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Colophon

The '**Practical Guide Antimicrobial Stewardship in the Netherlands**' is a publication created with the help of 'The Dutch Working Party on Antibiotic Policy' (SWAB).
You can download the guide via the website www.ateams.nl and www.swab.nl.

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Preface

Antimicrobial Stewardship is internationally recognised as one of the main control measures in combating antimicrobial resistance. At the initiative of SWAB, the professional organisations presented a plan of action in 2012 that was embraced by the Healthcare Inspectorate (IGZ) and the minister. By the end of 2015, every hospital in the Netherlands should have a properly functioning Antimicrobial Stewardship programme and an Antibiotics team (A-team). This 'Practical Guide Antimicrobial Stewardship in the Netherlands' is intended as a resource for future A-teams in setting up an Antimicrobial Stewardship Programme in their hospital. It is not a guideline, but a guide containing suggestions on how the different elements of a stewardship programme can be designed and what the conditions are for a properly functioning A-team taking into account the local situation. This guide is not a one-time or static product, but should be a living document: as such, an up-to-date version of this guide can be found on www.ateams.nl. This guide was created by means of SKMS funding (Association for Quality Funds Medical Specialists) and has been drawn up by representatives of the main involved professional groups: internists, clinical microbiologist, hospital pharmacists and paediatricians.



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Motivation

From 1 January 2014 onwards, it is expected that every hospital in the Netherlands has an Antimicrobial Stewardship team (A-team) tasked with monitoring the quality of the antibiotics policy throughout the hospital. The purpose of this practical guide is to offer a practical manual to the A-teams for setting up an Antimicrobial Stewardship Programme. The core elements of an Antimicrobial Stewardship Programme are discussed as described in the SWAB vision document 2012 and in international guidelines[1-2] supplemented with practical tips for the introduction of the programme in the hospital. Even though the A-teams are instrumental for monitoring the quality of the antibiotics use at hospitals, the appropriate prescription of antibiotics is the responsibility of all prescribing medical specialities.

It is probable that costs be saved in the long term thanks to the successful execution of Antimicrobial Stewardship and by limiting resistance development. However, the **primary goal** of an Antimicrobial Stewardship Programme is improving the quality of healthcare; Antimicrobial Stewardship should thus not be viewed as a means of saving money.

This guide does not contain guidelines; Instead it is a **practical resource** for setting up an Antimicrobial Stewardship Programme, but how this is eventually implemented depends on the suitability and feasibility of stewardship activities in the local situation (initial situation regarding prescribing behaviour and available infrastructure, manpower and means, etc.).

An evidence-based guideline for Antimicrobial Stewardship tailored to the situation in the Netherlands in terms of stewardship goals and possible stewardship interventions is currently in development at the Dutch Working Party on Antibiotic Policy (SWAB). It is expected that this guideline will appear in the first half of 2015. The contents of this guide will be adjusted to fit the guideline, if necessary. Thus, the recommendations in this guide are not binding in nature and also cannot be used as such for the purposes of supervision or compliance.

This guide can also be found on our website (www.ateams.nl).

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Links and QR codes

You will receive immediate access to the digital version of the Ateams website by means of entering the links below in your browser or by scanning the QR code below (and at the end of each chapter) with your mobile phone.



www.ateams.nl/links/intro



www.ateams.nl/links/hfst4



www.ateams.nl/links/hfst1



www.ateams.nl/links/hfst5



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www.ateams.nl/links/hfst6



www.ateams.nl/links/hfst3



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Chapter 1.
Backgrounds Antimicrobial Stewardship

The tasks of an A-team

In Dutch hospitals - in a cross-sectional study at a random point in time - antibiotics are prescribed to about 30 to 40% of the patients. Exposure to antibiotics is one of the main sources for the development and spread of resistance where the consequences of resistance are not restricted to the individual patient or hospital in question. Globally as well as in the Netherlands there is a steady increase in resistance against the most common antimicrobial agents. This is a worrisome development in light of the stagnation of the development of new antibiotics and, thus, the decreasing number of treatment options. The use of restricted antibiotics has been steadily increasing over the past years (Nethmap 2014)[3] in the Netherlands as well with the risk that in the future, these agents, too, can be used less and less often.

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Antimicrobial Stewardship involves monitoring the antibiotics policy and is viewed as one of the main measures for limiting the unnecessary or inappropriate use of antimicrobial agents and, as such, combating the resistance development, improving clinical results, and reducing costs. For the correct prescription of antibiotics, a number of basic principles are adhered to (appendix **'General principles responsible antibiotics use'** at www.ateams.nl). Adhering to these principles by all prescribers is the eventual goal of an Antimicrobial Stewardship Programme. In practice, however, guidelines that are based on such principles are not adhered to sufficiently; the estimate is that about 30 to 50% of the antibiotics prescriptions are incorrect (wrong indication, incorrect agent, dose, term or method of administration). Additionally, existing guidelines for antimicrobial therapy do not cover all indications and practical aspects of responsible antibiotics use. The A-teams have their work cut out for them filling in the gaps.

The tasks of the A-team are as follows (based on the SWAB vision document 2012):

- To supervise and improve the correct prescription of antibiotics in the hospital and the compliance with existing local, national or international guidelines for the treatment of patients.
- As such, the A-team monitors antibiotics use and prescribing behaviour and, if necessary, initiates interventions focused on the improvement of specific aspects of the prescribing behaviour.
- To track local antibiotics use figures and resistance problems and national trends regarding prevalent pathogens and resistant micro-organisms.
- To report the quality of the local antibiotics use as described above to the Board of Directors.

To this end, the A-team collaborates closely with the responsible hospital pharmacists, clinical microbiologists, infectious disease specialists, other medical specialists and the Hospital Hygiene and Infection Control department.

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There is no universally applicable Antimicrobial Stewardship Programme. The purpose of this guide is to offer support to the local A-teams in the execution of the tasks above. Attention is paid to aspects that are important to embedding the A-team in the local organisations and setting up an Antimicrobial Stewardship Programme. This guide provides tips for measuring antibiotics use and identifying points for improvement followed by a number of practical examples of improvement actions. The website (www.ateams.nl)has a pdf version of this guide and additional information available for download.

PDF files and links to websites (CHAPTER 1)



www.ateams.nl/links/hfst1

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Chapter 2.
Organising an Antimicrobial Stewardship Programme

Steps to take upon starting

Form an A-team

The A-team consists of at least one clinical microbiologist, one infectious disease specialist (or an internist with a composite infectious diseases profile) and a hospital pharmacist. The team is preferably supported by an expert in the field of healthcare quality.

Ensure cooperation and support

Essential to the success of an Antimicrobial Stewardship Programme is the support of the Board of Directors and the medical staff.

- A budget made available by the Board of Directors is vital for the A-team to function properly. The first task of

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the A-team is to create a sense of urgency with the Board of Directors.

- Agree on how the A-team is embedded in the local structure: ensure proper cooperation with the committee that is responsible for Hospital Hygiene and Infection Control and the local antibiotics committee. A decision can be made to create a joint committee. Plan a number of joint meetings per year in which the A-team reports its activities, in which the local resistance, use and quality figures are discussed and in which the goals of the A-team for the next six months are determined. Together, draw up the list of restricted antibiotics that will be monitored (see **chapter 4**). Also discuss how - if necessary based on the findings of the A-team - the guidelines of the Antibiotics and Infection Committee will be adjusted.
- Provision of IT support and its inclusion in the budget (see **chapter 3** 'Preconditions for an Antimicrobial Stewardship Programme').

Draw up a plan of action

After the A-team has been formed and (financial) support has been obtained, a plan of action will be drawn up, which will contain a clear long-term vision. Corresponding goals need to be formulated in a clear and quantifiable manner. This plan of action should at least contain information on:

- **The organisational structure**
  Describe the composition of the A-team and how it is embedded in the local organisation; also present this in an organisational chart.
- **The focus area**
  Indicate the A-team's objectives and work field as well as how the A-team presents itself in the hospital/ institution.

Coordination

Formulate how the A-team's tasks are coordinated with the Infection Committee, the antibiotics committee and the Hospital Hygiene and Infection Control department.

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- **Initial situation**
  At many hospitals, activities are already in place to improve the prescription of antibiotics, which to a certain extent already contributes to the Antimicrobial Stewardship. Give a short description of the initial situation and the day to day activities as they occur at the start of the Antimicrobial Stewardship Programme (**chapters 3**and **4**).
- **A short-term policy plan**
  Describe a plan for the short-term policy, for example by indicating how the inventory of local priorities will be performed (for example, by means of executing a Point Prevalence Survey, **chapter 5)**. Clearly indicate which concrete goals for improvement are set and use the PDCA quality cycle when performing interventions.
- **Task distribution**
  The mutual task distribution depends on the local availability of an infection specialist, clinical microbiologist and hospital pharmacist and the set goals for improvement. For the starting situation, describe how the tasks have been distributed (**chapter 4 'Standard monitoring and advice for specific patient categories'**) and describe specifically - for all activities presented in the annual plan - what the role of each of the A-team's members is and who does what.
- **Meeting frequency**
  Describe the meeting frequency of the A-team itself and of meetings between the A-team and other people involved within the organisation.
- **Communicating the vision and objective of the A-team in the hospital**
  Describe the nature and frequency of activities to stimulate familiarity with and support for the A-team's plans, for example by means of presentations at the staff convention or news items in the personnel magazine, etc.
- **Reporting**
  Describe which elements will be included in the annual report.
  (see page 14)

An example of an annual plan can be downloaded through www.ateams.nl.

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The general set-up of an Antimicrobial Stewardship Programme

Generally, the set-up of an Antimicrobial Stewardship Programme (ASP) can be summarised as follows:

1. The A-team creates the right **preconditions** (**chapter 3**).
2. The A-team coordinates **standard monitoring and advice for specific patient categories (chapter 4)**.
3. The A-team ensures **systematic audits of the prescribing behaviour and antibiotics use**, and coordinates **thematic improvement projects** if necessary (**chapter 5-7**).

The A-team has a coordinating role in the set-up of an Antimicrobial Stewardship Programme. This role will be further explained in the following chapters.

Time effort

When drawing up the annual plan, the A-team makes an inventory of which activities will take place, by whom and what the frequency of the activities is. An estimate of the amount of hours required for both the coordinating and the executive parties can be determined based on this information.

A rough guideline is given in **table 1** for this estimate. The table distinguishes between coordinating and executive tasks. We estimate that the coordination of an Antimicrobial Stewardship Programme requires at least 0.5 FTE/500 beds, which is based on an inventory performed among 9 Dutch hospitals in 2014: 2 academic institutions, 4 larger hospitals (500-1000 beds) and 3 smaller hospitals (300-500 beds). The amount of FTE that needs to be taken into account for the execution of the ASP cannot be determined exactly. Coordinating the improvement projects in particular will be time consuming and the scope of the programme will depend on the amount of FTE required. The time effort will further depend on the ease with which information from the patient files and prescription systems can be retrieved, the size of the hospital, the size of the patient population, the presence of support (specialist trainees medical microbiology or infectious diseases) and the number of executive tasks of the A-team's members themselves. However, all institutions indicated in the aforementioned inventory that they could not perform the core tasks of the A-team without a dedicated team.

It is recommended that the central coordinating role is attributed to one or two people who have primary responsibility. These people will in turn delegate tasks. If the available FTEs are divided over too many people, there is a risk that the intended activities will not be performed.

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Table 1. Example detailed time effort

What	By whom	Frequency?	Time effort
Core tasks A-team (chapter 2) - Organisational aspects (meetings, drawing up annual plan, annual report, cooperation of parties involved) - Coordination of day to day monitoring	- A-team members	To be determined locally	0.5 FTE/500 beds
- Coordination of preconditions (**chapter 3**)	- A-team in collaboration with antibiotics committee	At least once per year	
- Coordination of audits and improvement projects	- Members of A-team/ quality official	To be determined locally	
IT support/data management	- IT specialist/data manager	To be determined locally	0.1 FTE/500 beds
Execution of day to day monitoring and advice with respect to prescription selection (chapter 4) - Identifying patients/prescriptions	Example: - Nurse Practitioner/ nurse/ pharmacist's assistant, etc.	Daily	Variable*
- Giving advice	- specialist trainees/ members of A-team	Daily	
Measuring antibiotics use(chapters 5 and 6) - point prevalence survey	- Specialist trainees/ specialist infection control/ A-team members, etc.	Annually	Variable*
Performing improvement projects (chapter 7), for example: - Setting up monitoring of use of restricted antibiotics - IV-oral switch programme - Setting up systematic bedside assistance for *S. aureus* Bacteremia - Improving surgical prophylaxis	- To be elaborated locally	To be determined locally	Variable*

***** Determine the amount of prescriptions

We refer to the next chapters for an intrinsic discussion of separate components/activities.

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Reporting

The A-team writes a report at least once a year which contains an overview of the local stewardship activities. Apart from the fixed components mentioned on pages 10 and 11, this report at least contains information with respect to:

1. The status of the preconditions, including national/local resistance trends (see **chapter 3**).
2. The quantitative use of antibiotics, including the restricted antibiotics (see **chapter 3** and **6**).
3. An overview of the results of audits of the quality of prescribing behaviour (divided per department) based on the data of the point prevalence survey (see **chapter 5**).
4. The concrete results of the objectives mentioned in the annual plan, additional audits of the antibiotics use and improvement actions (**chapter 6** and **7**).

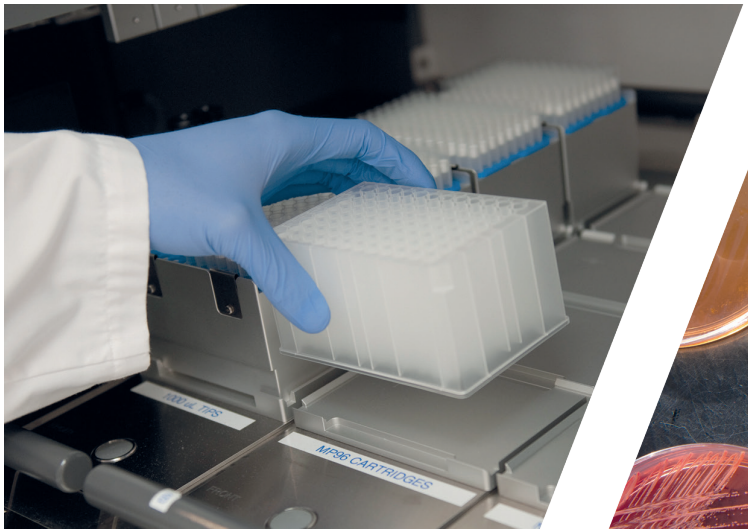
This report will at least be offered to the A-team's formal client,
the Board of Directors.

PDF files and links to websites (CHAPTER 2)



 www.ateams.nl/links/hfst2

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Chapter 3.

Preconditions for an Antimicrobial Stewardship Programme

Provide a local antibiotics formulary

A local antibiotics formulary containing treatment advice for common infections is an essential precondition for an Antimicrobial Stewardship Programme. Apart from the fact that the formulary is a guide for the treating physician, it can serve as a test tool within the ASP for monitoring the quality of the antibiotics use within the hospital. It offers the option of formulating strict criteria for accuracy of use so inaccurate use can be easily identified. Apart from treatment advice, the formulary thus also contains a list of restricted antibiotics and other 'limited prescribable' agents (for further information: continue reading).

Treatment advice in the formulary should correspond to the national and international guidelines and, if necessary, have been adjusted to local resistance data. Reports of susceptibility test s by the microbiological laboratory need to be in accordance with the local formulary. The local guidelines will be assessed by the antibiotics committee at least once a year, but preferably twice a year and will be revised, if necessary.

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As a basis for the formation of the local formulary, the recommendations of www.swabid.nl can be used.

A recent survey among all Dutch hospitals (June 2014) shows that a local formulary is already available at all hospitals; however, the scope and presentation method (electronic or paper) varies between hospitals. The advantage of a web-based formulary is that it can be expanded by decision support resources; for example, information regarding criteria for infection/clinical case definitions, possible differential diagnoses, required diagnostics and current information relevant to the prescriber. The A-team together with the local antibiotics committee sees what the options in this field are.

Draw up a list of restricted and other 'limited prescription'antibiotics tuned to the local situation

Restricted antibiotics are agents that can only be prescribed when the usual agents are not sufficiently effective. Due to the risk of developing resistance, these agents are not prescribed routinely; it will only be used in case of (suspicion of) an infection with a micro-organism that is resistant to the usual agents.
Together with the other interested parties (for example, the antibiotics committee and/or the medical staff), determine which agents can only be prescribed under specific conditions and which can be prescribed 'freely' and include this list in the local formulary.
The table below is a guideline for this division:

Restricted antibiotics	Limited prescription agents
Carbapenems (a.o. meropenem) Glycopeptides (a.o. vancomycin, teicoplanin) Tetracyclines (parenteral) (a.o tigecycline) Polymyxins (a.o. colistin) Rifamycins (a.o. rifampicin) Oxazolidinones (a.o. linezolid) (Glyco)lipopeptides (a.o. daptomycin) 5th generation cephalosporins (a.o. ceftaroline) Echinocandins (a.o. caspofungin) amphothericin B posaconazol ganciclovir/ anti HIV-HBV-HCV agents	3rd and 4th generation cephalosporins Chinolones Aminoglycosides piperacillin-tazobactam voriconazol

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A number of agents in this overview are restricted antibiotics in the strictest sense of the word. These agents can only be prescribed if an expert in the field of infectious diseases is involved in the treatment. The other agents are not reserve antibiotics in the strictest sense, but fall under the category 'limited prescription'. In some situations, these agents are a primary choice, but in others they are undesirable; for example, ciprofloxacin can be indicated as targeted therapy for prostatitis, but is not the 1st empirical choice for the treatment of complicated urinary infections; ceftriaxon can be indicated for meningitis, but is not preferred for the blind treatment of a mild pneumonia contracted at home. For all restricted antibiotics, they can generally only be prescribed after the results of the culture and resistance assessments are known. If prescription takes place before a pathogen has been found, then this must always be supported by performing the correct diagnostics for the purpose of identifying the pathogen so that narrowing can still occur.

Apart from the clinical efficacy, the effect on resistance development should also be considered when classifying antibiotics. Apart from exerting selective pressure on bacteria populations, antibiotics also have a direct effect on bacterial mutation frequency and the ease with which resistance genes are exchanged. For some classes of antibiotics (e.g. the chinolones), this effect is bigger than it is for other classes. An extensive discussion of these mechanisms falls outside the scope of this guide; for further background literature, we refer to the literature on the website.

Determine how the use of restricted antibiotics can be supervised

Determine which measure is used in daily monitoring to supervise the prescription of restricted antibiotics, including performing the corresponding diagnostics. If required, there are more strict supervision measures for some (groups of) agents than there are for other agents.
Options are:

- Providing an automated alert to the user when prescribing the agent.
- Giving feedback by telephone after prescribing the agent.
- Checking to see if diagnostic assays have been performed to find a pathogen.
- A mandatory bedside consultation after prescribing the agent.
- Filling in motivation and indication in the electronic prescription system (EVS) upon prescription, with subsequent feedback .
- Restrictive measures in which the agent can only be prescribed after consultation with and approval from the A-team or another specialist (pre-authorisation).
- Making specific antibiotics temporarily unavailable (formulary restriction).

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Criteria for the proper use of restricted antibiotics need to be unambiguously recorded in the local formulary. Thus, it will be relatively easy to identify and adjust incorrect use. Supervising the use of restricted antibiotics is an essential part of the day to day monitoring (**see chapter 4**).

A **practical example** of an improvement project in a Dutch hospital for the purpose of optimising the use of ciprofloxacin with a clear description of interventions and process and result measures is included in **chapter 7**. The publication (Willemsen et al., 2010) containing an extensive description of the results of this intervention can be downloaded from our website.

Provide IT support

Support from an IT specialist is important to facilitate: 1. the day to day monitoring of prescriptions; 2. audits of the quality of use; 3. reporting data. These tasks are not necessarily the responsibility of one person: processing and reporting data can also be supported by a data manager. Enter into agreements with the people involved on which information needs to be reported, at what frequency, which presentation method and which member of the A-team is the primary contact.

The efficient monitoring of the quality of antibiotics use for individual patients depends on the ease with which the data from patient files and prescription systems can be obtained and of the completeness with which information is recorded in the file. As it is currently not possible yet in most electronic patient files (EPDs) to simultaneously gain a clear overview of the required clinical, microbiological and pharmaceutical information per patient. Reviewing this information still requires a lot of time.

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Explore the possibilities of facilitating the integration and processing of data in the set-up phase of an ASP together with the IT supporter and/or data manager in question.

- Check which data can be easily retrieved from the EPR, for example, a day to day overview of patients who use the restricted antibiotics, or an overview of patients who use (specific) intravenous antibiotics for more than 72 hours.
- Look into the options of integrating data from various subsystems and presenting them together. There are a number of commercial providers who can integrate these data from the various subsystems. Examples are available on our website.
- Consider creating an Antibiotics Stewardship module in the EPR in which the prescriber fills in a standard set of data the moment an antimicrobial agent is prescribed and that will, for example, ensure that the prescriber will automatically receive reminders for streamlining the therapy.

Provide knowledge of the national and local resistance figures

Knowledge of local resistance figures is an important precondition for an ASP for the identification of (local or national) occurring resistant micro-organisms and pathogens, for example. This monitoring will take place in close collaboration with the responsible clinical microbiologist and the Infection Control department (**see chapter 6**), so that the A-team and the antibiotics committee can use the information for optimising the local antibiotics policy.

PDF files and links to websites (CHAPTER 3)

www.ateams.nl/links/hfst3

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Chapter 4.

Standard monitoring and advice for specific patient categories

Feasibility

Monitoring the correct prescription of (restricted) antibiotics will ideally take place by means of continuous monitoring of the accuracy of all prescriptions combined with giving advice where necessary. In the international literature on Antimicrobial Stewardship, this 'monitoring and advice' is considered to be one of the most effective ways of optimising antibiotics use ('Prospective audit with intervention and feedback')2. Contrary to formulary restriction and/or pre-authorisation of prescriptions (see appendix '**Overview stewardship interventions**' on our website), benefits of this work method are, among other things, that the autonomy of the prescriber is maintained while, at the same time, effective internal contacts are improved. Moreover, the moment in which the recommendation is received is also an important learning moment.

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However, reviewing individual patient information is labour-intensive and time consuming and, as such, still not feasible on a large scale. Checking all prescriptions at an individual level will only be feasible if an advanced integration of the EPR, EPS and laboratory system has been realised that contains the option of applying automatic selection and alert criteria. For now, monitoring a selection of 'critical' prescriptions (see below) is the most efficient approach. The A-team will determine the selection on the basis of a number of criteria (for example, on the basis of agent, indication or treatment duration).

In this chapter, we will give a schematic overview of how this day to day 'monitoring and advice' can take place.

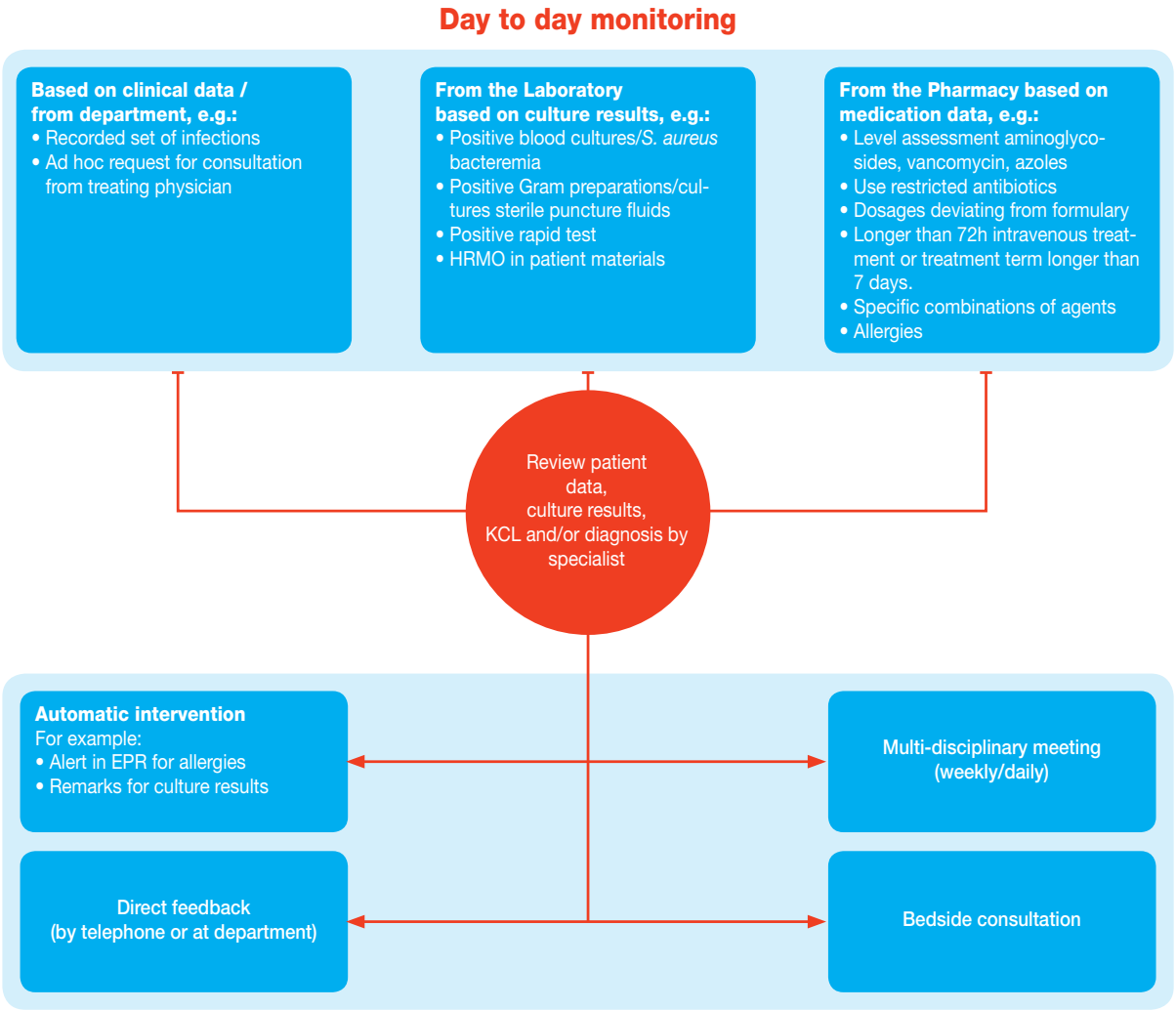
Map out how monitoring specific patient categories takes place at your hospital

A lot of hospitals already have some form of monitoring in which patients who are eligible for advice (from an infection specialist, clinical microbiologist or pharmacist) will be identified on the basis of:

- Clinical information (for example, patients with a specific infection for which consultation will take place routinely, such as for patients with endocarditis or prosthesis-related infections.)
- Culture results (for example, patients with positive blood cultures who will be phoned or patients with Candidemia or S. aureus bacteremia for whom there will be a follow-up.)
- Pharmacy data (for example, patients for whom specific agents are prescribed, such as patients with restricted antibiotics, aminoglycosides or vancomycin.)

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A schematic overview of the set-up of this day to day practice of monitoring and advice is provided in **figure 1**.



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In the set-up phase of an ASP it is wise to map out what the day to day practice in the hospital is what the criteria for giving advice are with respect to individual prescriptions. Also map out how the tasks have been distributed (who does what?) and how the provided advice is communicated to the prescriber and how it is recorded in the patient file. This inventory is an important tool to determine whether and where adjustments in monitoring and advice are required.

Critical prescriptions

The A-team plays a central role in determining the 'critical' prescriptions in which advice from a specialist (or other intervention) is always deemed necessary.

In the initial phase of the Antimicrobial Stewardship Programme, a decision will be made regarding whether or not the list of 'critical' prescriptions for which monitoring is already taking place needs to be expanded. Subsequently, for each critical patient category or type of prescription the A-team determines in which way advice is given. This could, for instance, be a discussion in the multidisciplinary meeting (e.g. for patients with endocarditis), a bedside consult by a infectious disease specialist (e.g. for patients with a S. aureus bacteremia), a consult by telephone by the clinical microbiologist upon prescription of restricted antibiotics, or an alert from the pharmacist's assistant upon long-term intravenous therapy. These advisory activities do not have to be performed by the members of the A-team themselves: the A-team takes up a coordinating role in this.

Monitoring prescriptions of restricted antibiotics is a vital component of an Antimicrobial Stewardship Programme. This monitoring can be set up relatively easily (also see the **practical example** from **chapter 7**). As such, it is essential that strict criteria for 'accuracy of use' are formulated that can be used as test criteria in the day to day monitoring. This sets requirements to the local formulary and the agreements on diagnostics tests that are an intrinsic part of prescribing restricted antibiotics.

The hospital pharmacist plays an important part in identifying the prescriptions that are included in the day to day monitoring for which advice is required. For example, this could entail creating a daily print-out of prescriptions of restricted antibiotics, introducing an alert from the hospital pharmacist or pharmacist's assistant for patients who are treated with antibiotics for longer than 10 days, or who receive antibiotics intravenously for longer than 48 hours.

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The employees at the nursing department can provide support, for example, in identifying patients with long-term intravenous therapy.

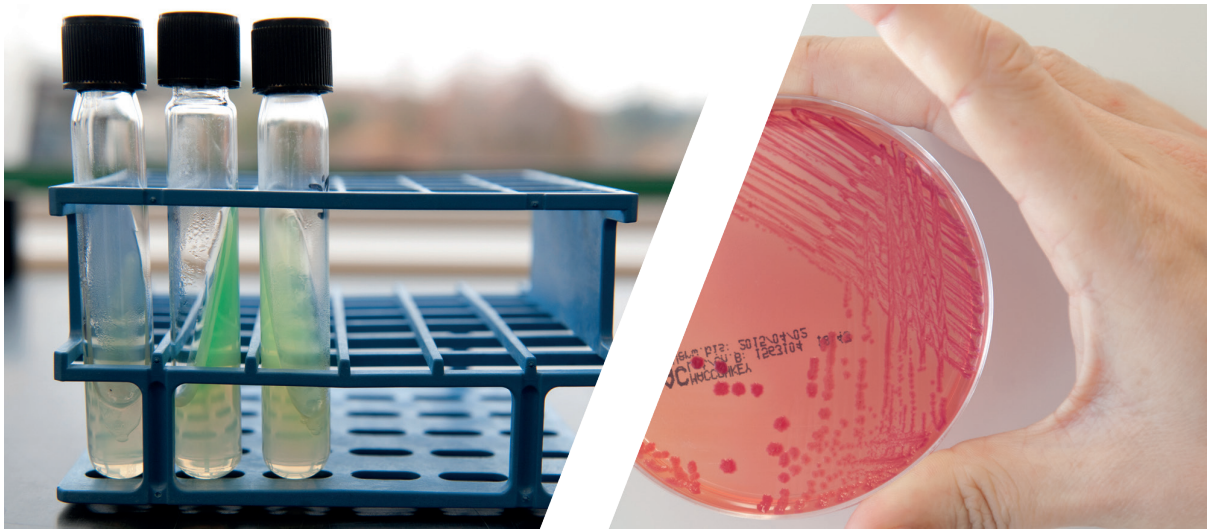
This day to day monitoring has an important **educational function**. This means it not only concerns 'adjusting' the antibiotics policy: ideally, the considerations for the advice are presented clearly so that they contribute to a structural improvement in prescribing behaviour and a reduction of the amount of incorrect prescriptions. Thus, it is important that various specialists involved give uniform advice. This is an important focal point for the A-team within the ASP.

PDF files and links to websites (CHAPTER 4)



 www.ateams.nl/links/hfst4

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Chapter 5.
The point prevalence survey

A cross-sectional audit of the quality of antibiotics use

During standard monitoring and advice (**chapter 4**) aspects of the prescribing behaviour can come to light for which improvement actions are desired (see **chapter 7**). This includes among other things the regular absence of cultures or other diagnostic methods, or the regular initiation of an empirical therapy that does not fit the patient category in question. However, as such it is often difficult to gain insight in how often, for which patients, and why specific prescription errors are made. Moreover, daily practice shows that patients with less severe infections largely stay below the A-team's radar. For these '**invisible**' patients especially, there is still a lot to gain. To this end, within each ASP systematic audits need to be conducted of the antibiotics use at the level of groups of patients so it can be determined which stewardship measures take priority. A Zon Mw subsidised research into the optimum manner of systematic audits of antibiotics use at the level of groups of patients started in the Netherlands from 2014 onwards (project leaders: J.M. Prins and M. Hulscher); about 20 hospitals are participating.

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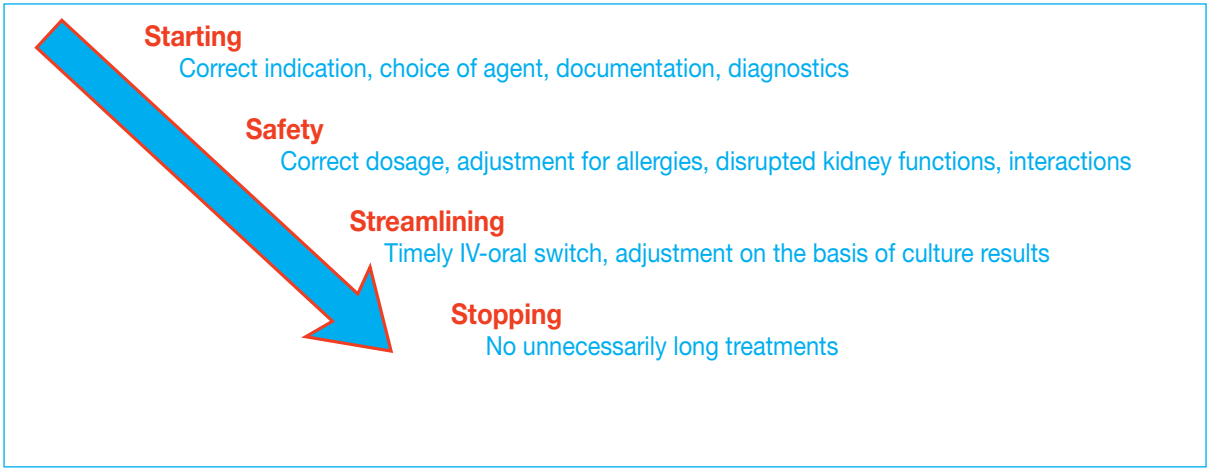
The goal of the point prevalence survey

A point prevalence survey (PPS) is a cross-sectional audit of the prescribing behaviour within the hospital. During this audit, the prescribing behaviour at one point in time within the entire hospital is measured with the following goals:

- Determining the starting situation with respect to using antimicrobial agents and continuing with prescribing behaviour over time within the own hospital in order to gain a global idea of the quality of the prescribing behaviour per department (especially for common indications and often used agents).
- Identifying structural shortcomings in the prescribing behaviour that remain unnoticed during the standard daily monitoring and advice (**chapter 4**). This can be used to identify the departments that require a more detailed audit of the prescribing conduct, or where improvement actions are immediately clear. Repeated audits can subsequently be used to evaluate the effects of interventions.

As the information on the prescribing conduct is collected only at one point in time, the PPS is less suitable for gaining insight into the quality of the prescriptions for less common indications and little prescribed agents. To this end, aggregated user data needs to be collected as described in **chapter 6**, or small-scale focused audits need to be conducted in which prescriptions over a longer period of time need to be checked.

Figure 2. Global distribution of aspects on which the quality of prescriptions can be assessed.



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Different methods for a point prevalence survey

It is unclear what the best method for a PPS is. A choice can be made to conduct a global audit (how many patients receive antibiotics, which agents, which indications) or to conduct a more detailed audit in which the quality of individual prescriptions is assessed on multiple aspects (see below: quality indicators). An overview of the points on which a prescription can be assessed is presented in **figure 2**. More information on specific quality indicators follows later in this document.
An example of an audit in which global information is obtained is the ECDC-HAI module. In this method, a record is made for each prescription containing information with respect to the reason for prescription (therapy or prophylaxis), the prescribed antibiotic agent and the prescription indication. However, this method does not assess the quality of the prescription.

Another example is the antibiotics module within the prevalence audits of PREZIES in which the quality of individual patient prescriptions are assessed based on a flow chart. A general assessment will be made with respect to whether starting antimicrobial therapy was warranted (is there an infection?) and if the choice of agent is in accordance with local guidelines. It is important to note that the absence of strict base criteria is a limiting factor in the assessment of indication accuracy. As a result, standardised assessment or checking whether the prescription was correct is not possible. It is possible, however, to pick up on 'large' and systematic inaccuracies in the indication. These include the systematic use of antibiotics on the basis of the urine culture for patients with a long-term catheter. The amount of patients who did not receive antimicrobial therapy, but who should have received it can be identified. However, the latter will concern only a very low amount of cases.

More information on these examples can be found on our website.

Quality indicators

The **detailed audit** of the ‘finer’ aspects of the prescription quality (does the patient receive the *right* dose through the *correct* method of administration, is there *correct* streamlining and will treatment stop *in time*, etc.?) takes more time. Moreover, the quality assessment based on strict criteria is required to prevent discrepancies between the quality assessment of different assessors. Thus, the audit is preferably conducted based on standardised and validated **quality indicators**, which - after training the data collectors, if necessary - are easy to measure and which give reproducible results by means of using strict decision-making rules.

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This it concerns process indicators, in which the percentage of patients within a specific group is checked to see who meets a set standard:

$$\frac{\text{number of patients within a defined group for which the set standards are met}}{\text{total number of patients within this group}} \times 100\%$$

In light of the amount of different patient categories, indications and aspects of prescribing antimicrobial agents, there can be many different indicators. There are generic indicators (generally applicable to patients for whom empirical antibiotics are initiated) and indicators specific to certain indications (e.g. for patients with pneumonia contracted at home, complicated urinary infections) or to specific agents (e.g. patients with vancomycin). An overview of possible indicators is provided in the appendix '**quality indicators of responsible antibiotics use**' on www.ateams.nl.

Determine which method is used and how often audits are conducted

The extensiveness and details of the PPS depend on the available time and means. For prescriptions of agents on the restricted list (see **chapter 3**) at least two essential conditions for correct prescriptions are preferably assessed: is there a specialist involved in the treatment, and have the correct diagnostics been performed? This especially applies to the agents that have not been included in the day to day monitoring.

Additionally, the local A-team **will determine which quality indicators are included for each audit**. For example:

- Is the choice of agent in accordance with the local formulary?
- Have blood cultures and cultures of the location of the infection been taken?
- Is it the correct dose (adjusted to kidney functions) and the correct dosing interval?
- Was there streamlining on the basis of clinical data/culture results?
- If applicable, was there a switch from intravenous to orally?

Finally, during the PPS it is important to gain an insight into how well the data regarding the antibiotic therapy can be documented. The absence of this information makes future audits of the quality of use more difficult and it also provides insight into the prescription culture within the department. The PPS can also be used to identify for which prescriptions advice from a specialist has been asked.

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The PPS will be performed at least once every 12 months.

The point prevalence survey in practice

Step 1. Determine which PPS method will be used and whether or not quality indicators are included. If so, determine which ones.

Step 2. Determine when, at what time and at which departments audits will take place. Due to seasonal variation in the occurrence of specific infectious diseases, it is wise to measure at the same time every year. It is recommended to at least include the following departments in the audit: internal medicine, surgery, pulmonary diseases, cardiology, orthopaedics and urology. Preferably, audits will take place in the entire hospital.

Step 3. Determine which agents/indications are included and excluded the audit.

Step 4. Determine how the data will be collected. This can be done by looking up the desired information in the EPS and/or EPR, or by means of direct interviews (at the department) with the treating physician. The latter method has the benefit of more complete and accurate information. It is not necessary to also give feedback on site regarding the prescribing behaviour during the PPS. Announce a PPS on the day it will take place to ensure the data is representative for the usual prescribing behaviour.

Step 5. Form the executive team. The composition of the team depends on the local availability of trained staff. A preliminary screening of the hospitalised patients (among other filtering patients without antibiotics and without signs of infection) can be performed by infection control specialists, nurses or specialist trainees of the department. This can save a lot of time.

Step 6. For each patient, at least gather the following information:

- Department
- Age, gender
- Does the patient receive antibiotics, and, if so, which?
- Is the therapy empirical or targeted, or does it concern prophylaxis?
- What is the indication and is it documented?

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And collect any additional data per prescription depending on the extensiveness of the PPS. For example:

- Dosage
- Starting date
- Form of administration (iv/oral)
- Is the prescription in accordance with the local guidelines taking into account the indication?
- Which microbiological diagnostics have been performed and what are the results thereof?
- Has advice on the treatment been given by a clinical microbiologist, infectious disease specialist or hospital pharmacist?

Etc.

Reporting the point prevalence survey

As it is expected that there is high amount of variation in prescribing behaviour between specialities, the results will be both drawn up and reported for the hospital and the separate departments.
At least report on the following results:

- The percentage of patients who are prescribed antibiotics and the prescription reason (therapy or prophylaxis).
- The percentage of patients for whom the indication for antibiotic therapy is documented in the status.
- The absolute number of prescriptions per indication and the number of prescriptions per indication as a percentage of the total number of prescriptions.

Any other parameters depend on how extensive the PPS is. For the restricted antibiotics that have not yet been included in the day to day monitoring, reporting the amount of prescriptions that have been supported by the correct diagnostics and for how many prescriptions specialist advice was given with respect to the treatment is recommended.

Often it is possible to point out points for improvement based on the PPS data. In this case, the results of the PPS will be discussed with the departments in question and subsequently a plan for improvement will be made together with the treating physicians (see **chapter 7**).

PDF files and links to websites (CHAPTER 5) www.ateams.nl/links/hfst5

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Chapter 6.

Additional audits of (the quality of) the antibiotics use and resistance

Small-scale longitudinal audits of the quality of prescriptions

In addition to the point prevalence survey, it might be useful to zoom in on specific departments or on specific partial aspects of the prescribing behaviour and to perform a temporary longitudinal measurement of the quality of prescriptions: the audit. This allows for an inspection of the quality of prescriptions at a smaller scale and in a more focused and detailed manner in order to gain a clear idea of which improvement goals are a priority. During these audits, the focus lies on one or more of the aspects of prescribing behaviour determined by the A-team, e.g. looking at sending in urine cultures for patients with a complicated urinary infection at the urology and internal medicine departments. It is also possible to look at level assessments for gentamicin in the past year, for example.

Audits can also be considered stewardship tools and can be a part of the PDCA quality cycle because it is also possible to give a recommendation to the prescriber after the audit. This is a very labour-intensive method and

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must be focused and used for a limited time as a result. These audits are preferably conducted on the basis of standardised and validated **quality indicators**.

Quantitative use

In addition to the PPS, it can also be useful to measure the total amount of prescribed antibiotics. An important function of measuring the absolute (or quantitative) use is to monitor **trends over time** within the own institution and identifying the departments where **the use of restricted antibiotics is concentrated**.

Collecting quantitative use data requires less time than collecting qualitative data. Semi-continuous monitoring of the use is possible with relatively little effort and can as a result be relatively easily used in the context of evaluating improvement actions that focus on a reduction of the use of specific agents.

These data are collected in a longitudinal manner and reported over a fixed time period, preferably hospital-wide. Including one denominator as a measure for hospital activity is important to compare data over different periods and for tracking trends over time.

There are various methods for measuring absolute use with various units in the numerator and the denominator. Examples of units in the numerator are: number of treatment days, total number of prescribed courses, or the number of standardised daily doses. Examples of units in the denominator are the number of admissions or the number of patient days. It is important to realise that the use of different denominators can influence the results of the calculations to an important extent. This needs to be taken into account when interpreting those results. It is recommended that both the total number of admissions and the total number of patient days are included as measures of care intensity. If admissions reduce in time and increase in number, then it might seem as if the antibiotics use is decreasing if the denominator is the number of admissions whereas in reality the number of doses per patient day stays the same or even increases. Thus, there is an intensification of the antibiotics use, even though this is not immediately clear in the figures.

A common method to measure the amount of prescribed antibiotics is by expressing it in the number of Defined Daily Doses (DDD). The DDD is a standardised measuring unit defined as 'the average daily dose of a agent if prescribed for the primary indication for adults' (WHO 2003, can be downloaded from our website).

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Use data per agent is collected for a specified period of time. For each agent and method of administration, the prescribed or dispensed quantities (expressed in grams or IU) are obtained from the EPS or the hospital pharmacy data system that can subsequently be recalculated into the standardised DDDs. WHO DDD data can be found through WHO's Anatomical Therapeutic Chemical Classification of Medicines. The WHO defined DDD allows for standardised measurement of the number of prescribed doses, which are subsequently expressed per 100 patient days or per 100 admissions. The data is easy to process in Excel. A tool for this purpose can be downloaded from our website. Moreover, the ESCMID website contains information on the latest version of this tool. The links to the components in question within the websites of the WHO and ESCMID can also be found on www.ateams.nl

The American Centers for Disease Control and Prevention (CDC) has a module for measuring absolute use. In this module, the numerator is the number of antibiotics days for which an antibiotics day is defined as 'any amount of a specific antimicrobial agent administered in a calendar day to a particular patient'. More information regarding this module can be found on the CDC website and via www.ateams.nl.

It is also possible to look at the percentage of admitted patients to whom antibiotics were prescribed on at least one day during the whole admission period.

Average treatment term

Finally, it can be useful to compare the average treatment term over various time periods. Here, too, the effect of admission duration trends needs to be taken into account, for example, by means of increasing options for intravenous treatment outside of the hospital.

Resistance audits

The A-team needs to gain insight into the local resistance data, but does not have a coordinating role in measuring these data. To this end, the team looks for collaboration with the specialists involved: the responsible clinical microbiologist and the Hospital Hygiene and Infection Control department.
Measuring resistance percentages can have various functions. Firstly, knowledge of the local resistance percentages is an important precondition for formulating the local antibiotics guidelines. Moreover, monitoring resistance is essential to identifying elevations that can be a cause of exercising a specific cautious policy with respect to certain agents. The question remains, however, whether the effect of the implementation of stewardship measures on the prevention of resistance (as an outcome measure) in the Dutch setting can always

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be measured locally. The size of a measured effect and the time at which this becomes measurable do not only depend on local interventions, but are also influenced by external factors, such as the resistance percentages in the general population, the occurrences of outbreaks, change in infection control measures and changes in patient populations (including the transfer of patients between hospitals). An example of a stewardship intervention in which an effect on local resistance percentages was measurable is described in **chapter 7**.

Audit methods

- Measuring resistance is done by means of **continuous surveillance** of resistance in isolates from clinical materials or by means of **cross-sectional audits**. Below, you will find a number of tips: Make a number of agreements on the frequency with which resistance data are made available to the A-team.
- For continuous surveillance, link up with the national Infectious Diseases Surveillance Information System - Antibiotics Resistance (ISIS-AR) of the National Institute of Public Health and Environmental Protection (RIVM). This can be used to download data of the own hospital from an interactive website.
- Provide data with respect to at least the following highly resistant micro-organisms (HRMO): ESBL, MRSA, CPE, VRE. This can be expanded by combinations of micro-organisms and resistance patterns tuned to the local situation.
- Consider audits of carrier prevalence of HRMO in the total population of admitted patients. For example, this is possible in combination with the PPS. Which micro-organisms are included depends on the local situation.
- Report resistance data to the Board of Directors at least once a year (see **chapter 2**).
- Together with the Hospital Hygiene and Infection Control department, consider including the percentage of blood cultures with above-mentioned HRMO in the report as a quality indicator.



PDF files and links to websites (CHAPTER 6) www.ateams.nl/links/hfst6

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Chapter 7.
Improving prescribing behaviour
Improvement within an ASP is a custom job

Improvement within an ASP is a custom job

There are many possible interventions to achieve improving the prescription of antibiotics as a result of the already performed audits (**chapters 5** and **6**). An overview of individual stewardship interventions focused on improving the prescribing behaviour is provided in the appendix '**overview stewardship interventions**'.

For the selection of improvement interventions, it is important to link up with the factors that inhibit or improve the correct use of antibiotics. In order to choose the most fitting intervention(s), first a problem analysis is performed of these experience-influencing factors. Individual factors (e.g. employee routines, lack of knowledge of guidelines, fear of complications), factors in a social context (e.g. present convictions in the treatment team, ways of cooperating and communicating) and organisational factors (e.g. available means or facilities, registration systems, protocols) or the (hierarchical) culture of a department or hospital influence the extent in which antibiotics are used correctly.

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An example of a Dutch project in which the barriers for optimal prescription were identified out can be found on www.ateams.nl.

In order to improve antibiotics use successfully, it is vital to offer custom-made work: an intervention that is very successful at one department or hospital can be ineffective in a different setting if other factors are in play.

It is important to map out the following matters when determining the priority of an improvement goal of:

- What are the **consequences** of specific prescribing behaviour? Try to quantify them, for example, by making an assessment of the number of unnecessary treatment days (per agent), or the number of days of unnecessary intravenous therapy, etc.
- What are the **causes** of specific prescribing behaviour? A large number of wide-ranging causes can lie at the basis of the current prescribing behaviour. To this end, contact employees of the department in question.
- Make an inventory of the interventions that is as complete as possible and that can offer an actual **solution** to the identified causes of the current prescribing behaviour. To this end, check the literature, examples of other hospitals, and talk with the prescribers involved or other involved parties at the department in question.

Planning interventions per department might be required. The benefit of this is that the improvement process is reasonably clear and that custom work can be provided. Start with a department where the employees are motivated, where clear improvements can be achieved, but where the problems are not so significant that the improvement process cannot be initiated. It is essential that the department in question is involved with the improvement process from the start in order for the interventions to succeed. To this end, follow the 'Plan-Do-Check-Act' improvement cycle.

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Below, you will find a general step-by-step plan and a number of tips for success:

1. Form an improvement team for each separate department. Within this team, appoint one person who will be co-responsible for the antibiotics use. This person is preferably 'the role model' of the department and can fulfil a coordinating role. Also involve a physician, the department manager and cooperative team manager in this team. Let the practical tasks be performed by the people involved in the department as much as possible.
2. Discuss the cause for setting up the improvement project (the outcomes of the audit or a different cause) during a meeting with all employees of the department based on an individually distributed report. Make sure there is consensus on the improvement goal to be pursued. Do not try to tackle too many prescription problems at the same time. Formulate the improvement goal in a SMART manner (Specific, Measurable, Acceptable, Realistic, Time-bound).
3. Together, draw up a fitting improvement plan that is based on the causes experienced by the employees and that contains the explicit goals, the measure and improvement activities and a realistic time frame: who does what and when? 'Change needs time' always applies!
   - Discuss a fitting (combination of) intervention(s) together with the department in question.
   - Start with an intervention that is easy to execute and of which an immediately visible result is expected; the 'low-hanging fruit'. Combining multiple interventions or performing them consecutively is an option.
   - For the execution of the interventions look at successful initiatives within and outside of your own organisation.
   - Use the methods that were applied there and link up with already available structures as well as possible. **For instance, look for possibilities of integrating improvement projects for antibiotics use and infection control**. Or, for instance, plan to implement improvement activities during structural meetings, link up with existing training activities, etc.
   - Divide tasks properly: who does what and when?
4. Draw up a plan to monitor and assess the efficacy of the intervention(s):
   - Determine the audit frequency (do it regularly!) together with the department.
   - Only measure the standards/indicators that provide information with respect to the intended improvement goal (no more than necessary).
   - Delegate as many activities to the department as possible: appoint one person who will be responsible for measuring the set standards/indicators.
5. Draw up a plan stating who reports on the monitoring results and how often this occurs.

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Examples of thematic improvement projects

Below, examples and backgrounds of a number of thematic improvement projects are discussed.

Supervision on the use of restricted antibiotics by means of standard monitoring and advice

Optimising the use of specific groups of restricted antibiotics can be done relatively easily by integrating it in the day to day monitoring (**chapter 4**). First of all, the formulary must define clear criteria for prescribing these agents, also with respect to performing the correct diagnostics. Subsequently, based on hospital pharmacy data, the patients in question can be identified. For these prescriptions, it is possible to have a first screening based on file data, after which the treating physician can be contacted for advice.

This intervention can be performed throughout the hospital, or (if this is not feasible with the available manpower) it can be targeted at departments where the incorrect use of these agents is prevalent. A focused improvement project can be initiated (**chapter 7**) if necessary and if the desired improvement has not yet been achieved.

An example of a project in which the use of ciprofloxacin was monitored is described below. The complete publication can be downloaded from www.ateams.nl.

The focused improvement of the use of ciprofloxacin with the help of a combination of interventions:

Motivation The results of a point prevalence survey in 2006 at a Dutch hospital (with about 40.000 admissions/year) showed that after amoxicillin-clavulanic acid, ciprofloxacin was prescribed most frequently. Moreover, the percentage of inaccurate prescriptions (assessed according to the PREZIES method; see chapter 5) was highest for ciprofloxacin. The reasons for these inaccurate prescriptions were: incorrect treatment (35%), incorrect choice (40%) or incorrect method of administration (25%). This mainly applied to prescriptions in which the clinical microbiologist was not involved in the treatment. It was most common in the urology department. In light of the ecological effects of ciprofloxacin (see literature review on www.ateams.nl), an intervention for the purpose of decreasing the absolute use by 30% and the number of intravenous administrations by 50% was initiated.

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Interventions and implementation

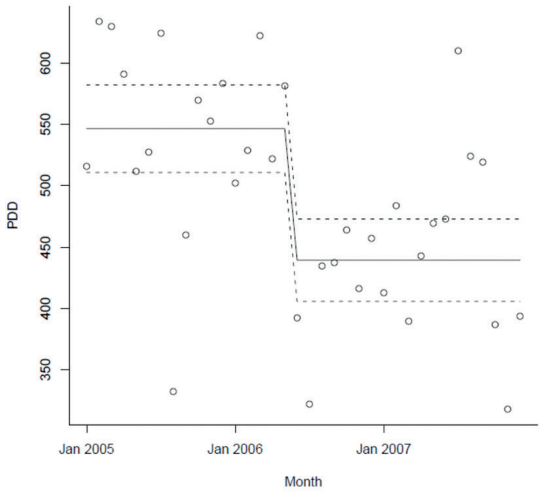
For this project, one project coordinator (Infection Control Specialist) was appointed who was responsible for the practical execution (including data processing) and the coordination of the activities of other people involved (microbiologists, hospital pharmacists and pharmacist's assistants and treating physicians). The following interventions have been implemented in phases over time:

1. Identification by the hospital pharmacy of patients who were eligible for IV-oral switch (based on standardised switch criteria). The pharmacist's assistant contacted the treating physician for these patients.
2. In adjustment to the local antibiotics formulary which clearly stated that ciprofloxacin is a restricted agent that was reserved for the empirical treatment of severe gastro-entitis, prostatitis or deep diabetic ulcers. For other indications, ciprofloxacin could only be prescribed on the basis of culture results.
3. Every culture result was provided with the comment that ciprofloxacin was a restricted agent and could only be prescribed for a select number of indications or in deliberation with a specialist.
4. Active monitoring of all ciprofloxacin prescriptions (based on a daily print of the pharmacy) in which a first screening took place performed by the infection control specialist and, for prescriptions that were not in accordance with the local guidelines, the clinical microbiologist contacted the treating physician for active feedback by telephone. This concerned about
   5 prescriptions per day.

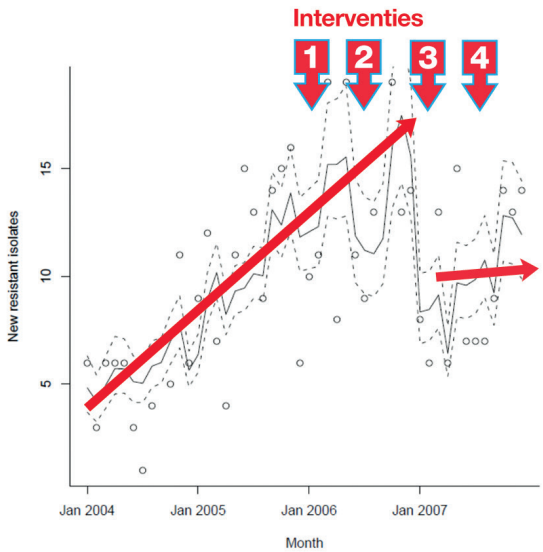
Outcome measures and results

The two main outcome measures were the absolute use of ciprofloxacin, and the resistance percentages (*E. coli*) in clinical materials. The use of ciprofloxacin within the entire hospital (absolute amount in Prescribed Daily Doses) was evaluated on a monthly basis by the team in question (infection control specialist, hospital pharmacist, clinical microbiologist). Resistance percentages were also evaluated on a monthly basis. Both outcome measures have been presented in the figure on the next page. Reducing the use of ciprofloxacin was associated with a clear reduction in resistance percentages.

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Monthly use ciprofloxacin (intravenous and oral) from 2005 through 2007 in PDD. Values predicted by the segmented regression model are shown by the solid line. Broken lines show 95% confidence intervals.



Observed resistance for ciprofloxacin in *E. coli* in hospitalised patients from 2004 through 2007. Values predicted by the best segmented regression model are shown by the solid line. Broken lines show 95% confidence intervals.

Optimising surgical prophylaxis

An audit of the surgical prophylaxis can be an attractive project for the initial phase of an ASP, because surgical prophylaxis concerns a relatively simple action (a one-time administration). The basic principles to which pre-surgical antibiotic prophylaxis should correspond with are also clearly described in guidelines and have been scientifically supported.

Nevertheless, in practice the (very extensive) guidelines are deviated from regularly in some crucial areas. The literature shows that it is important to design the organisational process in particular in such a way that the chances of deviation from the guidelines are minimal. Formulating clear local protocols is an essential precondition here, too, because the international guidelines are infeasible in practice due to how extensive they are. The A-team can play an important role here.

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During an audit, the following five quality indicators are used for measuring the quality of the surgical prophylaxis: indication, timing, choice of agent, dosage and duration.

A clear example of an improvement project for the optimisation of pre-surgery surgical prophylaxis in Dutch hospitals can be found on our website. In this project, ineffective distribution and knowledge of local protocols, lack of consensus with the surgeons regarding the content of the protocols and organisational factors in the operating rooms and the department are the main barriers for following the guidelines. By adjusting the local guidelines, providing better distribution of and education regarding these guidelines and facilitating the logistics, a clear improvement of the quality of the surgical prophylaxis was achieved.

A **guide** with tips for setting up an audit and possible interventions can be found on our website.

Supervision treatment *S. aureus* sepsis

For a lot of patients with an *S. aureus* bacteremia (SAB), the diagnostics and the treatment are not performed in accordance with guidelines. A recent study in a large Dutch hospital (Landman, et al., NTvG, 2011) showed that for 60% of the patients with an SAB, there was no TEE, that inspection blood cultures on day 3 have only been taken for 6% of the patients and that 33% of the patients was not treated long enough. A large Dutch study showed that the mortality among patients with SAB is significantly lower after a combined intervention with bedside consultations and tracking down complications with TEE and PET-CT scan (Vos, et al., Medicine 2012). Internationally, the added value of bedside consultations for patients with SAB has also been corroborated (Forsblom, et al., Clin Infect Dis 2013). That is why it is clear that this topic needs to be included in the 'critical prescriptions' that are eligible for standard monitoring and advice (**chapter 4**).
If apart from its standard monitoring and advice, the A-team chooses to optimise the policy for SAB as a specific improvement project, then pre and post audits must be performed to gain an insight into how well the diagnostics and treatment of *S. aureus* sepsis are performed at the own hospital and what the yield of the improvement project is.

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To this end (retrospectively, e.g. based on data of 1 year), the following parameters will be mapped out:

- Percentage of complicated vs uncomplicated bacteremias (and/or community-acquired vs hospital-acquired).
- Percentage of patients from whom blood cultures were taken.
- Percentage of patients for who bedside supervision by an infectious disease specialist took place.
- Percentage of patients for who a TEE was performed.
- Percentage of patients for who a PET-CT scan was performed.
- Percentage of patients for who complications (endocarditis, spreads) were found due to additional exams.
- Percentage of patients with adjusted treatment term based on identified complications.
- Mortality and/or recurrence percentages.

Subsequently, determine which improvement action is required while paying attention to, among other things, the following:

- Identifying the patients with SAB.
- Initial bedside consultation and advice.
- Follow-up, monitoring results of spread examination and advice of treatment term.
- Prospective measurement of above-mentioned process and outcome indicators.
- Including a treatment protocol in the local formulary.

Streamlining

When improving the prescribing behaviour in the field of streamlining it mainly revolves around finding the patients who are 'invisible' in the day to day monitoring; in other words, those who did not have consultation with a specialist. Moreover, it is important to find out whether additional attention needs to be paid to streamlining in the day to day monitoring for patients who have already been 'identified' for other reasons (e.g. because of a positive blood culture).

Streamlining is defined as evaluating on day 2 or 3 and subsequently on day 7 and, if necessary, adjusting the antimicrobial therapy based on clinical data and culture results. The following decisions can be made in this respect: stop, narrow or targeted switch to a different agent based on the culture results, or switch to oral administration. On day 7, it will also entail determining the treatment term or the continuation of the intravenous therapy in the home situation.

The A-team needs to determine in which way these 'invisible' patients can be identified. For example, this is possible based on treatment term (e.g. treatment longer than 7 days) or on the basis of method of

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administration (e.g. longer than 72 hours of intravenous administration). The hospital pharmacy plays an important part in this. In this way, hospital-wide supervision on streamlining antimicrobial therapy is possible, and the interventions can thus become a part of the day to day monitoring of individual patients.

A requirement for optimum streamlining is the execution of the correct diagnostics.

This important point should be the focus of improvement actions. The PPS is a good method to identify how well diagnostics are performed for common indications, e.g. pneumonia contracted at home. Education regarding the correct methods of sampling and 'logistics' support of the prescriber is essential. Making information available through the web-based formulary is an important precondition.

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Examples of intervention that can be used to structurally support the streamlining process:

- Standard alerts from the pharmacy, e.g. for patients who are treated with intravenous and/or combination therapy for longer than 3 days, for patients who are treated with antibiotics for longer than 7 days or for patients who are treated with restricted antibiotics or 'limited antibiotics'.
- Standard reminders at the department 72 hours after starting antibiotics (if necessary, also possible by means of separate forms or stickers on status).
- Education focused on specific patient categories, e.g. patients who contracted pneumonia or urosepsis at home.

For each selection criterion, map out how many patients are involved every day in order to assess whether evaluating the treatment for all these prescriptions will be possible in the local setting.

Switching from intravenous to oral therapy

Switching from intravenous to oral is one of the parts of streamlining antimicrobial therapy. Oral therapy has a number of benefits over intravenous treatment:

- It is less invasive for the patient (mobility, comfort).
- It reduces the risk of phlebitis.
- It is linked to lower costs (especially a reduction of the indirect costs regarding intravenous administration, such as nurse time).
- Can result in a shorter admission term.

For every patient who gets treated intravenously with an agent for which there is an oral alternative, whether or not the (locally determined) switch criteria have been met needs to be assessed after 48 hours.

A switch programme is often one of the first interventions performed in an ASP. Via the EPS/EPR, patients can be identified relatively easily with a clinical decision-making rule (can be downloaded from our website), the pharmacy plays a central role in this. By involving nurses in the process, the intervention will be relatively easy to execute.

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Dose optimisation

Dose optimisation largely consists of the following 3 interventions:

- Monitoring blood levels of specific agents (vancomycin, aminoglycosides, colistin, azoles) for the purpose of limiting toxicity and maximising efficacy.
- Checking dosages that deviate from the local formulary (the 'standard').
- Adjusting the dose based on individual patient data.

The hospital pharmacist plays an important part in identifying patients for whom the 'standard' dosages are deviated from, in executing level measurements and in adjusting the dose based on reduced liver or kidney functions. The local formulary also plays an important part in this final point. This formulary contains clear instructions for the prescriber on the logistics of the level assessment and which actions need to be taken when and by whom. Examples of protocols can be found on www.ateams.nl.

Bundled interventions

The international literature pleads for the introduction of antibiotics bundles comparable to the bundles described in the VMS practical guides. A bundle is a set of (usually 3 to 5) evidence-based actions that result in a more favourable treatment for the patient if performed correctly together. An 'all or nothing' approach applies here; the simultaneous compliance with all bundle components will be measures per patient. The percentage of patients for whom all bundle components are performed according to the standard can be used as a process measure for monitoring an implemented improvement strategy. In an ASP, a bundle could be a pragmatic approach to improve the prescribing behaviour simultaneously on multiple points. A publication containing an example of an 'antibiotics bundle' can be downloaded from our website.

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Take home messages

The above makes it clear that there are no 'one size fits all' Stewardship programmes. In time, automated integration of data must be achieved so that 'inaccurate' prescriptions will be automatically detected and adjusted.

Dos:

1. Formulate a clear vision and measurable goals. Communicate these within the organisation.
2. Ensure that the task division is clear and try not to fragment coordinating tasks too much.
3. Use the local formulary as a test tool for the quality of the antibiotics use, and make sure that this contains clear recommendations.
4. Draw up a list of critical prescriptions locally and use the day to day monitoring to supervise these prescriptions.
5. Start small and communicate the successes.

Don'ts:

1. Do not start if there is no commitment from the management and the medical staff.
2. Do not start if there are insufficient available means.
3. Try not to tackle too many problems at the same time.

PDF files and links to websites (CHAPTER 7)

www.ateams.nl/links/hfst7

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Literature

1. Dutch Working Party on Antibiotic Policy, 2012. The quality of the antibiotics policy in the Netherlands. Advice regarding the restrictive use of antibiotics and implementing Antibiotics teams in the Dutch hospitals and the Primary line. www.swab.nl
2. Dellit TH, Owens RC, McGowan JE Jr, Gerding DN, Weinstein RA, Burke JP, Huskins WC, Paterson DL, Fishman NO, Carpenter CF, Brennan PJ, Billeter M, Hooton TM; Infectious Diseases Society of America; Society for Healthcare Epidemiology of America. Infectious Diseases Society of America and the Society for Healthcare Epidemiology of America guidelines for developing an institutional program to enhance antimicrobial stewardship. Clin Infect Dis. 2007 Jan 15;44(2):159-77.
3. SWAB. NethMap 2014 – Consumption of antimicrobial agents and antimicrobial resistance among medically important bacteria in the Netherlands. www.swab.nl

An extensive overview of the international stewardship literature is available on the website.

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