

## **IMPORTANT NOTICE**

**This notice is not to be erased and must be included on any printed version of this publication.**

This publication was **rescinded** by the Commonwealth of Australia as represented by the Department of Health and Ageing (the “Department”) on 3 January 2008 and is available on the Internet **ONLY** for historical purposes.

- This publication was rescinded by the Department on 3 January 2008. The Department has made this publication available on its Internet Archives site as a service to the public for historical and research purposes **ONLY**.
- Rescinded publications are publications that no longer represent the Department’s position on the matters contained therein. This means that the Department no longer endorses, supports or approves these rescinded publications.
- The Department gives no assurance as to the accuracy, relevance or completeness of any of the information contained in this rescinded publication. The Department assumes no legal liability or responsibility for errors or omissions contained within this rescinded publication for any injury, loss or damage incurred as a result of the use of, reliance on, or interpretation of the information contained in this publication.
- Every user of this rescinded publication acknowledges that the information contained in it may not be accurate, complete or of relevance to the user’s purposes. The user undertakes the responsibility for assessing the accuracy, completeness and relevance of the contents of this rescinded publication, including seeking independent verification of information sought to be relied upon for the user’s purposes.
- Every user of this rescinded publication is responsible for ensuring that each printed version contains this disclaimer notice, including the date of rescission and the date of downloading the archived Internet version.

**Strategy for  
Antimicrobial Resistance  
(AMR) Surveillance in  
Australia**

September 2003

Rescinded

# Table of Contents

TABLE OF CONTENTS .....	II
LIST OF FIGURES .....	IV
EXECUTIVE SUMMARY .....	V
1. INTRODUCTION .....	1
2. BACKGROUND .....	2
2.1 JETACAR .....	2
2.2 COORDINATION AND IMPLEMENTATION .....	2
2.3 EXPERT ADVISORY GROUP .....	3
2.4 A STRATEGY FOR AMR SURVEILLANCE IN AUSTRALIA .....	3
2.5 AIM .....	5
2.6 STRATEGY OUTCOMES .....	5
3. DEVELOPMENT OF THE STRATEGY .....	5
3.1 COORDINATION AND IMPLEMENTATION AT THE NATIONAL LEVEL .....	5
3.2 CONSULTATIVE PROCESS .....	6
4. IMPLEMENTATION OF THE STRATEGY .....	7
4.1 INTRODUCTION: A STAGED APPROACH .....	7
4.2 ESTABLISHMENT OF A CENTRAL COORDINATING UNIT .....	8
4.3 GOVERNANCE .....	8
4.4 AIMS .....	9
4.5 GOALS .....	9
4.6 PROCESSES .....	9
4.7 REPORTING FROM THE CCU .....	10
5. SURVEILLANCE OF ANTIMICROBIAL RESISTANCE IN COMMUNITY ACQUIRED INFECTIONS .....	10
5.1 BACKGROUND .....	10
5.2 AIM .....	10
5.3 PRIMARY AGENCY .....	10
5.4 STAKEHOLDERS .....	10
5.5 GOALS .....	11
5.6 PROCESSES .....	11
5.7 ORGANISMS AND ANTIMICROBIALS FOR SURVEILLANCE .....	12
5.8 OUTCOMES .....	13
6. SURVEILLANCE OF ANTIMICROBIAL RESISTANCE IN HEALTHCARE ACQUIRED INFECTIONS .....	13
6.1 BACKGROUND .....	13
6.2 AIMS .....	13
6.3 PRIMARY AGENCY .....	13
6.4 STAKEHOLDERS .....	14
6.5 GOALS .....	14
6.6 PROCESSES .....	14
6.7 ORGANISMS AND ANTIMICROBIALS FOR SURVEILLANCE .....	15
6.8 OUTCOMES .....	16
7. SURVEILLANCE OF ANTIMICROBIAL RESISTANCE IN ANIMALS .....	16
7.1 BACKGROUND .....	16
7.2 AIM .....	16
7.3 PRIMARY AGENCY .....	16
7.4 STAKEHOLDERS .....	16
7.5 GOALS .....	17

7.6 PROCESSES .....	17
7.7 ORGANISMS AND ANTIMICROBIALS FOR SURVEILLANCE .....	18
7.8 OUTCOMES .....	18
8. SURVEILLANCE OF ANTIMICROBIAL RESISTANCE IN FOODS .....	19
8.1 BACKGROUND .....	19
8.2 AIM .....	19
8.3 PRIMARY AGENCY.....	19
8.4 STAKEHOLDERS .....	19
8.5 GOALS .....	19
8.6 PROCESSES .....	20
8.7 ORGANISMS AND ANTIMICROBIALS FOR SURVEILLANCE OF AMR IN FOODS .....	20
8.8 OUTCOMES .....	20
9. MONITORING OF ANTIMICROBIALS USED IN PEOPLE AND ANIMALS .....	21
9.1 BACKGROUND .....	21
9.2 AIM .....	21
9.3 PRIMARY AGENCY.....	21
9.4 STAKEHOLDERS .....	21
9.5 GOALS .....	21
9.6 PROCESSES .....	22
9.7 ANTIMICROBIALS FOR SURVEILLANCE IN HUMANS AND ANIMALS .....	22
9.8 OUTCOMES .....	23
10. MONITORING AND EVALUATION OF THE STRATEGY .....	23
11. APPENDICES .....	24
11.1 JETACAR RECOMMENDATIONS .....	24
11.2 ACKNOWLEDGMENTS .....	26
11.3 PROGRAMS COLLECTING HUMAN ANTIMICROBIAL RESISTANCE SURVEILLANCE INFORMATION.....	26
11.4 PROGRAMS FOR HUMAN ANTIBIOTIC UTILISATION INFORMATION.....	28
11.5 ANTIMICROBIAL RESISTANCE SURVEILLANCE IN ANIMALS IN AUSTRALIA .....	29
11.6 INTERNATIONAL SURVEILLANCE SYSTEMS .....	36
11.7 OTHER USEFUL WEBSITES – AUSTRALIA.....	37
11.8 BIBLIOGRAPHY FOR THE STRATEGY .....	38

Rescinded

## LIST OF FIGURES

---

FIGURE 1. AREAS OF SURVEILLANCE COLLATED BY THE CENTRAL COORDINATING UNIT.....	4
FIGURE 2. GOVERNANCE OF STRATEGY .....	6
FIGURE 3. GOVERNANCE OF CCU.....	8

## LIST OF TABLES

---

TABLE 1. STAGES IN THE IMPLEMENTATION OF THE NATIONAL AMR SURVEILLANCE STRATEGY .....	VI
TABLE 2. JETACAR RECOMMENDATIONS ADDRESSED IN THE STRATEGY .....	3
TABLE 3. AGENCIES INVOLVED IN SURVEILLANCE ACTIVITIES.....	4
TABLE 4. PROCESSES FOR REACHING GOALS OF AMR SURVEILLANCE IN HUMAN PATHOGENS.....	11
TABLE 5. ORGANISMS AND ANTIMICROBIALS PROPOSED AS NATIONAL PRIORITIES FOR HUMAN ANTIMICROBIAL RESISTANCE SURVEILLANCE IN HUMAN PATHOGENS .....	12
TABLE 6. PROCESSES FOR REACHING GOALS OF SURVEILLANCE OF AMR IN HAIS.....	14
TABLE 7. ORGANISMS AND ANTIMICROBIALS FOR SURVEILLANCE PRIORITY IN THE HEALTHCARE SETTING.....	15
TABLE 8. PROCESSES FOR REACHING GOALS OF AMR SURVEILLANCE IN ANIMALS .....	17
TABLE 9. ORGANISMS AND ANTIMICROBIALS PROPOSED AS NATIONAL PRIORITIES FOR ANIMAL ANTIMICROBIAL RESISTANCE SURVEILLANCE.....	18
TABLE 10. PROCESSES FOR REACHING GOALS OF AMR SURVEILLANCE IN FOODS .....	20
TABLE 11. ORGANISMS AND ANTIMICROBIALS PROPOSED AS PRIORITIES FOR AMR SURVEILLANCE IN FOOD.....	20
TABLE 12. PROCESSES FOR REACHING GOALS OF MONITORING ANTIMICROBIAL USE IN HUMANS AND ANIMALS .....	22
TABLE 13. ANTIMICROBIALS TO BE CONSIDERED FOR SURVEILLANCE OF USAGE .....	22
TABLE 14. BACTERIA FOR POTENTIAL INCLUSION IN A SURVEILLANCE PROGRAM .....	33
TABLE 15. ANTIMICROBIALS THAT MAY BE INCLUDED IN AN ANTIMICROBIAL RESISTANCE SURVEILLANCE PROGRAM.....	35

# Executive summary

Surveillance is an important component of a national antimicrobial resistance (AMR) management plan. An appropriate surveillance strategy can be cost effective in terms of infection control, by providing information vital for timely targeting and evaluation of public health interventions. This document outlines the framework for a national surveillance strategy for antimicrobial resistance in Australia, to address the recommendations made by the Joint Expert Technical Advisory Committee on Antibiotic Resistance (JETACAR) relevant to monitoring and surveillance, and antibiotic usage (recommendations 10, 11 and 14).

The Strategy proposes a cross-disciplinary, coordinated approach to antimicrobial resistance that will consolidate and build upon existing surveillance systems and initiatives rather than creating new ones. Vital to this is the establishment of a central coordinating unit (CCU) at the Australian Government Department of Health and Ageing (DoHA) that will act as a central site for collation, analysis and reporting of national surveillance data. Representatives will be engaged from human and animal health, industry and a range of other stakeholders to develop and implement specific action plans. The Strategy provides a framework for how these diverse groups can provide evidence for action.

The Strategy sets out a three-stage implementation process. This process has been summarised across the five areas of surveillance in Table 1. Stage one identifies the consultation, planning and implementation phases of the Surveillance Strategy. Stage two describes anticipated achievements by the end of the two year CCU development project including the correlation of data collected and improvement in data collection systems. Stage three describes the future planning and evaluation phases of the Strategy. An ongoing evaluation process will monitor and report progress against the Strategy.

Table 1. Stages in the implementation of the national AMR surveillance strategy

Community Acquired infections	Healthcare Acquired Infections	Food Animals	Food	Antibiotic Usage
<b>STAGE ONE: CONSULTATION, PLANNING, AND IMPLEMENTATION</b>				
<ol style="list-style-type: none"> <li>1. Establishing a Human Health Reference Network.</li> <li>2. Identify and evaluate existing human AMR surveillance systems and networks, identify systems with the potential for use on a national scale.</li> <li>3. Report on existing human AMR systems.</li> </ol>	<ol style="list-style-type: none"> <li>1. Identify and evaluate existing HAI surveillance systems that collect AMR data.</li> <li>2. Report on existing systems.</li> <li>3. Identify and evaluate other potential sources of AMR data.</li> </ol>	<ol style="list-style-type: none"> <li>1. Establishing an Animal Health Reference Network.</li> <li>2. Identify and evaluate existing animal AMR surveillance.</li> <li>3. Report on existing AMR systems.</li> <li>4. Develop a pilot program of active surveillance for AMR in animals.</li> </ol>	<ol style="list-style-type: none"> <li>1. Identify and evaluate existing systems and/or identify potential sources of relevant data.</li> <li>2. Report on existing systems.</li> <li>3. Develop a pilot program of active and passive surveillance for AMR in organisms originating from food.</li> </ol>	<ol style="list-style-type: none"> <li>1. Identify and evaluate existing sources of antibiotic usage data.</li> <li>2. Report on existing systems.</li> </ol>
<b>STAGE TWO: CORRELATION AND IMPROVING DATA SYSTEMS</b>				
<ol style="list-style-type: none"> <li>1. Integration of data from existing human AMR surveillance systems.</li> <li>2. Analysis, reporting, and evaluation of data.</li> <li>3. Identify gaps in human surveillance data.</li> <li>4. Integration with data from the four other areas of surveillance.</li> <li>5. Production of a comprehensive national AMR report incorporating the five surveillance areas.</li> </ol>	<ol style="list-style-type: none"> <li>1. Integration of the data from existing sources.</li> <li>2. Analysis, reporting and evaluation of data, and the development of guidelines for this process.</li> <li>3. Identify gaps in surveillance, making recommendations for improvement.</li> </ol>	<ol style="list-style-type: none"> <li>1. Integration of data from existing animal surveillance systems.</li> <li>2. Evaluation of pilot program and make recommendations regarding continuation of pilot program.</li> <li>3. Development of guidelines for analysis, interpretation and</li> </ol>	<ol style="list-style-type: none"> <li>1. Integration of data from existing systems and identified data sources.</li> <li>2. Evaluation of pilot program and recommendations made regarding continuation of pilot program.</li> <li>3. Development of</li> </ol>	<ol style="list-style-type: none"> <li>1. Integration of data from existing sources.</li> <li>2. Analysis, reporting and evaluation of data.</li> <li>3. Identify gaps in data and make recommendations for improvement and addressing data deficiencies.</li> <li>4. Integration with data</li> </ol>

	4. Integration of HAI data with data from the other four areas of surveillance and inclusion in a national report.	reporting of AMR data. 4. Integration with data from the other four areas of surveillance.	guidelines for analysis, interpretation and reporting of AMR data. 4. Integration with data from the four other areas of surveillance and production of a national AMR surveillance report.	from the four other areas of surveillance and production of national report.
<b>STAGE THREE: EVALUATION AND FUTURE PLANNING</b>				
1. Collection of AMR data in a representative sample of incident cases in humans according to an agreed national dataset in all States and Territories and collaboration at a national level. 2. Regular analysis and dissemination of AMR data to key agencies. 3. Operations of the CCU integrated into the functions of the Surveillance and Epidemiology Section, DoHA. 4. Integration with other four surveillance systems.	1. Systematic collection of AMR in HAIs at the state and territory level according to agreed case definitions into a national database. 2. Regular analysis and dissemination of data to key agencies. 3. Integration with the other four surveillance systems.	1. Routine collection of AMR surveillance data in animals, via the establishment of an on-going surveillance program. 2. Regular analysis and dissemination of AMR data. 3. Integration with the other four surveillance systems.	1. Implementation of an appropriate systematic surveillance system for AMR in food. 2. Regular analysis and dissemination of AMR data. 3. Integration with the other four surveillance systems.	1. Implementation of a comprehensive surveillance system for antibiotic usage in humans, animals, and animal-derived food. 2. Regular reporting of reliable, accurate antimicrobial import, supply and end-use data to key agencies. 3. 3. Integration with the other four surveillance systems.



# 1. Introduction

The importance of surveillance<sup>1</sup> in combating and managing antimicrobial<sup>2</sup> resistance (AMR) is recognised as an important component of the *World Health Organization (WHO) Global Strategy for Containment of Antimicrobial Resistance*, 2001. There is good evidence that surveillance is a cost-effective infection control strategy (Shlaes et al., 1997, Haley et al., 1985). Appropriate surveillance provides vital information for the targeting of interventions, and measures success or failure of these interventions. Surveillance enables early detection and intervention, and can therefore reduce the extent and severity of outbreaks. This in turn should reduce infection-related costs, making funds available for other healthcare activities. Short-term investment, therefore, leads to longer-term gains and overall savings.

Many healthcare facilities, professional groups, networks and surveillance programs already have extensive experience from which other parties can learn. Sharing of experiences and knowledge of successful interventions (eg improved infection control practices; antibiotic restriction policies; new methods and techniques; and surveillance findings) allows institutions to build upon the successes of others and avoid duplication. Better mechanisms are needed for reporting surveillance information at local, State/Territory and national levels that will increase awareness and access to information. It is also vital that surveillance information is incorporated into updates of best practice guidelines and adopted by medical and veterinary prescribers.

A national Surveillance Strategy provides an opportunity for consolidating and building upon existing, high quality, surveillance activities in Australia. This requires strengthening of existing networks and systems, and a re-focusing of priorities towards data for action at the local, State/Territory and national levels.

While controlling antimicrobial resistance impacts human health, control requires a cross-sectoral approach, engaging human and animal health, industry and a range of other stakeholders. This Strategy provides a framework for how these diverse groups can provide evidence for action to control AMR.

---

<sup>1</sup> **Surveillance** in a broad sense, and for the purpose of this document, is defined as the ongoing and systematic collection, analysis and interpretation of outcome-specific data essential to the planning, implementation, and evaluation of public health practice, closely integrated with the timely dissemination of these data to those who need to know. The final link of the surveillance chain is the application of these data to the control and prevention of human disease and injury (Thacker, 1996).

<sup>2</sup> For the purpose of the surveillance strategy, the term antimicrobial resistance (AMR) will be used however it will specifically refer to resistance to **antibiotics**. Antibiotics are defined as antibacterial agents (including ionophores) but not including antiprotozoals, antifungals, antiseptics, disinfectants, antineoplastic agents, antivirals, immunologicals, direct-fed microbials or enzyme substances (*The Commonwealth Government Response to the Report of the Joint Expert Technical Advisory Committee on Antibiotic Resistance (JETACAR)*, 2000). Notwithstanding this, similar considerations about monitoring utilisation and surveying resistance may be applied appropriately to other antimicrobial agents.

## 2. Background

### 2.1 JETACAR

The Joint Expert Technical Advisory Committee on Antibiotic Resistance (JETACAR) was established in April 1998 to provide independent expert scientific advice on the threat posed by antimicrobial resistant bacteria. The JETACAR released its report in September 1999, making 22 recommendations for an antimicrobial resistance management program covering:

- regulatory controls;
- monitoring and surveillance;
- infection prevention strategies;
- education; and
- research.

The Australian Government released its response to recommendations of the JETACAR report in August 2000. The Government response strongly supported the intent of the JETACAR report and outlined the mechanisms for implementing the recommendations.

### 2.2 Coordination and Implementation

To facilitate the implementation of the JETACAR recommendations the Commonwealth Government established the Commonwealth Interdepartmental JETACAR Implementation Group (CIJIG) comprising technical experts and senior representatives from:

- the Australian Government Department of Health and Ageing (DoHA);
- the Australian Government Department of Agriculture, Fisheries and Forestry (DAFF);
- the Australian Pesticides and Veterinary Medicines Authority (APVMA, formerly known as the National Registration Authority for Agricultural and Veterinary Chemicals (NRA));
- the Therapeutic Goods Administration (TGA);
- Food Standards Australia and New Zealand (FSANZ); and
- the National Health and Medical Research Council (NHMRC).

The Australian Health Ministers' Conference (AHMC) and the Primary Industries Standing Committee (PISC) each appointed a Taskforce to facilitate and monitor the implementation of the JETACAR recommendations and to provide policy advice to CIJIG.

The AHMC JETACAR Taskforce released its final report in November 2000. In summary, it recommended that:

- Expert Advisory Group on Antimicrobial Resistance (EAGAR) continue to provide scientific and policy advice on antimicrobial resistance issues;
- An AMR surveillance network implements a national surveillance strategy; and
- Ongoing implementation of all JETACAR recommendations, including those related to surveillance, to be coordinated by CIJIG.

### 2.3 Expert Advisory Group

The Expert Advisory Group on Antimicrobial Resistance (EAGAR) was established under the auspices of the NHMRC to provide independent scientific and policy advice on antimicrobial resistance and related matters to National, State and Territory Governments and regulatory authorities.

### 2.4 A Strategy for AMR Surveillance in Australia

This document is a national Surveillance Strategy to address both JETACAR recommendations relating to monitoring and surveillance and an additional recommendation relating to surveillance of antibiotic usage (Table 2). Further details of the JETACAR recommendations and the Government response are outlined in Appendix 1.

*Table 2. JETACAR recommendations addressed in the Strategy*

No.	Recommendation
10	Development of a comprehensive surveillance system for antimicrobial resistant bacteria and resistance genes in humans and animals. The surveillance system should include medical (including nosocomial), food-producing animal and veterinary areas with particular emphasis on the establishment of food-chain and environmental connections.
11	Monitoring and audit of antibiotic usage.
14	Surveillance of hospital acquired infections.

A key component in the development of a cross-disciplinary coordinated approach to antimicrobial resistance in Australia is the development of a central coordinating unit (CCU), at DoHA. Project officer(s) will work as part of the Surveillance and Epidemiology section, DoHA on the CCU development project. Following the development project, the CCU functions will be absorbed into the normal business of the Surveillance and Epidemiology Section, DoHA.

The CCU will act as a central site for the collation of national surveillance data (Figure 1). A variety of agencies will engage in the development and implementation of specific action plans. It is the responsibility of each sector and agency to examine the Strategy and decide how best to meet the national objectives by building upon current initiatives and refining these to allow best possible utilisation of data and information.

Figure 1. Areas of surveillance collated by the Central Coordinating Unit

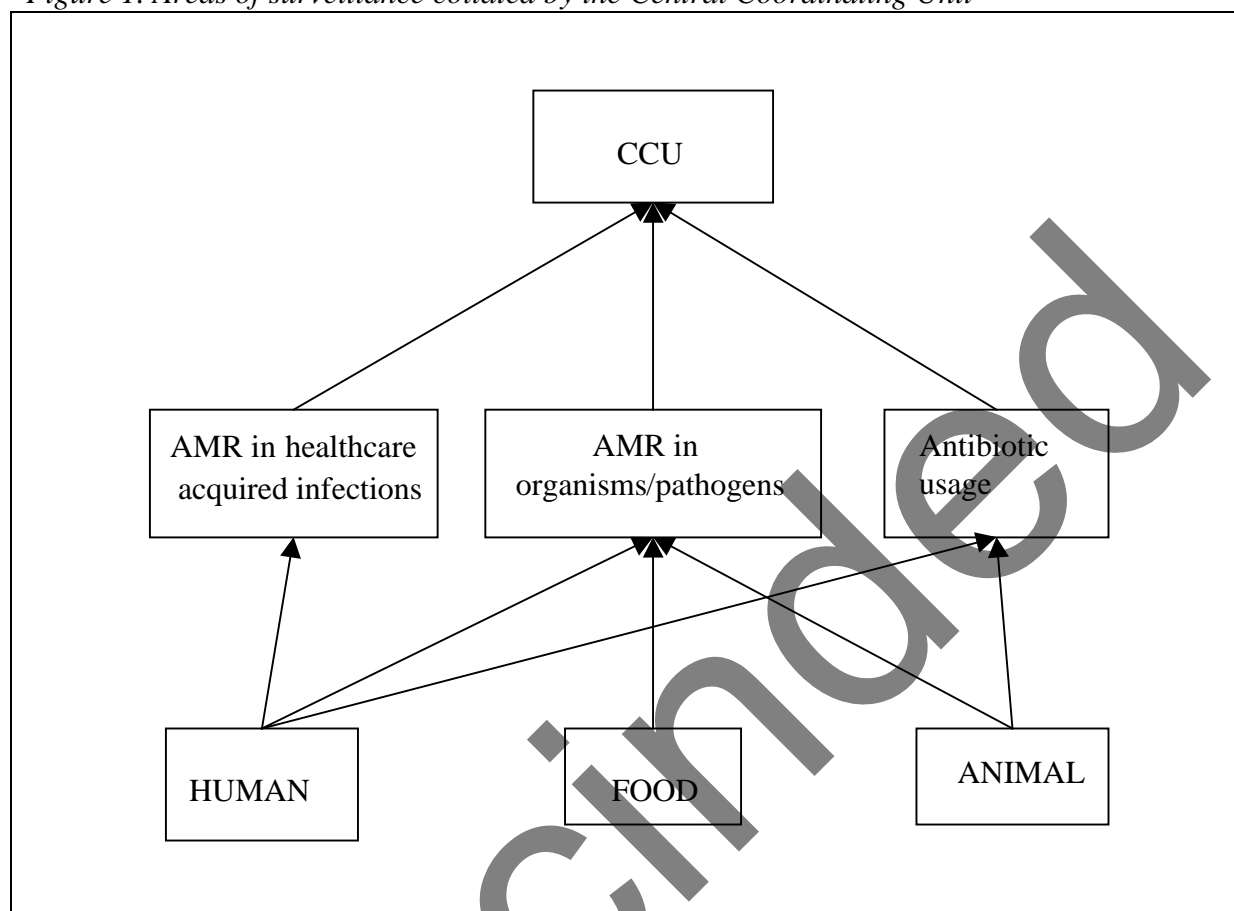


Table 3. Agencies involved in surveillance activities

Area of surveillance activity	Primary Agency
Antimicrobial resistance in community-acquired infections (humans)	DoHA (Communicable Disease Branch).
Antimicrobial resistance in animals	DAFF
Antimicrobial surveillance in animal-derived foods	DoHA (Food and Environmental Health Branch) through OzFoodNet
Surveillance of antimicrobial resistance in healthcare acquired infections	DoHA (Communicable Diseases Branch) with the Safety and Quality Council.
Surveillance of antibiotic usage in humans and animals	DoHA through the TGA and APVMA.

A number of overarching principles will guide the strategic approach taken when establishing a national network of surveillance activities. The CCU will:

1. Recognise and build on existing local, State and Territory, and national surveillance and monitoring systems rather than establish new ones.
2. Work towards nationally consistent standards for national AMR surveillance data.
3. Ensure security and confidentiality of data, and not identify individuals, companies or healthcare establishments. This will be guided by the Australian Health Ministers' Advisory Council (AHMAC) National Health Privacy Code.

## **2.5 Aim**

This Strategy aims to address recommendations 10, 11 and 14 of the JETACAR report (Appendix 1). More specifically, the Strategy aims to:

1. Identify priorities for action that will strengthen surveillance at the local, State/Territory and national levels.
2. Outline surveillance needs.
3. Strengthen communication and reporting mechanisms to ensure maximum utilisation of information.
4. Raise awareness of surveillance and antimicrobial resistance.

## **2.6 Strategy Outcomes**

The surveillance data generated will provide evidence to evaluate policies and set priorities to manage antimicrobial resistance, including:

- antibiotic therapeutic and prudent use guidelines and treatment regimes to improve public health outcomes;
- assessment of risks to public health to form the basis of risk management policy;
- infection control guidelines, hygiene measures and antibiotic restriction policies; and
- the cost-effectiveness of these interventions.

The surveillance data generated will provide data to inform:

- education strategies for medical and veterinary prescribers, hospital staff, food-animal producers, food handlers, industry and consumers;
- risk assessments of new and existing antibiotics for use in humans and animals;
- prudent use of antimicrobials by medical practitioners, veterinarians and industry, to prolong the efficacy of these products.

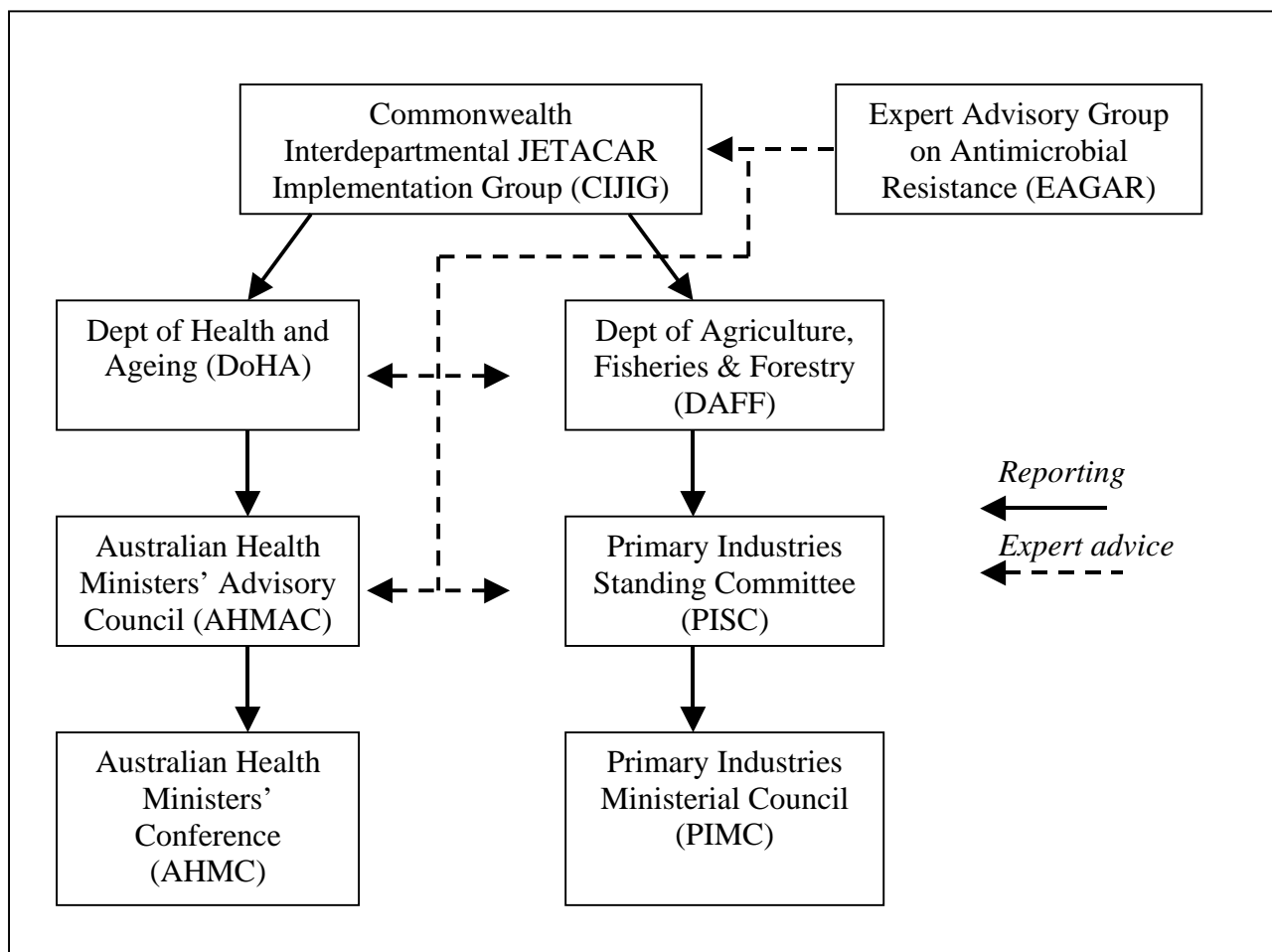
# **3. Development of the Strategy**

## **3.1 Coordination and implementation at the national level**

The National Public Health Partnership (NPHP) has provided funds to DoHA for a 2-year project to establish the CCU for the coordination of national AMR surveillance. The NPHP will utilise existing committee structures to progress the Strategy. The proposed mechanism for governance of the Strategy is given in Figure 2.

CIJIG has responsibility for the coordination and implementation of the Strategy. The EAGAR has a role in providing advice on antimicrobial resistance and related issues and the integration and interpretation of antimicrobial resistance surveillance information.

Figure 2. Governance of Strategy



### 3.2 Consultative process

A consultation process inclusive of Government bodies, professional organisations, industry, academics, consumers and representatives from the medical and agricultural sectors was undertaken to develop the Strategy. Cognisance was also taken of international developments and strategies for AMR surveillance.

Experience with overseas systems shows that containment of antimicrobial resistant infections can be achieved, and the overall pool of resistant bacteria reduced through an integrated system of surveillance. Critical to achieving similar outcomes in Australia's particular logistic and legislative context, will be ongoing consultation, networking and harmonisation between our six States and two Territories.

## **4. Implementation of the Strategy**

### **4.1 Introduction: a staged approach**

Establishing a comprehensive surveillance system across the human and animal sectors is not a task that can be fully implemented immediately. The plan therefore sets out a staged approach for implementation. Stage 1 and 2 will incorporate the CCU development project.

#### **Stage One – Consultation, planning and implementation**

Stage one is intended to acknowledge and draw upon the work that is taking place at State/Territory and local level. Stage one will include:

- Implementation of a central coordinating unit that will be responsible for collection and consolidation of nationally consistent information encompassing the areas of antimicrobial resistance in humans, animals and food, including healthcare acquired infections and antimicrobial usage;
- Consultation with key stakeholders to identify and evaluate existing antimicrobial resistance surveillance systems and making recommendations for developing longer term mechanisms to acquire national data on antimicrobial resistance;
- Report on existing systems;
- Identifying local and State/Territory activities that can serve as models or developmental projects for possible linking and/or adoption nationally; and
- Development and implementation of pilot surveillance programs for antimicrobial resistance, as appropriate.

#### **Stage Two – Correlation and improving data systems**

It is proposed that stage two focus on:

- Correlation of data from the diverse surveillance systems;
- Assessment of the surveillance activities to identify gaps and make recommendations for improvement;
- Achieving national consensus on national minimum datasets and consistent standards, definitions and methodology; and
- Collecting antimicrobial usage data at State/Territory and national level.

#### **Stage Three – Evaluation and future planning**

It is expected that stage three will involve:

- Full implementation and establishment of an ongoing, national surveillance program incorporating local and State/Territory surveillance data and data from established surveillance schemes;
- Integration of human and animal surveillance systems;
- Evaluation of the integrated national surveillance program;
- Production and supply of data and information to users to provide a clearer national view of national antimicrobial resistance trends;
- Using the data collected to inform future policy and strategic development and interventions.

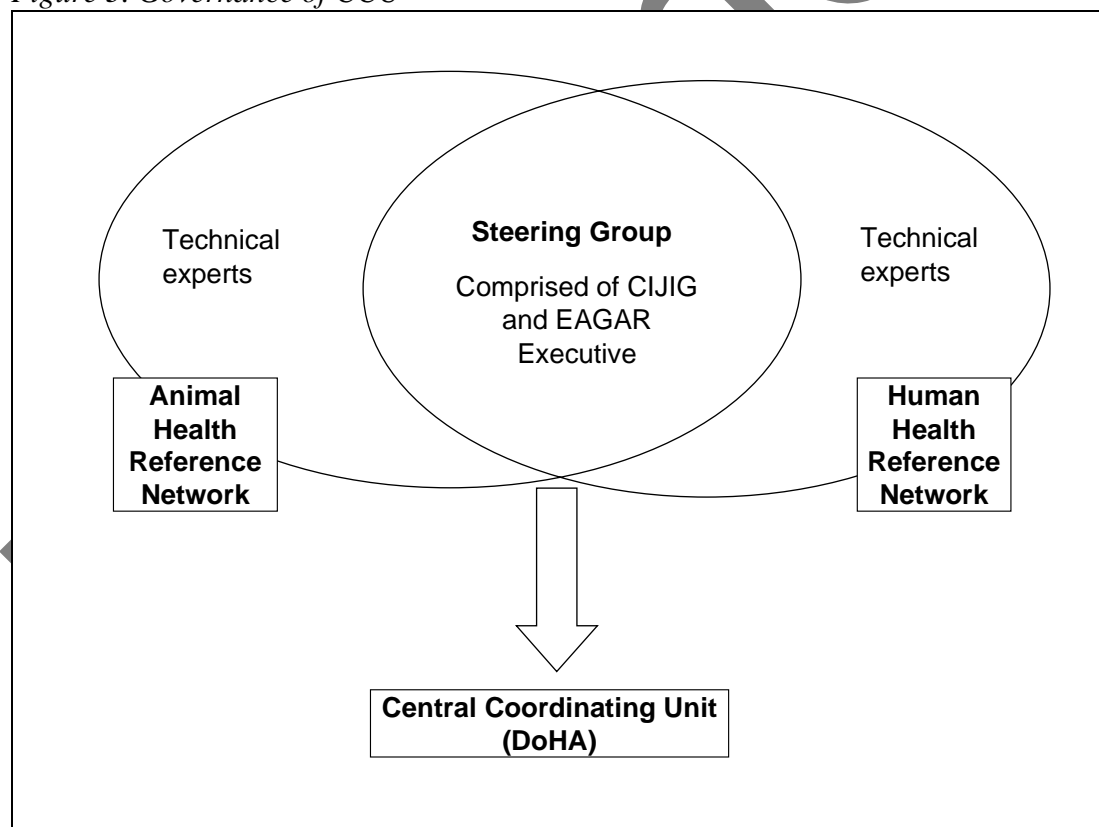
#### 4.2 Establishment of a Central Coordinating Unit

A central coordinating unit will be developed to construct a national system for collation of surveillance data. Central coordination of antimicrobial resistance surveillance activities will assist in development of specific action plans. The CCU will strengthen existing networks and bring together data from many different sources to provide a national perspective of the magnitude and distribution of antimicrobial resistance within Australia. Dissemination and uptake of useful information is essential for the development of policies and interventions that will improve health outcomes, improve communication with industry, enable risk assessments, and provide a foundation for further education to understand antimicrobial resistance issues.

#### 4.3 Governance

DoHA and DAFF (via CIJIG) are responsible for the establishment of the central coordinating unit. A Steering Group consisting of executive representatives from CIJIG and EAGAR will guide the CCU. As the number of stakeholders involved in the surveillance of antimicrobial resistance in humans and animals is large, human health and animal health reference networks will be established to provide surveillance advice and facilitate data collection. Composition of such networks should include members of the steering committee and technical experts from key stakeholders (Figure 3).

Figure 3. Governance of CCU





#### 4.4 Aims

The overall aim is to develop a national surveillance system utilising, where available, existing programs, to provide reliable information on antimicrobial resistance in Australia. Antimicrobial resistance surveillance will provide information on the magnitude and distribution of resistant organisms in Australia to identify changing trends and emerging resistance.

#### 4.5 Goals

1. Bring together national data collected by existing systems to meet immediate data needs.
2. Develop appropriate pilot programs where systems do not exist.
3. Develop nationally consistent standards of data quality.
4. Develop and implement protocols for appropriate data collection for national antimicrobial resistance surveillance.
5. Report on national prevalence of and trends in antimicrobial resistance.

#### 4.6 Processes

The CCU will facilitate the establishment of both a Human Health and an Animal Health Reference Network, and articulate the role of these networks across the four areas of surveillance.

Membership of the Human Health reference network may include:

- Federal, State and Territory Health Department Representatives;
- Communicable Diseases Network Australia (CDNA);
- Public Health Laboratory Network (PHLN); and
- Representatives from existing surveillance networks.

Membership of the Animal Health Reference Network may include:

- Federal, States and Territories Primary Industry Representatives;
- Food-animal producer representatives;
- Veterinary Testing Laboratories; and
- Individuals with specific expertise.

The CCU development project will proceed in implementing stages 1 and 2 of the Strategy by:

##### **Stage One of Strategy: Consultation, planning and implementation**

- Develop relationships with key stakeholders in AMR surveillance;
- Develop draft surveillance action plan for AMR in humans, and work with other agencies to further develop plans for AMR in animals, HAIs, and antimicrobial usage;
- Identify, strengthen and work with existing surveillance networks;
- Identify data gaps to be filled by pilot surveillance programs; and
- Collate and report on existing antimicrobial resistance data (as appropriate).

##### **Stage Two of Strategy: Correlation and improving data systems**

- Develop consistency in data formats;
- Develop consistent case definitions;
- Develop consistent laboratory methods and diagnoses;
- Develop protocols for data reporting, analysis and interpretation;
- Evaluate existing AMR surveillance systems; and

- Evaluate the need for a comprehensive surveillance system for AMR in humans and animals.

#### **4.7 Reporting from the CCU**

The CCU will publish and disseminate antimicrobial resistance surveillance reports. EAGAR will provide expert advice to the CCU on the most appropriate analysis of the surveillance data, and provide expert advice on the interpretation of these data.

## **5. Surveillance of antimicrobial resistance in community acquired infections**

### **5.1 Background**

Surveillance of antimicrobial resistant organisms in community acquired infections is essential to provide insight into the levels of resistant bacteria and their trends. Australia already has many systems in place at the local, state, and national level for the surveillance of antimicrobial resistant organisms in humans. The data collected via these systems are collected for many different purposes, however much of the data remains at the local level. There is no coordination of these programs, but they form a solid basis for an integrated national program for surveillance of antimicrobial resistance in bacteria of medical importance.

Some of the more well established surveillance systems currently collecting antimicrobial resistance data nationally from hospitals and the community include: the Australian Group on Antimicrobial Resistance (AGAR), the Australian Gonococcal Surveillance Programme (AGSP), the Australian Meningococcal Surveillance Programme (AMSP), the Australian Mycobacterium Reference Laboratory Network (AMRLN) and the National Enteric Pathogen Surveillance Scheme (NEPSS).

### **5.2 Aim**

To measure the prevalence of and trends in antimicrobial resistance in community-acquired organisms causing significant human diseases in Australia.

### **5.3 Primary agency**

Communicable Diseases Branch, Population Health Division, Department of Health and Ageing

### **5.4 Stakeholders**

State and Territory health department representatives and CDNA

Australian Group on Antimicrobial Resistance (AGAR)

National Enteric Pathogens Surveillance Scheme (NEPSS)

National Centre for Immunisation Research and Surveillance of Vaccine preventable diseases (NCIRS)

National Neisseria Network (NNN), incorporating the Australian Meningococcal Surveillance Programme (AMSP) and the Australian Gonococcal Surveillance Programme (ASGP)

OzFoodNet

Australian Mycobacterium Reference Laboratory Network (AMRLN)

National Notifiable Diseases Surveillance System (NNDSS)

### 5.5 Goals

1. Create links with key data collections of antimicrobial resistance in human pathogens.
2. Evaluate data quality in national data collections and identify deficiencies.
3. Estimate the prevalence of resistant bacteria in human pathogens and detect the emergence of new antimicrobial resistance patterns with assistance of surveillance networks and EAGAR.
4. Report national data on the prevalence of antimicrobial resistance in humans.

### 5.6 Processes

*Table 4. Processes for reaching goals of AMR surveillance in human pathogens*

<b>Goal</b>	<b>Process</b>
1. Establish links with data collections	Identify stakeholders; CCU coordinator to visit stakeholders and attend meetings, where appropriate.
2. Improve data quality	Evaluate data quality; identify gaps and deficiencies and work with stakeholders to improve data quality.
3. Estimate AMR prevalence	Summaries of AMR prevalence for key diseases and antimicrobials from existing data.
4. Reporting	Produce reports in consultation with stakeholders on trends in AMR in pathogens of interest and establish a reporting cycle and format.

## 5.7 Organisms and antimicrobials for surveillance

Table 5. Organisms and antimicrobials proposed as national priorities for human antimicrobial resistance surveillance in human pathogens

Organism	Passive surveillance	Targeted surveillance (current group)	Minimum antibiotics or classes
<i>Streptococcus pneumoniae</i>	Yes	Invasive only i.e. blood/CSF (none)	Benzylpenicillin, 3 <sup>rd</sup> generation cephalosporins, erythromycin, tetracycline, cotrimoxazole/trimethoprim
<i>Haemophilus influenzae</i>	Yes	Invasive type b only i.e. blood/CSF (none)	Ampicillin, cefaclor, tetracycline, cotrimoxazole
<i>Moraxella catarrhalis</i>	Yes	No	Ampicillin, erythromycin, tetracycline, cotrimoxazole
<i>Staphylococcus aureus</i>	Yes	Yes (AGAR)	Benzylpenicillin, methi/oxacillin, erythromycin, tetracycline, gentamicin, cotrimoxazole/trimethoprim (plus vancomycin, rifampicin, fusidic acid if methi/oxacillin resistant)
<i>Streptococcus pyogenes</i>	Yes	No	Benzylpenicillin, erythromycin
<i>Escherichia coli</i>	Yes	Yes (AGAR)	Ampicillin, 1 <sup>st</sup> generation cephalosporins, 3 <sup>rd</sup> generation cephalosporins, amoxicillin-clavulanate, gentamicin, fluoroquinolones, cotrimoxazole/trimethoprim
<i>Salmonella</i> species	No	Yes (NEPSS)	Ampicillin, 3 <sup>rd</sup> generation cephalosporins, fluoroquinolones, cotrimoxazole/trimethoprim, chloramphenicol
<i>Campylobacter</i> species	No	Yes (NEPSS)	Fluoroquinolones, gentamicin
<i>Neisseria gonorrhoeae</i>	No	Yes (NNN)	Benzylpenicillin, 3 <sup>rd</sup> generation cephalosporins, fluoroquinolones, tetracycline, spectinomycin
<i>Neisseria meningitidis</i>	No	Yes (NNN)	Benzylpenicillin, 3 <sup>rd</sup> generation cephalosporins, fluoroquinolones, rifampicin
<i>Mycobacterium tuberculosis</i>	No	Yes (AMRLN)	Isoniazid, rifampicin, ethambutol, pyrazinamide

## 5.8 Outcomes

- Estimation of the prevalence and detection of trends of AMR in invasive pneumococcal disease, *Haemophilus influenzae* type b, *Salmonella* causing gastroenteritis, meningococcal disease, gonorrhoea, *Campylobacter* and tuberculosis;
- Improvement in data quality on AMR infections in humans and the development of a national data set on the prevalence of AMR in humans;
- Regular reporting of data on AMR infections in humans;
- To have a national data set on the prevalence of AMR in humans. These data can be used:
  - in risk analysis to determine the risk to human health;
  - to detect the emergence of particular phenotypes of AMR;
  - to detect trends in AMR;
  - to identify the need for particular interventions and to assess the impact of interventions; and
  - to provide a basis for policy recommendations for public health.

## 6. Surveillance of antimicrobial resistance in healthcare acquired infections

### 6.1 Background

The incidence of HAIs in Australia is high, estimated to be 150,000 per year. These infections cause significant mortality, possibly contributing to as many as 7,000 deaths per year (AICA 2001). It is recognised that HAIs compromise patient safety and the quality of care provided, and add a significant resource burden to the health system. A proportion of HAIs involve antimicrobial resistant organisms, and these increase costs even further and often result in increased morbidity and mortality and even higher hospital and post-hospital care costs. HAI surveillance provides important information to hospital staff. It increases awareness of: the organisms present within the hospital and those entering the hospital, the risk of infection associated with a particular procedure, and appropriate and successful interventions. HAI surveillance can highlight deficiencies in infection control or faults in procedures and can assist in changing attitudes. HAI surveillance, including surveillance of antimicrobial resistant infections, better positions hospital staff to implement appropriate population health action to ensure improved patient outcomes.

The Strategy supports the development of a national minimum dataset and consistent case definitions for antimicrobial resistant HAIs, advocates wide participation, and aims to promote timely reporting and communication of successful interventions.

### 6.2 Aims

To measure the prevalence of and trends in antimicrobial resistance in HAIs (both inpatient and outpatient) in Australia.

### 6.3 Primary Agency

Communicable Diseases Branch, Department of Health and Ageing (with Safety and Quality Council)

## 6.4 Stakeholders

State and Territory Health Departments  
Australian Infection Control Association (AICA)  
AGAR  
Healthcare facilities and laboratories

## 6.5 Goals

1. Identify national and state-based HAI surveillance systems, which collect AMR data as well as laboratory networks, which report AMR data on key pathogens and seek cooperation in the development of a national surveillance system.
2. Evaluate data quality in available data collections and identify deficiencies.
3. Estimate the prevalence of AMR in HAI and emerging issues.
4. Report national data on the prevalence of AMR HAI.

## 6.6 Processes

*Table 6. Processes for reaching goals of surveillance of AMR in HAI.*

<b>Goals</b>	<b>Processes</b>
1. Identify national and state-based surveillance systems	Establish contacts with existing surveillance systems; CCU to visit and/or attend meetings of surveillance groups as appropriate
2. Evaluate data quality	In discussion with established surveillance systems, identify gaps and deficiencies and work with stakeholders to improve data quality
3. Estimate AMR prevalence	In collaboration with existing groups, estimate the prevalence of AMR in HAI in a variety of settings from existing data
4. Reporting	In collaboration with stakeholders produce reports on prevalence and trends in AMR HAI

## 6.7 Organisms and antimicrobials for surveillance

Table 7. Organisms and antimicrobials for surveillance priority in the healthcare setting.

Organism	Passive surveillance	Targeted surveillance (current group)	
<i>Staphylococcus aureus</i>	Yes	Yes –MRSA (AGAR)	Benzylpenicillin, methi/oxacillin, erythromycin, tetracycline, gentamicin, cotrimoxazole/trimethoprim, vancomycin, rifampicin, fusidic acid
<i>Enterococcus</i> species	Yes	Yes –VRE (AGAR)	Ampicillin or benzylpenicillin, vancomycin (plus quinupristin-dalfopristin and linezolid if vancomycin resistant)
<i>Escherichia coli</i>	Yes	Yes (AGAR)	Ampicillin, 1 <sup>st</sup> generation cephalosporins, 3 <sup>rd</sup> generation cephalosporins, amoxicillin-clavulanate, gentamicin, fluoroquinolones, cotrimoxazole/trimethoprim
<i>Klebsiella</i> species	Yes	Yes (AGAR)	Ampicillin, 1 <sup>st</sup> generation cephalosporins, 3 <sup>rd</sup> generation cephalosporins, amoxicillin-clavulanate, gentamicin, fluoroquinolones, cotrimoxazole/trimethoprim
<i>Enterobacter</i> species	Yes	Yes (AGAR)	Ampicillin, 1 <sup>st</sup> generation cephalosporins, 3 <sup>rd</sup> generation cephalosporins, amoxicillin-clavulanate, gentamicin, fluoroquinolones, cotrimoxazole/trimethoprim, carbapenems
<i>Acinetobacter</i> species	Yes	Yes –multi-R (SA only at present)	Ampicillin, 1 <sup>st</sup> generation cephalosporins, 3 <sup>rd</sup> generation cephalosporins, amoxicillin-clavulanate, gentamicin, fluoroquinolones, cotrimoxazole/trimethoprim, carbapenems (plus amikacin if gentamicin-resistant)
<i>Pseudomonas aeruginosa</i>	No	Yes –multi-R (SA only at present)	Ticarcillin/piperacillin, gentamicin/tobramycin, fluoroquinolones, carbapenems
<i>Clostridium difficile</i>	Yes	No	Nil

## **6.8 Outcomes**

To obtain an accurate estimate of the problem of antimicrobial resistance in Australian hospitals and healthcare facilities and to establish a network of surveillance systems which can provide on-going nationally representative data, to inform those responsible for management of HAI in Australia.

## **7. Surveillance of antimicrobial resistance in animals**

### **7.1 Background**

There is general agreement in the international literature with the JETACAR report finding that there is qualitative evidence that antimicrobials fed to animals leads to resistant bacteria and that these bacteria or their resistance genes can be passed to humans, principally via the food chain. There is little systematic surveillance of antimicrobial resistance in animals in Australia that is relevant and accessible to public health. A national system of surveillance is needed to monitor antimicrobial resistance in animals. Currently, most data are derived from individual veterinary investigations and are not collected in a routine and specified manner nor aggregated and analysed further. Some molecular studies of antimicrobial resistance genes are currently underway in Australia but these are generally conducted as research projects rather than surveillance programs.

Monitoring and surveillance of antimicrobial resistance derived from the veterinary and agricultural use of antimicrobials in Australia will require a new approach. The most relevant guide in the development of a program for Australia is the international standard developed by the world organisation for animal health, the Organisation International des Epizooties (OIE). The OIE is the international standards setting organisation recognised by the World Trade Organisation. This is elaborated further in Appendix 11.5.

### **7.2 Aim**

To measure the prevalence of and trends in antimicrobial resistance (that is of public health significance) in bacteria from animals.

### **7.3 Primary Agency**

Product Integrity Animal and Plant Health, DAFF.

### **7.4 Stakeholders**

Federal, State and Territory Primary Industry Departments  
Australian Veterinary Association and veterinarians in food animal practice  
Livestock Industries  
Animal Health Laboratories  
NEPSS  
Australian Salmonella Reference Centre (ASRC)  
OzFoodNet  
Commercial Companies and Industry



## 7.5 Goals

1. Determine the prevalence of antimicrobial resistant bacteria in animals and their environment and detect the emergence of new antimicrobial resistance patterns.
2. Investigate any association there might be between emergence of resistance and the pattern of use of antimicrobials in animals.
3. Identify circumstance where antimicrobial resistance in animals is related to resistance patterns and trends in humans.
4. Report national data on the prevalence of antimicrobial resistance in animals.

## 7.6 Processes

Table 8. Processes for reaching goals of AMR surveillance in animals

Goals	Processes
1. Prevalence of AMR in animals – public health focus	<ul style="list-style-type: none"><li>• develop and implement an active surveillance program for commensals that has a public health focus;</li><li>• summarise data on AMR prevalence for commensal bacteria and antimicrobials from the active surveillance program.</li></ul>
2. Prevalence of AMR in bacteria in animals	<ul style="list-style-type: none"><li>• identify sources of passive surveillance data for zoonotic bacteria;</li><li>• summarise data on AMR prevalence for zoonotic bacteria and antimicrobials from existing data.</li></ul>
3. Prevalence of AMR in animals – animal health focus	<ul style="list-style-type: none"><li>• identify stakeholders;</li><li>• evaluate data quality from passive surveillance;</li><li>• identify gaps and deficiencies and work with stakeholders to improve data quality;</li><li>• summarise AMR prevalence for key diseases and antimicrobials from existing data.</li></ul>
4. Data analysis	<ul style="list-style-type: none"><li>• identify any trends in AMR prevalence;</li><li>• identify any associations, if any, between AMR and use patterns of antimicrobials;</li><li>• identify associations, if any, between AMR in animals and AMR in humans.</li></ul>
5. Reporting	<ul style="list-style-type: none"><li>• establish a reporting cycle and format in conjunction with stakeholders;</li><li>• produce reports in consultation with stakeholders on trends in AMR in commensals, zoonotic agents and animal pathogens.</li></ul>

## 7.7 Organisms and antimicrobials for surveillance

Table 9. Organisms and antimicrobials proposed as national priorities for animal antimicrobial resistance surveillance

Antimicrobial class	Animal pathogens Gram -ve	Animal pathogens Gram +ve	Salmonella / E.coli	Campylobacter	Enterococcus
<b>Aminoglycosides</b> • Apramycin • Gentamicin • Neomycin • Streptomycin	√ √ √	√ √	√ √ √ √		√
<b>Amphenicols</b> • Chloramphenicol* • Florfenicol	√	√	√ √		
<b>Beta-lactams</b> • Ampicillin • Oxacillin/cloxacillin • Penicillin	√	√ √	√		√
<b>Cephalosporins</b> • Ceftiofur	√		√		
<b>Glycopeptides</b> • Vancomycin*		√			√
<b>Lincosamides</b> • Lincomycin		√			
<b>Macrolides</b> • Erythromycin • Tylosin	√	√		√	√ √
<b>Quinolones</b> • Enrofloxacin* • Ciprofloxacin*	√	√	√ √	√	√
<b>Streptogramins</b> • Virginiamycin					√
<b>Sulfonamides</b> • Trimethoprim/ sulphamethoxazole	√	√	√		
<b>Tetracyclines</b> • Tetracycline	√	√	√	√	√

\* Not registered for use in food animals in Australia

## 7.8 Outcomes

To obtain objective data on the prevalence of AMR in bacteria of animal origin that have the potential to transfer to humans and cause public health concerns. These data can be used:

- in risk analysis to determine the risk to human and animal health;
- to detect the emergence of particular phenotypes of AMR;
- to detect trends in AMR;
- to identify the need for particular interventions and to assess the impact of interventions; and
- to provide a basis for policy recommendations for public and animal health.

## 8. Surveillance of antimicrobial resistance in foods

### 8.1 Background

There is sufficient evidence in the literature to suggest a link between the use of antimicrobials in food producing animals and the emergence of antimicrobial resistant organisms and their spread to humans. Therefore surveillance for antimicrobial resistant organisms of public health importance in foods needs to be addressed. In Australia, there is little systematic surveillance of antimicrobial resistance in bacteria contaminating foods, including animal derived foods. Some data are collected by individuals States, however there is no integration of this data to determine trends in AMR at a national level. Data collected from existing food surveillance activities should form part of the overall resistance surveillance system. A possible future initiative includes the collection of resistance data on *Salmonella*, *E.coli* and *Campylobacter* in foods through OzFoodNet and AQIS Imported Foods Inspection Scheme (formerly the Imported Foods Program).

### 8.2 Aim

To measure the prevalence of and trends in antimicrobial resistance in bacteria recovered from food.

### 8.3 Primary Agency

Food and Environmental Health Branch, DoHA, with OzFoodNet

### 8.4 Stakeholders

Federal, State and Territory Primary Industry and Health Departments

FSANZ

AQIS Imported Food Inspection Scheme

Livestock Industries

Veterinarians in food animal practice.

Animal Health Laboratories

NEPSS

Australian Salmonella Reference Centre (ASRC)

### 8.5 Goals

1. To evaluate the prevalence of antimicrobial resistant bacteria in food at various stages of production and processing.
2. To investigate any association there might be between emergence of resistance and the pattern of antimicrobial use in food production.
3. To identify circumstances where antimicrobial resistance in foods is related to resistance patterns and trends in animals and humans.
4. To report national data on the prevalence of antimicrobial resistance in bacteria recovered from food.

## 8.6 Processes

Table 10. Processes for reaching goals of AMR surveillance in foods

1. Prevalence of AMR in animal-derived food	<ul style="list-style-type: none"> <li>• identify stakeholders;</li> <li>• evaluate data quality from passive surveillance, if any;</li> <li>• identify gaps and deficiencies and work with stakeholders to improve data collection and quality;</li> <li>• summarise AMR prevalence for key organisms and antimicrobials from existing data;</li> <li>• develop and implement a program of active surveillance in foods that has a public health focus.</li> </ul>
2. Data analysis	<ul style="list-style-type: none"> <li>• Identify any trends in AMR prevalence;</li> <li>• identify any associations, if any, between AMR and use patterns of antimicrobials;</li> <li>• identify associations, if any, between AMR in foods and AMR in humans.</li> </ul>
3. Reporting	<ul style="list-style-type: none"> <li>• establish a reporting cycle and format in conjunction with stakeholders;</li> <li>• produce reports in consultation with stakeholders on trends in AMR.</li> </ul>

## 8.7 Organisms and antimicrobials for surveillance of AMR in foods

Table 11. Organisms and antimicrobials proposed as priorities for AMR surveillance in food

Organism	Antimicrobials for surveillance
<i>Salmonella</i>	Multi resistance, including fluoroquinolones and 3G cephalosporins.
<i>Campylobacter</i>	Ciprofloxacin, Erythromycin, Tetracycline.
<i>Enterococcus</i>	Ampicillin, Vancomycin, Erythromycin, ciprofloxacin, tetracycline, streptogramins.
<i>Escherichia coli</i>	Gentamicin, Ampicillin, co-trimoxazole.

## 8.8 Outcomes

1. Systematic surveillance system that generates high quality data on the presence of AMR in food.
2. Effective mechanisms for collating, interpreting and reporting data at a national level.
3. Standardised documentation of trends in food AMR.
4. Data to inform risk assessment and that can be used to develop risk management measures for AMR in food.

## **9. Monitoring of antimicrobials used in people and animals**

### **9.1 Background**

Over the past 20 years there has been increasing concern about the overuse or inappropriate use of antimicrobials in human medicine and a general recognition that over use of antimicrobials can lead to rapid establishment of large pools of antimicrobial resistant pathogens. Surveillance of antimicrobials from the time they enter Australia to the time of their consumption in either animals or humans has to become an accepted component of the total surveillance system. Action is being undertaken through CIJIG and EAGAR to improve usage data. National data on antimicrobial use needs to include total antimicrobials imported, how much is used in humans (including community and hospital use) and animals, and what these antimicrobials are used for. The two regulatory bodies that approve antimicrobials for humans and animals, TGA and APVMA respectively, are already working towards enhancing the quality of antimicrobial import and supply data. Antimicrobial import data are currently collected by TGA, and this includes antimicrobials for human, veterinary and stockfeed use.

The use of antimicrobials in humans is monitored through the Pharmaceutical Benefits Scheme (PBS) and Pharmacies. The Drug Utilisation Sub Committee (DUSC) collates and reports on usage data collected by these two bodies. Few hospitals have usage surveillance in place, although a statewide antimicrobial use surveillance system across 15 public and private hospitals has recently commenced in South Australia (SA). There is no comparable system for collecting data on antimicrobial use in the agricultural sector.

### **9.2 Aim**

To provide reliable data on the volume of antimicrobials consumed by humans and animals in Australia and their patterns of use.

### **9.3 Primary Agency**

DoHA through the TGA and APVMA.

### **9.4 Stakeholders**

HealthCare facilities

Australian Infection Control Association (AICA)

Australian Customs Service

Pharmaceutical Benefits Scheme (PBS) and Pharmacy Guild

Therapeutic Goods Administration (TGA)

APVMA

State and Territory Health and Primary Industries Departments.

Australian Veterinary Association (AVA)

Drug Utilisation Sub-Committee (DUSC)

### **9.5 Goals**

1. Reliable and accurate antimicrobial import, supply and end-use data collected and provided nationally, involving the national collation of human antimicrobial use data from community and hospital pharmacies, PBS and veterinary sources.
2. Aggregated State/Territory antimicrobial utilisation information provided to the CCU for inclusion in the national annual publication.

- Human and Animal Health Reference Networks, AICA and other relevant groups, refine the definition for antimicrobial-use in the context of national surveillance.

## 9.6 Processes

Table 12. Processes for reaching goals of monitoring antimicrobial use in humans and animals

Goals	Processes
Collation of data on antimicrobials imported for use in humans, animals and animal-derived food.	<ul style="list-style-type: none"> <li>Conduct evaluation sessions to determine that importers define who has requested import and that import request tallies with registered product registers.</li> <li>Evaluate existing sources of antimicrobial import data (eg. TGA import data) and make recommendations for improvement.</li> </ul>
Collation of data on regulatory authority supply of antimicrobials for use in humans, animals and animal derived foods.	<ul style="list-style-type: none"> <li>Evaluate existing sources of regulatory supply data and make recommendations for improvement, including improving the review and follow-up of antimicrobial supply data.</li> <li>Obtain cooperation from the pharmaceutical companies to facilitate collection of regulatory authority supply data.</li> </ul>
Collation of end-use data on antimicrobials used in humans, animals, and animal derived foods.	<ul style="list-style-type: none"> <li>Evaluate existing sources of end use data and make recommendations, including methods for development of better data on antimicrobials consumption in food producing animals.</li> <li>Determine optimal mechanism for obtaining end use data in animal health and human health sectors.</li> <li>Identify financial infrastructure for collection of end-use data.</li> </ul>
Data analysis	<ul style="list-style-type: none"> <li>Reconciliation of import, regulatory authority and end use antimicrobial usage data.</li> <li>Identify trends in antimicrobial usage among humans and animals, for example in humans, by age group, setting, and indication, and in animals, by species and setting.</li> </ul>
Reporting	<ul style="list-style-type: none"> <li>Establish a reporting format in conjunction with stakeholders.</li> <li>Produce a report on findings and trends in antimicrobial usage in humans, animals, and animal derived food.</li> </ul>

## 9.7 Antimicrobials for surveillance in humans and animals

Table 13. Antimicrobials proposed as priorities for surveillance of usage

Settings	Antimicrobials to be considered for surveillance
Community	Third-generation cephalosporins, first-generation cephalosporins, penicillins, tetracycline, fluoroquinolones, rifamycins, spectinomycin, erythromycin, tetracyclines, co-trimoxazole/trimethoprim, gentamicin, vancomycin, fusidic acid, fluoroquinolones, chloramphenicol, isoniazid, spectinomycin, ethambutol, pyrazinamide
Hospitals	Penicillins, erythromycin, tetracycline, gentamicin, cotrimoxazole/trimethoprim, glycopeptides, First and third generation cephalosporins, rifampicin, fusidic acid, fluoroquinolones, carbapenems, amikacin, macrolides, linezolid, quinupristin-dalfopristin
Animals	Aminoglycosides, amphenicols, bambermycins, cephalosporins, lincosamides, macrolides, orthosomycins, penicillins, polyethers, polypeptides, quinolones, streptogramins, sulfonamides, tetracycline

### 9.8 Outcomes

- To improve existing collection of antimicrobial usage data, including the provision of import supply and end-use data for national surveillance reporting. The data collected will:
  - Facilitate risk analysis for registration applications, extensions of use application, and Pharmaceutical Benefits listing;
  - Be used in formal reviews of antimicrobials by regulatory authorities;
  - Enable evaluation of the effectiveness of prudent use efforts and mitigation strategies;
  - Enable trends in antimicrobial usage to be studied; and
  - Enable international reporting and comparisons.
- To facilitate the development of prescribing and regulatory interventions that would improve the prudent use of antimicrobials.

## 10. Monitoring and evaluation of the Strategy

An ongoing evaluation process should monitor progress against the Strategy. The performance of the strategy will be monitored against performance indicators that will be outlined in the detailed action plans for each of the four surveillance areas. Progress against the Strategy will be regularly reported by CIJIG on the *Implementing JETACAR* website, to the Communicable Diseases Network Australia (CDNA), the Public Health Laboratory Network (PHLN) and other relevant bodies including the Australian Health Ministers' Conference (AHMC) and the Primary Industries Standing Committee (PISC) as required.

## 11. Appendices

### 11.1 JETACAR Recommendations

#### JETACAR recommendation 10

*That a comprehensive surveillance system be established incorporating passive and active components measuring incidence and prevalence of antimicrobial resistant bacteria and resistance genes, covering all areas of antimicrobial use. To achieve this aim, it is further recommended that a multidisciplinary taskforce of relevant experts be formed by the federal ministers of health and agriculture to design, and recommend funding mechanisms and management systems for reporting and analysis of antimicrobial resistance data in Australia.*

*The overall surveillance system, should include medical (including nosocomial), food-producing animal and veterinary areas, with particular emphasis on the establishment of food-chain (including imported food) and environmental connections, and include molecular studies of resistance genes. The efforts of the taskforce should be directed at adopting a uniform, systematic and synergistic approach across all areas by utilising, enhancing and extending currently available systems and organisational structures.*

#### Government response to recommendation 10

The Government supports the overall concept of improving the surveillance of antimicrobial-resistant bacteria and resistance genes across the food chain and in human medicine, but emphasises the importance of further investigations to determine the most appropriate and cost-effective option for national integration of animal and human surveillance data.

The Government proposes that a feasibility study be commissioned to determine the way forward. The Departments of Agriculture, Fisheries and Forestry (AFFA) – Australia and Health and Aged Care will be jointly responsible for scoping, commissioning and managing the study, by whatever mechanisms they deem suitable. The scoping should define the parameters necessary to address the overall antimicrobial resistance issue. The feasibility study should include options for the design, costing, funding and management systems for the reporting and analysis of data, and should include a cost-benefit analysis and appropriate options for a pilot study to trial the system. The two Departments will consult with the WPA or its successor, other expert organisations and industry to develop a system that makes best use of existing surveillance systems and provides uniform and useful data.

The scoping and feasibility study will be funded and resourced jointly by the two Departments.

#### JETACAR Recommendation 11

*That a comprehensive monitoring and audit system for antimicrobial usage be established that covers all areas of antimicrobial use. To achieve this aim, it is recommended that the federal ministers of health and agriculture form a multidisciplinary taskforce of medical, veterinary, industry and regulatory experts (including Customs, Therapeutic Goods*



*Administration, Department of Health and Aged Care, National Registration Authority and Department of Agriculture, Fisheries and Forestry – Australia) to refine the current antimicrobial import data collection and audit process, and make recommendations to relevant authorities for developing methods of monitoring and auditing usage.*

#### Government Response to Recommendation 11

The Government supports the principles of accountability and audit trail inherent in this recommendation, but notes that it overlaps with Recommendation 3. If the proposals under the response to Recommendation 3 are successful, the Government considers that Recommendation 11 will be, for the most part, addressed.

The Therapeutic Goods Administration currently issues permits and collects end-use data to monitor the antimicrobials imported into Australia. The Government is supportive of this existing scheme and will establish an interdepartmental working group consisting of representative of the TGA, Customs, NRA, and AFFA to refine the existing systems for recording the use and distribution of antimicrobials by importers. This group will seek advice from the WPA or its successor and stakeholders in order to develop options for end-use schemes for auditing and improving import data collection, and report its findings to Government within 12 months.

The Government currently collects data on prescribing (not usage) of antimicrobials for human use through the Pharmaceutical Benefits Scheme (PBS). In the 2000/2001 budget Government committed additional resources for strategies to improve this data set. The Government recognises that monitoring antimicrobial usage in humans is both costly and difficult, and that additional benefits will flow through public education and best practice in prescribing. See also the responses to Recommendations 15-17 and 19-20.

#### JETACAR recommendation 14

*That the Department of Health and Aged Care examine current surveillance activities for hospital acquired (nosocomial) infections, particularly for antimicrobial resistant strains and that the Department work with stakeholders (including the States and Territories) to further develop a comprehensive and standardised national system for monitoring nosocomial infections that will facilitate:*

- *Earlier recognition of a public health problem;*
- *Improvements in infection control and hygiene measures; and*
- *The timely development of national standards, guidelines and practices for both surveillance and infection control in the healthcare setting.*

#### Government response to recommendation 14

The Government supports and is already taking action in response to this recommendation. The Government has initiated a national scoping study to examine existing surveillance of nosocomial infections in Australia. The study is funded and managed through the National Centre for Disease Control (NCDC) and will provide vital information for future national planning of nosocomial surveillance. Findings from the scoping study will be referred to the Departments of Health and Aged Care and Agriculture, Fisheries and Forestry - Australia and

to the WPA or its successor for consideration in the overall planning process for the coordinated resistance management plan for human antimicrobials (refer to Recommendations 21 and 22). The Government will consult with the States and Territories and other stakeholders to develop an affordable and useful national system for monitoring nosocomial infections, building on existing systems and harnessing current expertise.

A review of the national infection control guidelines pertaining to the healthcare setting is also well under way by the NCDC. The Government will review national infection control guidelines on a regular basis under the auspices of the Communicable Diseases Network Australia and New Zealand (CDNANZ) and the NHMRC.

In addition, the Government will work with the WPA or its successor, the Public Health Laboratory Network (PHLN), the CDNANZ and health professionals to develop national consistency with case definitions for nosocomial infections including antimicrobial-resistant bacteria, uniform laboratory testing standards, and national policies on monitoring of individuals who are at high risk or susceptible to colonisation with antimicrobial-resistant bacteria.

The NCDC will also work closely with the States and Territories through the CDNA to improve early recognition and reporting of nosocomial infections of public health significance, including vancomycin resistant enterococci (VRE).

The level of funding required to develop a national system of surveillance will be determined through the scoping study and the feasibility study described in response to recommendation 10. The government will develop new policy proposals to seek necessary funds that cannot be met from existing resources.

## **11.2 Acknowledgments**

Australian Action Plan for Antimicrobial Resistance Surveillance (the Plan) was developed in consideration of current literature, existing activities and valued contributions from key organisations, Government bodies and individuals. These contributions are all gratefully acknowledged.

## **11.3 Programs collecting human antimicrobial resistance surveillance information**

**Australian Group on Antimicrobial Resistance (AGAR)** consists of representatives from major teaching hospitals around Australia. AGAR collects human MRSA data annually and regularly conducts surveillance on other antimicrobial resistant organisms. AGAR has conducted antimicrobial resistance surveillance for 15 years and publishes the information in peer-reviewed journals. <http://antimicrobial-resistance.com/>

**Australian Gonococcal Surveillance Programme (AGSP)** is a long-term program to monitor susceptibility to antibiotics of gonococci, with data published in CDI since 1981. Surveillance information is published annually in CDI. A list of participating laboratories is provided in *Commun Dis Intell* 2001;25:59-63.

**Australian Institute for Health and Welfare (AIHW)** collects information via administrative databases using International Classification of Disease, 10<sup>th</sup> Revision, Australian Modification (ICD-10-AM) 3<sup>rd</sup> edition codes from July 2002. ICD-10-AM 3<sup>rd</sup>

edition includes codes for MRSA and VRE not previously captured by ICD codes. <http://www.aihw.gov.au/index.html>

**Australian Meningococcal Surveillance Programme (AMSP)** commenced in 1994 to examine isolates of *Neisseria meningitidis* from cases of invasive meningococcal disease and, on occasion, collects information on the antimicrobial susceptibility of invasive isolates. Surveillance information is published annually in CDI. A list of participating laboratories is provided in *Commun Dis Intell* 2001;25:113-121.

**Australian Salmonella Reference Centre (ASRC)** at the Institute of Medical and Veterinary Science (IMVS) in Adelaide (<http://www.imvs.sa.gov.au/>), provides reference, serotyping and phage typing services for Salmonella. The laboratory holds data on Australian Salmonella isolates dating back to the 1940s. It tests Salmonella isolates from humans, food-animals and related sources (such as animal feeds), and animal sources considered of less public health significance (such as reptiles). Human and non-human data are presented together in monthly and annual reports, not yet available on the IMVS website. The Centre commenced collection of Salmonella antibiotic susceptibility data in May 2000 and will include this information in the annual report, available from [dianne.davos@imvs.sa.gov.au](mailto:dianne.davos@imvs.sa.gov.au).

**Australian Tuberculosis Reporting Scheme (ATRS)** collects data from only laboratory-confirmed human cases and includes data on antibiotic susceptibility. The Mycobacterium Reference Laboratory Network (MRLN) has run the ATRS since 1986. Data are combined with information from the National Mycobacterial Surveillance System (NMSS) in an annual report published in CDI. A list of MRLN laboratories is given in *Commun Dis Intell* 2001;25:261-265. The enhanced NNDSS dataset for tuberculosis will collect all data previously collected by this scheme with effect from 2002.

**National Enteric Pathogens Surveillance Scheme (NEPSS)**, run through the Microbiological Diagnostic Unit (MDU) in Melbourne, collects data on human enteric bacterial infections diagnosed in Australia. These pathogens include *Salmonella*, *Shigella*, *Escherichia coli*, *Vibrio*, *Yersinia*, *Plesiomonas*, *Aeromonas* and *Campylobacter*. NEPSS began in its present form in 1985 and includes a database of isolates from non-human sources (food, industrial, veterinary). All Salmonella strains received by MDU are routinely tested for resistance to 11 antibiotics. Monthly summaries of regional and national trends in common *Salmonella* serovars and annual reports of the human and non-human data are produced. Contact annual report editor [joanp@unimelb.edu.au](mailto:joanp@unimelb.edu.au)

**National Mycobacterial Surveillance System (NMSS)** of the CDNA has collected statistics on tuberculosis cases (clinical and laboratory) reported to public health authorities since 1991 with national collection of antibiotic susceptibility data initiated in 2001. Data are combined with information from ATRS in an annual report published in CDI. The enhanced NNDSS dataset for tuberculosis will collect all data previously collected by this scheme with effect from 2002.

**National Notifiable Disease Surveillance System (NNDSS)** was established in 1990 under the auspices of the Communicable Diseases Network Australia (CDNA). The system coordinates the national surveillance of more than 50 communicable diseases or disease groups endorsed by the CDNA. Two enhanced NNDSS datasets for tuberculosis and invasive pneumococcal disease collect antibiotic susceptibility data on all notified cases with effect

from July 2002. NNDSS notifications are made to the State or Territory health authority under the provisions of the public health legislation in their jurisdiction. Computerised, de-identified unit records of notifications are supplied to the Department of Health and Ageing for collation, analysis and publication fortnightly on the *Communicable Diseases – Australia* website and quarterly in *CDI*. <http://www.health.gov.au/pubhlth/cdi/cdihtml.htm>

**OzFoodNet** is a collaborative network established in 2000. It is overseen by CDNA and has participation by all States and Territories. The aims of OzFoodNet include enhanced surveillance for food borne pathogens and the provision of data for risk assessments and policy interventions. The Network meets regularly and publishes quarterly reports in *CDI*. OzFoodNet is currently conducting case control studies that include monitoring antimicrobial resistance in human *Salmonella* and *Campylobacter* isolates against 11 antibiotics. Research projects will build on current work and will include surveillance of antimicrobial resistance. For further information, contact the coordinating epidemiologist [martyn.kirk@health.gov.au](mailto:martyn.kirk@health.gov.au).

**SENTRY Antimicrobial Resistance Surveillance Program** is a joint effort between the US University of Iowa and the Women's and Children's Hospital, Adelaide and is funded by an educational and research grant from Bristol-Meyer Squibb Company. It was established in January 1997 to monitor antibiotic resistance patterns of common bacterial causes of human disease worldwide. The program operates through a broad network of sentinel hospitals distributed by geographic region and size. SENTRY collects information from five continents on healthcare and community acquired infections, including bloodstream, respiratory tract, urinary tract and wound infections. The program uses standardised reference testing methods and reports regularly in scientific journals.

#### **11.4 Programs for human antibiotic utilisation information**

**The Antimicrobial Approval System (AAS)** is an Intranet-based antimicrobial approval system for broad-spectrum cephalosporins developed at the Royal Melbourne Hospital has proved effective in achieving sustained improvement in appropriate use of these agents. After an educational program for pharmacists and doctors, including resident staff, surgeons and emergency physicians, this program was introduced in March 2001. Prescribers log in to a web-based form linked to national antibiotic guidelines, to obtain a computer-generated approval number, which includes a coded stop order, specifying approval duration. The program is interactive. Prescribers must select an accepted indication according to guidelines, or otherwise seek phone approval from the Infection Diseases Unit staff. This intervention has led to a sustained reduction in use of these agents to approximately half previous levels. An indication-linked audit revealed substantially improved consistency of prescribing with national antibiotic guidelines. Extension of the approval system to other restricted antibiotics and to other campuses is underway.

**Australian Infection Control Association (AICA)** recommends that all hospitals monitor their antibiotic utilisation. AICA is currently developing an antibiotic utilisation definition for collecting hospital data and expects to publish this in the December 2002 edition of their journal. To enable hospitals to track antibiotic utilisation using Daily Defined Dose (DDD) as a measure, AICA has developed an Excel spreadsheet using the WHO definition. Monthly quantities for each agent and dosage and bed-day denominators are entered in the spreadsheet. The spreadsheet then calculates DDD rates and generates hospital utilisation charts for ICU and non-ICU. This spreadsheet will soon be available from <http://www.aica.org.au/>

**Antibiotic Consumption Calculator (ABC Calc),**  
<http://www.escmid.org/sites/science/studygroups/Index.asp>.

**Pharmaceutical Benefits Scheme (PBS)** collects community antibiotic utilisation information through community prescription data and publishes in *PBS Expenditure and Prescriptions* (<http://www.health.gov.au/pbs/pubs/pbbexp/index.htm>) (drugs falling under the co-payment are not included in this dataset). Schedule of pharmaceutical benefits is available at <http://www1.health.gov.au/pbs/contents/contents.htm>

**Pharmacy Guild of Australia** has conducted a survey of community pharmacies, since 1990, to capture data on the supply of antibiotics that fall under the co-payment. The survey was not conducted from September 1999 to December 2001 but has resumed with a reduced number of pharmacies and with capture of data from September 1999 onward. PBS antibiotic supply data and community pharmacy supply data are published in *Australian Statistics on Medicines* (last published in 1998, 1999/2000 joint edition is expected for release late in 2002) available at <http://www.health.gov.au/pbs/pubs/asm.htm>

**Infectious Diseases Electronic Antibiotic Advice and Approval System (IDEA3S)** was developed by the Austin and Repatriation Medical Centre to provide education and evidence-based approval for 11 antimicrobial agents. IDEA3S allows ready auditing of antibiotic use requests and approvals/denials according to prescriber, Unit, indication and antibiotic and will be further developed to link with the hospital's Medical Record Department to assess the validity of submitted information for monthly accuracy audits used to target educational interventions. It is expected that the program will be freely available to all Australian hospitals by late 2002.

**Australian Sentinel Practice Research Network (ASPREN)** is operated by the Research and Health Promotion Unit of the Royal Australian College of General Practitioners. It is a national network of general practitioners that report on a number of conditions each week. The aim of ASPREN is to provide an indicator of the burden of disease in the primary healthcare setting and to detect trends in consultation rates. The ASPREN management committee reviews the list of conditions annually and publishes an annual report. In 2001 the recordable conditions included *antibiotic prescription for upper respiratory tract infection (URTI)* and *patient request for antibiotics for URTI*. These conditions have not been recorded in 2002.

## 11.5 Antimicrobial Resistance Surveillance in Animals in Australia

### ***Introduction***

Contrary to the situation in human medicine, there are few antimicrobial resistance surveillance programs in the veterinary area that could be readily adapted into a national surveillance program. Current programs include:

- Limited passive surveillance of veterinary pathogens via diagnostic submissions with the data held in state and private veterinary pathology laboratories;
- Some ad hoc surveys undertaken by researchers in state government laboratories and universities or as part of research projects funded by Research and Development Corporations;

- Passive surveillance of Salmonella isolates submitted to the Australian Salmonella Reference Centre at the Institute of Medical and Veterinary Science, Adelaide (IMVS) and as part of the National Enteric Pathogens Surveillance Scheme (NEPSS) through the Microbiological Diagnostic Unit (MDU), Melbourne; and
- A limited amount of targeted surveillance undertaken by some industries for their own animal health purposes.

The main limitations to using existing veterinary data as the basis of a national program that has a public health focus are:

1. Passive collection of resistance data based on diagnostic submissions, while useful for identifying clinically important issues, generally provides data that is less representative of the target population of animals and farms than a program of active surveillance in healthy animals;
  2. Not all the existing antimicrobial susceptibility test data is comparable or has been generated using standardised test methods ie. not necessarily standardised between veterinary testing facilities producing largely qualitative data and human testing facilities producing largely quantitative data;
  3. Most of the available data is for antimicrobial resistance in clinically significant animal pathogens covering predominantly therapeutic antimicrobials used in veterinary medicine; and
- There is a lack of data on resistance in commensal bacteria to those antimicrobials that are used for growth promotant purposes, and also for some classes of antimicrobials used in humans only.

Monitoring and surveillance of antimicrobial resistance derived from the veterinary and agricultural use of antimicrobials in Australia will require a new approach. Existing systems do not address the public health concern about resistance that could originate from antimicrobial use in animals and are unlikely to meet the animal health and welfare requirements of the animal industries.

The most relevant guide in the development of a program for Australia is the international standard developed by the world organisation for animal health, the Organisation International des Epizooties (OIE). The OIE is the international standards setting organisation recognised by the World Trade Organisation for the elaboration of international standards, guidelines and recommendations on matters of animal health and zoonoses relevant for trade in animals and animal products. The OIE has produced a number of guideline documents outlining a comprehensive strategy that can form the blueprint for member countries to manage antimicrobial resistance arising from the agricultural and veterinary use of antimicrobials. One of the guidelines covers the harmonisation of national antimicrobial resistance monitoring and surveillance programs in animals and animal derived food.

Specific factors identified for harmonisation include antimicrobial usage patterns, animal species, food commodities, bacterial species, antimicrobials to be tested, laboratory methods, and data reporting.



## ***Issues for Consideration in Developing an Animal AMR Surveillance Program in Australia***

A number of factors need to be considered in developing a surveillance program for antimicrobial resistance of animal origin. These are discussed in the following section.

### Coordination and implementation

The EAGAR has a role in providing advice on antimicrobial resistance and related issues and the integration and interpretation of antimicrobial resistance surveillance information. The PISC Taskforce on JETACAR has a role in providing policy input on behalf of the agricultural sector. An Animal Health Reference Network (AHRN) will need to be established to coordinate, provide advice on the technical and operational aspects of the surveillance program and to collate results for consideration by EAGAR.

### Antimicrobial usage patterns

Acquired antimicrobial resistance arises from the selection pressure exerted on bacteria by antimicrobials in their immediate environment. The types of antimicrobials used and the extent, quantities and patterns of their use should be taken into account in designing a surveillance program.

Data is available on antimicrobial imports into Australia, by year, and broken down by active ingredient into human and agricultural use. However, the data are not detailed enough to use in the design of a surveillance program and therefore reliance, in the first instance, will need to be made on informal data provided by veterinarians and industry representatives. In the longer term the proposal by APVMA and TGA for national collection of antimicrobial use data in Australia (being considered by CIJIG and EAGAR) will provide objective data that can be used in developing a surveillance program and in interpreting the data gathered.

### Sampling strategies

An early consideration is whether reliance can be placed on existing passive surveillance programs (data from veterinary diagnostic submissions, *Salmonella* surveillance) or whether existing programs need to be modified, or whether a new active surveillance program should be undertaken to meet the objectives.

Existing surveillance systems do not address the public health concern about resistance that originates from antimicrobial use in animals and are unlikely to meet the animal health and welfare requirements of the animal industries. Therefore a combination of approaches may be required, in the following priority order:

- Utilise any existing passive surveillance programs (e.g. for *Salmonella*) that address public health concerns;
- Develop active targeted surveillance programs to meet the public health concerns that are not covered by existing passive surveillance programs;
- Capture data from current and past research and investigative programs that address public health concerns; and
- Capture data from existing passive surveillance programs that address animal health concerns.

The sampling strategy should ensure the representativeness of the population of interest by adopting a probabilistic approach. The target unit for sampling should be individual farms, rather than individual animals. Options for active sampling are therefore simple random, systematic or stratified collection or targeted at specific groups. If the sampling strategy is robust then use of statistically based sample sizes will allow a more accurate estimate of the prevalence of antimicrobial resistance in the population of interest (moreover the analysis can be conducted to estimate confidence limits).

Some knowledge of the expected prevalence of resistance will allow decisions to be made on the number of samples that will be required to give the desired level of precision of the prevalence estimate and the confidence limits of that estimate. For example, if the expected prevalence in a large population were 10%, then the number of samples required to give a statistically valid estimate of the prevalence with 5% precision and 95% level of confidence would be 138.

#### Animals to be sampled

An assessment should be made of the relative importance of the various categories of livestock potentially contributing to antimicrobial resistance. A key consideration will be knowledge of antimicrobial use patterns in the various livestock industry sectors. In Australia, categories of livestock that should be considered for sampling include dairy and feedlot cattle, bobby calves, slaughter pigs, broiler chickens, and aquaculture species.

From the public health perspective, the initial focus should be on those categories of livestock in which antimicrobials are used in feed or water over a prolonged period for growth promotion or prophylaxis. Using these criteria, feedlot cattle, slaughter pigs and broiler chickens should be the highest priority for sampling.

Further consideration will need to be given to inclusion of bobby calves, aquaculture species, cull dairy cows and possibly layer hens as the program evolves. Antimicrobial resistance transfer from companion animals to humans has not been highlighted as an area of particular public health concern. However, this issue will need to be kept under review and, if necessary, a surveillance program targeted at companion animals may need to be considered.

#### Point of sampling

Contaminated food is the principal route of transmission of antimicrobial resistance from animals to humans, either by pathogens or by transfer of resistance genes carried by commensal bacteria. The earlier in the processing chain that samples can be taken, the more likely that susceptibility test results can be assessed in relation to possible on-farm antimicrobial use and management.

If the objective is to monitor the public health impact of antimicrobial resistant bacteria from food of animal origin, faecal samples taken at the abattoir are likely to be the most practical and cost-effective point of sample collection. Samples taken at the abattoir or processing plant would enable animals from a number of properties to be sampled over a relatively short period of time.

There are a number of existing sampling programs for microbiological contamination (AQIS *E. coli* *Salmonella* Monitoring program (ESAM), Imported Food Program and industry



testing) and chemical residues (National Residue Survey - NRS). It is possible that some of these samples for microbiological testing could also be used for antimicrobial resistance testing. Opportunities to use abattoir-based sampling programs with the appropriate infrastructure for sample collection and transport to laboratories from abattoirs (eg. NRS) should be explored.

### Sample specimens to be collected

The best specimen for investigating resistance arising on-farm is faeces (10-50 gm) in livestock and whole caeca in poultry. These specimens can readily be collected at abattoirs or processing plants.

### Organisms to be tested

The organisms of interest are listed in Table 14 and can be divided into three groups:

1. **Zoonotic organisms**- Samples for isolation of *Salmonella* and *Campylobacter* can either be taken at the abattoir, or isolates originating from other sources such as the NEPSS and Australian Salmonella Reference Centre can be used. These isolates are likely to be of diverse origin – from sick and healthy food and companion animals and from food – both domestic and imported. *Salmonella* isolates should be identified and serotyped according to international methods. *Campylobacter* isolates should be identified to species level.
2. **Commensal/indicator organisms** - *Escherichia coli* and *Enterococci* are regarded as commensal bacteria common to all animals and man. They constitute a reservoir of resistance genes that are capable of transmitting horizontally to pathogens or to other commensals. It is particularly important that the various *Enterococcus* species are correctly identified, as there are differences in innate resistance to some antimicrobials among the different species.
3. **Animal pathogens** - Monitoring of resistance in animal pathogens will allow early detection of the emergence of resistance that could be of animal (and human) health concern. The results can be used by veterinarians to make informed prescribing decisions and in developing prudent use guidelines.

Table 14. Bacteria for potential inclusion in a surveillance program

Target animals	Zoonotics	Commensals	Animal Pathogens
Cattle	<i>Salmonella spp</i>	<i>E.coli</i> <i>Enterococcus faecium</i> <i>Enterococcus faecalis</i>	<i>Haemophilus somnus</i> <i>Pasteurella spp,</i> <i>Mannheimia haemolytica</i> <i>Staphylococcus aureus</i> <i>Streptococcus agalactiae/uberis</i>
Pigs	<i>Salmonella spp.</i>	<i>E.coli</i> <i>Enterococcus faecium</i> <i>Enterococcus faecalis</i>	<i>Actinobacillus pleuropneumoniae</i> Brachyspira <i>Streptococcus suis</i>
Poultry	<i>Campylobacter</i>	<i>E.coli</i>	<i>E.coli</i>

Target animals	Zoonotics	Commensals	Animal Pathogens
	<i>Salmonella spp</i>	<i>Enterococcus faecium</i> <i>Enterococcus faecalis</i>	
Aquaculture species			<i>Aeromonas spp</i> <i>Vibrio spp</i>

The first priority for a pilot program should be to address public health concerns. This will be best achieved by confining the sampling to zoonotic and commensal/indicator bacteria. *Salmonella* resistance can be effectively monitored through the existing programs of the Australian Salmonella Reference Centre at IMVS, Adelaide and NEPSS based at the MDU, Melbourne. This will yield isolates from clinically ill and healthy animals and from domestic and imported food sources. For *Campylobacter* and the commensals, a targeted active surveillance program will need to be developed.

Resistance of animal pathogens could be monitored by collating data from standardised testing from existing passive surveillance programs at veterinary diagnostic laboratories. However, indications are that the data is not easy to access and collate as it is in a wide range of formats.

#### Antimicrobials to be used in susceptibility testing.

It would be cost-prohibitive to monitor all clinically important antimicrobials used in animals and humans. Table 15 contains a list of antimicrobials that could be considered for inclusion in a national surveillance program.

Priority should be given to monitoring those antimicrobial/bacterial combinations having the greatest potential public or animal health concern in Australia. While some antimicrobial classes listed have never been registered (fluoroquinolones) or are no longer registered (glycopeptides, streptomycin, gentamicin, chloramphenicol) for use in food animals, there is merit in monitoring resistance to these compounds because of their public health significance if resistance should be identified.

Table 15. Antimicrobials that may be included in an antimicrobial resistance surveillance program

Antimicrobial class	Animal pathogens Gram -ve	Animal pathogens Gram +ve	Salmonella / E.coli	Campylobacter	Enterococcus
<b>Aminoglycosides</b> • Apramycin • Gentamicin • Neomycin • Streptomycin	√ √ √	√ √	√ √ √ √		√
<b>Amphenicols</b> • Chloramphenicol • Florfenicol	√	√	√ √		
<b>Beta-lactam penicillins</b> • Ampicillin • Oxacillin/cloxacillin • Penicillin	√	√ √	√		√
<b>Cephalosporins</b> • Ceftiofur	√		√		
<b>Glycopeptides</b> • Vancomycin		√			√
<b>Lincosamides</b> • Lincomycin		√			
<b>Macrolides</b> • Erythromycin • Tylosin	√	√		√	√ √
<b>Quinolones</b> • Enrofloxacin • Ciprofloxacin	√	√	√ √	√	√
<b>Streptogramins</b> • Virginiamycin					√
<b>Sulfonamides</b> • Trimethoprim/ sulphamethoxazole	√	√	√		
<b>Tetracyclines</b> • Tetracycline	√	√	√	√	√

#### Standardised testing methods and quality control.

A wide variety of antimicrobial sensitivity test (AST) methods are used around the world. The most commonly used methods are disk diffusion, broth dilution and agar dilution. Regardless of the AST method used, all aspects of the method must be rigorously standardised to ensure accurate and reproducible results. Appropriate reference organisms should be included in every AST run as a quality control measure to ensure the accuracy of the test results. Where a number of laboratories are involved in a testing program, it is advisable that the same method is used in all laboratories and that the performance of laboratories is monitored through regular participation in a proficiency testing program.

In choosing an AST method, it is preferable that the result can be recorded quantitatively (minimum inhibitory concentration in mg/litre or inhibition zones in millimetres) rather than qualitatively as “resistant” or “susceptible”. This will allow the early detection and critical assessment and evaluation of possible emerging resistance and trends to be followed.

Testing for the active surveillance program may need to be restricted to a few laboratories, all NATA accredited and preferably using agar micro-dilution to report a minimum inhibitory concentration.

Other methods being developed will require validation against the agar or broth microdilution method, as it is critical that results from animal and human testing can be readily compared.

Test results from passive surveillance programs should only be included in the national database if they have been generated at a laboratory that is NATA-registered for antimicrobial susceptibility testing and has demonstrated satisfactory performance in a national proficiency testing program.

#### Data collation, interpretation and reporting.

It will be necessary to have the raw data sent to a central point for entry into a national database to facilitate evaluation of the data in response to various questions and for the generation of regular reports for the information of national regulatory agencies, stakeholders and the public. In the first instance, the NRS database which is set up to receive chemical residue data electronically from laboratories could be readily adapted to receive quantitative susceptibility test data. This data can then be provided to the ARN for collation and to EAGAR for interpretation. EAGAR, with assistance from the DoHA central coordinating unit, should report the animal surveillance data as a subset of the integrated antimicrobial resistance surveillance information.

### **11.6 International surveillance systems**

**Danish Integrated Antimicrobial Resistance Monitoring and Research Programme (DANMAP)** <http://www.vetinst.dk>

**European Antimicrobial Resistance Surveillance System (EARSS)**  
<http://www.earss.rivm.nl/>

**European Surveillance of Antimicrobial Consumption (ESAC)**  
<http://esac-www.uia.ac.be/esac/index.html>

**Finland Bacterial Resistance Program**  
<http://www.mmm.fi/el/julk/finres99en.html>

**Foodborne Diseases Active Surveillance Network (FoodNet)**  
[http://www.cdc.gov/foodnet/whats\\_new/hhs\\_mar0/hhs\\_mar0.htm](http://www.cdc.gov/foodnet/whats_new/hhs_mar0/hhs_mar0.htm)

**Intensive Care Antimicrobial Resistance Epidemiology (ICARE)**  
<http://www.sph.emory.edu/ICARE/>

**National Antimicrobial Resistance Monitoring System (NARMS) for Enteric Bacteria**  
<http://www.cdc.gov/narms/default.htm>

**National Nosocomial Infections Surveillance (NNIS) System**

<http://www.cdc.gov/ncidod/hip/SURVEILL/NNIS.HTM>

**Norway: Antimicrobial resistance in bacteria from animals, feed, and food**

<http://www.zoonose.no/Zoonosis-centre.htm>

**Swedish Veterinary Antimicrobial Resistance Monitoring (SVARM)**

<http://www.sva.se/dokument/stdmall.html?id=341&lang=e>

**WHONET**

<http://www.who.int/emc/WHONET/WHONET.html>

**11.7 Other useful websites – Australia**

**Australian Infection Control Association (AICA)**

<http://www.aica.org.au/>

**Australian Pesticides and Veterinary Medicines Authority (APVMA)**

<http://www.apvma.gov.au/>

**Australian Prescriber**

<http://www.australianprescriber.com/>

**Australian Society for Antimicrobials**

<http://www.asainc.net.au/>

**Australian Society for Microbiology**

<http://www.theasm.com.au>

**Australian Veterinary Association**

<http://www.ava.com.au/>

**Centre for Healthcare Related Infection Surveillance and Prevention (CHRISP)**

<http://www.chrispqld.com/>

**Expert Advisory Group on Antimicrobial Resistance (EAGAR)**

<http://www.health.gov.au/nhmrc/eagar/about.htm>

**Implementing JETACAR**

<http://www.health.gov.au/pubhlth/strateg/acar/index.htm>

**National Centre for Classification in Health (NCCH)**

<http://casino.cchs.usyd.edu.au/ncch/home.htm>

**National Prescribing Service (NPS)**

<http://www.nps.org.au/>

**OIE Guidelines**

<http://www.anmv.afssa.fr/oiecc/conference/guidelines.htm>

## Post Graduate Foundation in Veterinary Science

<http://www.pgf.edu.au/>

## Quality Use of Medicines (QUM)

<http://www.health.gov.au/hbd/qum/index.htm>

## Therapeutic Goods Administration (TGA)

<http://www.health.gov.au/tga/index.htm>

## Therapeutic Guidelines – Antibiotics

<http://www.tg.com.au/home/products/ant.html>

## 11.8 Bibliography for the Strategy

Australian Infection Control Association, draft 2001. National Surveillance of Healthcare Associated Infection in Australia. A report to the Commonwealth Department of Health and Ageing. <http://www.health.gov.au/pubhlth/strateg/jetacar/reports.htm>

Commonwealth Department of Health and Aged Care, Commonwealth Department of Agriculture, Fisheries and Forestry - Australia. August 2000. Commonwealth Government Response to the Report of the JETACAR.

<http://www.health.gov.au/pubhlth/strateg/jetacar/index.htm>

Haley RW, Culver DH, White J, Morgan WE, Amber TG, Mann VP et al. 1985. The efficacy of infection surveillance and control programs in preventing nosocomial infection in US hospitals. *Am J Epidemiol* 121:182-205.

Joint Expert Advisory Committee on Antibiotic Resistance (JETACAR). The Use Of Antibiotics In Food-Producing Animals: Antibiotic-Resistant Bacteria In Animals And Humans. Commonwealth Department of Health and Aged Care, Commonwealth Department of Agriculture, Fisheries and Forestry - Australia. September 1999.

<http://www.health.gov.au/pubhlth/strateg/jetacar/index.htm>

Organisation International des Epizooties (OIE). World Wide Public Consultation on Antimicrobial Resistance. 2001. <http://www.anmv.afssa.fr/oiecc/conference/guidelines.htm> includes the OIE Ad Hoc Group on Antimicrobial Resistance Guideline No.5 *Harmonisation of national antimicrobial resistance monitoring and surveillance programmes in animals and in animal derived food.*

Shlaes DM, Gerding DN, John JF, Craig WA, Bornstein DL, Duncan RA, Eckman MR, Farrer WE, Greene WH, Lorian V, Levy S, McGowan JE, Paul SM, Ruskin J, Tenover FC and Watanakunakorn C. 1997. Society for Healthcare Epidemiology of America and Infectious Diseases Society of America Joint Committee on the Prevention of Antimicrobial Resistance: Guidelines for the Prevention of Antimicrobial Resistance in Hospitals. *Infect Control Hosp Epidemiol* 18:275-291.

Thacker SB. Surveillance. In Gregg MB, ed. Field epidemiology, Oxford University Press, Oxford UK. 1996:16-32.

World Health Organization (WHO) 2001. WHO Global Strategy for Containment of Antimicrobial Resistance. <http://www.who.int/emc/amr.html>

World Health Organization (WHO) 2001. WHO Surveillance Standards for Antimicrobial Resistance. WHO/CDS/CSR/DRS/2001.5. <http://www.who.int/emc/surveill/index.html>

Rescind