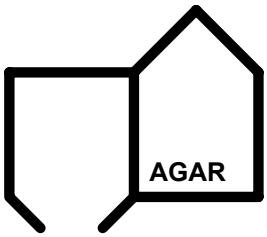

The Australian Group on Antimicrobial Resistance
http://antimicrobial-resistance.com

Staphylococcus aureus Programme 2003 (SAP 2003) Hospital/Community Survey

SAP Antimicrobial Susceptibility Report

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On behalf of the Australian Group for Antimicrobial Resistance (AGAR)

Funded by
Commonwealth of Australia
Department of Health and Ageing

SEPTEMBER 2004

Australian Group on Antimicrobial Resistance (AGAR)
Staphylococcus aureus Surveillance Programme (SAP 2003)

Isolates

Up to 100 clinically significant consecutive isolates of *Staphylococcus aureus* from different patients were collected by each institution commencing November 1 2003. Isolates were collected from inpatients and out patients who were seen at the hospitals. This is known as a "hospital/community survey". This survey is designed to provide a "snapshot" of the antibiotic profile of *Staphylococcus aureus* in patients admitted to or treated at Australian hospitals. AGAR members have participated in hospital/community surveys every year from 1989 to 1999 and again in 2001 and 2003.

Twenty three institutions participated in the SAP 2003 survey.

Australian Capital Territory (1)

The Canberra Hospital

New South Wales (5)

Concord Hospital
Nepean Hospital
Royal North Shore Hospital
South West Area Pathology Services
Westmead Hospital

Northern Territory (1)

Royal Darwin Hospital

Queensland (3)

Princess Alexandra Hospital
Royal Brisbane Hospital
Sullivan Nicolaides Pathology

South Australia (4)

Flinders Medical Centre
Gribbles Pathology
Institute of Medical Veterinary Science
Women's and Children's Hospital

Tasmania (1)

Royal Hobart Hospital

Victoria (4)

Alfred Hospital
Gribbles Pathology
Royal Children's Hospital
St Vincent's Hospital

Western Australia (4)
Fremantle Hospital
PathCentre
Royal Perth Hospital
Saint John of God Pathology

Methods

Identification

At least two of the following three tests for the identification of Staphylococcus *aureus* were used:

1. Slide coagulase test
2. Tube coagulase test
3. Demonstration of deoxyribonuclease production

Additional tests such as *nuc* gene PCR, fermentation of mannitol or growth on mannitol-salt agar may also have been performed for confirmation.

Antimicrobial Susceptibility Testing

Agar dilution methodology was used as described in 'Methods for Dilution Antimicrobial Susceptibility Tests for Bacteria that Grow Aerobically - Fifth Edition', Approved Standard, National Committee for Clinical Laboratory Standards, Wayne, PA (NCCLS Document M7-A5, VOL 20 No.2, January, 2000). Refer to Attachment 1.

The break points that were selected to determine resistance are described in 'Performance Standards for Antimicrobial Susceptibility Testing; Supplemental Tables, (NCCLS Document M100-S13 (M7), January 2003), Table 2C, MIC Interpretive Standards (µg/ml) for *Staphylococcus* spp.

The following antimicrobial concentrations were employed:

Antimicrobials and concentrations:

Antimicrobial	Concentrations (mg/L)
Penicillin	0.125
Cefoxitin	0.25
Oxacillin	2
Vancomycin	2
Vancomycin – Brain Heart Infusion Agar	6
Rifampicin	1
Fusidic acid	1
Gentamicin	4
Chloramphenicol	8
Erythromycin	0.5
Clindamycin	0.5
Tetracycline	4
Trimethoprim	8
Ciprofloxacin	1
Mupirocin	1
Quinupristin/dalfopristin (Synercid®)	1
Teicoplanin	2
Linezolid	4

Isolates that failed to grow on the penicillin plate were tested for the production of ß-lactamase by using the nitrocefin method.

Data Analysis

Data from each institution is entered on a standard excel worksheet. Data is analysed using Microsoft Office Access 2003.

Results

2,184 *Staphylococcus aureus* were tested by 23 institutions in the SAP 2003. Each state and territory of Australia was represented. Table 1 shows the number and proportion of isolates tested in each jurisdiction.

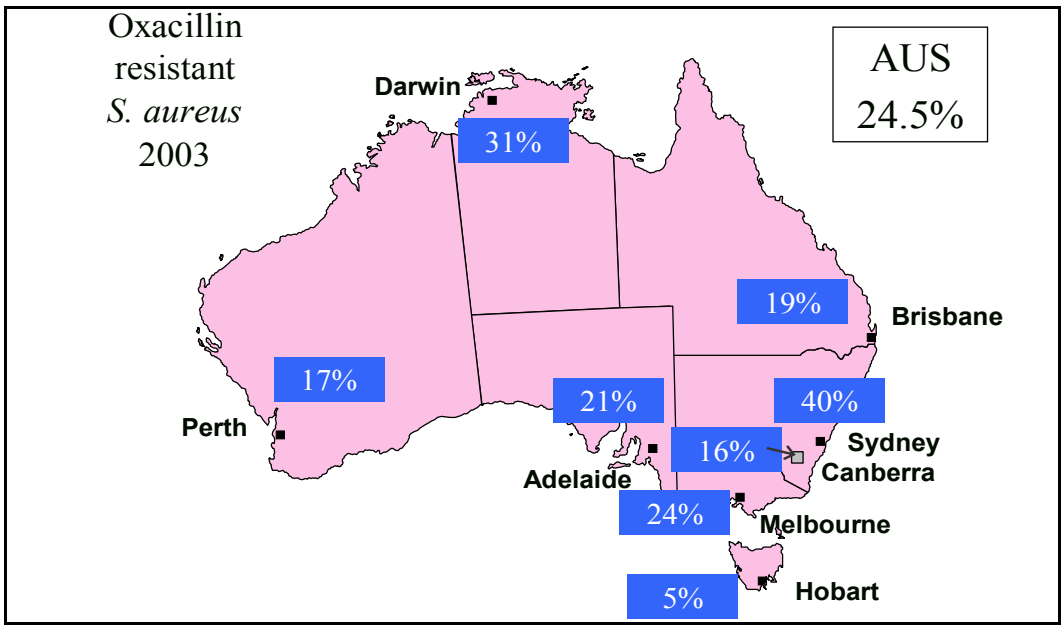
TABLE 1: *Staphylococcus aureus* isolates tested in the SAP 2003.

STATE / TERRITORY	NUMBER (%)
Australian Capital Territory	100 (4.6)
New South Wales	499 (22.8)
Northern Territory	100 (4.6)
Queensland	300 (13.7)
South Australia	326 (14.9)
Tasmania	99 (4.5)
Victoria	399 (18.3)
Western Australia	361 (16.5)
Total	2184

ANTIMICROBIAL RESISTANCE IN *Staphylococcus aureus*

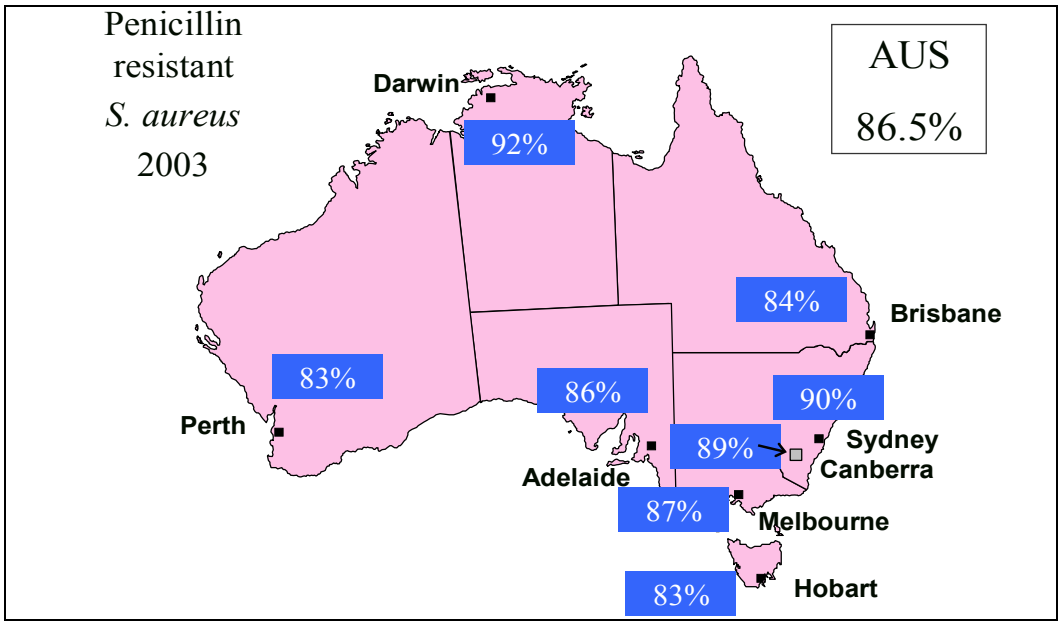
Oxacillin

Australia-wide 24.5% (n= 536) of *Staphylococcus aureus* were oxacillin resistant, ranging from 5.1% in Hobart to 40.5% in Sydney.



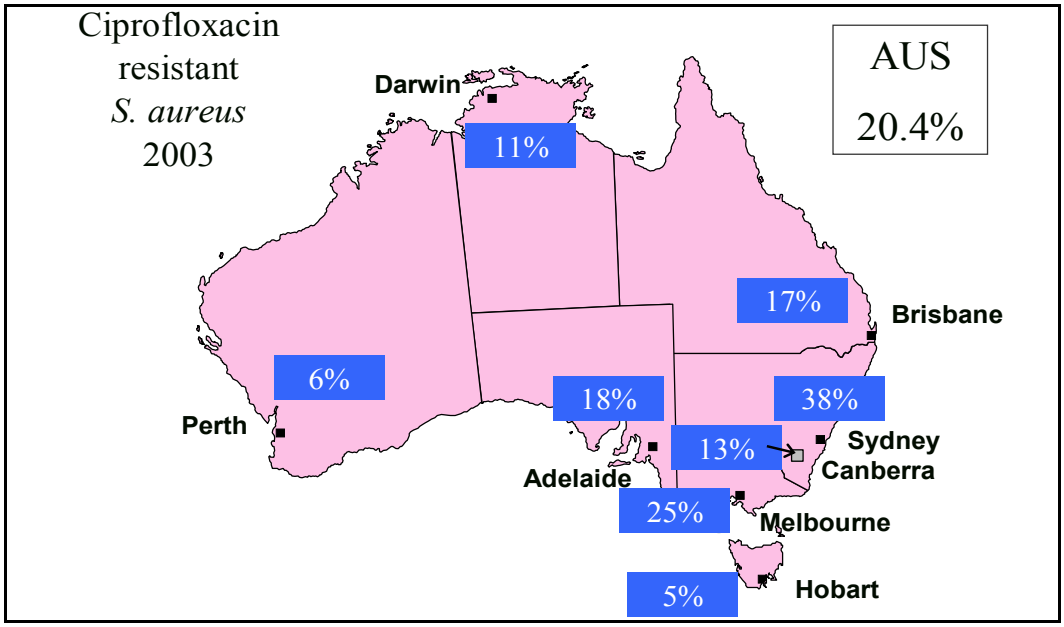
Penicillin

Australia-wide 86.5% (n= 1889) of *Staphylococcus aureus* were penicillin resistant ranging from 82.8% in Perth and Hobart to 92.0% in Darwin.



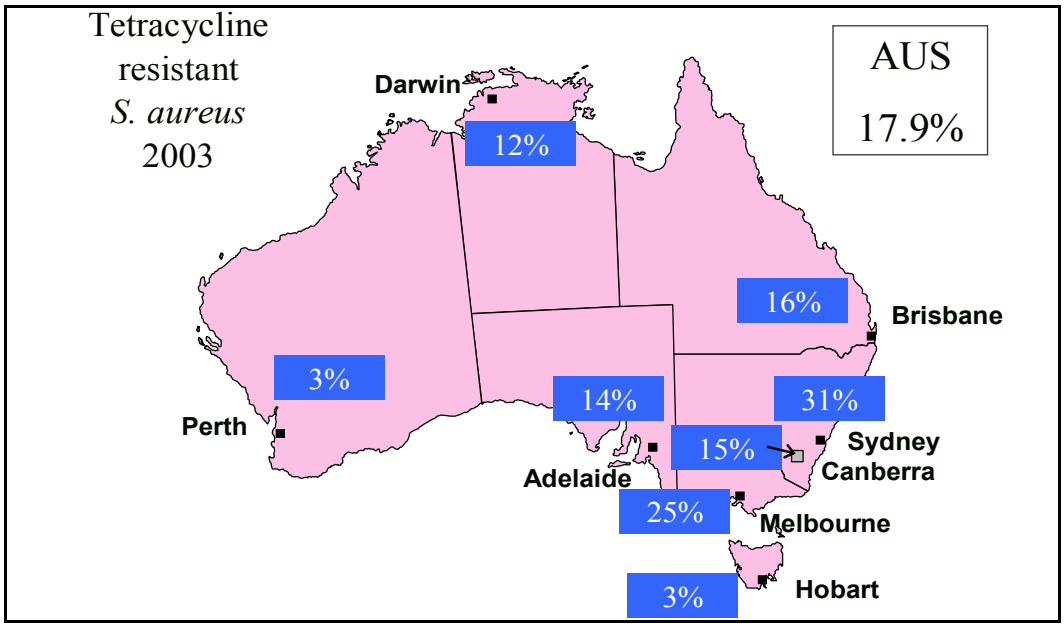
Ciprofloxacin

Australia-wide 20.4% (n = 445) of *Staphylococcus aureus* were ciprofloxacin resistant, ranging from 5.1% in Hobart to 37.7% in Sydney.



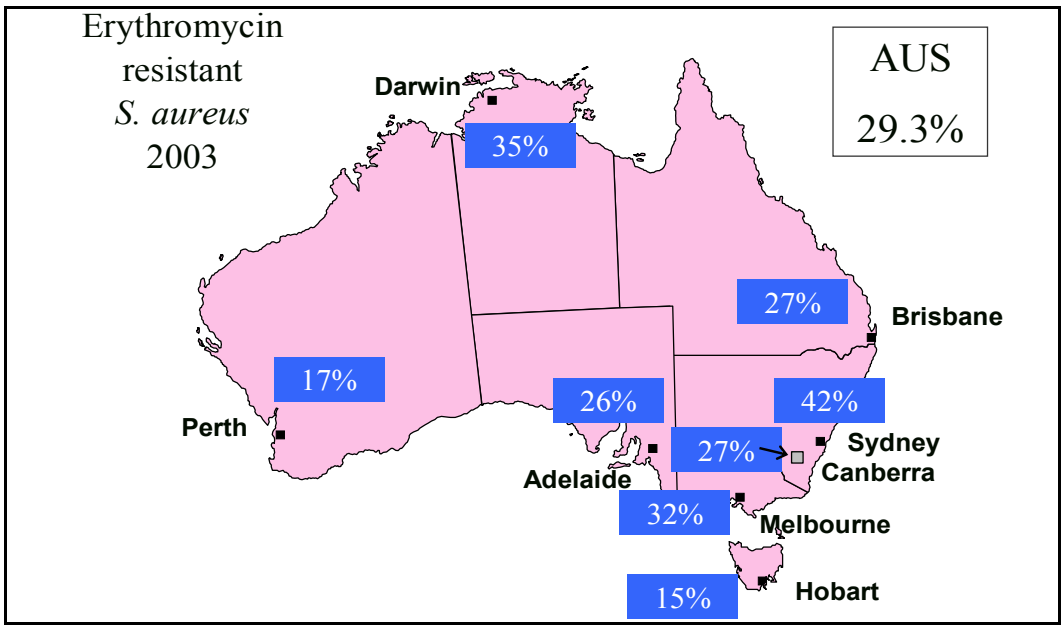
Tetracycline

Australia-wide 17.9% (n = 390) of *Staphylococcus aureus* were tetracycline resistant, ranging from 2.8% in Perth to 31.1% in Sydney.



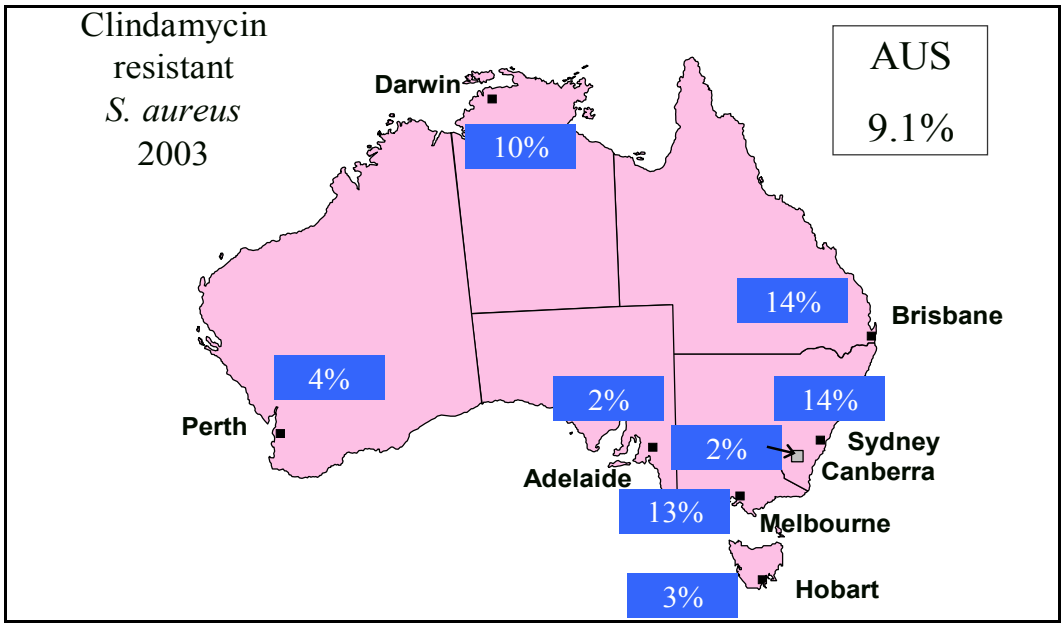
Erythromycin

Australia-wide 29.3% (n = 639) of *Staphylococcus aureus* were erythromycin resistant, ranging from 15.2% in Hobart to 41.9% in Sydney.



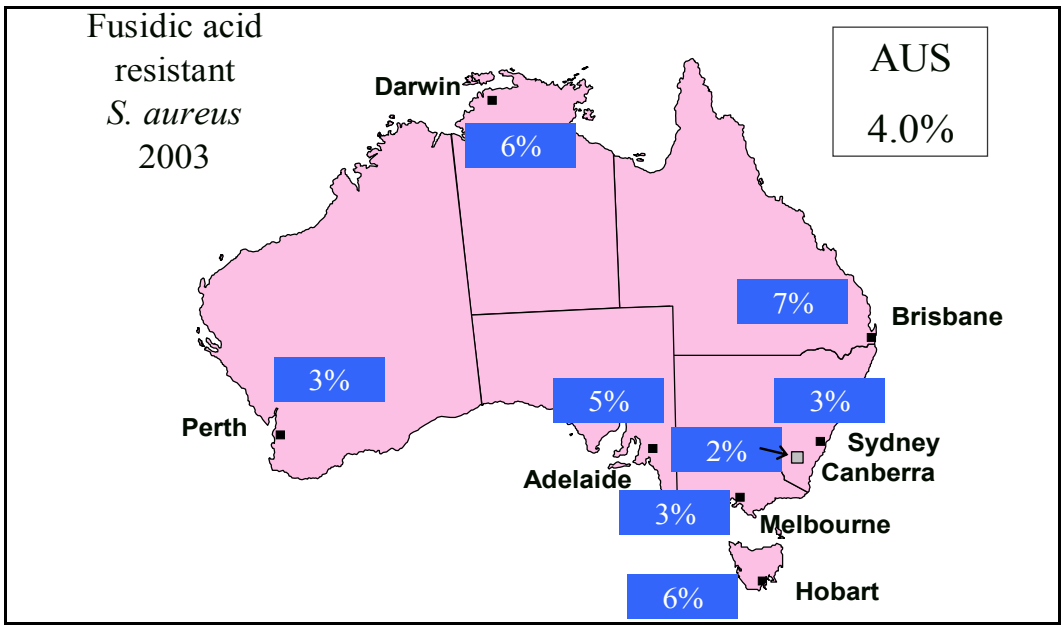
Clindamycin

Australia-wide 9.1% (n = 198) of *Staphylococcus aureus* were clindamycin resistant ranging from 2.0% in Canberra to 14.0% in Brisbane.



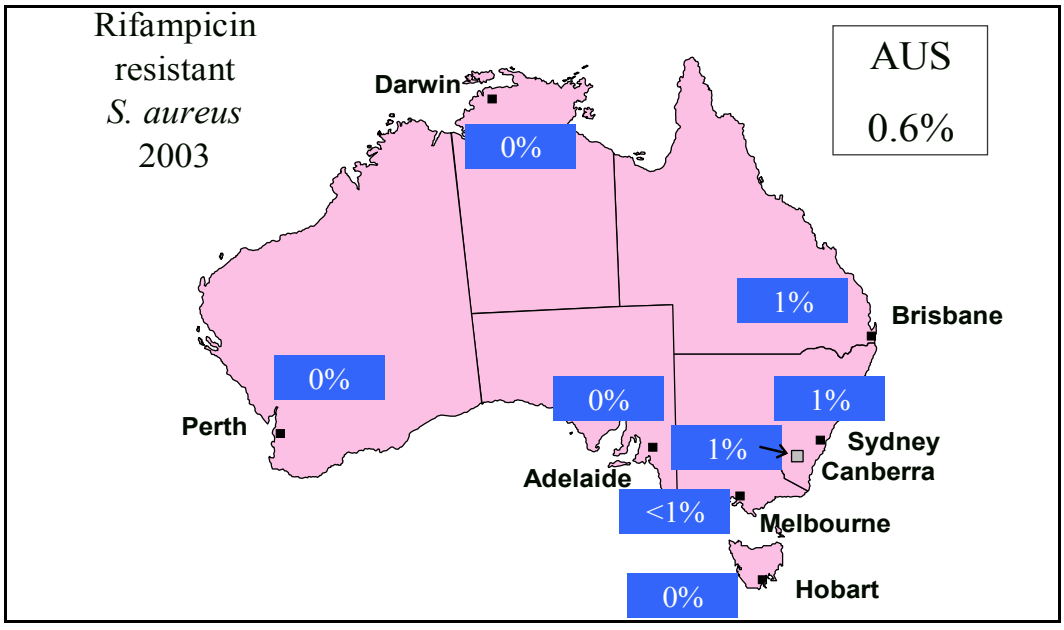
Fusidic acid

Australia-wide 4.0% (n = 88) of *Staphylococcus aureus* were fusidic acid resistant, ranging from 2.0% in Canberra to 7.0% in Brisbane.



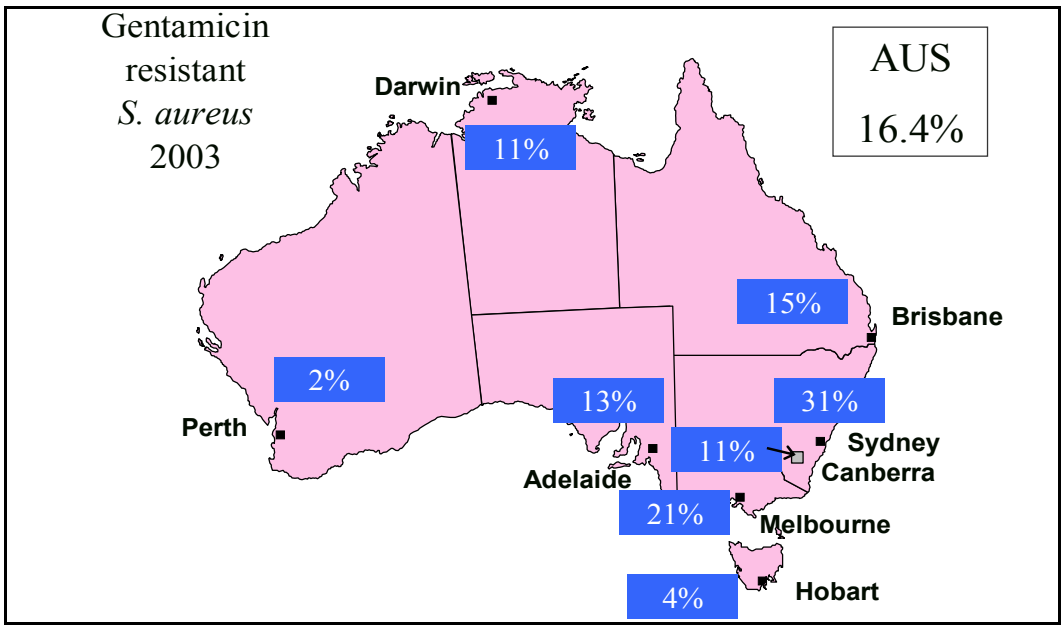
Rifampicin

Australia-wide 0.6% (n = 13) of *Staphylococcus aureus* were rifampicin resistant, ranging from 0% in Perth, Darwin, Adelaide and Hobart to 1.3% in Brisbane.



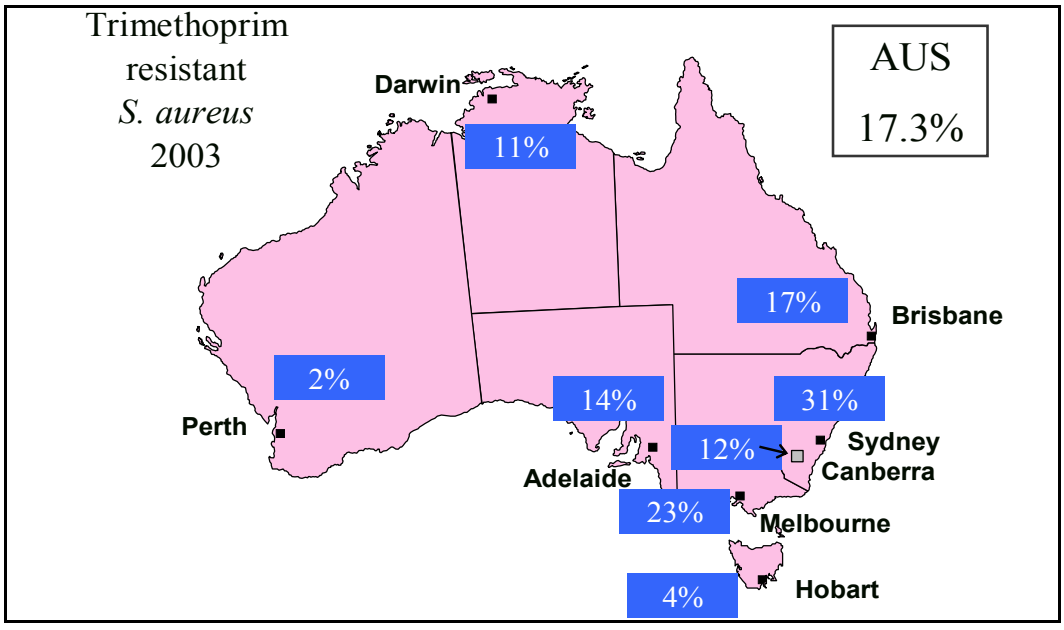
Gentamicin

Australia-wide 16.4% (n = 358) of *Staphylococcus aureus* were gentamicin resistant, ranging from 1.9% in Perth to 31.1% in Sydney.



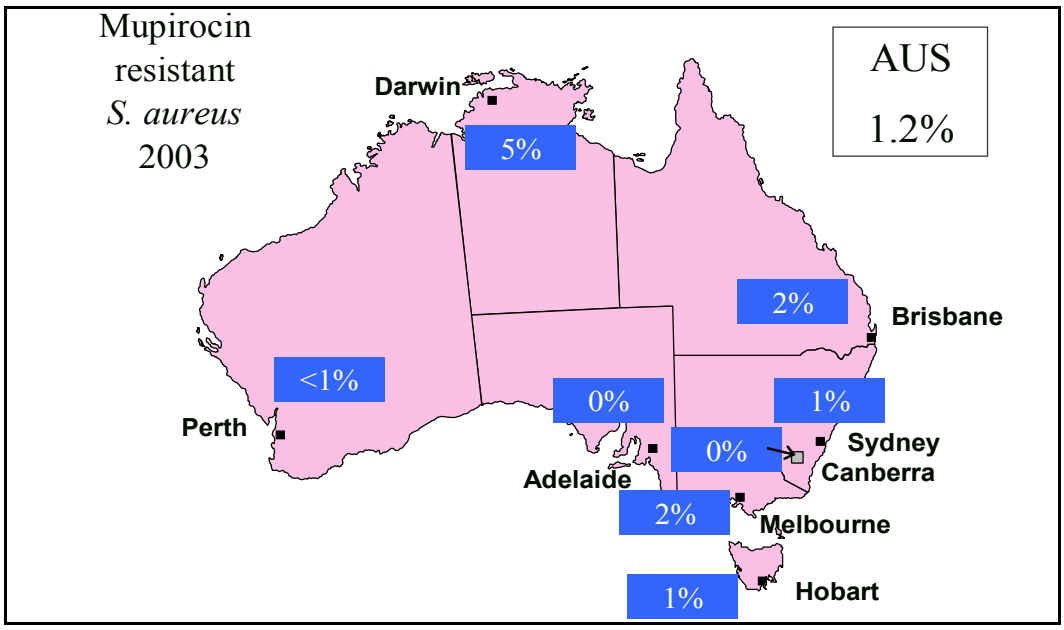
Trimethoprim

Australia-wide 17.3% (n = 378) of *Staphylococcus aureus* were trimethoprim resistant, ranging from 2.2% in Perth to 30.7% in Sydney.



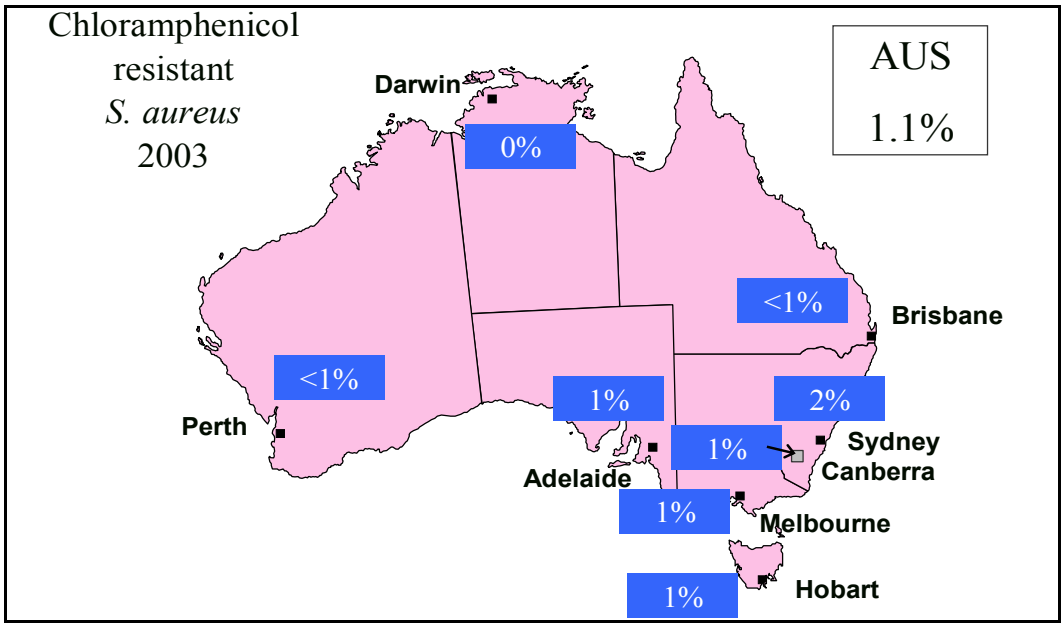
Mupirocin

Australia-wide 1.2% (n = 27) of *Staphylococcus aureus* were mupirocin resistant, ranging from 0% in Canberra and Adelaide to 5.0% in Darwin.



Chloramphenicol

Australia-wide 1.1% (n = 24) of *Staphylococcus aureus* were chloramphenicol resistant ranging from 0% in Darwin to 2.0% in Sydney.



Vancomycin and Teicoplanin

Vancomycin 2mg/L and teicoplanin 2mg/L were included in the SAP testing for screening of *S. aureus* with increased glycopeptide MICs (eg hetero VISA and VISA). In 2003 no *S. aureus* isolates grew on the vancomycin plate. Thus there were no vancomycin resistant strains identified. Five isolates (three MRSA and two MSSA) grew on the teicoplanin plate. The highest teicoplanin MIC recorded was 4mg/L. Thus there were no teicoplanin resistant strains identified.

Quinupristin / dalfopristin (Synercid®)

All isolates were sensitive to quinupristin / dalfopristin.

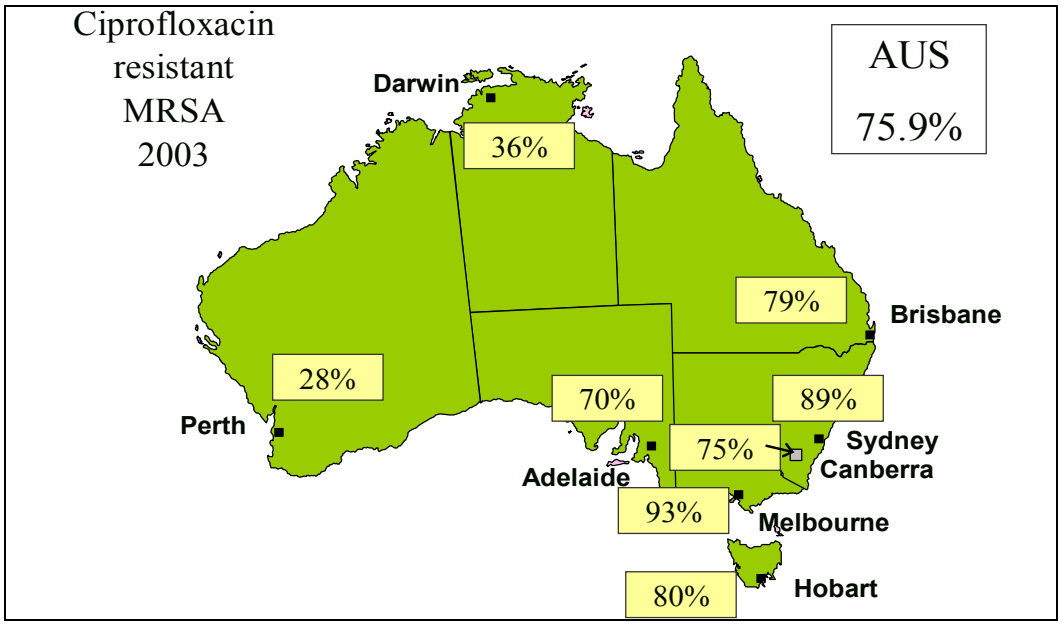
Linezolid

All isolates were sensitive to linezolid.

ANTIMICROBIAL RESISTANCE IN METHILLIN-RESISTANT *Staphylococcus aureus* (MRSA)

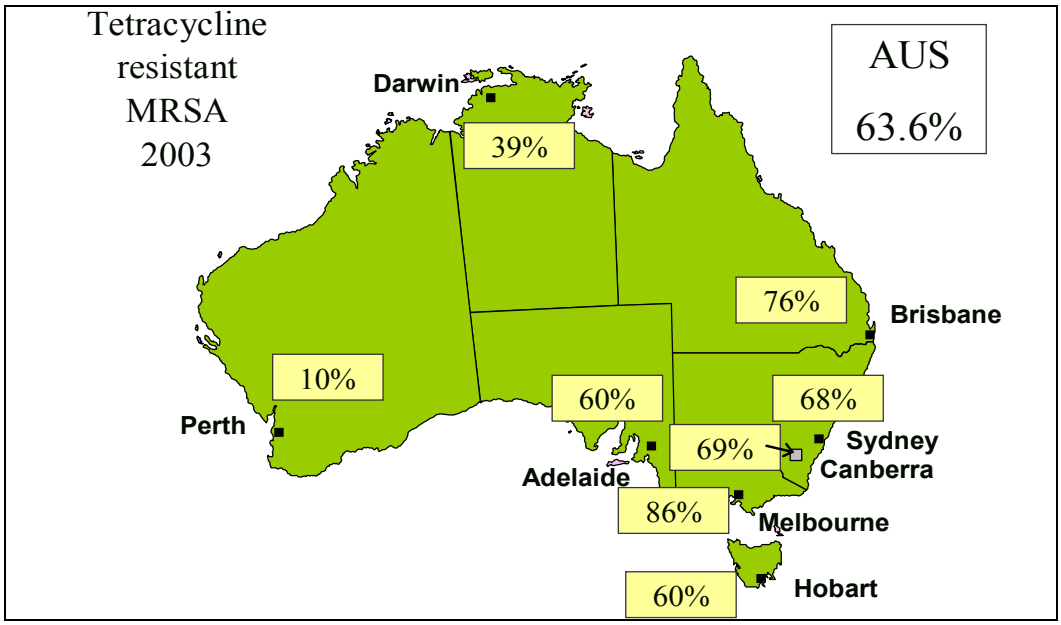
Ciprofloxacin

Australia-wide 75.9% (n = 401) of MRSA were ciprofloxacin resistant, ranging from 27.9% in Perth to 92.7% in Melbourne.



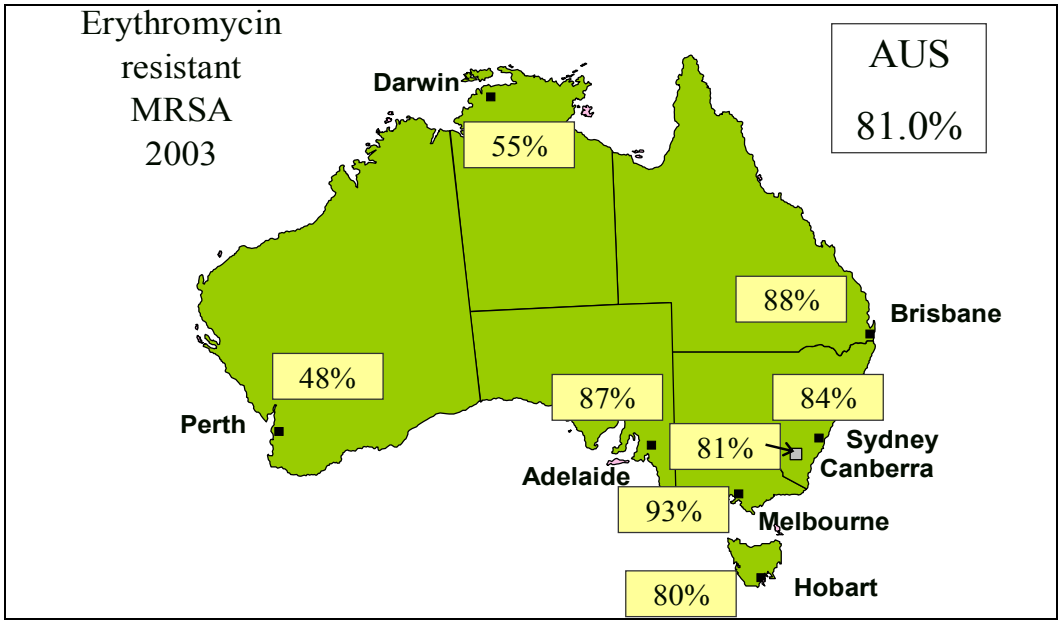
Tetracycline

Australia-wide 63.6% (n = 341) of MRSA were tetracycline resistant, ranging from 9.8% in Perth to 85.6% in Melbourne.



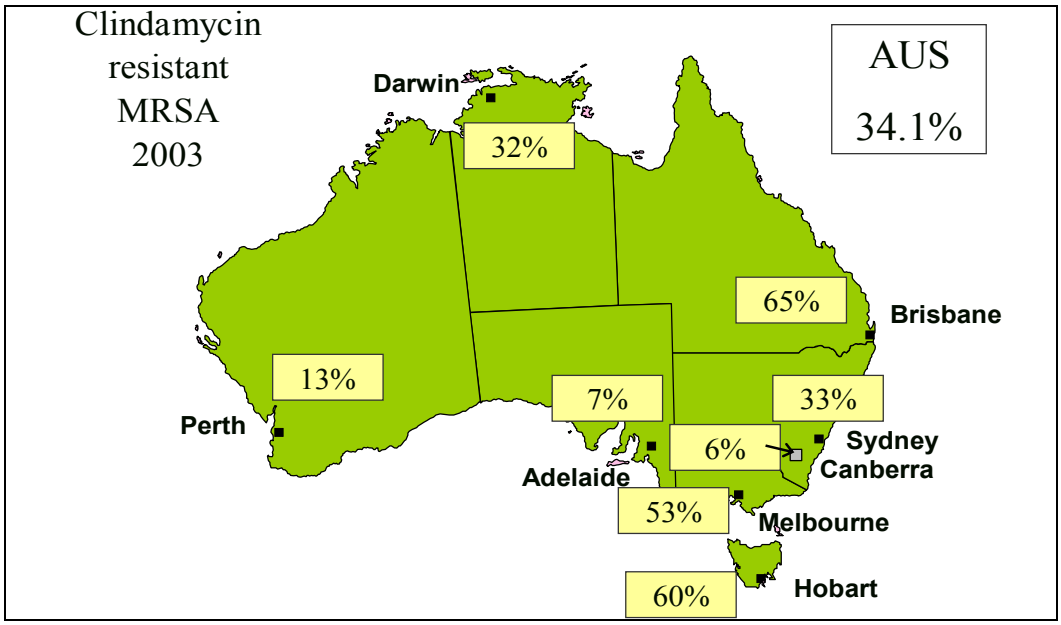
Erythromycin

Australia-wide 81.0% (n = 434) of MRSA were erythromycin resistant, ranging from 47.5% in Perth to 92.7% in Melbourne.



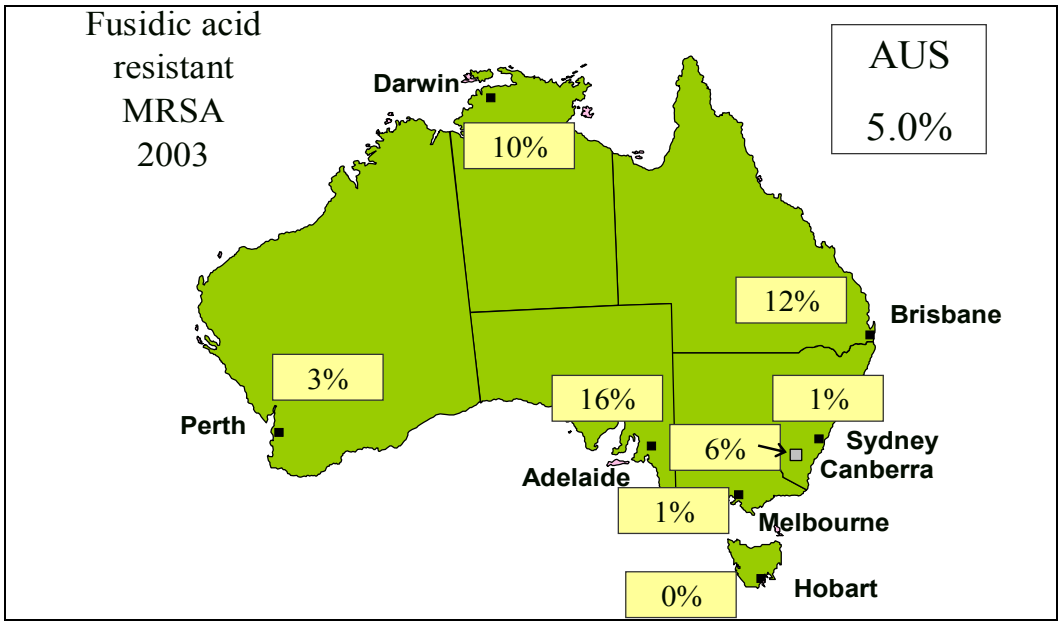
Clindamycin

Australia-wide 34.1% (n = 183) of MRSA were clindamycin resistant, ranging from 6.3% in Canberra to 65.5% in Brisbane.



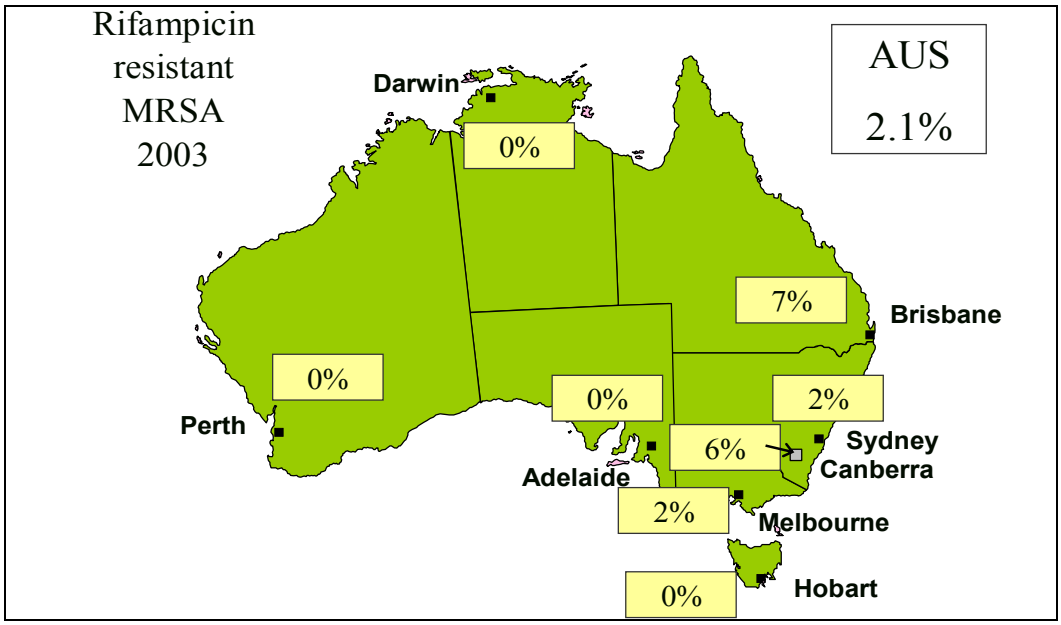
Fusidic acid

Australia-wide 5.0% (n = 27) of MRSA were fusidic acid resistant, ranging from 0% in Hobart to 16.4% in Adelaide.



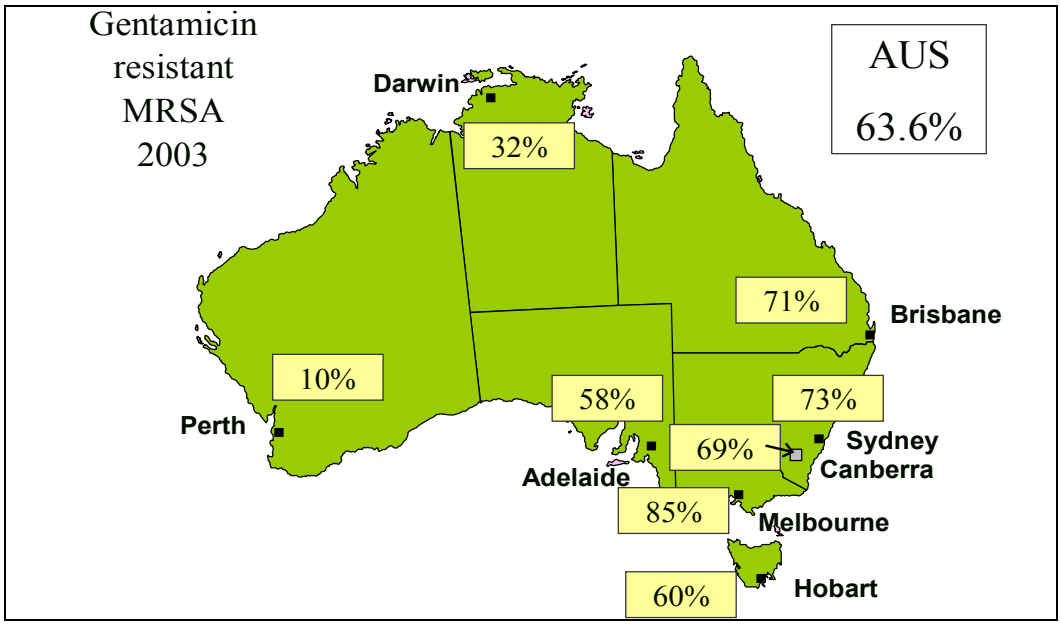
Rifampicin

Australia-wide 2.1% (n = 11) of MRSA were rifampicin resistant, ranging from 0% in Hobart, Adelaide, Perth and Darwin to 6.9% in Brisbane.



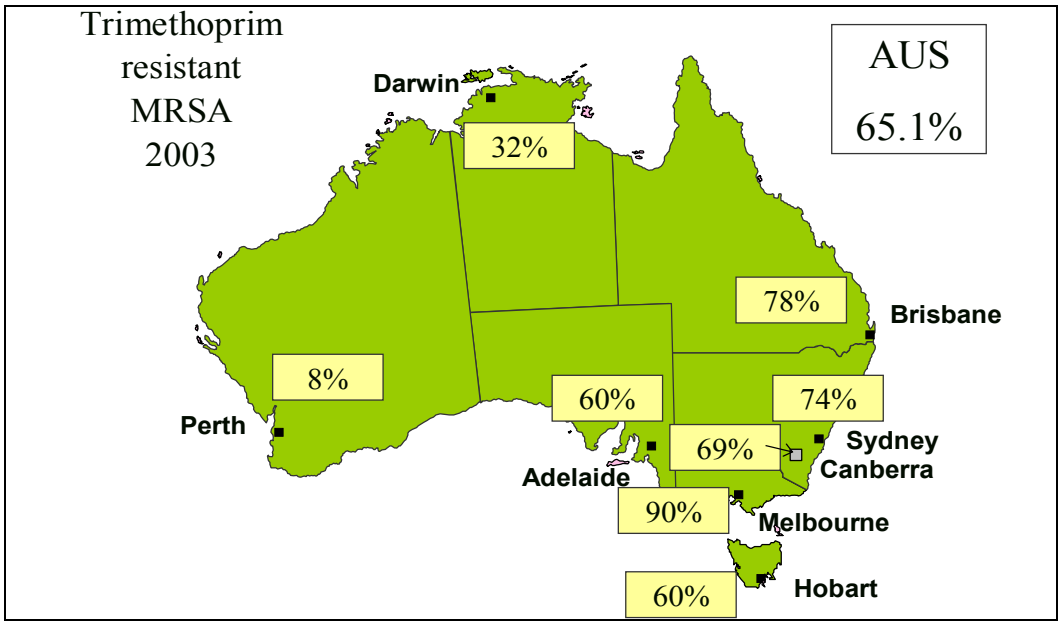
Gentamicin

Australia-wide 63.6% (n = 341) of MRSA were gentamicin resistant, ranging from 9.8% in Perth to 85.4% in Melbourne.



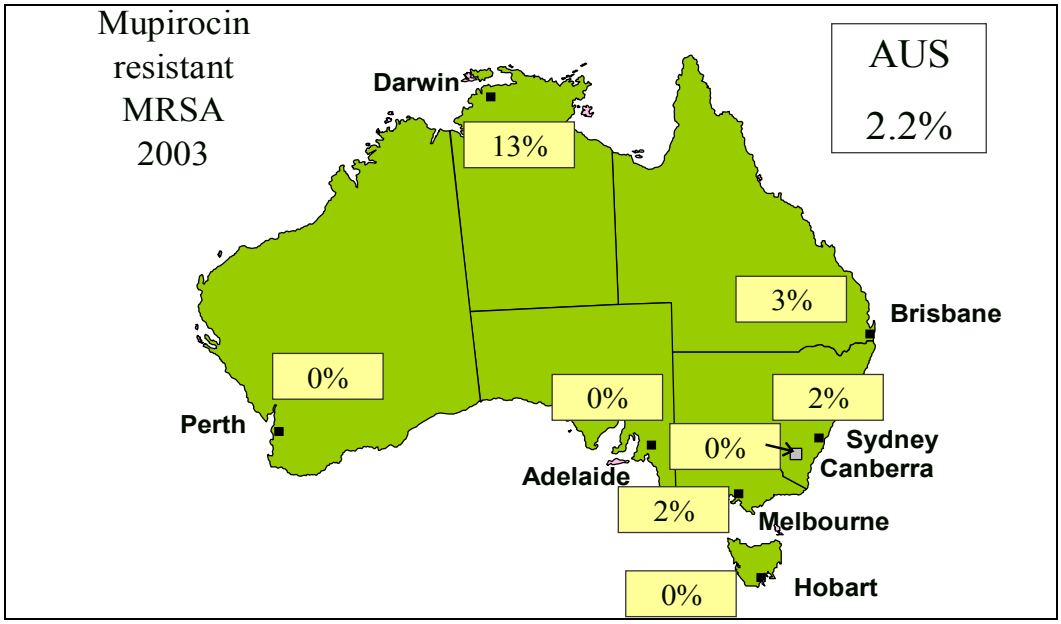
Trimethoprim

Australia-wide 65.1% (n = 349) of MRSA were trimethoprim resistant, ranging from 8.2% in Perth to 89.6% in Melbourne.



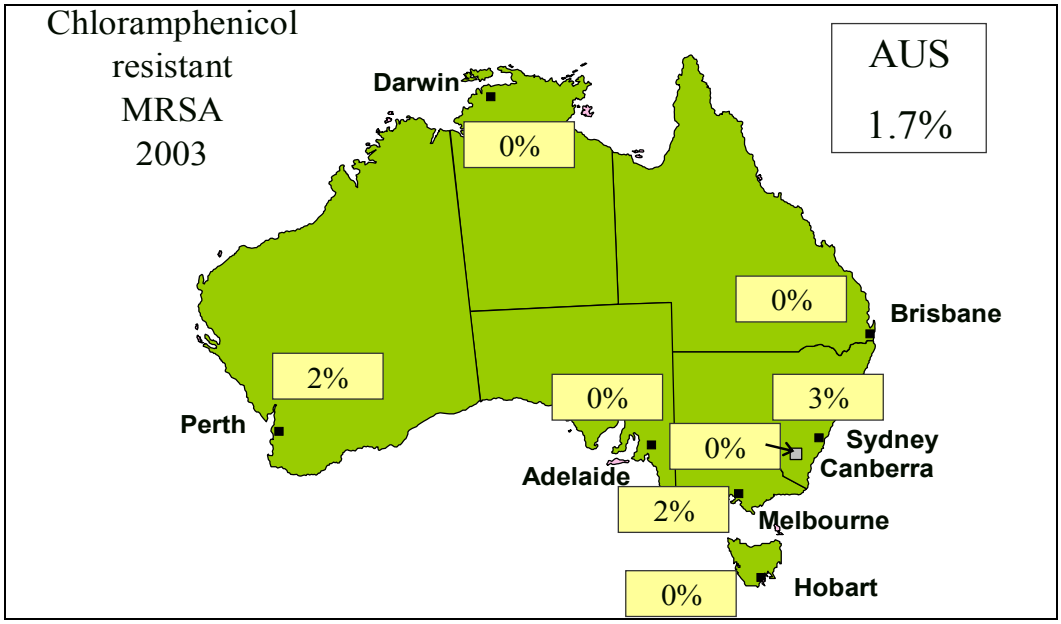
Mupirocin

Australia-wide 2.2% (n = 12) of MRSA were mupirocin resistant, ranging from 0% in Canberra, Hobart, Adelaide and Perth to 12.9% in Darwin.



Chloramphenicol

Australia-wide 1.7% (n = 9) of MRSA were chloramphenicol resistant, ranging from 0% in Brisbane, Canberra, Hobart, Adelaide and Darwin to 3.0% in Sydney.



Vancomycin and Teicoplanin

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Quinupristin / dalfopristin (Synercid®)

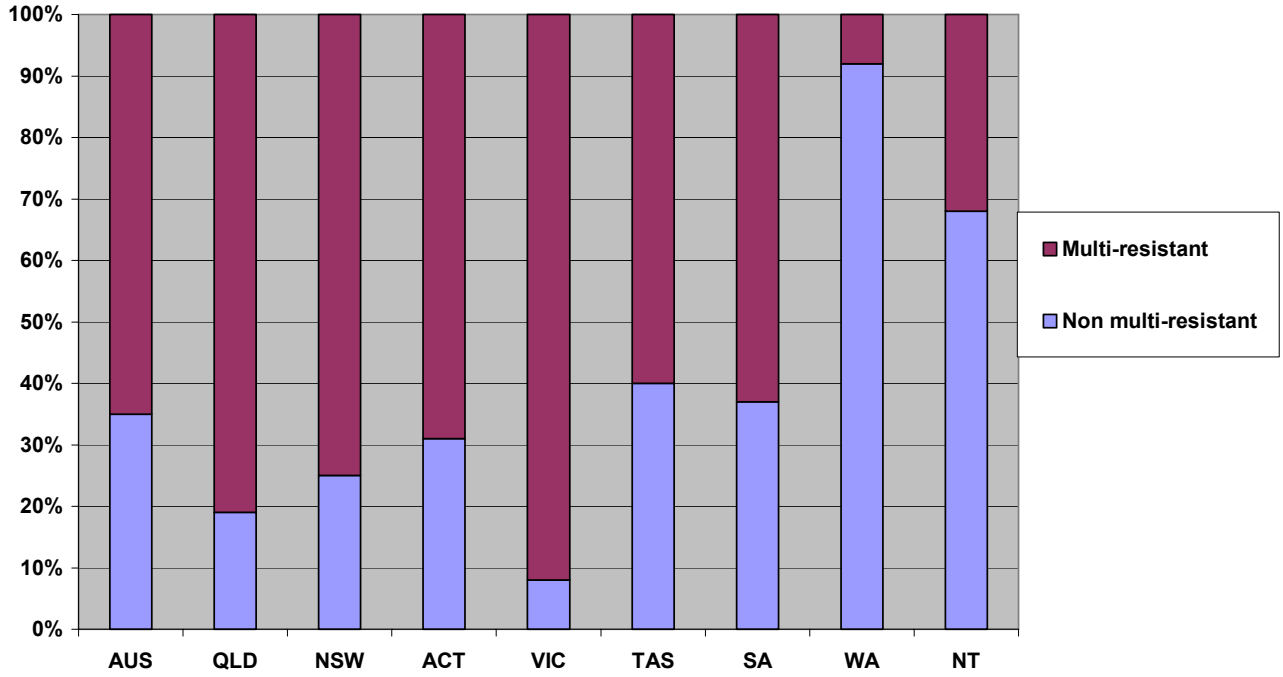
All isolates were sensitive to quinupristin / dalfopristin.

Linezolid

All isolates were sensitive to linezolid.

MULTIRESISTANT VS NON-MULTIRESISTANT MRSA BY STATE

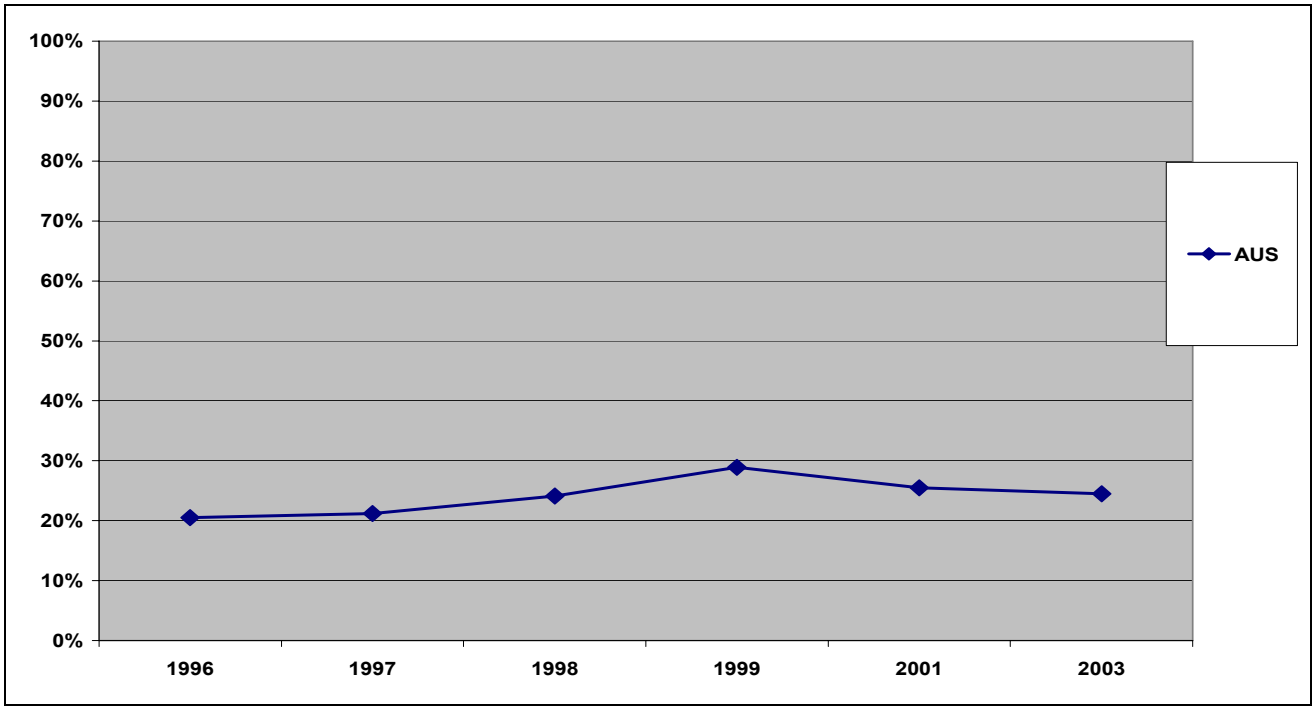
Strains resistant to >2 non-betalactam antibiotics are defined as multiresistant MRSA and strains resistant to <3 non-betalactam antibiotics are defined as non-multiresistant MRSA.

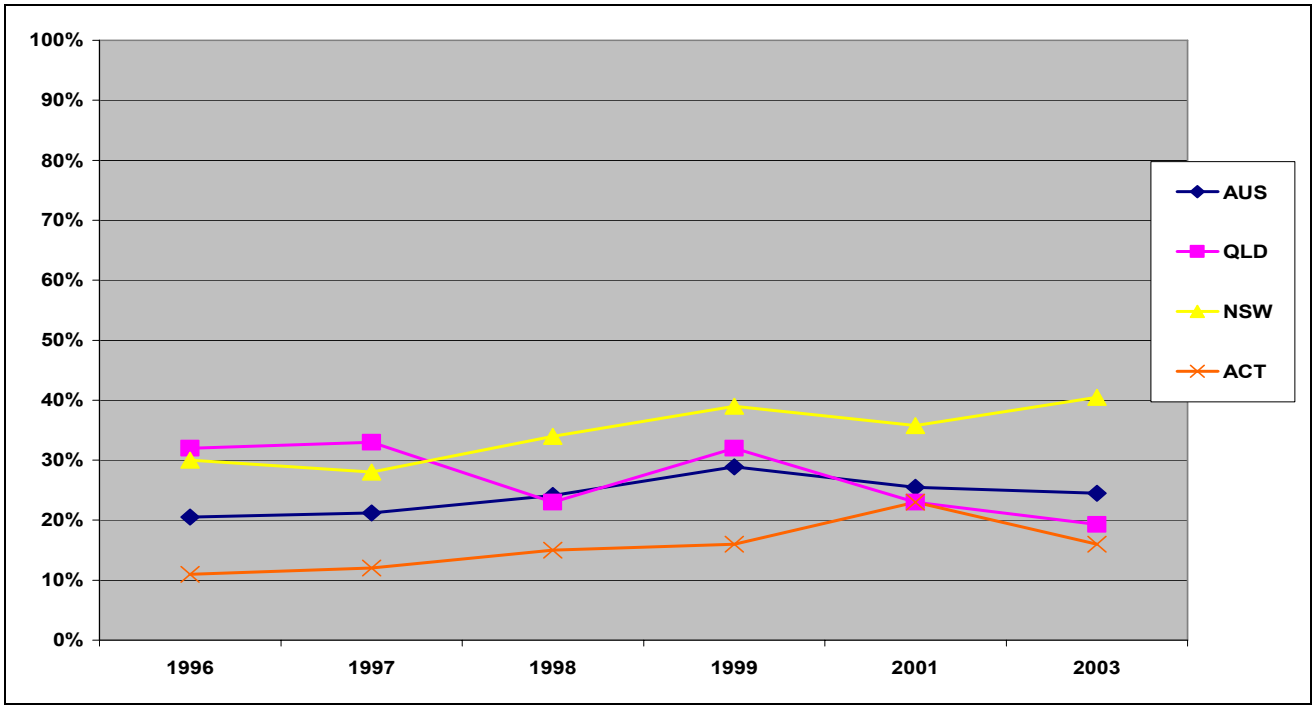


HOSPITAL/COMMUNITY SURVEYS 1996 – 2003: TREND DATA BY STATE

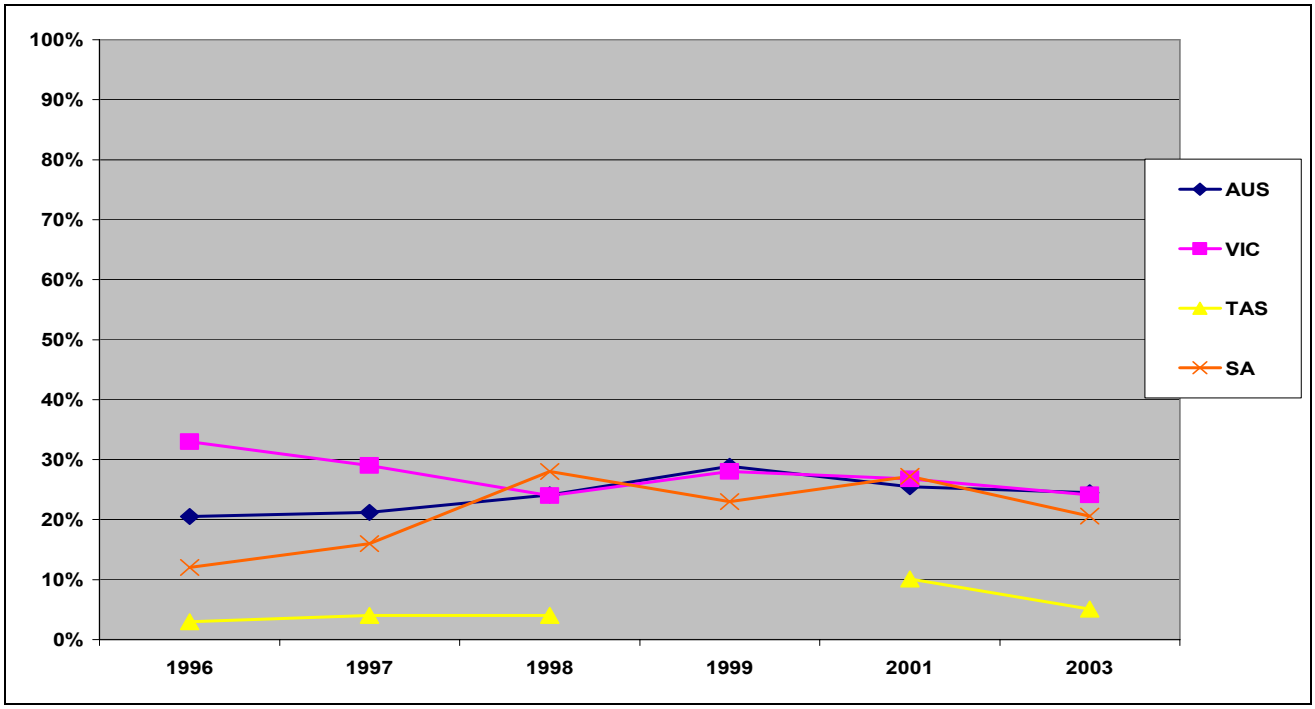
ANTIMICROBIAL RESISTANCE IN *Staphylococcus aureus*

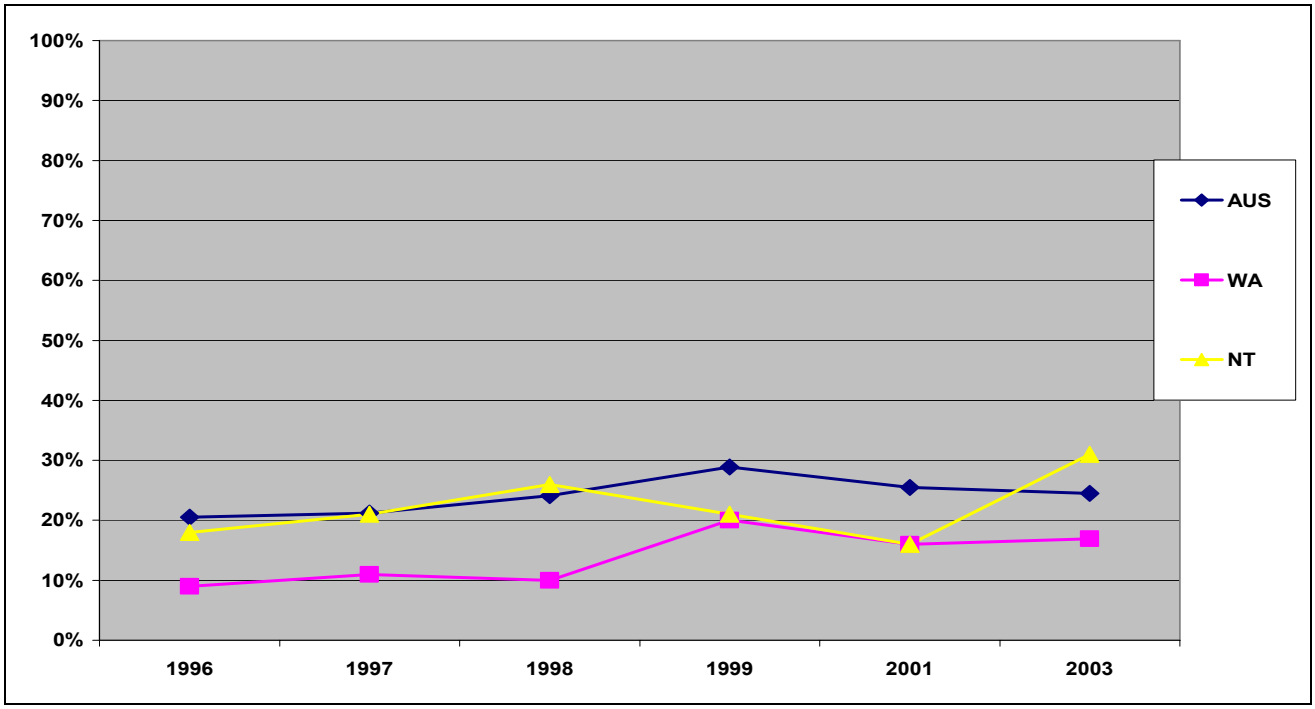
Oxacillin



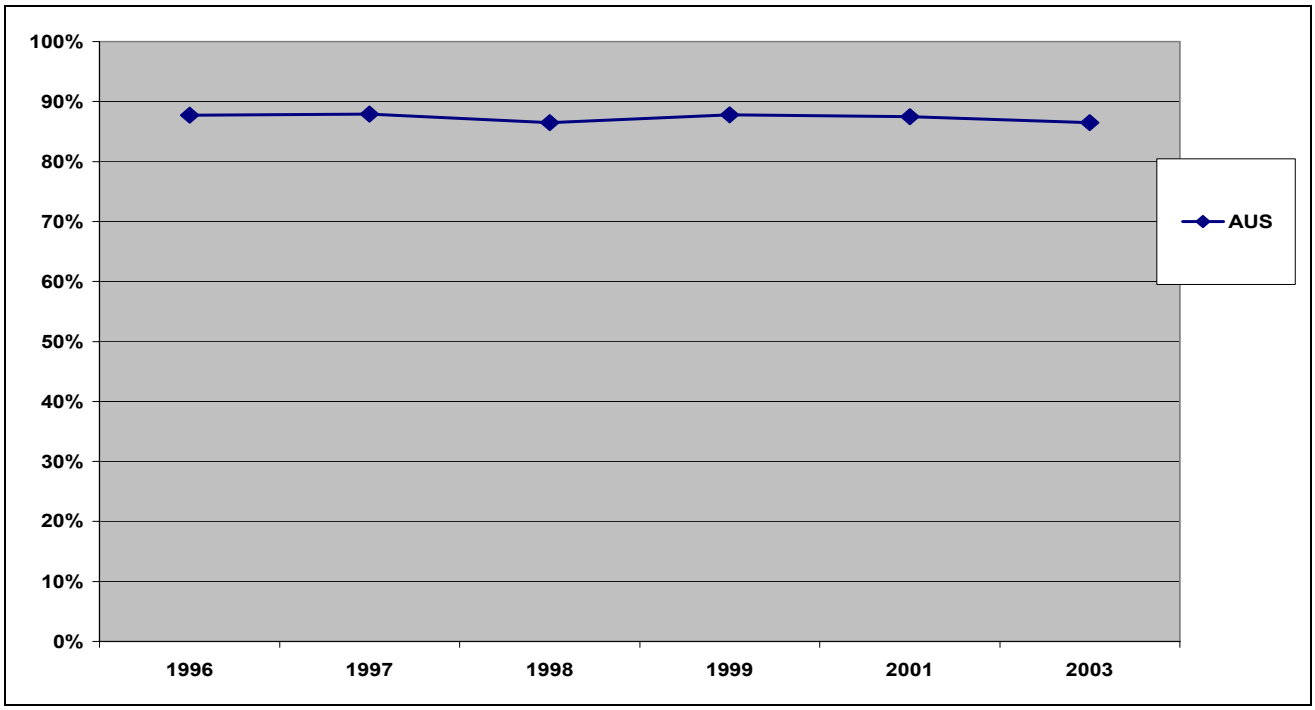


Oxacillin continued





Penicillin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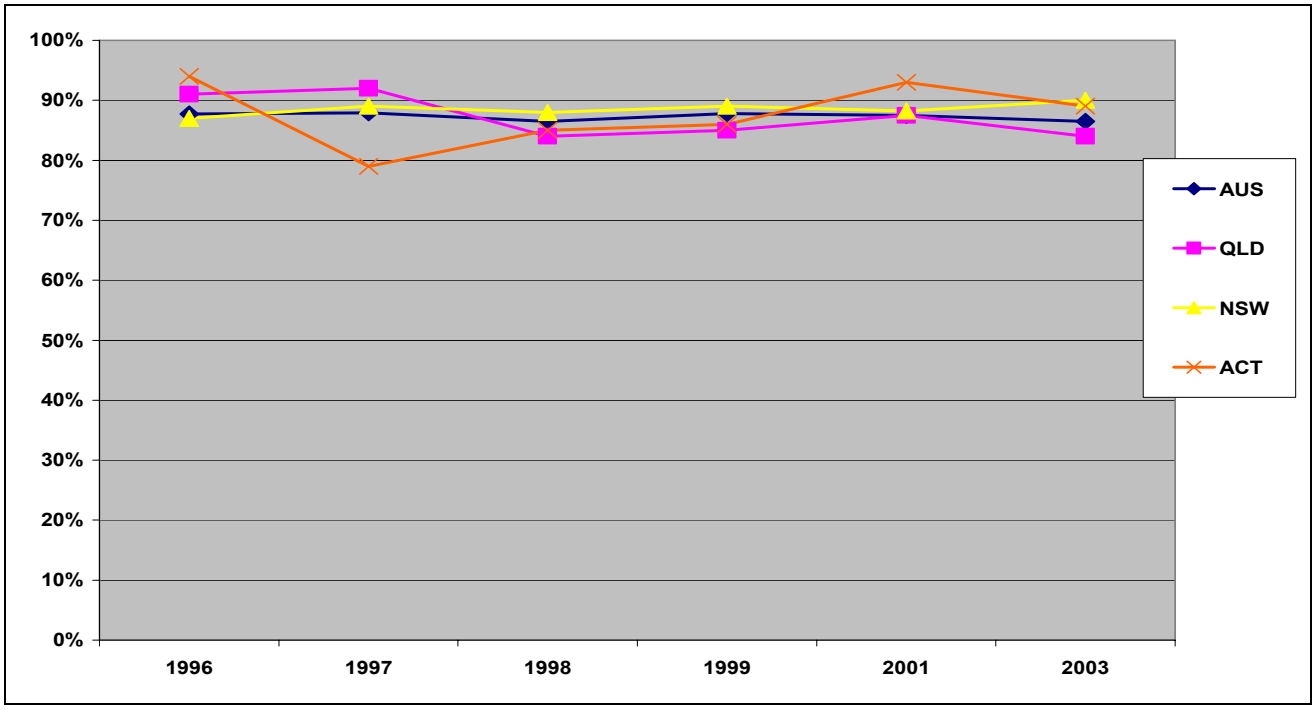
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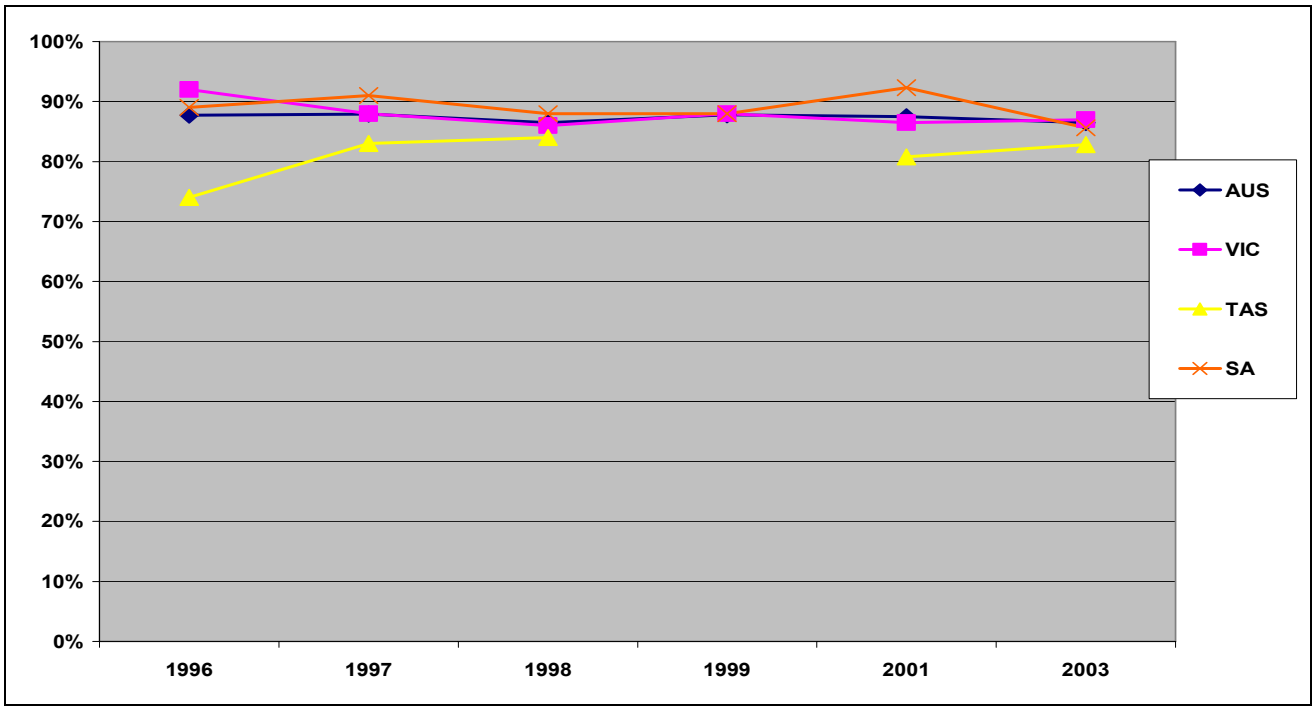
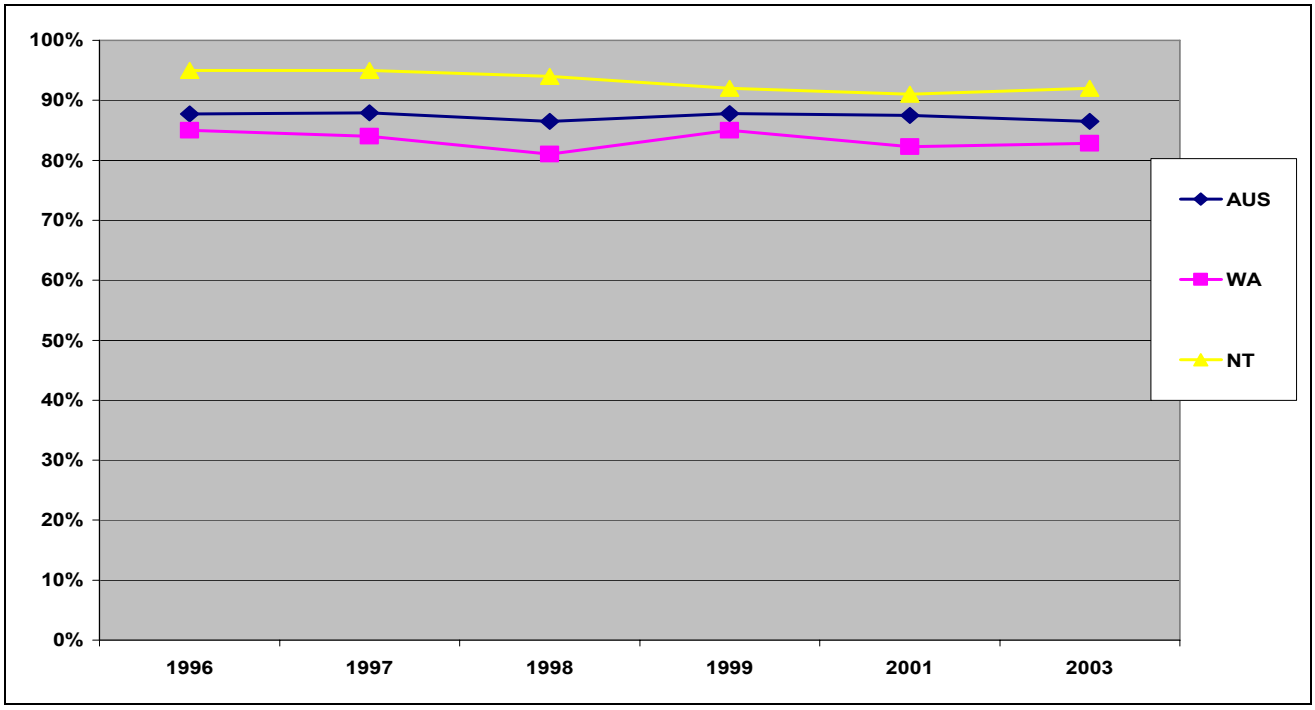
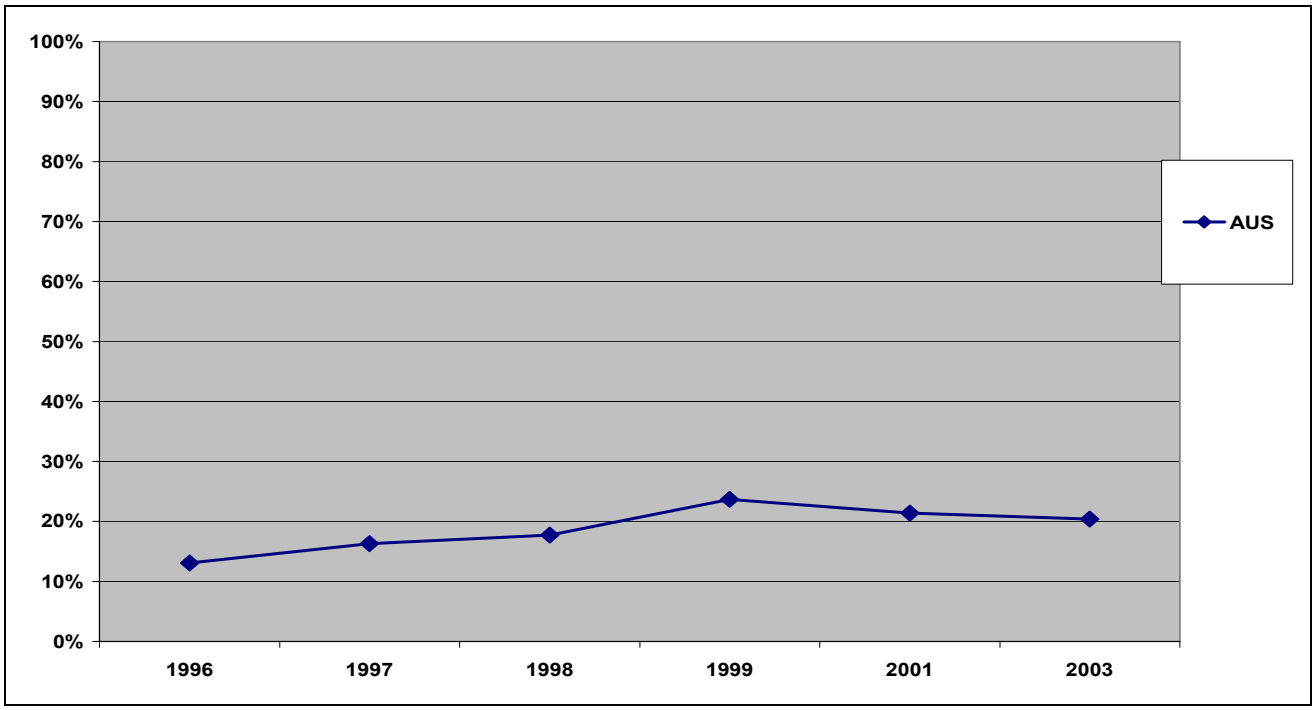
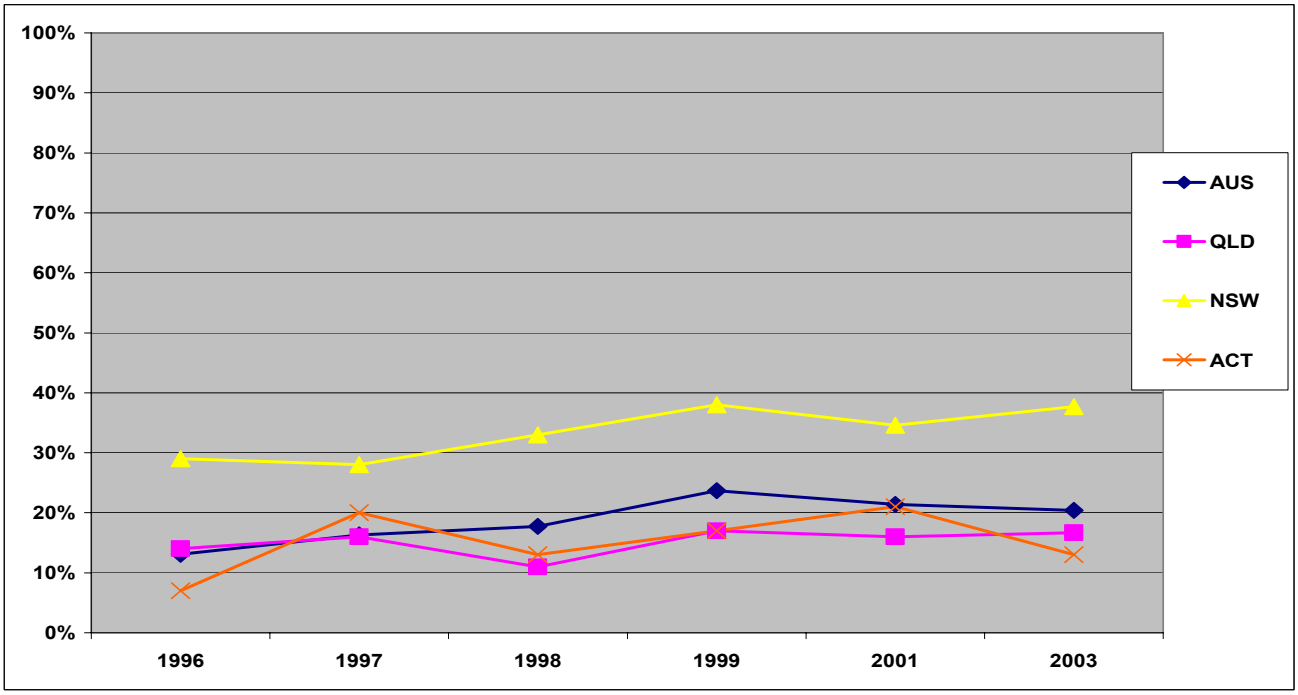
Penicillin continued



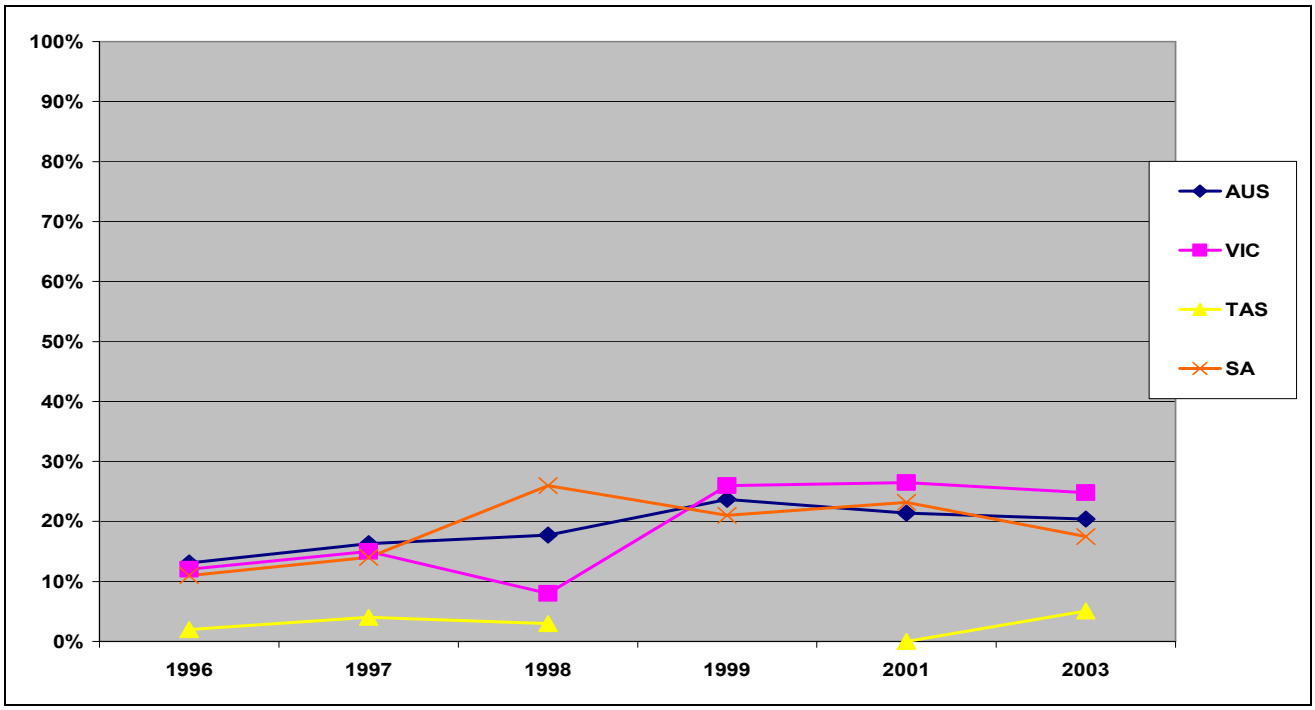


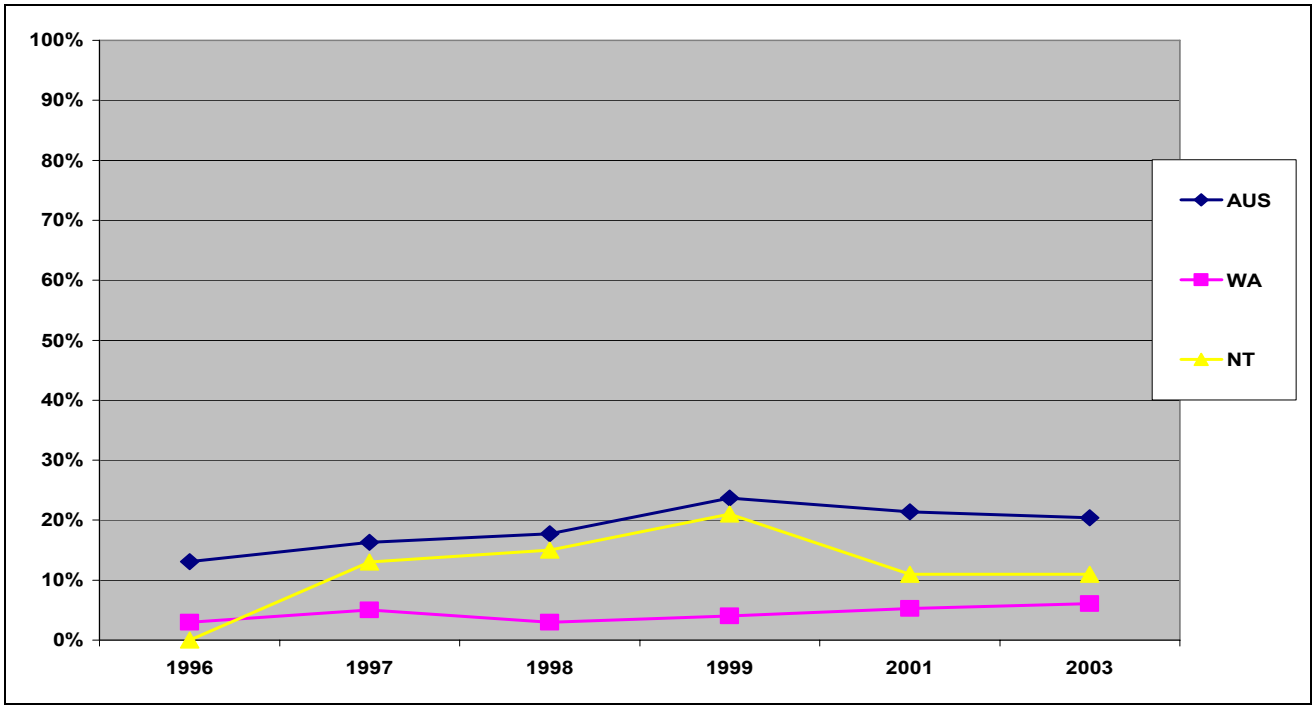
Ciprofloxacin



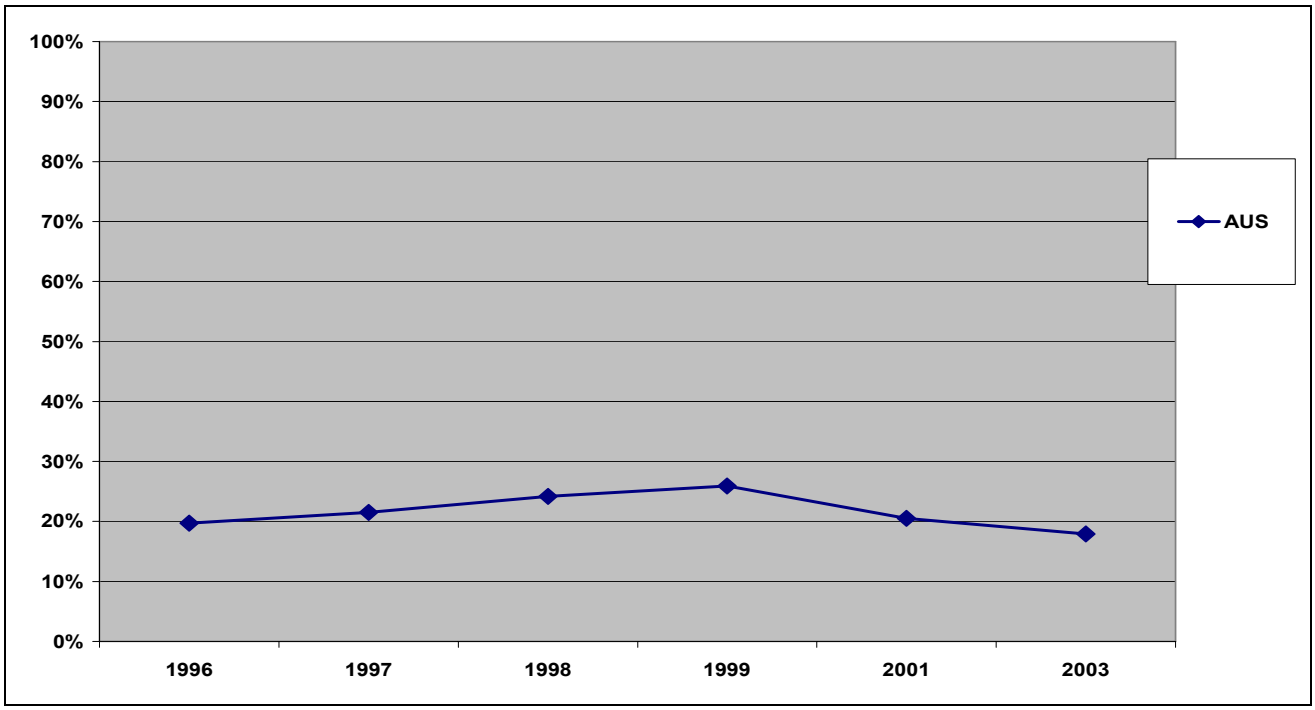


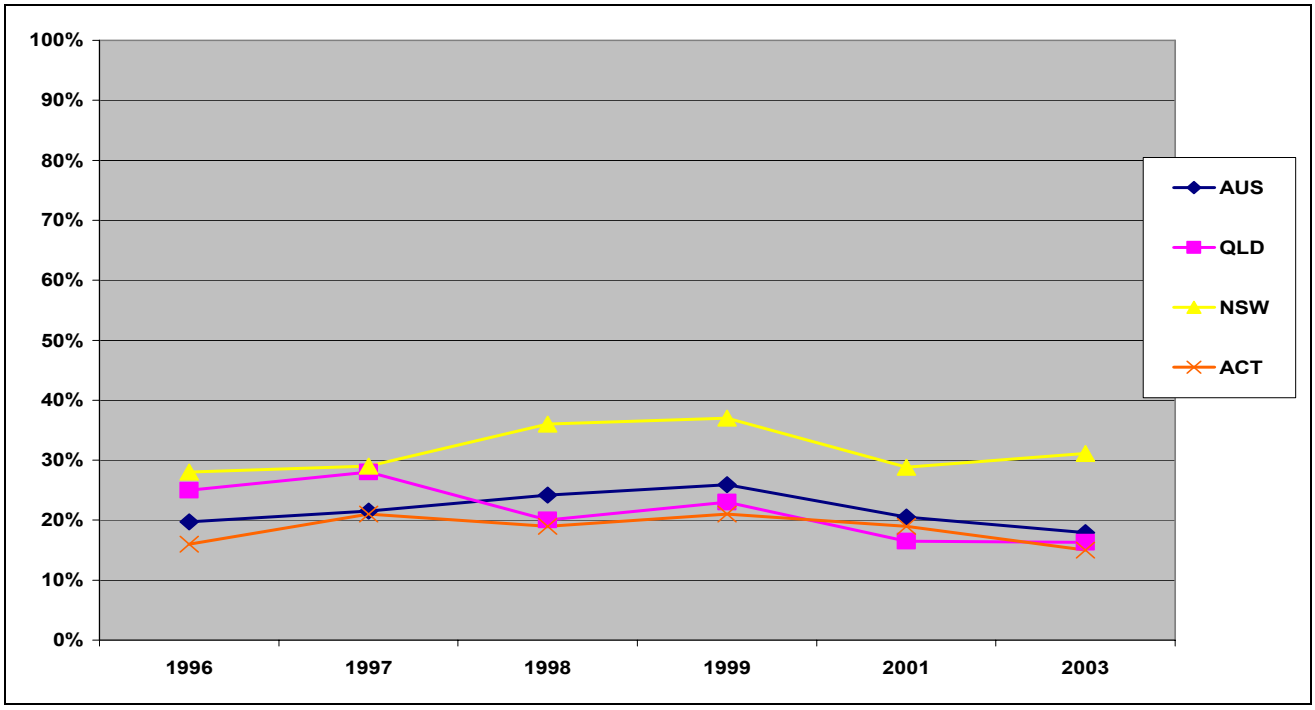
Ciprofloxacin continued



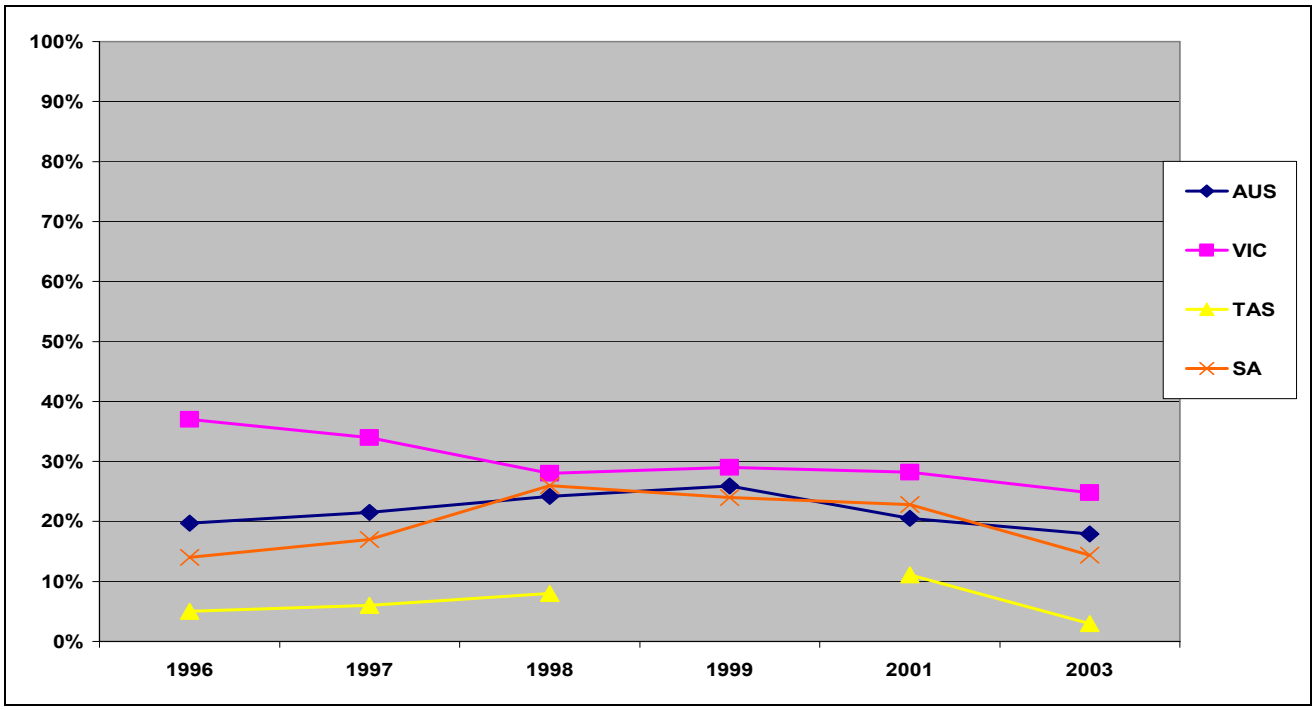


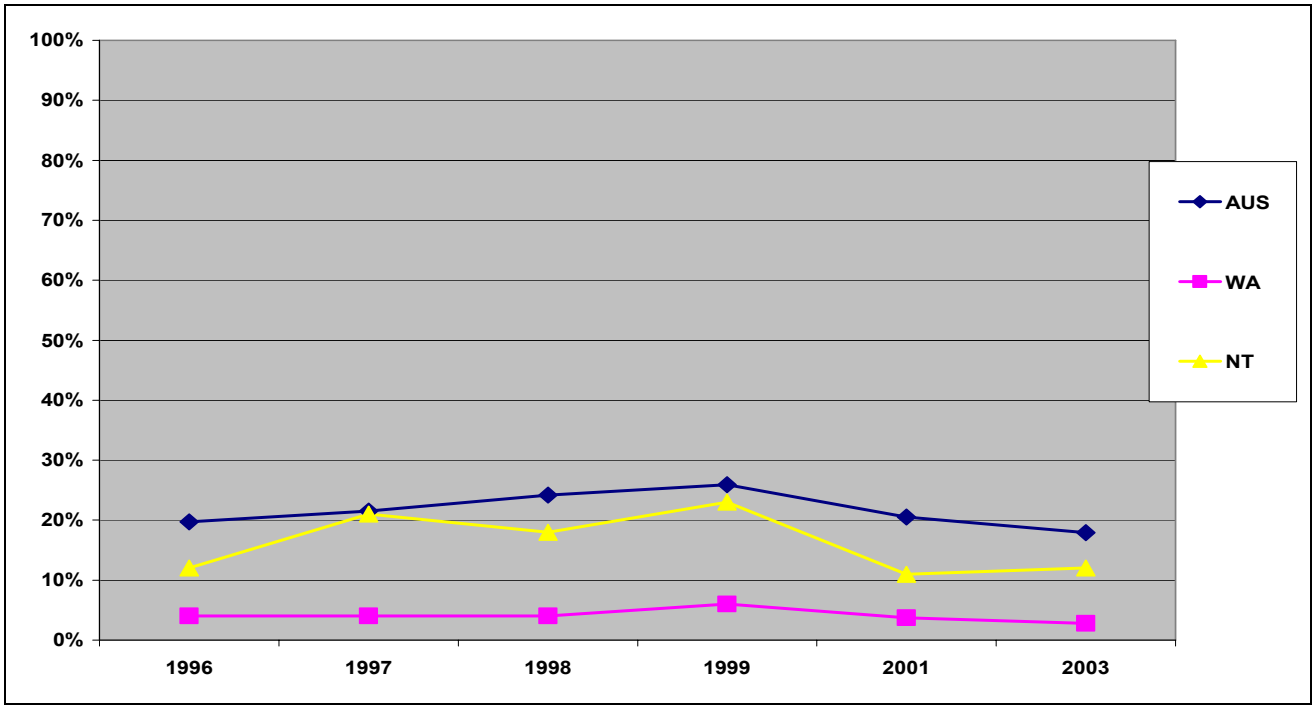
Tetracycline



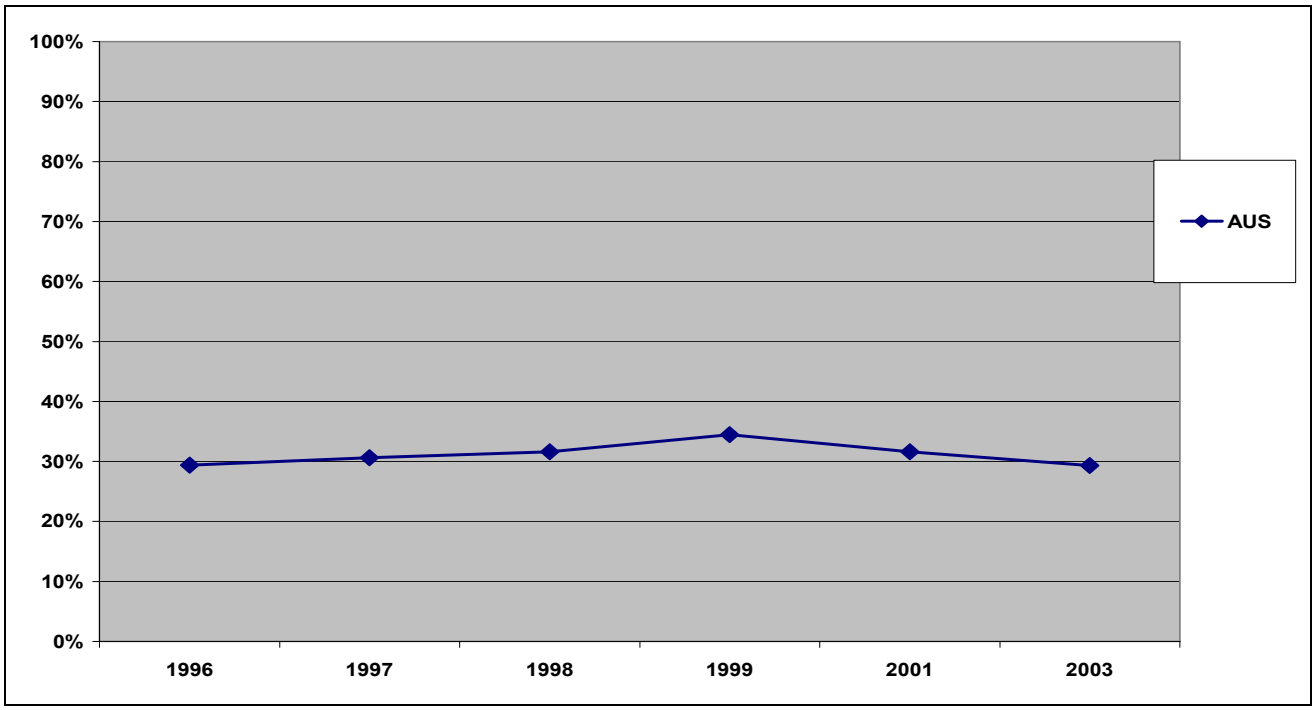


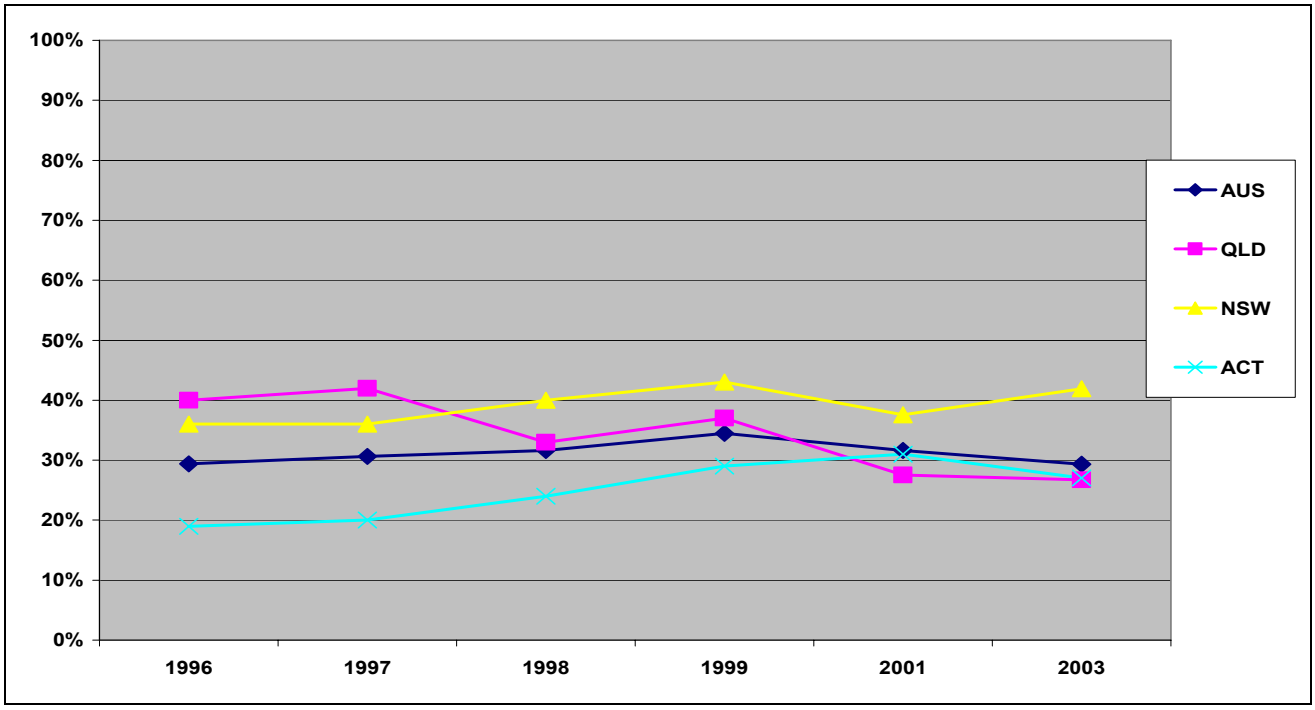
Tetracycline continued





Erythromycin





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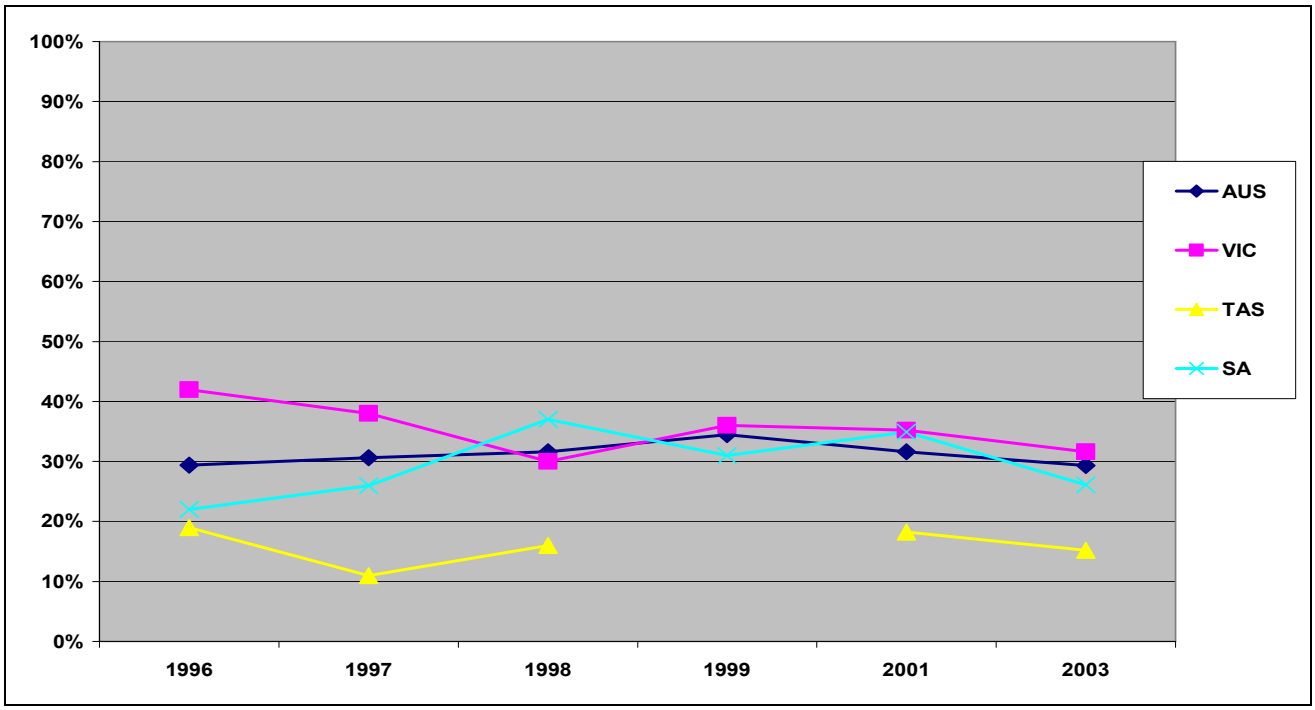
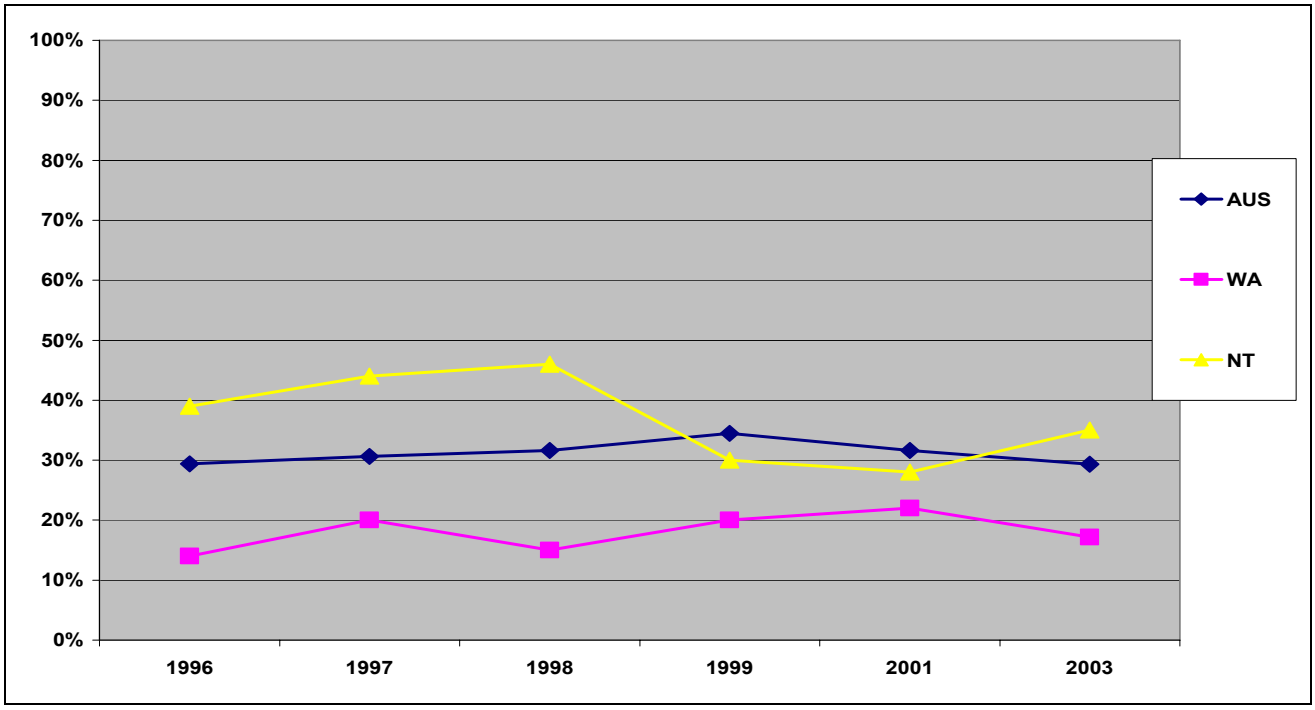
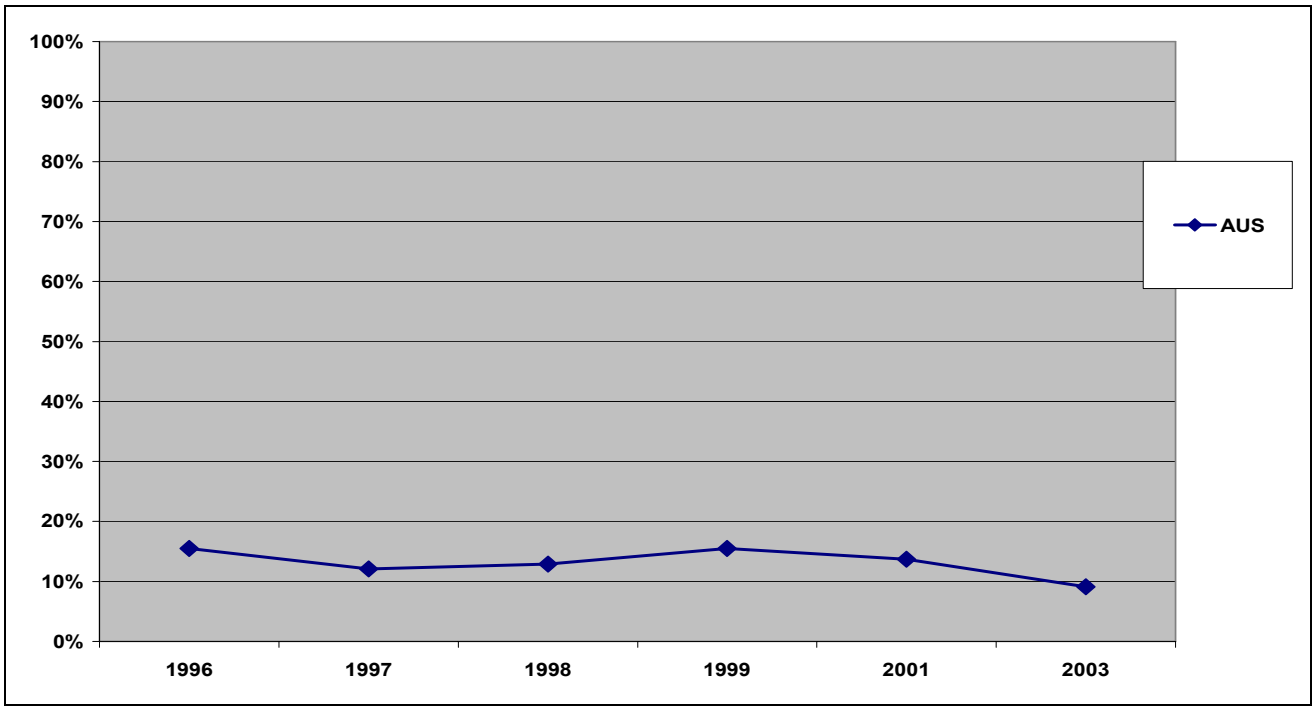
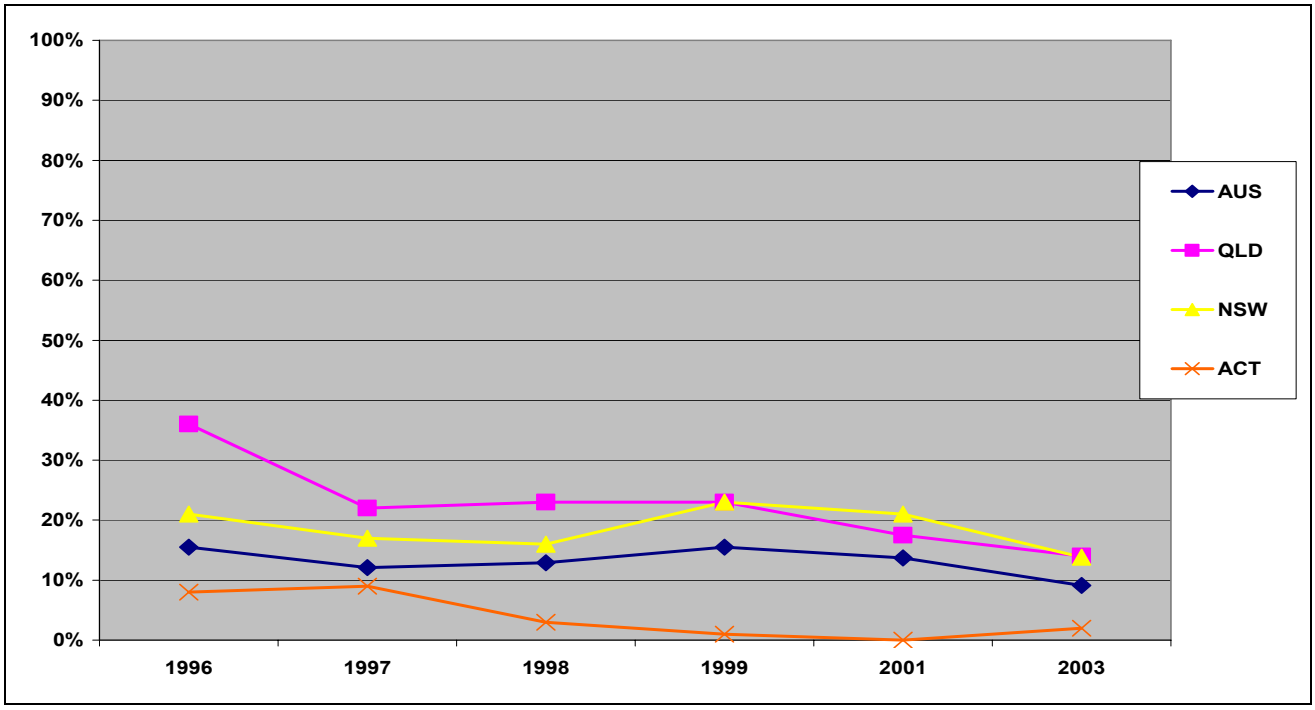




Clindamycin





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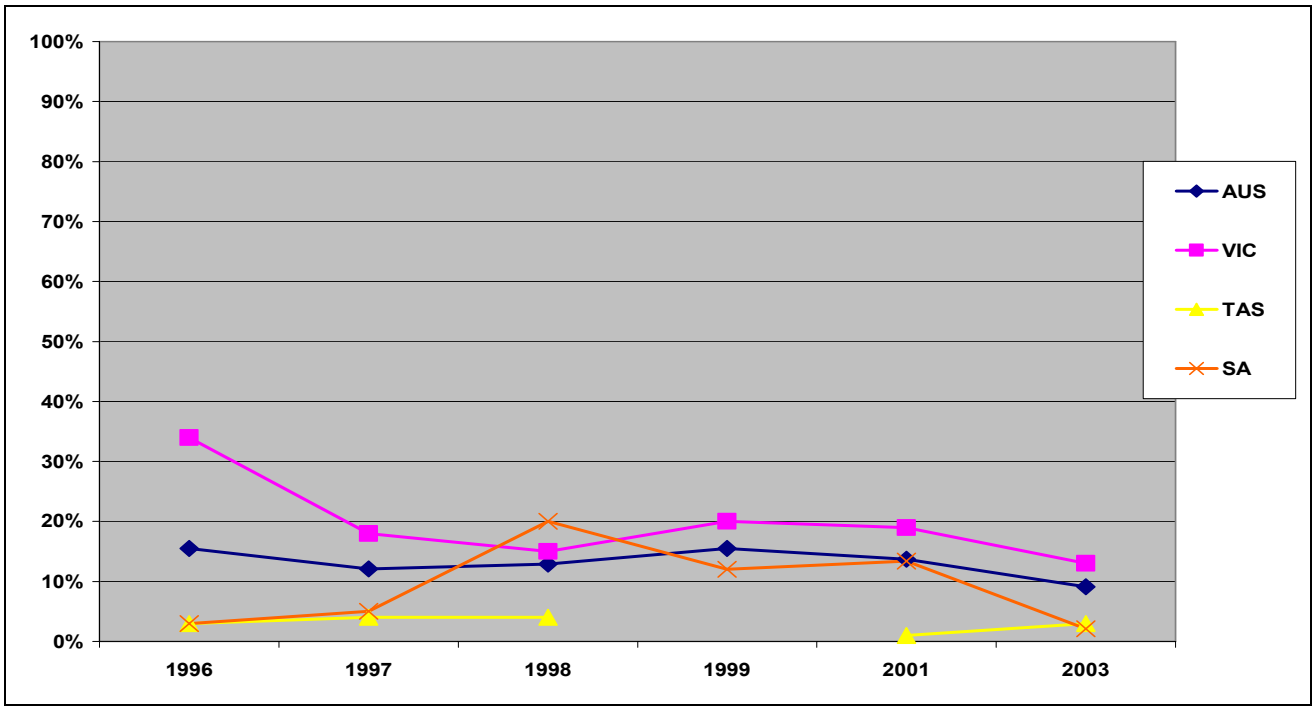
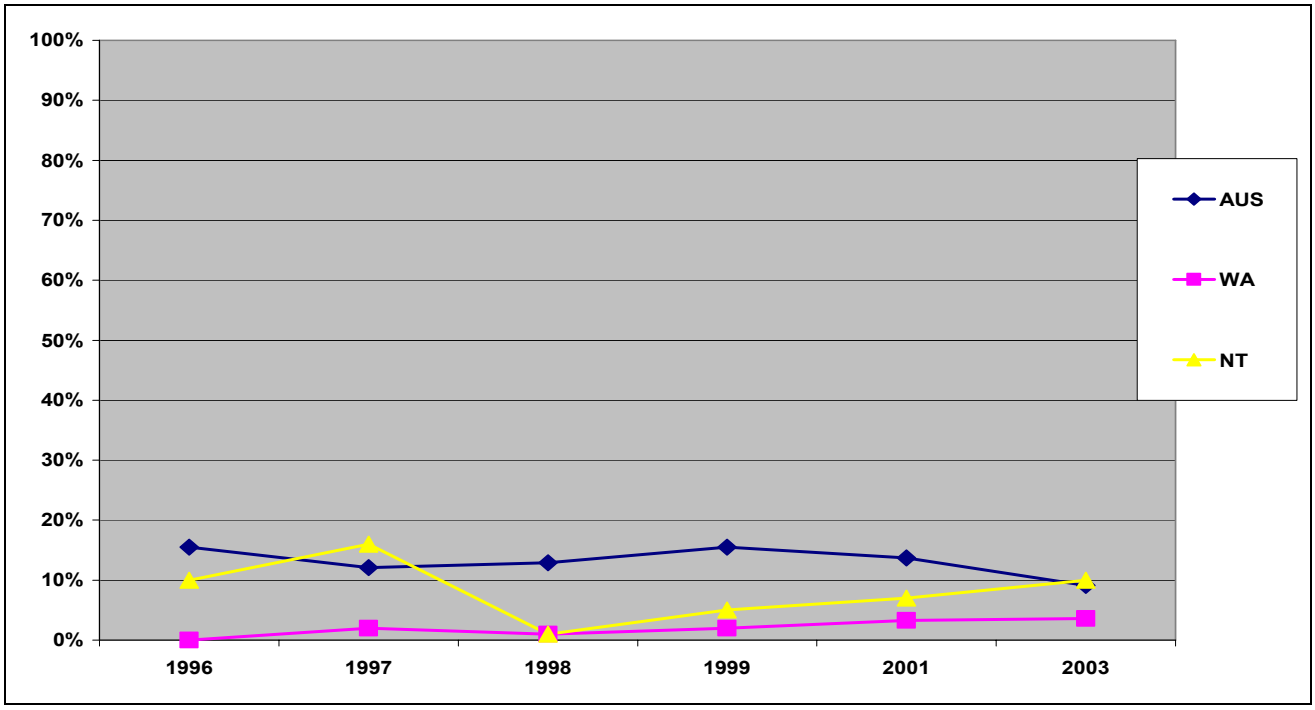
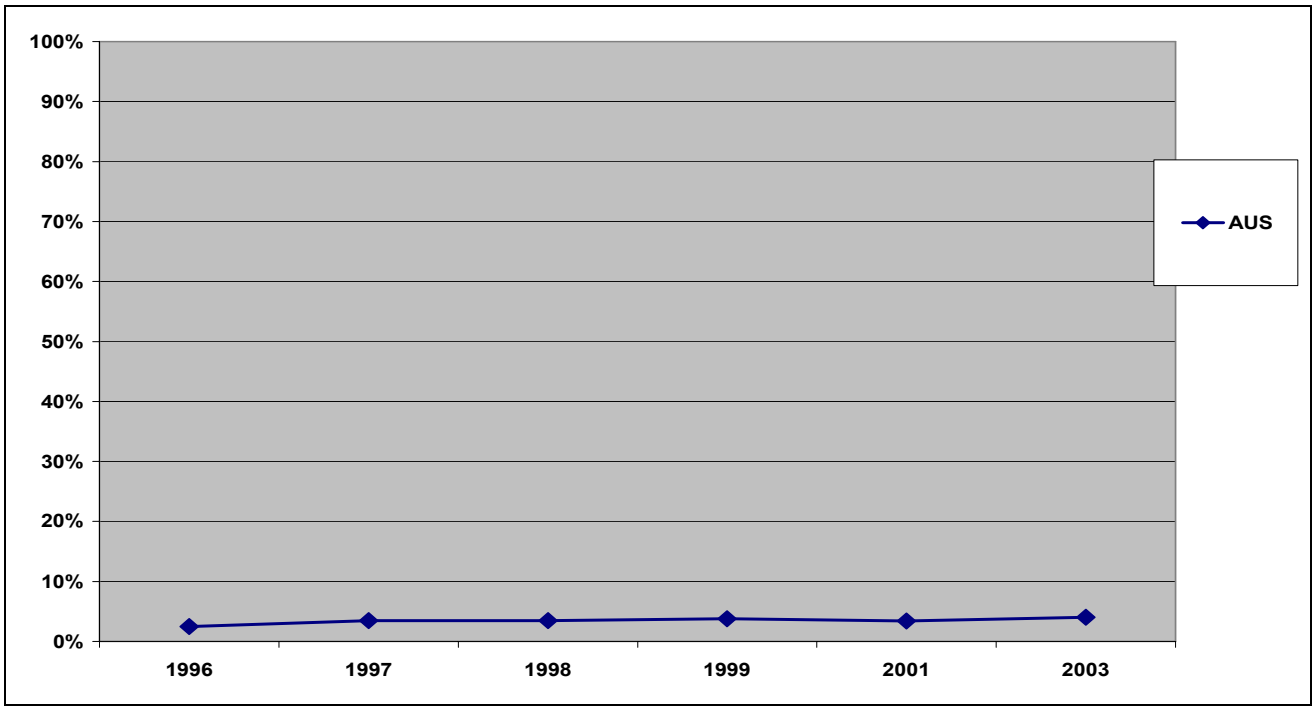
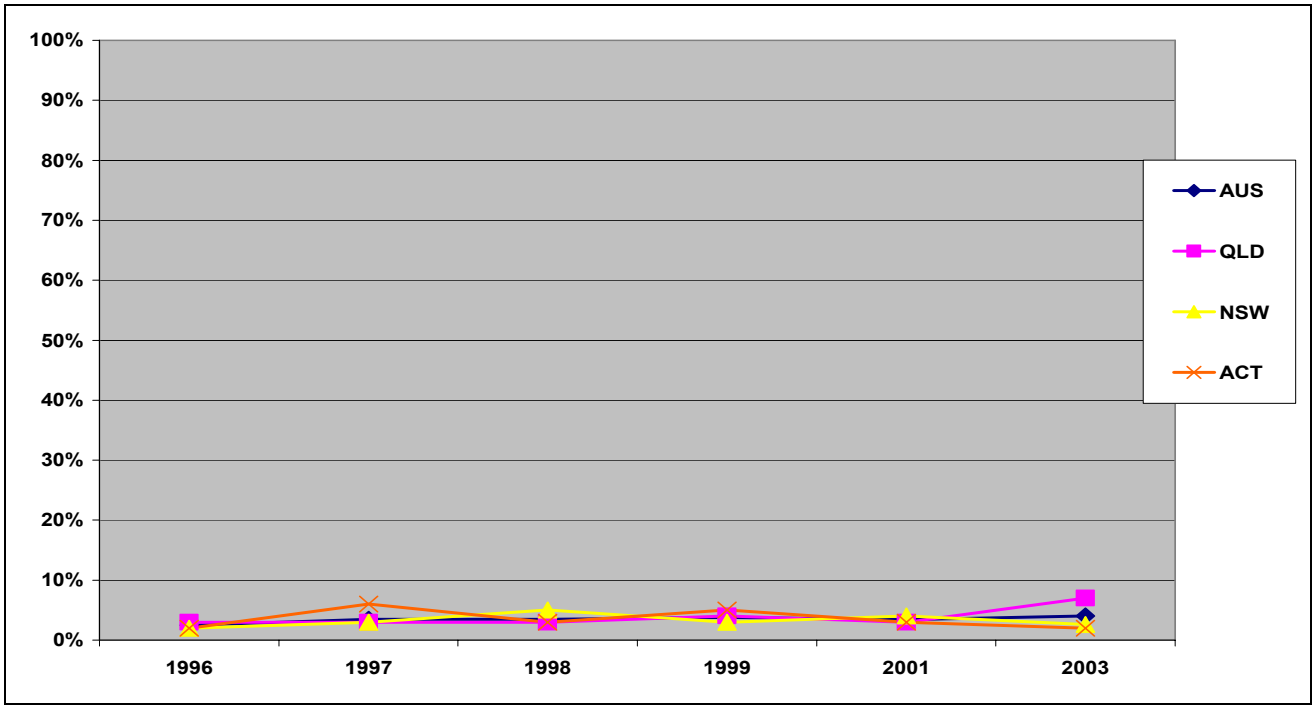




Fusidic acid





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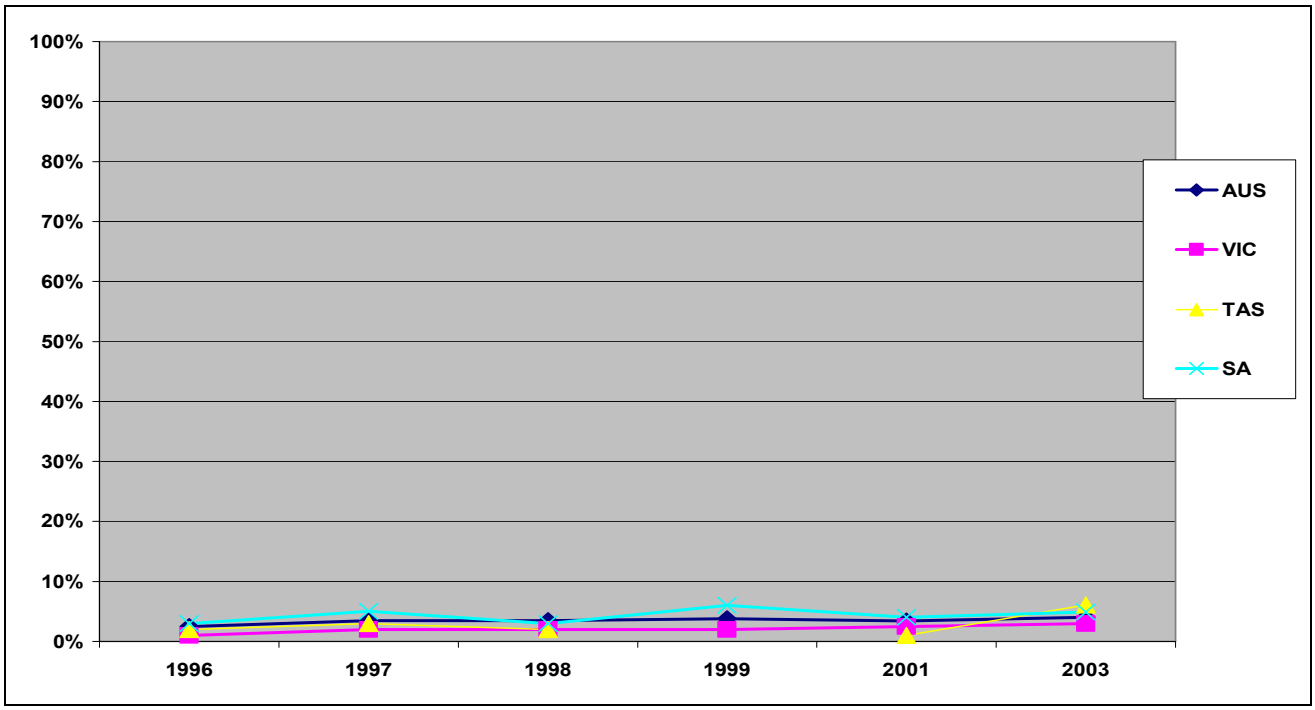
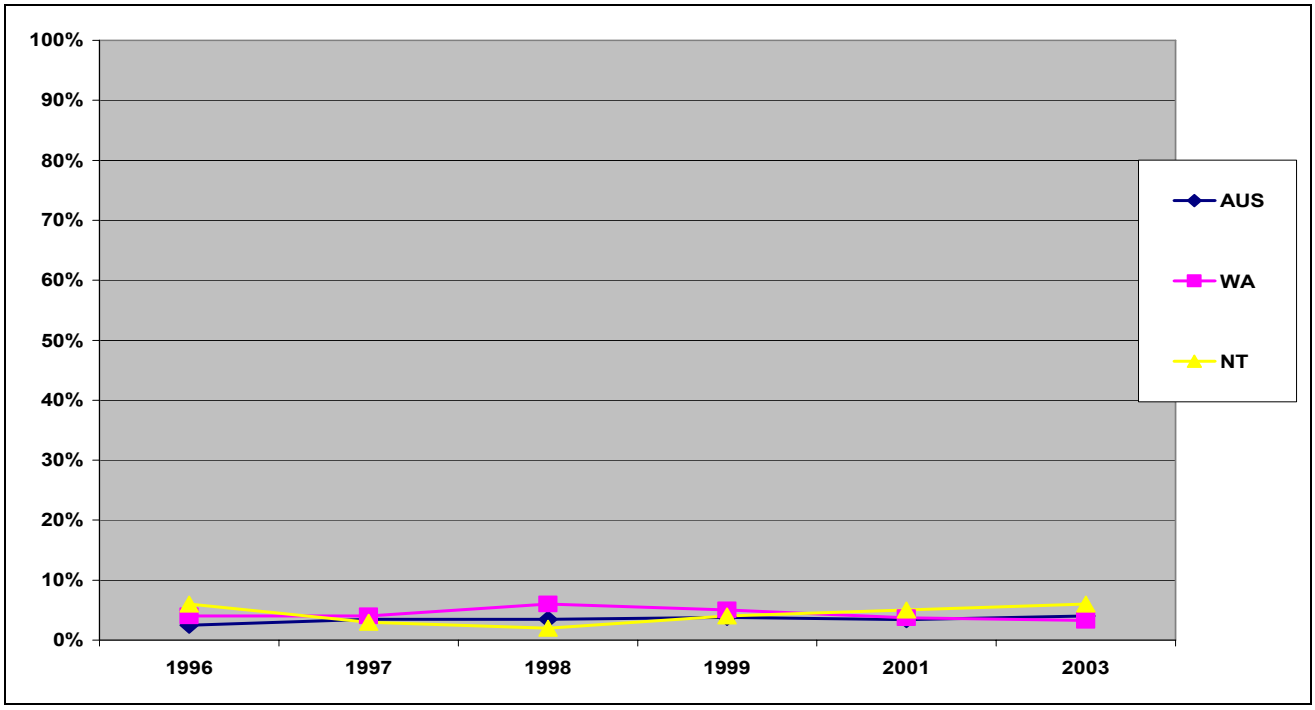
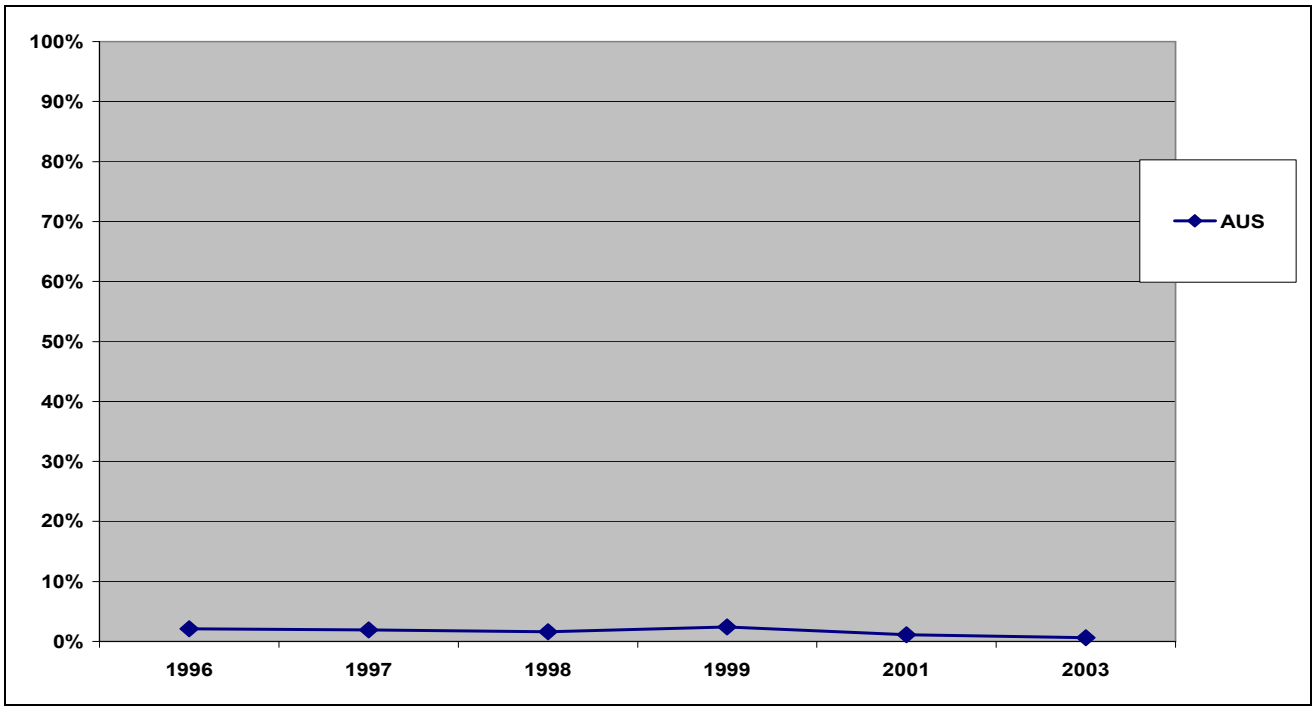




Rifampicin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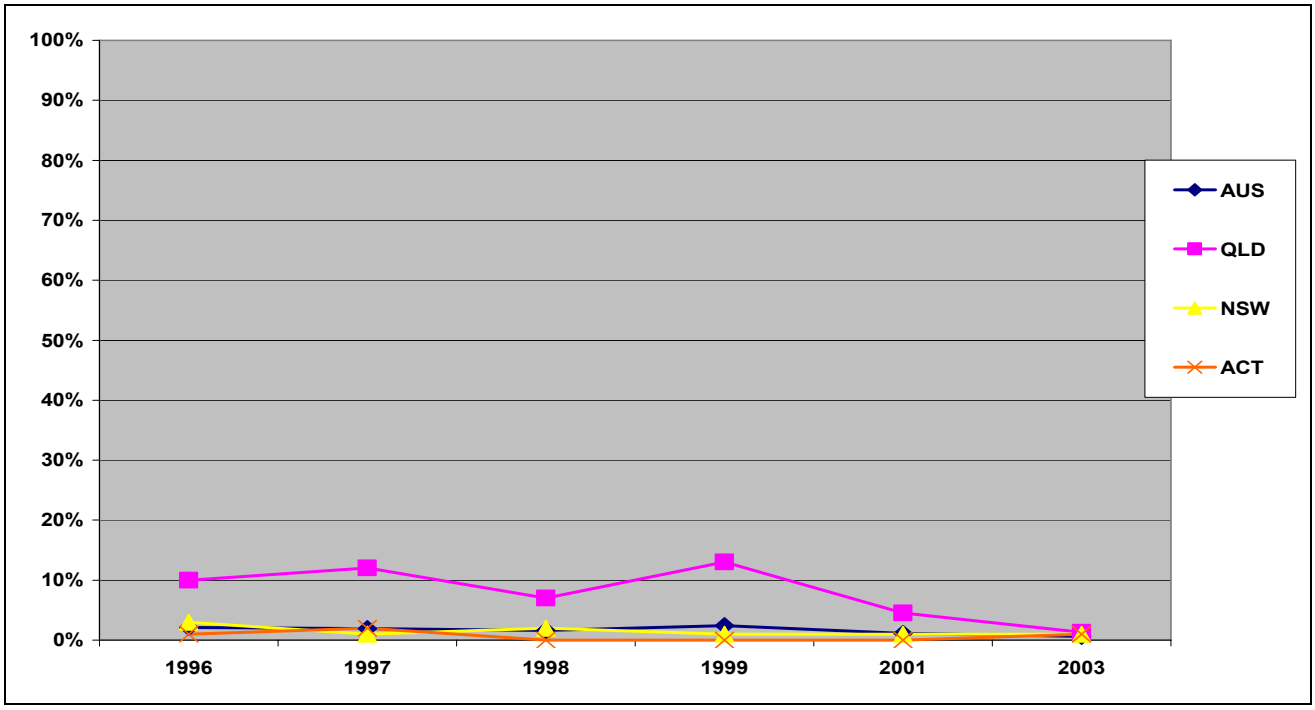
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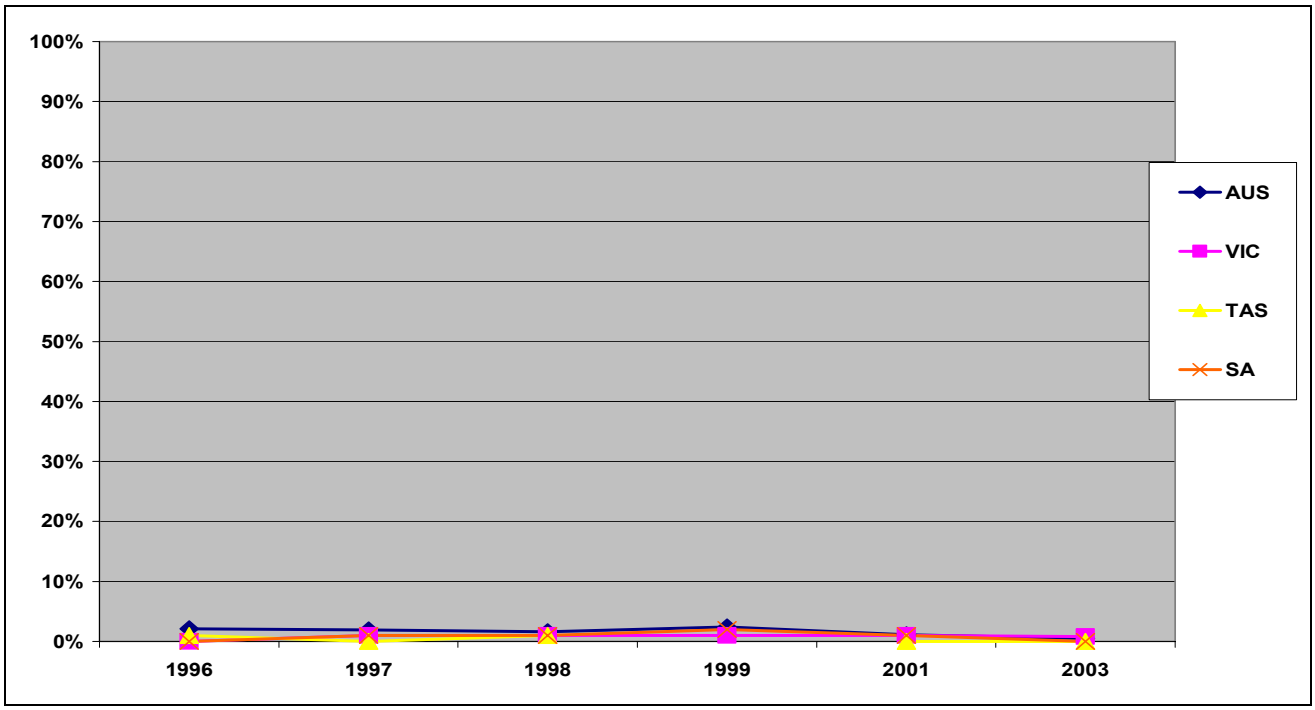
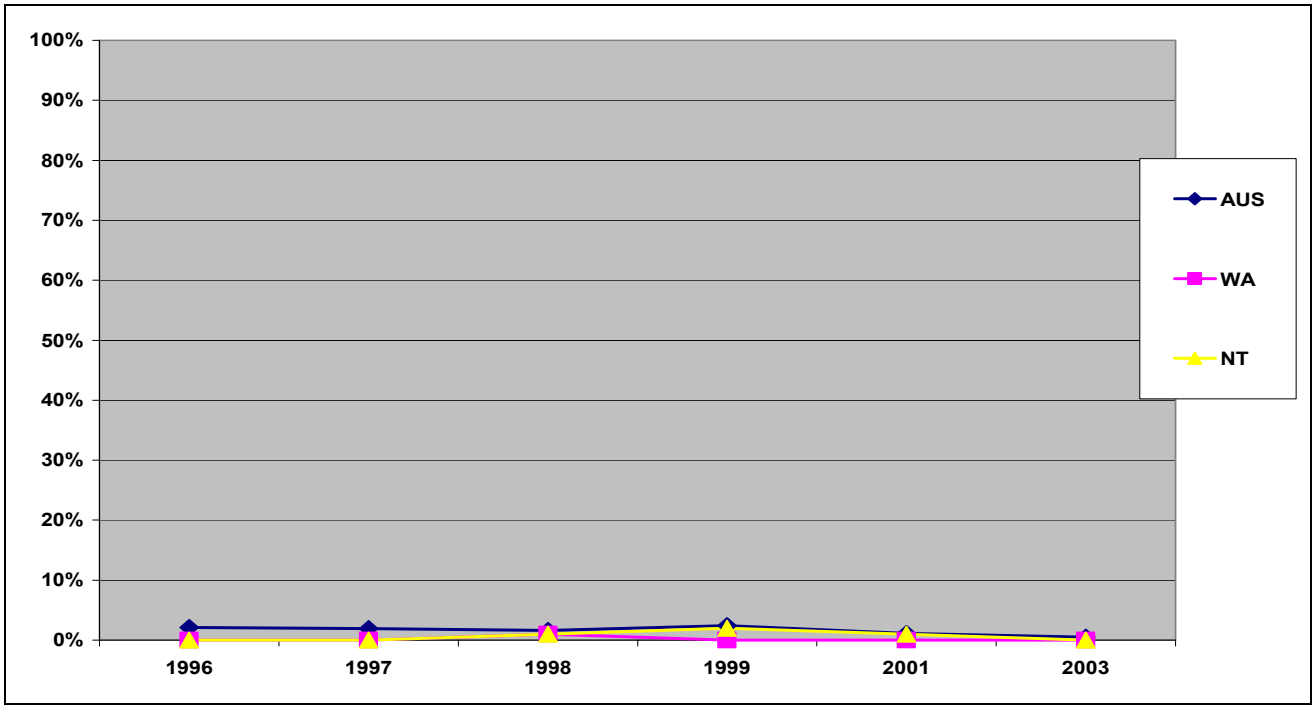
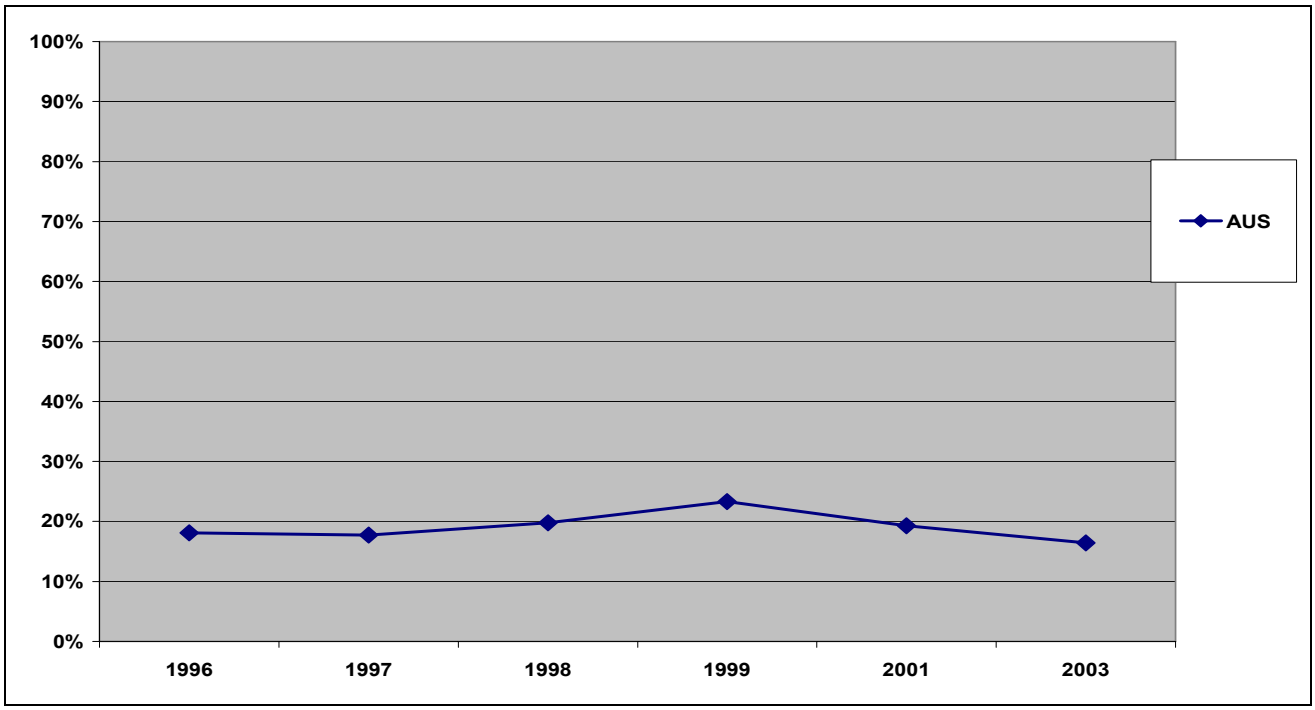
Rifampicin continued





Gentamicin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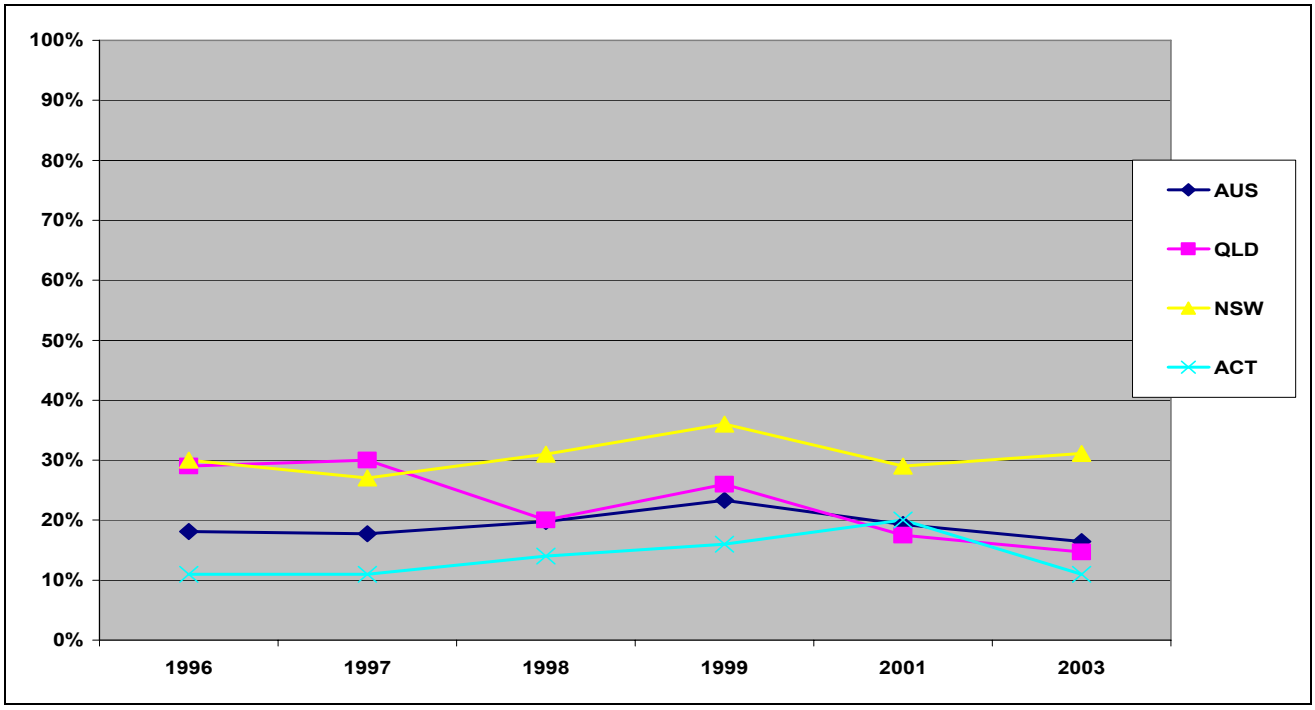
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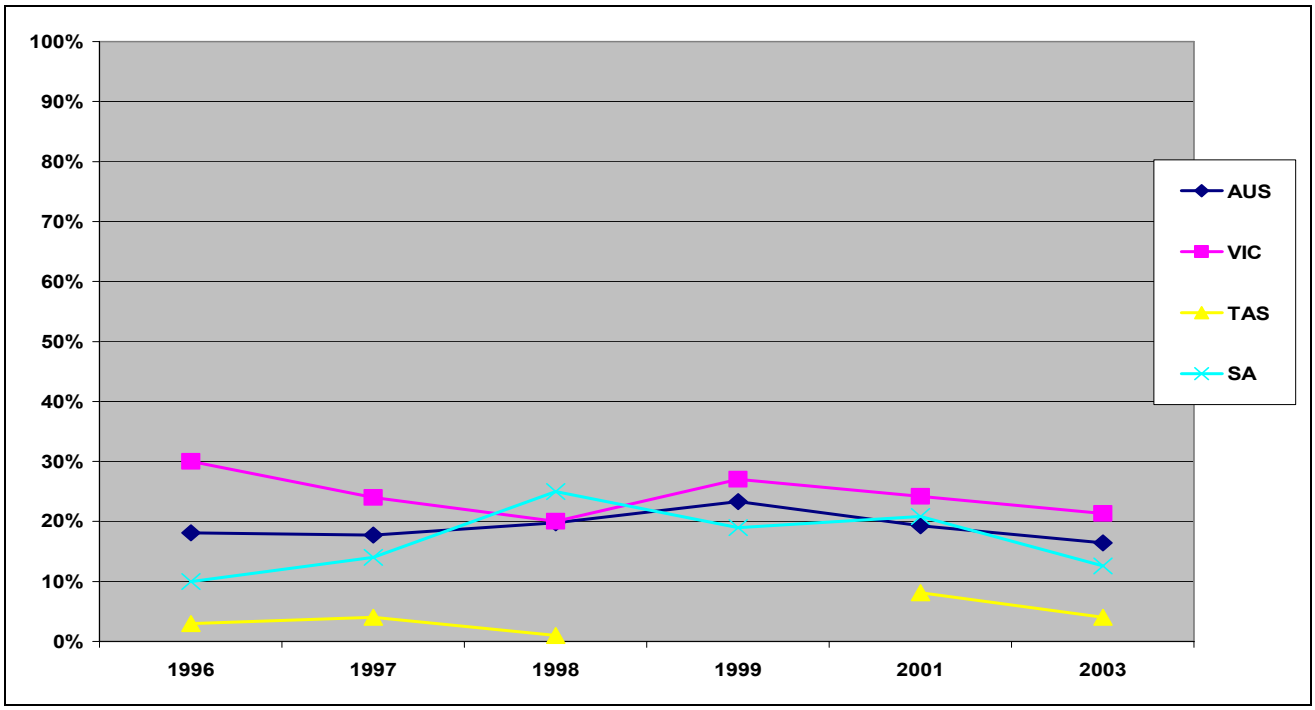
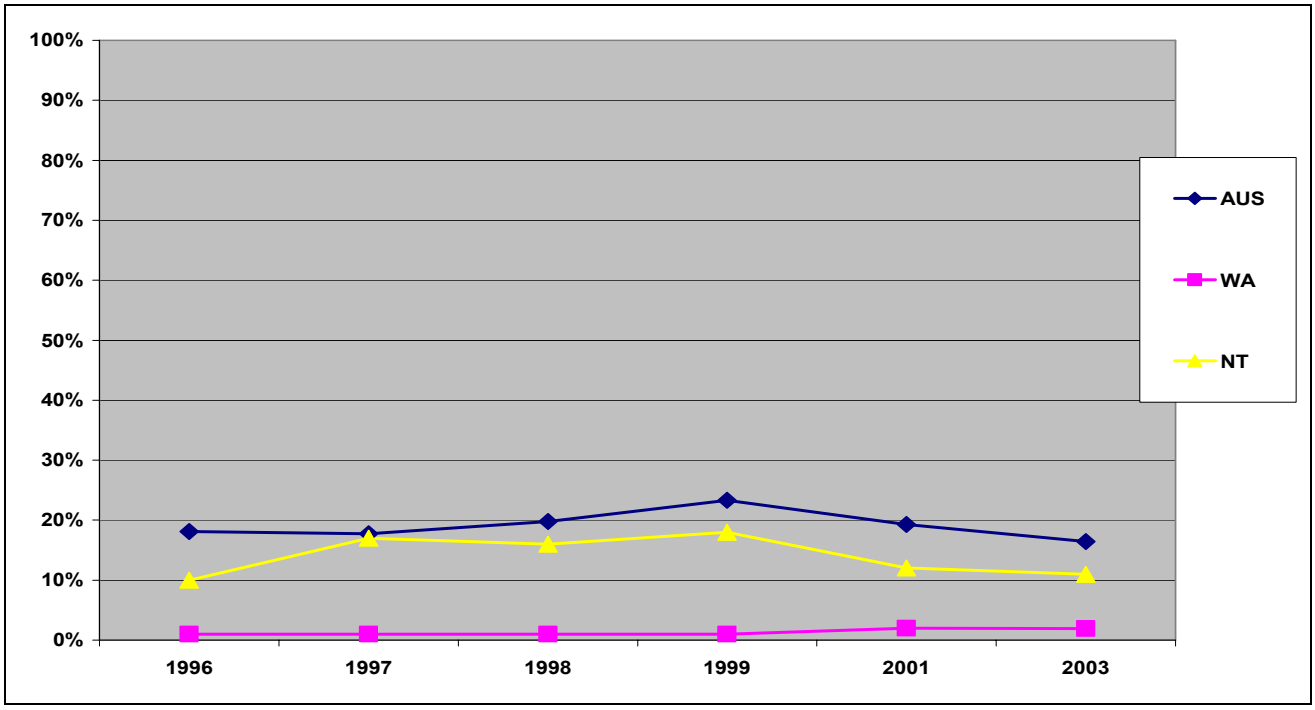
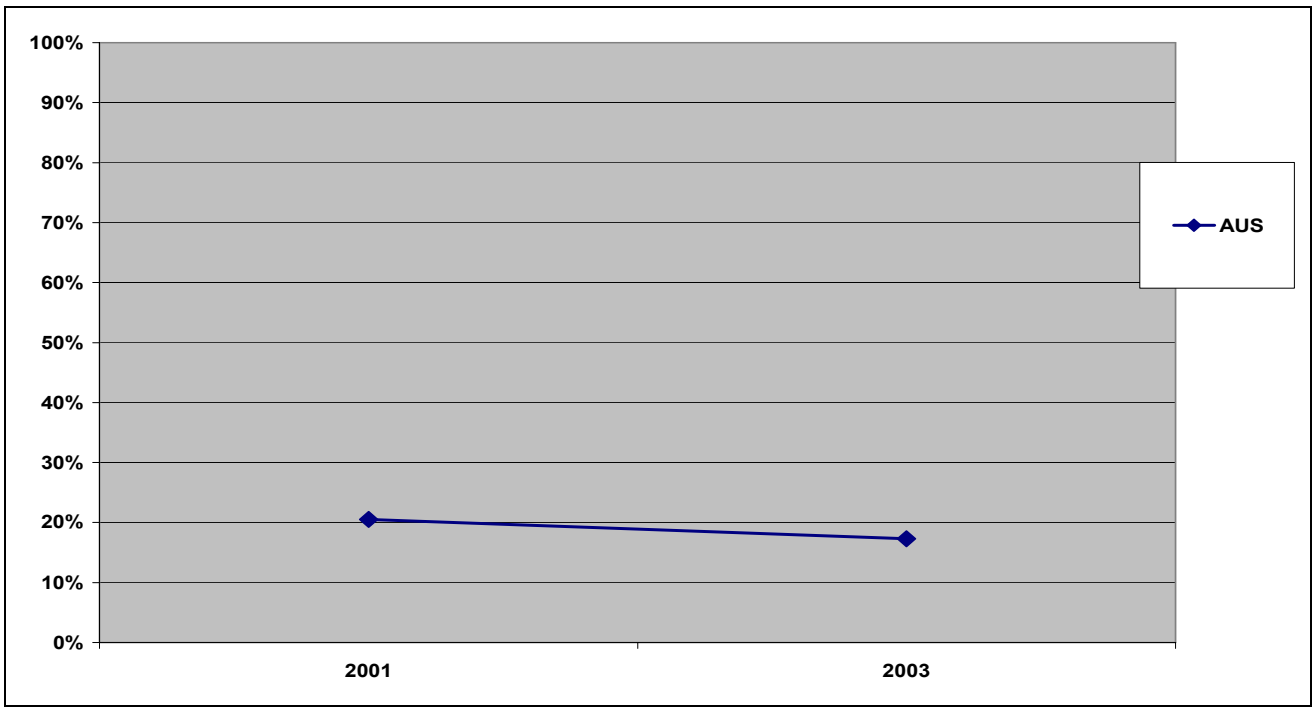
Gentamicin continued

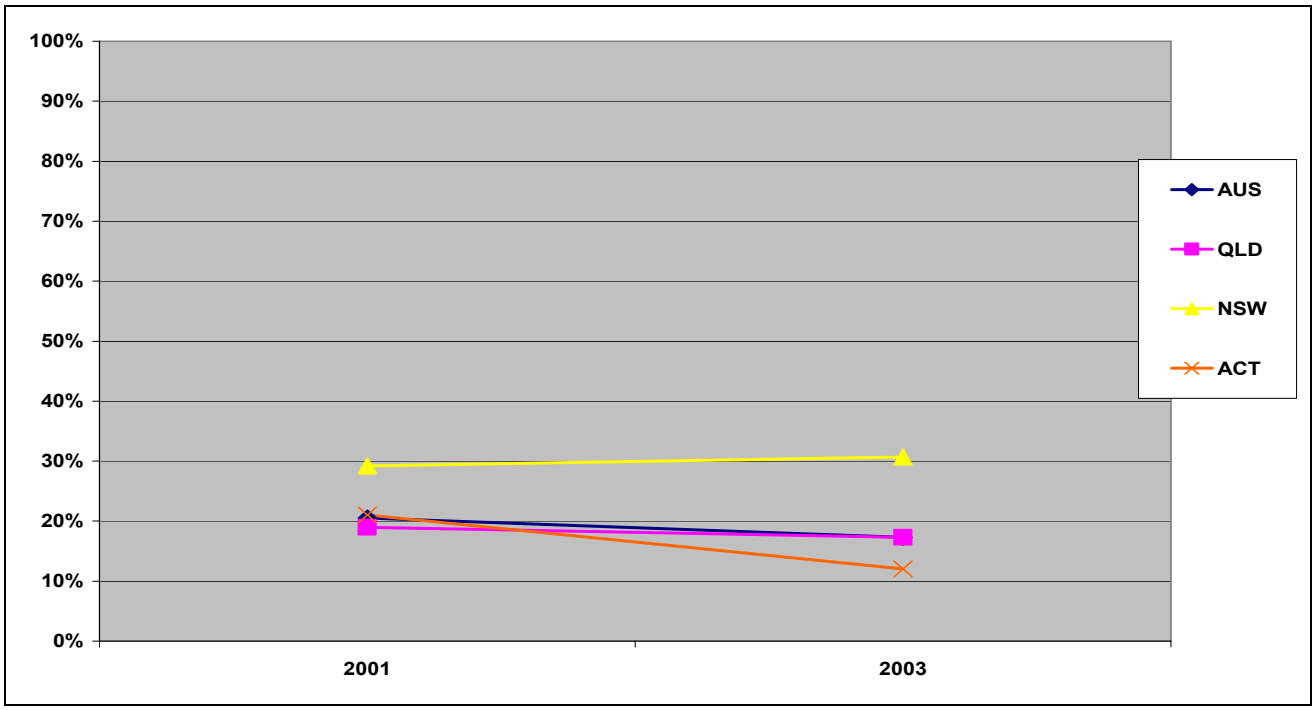




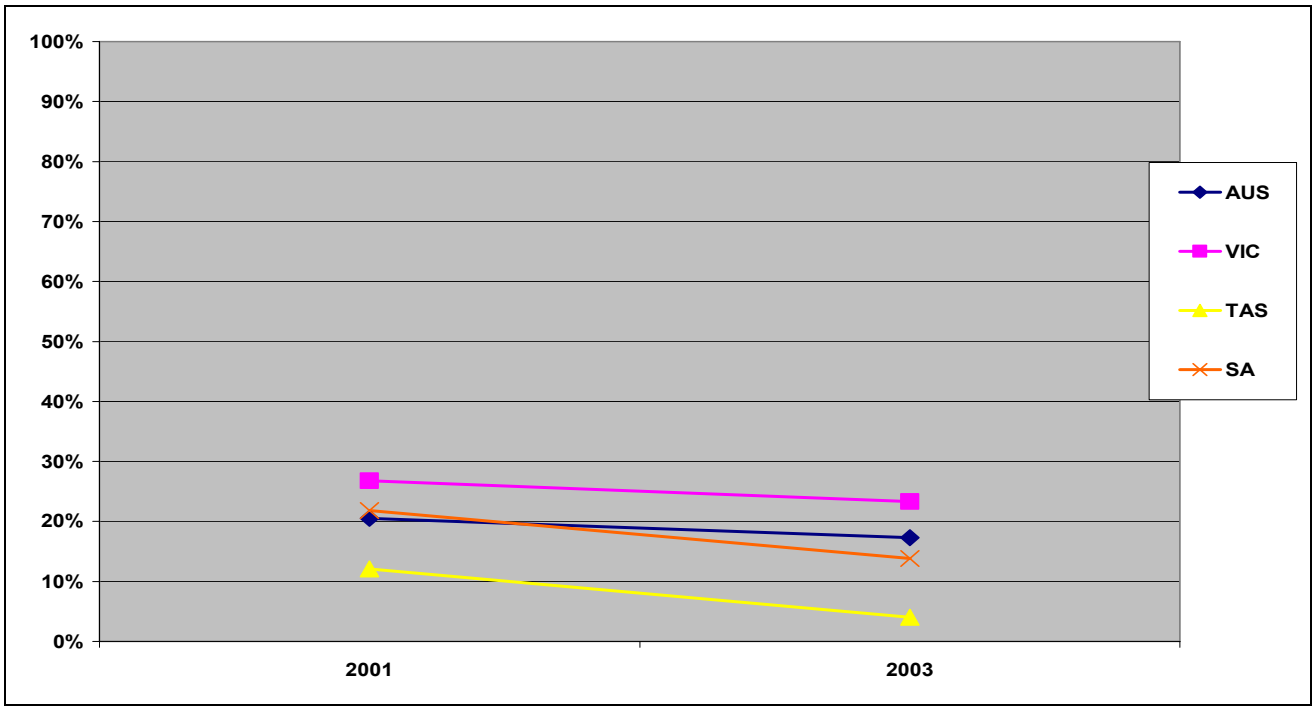
Trimethoprim

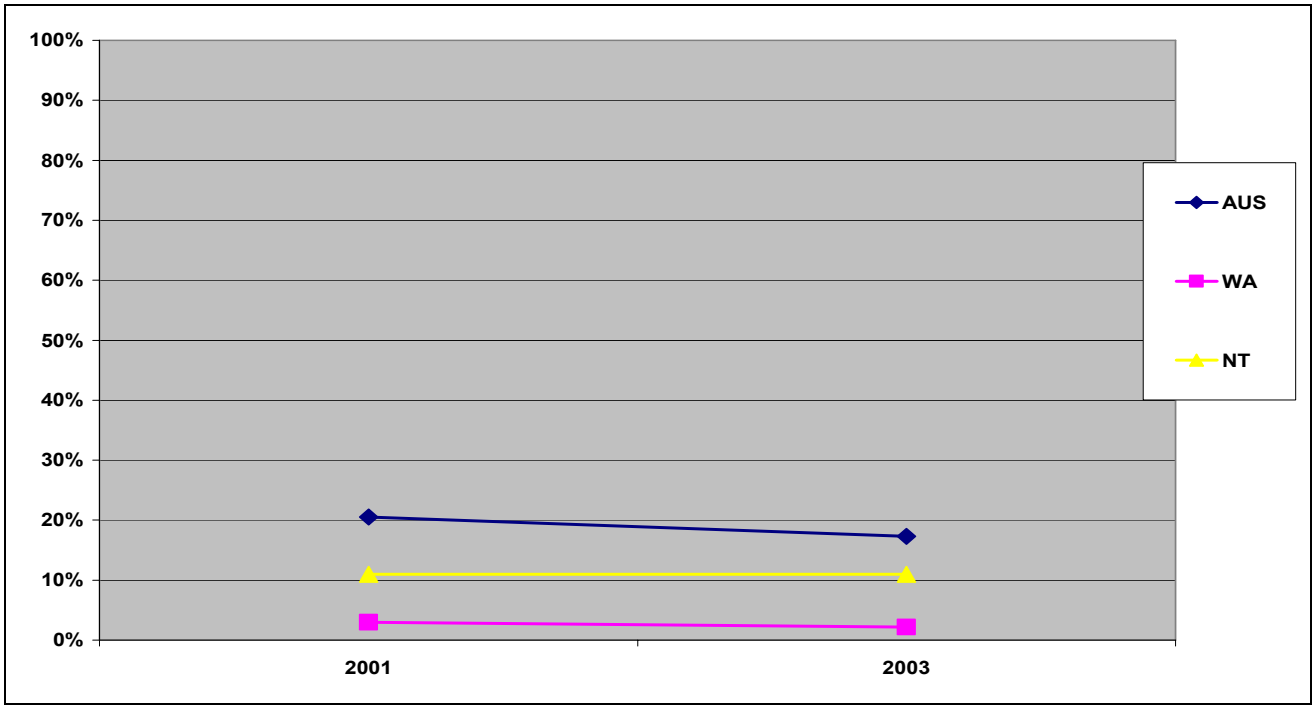
Trimethoprim 8mg/L was introduced in 2001.



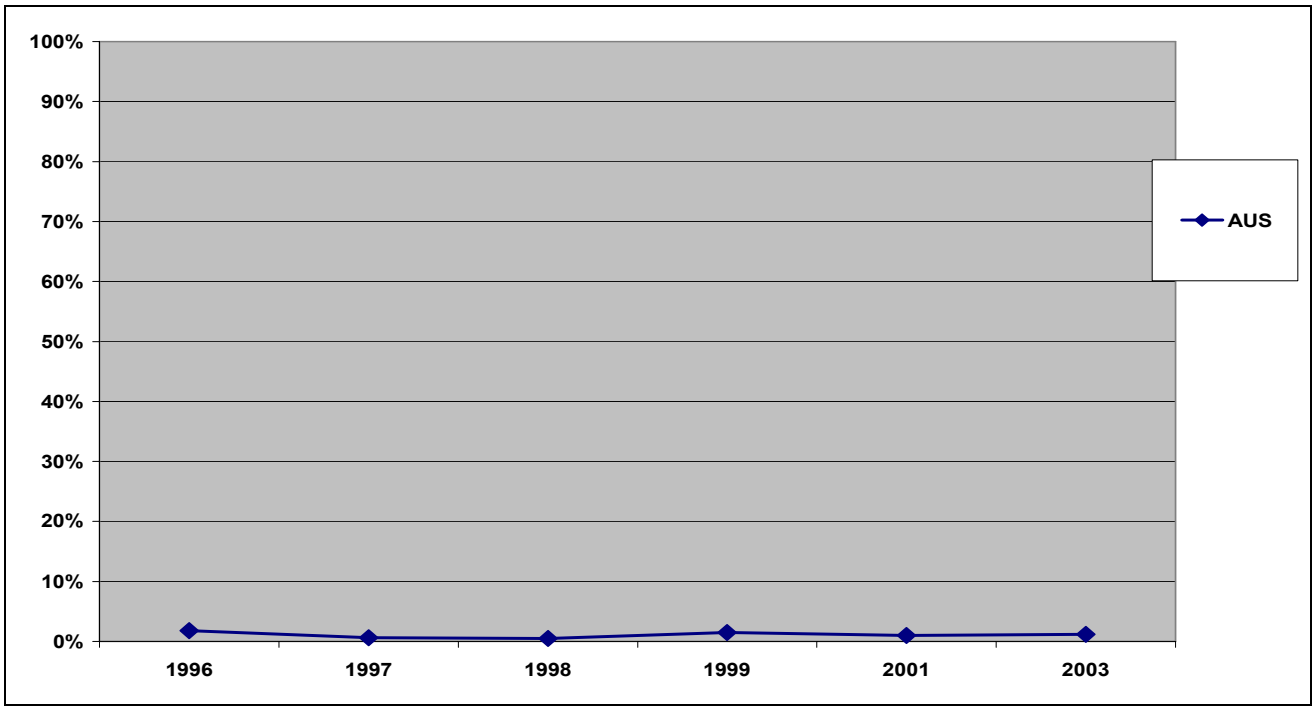


Trimethoprim continued





Mupirocin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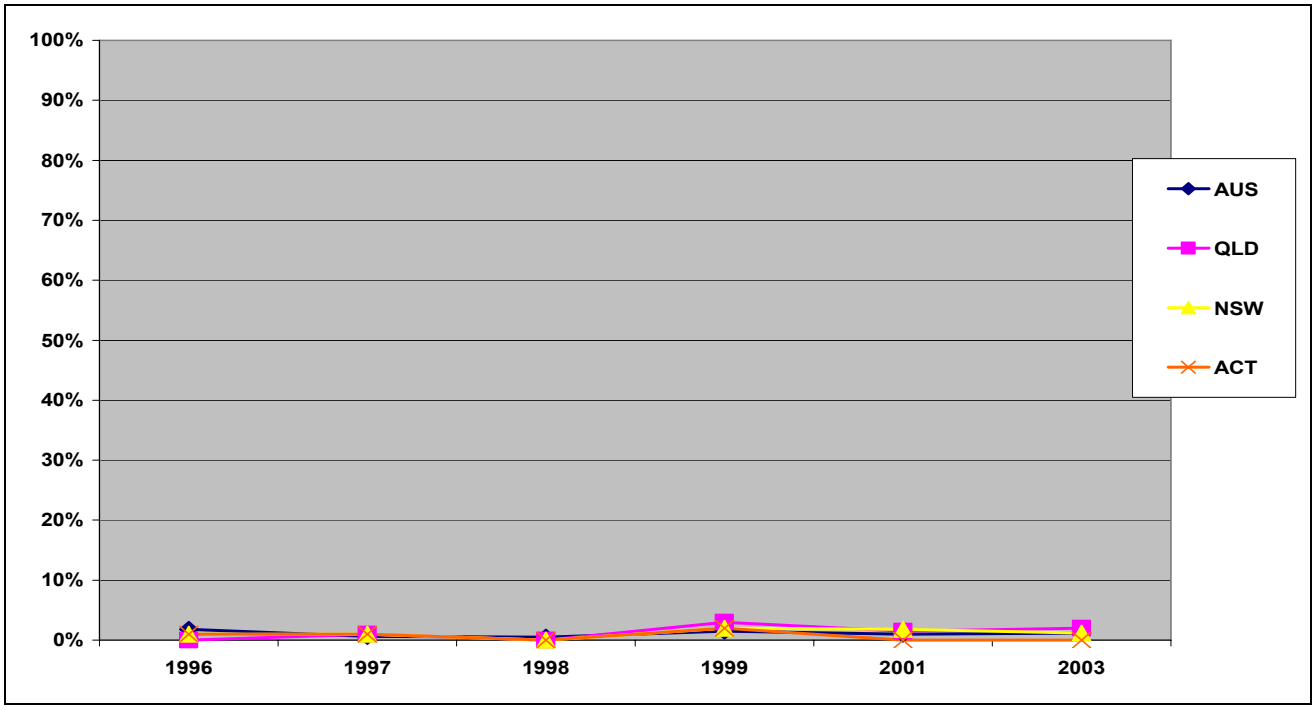
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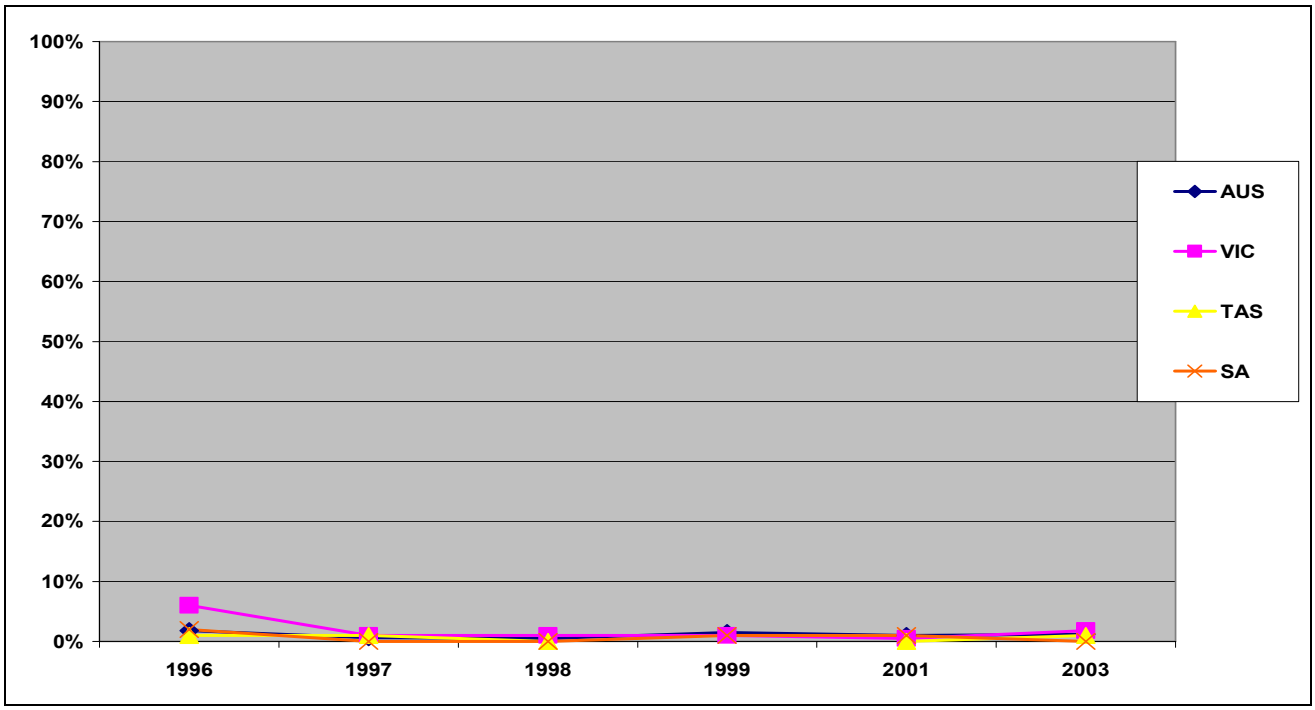
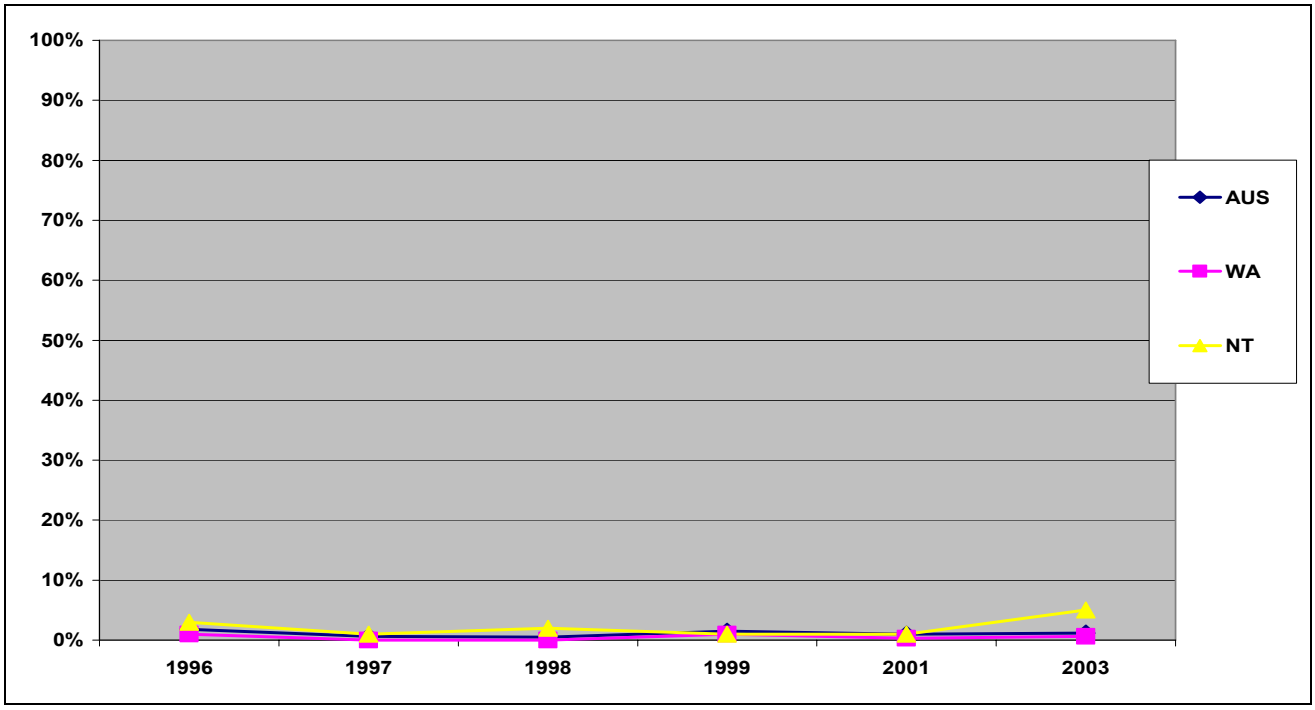
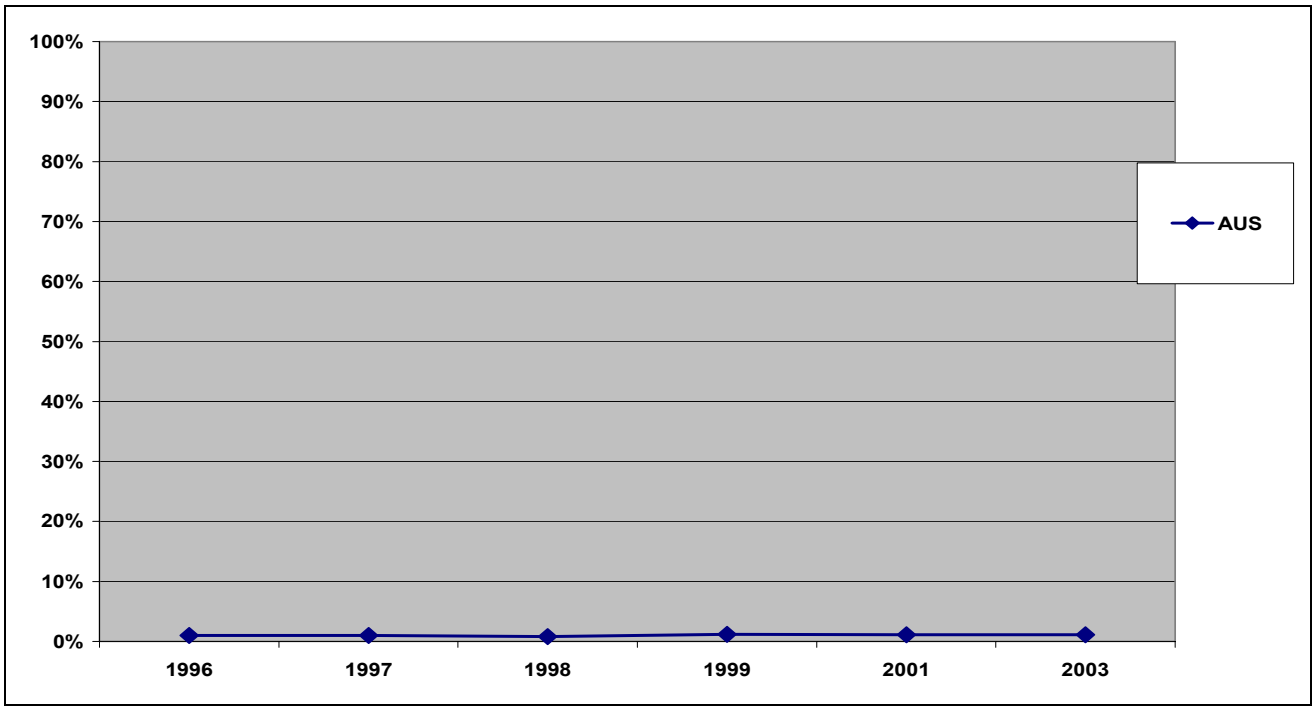
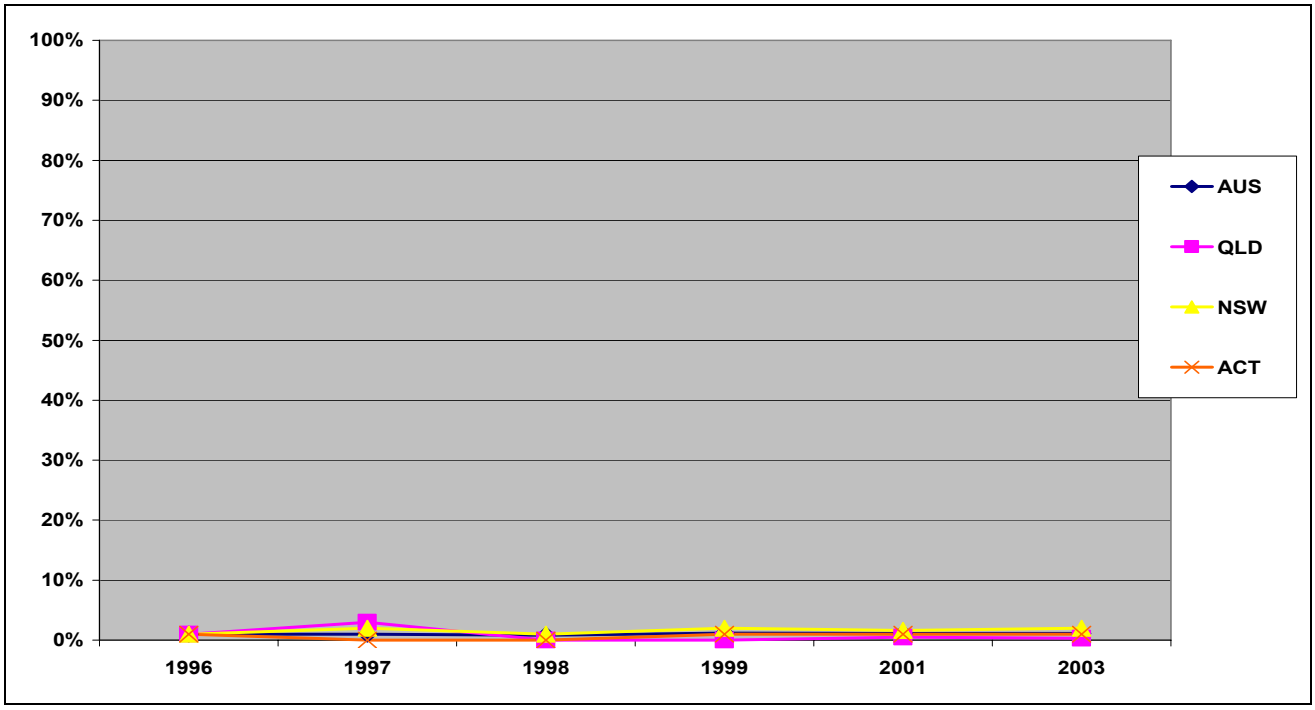
Mupirocin continued



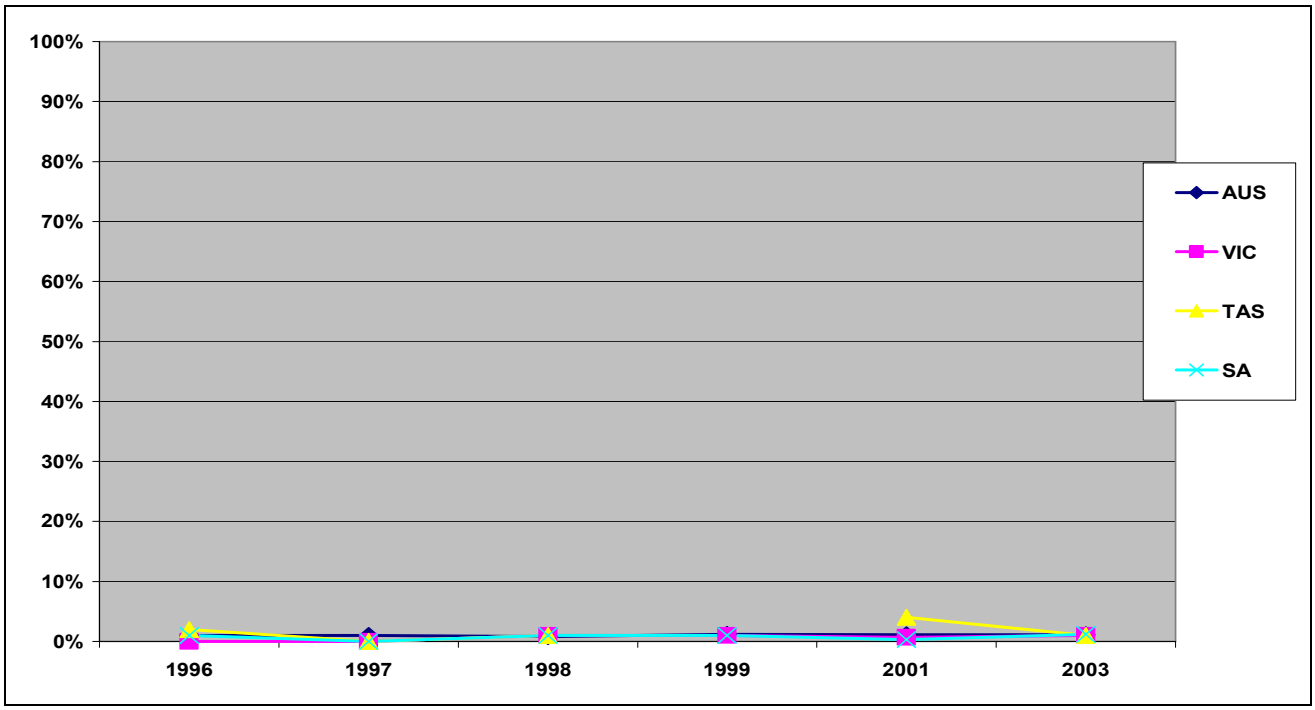


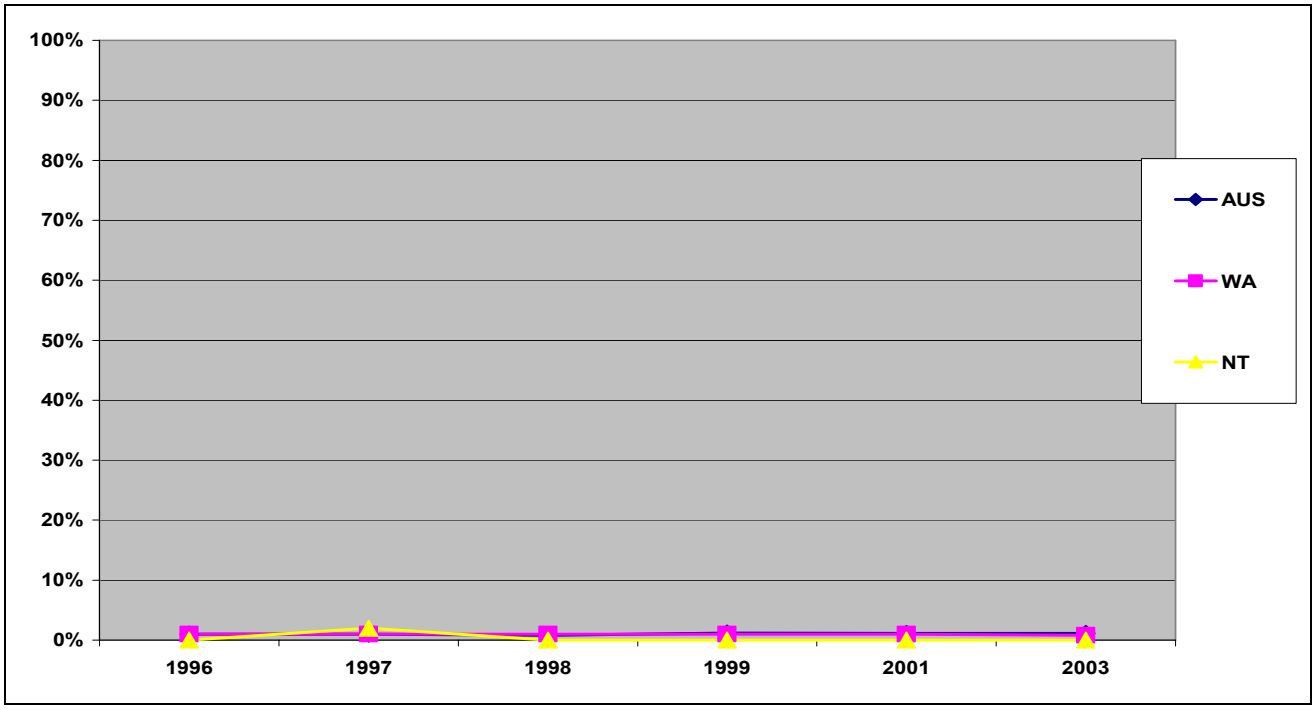
Chloramphenicol





Chloramphenicol continued

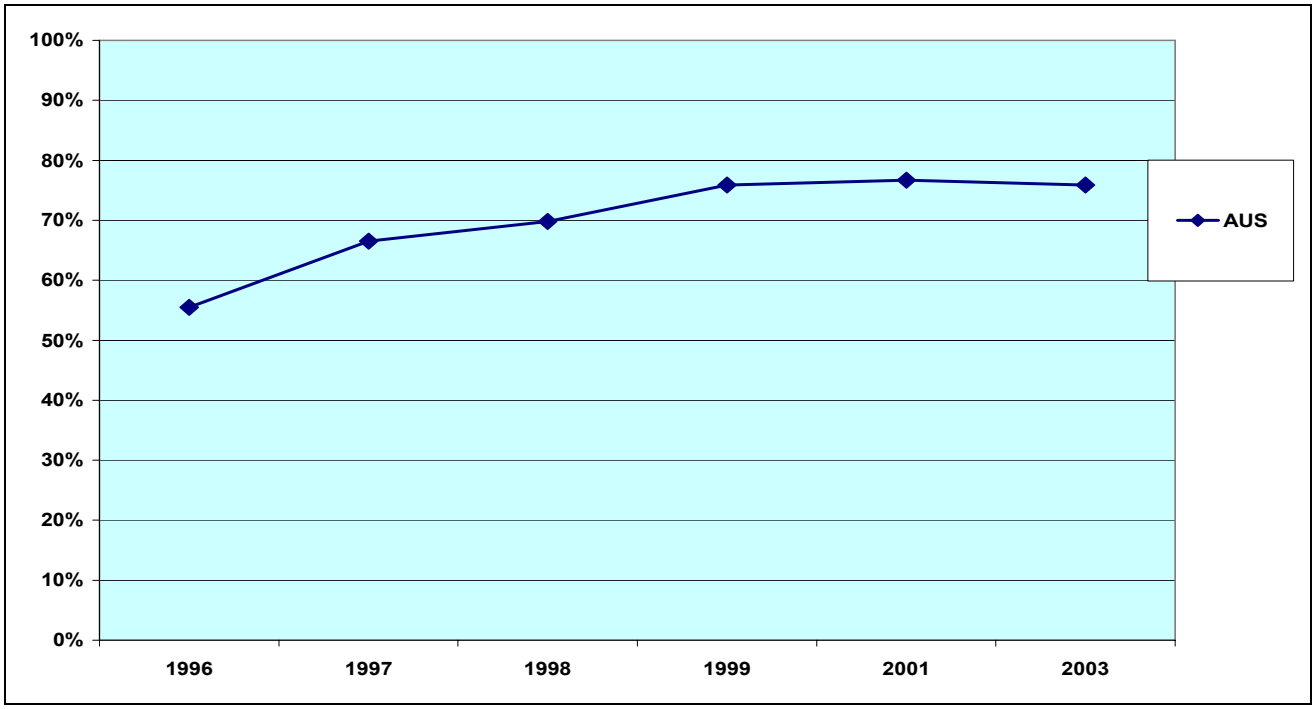


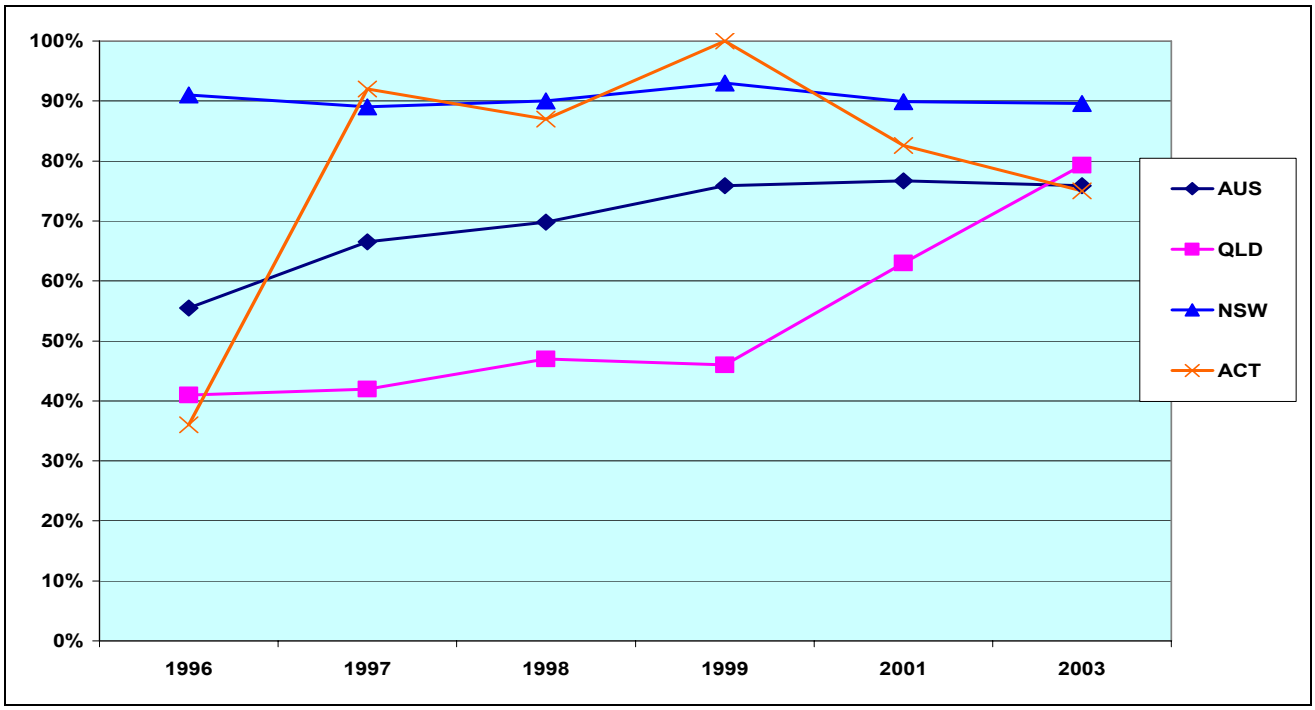


HOSPITAL/COMMUNITY SURVEYS 1996 – 2003: TREND DATA BY STATE

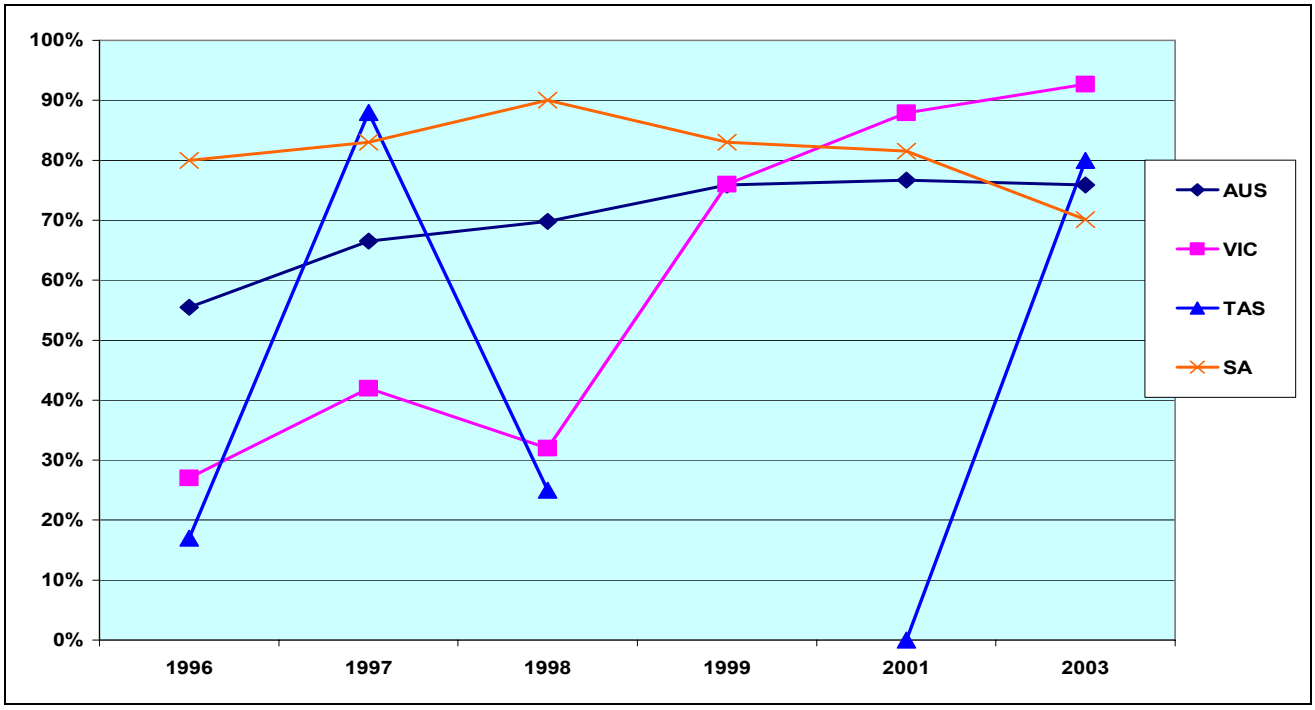
ANTIMICROBIAL RESISTANCE IN METHICILLIN-RESISTANT *Staphylococcus aureus* (MRSA)

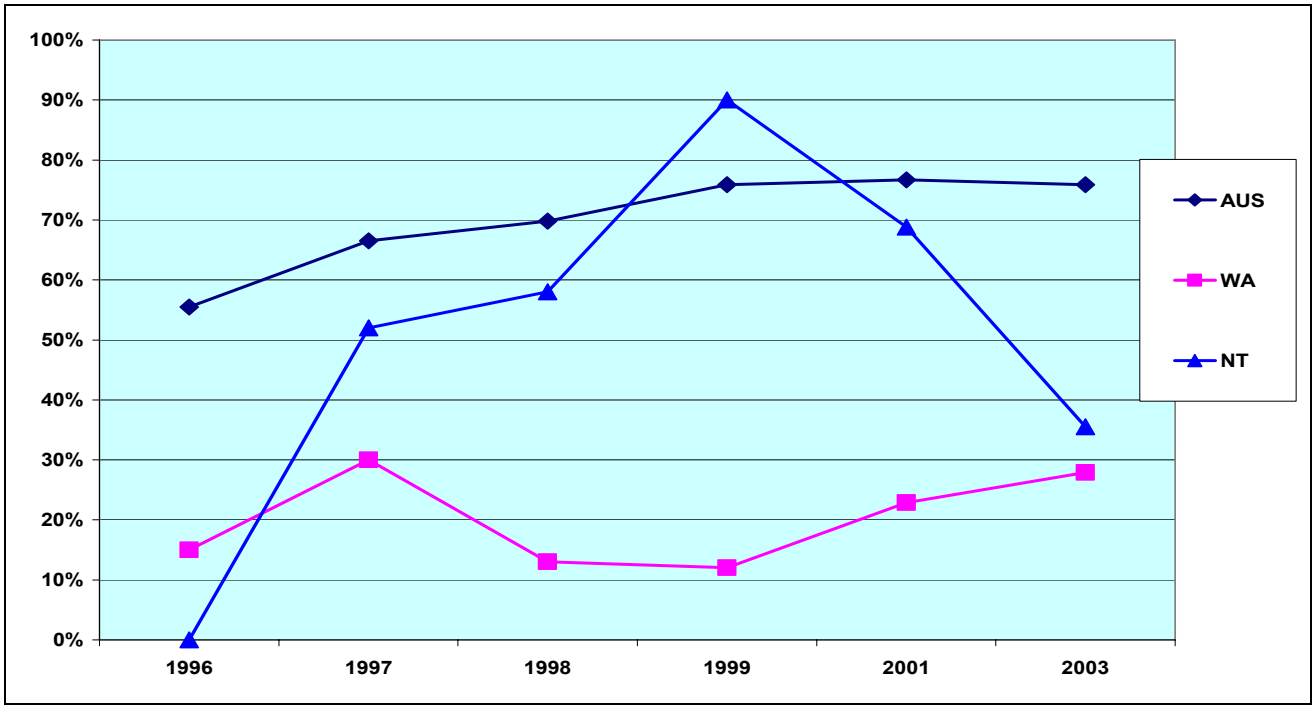
Ciprofloxacin



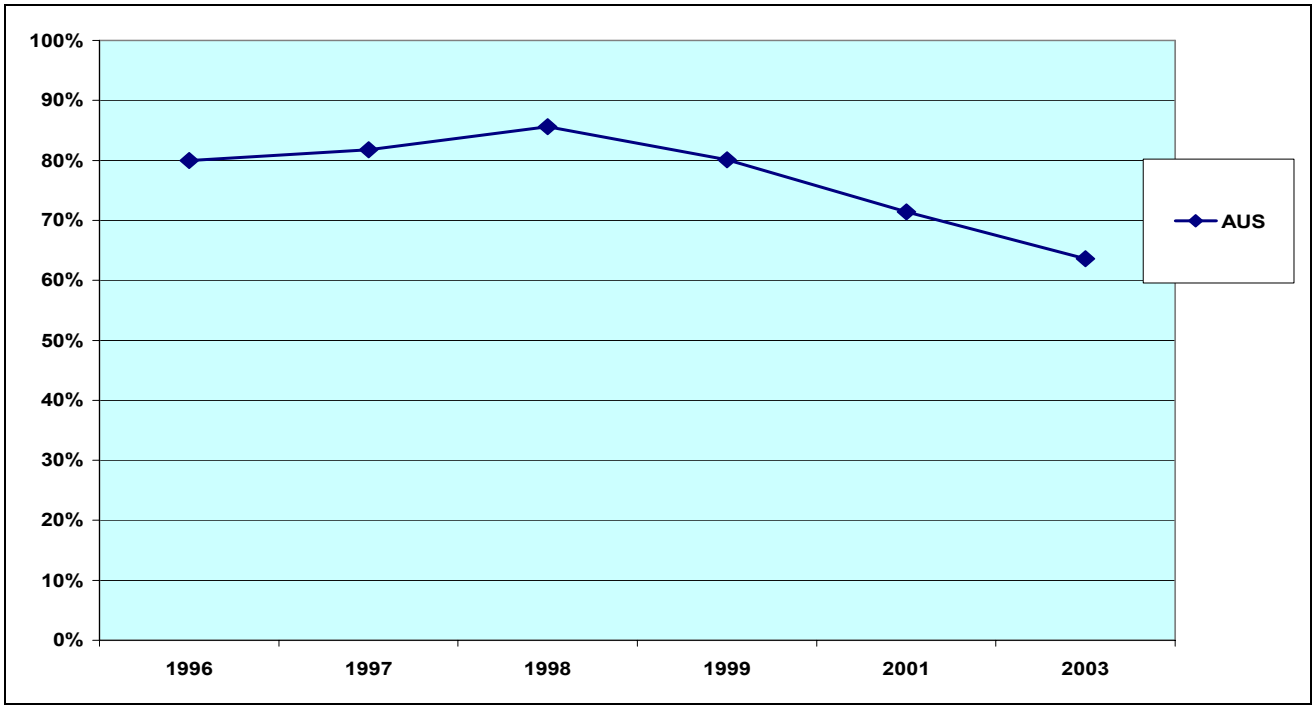


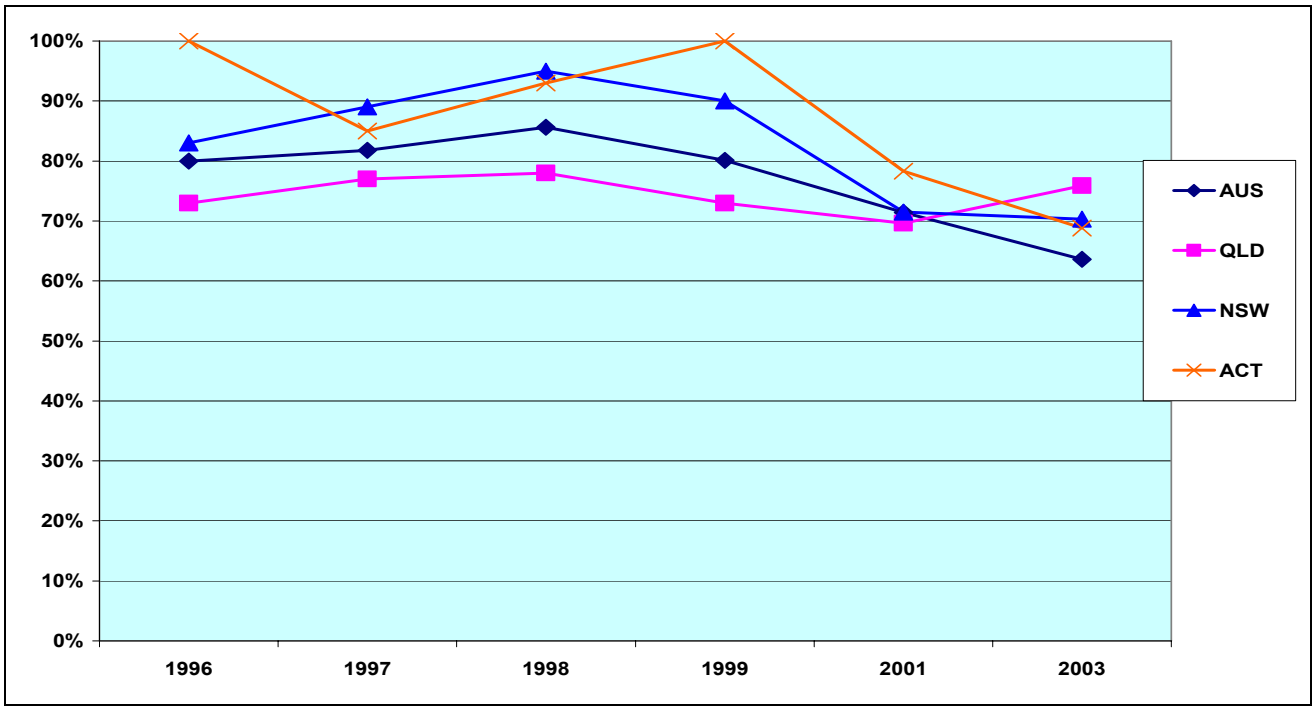
Ciprofloxacin continued





Tetracycline





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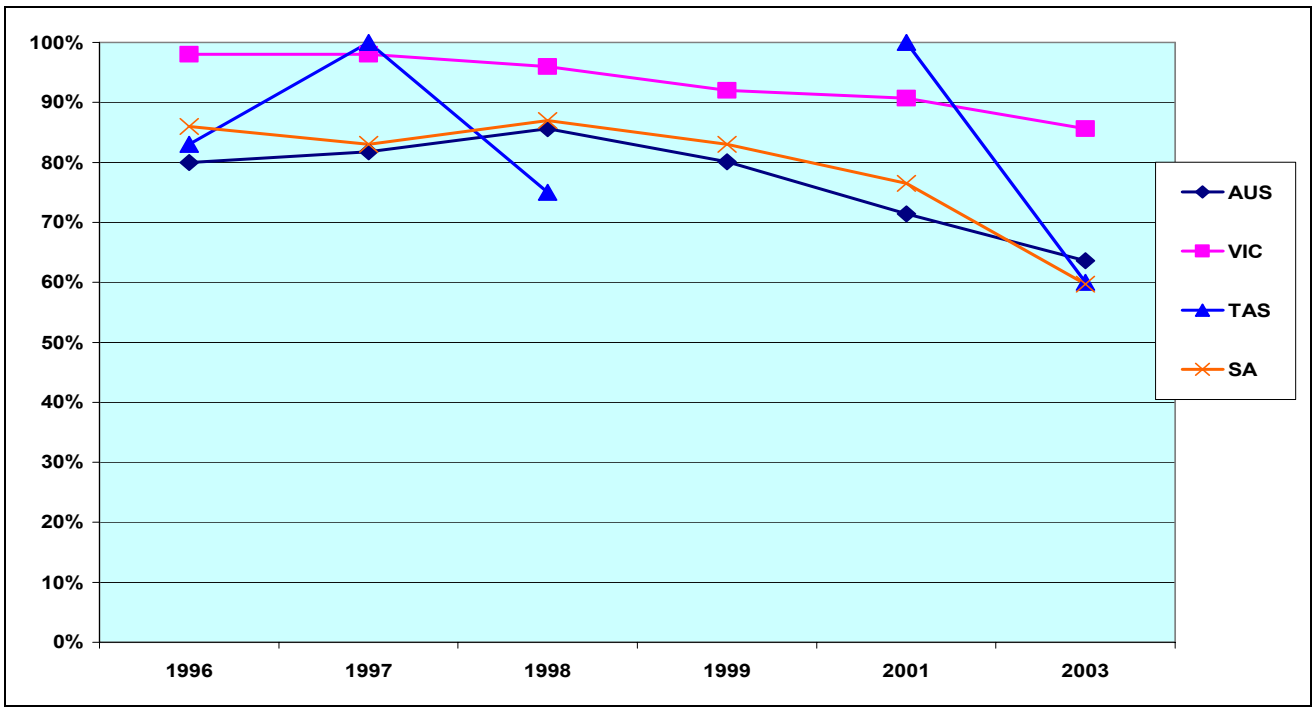
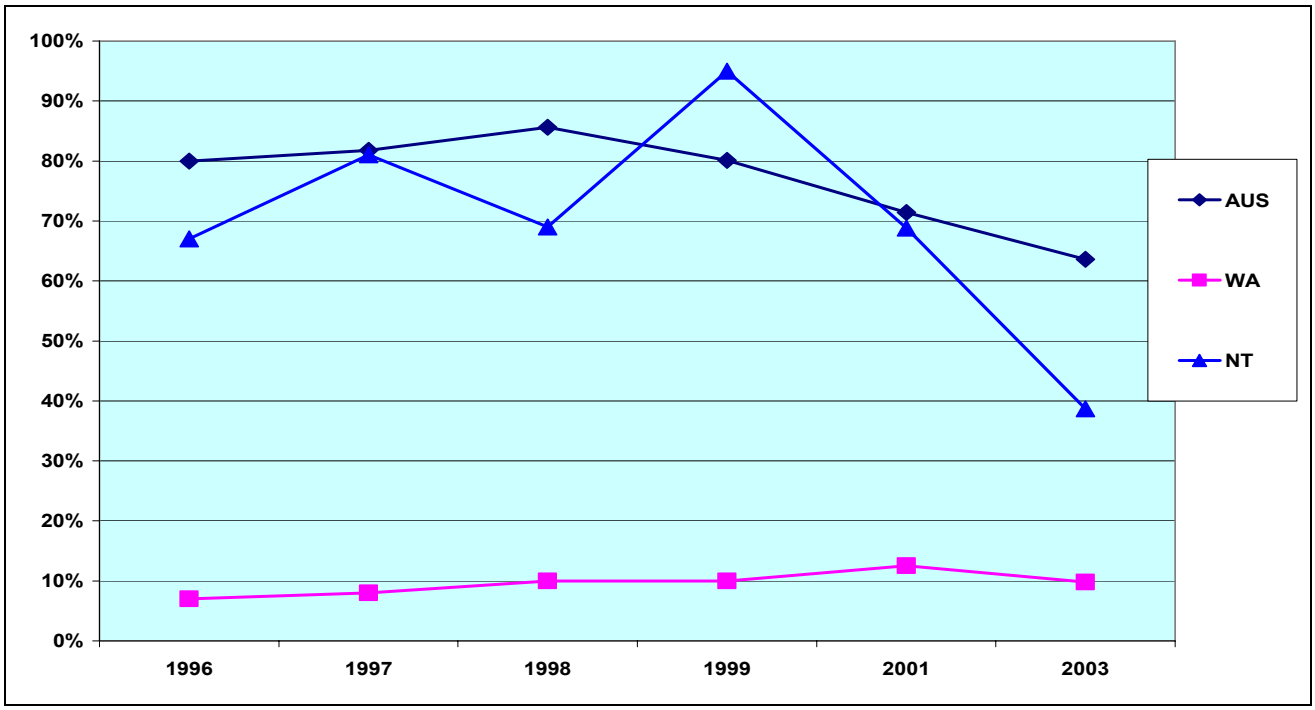
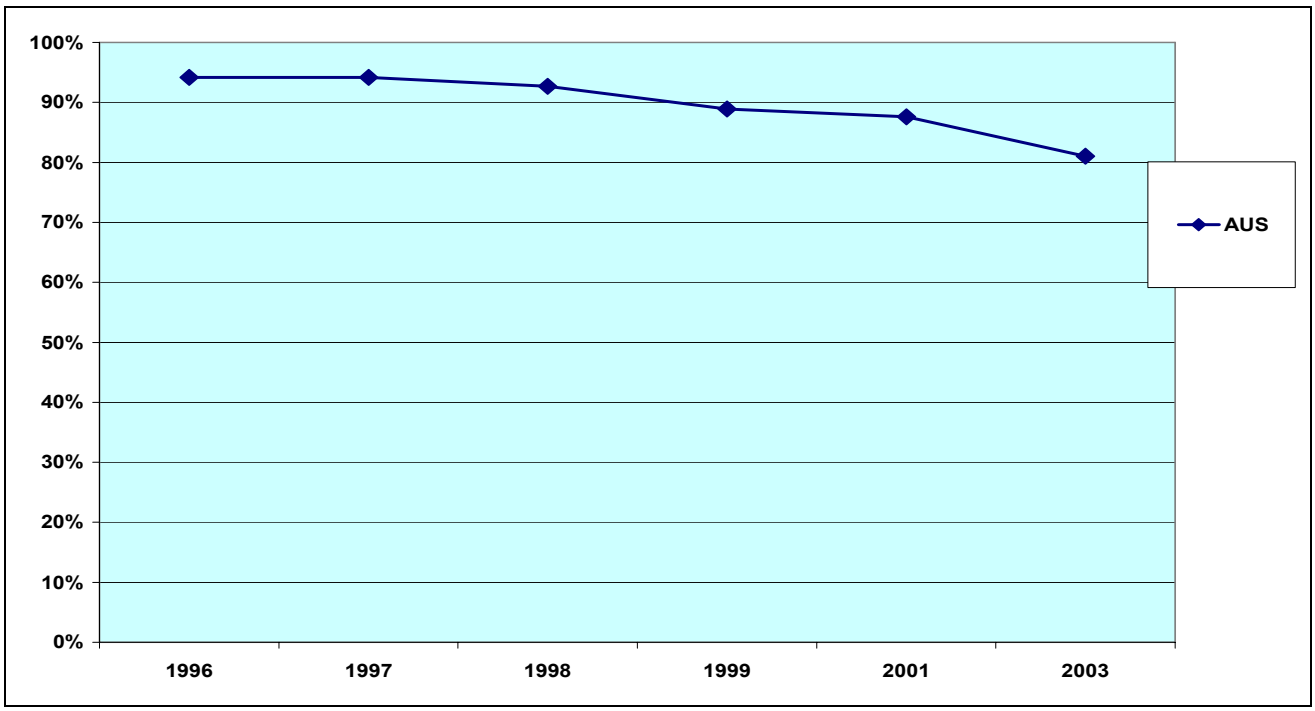
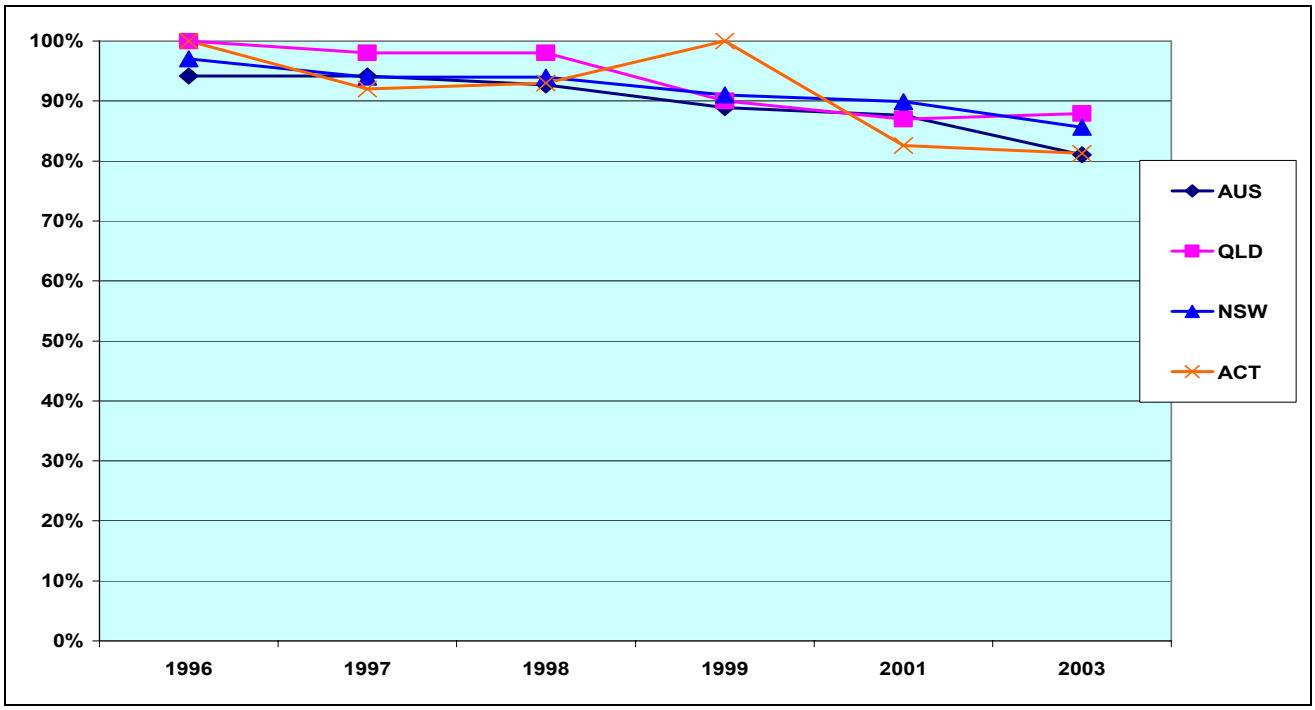


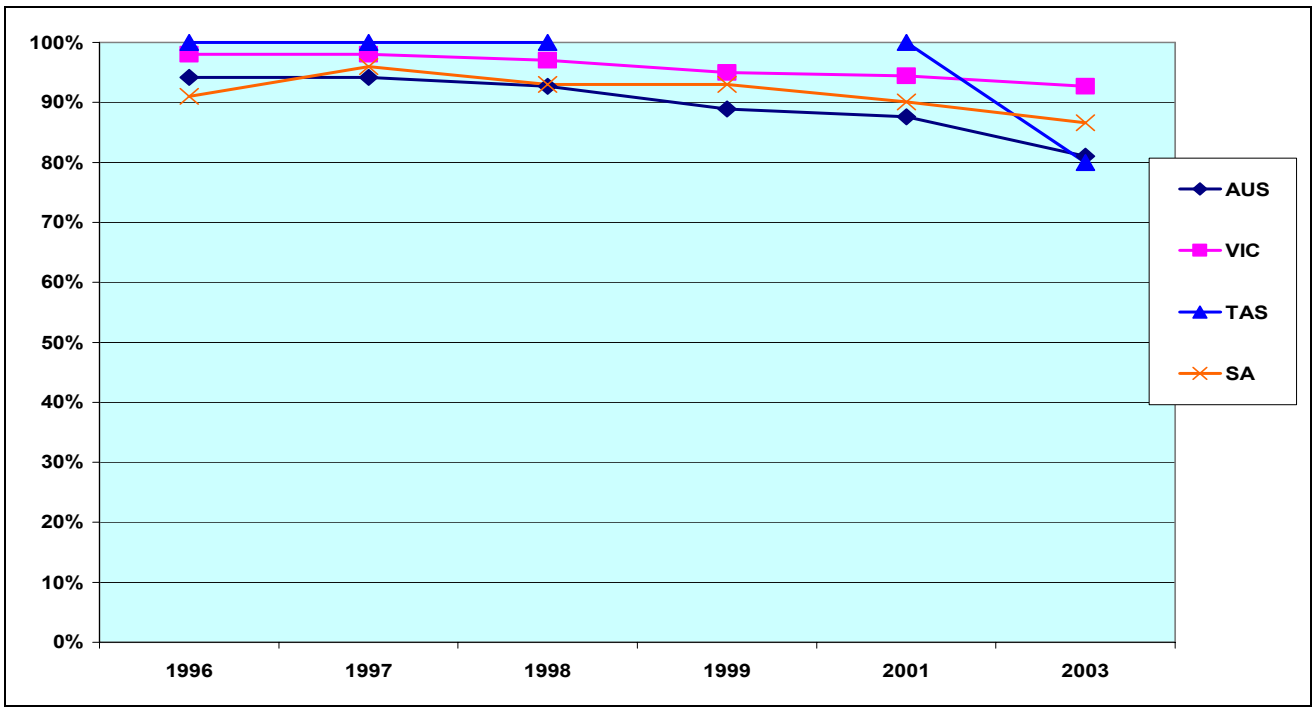


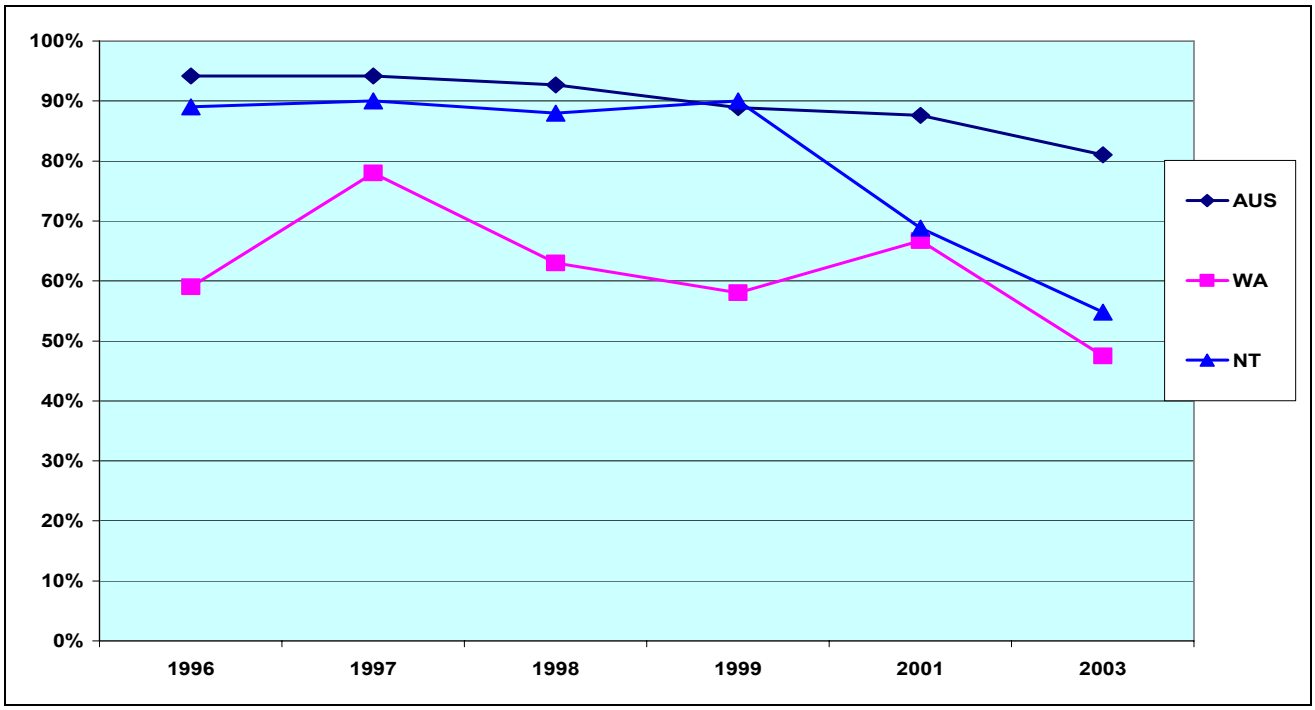
Erythromycin



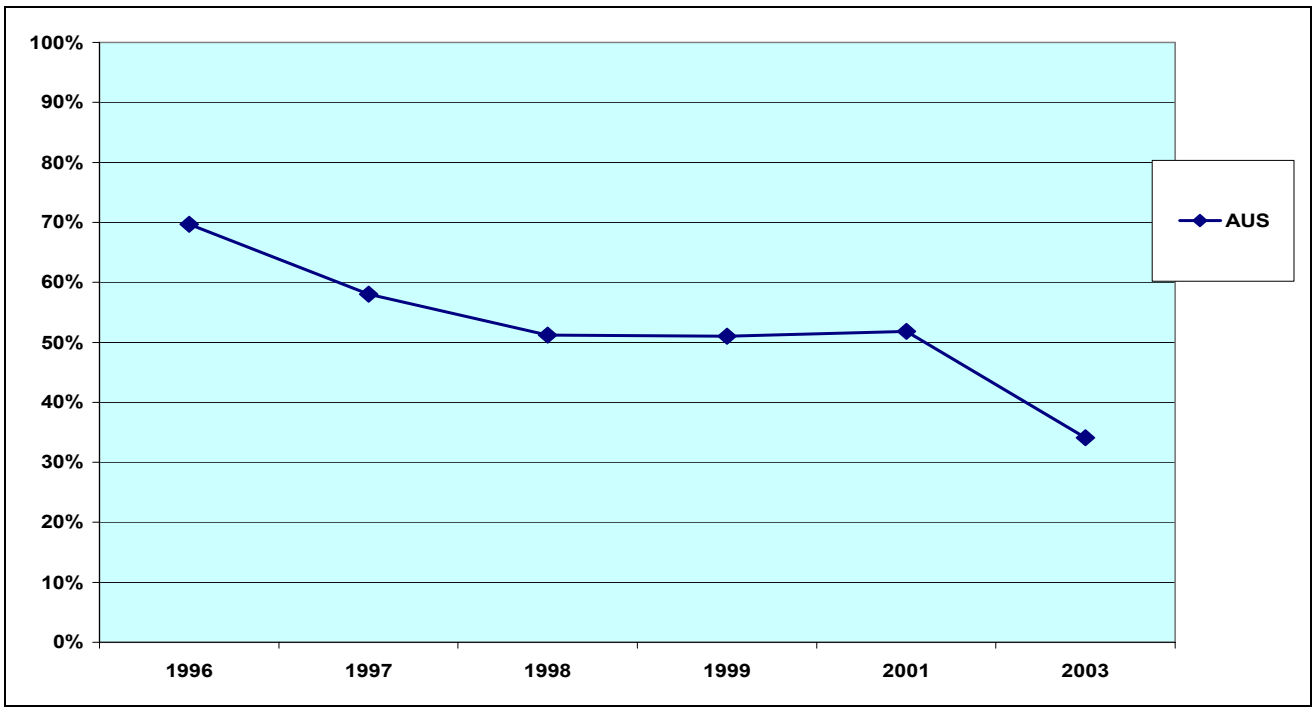


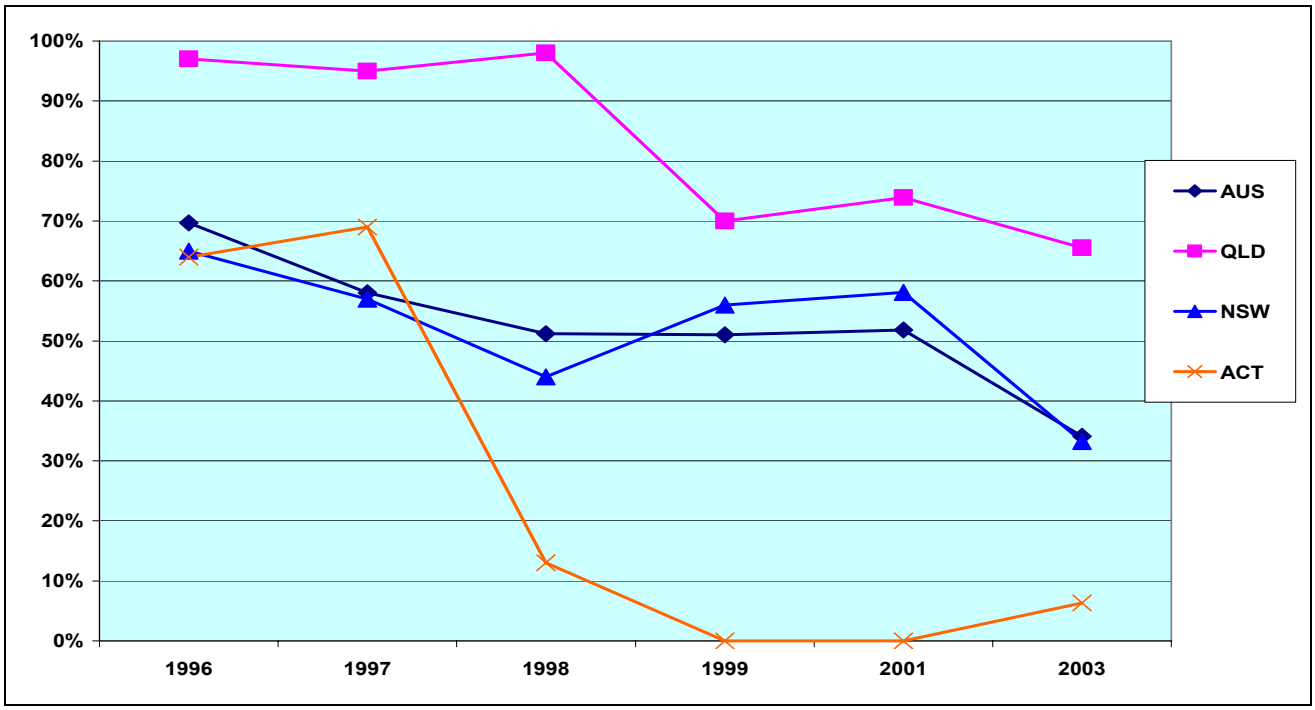
Erythromycin continued





Clindamycin





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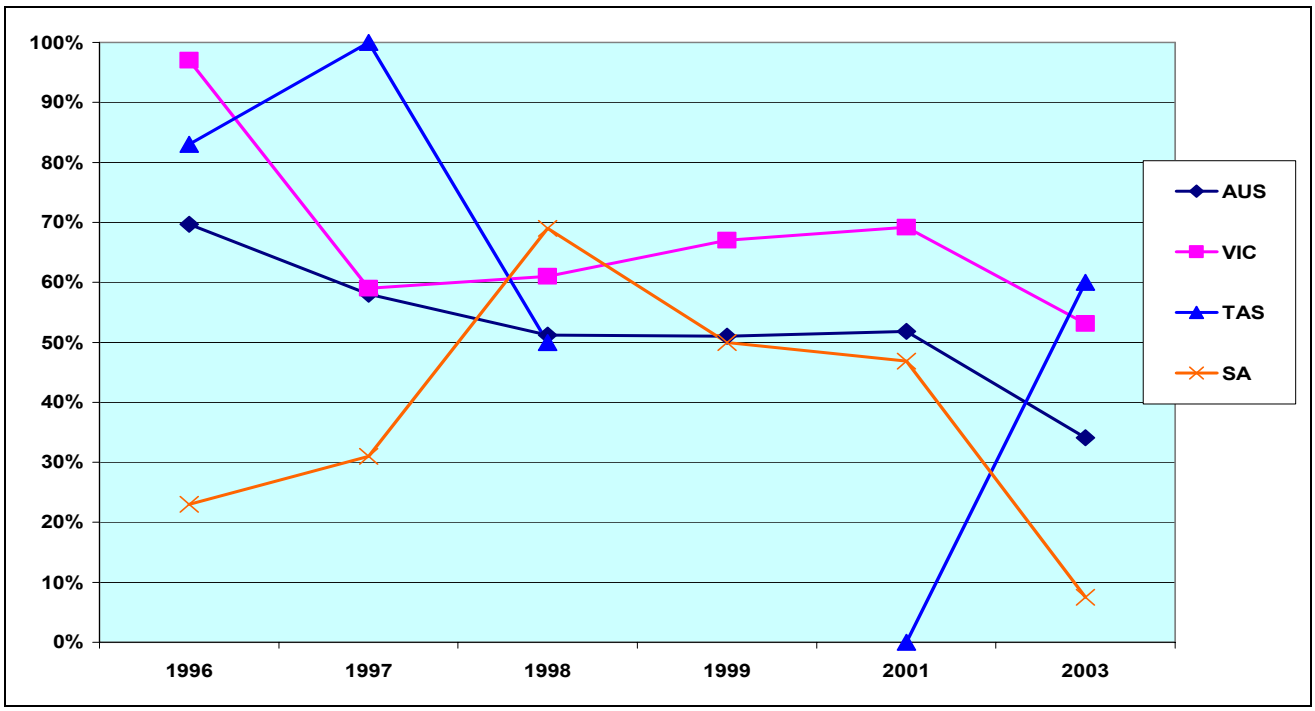
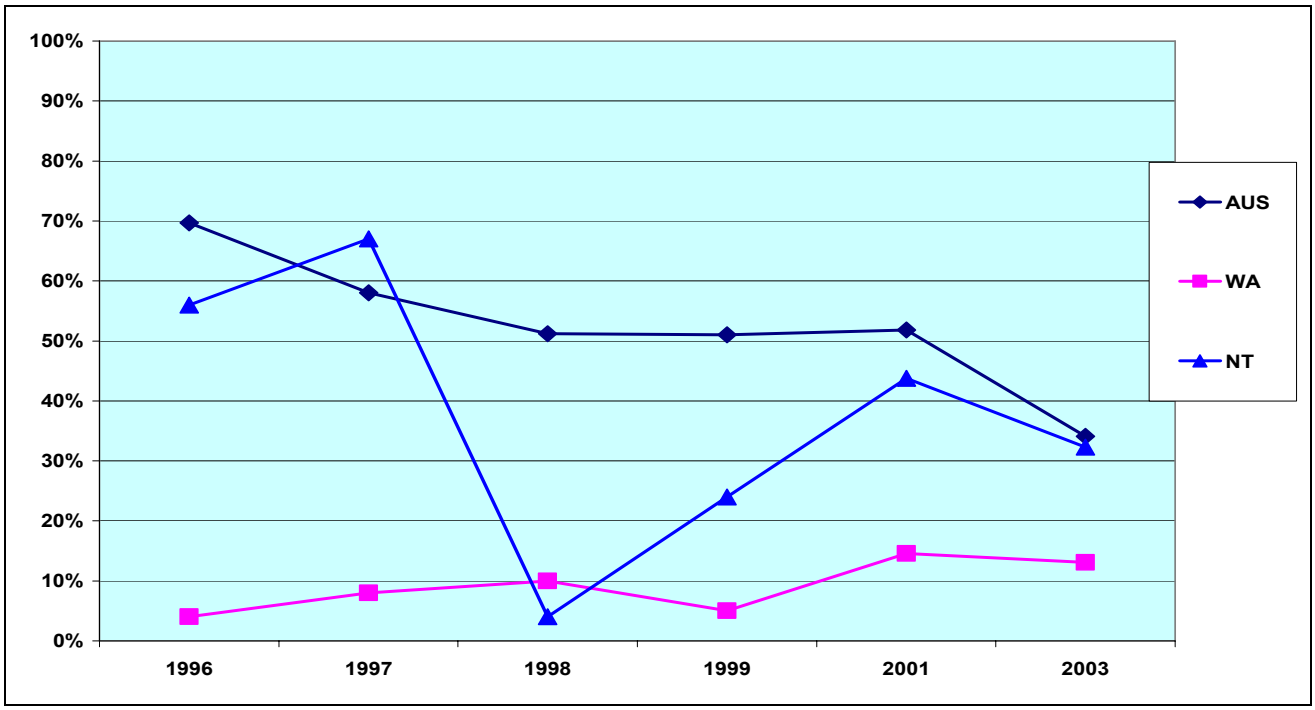
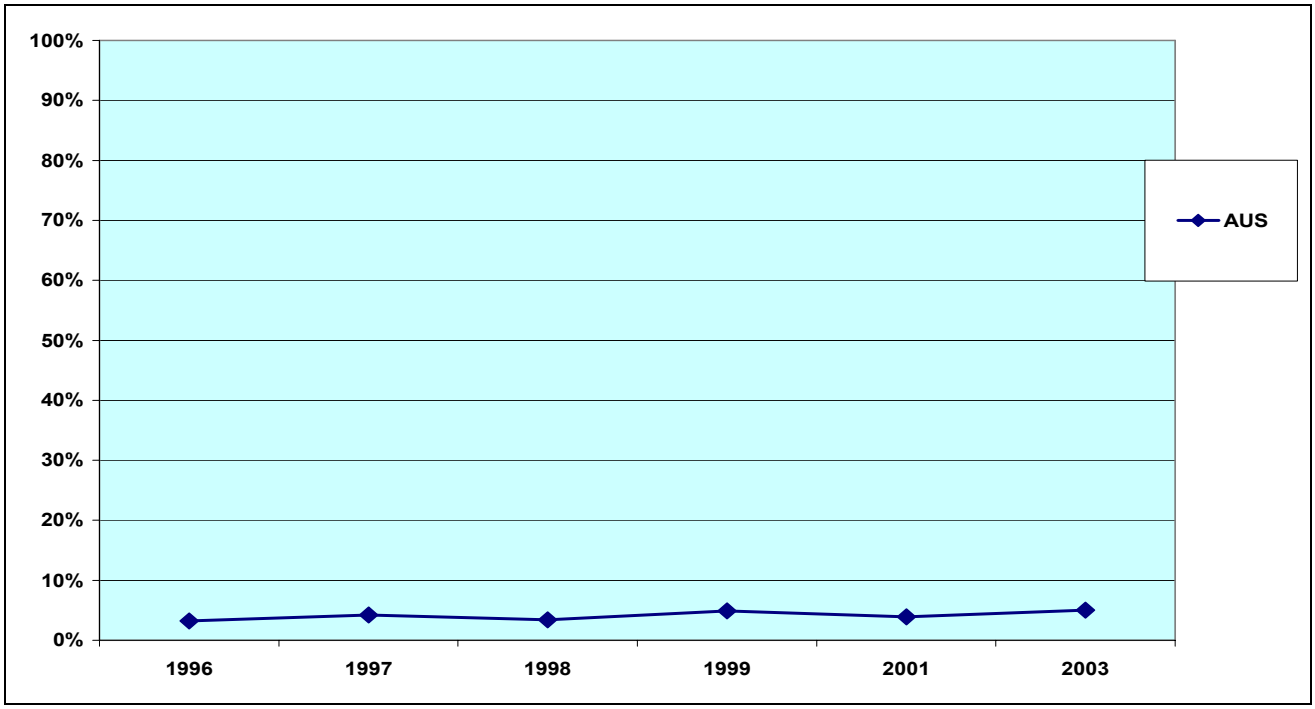
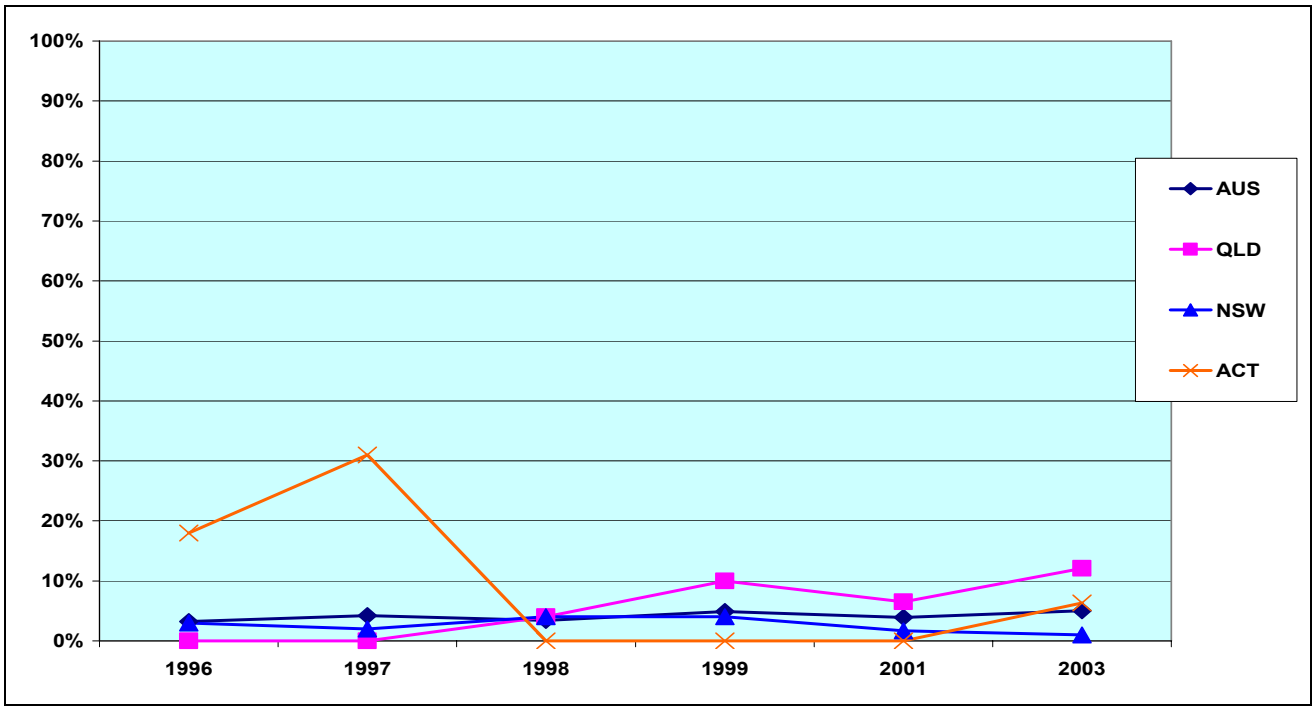


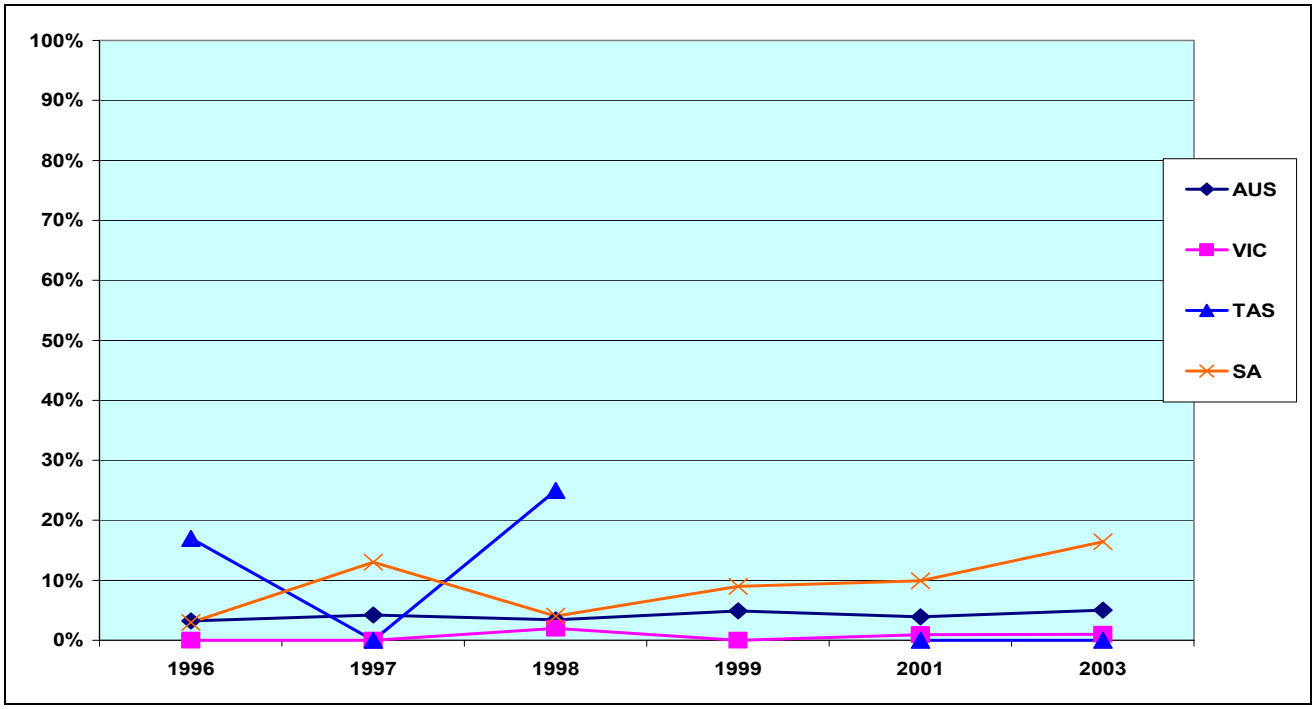


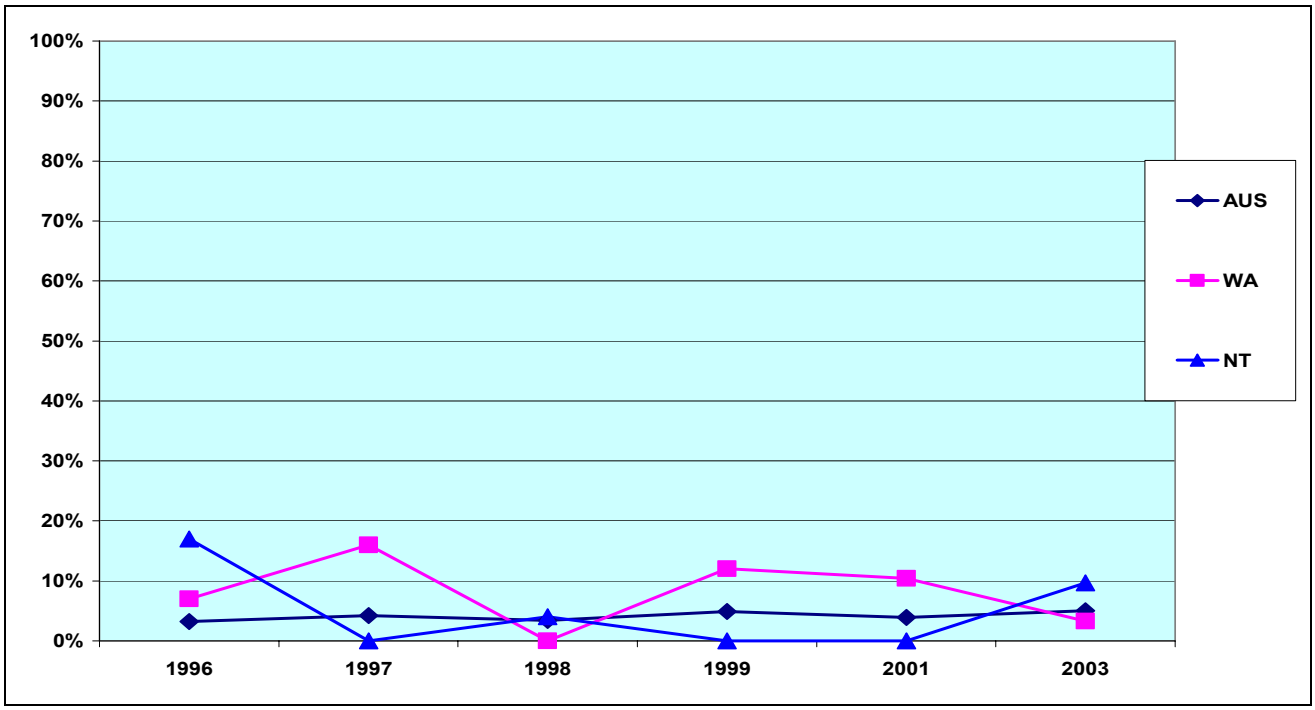
Fusidic acid



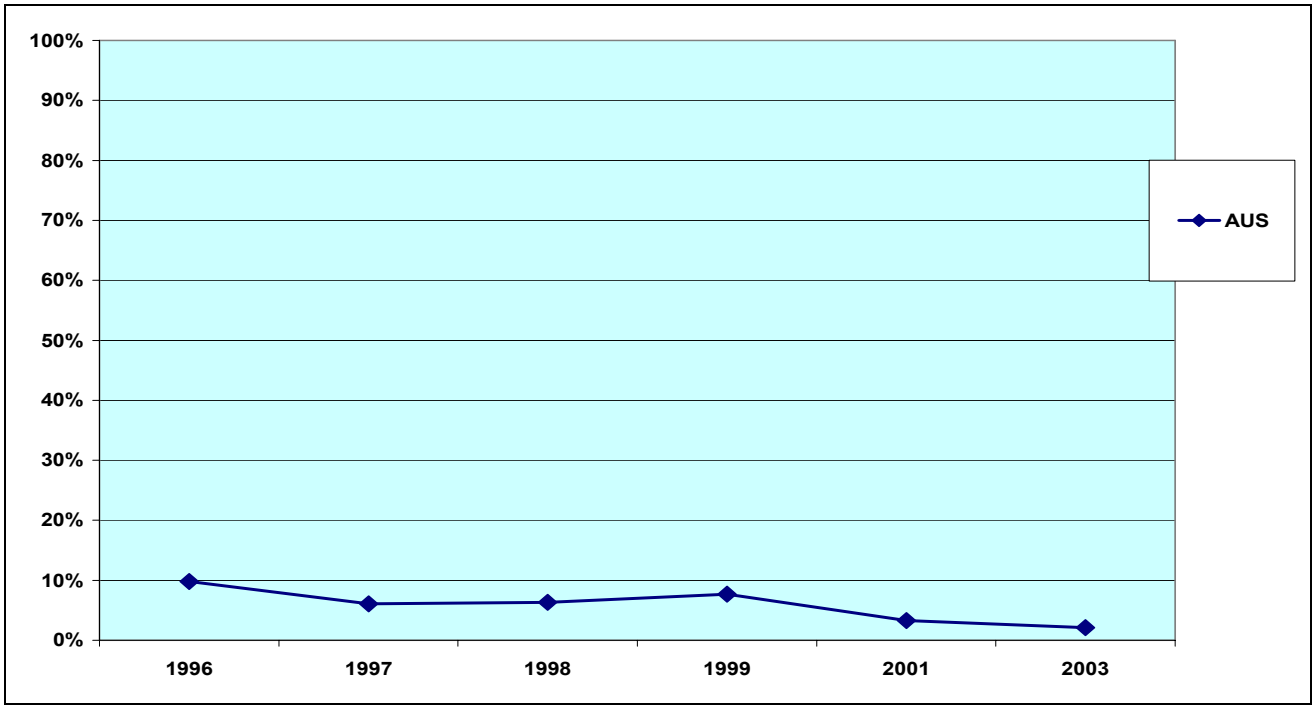


Fusidic acid continued





Rifampicin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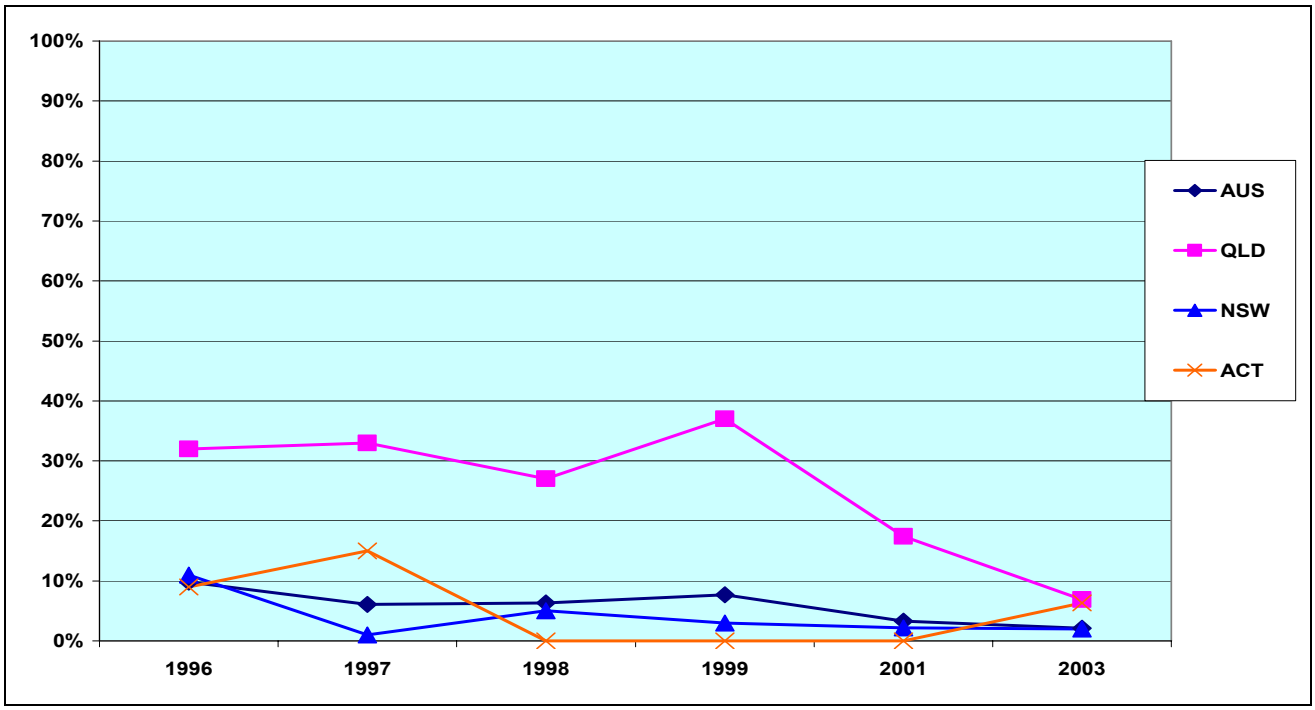
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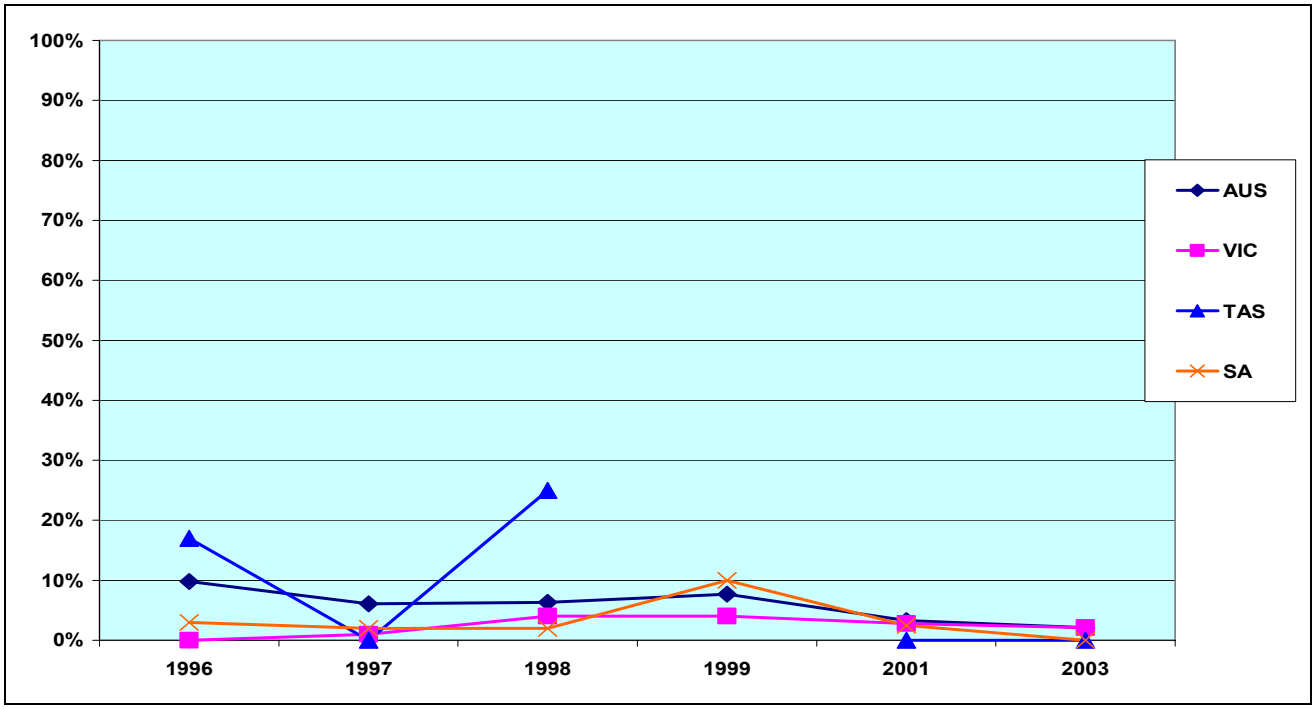
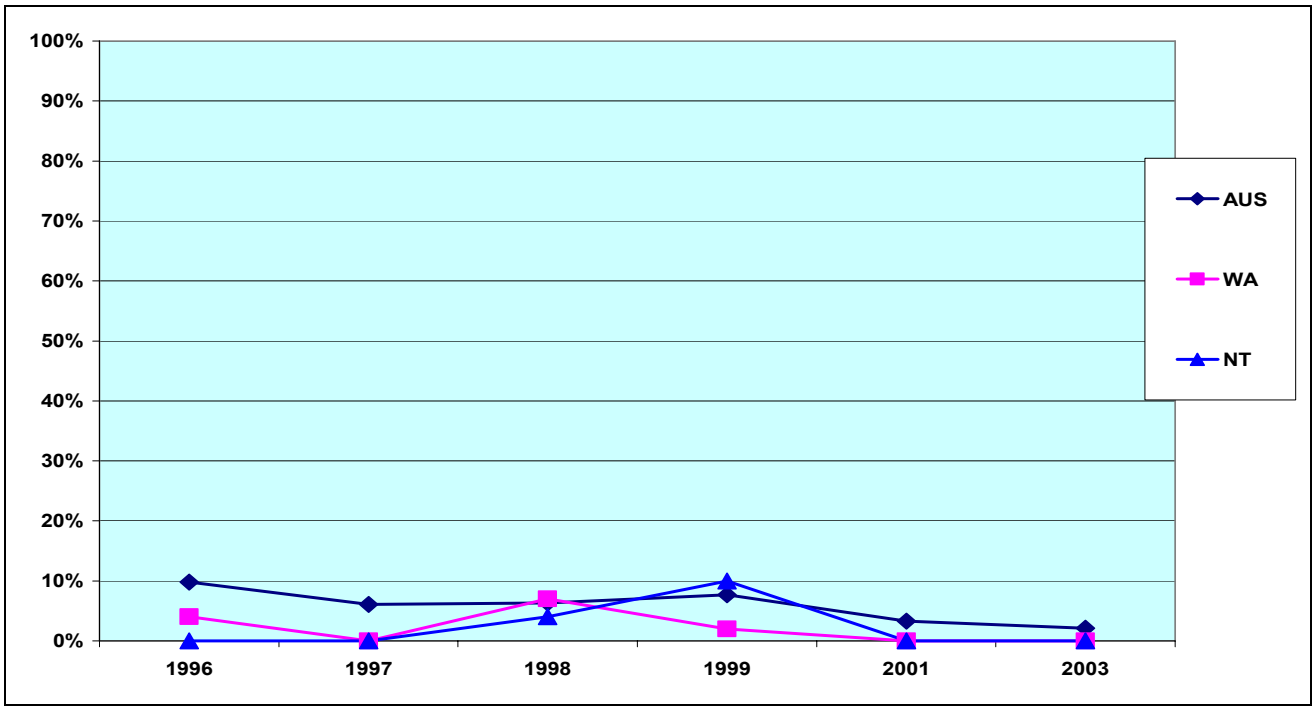
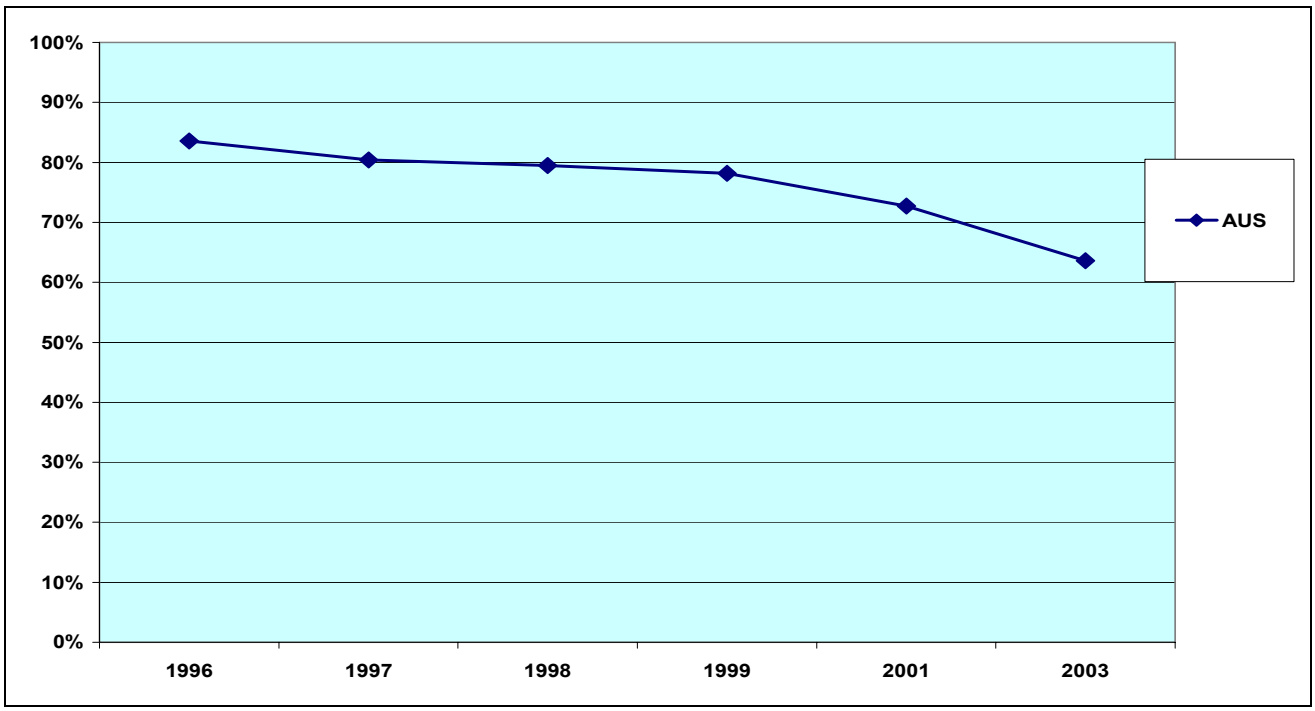
Rifampicin continued





Gentamicin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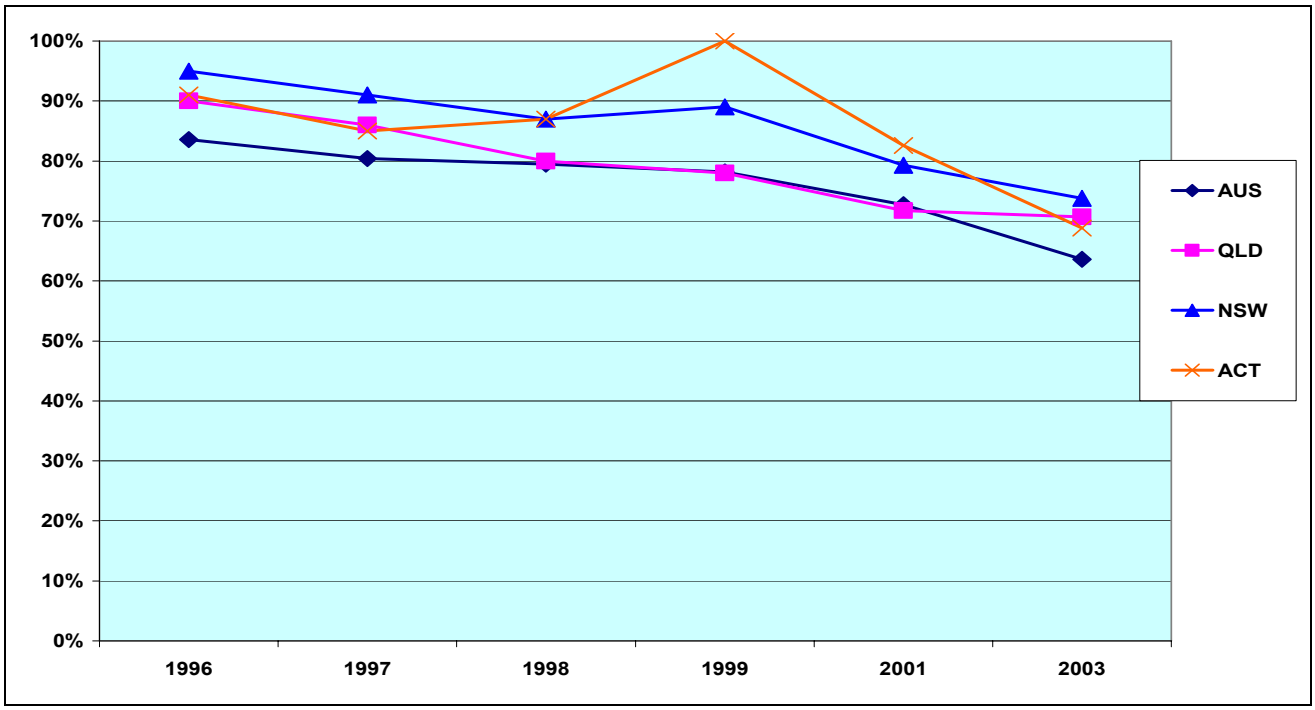
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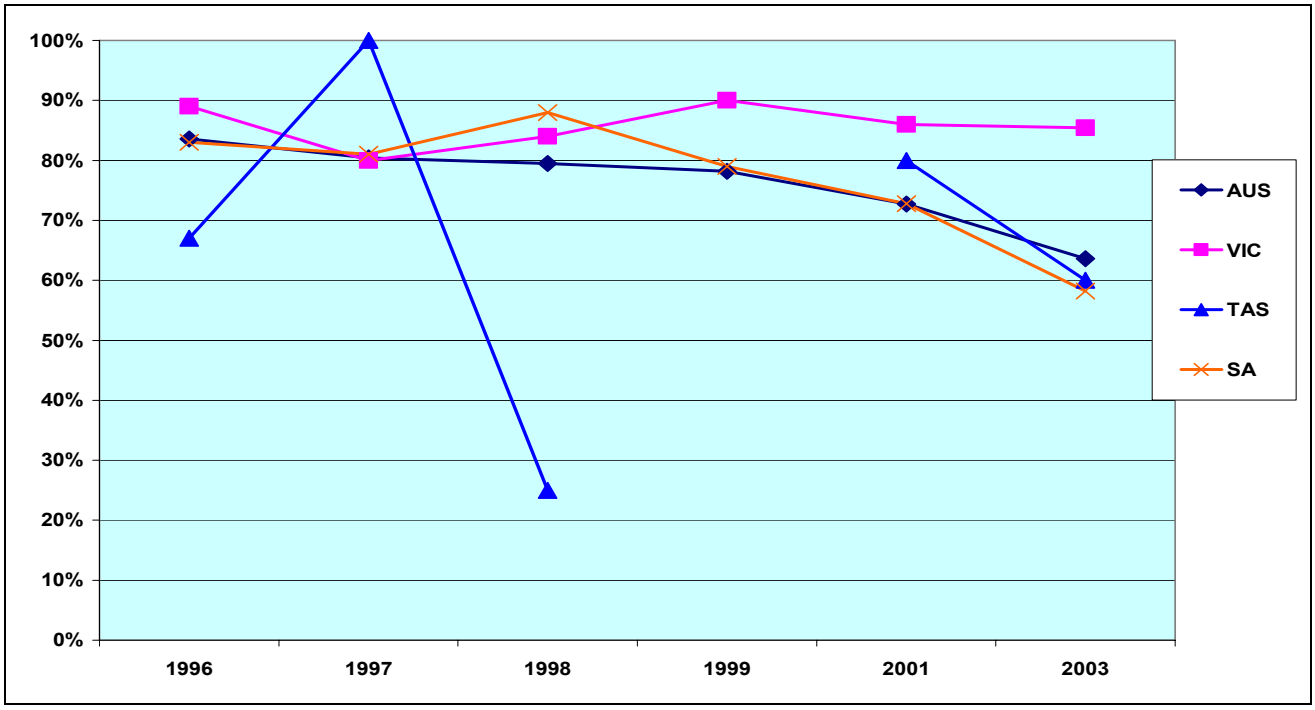
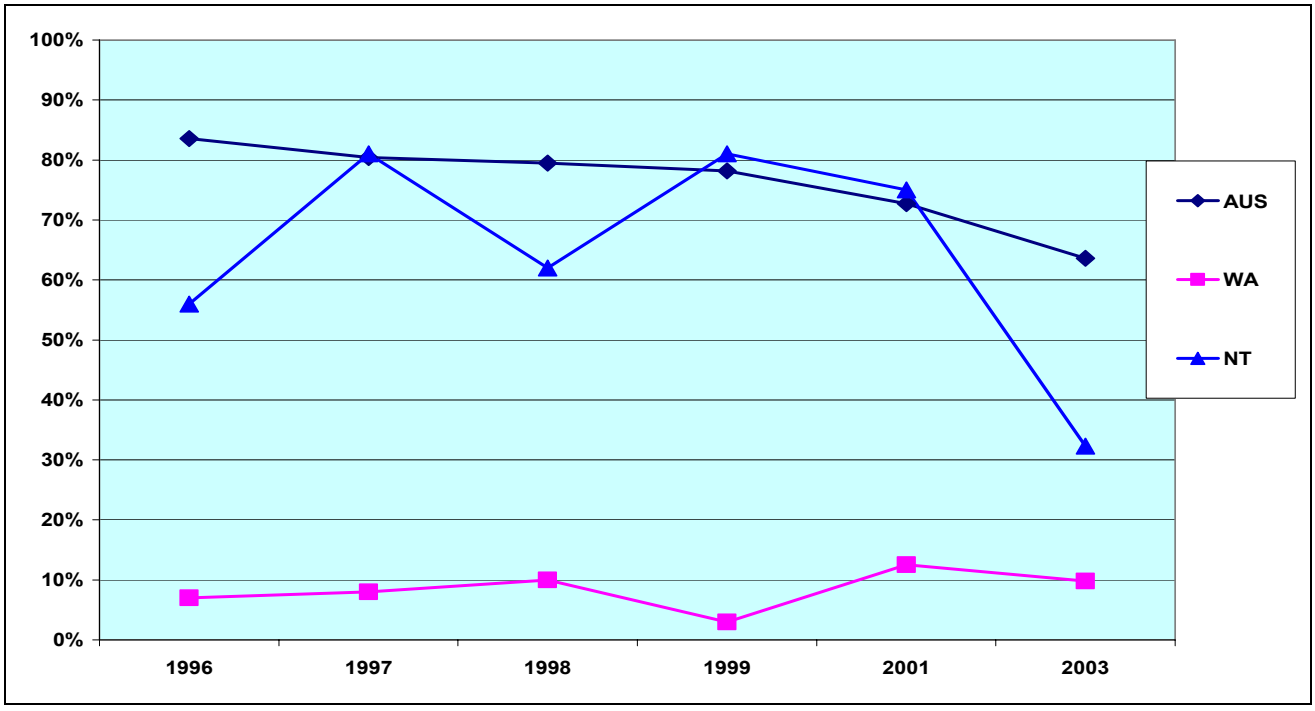
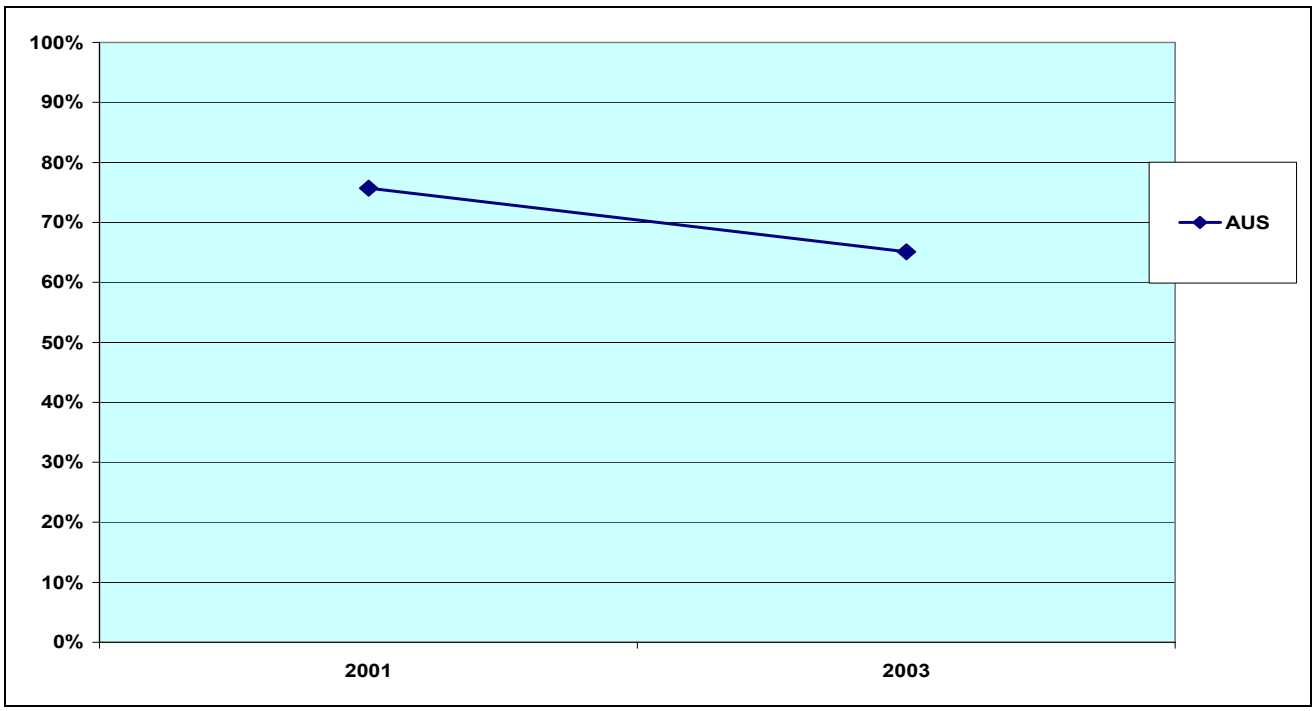
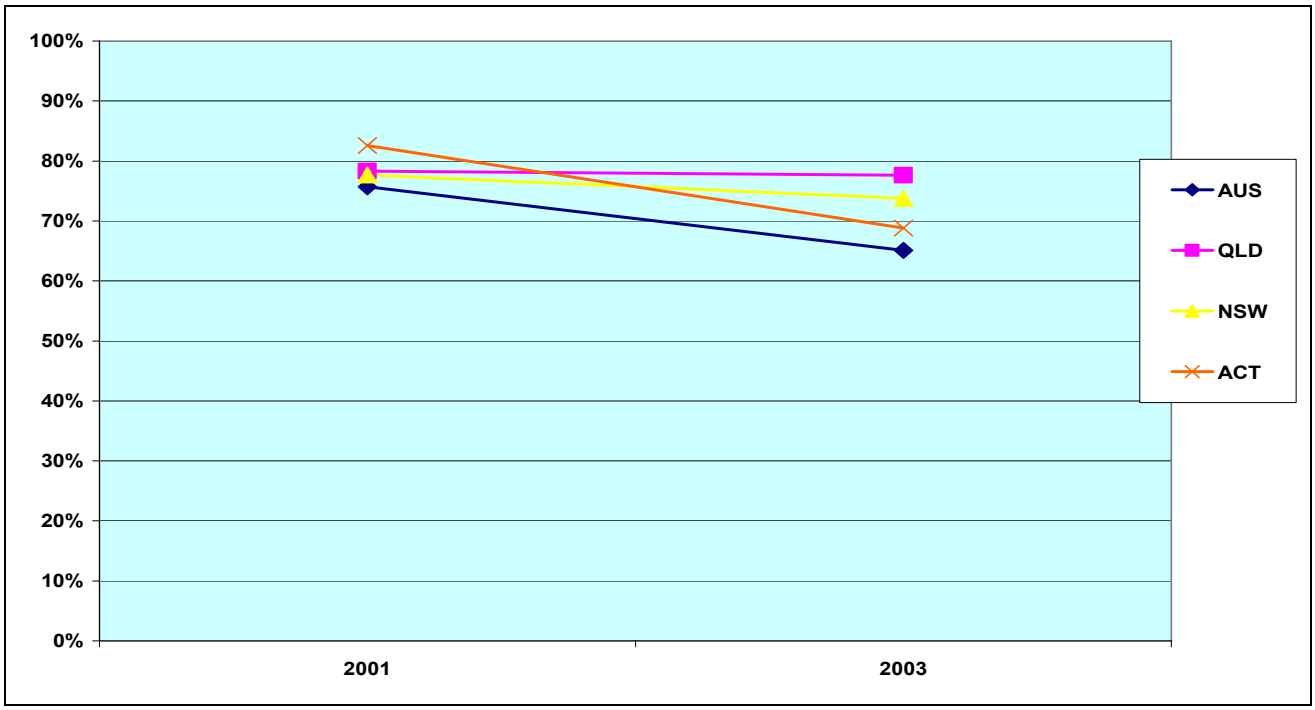




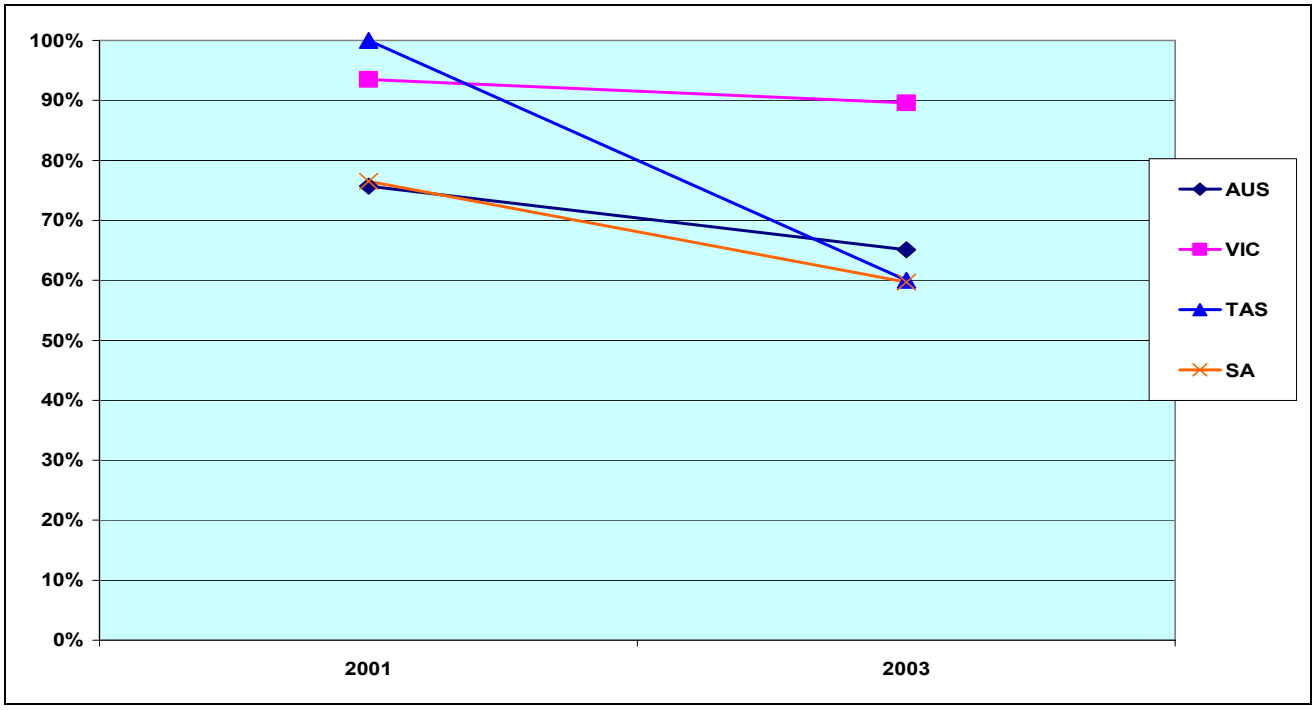
Trimethoprim

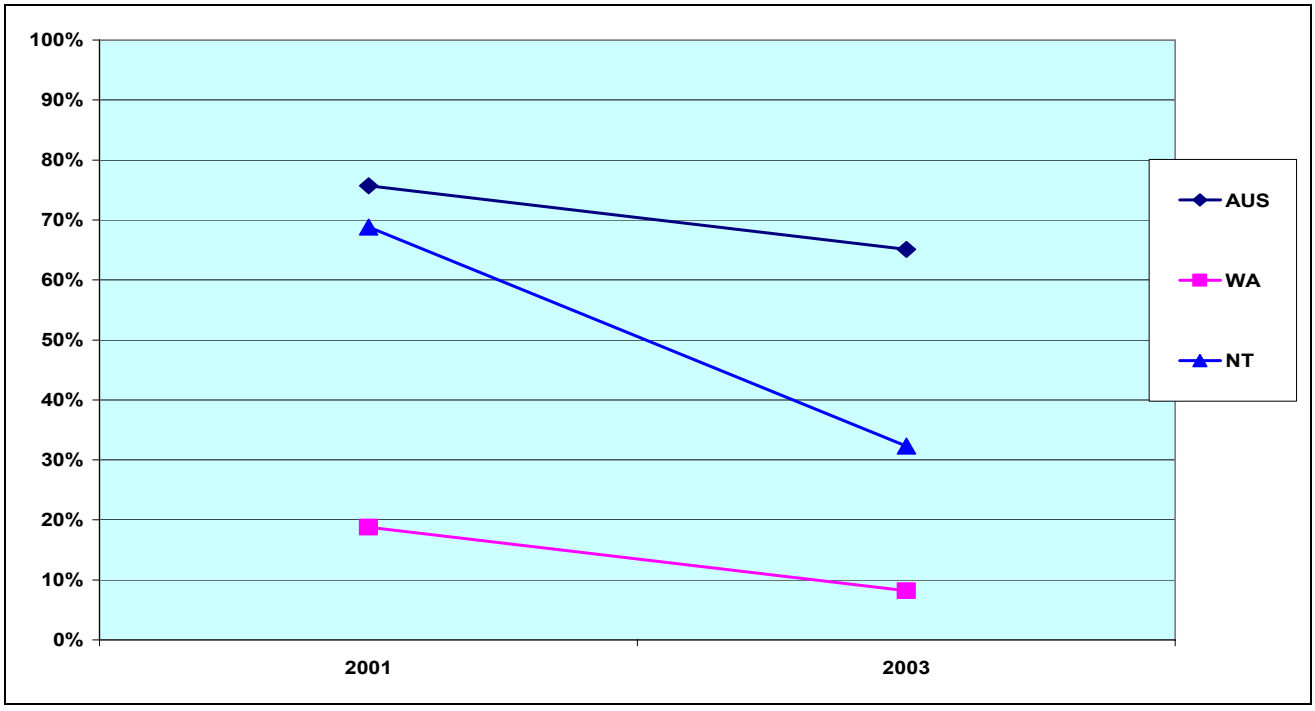
Trimethoprim 8mg/L was introduced in 2001.



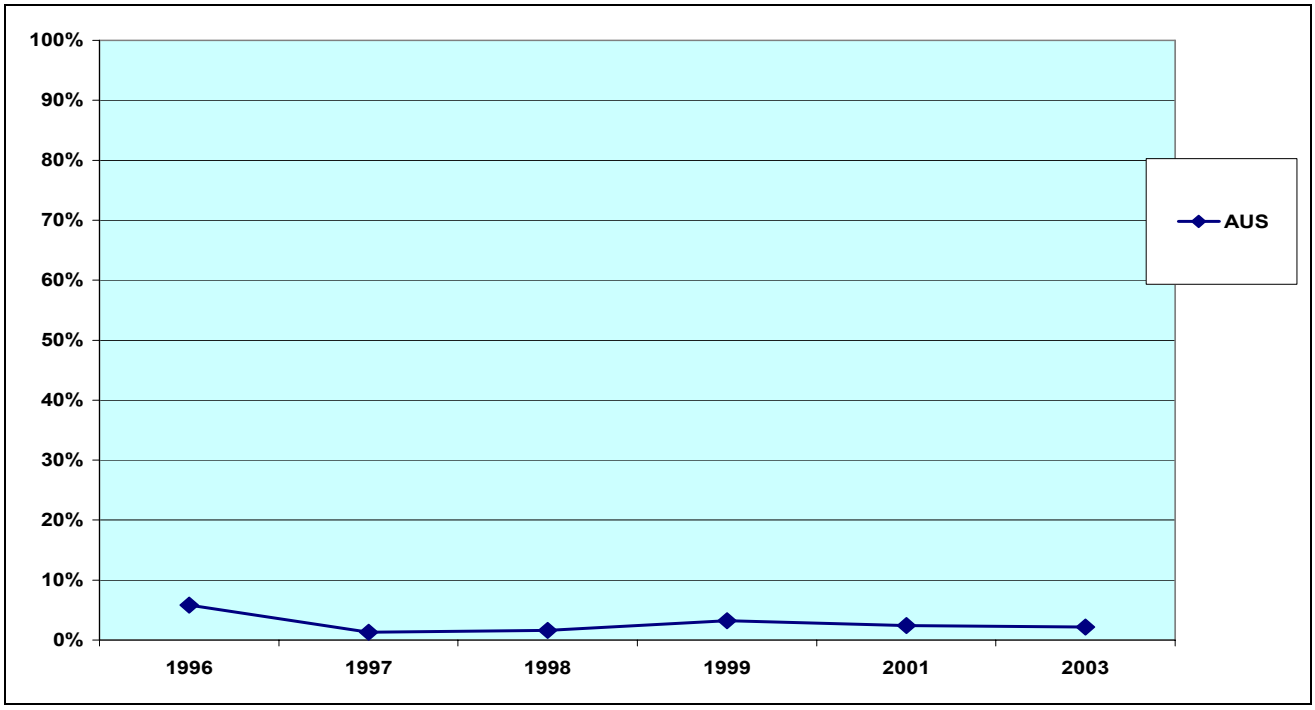


Trimethoprim continued





Mupirocin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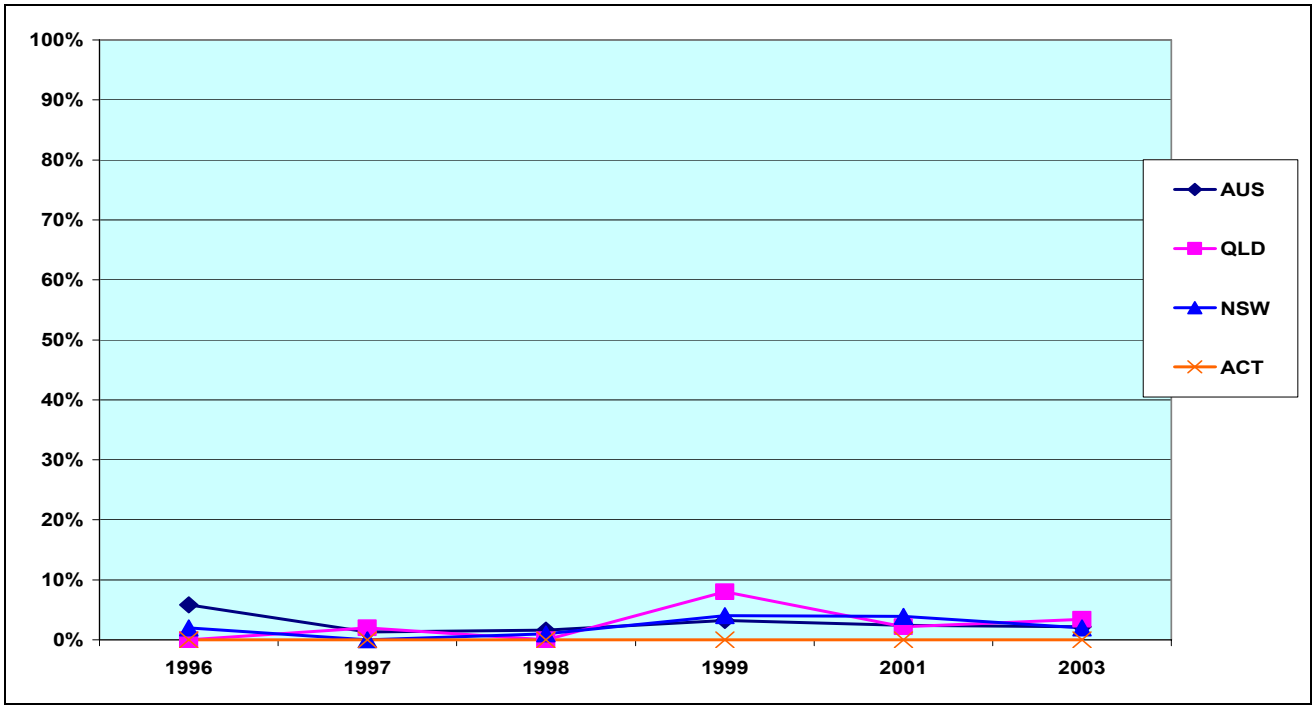
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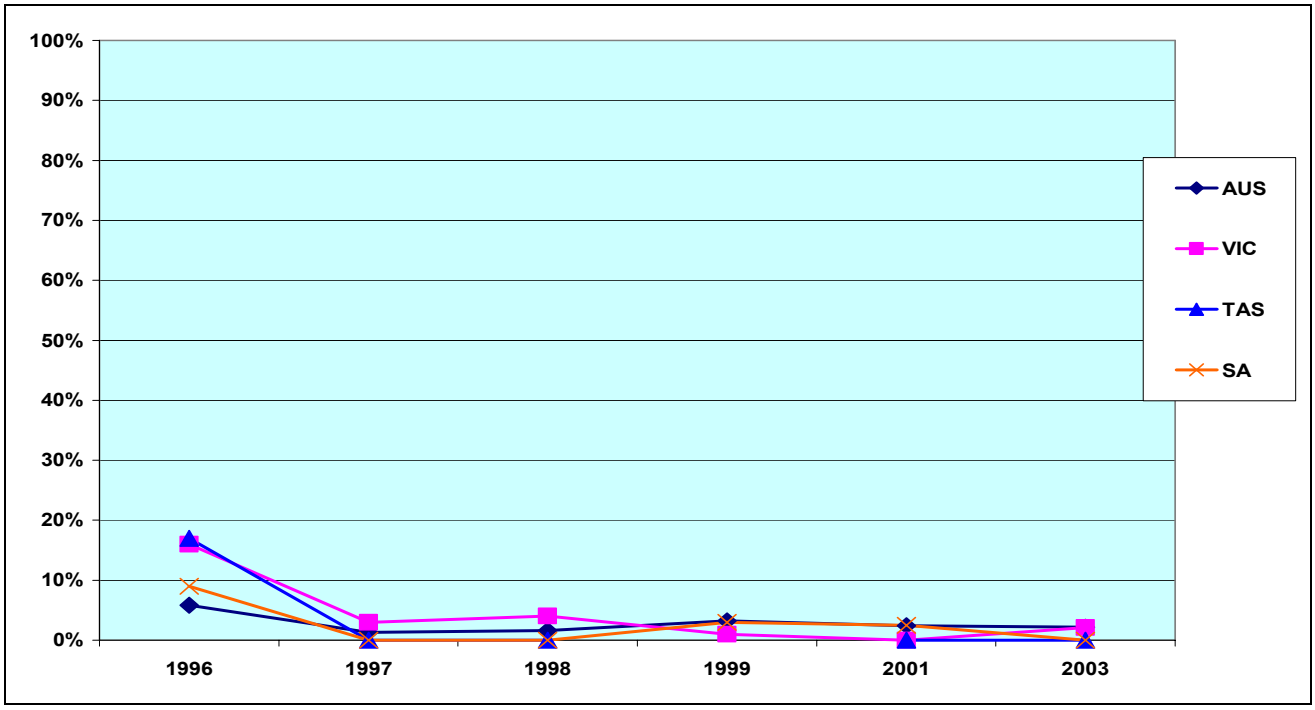
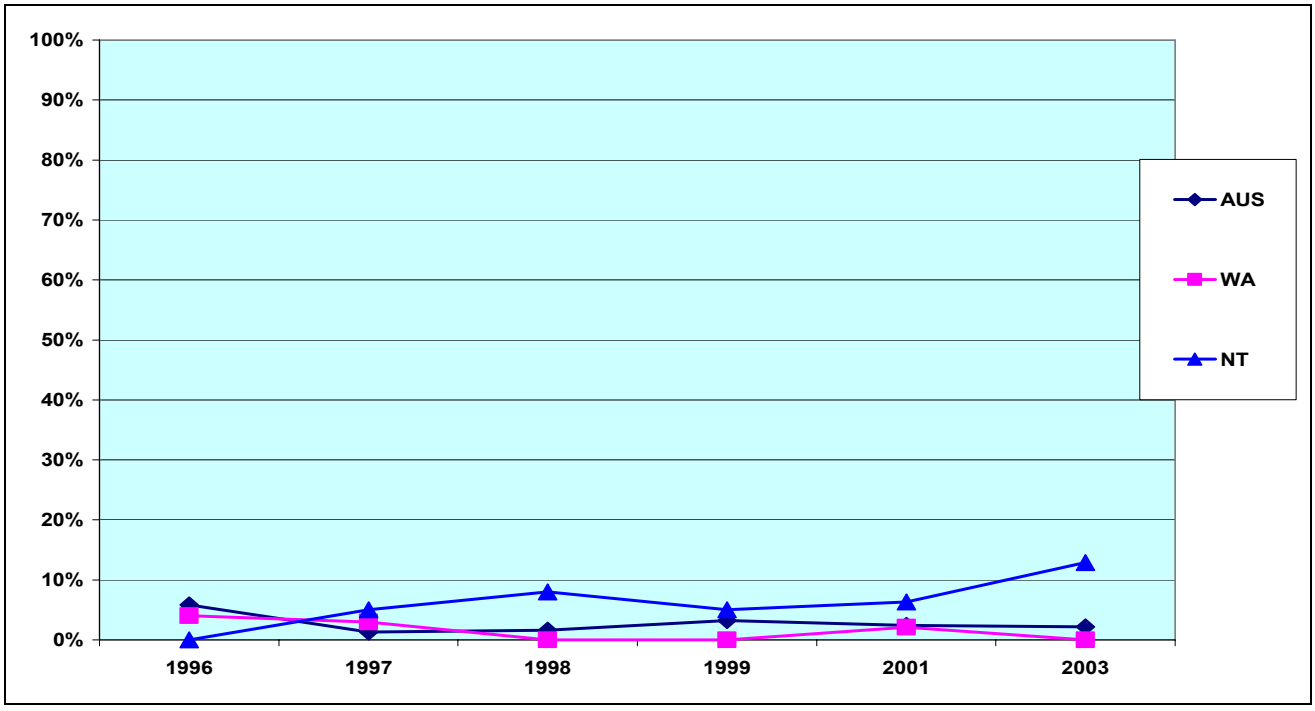
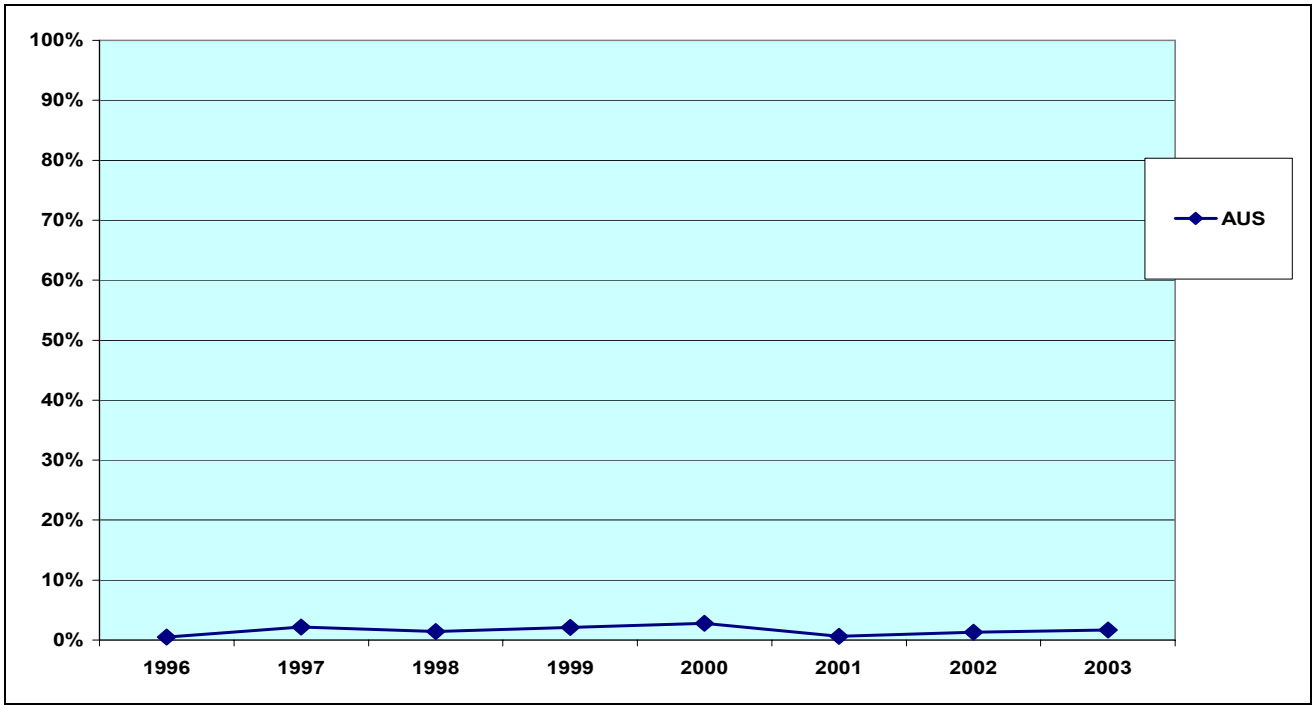
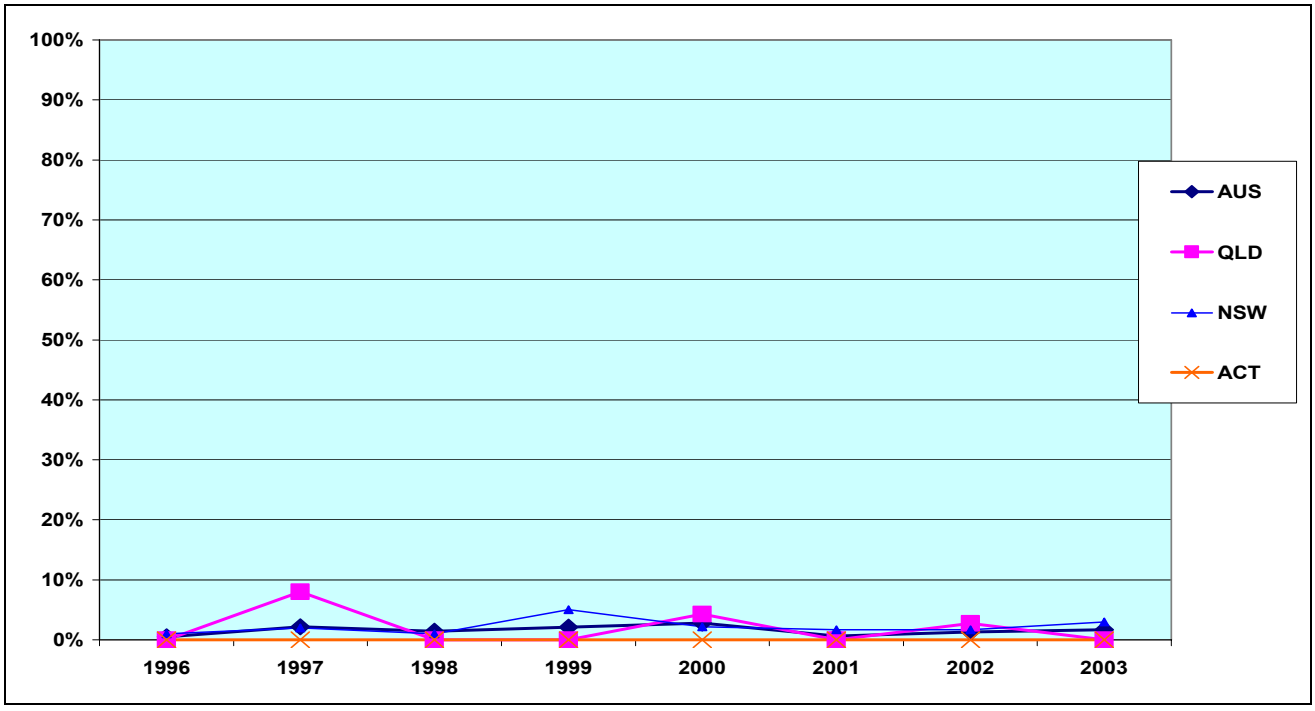


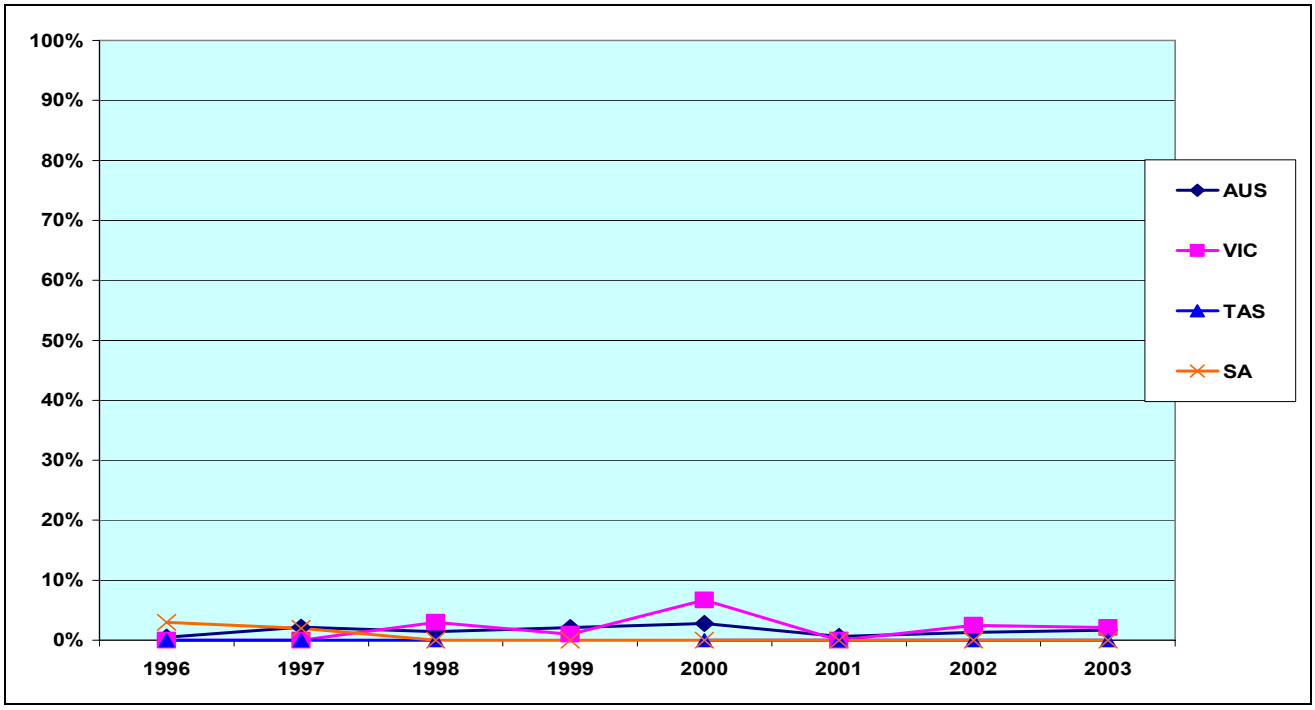


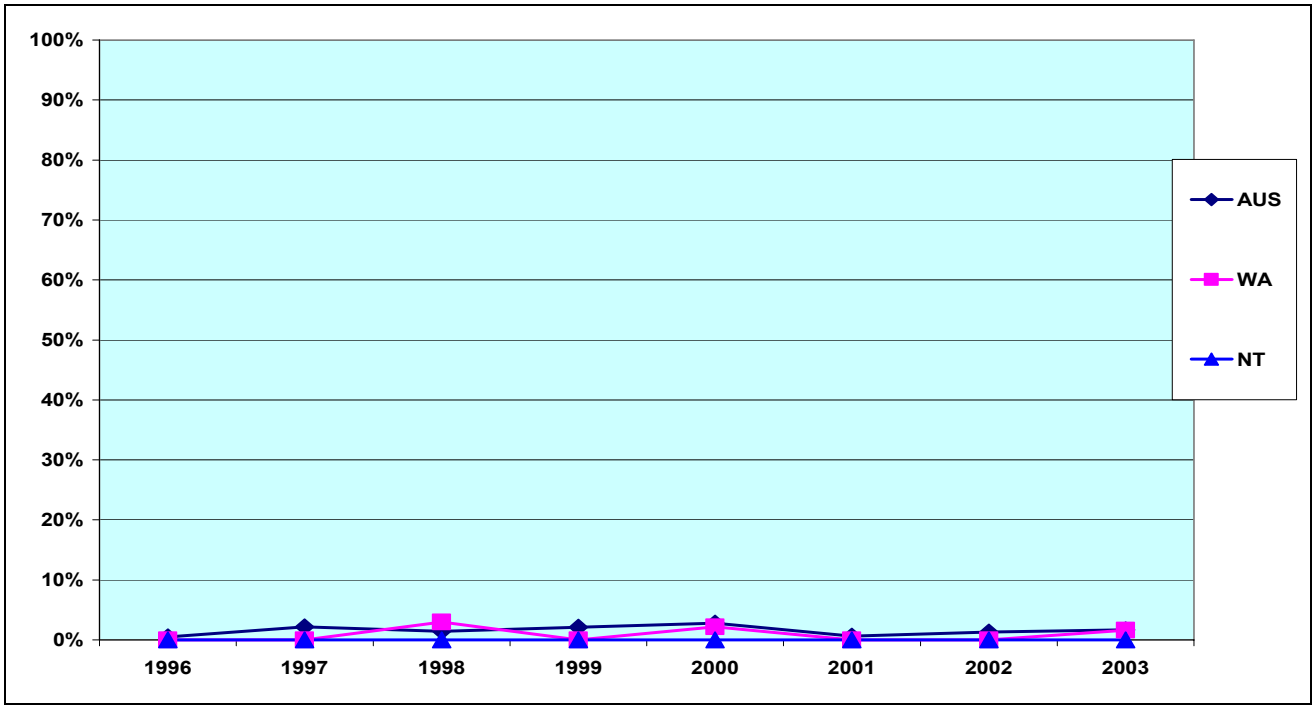
Chloramphenicol





Chloramphenicol continued





APPENDIX 1: ANTIBIOTIC SUSCEPTIBILITY TESTING METHOD.

Medium for General Testing: Mueller Hinton agar (BBL Mueller Hinton II, Cat No. 11438, acumedia, Cat. No. 7101) will be used. Growth-promoting supplements, such as blood, are not to be added. *p*NPG (*paranitrophenylglycerol*) is not to be added. Care must be taken that plates are dried before inoculation.

Medium for Oxacillin Testing: Mueller Hinton agar (as above) supplemented with 2% (w/v) NaCl.

Replicating Apparatus: Steers replicator, Clements replicator, Denley replicator.

Preparation of Inoculum: Only fresh, overnight agar-plate cultures should be used for susceptibility testing. Inoculate portions of 4 or 5 colonies into a tube containing 3 ml of sterile distilled water or saline (0.85%). Adjust the density of the cultures equivalent to that of a 0.5 McFarland standard. Cultures adjusted to this standard contain approximately 1 x 10^8 CFU/ml. Dilute the adjusted inoculum 1:10, in sterile distilled water or saline, in order to provide a suspension that is approximately 1 x 10^7 CFU/ml. Most replicators deposit approximately 1 µl on the agar surface; the final inoculum on the agar will be approximately 1 x 10^4 CFU per replicator spot.

Control Strains: The following five control strains are to be used for each replicator:

(1) *Staphylococcus aureus* (ATCC 25923)
(2) *Staphylococcus aureus* (ATCC 29213)
(3) *Staphylococcus epidermidis* (ATCC 14990)
(4) *Escherichia coli* (ATCC 25922)
(5) *Enterobacter cloacae* (ATCC 13047)

The inocula for the control strains are prepared in the same manner as the test cultures. The cultures may be obtained from Clarence Fernandes (RNS).

Expected results for the control strains are provided in Appendix 1. If the results obtained by the participating laboratory do not conform to the expected results, the laboratory should repeat the testing.

Incubation of Plates: Plates containing oxacillin and methicillin are incubated at 35^{o}C for 24 hours. All other plates are incubated at 35^{o}C for 16 - 20 hrs.

Interpretation of Growth: When growth as seen by the naked eye is less than that seen on the antibiotic-free control plate, the following rules should be observed:

(1) Single colonies: One single colony on an antibiotic plate is to be ignored, except for fusidic acid and rifampicin. More than one colony is significant; the organism should be considered resistant.

(2) One or more than one colony on fusidic acid and rifampicin - the organism should be retested. On retesting, more than 2 single colonies on fusidic acid and rifampicin should be observed before considering these colonies as significant i.e. organism is resistant.

(3) Resistance to vancomycin 2 mg/L or teicoplanin 2 mg/L should be retested.

(4) When small amounts of growth or haze is present, interpret as follows:

Interpret as significant growth (Resistant to the antibiotic)		Interpret as not significant growth (Susceptible to the antibiotic)
Penicillin	Vancomycin	Chloramphenicol
Oxacillin	Teicoplanin	Tetracycline
Clindamycin	Ciprofloxacin	Trimethoprim
Erythromycin	Mupirocin	
Rifampicin	Linezolid	
Fusidic acid	Gentamicin	
Quinupristin/dalfopristin	Oritavancin	

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