Guidelines for the
# Prevention and Containment of Antimicrobial Resistance
in South African Hospitals

**Supporting the Antimicrobial Resistance Strategy Framework and the Guidelines on Implementation of the Antimicrobial Strategy in South Africa:**
One Health Approach and Governance, 2018

National Department of Health
Private Bag X 828, Pretoria, 0001
Republic of South Africa

**health**

Department:
Health
**REPUBLIC OF SOUTH AFRICA**

**NDP**
2030

# CONTENTS

# LIST OF FIGURES

# LIST OF TABLES

# FOREWORD

South Africa pledged its commitment to the World Health Assembly resolution EB134/37 "Combating antimicrobial resistance including antibiotic resistance", adopted in May 2014, to develop a National Action Plan on Antimicrobial Resistance (AMR). By October 2014 our *AMR National Strategic Framework, 2014-2024* was developed and launched with the commitment of most of the key stakeholders within human and animal health, agriculture, and science and technology sectors to support interventions to combat AMR in the country.

The *AMR Strategic Framework* defines South Africa's approach to manage AMR and limit further increases in resistant microbial infections and improve patient outcomes and livestock production and health. The vision is "to ensure the appropriate use of antimicrobials by healthcare and animal health professionals in all health establishments in South Africa to conserve the efficacy of antimicrobials for the optimal management of infections in human and animal health".

**Ms Precious Matsoso**
*Director-General:*
*National Department of Health*

A key component of the Strategic Framework is the institutionalisation of AMR activities within all health facilities in South Africa. The Guidelines for the Prevention and Containment of AMR in South African Hospitals aim to serve as a practical, step-by-step or 'how to' guide, addressing the infection prevention and control (IPC) and antimicrobial stewardship (AMS) components of a robust response in a hospital.

Taking the holistic view that IPC and AMS are interrelated activities and require the same multidisciplinary and multimodal approach, these guidelines seek to introduce the implementation of prevention, containment and AMS activities.

The guidelines were developed by a task team of IPC and AMS experts from both the public and private sectors and reviewed by the Ministerial Advisory Committee on AMR, provincial AMR champions and experts in the public and private sectors working in AMR and IPC. These guidelines are therefore applicable to both the public and private health sectors.

Working together we can change direction to contain AMR and ensure that people have access to safe and effective antimicrobials.

**Ms Precious Matsoso**
*Director-General: National Department of Health*

# ACKNOWLEDGEMENTS

# PURPOSE OF THE DOCUMENT

These guidelines form part of efforts to institutionalise the prevention and containment of antimicrobial resistance (AMR) in health care facilities in South Africa, as outlined in the Antimicrobial Resistance Strategic Framework[1] and Implementation Plan.[2] The focus of these guidelines is on two interrelated aspects of prevention of healthcare associated infections (HAIs) and their spread; and the application of antimicrobial stewardship (AMS) practices at hospital level. They aim to serve as a practical, step-by-step or 'how-to' guide, addressing the infection prevention and AMS components of a robust response in a hospital. They draw on evidence from various international guidance documents and standards for interventions that have been shown to be successful in infection prevention and AMS programmes. [3, 4, 5, 6, 7] These interventions have been customised to the South African hospital setting based on local experiences in the public and private health sectors. This was done through a series of workshops and requests for comment involving country-level experts.

The focus of the guidelines will be on prevention of HAIs and stewardship of antibiotics used to treat bacterial infections other than tuberculosis, however the suggested interventions can be applied equally to antifungals as they share the same stewardship principles. National guidelines already exist for the management of multidrug-resistant tuberculosis and HIV.

The guidelines are intended for use by a multidisciplinary cadre of healthcare professionals – doctors, nurses, pharmacists, microbiologists, and infection prevention and control (IPC) practitioners, in their day-to-day management of AMR in a hospital setting.

The guidelines should also be read in conjunction with the Guidelines on Implementation of the Antimicrobial Strategy in South Africa: One Health Approach and Governance, which provides direction on the governance structures within hospitals that should be established. These are further dealt with in Section 2.

1 National Department of Health. South African Antimicrobial Resistance National Strategy Framework; A One Health Approach and Governance; 2017 – 2024; Pretoria 2014 (updated 2018)
2 National Department of Health. Implementation Plan for The Antimicrobial Resistance Strategy Framework in South Africa: 2014–2019. Pretoria; 2015.
3 Centers for Disease Control and Prevention. Core elements of hospital antibiotic stewardship programs. Atlanta, GA: US Department of Health and Human services, CDC; 2014
4 Australian Commission on Safety and Quality in Health Care. Antimicrobial stewardship in Australian Hospitals; 2011.
5 Public Health England. Start Smart – Then Focus. antimicrobial stewardship toolkit for English Hospitals; 2015
6 Tonkin-Crine SKG, Tan PS, van Hecke O, Wang K, Roberts NW, McCullough A, Hansen MP, Butler CC, Del Mar CB. Clinician-targeted interventions to influence antibiotic prescribing behaviour for acute respiratory infections in primary care: an overview of systematic reviews. Cochrane Database of Systematic Reviews 2017;9: CD012252.
7 T. F. Barlam et al. Implementing an Antibiotic Stewardship Program: Guidelines by the Infectious Diseases Society of America and the Society for Healthcare Epidemiology of America. Clinical Infectious Diseases, 2016;62(10):e51–e77

# DEFINITIONS

| | |
|---|---|
| **Antibiogram** | A report displaying the sensitivity of a set of microbes to one or more antimicrobials. |
| **Antimicrobial** | A substance that may be natural, semi-synthetic or synthetic, which can kill or inhibit the growth of microorganisms. This includes antibiotics (i.e. antibacterials), antivirals, antifungals, antihelminthics and antiprotozoals. |
| **Antimicrobial Steward-ship (AMS)** | AMS is a multi-disciplinary, systematic approach to optimising the appropriate use of one or more antimicrobials to improve patient outcome and limit emergence of resistant pathogens whilst ensuring patient safety. |
| **Antimicrobial resistance (AMR)** | When a microorganism is rendered resistant to one or more antimicrobials used to treat or prevent it. |
| **Diagnostics** | The tools used to determine the nature of a disease or condition, or to distinguish one disease or condition from another. Diagnostics may include physical examination, radiological investigations, laboratory tests, or biomarker results. |
| **Diagnostic stewardship** | The coordinated intervention to improve and measure the appropriate use of microbial diagnostics to identify pathogens and guide therapeutic decisions by promoting appropriate and timely selection and collection of specimens, accurate and timely testing, and reporting of results. |
| **Hang-time** | The time from prescription (be it handwritten or as part of an electronic order) of an intravenous antimicrobial to the time of infusion of said antimicrobial. |
| **Healthcare-associated infection (HAI)** | An infection that is acquired in a healthcare facility by a healthcare user, healthcare worker or visitor to a healthcare facility. Such an infection should not have been clinically or radiologically apparent at the time of admission or at the time of initial contact with the healthcare facility. The term includes infections that appear after discharge, including any infection in a surgical site up to 30 days after the operation or within one year for implants. This also includes occupational infection amongst facility staff. |
| **Infection prevention and control (IPC)** | A systematic approach to prevent infectious diseases and control their spread in the community and to patients and healthcare workers in healthcare establishments. Infection prevention refers to measures, practices, protocols and procedures that are geared towards preventing the transmission of infection within a healthcare setting. |
| **Ministerial Advisory Committee on AMR (MAC-AMR)** | The multi-disciplinary, intersectoral committee mandated to advise the Minister of Health on matters relating to AMR; to coordinate intersectoral efforts nationally; provide advocacy and awareness; as well as monitoring and evaluation of the implementation of the AMR Strategy Framework. |
| **Personal Protective Equipment (PPE)** | Items specifically used to protect healthcare personnel from exposure to body substances or from droplet or airborne organisms. This includes, but is not limited to gloves, aprons, gowns, caps, face covers, and protective eyewear. |

| Prescriber | Any person authorised to prescribe medicines in terms of the Medicines and Related Substances Act, 1965 (Act no. 101 of 1965) and the Nursing Act, 2005 (Act no. 33 of 2005). |
|---|---|
| Surveillance | Surveillance is the systematic, longitudinal collection, analysis and interpretation of data, closely integrated with timely dissemination of results to those who require them so that remedial action can be taken. The final phase in the surveillance chain is application of the information to disease control and prevention. |
| Standard precautions | Standard precautions are a set of infection control practices used to prevent transmission of diseases that can be acquired by contact with blood, body fluids, non-intact skin (including rashes), and mucous membranes. These include hand hygiene, appropriate use of personal protective equipment, patient placement, cleaning patient equipment between patients, clean environment, healthcare waste management, laundry, safe handling of sharps, injection safety, occupational health, and respiratory hygiene. |
| Transmission-based precautions | Transmission-based precautions are always in addition to standard precautions and are based on the routes of transmission. These include contact, droplet and airborne precautions. |

# ANTIMICROBIAL RESISTANCE PREVENTION AND CONTAINMENT FRAMEWORK

The framework takes a patient-centred approach, following the patient from the time of admission to diagnosis and treatment of hospital-acquired or community-acquired infections and includes the precautions that should be applied to prevent hospital-acquired infections from occurring as well as their spread. It consists of two main components, infection prevention and antimicrobial stewardship (AMS) (see Figure 1), which are underpinned by training, to improve healthcare professional skills.

**Figure 1:** Framework for the prevention and containment of AMR in South African hospitals

## Infection Prevention

**Prevention of health care associated infections and spread**

- Hand Hygiene
- Personal Protective Equipment
- Standard Precautions
- Environmental cleaning
- Decontamination of equipment
- Transmission based precautions

**Bundles of infection interventions**

**Monitoring and evaluation of prevention interventions and HAI surveillance**

## Antimicrobial Stewardship

**Structures for governance and oversight**

**Facility level interventions**

**Patient level interventions**
- Does the patient need an antimicrobial
- Which antimicrobial
- Now that they have an antimicrobial what next

**Monitoring and evaluation of AMS interventions**

**Training** - In service and behavior change

The main components of the implementation framework include:

- **Infection Prevention**
  - o The prevention of healthcare-acquired infections (HAI) from occurring through the use of standard precautions (see definition).
  - o The application of evidence-based multimodal strategies including infection prevention and control (IPC) bundles to prevent HAIs from occurring.
  - o However, once a HAI is acquired, infection control measures (such as transmission-based precautions) may be required in addition to the standard precautions to ensure that the infection doesn't spread to other patients or healthcare workers (HCWs).
  - o Monitoring both the effectiveness and compliance to IPC measures and the impact of multimodal strategies including bundles of care and HAI surveillance is required to determine gaps and put in place corrective measures.
  - o Immunisation of HCWs against relevant communicable diseases such as hepatitis B should be provided.

- **Antimicrobial Stewardship** seeks to systematically optimise the appropriate use of antimicrobials to treat community-acquired infections or HAIs by applying evidence-based practices, and consists of four key components:
  - o Structures to oversee stewardship at the facility and technical expertise in the form of AMS teams to perform stewardship activities at the bedside.
  - o Facility-level interventions such as local antimicrobial prescribing guidelines, pre-prescription authorisation and prospective audit of antimicrobial use.
  - o Patient-level interventions which help to identify the organisms responsible for the infection using the appropriate diagnostic tools. Once an infection is diagnosed and it is determined that an antimicrobial is required, it becomes important to ensure that the correct antimicrobial is chosen, administered in the correct dose and for the appropriate period of time.
  - o A strong monitoring and evaluation system, which monitors for AMR and assesses compliance to AMS and infection prevention interventions.

- Underpinning the process is an effective on-going in-service training programme of healthcare professionals to understand AMR, their role in prevention of infections and their containment, how to follow treatment guidelines and ensure that patients are receiving the correct level of care and appropriate treatment every time.

In the next few chapters, each step of this process will be detailed including what the interventions should be and who is responsible, as well as providing the tools to support implementation, monitoring and evaluation.

# 1. PREVENTION OF HAIs

A key step to mitigate AMR is to prevent HAIs from occurring. In the setting of a healthcare facility this is relevant on a day-to-day basis and impacts ALL health care workers and support staff who are in contact with patients or each other.

## 1.1. IPC measures using a multimodal approach

**Figure 2:** *Five common multimodal components*

> The five most common multimodal components for infection prevention include:
>
> 1. **System change:** availability of the appropriate infrastructure and supplies to enable the implementation of infection prevention recommendations.
> 2. **Education and training** of HCWs and key players.
> 3. **Monitoring** infrastructure, practices, processes, outcomes and providing data feedback;
> 4. **Reminders** and communication improvements in the workplace.
> 5. **Culture change** within the establishment or the strengthening of a safety climate.

Multimodal strategies have shown to be effective in bringing about change and reduction in infections because safe patient care is implemented using different components with the same goal in mind: to introduce a change in culture thereby reducing infection.

A multimodal strategy is comprised of several elements or components (see Figure 2) implemented in an integrated way with the aim of

*The prevention of infection is everyone's responsibility and must be overseen by a healthcare worker, ideally with infection prevention and control expertise and training.*

improving an outcome and changing behaviour. It includes tools such as bundles and checklists, which are developed by multidisciplinary teams that take into account local conditions. For more details on the multimodal approach please refer to Annexure A.

Prevention of HAIs includes the following multimodal aspects:[8]

## 1. System changes

a. Healthcare facility managers need to engage and commit to reducing infection rates.
b. There must be a ring-fenced budget for IPC equipment and investigation of outbreaks.
c. Infrastructure to support IPC must be in place including procurement and supplies.
d. Access to microbiology laboratory support for aetiological diagnosis of infection and antimicrobial resistance testing at least to secondary level hospitals with a referral system in place for remote facilities.

## 2. Education and training

a. All healthcare facilities need to have trained infection prevention professionals who have dedicated time for IPC as part of their job description.
b. They must be trained in evidence-based IPC processes and act as a resource for other HCWs.

---

8   World Health Organization. 2018. Improving infection prevention and control at the health facility: interim practical manual supporting implementation of the WHO Guidelines on Core Components of Infection Prevention and Control Programmes.

c.  The recommended minimum ratio is at least one trained full-time IPC practitioner per 250 acute care beds as per the World Health Organization (WHO) guidance.[9]

d.  IPC practitioners in healthcare facilities will be responsible for training other HCWs in evidence-based IPC practices.

e.  IPC practitioners will attend regular in-service training and scientific meetings of the National Infection Control Societies, such as the Infection Control Society of Southern Africa (ICCSA), to keep abreast of recent developments.

## 3.  Monitoring

a.  Annual assessment to monitor improvement in IPC standards from baseline using the Infection Control Assessment Tool (ICAT).[10]

b.  The simplest and most effective way to implement this would be regular point prevalence survey (PPS) of HAIs including appropriate antibiotic usage.

c.  A risk assessment is recommended to develop clear objectives that evaluate and contribute to prevention of HAIs and the prevention of the spread of AMR.

## 4.  Reminders in the workplace

a.  Posters and visible reminders in the workplace.

b.  An IPC manual with the essential IPC practices should be available as a reference in each clinic area of the healthcare facility.

c.  An application which can be downloaded to the HCW mobile phones should be considered.

## 5.  Culture change

a.  Feedback from the monitoring of IPC practices and appropriate use of antibiotics will result in change in practice.

b.  IPC practitioners must be supported by management to have the authority to support and train all categories of staff

(including non-medical staff) in IPC at healthcare facility level.

Although many of these aspects are already dealt with in other guidelines (see Annexure A for a summary of the most important components), it is important that HCWs are reminded of the key principles and important concepts and actions that each hospital should take to prevent HAIs as part of the AMR prevention strategy.

## The sections below provide an overview of the key strategies to reduce the incidence of HAIs and prevent their spread.

### 1.1.1.  Hand hygiene

The most common route of transmission of HAI pathogens is through direct contact between healthcare professionals and patients, thus hands are the main route of transmission in healthcare facilities. Hand hygiene is the most important evidence-based intervention for the prevention of transmission of organisms following direct contact with patients, other HCWs or contaminated equipment such as bedpans or urinals.[11]  Hand hygiene is a general term referring to "any action of hand cleansing" including *hand washing* with plain or antimicrobial soap and water and *hand cleansing* which is for the purpose of "physically or mechanically removing dirt, organic material, and/or microorganisms".[6]

When hands need to be cleaned depends on the activity and associated risk of transferring microbes to or from a patient. Generally, hand hygiene is carried out after performing any activity that may contaminate the hands and transfer microbes to the patient. The WHO defines **5 moments for hand hygiene** which should be practiced (see Figure 3):[12]

1.  **Before patient contact:** clean hands before every direct contact with a patient.

2.  **Before any task requiring asepsis:** clean hands immediately before any task requiring an aseptic approach. Examples

---

9   World Health Organization. Core components of IPC. NCS regulations on Quality of care in Health Establishments. Geneva; 2016.
10  National Department of Health. Infection Control Assessment Tool: A Standardized Approach for Improving Hospital Infection Control Practices. Pretoria; 2012.
11  World Health Organization. WHO guidelines on hand hygiene in health care. Geneva; 2009.
12  World Health Organization. 5 moments for hand hygiene. http://www.who.int/gpsc/5may/background/5moments/en/

Guidelines for the Prevention and Containment of Antimicrobial Resistance in South African Hospitals

include the insertion of indwelling urinary catheters, central intravascular catheters, peripheral vascular catheters, or other invasive devices that do not require a surgical procedure.

3. **After body fluid exposure:** clean hands immediately after any exposure to body fluids (i.e. excretions, mucous membranes, broken skin, and wound dressings), even if there was no noticeable contact, and after any glove removal.

4. **After patient contact:** clean hands when leaving the patient if you have touched her/him in any way, e.g. when taking a pulse or blood pressure or lifting a patient.

5. **After contact with patient surroundings:** when leaving a patient, clean hands even if the patient has not been touched directly, e.g. after touching inanimate objects (including medical equipment, patient files etc.) in the immediate vicinity of the patient.

**Figure 3:** *The WHO 5 moments for hand hygiene*
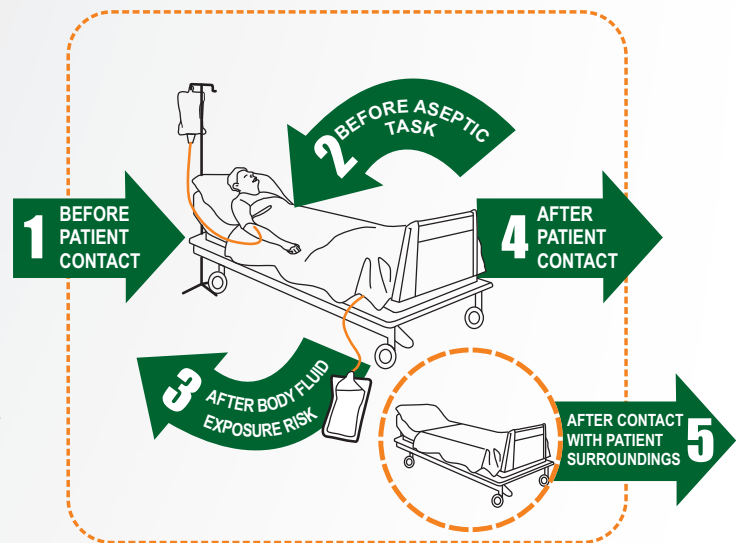


*Source: WHO, Guidelines on Hand Hygiene in Health Care: First global patient safety challenge; clean care is safer care. 2009*

## Recommendations

- Hand washing is recommended when hands are visibly soiled; wash hands with soap and water and dry thoroughly.

- The use of **alcohol-based handrub** is for hands that are visibly clean but have been in contact with patients or potentially contaminated surfaces.

- Alcohol-based handrub is inactivated by organic matter and therefore will not remove organic material or dirt.

- Alcohol-based handrub is usually preferred by healthcare professionals because it is quick, easy to use and usually kinder to the hands.

Table 1 below summarises the methods of hand hygiene, the aim thereof, what product is to be used and the main indications for using that hygiene method. For more details on hand hygiene methods and products please refer to the Cleanliness Guidelines for Health Workers.[13]

**Table 1:** *Summary of hand hygiene methods*

| Method | Aim | Products | Main indicators |
|---|---|---|---|
| Social hand hygiene | Remove transient microbes | • Wash with plain liquid soap and water and dry thoroughly with a paper towel | • When visibly soiled<br>• After personal hygiene processes<br>• After handling disposable waste |
| Aseptic hand hygiene | Destroy or remove transient microbes | • Wash with antiseptic liquid soap (chlorhexidine) or alcohol-based handrub | • Before aseptic procedures or insertion of sterile devices |
| Surgical hand hygiene | Reduce resident microbes on skin for prolonged time | • Three-minute washing with antiseptic agents (2% or 4% chlorhexidine)<br>• NO SCRUBBING/ NAIL BRUSH<br>• Alcohol-based handrub can be used between patients | • Starting operating sessions or between procedures when contact with patient's bacteria occurred<br>• Use alcohol-based handrub between cases |

## 1.1.2. Standard precautions

Standard precautions are designed to reduce the risk of transmission of microorganisms from both recognized and unrecognized sources of infection in healthcare settings.

Standard precautions are the basic level of infection control precautions which are to be used, as a minimum, in the care of all patients.[14] **They apply to ALL patients and in all situations, regardless of diagnosis or presumed infection status** because all patients can serve as reservoirs for infectious agents.

Standard precautions apply to most contacts with the patient particularly if there is the risk of exposure to:

- blood;
- body fluids, secretions, and excretions except sweat, regardless of whether they contain visible blood;
- non-intact skin; or
- contact with mucous membranes.

Standard precautions for prevention of HAIs include:

- Hand hygiene by all HCWs and staff;
- Appropriate use of personal protective equipment (PPE);
- Use of transmission-based precautions including patient placement;
- Environmental cleaning to ensure a safe and clean environment;
- Cleaning and decontamination of medical devices;
- Healthcare waste management and correct disposal according to colour coding;
- Laundry;
- Cleaning of patient items between each patient use such as bedpans and urinals;
- Safe disposal of sharps;
- Injection safety;
- Occupational health; and
- Respiratory hygiene.

(See Annexure A for more details).

## 1.1.3. Environmental cleanliness

Definitions of patient 'environment' which requires environmental cleaning vary widely, however the definition within the healthcare context includes high-touch surfaces on the ward and treatment areas, floors, walls, bedside lockers, bed-curtains. It may also include some parts of medical devices that have patient contact such as blood pressure cuffs as well as items that have prolonged patient contact (mattress/pillow covers, curtains).

The routes of infection may be short (e.g. source to patient to staff hand to susceptible patient) or multi-step (e.g. source to patient to air to surface to staff hand to susceptible patient). A classic example is the communal use of bedpans and urinals that are not properly cleaned and disinfected.

Hand wash basins and sinks have recently been shown to be a major source of multidrug-resistant organisms (MDROs) because of their ability to produce biofilm and survive in the presence of disinfectants. By tipping contaminated fluids down the sink, the risk is increased not only because of encouraging growth but also splashing and contamination of the HCWs. Regular cleaning is essential.

The environment of the hospital must always be clean and dry, with intact surfaces to reduce harbouring of dirt and pathogens. There must be clear instruction and training for the teams who carry out environmental cleaning and a robust but simple means of evaluating cleanliness other than by visual assessment must be established.

Different staff groups may be responsible for cleaning different environmental items (e.g. floors, bed-curtains, blood pressure cuffs, monitoring equipment) and this must be clearly defined in a Standard Operating Procedure for the hospital.

The environmental surfaces must be cleaned at least daily, and more frequently in high risk areas. Routinely, cleaning with water and detergent is sufficient - no disinfectant is required as these promote AMR. However, for terminal cleaning, disinfection of the environment AFTER thorough

---

13 National Department of Health. Draft, Cleanliness Guideline for Health Workers. Pretoria; 2015.

Guidelines for the Prevention and Containment of Antimicrobial Resistance in South African Hospitals

clean is recommended. Again, the appropriate disinfectant must be used in the correct dilution and for the recommended contact time with the surface to be disinfected.

### 1.1.4. Disinfection and decontamination

The WHO Decontamination Guidelines (2016)[14] clearly outlines and emphasises the need for optimal cleaning, disinfection and sterilization of reprocessed medical devices that are used for patient care.

*All reprocessed medical devices intended for use on patients must be thoroughly cleaned prior to either disinfection or sterilization - there are NO exceptions.*

The WHO Decontamination Guidelines make use of Spaulding's classification, which divides medical devices into categories based on the patient's risk of infection due to contact with the various types of devices. This is summarised in Table 2 below.

**Table 2:** *Spaulding's classification for decontamination*

| Risk classification | Type of decontamination required |
|---|---|
| Critical<br>high risk | Any reprocessed medical device (such as surgical devices) used to enter a sterile cavity (e.g. abdominal cavity, cranium, joint cavity) will require sterilization either by steam (if heat stable) or by chemical means (if heat sensitive). |
| Semi-critical<br>medium risk | Medical devices that come into contact with non-intact skin and mucous membranes will require high level disinfection or, rarely, sterilization. Examples include endoscopes (gastroscopes, bronchoscopes) and respiratory devices.<br>It is recommended that one ventilator tubing be used per patient and not to be reused between patients, because the tube is long, coiled and can neither be cleaned nor disinfected properly. |
| Non-critical<br>low risk | Devices that come into contact with intact skin, environmental surfaces or other areas which pose a low risk will require thorough cleaning and drying, with low level disinfection if indicated. Examples include blood pressure machine cuffs and thermometers. |

For further guidance on the required infrastructure and standard procedures for effective sterilisation and decontamination reprocessing of medical devices, please refer to Decontamination and Reprocessing of Medical Devices for Healthcare Facilities (WHO).[15]

## 1.2. Infection control bundles of care for the prevention of HAIs

A bundle is a structured way of improving the processes of care and patient outcomes. They consist of a small, straightforward set of evidence-based practices — generally three to five — that, when performed collectively and reliably, have been proven to improve patient outcomes and prevent the development of HAIs.

Bundles should be part of a multimodal strategy to prevent infection.

See the following resources for an explanation of the details of the common bundles of central line-associated bloodstream infections (CLABSI), catheter-associated urinary tract infections (CAUTI), surgical site infections (SSI), peripheral line-associated bloodstream infections (PLABSI) and ventilator-associated pneumonias (VAP):

• Annexure B

• Best care... Always! website (www. bestcare.org.za)

• Institute for Healthcare Improvement website (www.ihi.org/Topics/Bundles/ Pages/default.aspx)

---

14 World Health Organization. Decontamination and Reprocessing of Medical Devices for Health-care Facilities. Geneva; 2016. http://www.who.int/infection-prevention/publications/decontamination/en/
15 Guidelines on core components of infection prevention and control programmes at the national and acute health care facility level. Geneva: World Health Organization; 2016.

## 1.3. Preventing the spread of infection

Transmission-based precautions **are always IN ADDITION to standard precautions** and are designed to interrupt transmission of highly transmissible or epidemiologically important pathogens based on the **route of transmission.** Common practise to all three types of precautions include gloves, disposable gowns/ aprons and isolation of the patient, if indicated (see Figure 4). In addition, the isolation cubicles, should ideally have their own dedicated equipment for patient use.

**Figure 4:** *Transmission-based precautions*

| Transmission-based precautions |
| --- |
| **Contact**<br>• Gloves and placement |
| **Droplet**<br>• Facemask to protect mucous membrances |
| **Airborne**<br>• N95 respirator and negative pressure ventilation and placement |

Identifying when to use transmission-based precautions is the role of the IPC staff in consultation with the doctor, microbiologist and nurse in charge of the unit. A tool to support this task is the "alert organism list" which helps identify patients with resistant organisms in the hospital. An example of such a report is provided in Annexure C. "Alert" organisms are those that either necessitate an infection control intervention as they are important from a public health perspective (outbreak prevention or control) or may serve as an indicator of inadequate infection control practices or processes.

The action to be taken will depend on each hospital's practices and should be undertaken in consultation with facility level microbiologists or infectious disease/ infection control experts and infection control guidelines. The nurse in charge of the ward and the doctor responsible for the patient concerned should be informed and be involved where necessary in any action is to be taken. Their role will be to implement and enforce appropriate IPC measures.

## 1.3.1. Contact precautions

Conditions and/or organisms (either colonising or pathogenic) which require contact precautions include the following:

• Antimicrobial-resistant bacteria transmitted by contact such as but not limited to methicillin-resistance *Staphylococcus aureus* (MRSA), *Acinetobacter,* Vancomycin-resistant enterococci, multi- and extensively drug-resistant Gram-negative bacteria (GNB), *Candida* spp etc.

• Conditions: skin infections, diarrhoeal diseases.

• In addition, procedures such as wound dressing or where contact with faeces, urine, secretions or excretions is anticipated necessitate contact precautions.

Patients who need contact precautions should ideally be placed in a single room (if possible, with *en suite* ablution facilities or a commode) and the door closed. However, if such facilities are not available the patient should be nursed in the ward separated from the rest of the patients by at least 2 metres or cohorted (i.e. patients managed in adjacent beds).

There should be dedicated equipment used for the patient, ideally disposable, such as stethoscopes, blood pressure cuffs and thermometers. Should disposable equipment not be available then decontamination procedures in accordance with standard operating practices should be applied to the equipment used for infectious patients including those in isolation. The room should be cleaned thoroughly and disinfected between each patient use and after discharge (terminal cleaning). Any shared equipment is to be cleaned with hospital disinfectant (e.g. disposable detergent disinfectant-impregnated wipes) after each use. All linen, including bed curtains, should be removed after discharge.

A "**Contact Precautions**" sign (see Figure 5) should be affixed to the door to remind staff of the precautions they need to apply which include the following:

• Hand hygiene before and after entering the room.

• Put on gloves before entering the room.

- Put on a disposable gown/apron prior to entering the patient's room when direct contact with the patient or the patient's environment is anticipated.

- Keep door closed at all times.

- Remove and discard gloves and gown and clean hands before leaving the patient's room or, in a semi-private room or multi-bed bay situation, before leaving the patient's immediate vicinity.

**Figure 5:** *Contact precautions signage*



**CONTACT PRECAUTIONS**

**ALL VISITORS AND STAFF**

**STOP**

**REPORT TO NURSE IN CHARGE**

**INSTRUCTION BEFORE ENTERING THE ROOM**

| | HANDS | Use alcohol rub or wash hands before touching patient |
|---|---|---|
| | PROCEDURE MASK | Wear fluid resistant mask ONLY IF danger of splash contamination |
| | APRONS GLOVES | Wear an plastic apron when entering the room. Wear gloves for contact with the patient or secretions excretions |
| | DOOR | Keep door closed as long as patient is in isolation |
| | BEFORE LEAVING | Decontaminate equipment when it leaves the room. Discard gloves, apron and mask. Carry out hand hygiene before leaving the room. |

Source: Infection Prevention and Control Manual: Tygerberg Hospital

Contact precautions may be discontinued following consultation between the clinical and IPC teams but usually lasts until the patient is discharged.

## 1.3.2. Droplet precautions

Transmission occurs when droplets containing microorganisms generated from an infected person are propelled a short distance (about 1 metre) away, and come in contact with another person's conjunctivae or mucous membranes (eyes, nose or mouth). Droplets do not remain suspended in the air but travel for short distances before they fall due to gravity, landing on surfaces surrounding the patient, thus contaminating the environment. Microbes transmitted by the droplet route include influenza and other respiratory viruses, and *Neisseria meningitidis,* the cause of meningococcal meningitis. Some viruses and bacteria survive outside the body in the presence of mucous, serum and organic matter.

Risk-prone procedures for droplet transmission in hospitals include:

- Coughing up or inducing sputum production for laboratory tests;

- Endotracheal suctioning (open and closed) of ventilated patients;

- Chest physiotherapy;

- Taking Chest X-Rays from patients who are coughing, especially with poor cough etiquette;

- Bronchoscopy;

- Re-use of ventilator circuits and respiratory equipment;

- Washing and cleaning respiratory ventilation equipment in clinical areas without adequate knowledge or protection.

Patients on droplet precautions usually require a private room with the door closed at all times. Patients are encouraged to remain in their room except for essential purposes. However, if private rooms are not available the patient should either be nursed in the ward close to a window and separated from the rest of the patients by at least 2 metres or they should be cohorted.

A **"Droplet Precautions"** sign (see Figure 6) should be affixed to the door or at the bedside. HCWs should wear a face mask that covers the mouth and nose, such as a regular surgical mask, and eye protection (safety goggles, face shield) if high risk procedures that generate large numbers of droplets are being undertaken.

Droplet precautions may be discontinued when symptoms resolve or when criteria for discontinuing precautions have been met.

**Figure 6:** *Droplet precautions signage*



DROPLET PRECAUTIONS

ALL VISITORS AND STAFF

STOP

REPORT TO NURSE IN CHARGE

INSTRUCTION BEFORE ENTERING THE ROOM

| | HANDS | Use alcohol rub or wash hands before touching patient |
|---|---|---|
| | PROCEDURE MASK | Wear fluid resistant mask ONLY IF danger of splash contamination |
| | APRONS GLOVES | Wear an plastic apron when entering the room. Wear gloves for contact with the patient or secretions excretions |
| | DOOR | Keep door closed as long as patient is in isolation |
| | BEFORE LEAVING | Decontaminate equipment when it leaves the room. Discard gloves, apron and mask. Carry out hand hygiene before leaving the room. |

Source: Infection Prevention and Control Manual: Tygerberg Hospital

### 1.3.3. Airborne precautions

Airborne precautions are required for patients infected with **tuberculosis, measles, and chickenpox.** Airborne droplet nuclei (particles sized 5 microns or smaller) carry the microbe and may be released into the air to be carried via air currents. These droplet nuclei can remain suspended in the air for prolonged periods of time.

Negative pressure air handling (ventilation) is required for isolating patients diagnosed or suspected of being infected with the above organisms and should provide no less than 6 air changes per hour (ACH). Ideally a private negative pressure isolation room (NPIR) should be available within all facilities. In the absence of negative pressure ventilation, open window ventilation with fans may be used to reduce the microbial burden in the environment and should achieve around 6-12 ACH. All HCWs

entering the room of a patient with suspected or confirmed tuberculosis, should wear a fit-tested N95 respirator or equivalent.

An **"Airborne Precautions"** sign (see Figure 7) should be affixed to the door. Airborne precautions may be discontinued following consultation between the clinical and IPC team or when the patient is discharged.

**Figure 7:** *Airborne precautions signage*



AIRBORNE PRECAUTIONS

ALL VISITORS AND STAFF

STOP

REPORT TO NURSE IN CHARGE

INSTRUCTION BEFORE ENTERING THE ROOM

| | HANDS | Use alcohol rub or wash hands before touching patient |
|---|---|---|
| | PROCEDURE MASK | Wear fluid resistant mask ONLY IF danger of splash contamination |
| | APRONS GLOVES | Wear an plastic apron when entering the room. Wear gloves for contact with the patient or secretions excretions |
| | DOOR | Keep door closed as long as patient is in isolation |
| | BEFORE LEAVING | Decontaminate equipment when it leaves the room. Discard gloves, apron and mask. Carry out hand hygiene before leaving the room. |

Source: Infection Prevention and Control Manual: Tygerberg Hospital

## 1.4. Surveillance of HAIs in the hospital

HAIs are the most common adverse events related to hospitalisation and have a major impact on morbidity, mortality and healthcare costs. The most common HAIs in low- and middle-income countries (LMICs) were reported to be surgical site infections (SSI) (29%), followed by urinary tract infections (UTI) (24%), bloodstream infections (BSI) (19%) and hospital-acquired pneumonia (HAP) (15%).[16, 17] However, these

16 Allegranzi B, Nejad SB, Combescure C, Graafmans W, Attar H, Donaldson L, et al. Burden of endemic health-care-associated infection in developing countries: systematic review and meta-analysis. The Lancet. 2011;377(9761):228-41.
17 World Health Organization. Report on the burden of endemic health care-associated infection worldwide. Geneva; 2011.

rates differ considerably by region, hospitals and type of ward.

Surveillance is the first important step in identifying practices that can lead to IPC issues and priorities related to HAIs and IPC. In other countries, national surveillance for HAIs, including mechanisms for timely feedback, has led to significant reductions in HAI rates[18].

### 1.4.1. Purpose of surveillance for HAIs

A standardised surveillance model for HAIs is essential to:

- Establish a baseline prevalence of HAIs in the hospital, in order to guide IPC and AMS activities;

- Compare and benchmark hospitals to one another, where possible;

- Assess the hospital-level impact or effectiveness of interventions, e.g. multimodal IPC strategies including "bundles of care"; and

- Detect clusters or outbreaks, leading to timely action by the healthcare team.

### 1.4.2. Steps for implementing HAI surveillance

The steps required for implementing HAI surveillance are described in Figure 8 below and include:

1. Establishing the baseline of HAIs in the hospital – either through point prevalence surveys (PPS) or laboratory reports from the hospital laboratory or from the NICD dashboard and identifying the most relevant AMR patterns;

2. Choosing an appropriate intervention or bundle of care to prevent infections;

3. Implementing that bundle through repeated quality improvement cycles of plan-do-study-act (PDSA); and

4. Monitoring and measuring the impact by measuring HAI rates and compliance to bundle interventions.

**Figure 8:** *HAI surveillance, intervention and improvement cycle*



Establish Baseline of infections
-PPS or lab surveillance report

Choose HAI bundle (CAUTI/SSI/ CLABSI, PLABSI, VAP)

Implement bundle through repeated plan - do - study - act cycles

Monitor and measure (Process & outcome HAI rates) - using PPS or lab surveillance report

---
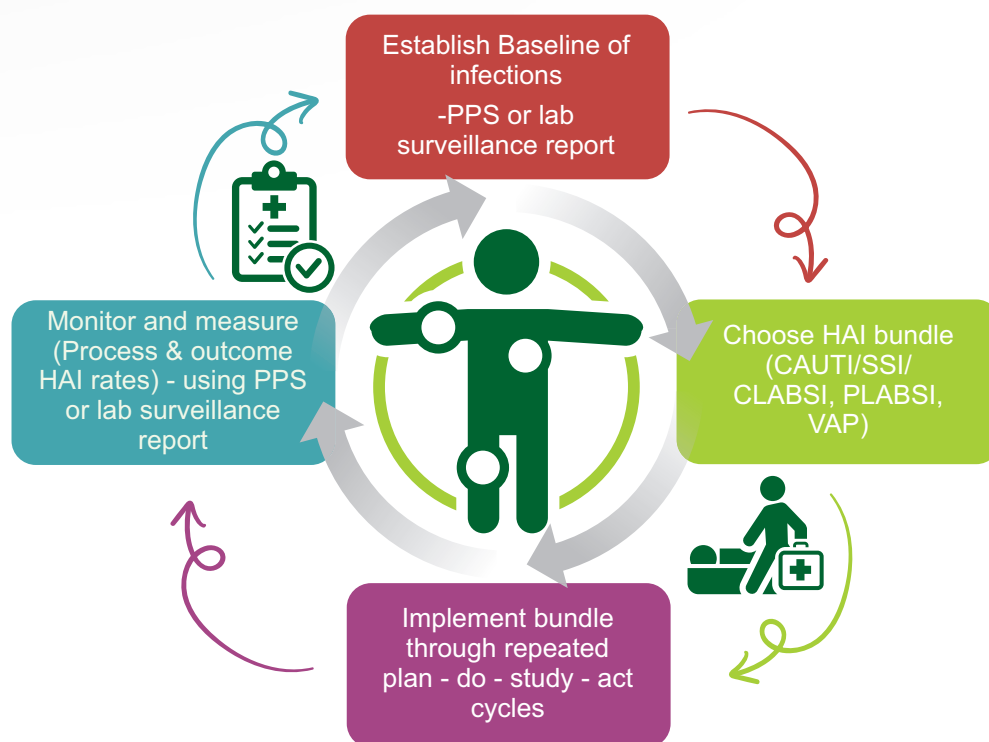
18 Rosenthal VD, Al-Abdely HM, El-Kholy AA, AlKhawaja SAA, Leblebicioglu H, Mehta Y, et al. International Nosocomial Infection Control Consortium report, data summary of 50 countries for 2010-2015: Device-associated module. American Journal of Infection Control. 2016;44(12):1495-504.

# Step 1:

## A baseline of HAI rates and/or AMR should be determined first

A process assessment or audit such as a point prevalence study (PPS) should be conducted to understand the baseline of the HAI rates (see Figure 9 for how to conduct a point prevalence survey). This will provide the hospital with a summary of its important HAI syndromes and the commonest bacterial pathogens and their resistance patterns. Ideally, the hospital should participate in a nationwide PPS, to be conducted once a year at the same time. This step is important to set the baseline.

**Global Point Prevalence of Antimicrobial Consumption and Resistance** (GLOBAL-PPS) (www.global-pps.com)

The GLOBAL-PPS coordinates surveillance of antimicrobial prescribing and resistance in hospitalised adults, children and neonates worldwide. The GLOBAL-PPS supports planning and local stewardship interventions in a range of resources and geographical settings. The GLOBAL-PPS assists with conducting a one-day survey, and provides data-collection forms with anonymous online data entry for validation and reporting. Feedback is provided in the form of a downloadable report, which includes graphs and tables that can used for local communication and presentations. Supplementary longitudinal feedback can be downloaded by hospitals who have participated at least 2 times. An example report can be viewed at: www.global-pps.com/documents/

Participants can receive assistance through the website, including access to all working documents, educational E-learning tool, and networks through which to share experiences.

**Figure 9:** *Basic approach in a Point Prevalence Study for HAIs*

**Phase 1: Planning**
- Set a date or time period for the PPS.
- You will need a lead-in time of at least nine months to allow preparation in order to allow for the staff involved to be trained.
- Ensure that all relevant hospital staff members are involved in the planning process and are aware of the planned date.

**Phase 2: Training**
- Focused IPC training should be conducted by IPC team or quality improvement team.
- All hospital staff members who are to be involved in the PPS should be trained on their specific roles and responsibilities.
- All data collectors should be trained to identify patients with a HAI using simple standardised case definitions (see Annexure D for details).
- Staff members should be trained to use a standardised data collection tool for the PPS.

**Phase 3: Conducting the survey**
- Identify all patients with a HAI on the day/ week of the PPS.
- Complete the data collection tool for every identified patient.
- Capture data on the standardised database template (examples [19,20]).
- Check and clean data.

**Phase 4: Analysing data and reporting**
- Calculate overall prevalence of HAIs for the healthcare facility (using definitions in Annexure D).

---

19 Public Health England/ ECDC PPS Data collection forms and flow charts. 2016. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/541856/PPS_forms_flowcharts.pdf.

20 Point prevalence survey of healthcare associated infections, antimicrobial use and antimicrobial stewardship in England. Protocol 2016. https://www.gov.uk/government/publications/healthcare-associated-infections-hcai-point-prevalence-survey-england

Guidelines for the Prevention and Containment of Antimicrobial Resistance in South African Hospitals

- Calculate prevalence for each HAI syndrome and per broad department in the hospital (e.g. medical, surgery, paediatrics, obstetrics and gynaecology) of the hospital (using definitions of rates in Annexure D).
- Compile a report and send report to the Hospital AMR Committees and the Provincial AMR Committee.
- Communicate the results to all HCWs and professionals.

# Step 2:

## Identify a bundle of care

Step 1 will provide the hospital with the commonest infections in the facility. Based on these results, bundles should be implemented that prevent these infections.

**Even if the data are not conclusive as to the commonest infections or a baseline has not been completed, it is recommended that hospitals should immediately implement one of following HAI bundles in the appropriate hospital unit/s:**

- Catheter-associated urinary tract infections (CAUTI): intensive care units (ICU), surgical and orthopaedics wards.

- Surgical site infections (SSI): post-caesarean section, surgical wards.

- Central line-associated bloodstream infections (CLABSI): ICU, neonatal ICU, haematology/oncology units and wards where central lines are commonly used.

- Peripheral line-associated bloodstream infections (PLABSI): paediatric and adult general medical and surgical wards.

- Ventilator-associated pneumonias (VAP): ICU, neonatal ICU.

The definitions of each of these HAIs and how to determine them are provided in Annexure D and described in Section 1.2.

# Step 3:

## Implement the multimodal strategies including bundles through repeated PDSA cycles

The implementation of these strategies should follow quality improvement methodology as described in the Quality Improvement programme of the National Department of Health (NDOH),[21] i.e. the PDSA cycles of repeated small-scale rapid improvements. They should be tested in one ward first, adapted and monitored before scaling up and spreading to other wards.

As part of this quality improvement process, communication to and education and training of health care professionals is necessary throughout all the steps with regular provision of data on impact of the bundles on infection rates. Therefore, it is imperative that there is a small task team that is set up to monitor and support the implementation wards; and regular data is being collected to ensure tracking of progress; and that the identification of gaps can occur.

# Step 4:

## Continue to monitor HAIs and impact of multimodal strategies

A continuous cycle of monitoring HAI rates through surveillance (either the PPS or laboratory-based surveillance reports), imple-mentation of IPC interventions and specific bundle of care and evaluation of outcomes should be established (see Table 3).

**Table 3:** *Monitoring bundle compliance rates and HAI rates*

| Process measures | Outcome measures |
|---|---|
| Bundle compliance rate = number of patients receiving all components of the bundle / total patients with a device for the day of the sample. | Bundles rates per 1000 device days for CLABSI, CAUTI, VAP, SSI overall as well as in specific disciplines such as caesarean sections, joint replacements, colorectal surgery and coronary artery bypass grafts. |
| **Goal:** 95% of all patients with a device in the unit receive all elements of the bundle | **Goal:** Decrease in the bundle rate of infections by "X" % per year |

Outcomes measures will need to be determined as per the definitions in Table 4 below and therefore ward-level data such as patient days and device days will need to be collected.

**Table 4:** *Measure definitions for HAI rates by type*

| Measurement of HAI rates per type | |
|---|---|
| **CLABSI rate =** | (Number of central line-associated bloodstream infections / number of central line days) x 1000 |
| **Goal:** Reduce CLABSI rate by 40% in one year | |
| **CAUTI rate =** | (Number of catheter-associated urinary tract infections / number of urinary catheter days) x 1000 |
| **Goal:** Reduce CAUTI by 25% in one year | |
| **SSI Rate =** | (Number of surgical site infections in a specific discipline / number of surgeries in that discipline) x 1000 |
| **Goal:** Reduce SSI rate by 30% in one year OR number of cases between surgical site infections | |
| **VAP rate =** | (Number of ventilator-associated pneumonias / number of ventilator days) x 1000 |
| **Goal:** Reduce VAP rate by 25% in one year | |
| **PLABSI rate =** | (Number of Peripheral line-associated bloodstream infections / number of peripheral lines inserted) x 1000 |
| **Goal:** Reduce PLABSI by 50% in one year | |

For more details of the bundles and how to measure them, refer to the resources outlined under Section 1.2.

21 National Department of Health. Quality improvement guides: Quality improvement – the key to providing improved quality of care. Pretoria; 2012.

Guidelines for the Prevention and Containment of Antimicrobial Resistance in South African Hospitals

# 2. ANTIMICROBIAL STEWARDSHIP

Antimicrobial stewardship (AMS) has been defined as a multi-disciplinary, systematic approach to optimising the appropriate use of one or more antimicrobials to improve patient outcomes and limit emergence of resistant pathogens whilst ensuring patient safety. The key aims of AMS are to improve patient outcomes and to reduce the unintended consequences of antimicrobial use, including toxicity and selection of resistant organisms.[22,23]

## 2.1. Key components of an AMS programme

All AMS programmes require four components as part of their basic structure (see Figure 10):

1. Structures including a Hospital Antimicrobial Stewardship Committee (HAMSC) and an AMS team;

2. Facility-level interventions which include the use of local guidelines for antimicrobial prescribing and pre-prescription authorisation and/or prospective audit and feedback systems;

3. Patient-level interventions for implementation of AMS activities (4 steps flow);

4. Monitoring and evaluation of AMS activities and progress.

**Figure 10:** *AMS components*



**Structures**
- **Hospital AMS Committee**
- **AMS team**

**Facility level interventions**
- **Local guidelines for antimicrobial prescribing**
- **Pre prescription authorisation and/or prospective audit and feedback**

**Patient level interventions**
- **Does the patient need an antimicrobial?**
- **If yes, which antimicrobial is the most appropriate?**
- **Ensure appropriate administration of antimicrobial**
- **Review the need for antimicrobial every day**

**Monitoring and evaluation of interventions**
- **Process compliance measures**
- **Output and outcome measures**

---

22 Baur, David et al. Effect of antibiotic stewardship on the incidence of infection and colonisation with antibiotic-resistant bacteria and Clostridium difficile infection: a systematic review and meta-analysis. The Lancet Infectious Diseases. 2017; 17(9):990 – 1001.
23 Schuts, Emelie C et al. Current evidence on hospital antimicrobial stewardship objectives: a systematic review and meta-analysis. The Lancet Infectious Diseases. 2016;16(7):847 – 856.

## 2.2. AMS Structures

### 2.2.1. The Hospital AMS Committee

The AMR One Health Approach and Governance Guidelines[24] require that all health facilities establish a HAMSC to provide oversight and coordination for AMS activities at the institution, including the activities of the hospital's AMS team. The composition and specific responsibilities of the HAMSC are described in those guidelines (see also Annexure E) and organogram below (see Figure 11).

**Figure 11:** *AMS structures in hospitals*



**AMS COMMITTEE**

Generally made up of high-ranking managers in hospital and include:
- Hospital CEO
- Senior Physician or Clinical Director
- Chief Pharmacist
- Nursing Service Manager
- IPC Practitioner
- Medical Microbiologist

**AMS TEAM**

Team responsible for the operationalisation of AMS and should include at least two of the following disciplines

CLINICIAN

PHARMACIST

PROFESSIONAL NURSE

Infection control practitioner

OTHERS

Microbiologist Infectious disease specialist

The role of the HAMSC is to provide oversight and coordination for AMS activities at the institution, including the activities of the hospital's AMS team(s), and to provide 6-monthly progress reports to the Provincial AMS Committee (PAMSC).

The position of the HAMSC within the hospital management structure is at the discretion of the Chief Executive Officer. The HAMSC may either form a standalone committee or be incorporated into the agenda of either the hospital's IPC or another clinical or quality committee. If AMS is positioned within an already existing committee, AMS activities defined in Figure 12 below must be included in the agenda of that committee as standing items. For smaller hospitals the AMS Committee and AMS team may be one and the same structures.

**Figure 12:** *Key agenda items for AMS and IPC discussions*



Surveillance of HAIs

Antimicrobial resistance profiles

Compliance with AMS programme interventions/ indicators

Communication and feedback needs for prescribers and units

Determination of in-service training needs

---
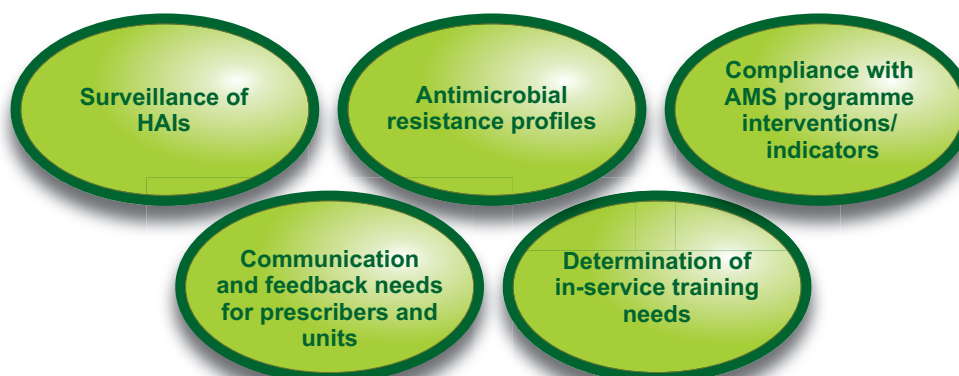
24 National Department of Health, Guidelines for the Implementation of the Antimicrobial Resistance Strategy in South Africa: One Health Approach and Governance. Pretoria; 2017

There must be clearly defined lines of communication and feedback provided between the HAMSC and other relevant hospital committees, heads of nursing, pharmacy, quality improvement, other relevant heads of departments, as well as with the PAMSC.

## 2.2.2. The AMS team

The AMS team is a small, on-the-ground clinical team that should be represented on the HAMSC but is a distinct entity that performs patient-level AMS activities in the institution.

**Composition of AMS team**
International guidelines recommend that AMS programmes should be led by infectious diseases physicians or clinical pharmacists with advanced AMS training. These are scarce skills in South Africa and will be unavailable at almost all health care facilities. However, other trained staff members can effectively lead AMS programmes, and these should be identified by the HAMSC.

It is important to identify a respected, well-known **team leader** in order to enhance buy-in from prescribers and other HCWs. The team leader should undergo some form of training in AMS. The rest of the AMS team should ideally be comprised of a multidisciplinary group of staff members who have also received training in AMS. The specific size and makeup of the AMS team will depend on the needs and resources of each facility. Should the hospital be very small, it may be difficult to resource an entire team, in which case the respected, well-known leader will implement the programme.[25] The following staff members may be included (see Figure 11):

- Pharmacist;
- Practitioner with IPC knowledge;
- Clinician;
- Other members may not necessarily be on-site, but may be included as necessary on an ad hoc basis;
  - o Quality manager;
  - o Microbiologist (to consult on specific cases or in facilities with access to microbiology support they should form part of the core AMS team);
  - o Infectious diseases specialist.

## 2.2.3. Roles of the AMS team

The role of each member of the AMS team is summarised in Table 5 and Table 6 below. Depending on the composition of the team at each facility, there may be substantial overlap in responsibilities between team members. The team has overall responsibility for providing regular patient-level AMS activities in the facility. These activities are described in detail below.

**Table 5:** *Role of AMS team members and treating clinical team*

| AMS Clinician or Infectious Disease Specialist | Pharmacy |
|---|---|
| • Accurate antimicrobial use and allergy history<br>• Early and appropriate cultures taking<br>• Appropriate empiric antimicrobial<br>• Timely antimicrobial initiation<br>• Preliminary microbiology results and antimicrobial adjustment<br>• Antimicrobial dosing and de-escalation<br>• IV to oral antimicrobial switch<br>• Evaluation of clinical response<br>• Final culture report review and antimicrobial adjustment<br>• Identification of AMR<br>• Hand hygiene<br>• Infection control precautions | • Accurate antimicrobial use and allergy history<br>• Medication reconciliation<br>• Preliminary microbiology results and empiric antimicrobial adjustment<br>• Antimicrobial dosing and de-escalation<br>• Therapeutic drug monitoring if indicated<br>• Discontinuation of the antimicrobial therapy<br>• Adverse events<br>• Final culture report and antimicrobial adjustment<br>• IV to oral antimicrobial switch<br>• Compatibility of IV antimicrobials with infusion solutions and rate of IV administration<br>• Appropriate duration |

---

25 C Pulcini, F Binda et al. Developing core elements and checklist items for global hospital antimicrobial stewardship programme: A Consensus approach. ESCMID; 2018.

| AMS Clinician or Infectious Disease Specialist (continued) | Pharmacy (continued) |
|---|---|
| • Evaluate need for IV cannulas and urinary catheters<br>• Adverse events | • Ensuring medications are available timeously for administration<br>• Patient education |
| **Nursing**<br>• Triage and appropriate isolation<br>• Accurate antimicrobial use and allergy history<br>• Early and appropriate cultures taking<br>• Timely antimicrobial administration<br>• Medication reconciliation<br>• Monitor and report on progress<br>• Adverse events<br>• Monitor for changes in patient condition<br>• IV to oral antimicrobial switch<br>• Hand hygiene<br>• Infection control precautions<br>• Assess for appropriate care of IV cannulas and urinary catheters<br>• Patient education | **IPC practitioner**<br>• Triage and appropriate initial isolation<br>• Identification of AMR<br>• Infection control precautions<br>• Hand hygiene<br>• Assess for appropriate care of cannulas and urinary catheters<br>• Patient education |
| **Microbiology**<br>• Preliminary microbiology results and antimicrobial adjustment<br>• Final culture report and antimicrobial adjustment<br>• Identification of AMR<br>• Advise infection control precautions<br>• Advisory role on AMS progress | |

*IV – intravenous

Source: SASOCP[26]

26 SASOCP. Position Statement on the Pharmacists Role in Antibiotics Stewardship. 2018.

**Table 6:** Roles of AMS team at decision points in stewardship pathway

| | Nurse | Doctor | Pharmacists | IPC practitioner | Microbiologist |
|---|---|---|---|---|---|
| **Step 1: Does the patient need an antimicrobial?** | | | | | |
| **Clinical evaluation of patient's condition** | • Accurate allergy and medication history specifically antimicrobial use<br>• Triage and appropriate isolation | • Decide if an antimicrobial is indicated: does the patient have a bacterial infection?<br>• Accurate allergy history<br>• Medication history-taking to inform prior antimicrobial use | • Accurate allergy history<br>• Check and monitor for drug reactions<br>• Medication history-taking to inform prior antimicrobial use | • Triage and appropriate isolation | • Advice on appropriate specimen-taking practices |
| **What appropriate diagnostics are needed to support that decision (based on STGs/EML). Take the appropriate culture before the first dose.** | | • Early and appropriate taking of cultures | | | • Preliminary microbiology results and antimicrobial adjustment |
| **Step 2: If yes, which antimicrobial is the most appropriate?** | | | | | |
| **Empiric therapy based on site, community infection or HAI and local hospital epidemiology** | | • Appropriate empiric antimicrobial prescribing | • Review of antimicrobial scripts for appropriateness<br>• Ensuring medications are available timeously for administration<br>• Optimising antimicrobial dosing according to guideline recommendations, and PK/PD principles | | • Preliminary microbiology results and antimicrobial adjustment |

| | Nurse | Doctor | Pharmacists | IPC practitioner | Microbiologist |
|---|---|---|---|---|---|
| **Step 3: Ensure appropriate administration of antimicrobial** | | | | | |
| **Administer antimicrobial early Delivery/ route Dose Duration** | • Timely antimicrobial administration, correct route, dose and duration | • Correct, delivery, route, dose and duration of antimicrobial prescribed | • Correct, delivery, route, dose and duration of antimicrobial prescribed<br>• Timely medication dispensing | • Triage and appropriate initial isolation | |
| | • Hand hygiene<br>• Infection control precautions<br>• Triage and appropriate isolation | | • Antimicrobial dosing<br>• Recommend the right route of administration | | |
| **Step 4: Review the need for antimicrobial every day** | | | | | |
| | • Timely antimicrobial administration, correct route, dose and duration | • Review of preliminary microbiology results and antimicrobial adjustment | • Medication reconciliation<br>• Ensuring medications are available timeously for administration | | • Follow up if needed |
| | • Medication reconciliation | • Antimicrobial dosing and de-escalation | • Therapeutic drug monitoring if indicated<br>• Antimicrobial dosing and de-escalation | | |
| | • Monitor and report on progress | • Evaluation of clinical response | • Appropriate duration monitoring and notification of doctor | | |
| | • IV to oral antimicrobial switch | • IV to oral antimicrobial switch | • IV to oral antimicrobial switch | | |

| Nurse | Doctor | Pharmacists | IPC practitioner | Microbiologist |
|---|---|---|---|---|
| • Monitor for changes in patient condition | | • AMS audit and feedback | | |
| | • Final culture report review and antimicrobial adjustment | • Review of antimicrobial script for appropriateness | • Advise on infection control precautions upon identification of antimicrobial resistance | • Final culture report and antimicrobial adjustment |
| • Monitor and report on progress | • Identification of antimicrobial resistance | | | • Identification of antimicrobial resistance<br>• Alerting clinician and nurse |
| • Assess for appropriate care of IV cannulas and urinary catheters and evaluate need to continue | • Evaluate need for IV cannulas and urinary catheters | | • Evaluate need for IV cannulas and urinary catheters | |
| • Adverse events identification and notification to doctor | • Adverse events identification and reporting | • Pharmacovigilance (medication error reporting, adverse drug reaction identification)<br>• Advisory role on AMS progress | | |

| | Nurse | Doctor | Pharmacists | IPC practitioner | Microbiologist |
|---|---|---|---|---|---|
| **General precautions** | • Patient education | | • Patient education for TTO medicines | | |
| | • Hand hygiene<br>• Infection control precautions | • Hand hygiene<br>• Infection control precautions | • Hand hygiene<br>• Infection control precautions | • Hand hygiene<br>• Infection control precautions | • Hand hygiene<br>• Infection control precautions |

Source: SASOCP[27]

27 Schellack N, Bronkhorst E, *et al.* SASOCP Position Statement on the Pharmacists Role in Antibiotics Stewardship; SAJID 2017;33(1):28-35.

## 2.3. Facility-level interventions

These are interventions that occur across the units within a facility and will form part of the AMS policy of the hospital, determined by the HAMSC under consultation with their prescribers and staff.

### 2.3.1. Use of South African guidelines for antimicrobial prescribing

The use of guideline-adherent empirical antimicrobial therapy is associated with reduced mortality in hospitals[28], as well as other benefits including shorter duration of hospitalisation and fewer adverse events. Each HAMSC should adopt locally relevant antimicrobial prescribing guidelines for use at their facility. These guidelines could relate to specific infections (for example, the published South African guidelines on community-acquired pneumonia or meningitis) or could be adapted from existing guidelines such as the Standard Treatment Guidelines (STGs) and Essential medicines List (EML)[29] or from the South African Antimicrobial Stewardship Programme (SAASP) antibiotic guidelines[30] to include the most relevant infection syndromes encountered at the facility, and to incorporate local cumulative antibiograms, which describes the antimicrobial sensitivity rates for the organisms cultured, if available (see Annexure F for examples).

The diagnostic laboratory that processes microbiology specimens for the hospital, should generate these local cumulative antibiograms. This can be done either for the facility as a whole or focused on specific units or broad hospital subdivisions level (e.g. intensive care, medical, surgery, paediatrics, obstetrics and gynaecology) based on the size and complexity of the facility. These reports should include as a minimum:

- The frequency and relative frequency (percentage) of pathogens isolated from blood culture, urine and respiratory tract specimens;

- Antibacterial susceptibility results stratified by pathogen (e.g. Enterobacteriaceae, non-fermenting Gram-negative bacilli) or pathogens from the ESKAPE group (*i.e. Enterococcus faecium, Staphylococcus aureus, Klebsiella pneumoniae, Acinetobacter baumannii, Pseudomonas aeruginosa and Enterobacter* spp.);

- Antifungal susceptibility results for Candida species.

The development and use of local guidelines should be coupled with a dissemination and communication plan and an implementation strategy for all health care providers and prescribers, so that prescribing practices are standardised at each facility. This could include induction and training for all current and new prescribers, making the guidelines available as a summary or in the form of clinical pathways, and the use of guidelines during ward rounds and in the pharmacy.

### 2.3.2. Pre-prescription authorisation and/or prospective audit and feedback

These strategies improve antimicrobial utilisation and reduce AMR, without negative impacts on patient outcomes, and are recommended as core components of AMS programmes, either as a single strategy or in combination.[31,32]

28 Schuts, Emelie C Et al. Current evidence on hospital antimicrobial stewardship objectives: a systematic review and meta-analysis. The Lancet Infectious Diseases 2016;16(7):847 – 856.

29 National Department of Health, Standard Treatment Guidelines and Essential Medicines List for South Africa: Hospital level, adults, 2015 edition; Hospital level, paediatrics, 2017 edition. Available from http://www.health.gov.za/index.php/standard-treatment-guidelines-and-essential-medicines-list

30 South African Antibiotics Stewardship Programme (SAASP). A pocket guide to antibiotics prescribing for adults in South Africa, 2015, https://www.fidssa.co.za/Content/Documents/SAASP_Antibiotic_Guidelines_2015.pdf

31 Tamar F. Barlam, Sara E. Cosgrove, et al. Implementing an Antibiotic Stewardship Program: Guidelines by the Infectious Diseases Society of America and the Society for Healthcare Epidemiology of America, Clinical Infectious Diseases 2016;62(10):e51–e77. https://doi.org/10.1093/cid/ciw118

32 Centers for Disease Control and Prevention (CDC). Get Smart for Healthcare: Overview and Evidence to Support Stewardship. Impact of ASP Interventions on Use. 2015. http://www.cdc.gov/getsmart/healthcare/evidence/asp-int-use.html

**Figure 13:** AWaRe antibiotics list

<div style="background-color:green">

## AWaRe Antibiotics List

In June 2017, the WHO categorized antibiotics in the Essential Medicine List into three sections - **Access, Watch and Reserve** - with recommendations on when each category should be used.

WHO recommends that antibiotics in the **Access** group to be available always, as this includes 1st & 2nd line treatments for a wide range of common infections, like amoxicillin, a widely used antibiotic to treat infections such as pneumonia.

The **Watch** group includes antibiotics that should be dramatically reduced to avoid further development of resistance. For example, the use of ciprofloxacin, used to treat cystitis and upper respiratory tract infections (such as bacterial sinusitis and bacterial bronchitis),

The third group, **Reserve**, includes antibiotics such as colistin and some cephalosporins that should be considered last-resort options, and used only in the most severe circumstances when all other alternatives have failed, such as life-threatening infections due to multidrug-resistant bacteria.

</div>

**Pre-Prescription Authorisation (PPA)** requires justification from clinicians to obtain approval for certain antibiotics prior to prescribing (so-called 'restrictive' policy). Whilst this strategy can be very effective in reducing overuse, it is also considered the most difficult for prescribers to comply with due the additional administrative burden required to get authorisation, the potential delay in initiating critical therapy and the overuse of unrestricted antibiotics. This strategy can only be effective if built together with the clinicians who will be prescribing and tested using repeated PDSA cycles to find the most appropriate way to perform PPA.[33]

Specific areas such as Intensive Care Units and specific conditions can be exempt from pre-authorization.

Determination of the antibiotics to be pre-authorised may be based upon the AMR concerns of the facility, the antibiotics with high consumption or antibiotics considered "watch" or "reserve" by WHO[34] (see Figure 13) or last resort antibiotics such as carbapenems and colistin.

**Prospective Audit and Feedback (PAF)** is a method that allows the AMS programme to interact directly with prescribers in order to tailor specific antibiotic therapy for each patient. These strategies are employed after the initial prescribing and dispensing of the antibiotic (so-called 'persuasive' policy). This strategy has seen reduction in antimicrobial use and resistance with no negative impact on patient outcomes and has been used effectively in the public[35] and private sectors[36,37] in South Africa. The pharmacist or the AMS team in consultation with the prescriber can drive this audit and feedback process. To be successful, the PAF strategy needs to be built on top of an effective communication plan and good relationship between prescribers and pharmacists. It can occur at the bedside during the AMS team ward rounds or at the point of dispensing at the pharmacy during the script reviews.

Each strategy offers advantages and disad-vantages, and their implementation is dependent on the resources and needs of each facility and should be determined in consultation with the prescribers, pharmacists and nurses. Table 7 gives practical examples for using PPA and PAF.

33 SASOCP Position Statement on the Pharmacists Role in Antibiotics Stewardship, 2017.
34 World Health Organization. Model List of Essential Medicines. Geneva; 2017. http://www.who.int/medicines/publications/essentialmedicines/en/ Boyles TH, Whitelaw A, Bamford C, Moodley M, Bonorchis K, et al. Antibiotic Stewardship Ward Rounds and a Dedicated Prescription Chart Reduce Antibiotic Consumption and Pharmacy Costs without Affecting Inpatient Mortality or Re
35 Admission Rates. PLoS ONE 2013;8(12): e79747. doi:10.1371/journal.pone.0079747
36 Brink AJ, Messina AP, Feldman C, Richards GA, van den Bergh D. From guidelines to practice: a pharmacist-driven prospective audit and feedback improvement model for peri-operative antibiotic prophylaxis in 34 South African hospitals, Journal of Antimicrobial Chemotherapy 2017;72(4): 1227–1234.
37 Brink, Adrian J et al. Antimicrobial stewardship across 47 South African hospitals: an implementation study. The Lancet Infectious Diseases 2016; 16(9): 1017-102.

Guidelines for the Prevention and Containment of Antimicrobial Resistance in South African Hospitals

**Table 7:** Examples of PPA and PAF interventions

| Example | Pre-Prescription Authorisation (PPA) | Prospective Audit & Feedback (PAF) |
|---------|--------------------------------------|-------------------------------------|
| 1 | Restrict use of all carbapenem antibiotics until authorisation by pharmacist according to guidelines. | Regular bedside ward rounds by AMS team to review prescription charts for carbapenems and other reserve antibiotics. |
| 2 | Require clear diagnosis before release of ceftriaxone by pharmacist. | Regular chart reviews and feedback by pharmacist. |
| 3 | Restriction of cefazolin to pre-operative prophylaxis (unless motivated for). | All antibiotics stopped by pharmacist on day 5 or 7 unless specifically motivated to extend. |
| 4 | Restriction of echinocandins for specialist use in invasive candidiasis resistant to fluconazole or Amphotericin B. | Echinocandin prescribed for an additional duration of 14 days after the first negative blood culture. |

The specific strategy should be discussed at the level of the HAMSC and implemented by the AMS team.

**Enabling tools for PPA and PAF**

An important enabling tool for PAF and PPA is the use of a dedicated antimicrobial prescription chart (see Annexure G), and AMS programmes are strongly encouraged to implement this. These can be either a standalone dedicated chart purely for antibiotic prescriptions, or can be integrated into the general prescription chart, or may consist of an antimicrobial plan which is documented in the patient's file including all the key components described below.[38] Their use has been demonstrated to be an effective tool for AMS. [34, 39, 40]

Prompting the prescriber to stop and consider what they're treating, whether it is community- or hospital-acquired, duration of therapy etc., has both a useful pre-prescribing function, as well as assisting in post-prescribing feedback by the pharmacist or AMS team.

The key components of an antimicrobial pre-scription chart are as follows:

- Infection/site being treated;
- Whether it is community- or hospital-acquired;
- Empiric, definitive (culture-directed) or prophylaxis indication for treatment;
- Dose, duration, route, patient's weight;
- Whether cultures have been sent (and if result is positive).

Examples of standalone and integrated charts can be found at the following websites:

- South African Antibiotic Stewardship Programme, available at https://www.fidssa.co.za/SAASP/Prescription_Chart
- Best care... Always!, available at http://www.bestcare.org.za/file/view/Prescribing%20Tool%2003-2009.pdf/184539537/Prescribing%20Tool%2003-2009.pdf
- See Annexure G for further details

## 2.4. Patient-level interventions

This is the primary activity of the AMS team. There are various models (see Table 8) for implementing patient-level AMS, and each facility will need to adopt a strategy that is appropriate for the available resources and needs. The standard model is the AMS ward round, where the AMS team is joined by the prescriber/clinician caring for the patient and each antimicrobial prescription is reviewed as a team. This forms part of a PAF strategy, and has a number of benefits, including skills transfer and sustainable stewardship practices.

---

38 Pulcini C, Binda F et al. Developing core elements and checklist items for global hospital antimicrobial stewardship programme: A Consensus approach. ESCMID, 2018.

39 Centers for Disease Control and Prevention (CDC). Get Smart for Healthcare: Overview and Evidence to Support Stewardship. Impact of ASP Interventions on Use. 2015. Available from http://www.cdc.gov/getsmart/healthcare/evidence/asp-int-use.html

40 Ashiru-Oredope, D et al. Does an antimicrobial section on a drug chart influence prescribing? 2011. Available at https://www.pharmaceutical-journal.com/files/rps-pjonline/pdf/2011_jul_prescribing_antimicrobial_chart.pdf

However, this approach is labour-intensive, and may not be feasible in many settings. Other approaches include limited AMS ward rounds (either in terms of frequency or location, for example focussing on a different ward every week), folder reviews with or without feedback sessions, or identifying focussed interventions to target (for example, ensuring the correct administration of pre-operative antibiotic prophylaxis).

**Table 8:** Examples of different AMS strategies

| Model | Comments |
|---|---|
| AMS bedside rounds | • Evidence-based, supports skills transfer and behaviour modification, part of PAF strategy.<br>• Labour-intensive, requires buy-in from clinicians.<br>• Can be performed by any member of the AMS team, but usually clinician-led. |
| Regular chart reviews | • Can support PAF, but no direct engagement with clinicians or patients.<br>• Can be performed by any member of the AMS team, particularly well-suited to pharmacists. |
| Targeted interventions for quality improvement (see Section 3.1) | • This can be done together with another global AMS strategy or as a single strategy.<br>• Potentially high impact for the chosen intervention. Requires clear strategy and dedicated team to implement and measure. |

## 2.4.1. The core components of AMS practice

Regardless of the strategy adopted by each facility, the practice of AMS requires a standard approach as depicted in Figure 14 below. The section below describes each step of these core AMS practices.

**Figure 14:** Standard approach to conducting AMS

**Does the patient need an antimicrobial?**
• Algorithm decision on clinical basis
• What appropriate diagnostics are needed to support that decision (based on STG's/EML)
• Take the **appropriate** culture before the first dose

**If yes, which antimicrobial is the most appropriate?**
• Empiric therapy based on site, CAI, HAI and local hospital epidemiology

**Ensure appropriate administration of antimicrobial**
• Administer antimicrobial early
• Delivery/route
• Dose
• Duration

**Review the need for antimicrobial every day**
• Delivery/ route
• Dose
• Duration
• De-escalation-review antibiogram from patient's cultures

# Step 1:

## Decide if an antimicrobial is indicated

AMS is almost always a retrospective exercise, and besides PPA and education, it may be difficult to intervene prior to antimicrobial prescription. However, it is still critical to review the initial and on-going indication for an antimicrobial, which can often be done retrospectively after more diagnostic information has become available. There is limited evidence for discontinuing therapy based on lack of clinical or microbiological evidence of infection, but AMS ward rounds are an important opportunity to emphasise the importance of diagnostic decision-making to prescribers. Clinicians, in consultation with prescribers, should perform this aspect of AMS.

Figure 15 summarises the key decision pathways and areas for AMS intervention prior to prescribing antimicrobials.

> **The primary decision of which antimicrobial is indicated is a clinical one whereby the patient's condition provides an indication of whether a bacterial or fungal infection is present or not.**

**Figure 15:** Decision algorithm for antimicrobial prescribing



**Is there evidence of infection?**
1. Clinical evidence of organ dysfunction or local/systemic inflammation
   - Tachypnoea, dysuria, skin redness, etc
   - Fever, neautrophilia and left shift
   - Raised inflammatory markers (CRP, PCT)
2. Direct/ indirect evidence of bacterial cause
   - Nitrifies on urine dipstick, positive culture from relevant site, serological testing, PCR

**Yes** → **Unsure** → **No**

Unsure → **Unstable** / **Stable/Well**

Yes / Unstable → **Clear site of infection/disease**
- **NO** Perform blood culture
- **YES** Send targeted specimen
→ **Rapid initiation of empiric antibiotics**

Stable/Well → **Withhold antimicrobials, investigate for potential focus of infection**

No → **No antimicrobial Symptomatic treatment & look for other cause**

Source: Adapted from A pocket guide to antibiotics prescribing for adults in South Africa, 2015, South African Antibiotics Stewardship Programme (SAASP).

**Appropriate diagnostic tests**

If there is evidence or suspicion of bacterial or fungal infection, an appropriate diagnostic test should be performed to support or exclude the diagnosis of infection.

Specimens for "diagnostic" purposes are usually submitted to identify causative organisms, rather than to confirm a clinical diagnosis. For example, a patient will present with symptoms of a lower respiratory tract infection (LRTI), and sputum and/or blood culture may help identify which organism is responsible. However, the presence of the organism does not confirm the diagnosis of LRTI. Conversely, the absence of an organism does not exclude the diagnosis of LRTI.

Types of diagnostic tests include:

- Cultures from sterile (blood, cerebral spinal fluid, urine, tracheal aspirate) and non-sterile sites (pus swabs, sputum, etc.);

- Non-culture-based tests such as peripheral white blood cell counts and C-reactive protein (to confirm the presence of inflammation) or a urinary dipstick.

The type of specimen and test would be informed by local guidelines and policies, as well as the likely site of infection (e.g. pneumonia[41] and meningitis[42] guidelines).

> ## Key AMS interventions:
> - Clinical decision on evidence of bacterial or fungal infection.
> - Performance of appropriate diagnostic tests to support (or exclude) diagnosis of infection.
> - Performance of appropriate culture before the first dose of antimicrobial is administered.

Some general principles include:

- Sterile site samples are preferred to non-sterile site samples;

- Specimens should be submitted prior to antibiotic administration if at all possible;

- The information that a specimen has been collected must be documented in the patient notes.

The specimen collection practices and submission to the laboratory is essential and this guidance can be found in the local laboratory handbook, which should be available in all clinical areas, and where applicable, appropriate specimen collection guidelines, such as the South African Medical Journal Blood Culture guidelines should be followed.[43] (See Annexure H for more guidance.)

# Step 2:

## If an antimicrobial is indicated, what is the most appropriate empiric choice?

This decision is influenced by the likely pathogens for the presumed site of infection, whether the infection was acquired in the community or a healthcare setting, local drug susceptibility profiles, and whether there are any recent culture results. The use of local guidelines will enhance the adequacy of empiric antibiotic prescribing and support this AMS activity.

Preferably, each hospital should have their own antibiogram, which describe the antimicrobials sensitivity rates for organisms cultured in that facility (as described in section 2.3.1 and Annexure F). Should a hospital not be able to generate one then accessing the NICD AMR dashboard[44] will provide the regional antibiotic and antifungal resistance data, which may help inform local guidelines.

Other important considerations when selecting an antimicrobial are a history of allergy to that specific drug or class, and any drug-drug interactions or specific toxicities that may preclude

---

41 Boyles TH, Brink A, Calligaro GL et al. South African guideline for the management of community-acquired pneumonia in adults. J Thorac Dis 2017;9(6):1469-1502

42 Boyles TH, Bamford C, Bateman K Et al. Guidelines for the management of acute meningitis in children and adults in South Africa. South Afr J Infect Dis 2013;28(1):5-15

43 N Ntusi, L Aubin, S Oliver et al. Guidelines for the optimal use of blood cultures. S Afr Med J 2010;100(12): 839-43

44 NICD AMR Dashboard. Available from http://www.nicd.ac.za/

use. Note that a drug allergy is manifested by hypersensitivity reactions, and other forms of intolerance (such as gastrointestinal upset) are not necessarily contraindications to a drug. Figure 16 summarises this.

**Figure 16:** Selecting an appropriate antimicrobial
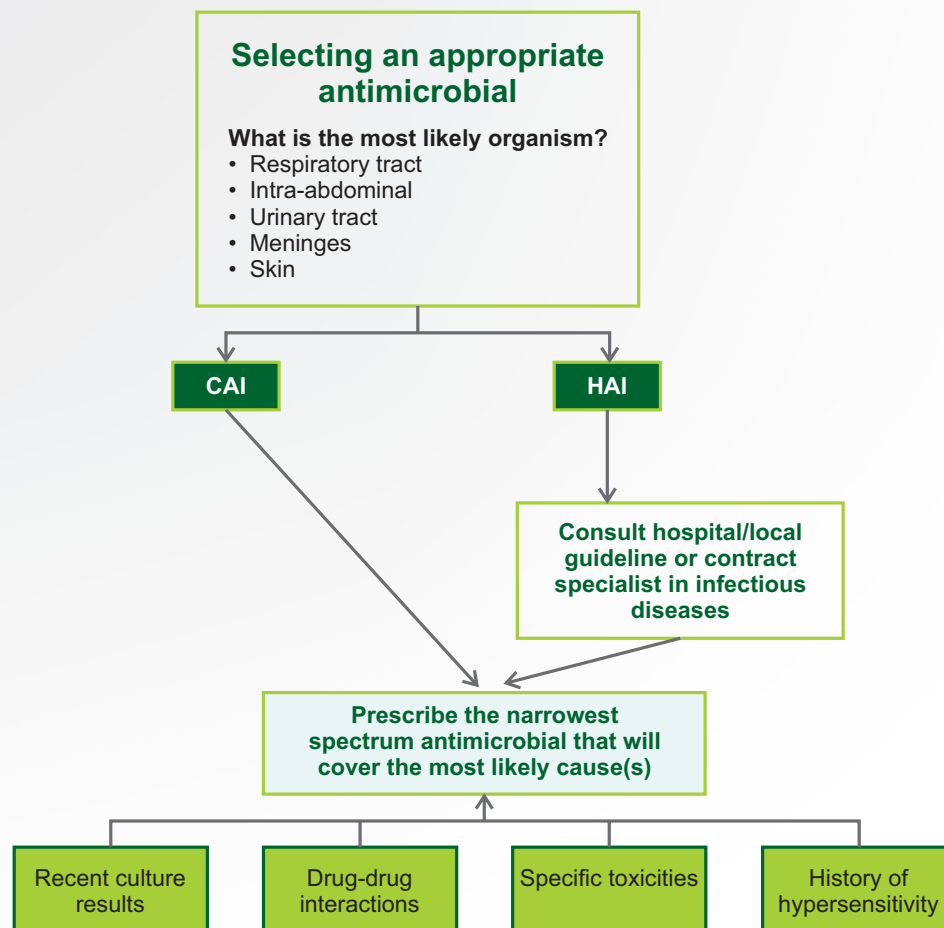


**Selecting an appropriate antimicrobial**

**What is the most likely organism?**
- Respiratory tract
- Intra-abdominal
- Urinary tract
- Meninges
- Skin

CAI

HAI

**Consult hospital/local guideline or contract specialist in infectious diseases**

**Prescribe the narrowest spectrum antimicrobial that will cover the most likely cause(s)**

Recent culture results

Drug-drug interactions

Specific toxicities

History of hypersensitivity

Source: adapted from "A pocket guide to antibiotics prescribing for adults in South Africa", 2015, South African Antibiotics Stewardship Programme (SAASP).

**Key AMS interventions:**
- Clinical decision on evidence of bacterial or fungal infection.
- Performance of appropriate diagnostic tests to support (or exclude) diagnosis of infection.
- Performance of appropriate culture before the first dose of antimicrobial is administered.

# Step 3:

## Ensure optimal administration of antimicrobial

Once an appropriate antibiotic is selected, its administration needs to be optimised to improve patient outcomes and reduce risk of resistance selection.

The administration of antibiotics is a critical driver of antibiotic resistance and presents a complex set of challenges that is by no means a linear process. Administration of antibiotics includes seven steps (see Table 9), namely (i) early administration of a correct antibiotic, (ii) the correct dose, (iii) the appropriate route

of delivery, (iv) the correct duration, (v) the correct frequency, (vi) the correct patient and (vii) the correct documentation. Several role players are involved in each of these steps and hospitals should measure whether their staff are compliant to these on a regular basis as part of basic nursing care.

**Table 9:** Steps in administration of antimicrobial

| STEP | ACTION |
|---|---|
| **Early administration** | • Timeous administration of antimicrobial after a diagnosis of possible/probable/confirmed bacterial or fungal infection is made. |
| **Correct dose** | • The prescribing clinician should determine correct dosing in terms of weight and renal function. Many antimicrobials require weight-based dosing, and weight needs to be documented for each patient to ensure optimal dosing. Renal function can profoundly influence the exposure of renally-excreted antimicrobials. In the case of renal impairment, there is an increased risk of toxicity. In augmented renal function (e.g. critical care patients) there may be increased risk of treatment failure as the drug is more rapidly eliminated.<br>• For concentration-dependant drugs (e.g. gentamicin), it is especially important to ensure the correct dose is given to mitigate AMR.<br>• Both the pharmacist and the professional nurse administering the antimicrobial needs to make sure that the correct dose is prescribed.<br>• Professional nurses responsible for reconstituting antimicrobials should familiarise themselves with the appropriate mixing solution, volume required and administration time.<br>• It is recommended that professional nurses assigned to medication administration in the ward be supported in their roles to minimise distractions and interruptions during medication rounds (for example do not assign extra roles such as ward rounds, preparation for surgery etc. to these nurses). |
| **Appropriate route of delivery** | • Most infections, even for hospitalised patients, do not require IV antimicrobials. Figure 17 lists the indications for IV administration. |
| **Correct duration** | • Empiric antibiotic therapy should be reviewed every 48-72 hours.<br>• Most infections require fewer than 7 days of antimicrobials. Unnecessary additional exposure may lead to adverse events and contribute further to selection of AMR.<br>• Prescribers should consult with local guidelines on the correct duration for a particular condition.<br>• Duration of the antimicrobial should be documented on the prescription chart.<br>• Members of the healthcare team can provide support in this action by asking/reminding the prescriber when the suggested duration is exceeded. |
| **Correct frequency** | • Antimicrobials should be administered within the times prescribed.<br>• Late administration of time-dependant antibiotics (e.g. amoxicillin) results in concentration of drug below the minimum inhibitory concentration, which may lead to AMR.<br>• If administered too early, the patient may experience more side-effects.<br>• Missed doses (doses given at the incorrect time) or omitted doses (doses not given at all) should be reported to the prescriber and noted on the prescription chart. |
| **Correct patient** | • The prescriber, professional nurse and pharmacist need to check prescription charts with laboratory findings and patient identifiers before administering the antimicrobial. |

| STEP | ACTION |
|---|---|
| **Correct documentation** | • It is recommended that the length of administration of all antimicrobials be clearly visible on the prescription chart.<br>• Any side-effects/adverse events should be recorded and reported immediately. |

# Step 4:

## Review the need for antimicrobials every day

Each of the above aspects of antimicrobial administration need to be reviewed during AMS activities, whether on ward rounds or during record reviews. These activities are summarised in Figure 17.

Key questions that should be asked every day are:

• Can the antimicrobial be stopped?

• Can the drip come out?

• Can the catheter come out?

**Key AMS interventions:**
• Administer antimicrobials early after diagnosis.

• Aim for oral administration.

• Ensure correct dosing for weight and renal function.

• Do not prescribe antimicrobials > 7 days (unless specific indication).

**Figure 17:** Review need for antimicrobials daily



| Delivery | Dose | Duration | De-escalation |
|---|---|---|---|
| • Review indications for IV daily<br>• Always aim for oral | • Weight<br>• Renal function<br>• Correct intervals | • Most infections require less than 7 days | • Narrow the spectrum of antimicrobial based on drug susceptibility testing |
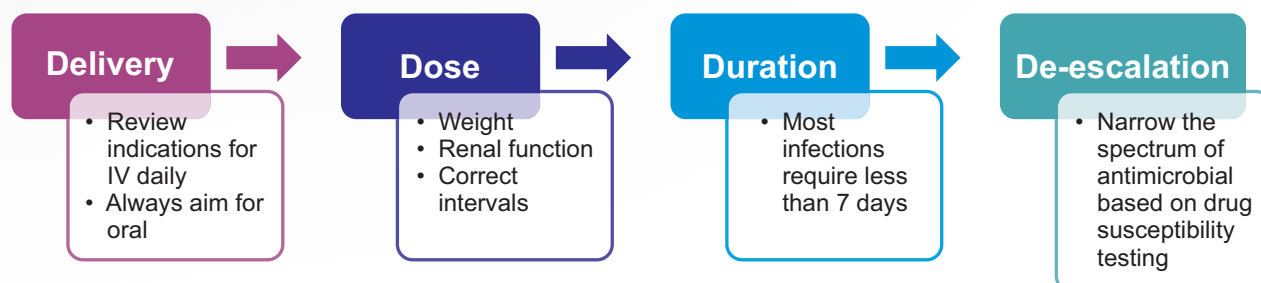
**Indication for IV administration**

1. **Specific infections**
   • Meningitis
   • Endocarditis
   • Blood stream infections
   • Osteomyelitis

2. **Oral administration not effective or possible**
   • Too ill to swallow
   • Poor absorption: forming, ileus
   • Oral-tracheal incubation (use NG route if possible)

3. **Homodynamic instability**

4. **Initial therapy for severe infections** (but can consider oral agents with good bioavailability)

5. **No appropriate oral antimicrobial available**

**Guidelines for stopping antimicrobial**

**Follow recommendations for specific infections, plus all of the following:**

1. **Afebrille for 48 hours**

2. **White cell count and/or inflammatory biomarkers improving**

3. **Clinical improvement** (but not necessarily complete resolution)

An additional aspect of the daily review is de-escalation of therapy, which refers to narrowing of definitive antimicrobials therapy once the results of drug susceptibility testing are available (see Figure 18). This practice has a mortality benefit[45], and forms a critical component of AMS activities.

> ## Key AMS interventions:
> - Aim for oral administration.
> - Ensure correct dosing for weight and renal function.
> - Do not prescribe antimicrobials > 7 days (use evidence-based duration guidelines).
> - Review culture results and de-escalate to narrower spectrum definitive antimicrobials.

## Accessing and interpreting results of diagnostic and drug-susceptibility tests

There should be an effective two-way communication system between the microbiology laboratory and clinical services and results should be checked for every day (preferably using an electronic laboratory information system), until a final result is provided. (NOTE: due to the nature of microbiology laboratory work, provisional results may be amended or added to on a daily basis until finalised).

The results must be documented in the patient's file and appropriately interpreted. Some key points related to interpreting microbiology results include:

- Is the specimen appropriate for the suspected infection?
- How was the specimen collected, and is it a sterile or non-sterile specimen?
- Is/are the organism/s isolated likely to be pathogenic? For example:

  o Coagulase negative staphylococci from non-sterile samples (and sometimes from sterile samples) are often skin flora;

  o *Candida* species isolated from lower respiratory tract specimens are usually colonisers of the oropharynx (or in some cases, a cause of mucosal candidiasis) but rarely pathogens causing lower respiratory tract infections;

  o Many non-fermenting Gram-negative bacilli are environmental and are uncommon pathogens (except for *A. baumannii*, *P. aeruginosa* and to a lesser degree *B. cepacia* and *S. maltophilia*);

  o Enterococci are recognised pathogens from urinary tract infections and intra-abdominal sepsis, but very rarely causes of lower respiratory tract infections.

- Results of in-vitro susceptibility testing reflect the likely clinical response, but this may be influenced by site of infection, age of patient, severity of illness.

- Not all antimicrobials that are tested are necessarily reported – laboratories will often display the most appropriate agents based on how resistant the organism is. If an organism is resistant to 1st line antibiotics, then 2nd or 3rd line agents will be displayed.

- Antibiotics or antifungals to which the organism is intrinsically resistant, or which have poor in-vitro efficacy, are usually not tested or reported. Common examples include:

  o Macrolides, lincosamides and glycopeptides for most Gram-negative organisms;

45 Schuts EC, Hulscher MEJL, Mouton JW, Verduin CM, Stuart JWTC, Overdiek HWPM, et al. Current evidence on hospital antimicrobial stewardship objectives: a systematic review and meta-analysis. The Lancet Infectious Diseases 2016;16(7):847-56. doi: 10.1016/s1473-3099(16)00065

**Accessing and interpreting results of diagnostic and drug-susceptibility tests** (continued)

- o Colistin for Gram-positive organisms;
- o Fluconazole for *Candida krusei*.
- Results of certain antibiotic or antifungal susceptibility results can be used to predict susceptibility to other agents:
  - o *S. aureus* susceptible to oxacillin (cloxacillin) is regarded as susceptible to all beta-lactamase stable beta lactams;
  - o S. aureus resistant to oxacillin (cloxacillin) (MRSA) is regarded as resistant to all beta lactams with the exception of some of the newer 5th generation cephalosporins;
  - o S. pneumoniae susceptible to penicillin is regarded as susceptible to cephalosporins;
  - o Candida susceptible to anidula-fungin or micafungin is considered susceptible to caspofungin.

**When in doubt how to interpret the diagnostic results, phone the laboratory and speak to the microbiologist for guidance.**

**Figure 18:** Results of diagnostic and drug-susceptibility tests

# 3. MONITORING AND EVALUATION OF INTERVENTIONS

Implementation of an AMS is best executed with the application of quality improvement science. The 6-step process described in the NDoH Quality Improvement Guide[46] has been adapted below for application to the AMS programme (see Figure 19).

**Figure 19:** Quality improvement steps for AMS interventions



1. Establish baseline of compliance, to basic AMS principles through prescription audits

2. Identify gaps in current AMS practices

3. Explore ways to improve based on gaps and barriers in system

4. Develop a plan to address the gaps using the tiered interventions proposed for AMS

5. Test and monitor the changes through repeated Plan-Do-Study-Act cycles

6. Sustain changes through continuous quality improvement

Source: Adapted from NDOH Quality Improvement Guide

## 3.1. Tiered approach to interventions

Table 10 describes the different interventions which have been shown to improve AMS at hospital level. Interventions have been tiered according to ease of implementation and greatest impact with tier one considered 'low hanging fruit' or easier to implement stewardship interventions. It is recommended that the AMS committee agrees on the most applicable interventions to implement based on gaps or non-compliances noted regarding antibiotic prescribing in the local setting. Implementation of interventions should be done in a stepwise manner and the implementation of too many interventions at once is cautioned against.

46 National Department of Health. Quality improvement guide: Quality improvement – the key to providing improved quality of care. Pretoria; 2012.

**Table 10:** Tiered interventions for AMS quality improvement

| Intervention | Action |
|---|---|
| **FIRST TIER** | |
| **Appropriate culture prior to starting antibiotics** | Establish whether an appropriate culture was taken prior to the commencement of antibiotics according to recommended guidelines of the infection being managed. |
| **Distribution / administration** | Time to administration of antibiotic ("hang-time") is the time elapsed between antimicrobial prescription and actual antimicrobial administration which should aim to be less than one hour. |
| | It is important for prescribers to note the time of antimicrobial prescription on the prescription chart to assist with the measurement of this intervention.[47] |
| **Dose** | Optimising antimicrobial dosing according to guideline recommendations, and pharmacokinetic/ pharmacodynamic (PK/PD) principles is critically important in ensuring best patient care. |
| | For those antimicrobials that require a loading dose, ensuring that these loading doses are prescribed and administered is essential in optimising the antimicrobials' efficacy. |
| **Duration** | Inappropriate extended duration of antimicrobial therapy is unnecessary and can render unintended consequences, such as multidrug-resistance selection or Clostridium difficile infection. Antibiotic therapy that extends for longer than seven days for immuno-competent patients, or for acute conditions, should be monitored and intervened upon. |
| | Duration of therapy for patients who are culture negative should be monitored for appropriateness based on other clinical signs and symptoms. |
| **Duplicate cover** | When more than one antimicrobial is prescribed, evaluation of the spectrum of activity of these agents is necessary to ensure that there is no duplication in spectra, which could be considered redundant therapy. |
| | Duplicate cover can refer to double Gram-positive, Gram-negative and/or anaerobic therapy. Knowing the antimicrobials' spectrum of activity is important to execute this intervention. |
| **Co-administration of more than four antimicrobials** | Review patients who receive more than four antimicrobials simultaneously to minimise redundancy in therapy according to antibiotic spectrum. |

---

47 Messina AP, van den Bergh D, Goff DA. Antimicrobial stewardship with pharmacist intervention improves timeliness of antimicrobials across Thirty-three Hospitals in South Africa. Infect. Dis. Ther 2015; 4(Suppl. 1): 5–14. 10.1007/s40121-015-0082-x

| Intervention | Action |
|---|---|
| **SECOND TIER** ||
| **Intravenous-to-oral-switch (IVOS)** | To decrease the infection risk and higher cost due to unnecessary IV medication it is recommended that a patient is switched from IV antibiotics to oral bioequivalent antibiotics if clinically stable and suitable (e.g. patient can tolerate oral medication intake). |
| **De-escalation/ escalation of antibiotic therapy (drug-bug match)** | Antibiotic therapy should be tailored according to the sensitivity profile of the organism cultured. De-escalation to the narrowest spectrum agent or escalation of therapy should be considered as soon as culture sensitivity results are available. |
| **Therapeutic drug monitoring (TDM)** | Therapeutic drug monitoring is recommended for aminoglycosides and vancomycin to ensure optimal therapeutic drug concentrations in individual patients. Refer to the Hospital Level: Adult STGs and EML.[48] |
| **Monitoring the implementation of the prescription chart** | Measuring compliance to the completion of the following indicators of the prescription chart is recommended to enhance stewardship assessment of antibiotic therapy prescribed for patients. Documentation of:<br><br>• Diagnosis;<br><br>• Indication of treatment;<br><br>• Culture taken before/after antibiotic administration;<br><br>• Prescription time; and<br><br>• Duration of therapy. |

Steps to consider when implementing a quality improvement AMS strategy for any of the interventions listed in Table 10:

1. Obtain approval, commitment and endorsement from the HAMSC. Be clear on the purpose and collective goal of the desired process and communicate this message.

2. Create awareness through the necessary training and education of frontline team members and provide the applicable guidelines, evidence and toolkits required to execute the implementation of the intervention, e.g. standardised data collection sheets.

3. Test the implementation of the desired intervention in a ward (or within the pharmacy) to establish the appropriate methodology of monitoring.

4. Measurement or the monitoring of compliance to an intervention should be standardised, accurate, consistent and ongoing to authentically reflect hospital practice. Weekly or monthly measurement is recommended.

5. When measuring compliance, it is important to note that not all patients in a hospital need to be monitored but a suitable sample size to reflect hospital practice is the desired aim. A 'start small then spread' approach is recommended.

6. Always report on the infection prevention and AMS indicators to the clinicians and hospital management and leadership team.

7. A period of four to six weeks should be set aside to establish baseline compliance to a particular intervention.

8. The PDSA methodology should be used to render rapid process improvements or to test change ideas in order to improve compliance.[49]

---

48 National Department of Health. Standard Treatment Guidelines and Essential Medicines List for South Africa: Hospital level, adults, 2015 edition.   http://www.health.gov.za/index.php/standard-treatment-guidelines-and-essential-medicines-list
49 Institute for Healthcare Improvement, The Breakthrough Series: IHI's Collaborative Model for Achieving Breakthrough Improvement, 2003.

## 3.2. Measuring improvement

### 3.2.1. Measuring improvement in interventions

During the test and monitor phase of the QI cycle, rapid continuous PDSA cycles are undertaken. Measurement of intervention compliance is critical at this point to monitor if the changes implemented by the team have resulted in an improvement. Table 11 below suggests monitoring indicators for each of the interventions in the tiered approach above:[50]

**Table 11:** Measurement of tiered AMS interventions

| Intervention | Measurement |
|---|---|
| **FIRST TIER** ||
| **Appropriate culture prior to the commencment of antibiotics** | • Measure the number of patients who did not have a culture taken prior to the commencement of antibiotics as a percentage of all patients on antibiotics reviewed. |
| **Distribution / administration compliance** | • Determine the antimicrobial "hang-time" compliance in a ward or hospital by measuring the number of patients who did receive their antibiotic within one hour as a percentage of all patients seen that were prescribed day 1 antimicrobial. |
| **Dose compliance** | • Measure the number of patients who were prescribed an incorrect antimicrobial dose as a percentage of patients reviewed on antimicrobials. |
| | • Measure the number of patients who were not prescribed a loading dose as a percentage of patients reviewed who required a loading dose for their antimicrobial treatment. |
| **Duration > 7 days** | • Measure the number of patients with an inappropriate extended duration (> 7 days) of antimicrobial therapy as a percentage of patients reviewed on antimicrobials. |
| | • Consider selecting one disease state (e.g. community-acquired pneumonia) and measure compliance to duration of therapy for this condition according to recommended guidelines. |
| **Duplicate cover** | Measure the number of patients with inappropriate duplicate antimicrobial cover as a percentage of patients reviewed on antimicrobial therapy. |
| **Co-administration of more than four antimicrobials** | • Measure the number of patients with more than four antimicrobials administered at the same time as a percentage of patients reviewed on antimicrobial therapy. |
| | • Note: Trimethoprim-sulphamethoxazole prescribed as the fourth agent should not be considered inappropriate. |
| **De-escalation** | • Measure the number of patients where de-escalation of antimicrobial therapy based on culture sensitivity was performed as a percentage of patients reviewed on antimicrobials. |

50 Brink AJ, Messina AP, Feldman C, et al on behalf of the Netcare Antimicrobial Stewardship Study Alliance. Antimicrobial stewardship across 47 South African hospitals: an implementation study. Lancet Infectious Diseases 2016. DOI:10.1016/S1473-3099 ((16)30012-3).

| Intervention | Measurement |
|---|---|
| **SECOND TIER** ||
| **Intravenous-to-oral-switch (IVOS)** | • Measure the numer of patients where the appropriate antimicrobial IVOS was done as a percentage of patients seen. |
| **De-escalation/ escalation of antibiotic therapy (drug-bug match)** | • Measure the number of patients where de-escalation of antimicrobial therapy based on culture sensitivity was performeed as a percentage of patients reviewed on antimicrobials. |
| **Therapeutic drug monitoring (TDM)** | • Ensure the appropriate dose according to PK/PD principles and disease state. |
| | • Patient or population specific. |
| **Monitoring the implementation of the prescription chart** | • Measure the number of patients where the prescription chart was correctly completed for all elements in the bundle as a percentage of all prescription charts reviewed. |
| **Operational indicators for AMS** | • Annual report of AMS completed for the hospital and reported to the PAMSC. |
| | • Number of AMS committee meetings per year as per schedule. |

### 3.2.2. Measuring AMS intervention outcomes

It is necessary to determine whether the AMS interventions are having an impact. This will help focus efforts and support buy-in from staff when progress is being made or to help motivate for improvements to continue. These results should be reported regularly to the hospital management and leadership team.

Outcome indicators are already provided in the Guidelines on Implementation of the Antimicrobial Strategy in South Africa: One Health Approach and Governance; and replicated below for ease of reference (see Table 12). In addition, Clostridium difficile has been added as it is associated with a breakdown in infection control practices and the overuse of antibiotics in general. There is evidence for the restriction of quinolones, clindamycin and 2nd and 3rd generation cephalosporins in order to control C. difficile outbreaks. It has thus been proposed as an additional measure for hospitals.

**Table 12:** Indicators and measurement for outcomes

| Category | Indicator | Measure unit | Numerator | Denominator |
|---|---|---|---|---|
| **AMR** | % non-susceptible for ESKAPE bacteria Plus<br>• % 3rd generation cephalosporin non-susceptible *Klebsiella pneumoniae*<br>• % carbapenem non-susceptible *Klebsiella pneumoniae*<br>• % MRSA<br>• % 3rd generation cephalosporin non-susceptible *E. coli*<br>• % quinolone non-susceptible *E. coli*<br>• % echinocandin non-susceptible *Candida* species<br>• % amphotericin B non-susceptible *Candida* species<br>• % *Candida auris* | % non-susceptible organisms | # of organism non-susceptible | Total number of cases of organisms cultured |
| **Antimicrobial Consumption** | Ratio broad (J01CA + J01CR) to narrow (J01CE + J01CF) spectrum antibiotics | Ratio | J01CA + J01CR | J01CE + J01CF |
| | Ratio of IV to oral for the following: ciprofloxacin; amoxicillin-clavulanate; ampicillin/amoxicillin; cloxacillin | Ratio | Intravenous:<br>J01CA01 + J01CR02 + J01CR04 + J01CF02 + J01MA02 | Oral: J01CA01 + J01CR02 + J01CR04 + J01CF02 + J01MA02 |
| | Consumption of all J01 antibacterials and specific ATC antibacterials such as carbapenems, vancomycin, 3rd gen cephalosporins, fluoroquinolones, macrolides | Consumption in DDD's per 1000 inhabitants | Consumption in DDD's for each antimicrobial | Inhabitants in province x 1000 or patient days for hospital x 100 |
| **CDI surveillance** | *C. difficile* Infection rate | Rate | Number of C. difficile healthcare-associated infections | Number of patient days x 10,000 |

# 4. TRAINING ON IMPLEMENTATION OF AMS/IPC IN HOSPITALS

Each hospital should have in place an in-service training programme on the prevention of infections and AMS. The key personnel who should receive this training include:

- Clinicians at all levels;
- Pharmacists;
- IPC practitioners; and
- Laboratory staff members.

In addition, the basics of IPC should also be provided to administrative personnel and hospital management who come in contact with patients.

## 4.1. In-service prevention training

In–service training should be an annual event and should be offered to all staff in the hospital. The basic in-service training curriculum for prevention should include:

- Contact precautions (PPE, barrier precautions, safe injection practices, respiratory precautions);
- Prevention of respiratory infections especially TB;
- Hand washing and hand hygiene;
- Waste management and disposal;
- Safe injection practices/sharps safety;
- Blood and body fluid spill management;
- Wound care (if applicable);
- Environmental cleanliness;
- HAI's bundles management SSI, CAUTI, CLABSI, VAP, PLI (for healthcare professionals only).

For staff who will be involved in surveillance of HAIs, the in-service training curriculum should include:

- Importance of HAIs;
- Importance of surveillance for HAIs and how this links together with IPC and AMS interventions;
- Objectives of hospital-level HAI surveillance;
- Compilation of and interpretation of summary laboratory reports (compilation of reports specific to laboratory personnel);
- Surveillance case definitions;
- Detailed surveillance methods;
- Basics of data management (entry, cleaning, analysis, reporting);
- Surveillance report writing.

## 4.2. In-service AMS training

The in-service training for staff involved in the AMS team plus the general clinicians and nurses who are involved in day-to-day care of patients should include:

- Basics of microbiology and pharmacology;
- AMS practices;
- Quality improvement methodology and science to understand how to implement the interventions sustainably.

# ANNEXURE A:
## INFECTION PREVENTION MULTIMODAL MEASURES

### 1. HAND HYGIENE MULTIMODAL APPROACH

A significant amount of information is available on hand hygiene within the NDoH Cleanliness Guideline for Health Workers document.[51]

Ensuring hand hygiene is effectively implemented requires a multimodal approach.

| Strategy | Action/ Reference |
|---|---|
| Systems adoptions | • Attitude change towards hand hygiene.<br>• Make hand hygiene possible, easy and convenient.<br>• Make alcohol-based handrub available at bed side.<br>• Make water and soap available (place basin outside ward).<br>• Have champion in each ward. |
| Hand hygiene education | • Effectiveness of a hospital-wide programme to improve compliance with hand hygiene.[52] |
| Promote/facilitate skin care for HCW's hands | • Involve dermatology in cases of skin irritation. |
| Routine observation and feedback | • Effectiveness of a hospital-wide programme to improve compliance with hand hygiene. |
| Reminders in the workplace | • Wall mounted visual reminders. |
| Improve institutional safety climate | • General attitude improvement.<br>• Promote active participation at individual and institutional level.<br>• Avoid overcrowding, understaffing and excessive workload.<br>• Institute administrative sanction/ rewarding.<br>• Ensure patient empowerment. |
| Combination of several of the above strategies | • Effectiveness of a hospital-wide programme to improve compliance with hand hygiene. |

For hand hygiene to be effectively implementation in health facilities, the following needs to be in place as basics:

---

51 National Department of Health. A Cleanliness Guideline for Health Workers (Draft). Pretoria; 2015. Available from: https://www.idealclinic.org.za/#documents
52 Pittet D, et. al. Effectiveness of a hospital-wide programme to improve compliance with hand hygiene. Infection Control Programme. Lancet 2000; 356(9238): 1307-12.

| Multimodal strategy | Minimum criteria for implementation |
|---|---|
| Systems change: Alcohol-based handrub next to bed | Bottles of alcohol-based handrub positioned at the point of care in each ward or given to staff. |
| Systems change: Access to safe continuous water supply and towels | One sink (outside ward) to at least every 10 beds.<br>Soap and paper towels available at every sink. |
| Training and education | All staff involved in the test phase receive training.<br>Follow WHO hand wash evaluation method.<br>Long term programme must be planned and executed. |
| Observation and feedback | Two periods of observational monitoring are undertaken and feedback immediately. |
| Reminders in the workplace | Hand washing "How-to" and "5 Moments" posters are displayed in all wards. |
| Institutional safety climate | The Chief Executive Officer and Chief Nurse need to make a visible commitment to support hand hygiene improvement. |

## 2. PERSONAL PROTECTIVE EQUIPMENT

Personal Protective Equipment (PPE) includes the following pieces of equipment which should be available to all HCWs and staff near patient care areas in every hospital as a minimum:

- Eye and face protection;
- Respiratory protection;
- Hand protection;
- Body protection;
- Head protection;
- Foot protection (change footwear to closed shoes).

### 2.1. Some basic principles to follow in the use of PPE:

- No white coats should be used by clinical staff.
- Scrubs must be seen as preferred clothing. Scrubs should be put on at work and removed before going home and washed daily. This is not for every situation and is only recommended in high risk areas.
- PPE is used in addition to normal clothing and uniforms.
- The use of PPE should be task-related rather than disease related, with the aim of preventing exposure. For example, wearing gloves when coming into contact with blood or body fluids is task related as this is done regardless of the patient's disease status.
- PPE will not protect against sharps injuries; however, risk can be reduced by using safety engineered devices.
- Protective equipment should be selected on the basis of an assessment of the risks of transmission of micro-organisms as performed annually by the health facility.
- PPE only protects intact skin of the HCWs. Therefore, cuts, abrasions, exposed fresh unhealed body piercings and unhealed tattoos must be covered by a waterproof plaster or other suitable dressing in addition to PPE.
- Hand decontamination must be used before and after using PPE.
- **Arms must be 'bare below the elbow' to prevent contamination, including no jewellery or watches to be worn – this applies to all clinical staff including doctors.**
- PPE identified by the manufacturer as single use must be discarded after a single use and not re-used under any circumstances.

## 2.2. When PPE should be used

| Situation | PPE to be used |
|---|---|
| • NO risk of exposure | • Hand hygiene essential. |
| • LOW risk of exposure | • Gloves should be available. |
| | • Hand hygiene should be instituted after removal of gloves. |
| • PROBABLE risk of exposure  (e.g. contact with blood/ bodily fluids with a risk of splashing to face deemed unlikely) | • Gloves need to be worn. <br> • Disposable apron, safety goggles and mask should be available. |
| • DEFINITE risk of exposure (e.g. contact with blood, with a risk of uncontrolled bleeding or splashing to face considered likely) | • Gloves and an apron need to be worn. <br> • Water repellent gown, safety goggles and masks should be readily available. |

## 2.3. Choice of PPE

### 2.3.1. Gloves

| Type of Glove | Function | Examples of use |
|---|---|---|
| Clinical: non-sterile Standard length | Minimise cross infection (patients to staff and staff to patients). Reduce transmission of blood and body fluids. | • Potential exposure to blood. <br> • Contact with mucous membranes. <br> • Contact with non-intact skin. |
| Clinical: sterile Standard mid-forearm length | Ensure minimum contamination of site. | • Invasive procedures - surgery. <br> • Contact with sterile sites - insertion of devices. |
| Long cuff gloves | Used in cases where fluid may enter over the cuff of the glove. | • Cleaning of leg ulcers in deep water. <br> • Certain emergency situations in obstetrics and gynaecology. |
| Nitrile glove | Substitute for latex gloves. Used when handling chemicals. | • Mixing chemicals such as chlorine. <br> • Soaking endoscopes in glutaraldehyde. |
| Domestic gloves | Environmental cleaning. | • When carrying out daily or routine cleaning in clinical areas. |
| Heavy duty gloves | Handling healthcare waste. | • When lifting, transporting or disposing of healthcare waste. |

## 2.3.2. Other PPE

| | Function | Examples of Use |
|---|---|---|
| **Aprons** | Standard plastic disposable apron:<br>• Protect HCWs clothes from contamination. | • For direct contact with infectious patients and their environment.<br>• Cleaning contaminated equipment.<br>• Contact with blood/ bodily fluids, secretions and excretions.<br>• When clothes are likely to become wet or soiled. |
| | Long sleeved disposable apron or gowns. | • Use where standard disposable aprons give insufficient coverage of exposed skin and clothing- e.g. viral haemorrhagic fever cases. |
| **Masks** | Face mask:<br>• Protects HCWs from exposure to micro-organisms via splashes of blood and body fluids;<br>• Protects patient from HCW particles;<br>• Decrease airborne infections to environment.<br><br>N95 mask:<br>• Protect HCWs where high level of particle filtration is required.<br>• Needs individual assessments and fittings. | • Healthcare where treatment may cause facial splashing.<br>• Dental treatments.<br>• Cleaning of contaminated surgical equipment.<br>• For close patient care in pandemic situation.<br><br>• Cough-inducing procedures.<br>• Airborne diseases. |
| **Eye protection** | • Protects eyes from splash or spray of blood and bodily fluids.<br>• Protects eyes from chemicals.<br>• Includes safety spectacles.<br>• Combined single use visor and facemask. | • During aerosol-prone procedures (dental and other surgical interventions).<br>• During procedures where splashing is possible (cleaning equipment). |
| **Overshoes** | • Overshoes are not recommended.<br>• Change into closed toe footwear if indicated and working in Sterile Services Department to package equipment. | |
| **Head gear** | • Not recommended for routine use.<br>• Indications- sterile areas only such as:<br>  o Operating theatre,<br>  o Preparing sterile fluids in pharmacy.<br>• To be worn while inspecting/assembling sterile equipment packs. | |

# ANNEXURE B:
## INFECTION CONTROL BUNDLES FOR PREVENTION OF HAIS

The following descriptions of infection control bundles are sourced from BestCare.[53]

### Prevent ventilator-associated pneumonia (VAP) in adults

**Definition of VAP:**

Pneumonia occurring in a patient:

- requiring continuous ventilation* through either a tracheostomy or endotracheal tube
- where the infection occurs during the period of ventilation or within 48 hours of the removal of the assisting device
- diagnosis of pneumonia is based on radiological features as well as clinical features of infection

This (summarised) definition must be read together with the full CDC/NHSN surveillance criteria in order to diagnose a VAP in practice.

*A ventilator: a device to assist or control respiration continuously through a tracheostomy or by endotracheal intubation. Lung expansion devices like: intermittent positive pressure breathing (IPPB) or nasal positive end-expiratory pressure (PEEP) or continuous nasal positive airway pressure (CPAP or hypoCPAP) are NOT considered ventilators unless delivered via tracheostomy or endotracheal intubation (e.g. ET-CPAP).*

**Background:**

- Ventilator-associated pneumonia (VAP) is the leading cause of death among healthcare associated infections. Studies show that the hospital mortality of ventilated patients who develop VAP is 46% compared to 32% for ventilated patients who do not develop VAP.

- VAP leads to an extended period of mechanical ventilation and a longer length of stay (LOS) in critical care units and in hospital.

**Intervention:**

There are key elements contained in the VAP bundle

1. Elevate the head of the bed to 45 degrees when possible, otherwise attempt to maintain the head of the bed greater than 30 degrees
2. Daily evaluation of readiness for extubation
3. Subglottic secretion drainage
4. Oral care and decontamination with chlorhexidine
5. Initiation of safe enteral nutrition within 24-48 hours of ICU admission

### Prevent surgical site infections (SSI)

**Background:**

- Surgical site infections (SSI) are the second most common type of adverse event occurring in hospitalised patients in the United States. Surgical complications, including SSIs, were the most frequent type of adverse event reported in the 2004 Canadian Adverse Event Study.

- SSIs can increase mortality, re-admission rate, length of stay and costs in terms of more out-patient/ wound care visits, emergency room visits, radiology services, laboratory investigations, antimicrobial therapy and home wound care services for patients who acquire a healthcare-associated SSI.

---

53 Based on the Best Care... Always! Bundles, available from www.bestcare.org.za

**Intervention:**

There are 4 components of the SSI Bundle:

- Appropriate use of prophylactic antibiotics (including appropriate selection, timing and duration/ discontinuation)
- Appropriate hair removal: Avoid shaving; where depilation is necessary, use of clippers or depilatory creams
- Maintain post-operative glucose control (*for major cardiac surgery patients cared for in an ICU)
- Post-operative normothermia (** for all open abdominal surgery patients).

   *Glucose control: Review of evidence shows that the degree of hyperglycaemia in the postoperative period correlates with the rate of SSI in patients undergoing major cardiac surgery. Although glucose control may benefit other surgical populations, for the BCA Campaign, this measure will apply only to the cardiac surgery population for the purposes of national measurement.*

   **Normothermia: Evidence suggests that patients have a deceased risk of surgical site infection if they are not allowed to become hypothermic during the peri-operative period. Although temperature control may benefit other surgical populations, for the BCA Campaign, this measure will only apply to the colorectal or open abdominal surgical population for the purposes of measurement of compliance.*

Additional evidence-based components of good quality surgical care may be added by each individual facility.

Compliance with the SSI bundle has been most successful when all elements are executed together.

## Prevent central-line associated bloodstream infections (CLABSI)

**Background:**

Ninety percent of catheter-related bloodstream infections occur with central venous catheters (CVCs)

- Central-line associated bloodstream infections (CLABSI) prolong hospitalisation by a mean of seven days
- CLABSI mortality (controlled for underlying severity) is between 4% and 20%
- The odds ratio for developing CLABSI was 2.2 – 6.6 times greater without maximum barrier precautions

**Intervention:**

There are key elements contained in the CLABSI Bundle:

1. Hand hygiene
2. Maximal barrier precautions
3. Chlorhexidine skin antisepsis
4. Optimal catheter insertion site selected after weighing infection risk* and possible complications
5. Daily review of necessity for line, prompt removal of unnecessary central lines

   *The subclavian route has the lowest risk of infection; the femoral site the highest (especially in obese adult patients)*

Other evidence-based element of care are not excluded and may be added to the Central Line Bundle by individual facilities, for example:

- Line is secured
- Dressing is clean and intact

Compliance with the CLABSI bundle has been most successful when all elements are executed together.

## Prevent catheter-associated urinary tract infections (CAUTI)

**Background:**

- Urinary tract infections account for approximately 40% of all hospital-associated infections annually and 80% of these can be attributed to indwelling catheters.
- Between 12% and 15% of all hospitalized patients will have a urinary catheter inserted during their hospital stay and up to half of these do not have an appropriate indication.

- Duration of catheterisation is directly related to risk of developing a urinary tract infection. Although CAUTIs are not usually life-threatening, a complication of a CAUTI (e.g. urethritis, urethral strictures, haematuria, bladder obstruction, and sepsis secondary to the UTI) does cause suffering and can increase a patient's length of stay and costs.

- Application of accepted evidence-based prevention guidelines has led to considerable reductions in CAUTI rates.

**Intervention:**

There are key elements contained in the CAUTI Bundle ("Bladder Bundle"):

1. Avoid unnecessary urinary catheters

2. Insert urinary catheters using aseptic technique

3. Maintain urinary catheters based on recommended guidelines

4. Review urinary catheter necessity daily and remove promptly

The bundle elements are not exclusive and other scientifically proven elements of available evidence-based guidelines can be added by each individual facility.

Compliance with the CAUTI bundle has been most successful when all elements are executed together.

# ANNEXURE C:
## LABORATORY ALERT ORGANISM REPORT

The alert organism list contains a line listing of all specimens from which one (or more) of the "alert" organisms have been isolated. These "alert" organisms are those that either necessitate an infection control intervention as they are important from a public health perspective (outbreak prevention or control) or may serve as an indicator of inadequate infection control practices. The table below shows all the organisms included in the alert list, which specimens they may come from, and a brief explanation of why they are reported on.

**List of organisms/ conditions included in Alert Organism Reports**

| Organism | Specimen | Reason / Action |
|---|---|---|
| Methicillin resistant *S. aureus* (MRSA) | All | Antibiotic resistance – contact precautions |
| ESBL producing *Enterobacteriaceae* | All | Antibiotic resistance – contact precautions |
| Vancomycin resistant Enterococci (VRE) | All | Antibiotic resistance – contact precautions, notification |
| Carbapenem resistant or multidrug- or extensively drug-resistant Acinetobacter *baumannii* | All | Antibiotic resistance – contact precautions |
| Multi- or extensively drug-resistant *P. aeruginosa*[1] | All | Antibiotic resistance – contact precautions |
| Carbapenem resistant *Enterobacteriaceae* | All | Antibiotic resistance – contact precautions, notification |
| *Candida auris* | All | Antibiotic resistance – contact precautions |
| *Candida* species resistant to >1 antifungal class, e.g. Candida *glabrata* resistant to fluconazole and echinocandins or *Candida krusei* resistant to fluconazole and Amphotericin B | All | Antibiotic resistance – contact precautions |
| Tuberculosis (TB) smear positive or GeneXpert positive | All | Airborne precautions, notification |
| *Clostridium difficile* | Stool | Contact precautions, notification |
| Rotavirus | Stool | Contact and droplet precautions |
| *Neisseria meningitidis* | BC and CSF | Droplet precautions, prophylaxis, public health, notification[2] |
| *Vibrio cholerae* | Stool | Contact precautions, public health, notification[2] |
| *Salmonella typhi* | All | Contact precautions, public health, notification[2] |

| BC – blood culture; CSF – cerebrospinal fluid |
| :--- |
| 1: Multi-resistant Pseudomonas; defined as resistant to three or more of the following:<br>   • Piperacillin tazobactam<br>   • Cefipime and/or ceftazidime<br>   • Amikacin and/or gentamicin and/or tobramycin<br>   • Imipenem and/or meropenem and/or doripenem<br>   • Ciprofloxacin<br><br>2: "Public health, notification" here means that the relevant local authority needs to be notified (including the completion of a notification form) so that they may conduct a community level investigation and manage appropriately. |

## Please note: The list of alert organisms does NOT include all organisms isolated by the laboratory. It is NOT therefore a substitute for the normal laboratory reporting methods that clinicians are accustomed to using to obtain their results.

The alert organism report will include the following headings (See an example in the table below):

- Laboratory number: Unique number assigned to each specimen received by the laboratory. If you want to query a result with the laboratory, having this number available will facilitate the enquiry.

- Patient name and surname.

- Gender.

- Age.

- Folder number: Unique number generated by the hospital.

- Hospital name.

- Ward: Indicates the ward the patient was in at the time the sample was taken (if no ward is indicated on the request form, this will be blank).

- Collection date: Date specimen collected (if captured on request form; if not it usually defaults to the registration/ admission date).

- Specimen type.

- Test name: Indicates how the result was generated – Culture, GeneXpert, microscopy etc.

- Alert reason: as defined in the table above.

- Result: The actual name of the organism (thus for example the "alert reason" may state "presumed ESBL producing Enterobacteriaceae", and the "Organism" column will specify *Klebsiella pneumoniae*, *E. coli,* etc.).

The diagnostic laboratory should send an "alert organism list" to the hospital infection control services, and the person receiving the report should have the appropriate IPC and/ or epidemiological skills to utilise the report appropriately.

In summary, the alert organism list:

1. Includes common, important resistant bacterial and fungal pathogens (e.g. ESBL producing Enterobacteriaceae, carbapenem resistant Enterobacteriaceae, carbapenem resistant *Acinetobacter*, methicillin resistant *S. aureus, Candida auris*).

2. Includes common pathogens that may be transmitted from patient to patient or patient to HCWs (e.g. *C. difficile, M. tuberculosis*).

3. Should be sent daily, as well as collated monthly and presented to the HAMSC.

4. Is NOT used to measure HAI rates, but should be used to identify patients who need transmission-based precautions (see IPC section) and can be used to identify hospital units where there is an increased occurrence of particular AMR/ other pathogens.

5. Is NOT a surrogate for clinicians retrieving results for individual patients (see diagnostic stewardship). The report only includes certain pathogens (based on resistance phenotype) and does not provide a full antibiogram for each organism.

Alert organism list/ example

**Dates Range: 22/02/2018 - 22/02/2018**

**Region: Western Cape and Northern Cape**

| Sex | Age | Hosp/Clinic Name | Ward Name | Collection Date and Time | Specimen Type | Test Name | Alert Reason | Result / Organism Identified |
|---|---|---|---|---|---|---|---|---|
| M | 66 | Tygerberg Hospital wc TBH | Ward A1 West | 17/02/2018 15:30:00 | Blood culture | Automated culture | Methicillin resistant S. aureus (MRSA) | STAAU - *Staphylococcus aureus* |
| M | 5 | Tygerberg Hospital wc TBH | Ward G9 | 18/02/2018 10:00:00 | Urine | Culture urine | ESBL producing Enterobacteriaceae | KLEPP - *Klebsiella pneumoniae* subsp pneumoniae |
| F | 61 | Tygerberg Hospital wc TBH | Ward D6 | 19/02/2018 00:00:00 | Swab (superficial) | Culture pus | Carbapenem resistant *Acinetobacter baumannii* | ACIBA - *Acinetobacter baumannii* |
| F | 61 | Tygerberg Hospital wc TBH | Ward D6 | 19/02/2018 00:00:00 | Swab (superficial) | Culture pus | ESBL producing Enterobacteriaceae | ESCCO - *Escherichia coli* |
| F | 20 | Tygerberg Hospital wc TBH | Ward A4 West | 19/02/2018 09:00:00 | CSF | Culture for CSF | Carbapenem resistant *Acinetobacter baumannii* | ACIBA - *Acinetobacter baumannii* |
| F | 38 | Tygerberg Hospital wc TBH | Ward F Ground | 19/02/2018 13:30:00 | Blood culture | Automated culture | ESBL producing Enterobacteriaceae | ESCCO - *Escherichia coli* |
| M | 67 | Tygerberg Hospital wc TBH | Ward G9 | 17/02/2018 | Urine | Culture urine | Candida auris | CANAU – *Candida auris* |
| F | 22 | Tygerberg Hospital wc TBH | Ward J4 | 19/02/2018 | Urine | Culture urine | ESBL producing Enterobacteriaceae | KLEPP - *Klebsiella pneumoniae* subsp pneumoniae |

**Limitations of the alert organism report**

The report has several limitations, which need to be carefully understood to avoid inappropriate use / interpretation of the data:

- The list does NOT represent health care associated infections, for three reasons:

  - The lists of organisms in the reports are based on samples collected in the wards, based on clinical indication and as such have not been distinguished as community- or hospital-acquired.

  - Many isolates may represent colonisation rather than infection.

  - Some patients may have an infection without an appropriate sample being taken, or with no organism being isolated from a sample.

- Different facilities have very different types of patients, different numbers of beds etc., and the data is thus not appropriate for comparing one facility to another.

- Specimens are not collected in a standardised fashion – either with respect to which patients are sampled, or with respect to how samples are collected.

- The data should ideally not be referred to as surveillance data. It is certainly not surveillance for HAIs, and it is not truly surveillance for multi-resistant organisms.

- The reports contain no information about total number of specimens submitted, or about total number of patients sampled, or about total number of patients admitted. The data therefore cannot be used to calculate rates. There are no standardised denominators, and the data is based on routine samples.

# ANNEXURE D:
## HEALTHCARE ASSOCIATED INFECTIONS SURVEILLANCE AND DEFINITIONS

Definitions of HAIs can follow either the United States Centers for Disease Control and Prevention (CDC) or Institute for Healthcare Improvement (IHI) definitions below:

| HAI | CDC | IHI |
|---|---|---|
| **Central Line-associated Blood Stream Infections (CLABSI)** | A laboratory-confirmed bloodstream infection (LCBI) where central line (CL) or umbilical catheter (UC) was in place for >2 calendar days on the date of event, with day of device placement being Day 1, AND the line was also in place on the date of event or the day before. If a CL or UC was in place for >2 calendar days and then removed, the date of event of the LCBI must be the day of discontinuation or the next day to be a CLABSI. If the patient is admitted or transferred into a facility with an implanted central line (port) in place, and that is the patient's only central line, day of first access in an inpatient location is considered Day 1. "Access" is defined as line placement, infusion or withdrawal through the line. Such lines continue to be eligible for CLABSI once they are accessed until they are either discontinued or the day after patient discharge (as per the Transfer Rule). Note that the "de-access" of a port does not result in the patient's removal from CLABSI surveillance.[54] | Primary bloodstream infection occurring in a patient: Criterion 1: with a central line[#] in situ; OR where infection occurs within 48 hours of the removal of the central line; and Criterion 2: where no other possible source of the bloodstream infection is identified (i.e. does not include secondary bloodstream infections). There is no minimum period of time that the central line must be in place in order for the bloodstream infection to be considered central line-associated. There must be no evidence that the infection was present or incubating at the time of insertion  # Central line: an intravascular catheter that terminates at or close to the heart or in one of the great vessels (aorta, pulmonary artery, superior & inferior vena cava, brachiocephalic veins, internal jugular veins, subclavian veins, external iliac veins and common iliac or femoral veins; neonates: umbilical artery or vein). Must be a lumened device which is used for infusion, withdrawal of blood or hemodynamic monitoring. May be temporary or permanent (e.g. dialysis tunnelled or implanted catheters, including ports). |

54 Centers for Disease Prevention and Control. Bloodstream Infection Event (Central Line-Associated Bloodstream Infection and Non-central Line Associated Bloodstream Infection), 2018. Available from https://www.cdc.gov/nhsn/pdfs/pscmanual/4psc_clabscurrent.pdf.

| HAI | CDC | IHI |
|---|---|---|
| **Catheter-associated Urinary Tract Infections (CAUTI)** | A UTI where an indwelling urinary catheter was in place for >2 calendar days on the date of event, with day of device placement being Day 1, <br><br> AND <br><br> an indwelling urinary catheter was in place on the date of event or the day before. If an indwelling urinary catheter was in place for > 2 calendar days and then removed, the date of event for the UTI must be the day of discontinuation or the next day for the UTI to be catheter-associated.[55] | UTI in a patient <br> • with an in-dwelling urinary catheter# at the time or within 48 hrs before onset of the event, where a positive culture is available; OR <br> • the patient has signs and symptoms of a UTI with no other possible cause and a positive urine culture of >100 000 CFU/ml with no more than 2 species of microorganisms (uropathogens##); OR <br> • the patient has NO signs or symptoms of UTI but DOES have a positive urine culture of >100 000 CFU/ml with no more than 2 species of uropathogen and has a positive blood culture with at least one matching uropathogen. <br> • There is no minimum period of time that the catheter must be in place in order for the UTI to be considered catheter-associated. <br> • There must be no evidence that the infection was present or incubating at the time of catheter placement. <br><br> # In-dwelling catheter: A drainage tube that is inserted into the urinary bladder through the urethra AND is left in place AND is connected to a closed drainage system. <br><br> Straight in-and-out catheters, condom catheters and supra-pubic catheters are not included in the definition. <br><br> ## Uropathogens are: Gram-negative bacilli, Staphylococcus spp, yeasts, Beta-haemolytic Streptococcus spp, Enterococcus spp, *G. vaginalis, Aerococcus urinae* and Corynebacterium (urease positive) |

55 Centers for Disease Prevention and Control. Urinary Tract Infection (Catheter-Associated Urinary Tract Infection [CAUTI] and Non-Catheter-Associated Urinary Tract Infection [UTI]) and Other Urinary System Infection [USI]) Events, 2018. Available from www.cdc.gov/nhsn/pdfs/pscManual/7pscCAUTIcurrent.pdf.

| HAI | CDC | IHI |
|---|---|---|
| **Surgical site infection (SSI)** | A surgical site infection is an infection that occurs after surgery in the part of the body where the surgery took place.<br><br>Surgical site infections can sometimes be superficial infections involving the skin only. Other surgical site infections are more serious and can involve tissues under the skin, organs, or implanted material. | An infection related to a surgical intervention or operation#<br>• that occurs within thirty days of surgery; OR<br>• within one year of surgery if an implantable device or non-human foreign body is placed.<br><br># An operation: takes place in an operating room, during a single trip, where the surgeon makes at least one incision through the skin or mucous membranes and the incisions are closed before the patient leaves the operating room. Includes laparoscopy. Debridement of burns or pressure ulcers and skin grafts are NOT included.<br><br>SSI's are further differentiated as superficial, deep incisional or organ space, depending on the location of the infection within the wound. There must be no evidence that the infection was present or incubating at the time of incision. |

| HAI | CDC | IHI |
|---|---|---|
| **Ventilator-associated pneumonia (VAP)** | Pneumonia occurring in a patient:<br>• requiring continuous assisted ventilation# through either a tracheostomy or endotracheal tube;<br>• where the infection occurs during the period of ventilation or within 48 hours of the removal of the assisting device.<br><br>Diagnosis of pneumonia is based on radiological features as well as clinical features of infection. There is no minimum period of time that the ventilator must be in place in order for the pneumonia to be considered ventilator-associated. There must be no evidence that the infection was present or incubating at the time of intubation.<br><br># Ventilator: a device to assist or control respiration continuously through a tracheostomy or by endotracheal intubation. Lung expansion devices like: intermittent positive pressure breathing (IPPB) or nasal positive end-expiratory pressure (PEEP) or continuous nasal positive airway pressure (CPAP or hypoCPAP) are NOT considered ventilators unless delivered via tracheostomy or endotracheal intubation (e.g. ET-CPAP). | Pneumonia in a patient intubated and ventilated at the time of or within 48 hours before the onset of the event.<br><br>(There is no minimum period of time that the ventilator must be in place in order for the pneumonia to be considered ventilator-associated.)[56] |

**Measurement of HAI rates per type:**

- CLABSI rate = (Number of central line-associated bloodstream infections / number of central line days) x 1000

  **Goal:** Reduce CLABSI rate by 40% in one year

- CAUTI rate = (Number of catheter-associated urinary tract infections / number of urinary catheter days) x1000

  **Goal:** Reduce CAUTI by 25% in one year

- SSI Rate = (Number of surgical site infections in a specific discipline / number of surgeries in that discipline) x 1000

**Goal:** Reduce SSI rate by 30% in one year OR number of cases between surgical site infections

- VAP rate = (Number of ventilator-associated pneumonias / number of ventilator days) x 1000

  **Goal:** Reduce VAP rate by 25% in one year

56 Institute for Healthcare Improvement, accessible at www.ihi.org

# ANNEXURE E:
## HOSPITAL AMS COMMITTEE

**Composition**

It is critical that the highest-ranking member of each component of the AMS response represents the hospital on the Hospital Antimicrobial Steering Committee (HAMSC). This is to ensure translation of policy into action and is especially important in choosing the most senior level administrator.

The committee should consist of the following core members:

a.  Chairperson: should be the CEO or highest-ranking management representative of the hospital;

b.  Senior Physician of the hospital;

c.  Head of Pharmacy Services of the hospital;

d.  IPC practitioner of the hospital;

e.  Head of Nursing – or highest-ranking nurse manager, under whose brief AMS falls;

f.  Medical Microbiologist - where not available, either the most experienced member of the NHLS that services the hospital, OR a seconded microbiologist from another NHLS laboratory or private laboratory.

Additional members who can be included, depending on the size of institution and their access to resources, include:

a.  Other clinicians representing each clinical department of the hospital or as a minimum the key departments consuming the most antibiotics – e.g. ICU, surgery, emergency medicine, gynaecology and/or obstetrics;

b.  Adult infectious diseases specialist (where not available, a prescribing specialist clinician, family practitioner or equivalent with experience in AMS);

c.  Paediatric infectious diseases specialist if the hospital is a specialist paediatric hospital or has joint adult and paediatric services. Where a paediatric infectious

diseases specialist is not available, a prescribing specialist paediatrician with experience in AMS or similar at the level of family practitioner or equivalent should substitute;

d.  Quality improvement/assurance practitioner;

e.  Ward pharmacist or any pharmacist trained in AMS.

**Responsibilities of the HAMSC**

•  Surveillance – HAMSC must monitor and report on:

o  Antimicrobial usage data from pharmacy – ideally data from each hospital department should be presented in Defined Daily Doses per hundred patient days (DDD/100 patient days) for ward patients and as DDD for emergency unit and outpatients. However, the institutions should look at the data available and work with existing data constraints moving towards the ideal. The list of antibiotics for reporting will depend on their availability as per the STGs and EML for that facility level (Appendix A);

o  Local antibiotic resistance profile data of microorganisms in each facility collected from the local NHLS laboratory. Some facilities refer to regional referral laboratory for processing and reports would be available at regional level. Hospital-wide bug-drug combinations (as defined in Appendix B) should be reviewed and reported annually to the PAMSC. Resistance profiles should also be fed back to all clinicians in the hospital on a 6 monthly basis and presented as part of the quality committee agenda to the management staff;

o  Outbreaks of MDROs in the hospital should be reviewed by the HAMSC,

which should work with the hospital's IPC team, the provincial outbreak response team, and NICD (when necessary) to control the outbreak according to the Health Act;

o  Hospital-acquired infections – institutions must phase in the monitoring of rates for the number of CLABSI, CAUTI, SSI and/or VAP (if surgery and/or ICU services are provided at the hospital). Number of C. difficile infections per hospital should also be reported. 12-monthly data should be reported to the PAMSC. The IPC Practitioner plays a critical role in providing this information, along with the microbiologist or laboratory staff in the hospital;

o  Volume of infection-related laboratory investigations (blood cultures, CRP, PCT, white blood cell count) from NHLS laboratories servicing the hospital;

• Follow up with existing IPC structures that all clinical areas follow standard precautions and appropriate additional (transmission-based) precautions as required to reduce the risk of transfer of contagious and resistant pathogens to patients and staff. Supervise terminal cleaning of isolation facilities after patient discharge;

• Coordinate the activities of the hospital's antibiotic stewardship team/s. Identify clinical units in need of support;

• Ensure that regular feedback is given to all prescribers on the status of AMR interventions and surveillance information as part of ongoing feedback and awareness. Consideration should be given to reporting systems for prescribers who consistently do not follow protocols and guidelines and should be dealt with through the HAMSC and the Management of the hospital;

• Provide regular in-service training in AMS and IPC for clinicians, nurses, and allied health care professionals, through access to antibiotic stewardship ward rounds, web-based training materials and workshops at regional training centres;

• Coordinate and publicise the hospital's participation in awareness days related to AMS/IPC i.e. World Hand Hygiene day (5th May), Infection Control Week (September), Pharmacy Month (September), and World Antibiotics Awareness Week (November).

## Role of HAMSC

- Surveillance
- Communicate with IPC and quality structures
- Coordinate AMR activities
- Feedback to prescribers
- Provide regular in-service training

# ANNEXURE F:
## CUMULATIVE ANTIBIOGRAMS

In order to make informed decisions about antibiotic choices, and in order to monitor antibiotic resistance trends, it is important to be able to review antibiotic resistance rates for certain organisms or organism groups periodically. The cumulative antibiogram aims to describe the format such reports will take, as well as some of the limitations of the reporting, and the parameters that are used to generate the reports. The cumulative antibiogram is aimed primarily at clinicians and hospital managers who may be receiving and reviewing these reports. It is strongly recommended that these cumulative antibiograms be analysed in conjunction with a microbiologist familiar with the laboratory where the testing had taken place.

The cumulative antibiogram contains the following key aspects:

- the micro-organisms;

- how many isolates of that organisms were cultured;

- their percentage susceptibility to the drugs that are usually used to treat them.

A general example of the format would be:

| % Susceptible, 2011, XXX Hospital | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Organism | Number | AMIK | GENT | CIP | CTX | CTZ | IMP | SXT |
| E. coli | 367 | 45 | 23 | 89 | 65 | 65 | 100 | 45 |
| K. pneumoniae | 234 | 78 | 65 | 67 | 38 | 38 | 99 | 59 |
| E. aerogenes | 123 | 88 | 79 | 78 | 45 | 48 | 100 | 48 |
| E. cloacae | 108 | 91 | 83 | 80 | 35 | 39 | 100 | 23 |
| Proteus spp | 201 | 100 | 89 | 95 | 88 | 88 | 100 | 51 |

**General principles**

- Results will be expressed as % susceptible.

- Only the first isolate of a given species per patient is included i.e. multiple occurrences of the same organisms in the same patient are excluded to prevent double counting.

- If there are less than 30 isolates of a given species, the results will not be presented unless there are compelling reasons to do so. Any such data must be interpreted very carefully.

- Data should be requested at least annually. However, more frequent analyses may be necessary in certain situations. If more frequent analysis is performed, note must be taken of the recommendation that results should not be presented if <30 of a particular species are present.

- The antibiotics reported are those that are routinely tested and reported on all isolates, and that are appropriate for the species. This means that if some antibiotics are only tested on a selection of isolates (e.g. colistin, which is only tested on multi-resistant *Pseudomonas aeruginosa*; or nitrofurantoin which is only tested on urinary tract isolates), these will not be included in the routine report, although may be included in a special report.

## Antibiogram example

### Blood Culture Pathogens

| ORGANISM | Number of isolates | ANTIBIOTIC (% susceptible) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Amikacin | Amox-Clav | Cafepime | Cefotaxime / Cefrinaxone | Ceftazidime | Ciprofloxacin | Ertapenem | Gentamicin | Imipenem | Metropenem | Pip-Taz | TMX |
| Non-fermenting GNBs[1] | 45 | 62 | R | 67 | R | 64 | 61 | R | 48 | 75 | 67 | 49 | 32 |
| Enterobacteriaceae[2,3] | 17 | 100 | 56 | 94 | 82 | 81 | 100 | 94 | 94 | 87 | 94 | 75 | 76.5 |

GNBs= Gram-negative bacilli; TMX = Trimethoprim-sulfamethoxazole
[1]Non-fermenting GNB include: *Acinetobacter baumannii* (19), *Pseudomonas aeruginosa* (16), *Burkholderia cepacia* (5), *Delifia acidonvorans* (2), *Stenotrophomonas maltophilia* (2) and *Acinetobacter lwoffili* (1)
[2]Enterobacteriaceae include: *Klebsiella pneumoniae* (4), *Proteus mirabilis* (4), *Enterobacter aerogens* (3), *Escherichia coli* (3), *Serratia species* (2) and *Aeromonas hydrophila* (1)
[3]Calculated less than the standard recommendation of 30 isolates which may be misleading, therefore, interpret results with caution

| R | The organism is intrinsically resistant to the antibiotic indicated OR os not recommended dur to poor clinical response and/or poor activity

### Respiratory Tract Pathogens

| ORGANISM | Number of isolates | ANTIBIOTIC (% susceptible) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Amikacin | Amox-Clav | Cafepime | Cefotaxime / Cefrinaxone | Ceftazidime | Ciprofloxacin | Ertapenem | Gentamicin | Imipenem | Metropenem | Pip-Taz | TMX |
| *Pseudomonas aeruginosa* | 80 | 97.5 | R | 95 | R | 94 | 97.5 | R | 100 | 91 | 92.5 | 85 | R |
| Enterobacteriaceae[1] | 45 | 87 | 50 | 64 | 62 | 62 | 84 | 95 | 82 | 87 | 96 | 79.5 | 58 |
| *Acinetobacter baumannii* | 36 | 33 | R | 14 | R | 14 | 14 | R | 31 | 19 | 22 | 11 | 19 |

TMX = Trimethoprim-sulfamethoxazole
[1]Enterobacteriaceae include: *K. pneumoniae* (16), Enterobacter cloacae (9), *E. coli* (3), *Citrobacter spp*. (2), *Proteus vulgaris* (2), *E. aerogenes* (1), *Klebsiella oxytoca* (1), *Morganella morganii* (1) and *Raoultella planticola* (1)

| R | The organism is intrinsically resistant to the antibiotic indicated OR os not recommended dur to poor clinical response and/or poor activity

A common query about these reports relates to why some agents are NOT reported for certain organisms. There are three main reasons for this:

1. The organism (or organism group) is intrinsically resistant, and the agent is not tested as it is of no clinical value. Examples would include vancomyin for *Enterobacteriaceae*; clindamycin for enterococci, cephalosporins for enterococci, macrolides for *Enterobacteriaceae*, ertapenem for *Pseudomonas* and *Acinetobacter* etc.

2. Susceptibility can be deduced from results of other agents. The commonest example is beta-lactam antibiotics and *S. aureus*. If *S. aureus* is susceptible to oxacillin, it is regarded as susceptible to most other beta lactams (except the penicillins); and conversely, *S. aureus* resistant to oxacillin (i.e. MRSA) is regarded as resistant to all currently available beta lactams. Hence only oxacillin (or cloxacillin) susceptibility is reported. Another example would be *S. pneumoniae*, where the beta lactams commonly tested include penicillin and cefotaxime/ceftriaxone. The activity of other beta lactams (such as 2nd generation cephalosporins, co-amoxiclav, carbapenems) can be inferred from these data.

3. Susceptibility testing is not routinely performed since no standardised methodology or interpretive criteria exist. Common examples of this would be certain topical agents (such as silver sulfadiazine, chlorhexidine, as well as ciprofloxacin or aminoglycosides against streptococci from eye swabs); certain non-fermentative Gram-negative bacilli (e.g. *Stenotrophomonas, Burkholderia*).

**Limitations**

The data presented does NOT provide an indication of infection rates and should not be used as such. The only exception would probably be susceptibility data from blood cultures.

It does not differentiate between healthcare-associated and community-acquired infection rates (this will hopefully change). Thus, the ability to use the data to drive empiric regimens may be limited. This can be circumvented to a degree by analysing data from specific units (rather than the hospital as a whole); however, this comes at the cost of reducing the number of isolates in the data.

The data is obtained from samples submitted to the laboratory as routine clinical samples, and thus if there are changes in specimen collection practices, the data will also change.

# ANNEXURE G:
## ANTIMICROBIAL PRESCRIPTION CHARTS

Ensuring information about how an antimicrobial prescription is recorded is critical to the imple-mentation of sound AMS activities, either in the existing prescription chart or on a dedicated antimicrobial prescription chart (see example provided below).[14] The core information about the antimicrobial prescription that needs to be included are:

- Infectious diagnosis for the antimicrobial - pneumonia, meningitis etc. This forces the prescriber to focus antibiotic choice on target organ and likely bacteria, e.g. Gram-negative *Enterobacteriaceae* in UTI.

- Indication for the antimicrobial - Mark indication as prophylactic, empirical or definitive:

    o   Prophylactic therapy, e.g. surgical prophylaxis and other antimicrobial prophylaxis;

    o   Empiric therapy refers to initiation of treatment prior to determination of a firm diagnosis;

    o   Definitive therapy refers to therapy that is adjusted according to the cultured organism.

- Whether appropriate cultures were sent prior to or after the first dose of antimicrobial.

- Microbiology results with susceptibility profile of microorganisms and any other diagnostic indicators such as AST, CRP, procalcitonin, white cell count.

- Determining the source of the infection, i.e. community- (commonly sensitive to 1st line antimicrobials) or hospital-acquired (more commonly caused by resistant bacteria).

- Patient's weight.

- Documentation of antimicrobial allergies.

- Date and time of prescription.

- Dose.

- Duration of therapy.

- Route of administration.

- Day on which antimicrobial is to be stopped/deescalated or changed to oral.

- And if possible separating infection episodes to enable evaluation of an antimicrobial for each individual episode of infection, e.g. patient presents with a community-acquired pneumonia (infection episode 1) and receives antimicrobial for pneumonia. During hospital admission he/she develops a CLABSI (infection episode 2) and is evaluated for a different set of antimicrobial/s.

**Example of an Antimicrobial Prescription Chart developed by the South African Antibiotic Stewardship Programme**

| Infection Episode 1 | **Diagnosis** | ☐ Pneumonia | ☐ UTI | ☐ Meningitis | ☐ Line infection |
| | ☐ Cellulitis | ☐ Intra-abdominal infection | ☐ Other_____ | | |

| **Source*** | ☐ Community Acquired  ☐ Hospital acquire | **Indication** | P = Prophylactic    E = Empirical    D = Definitive |
| --- | --- | --- | --- |

**SEND APPROPRIATE CULTURES BEFORE PRESCRIBING ANTIBIOTICS**

| **Cultures** | ☐ Sent before antibiotics | ☐ Sent after antibiotics | ☐ Not Sent |
| --- | --- | --- | --- |

*CA = Community acquired: within 48h, of admission
HA = Hospital-acquired: 48h after admission or within 30 days of discharge

| Antibiotic Day | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| Date → Time ↓ | | | Review | | Review | | Review | | | |

| Indication | Medical Approved name of GE | Dose    Route | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ☐ P | | | | | | | | | | | | |
| ☐ E | Start Date / Time | Duration | Frequency | | | | | | | | | |
| ☐ D | Drs Signature & Name    Contract | Pharmacy | | | | | | | | | | |

## Implementation of the prescription chart

It is crucial to have a proper project plan for the introduction of an antimicrobial section in the existing prescription chart or of a dedicated antimicrobial prescription chart, if these are not yet in place. Thorough communication with all role players and adequate training for everyone that uses the chart is key to the success of the project.

## References

- Bratzler, D.W., Dellinger, E.P., Oslen, K.M. et al. 2013. Clinical practice guidelines for antimicrobial prophylaxis in surgery. ASHP report. Am J Health-Sys Pharm; 70:195-283. Available from: https://doi.org/10.2146/ajhp120568

- Allegranzi B, Bischoff P, de Jonge S, et al. New WHO recommendations on preoperative measures for surgical site infection prevention: an evidence-based global perspective. Lancet Infect Dis 2016; published online Nov 2. Available from: http://dx.doi.org/10.1016/S1473-3099(16)30398-X

- Gilbert, D.N., Moellering, R.C., Eliopoulos G.M. et al. 2015. Surgical antibiotic prophylaxis. The Sanford Guide to Antimicrobial Therapy. 45th ed. Antimicrobial Therapy, Inc.: USA. p191-194.

- Cosgrove, S.E., Avdic, E. 2016. Antibiotic guidelines 2015-2016. Johns Hopkins Medicines. Available from: http://www.insidehopkinsmedicine.org/amp
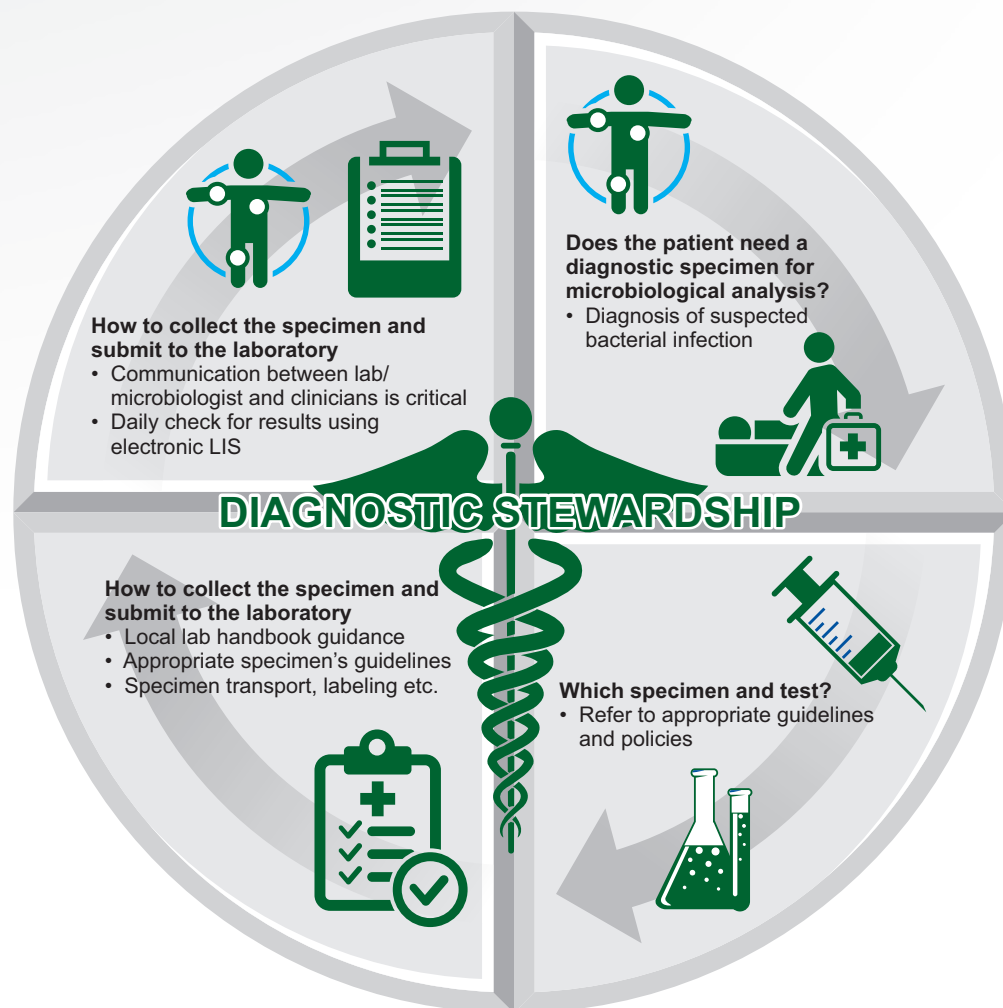
# ANNEXURE H:
## DIAGNOSTIC STEWARDSHIP

Diagnostic stewardship is defined as the "coordinated intervention to improve and measure the appropriate use of microbial diagnostics to identify pathogens and guide therapeutic decisions by promoting appropriate and timely selection and collection of specimens, accurate and timely testing, accurate and timely reporting of results."[57]

Diagnostic stewardship extends beyond the patient into the laboratory and relies on the skills, expertise, and capacity of the laboratory and its staff to accurately test and report on specimens it receives to guide treatment and active management of resistant organisms by the health professionals (see Figure below). Focus will be on providing timely microbiological data to deliver safer and more effective and efficient treatment; and accurate and representative AMR surveillance data to inform treatment guidelines, and AMR control strategies.

### Diagnostic stewardship steps



**Does the patient need a diagnostic specimen for microbiological analysis?**
- Diagnosis of suspected bacterial infection

**How to collect the specimen and submit to the laboratory**
- Communication between lab/microbiologist and clinicians is critical
- Daily check for results using electronic LIS

**DIAGNOSTIC STEWARDSHIP**

**How to collect the specimen and submit to the laboratory**
- Local lab handbook guidance
- Appropriate specimen's guidelines
- Specimen transport, labeling etc.

**Which specimen and test?**
- Refer to appropriate guidelines and policies

---

57 World Health Organization, Draft Implementation Manual on Global Surveillance of Antimicrobial Resistance (GLASS). Geneva; 2015.

## Section 1: Does the patient need a specimen for microbiological analysis?

Specimens for "diagnostic" purposes are usually submitted to identify causative organisms, rather than to confirm a clinical diagnosis. For example, a patient will present with symptoms of a lower respiratory tract infection (LRTI), and sputum and/or blood culture may help identify which organism is responsible. However, the presence of the organism does not confirm the diagnosis of LRTI; the absence of an organism does not exclude the diagnosis of LRTI.

## Section 2: Which specimen and test

This would be informed by local guidelines and policies, as well as the likely site of infection (e.g. pneumonia guidelines, meningitis guidelines). Some general principles include:

- Sterile site samples are preferred to non-sterile site samples, as far as possible.

- Specimens should be submitted prior to antimicrobial administration if at all possible.

- The fact that a specimen has been collected must be documented in the patient notes.

## Section 3: How to collect the specimen and submit to the laboratory

Local guidelines and SOPs normally specify how different specimens should be collected, including the appropriate material to be used (e. g. blood culture bottle, urine container, swabs), the required amount of specimen and technique for clean and safe sampling (e.g. sterile venepuncture for blood specimen) and the appropriate precautions, including use of PPE such as gloves, that must be adhered to.

Based on clinical symptoms implementation of related guidelines for specimens' selection should apply.

General principles for specimen collection:

- Microbiology specimen selection and collection are the responsibility of the medical staff, not usually the laboratory. Continuous training on specimen collection practices for clinicians should be hosted annually at facility level.

- Importance of good specimen collection:
    - It is the key to accurate laboratory diagnosis and confirmation;
    - It directly affects patient care and patient outcomes;
    - It influences therapeutic decisions;
    - It impacts hospital infection control;
    - It impacts patient length of stay, hospital costs, and laboratory costs, and influences laboratory efficiency.

- The quality of a result is directly related to the quality of the specimen being cultured. The best results are obtained when the following guidelines are maintained:
    - Follow standard precaution guidelines. Treat all specimens as potential biohazards.
    - Collect the specimen before administering antimicrobial agents when possible.
    - Collect the specimen with as little contamination from indigenous flora.
    - Utilize appropriate collection devices, sterile equipment, and aseptic technique to collect specimens.
    - Various types of transport media are provided, depending on the type of culture required.
    - All swabs are to be kept moist in a transport medium after the specimen is collected.
    - Clearly label the specimen container with: patient's name, date, time of collection.
    - Collect an adequate amount of specimen. Inadequate amounts may yield false negative results.
    - Identify the specimen source and/or specific site correctly so that proper culture media will be selected during processing in the laboratory.
    - Transport all specimens to the laboratory on time. This ensures the survival and isolation of fastidious organisms and prevents overgrowth by more hardy bacteria. It also shortens the duration of specimen contact with some local anaesthetics used in

collection procedures, that may have antibacterial activity.

- Physicians or specialists with advanced training and skills should collect specimens requiring extreme invasive technique.

- Any other questions or requests should be directed to the microbiology laboratory.

- Microbiology should be informed in advance if there are any special requests that might require special handling.

- Clinicians should consult the laboratory to ensure that selection, collection, transport, and storage of patient specimens are performed properly.

## Section 4: Accessing and interpreting the results

- An effective two-way communication system between the microbiology laboratory and clinical service must be in place.

- Results should be checked for every day (preferably using an electronic laboratory information system), until a final result is provided. (Note: due to the nature of microbiology laboratory work, provisional results may be amended or added to on a daily basis until finalised).

- Results must be documented in the patient's file.

- Results should be appropriately interpreted. Some key points related to interpreting microbiology results include:

- Is the specimen appropriate for the suspected infection?

- How was the specimen collected, and is it a sterile or non-sterile specimen?

- Is/are the organism/s isolated likely to be pathogenic?

  – Coagulase-negative staphylococci from non-sterile samples (and sometimes from sterile samples) are often skin flora (contaminant);

  – Many non-fermenting Gram-negative bacilli are environmental and are uncommon pathogens (except for *A. baumannii*, *P. aeruginosa*, and to a lesser degree *B. cepacia* and *S. maltophilia*).

– Enterococci are recognised pathogens from UTIs and intra-abdominal sepsis, and as an uncommon cause of LRTI.

- Results of in-vitro susceptibility testing reflect the likely clinical response, but this may be influenced by site of infection, age of patient, severity of illness.

- Not all antimicrobials that are tested are necessarily reported – laboratories will often display the most appropriate agents based on how resistant the organism is. If an organism is resistant to 1st line antimicrobial, then 2nd or 3rd line agents will be displayed.

- Antimicrobials to which the organism is intrinsically resistant, or which have poor in-vitro efficacy, are usually not tested or reported. Common examples include:

  – Macrolides, linocosamides and glycopeptides for most Gram-negative organisms;

  – Colistin for Gram-positive organisms;

  – Fluconazole for *Candida krusei*.

- Results of certain antimicrobial susceptibility results can be used to predict susceptibility to other agents:

  – *S. aureus* susceptible to oxacillin (cloxacillin) is regarded as susceptible to all beta-lactamase stable beta lactams;

  – *S. aureus* resistant to oxacillin (cloxacillin) (MRSA) is regarded as resistant to all beta lactams with the exception of some of the newer 5th generation cephalosporins;

  – *S. pneumoniae* susceptible to penicillin is regarded as susceptible to cephalosporins;

  – *Candida* species susceptible to micafungin or anidulafungin is considered susceptible to caspofungin.

**References:**

1. World Health Organization. Diagnostic stewardship: A guide to implementation in antimicrobial resistance surveillance sites. Global AMR Surveillance System. Geneva; 2016. Available from http://apps.who.int/iris/bitstream/handle/10665/251553/WHO-DGO-AMR-2016.3-eng.f;-jsessionid=BCA2F0E5CF77E-3709C84387A49A6B93D?sequence=1

2. Infectious Diseases Society of America and the America Society for Microbiology. A guide to utilization of the microbiology laboratory for diagnosis of infectious diseases: 2018 update. Clinical Infectious Diseases. 2018. Available from:  www.idsociety.org/Guidelines/Patient_Care/IDSA_Practice_Guidelines/Laboratory_Diagnosis_of_Infectious_Disease/

3. South African Antibiotic Stewardship Programme mobile application, available for download from:
   a.   iPhone APP store
   b.   Android Google Play store

4. BacT/ALERT® Blood Culture Collection Procedure. Biomeriuex. Available from: www.biomerieux-usa.com/sites/subsidiary_us/files/worksafe-blood-culture-collection-procedure-1.pdf

5. Centers for Disease Prevention and Control. Specimen Collection Guidelines. Available from: www.cdc.gov/urdo/downloads/speccollectionguidelines.pdf