



**National Public Health
Service for Wales**

**Gwasanaeth Iechyd Cyhoeddus
Cenedlaethol Cymru**

Antimicrobial Resistance in Wales (2006)

Authors: Maggie Heginbotham Robin Howe	Date: 20/11/2007	Status: Final
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Table of Contents

Table of Contents	2
Section 1: Introduction	3
Section 2: Key points of interest.....	6
Section 3: Synopsis of all-Wales resistance rates.....	8
Section 4: Methods	11
Section 5: Antimicrobial resistance rates for the most common organisms causing bacteraemia in 2006	13
<i>Background</i>	13
<i>Escherichia coli</i>	15
<i>Klebsiella spp.</i>	19
<i>Serratia spp.</i>	21
<i>Enterobacter spp.</i>	23
<i>Pseudomonas aeruginosa</i>	25
<i>Meticillin Sensitive Staphylococcus aureus (MSSA)</i>	27
<i>Meticillin Resistant Staphylococcus aureus (MRSA)</i>	29
<i>Enterococcus spp.</i>	31
<i>Streptococcus pneumoniae</i>	33
Section 6: Antimicrobial resistance rates for urinary coliforms	35
<i>Community Urinary Coliforms</i>	37
<i>In-patient Urinary Coliforms</i>	41
Section 7: Antimicrobial resistance rates for <i>S. aureus</i> from general practice wound swabs.....	43
<i>MSSA</i>	45
<i>MRSA</i>	47
Section 8: Antimicrobial resistance rates for other pathogens	49
<i>S. pneumoniae</i>	51
<i>Streptococcus pyogenes</i>	53
<i>Haemophilus influenzae</i>	55
<i>Campylobacter species</i>	56
Acknowledgments.....	57

Section 1: Introduction

Welsh Antimicrobial Resistance Programme Surveillance Unit

This is the first annual report from the Welsh Antimicrobial Resistance Programme Surveillance Unit, and is aimed at providing an overview of antimicrobial resistance in Wales. Given the unique access to microbiological data available across Wales (see below), the report has had to be selective in what is presented. However we would welcome feedback and would be happy to discuss any bespoke reports for specific units, patient groups, or sample types that might be helpful.

Data presented

Antimicrobial resistance data is provided for the following selected areas and specific pathogens:

- Top ten bacteraemia pathogens
- Urinary coliforms (community & hospital)
- Wound swab isolates
 - *Staphylococcus aureus* including MRSA from wound swabs (community)
- All specimens (community & hospital)
 - *Streptococcus pneumoniae*
 - *Streptococcus pyogenes*
 - *Haemophilus influenzae*
 - *Campylobacter spp.*

Community data is from samples referred from a general practice and hospital data is from samples submitted from hospital in-patients.

Data sources

Antimicrobial susceptibility testing (AST) data was extracted from the Laboratory Information Management Systems (LIMS) via the regional DataStore systems. DataStore collects all data stored on the LIMS and maps information into a pseudo-anonymised standardized format.

Data from Prince Charles Hospital and the general practices served by the Merthyr laboratory, and Nevill Hall Hospital and the practices served by the Abergavenny laboratory are not included in this report as their LIMS were not linked to DataStore at the time of data extraction. It is intended that these data will be included in future reports.

The laboratories and hospitals with their code included in this report comprise:

Laboratory	Hospital	Code
NPHS - Aberystwyth	Bronglais General Hospital	A
NPHS – Bangor	Ysbyty Gwynedd	K
Bridgend	Princess of Wales Hospital	B
NPHS - Cardiff	Llandough Hospital	P
	University Hospital of Wales	F
	Velindre Hospital	Q
NPHS - Carmarthen	West Wales General Hospital	J
	Prince Philip Hospital	R
Haverfordwest	Withybush General Hospital	G
Newport	Royal Gwent Hospital	D
Pontypridd	Royal Glamorgan Hospital	C
NPHS - Rhyl	Ysbyty Glan Clwyd	L
NPHS - Swansea	Neath General Hospital	T
	Morrison Hospital	E
	Singleton Hospital	S
Wrexham	Wrexham Maelor Hospital	H
All Wales		Z

Data interpretation

As with all surveillance schemes, appropriate interpretation of the data, with an appreciation of the potential biases, is key. The main potential biases which should be considered in the data presented herein are:

- Sampling bias
 - This occurs if the submission of samples to the microbiology laboratory does not represent all patients presenting with that infection, but is selective in some way. If this is the case, the published resistance rate may be skewed, and not representative of the true rate in patients presenting with uncomplicated infection. This effect is likely to be more of an issue with certain sample types. For example bacteraemia data is felt to be fairly representative, since most patients presenting with sepsis will have a blood culture sent. However if general practitioners only submit urine samples from patients who have failed initial therapy, the published rates of resistance will be falsely high.
- Selective testing
 - This occurs if a laboratory only tests susceptibility to a certain agent against selected organisms. For example, a laboratory might only test some agents when an organism is resistant to first-line drugs. This would result in falsely high published rates of resistance. In order to reduce the effect of selective testing on the published rates, data is only included if >80% of a given isolate from a given specimen is tested against the agent.
- Methodological variability
 - There are many methods available for antimicrobial susceptibility testing which may give inconsistent results. In order to reduce this effect on the published rates the Welsh Antimicrobial Chemotherapy

Group is working to standardize testing across Wales. All but one laboratory use a combination of the BSAC (British Society for Antimicrobial Chemotherapy) standardized disc sensitivity method, and the BD Phoenix automated AST/ID system.

- Duplicate testing
 - This occurs if a patient has multiple specimens tested from a single infection episode. Potentially this can skew the resistance data. In order to reduce the effect of this; duplicate isolates are removed from analysis by a sub-routine in DataStore. Isolates are deemed to be duplicates if the same organism with the same antibiogram is grown from the same sample type within 14 days (for hospital in-patients) or 90 days (for community patients).

Other surveillance schemes

This report focuses on data collected in the calendar year 2006. To provide some context to the data presented, it has been compared to surveillance data from other sources:

- Health Protection Agency (HPA)
Website: <http://www.hpa.org.uk/>
Publication: 'Trends in Antimicrobial Resistance in England and Wales 2004-2005'
<http://www.hpa.org.uk/publications/PublicationDisplay.asp?PublicationID=65>
This publication includes data derived from voluntary and mandatory reporting schemes lead by the HPA.
- British Society of Antimicrobial Chemotherapy (BSAC)
Website: <http://www.bsac.org.uk/>
BSAC Resistance Surveillance Programme
Interactive databases: <http://www.bsacsurv.org/mrsweb/bacteraemia>
National Sentinel Surveillance System
- European Antimicrobial Surveillance Scheme (EARSS)
Website: <http://www.rivm.nl/earss/>
Interactive database: <http://www.rivm.nl/earss/database/>
A European wide network of national surveillance systems, providing reference data on antimicrobial resistance for public health purposes.

All of the above surveillance schemes are also susceptible to potential biases, particularly selective coverage and selective reporting. Thus comparisons with the presented data should be treated with caution.

NB. Throughout this document all resistance rates quoted from the HPA publication 'Trends in antimicrobial resistance in England and Wales' relate to the calendar year **2005**, and data quoted from the BSAC Resistance Surveillance Programme interactive database and the EARSS website database relate to the United Kingdom (UK) and the calendar year **2006**.

Section 2: Key points of interest

Rates of resistance across Wales are broadly in-line with published data from the rest of the UK. However resistance in certain bacteria may vary quite widely between different laboratories and hospitals due to the presence of different specialist units or differences in local antimicrobial prescribing guidance.

Blood culture isolates

Escherichia coli (commonest blood culture isolate)

- Resistance rates were not significantly different from the rest of the UK
- Resistance to 3rd generation cephalosporins (e.g. cefotaxime, ceftazidime) was 9%. Resistance has increased across the UK in the last 5 years due, largely, to the spread of *E. coli* producing extended spectrum beta-lactamases (ESBLs). This has also occurred across Wales.
- Resistance to fluoroquinolones (e.g. ciprofloxacin) was 18%. This has risen from a rate of ~5% for England and Wales in 2000.

Meticillin-sensitive *Staphylococcus aureus* (MSSA)

- Resistance to vancomycin or linezolid was not detected.
- Resistance rates for fusidic acid, and gentamicin (agents that may be used as part of combination therapy) were 12.1% & 2.3% respectively.
- Only 2 rifampicin resistant isolates were detected across Wales.

Meticillin-resistant *Staphylococcus aureus* (MRSA)

- Resistance to vancomycin or linezolid was not detected.
- Resistance rates for fusidic acid, rifampicin, and gentamicin (agents that may be used as part of combination therapy) were 11.5%, 2.2% and 3.4% respectively.

Enterococcus spp.

- Vancomycin resistance rates were variable with 7 hospitals having a rate of <5%. However the rate for isolates from UHW was 31.2% (high rates are not unusual in centres with tertiary haematology or renal units).

Urinary Coliforms

Community isolates

- Resistance rates for trimethoprim (first-line empiric therapy for uncomplicated urinary tract infection (UTI) in the community) were 28.5%. The “true” rate for patients presenting to General Practice with UTI is likely to be lower than this due to potential biases in the data (see pages 4 and 34).

Hospital isolates

- Resistance rates were higher than those for community isolates and are variable between hospitals, reflecting local prescribing patterns.
- Resistance rates to fluoroquinolones (e.g. ciprofloxacin) were particularly high in Llandough Hospital (25.1%) and UHW (21.0%) compared to the All-Wales average of 13.7%.
- Resistance rates to co-amoxiclav were particularly high in the Royal Glamorgan Hospital (35.2%) compared to the All-Wales average of 17.9%.

Community Wound Isolates

Meticillin-resistant *Staphylococcus aureus* (MRSA)

- Resistance to vancomycin or linezolid was not detected.
- Tetracyclines are suggested as a treatment for soft tissue infections caused by MRSA by a Joint Working Party of the British Society for Antimicrobial Chemotherapy (BSAC), Hospital Infection Society (HIS) and Infection Control Nurses Association (ICNA) (<http://jac.oxfordjournals.org/cgi/reprint/dkl017v1>). Resistance remains low in general in Wales low at 6.7% although the rate is considerably higher (24.6%) for the community around Ysbyty Glan Clwyd.
- Rifampicin and fusidic acid are also suggested as a treatment for soft tissue infections caused by MRSA by a Joint Working Party of BSAC, HIS and the ICNA (<http://jac.oxfordjournals.org/cgi/reprint/dkl017v1>); resistance rates are 0.5% and 13.5% respectively.

Other pathogens (all specimens)

Streptococcus pneumoniae

- The rate non-susceptible (intermediate or fully resistant) to penicillin was 4.5%. This is similar to the rates from blood culture isolates for the rest of the UK.

Campylobacter spp.

- Resistance to ciprofloxacin (often used as first-line choice when antimicrobial therapy is deemed necessary) was 24.9%.
- Resistance to erythromycin remains low at 2.1%.

Section 3: Synopsis of all-Wales resistance rates

Blood Culture Isolates

<i>Escherichia coli</i> n = 1270			
Antimicrobial	Resistance rate %	Lower 95% CI	Upper 95% CI
Amoxicillin/ampicillin	56.4	53.6	59.1
Co-amoxiclav	22.0	19.4	24.8
Piperacillin/tazobactam	6.0	4.7	7.6
Cefuroxime	10.4	8.7	12.4
Third generation cephalosporin (3GC)	9.0	7.5	10.7
Carbapenem	0.0	0.0	0.4
Fluoroquinolones (FQ)	18.0	15.8	20.3
Co-resistance 3GC/FQ	5.9	4.7	7.4
Gentamicin	5.8	4.7	7.3
<i>Klebsiella spp.</i> n = 371			
Antimicrobial	Resistance rate %	Lower 95% CI	Upper 95% CI
Amoxicillin/ampicillin	97.0	94.7	98.3
Co-amoxiclav	17.2	13.2	22.1
Piperacillin/tazobactam	13.8	10.4	18.1
Cefuroxime	22.5	18.2	27.5
Third generation cephalosporin (3GC)	17.9	14.4	22.2
Carbapenem	0.3	0.1	1.7
Fluoroquinolones (FQ)	18.7	14.9	23.2
Co-resistance 3GC/FQ	15.0	11.6	19.3
Gentamicin	10.8	8.0	14.4
<i>Serratia spp.</i> n = 150			
Antimicrobial	Resistance rate %	Lower 95% CI	Upper 95% CI
Amoxicillin/ampicillin	97.3	93.3	99.0
Co-amoxiclav	97.0	92.6	98.8
Piperacillin/tazobactam	25.9	19.4	33.6
Cefuroxime	96.9	92.4	98.8
Third generation cephalosporin (3GC)	62.1	54.0	69.6
Carbapenem	0.0	0.0	2.6
Fluoroquinolones (FQ)	55.7	47.7	63.4
Co-resistance 3GC/FQ	52.8	44.7	60.8
Gentamicin	2.7	1.1	6.7
<i>Enterobacter spp.</i> n = 159			
Antimicrobial	Resistance rate %	Lower 95% CI	Upper 95% CI
Amoxicillin/ampicillin	95.0	90.4	97.4
Co-amoxiclav	86.7	80.2	91.3
Piperacillin/tazobactam	17.4	12.0	24.6
Third generation cephalosporin	48.0	40.2	55.9
Carbapenem	0.8	0.1	4.2
Fluoroquinolones	15.5	10.6	22.2
Gentamicin	10.1	6.3	15.7
<i>Pseudomonas aeruginosa</i> n = 124			
Antimicrobial	Resistance rate %	Lower 95% CI	Upper 95% CI
Piperacillin/tazobactam	2.1	0.6	7.4
Ceftazidime	0.0	0.0	3.4
Carbapenem	12.4	7.5	19.7
Fluoroquinolones	18.7	12.8	26.5
Gentamicin	8.9	5.0	15.2

S. aureus (MSSA)		n = 621	
Antimicrobial	Resistance rate %	Lower 95% CI	Upper 95% CI
Pencillin	86.6	83.4	89.2
Tetracycline	3.3	1.9	5.7
Erythromycin	8.8	6.8	11.3
Fusidic Acid	12.1	9.7	14.9
Gentamicin	2.3	1.4	3.8
Linezolid	0.0	0.0	1.0
MRSA		n = 295	
Antimicrobial	Resistance rate %	Lower 95% CI	Upper 95% CI
Ciprofloxacin	97.7	93.5	99.2
Erythromycin	76.7	71.3	81.3
Fusidic Acid	11.5	8.4	15.7
Gentamicin	3.4	1.9	6.2
Linezolid	0.0	0.0	2.4
Rifampicin	2.2	0.9	5.0
Tetracycline	5.8	3.2	10.4
Vancomycin	0.0	0.0	2.1
Enterococcus spp.		n = 608	
Antimicrobial	Resistance rate %	Lower 95% CI	Upper 95% CI
Amoxicillin/ampicillin (AMO)	36.5	32.8	40.4
Vancomycin - all isolates	15.5	12.9	18.7
Vancomycin - AMO susceptible isolates	3.3	1.8	5.8
Vancomycin - AMO resistant isolates	32.4	26.1	39.5
Streptococcus pneumoniae		n = 389	
Antimicrobial	Resistance rate %	Lower 95% CI	Upper 95% CI
Pencillin	4.1	2.6	6.6
Tetracycline	3.3	1.7	6.4
Erythromycin	8.9	6.4	12.3

Urinary coliforms

Community Urinary Coliforms		n = 51984	
Antimicrobial	Resistance rate %	Lower 95% CI	Upper 95% CI
Amoxicillin/ampicillin (AMO)	51.5	51.1	51.9
Co-amoxiclav	10.0	9.7	10.3
First generation cephalosporin	7.5	7.2	7.7
Trimethoprim (TRI)	28.5	28.2	28.9
Co-resistance AMO/TRI	22.4	22.1	22.8
Fluoroquinolones (FQ)	6.5	6.3	6.7
Co-resistance AMO/TRI/FQ	5.0	4.8	5.2
Nitrofurantoin	11.5	11.2	11.8
Nitrofurantoin (excluding <i>Proteus</i> spp.)	7.3	7.1	7.5
In-Patient Urinary Coliforms		n = 16117	
Antimicrobial	Resistance rate %	Lower 95% CI	Upper 95% CI
Amoxicillin/ampicillin (AMO)	59.6	58.9	60.4
Co-amoxiclav	17.9	17.2	18.5
First generation cephalosporin	14.4	13.8	15.0
Trimethoprim (TRI)	32.7	32.0	33.5
Co-resistance AMO/TRI	27.5	26.8	28.2
Fluoroquinolones (FQ)	13.7	13.1	14.3
Co-resistance AMO/TRI/FQ	11.4	10.8	11.9
Nitrofurantoin	17.6	16.9	18.2
Nitrofurantoin (excluding <i>Proteus</i> spp.)	13.1	12.6	13.7

Community *Staphylococcus aureus* from wound swabs

S. aureus (MSSA) - wound swabs		n = 9275	
Antimicrobial	Resistance rate %	Lower 95% CI	Upper 95% CI
Pencillin	86.6	85.9	87.4
Tetracycline	4.1	3.4	4.9
Erythromycin	11.5	10.9	12.2
Fusidic Acid	13.6	12.9	14.4
Gentamicin	0.5	0.4	0.7

MRSA - wound swabs		n = 1974	
Antimicrobial	Resistance rate %	Lower 95% CI	Upper 95% CI
Ciprofloxacin	96.4	95.1	97.4
Erythromycin	71.2	69.0	73.3
Fusidic Acid	13.5	12.1	15.1
Gentamicin	1.3	0.9	2.0
Linezolid	0.0	0.0	0.6
Mupirocin	3.4	2.5	4.5
Rifampicin	0.5	0.2	1.2
Tetracycline	6.7	5.5	8.1
Vancomycin	0.0	0.0	0.3

Other pathogens (all-specimens, community & hospital)

<i>Streptococcus pneumoniae</i>		n = 3048	
Antimicrobial	Resistance rate %	Lower 95% CI	Upper 95% CI
Pencillin	4.5	3.8	5.3
Tetracycline	4.9	4.1	5.9
Erythromycin	11.9	10.7	13.1

<i>Streptococcus pyogenes</i>		n = 3048	
Antimicrobial	Resistance rate %	Lower 95% CI	Upper 95% CI
Pencillin	0.0		
Tetracycline	11.4	9.7	13.4
Erythromycin	3.5	2.9	4.3

<i>Haemophilus influenzae</i>		n = 5186	
Antimicrobial	Resistance rate %	Lower 95% CI	Upper 95% CI
Amoxicillin/ampicillin	20.1	19.0	21.2
Co-amoxiclav	6.2	5.5	7.0
Tetracycline	2.4	1.8	3.2

<i>Campylobacter</i> spp.		n = 2093	
Antimicrobial	Resistance rate %	Lower 95% CI	Upper 95% CI
Ciprofloxacin	24.9	23.1	26.8
Erythromycin	2.1	1.5	2.8

Section 4: Methods

All Wales data

The All-Wales resistance rates for each antimicrobial comprise an aggregate of data from a number of different laboratories, and selectively include data from laboratories that perform susceptibility testing on $\geq 80\%$ of isolates.

Individual Hospital/Laboratory data

Individual hospital or laboratory resistance rates are only presented for organisms where $\geq 80\%$ of isolates was tested and where the number of isolates tested exceeds 10.

Duplicates

Duplicates were removed from the data sets prior to analysis. For community data, organisms from the same patient, with the same identification and susceptibility pattern isolated ≤ 90 days from the date of the initial isolate were excluded, and for hospital data the cut off was ≤ 14 days.

Antimicrobial Groups

Although there has been a move towards standardization of antimicrobials used for AST, some variation between laboratories remains e.g. differences in choice and number of third generation cephalosporins tested. In such cases data is aggregated and resistance rates are expressed at group level.

Generally, laboratories test a single fluoroquinolone and carbapenem where appropriate, but the choice of agent varies between laboratories. The antimicrobial groups included in this report comprise of the following aggregated susceptibility data:

- **Quinolones** – ciprofloxacin &/or levofloxacin, norfloxacin
- **Third generation cephalosporins (3GC)** – ceftazidime &/or cefotaxime, ceftriaxone, cefpodoxime.
- **Carbapenems** – imipenem &/or meropenem

Susceptibility results

Throughout data is presented in tables and on graphs as resistance rates with 95% confidence intervals (95% CI).¹ For the purpose of this report susceptibility results recorded as 'intermediate' are included in the category 'resistant', and in the case of penicillin susceptibility results for *S. pneumoniae* results recorded as intermediate, low- level or high-level resistance are included in the category 'resistant'.

1. Newcombe, Robert G. "Two-Sided Confidence Intervals for the Single Proportion: Comparison of Seven Methods," *Statistics in Medicine*, **17**, 857-872 (1998).

Section 5: Antimicrobial resistance rates for the most common organisms causing bacteraemia in 2006

Background

The 2006 top ten bacteraemia report for Wales comprises the commonest organisms isolated from blood cultures in Wales

<http://www.wales.nhs.uk/sites3/page.cfm?orgid=379&pid=23019>

Rank	Organism	Rate per 100,000 bed days
1	<u><i>Escherichia coli (E. coli)</i></u>	38
2	<u><i>Staphylococcus aureus (MSSA)</i></u>	17
3	<u><i>Enterococcus species</i></u>	13
4	<u><i>Streptococcus pneumoniae</i></u>	12
5	<u><i>Klebsiella species</i></u>	10
6	<u><i>Staphylococcus aureus (MRSA)</i></u>	9
7	<u><i>Coagulase negative staphylococci</i></u>	8
=8	<u><i>Serratia species</i></u>	5
=8	<u><i>Enterobacter species</i></u>	5
10	<u><i>Pseudomonas aeruginosa</i></u>	4

The datasets include infections originating from community and hospital sources, and so may be affected by local clonal strains which can result in marked variability in resistance rates between hospitals/regions; results should be interpreted with caution.

Since coagulase negative staphylococci are frequently contaminants when isolated from blood cultures, data on susceptibility are not presented here.

The data in this report is not presented in rank order, but rather an order to allow easy comparison of resistances for related bacteria.

Table 1: Escherichia coli

TABLE 1: <i>Escherichia coli</i> from blood cultures										
Resistance rates including (95% Confidence Intervals)										
Duplicate Cut Off: ≤14 days										
Time period: 1 January - 31 December 2006										
Location Code	AMO	AUG	PTZ	CXM	3GC	CARB	FQ	3GC/FQ	GEN	
A	57.8 (43.3, 71.0)	22.2 (12.5, 36.3)	4.7 (1.3, 15.5)	6.7 (2.3, 17.9)	0.0 (0.0, 7.9)	0.0 (0.0, 7.9)	22.2 (12.5, 36.3)	0.0 (0.0, 7.9)	6.7 (2.3, 17.9)	
B	60.5 (49.9, 70.1)	24.7 (16.8, 34.8)		9.3 (4.8, 17.3)	8.2 (4.1, 16.0)	0.0 (0.0, 4.3)	12.8 (7.3, 21.5)	0.0 (0.0, 4.3)	3.5 (1.2, 9.8)	
C	50.7 (39.7, 61.5)	19.5 (12.2, 29.7)	2.6 (0.7, 9.0)		3.9 (1.3, 10.8)	0.0 (0.0, 4.6)	15.6 (9.2, 25.3)	3.9 (1.3, 10.8)	1.3 (0.2, 7.0)	
D	54.9 (46.7, 62.9)		5.0 (2.4, 9.9)	8.5 (4.9, 14.2)	9.9 (6.0, 15.9)	0.0 (0.0, 2.7)	17.5 (12.1, 24.5)	5.7 (2.8, 11.2)	6.3 (3.4, 11.5)	
E	50.0 (39.3, 60.7)	16.5 (9.9, 26.2)	2.5 (0.7, 8.7)	10.0 (5.2, 18.5)	6.3 (2.7, 13.8)	0.0 (0.0, 4.9)	15.0 (8.8, 24.4)	3.8 (1.3, 10.5)	2.5 (0.7, 8.7)	
F	66.3 (59.3, 72.7)	31.9 (25.7, 38.9)	11.2 (7.4, 16.5)	19.2 (14.2, 25.4)	18.6 (13.7, 24.8)	0.0 (0.0, 2.0)	33.0 (26.7, 40.0)	15.5 (10.9, 21.5)	10.1 (6.6, 15.2)	
G	75.0 (57.9, 86.8)	46.9 (30.9, 63.6)	17.9 (7.9, 35.6)	12.5 (5.0, 28.1)	7.1 (2.0, 22.7)	0.0 (0.0, 12.1)	12.5 (5.0, 28.1)	7.1 (2.0, 22.7)	9.4 (3.2, 24.2)	
H	64.4 (54.9, 73.0)				14.6 (9.2, 22.3)				7.2 (3.7, 13.6)	
J	47.4 (35.0, 60.1)	8.9 (3.9, 19.3)	0.0 (0.00, 6.4)	1.8 (0.3, 9.5)	0.0 (0.0, 6.4)	0.0 (0.0, 6.4)	8.8 (3.8, 19.0)	0.0 (0.00, 6.4)	3.5 (1.0, 11.9)	
K	57.6 (48.1, 66.5)		11.3 (6.6, 18.8)	11.4 (6.7, 18.9)	9.5 (5.3, 16.7)		16.0 (10.3, 24.2)	7.6 (3.9, 14.3)	8.5 (4.5, 15.4)	
L	51.1 (40.9, 61.3)	24.7 (16.8, 34.8)	5.0 (2.0, 12.2)	12.6 (7.2, 21.2)	7.1 (3.3, 14.6)	0.0 (0.0, 4.7)	15.9 (9.7, 25.0)	5.9 (2.5, 13.0)	3.4 (1.2, 9.6)	
P	59.6 (46.1, 71.8)	21.2 (12.2, 34.0)	1.9 (0.3, 10.1)	11.5 (5.4, 23.0)	9.6 (4.2, 20.6)	0.0 (0.0, 6.9)	19.2 (10.8, 31.9)	7.8 (3.1, 18.5)	3.9 (1.1, 13.0)	
Q	40.0 (19.8, 64.3)	20.0 (7.1, 45.2)	6.7 (1.2, 29.8)	6.7 (1.2, 29.8)	6.7 (1.2, 29.8)	0.0 (0.0, 20.4)	13.3 (3.7, 37.9)	6.7 (1.2, 29.8)	13.3 (3.7, 37.9)	
R	44.2 (31.6, 57.7)	11.5 (5.4, 23.0)	4.0 (1.1, 13.5)	6.0 (2.1, 16.2)	2.0 (0.4, 10.5)	0.0 (0.0, 7.1)	5.8 (2.0, 15.6)	2.0 (0.4, 10.5)	1.9 (0.3, 10.1)	
S	47.8 (37.9, 57.9)	13.0 (7.6, 21.4)	2.2 (0.6, 7.6)	6.5 (3.0, 13.5)	6.5 (3.0, 13.5)	0.0 (0.0, 4.3)	14.1 (8.5, 22.7)	4.4 (1.7, 10.7)	5.4 (2.3, 12.1)	
T	52.2 (38.1, 65.9)	15.2 (7.6, 28.2)	4.4 (1.2, 14.5)	2.2 (0.4, 11.3)	4.4 (1.2, 14.5)	0.0 (0.0, 8.2)	17.4 (9.1, 30.7)	0.0 (0.0, 7.7)	4.4 (1.2, 14.5)	
All-Wales: Resistance rates	56.4 (53.6, 59.1)	22.0 (19.4, 24.8)	6.0 (4.7, 7.6)	10.4 (8.7, 12.4)	9.0 (7.5, 10.7)	0.0 (0.0, 0.4)	18.0 (15.8, 20.3)	5.9 (4.7, 7.4)	5.8 (4.7, 7.3)	
All-Wales: Number of isolates	1261	904	1054	1076	1256	1017	1159	1121	1270	

Key: AMO = amoxicillin &/or ampicillin, AUG = co-amoxiclav, PTZ = piperacillin/tazobactam, CXM = cefuroxime, CARB = imipenem &/or meropenem, 3GC = resistance to ceftazidime &/or cefotaxime, ceftriaxone, cefepodoxime, FQ = ciprofloxacin &/or levofloxacin, 3GC/FQ = resistance to any third generation cephalosporin & any quinolone, GEN = gentamicin

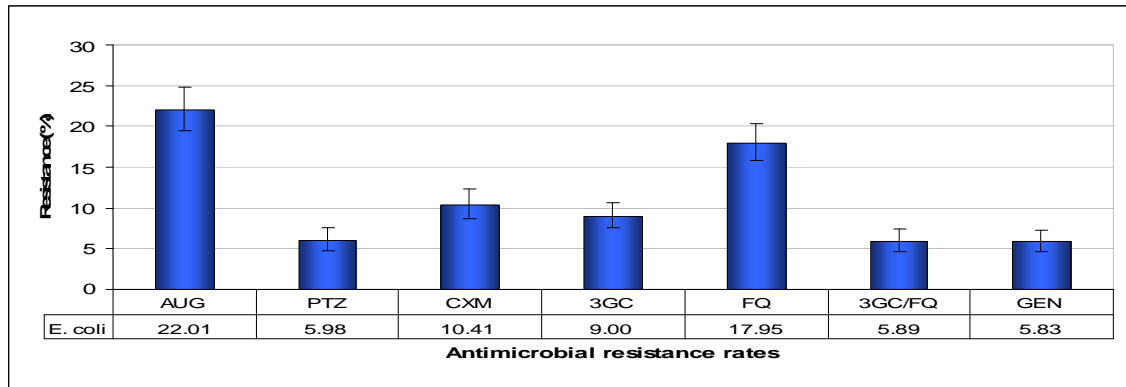


Figure 1: All-Wales antimicrobial resistance rates for *E. coli*; isolated from blood culture (2006)

Escherichia coli

The All-Wales pattern of antimicrobial resistance is shown in Figure 1 & Table 1. Overall higher rates of resistance to a number of antimicrobial agents are seen in isolates from University Hospital of Wales (UHW) which may reflect the specialty mix in this hospital.

Resistance to β -lactams

- The All-Wales resistance rate for amoxicillin/ampicillin was 56.4% (53.6, 59.1); comparable to the rate published by the HPA for England & Wales (E&W) of 58%, but lower than the rate published by the BSAC of 65.9% (59.2, 72.0). Resistance rates at different hospitals are shown in Table 1, and range from 40% (19.8, 64.3) to 75% (57.9, 86.8).
- The All-Wales resistance rate for co-amoxiclav was 22.0% (19.4, 24.8); significantly lower than the rate published by BSAC of 42.1% (35.6, 48.9), which shows a marked increase from the BSAC rate for 2005 of 27.8% (22.1, 34.1). Resistance rates for individual hospitals ranged widely from 8.9% (3.9, 19.3) to 46.9% (30.9, 63.6). **Note:** The high rate seen in Wwithybush Hospital may relate to differences in laboratory methods.
- The All-Wales resistance rate for piperacillin/tazobactam was 6.0% (4.7, 7.6); not significantly different to the rate published by BSAC of 9.0 % (5.7, 13.7). Resistance rates for individual hospitals ranged from 0% (0.0, 6.4) to 17.9% (7.9, 35.6). The high rate seen in Wwithybush Hospital may relate to differences in laboratory methods.
- Resistance to third generation cephalosporins in *E. coli* is largely due to the production, by the bacteria, of extended-spectrum beta-lactamases (ESBLs). Over the last five years a new type of ESBL (CTX-M) has spread across the UK. The All-Wales resistance rate for third generation cephalosporins (ceftazidime &/or cefotaxime, ceftriaxone, cefpodoxime) was 9% (7.5, 10.7), and is similar to the rates for E&W published by the HPA for cefotaxime and ceftazidime (\approx 9%), but lower than the rates published by BSAC: cefotaxime 13.0 % (9.0, 18.3) and ceftazidime 12.1% (8.3, 17.3). A study of the specific resistance mechanisms in Cardiff area showed that 72% of resistance was due to CTX-M production. The rates for resistance to third generation cephalosporins at individual hospital level shown in Figure 3, range from 0% (0.0, 6.4) to 18.6% (13.7, 24.8).

Resistance to fluoroquinolones

- The All-Wales resistance rate for fluoroquinolones was 18.0% (15.8, 20.3); resistance rates for individual hospitals are shown in Figure 4, and range from 5.8% (2.0, 15.6) to 33% (26.7, 40.0). The All-Wales rate for fluoroquinolones is significantly higher than the figure published by the HPA for ciprofloxacin resistance in Wales (\approx 12.5%), but similar to the ciprofloxacin resistance rate published by the HPA for E&W (19.2%), and within the 10-25% range for fluoroquinolone resistance in the UK published by EARSS (see Figure 2). The UK ciprofloxacin resistance rate published by BSAC was 26.4% (20.9, 32.8), higher than the All-Wales rate and higher than the 2005 UK rate published by BSAC of 18.1% (13.4, 23.8).

Combined resistance to both third generation cephalosporins and fluoroquinolones

- The All-Wales rate for co-resistance to a third generation cephalosporin and a fluoroquinolone was 5.9% (4.7, 7.4); resistance rates for individual hospitals are shown in Figure 5 and range from 0% (0.0, 4.3) to 15.5% (10.9, 21.5).
- Of the isolates tested, 65.5% of those that were resistant to a third generation cephalosporin (ceftazidime &/or cefotaxime, ceftriaxone, cefpodoxime) were also resistant to a fluoroquinolone; this reflects the association of fluoroquinolone resistance with the presence of ESBLs. The high rates of resistance to fluoroquinolones observed by BSAC may be attributable to the spread of ESBL-producing *E. coli* in some parts of England.

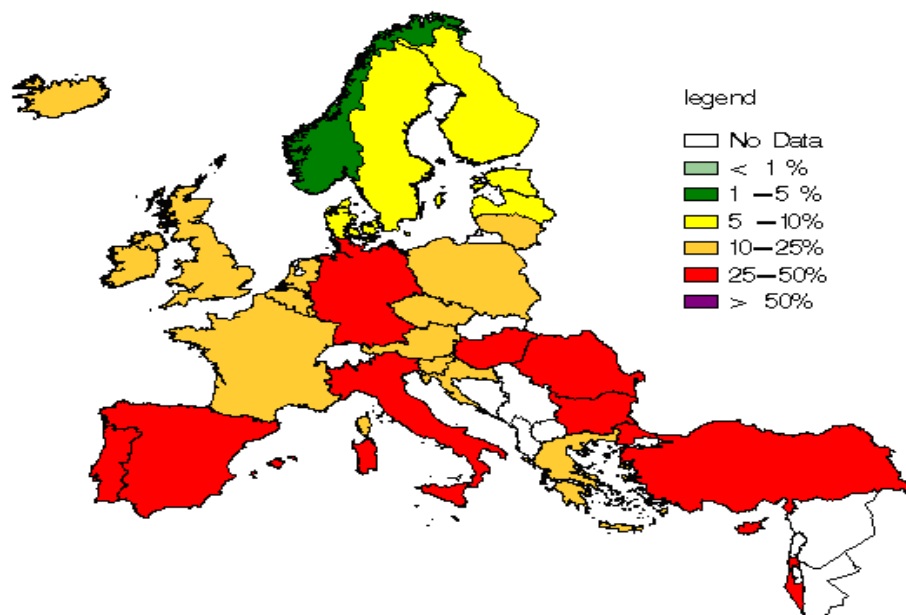


Figure 2: Proportion of *E. coli* from bacteraemia resistant fluoroquinolones in the different European countries in 2006: Data from EARSS

Resistance to gentamicin

- The All-Wales resistance rate for gentamicin was 5.8% (4.7, 7.3); lower than the gentamicin resistance rate published by the HPA for E&W (7.6%) and lower than the UK rate for gentamicin resistance published by BSAC of 11.6% (7.9, 16.8), but similar to the specific rate published by the HPA for Wales alone (\approx 4%). Resistance rates for individual hospitals ranged from 1.3% (0.2, 7.0) to 13.3% (3.7, 37.9). The high rate at Velindre Hospital presumably relates to the patient mix at this hospital.

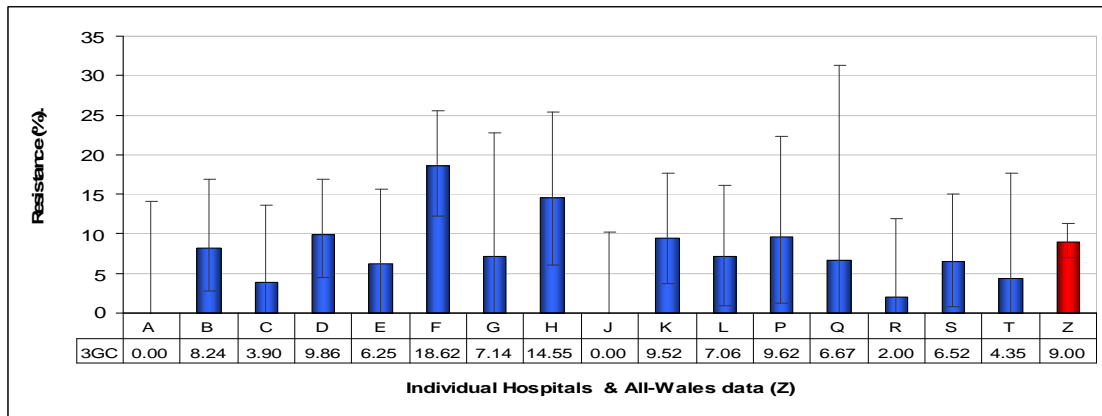


Figure 3: Third generation cephalosporin resistance in *E. coli*; individual hospital data (2006).

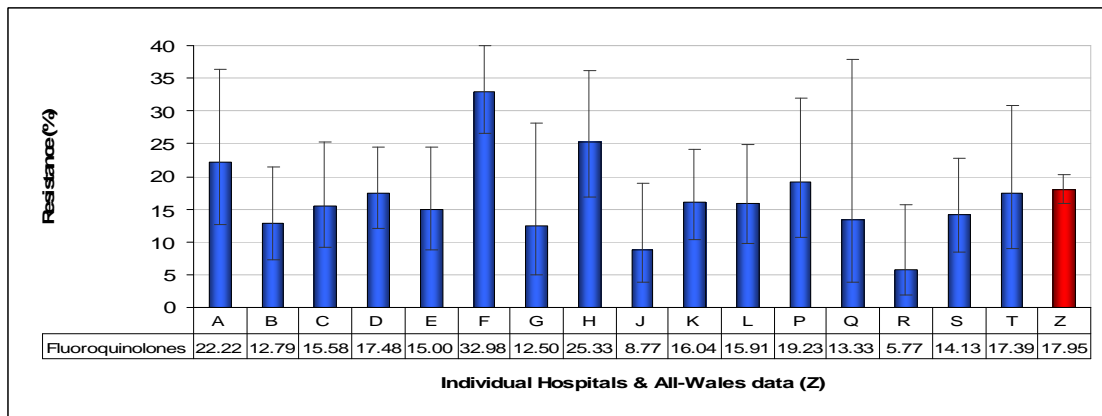


Figure 4: Fluoroquinolone resistance in *E. coli*; individual hospital data (2006).

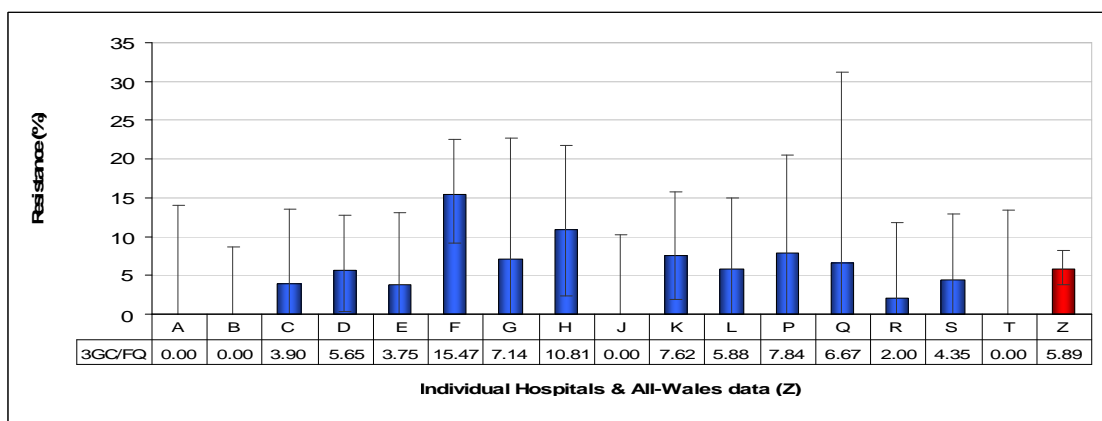


Figure 5: Combined third generation cephalosporin and fluoroquinolone resistance in *E. coli*; individual hospital data (2006).

Table 2: *Klebsiella* spp.

TABLE 2: <i>Klebsiella</i> spp. from blood cultures										
Resistance rates including (95% Confidence Intervals)										
Duplicate Cut Off: ≤14 days										
Time period: 1 January - 31 December 2006										
Location Code	AMO	AUG	PTZ	CXM	3GC	CARB	FQ	3GC/FQ	GEN	
A	100 (75.8, 100)	16.7 (4.7, 44.8)	8.3 (1.5, 35.4)	8.3 (1.5, 35.4)	8.3 (1.5, 35.4)	0.0 (0.0, 24.3)	8.3 (1.5, 35.4)	8.3 (1.5, 35.4)	8.3 (1.5, 35.4)	8.3 (1.5, 35.4)
B	100 (84.5, 100)	19.1 (7.7, 40.0)		28.6 (13.8, 50.0)	27.3 (13.2, 48.2)	0.0 (0.0, 14.9)	22.7 (10.1, 43.4)	18.2 (7.3, 38.5)	13.6 (4.8, 33.3)	13.6 (4.8, 33.3)
C	100 (88.3, 100)	34.5 (19.9, 52.7)	23.1 (11.0, 42.0)		27.6 (14.7, 45.7)	0.0 (0.0, 12.5)	27.6 (14.7, 45.7)	24.1 (12.2, 42.1)	10.3 (3.6, 26.4)	10.3 (3.6, 26.4)
D	93.6 (79.3, 98.2)		9.7 (3.4, 24.9)	12.9 (5.1, 28.9)	9.7 (3.4, 24.9)	0.0 (0.0, 11.0)	12.9 (5.1, 28.9)	9.7 (3.4, 24.9)	6.5 (1.8, 20.7)	6.5 (1.8, 20.7)
E	100 (89.6, 100)	24.3 (12.8, 41.0)	12.5 (5., 28.1)	42.4 (27.2, 59.2)	36.4 (22.2, 53.4)	0.0 (0.0, 10.7)	39.4 (24.7, 56.3)	37.5 (22.9, 54.8)	36.4 (22.2, 53.4)	36.4 (22.2, 53.4)
F	100 (94.2, 100)	18.0 (10.4, 29.5)	12.9 (6.7, 23.5)	21.0 (12.7, 32.7)	11.3 (5.6, 21.5)	1.6 (0.3, 8.6)	11.3 (5.6, 21.5)	8.1 (3.5, 17.5)	6.5 (2.5, 15.5)	6.5 (2.5, 15.5)
G	100 (77.2, 100)	15.4 (4.3, 42.2)	0.0 (0.0, 24.3)	0.0 (0.0, 22.8)	0.0 (0.0, 22.8)	0.0 (0.0, 22.8)	0.0 (0.0, 22.8)	0.0 (0.0, 22.8)	0.0 (0.0, 22.8)	0.0 (0.0, 22.8)
H	100 (86.7, 100)				11.1 (3.9, 28.1)				3.7 (0.7, 18.3)	3.7 (0.7, 18.3)
J	100 (78.5, 100)	0.0 (0.0, 21.5)	0.0 (0.0, 21.5)	7.1 (1.3, 31.5)	0.0 (0.0, 21.5)	0.0 (0.0, 21.5)	0.0 (0.0, 21.5)	0.0 (0.0, 21.5)	0.0 (0.0, 21.5)	0.0 (0.0, 21.5)
K	87.9 (72.7, 95.2)		29.4 (16.8, 46.2)	42.4 (27.2, 59.2)	48.6 (33.0, 64.4)	0.0 (0.0, 12.1)	44.1 (28.9, 60.6)	42.4 (27.2, 59.2)	22.9 (12.1, 39.0)	22.9 (12.1, 39.0)
L	100 (84.54, 100)	10.0 (2.8, 30.1)	11.1 (3.1, 32.8)	30.0 (14.6, 51.9)	20.0 (8.1, 41.6)	0.0 (0.0, 17.6)	0.0 (0.0, 16.1)	0.0 (0.0, 16.8)	4.8 (0.9, 22.7)	4.8 (0.9, 22.7)
P	100 (79.6, 100)	33.3 (15.2, 58.3)	26.7 (10.9, 52.0)	33.3 (15.2, 58.3)	20.0 (7.1, 45.2)	0.0 (0.0, 20.4)	26.7 (10.9, 52.0)	20.0 (7.1, 45.2)	20.0 (7.1, 45.2)	20.0 (7.1, 45.2)
R	84.6 (57.8, 95.7)	0.0 (0.0, 22.8)	7.7 (1.4, 33.3)	7.7 (1.4, 33.3)	0.0 (0.0, 22.8)	0.0 (0.0, 22.8)	7.7 (1.4, 33.3)	0.0 (0.0, 22.8)	0.0 (0.0, 22.8)	0.0 (0.0, 22.8)
S	90.3 (75.1, 96.7)	6.7 (1.9, 21.3)	10.3 (3.6, 26.4)	12.9 (5.1, 28.9)	3.5 (0.6, 17.2)	0.0 (0.0, 12.5)	12.9 (5.1, 28.9)	0.0 (0.0, 12.9)	3.2 (0.6, 16.2)	3.2 (0.6, 16.2)
All-Wales: Resistance rates	97.0 (94.7, 98.3)	17.2 (13.2, 22.1)	13.8 (10.4, 18.1)	22.5 (18.2, 27.5)	17.9 (14.4, 22.2)	0.3 (0.1, 1.7)	18.7 (14.9, 23.2)	15.0 (11.6, 19.3)	10.8 (6.0, 14.4)	10.8 (6.0, 14.4)
All-Wales: Number of isolates	371	278	322	342	371	344	344	344	371	371

Key: AMO = amoxicillin &/or ampicillin, AUG = co-amoxiclav, PTZ = piperacillin/tazobactam, CXM = cefuroxime, CARB = imipenem &/or meropenem, 3GC = resistance to ceftazidime &/or cefotaxime, ceftriaxone, cefpodoxime, FQ = ciprofloxacin &/or levofloxacin, 3GC/FQ = resistance to any third generation cephalosporin & any quinolone, GEN = gentamicin

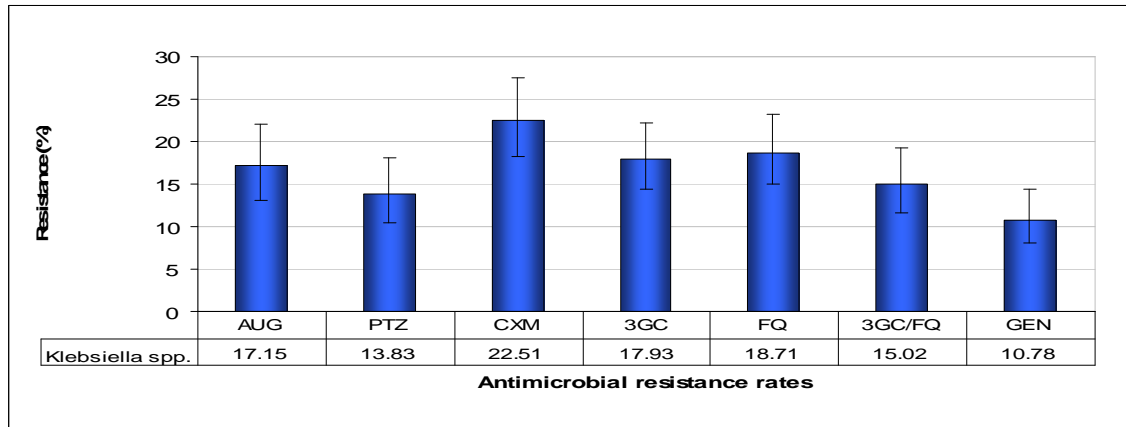


Figure 6: All-Wales antimicrobial resistance rates for *Klebsiella* spp., isolated from blood culture (2006).

***Klebsiella* spp.**

The All-Wales pattern of antimicrobial resistance is shown in Figure 6 & Table 2. Overall high rates of resistance to multiple agents were seen at Morriston and Ysbyty Gwynedd.

Resistance to β -lactams

- The All-Wales resistance rate for co-amoxiclav was 17.2% (13.2, 22.1); not significantly different to the UK rate published by BSAC of 16.0% (11.6, 21.8). Resistance rates for individual hospitals ranged widely from 0% (0.0, 21.5) to 34.5% (19.9, 52.7).
- The All-Wales resistance rate for piperacillin/tazobactam was 13.8% (10.4, 18.1); comparable to the rate published by BSAC of 12.4% (8.5, 17.7). The resistance rates for individual hospitals ranged from 0% (0.0, 21.5) to 29.4% (16.8, 46.2).
- The All-Wales resistance rate for cefuroxime was 22.5% (18.2, 27.5); similar to the rate published by BSAC of 23.9% (18.5, 30.2). The resistance rates for individual hospitals ranged widely from 0% (0.0, 22.8) to 42.4% (27.2, 59.2).
- The All-Wales resistance rate for third generation cephalosporins (ceftazidime &/or cefotaxime, ceftriaxone, cefpodoxime) was 17.9% (14.4, 22.2), and is comparable to the rates published by the HPA for E&W for the single agents: cefotaxime and ceftazidime (\approx 16.0%), and the UK rates published by BSAC: cefotaxime 15.6% (11.2, 21.3) and ceftazidime 13.8% (10.0, 19.7). Resistance rates for individual hospitals showed considerable variation, ranging from 0% (0.00, 21.5) to 48.6% (33.0, 64.4).

Resistance to fluoroquinolones

- The All-Wales resistance rate for fluoroquinolones was 18.7% (14.9, 23.2), and is similar to the ciprofloxacin resistance rate published by the HPA for Wales alone (\approx 18%), and not significantly different to the UK rate published by BSAC of 13.8% (11.6, 21.8). Resistance rates for individual hospitals ranged widely from 0% (0.00, 21.5) to 44.1% (28.9, 60.6).

Co-resistance to third generation and fluoroquinolones

- The All-Wales rate for co-resistance to third generation cephalosporins and fluoroquinolones was 15.0 (11.6, 19.3); resistance rates for individual hospitals ranged from 0% (0.0, 12.9) to 42.4% (27.2, 59.2). Of those tested, 76.1% of the isolates that were resistant to a third generation cephalosporin were also resistant to a fluoroquinolone. This is consistent with the observation of high rates of fluoroquinolone resistance in ESBL-producing *Klebsiella* spp. internationally.

Resistance to gentamicin

- The All-Wales resistance rate for gentamicin was 10.8% (8.0, 14.4); similar to the gentamicin resistance rate published by the HPA for Wales alone (\approx 10%), and not significantly different to the UK rate published by BSAC of 11.5% (7.7, 16.6). Resistance rates for individual hospitals ranged widely from 0% (0.0, 21.5) to 36.4% (22.2, 53.4).

Table 3: *Serratia* spp.

TABLE 3: <i>Serratia</i> spp. from blood cultures										
Resistance rates including (95% Confidence Intervals)										
Duplicate Cut Off: ≤14 days										
Time period: 1 January - 31 December 2006										
Location Code	AMO	AUG	PTZ	CXM	3GC	CARB	FQ	3GC/FQ	GEN	
C	100 (83.2, 100)	100 (83.2, 100)	22.2 (9.0, 45.2)		63.2 (41.0, 80.9)	0.0 (0.0, 17.6)	73.7 (51.2, 88.2)	63.2 (41.0, 80.9)	0.0 (0.0, 16.8)	
D	100 (78.5, 100)		23.1 (8.2, 50.3)	92.9 (68.5, 98.7)	50.0 (26.8, 73.0)	0.0 (0.0, 22.8)	50.0 (26.8, 73.2)	50.0 (26.8, 73.2)	7.1 (1.3, 31.5)	
E	100 (88.7, 100)	100 (88.7, 100)	20.0 (9.5, 37.3)	96.7 (83.3, 99.4)	76.9 (58.0, 89.0)	0.0 (0.0, 11.4)	56.7 (39.2, 72.6)	61.5 (42.5, 77.6)	3.3 (0.6, 16.7)	
F	100 (89.0, 100)	100 (89.0, 100)	45.2 (29.2, 62.2)	100 (89.0, 100)	64.5 (47.0, 78.9)	0.0 (0.0, 11.0)	58.1 (40.8, 73.6)	58.1 (40.8, 73.6)	0.0 (0.0, 11.0)	
L	100 (75.8, 100)	100 (75.8, 100)	45.5 (21.3, 72.0)	100 (75.6, 100)	66.7 (39.1, 86.2)	0.0 (0.0, 25.9)	66.7 (39.1, 86.2)	58.3 (32.0, 80.7)	16.7 (4.7, 44.8)	
All-Wales: Resistance rates	97.3 (93.3, 99.0)	97.0 (92.6, 98.8)	25.9 (19.4, 33.6)	96.9 (92.4, 98.8)	62.1 (54.0, 69.6)	0.0 (0.0, 2.6)	55.7 (47.7, 63.4)	52.8 (44.7, 60.8)	2.7 (1.1, 6.7)	
All-Wales: Number of isolates	150	134	143	130	145	146	149	144	149	

Key: AMO = amoxicillin &/or ampicillin, AUG = co-amoxiclav, PTZ = piperacillin/tazobactam, CXM = cefuroxime, CARB = imipenem &/or meropenem, 3GC = resistance to ceftazidime &/or cefotaxime, ceftriaxone, cefpodoxime, FQ = ciprofloxacin &/or levofloxacin, 3GC/FQ = resistance to any third generation cephalosporin & any quinolone, GEN = gentamicin

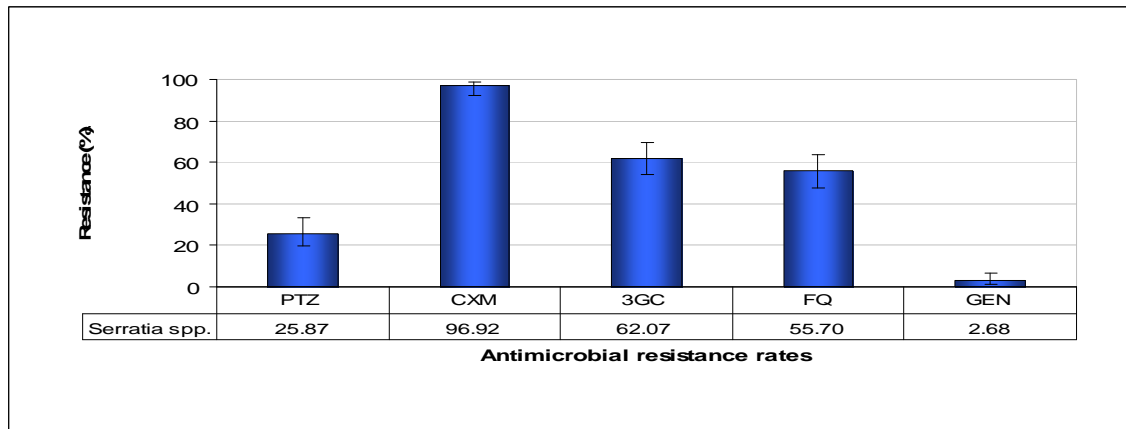


Figure 7: All-Wales antimicrobial resistance rates for *Serratia* spp. isolated from blood culture (2006).

Serratia spp.

The All-Wales pattern of antimicrobial resistance is shown in Figure 7 & Table 3. Notably, resistance to third generation cephalosporins and fluoroquinolones was significantly higher than that reported by HPA and BSAC (see below).

Resistance to β -lactams

- The All-Wales resistance rate for piperacillin/tazobactam was 25.9% (19.4, 33.6); not significantly different to the rate published by BSAC of 18.3% (10.9, 28.7). Resistance rates for individual hospitals ranged from 20% (9.5, 37.3) to 45.5% (21.3, 72.0).
- The All-Wales rate for resistance to third generation cephalosporins (ceftazidime, cefotaxime, ceftriaxone or cefpodoxime) was 62.1% (54.0, 69.6), and is significantly higher than rates for E&W published by the HPA for the single agents: cefotaxime (27%) and ceftazidime (17.6%), and the UK rates published by BSAC: cefotaxime 33.0% (23.2, 44.3) and ceftazidime 7.3% (3.0, 15.8). These high rates of resistance were observed at all hospitals, the rates ranging from 50.0% (26.8, 73.0) to 76.9% (58.0, 89.0).

Resistance to fluoroquinolones

- The All-Wales resistance rate for fluoroquinolones was 55.7% (47.7, 63.4); higher than the ciprofloxacin rate for E&W published by the HPA (27%), and the UK rate published by BSAC of 24.4% (15.9, 35.3). Resistance rates at individual hospitals ranged from 50% (26.8, 73.2) to 73.7% (51.2, 88.2).

Resistance to gentamicin

- The All-Wales resistance rate for gentamicin was 2.7% (1.1, 6.7), comparable to the 2005 average rate published by the HPA for E&W (\approx 2.5%) and the UK rate published by BSAC of 2.4% (0.4, 9.4). Resistance rates at individual hospitals ranged from 0% (0.0, 11.0) to 16.7% (4.7, 44.8).

Table 4: *Enterobacter* spp.

TABLE 4: <i>Enterobacter</i> spp. from blood cultures								
Resistance rates including (95% Confidence Intervals)								
Duplicate Cut Off: ≤14 days								
Time period: 1 January - 31 December 2006								
Location Code	AMO	AUG	PTZ	3GC	CARB	FQ	GEN	
D	83.3 (55.2, 95.3)	50.0 (25.4, 74.6)	8.3 (1.5, 35.4)	50.0 (25.3, 74.6)	0.0 (0.0, 25.9)	25.0 (8.9, 53.2)	25.0 (8.9, 53.2)	
E	100 (81.6, 100)	100 (81.6, 100)	17.7 (6.2, 41.0)	29.4 (13.3, 53.1)	0.0 (0.0, 18.4)	11.8 (3.3, 34.3)	5.9 (1.1, 27.0)	
F	100 (88.7, 100)	100 (88.7, 100)	16.7 (7.3, 33.6)	36.7 (21.9, 54.5)	0.0 (0.0, 11.4)	23.3 (11.8, 40.9)	10.0 (3.5, 25.6)	
H	90.0 (59.6, 98.2)			40.0 (16.8, 68.7)			20.0 (5.8, 51.0)	
L	88.2 (65.7, 96.7)		20.0 (7.1, 45.2)	35.3 (17.3, 58.7)	0.0 (0.0, 21.5)	11.8 (3.3, 34.3)	17.7 (6.2, 41.0)	
R	91.7 (64.6, 98.5)	72.7 (43.4, 90.3)	25.0 (8.9, 53.2)	54.6 (28.0, 78.7)	8.3 (1.5, 35.4)	9.1 (1.6, 37.7)	16.7 (4.7, 44.8)	
S	92.3 (66.7, 98.6)	92.3 (66.7, 98.6)	18.2 (5.1, 47.7)	54.6 (28.0, 78.7)	0.0 (0.0, 22.8)	15.4 (4.3, 42.2)	0.0 (0.0, 22.8)	
All-Wales: Resistance rates	95.0 (90.4, 97.4)	86.7 (80.2, 91.3)	17.4 (12.0, 24.6)	48.0 (40.2, 55.9)	0.8 (0.1, 4.2)	15.5 (10.6, 22.2)	10.1 (6.3, 15.7)	
All-Wales: Number of isolates	159	143	138	148	132	148	159	

Key: AMO = amoxicillin/ampicillin, AUG = co-amoxiclav, PTZ = piperacillin & tazobactam, 3GC = resistance to ceftazidime &/or cefotaxime, ceftriaxone, cefpodoxime, CARB = imipenem &/or meropenem, FQ = ciprofloxacin &/or levofloxacin, GEN = gentamicin

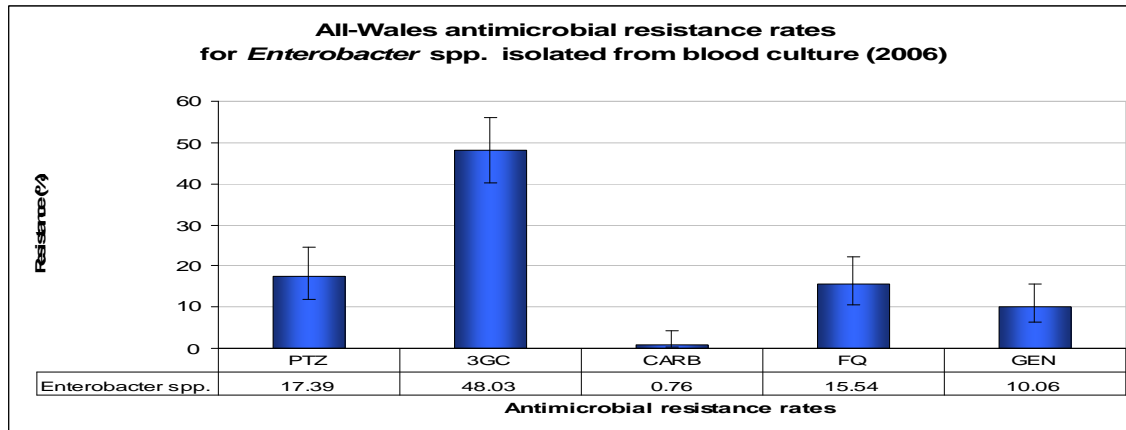


Figure 8: All-Wales antimicrobial resistance rates for *Enterobacter* spp., isolated from blood culture (2006).

Enterobacter spp.

The All-Wales pattern of antimicrobial resistance is shown in Figure 8 & Table 4.

Resistance to β -lactams

- The All-Wales resistance rate for piperacillin/tazobactam was 17.4% (12.0, 24.6); comparable to the rate published by BSAC of 17.8% (12.8, 24.3). Resistance rates at individual hospitals ranged from 8.3% (1.5, 35.4) to 25% (8.9, 53.2).
- The All-Wales rate for resistance to third generation cephalosporins (ceftazidime, cefotaxime, ceftriaxone or cefpodoxime) was 48.0% (40.2, 55.9); not significantly different to the rates published by BSAC for the single agents: cefotaxime 36.2% (29.4, 43.6) and ceftazidime 33.5% (26.9, 40.9). Resistance rates at individual hospitals ranged from 29.4% (13.3, 53.1) to 54.6% (28.0, 78.7).

Resistance to fluoroquinolones

- The All-Wales resistance rate for fluoroquinolones was 15.5% (10.6, 22.2); similar to the ciprofloxacin resistance rate for E&W published by the HPA (14.3%) and comparable to the UK rate published by BSAC of 15.7% (10.9, 21.9). Resistance rates at individual hospitals ranged from 9.1% (1.6, 37.7) to 25% (8.9, 53.2).

Resistance to gentamicin

- The All-Wales resistance rate for gentamicin was 10.1% (6.3, 15.7), comparable to the 2005 rate published by the HPA for England & Wales (11.3%), and not significantly different to the UK rate published by BSAC of 15.6% (10.0, 20.7). Resistance rates at individual hospitals ranged widely from 0% (0.0, 22.8) to 25% (8.9, 53.2).

Table 5: Pseudomonas aeruginosa

TABLE 5: <i>Pseudomonas aeruginosa</i> from blood cultures					
Resistance rates including (95% Confidence Intervals)					
Duplicate Cut Off: ≤14 days					
Time period: 1 January - 31 December 2006					
Location Code	PTZ	CAZ	CARB	FQ	GEN
D	6.3 (1.1, 28.3)	0.0 (0.0, 19.4)	6.2 (1.1, 28.3)	17.7 (6.2, 41.0)	11.8 (3.3, 34.3)
E	0.0 (0.0, 25.9)		33.3 (13.8, 60.9)	16.7 (4.7, 44.8)	8.3 (1.5, 35.4)
F	3.0 (0.5, 15.3)	0.0 (0.0, 10.4)	12.1 (4.8, 27.3)	21.2 (10.7, 37.8)	18.2 (8.6, 34.4)
All-Wales: Resistance rates	2.1 (0.6, 7.4)	0.0 (0.0, 3.4)	12.4 (7.5, 19.7)	18.7 (12.8, 26.5)	8.9 (5.0, 15.2)
All-Wales: Number of isolates	95	109	113	123	124
Key: PTZ = piperacillin/tazobactam, CAZ = ceftazidime, CARB = imipenem &/or meropenem, FQ = ciprofloxacin &/or levofloxacin, GEN = gentamicin					

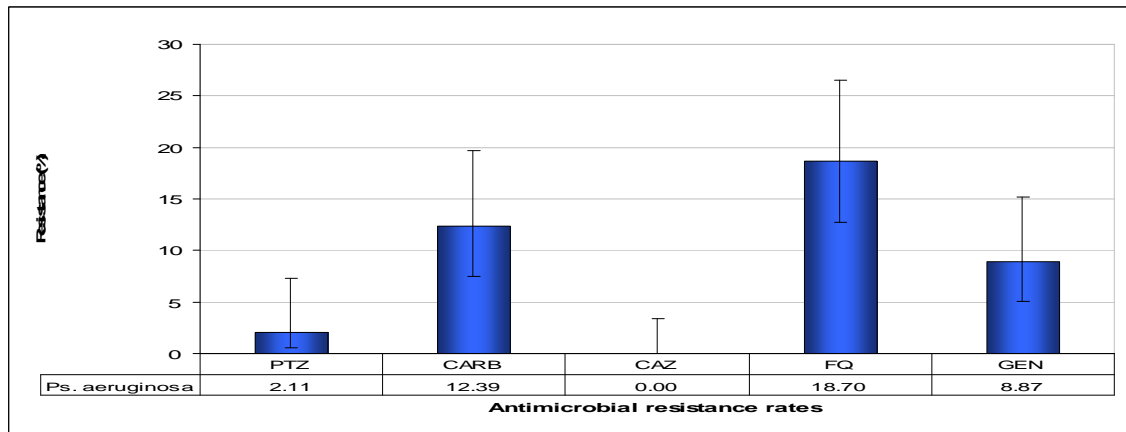


Figure 9: All-Wales antimicrobial resistance rates for *Ps. aeruginosa* isolated from blood culture (2006).

Pseudomonas aeruginosa

The All-Wales pattern of antimicrobial resistance is shown in Figure 9 & Table 5.

Resistance to β -lactams

- The All-Wales resistance rate for piperacillin/tazobactam was 2.1% (0.6, 7.4); not significantly different to the rate published by the HPA for E&W (4.1%), and comparable to the UK rate published by BSAC of 2.0% (0.7, 5.5). Resistance rates for individual hospitals ranged from 0.0% (0.0, 25.9) to 6.3% (1.1, 28.3).
- The All-Wales resistance rate for ceftazidime was 0% (0.0, 3.4); lower than the rate published by the HPA for E&W (6.5%), but not significantly different to the UK rate published by BSAC of 1.5% (0.4, 4.8).
- The All-Wales resistance rate for carbapenems was 12.4% (7.5, 19.7); higher than the average rates published by the HPA for E&W for imipenem (6.8%) but not significantly different to the UK rate published by BSAC of 7.7% (4.5, 12.5). Resistance rates for individual hospitals ranged from 6.2% (1.1, 28.3) to 33.3% (13.8, 60.9). **Note:** The high rate of carbapenem resistance observed in Morriston Hospital may relate to the presence of the Burn's Unit.

Resistance to fluoroquinolones

- The All-Wales resistance rate for fluoroquinolones was 18.7% (12.8, 26.5); higher than the rate published by the HPA for E&W (11.7%), but similar to the UK rate for ciprofloxacin resistance published by BSAC of 17.4% (12.5, 23.5). Resistance rates for individual hospitals ranged from 16.7% (4.7, 44.8) to 21.2% (10.7, 37.8).

Resistance to aminoglycosides

- The All-Wales resistance rate for gentamicin was 8.9% (5.0, 15.2); not significantly different to the rate published by the HPA for E&W (7%) but higher than the UK rate published by BSAC of 4.6% (2.3, 8.8). Resistance rates for individual hospitals ranged from 8.3% (1.5, 35.4) to 18.2% (8.6, 34.4).

Table 6: Meticillin Sensitive *Staphylococcus aureus* (MSSA)

TABLE 6: Meticillin sensitive <i>Staphylococcus aureus</i> (MSSA) from blood cultures						
Resistance rates including (95% Confidence Intervals)						
Duplicate Cut Off: ≤14 days						
Time period: 1 January - 31 December 2006						
Location Code	PEN	TET	ERY	FUS	GEN	LZD
A	100 (78.5, 100)	7.1 (1.3, 31.5)	7.2 (1.3, 31.5)	7.1 (1.2, 31.5)	0.0 (0.00, 21.5)	
B	90.0 (74.4, 96.5)	3.6 (0.6, 17.7)	13.3 (5.3, 29.7)	20.0 (9.5, 37.3)	3.3 (0.6, 16.7)	
C	83.3 (68.1, 92.1)		12.2 (5.3, 25.5)	9.8 (3.9, 22.6)	7.3 (2.5, 19.4)	
D	94.1 (85.8, 97.7)	5.8 (2.3, 14.0)	11.6 (6.0, 21.3)	20.3 (12.5, 31.2)	0.0 (0.0, 5.1)	0.0 (0.0, 5.3)
E	90.1 (82.3, 94.7)	1.3 (0.21, 6.30)	6.6 (3.1, 13.7)	11.0 (6.1, 19.1)	2.2 (0.6, 7.6)	0.0 (0.0, 4.3)
F	82.9 (75.3, 88.6)		4.9 (2.3, 10.2)	13.8 (8.8, 21.0)	0.0 (0.0, 3.0)	0.0 (0.0, 3.3)
G	90.5 (71.1, 97.4)	4.7 (0.9, 22.7)	9.5 (2.7, 28.9)	0.0 (0.0, 15.5)	0.0 (0.0, 15.5)	
H			12.5 (5.5, 26.1)	9.3 (3.7, 21.6)	12.8 (6.0, 25.2)	
J	86.7 (70.3, 94.7)	0.0 (0.0, 11.4)	3.3 (0.6, 16.7)	3.3 (0.6, 16.7)	3.3 (0.6, 16.7)	0.0 (0.0, 11.4)
K	81.0 (66.7, 90.0)	0.0 (0.0, 9.2)	11.9 (5.2, 25.0)	9.5 (3.8, 22.1)	0.0 (0.00, 8.4)	
L		10.0 (2.8, 30.1)	16.0 (6.4, 34.7)	4.6 (0.8, 21.8)	0.0 (0.0, 14.3)	
P	79.0 (56.7, 91.5)		15.8 (5.5, 37.6)	26.3 (11.8, 48.8)	0.0 (0.0, 16.8)	0.0 (0.0, 17.6)
R	75.0 (46.8, 91.1)	0.0 (0.0, 24.3)	8.3 (1.5, 35.4)	0.0 (0.0, 24.3)	0.0 (0.0, 24.3)	0.0 (0.0, 24.3)
S	81.8 (65.6, 91.4)	0.0 (0.0, 11.7)	3.0 (0.5, 15.3)	9.1 (3.1, 23.6)	3.0 (0.5, 15.3)	0.0 (0.0, 11.7)
T	100 (79.6, 100)	13.3 (3.7, 37.9)	13.3 (3.7, 37.9)	26.7 (10.9, 52.0)	0.0 (0.0, 20.4)	0.0 (0.0, 20.4)
All-Wales: Resistance rates	86.6 (83.4, 89.2)	3.3 (1.9, 5.7)	8.8 (6.8, 11.3)	12.1 (9.7, 14.9)	2.3 (1.4, 3.8)	0.0 (0.0, 1.0)
All-Wales: Number of isolates	543	362	614	614	621	383

Key: PEN = penicillin, TET = tetracycline, ERY = erythromycin, FUS = fusidic acid, GEN = gentamicin, LZD = linezolid

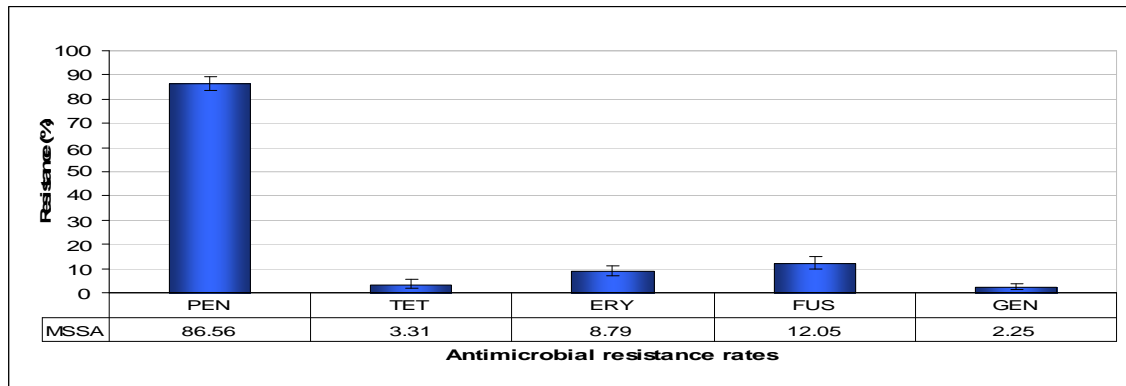


Figure 10: All-Wales antimicrobial resistance rates for Meticillin Sensitive *Staphylococcus aureus* (MSSA) isolated from blood culture (2006).

Meticillin Sensitive Staphylococcus aureus (MSSA)

The All-Wales pattern of antimicrobial resistance is shown in Figure 10 & Table 6.

Resistance to penicillin

- The All-Wales resistance rate for penicillin was 86.6% (83.4, 89.2); similar to the rate published by BSAC of 83.2% (75.2, 89.1). Resistance rates for individual hospitals ranged from 75% (46.8, 91.1) to 100% (79.6, 100).

Resistance to tetracycline

- The All-Wales resistance rate for tetracycline was 3.3% (1.9, 5.7); similar to the rate published by BSAC of 6.4% (3.0, 12.6). Resistance rates for individual hospitals ranged from 0% (0.0, 9.2) to 13.3% (3.7, 37.9).

Resistance to erythromycin

- The All-Wales resistance rate for erythromycin was 8.8% (6.8, 11.3); similar to the rate published by BSAC of 14.4% (9.0, 22.1). Resistance rates for individual hospitals ranged from 3.0% (0.5, 15.3) to 16% (6.4, 34.7).

Resistance to fusidic acid

- The All-Wales resistance rate for fusidic acid was 12.1% (9.7, 14.9); similar to the rate published by BSAC of 8.8% (4.7, 15.6). Resistance rates for individual hospitals ranged from 0% (0.0, 15.5) to 26.7% (10.9, 52.0).

Resistance to gentamicin

- The All-Wales resistance rate for gentamicin was 2.3% (1.4, 3.8); similar to the rate published by BSAC of 4.8% (2.0, 10.6). Resistance rates for individual hospitals ranged from 0% (0.0, 3.0) to 12.8% (6.0, 25.2).

Resistance to linezolid

- Resistance to linezolid was not detected.

Table 7: Methicillin Resistant *Staphylococcus aureus* (MRSA)

TABLE 7: Methicillin resistant <i>Staphylococcus aureus</i> (MRSA) from blood cultures									
Resistance rates including (95% Confidence Intervals)									
Duplicate Cut Off: ≤14 days									
Time period: 1 January - 31 December 2006									
Location Code	CIP	ERY	FUS	GEN	LZD	RIF	TET	VAN	
A	100 (64.6, 100)	85.7 (48.7, 97.4)	0.0 (0.0, 35.4)	14.3 (2.6, 51.3)		0.0 (0.0, 39.0)	0.0 (0.0, 39.0)	0.0 (0.0, 39.0)	
B	100 (81.6, 100)	70.6 (46.9, 86.7)	23.5 (9.6, 47.3)	0.0 (0.0, 18.4)		0.0 (0.0, 18.4)	0.0 (0.0, 19.4)	0.0 (0.0, 18.4)	
C	96.0 (80.5, 99.3)	84.0 (65.4, 93.6)	8.0 (2.2, 25.0)	0.0 (0.0, 13.3)				0.0 (0.0, 13.3)	
D	86.7 (62.1, 96.3)	80.0 (54.8, 93.0)	6.7 (1.2, 29.82)	0.0 (0.0, 20.4)	0.0 (0.0, 20.4)	0.0 (0.0, 20.4)	0.0 (0.0, 20.4)	0.0 (0.0, 20.4)	
E	100 (89.9, 100)	57.1 (40.9, 72.0)	11.8 (4.7, 26.6)	17.7 (8.4, 33.5)	0.0 (0.0, 9.9)	2.9 (0.5, 14.9)	0.0 (0.0, 10.2)	0.0 (0.0, 9.9)	
F		82.1 (71.3, 89.5)	4.5 (1.5, 12.4)	0.0 (0.0, 5.4)	0.0 (0.0, 5.8)	4.8 (1.7, 13.3)		0.0 (0.0, 5.4)	
H			9.5 (2.7, 28.9)	14.3 (5.0, 34.6)		0.0 (0.0, 15.5)	14.3 (5.0, 34.6)		
J	100 (72.3, 100)	60.0 (31.3, 83.2)	0.0 (0.0, 27.8)	0.0 (0.0, 27.8)	0.0 (0.0, 27.8)	0.0 (0.0, 27.8)	0.0 (0.0, 27.8)	0.0 (0.0, 27.8)	
K	66.7 (20.8, 93.9)	73.5 (56.9, 85.4)	26.5 (14.6, 43.1)	0.0 (0.0, 10.2)		3.3 (0.6, 16.7)	6.7 (1.9, 21.3)	0.0 (0.0, 10.4)	
L		96.4 (82.3, 99.4)	17.2 (7.6, 34.6)	0.0 (0.0, 12.5)			17.2 (7.6, 34.6)		
P		76.9 (49.8, 91.8)	15.4 (4.3, 42.2)	0.0 (0.0, 22.8)	0.0 (0.0, 22.8)	0.0 (0.0, 22.8)		0.0 (0.0, 22.8)	
R	100 (72.3, 100)	10.0 (1.8, 40.4)	10.0 (1.8, 40.4)	0.0 (0.0, 27.8)	0.0 (0.0, 27.8)	0.0 (0.0, 27.8)	0.0 (0.0, 27.8)	0.0 (0.0, 27.8)	
S	100 (77.2, 100)	46.2 (23.2, 70.9)	7.7 (1.4, 33.3)	0.0 (0.0, 22.8)	0.0 (0.0, 22.8)	0.0 (0.0, 22.8)	0.0 (0.0, 22.8)	0.0 (0.0, 22.8)	
All-Wales: Resistance rates	97.7 (93.5, 99.2)	76.7 (71.3, 81.3)	11.5 (8.4, 15.7)	3.4 (1.9, 6.2)	0.0 (0.0, 2.4)	2.2 (0.9, 5.0)	5.8 (3.2, 10.4)	0.0 (0.0, 2.1)	
All-Wales: Number of isolates	131	274	295	293	158	231	171	177	

Key: CIP = ciprofloxacin, ERY = erythromycin, FUS = fusidic acid, GEN = gentamicin, LZD = linezolid, RIF = rifampicin, TET = tetracycline, VAN = vancomycin

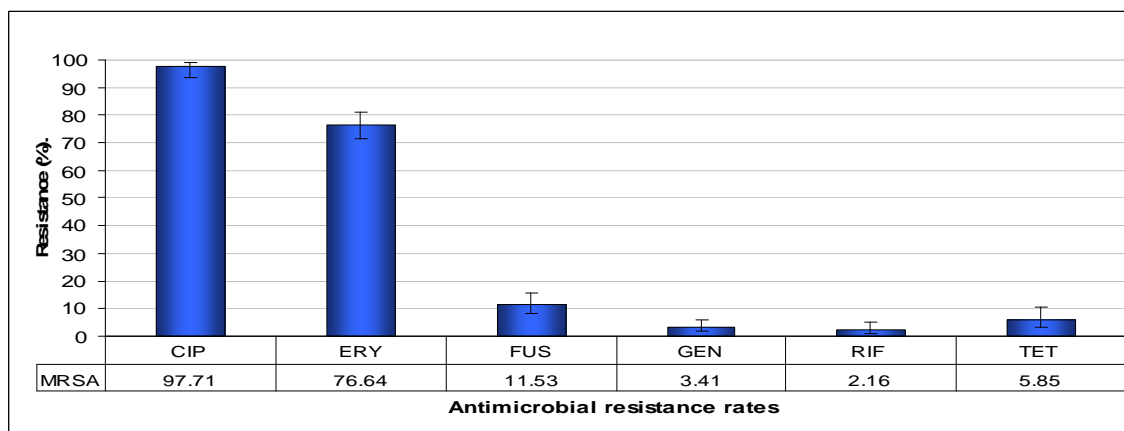


Figure 11: All-Wales antimicrobial resistance rates for Methicillin Resistant *Staphylococcus aureus* (MRSA) isolated from blood culture (2006).

Meticillin Resistant Staphylococcus aureus (MRSA)

The All-Wales pattern of antimicrobial resistance is shown in Figure 11 & Table 7.

Resistance to ciprofloxacin

- The All-Wales resistance rate for ciprofloxacin was 97.7% (93.5, 99.2); similar to the rate published by BSAC of 91.8% (83.9, 96.1). Resistance rates for individual hospitals ranged from 86.7% (62.1, 100) to 100% (89.9, 100).

Resistance to erythromycin

- The All-Wales resistance rate for erythromycin was 76.7% (71.3, 81.3); similar to the rate published by BSAC of 73.2% (63.1, 81.4). Resistance rates for individual hospitals ranged from 46.2% (23.2, 70.9) to 100% (72.3, 100).

Resistance to fusidic acid

- The All-Wales resistance rate for fusidic acid was 11.5% (8.4, 15.7); similar to the rate published by BSAC of 14.4% (8.4, 23.4). Resistance rates for individual hospitals ranged from 0% (0.0, 35.4) to 26.5% (14.6, 43.1).

Resistance to gentamicin

- The All-Wales resistance rate for gentamicin was 3.4% (1.9, 6.2); similar to the rate published by BSAC of 6.2% (2.5, 13.5). Resistance rates for individual hospitals ranged from 0% (0.0, 10.2) to 17.7% (8.4, 33.5). In fact resistance to gentamicin was only reported from three hospitals, Bronglais Hospital, Morriston Hospital, and Wrexham Maelor Hospital.

Resistance to rifampicin

- The All-Wales resistance rate for rifampicin was 2.2% (0.9, 5.0); comparable to the rate published by BSAC of 2.1% (0.4, 8.0). Resistance rates for individual hospitals ranged from 0% (0.0, 15.5) to 4.8% (1.7, 13.3).

Resistance to tetracycline

- The All-Wales resistance rate for tetracycline was 5.8% (3.2, 10.4); similar to the rate published by BSAC of 4.1% (1.3, 10.8). Resistance rates for individual hospitals ranged from 0% (0.0, 10.2) to 17.2% (7.6, 34.6).

Resistance to vancomycin

- Resistance to vancomycin was not detected.

Resistance to linezolid

- Resistance to linezolid was not detected.

Table 8: *Enterococcus* spp.

TABLE 8: <i>Enterococcus</i> spp. from blood cultures					
Resistance rates including (95% Confidence Intervals)					
Duplicate Cut Off: ≤14 days					
Time period: 1 January - 31 December 2006					
Location Code	AMO	GEN	VAN	VAN (AMO = S)	VAN (AMO = R)
B	24.3 (13.4, 40.1)		2.8 (0.5, 14.5)		
C	28.6 (15.3, 47.1)		3.7 (0.6, 18.3)		
D	36.5 (24.8, 50.1)		10.2 (4.4, 21.8)		
E	20.4 (11.5, 33.6)		10.2 (4.4, 21.8)		
F	47.6 (41.3, 54.1)		31.2 (25.5, 37.4)		
H	17.4 (7.0, 37.1)		15.4 (6.2, 33.5)		
J	29.4 (13.3, 53.1)	66.7 (41.7, 84.8)	0.0 (0.0, 18.4)		
K	43.8 (28.2, 60.7)		10.3 (3.6, 26.4)		
L	33.3 (22.0, 47.0)	53.1 (39.4, 66.3)	0.0 (0.0, 7.9)		
P	41.7 (24.5, 61.2)		4.1 (0.7, 20.2)		
R	20.0 (7.1, 45.2)	35.7 (16.3, 61.2)	0.0 (0.0, 20.4)		
S	28.0 (14.3, 47.6)		0.00 (0.00, 13.32)		
All-Wales: Resistance rates	36.5 (32.8, 40.4)		15.5 (12.9, 18.7)	3.3 (1.8, 5.8)	32.4 (26.1, 39.5)
All-Wales: Number of isolates	608	N/A	592	336	185

Key: AMO = amoxicillin &/or ampicillin, GEN = gentamicin, VAN = vancomycin, VAN (AMO = S) = vancomycin resistance in amoxicillin susceptible isolates, VAN (AMO = R) = vancomycin resistance in amoxicillin resistant isolates

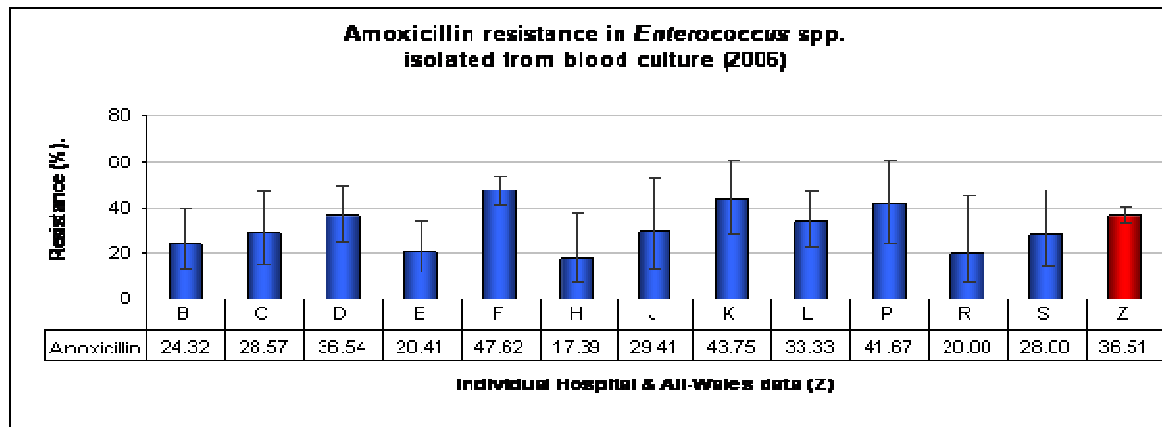


Figure 12: Amoxicillin resistance in *Enterococcus* spp.; individual hospital data (2006)

Enterococcus spp.

The All-Wales pattern of antimicrobial resistance is shown in Table 8.

Resistance to amoxicillin/ampicillin

- The All-Wales resistance rate for amoxicillin/ampicillin was 36.5% (32.8, 40.4), Susceptibility to amoxicillin/ampicillin is a guide to the identification of the organism as *E. faecalis*; and suggests that 63.5% of enterococcal bacteraemias were due to *E. faecalis*. This proportion is consistent with the 2005 rate of *E. faecalis* bacteraemias published by the HPA for England & Wales (65%).
- The rates for amoxicillin/ampicillin resistance at individual hospital level are shown in Figure 12, and range from 17.4% (7.0, 37.1) to 43.8% (28.2, 60.7).

Resistance to vancomycin

- The All-Wales resistance rate for vancomycin was 15.5% (12.9, 18.7); the rate may be highly skewed by the inclusion of a large number of isolates from University Hospital of Wales which has the highest resistance rate. However, the rate is similar to the rate published by BSAC of 11.9% (8.0, 17.1). Resistance rates for individual hospitals, and the number of isolates included in this data set are shown in Figure 13.
- Of the isolates that were susceptible to amoxicillin/ampicillin, 3.3% (1.8, 5.8) were resistant to vancomycin. This rate is consistent with the 2005 rate for *E. faecalis* bacteraemias, published by the HPA for E&W (3%).
- Of the isolates that were resistant to amoxicillin/ampicillin, 32.4% (26.1, 39.5) were resistant to vancomycin. This rate is higher than the rate for *E. faecium* bacteraemias, published by the HPA for E&W (25%).

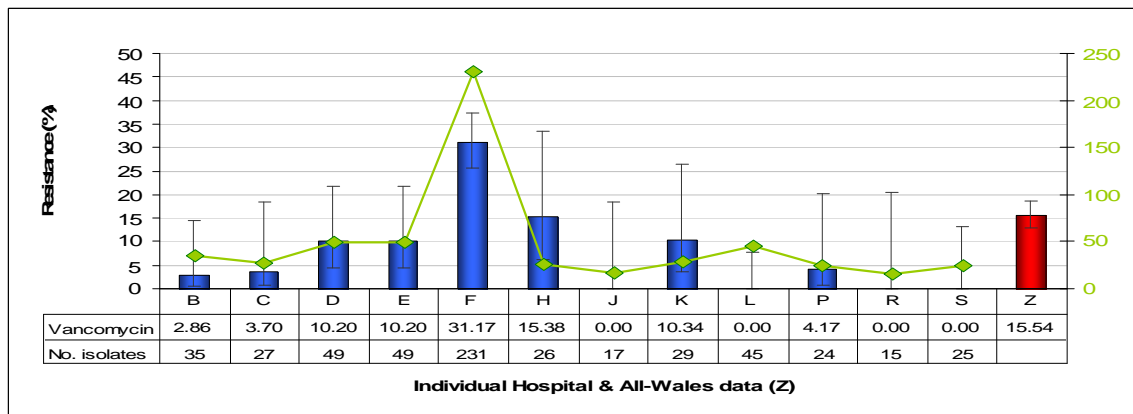


Figure 13: Vancomycin resistance in *Enterococcus* spp. (all-isolates); individual hospital data (2006)

Table 9: Streptococcus pneumoniae

TABLE 9: <i>Streptococcus pneumoniae</i> from blood cultures			
Resistance rates including (95% Confidence Intervals)			
Duplicate Cut Off: ≤14 days			
Time period: 1 January - 31 December 2006			
Location Code	PEN	TET	ERY
A	0.0 (0.0, 25.9)	0.0 (0.0, 25.9)	0.0 (0.0, 25.9)
B	0.0 (0.0, 9.4)		8.1 (2.8, 21.3)
C	7.1 (2.0, 22.7)	7.1 (2.0, 22.7)	14.3 (5.7, 31.5)
D	5.0 (1.4, 16.5)	5.0 (1.4, 16.5)	7.5 (2.6, 19.9)
E	0.0 (0.0, 12.1)		7.2 (2.0, 22.7)
F	2.5 (0.4, 12.9)	2.5 (0.4, 12.9)	2.5 (0.4, 12.9)
G	4.8 (0.9, 22.7)	4.8 (0.9, 22.7)	9.5 (2.7, 28.9)
H	3.5 (0.6, 17.2)		
J	5.3 (0.9, 24.6)	5.3 (0.9, 24.6)	10.5 (2.9, 31.4)
K	8.0 (2.2, 25.0)	4.0 (0.7, 19.5)	12.0 (4.2, 30.0)
L	3.2 (0.6, 16.2)	0.0 (0.0, 11.0)	12.9 (5.1, 28.9)
R	7.1 (1.3, 31.5)	0.0 (0.0, 21.5)	7.1 (1.3, 31.5)
S	9.3 (3.7, 21.6)		16.3 (8.1, 30.0)
T	0.0 (0.0, 24.3)		0.0 (0.0, 24.3)
All-Wales: Resistance rates	4.1 (2.6, 6.6)	3.3 (1.7, 6.4)	8.9 (6.4, 12.3)
All-Wales: Number of isolates	389	240	360

Key: PEN = penicillin, TET = tetracycline, ERY = erythromycin

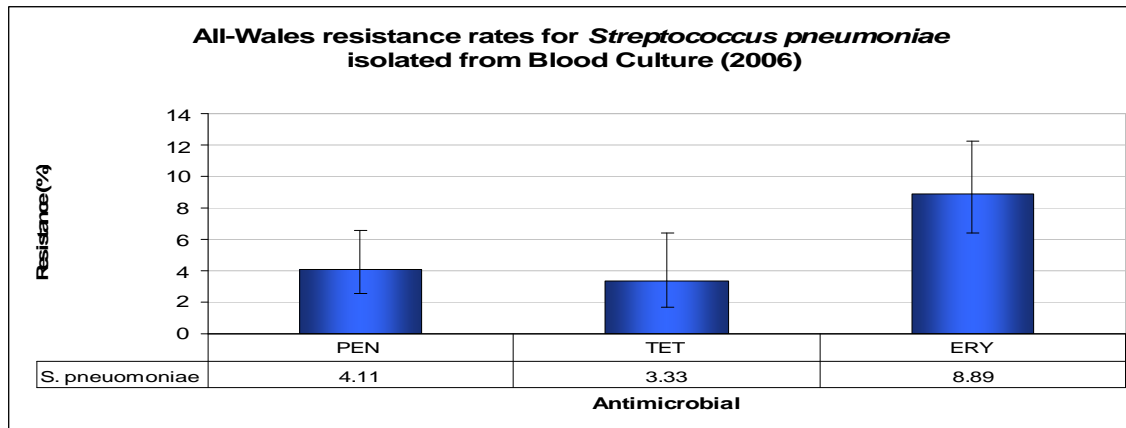


Figure 14: All-Wales antimicrobial resistance rates for *Streptococcus pneumoniae*; isolated from blood culture (2006).

Streptococcus pneumoniae

The All-Wales pattern of antimicrobial resistance is shown in Figures 14 & Table 9.

Resistance to penicillin

- The All-Wales resistance rate for penicillin was 4.1% (2.6, 6.6); not significantly different to the range published by the HPA for England & Wales (2.1 - 3.3%), or the UK rate published by BSAC of 4.7% (2.4, 8.8). Resistance rates at individual hospitals ranged from 0% (0.0, 9.4) to 9.3% (3.7, 21.6).
- The All-Wales rate for penicillin resistance falls within the 1-5% range for England & Wales published by EARSS (see Figure 15); the rate is comparable to the rates for Northern Europe and Scandinavia (1-5%), and is lower than the rates for some of the Southern European countries (25-50%).

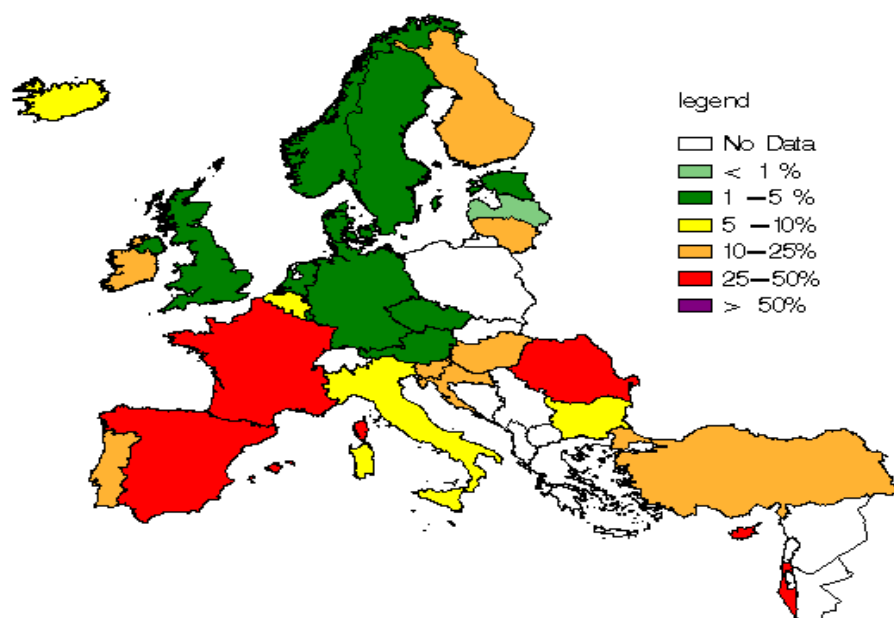


Figure 15: Proportion of Penicillin non-susceptible *S. pneumoniae* from the different European countries in 2006: Data from EARSS
(Available at www.earss.rivm.nl)

Resistance to tetracycline

- The All-Wales resistance rate for tetracycline was 3.3% (1.7, 6.4); similar to the UK rate published by BSAC 6.6% (3.8, 11.1). Resistance rates for individual hospitals level ranged from 0% (0.0, 11.0) to 7.1% (2.0, 22.7).

Resistance to erythromycin

- The All-Wales resistance rate for erythromycin was 8.9% (6.8, 11.3); lower than the range published by the HPA for England & Wales (11.6% - 14.3%), but not statistically different to the UK rate by BSAC 13.2% (9.1, 18.7).

Resistance rates for individual hospitals ranged from 0% (0.0, 24.3) to 16.3% (8.1, 30.0).

- The All-Wales rate for erythromycin resistance falls below the resistance range of 10-25% for England & Wales, published by EARSS (see Figure 16).

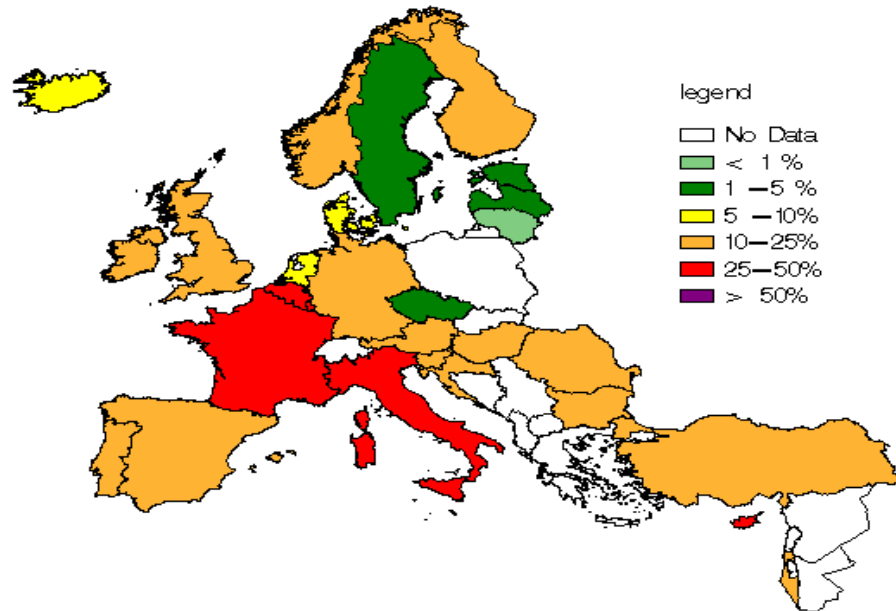


Figure 16: Proportion erythromycin resistant *S. pneumoniae* in various European countries in 2006: Data from EARSS (Available at www.earss.rivm.nl)

Section 6: Antimicrobial resistance rates for urinary coliforms

For the purposes of this report the term coliform refers to organisms that were reported as a 'coliform' by the laboratory, or when identified further, were reported as one of the genera belonging to the family *Enterobacteriaceae*.

The genera included in this section of the report comprise: *Citrobacter*, *Edwardsiella*, *Enterobacter*, *Escherichia*, *Hafnia*, *Klebsiella*, *Kluyvera*, *Morganella*, *Pantoea*, *Proteus*, *Providencia*, *Rahnella*, *Salmonella* and *Serratia*.

It should be noted that data from routinely-submitted urine specimens is more prone to bias than data from blood culture isolates due to variable sampling by clinicians. Thus resistance rates quoted here are likely to be higher due to increased sampling from patients who are more likely to have resistant organisms (e.g. patients with recurrent infections or infections that have failed to respond to initial therapy). This should be factored into any use of the data presented for the design of empiric treatment guidance.

The generation of more specific data reports (e.g. different patient age groups) can be discussed with the Welsh AR Programme.

Table 10: Community Urinary Coliforms

TABLE 10: Community urinary coliforms (including <i>E. coli</i> & <i>Proteus</i> spp.)										
Resistance rates including (95% Confidence Intervals)										
Duplicate Cut Off: ≤91 days										
Time period: 1 January - 31 December 2006										
Location Code	AMO	AUG	1GC	TRI	AMO/TRI	FQ	AMO/TRI/FQ	NIT		
A	49.8 (47.6, 52.1)	10.6 (9.3, 12.1)	10.5 (9.2, 12.0)	29.4 (27.4, 31.5)	23.4 (21.6, 25.4)	6.9 (5.8, 8.1)	5.8 (4.9, 7.0)	12.9 (11.5, 14.5)		
B	51.4 (49.4, 53.3)	8.3 (7.3, 9.4)	5.8 (4.9, 6.8)	27.7 (26.0, 29.5)	21.8 (20.2, 23.5)			11.5 (10.3, 12.8)		
C	56.3 (54.2, 58.3)	24.6 (22.9, 26.4)	20.0 (18.4, 21.7)	32.7 (30.8, 34.6)	26.8 (25.0, 28.7)	5.7 (4.9, 6.8)	5.2 (4.4, 6.2)	12.3 (11.1, 13.7)		
D	53.0 (51.9, 54.0)	5.7 (5.3, 6.2)	5.2 (4.8, 5.7)	28.2 (27.3, 29.2)	22.3 (21.5, 23.2)	5.9 (5.4, 6.4)	4.3 (3.9, 4.8)	10.1 (9.4, 10.8)		
E	51.6 (50.4, 52.9)	8.4 (7.7, 9.1)	7.3 (6.7, 8.0)	29.7 (28.6, 30.9)	23.3 (22.2, 24.4)	7.0 (6.4, 7.7)	5.1 (4.6, 5.7)	10.8 (10.1, 11.6)		
F	52.4 (51.3, 53.4)	13.1 (12.4, 13.8)	7.3 (6.7, 7.8)	29.8 (28.9, 30.8)	24.0 (23.2, 24.9)	7.7 (7.2, 8.3)	5.9 (5.4, 6.4)	14.5 (13.8, 15.2)		
G	49.4 (47.5, 51.3)	13.9 (12.6, 15.3)		30.3 (28.6, 32.1)	22.5 (21.0, 24.2)	7.4 (6.4, 8.4)	5.1 (4.4, 6.0)	15.5 (14.2, 16.9)		
H	52.1 (50.5, 53.7)		6.0 (5.3, 6.8)	28.1 (26.8, 29.6)	22.1 (20.8, 23.5)		7.2 (6.3, 8.3)	7.4 (6.6, 8.2)		
J	48.8 (47.4, 50.3)	5.3 (4.6, 6.0)	5.1 (4.5, 5.8)	27.6 (26.3, 29.0)	21.4 (20.2, 22.6)	4.2 (3.6, 4.8)	3.2 (2.7, 3.7)	10.4 (9.5, 11.4)		
K	48.3 (46.9, 49.7)		7.5 (6.8, 8.2)	26.0 (24.8, 27.2)	21.1 (20.0, 22.3)	6.2 (5.6, 6.9)	4.4 (3.8, 5.0)	10.3 (9.4, 11.1)		
L	51.7 (50.3, 53.0)		7.2 (6.5, 7.9)	26.4 (25.3, 27.6)	19.4 (18.4, 20.5)	6.8 (6.2, 7.5)	5.0 (4.4, 5.6)	11.6 (10.8, 12.5)		
All-Wales: Resistance rates	51.5 (51.1, 51.9)	10.0 (9.7, 10.3)	7.5 (7.2, 7.7)	28.5 (28.2, 28.9)	22.4 (22.1, 22.8)	6.5 (6.3, 6.7)	5.0 (4.8, 5.2)	11.5 (11.2, 11.8)		
All-Wales: Number of isolates	51857	51984	51818	45182	47661	37476	51060	51135		

Key: AMO = amoxicillin &/or ampicillin, AUG = co-amoxiclav, 1GC = resistance to any first generation cephalosporin, TRI = trimethoprim, AMO/TRI = co-resistance to amoxicillin & trimethoprim, FQ = ciprofloxacin &/or levofloxacin or norfloxacin, AMO/TRI/FQ = co-resistance to amoxicillin, trimethoprim & fluoroquinolone, NIT = nitrofurantoin

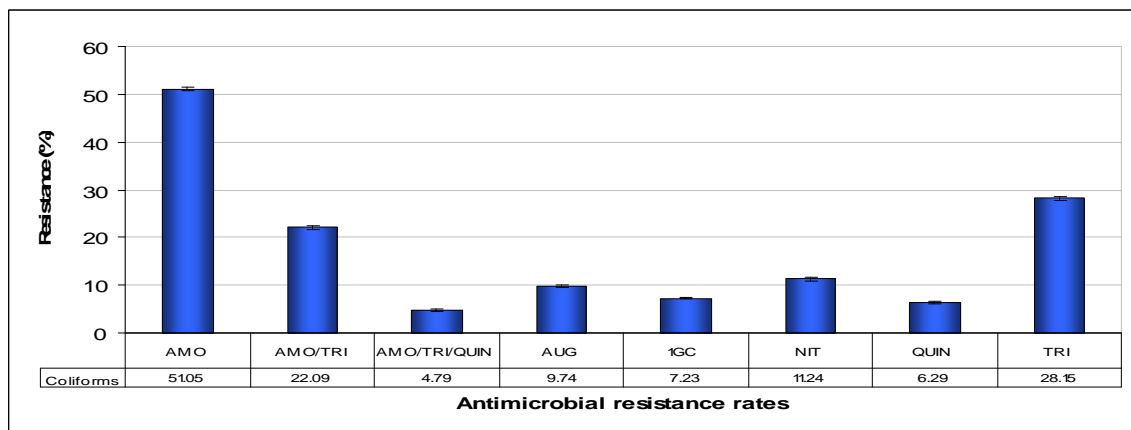


Figure 17: All-Wales antimicrobial resistance rates for coliforms from community urine samples (2006).

Community Urinary Coliforms

The All-Wales pattern of antimicrobial resistance is shown in Figures 17 & Table 10.

Resistance to β -lactams

- The All-Wales resistance rate for amoxicillin/ampicillin was 51.5% (51.1, 51.9); regional rates are shown in Figure 18, and range from 48.3% (46.9, 49.7) to 56.3% (54.2, 58.3).
- The All-Wales resistance rate for co-amoxiclav was 10.0% (9.7, 10.3); regional rates are shown in Figure 19, and range from 5.3% (4.6, 6.0) to 24.6% (22.9, 26.4). The All-Wales resistance rate for first generation cephalosporins was 7.5% (7.1, 7.5); regional rates ranged from 5.1% (4.5, 5.8) to 20.0% (18.5, 21.7). The rates of resistance to both 1st generation cephalosporins and co-amoxiclav are particularly high in the community served by the laboratory at the Royal Glamorgan Hospital.

Resistance to trimethoprim

- The All-Wales resistance rate for trimethoprim was 28.5% (28.2, 28.9); regional rates are shown in Figure 20, and range from 26.0% (24.8, 27.2) to 32.7% (30.8, 34.6).

Co-resistance to amoxicillin and trimethoprim

- The All-Wales rate for co-resistance to amoxicillin/ampicillin and trimethoprim was 22.4% (22.1, 22.8); regional rates ranged from 19.5% (18.4, 20.1) to 26.8% (25.0, 28.7).

Resistance to fluoroquinolones

- The All-Wales resistance rate for fluoroquinolones was 6.5% (6.3, 6.8); regional rates are shown in Figure 21, and range from 4.2% (3.6, 4.8) to 7.7% (7.2, 8.3).

Co-resistance to amoxicillin, trimethoprim and fluoroquinolones

- The All-Wales rate for co-resistance to amoxicillin/ampicillin, trimethoprim and a fluoroquinolone was 5.0% (4.8, 5.2); regional rates ranged from 3.2% (2.7, 3.7) to 7.2% (6.3, 8.3).

Resistance to nitrofurantoin

- The All-Wales resistance rate for nitrofurantoin was 11.5% (11.2, 11.8); regional rates ranged from 7.4% (6.6, 8.2) to 15.5% (14.2, 16.9). The inclusion of *Proteus* species in the coliform group undoubtedly inflates the nitrofurantoin resistance rates. When *Proteus* species were excluded from the analysis the All-Wales resistance rate was 7.3% (7.1, 7.5) with regional variation of 3.6% (3.1, 4.2) to 12.1% (11.6, 14.1).

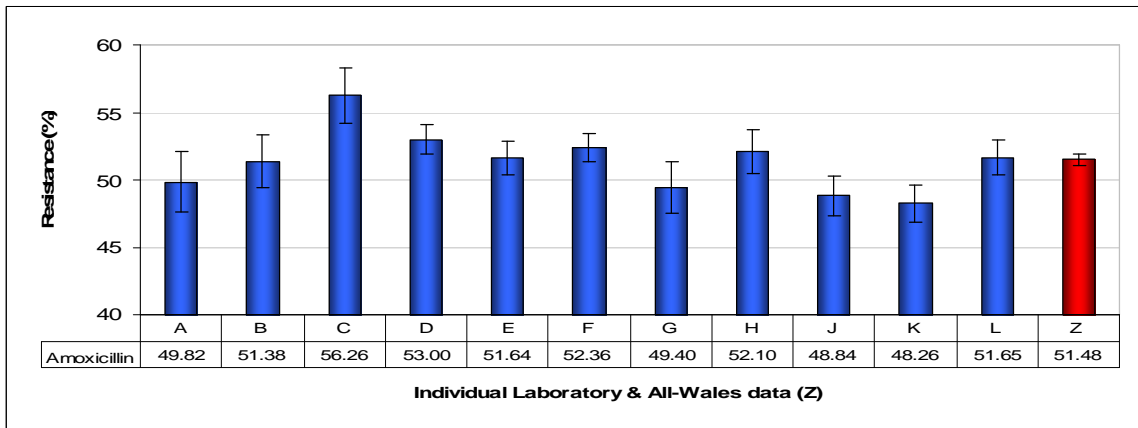


Figure 18: Amoxicillin resistance in community urinary coliforms; individual laboratory data (2006).

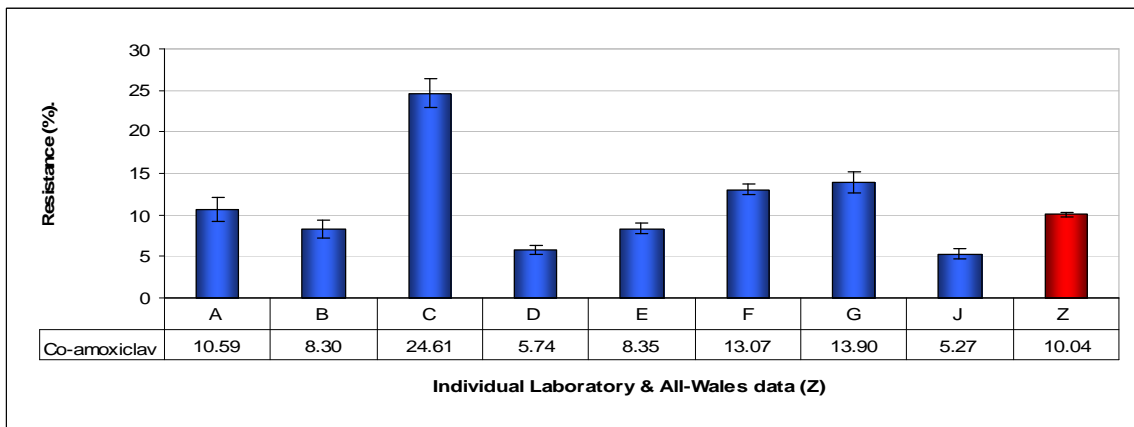


Figure 19: Co-amoxiclav resistance in community urinary coliforms; individual laboratory data (2006).

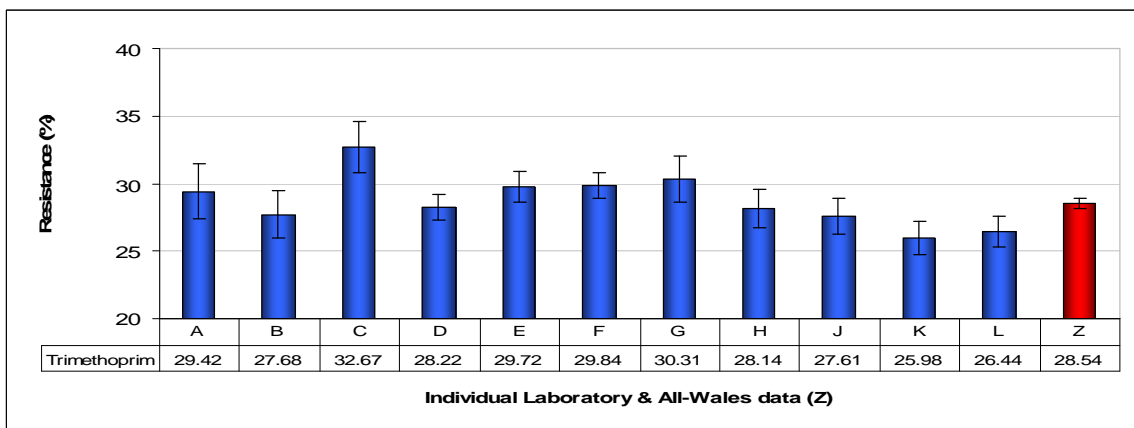


Figure 20: Trimethoprim resistance in community urinary coliforms; individual laboratory data (2006).

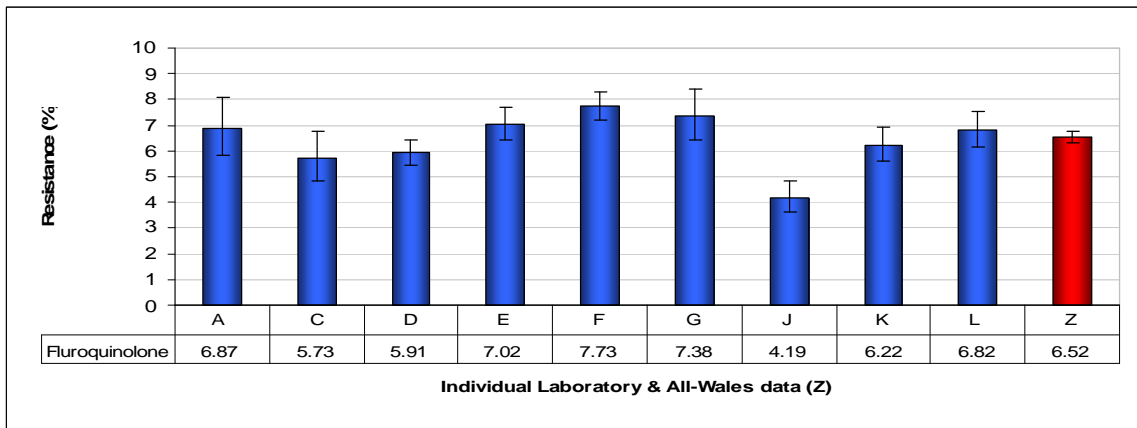


Figure 21: Fluoroquinolone resistance in community urinary coliforms; individual laboratory data (2006).

Table 11: Hospital In-Patient Urinary Coliforms

TABLE 11: Hospital in-patient urinary coliforms (including <i>E. coli</i> & <i>Proteus</i> spp.)									
Resistance rates including (95% Confidence Intervals)									
Duplicate Cut Off: ≤91 days									
Time period: 1 January - 31 December 2006									
Location Code	AMO	AUG	1GC	TRI	AMO/TRI	FQ	AMO/TRI/FQ	NIT	
A	57.1 (51.3, 62.8)	22.1 (17.7, 27.4)	23.2 (18.7, 28.5)	31.4 (26.3, 37.1)	24.6 (20.0, 30.0)	7.5 (5.0, 11.2)	6.1 (3.8, 9.5)	20.0 (15.7, 25.1)	
B	56.6 (53.6, 59.5)	14.1 (12.1, 16.2)	11.7 (10.0, 13.7)	31.2 (28.5, 34.0)	25.9 (23.4, 28.5)			16.4 (14.3, 18.7)	
C	65.6 (62.4, 68.7)	35.2 (32.1, 38.5)	33.3 (30.3, 36.5)	39.7 (36.5, 43.0)	34.4 (31.3, 37.6)	15.0 (12.8, 17.5)	14.0 (11.8, 16.4)	22.6 (19.9, 25.5)	
D	58.4 (56.3, 60.5)	8.9 (7.8, 10.2)	8.4 (7.3, 9.6)	27.1 (25.3, 29.0)	21.8 (20.1, 23.6)	8.4 (7.3, 9.6)	6.1 (5.2, 7.2)		
E	61.3 (58.2, 64.4)	16.8 (14.6, 19.3)	20.6 (18.1, 23.3)	37.6 (34.5, 40.7)	31.5 (28.7, 34.5)	18.8 (16.5, 21.4)	15.6 (13.4, 18.0)	22.0 (19.5, 24.7)	
F	64.3 (62.3, 66.3)	26.7 (24.9, 28.6)		38.3 (36.3, 40.4)	33.9 (32.0, 35.9)	21.0 (19.4, 22.8)	17.0 (15.5, 18.6)	21.9 (20.3, 23.7)	
G	57.3 (53.5, 60.9)	20.9 (18.0, 24.1)		39.0 (35.5, 42.7)	31.6 (28.3, 35.2)	13.5 (11.1, 16.2)	10.8 (8.7, 13.3)	22.0 (19.1, 25.3)	
H	58.7 (56.2, 61.2)	14.0 (12.2, 15.9)	13.1 (11.5, 14.8)	34.1 (31.8, 36.5)	27.5 (25.3, 29.8)			12.4 (10.9, 14.2)	
J	55.4 (52.5, 58.3)	9.8 (8.2, 11.7)	12.2 (10.4, 14.2)	24.5 (22.1, 27.1)	19.7 (17.5, 22.1)	7.4 (6.0, 9.0)	5.8 (4.6, 7.3)	13.9 (12.0, 16.0)	
K	59.5 (56.6, 62.4)		15.6 (13.6, 17.9)	30.6 (28.0, 33.5)	26.3 (23.7, 29.0)	12.9 (11.0, 15.0)	11.7 (9.9, 13.8)	15.3 (13.3, 17.6)	
L	56.6 (54.0, 59.1)		11.3 (9.8, 12.9)	27.6 (25.4, 29.8)	22.9 (20.8, 25.1)	10.2 (8.8, 11.9)	8.1 (6.8, 9.7)	13.8 (12.2, 15.5)	
P	67.1 (63.7, 70.4)	27.2 (24.2, 30.6)		44.4 (40.8, 47.9)	40.3 (36.9, 43.9)	25.1 (22.1, 28.3)	22.3 (19.5, 25.4)	22.2 (19.3, 25.3)	
Q	54.2 (41.7, 66.3)	23.7 (14.7, 36.0)		18.6 (10.7, 30.4)	15.3 (8.2, 26.5)	11.9 (5.9, 22.5)	8.5 (3.7, 18.4)	16.9 (9.5, 28.5)	
R	59.6 (54.4, 64.6)	15.5 (12.1, 19.7)	15.0 (11.6, 19.1)	31.1 (26.5, 36.1)	23.7 (19.6, 28.4)	9.0 (6.5, 12.5)	7.6 (5.3, 10.9)	17.2 (13.7, 21.5)	
S	55.0 (51.6, 58.3)	12.5 (10.4, 14.9)	12.3 (10.2, 14.7)	28.2 (25.2, 31.3)	22.9 (20.1, 25.8)	10.6 (8.7, 12.9)	8.1 (6.4, 10.1)	14.1 (11.9, 16.6)	
T	61.0 (56.3, 65.4)	16.7 (13.5, 20.5)	15.1 (12.1, 18.8)	35.2 (30.9, 39.8)	29.1 (25.0, 33.5)	15.6 (12.5, 19.3)	13.5 (10.6, 17.0)	17.0 (13.7, 20.8)	
All-Wales: Resistance rates	59.6 (58.9, 60.4)	17.9 (17.2, 18.5)	14.4 (13.8, 15.0)	32.7 (32.0, 33.5)	27.5 (26.8, 28.2)	13.7 (13.1, 14.3)	11.4 (10.8, 11.9)	17.6 (16.9, 18.2)	
All-Wales: Number of isolates	15894	13199	12427	16117	15872	13314	13158	13888	

Key: AMO = amoxicillin &/or ampicillin, AUG = co-amoxiclav, 1GC = resistance to any first generation cephalosporin, TRI = trimethoprim, AMO/TRI = co-resistance to amoxicillin & trimethoprim, FQ = ciprofloxacin &/or levofloxacin or norfloxacin, AMO/TRI/FQ = co-resistance to amoxicillin, trimethoprim & fluoroquinolone, NIT = nitrofurantoin

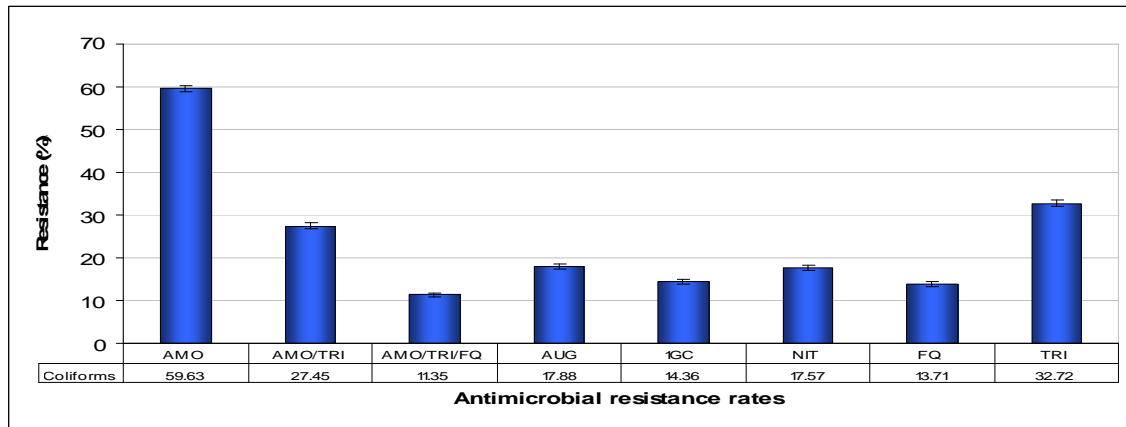


Figure 22: All-Wales antimicrobial resistance rates for coliforms from hospital in-patient urine samples (2006).

In-patient Urinary Coliforms

The All-Wales pattern of antimicrobial resistance is shown in Figures 22 & Table 11. It should be noted that there is significant variability in resistance rates between hospitals (even hospitals served by the same laboratory). This highlights the need to use local data when devising empiric treatment guidance.

Resistance to β -lactams

- The All-Wales resistance rate for amoxicillin/ampicillin 59.6% (58.9, 60.4). The resistance rate for hospital urinary coliforms is significantly higher than the rate for community urinary coliforms of 51.5% (51.1, 51.9); resistance rates for individual hospitals ranged from 54.2% (41.7, 66.3) to 67.1% (63.7, 70.4).
- The All-Wales resistance rate for co-amoxiclav was 17.9% (17.2, 18.5); the rate is significantly higher than the All-Wales rate for community urinary coliforms 10.0% (9.7, 10.3). Resistance rates for individual hospitals are shown in Figure 23, and range from 8.9% (7.8, 10.2) to 35.2% (32.1, 38.5). The All-Wales resistance rate for first generation cephalosporins was 14.4% (13.8, 15.0); resistance rates for individual hospitals ranged from 8.4% (7.3, 9.6) to 33.3% (30.3, 36.5). The high rates of resistance to both co-amoxiclav and first generation cephalosporins reported from the Royal Glamorgan Hospital correlates with the high rates observed in the community.

Resistance to trimethoprim

- The All-Wales resistance rate for trimethoprim was 32.7% (32.0, 33.5), significantly higher than the All-Wales rate for community urinary coliforms of 28.5% (28.2, 28.9). Resistance rates for individual hospitals ranged from 18.6% (10.7, 30.4) to 44.4% (40.8, 47.9).

Resistance to fluoroquinolones

- The All-Wales resistance rate for fluoroquinolones was 13.7% (13.1, 14.3), significantly higher than the All-Wales resistance rate for community urinary coliforms 6.5% (6.3, 6.8). Resistance rates for individual hospitals are shown in Figure 24, and range widely from 7.4% (6.0, 9.0) to 25.1% (22.1, 28.3).

Co-resistance to amoxicillin and trimethoprim

- The All-Wales rate for co-resistance to amoxicillin/ampicillin and trimethoprim was 27.5% (26.8, 28.2); resistance rates for individual hospitals ranged from 15.3% (8.2, 26.5) to 40.3% (36.9, 43.9).

Co-resistance to amoxicillin, trimethoprim and fluoroquinolones

- The All-Wales rate for co-resistance to amoxicillin/ampicillin, trimethoprim and a fluoroquinolone was 11.4% (10.8, 11.9); resistance rates for individual hospitals ranged from 5.8% (4.6, 7.3) to 22.3% (19.5, 25.4).

Resistance to nitrofurantoin

- The All-Wales resistance rate for nitrofurantoin was 17.6% (16.9, 18.2); resistance rates for individual hospitals ranged from 12.4% (10.9, 14.2) to 22.2% (19.3, 25.3). When *Proteus* species were excluded from the analysis the All-Wales resistance rate was 13.1% (12.6, 13.7) with regional variation of 6.3% (5.0, 7.9) to 19.6% (15.8, 23.9).

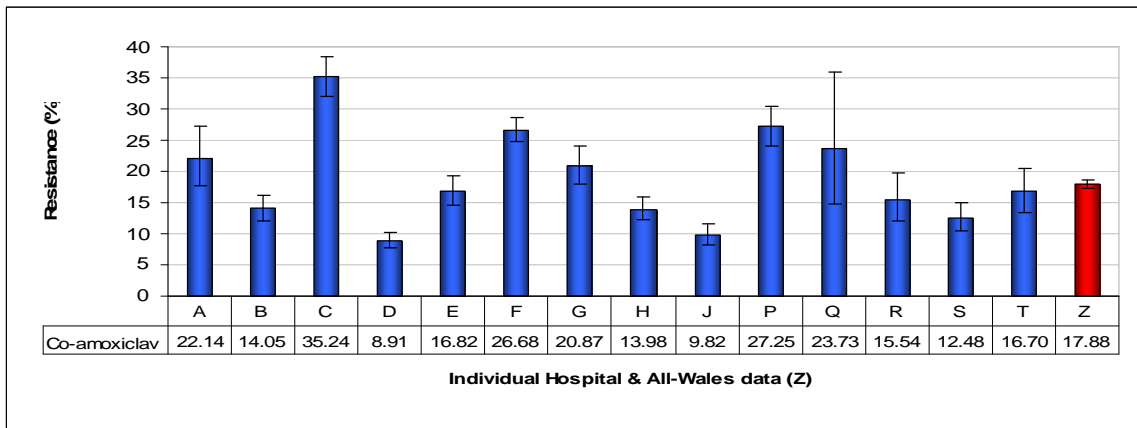


Figure 23: Co-amoxiclav resistance in hospital in-patient urinary coliforms; individual hospital data (2006).

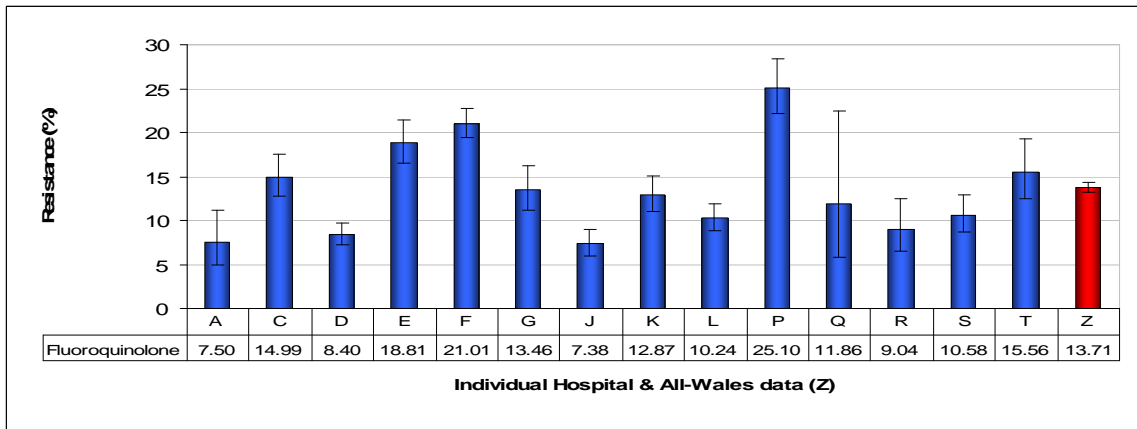


Figure 24: Fluoroquinolone resistance in hospital in-patient urinary coliforms; individual hospital data (2006).

Section 7: Antimicrobial resistance rates for *S. aureus* from general practice wound swabs

The data in this section is presented to purport the antimicrobial susceptibility of organisms causing skin and soft tissue infections occurring in the community. However, it should be noted that there is a significant sampling bias in this data. Thus the fact that 21% of *S. aureus* isolates are resistant to Meticillin should not be interpreted to mean that this rate of resistance pertains to infection in the majority of patients in the community.

Table 12: Community Methicillin sensitive *Staphylococcus aureus* (MSSA)

TABLE 12: Methicillin sensitive <i>Staphylococcus aureus</i> (MSSA) from community wound swabs					
Resistance rates including (95% Confidence Intervals)					
Duplicate Cut Off: ≤90 days					
Time period: 1 January - 31 December 2006					
Location Code	PEN	TET	ERY	FUS	GEN
A	100 (99.2, 100)		8.8 (6.6, 11.8)	16.2 (13.0, 19.8)	0.2 (0.0, 1.2)
B	85.1 (81.2, 88.3)		4.1 (2.6, 6.6)	11.3 (8.6, 14.9)	0.0 (0.0, 1.0)
C	90.2 (87.6, 92.3)	3.3 (2.1, 5.2)	12.3 (10.0, 15.1)	11.0 (8.8, 13.6)	2.0 (1.2, 3.4)
E	85.6 (84.1, 87.0)		12.3 (11.0, 13.7)	13.8 (12.4, 15.3)	0.7 (0.4, 1.2)
F	86.2 (84.5, 87.8)		10.5 (9.1, 12.1)	17.3 (15.6, 19.3)	0.3 (0.1, 0.6)
G	83.5 (79.6, 86.8)	4.0 (2.5, 6.4)	9.7 (7.2, 13.0)	7.5 (5.3, 10.5)	0.3 (0.0, 1.4)
H			9.7 (7.8, 12.0)		
J	83.1 (80.7, 85.2)	3.5 (2.6, 4.8)	7.9 (6.4, 9.7)	9.0 (7.4, 10.9)	0.3 (0.1, 0.8)
K	87.2 (84.7, 89.3)		24.1 (21.4, 27.1)	13.3 (11.2, 15.8)	0.5 (0.2, 1.2)
L		5.4 (4.0, 7.2)	9.9 (8.1, 12.1)	17.2 (14.7, 20.0)	0.1 (0.0, 0.7)
All-Wales: Resistance rates	86.6 (85.9, 87.4)	4.1 (3.4, 4.9)	11.5 (10.9, 12.2)	13.6 (12.9, 14.4)	0.5 (0.4, 0.7)
All-Wales: Number of isolates	7624	2795	9275	8498	8498

Key: PEN = penicillin, TET = tetracycline, ERY = erythromycin, FUS = fusidic acid, GEN = gentamicin

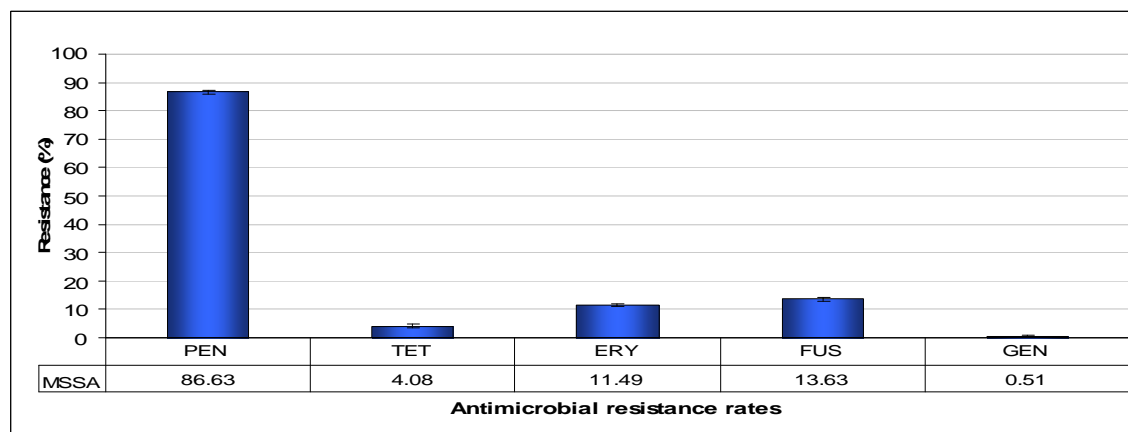


Figure 25: All-Wales antimicrobial resistance rates for MSSA isolated from wound swabs referred from general practice (2006).

MSSA

The All-Wales pattern of antimicrobial resistance for Meticillin-sensitive *S. aureus* (MSSA) isolated from wound swabs referred from general practice is shown in Figure 25 & Table 12.

Resistance to penicillin

- The All-Wales resistance rate for penicillin was 86.6% (86.0, 87.4), the same as that for blood culture 86.6% (83.4, 89.2). The regional rates ranged from 83.1% (80.8, 85.2) to 100% (99.16, 100).

Resistance to tetracycline

- The All-Wales resistance rate for tetracycline was 4.1% (3.4, 4.9), only four of the ten laboratories tested $\geq 80\%$ of isolates and so the All-Wales figure cannot be compared to that for blood cultures. The regional rates ranged from 3.3% (2.1, 5.2) to 5.4% (4.0, 7.2).

Resistance to erythromycin

- The All-Wales resistance rate for erythromycin was 11.5% (10.9, 12.2) and is not significantly different to the All-Wales erythromycin rate for MSSA from blood culture 8.8% (6.8, 11.3). The regional rates ranged widely from 4.1% (2.6, 6.6) to 24.1% (21.4, 27.1).

Resistance to fusidic acid

- The All-Wales resistance rate for fusidic acid was 13.6% (12.9, 14.4), and is not significantly different to the All-Wales fusidic acid rate for MSSA from blood culture 12.1% (9.7, 14.9). The regional rates ranged from 7.5% (5.3, 10.5) to 17.2% (14.7, 20.0).

Resistance to gentamicin

- The All-Wales resistance rate for gentamicin was 0.5% (0.4, 0.7) significantly lower than the All-Wales rate for blood culture of 2.3% (1.4, 3.8). The regional rates ranged from 0% (0.0, 0.1) to 2.0% (1.2, 3.4).

Table 13: Community Meticillin resistant *Staphylococcus aureus* (MRSA)

TABLE 13: Methicillin resistant <i>Staphylococcus aureus</i> (MRSA) from community wound swabs									
Resistance rates including (95% Confidence Intervals)									
Duplicate Cut Off: ≤90 days									
Time period: 1 January - 31 December 2006									
Location Code	CIP	ERY	FUS	GEN	LZD	MUP	RIF	TET	VAN
A	98.5 (92.0, 99.7)	65.7 (53.7, 75.9)	6.0 (2.3, 14.4)	4.5 (1.5, 12.4)					
B	97.9 (88.9, 99.6)	72.9 (59.0, 83.4)	12.5 (5.9, 24.7)	0.0 (0.0, 7.4)		2.1 (0.4, 11.1)	0.0 (0.0, 7.6)	2.1 (0.4, 11.1)	0.0 (0.0, 7.4)
C	94.0 (89.6, 96.6)	73.2 (66.4, 79.1)	6.6 (3.8, 11.1)	2.2 (0.9, 5.5)				3.7 (1.7, 7.8)	0.0 (0.0, 2.1)
E	96.7 (94.5, 98.0)	72.6 (68.1, 76.6)	14.2 (11.2, 17.8)	2.6 (1.5, 4.6)	0.0 (0.0, 0.9)	4.2 (2.7, 6.5)	0.9 (0.4, 2.4)	1.2 (0.5, 2.7)	0.0 (0.0, 0.9)
F		65.7 (60.7, 70.4)	13.3 (10.1, 17.1)	0.6 (0.2, 2.0)		3.3 (1.9, 5.7)			0.0 (0.0, 1.1)
G	100 (94.3, 100)	79.1 (67.9, 87.1)	7.5 (3.2, 16.3)	0.0 (0.0, 5.4)		3.2 (0.9, 10.9)	0.0 (0.0, 5.7)	0.0 (0.0, 5.4)	0.0 (0.0, 5.8)
H		16.0 (11.5, 21.8)	1.0 (0.3, 3.7)			0.5 (0.1, 2.9)	0.0 (0.0, 1.9)	5.7 (3.2, 9.9)	
J	96.0 (91.9, 98.0)	65.3 (58.0, 72.0)	7.5 (4.4, 12.4)	0.0 (0.0, 2.2)	0.0 (0.0, 2.2)	4.8 (2.4, 9.1)	0.0 (0.0, 2.2)	0.6 (0.1, 3.2)	0.0 (0.0, 2.2)
K		76.6 (69.7, 82.3)	9.9 (6.3, 15.3)	1.2 (0.3, 4.2)					0.0 (0.0, 2.2)
L		74.2 (68.9, 78.9)	24.8 (20.2, 30.1)	0.8 (0.2, 2.8)				24.6 (20.0, 30.0)	
All-Wales: Resistance rates	96.4 (95.1, 97.4)	71.2 (69.0, 73.3)	13.5 (12.1, 15.1)	1.3 (0.9, 2.0)	0.0 (0.0, 0.6)	3.4 (2.5, 4.5)	0.5 (0.2, 1.2)	6.7 (5.5, 8.1)	0.00 (0.0, 0.3)
All-Wales: Number of isolates	956	1781	1974	1943	590	1329	962	1424	1482

Key: CIP = ciprofloxacin, ERY = erythromycin, FUS = fusidic acid, GEN = gentamicin, LZD = linezolid, MUP = mupirocin, RIF = rifampicin, TET = tetracycline, VAN = vancomycin

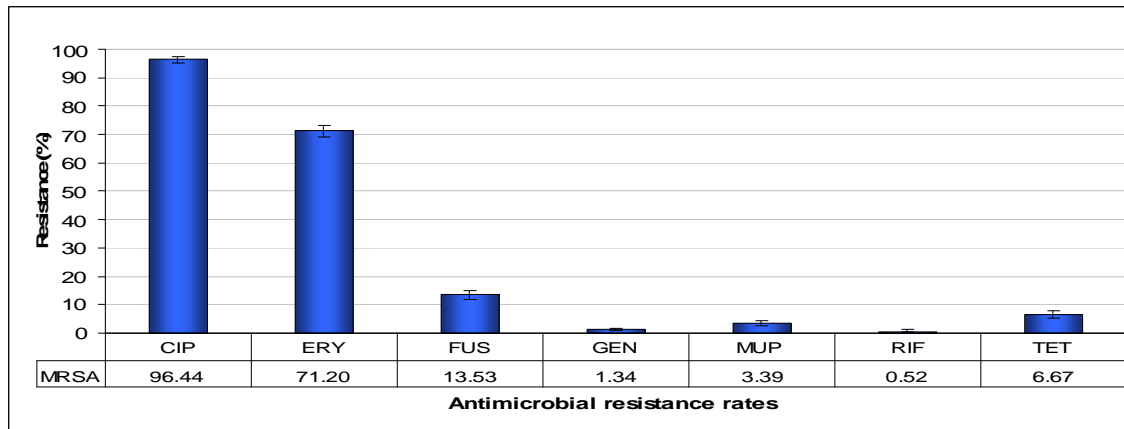


Figure 26: All-Wales antimicrobial resistance rates for MRSA isolated from wound swabs referred from general practice (2006).

MRSA

The All-Wales pattern of antimicrobial resistance is shown in Figure 26 & Table 13.

Resistance to ciprofloxacin

- The All-Wales resistance rate for ciprofloxacin was 96.4% (95.1, 97.4); regional rates ranged from 94.0% (89.6, 96.6) to 100% (94.3, 100).

Resistance to erythromycin

- The All-Wales resistance rate for erythromycin was 71.2% (69.0, 73.3); not significantly different to the All-Wales rate for MRSA in blood culture 76.6% (71.3, 81.3). The regional rates ranged from 65.3% (58.0, 72.0) to 79.1% (67.9, 87.1).
- (67.9, 87.1).

Resistance to fusidic acid

- The All-Wales resistance rate for fusidic acid was 13.5% (12.1, 15.1), not statistically different to the All-Wales fusidic acid rate for MRSA from blood culture 11.5% (8.4, 15.7). The regional rates ranged widely from 6.0% (2.3, 14.4) to 24.8% (20.2, 30.1).

Resistance to gentamicin

- The All-Wales resistance rate for gentamicin was 1.3% (0.9, 2.0), not significantly different to the All-Wales gentamicin rate for MRSA from blood culture 3.4% (1.9, 6.2). The regional rates ranged widely from 0% (0.0, 2.2) to 4.5% (1.5, 12.4).

Resistance to mupirocin

- The All-Wales resistance rate for mupirocin was 3.4% (2.5, 4.5); regional rates ranged from 0.5% (0.1, 2.9) to 4.8% (2.4, 9.1).

Resistance to rifampicin

- The All-Wales resistance rate for rifampicin was 0.5% (0.2, 1.2); not significantly different to the All-Wales rifampicin rate for MRSA from blood culture 2.2% (0.9, 5.0). The regional rates ranged from 0% (0.0, 1.9) to 1.5% (0.3, 8.1).

Resistance to tetracycline

- The All-Wales resistance rate for tetracycline was 6.7% (5.5, 8.1), not significantly different to the All-Wales rate for blood culture isolates of 5.9% (3.2, 10.4). The regional rates ranged from 0.0% (0.0, 5.4) to 24.6% (20.0, 30.0). Rates of resistance were particularly high, at 24.6%, for Ysbyty Glan Clwyd. This high rate of resistance was reflected by a high rate of resistance in blood culture isolates (17.2%).

Resistance to vancomycin

- Resistance to vancomycin was not detected.

Resistance to linezolid

- Resistance to linezolid was not detected.

Section 8: Antimicrobial resistance rates for other pathogens (all-specimens, community & hospital).

The data in this section of the report comprises other pathogens which may commonly cause import infections other than bacteraemia.

- *Streptococcus pneumoniae*
- *Streptococcus pyogenes*
- *Haemophilus influenzae*
- *Campylobacter species*

Table 14: *Streptococcus pneumoniae* (all specimens and all locations)

TABLE 14: <i>Streptococcus pneumoniae</i> - all specimens & locations			
Resistance rates including (95% Confidence Intervals)			
Duplicate Cut Off: ≤90 days			
Time period: 1 January - 31 December 2006			
Location Code	PEN	TET	ERY
A	6.3 (2.9, 13.0)	3.1 (1.1, 8.8)	13.5 (8.1, 21.8)
B	2.6 (1.2, 5.5)		11.1 (7.7, 15.7)
C	4.3 (2.3, 8.0)	4.3 (2.2, 8.2)	9.0 (5.7, 14.0)
D	3.8 (2.3, 6.0)	4.2 (2.7, 6.6)	9.9 (7.4, 13.1)
E	6.5 (4.5, 9.2)		17.0 (13.8, 20.9)
F	6.3 (4.5, 8.7)	5.7 (4.0, 8.1)	10.1 (7.8, 13.0)
G	4.4 (1.5, 12.2)	3.1 (0.9, 10.7)	9.4 (4.4, 19.0)
H	3.8 (2.0, 7.1)		
J	6.7 (4.1, 11.0)	7.7 (4.8, 12.1)	14.9 (10.7, 20.4)
K	1.8 (0.8, 3.9)	4.9 (3.1, 7.8)	12.0 (8.9, 15.9)
L	2.4 (1.2, 4.9)	3.7 (2.0, 6.7)	10.6 (7.6, 14.7)
All-Wales: Resistance rates	4.5 (3.8, 5.3)	4.9 (4.1, 5.9)	11.9 (10.7, 13.1)
All-Wales: Number of isolates	3048	2100	2786

Key: PEN = penicillin, TET = tetracycline, ERY = erythromycin

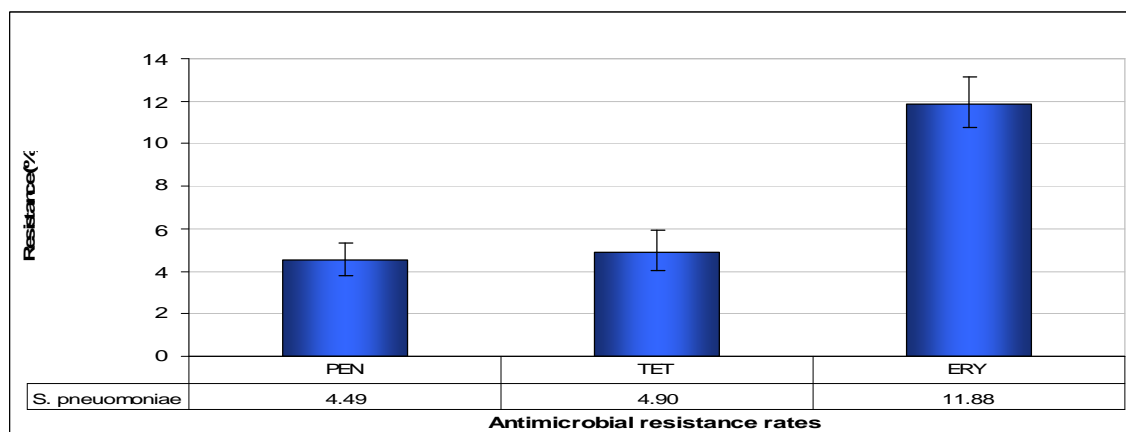


Figure 27: All-Wales antimicrobial resistance rates *S. pneumoniae*: All specimens, both hospital & community (2006).

S. pneumoniae

The All-Wales pattern of antimicrobial resistance is shown in Figures 27 & Table 14.

Resistance to penicillin

- The All-Wales resistance rate for penicillin was 4.5% (3.8, 5.3); not statistically different to the All-Wales penicillin resistance rate for *S. pneumoniae* from blood culture 4.1% (2.6, 6.6). The regional resistance rates ranged from 1.8% (0.8, 3.9) to 6.7% (4.1, 11.0), the higher rate being seen in the area served by the laboratory at Carmarthen.

Resistance to tetracycline

- The All-Wales resistance rate for tetracycline was 4.9% (4.1, 5.9); not significantly different to the tetracycline resistance rate for *S. pneumoniae* from blood cultures of 3.3% (1.7, 6.4). The regional rates ranged from 3.1% (0.9, 10.7) to 7.7% (4.8, 12.1).

Resistance to erythromycin

- The All-Wales resistance rate for erythromycin was 11.9% (10.7, 13.1); not significantly different to the resistance rate for blood cultures of 8.9% (6.8, 11.3). The regional rates ranged from 9.0% (5.7, 14.0) to 17.0% (13.8, 20.9).

Table 15: *Streptococcus pyogenes* (all specimens including wound swabs)

TABLE 15: <i>Streptococcus pyogenes</i> - all specimens including wound swabs			
Resistance rates including (95% Confidence Intervals)			
Duplicate Cut Off: ≤90 days			
Time period: 1 January - 31 December 2006			
Location Code	PEN	TET	ERY
A	0.0 (0.0, 2.4)	11.8 (7.6, 17.8)	7.2 (4.1, 12.4)
B	0.0 (0.0, 2.3)		5.0 (2.6, 9.6)
C			
D			0.0 (0.0, 0.8)
E	0.0 (0.0, 0.9)		3.0 (1.7, 5.0)
F	0.0 (0.0, 0.9)	9.5 (7.0, 12.7)	6.2 (4.2, 9.0)
G	0.0 (0.0, 3.2)	7.8 (4.1, 14.1)	1.7 (0.5, 6.1)
H	0.0 (0.0, 1.5)		2.9 (1.4, 5.8)
J	0.0 (0.0, 2.3)	13.5 (9.1, 19.6)	9.8 (6.1, 15.3)
K	0.0 (0.0, 1.4)	9.2 (6.3, 13.3)	1.9 (0.8, 4.4)
L	0.0 (0.0, 1.6)	18.2 (13.6, 23.8)	2.9 (1.4, 5.8)
All-Wales: Resistance rates	0.0 (0.0, 0.2)	11.4 (9.7, 13.4)	3.5 (2.9, 4.3)
All-Wales: Number of isolates	2206	1162	2676

Key: PEN = penicillin, TET = tetracycline, ERY = erythromycin

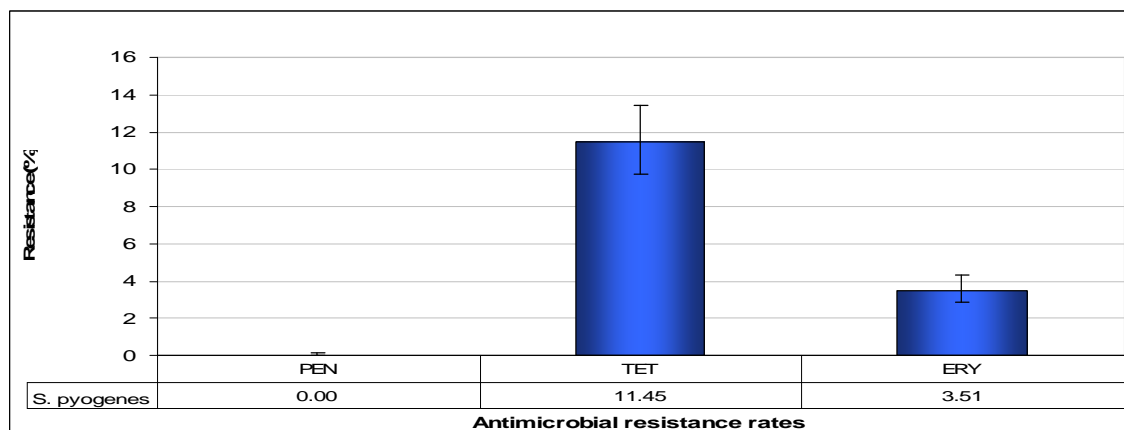


Figure 28: All-Wales antimicrobial resistance rates *S. pyogenes*: All specimens both hospital & community (2006).

Streptococcus pyogenes

The All-Wales pattern of antimicrobial resistance is shown in Figures 28 & Table 15.

Resistance to penicillin

- Resistance to penicillin was not detected. Penicillin resistance has not been described in the UK or, indeed, from any other country.

Resistance to tetracycline

- The All-Wales resistance rate for tetracycline was 11.4% (9.7, 13.4); lower than the 2005 resistance rate published by the HPA for England & Wales (17.6%). Regional rates ranged from 7.8% (4.1, 14.1) to 18.2% (13.6, 23.8).

Resistance to erythromycin

- The All-Wales resistance rate for erythromycin was 3.5% (2.9, 4.3); lower than the 2005 resistance rate published by the HPA for England & Wales (4.7%). Regional rates ranged from 0% (0.0, 0.8) to 9.8% (6.1, 15.3).

Table 16: *Haemophilus influenzae* (all specimens and all locations)

TABLE 16: <i>Haemophilus influenzae</i> - all specimens & locations			
Resistance rates including (95% Confidence Intervals)			
Duplicate Cut Off: ≤90 days			
Time period: 1 January - 31 December 2006			
Location Code	AMO	AUG	TET
A	14.8 (10.5, 20.6)	4.8 (2.5, 8.8)	1.1 (0.3, 3.8)
B	26.5 (22.2, 31.2)	7.7 (5.4, 11.0)	
C	20.3 (17.0, 24.1)		4.3 (2.8, 6.5)
D	21.2 (18.5, 24.2)	4.6 (3.3, 6.3)	
E	16.0 (13.2, 19.3)	3.6 (2.3, 5.5)	
F	21.2 (18.5, 24.1)	6.4 (4.9, 8.2)	2.1 (1.3, 3.3)
G			
H	14.9 (11.7, 18.8)		1.5 (0.7, 3.3)
J	21.8 (18.2, 26.0)	4.9 (3.2, 7.4)	
K	15.3 (12.8, 18.3)	4.2 (2.9, 6.0)	
L	27.6 (23.8, 31.7)	15.8 (12.7, 19.5)	
All-Wales: Resistance rates	20.1 (19.0, 21.2)	6.2 (5.5, 7.0)	2.4 (1.8, 3.2)
All-Wales: Number of isolates	5186	4257	1894

Key: AMO = amoxicillin &/or ampicillin, AUG = co-amoxiclav, TET = tetracycline

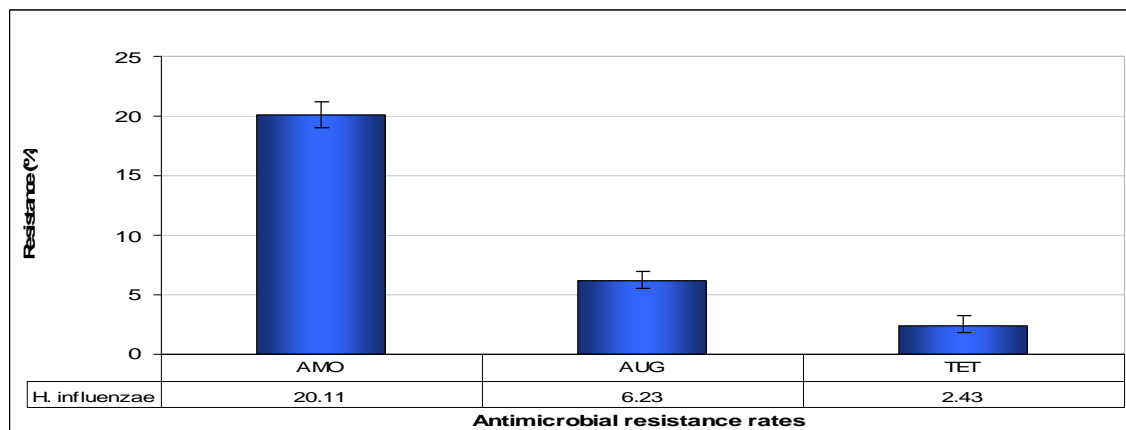


Figure 29: All-Wales antimicrobial resistance rates *H. influenzae*: All specimens, both hospital & community (2006).

Haemophilus influenzae

The All-Wales pattern of antimicrobial resistance is shown in Figures 29 & Table 16.

Resistance to β -lactams

- The All-Wales resistance rate for amoxicillin/ampicillin was 20.1% (19.0, 21.2); regional rates ranged from 14.8% (10.5, 20.6) to 27.6% (23.8, 31.7).
- The All-Wales resistance rate for co-amoxiclav was 6.2% (5.5, 7.0); regional rates ranged from 3.6% (2.3, 5.5) to 15.8% (12.7, 19.5).

Resistance to tetracycline

- The All-Wales resistance rate for tetracycline was 2.4% (1.8, 3.2); regional rates ranged from 1.1% (0.3, 3.8) to 4.3% (2.8, 6.5).

Campylobacter species

The All-Wales pattern of antimicrobial resistance is shown in Table 17.

Resistance to ciprofloxacin

- The All-Wales rate for ciprofloxacin resistance was 24.9% (23.1, 26.8); regional rates ranged from 11.7% (5.8, 22.2) to 33.7% (30.0, 37.6). The majority of campylobacter isolates were not identified to species level, and so resistance rates are not comparable to other surveillance scheme data.
- The following rates for resistance to ciprofloxacin in 2005 were published by the HPA for England and Wales: *C. jejuni* (29%), *C. coli* (45%).

Resistance to erythromycin

- The All-Wales resistance rate for erythromycin was 2.1% (1.5, 2.8); regional rates ranged from 0% (0.0, 6.0) to 7.4% (4.2, 12.8).
- The following rates for resistance to erythromycin in 2005 were published by the HPA for England and Wales: *C. jejuni* (2%), *C. coli* (39%).

Table 17: Campylobacter spp. (Community & hospital)

TABLE 17: Campylobacter spp. community and hospital isolates		
Resistance rates including (95% Confidence Intervals)		
Duplicate Cut Off: ≤90 days		
Time period: 1 January - 31 December 2006		
Location Code	CIP	ERY
A	14.1 (9.2, 20.9)	1.5 (0.4, 5.2)
B	11.7 (5.8, 22.2)	0.0 (0.0, 6.0)
C	25.7 (19.3, 33.3)	7.4 (4.2, 12.8)
D	33.7 (30.0, 37.6)	2.9 (1.8, 4.6)
E	23.7 (19.6, 28.4)	1.4 (0.6, 3.2)
F	19.2 (8.5, 37.9)	3.8 (0.7, 18.9)
G	13.8 (8.7, 21.2)	2.6 (0.9, 7.3)
H		0.4 (0.1, 2.5)
J	21.5 (16.2, 28.1)	0.6 (0.1, 3.1)
L	21.5 (16.9, 27.0)	0.8 (0.2, 2.9)
All-Wales: Resistance rates	24.9 (23.1, 26.8)	2.1 (1.5, 2.8)
All-Wales: Number of isolates	2044	2093
Key: CIP = ciprofloxacin, ERY = erythromycin		

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