is it possible to obtain data on sales to nursing homes; but a survey of 133 nursing homes in 2003 estimated that sales of antibacterial agents to patients in nursing homes constituted about 6% of total sales.

The occurence of antibacterial agents in the primary health service was 200/203 per 1000 men and 285/288 per 1000 women in 2005/2006. In other words, in the Norwegian population 20% of the men and 29% of the women will be prescribed an antibacterial agent in the course of one year. Here we define antibacterial use to mean antibacterial agents for systemic use. Antibacterial agents are used to varying degrees in different age groups. Children between the ages of 8 and 15 use little antibiotics. Starting at age 16-17, we see a rapid increase in antibacterial use. Major users of antibacterial agents are the very youngest children and the elderly. Penicillinase-sensitive penicillins are used by nearly one in ten Norwegians in the course of a year. This is the most-used antibiotic group in all age groups with the exception of women over age 75 in which more people use penicillins with an extended spectrum.

In the period 1995–2001, sales of antibacterial agents for animals declined by 40%. Since then, the level has been relatively stable, with a slight increase in the last two years (2005–2006). The consumption of antibiotics in the aquaculture industry declined by 97% from 1987 to 2001. Thereafter, the trend was reversed, and in 2006 the total sales of antibiotics for fish in Norway came to 1,478 kg of active substance, of which quinolones constituted 79%. The change was due to their increased use for cod in fish farming. From 2006 to 2007, however, there has been a very positive trend so that sales in 2007 were down to 649 kg, the same level as in 2001. The substantial improvement since 1987 can be attributed to the introduction of effective vaccines for salmon and trout together with disease-preventing measures, including better environmental conditions.

3. Individual trends and special challenges

For further discussion of the current status in Norway, cf. chapters 2 and 3 of the appendix.

Since the previous plans were issued, there have been certain trends in social developments that will pose new challenges with regard to infections in the health service and antibiotic resistance. These trends and the challenges they pose are discussed here because they are important for the work in the upcoming plan period. Other challenges and problem areas are described under the individual sub-targets in chapter 4.

Patient mobility in Europe

Norway probably has the lowest occurence of resistant bacteria in hospitals in Europe. So far, for example, we have succeeded in preventing MRSA bacteria from establishing themselves in Norwegian hospitals. The situation is considerably worse in Europe with the exception of the Nordic countries and the Netherlands. When arrangements are made for freer use of health services in the EEA, we will face a special challenge. We must ensure that Norwegian and foreign patients who are treated in health care institutions outside Norway that have a high occurence of MRSA and other resistant bacteria do not transmit these to others during their stay in Norwegian health care institutions.

Health and animal health personnel educated abroad

A shortage of health personnel is expected in Norway in the coming years. Gradually more people will come to Norway from other countries to work in the health service and in the field of veterinary medicine, and young Norwegians will return after got an education abroad. This will make it necessary to give the personnel updated training in Norwegian antibiotic policy.

Antibiotic treatment is unique in the sense that it is the only form of treatment in medicine that varies from country to country. For example, primary care doctors in Norway are advised to treat pneumonia with ordinary penicillin. In most other countries in the world, this would be a life threatening incorrect treatment because there is a high probability that the bacteria there are resistant to ordinary penicillin. Since we have such a favourable situation with regard to resistance, we can use cheap, narrow-spectrum antibiotics in situations where in most other countries they use new, resistance-inducing and also more expensive antibiotics. Health and animal health personnel must learn that an incorrect treatment in another country may be professionally acceptable treatment in Norway.

Secondly, it is necessary to prevent personnel who have worked or trained in foreign hospitals from

inadvertently bringing MRSA and other resistant bacteria with them to Norwegian hospitals. In this case, we already have defined routines, and these must be regularly monitored and evaluated.

Transfer of patients between hospital and nursing home

Norway's hospitals are becoming more advanced and specialised and are trying to reduce the length of hospital stays. Patients who have completed their treatment shall be transferred more rapidly to follow-up in the primary health service, or in nursing homes, if necessary. This is probably a favourable development with regard to controlling communicable diseases because there will be shorter exposure times to possible infectious agents in the hospitals. However, it also results in more frequent transfers of patients between hospitals and nursing homes. Patients who have been discharged early may run the risk of having to be admitted to the hospital again.

In nursing homes it is not possible for various reasons to have a control of communicable diseases that is as rigorous as in hospitals, because of more extensive interaction among the patients in common rooms, etc. That means, for example, that MRSA will probably be able to establish itself more easily in nursing homes than in hospitals. Thus, the nursing homes may become providers of patients who are infected with MRSA to the hospitals.

Online purchase of medicines

Norway has a strict antibiotic policy. Antibiotics are only issued to persons with a prescription, and advertisement of antibiotics to the general public is forbidden. This has contributed to a favourable resistance situation because the consumption of antibiotics is kept low. Lay persons' overconsumption and incorrect use of antibiotics are a major problem in a number of countries, especially in Asia, and can potentially also become a problem in Norway if there should be a liberalisation of the antibiotic policy. The sale of medicines from abroad on the Internet may therefore undermine Norwegian antibiotic policy. If many people become accustomed to ordering antibiotics themselves and use what they themselves believe to be correct, we may also see a worsening of the resistance situation in Norway.

International cooperation

Broad global cooperation on preparedness is a basic condition for ensuring that we in the Nordic region will still be able to maintain a good status with regard to serious infectious animal diseases and zoonoses. It has been shown that many zoonoses may be spread over long distances and result in serious outbreaks of exotic diseases in new regions, and there are many challenges in this area. It is primarily through international cooperation that we prevent these zoonoses from evolving into a serious global public-health problem.

Norway participates in the EU's reporting system for zoonoses and submits data to the zoonosis report – Community Summary Report on Zoonoses – that is published by the EFSA each year. This report also includes reporting on antibiotic resistance. The National Veterinary Institute is responsible for coordinating this work. Norway also participates in working groups under the EU and Codex in this area.

European Centre for Disease Control and Prevention

The European Centre for Disease Control and Prevention (ECDC) was established in 2005. As an EEA country, Norway takes part in this cooperation. The ECDC plays an important role in coordinating European surveillance of communicable diseases and antibiotic resistance and works for better and more harmonised advice on the control of communicable diseases in Europe.

The cooperation in the ECDC gives Norway good opportunities to benefit from expertise and joint European councils. The cooperation also gives us the opportunity to influence developments in the rest of Europe. Many other European countries may benefit from following our example for the control of communicable diseases and the struggle against resistance. If we are to benefit from the ECDC, we must invest in the processes that the ECDC conducts by participating in meetings and groups and lending out personnel.

4. National objectives

This strategy is based on two previous action plans against hospital infections and antibiotic resistance respectively. Since 2000, a number of permanent improvements have been achieved and several permanent systems have been established that have given Norway a basis for further prevention of infections in the health service and for preventing the development of more antibiotic resistance. It is assumed that these measures will continue to be carried out.

National goals for the period 2008–2012 are:
1. The occurence of antibiotic resistance in Norway shall not increase.
2. The occurence of infections acquired in the health service in Norway shall be reduced.
3. Knowledge about occurence, causal relations and effects of measures to prevent infections in the health service and antibiotic resistance shall be improved.

4.1 Primary goal 1: The occurence of antibiotic resistance in Norway shall not increase

Norway is still in a good position with regard to the occurence of antibiotic resistance. Many European countries are in a much more difficult situation than we are. With increasing internationalisation and increased use of antibiotics, the development of resistant strains of bacteria and viruses could rapidly increase in Norway as well.

Efforts to quality assure resistance detection in general in Norwegian microbiological laboratories constitute an important function that forms the basis for good diagnostics and a credible surveillance system. This important function is taken care of by several key national participants, e.g. the Norwegian Working Group on Antibiotics (AFA), the Reference Centre for Detection of Antimicrobial Resistance (K-res), the Norwegian surveillance programme for antimicrobial resistance (NORM), the Norwegian surveillance programme for antimicrobial resistance in bacteria from feed, food and animals (NORM-VET), and the reference laboratory for MRSA, in cooperation with the other medical microbiological laboratories.

The first six sub-targets entail building further on several years' work to establish good surveillance of antibiotic resistance. In the strategy period, the systems are to be developed further and utilised better in quality assurance and research. The surveillance of the use of antibiotics is also going to be improved. Sub-targets 7 to 10 entail the further development of several years' work to establish good surveillance of the use of antibiotics outside health care institutions. In this plan period, surveillance shall be extended to health care institutions.

Sub-targets 11 to 16 aim to maintain the professionally acceptable use of antibiotics that we have had in Norway. In this plan period, new guidelines for the use of antibiotics shall be drawn up, and a resource centre for antibiotic treatment in the specialist health service shall be established.

Sub-target 17 concerns efforts to reduce the total environmental impact of antibiotics.

Sub-target 1-1: Further develop the Norwegian surveillance programme for antimicrobial resistance (NORM)

The Norwegian surveillance programme for antimicrobial resistance (NORM) was established in 2000 and is now fully developed. Together with the corresponding systems in the other Nordic countries, NORM is at the global forefront in the national surveillance of antibiotic resistance. NORM is authorised by separate regulations under the Personal Health Data Filing System Act and the Communicable Disease Control Act, and the entity responsible for data processing is the Norwegian Institute of Public Health with the University Hospital of North Norway Trust acting as the data processor. NORM has been a success that provides important information to the efforts to prevent antibiotic resistance.

At present, surveillance consists of all of the medical microbiological laboratories making extra resistance surveys using standardised methods on specified samples of bacteria. Hence, the results are of a high quality, and they can be compared among the laboratories. The sample of bacteria can vary from year to year and is determined in cooperation with the research communities.

The disadvantage of the current system is that the surveillance entails extra work for the laboratories, which have already examined the same bacteria with their routine methods. The research community must therefore discuss further whether NORM should gather data from the routine examinations in the laboratories. This would save resources and improve the quality of the routine data. However, it would require a greater harmonisation of the laboratories under the direction of NORM than at present, e.g. with regard to the use of common, quality assured methods, common templates for recording data, registration of quantitative results and documented quality assurance in the laboratories. Many experts have wanted to have personally identifiable data in NORM so as to be able to link

NORM data to other personal health data filing systems in connection with research, which, among other things, can be useful for research on the development of resistance.

Resistance data on bacteria submitted from patients can give a distorted picture because these bacteria are more likely to be resistant. Thus, the occurence of resistance will be overestimated, which may lead to unnecessary use of broad-spectrum antibiotics in empirical treatment. With regard to many bacteria it is therefore desirable in many cases to establish surveillance systems that are not dependent on spontaneously submitted specimens, but that use bacteria that are cultivated from screening tests of population samples.

Relevant measures:	Responsible for follow-up:
Evaluate whether it is appropriate to make NORM personally identifiable.	**HOD**, FHI, AK
Discuss the further development of NORM, including greater use of routine data.	FHI
Make better arrangements for the use of NORM data in research.	FHI
Look into a possible surveillance system or surveys based on population-based bacteria specimens.	AK
Contribute to NORM, and utilise NORM data in research.	RHF

Sub-target 1-2: Further develop surveillance of MRSA

Methicillin-resistant Staphylococcus aureus (MRSA) is Staphylococcus Aureus that is resistant to the most commonly used antibiotics. Staphylococcus Aureus are innocuous, commonly occurring skin bacteria for many of us, but they are also frequent causes of a broad range of infections (from paronychia and wound infections to pneumonia and blood poisoning), especially in patients in health care institutions. As long as the MRSA occurence in Norwegian health care institutions is very low, the doctor may assume that these infections are not caused by MRSA and select antibiotics accordingly. If we in Norway should get a situation like the one on the Continent or in the United Kingdom(where 30-50 % of pathogenic golden staphylococci are MRSA), doctors will face other choices while they wait for the laboratory results. They must then choose more broad-spectrum and

expensive antibiotics in order to be certain of also killing MRSA. This may result in turn in increased resistance among other bacteria, and we are caught in a vicious circle. Therefore, it is important to monitor the occurence of MRSA and to try to keep it as low as possible.

Surveillance of MRSA was substantially improved during the previous plan period. There is now a duty to also report to the Norwegian Surveillance System for Communicable Diseases (MSIS) if MRSA is confirmed among healthy carriers, i.e. no longer only in the event of infection and disease. In addition, a national reference laboratory has been designated at St. Olavs Hospital. The other laboratories will send their confirmed MRSA bacteria to the reference laboratory for genetic typing. Only a few details still remain to be ironed out in the operationalisation of this surveillance and in the distribution of tasks among laboratories at different levels and MSIS at the Norwegian Institute of Public Health.

The MRSA bacteria are also being confirmed with increasing frequency in animals. In recent years, special "animal-adapted" MRSA clones have established themselves among production animals and horses in Europe. So far in Norway, the bacteria have only been confirmed a few times.

Relevant measures:	Responsible for follow-up:
See that a national medical microbiological reference function for MRSA is maintained.	HOD
Together with the municipalities, the regional centres for hospital hygiene, the national reference laboratory for MRSA, and the rest of the microbiological research community, clarify tasks and delegate responsibilities among the local, regional and national levels.	FHI
Support the national surveillance by having the hospitals report cases of MRSA to MSIS and send MRSA strains to a national reference laboratory.	RHF
Ensure that diagnostics of MRSA are available to all hospitals in the region, whether it be locally or through cooperation with other laboratories.	RHF
Through the regional laboratories or the regional hospital hygiene centres be able to offer genotypic characterisation of MRSA bacteria during the investigations of outbreaks.	RHF
Evaluate guidelines for handling MRSA in animals in connection with a broad review of future animal health management.	MT

Sub-target 1-3: Improve the surveillance of other resistant microbes in the health service

A number of gram-negative bacteria are important causes of serious infections among patients in hospitals, especially patients weakened by old age or a serious basic illness. Many of these bacteria can take up genes that code for production of the enzyme extended-spectrum betalactamase (ESBL). This enzyme destroys the most important antibiotics that are currently used against these bacteria. Thus, the bacteria have become resistant.

After MRSA and vancomycin-resistant enterococcus (VRE), ESBL is the greatest resistance threat to hospitals. The problem with ESBL bacteria can increase in two ways. First, the actual gene can be transferred among bacteria, i.e. the ESBL property can be transferred among different bacteria. Second, the bacteria can spread from patient to patient in hospitals. So far, this problem is minor in Norway. If the ESBL property becomes common among bacteria in Norwegian hospitals, many types of antibiotics will become ineffective, and we will have to change the standard treatment for many conditions.

ESBL bacteria are not subject to systematical surveillance in Norway at present. A summation of current knowledge ought to be conducted with regard to the clinical utility and usefulness in controlling communicable diseases of national surveillance of ESBL strains. The reason for this is that ESBL is a complex field. There are many different types of ESBL. The diagnostic basis for identification of ESBL strains has not been clarified, and there is currently no standardised system for clonal identification of strains of bacteria that are carriers of the different types of ESBL.

Relevant measures:	Responsible for follow-up:
Develop a standardised method for providing a general overview of resistance conditions in hospitals. This method may be used in practical work at the health trust level, including defining which antibiotic groups are to be subject to surveillance and which microbes are to be "indicator microbes" in this surveillance.	**FHI**, RHF, NORM
Conduct a summation of current knowledge with regard to the clinical utility and usefulness in controlling communicable diseases of national surveillance of ESBL strains.	**FHI**, LMM
Continue to monitor infections and colonisation by vancomycin-resistant enterococci (VRE) in MSIS. If the VRE situation should change, consider recommending a more detailed surveillance with a reference function for detailed characterisation of the bacteria.	FHI
Develop a standardised method for a general overview of resistance conditions in hospitals.	**RHF**, FHI, NORM
Contribute to appropriate in-house reporting in hospitals on resistant bacteria (have an epidemiological overview, clarify outbreaks, discover and report on particular virulence).	RHF
Help prepare overviews of bacteria's antibiotic sensitivity, which will be distributed regularly and at least once a year internally to the clinical departments.	RHF

Sub-target 1-4: Enhance participation in European resistance surveillance

Through the EEA agreement, Norway has obligations in the EU's regulations in the area of controlling communicable diseases, including the network for epidemiological surveillance and the European Centre for Disease Control and Prevention (ECDC). The ECDC has taken over the coordination and financing of the European Antimicrobial Resistance Surveillance System (EARSS). In this system, anonymous routine data is gathered on resistance in certain bacteria isolated from blood and spinal fluid. As a competent authority for ECDC, the Norwegian Institute of Public Health has delegated the Norwegian participation in ECDC's resistance surveillance to the data processor for NORM, the

University Hospital of North Norway Trust. Hence, the system supplements the Norwegian NORM system and can, for example, document the favourable Norwegian situation internationally. It is therefore desirable that more than the current eleven laboratories participate.

In animal health matters, Norway participates through the Norwegian Food Safety Authority and the National Veterinary Institute in European cooperation on zoonoses. Norway participates in the EU's reporting system for zoonoses and submits data to the *Zoonose Report - Community Summary Report on Zoonoses* that is published each year by EFSA (the European Food Safety Authority). This report also includes reporting on antibiotic resistance. The National Veterinary Institute is responsible for coordinating this work. Norway also participates in working groups under the EU and Codex in this area. The National Veterinary Institute also coordinates the work with NORM-VET (the Norwegian surveillance programme for antimicrobial resistance in bacteria from feed, food and animals).

Relevant measures:	Responsible for follow-up:
Follow the developments in European resistance surveillance.	**FHI**, UNN
Enhance Norwegian participation in European resistance surveillance by increasing the number of participating laboratories.	**FHI**, UNN
Contribute routine data to European resistance surveillance from the medical microbiological laboratories.	RHF
Follow the developments in Europe with regard to the occurence of zoonotic infectious agents and antibiotic resistance in these countries in feed, food, animals and people.	MT
Contribute routine data to the European surveillance of zoonoses and resistance.	VI

Sub-target 1-5: Surveillance in order to prevent resistance to antiviral agents

Virus infections are increasingly being treated with antiviral agents. That is the case, for example, for infection with HIV, hepatitis B and hepatitis C, herpes simplex, cytomegalovirus, Epstein-Barr and influenza. As with bacteria, this treatment may result in the development of viruses that are resist-

ant to medicines. This is especially problematic for chronic infections, such as HIV and hepatitis B, for which long-term – in some cases lifelong – treatment is given. Choice of treatment for the individual patient can be adapted to the resistance surveys, but sometimes the treatment must start before the results of the resistance survey are available. Surveillance of virus resistance can guide such empirical treatment. In addition, the surveillance can warn of adverse trends. Surveillance resistance to the influenza virus is especially important. This surveillance can provide the basis for evaluating the expected effect of antiviral agents during a pandemic. The surveys of virus resistance are resource intensive and ought to be compiled in only a few laboratories.

Relevant measures:	Responsible for follow-up:
Take a position on a study of the surveillance system for resistance to antiviral medicines.	**HOD**, FHI, AK
Further develop the surveillance system for resistance in the case of HIV.	**FHI**, RHF
Develop a surveillance system for resistance to the influenza virus by making use of the experiences from the system for HIV and further develop the national surveillance of influenza viruses.	FHI
Contribute to the surveillance systems for resistance to the HIV and influenza viruses.	RHF

Sub-target 1-6: Further develop the Norwegian surveillance programme for antimicrobial resistance in bacteria from feed, food and animals (NORM-VET).

NORM-VET documents the occurence of resistance in bacteria from Norwegian domestic animals and Norwegian food. This provides a good basis for identifying trends, for risk assessment and for the implementation of intervention with relevant measures and the evaluation of this intervention. Internationally, NORM-VET is regarded as a good model for resistance surveillance and will contribute to Norway's fulfilment of the obligations in the EU's zoonose directive (Council Directive 2003/99/EC) concerning antibiotic resistance in Salmonella and Campylobacter.

The implementation of the obligation in accordance with the Zoonose Directive has been attended to

through internal instructions to the Norwegian Food Safety Authority's district offices and in cooperation with the National Veterinary Institute regarding NORM-VET. The National Veterinary Institute takes care of the cooperation with institutions that survey resistance in humans and prepares reports. This has been an established practice since 2000.

In order to ensure a good further development of NORM-VET, it is important to have good interaction between the Norwegian Food Safety Authority and the National Veterinary Institute.

Relevant measures:	Responsible for follow-up:
Further develop NORM-VET.	**VI**, MT

Sub-target 1-7: Further develop and utilise the Norwegian Prescription Database

The Norwegian Prescription Database now provides very good information about the scope and the distribution of the use of antibiotics outside health care institutions, but so far these data have been little used for quality improvement and research on the use of antibiotics. One limitation is that the data are not linked to the diagnosis. Therefore, it is not possible to study which antibiotics are given for the individual diagnoses.

Relevant measures:	Responsible for follow-up:
Report on the introduction of a diagnostic code for antibiotics prescribed with a non-reimbursable prescription ("white prescription" meaning patient payd prescription as opposed to public payd prescription)) in the Norwegian Prescription Database.	HOD
Encourage more use of the Norwegian Prescription Database for quality improvement and research.	**FHI**, professional circles
Make use of the Norwegian Prescription Database for quality improvement and research on the use of antibiotics.	RHF, KHT, research circles

Sub-target 1-8: Establish a national template for surveillance the use of antibiotics at hospitals and nursing homes

The vast majority of the antibiotics sold are used outside health care institutions, but consumption per person per day is much higher in hospitals, and the most advanced and resistance-inducing antibiotics are used there. It is therefore of great importance to establish a system for surveillance the use of antibiotics in hospitals (and nursing homes) so that we can follow the consumption and measure the effect of any interventions that may be made. The utility of this information is greatest for the hospital itself, e.g. for use in following up the antibiotic policy, but national data can also be interesting.

Starting in 2006, the Pharmaceutical Trust in Norway established a central database for drug statistics. This is an in-house database for Norwegian hospitals that contains all sales of medicines (including antibiotics) from the Pharmaceutical Trust to the hospital. The database is meant to serve as a local management tool, but also provides an opportunity for comparison at the regional and national levels.

The pharmacies also report deliveries to hospitals and nursing homes to the Norwegian Prescription Database. However, no standardised coding of hospitals, nursing homes, departments and wards is used in this reporting. Therefore, these data provide very spotty information so far about the use of antibiotics in hospitals and other health care institutions. The Norwegian Prescription Database has arranged for the new Norwegian Healthcare Unit Registry to be used in the reporting from pharmacies as soon as there is a final version, but it is assumed that this still lies many years ahead.

Most of the sales to nursing homes are from local pharmacies. These data are not gathered in any central database for the withdrawal of statistics of individual institutions. It is possible for the local pharmacies to obtain statistics for the sale of antibiotics to the institutions to which the pharmacy delivers medicines. Therefore, there ought to be an arrangement in the ongoing work for cooperation with the private pharmacies, through the local authority supervisory pharmacists, who to a great extent are associated with the local pharmacies.

The Norwegian Drug Wholesaler Database – a database that reports all sales of medicines from wholesaler to pharmacy or Pharmaceutical Trust – gives a picture of the total use of antibiotics in Norway. It is possible to sort out the sale of antibiotics to hospitals in this database, but so far no method has been developed to extract data on the use of antibiotics. The Norwegian Institute of Public Health is responsible for the Norwegian Drug Wholesaler Database.

Based on existing statistics, a national template for measuring the consumption of antibiotics per hospital department and hospital (and possibly per nursing home) ought to be developed. The template can also facilitate the gathering of data at the regional and national levels after it has been reported in from the individual departments and hospitals. This can be in accordance with the model of NOIS. The Norwegian Institute of Public Health ought to be given responsibility for this coordination, and it should also develop expertise in pharmacoepidemiological methods. It may be relevant to establish some pilot circles where the method for the local gathering of data can be tested, and where they can try out methods for active feedback and dialogue with the departments.

The use of antibiotics can also be registered in connection with the annual prevalence surveys of hospital infections. In connection with that, a method ought to be established for recording prescription quality (compliance with guidelines), which is linked to the registration of the prevalence of hospital infections.

Relevant measures:	Responsible for follow-up:
Arrange for the regional health authorities to allocate resources at the regional and health trust levels, so that the surveillance can be implemented.	HOD
Review the legislation and ensure that favourable conditions are provided for the surveillance.	Hdir
Ensure that an agreement is entered into at the national or regional level to the effect that the Pharmaceutical Trust will provide drug statistics in a format that can be linked to activity data.	Hdir
Ensure that the Norwegian Patient Register can provide bed-day data for surveillance.	Hdir

Develop a national template for surveillance the consumption of antibiotics in departments and hospitals (and nursing homes), including the testing of relevant measuring units for the use of antibiotics.	FHI
Establish a national database for the consumption of antibiotics by departments and hospitals.	FHI
Devise a method that can extract data on the use of antibiotics in Norwegian hospitals from the Norwegian Drug Wholesaler Database.	FHI
Establish expertise on methods in order to support the individual nursing homes in their surveillance of antibiotics.	FHI
Evaluate the utility of including the use of antibiotics as a variable in the national occurence surveys of hospital infections in hospitals and municipal health care institution for the elderly.	FHI
Support the individual health trusts in their surveillance of antibiotics.	RHF
Ensure that the health trusts establish surveillance of the consumption of antibiotics and that results from the surveillance of the consumption of antibiotics are followed up.	RHF
Make sure that consumption data can be provided for use in the surveillance.	SA
Present reports on consumption data including costs to the health trust management and departments.	SA

Sub-target 1-9: Active participation in European surveillance of the consumption of antibiotics

In recent years, Norway has developed good systems for surveillance infections in hospitals and health care institutions for the elderly. Efforts are now being made to expand the systems to also include surveillance of the use of antibiotics. Surveillance the consumption of antibiotics is important in order to determine whether too many or the wrong antibiotics are being given so that advice can be given about continued prudent use. Norwegian surveillance templates should be based on European protocols for surveillance antibiotics in health care institutions (ESAC – European Surveillance of Antimicrobial Consumption), so we can compare consumption data from different countries.

Relevant measures:	Responsible for follow-up:
Follow the developments in European surveillance of the consumption of antibiotics, and contribute antibiotic consumption data to European antibiotic statistics.	FHI
Follow the developments in European surveillance of antibiotics in feed, food and animals, and contribute routine data to European antibiotic statistics.	MT

Sub-target 1-10: Establish a database for medicines for animals (Veterinært legemiddelregister)

The Norwegian Prescription Database also contains information about medicines given to fish and animals, but has a number of limitations for use in surveillance. Veterinarians' use of antibiotics cannot be traced to specific animal species. Sales of medicinal feed or feed additives with an antibacterial effect are not included and the prescribers identity is concealed with a pseudonym. Therefore, there is a need for a separate database of drug prescriptions for fish and terrestrial animals.

The objective of the database will be to promote food safety, animal health and animal welfare by providing a basis for i) targeted supervision of the requisition and use of medicines for animals, retention times and residual substances, ii) knowledge-based antibiotic policy, including efforts to prevent resistance, iii) quality improvement, consulting, optimising of instruction and information activities, iv) research and instruction and v) promoting consumer considerations.

In order to achieve these goals, the database must be able to provide data for all uses of antibiotics per animal species, per herd or fish farming location and, for certain categories of food-producing animals, per age class. The requisitioner's identity must be specified in the database. The database must be governed in regulations in order to be able to require reporting of data from the relevant sources of data.

Relevant measures:	Responsible for follow-up:
Specify and implement regulations concerning a database for medicines for animals.	**FKD**, LMD, HOD

Sub-target 1-11: Restrictive practices for the approval of antibiotics

Through participation in the European approval procedures, the Norwegian Medicines Agency is working actively to influence the decision on antibacterial agents so that the use is in accordance with the restrictive Norwegian attitudes on matters pertaining to antibiotics. This is reflected in the product descriptions that are the basis for all further information about medicines in Norway.

Relevant measures:	Responsible for follow-up:
Continue to influence the decision-making processes for approval of antibiotics.	SLV
Work to ensure that the indication and dosage are in accordance with Norwegian antibiotic policy.	SLV

Sub-target 1-12: Develop guidelines for the use of antibiotics

Guidelines for the rational use of antibiotics can be an important tool in the quality assurance of medicinal use. Currently, however, there is not any uniform system for the development and maintenance of these guidelines, neither for people (in and outside of hospitals) or for animals.

There are national guidelines issued in the 1990s by the Norwegian Board of Health Supervision for the use of antibiotics in general practice and in hospitals. In addition, there are several nationwide guidelines for the use of antibiotics in general practice, e.g. *Norsk elektronisk legehåndbok* (NEL/ Electronic Medical Handbook) and *Legemiddelhåndboken* (Norwegian medicines handbook for health care staff), together with local or regional guidelines for the use of antibiotics in hospitals, e.g. issued by the individual medical specialities. There are also therapeutic guidelines for the use of antibiotics on animals. No one knows to what extent and how many people use the various guidelines, and there can be discrepancies among them.

Hence, there is a need for a clarification of the distribution of the work. Guidelines for hospitals can be based on the national guidelines. Guidelines ought to be available in a user-friendly format, usually both on paper and in PDA format, and they must clearly indicate the knowledge base.

There is an obvious need for updating the guidelines ("the therapeutic recommendations") pertaining to the use of antibiotics on animals, and the guidelines must also include fish. The updating must be done by a broad professional circle and contribute to a judicious use of antibiotics so that the resistance problems are minimised.

Relevant measures:	Responsible for follow-up:
Ensure that relevant professional circles provide new guidelines on the use of antibiotics on people in the primary health service, in municipal health care institutions and in hospitals	Hdir
Evaluate the involvement of NKH and SLV in the preparation of new guidelines.	Hdir
Ensure that the Norwegian Working Group on Antibiotics (AFA) in cooperation with the Norwegian Institute of Public Health and NORM draws up national guidelines for determining resistance and quality control of these surveys, and evaluate whether it is appropriate to coordinate this work with the Norwegian Food Safety Authority so that fish and terrestrial animals are also included in this work.	Hdir
Contribute to new guidelines pertaining to the use of antibiotics in municipal health care institutions.	KHT
Revise the guidelines for the use of antibiotics in the primary health service.	ASP
In cooperation with SLV, see that the guidelines for the use of antibiotics for animals are updated.	MT

Sub-target 1-13: Ensure a professionally acceptable use of antibiotics

Guidelines for the use of antibiotics are of little value without active implementation and follow-up. The hospitals must therefore put the guidelines in a context that facilitates learning them, elements of which may include regular feedback at a suitable level concerning the use of antibiotics and antibiotic resistance, courses and individual instruction. This is the hospital management's responsibility, and it must be possible to check this activity through the hospital's internal audit and with external inspections. The requirements must be formulated in an effective way through separate circulars or the

commissioner's document to the health trusts and as professional recommendations in the guidelines to regulations concerning the control of communicable diseases in the health service. There is also a need for an upgrading of the antibiotic policy in the municipal health care institutions.

Veterinarians and fish health biologists can requisition antibiotics for animals. The requisition and the use must be acceptable, and that applies to both the individual treatment and the requisitioner's total prescription. The Norwegian Food Safety Authority supervises whether the requisitioner is operating in an acceptable manner, and violations may result in reactions from the Norwegian Food Safety Authority, in the worst case the loss of prescription rights or certification and punishment. If a veterinarian or a fish health biologist has performed acceptable activities, it must be specifically evaluated on the basis of all relevant information in the case and on a sound professional basis, including professional assessments from relevant professional circles.

As discussed in greater detail in chapter 3, increased online trading of medicines may become a challenge to Norwegian antibiotic policy. In addition to the fact that online trading increases the risk of access to medicines of poor quality, it may also contribute to overconsumption and incorrect use of antibiotics.

Relevant measures:	Responsible for follow-up:
Specify the requirements to the regional health authorities and the municipalities to conduct an active antibiotic policy, perhaps through a strengthening of regulations concerning the control of communicable diseases in the health service.	HOD
See that the professional circles draw up expanded guidelines on how the hospitals and the municipal health care institutions can create an active antibiotic policy.	Hdir
Ensure that the hospitals have an antibiotic policy that includes feedback on the consumption of antibiotics and antibiotic resistance, among other things.	RHF

Explain whether a total ban on the private import of antibiotics is a suitable measure.	SLV
Ensure that the muncipal health care institutions have an antibiotic policy.	KHT
Conduct inspections to ensure that veterinarians and fish health biologists use antibiotics for animals in an acceptable manner.	MT

Sub-target 1-14: Establish and run competence centres for the use of antibiotics

The Antibiotic Centre for Primary Care was established on 1 July 2006 and works with research projects, the generation of knowledge and public information about research activities. The centre plays a key role in the revision of the guidelines for antibiotic treatment in the primary health service.

There is a need for a similar arrangement for the use of antibiotics in the specialist health service. It ought to be considered whether it is expedient to establish an Antibiotic Centre for Specialist Health Care based on the model for the primary health service.

The centres must collaborate closely and encourage cross-sectoral cooperation. The efforts to combat antibiotic resistance in the primary health service and in the specialist health service must be considered in context. This is particularly illustrated in the nursing homes. In Sweden, they have good experience with local groups where professionals from various sectors meet regularly to tackle challenges in antibiotic resistance in their own service area. A similar model ought to be tried out in Norway, preferably with geographical boundaries such as the counties or the health trusts' service area.

Relevant measures:	Responsible for follow-up:
Ensure a continuation of the Antibiotic Centre for Primary Care.	HOD
Consider establishing a national resource centre for the use of antibiotics in the specialist health service based on the same model as for the primary health service.	**HOD**, FHI, RHF

Try out an arrangement with a local collaborative committee for antibiotic resistance in some municipalities and in health trusts.	**Hdir**, FHI
Develop models where supervisory pharmacists with enhanced expertise in the correct use of antibiotics initiate measures that can help improve the use of antibiotics in nursing homes, e.g. by means of drug statistics, guidelines, etc.	Hdir
Include the competence centres in *Antibiotikakomiteen* (the Antibiotic Committee) and thereby contribute to national coordination.	FHI
Ensure cooperation with the Antibiotic Centre for Primary Care in the further development of information to the general public concerning resistance and the professionally acceptable use of antibiotics.	FHI

Sub-target 1-15: Develop expertise in the professionally acceptable use of antibiotics

Personnel who have the right to issue prescriptions for antibiotics are the most important factor in the efforts to achieve a professionally acceptable use of antibiotics. There are no guidelines that ensure that these personnel have sufficient expertise on the diagnostics and treatment of infectious diseases.

In 2007, an introductory course was held for the first time for veterinarians educated outside Norway in order to ensure that they had knowledge about the Norwegian resistance situation and antibiotic policy. The course was under the direction of the Norwegian Veterinary Association and in cooperation with the Norwegian School of Veterinary Science, the National Veterinary Institute and the health services for animals.

Physicians educated outside the Nordic countries and the EU and/or EEA have had to take a course in antibiotic resistance and the practical use of antibiotics in order to be allowed to practise as doctors in Norway. The system is now undergoing revision, and it has not been decided what the requirements will be in the future.

Medical quality registers in infectious diseases can help improve the knowledge base for sensible antibiotic treatment and for evaluation of treatment. Efforts are now being made to establish registers for meningitis and endocarditis and eventually for other

diseases with a strong impact on the use of antibiotics and the development of resistance.

Relevant measures:	Responsible for follow-up:
Work to increase the number of hours of instruction on the use of antibiotics in medical training.	Hdir
Assess the need to require education in the use of antibiotics for medical specialities.	Hdir
Ensure that instruction on the professionally acceptable use of antibiotics is included in the introductory courses for doctors educated abroad.	Hdir
Facilitate the establishment of medical quality registers for infectious diseases.	**Hdir**, RHF
Arrange courses and seminars on the use of antibiotics.	**FHI**, AK, KFA
Arrange matters so that doctors are given an opportunity to gain expertise in the professionally acceptable use of antibiotics.	RHF
Ensure that an introductory and/or post-school course is offered to veterinarians and/or other animal health personnel educated outside Norway, which provides knowledge on the Norwegian resistance situation and antibiotic policy.	MT
Take part in the established *Antibiotika-komiteen* (Antibiotic Committee) that deals with the problem in humans in order to help facilitate a better cooperation with those who deal with the problem in animals.	MT

Sub-target 1-16: Further develop communication with and information to the general public

The decision as to whether an adult patient, a child or a pet or other animal should use antibiotics for an infectious disease emerges from an interaction between patient, parents or animal owner on the one hand and doctor or veterinarian on the other. This interaction may be characterised by different understandings of the disease and unexpressed expectations and perceptions.

Since the previous plan period, the Norwegian Institute of Public Health has distributed over

100,000 brochures on the professionally acceptable use of antibiotics to parents of small children through public health centres and doctor's offices, under the catchword "All children get ear infections". The brochure gives brief information about symptoms of various respiratory tract infections and ways in which the parents can alleviate the ailments of their sick children. The brochure also provides information about when it is necessary to visit a doctor, which side effects the antibiotics can give the child and in which cases antibiotics may be necessary.

In addition, doctors have been able to use so-called "antibiotic-free prescriptions", which are small brochures on throat infection, fever, ear infection and bronchiolitis respectively. The doctor can use these in consultations with parents of small children. The brochures support the message that the child's infection will most likely get better by itself – without any treatment with antibiotics. The antibiotic-free prescriptions contain information about common virus infections and why antibiotics do not have any effect on them. They also explain what the parents themselves can do to alleviate their child's ailments and what the parents must be particularly attentive to.

Since there is a steady influx of new parents and small children, it is necessary to regularly repeat the information and continue this work.

Relevant measures:	Responsible for follow-up:
Continue the campaign for parents of small children regarding the sensible use of antibiotics.	FHI
Consider revising the "antibiotic-free prescriptions" in keeping with new guidelines for the use of antibiotics by children.	FHI, ASP
Encourage more popular-science coverage in the mass media of the correct use of antibiotics.	FHI, KFA
Produce information material for use by owners of pets and hobby animals, for possible distribution through small animal clinics.	MT

Sub-target 1-17: Reduce the total environmental impact of antibiotics

Since bacteria exchange genetic information, resistance in naturally occurring bacteria can have a significant effect on bacteria that are pathogenic for people. Therefore, it is desirable to reduce the total environmental impact of antibiotics. In some areas, there are special challenges. That is the case for genetically modified organisms that have been provided with marker genes that code for resistance. It is conceivable that these genes can be transferred into other bacteria.

Furthermore, there is too little knowledge about how antibiotics decompose or accumulate in the nature. It is also a challenge that more and more products, such as detergents and surface materials, are given antibacterial agents as additives.

Through the Product Control Act, there is a focus, among other things, on regulating the use of active ingredients (chemical substances or microorganisms, including bacteria, viruses or fungi) included in a biocide product with an intended effect on one or more pests. Products with biocides are used to combat unwanted organisms and include disinfectants, among other things. Many biocides have very damaging properties with regard to health and the environment.

The environmental protection authorities have a specific focus on reducing the use of triclosan. Triclosan is an anti-bacterial substance that is suspected of promoting increasing antibiotic resistance in bacteria. Triclosan is extremely toxic to aquatic organisms, bioaccumulates and takes a long time to decompose, and triclosan has been found in studies in the environment. Well-known areas of use for triclosan include antibacterial agents in plastic products, cosmetics and textiles.

Relevant measures:	Responsible for follow-up:
Continue a strict policy regarding approval of genetically modified organisms that have been given genes that code for antibiotic resistance.	**FKD**, HOD, LMD, MD
Work to obtain better knowledge about horizontal gene transfer.	**DN**, MT
Monitor the biocide regulations, which regulate the approval and marketing of biocide products.	**MD**, SFT
Evaluate the best-suited policy instruments for reducing the use and release of triclosan, which is suspected of promoting increasing antibiotic resistance in bacteria.	**MD**, SFT

Primary goal 2: The occurence of infections acquired in the health service in Norway shall be reduced

The surveillance of infections acquired in the health service shall be improved. Sub-targets 1 to 3 involve further developing several years' work to establish good surveillance of infections acquired in the health service. With this strategy, the systems are to be developed further and utilised better in quality assurance and research. The control of communicable diseases in the health service shall be improved. Sub-targets 4 to 9 involve improving the control of communicable diseases in the health service in order to spare patients from suffering and reduce the need for antibiotic treatment, as well as to reduce the risk of infectious agents of personnel. In addition, the control of communicable diseases for children and the elderly shall be improved so that there are fewer infections that have to be treated with antibiotics. Sub-targets 10 to 13 involve ensuring sensible regulation and organisation together with sufficient personnel in the efforts to prevent antibiotic resistance and infections in the health service. In this period, health care institutions should set goals for efforts to control communicable diseases and clarify their manpower needs.

Sub-target 2-1: Further develop the Norwegian surveillance system for infections in the hospital service (NOIS)

The Norwegian Surveillance System for Infections in the Hospital Service (NOIS) was established in 2005 and has now completed three three-month periods of national surveillance of infections after normal surgical intervention at all of the country's hospitals. Together with the two annual one-day occurence surveys, NOIS has become the cornerstone in the surveillance of hospital infections. The development of NOIS has promoted Norway to a prominent European position in this area. The further development of surveillance of hospital infections should primarily occur within the framework of NOIS and should utilise its technical infrastructure and legal framework.

The scope of the surveillance of post-operative wound infections should be increased. The obligatory three-month observation periods should be gradually increased to continuous (twelve-month) surveillance. This will give the hospitals a greater numerical basis for their evaluations. In addition, it will be easier to incorporate NOIS as a part of the strategic effort to improve the treatment of patients. The types of operations that are to be included should be regularly evaluated. We should select common types of operations where there are special professional grounds for surveillance the quality.

In addition to operations, there are two other minimally invasive procedures that particularly expose hospital patients to infections. The insertion of catheters into blood vessels (intravascular) increases the risk of infection in the blood stream ("blood poisoning"), and treatment with a respirator increases the risk of pneumonia. These procedures and infections are especially frequent in the intensive care units. It is assumed that many of the infections can be prevented and that surveillance provides a basis for this prevention. In the strategy period, NOIS ought to be expanded to include surveillance of bloodstream infections associated with intravascular catheters. We should also evaluate more carefully whether it may be appropriate to introduce surveillance of respirator-associated pneumonia.

Relevant measures:	Responsible for follow-up:
Evaluate whether it is appropriate to make NOIS personally identifiable.	**HOD**, FHI
Further improve the quality of NOIS by improving the definitions, simplifying runnings, improving the presentation of results on the Internet and improving the feedback of the results to the hospitals.	FHI

Further develop the work in the reference group for NOIS to further involve professional circles in surgery and intensive care medicine in the work.	FHI
During the strategy period, gradually implement continuous surveillance of infections after certain surgical interventions.	FHI
Evaluate NOIS in accordance with the standard procedure for evaluating surveillance systems.	FHI
Encourage the use of NOIS in clinical epidemiological research.	FHI
Introduce a new module in NOIS with obligatory surveillance of bloodstream infections related to the use of intravascular catheters.	FHI
Evaluate whether a new module ought to be introduced in NOIS for microbiological surveillance of respirator-associated pneumonia, giving consideration to cost-benefit aspects.	FHI
Participate in the development of European surveillance systems for hospital infections.	FHI
Complete the implementation of obligatory surveillance and reporting of hospital infections to NOIS at all of the country's hospitals, and initiate continuous surveillance.	RHF
Initiate obligatory surveillance in NOIS of bloodstream infections related to the use of intravascular catheters.	RHF
Employ the results of strategic efforts to improve services.	RHF
See that computer assistance is established for the surveillance.	RHF
Ensure statistical and epidemiological competence.	RHF
Ensure that the responsibility for implementing the surveillance activities is clearly delegated in the organisation, including delegation of management responsibility and authority, selection of the person(s) who are to carry out the task and organisation of the lines of communication.	RHF
Establish routines for utilising the results of the surveillance in a separate quality-improvement effort.	RHF
Actively contribute to the national effort to maintain and develop NOIS.	RHF

Sub-target 2-2: Develop better surveillance systems for infections acquired in municipal health care institutions for the elderly

Infections acquired in nursing homes are a serious problem. Occurence surveys have shown that these infections are just as widespread in institutions for the elderly as they are in hospitals. Moreover, recent studies from Norway show that health-service-associated infections increase the risk of admission to a hospital and death.

At present, the only established surveillance method is point prevalence surveys. A programme of continuous surveillance of infections in municipal health care institutions for the elderly ought to be developed, e.g. in 3-6 month periods.

Relevant measures:	Responsible for follow-up:
Prepare a template for occurence surveillance in nursing homes.	**FHI**, KHT
Establish a system for occurence surveillance in nursing homes with voluntary reporting to a national database.	FHI
Evaluate the improvement of existing surveillance systems for infections in municipal health care institutions, and, among other things, evaluate the introduction of a system for occurence surveillance in nursing homes.	KHT
Encourage and arrange for nursing homes to participate in national occurence surveillance	KHT

Sub-target 2-3: Develop in-house surveillance systems for infections in hospitals

Now and then at some hospitals there is an outbreak of hospital infections caused by certain strains of bacteria, e.g. *Pseudomonas aeruginosa* or *Acinetobacter baumannii*. Sometimes the strain may establish itself in the hospital and give persistent challenges related to the control of communicable diseases that last for a number of months. The hospitals should utilise the close cooperation among the clinical departments, the hospitals' staff who specialise in the control of communicable diseases and the medical microbiological laboratories to detect these situations early. It is necessary to prepare a template that can be put to use by the hospitals that want to establish surveillance in order

to quickly detect changes in the frequency or distribution of infectious agents that cause hospital infections.

Clostridium-difficile-associated diarrhoea (CDAD) is usually triggered by the use of antibiotics. In a number of countries, serious outbreaks of CDAD have occurred that are caused by certain strains of *Clostridium difficile* and that are not related to the use of antibiotics. A system of microbiological diagnostics to detect these strains in Norway has not been established.

Relevant measures:	Responsible for follow-up:
Prepare a template for in-house hospital surveillance of hospital infections with an aetiological diagnosis.	**FHI**, RHF.NORM
Study how best to diagnose various strains of the bacteria *Clostridium difficile* and monitor infections caused by these bacteria.	**FHI**, RHF, LMM

Sub-target 2-4: Improve the guidelines regarding practical control of communicable diseases in the health service

The efforts to control communicable diseases in the health service are a continuous process, where challenges are constantly turning up. There is a great need for local, regional and national guidelines, guides and information material. At the same time, the preparation of this material is time-consuming and resource demanding. The work should therefore be divided among the various participants and freely distributed and coordinated among them. An increasing percentage of this material should be available on the Internet.

Relevant measures:	Responsible for follow-up:
Prepare a campaign focusing on standard measures in the control of communicable diseases in health care institutions.	FHI
Revise national MRSA guidelines and work to have common guidelines used throughout the whole country.	FHI
Consider drawing up guidelines for the prevention of the most common hospital infections.	FHI
Consider drawing up guidelines for the prevention of infections in intensive care units	FHI
Consider drawing up guidelines for risk assessment of the control of communicable diseases in the hospitals (including analysis of the need for staff who specialise in the control of communicable diseases) and for the management's annual review of the control of communicable diseases, among other things in cooperation with the Norwegian Labour Inspection Authority.	FHI
Consider drawing up information material (posters, brochures, etc.) about various topics such as MRSA, tuberculosis, the use of antibiotics.	FHI
Consider preparing general guidelines for microbiological surveys (screening) of patients and health personnel, including the situations in which surveys shall be conducted (upon admission to and/or commencement of work in hospitals, in connection with transfers, on a regular basis during stays in certain departments), what is to be surveyed, and which measures are to be implemented pending test results and if specific antibiotic-resistant bacteria are shown to exist.	**Hdir**, FHI

Sub-target 2-5: Ensure that the regulations concerning the control of communicable diseases in the health service are better implemented in municipal health care institutions for the elderly

There are many reasons why the control of communicable diseases in the municipal health care institutions for the elderly has become increasingly more important. There are more residents, they are older, and they are more dependent on assistance and vulnerable to infection than they used to be. Both residents and health personnel move from one of these institutions and hospitals to another. In addition, the residents move between the institutions and their own homes, where services are also provided for them.

Measures to control communicable diseases in nursing homes will differ somewhat from measures in hospitals, not least because this is the resident's home and the stay is usually long-term.

Relevant measures:	Responsible for follow-up:
Give advice and recommendations to the municipal health service concerning the control of communicable diseases.	FHI
Offer to assist the municipal health service by drawing up suitable infection control programmes.	RHF
See that nursing homes draw up an infection control programme and assist the enterprises in this work	K
Ensure that local guidelines in the control of communicable diseases are in keeping with national recommendations.	KHT
See that staff who specialise in the control of communicable diseases have sufficient expertise to attend to delegated tasks and responsibilities.	KHT
Arrange matters so that staff who specialise in the control of communicable diseases get an opportunity to gain competence through both formalised further education and continuing education.	KHT
Evaluate the need for other personnel with tasks that are related to the control of communicable diseases.	KHT
Supervise the municipal health care institutions' compliance with regulations concerning control of communicable diseases in the health services	Htil

Sub-target 2-6: Further develop expertise on the control of communicable diseases in the health service

The health personnel are the most important factor in the control of communicable diseases in the health service. There is not any comprehensive plan to ensure that different categories of staff who specialise in the control of communicable diseases have sufficient expertise nor is there any formalised educational programme.

In many hospitals, it is difficult to recruit doctors to positions such as infection control practitioner, and many of them will only remain in the position for a short time. This is particularly a problem for doctors in part-time positions in small and medium-sized hospitals. What's more, many infection control practitioner have not set aside any time for this

work, have no formal training and do not participate in the daily efforts to control communicable diseases in hospitals. Recruitment, organisation and the arrangement of working conditions ought to be assessed.

Sterile supply units are important in order to prevent infections in health care institutions. In small hospitals, the units are often organised under the surgical ward. Many employees do not have sufficient training in the control of communicable diseases and quality assurance, and some do not have any health science education either. New knowledge, extensive legislation, new professional standards and the steady development of new and often complicated medical equipment have resulted in stricter requirements for quality assurance of the whole sterile supply service, and this activity must be quality assured through education of the employees, among other measures.

Relevant measures:	Responsible for follow-up:
In cooperation with their own and other relevant agencies, ensure that there is necessary capacity and quality in organised educational programmes for all groups of staff who specialise in the control of communicable diseases (chief municipal medical officers, infection control practitioners advisors on the control of communicable diseases, hygiene nurses, personnel in sterile supply, technical auditors, hygiene contact persons, etc.)	HOD
Help facilitate establishment of the necessary capacity and quality in organised educational programmes for all groups of staff who specialise in the control of communicable diseases (chief municipal medical officers, infection control practitioner advisors on the control of communicable diseases, hygiene nurses, personnel in sterile supply, technical auditors, contact persons involved in the control of communicable diseases, etc.)	**Hdir**, FHI
Review the country's sterile supply units with a focus on quality and expertise.	**Hdir**, FHI
Work to increase the number of hours of instruction in the control of communicable diseases in relevant health science educations.	**Hdir**, FHI

Measure	Responsible
Assess the need for requiring education in the control of communicable diseases for certain medical specialities and further education in nursing.	**Hdir**, FHI
Hold courses and seminars for staff who specialise in the control of communicable diseases, and hold seminars on relevant topics relating to the control of communicable diseases and epidemiology in cooperation with the regional competence centres.	FHI
See that staff who specialise in the control of communicable diseases are correctly placed in the health trusts and in the organisation and that they have sufficient expertise to attend to the imposed tasks and responsibilities.	RHF
Arrange matters so that staff who specialise in the control of communicable diseases get an opportunity to gain competence through both formalised further education and continuing education.	RHF
Evaluate the need for other personnel with tasks that are related to the control of communicable diseases.	RHF

Sub-target 2-7: Improve the physical design and use of health care institutions

Health care institutions are complicated buildings with many special functions. In order to prevent the spread of infectious agents, including the spread of resistant bacteria, it is important that the building stock be appropriately arranged so that patients, staff and visitors are protected from unnecessary situations where communicable diseases might be spread. This applies to general conditions such as the design of patient rooms and the location of wash basins and disinfection rooms (previously called washing rooms). Statutory requirements have also been specified for many types of special rooms such as operating theatres, treatment rooms for invasive examinations and isolation rooms (simple isolation rooms and complex airborne infection isolation rooms). These special rooms are expensive to build and can be expensive to operate. In general, there are too few of these types of rooms that meet the statutory requirements and professional standards.

There is currently no comprehensive expertise in this area in Norway. Expertise can be found in the health trusts' technical staff, among certain architects and building consultants and to some extent among a small number of doctors and hygiene nurses interested in the control of communicable diseases.

In the new construction and renovation of health care institutions, there are many competing interests from various professional groups and from the administration and these interests must be weighed against the costs. Expertise is required from professional fields as different as architecture, construction technology and health science including the control of communicable diseases. In the planning and execution of construction projects, consideration must be given to the control of communicable diseases throughout the whole process. When a construction project is completed, it is important to retain the expertise that has been developed throughout the construction period.

Relevant measures:	Responsible for follow-up:
In cooperation with one's own and other relevant agencies, ensure that national and regional expertise on the control of communicable diseases in the new construction and renovation of health care institutions is established.	HOD
Help ensure that most beds that are established in health care institutions – including those in intensive care units and municipal health care institutions for the elderly – are in single rooms.	HOD
Ensure that the regional health authorities carry out previous orders to phase out the practice of placing patients in corridor beds.	HOD
In cooperation with other relevant agencies, draw up plans for the establishment of national and regional expertise on the control of communicable diseases in the new construction and renovation of health care institutions.	Hdir
In cooperation with relevant participants, draw up guidelines concerning which aspects in the control of communicable diseases ought to be evaluated during the planning of new construction and renovation of health care institutions and how staff who specialise in the control of communicable diseases should be involved in the process.	Hdir

Especially evaluate the conditions pertaining to the risk of infectious agents in the administration of building projects by health care institutions.	AT
See that regional expertise on the control of communicable diseases is established for new construction and renovation of health care institutions.	RHF
Ensure that the need for isolation rooms as described in the isolation guidelines is evaluated, including conducting risk and vulnerability analyses and taking preparedness into consideration and then devising a plan for the way in which this need shall be met by new construction and renovation.	RHF
Phase out the practice of putting patients in corridor beds.	RHF
In new construction, give priority to building a sufficient number of single rooms with their own shower, toilet and rinsing room in somatic units, including intensive care units.	RHF
Include staff who specialise in the control of communicable diseases in the planning of new construction and renovation in hospitals.	RHF
In new construction, give priority to building a sufficient number of single rooms with their own shower, toilet and a sufficient number of disinfection rooms.	K
Include staff who specialise in the control of communicable diseases in the planning of new construction and renovation of nursing homes and assisted living facilities.	K
Get involved in the planning of new institutions at an early stage.	KHT

Sub-target 2-8: Improve vaccination

The vaccination programme in Norway has very high coverage and has the main honour for the elimination more or less in Norway of diseases such as poliomyelitis, diphtheria, tetanus, Haemophilus influenza type b, measles, mumps and rubella. The high coverage in Norway compared with many other European countries can probably be attributed to parents' trust in the programme, the health personnel's good dialogue with the parents and the programme's orderly organisation on the axis between the Norwegian Institute of Public Health and the municipal child health clinics and school health services.

In addition to the fact that vaccination prevents disease and death, vaccination can prevent the unnecessary use of anti-biotics in two ways. First: vaccination prevents cases of diseases (such as diphtheria and tetanus) where the treatment had entailed the use of antibiotics. Second: vaccination prevents cases of other diseases (such as measles and influenza) that can lead to bacterial secondary infections that require antibiotic treatment. By preventing communicable diseases that may have to be treated with antibiotics, vaccination is thereby involved in preventing the unnecessary use of antibiotics.

There is a potential for preventing even more disease, death and use of antibiotics by improving vaccination against three diseases:

Whooping cough: The goal for whooping cough vaccination is to protect the youngest children against this disease, which can have serious complications. In recent years, however, whooping cough has become more frequent among school children and young adults. This is not dangerous to them, but it leads to long-term, unnecessary ailments and considerable use of antibiotics, and it maintains the circulation of the whooping cough bacteria in the population. Therefore, starting in 2006, a new dose of whooping cough vaccine was introduced at the school start (in Norway age 5 – 6 years).. This should help the protection against whooping cough to last farther into the children's school age.

*Pneumoc*occal disease: Pneumococcal vaccine was introduced in the child vaccination programme as of 1 July 2006 in order to prevent serious invasive pneumococcal disease among small children. An additional effect may be a lower occurence of respiratory tract infections caused by pneumococci. These must often be treated with antibiotics. The coverage is very high. Introduction of the vaccine has led to a 74% reduction in the number of children who have contracted invasive (serious) pneumococcal disease (IPD). For children under 2, the occurence of IPD dropped from 67.7/100,000 to 32.6/100,000 after the introduction of the vaccine according to a fresh study from the Norwegian Institute of Public Health (FHI). Among the elderly, pneumococcal vaccination may result in fewer cases of pneumonia, which must be treated with antibiot-

ics. The vaccine is recommended for elderly persons over age 65 and for people with chronic lung or heart diseases. So far, too few of the elderly are taking the vaccine.

Influenza: Influenza vaccination every autumn is recommended for elderly persons and people with chronic lung or heart diseases or certain other diseases. Vaccination can prevent influenza and thus also sequelae to influenza, such as pneumonia, which require antibiotic treatment. The coverage of influenza vaccination among the elderly, however, is still too low.

Relevant measures:	Responsible for follow-up:
Consider measures to encourage increased coverage of influenza and pneumococcal vaccine in defined target groups outside of the child vaccination programme.	**HOD**, FHI
Strengthen the efforts to increase the coverage among the elderly and other high-risk groups for vaccination against invasive pneumococcal disease and annual influenza vaccination.	FHI, RHF
Monitor the introduction of a new dose of whooping cough vaccine, and measure the effect on the occurence of whooping cough.	FHI
Monitor the introduction of pneumo-coccal vaccine in the child vaccination programme, and measure the effect on the occurence of invasive pneumo-coccal disease, serotype distribution and antibiotic resistance among pneumococci.	FHI
Strengthen the efforts to increase the coverage for influenza vaccination among health personnel.	FHI, RHF
Keep updated on the development of new vaccines, and give advice to the Ministry of Health and Care Services about this.	FHI

Sub-target 2-9: Improve the control of communicable diseases in day nurseries

Day nurseries have a number of positive effects on children and the society. Since the youngest children in day nurseries naturally have a poorly developed immunological defence and daily contact with many other children, children in day nurseries have a greater occurence of respiratory tract infections and gastrointestinal infections than children who do not attend a day nursery. A continu-ously increasing percentage of Norwegian children now go to day nurseries. A high percentage of the Norwegian total consumption of antibiotics is prescribed to children. If we can better prevent the spread of infectious agents in day nurseries, we will indirectly be able to reduce the consumption of antibiotics.

Both the child density in day nurseries and hand hygiene probably have some effect on the increased risk of spread of infectious agents. Therefore, measures such as increasing indoor space, increas-ing the amount of time spent outdoors, improving the ventilation and improving hand hygiene have been discussed. In this area, however, there has been little research, and little is known about which measures are the most effective. It would be unwise to initiate expensive, intrusive measures without a sufficient knowledge base.

Relevant measures:	Responsible for follow-up:
Study the knowledge base for measures to control communicable diseases in day nurseries.	**FHI**, NKH
Research the causes of the spread of infectious agents in day nurseries and the effect of measures to control communicable diseases.	**FHI**, KHT

Sub-target 2-10: Revise the regulations and set goals for the efforts to control communicable diseases in the health service

The organisation of the control of communicable diseases does not function well enough in the health service. The control of communicable diseases in the health service is regulated by the Communicable Disease Control Act and the regulations concerning the control of communicable diseases and by the Working Environment Act and regulations concern-ing biological factors. Not all sectors of the health and social services and the dental health service are regulated by these regulations.

In the municipal health service, health personnel and users meet both in nursing homes, assisted living facilities and home-based services in a number of arenas. A study should therefore be conducted of

the ways in which regulations and guidelines can be coordinated in the best possible way.

Relevant measures:	Responsible for follow-up:
Consider clarifying the organisational placement and administration of the control of communicable diseases as described in Section 2-3 of the regulations concerning the control of communicable diseases.	HOD
Evaluate the form and content of the steering document of the regional health authorities and the annual reports from the regional health authorities to the Ministry of Health and Care Services that cover the control of communicable diseases.	HOD
Set goals for the efforts to control communicable diseases and incorporate these into steering documents of the regional health authorities.	HOD
Clarify the municipalities' responsibility for the control of communicable diseases in municipal health care institutions, and evaluate reporting that manifests this responsibility.	HOD
Evaluate the need for regulation of measures to control communicable diseases in health services in addition to those measures that are covered by regulations concerning the control of communicable diseases in the health service.	Hdir
Evaluate whether there is a need for guidelines that clarify what constitutes acceptable control of communicable diseases and how the control of communicable diseases should be incorporated into the internal control system.	Hdir
Consider developing a permanent network forum with the municipal health service concerning the control of communicable diseases in health care institutions.	FHI
Ensure the satisfactory organisation and administration of the control of communicable diseases in the health region and at the individual health trusts.	RHF
Draw up and circulate a regional plan for the control of communicable diseases.	RHF
Ensure an adequate emergency preparedness in case of an outbreak of infection.	RHF
Clarify the management's responsibility for the control of communicable diseases in municipal health care institutions.	K
In cooperation with the Norwegian Directorate of Health and the Norwegian Institute of Public Health, define their main challenges in the control of communicable diseases in municipal health care institutions, and specify goals and measures for the control of communicable diseases in the various municipal health services in the municipalities' plan for the control of communicable diseases.	KHT
Draw up a plan for the municipality's supervision of the control of communicable diseases in the various health services.	KHT
Assist the management of the health care institutions in evaluating the competency needs in the control of communicable diseases.	KHT
See that the nursing homes draw up an infection control programme and assist the enterprises in this work.	KHT
Aim for close contact and dialogue with the management, chief municipal medical officer, nursing home physician and hygiene contact person in order to ensure that the control of communicable diseases is taken care of.	KHT
Focus on the control of communicable diseases and factors relating to the spread of infectious agents on an equal basis with other biological factors (cf. the regulations concerning protection against exposure to biological factors in the workplace), in the inspection of the working environment at health care institutions.	AT

Sub-target 2-11: Define the manpower needs and, if necessary, increase the number of personnel

The tasks for staff who specialise in the control of communicable diseases in hospitals are insufficiently described in many places, and the need for personnel has not been quantified. Specialists in infectious diseases, medical microbiologists and hospital pharmacists are important to the profes-

sionally acceptable use of antibiotics in health care institutions. As a rule, it is also the two above-mentioned medical specialists who become infection control practitioners in hospitals. The need for personnel trained in the control of communicable diseases must be assessed.

Relevant measures:	Responsible for follow-up:
Review the need for training positions for medical microbiologists and specialists in infectious diseases with a survey of the situation at present and new needs in the coming years and ensure that the necessary number of training positions will be established.	Hdir
Evaluate the need to increase the number of training positions and senior consultant positions in infectious diseases and medical micro-biology, and assess the need for hygiene nurses.	RHF
Evaluate, systematise and describe the tasks that are to be performed in the control of communicable diseases pursuant to national requirements and professional recommendations, adapted to the health trust's other goals and strategies.	RHF
Draw up job instructions for staff who specialise in the control of communicable diseases on the basis of a functional description.	RHF
Help facilitate the establishment of operative interdisciplinary antibiotics committees of doctors, nurses and pharmacists, among others.	RHF
Draw up job instructions for staff who specialise in the control of communicable diseases on the basis of functional descriptions.	**RHF**, professional circles

Sub-target 2-12: Conduct an internal audit in hospitals

An internal audit is an important quality assurance tool in the health service and is frequently used in many areas. It is increasingly being put to use in the control of communicable diseases, but so far there are not satisfactory tools that are easily accessible to everyone.

Relevant measures:	Responsible for follow-up:
Ensure that the internal audit in health trusts and hospitals also includes the control of communicable diseases and infection control.	RHF
Create a plan for including activities in the infection control programme in the hospitals' internal audit pro-gramme and ensure that the infection control programme, including the antibiotic policy, is revised in the same way as the other internal audits.	RHF
Make sure that non-conformance systems also cover the control of communicable diseases.	RHF
Measure the effect of the measures to control communicable diseases in the form of occurence of hospital infections and in other ways.	RHF

Primary goal 3: Knowledge about the occurence, causal relations and effects of measures to prevent infections in the health service and antibiotic resistance shall be improved.

Research as a basis for improving the control of communicable diseases and decreasing antibiotic resistance shall be strengthened. The sub-targets concern the knowledge base for improving the control of communicable diseases and decreasing antibiotic resistance.

Sub-target 3-1: Draw up a national plan for research and development relating to infections in the health service and antibiotic resistance

Both of the previous plans indicated the need for more research. Some research has been conducted on hospital hygiene and antibiotic resistance under these plans, but few of the specific measures were carried out. It is therefore recommended that this area be specified in greater detail through a separate comprehensive national research plan concerning infections in the health service and antibiotic resistance in Norway.

The need for better research is clear: We lack fundamental knowledge about the occurence, causal relations and effects of the control of communicable diseases and the prevention of resistance. Some

research knowledge is not communicable from country to country. Special conditions in Norway require specific knowledge of Norwegian conditions both with regard to occurence and preventive measures. Furthermore, research expertise is an important condition for evaluating and applying results from scientific studies.

Expertise in research is necessary. In particular, this ought to be developed in epidemiology and statistics, economic evaluation and behavioural research. In addition, expertise ought to be developed in the presentation and formulation of applications.

Cooperation is necessary. The plan ought to include guidance on coordination and network cooperation. A national "database" with an overview of ongoing projects ought to be established. An organisation should also be established to which you can submit outlines for projects or report an interest in establishing cooperation. Likewise a national overview of Norwegian publications ought to be established, including abstracts and "posters". A national research forum should also be established and a plan should be devised for national and international alliance building.

Funding must be clarified. This kind of research effort can be funded through established national, regional and local research channels, and perhaps in addition by labeling funds.

Research topics are numerous, and their respective priorities must be specified in a national plan. Examples of topics include:

A. Occurence and consequences of resistance, hospital infections and the use of antibiotics
- The use of data from NOIS, NORM, MSIS, the Norwegian Drug Wholesaler Database and the Norwegian Prescription Database must be encouraged.
- Hospital infections' occurence and consequences, through the use of NOIS data, among others.
- Occurence and consequences of antibiotic resistance, through the use of NORM data, among others.
- Occurence of the use of antibiotics in general practice and in nursing homes and hospitals.
- Occurence of antibiotic resistance among pathogenic agents in fish.

B. Causes of healt institution acquired infections and resistance
- The causes of the infections, through the use of NOIS data, among others.
- Significance of patient transfers among health care institutions.
- The importance of health personnel and patient behaviour for antibiotic resistance and health-institution-acquired infections.
- The importance of the use of antibiotics and antibiotic prophylaxis for the occurence of infection with resistant bacteria.
- Causes of MRSA infections outside hospitals.
- Meat as a possible source of certain resistant bacteria (especially ESBL producing Escherichia coli) in Norway.
- Importance of domestic animals and pets as reservoirs for MRSA bacteria.

C. Effectiveness of preventive measures against infections in the health service and resistance
- Effectiveness of infection surveillance in NOIS and other surveillance systems in preventing the spread of communicable diseases, and evaluation of the quality of the surveillance systems.
- Effectiveness of screening for resistant bacteria prior to admission, and methods for screening.
- Effectiveness of measures to control communicable diseases (such as isolation, standard measures, the use of protective equipment, decontamination and disinfection) on high priority areas, including infections in the operation field, bloodstream infections, pneumonia and exogenous vs. endogenous infections.
- Cost-benefit effect of measures to control communicable diseases studies of which methods are best suited and which measures are most effective.
- Effectiveness of interventions to change doctors' prescriptions of antibiotics, both in general practice and in nursing homes and hospitals.
- Development of better vaccines against diseases in farmed fish.
- Optimal use of antibiotics for terrestrial animals and fish.

Relevant measures:	Responsible for follow-up:
Prepare a national strategy for research on the control of communicable diseases in the health service and antibiotic resistance.	**HOD**, FKD, LMD, FHI, Hdir, MT, RHF

Consider giving earmarked grants to the Research Council of Norway for a special research effort on infections in the health service and antibiotic resistance.	**HOD**, FKD, LMD
Establish systematic cooperation in research and development.	**FHI**, RKS, ASP, AFS
Arrange matters so that the health service encourages research on antibiotic resistance and hospital infections.	Hdir
Establish research circles at the regional competence centres and encourage research, organisationally and financially.	RHF
Include antibiotic resistance and the control of hospital infections in the research plans.	RHF
Evaluate the regional competence centres with regard to their research activities, among other things.	RHF
Ensure that staff who specialise in the control of communicable diseases and other professional personnel are able to allocate sufficient time to make contributions to research and development.	RHF
Ensure that research circles assist the authorities in defining research areas in antibiotic resistance and hospital hygiene.	RHF

Relevant measures:	Responsible for follow-up:
Devise a robust, knowledge-based method for calculating the costs of the most important hospital infections and the costs of preventive work.	FHI, Hdir, NKH
Contribute to the preparation and quality assurance of methods for cost estimation.	RHF
Employ the method for cost estimation.	RHF

Sub-target 3-2: Develop models for cost estimation of infections acquired in health care institutions

It is difficult to estimate costs resulting from infections acquired in health care institutions. Thus, it will also be difficult to estimate the possible economic benefit of measures to control communicable diseases. It is desirable to have a simple, robust method that the health trusts can use to calculate the costs that these infections will inflict on them.

Appendix – Description of the facts for the national strategy for the prevention of infections in the health service and antibiotic resistance.

1. Roles and responsibility

1.1 Distribution of roles

The action plan's goals and measures affect many sectors of society and involve participants at all administrative levels. The relevant participants and their tasks and authority are described below.

The Norwegian Ministry of Labour and Social Inclusion (AID) is responsible for labour market policy, working environment and safety policy, integration and diversity policy, immigration and asylum policy, Sami and minority policy, pension policy and welfare and social policy.

In the working environment area, there are over-arching goals of helping to promote safe, inclusive employment for everyone, where emphasis has been placed on preventing damage to health, disease, accidents and exclusion. The main strategy is to help make it possible for the entities themselves to take responsibility for preventing accidents and damage to health. The authorities' main policy instruments in the efforts to develop regulations for, supervise and promote the development of knowledge and methods.

The Norwegian Ministry of Fisheries and Coastal Affairs (FKD) has the highest responsibility for the organisation and supervision of the fishery and the aquaculture industry, fish health and welfare, and seafood safety and quality. In aquacul-ture, the Ministry lays down guidelines for the management of fish diseases where one of the goals is to minimise the need for medicines. The indus-try's reporting and the Norwegian Food Safety Authority's supervision of the use of medicines is important for ensuring safe seafood. The objective is to ensure the consumers safe, healthy seafood of proper quality. The professional responsibility in the food policy area is divided among the Norwegian Ministry of Fisheries and Coastal Affairs, the Norwegian Ministry of Health and Care Services and the Norwegian Ministry of Agriculture and Food. Together with the Ministry of Health and Care Services, the Ministry of Fisheries and Coastal Affairs is responsible for ensuring safe seafood.

The Norwegian Ministry of Health and Care Services (HOD) is the highest administrative body for the health service in Norway and also adminis-ters ownership of the five regional health authori-ties. As the highest body in the health service, the Ministry lays down guidelines for the correct use of medicines and the infection preventing work in the health service.

In the specialist health service, the central govern-ment acting through the Ministry of Health and Care Services is the owner of the regional health authorities (RHF) which in turn own the health trusts (HF). The Ministry of Health and Care Services issues its steering signals either through

management by the authorities in the annual steering document or, through its position as owner, in trust meetings with the regional health authorities. The Norwegian Directorate of Health plays an important role in the implementation of the management by the authorities, e.g. through the administration of a number of acts, regulations and subsidy schemes.

The Norwegian Ministry of Agriculture and Food (LMD) is administratively responsible for the Norwegian Food Safety Authority, and together with the Ministry of Health and Care Services and the Ministry of Fisheries and Coastal Affairs it has the highest professional responsibility when it comes to food. Pursuant to the Food Act, the responsibility is divided among the three ministries. The Ministry of Agriculture and Food's areas of responsibility are especially tied to material inputs, primary production, animal health and animal welfare of terrestrial animals and quality regulations and regulations that are supposed to protect special forms of production and product names. The Ministry of Agriculture and Food also has responsibility for the Act relating to veterinarians and other animal health personnel.

The Norwegian Ministry of the Environment (MD) has the primary responsibility for the implementation of the government's environmental policy and is responsible for the Product Control Act and the Gene Technology Act, among others. Within the constraints of the Gene Technology Act, the Ministry should conduct a strict policy concerning the approval of organisms that have received genes that code for antibiotic resistance.

Within the constraints of the Product Control Act, the Ministry focuses, among other things, on the approval of biocides and biocide products that are used to combat undesirable organisms.

The Ministry also focuses on reducing the use of triclosan, which is suspected of contributing to increasing antibiotic resistance among bacteria.

The Norwegian Labour Inspection Authority (AT) provides supervision to ensure that the provisions specified in and pursuant to the Working Environment Act are complied with. The Authority provides supervision to ensure that the enterprises comply with the requirements of the Act relating to an acceptable working environment, that systematic HSE work is carried out in order to evaluate risk factors, and that risk-reducing and disease and injury-preventing measures are implemented. The Norwegian Labour Inspection Authority is responsible for coordinating enterprise-oriented HSE inspections.

Among other things, the Norwegian Labour Inspection Authority is supposed to supervise the municipal health care institutions' compliance with regulations concerning protection against exposure to biological factors (bacteria, viruses, fungi, etc.) at the workplace.

The Petroleum Safety Authority Norway (PT) is responsible for regulations and supervision of health, safety and the environment on the Norwegian continental shelf and in a number of onshore facilities. The Petroleum Safety Authority Norway is also responsible for coordinating the comprehensive development of regulations and supervising health, safety and the environment (HSE) in the petroleum operations.

In the HSE area, the Petroleum Safety Authority Norway cooperates with the Norwegian Directorate of Health, among others, on developing comprehensive regulations. The health-related topics in the supervision are handled by the Norwegian Board of Health Supervision.

The Norwegian Food Safety Authority (MT) has the primary responsibility for supervising compliance with the regulations concerning food safety, plant, fish and animal health, welfare of fish and terrestrial animals and quality and consumer considerations in the food production chain. One basic task is to ensure protection of the health of consumers and animals, including the surveillance and inspection of the status, development of regulations and necessary emergency preparedness in the area. Active guidance is also important. This administrative area is almost completely harmonised with the EU through the EEA agreement.

The Norwegian Institute of Public Health (FHI) is the central government's institute for the control of communicable diseases, pursuant to Section 7-9 of the Communicable Disease Control Act. Important tasks include surveillance of communicable diseases, conducting research in the area of controlling communicable diseases, ensuring the supply of vaccine and/or emergency preparedness and providing guidance to institutions and the population concerning measures to control communicable diseases. Pursuant to regulations concern-

ing the control of communicable diseases in the health service, the Norwegian Institute of Public Health shall, among other things, maintain an overview of the occurence of infections in institutions, develop statistics and provide assistance relating to the clearing up of outbreaks. Furthermore, the institute is supposed to conduct educational activities, hold courses and update the knowledge on the control of communicable diseases.

The Norwegian Directorate of Health (Hdir) is a national authority concerned with the control of communicable diseases and, pursuant to Section 7-10 of the Communicable Disease Control Act, has the authority to issue a number of orders. Examples of this include the authority to impose the temporary obligation to report and obligation to give notification, order surveys, order vaccination and make rapid decisions about a number of matters.

Pursuant to the regulations concerning the control of communicable diseases in the health service, the Directorate of Health should have a comprehensive strategy for preventing infections in the health service, set standards and formulate requirements for training in hospital hygiene for health personnel.

The Norwegian Board of Health Supervision (Htil) has the comprehensive professional supervision of the health service in Norway, pursuant to the Health Services Supervision Act. Pursuant to Section 7-10a of the Communicable Disease Control Act, the Norwegian Board of Health Supervision has the overall supervision to ensure that the municipal, county administration and central government activities are in accordance with the acts and regulations. The Board of Health Supervision also supervises private health care institutions. Pursuant to regulations concerning the control of communicable diseases in the health service, the Board of Health Supervision should have the comprehensive supervision of the control of communicable diseases in Norwegian health care institutions. Pursuant to acts and regulations, the Board of Health Supervision in the county is supposed to pay particular attention to communicable diseases that pose a threat to public health and supervise the infection-preventing efforts in health care institutions, including infection control programmes.

The Norwegian Medicines Agency (SLV) has administrative tasks that are associated with clinical testing of medicines, examination of quality, safety and effectiveness in connection with the authorisation of medicines (marketing authorisation), maximum-price setting, admission of medicines with pre-approved refunds, maintenance of marketing authorisation for medicines on the market, surveillance of side-effects, quality control, guidance about the correct use of medicines, administration and supervision of the medical supply chain and administration and surveillance of the legal sale of narcotic medicines and active ingredients.

The National Veterinary Institute (VI) is a biomedical research institute with animal health, fish health and food safety as its core areas. The Institute receives basic allocations from the Ministry of Agriculture and Food, the Ministry of Fisheries and Coastal Affairs and the Research Council of Norway. The main tasks of the National Veterinary Institute are research, development of knowledge and providing knowledge-based support to the authorities, primarily the Norwegian Food Safety Authority. Important supporting tasks for the authorities are diagnostics, reference functions, surveillance and emergency preparedness against communicable diseases in animals, zoonoses and antibiotic resistance in animals and in food.

Regional health authorities (RHF) shall, pursuant to Section 7-3 of the Communicable Disease Control Act, see that the population is ensured the necessary specialist health service with respect to communicable diseases, and they should have drawn up a regional plan for the control of communicable diseases. Pursuant to regulations concerning the control of communicable diseases in the health service, the regional health authorities have the overall responsibility for the establishment and maintenance of the infection control programme for their health care institutions. Among other things, regional health authorities are responsible for seeing that necessary services are established, for ensuring an appropriate distribution of staff who specialise in the control of communicable diseases and for training. Regional health authorities have delegated responsibility to the former regional hospitals to establish and operate regional competence centres in hospital hygiene.

Pursuant to the regulations concerning the control of communicable diseases in the health service, the management of institutions that are covered by Section 1-2 of the Act relating to the specialist health services shall be responsible for seeing that infection control programmes are devised, imple-

mented and maintained as part of the internal control system. In addition, the management shall provide necessary hospital hygiene specialists, including hygiene nurses and a doctor coordinating the control of communicable diseases, and they shall see that the duty to report is observed.

In addition to managing the state ownership, the regional health authorities also have the task of seeing that the population gets the specialist health services they need, given the relevant professional quality requirements and economic constraints. The regional health authorities pass along the Ministry of Health and Care Services' policy signals, e.g. through trust meetings with the health trusts. The health trusts play an executive role in this together with private service providers with which the regional health authorities have an agreement. On this basis, we have only mentioned the regional health authorities responsibility for various measures in this strategy, since they place constraints on the health trusts' activities. This does not change the fact that the health trusts have a professional responsibility to implement the tasks that they have been delegated.

The County Governor (FK) and/or the Board of Health in the counties (HiF) are supposed to pay particular attention to communicable diseases that pose a threat to public health, and should keep the Norwegian Board of Health Supervision and the Norwegian Directorate of Health informed about the situation in their county.

The municipalities (K) should, pursuant to Section 7-1 of the Communicable Disease Control Act, see that everyone who lives or has temporary residence in the municipality will receive the necessary health services with regard to communicable diseases. The municipality should draw up a municipal plan for the control of communicable diseases and is the supervisory authority. The chief municipal medical officer plays a special role in the control of communicable diseases and, pursuant to Section 7-2 of the Communicable Disease Control Act, should perform the tasks in the control of communicable diseases that are imposed in the Act. The municipality is responsible for seeing that regulations concerning the control of communicable diseases in the health service are complied with by the municipal institutions that are covered, including the duty to have an infection control programme.

1.2 Relevant regulations

There is an extensive body of regulations that set constraints for participants' and services' obligations with regard to the target areas of this action plan. In the following section, acts and regulations **are described** with the emphasis on relevance to the areas covered by this action plan.

Act relating to control of communicable diseases[1]
The Communicable Disease Control Act has the purpose of protecting the population from communicable diseases by preventing them and hindering them from being spread among the population and by preventing such diseases from being brought into Norway or carried out of Norway to other countries. The Act shall ensure that the health authorities and other authorities implement the measures necessary to control communicable diseases and coordinate their efforts to control such diseases. This Act shall preserve the due process protection of the individual who is covered by measures to control communicable diseases pursuant to the Act.

Act relating to food production and food safety etc. (the Food Act)[2]
The Food Act has the purpose of ensuring safe, healthy food, promoting health, quality and consumer considerations throughout the whole production chain, and promoting environment-friendly production. The Act is also supposed to promote good plant and animal health and take care of the considerations of the participants throughout the whole production chain, including access to markets abroad.

Act relating to veterinarians and other animal health personnel[3]
The purpose of the Act is to help see that animal health personnel perform acceptable activities and hence contribute to good animal health, acceptable animal welfare, safe food and the preservation of environmental considerations.

Regulations concerning the control of communicable diseases in the health service[4]
These regulations have the purpose of preventing and limiting the occurence of infections in the

1 Act no. 55 of 5 August 1994 relating to control of communicable diseases
2 Act no. 124 of 19 December 2003 relating to food production and food safety etc.
3 Act no. 75 of 15 June 2001 relating to veterinarians and other animal health personnel
4 Regulations no. 610 of 17 June 2005 concerning the control of communicable diseases in the health service

health service. Pursuant to the regulations, all institutions that are covered by the regulations are obligated to have an infection control programme that, among other things, shall include measures for the prevention of infection, written guidelines pertaining to examination, treatment and nursing, and written guidelines for the use of antibiotics in the enterprise and for the isolation of patients with communicable diseases. The infection control programme also makes requirements on establishing a system for surveillance infections in the institution and guidelines for clearing up and limiting outbreaks of infections.

Regulations concerning the gathering and processing of health information in the Norwegian surveillance system for infections in the hospital service (the NOIS register regulations)[5]

These regulations establish a nationwide Norwegian surveillance system for infections in hospitals and day-surgery clinics. The regulations specify rules for gathering and processing health information in the surveillance system. The register shall help facilitate the surveillance of infections in patients in hospitals and day-surgery clinics through continuous, systematic gathering, analysis, interpretation and reporting of information about the occurence of infections in the enterprises. Enterprises that treat patients in specifically defined patient groups should take part in the surveillance system for infections in the hospital service, unless the person in charge of data processing has not exempted them from participation. Health personnel at these enterprises have a duty to report more specifically defined information to the register.

Regulations concerning internal control in the social and health services[6]

The purpose of these regulations is to help promote professionally acceptable social and health services and to ensure that the social and health legislation is complied with through requirements for systematic steering and continuous efforts to improve the services. Internal control entails systematic measures that are supposed to ensure that the enterprise's activities are planned, organised, conducted and maintained in accordance with requirements laid down in or pursuant to the social and health legislation.

Act relating to working environment, working hours and employment protection, etc.[7]

The Working Environment Act has the central objective of ensuring a working environment that provides a basis for a health-promoting and meaningful job situation that provides full safety from physical and mental damaging effects. It is the employer who must see that the provisions of the Act are complied with. The Working Environment Act has special rules linked to routines for handling, replacing and registering chemical and biological materials, cf. Section 4-5.

Regulations concerning systematic health, safety and environmental work in enterprises (the Regulations of the audit procedures)[8]

Through requirements concerning the systematic implementation of measures, these regulations shall promote efforts to improve the working environment and safety in the enterprises, prevention of damage to health or environmental disruptions from products or consumer services, protection of the external environment against pollution and an improved disposal of waste so that the goals in the health, safety and environmental legislation are achieved. In the petroleum operations on the continental shelf, a separate, corresponding set of regulations apply.

Regulations concerning the design and outfitting of facilities, etc. in the petroleum operations (the Facilities Regulations)[9]

Among other things, these regulations have provisions concerning the design of health units and emergency hospitals in the facilities that are used in the petroleum operations on the continental shelf.

Regulations concerning the performance of activities in the petroleum operations (the Activities Regulations)[10]

Among other things, these regulations include provisions concerning tasks for and the organisation of the health service on the facilities that are used in the petroleum operations.

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5   Regulations no. 611 of 17 June 2005 concerning the gathering and processing of health information in a Norwegian surveillance system for infections in the hospital service
6   Regulations no. 1731 of 20 December 2002 concerning internal control in the social and health services.
7   Act no. 62 of 17 June 2005 relating to working environment, working hours and employment protection etc.
8   Regulations no. 1127 of 6 December 1996 concerning systematic health, safety and environmental work in enterprises
9   Regulations no. 1100 of 3 September 2001 concerning the design and outfitting of facilities, etc. in the petroleum operations
10 Regulations no. 1157 of 3 September 2001 concerning the performance of activities in the petroleum operations

Regulations concerning protection against exposure to biological factors (bacteria, viruses, fungi etc.) in the workplace[11]

The purpose of these regulations is to protect the employees' health and safety and to prevent their exposure to hazards that occur or that may occur through their being exposed to biological factors in the working environment and that apply to activities where the employees are exposed or may be exposed to biological factors in connection with their work.

The Gene Technology Act with regulations[12]

The purpose of this Act is to ensure that the production and use of genetically modified organisms and the production of cloned animals occurs in an ethically and socially acceptable manner, in accordance with the principle of sustainable development and without any damaging effects on health and the environment. Among other things, this occurs through a study of the consequences of a genetically modified organism in accordance with the consequence analysis regulations. Among other things, the study covers the extent to which this kind of organism contains genes that code for antibiotic resistance, and, if so, which antibiotics it applies to and to what extent they are in use to prevent and treat diseases in animals and people.

Regulations concerning approval of biocides and biocide products (the Biocide Regulations).[13]

The purpose of these regulations is to prevent unacceptable effects on health and the environment resulting from the handling and use of active ingredients (biocides) and biocide products. The regulations are an implementation of the EU directive for approval and marketing of biocide products, and among the products it covers are disinfectants. The Biocide Directive specifies bans on the import, sale and *use of active ingredients and of biocide products as long as the substances and products have not been evaluated* for approval and found acceptable pursuant to the requirements of the directive.

Regulations concerning control measures for residues of certain substances in foodstuffs of animal origin, production animals and fish in order to ensure safe, healthy food (the Residue Control Regulations)[14]

These regulations are supposed to help prevent the production, processing, import and sale of production animals and foodstuffs of animal origin that contain residual amounts of prohibited substances, polluting substances, and residual amounts of veterinary medicinal products above specified limits and to ensure that the requirements for health, quality and integrity are met.

Regulations concerning journals for animal health personnel[15]

These regulations shall help ensure that animal health personnel who provide animal health assistance document their activity in an acceptable way and thus contribute to good animal health, acceptable animal welfare, safe food and the protection of the environment. The journal should contain information about the requisitioning and use of medicines, including the medicine's name and product number, dosage and the duration of use of the medicine. In addition, the journal should contain retention times for meat, milk, eggs and fish, which the animal health personnel have set for the use of medicines.

Regulations concerning the use of medicines for animals[16]

The regulations shall help facilitate an acceptable use of medicines for animals in order to avoid unnecessary suffering of animals, promote good animal health and attain safe, healthy food.

Regulations in the area of zoonoses

The zoonosis regulations consist of Regulation (EC) No 2160/2003 of the European Parliament and of the Council of 17 November 2003 on the control of salmonella and other specified food-borne zoonotic agents and Directive of the European Parliament and of the Council of 17 November 2003 on the surveillance of zoonoses and zoonotic agents. Both the regulation and the directive are incorporated into the EEA agreement. The Norwegian Food Safety Authority is participating in working groups

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11 Regulations no. 1322 of 19 December 1997 concerning protection against exposure to biological factors (bacteria, viruses, fungi, etc.) in the workplace
12 Act no. 38 of 2 April 1993 relating to the production and use of genetically modified organisms, etc.
13 Regulations no. 1848 of 18 December 2003 concerning approval of biocides and biocide products

14 Regulations no. 65 of 27 January 2000 concerning control measures for residues of certain substances in foodstuffs of animal origin, production animals and fish in order to ensure safe, healthy food
15 Regulations no. 229 of 20 February concerning journals for animal health personnel
16 Regulations no. 50 of 16 January 2007 concerning the use of medicines for animals

in the EU and is regularly working to implement changes and/or implementation provisions of the regulation and the directive.

The regulation is implemented in Norwegian law in the regulations no. 1703 of 23 December 2005 concerning the implementation of Regulation (EC) No 2160/2003 of the European Parliament and of the Council of 17 November 2003 on the control of salmonella and other specified food-borne zoonotic agents. It specifies requirements for the implementation of a national control programme for the zoonoses and zoonotic agents for which the EU specifies common goals to combat.

The duties of the authorities to map and evaluate data on zoonoses and anti-microbial resistance, which are incorporated into the Zoonosis Directive, are attended to through internal instructions to the Norwegian Food Safety Authority's district offices. In addition, the Norwegian Food Safety Authority evaluates whether separate regulations should be drawn up concerning the surveillance of zoonoses, zoonotic agents, anti-microbial resistance and the outbreak of diseases (the zoonosis regulations).

The Aquaculture Operation Regulations[17]
The regulations are supposed to improve the aquaculture industry's profitability and competitiveness within the constraints of sustainable development and to help promote economic growth in coastal communities. The objective is also to ensure good health among aquaculture animals and promote good welfare for fish. There is a separate provision for the use of medicines and chemicals. When using medicines and chemicals, special care should be taken to prevent these agents from being discharged into the surrounding environment. If aquaculture animals are being given pharmaceuticals that entail a duty to retain the animals (retention period), due notification shall be given on a sign placed beside the locality/site sign. The sign must be clearly visible from the sea and other natural approachways. The duty of notification applies from the commencement of treatment until the retention period has expired for the medication that was used.

The quality regulations for fish and fish products[18]
These regulations cover the sale, processing and transport of fish and fish products and products where fish, fish products, etc., are the only or a major component of the raw material and the product has the nature of being a fish product. The regulations also cover fish and fish products of foreign origin. They cover the control of pharmaceutical residues. This entails that fish that have been treated with a pharmaceutical should not be slaughtered before residues of that pharmaceutical are below permitted limits specified in the veterinary medicinal product residue regulations. When using medicines that do not need limits pursuant to the veterinary medicinal product residue regulations, the fish should not be slaughtered until the Norwegian slaughtering deadline has been met. When using medicines that do not have any other Norwegian slaughter deadline for fish, a slaughter deadline of at least 500 day degrees will apply.

Regulations concerning feed products[19]
The Animal Feed Regulations are supposed to ensure that feed products do not entail any risk of damage to the health of animals or people or damage to the environment. It should also help ensure feed products of high quality. The regulations cover the processing, import, export and sale of feed products and the feeding of animals. They specify general provisions for feed products, approval of enterprises, limit values for undesirable substances, a list of prohibited feed agents, rules for labelling feed products and provisions concerning salmonella in feed.

The Animal Feed Regulations cover diet feed, but not medicines, which are regulated by the pharmaceutical legislation. Production of medicinal feed for aquatic animals is subject to approval and inspection by the Norwegian Medicines Agency.

Regulations concerning feed hygiene
The Feed Hygiene Regulations will probably come into force on 1 August 2008. The regulations specify general rules for the hygiene of feed products, for the registration of enterprises and for traceability. It covers the activities of operating managers of feed enterprises in all stages from primary production up to and including the sale of feed products. The

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17 Regulations no. 1785 of 22 December 2004 relating to operation of aquaculture establishments

18 Regulations no. 667 of 14 June 1996 The quality regulations for fish and fish products

19 Regulations no. 319 of 12 April 2005 concerning additives for use in feed products

feeding of animals that are intended for food production is also covered. The regulations will require all feed enterprises except the primary producers to have an HACCP-based self-control system.

Regulations concerning seeds[20]

These regulations should help ensure the production and sale of seeds of the best possible health and quality. A key element here is that all seeds that are sold from cultivated plant species should meet specified quality requirements, be subject to government control during production, and finally be approved for sale through a government certification scheme. The regulations also regulate the import of seeds that are supposed to meet quality and certification requirements that are equivalent to Norwegian-produced products.

20 Regulations no. 1052 of 13 September 1999 concerning seeds

2. Health-service-acquired infections

During treatment in the health service, and especially in hospitals, there is always a certain risk of becoming infected and getting an infection. In fact, we must always regard infections as a potential side effect of hospital treatment; a zero vision is unrealistic. Internationally, it is expected that improved control of communicable diseases in the hospitals may prevent up to one third of these infections.

Usually we expect the risk to be affected by the following factors:
- Factors of communicability: These are factors concerning infectious agents. In hospitals, certain particularly pathogenic strains can gain a foothold. Resistant infectious agents often evolve in hospitals because of the high consumption of antibiotics there. These infectious agents also thrive in the hospital environment because they have an advantage over other infectious agents.
- Patient factors: These are factors relating to the patients. The following factors are among those that can increase the risk of infection during the stay: age (the elderly and the very young); underlying diseases such as cancer, kidney disease or other immunity-reducing diseases; poor nutrition and immuno-supressive medicines.
- Treatment factors: These are factors relating to the treatment. Invasive procedures in particular will increase the risk of infection, e.g. entry of intravascular catheters or urinary tract catheters, intubation and operations.

- Work-environment factors: These are factors relating to the personnel and the physical environment. Poor hand hygiene, poor general hygiene and high patient density can increase the risk.

In several of these areas, a deterioration may be expected. The percentage of resistant strains in hospitals is increasing somewhat, and there is a constant danger of importing resistant infectious agents from abroad. The mean age of the patients is increasing, and more and more patients are developing immunity-reducing diseases. Treatments are becoming more and more complex. If no measures are taken, we can therefore expect an increase in the occurence of health-service-acquired infections.

2.1 The situation for health-service-acquired infections in Norway

Surveillance
Prevalence surveys are one-day counts in the health care institutions of the number of admitted patients and the percentage of them who have an infection. The aim of the prevalence surveys is to get a rough overview of the burden of infection acquired in hospitals and health care institutions for elderly patients as well as which infections are predominant and to follow trends over a period of time.

Participation in the prevalence surveys is voluntary, and both hospital and health care institutions for elderly persons are invited to participate twice a year. The registration is performed by checking all admitted patients on the day they are examined to see whether they have one of the four infections that are being monitored. In addition, the number who use antibiotics is recorded and whether the patient and/or resident has undergone an operation in the last 30 days (the last year for implant surgery).

The following infections are registered in the survey:
- Urinary tract infections (UVI)
- Lower respiratory tract infections (NLVI)
- Superficial and deep post-operative wound infections (SI)
- Skin infections (only in health care institutions for the elderly) (HUD)
- Septicaemia (only in hospitals) (SEPT)

These infections constitute the majority of the total number of health-institution-acquired infections. Examples of infections that are not included in the registration are gastrointestinal infections and eye infections.

In NOIS, the frequency of post-operative wound infections that occur after selected surgical inter-ventions is measured. The surveillance takes place in a three-month period each year and follows a standardised method described in the NOIS template. Participation in this national surveillance is obligatory for all hospitals in Norway. The first surveillance period (NOIS-1) was from 1 September to 30 November 2005 and included five types of surgical intervention. NOIS-2 took place during the same period in 2006.

The following surgical procedures were included in NOIS-1 and 2 (in order of their priority):
- Aorta-coronary bypass (including the location of the graft)
- Caesarean section
- Insertion of a prosthesis in the hip joint
- Appendectomy
- Cholecystectomy

All patients who undergo the relevant procedures are followed up in 30 days after the operation. All hospitals that perform aorta-coronary bypasses monitor this intervention; if the hospital does not perform this intervention, the next intervention on the list will be monitored.

Infection status is recorded upon discharge and 30 days (one year for implant surgery) after the operation (with a follow-up letter or contact by telephone).

The degree of seriousness of the infections will also be recorded. One distinguishes between superficial and deep infection, together with infections that involve organs and/or cavities. Serious infections must be diagnosed by a doctor, whereas superficial infections can be diagnosed by the patient him/herself. All post-operative wound infections must be recorded, and the patients are encouraged to consult with a doctor if they have any sign of infection. In addition, variables are recorded that are assumed to influence the risk of infection, such as the use of an antibiotic prophylaxis, an ASA-score (a measure of the patient's state of health), the intervention's degree of cleanliness and duration, and whether or not the intervention is elective.

Staff who specialise in the control of communicable diseases at the hospital gather data and relate it to information about patients from the hospital's database, and after a quality check the data will be submitted (in anonymised form) to the Norwegian Institute of Public Health after the close of the surveillance period.

Prevalence of infections in hospitals in 2007
The prevalence surveillance was last conducted on 24 October 2007. A total of 10,167 patients from hospitals were included. 639 infections were re-corded as at 8 December 2007. The national preva-lence of hospital infections was thus 6.3%. The trend in recorded hospital infections with time and the distribution of the various types of infections are depicted in the figure below. The prevalence of hospital infections in Norway has been quite stable in recent years, including the distribution of the various types of infections.
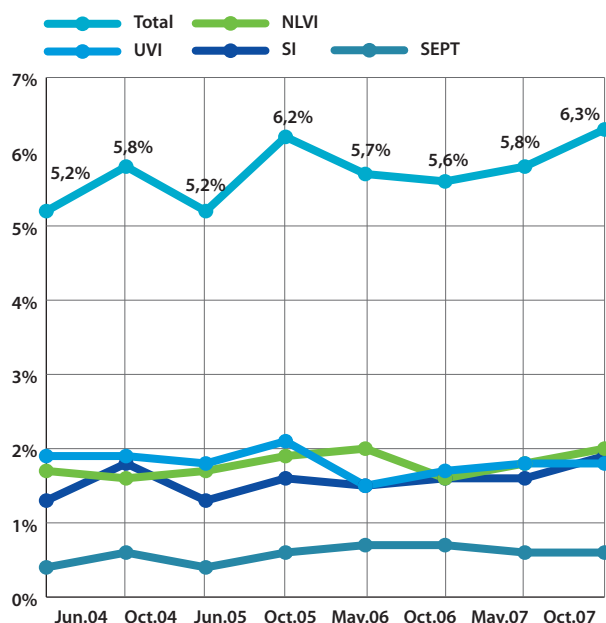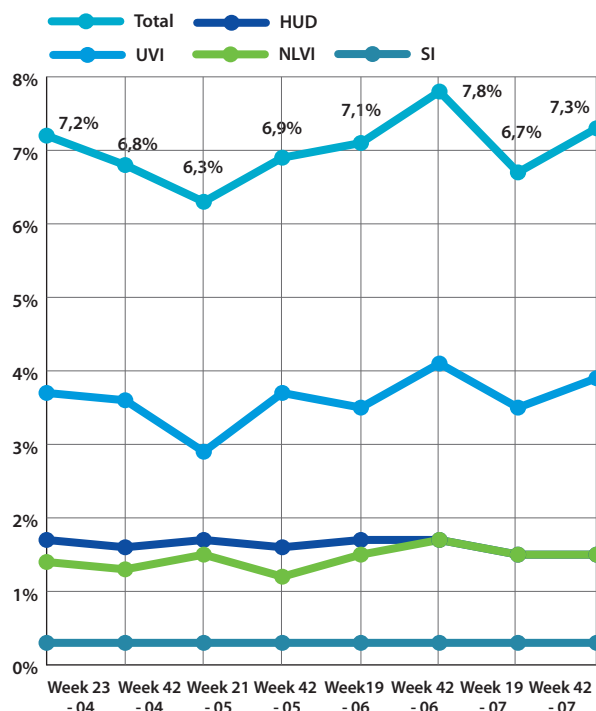
Figure 2.1
Prevalence of four hospital infections in hospitals 2004-2007, broken down according to type of infection (uvi: urinary tract infection, nlvi: lower respiratory tract infection, si: post-operative wound infection, sept: septicaemia)

Prevalence of infections in health care institutions for the elderly in 2007

The prevalence surveys in health care institutions for the elderly were last conducted in week 42 of 2007. A total of 19,480 residents of 401 institutions were included. 1,413 health-service-acquired infections were recorded. This gives a national prevalence of 7.3%. Urinary tract infections occurred most frequently and amounted to 53% of the infections. Skin infections and lower respiratory tract infections each constituted 21% of the infections.

The trend in recorded infections with time and the distribution of the various types of infections are depicted in the figure below.

Figure 2.2
Prevalence of four infections acquired in health care institutions for the elderly 2004-2007, broken down by type of infection (uvi: urinary tract infection, nlvi: lower respiratory tract infection, si: post-operative wound infection, hud: skin infection)

The results show a relatively stable prevalence in recent years. Urinary tract infections are the most common infection, followed by lower respiratory tract infections and skin infections.

The figure above shows a decline in prevalence in the spring of 2005, but that may be due to unusually low participation in that survey. In the autumn of 2006, an increased participation was recorded, which gives more certain data at the national level. A prevalence of 7.8% in 2006 was the highest reported prevalence since the national surveys began in 2002. The prevalence of urinary tract infections and lower respiratory tract infections has increased. The cause of this increase is unknown.

Infection after surgical intervention

Data from 38 hospitals was submitted to NOIS for the surveillance period in 2006 (NOIS-2). 92% of all patients who were operated on during the surveillance period were followed up 30 days after an operation, and this is a very high percentage compared with other countries that are taking part in European cooperation on this surveillance.

NOIS-2 included 3,693 operations and 241 infections were recorded. The percentage of operated patients who got an infection within 30 days after the surgery (the incidence risk) varied among the different surgical interventions. Only 15.4 % of the infections were diagnosed prior to discharge, but this also varied among the different surgical interventions. The total incidence percentage for 2006 was 6.5%; in 2005 it was 6.0%.

After a Caesarean section, 9.1% of the women developed a wound infection. After insertion of a hip prosthesis, 4.4% of the patients developed an infection.

Incidence rate (all patients)
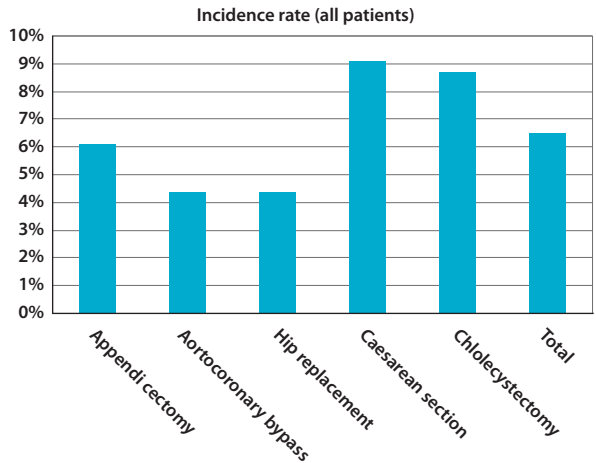
Figure 2.3.
Total incidence percentage after 30 day follow-up, broken down by type of operation, NOIS-2, 2006

2.2 The situation of hospital infections in Europe

There are few comparative studies of hospital infections in Europe, and a European surveillance project (HELICS/IPSE) has had limited success in obtaining comparable data from all of Europe. Norway ranks high relative to other countries in the occurence of infections after surgical intervention. This is primarily due to the superiority of the follow-up after discharge from hospital in Norway. Thus, more infections are detected. In many other countries, they only count infections that occur up to the date when the patient leaves the hospital. There is no reason to believe that the situation in Norway is worse than in other European countries.

2.3 Basis of a new plan

Action plan to prevent hospital infections 2004–2006
In an assignment from the Ministry, a working group from the Norwegian Directorate for Health, the Norwegian Board of Health Supervision and the Norwegian Institute of Public Health drew up a proposal for an action plan. The Ministry refined this draft and issued it as the Action plan to prevent hospital infections 2004–2006.

The action plan's primary goal was to reduce the number of hospital infections, defined as infections that occur during or after and as a result of a stay in a hospital or other health care institution. The action plan was primarily aimed at preventing infections in hospitals. The plan had three sub-targets: establish better surveillance of hospital
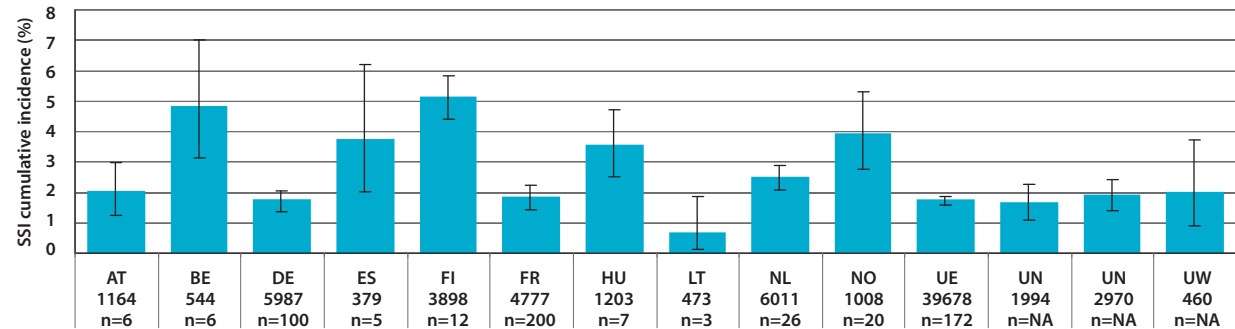
Figure 2.4
Percentage of patients with hip surgery who developed a surgical wound infection after the intervention at selected hospitals in European countries 2004-5. Data from Improved Patient Safety in Europe (IPSE). The number of patients and number of hospitals are listed under the columns.

infections; improve measures to prevent hospital infections; and bolster research and development.

The following ten target areas were set up to achieve these goals:
1. Transition from prevalence surveys to surveillance of incidence risk of hospital infections
2. Surveillance of the use of antibiotics
3. Surveillance of resistant microorganisms
4. Hand-hygiene project
5. Responsibility for and management of the efforts to control communicable diseases in the institution
6. Staff who specialise in the control of communicable diseases
7. Construction and structural matters
8. Internal audit
9. Research
10. Documentation and models for cost estimation

The action plan has played a key role in improving the control of communicable diseases in Norwegian health care institutions. It has been influential for both the Ministry's and the health trusts' selection of priorities in this area.

Some of the more important measures that have been implemented under this action plan are:
- The Norwegian surveillance system for infections in the hospital service (NOIS) has been established as a permanent personal health register.
- Prevalence surveys of hospital infections are conducted twice a year in the nation's hospitals and nursing homes.
- A national reference laboratory for MRSA has been appointed.
- The duty to report on MRSA has been expanded to apply to any detection of the bacteria, not just the disease.
- A campaign for better hand hygiene in the health service has been implemented.
- Guidelines for isolation, for hand hygiene and against MRSA have been issued.
- Regulations concerning the control of communicable diseases in the health service have come into force and a guidelines has been issued.
- A Masters Degree programme in the control of communicable diseases in the health service has been established at the Nordic School of Public Health.

On 6 March 2007, the Norwegian Institute of Public Health held a conference to summarise the experiences gained from the action plan to prevent hospital infections. The objective of the conference was to take stock of the action plan, recommend further action on the individual measures and draw up an outline for a continuation of the action plan. About 80 persons participated: mainly staff who specialise in the control of communicable diseases from hospitals and the municipal health service and representatives from the government health administration and the administration of the health trusts.

2.4 Need for further efforts

The action plan to prevent hospital infections was an important event that gave new encouragement to the efforts to prevent hospital infections. A number of measures were initiated. The battle, however, is far from being won, so the work must continue. The key factors in the measures are the surveillance of the infections, better measures to control communicable diseases and better organisation, regulation and staffing.

Surveillance of infections acquired in the health service

Surveillance of infections in patients in hospitals is defined as continuous and systematic gathering, analysis, interpretation and reporting of information about the occurence of infections in the enterprises to provide a basis for describing the incidence of infections in the enterprises over a period of time and broken down by characteristics of the patients, their treatment and the enterprises, for giving advice to health personnel, enterprises and the administration on measures to control communicable diseases, for evaluating effects of measures to control communicable diseases in the enterprises, for detecting and helping clear up outbreaks of communicable diseases and for conducting research on the spread of infections and their causes.

The surveillance of hospital infections has been recognised as a key aspect of the control of communicable diseases in hospitals since 1970. The surveillance may reveal problem areas, possible outbreaks, sources of cross infection and deficiencies in the treatment of patients. One necessary condition for efficient surveillance is a good and comparable method. In Norway, prevalence surveys of hospital infections have been conducted since the 1970s; in recent years; twice yearly. These surveys provide valuable, but rough data on the situation. Starting in 2005, the personal health data filing system, NOIS, has provided considerably more

precise information about the frequency of infections after surgical interventions.

The NOIS regulations, the MSIS regulations and regulations concerning the control of communicable diseases in the health service arrange matters to facilitate the surveillance of infections in the health service. NOIS can be further developed to encompass more aspects of the activities than just the surgical. Patients in intensive care units are particularly vulnerable to infection. Furthermore, it is possible that nursing homes should also conduct a simple surveillance according to the same model as the hospitals. Internally in the hospitals, it is important that they have systems to detect unfavourable trends.

Control of communicable diseases in the health service

The control of communicable diseases in the health service is based on the so-called hospital hygiene standard measures. These are a set of basic hygiene rules that apply to all personnel and all patients. Perhaps the most important measure is hand hygiene. In the previous plan period, the Norwegian Institute of Public Health in collaboration with the hospitals implemented a change from hand washing with soap and water to hand disinfection with rubbing alcohol as the predominant method of hand hygiene. The new routines are described in the institute's publication, *Nasjonal veileder for håndhygiene* (National Guidelines for Hand Hygiene).

In addition to the standard measures, there are other individually enhanced measures described in the Norwegian Institute of Public Health's guidelines, *MRSA-veilederen* (the MRSA Guidelines) and *Isoleringsveilederen* (the Isolation Guidelines).

Pursuant to the regulations concerning the control of communicable diseases in the health service, all health care institutions should have an infection control programme that shall include all necessary measures to prevent infections in the institution, and to handle and follow up outbreaks. The programme has two main goals: prevention and surveillance. The programme is supposed to be based on a risk assessment in the individual institution, which means that they have to survey factors in the institution's operations that may entail a danger of infection.

There is a constant need to update health personnel on standard measures and other measures to control communicable diseases. This kind of need is especially pronounced in nursing homes and other institutions for the elderly. These institutions have many employees with shorter formal educations and many substitutes who may not have been given sufficient training before.

Regulation, organisation and sufficient personnel

The efforts to control communicable diseases in the health care institutions are well regulated through the Communicable Disease Control Act and the regulations concerning the control of communicable diseases. There may be reason to evaluate how the latter work. It is equally important to specify the number of dedicated staff who specialise in the control of communicable diseases are needed in the health care institutions in order to achieve an effective control of communicable diseases.

3. Antibiotic resistance

3.1 Historical background

Communicable diseases have always had a significant effect on human development. In the last 150 years, a number of factors have helped reduce the impact of communicable diseases in many parts of the world. The discovery of infectious agents and the understanding of its communicability have provided the basis for a rational control of communicable diseases. Paths of infection have been broken by means of measures such as improved housing standards and hence lower density of residents, pure drinking water, improved food safety, improved hand hygiene, and isolation of infectious patients.

Better nutrition has yielded stronger general resistance. Vaccination has improved the specific resistance (immunity) to a number of infectious diseases and helped exterminate smallpox and more or less eliminate poliomyelitis, measles and rubella in Norway.

In addition, antibiotics have amounted to a significant advance since the middle of the 20th century. Antibiotics changed many common, but serious infections from having a high mortality, a high occurence of sequelae and long-term morbidity to becoming more everyday events that largely develop favourably with only a brief illness.

When the first antibiotics, the sulphonamides, came out on the market in the middle of the 1930s, they introduced a whole new era in the treatment of such common diseases as pneumonia, which annually took the lives of thousands of healthy young people, urinary tract infections, erysipelas, serious throat infections, gonorrhoea and even cerebrospinal meningitis, which was almost always fatal. Then in 1943–44, penicillin, which Alexander Flemin had already discovered in 1929, became available. This was followed by the discovery in the next few years of many antibiotics such as streptomycin, tetracyclines and chloramphenicole.

Thus was the age of antibiotics introduced, and it brought great optimism in the battle against the communicable diseases. Scarlet fever, which took the life of every tenth child who caught it 100 years ago, became an almost harmless disease. Tuberculosis became a disease that could be cured. Soldiers could survive serious wounds because antibiotics prevented wound infections. Surgical intervention became safer because one could now treat the life-threatening post-operative infections. Today, AIDS is more or less eliminated in the western world because HIV-infected patients receive antiviral medicines and can live on for many decades, maybe even a normal life span, without developing AIDS. There are even medicines now that can shorten the length of the illness in the case of influenza.

For many diseases, antibiotics have an additional effect; the period of communicability is shortened so that the infection pressure in the society is reduced.

3.2 Antibiotics

Antibiotic are substances that kill or inhibit the growth of microbes and that do not or only slightly harm the individual who takes the substance. The first known antibiotics were substances that some microbes (especially fungi) produced naturally to defend themselves against other microbes. Later, people succeeded in artificially producing substances, called chemotherapeutica, with the same properties. Some of them are only slightly altered variants of the original antibiotics, whereas others are completely new chemical substances. The name anti-microbial agent should actually be used as a common name for the actual antibiotics and chemotherapeutica, but we use antibiotics here as a common term for all of these substances because this is the term used in everyday speech.

Antibiotics are supposed to kill or inhibit live infectious agents, without damaging the cells of the host's (human or animal's) own body. Therefore, antibiotics must attack either certain parts of the infectious agent or the microbes' metabolic processes that do not exist in the host cells or that are very different in the host cells. For example, many antibiotics attack the actual cell wall of the bacteria so that the wall ruptures and the bacteria die. The cell wall in humans and animals is completely different so that these antibiotics are not toxic to people. Other antibiotics inhibit the bacteria's ribosomes (protein factories) where the cell's building blocks are produced so that the bacteria are weakened or die. This does not damage the host cells either, because the host has other types of ribosomes. Still other antibiotics act by inhibiting certain steps in the metabolism so that the bacteria do not get enough energy.

It has been more difficult to find substances that act effectively against viruses (antiviral agents) than to find those that act against bacteria or fungi. This is because viruses have very little of their own metabolism and are dependent on the host cells' biochemical machinery. Thus, it is more likely that agents that affect a virus will also damage the patient's own cells.

3.3. Antibiotic resistance

Antibiotic resistance is defined as a microbe's ability to withstand the effects of antibiotics. We say that the microbe has become resistant to the antibiotic. A few years before the first antibiotic was put to use, bacteria were discovered that were resistant. Now we know that the increased consumption of antibiotics has caused more and more infectious agents to become resistant to more and more antibiotics. Now and then, infectious agents are demonstrated that are resistant to more or less all antibiotics. Among other things, this applies to certain strains of tuberculosis bacteria. That means that the patients must manage without antibiotics, just like they had to do before the age of antibiotics.

Why do microbes become resistant?
The development of resistance among microbes is an example of how living organisms evolve through natural selection in the classic Darwinian sense. This evolution requires that there be some genetically controlled variation in the microbe's properties, and especially their ability to withstand antibiotics. Such a variation exists, and it is due to the fact that the microbe's genetic material is constantly changing. That occurs through random mutations in the genetic material of individual microbes and through genetic transfer between microbes.

Mutations are spontaneous changes in the microbes' genetic material (DNA or RNA) without the infusion of any new genetic material from outside that organism. These changes occur continuously.

Genetic transfer of genetic material (horizontal transfer of properties) occurs when the microbe takes in genetic material from its surroundings in the form of genetic elements that are called plasmids and transposons.

This can occur in several ways:
- Transformation is a change of the microbes where free genetic material (from microbes in the vicinity) is taken in and incorporated into the microbe's own genetic material so that the microbe's properties are slowly altered.
- Transduction is a transfer of genes from one bacterium to another by means of a bacterial virus (i.e. a virus that can infect bacteria).
- Conjugation is a transfer of genetic material through direct contact between two microbes.

These mutations or genetic transfers can completely randomly cause one or a few microbes in a population to become resistant to a given antibiotic Z. It may be the case that the microbe lacks the properties or structures that the antibiotic attacks, that the antibiotic does not manage to penetrate the cell wall (or is rejected again at once) or that the microbe produces an "antidote" in the form of antibiotic-destroying enzymes. If the population of microbes is then exposed to the antibiotic Z, the resistant microbes will have an advantage. They will survive while all of the others will be inhibited or die because of the effect of the antibiotic. The resistant microbes will thus be naturally selected.

Since the property "resistance against antibiotic Z" is genetically controlled, the change in the genetic material will be transmitted to the next generation (vertical transfer of properties). Since the microbes have a so much shorter generation time than humans (hours as opposed to several decades), whole populations of microbes with altered properties can emerge very quickly. We say that the microbe has undergone adaptation; it has adapted so that it can live under altered environmental conditions.

Spread of antibiotic resistance
At present, antibiotic resistance is a global problem for a number of infectious agents. Many of these problems also exist in Norway. That means that antibiotic resistance must have spread. That can occur in two ways:

First, as we have seen, the microbes can be infused with genetic material (genes) that make them resistant, the so-called horizontal spread of genes without their having propagated. (People cannot exchange genes with new properties in this way.) The exchange can occur both to closely related microbes and more rarely to more distantly related species. In earth and water and among the microbes that live normally on and within humans and animals, there are many bacteria that have resistance genes that they constantly share with other microbes.

Second, the microbes can spread infection among people and between humans and animals. That can occur through so-called direct *contact transmission,* where the infectious agents are transferred when the individuals have bodily contact. Indirect contact transmission can occur via objects, such as door knobs. Droplet infection is also regarded as contact

transmission. In that case, the spread occurs when the infectious agents are flung out of the nose and mouth through speech or coughing and contact another person in the face. Most respiratory tract diseases infect in this way. A few infectious agents can infect over somewhat longer distances with droplet nuclei and airborne particles, so-called *airborne infecti*on. That is especially true of the infectious agents that cause tuberculosis, chicken pox and measles. Otherwise, there is a tremendous potential for *vehicle infecti*on, i.e. where the infectious agent is transmitted by a common vehicle (e.g. food or water) from animals or people to other people or animals, because this mechanism can contact very many people and animals simultaneously.

Increased international traffic of people, animals, meat, vegetables and fruit help transport microbes rapidly throughout much of the world. Thus, resistance problems in one part of the world can rapidly become a problem in our country as well. A special challenge concerns personnel and patients who have resided in health care institutions abroad. There may be a occurence of many resistant microbes there that patients or the personnel can bring with them to Norwegian health care institutions.

Microbes and ecology
Bacteria are the dominant form of life on our planet. Humans have ten times as many bacteria cells in their intestines as all of their own cells throughout their whole organism. Here there are over 500 bacteria species. There are also a number of microbes on the skin and mucous membranes. Since we do not live in a sterile environment, this ecosystem is both continuously infused with and emits a large number of microbes. These are constantly exchanged with the surrounding environment.

When an antibiotic is given to an individual, it will therefore have effects not only on this one individual's microbiological ecosystem, but also on the others who come into his or her close surroundings. This is probably the most important explanation why the use of antibiotics by relatively few individuals in an environment can lead to the development of resistance among microbes in the whole local environment. This spread of resistance properties in one individual's microbes to the microbes of another individual seems to occur more rapidly the more crowded the environment they are in, e.g. in institutions.

As we have seen, microbes have a great potential for adapting to new conditions in the environment. In the natural world and in animals and people's normal flora, there are a very high number of resistance genes. Extensive use of antibiotics on animals and people has exerted considerable pressure on the microbes so that the resistant microbes are selected for.

Use of antibiotics as a cause of resistance
There is strong evidence that the use of antibiotics really is a cause of the development of resistance in microbes. This is true regardless of whether the use is by people, animals or plants and regardless of whether or not the use is correct.

The evidence includes:
- In bacteria from prior to the discovery of antibiotics, there is not any acquired resistance.
- Time after time, the development of resistance to new antibiotics has been observed shortly after they are put into use.
- Persons who develop an additional infection during antibiotic treatment from a bacteria from their own normal flora (e.g. a recently operated patient who is treated for pneumonia and then develops a urinary tract infection), are infected with resistant bacteria more often than other patients.
- Resistance is most common where antibiotics are used the most. This is true of both comparisons among countries and comparisons among hospital departments.

It requires extra energy for microbes to be resistant. It is therefore conceivable that the resistant microbe will have little chance of winning in the competition with their non-resistant fellow species. Therefore, the resistant microbes run the risk of dying out. However, they can manage to survive if further changes occur in the genetic material that compensate for the increased use of energy. It has been found in certain studies, primarily from hospitals, that the resistance problem has diminished after the use of antibiotics was reduced. At any rate, the problem will not get worse with less use of antibiotics.

What are the impacts of resistant bacteria in animals and foodstuffs on public health?
Zoonoses are diseases and infections that can be transmitted between people and other vertebrates. In Norway, the most important zoonoses are those that are spread with foodstuffs and that are due to the bacteria Salmonella, Campylobacter, Yersinia and E coli. The most important reservoir for these bacteria is the gastrointestinal canal of healthy animals. When they are slaughtered, the faeces from the animals may pollute the meat and thereby infect the people who eat the meat. Other possible means of infecting people are that faeces from animals pollute drinking water or fruit and vegetables, e.g. through fertilising or watering. It is usually not necessary to treat the above-mentioned diseases in people with antibiotics. Resistance can, however, be a problem in the cases where such treatment is necessary.

In a similar way, resistant bacteria that usually do not cause illness in people can be transmitted from animals to people's intestines. In some situations, these bacteria can cause illness, and they can transfer their resistance genes to other bacteria in the intestines regardless.

Modern livestock production entails that the livestock in many countries will often be given antibiotics orally in order to prevent or treat disease. There is reason to assume that a substantial amount of the development of resistance among zoonosis bacteria is due to the use of antibiotics among animals and to a lesser extent the use of antibiotics in the treatment of people. Among other things, this applies to multi-resistant variants of Salmonella Typhimurium (DT104).

In Norway, farmers do not prevent illness in livestock by putting antibiotics in feed. The Salmonella situation here in Norway is very favourable compared with many European countries and that is also one of the reasons why Norway has been given permission to require that fresh meat and fresh poultry meat from the EU must be accompanied by a Salmonella certificate.

If Salmonella Typhimurium (DT104 or other types) should be proven to exist among livestock in Norway, restrictions will be imposed on the relevant herd until relevant decontamination measures have been decided upon. The slaughtering of the infected animal will be one of several possible measures.

Antibiotic resistance as a public health problem
As we have seen, in the period before antibiotics became available a number of communicable diseases could lead to serious complications and death. If antibiotics become ineffective, this could happen again. In addition, new forms of treatment

have come about that increase the risk of getting infections, e.g. advanced surgery, transplants and treatment of persons infected with HIV. These patients will suffer if normal bacteria infections gradually become more difficult to treat as a result of resistance.

Fortunately, antibiotic-resistant bacteria as a rule are no more infectious or pathogenic than other bacteria. Infections with resistant bacteria, however, are more difficult to treat and can therefore have a longer and more serious progression. Successful antibiotic treatment against sensitive bacteria usually causes the spread from the patients to decrease relatively quickly. If the effect of the treatment is negative, the sick persons may emit the bacteria in large amounts over a long period of time. This increases the risk of spreading these bacteria.

Possible consequences of increased antibiotic resistance may include:
- Longer duration of illness for both serious and minor infections will result in a need for longer hospital stays.
- More complications and deaths from serious infections, and infections we currently do not regard as serious may more often develop in an unfavourable direction.
- More complications and deaths from some types of advanced medical treatment of other basic conditions, e.g. advanced surgery, immunity-weakening treatment, cytostatic treatment and transplants.
- Reduced effectiveness of antibiotic prophylaxis for surgery will lead to more complications.

- An increased need to use newer antibiotics, which can be more expensive, more toxic and have a more detrimental ecological profile.
- Greater difficulties in choosing an antibiotic for treatment of patients with serious acute infections before the microbiological diagnosis is known. This may more often lead to a non-optimal first choice more often than before.
- The need for more frequent hospital admissions.
- Longer periods of communicability for some infections and hence increased infection pressure on the rest of society.
- Increased need for isolation of infectious agents in hospitals, which makes greater demands on construction facilities and requires greater efforts from personnel than standard regimes.

The struggle against antibiotic resistance
Increasing occurence of resistant microbes is partly due to increased consumption of antibiotics and partly to the increased spread of resistant microbes. Fortunately, research has managed to develop more and more new antibiotics in recent decades. These have been able to replace those that no longer are effective because of the microbes' resistance. In the most recent years, however, this trend has slowed down. Fewer antibiotics are being developed now, and it has become much more expensive to develop new antibiotics. That means that we must attack the problem from the other end, by using less antibiotics and improving the control of communicable diseases. In addition, the situation must be carefully monitored.

Clinical diagnosis	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Sepsis	1	1	3	4	4	2	6	6	6	10	4	3
Meningitis				1								2
Osteomyelitis	2	1		2			2	1	2	2	1	2
Arthritis			1	1				1				2
Respiratory tract infection	1		1	4	8	6	9	11	7	9	12	18
Urinary tract infection		1		4	3	4	2	9	12	13	16	19
Wound infection, abscess	10	9	15	31	63	49	95	110	169	156	214	271
Other, unknown	8	4	5	15	10	6	7	5	18	29	13	16
Total infections	22	16	25	62	88	67	121	143	214	219	260	333
Carriership											197	270
Total infections and carriership	22	16	25	62	88	67	121	143	214	219	457	603

Table 3.1
Number of cases of MRSA infections (1995–2006) and MRSA carriership (2005–2006) reported to MSIS.

3.4 The situation of antibiotic resistance in Norway

Surveillance

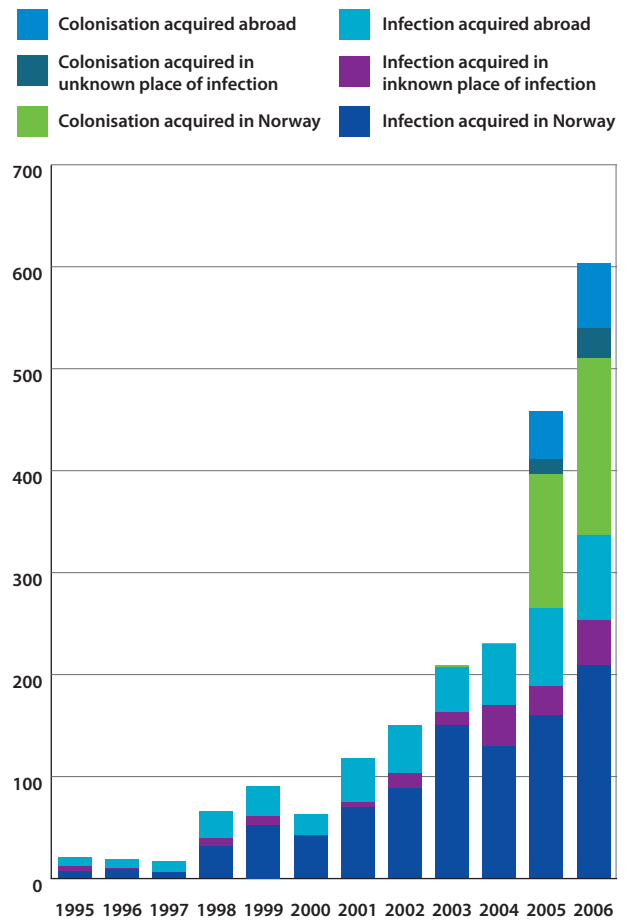In Norway, the national surveillance of antibiotic resistance is organised along four different axes:
- the Norwegian surveillance programme for antimicrobial resistance (NORM) is based on a standardised microbiological survey and reporting of specific microbes in specific periods of time.
- the European Antimicrobial Resistance Surveillance System (EARSS) is based on results drawn from the computer systems of various laboratories. About ten Norwegian laboratories report to EARSS.
- the Norwegian Surveillance System for Communicable Diseases (MSIS) receives reports about every case of infection and carriership by specific antibiotic-resistant types of bacteria.
- the Norwegian surveillance programme for antimicrobial resistance in bacteria from feed, food and animals (NORM-VET) is based on centralised analysis of pathogenic bacteria and indicator bacteria from feed, food and animals.

The different axes illustrate the resistance epidemiology from various points of view and complement each other. The summary that follows is based on a comparison of data from the various sources.

Staphylococcus aureus

S. aureus is the most common cause of infections of the skin and soft tissue, and in some cases it can lead to sepsis or infections in the bones, joints and internal organs. Methicillin-resistant Staphylococcus Aureus (MRSA) is the clinically most important type of antibiotic-resistant bacteria in the western world. The percentage of MRSA among S. aureus lies below 0.5% in Norway, but the number of reported cases of infection and colonisation is rapidly increasing. Most of these cases are reported as wound infections and abscesses.

There has been a gradual change in the MRSA epidemiology in Norway in recent years. Previously, MRSA was associated with specialised hospital departments and imported from other countries, but we are now seeing more and more cases outside hospitals without any known connection to foreign health care institutions. Many major outbreaks have also been discovered in nursing homes and home-based care services for the elderly. Regional differences in the occurence of MRSA mirror these outbreaks.

Legend:
- Colonisation acquired abroad
- Infection acquired abroad
- Colonisation acquired in unknown place of infection
- Infection acquired in inknown place of infection
- Colonisation acquired in Norway
- Infection acquired in Norway

Figure 3.2.
The number of reported cases of MRSA infection and carriership broken down by place of infection 1995–2006.

In addition to MRSA, fusidic-acid-resistant S. aureus has been a clinical problem, especially among children with the skin condition bullous impetigo. Fully 25% of S. aureus from wounds was fusidic-acid-resistant in 2004, but this percentage declined to 14.5% in 2006.

Streptococcus pneumoniae (pneumococci)

Streptococcus pneumoniae causes respiratory tract infections and serious invasive diseases that are usually treated with penicillin V (tablets) or G (intravenous). Many countries have a high occurence of pneumococci with reduced sensitivity to penicillin (PNSP), and this results in major difficulties in the treatment of banal infectious conditions in children. In Norway, the percentage of blood culture isolates with reduced sensitivity to penicillin was only 1.9% in 2006. However, there has been a dramatic increase in the percentage of macrolide-resistant pneumococci from 2.4% in 2001 to 12.4% in 2006.

Macrolides are an important treatment alternative in cases where there is a penicillin allergy.

The resistance situation seems relatively stable for other frequently pathogenic bacteria such as S. pyogenes, S. agalactiae, Haemophilus influenzae and Moraxella catarrhalis.
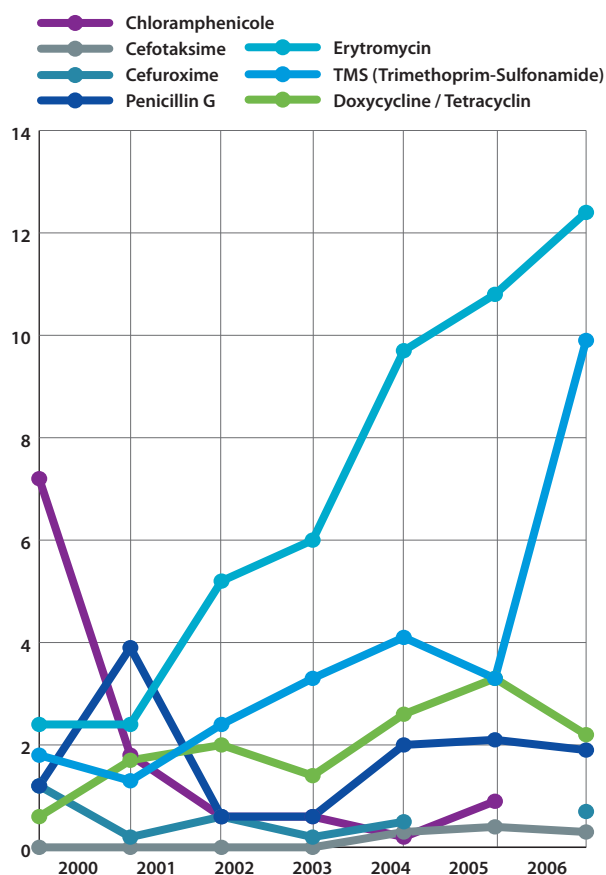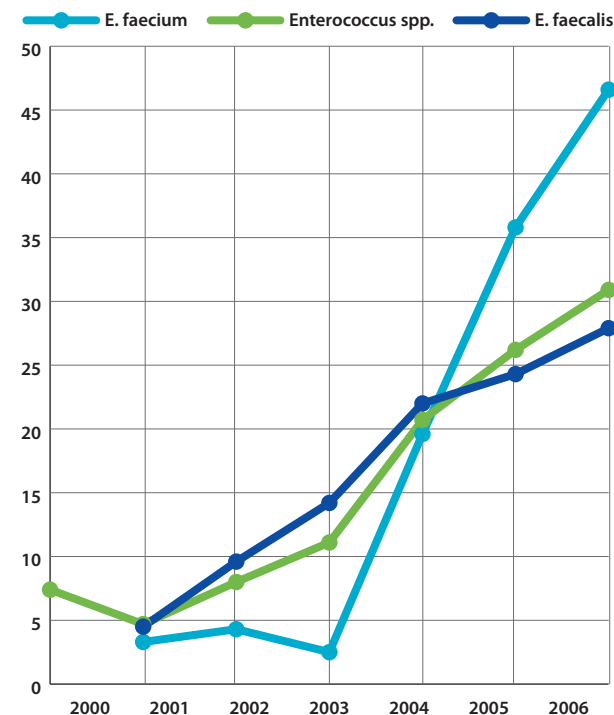

Figure 3.3
The percentage of isolates (%) with reduced antibiotic sensitivity among S. pneumoniae from blood cultures 2000–2006.

Enterococcus faecalis and Enterococcus faecium (enterococci)

Enterococci (E. faecalis and E. faecium) cause urinary tract infections and play an important role in serious infectious conditions in the abdomen. Enterococci are naturally resistant to a number of antibiotics, and they often have to be treated with several different active ingredients in order to achieve any effect in the case of serious infections. Therefore, it is alarming that the occurence of resistance to aminoglycosides and ampicillin has increased sharply in recent years. Among E. faecium, 81.0% of the blood culture isolates had

reduced ampicillin sensitivity in 2006 compared with 50.0% in 2001. The percentage of isolates with aminoglycoside resistance was 27.9% for E. faecalis and 46.6% for E. faecium in 2006.

Figure 3.4
The percentage of isolates (%) with high-level gentamicin resistance among enterococci from blood cultures 2000–2006.

Escherichia coli, Klebsiella, Enterobacter, Proteus and Pseudomonas aeruginosa

Enterobacteria and Pseudomonas aeruginosa cause urinary tract infections and various serious infectious conditions beginning in internal organs. They are also important in connection with hospital infections. Urinary tract infections caused by enterobacteria can often be treated with traditional antibiotics even though a significant percentage of the bacterial isolates are resistant to these agents (e.g. 31.2% ampicillin resistance and 18.5% trimethoprim resistance in E. coli from urine samples in 2006). However, an increasing resistance has been recorded to ciprofloxacin, an antibiotic that ought to be reserved for more complicated infections. This increase must be viewed in connection with a steadily increasing consumption of ciprofloxacin.

Individual cases and minor outbreaks of enterobacteria have also been demonstrated with extended-

spectrum betalactamase production (ESBL). These bacteria are resistant to many of the most important antibiotics and the spread of ESBL will make it necessary to change the prescription pattern for common infectious conditions.

Pseudomonas aeruginosa is a special challenge because this bacteria species is insensitive to various antibiotics and easily develops resistance during aggressive treatment.
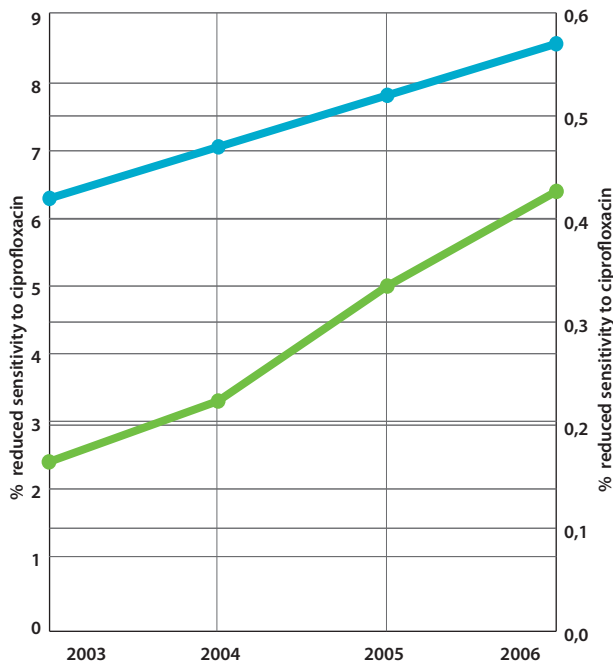
Figure 3.5
The percentage of E. coli in blood culture with reduced sensitivity to ciprofloxacin (green line) compared with the consumption of ciprofloxacin (DDD/1000 inhabitants/day) 2003–2006.

Salmonella, Campylobacter, Shigella and Yersinia
This group of bacteria causes intestinal infections, and with the exception of Shigella they are usually zoonoses which spread from animals through food and water.

The occurence of Salmonella is very low in Norwegian livestock, and the resistance pattern among isolates from Norwegian patients therefore reflects the situation in the countries where relevant food products are produced or the person in question has been travelling.

Shigella is also mainly prevalent as travel infections, and the high occurence of antibiotic resistance can

be explained on the basis of the use of antibiotics in other countries.

For Campylobacter, the situation is more complex. Isolates from Norwegian livestock are generally sensitive to all antibiotics. This results in a low occurence of antibiotic resistance among bacterial isolates from patients who are infected in Norway. Patients who are infected on travel abroad or from imported food often have strains that are far more resistant. For example, 58.8% of Campylobacter jejuni from patients infected abroad or from imported food were ciprofloxacin resistant in 2006. Such was not the case for resistance in patients infected from domestic sources.
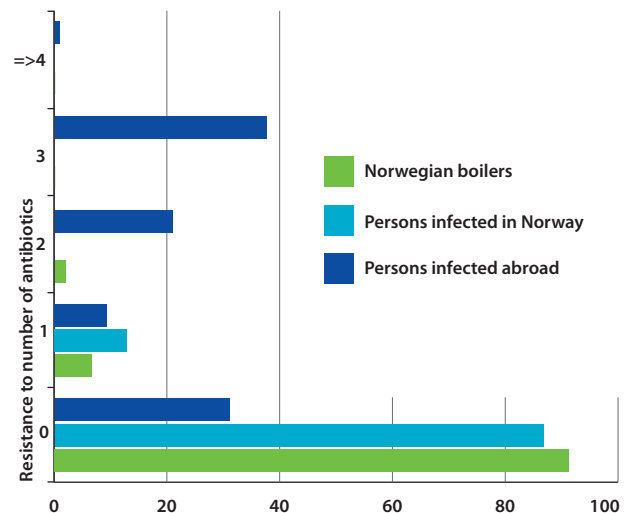
Figure 3.6
The percentage of Campylobacter jejuni from Norwegian broilers, patients infected in Norway and patients infected abroad who were resistant to 0, 1, 2, 3 or ≥ 4 antibiotics in 2006.

Neisseria gonorrhoeae (gonococci)
N. gonorrhoeae causes gonorrhoea. The occurence of antibiotic resistance is very high in many countries, and hence the resistance pattern in Norwegian isolates reflects the place of infection. Based on the reports to MSIS, the percentage of resistant bacteria increased from 24% in 2003 to 44% in 2006. Around half of the isolates were resistant to both penicillin and ciprofloxacin so that it is increasingly necessary to use new, expensive and more broad-spectrum antibiotics in the treatment of gonorrhoea.

Mycobacterium tuberculosis
M. tuberculosis causes tuberculosis. In large parts of the world, multi-resistant tuberculosis (MDR-TB)

is a serious problem resulting in therapeutic failure, the long-term spread of the infectious agent and use of expensive secondary medicines. In Norway, only scattered individual cases of multi-resistant tuberculosis have been observed, mainly in patients infected abroad.

Yeast-like fungi

Systemic yeast-like fungi infections are a difficult clinical problem for seriously ill patients. The resistance situation for yeast-like fungi is favourable in Norway, but there has been a certain selection of fungi species that have naturally reduced sensitivity to important anti-fungal agents.

HIV

Starting in 2006, the occurence of genetic alterations in human immune deficiency virus (HIV) that can reduce the effectiveness of antiretroviral treatment has been monitored. The resistance of virus isolates was determined for 118 of 275 recently diagnosed HIV positive patients (43%), and 14 of those patients (12%) had one or more resistance mutations.

Clinical bacterial isolates from animals

Staphylococcus intermedius is the most common cause of skin and ear infections in dogs, and the occurence of resistance is high. Staphylococcus aureus causes mastitis in cattle, goats and sheep. There is a low occurence of antibiotic resistance in these isolates. The number of pathogenic E. coli from swine and poultry submitted for the determination of resistance has been so low that they are no longer included in the surveillance.

Indicator bacteria from animals and food

The occurence of acquired antibiotic resistance among bacteria from the normal intestinal flora can serve as an indicator of selective antibiotic pressure in various populations. In the Norwegian surveillance programme for antimicrobial resistance in bacteria from feed, food and animals (NORM-VET), E. coli and enterococci are used as indicator bacteria. The occurence of resistance among indicator bacteria from Norwegian production animals and Norwegian-produced food is stable and low from an international perspective.

3.5 The situation of antibiotic resistance in Europe

The project European Antimicrobial Resistance Surveillance System (EARSS) has gathered data for a number of years from many European countries concerning the spread of antibiotic resistance. The system has been funded by the Public Health Programme in the EU. Norway is a full member of EARSS.

In its annual reports, EARSS provides good summaries for comparison among the different countries. For more or less all of the monitored infectious agents, Norway emerges as one of the countries with the most favourable situation. The figures below show the conditions for two important infectious agents. Pneumococci are the most important cause of respiratory tract infections, which in some cases lead to pneumonia and even blood poisoning. For large parts of Europe, a high percentage of pneumococci are resistant to penicillin. That means that pneumonia cannot be treated with this cheap and usually effective medicine. Such is not yet the case in Norway.
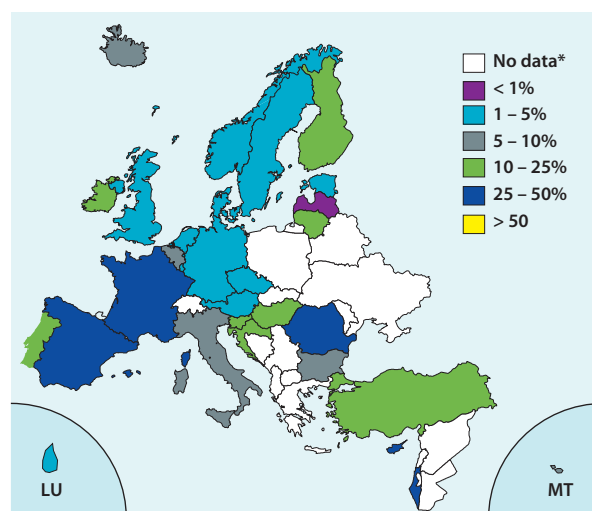
Figure 3.7
The percentage of pneumococci strains from invasive infections that have reduced sensitivity to penicillin in European countries, 2006. Source: EARSS annual report 2006.

For Staphylococcus Aureus, one of the most important hospital infection bacteria, the differences are even more pronounced. The percentage of strains that have the serious form of resistance MRSA is very low in Norway and the Nordic countries, but high in large parts of the rest of Europe.
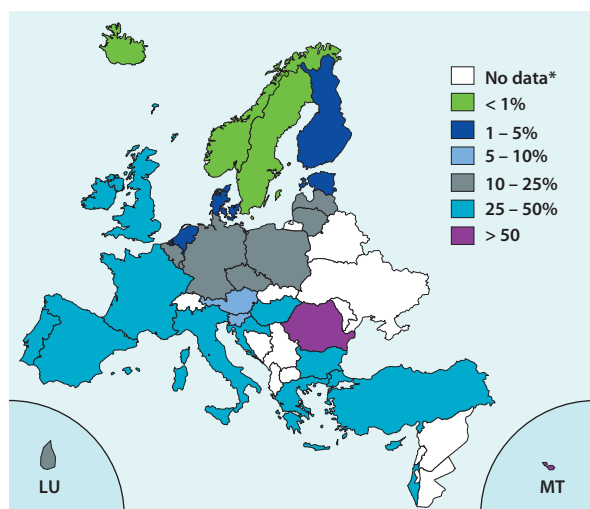
Figure 3.8
The percentage of strains of Staphylococus Aureusi from invasive infections that are MRSA in European countries, 2006. Source: EARSS annual report 2006.

3.6 Consumption of antibiotics

Surveillance the use of antibiotics in Norway
In Norway, antibacterial agents for systemic use (antibiotics) can only be obtained by prescription. Two important databases have information on the use of antibiotics in Norway: the Norwegian Drug Wholesaler Database and the Norwegian Prescription Database (NorPD). The Norwegian Drug Wholesaler Database lists all sales of medicines from medical wholesalers to pharmacies and hospitals in Norway, and included in the Norwegian

Prescription Database are medicines dispatched from pharmacies to the individual customer.

The Norwegian Institute of Public Health is responsible for these two databases. In addition, the Norwegian Institute of Public Health gathers hospital data from *Sykehusapotekenes Legemiddelstatistikk* (the Pharmaceutical Trust's drug statistics), an amalgamation of the hospital pharmacies in Norway and *Legemiddelinnkjøpssamarbeidet (LIS)* (a medicinal products purchasing cooperative). *Sykehusapotekenes Legemiddelstatistikk* gathers data on sales to hospital departments from the Pharmaceutical Trust. Since the databases gather data in different ways, the information from the databases cannot be linked.

In the statistics, the medicines are classified according to the so-called ATC classification system. In this system, the medicines are divided into groups according to the organ or organ system that they affect and their chemical, pharmacological and therapeutic properties. The measuring unit for the use of medicines by people is defined daily doses (DDD). This theoretical measuring unit is defined as: assumed average dose per day of a medicine used for its main indication for adults. For antibiotics, the main indication is a moderately serious infection. From the Norwegian Prescription Database, we can determine the prevalence, i.e. the percentage of the population who are users.

Consumption of antibiotics by humans
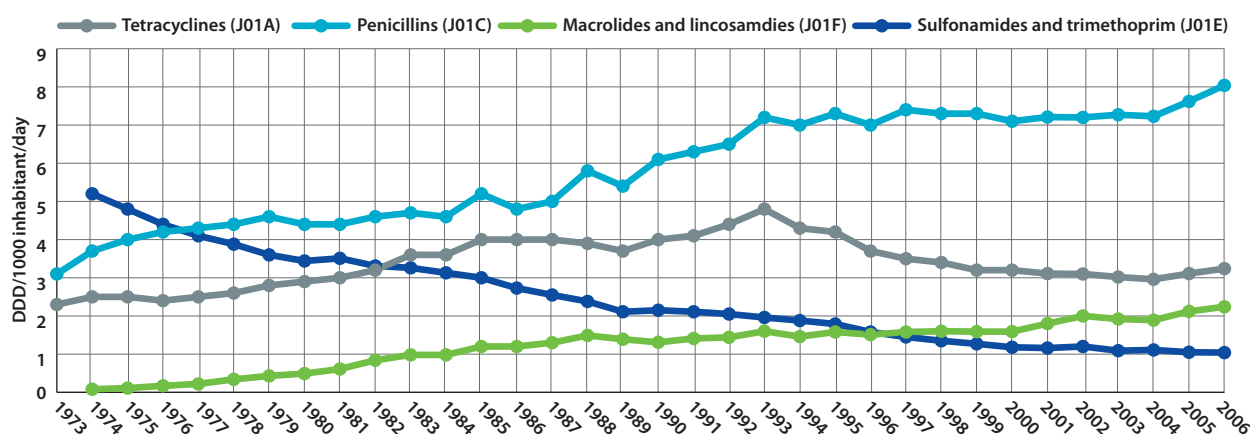
Figure 3.9
Sales of penicillins (J01C), tetracyclines (J01A), macrolides and lincosamides (J01F) and sulfonamides and trimethoprim (J01E) in Norway 1973–2006.

The total consumption of antibacterial agents has been relatively stable since the beginning of the 1990s. However, the total sale of antibiotics for systemic use in the last two years has shown an annual increase of around 5-6 % measured in doses. In 2006, sales amounted to 19 DDD/1000 inhabitants/day. This increase is primarily due to the penicillin group and methenamine (J01XX05). Sales of tetracyclines, macrolides and quinolones are also increasing, while sales of sulfonamides and trimethoprim are decreasing.

In 2006, penicillins, measured in DDD, constituted 42% of the total consumption of antibiotics in Norway. Within the penicillin group, there has been a shift over a period of time toward broad-spectrum penicillins, but both in 2005 and 2006 the sale of penicillinase-sensitive penicillins was higher than in the previous years. It is still too early to say whether this is a trend. Tetracyclines accounted for 17% of the total consumption in DDD. The sale of this group of medicines has been declining since 1993, but increased somewhat in both 2005 and 2006.

The consumption of macrolides, lincosamides and streptogramines were relatively stable throughout the 1990s, but has increased since 2000 and amounted to 12% of the total consumption in 2006. Erythromycin constituted 55% of the sales in this group. Sales of cephalosporines, monobactams and carbapenems have increased in the last year, but are still at a relatively low level. This group of medicines accounted for 3% of the total sales in 2006.

Quinolones accounted for only 3% of the total consumption, but sales have increased by 88% since 1999.

The urinary tract antiseptic agent methenamine accounted for 14% of the total consumption, and sales have increased by 39% since 1999.

Use of antibiotics in institutions
In 2006, sales of antibacterial agents to hospitals came to about 8% of total sales registered in the Norwegian Drug Wholesaler Database. Penicillins account for 48% of the sales in hospitals measured in DDD, followed by cephalosporines (22%), quinolones (7%) and metronidazole (6%). These are estimated numbers since it is currently not possible to distinguish hospital institutions in the Norwegian Drug Wholesaler Database (cf. above), nor is it possible to obtain data on sales to nursing homes; but a survey of 133 nursing homes in 2003 estimated that sales of antibacterial agents to patients in nursing homes amounted to about 6% of total sales.

Use of antibiotics in the primary health service
The prevalence of antibacterial agents in 2005 and 2006 (January to December) is presented in Figure 3.11. The gathering of data for the Norwegian Prescription Database (NorPD) commenced in January 2004. All prescriptions prescribed for inhabitants of Norway in the period are included in NorPD. The database has information about age, gender, place of residence, prescriber, delivering pharmacy, delivery date and information about the medicine whereas the indication for the medicine is not included. The prevalencess were 200/203 per 1000 men and 285/288 per 1000 women for 2005/2006. In other words, in the Norwegian population 20% of the men and 29% of the women will be prescribed an antibacterial agent in the course of one year. Antibacterial use is defined here as antibacterial agents for systemic use (ATC J01, excluding methenamine J01XX05), oral vancomycin (A07AA09) and oral metronidazole (P01AB01).

Antibacterial agents are used to varying degrees in different age groups. Children between the ages of 8 and 15 use few antibiotics. Starting at age 16-17, we see a rapid increase in antibacterial use. Major users of antibacterial agents are the very youngest children and the elderly.

Penicillinase-sensitive penicillins are used by nearly one in ten Norwegians in the course of a year. This is the most used antibiotic group in all age groups with the exception of women over age 75 in which more people use penicillins with an extended spectrum.

Use of antibacterial medicines for animals
Table 3.12 presents the sale of antibacterial medicines for animals in Norway in 2006. Sales of antibacterial agents for animals declined by 40% in the period 1995–2001. Since then the level has been relatively stable, with a slight increase in the last two years (2005–2006). More information about the trend in the consumption of medicines for animals is available in the NORM/NORM-VET report for 2005. This report is available (in Norwegian) at www.vetinst.no and at www.antibiotikaresistens.no.

The consumption of antibiotics in the aquaculture industry declined by 97% from 1987 to 2001. Thereafter, the trend was reversed, and in 2006 the total sales of antibiotics for fish in Norway came to

ATC		1999	2000	2001	2002	2003	2004	2005	2006	1999 -2006 change (%)
J01A	Tetracyclines	3.19	3.17	3.11	3.13	3.03	2.97	3.11	3.24	+ 2
J01B	Amphenicoles	0.005	0.004	0.003	0.002	0.002	0.001	0.001	0.002	
J01CA	Penicillins with an extended spectrum	1.96	2.01	2.1	2.23	2.29	2.37	2.53	2.74	+ 40
J01CE	β-lactamase-sensitive penicillins	5.01	4.66	4.68	4.48	4.38	4.23	4.55	4.63	- 8
J01CF	β-lactamase-resistant penicillins	0.32	0.35	0.41	0.50	0.59	0.63	0.56	0.66	+ 106
J01CR	Combinations of penicillins	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	
J01D	Cephalosporines, monobactams, carbapenems	0.47	0.52	0.55	0.58	0.62	0.61	0.57	0.60	+ 28
J01E	Sulfonamides and trimethoprim	1.26	1.17	1.16	1.15	1.08	1.09	1.06	1.04	- 17
J01F	Macrolides, lincosamides and streptogramines	1.59	1.59	1.8	1.98	1.92	1.89	2.12	2.24	+ 41
J01G	Aminoglycosides	0.05	0.04	0.06	0.06	0.07	0.06	0.07	0.07	
J01M	Quinolones	0.33	0.35	0.40	0.44	0.48	0.52	0.57	0.62	+ 88
J01X	Other antibacterial agents	2.34	2.39	2.55	2.57	2.63	2.83	3.05	3.18	+ 36
	Total	**16.6**	**16.3**	**16.8**	**17.1**	**17.1**	**17.2**	**18.2**	**19.0**	**+ 14**

Table 3.10
Sale of antibacterial agents for human consumption in Norway 1999–2006. Use is presented in DDD (defined daily dose)/1000 inhabitants/day and in % change 1999 –2006.
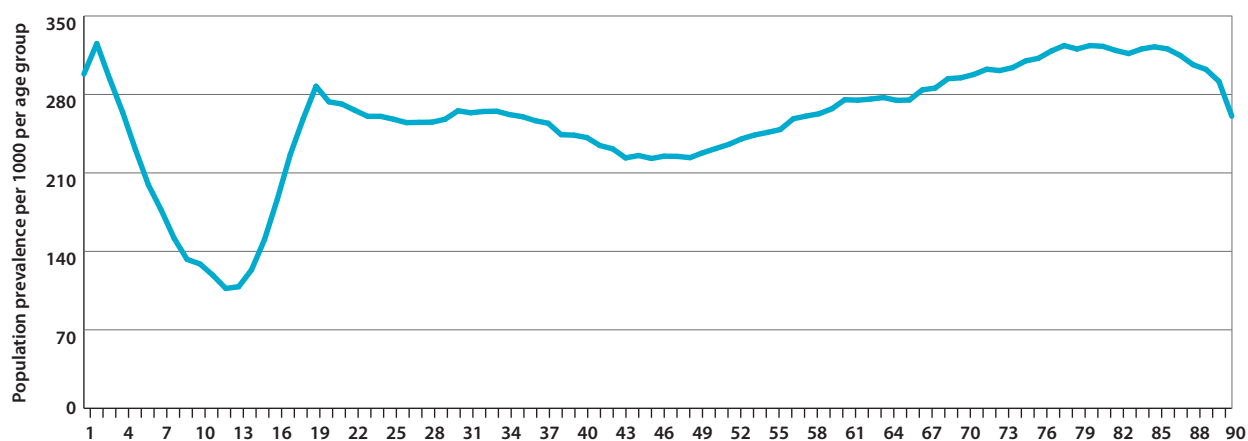
Figure 3.11
Population prevalence per year for patients who use antibacterial agents for systemic use in Norway, 2006. Antibacterial agents for systemic use include the ATC group J01 (excl. methenamine), vancomycin (A07AA09) and metronidazole (P01AB01).

Groups of antibacterial agents	ATCvet codes	Substances	Oral and parenteral administration (kg)	Intra-mammaries (kg)	Other forms of administration (kg)
Tetracyclines	QG01AA07/ QJ01AA06	Oxytetracycline	275		3
	QJ01AA02	Doxycycline	0.1		
Betalactames, penicillins	QJ01CA04	Amoxicillin	303		
	QJ01CE09/ QJ51CE09	Benzylpenicillin-procainee2,3	2059	7	
	QJ01CE90	Penethamate hydroio-dide2	4		
	QJ01CR02/ QJ51RV01	Amoxicillin+clavulanic acid4	232	7	
Sulfonamides and trimethoprim combinations	QJ01EW10	Sulfadiazine and trimetho-prim5	1547		
	QJ01EW13	Sulphadoxin and tri-methoprim	105		
Lincosamides	QJ01FF01	Clindamycin	16		
	QJ01FF02	Lincomycin	3		
Aminoglycosides	QA07AA01	Neomycin			29
	QA07AA90	Dihydrostreptomycin (DHS)			128
Quinolones	QJ01MA90	Enrofloxacin	28		
	QJ01MA96	Ibafloxacin	1		
Pleuromutilines	QJ01XQ01	Tiamulin2	154		
Sulphonamides, combined with other substances	QG51BE	Sulphadimedine + procaine penicillin + DHS			201
Combined antibacterial agents	QJ01RA01/ QJ51RC23	Benzylpenicillin-procaine + DHS2	529	736	
	QJ51RC25	Penethamate hydroiodide + DHS2		13	
Total per adminis-tration route (kg)			5256	763	361
Total (kg)					6380

Table 3.12

Sales1 of antibacterial agents for veterinary medicinal use in 2006.

1 *Sales are calculated as the number of kilos of active ingredients in veterinarian antibacterial agents approved in Norway (Sales of medicines for fish are not included). Sales data are taken from the Norwegian Drug Wholesaler Database at the Norwegian Institute of Public Health, which contains sales data from the pharmaceutical wholesalers for all pharmacies in Norway.*

2. *Calculated as benzyl penicillin*

3 *Includes one package sold with exemption from registration*

4 *Estimated content of amoxicillin*

5 *Includes a premix approved for farmed fish, but used almost exclusively for terrestrial animals, such as swine and horses (source: the Norwegian Prescription Database NorPD)*

Type of antibiotic	2001	2002	2003	2004	2005	2006	2007
Florfenicol	109	205	154	111	202	302	139
Flumequine	7	5	60	4	28	7	18
Lincomycin/ Spectinomycin (1:2)						50	67
Oxytetracycline	12	11	45	5	8	0	19
Oxolinic acid	517	998	546	1035	977	1119	406
Total	645	1219	805	1159	1215	1478	649

Table 3.13
Sales (in kg) of antibacterial agents for use with fish 2001–7.

1,478 kg of active ingredient, of which quin-olones constituted 79%. The change was due to the increased use for cod in fish farming. From 2006 to 2007, however, there has been a very positive trend so that the sales in 2007 were down to 649 kg, the same level as in 2001 (tab. 3.13).

The significant decrease since 1987 can be attributed to the introduction of effective vaccines for salmon and trout together with disease-preventing measures, including improved environmental conditions. It will be important to build on previous experiences for new species such as cod in fish farming, where we see an increase in the use of antibiotics.

3.7 Basis for a new plan

Action plan for preventing antibiotic resistance 2000–2004

After half a year of intensive effort, the interdisciplinary *Hareide-utvalget* (a committee charged with studying the matter) presented a proposal for a national action plan to prevent antibiotic resistance in 1999. In March of 2000, the five-year plan was launched by five ministries. The plan was a pioneering effort in Europe. Its cross-sectoral perspective was especially important. Professionals and administrators from a number of sectors came together and agreed about the challenges.

The primary objective of the Government's action plan to prevent antibiotic resistance (2000–2004) was "to preserve antibiotics as good and effective medicines against infectious diseases in the 21st century by counteracting the development and spread of antibiotic resistance". The goals were to acquire better knowledge about the use of antibiotics, the occurence of resistant microbes in humans and animals and in food products and the environ-ment, and the causes of the development and spread of resistant microbes, to improve the use of antibiotics and to improve the control of communicable diseases.

The Norwegian Ministry of Health and Social Affairs (later renamed the Ministry of Health and Care Services) has had the primary coordinating responsibility for the plan, but the Ministry of Agriculture, the Ministry of Fisheries, the Ministry of the Environment and the Ministry of Local Government and Regional Development have also been involved in the work. An interministerial steering committee has provided annual summaries of the status in accordance with the plan.

The following eight primary target areas were set up in order to achieve the goals of the plan:
1. Surveillance of antibiotic resistance
2. Surveillance of the use of antibiotics
3. Prescription
4. Communication with and information to the general public
5. Control of communicable diseases
6. Microbiological diagnostics and determination of resistance
7. Management and supervision
8. Research, development and study

In addition, high-priority measures were established in order to achieve sub-targets in each target area.

The Government's action plan to prevent antibiotic resistance (2000–2004) has played a key role in the efforts to prevent antibiotic resistance in Norway. In consultation with the interministerial steering committee, the Norwegian Institute of Public Health wanted a broad evaluation of the original plan and wanted to propose strategies and measures for the ongoing work. On this basis, the Norwegian Institute of Public Health's conference for the

evaluation and continuation of the Government's Action plan to prevent antibiotic resistance (2000–2004) was held on 14 and 15 September 2004 at Olavsgård Hotel in Akershus County. The conference was organised by the Norwegian Institute of Public Health's committee for the prevention and combating of antibiotic resistance *(Antibiotikakomitéen)*, which is an advisory working group in the fields of medical microbiology, infectious diseases, pharmacy, general medicine, veterinary medicine and public health that makes efforts to prevent and combat antibiotic resistance in Norway.

In 2004, it could be ascertained that there had been a negative trend internationally with the increasing spread of resistance and fewer and fewer suitable antibiotics for use in difficult cases. In Norway, we still have a satisfactory situation, but especially the increasing occurence of methicillin-resistant golden staphylococcus (MRSA) both in hospitals and in the primary health service gives cause for concern. A number of the measures in the plan were fully implemented; some were well underway, while others had not yet been initiated. Several measures have become permanent and are incorporated into the individual agencies' normal efforts. Networks have been established among professionals.

The Norwegian Institute of Public Health established a committee for preventing and combating antibiotic resistance. The committee took special responsibility for carrying on the efforts against antibiotic resistance. The Ministry maintained separate allocations earmarked for the measures in the plan even though the plan period was formally over.

The plan specified over fifty measures in eight target areas. Some of the more important measures that have been implemented under this action plan are:
- The Norwegian surveillance system for resistance in microbes (NORM) has been established as a permanent personal health data filing system.
- Norway provides high quality data to the European Antimicrobial Resistance Surveillance System (EARSS).
- Surveillance of resistance in the HIV virus has been established as a part of the Norwegian Surveillance System for Communicable Diseases (MSIS).
- The Norwegian Prescription Database, which also includes antibiotics, has been established as a permanent personal health data filing system.

- The Centre for Antibiotic Treatment in The Primary Health Service has been established.
- The public health campaign for better use of antibiotics ("All Children catch Ear Infections") has been implemented.
- The Norwegian Working Group on Antibiotics has been formalised and provides guidance, standardisation and quality assurance to the medical microbiological laboratories.
- The Veterinary Medicine Centre for Producer-independent Information on Medicines *(VETLIS)* has become a permanent measure.
- A surveillance system for resistance in microbes from animals and food (NORM-VET) has been established.

Need for further efforts

The first Norwegian action plan to prevent antibiotic resistance was a pioneering effort and resulted in a number of new measures. The battle, however, is far from being won, so the work must continue. The key measures are the surveillance of the resistance situation and the use of antibiotics and the measures to reduce the consumption of antibiotics and prevent spread.

Surveillance antibiotic resistance

Surveillance of antibiotic resistance is defined as continual, systematic gathering, analysis and interpretation of data on microbes' resistance conditions and their significance for public health for use in the planning, implementation and evaluation of public health measures. Surveillance can help increase our understanding of the relationship between the use of antibiotics and measures to control communicable diseases on the one hand and the development of resistance on the other. The surveillance can therefore also be utilised in the evaluation of the measures in this plan. In addition, the surveillance can influence the choice of medicine in empirical treatment (i.e. treatment before the microbe and its resistance pattern are known).

Surveillance is therefore a key measure that must continue in this plan period. Relative to the year 2000, the situation is much better now. Extensive surveillance is being conducted through the government personal health data filing systems MSIS and NORM and, for animals, NORM-VET. These can be further improved. It will also become increasingly important to develop good surveillance of resistance against antiviral medicines to combat important diseases, such as HIV infection and influenza. Furthermore, the individual hospitals

must have good systems for the internal detection of special resistance problems.

Surveillance of the use of antibiotics

Since the use of antibiotics is the most important cause of the development of resistant microbes, it is fundamentally important to have an overview of the amount and pattern of consumption in Norway. Surveillance of the use of antibiotics is defined as continual, systematic gathering, analysis and interpretation of data on the use of antibiotics for people and animals for use in the planning, implementation and evaluation of measures for the optimisation of this use. Surveillance can also help increase our understanding of the relationship between the consumption of antibiotics and measures to control communicable diseases on the one hand and the development of resistance on the other.

The surveillance is therefore a key measure that must continue in this plan period. Relative to the year 2000, the situation is much better now. Extensive surveillance is conducted through the Norwegian Drug Wholesaler Database and the Norwegian Prescription Database. Especially the latter provides very precise data about the pattern of consumption, even though a diagnosis is currently lacking in the individual prescription. Better surveillance of the consumption by the individual health care institutions is needed, however, preferably down to the department level. In addition, the surveillance of antibiotics given to animals and fish must be improved.

Better use of antibiotics

In Norway, as elsewhere, more antibiotics are still used than necessary. Antibiotics are sometimes used on incorrect indications and incorrect antibiotics, incorrect doses and incorrect treatment periods are chosen. On the basis of consideration of the individual patient or the resistance situation, the use of antibiotics is not good enough.

Especially in the treatment of upper respiratory tract infections outside hospitals, there are great opportunities for a more correct use of antibiotics. Whereas the largest *total amount* of antibiotics is used outside hospitals, especially for rather banal infections of ears, throat and sinuses, the largest *amount per patient* is used in hospitals. More or less all patients with serious infections such as blood poisoning, extensive surgical wound infections, serious types of pneumonia, cerebrospinal meningitis, inflammations of the heart valves and not least

infections in patients with reduced immune defences (patients with transplanted organs, leukaemia, HIV infection, etc.) are treated with antibodies. In addition, patients with a number of less serious infections (infections of the skin, bones, joints and abdomen, gastrointestinal infections, moderate pneumonia, etc.) are also treated in this way. Finally, antibiotics are often used for the prevention of surgical wound infections. Hospitals typically have a large consumption of broad-spectrum medications that entail considerable risk of the development of resistance. This is especially true of intensive care units, but also departments of surgery, internal medicine and pediatrics.

Since the year 2000, there has been increasing awareness among health personnel of the importance of a sensible use of antibiotics. Nevertheless, a continued effort is necessary. A change in the incorrect use of antibiotics requires measures aimed at those who prescribe antibiotics, i.e. doctors, dentists and veterinarians. Pharmacists, nurses and other groups of health care personnel will also play important roles.

Attempts to change the prescribers behaviour must occur simultaneously with attempts to influence the general public's knowledge, attitudes and behaviour. The situation is in fact such that the general public themselves can exert considerable influence on the doctor or veterinarian to prescribe antibiotics for their child or pet. Thus, measures are needed to increase the general public's knowledge of antibiotics and resistance, to change their attitudes to the use of antibiotics, to influence their behaviour with regard to asking the doctor for antibiotics for themselves and their children, and to influence their behaviour with regard to becoming more skilful at alleviating the suffering of sick children.