Antibacterial Resistance in Wales 2006-2015

June 2016

About us

Public Health Wales exists to protect and improve health and wellbeing and reduce health inequalities for people in Wales.

We are part of the NHS and report to the Minister for Health and Social Services in the Welsh Government.

Our vision is for a healthier, happier and fairer Wales. We work locally, nationally and, with partners, across communities in the following areas:

Health protection – providing information and advice and taking action to protect people from communicable disease and environmental hazards

Primary, community and integrated care – strengthening its public health impact through policy, commissioning, planning and service delivery

Microbiology – providing a network of microbiology services which support the diagnosis and management of infectious diseases

Safeguarding - providing expertise and strategic advice to help safeguard children and vulnerable adults

Screening – providing screening programmes which assist the early detection, prevention and treatment of disease

Health intelligence – providing public health data analysis, evidence finding and knowledge management

NHS quality improvement and patient safety – providing the NHS with information, advice and support to improve patient outcomes

Policy, research and international development – influencing policy, supporting research and contributing to international health development

Health improvement – working across agencies and providing population services to improve health and reduce health inequalities

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Section 1: Introduction

Antimicrobial resistance is an increasing problem that can result in difficulty in treating infections, leading to failed therapy and potential complications. Treatment for most infections is started empirically before antimicrobial susceptibilities are known. A particular problem with the spread of antimicrobial resistance is that it becomes more difficult to select empirical therapy that will have reliable activity.

The aim of this report from the Welsh Antimicrobial Resistance Programme Surveillance Unit is to provide data that can be used to design empirical therapy guidance, and to track antimicrobial resistance trends in Wales from 2005 to 2014. The report has had to be selective in what is presented, and concentrates on the major acute hospitals and district general hospitals in Wales, and the local community health boards.

Section 2: Key points of interest

UK 5 Year Antimicrobial Resistance Strategy
The Wales resistance trends for drug-bug combinations reported by ARHAI as part of the UK 5 year Antimicrobial Resistance Strategy are comparable to the aggregated rates and trends for the UK (page 10). However, in some cases there is considerable variability in resistance rates between different areas and hospitals.

E. coli (the commonest cause of blood stream infections in Wales)
   ❖ No significant change in resistance to co-amoxiclav in 2015 , but resistance was variable between hospitals and ranged from 18.2% in Velindre to 46.2% in University Hospital Llandough (UHL)
   ❖ Resistance to gentamicin appears to be increasing, with particularly high rates emerging in some hospitals (23% in UHL).
   ❖ Carbapenem resistance remains below 1% in Wales

Enterobacter spp. and Serratia spp. (Blood stream infections)
   ❖ Third generation cephalosporins and fluoroquinolone resistance decreasing across time (2006-2015).

Staphylococcus aureus
   ❖ Flucloxacillin resistance rates for *Staphylococcus aureus* bacteraemias were variable between hospitals and ranged from 0% in Bronglais general hospital to 30.0% in University Hospital Llandough (page 28).

Urinary tract infections
"Coliforms" (the commonest cause of urinary tract infections in Wales)
   ❖ Resistance to most antimicrobials has increased over the last 10 years in coliforms from community urinary samples (page 39):
      o Trimethoprim (first-line empirical therapy for uncomplicated UTI in the community) resistance has increased to 38.2%.This high rate of resistance reflects an element of selective testing. The true rate of resistance in patients presenting with uncomplicated UTI in the community is likely to be considerably lower, and trimethoprim remains the suggested first-line empirical therapy for these patients.
      o However, in the elderly, or patients who have received antibiotics within the last 3 months, the likelihood of infection with a resistant organism is higher, and an alternative antibiotic should be considered.
      o Co-amoxiclav resistance increased from 10.5% in 2013, to 12.9% in 2014, and 15.1% in 2015.
      o Ciprofloxacin resistance remained stable at approximately 10%.
      o Nitrofurantoin resistance remained stable at approximately 11%.

Section 3: Methods

Resistance data

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 (community & hospital)
  - *Staphylococcus aureus* including MRSA from wound swabs
- All specimens (community & hospital)
  - *Streptococcus pneumoniae*
  - *Streptococcus pyogenes*
  - *Haemophilus influenzae*
  - *Campylobacter spp.*
  - *Neisseria gonorrhoeae*

"Community" data is from samples referred from a general practice and hospital data is from samples submitted from hospital in-patients or out-patients as described.

Data sources
Antimicrobial susceptibility testing data was extracted from the regional DataStore systems. Data from Nevill Hall Hospital for 2005 & 2006 is not included in this report as it was not available for this period. Community data is presented by DataStore site e.g. data for specimens processed by the laboratories at Prince Philip and West Wales General hospitals will both be reported together as Carmarthen community data (J). The DataStore sites, and the codes and abbreviations for community and hospital data included in this report are shown in **Table 1.**

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 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 91 days (for community patients).

All Wales data

The All-Wales resistance rates for each antimicrobial comprise an aggregate of data from a number of different laboratories. All-Wales resistance rates are only presented for organisms where no testing bias occurred at individual hospital level – see below.

Individual Hospital/Laboratory data

Individual hospital or laboratory resistance rates are only presented for organisms where ≥80% of such isolates from the given sample type was tested and where the number of isolates tested exceeds 9.

Duplicates

Data from duplicate isolates was removed prior to analysis. For community data, organisms from the same patient, with the same identification and susceptibility pattern isolated ≤ 91 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, most laboratories only test a single agent from antimicrobial groups such as fluoroquinolones and carbapenems where appropriate, but the choice of agent often varies between laboratories. The antimicrobial groups included in this report comprise of the following aggregated susceptibility data:

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

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).

Other surveillance schemes

This report focuses on comparisons of data collected for Wales in the calendar years 2005 and 2013. To provide some external context to the data presented, it has been also been compared to surveillance data from other sources – see websites:

- Public Health England (PHE):
  https://www.gov.uk/health-protection/infectious-diseases
- British Society for Antimicrobial Chemotherapy (BSAC):
  http://www.bsacsurv.org/reports/bacteraemia

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 PHE publications relate to England, Wales and Northern Ireland (unless otherwise stated).

Table 1: Codes for hospital and community data

Hospital	Hospital Code	DataStore Site
Princess of Wales	B	Swansea
Neath Port Talbot	T	
Singleton	S	
Morriston	E	
Nevill Hall	M	Newport
Royal Gwent	D	
Wrexham Maelor	H	Wrexham
Ysbyty Gwynedd	K	Bangor
Ysbyty Glan Clwyd	L	Rhyl
University Hospital of Wales	F	Cardiff
University Hospital Llandough	P	
Prince Charles	N	
Royal Glamorgan	C	Pontypridd
Glangwili	J	Carmarthen
Prince Philip	R	
Bronglais	A	Aberystwyth
Withybush	G	Haverfordwest
All-Wales	**Z**	

Section 4: Monitoring Trends in Resistance
UK 5 Year Antimicrobial Resistance Strategy

Background

In 2014, a sub-group of ARHAI was established to recommend surveillance outputs to support the UK Five Year Antimicrobial Resistance Strategy. Appendix C "Monitoring Trends in Resistance" of the Strategy document states: "Changes in the level of resistance to antibiotics like the carbapenems, which are often the last option for hard to treat infections, will be monitored".

The agreed "drug-bug" combinations for monitoring resistance are listed in **Table 2**; the combinations were ratified by the Department of Health (DoH) High-Level Steering Group. Public Health Wales provided the Wales data to ARHAI for this surveillance project.

- Blood specimens (except N. gonorrhoeae data)
- 14 day episode de-duplication
- Non-susceptible (NS) is resistant and intermediate isolate totals combined
- Where two antimicrobials from the same class are listed an 'or' relationship is applied, the more resistant result takes priority

Table 2: ARHAI Drug-Bug Combinations

Specimen	Organism	Data Set	Antimicrobial
Blood Culture	*Escherichia coli*	Primary	cefotaxime or ceftazidime
			imipenem or meropenem
			ciprofloxacin
			gentamicin
		Secondary	piperacillin/tazobactam
	Klebsiella pneumoniae	Primary	cefotaxime or ceftazidime
			imipenem or meropenem
			ciprofloxacin
			gentamicin
		Secondary	piperacillin/tazobactam
	Klebsiella oxytoca	Primary	cefotaxime or ceftazidime
			imipenem or meropenem
			ciprofloxacin
			gentamicin
			piperacillin/tazobactam
	Pseudomonas spp.	Primary	ceftazidime
			imipenem or meropenem
	Acinetobacter spp.	Secondary	colistin
	Enterococcus spp.	Secondary	vancomycin
	Staphylococcus aureus	Secondary	meticillin
	Streptococcus pneumoniae	Primary	penicillin
All specimens	Neisseria gonorrhoeae	Primary	ceftriaxone
			azithromycin

ARHAI Primary Data Set

Table 3 shows the resistance rates for Wales compared with the UK aggregate rates for some primary data set drug-bug combinations. There are small differences in some of the resistance rates, but generally the trends in resistance are comparable.

Table 3: ARHAI Primary Data Set

ARHAI Primary data set								
Escherichia coli		**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
Cefotaxime &/or ceftazidime	Wales	14	14	13	16	13	14	14
	*UK	11	10	11	11	10	11	-
Ciprofloxacin	Wales	22	22	21	23	20	22	22
	*UK	20	19	19	19	18	19	-
Gentamicin	Wales	6	9	9	10	11	11	12
	*UK	8	9	9	10	10	10	-
Piperacillin/tazobactam	Wales	7	8	7	8	9	8	10
	*UK	-	8	8	9	10	11	-
Imipenem &/or meropenem	Wales	0.0	0.0	0.0	0.0	0.1	<0.1	0.2
	*UK	0.1	0.0	0.1	0.1	0.1	0.1	-
Klebsiella pneumoniae		**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
Cefotaxime &/or ceftazidime	Wales	14	10	8	9	10	10	11
	*UK	11	11	10	11	11	11	-
Ciprofloxacin	Wales	12	10	8	9	10	8	7
	*UK	10	10	9	10	11	11	-
Gentamicin	Wales	7	7	4	3	5	5	7
	*UK	7	7	7	7	8	7	-
Piperacillin/tazobactam	Wales	10	8	9	8	9	10	13
	*UK	-	10	11	12	15	17	-
Imipenem &/or meropenem	Wales	0.0	0.4	0.7	0.3	0.6	0.3	0.7
	*UK	0.3	0.6	0.8	0.7	0.8	1.3	-
Pseudomonas spp.		**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
Ceftazidime	Wales	8	12	8	6	6	6	8
	*UK	8	8	8	7	7	7	-
Imipenem &/or meropenem	Wales	10	13	10	11	4	12	7
	*UK	12	10	11	10	9	12	-
Streptococcus pneumoniae		**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
Penicillin	Wales	2	2	3	2	5	4	5
	*UK	2	3	3	3	3	4	-

*UK rates include data for England, Scotland, Wales and Northern Ireland provided by ARHAI sub-group.

No UK data has been collected for 2015.

Section 5.1: Antimicrobial resistance rates for the most common organisms causing bacteraemia

Background

The 2015 top ten bacteraemia report for Wales comprises the commonest organisms isolated from blood cultures in Wales, see **Table 4** below. The data for 2015 is not yet published but will be available on the Public Health website later in the year.
Internet: http://www.wales.nhs.uk/sites3/page.cfm?orgId=379&pid=13066#z
Intranet: http://howis.wales.nhs.uk/sites3/page.cfm?orgid=379&pid=18707#topt

Table 4: Top Ten Bacteraemias 2015

Rank	Organism	Rate per 100,000 bed days
1	*Escherichia coli* (E. coli)	76
2	*Staphylococcus aureus* (MSSA)	26
3	Enterococcus species	15
3	Klebsiella species	15
5	*Streptococcus pneumoniae*	11
6	Coagulase-negative Staphylococcus	8
7	Proteus species	7
8	*Pseudomonas aeruginosa*	5
9	Enterobacter species	4
10	Streptococcus group B	4

The datasets include infections originating from community and hospital sources (in-patient and out-patient), 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. Streptococcus group B has for the first time appeared in the Top 10 list and susceptibility are not presented here. However, although *Serratia* species and Staphylococcus aureus (MRSA) have dropped out of the 'top 10', resistance data for these organisms will be presented as they have appeared in previous reports.

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

Escherichia coli (n=2238 in 2015)

E. coli is the commonest organism grown from blood cultures in Wales and the UK. The All-Wales patterns of resistance for 2006 to 2015 are shown in **Figure 1**, and the individual hospital resistance rates for ARHAI primary drug set are shown in **Table 5**.

There has been a statistically significant increase in resistance rates for the third generation cephalosporins (3GC), gentamicin (GEN), and piperacillin/tazobactam (PTZ) across time (2006-2015). Imipenem and meropenem resistance rates remain below 1% in the UK.
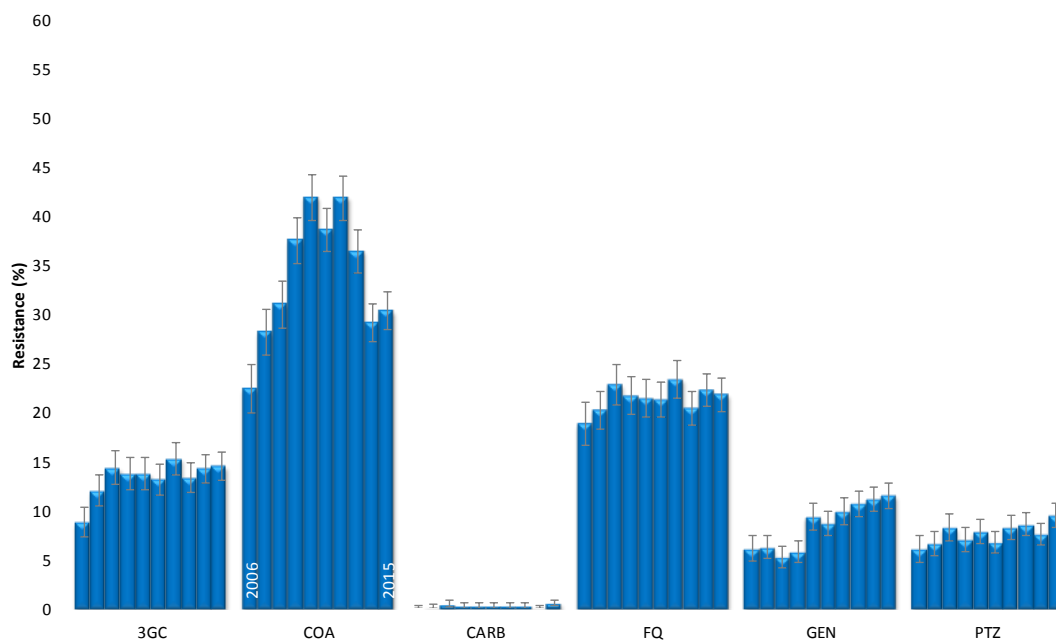

Figure 1: All-Wales resistance rates for *E. coli* bacteraemia (2006 to 2015).

Table 5: *Escherichia coli*

Escherichia coli from blood cultures
Resistance rates including (95% Confidence Intervals)
Duplicate Cut Off: ≤14 days
Time period: 1 January - 31 December 2015

Location Code (Number)	COA	(95% CI)	PTZ	(95% CI)	GEN	(95% CI)	PTZ+GEN	(95% CI)
A (n=64)	18.8	(11.1, 30.0)	1.6	(0.3, 8.3)	9.4	(4.4, 19.0)	0.0	(0.0, 5.7)
B (n=114)	25.4	(18.3, 34.1)	9.6	(5.5, 16.5)	7.9	(4.2, 14.3)	2.6	(0.9, 7.5)
C (n=136)	40.3	(32.4, 48.8)	11.2	(6.9, 17.6)	12.5	(8.0, 19.1)	2.2	(0.8, 6.4)
D (n=256)	28.1	(23.0, 33.9)	10.9	(7.7, 15.4)	10.5	(7.4, 14.9)	3.1	(1.6, 6.0)
E (n=177)	24.9	(19.1, 31.7)	11.9	(7.9, 17.6)	7.3	(4.3, 12.2)	3.4	(1.6, 7.2)
F (n=259)	30.1	(24.9, 36.0)	6.2	(3.9, 9.8)	11.2	(7.9, 15.6)	1.9	(0.8, 4.5)
G (n=73)	30.1	(20.8, 41.4)	5.5	(2.2, 13.3)	8.2	(3.8, 16.8)	0.0	(0.0, 5.0)
H (n=158)	31.0	(24.3, 38.6)	13.9	(9.4, 20.2)	14.6	(9.9, 20.9)	7.0	(3.9, 12.0)
J (n=152)	35.5	(28.4, 43.4)	7.3	(4.1, 12.6)	7.2	(4.1, 12.5)	1.3	(0.4, 4.7)
K (n=147)	31.3	(24.4, 39.2)	8.2	(4.7, 13.7)	13.6	(9.0, 20.1)	3.4	(1.5, 7.7)
L (n=231)	25.5	(20.3, 31.5)	8.7	(5.7, 13.0)	18.6	(14.1, 24.1)	4.3	(2.4, 7.8)
M (n=114)	34.2	(26.1, 43.3)	15.8	(10.2, 23.6)	9.6	(5.5, 16.5)	2.6	(0.9, 7.5)
N (n=122)	33.3	(25.5, 42.2)	13.1	(8.2, 20.2)	9.8	(5.7, 16.4)	4.1	(1.8, 9.2)
P (n=52)	46.2	(33.3, 59.6)	5.8	(2.0, 15.6)	23.1	(13.7, 36.1)	3.8	(1.1, 13.0)
Q (n=11)	18.2	(5.1, 47.7)	9.1	(1.6, 37.7)	9.1	(1.6, 37.7)	9.1	(1.6, 37.7)
R (n=74)	28.4	(19.4, 39.5)	4.1	(1.4, 11.3)	6.8	(2.9, 14.9)	1.4	(0.2, 7.3)
S (n=86)	32.6	(23.6, 43.0)	8.1	(4.0, 15.9)	10.5	(5.6, 18.7)	2.3	(0.6, 8.1)
T (n=10)	40.0	(16.8, 68.7)	30.0	(10.8, 60.3)	30.0	(10.8, 60.3)	30.0	(10.8, 60.3)
All-Wales: Resistance rates	30.3	(28.5, 32.3)	9.5	(8.3, 10.8)	11.5	(10.2, 12.9)	3.1	(2.5, 3.9)
All-Wales: Number of isolates	2234		2233		2238		2233	

Location Code (Number)	AMO	(95% CI)	3GC	(95% CI)	AMI	(95% CI)	FQ	(95% CI)
A (n=64)	68.8	(56.6, 78.8)	9.4	(4.4, 19.0)	0.0	(0.0, 5.7)	17.2	(9.9, 28.2)
B (n=114)	61.4	(52.2, 69.8)	11.4	(6.8, 18.5)	2.7	(0.9, 7.5)	14.9	(9.5, 22.6)
C (n=136)	66.2	(57.9, 73.6)	11.0	(6.8, 17.4)	2.2	(0.8, 6.3)	14.7	(9.7, 21.6)
D (n=256)	68.0	(62.0, 73.4)	16.0	(12.0, 21.0)	0.8	(0.2, 2.8)	20.7	(16.2, 26.1)
E (n=177)	58.8	(51.4, 65.7)	13.6	(9.3, 19.4)	1.1	(0.3, 4.0)	14.7	(10.2, 20.7)
F (n=259)	65.6	(59.7, 71.2)	15.4	(11.6, 20.3)	1.6	(0.6, 3.9)	27.4	(22.3, 33.1)
G (n=73)	56.2	(44.8, 67.0)	6.8	(3.0, 15.1)	0.0	(0.0, 5.1)	16.4	(9.7, 26.6)
H (n=158)	66.5	(58.8, 73.3)	19.0	(13.6, 25.8)	2.5	(1.0, 6.3)	29.7	(23.2, 37.3)
J (n=152)	66.4	(58.6, 73.5)	11.2	(7.1, 17.2)	2.6	(1.0, 6.6)	17.2	(12.0, 24.0)
K (n=147)	71.4	(63.7, 78.1)	17.0	(11.8, 23.9)	2.7	(1.1, 6.8)	29.9	(23.1, 37.8)
L (n=231)	68.4	(62.1, 74.1)	17.7	(13.4, 23.2)	1.7	(0.7, 4.4)	30.6	(25.0, 36.8)
M (n=114)	65.8	(56.8, 73.8)	17.5	(11.7, 25.6)	0.9	(0.2, 4.8)	18.4	(12.4, 26.5)
N (n=122)	62.3	(53.4, 70.4)	11.5	(7.0, 18.3)	0.8	(0.1, 4.5)	12.3	(7.6, 19.3)
P (n=52)	78.8	(66.0, 87.8)	21.2	(12.2, 34.0)	5.8	(2.0, 15.6)	32.7	(21.5, 46.2)
Q (n=11)	72.7	(43.4, 90.3)	9.1	(1.6, 37.7)	0.0	(0.0, 25.9)	36.4	(15.2, 64.6)
R (n=74)	66.2	(54.9, 76.0)	6.8	(2.9, 14.9)	1.4	(0.2, 7.3)	13.5	(7.5, 23.1)
S (n=86)	64.0	(53.4, 73.3)	12.8	(7.3, 21.5)	1.2	(0.2, 6.4)	22.1	(14.6, 31.9)
T (n=10)	80.0	(49.0, 94.3)	40.0	(16.8, 68.7)	20.0	(5.7, 51.0)	40.0	(16.8, 68.7)
All-Wales: Resistance rates	65.9	(63.9, 67.8)	14.5	(13.1, 16.0)	1.8	(1.3, 2.4)	21.8	(20.2, 23.6)
All-Wales: Number of isolates	2238		2238		2230		2235	

Location Code (Number)	ERT	(95% CI)	IMI	(95% CI)	MER	(95% CI)	IMI or MER	(95% CI)
A (n=64)	0.0	(0.0, 5.7)	0.0	(0.0, 5.7)	0.0	(0.0, 5.7)	0.0	(0.0, 5.7)
B (n=114)	0.9	(0.2, 4.8)	0.0	(0.0, 3.3)	0.0	(0.0, 3.3)	0.0	(0.0, 3.3)
C (n=136)	0.0	(0.0, 2.8)	0.0	(0.0, 2.7)	0.0	(0.0, 2.7)	0.0	(0.0, 2.7)
D (n=256)	0.8	(0.2, 2.8)	0.0	(0.0, 1.5)	0.0	(0.0, 1.5)	0.0	(0.0, 1.5)
E (n=177)	0.6	(0.1, 3.1)	0.0	(0.0, 2.1)	0.0	(0.0, 2.1)	0.0	(0.0, 2.1)
F (n=259)	0.0	(0.0, 1.5)	0.0	(0.0, 1.5)	0.0	(0.0, 1.5)	0.0	(0.0, 1.5)
G (n=73)	0.0	(0.0, 5.1)	0.0	(0.0, 5.0)	0.0	(0.0, 5.0)	0.0	(0.0, 5.0)
H (n=158)	0.6	(0.1, 3.5)	0.0	(0.0, 2.4)	0.0	(0.0, 2.4)	0.0	(0.0, 2.4)
J (n=152)	0.7	(0.1, 3.6)	0.0	(0.0, 2.5)	0.0	(0.0, 2.5)	0.0	(0.0, 2.5)
K (n=147)	0.0	(0.0, 2.5)	0.7	(0.1, 3.8)	0.0	(0.0, 2.5)	0.7	(0.1, 3.8)
L (n=231)	0.0	(0.0, 1.6)	0.9	(0.2, 3.1)	0.0	(0.0, 1.6)	0.9	(0.2, 3.1)
M (n=114)	0.0	(0.0, 3.3)	0.0	(0.0, 3.3)	0.0	(0.0, 3.3)	0.0	(0.0, 3.3)
N (n=122)	0.0	(0.0, 3.1)	1.6	(0.5, 5.8)	0.0	(0.0, 3.1)	1.6	(0.5, 5.8)
P (n=52)	0.0	(0.0, 6.9)	0.0	(0.0, 6.9)	0.0	(0.0, 6.9)	0.0	(0.0, 6.9)
Q (n=11)	0.0	(0.0, 25.9)	0.0	(0.0, 25.9)	0.0	(0.0, 25.9)	0.0	(0.0, 25.9)
R (n=74)	0.0	(0.0, 4.9)	0.0	(0.0, 4.9)	0.0	(0.0, 4.9)	0.0	(0.0, 4.9)
S (n=86)	1.2	(0.2, 6.3)	0.0	(0.0, 4.3)	0.0	(0.0, 4.3)	0.0	(0.0, 4.3)
T (n=10)	0.0	(0.0, 27.8)	0.0	(0.0, 27.8)	0.0	(0.0, 27.8)	0.0	(0.0, 27.8)
All-Wales: Resistance rates	0.3	(0.2, 0.6)	0.2	(0.1, 0.5)	0.0	(0.0, 0.2)	0.2	(0.1, 0.5)
All-Wales: Number of isolates	2235		2233		2234		2233	

Key: **COA** = co-amoxiclav, **PTZ** = piperacillin/tazobactam, **GEN** = gentamicin, **PTZ/GEN** = combined resistance to both agents, **AMO** = amoxicillin,
3GC = resistance to ceftazidime &/or cefotaxime, cefpodoxime, ceftriaxone, **AMI** = amikacin, **FQ** = resistance to ciprofloxacin &/or levofloxacin,
ERT = ertapenem, **IMI** = imipenem, **MER** = meropenem, **IMI or MER** = resistance to either or both agents

Note: The range of resistance is outlined with boxes e.g. the range for co-amoxiclav (COA) was 18.2% to 46.2%; individual hospital resistance rates statistically higher than the All-Wales rate are highlighted in blue. Resistance rates are not recorded when <80% of the isolates were tested. The resistance rates for *E. coli* bacteraemia in Neath Port Talbot were notably high to a number of agents, but the number of isolates was small (n=10). Imipenem resistant *E. coli* were reported from Ysbyty Gwynedd (K), Ysbyty Glan Clwyd (L) and Prince Charles hospital (N).

ARHAI Primary data Set

Interpretation Tables 6-10: The tables show trends in resistance to drug/bug combinations in the ARHAI primary data set at hospital level, across time. The tables use a colour gradation based on the lowest resistance to the highest resistance figures, to highlight local patterns of resistance across time. The first column in the tables show the hospital code and the median number of isolates tested across the time period e.g. in Table 6, hospital code A (55) denotes Bronglais hospital with a median number of 55 isolates tested per year across the six year period. **Note:** Individual hospital or laboratory resistance rates are only presented for organisms where ≥80% of such isolates from the given sample type was tested and where the number of isolates tested exceeds 9. It is important to remember when interpreting this data set that hospital level data often represents small numbers of organisms, and single isolate resistance within these numbers can produce misleadingly large changes in resistance.

Table 6: Trends in third generation cephalosporin resistance for *E. coli* by hospital (2010-2015)

| | AB Code / Year | | | | | |
| | 3GC | | | | | |
Hospital Cod..	2010	2011	2012	2013	2014	2015
A (55)	5.3	9.3	11.5	18.0	11.7	9.4
B (118)	23.7	21.6	16.9	13.5	14.0	14.0
C (117)	14.9	21.2	17.4	20.0	10.5	11.0
D (214)	8.6	10.6	13.1	12.0	11.9	16.0
E (99)	13.3	17.3	20.0	14.3	14.1	13.6
F (262)	16.7	13.1	13.5	10.9	10.5	15.4
G (58)	4.8	4.8	5.6	5.6	10.5	6.8
H (158)	15.2					19.0
J (144)	9.3	11.0	10.9	12.2	10.8	11.2
K (122)	14.6	11.0	11.9	24.8	19.6	17.0
L (149)	13.5	14.4	19.0	17.3	24.9	17.7
M (117)	17.4	9.3	11.8	11.7	8.2	17.5
N (96)	8.8	16.3	15.7	11.4	17.9	11.5
P (70)	18.6	12.4	27.5	12.7	13.3	21.2
Q (12)	15.4	28.6	36.4	0.0	0.0	9.1
R (50)	17.6	0.0	13.0	3.8	12.1	6.8
S (151)	14.1	11.6	15.0	11.3	15.2	12.8
T (33)	10.3	6.5	17.9	6.7	25.9	40.0

%R 0.0 ▭ 40.0

Key:
A= Bronglais
B = Princess of Wales
C = Royal Glamorgan
D = Royal Gwent
E = Morriston
F = UHW
G = Withybush
H = Wrexham Maelor
J = Glangwili
K = Ysbyty Gwynedd
L = Ysbyty Glan Clwyd
M = Nevill Hall
N = Prince Charles
P = UHL
Q = Velindre
R = Prince Philip
S = Singleton
T = Neath Port Talbot

Table 7: Trends in fluoroquinolone resistance for *E. coli* by hospital (2010-2015)

AB Code / Year

%R 0.0 ▢▢▢▣▣■ 45.5

Hospital Cod..	FQ					
	2010	2011	2012	2013	2014	2015
A (54)	25.6	11.4	13.1	27.1	21.7	17.2
B (118)	22.7	25.2	15.3	17.7	20.7	14.9
C (118)	23.0	26.0	21.1	20.6	22.8	14.7
D (214)	16.8	14.9	16.0	18.8	14.0	20.7
E (99)	25.6	23.5	22.1	19.0	24.2	14.7
F (262)	25.1	22.7	22.9	20.7	21.6	27.4
G (58)	14.3	28.6	10.3	15.6	19.0	16.4
H (160)	20.9	34.6	38.2	41.6	32.3	29.7
J (140)	13.6	9.3	20.0	9.9	16.7	17.2
K (122)	21.9	22.9	19.3	24.0	27.5	29.9
L (149)	20.6	24.8	29.3	25.0	33.2	30.6
M (117)	22.5	16.9	17.4	15.0	8.9	18.4
N (95)	21.3	17.6	24.4	13.3	21.4	12.3
P (70)	28.6	23.7	42.0	20.6	28.9	32.7
Q (12)	38.5	35.7	45.5	0.0	16.7	36.4
R (49)	5.9	0.0	33.3	11.3	15.2	13.5
S (151)	22.0	20.9	22.4	15.0	23.4	22.1
T (33)	20.5	19.6	30.8	13.3	37.0	40.0

Table 8: Trends in gentamicin resistance for *E. coli* by hospital (2010-2015)

AB Code / Year

%R 0.0 ▢▢▢▣▣■ 30.0

Hospital Cod..	GEN					
	2010	2011	2012	2013	2014	2015
A (54)	0.0	0.0	4.9	8.3	8.3	9.4
B (118)	13.4	16.4	7.3	7.9	6.6	7.9
C (118)	13.9	12.0	12.8	10.3	15.4	12.5
D (214)	6.8	4.3	8.6	10.6	14.8	10.5
E (99)	7.8	4.1	8.6	8.3	6.1	7.3
F (262)	13.4	10.2	7.5	9.3	9.8	11.2
G (58)	7.1	2.4	7.7	5.6	6.7	5.5
H (162)	11.0	24.5	18.8	27.5	17.1	14.6
J (140)	4.2	4.7	6.7	2.8	6.5	7.2
K (122)	7.3	1.7	11.9	20.0	13.6	13.6
L (149)	9.9	8.8	16.4	14.7	17.1	18.6
M (117)	12.6	5.3	3.6	5.9	8.9	9.6
N (93)	6.3	2.3	11.0	8.0	11.1	9.8
P (70)	14.3	9.3	15.9	4.8	7.2	23.1
Q (12)	7.7	28.6	27.3	0.0	8.3	9.1
R (49)	0.0	10.0	6.7	5.7	12.1	6.8
S (151)	5.3	7.8	5.9	6.7	6.6	10.5
T (33)	5.1	4.3	10.3	13.3	11.1	30.0

Key:
A= Bronglais
B = Princess of Wales
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D = Royal Gwent
E = Morriston
F = UHW
G = Withybush
H = Wrexham Maelor
J = Glangwili
K = Ysbyty Gwynedd
L = Ysbyty Glan Clwyd
M = Nevill Hall
N = Prince Charles
P = UHL
Q = Velindre
R = Prince Philip
S = Singleton
T = Neath Port Talbot

Table 9: Trends in piperacillin/tazobactam resistance for _E. coli_ (2010-2015)

AB Code / Year — PTZ

%R 0.0 ▭ 20.7

Hospital Cod..	2011	2013	2012	2010	2014	2015
A (54)	7.0	6.3	3.3	2.6	1.7	1.6
B (118)	5.4	6.4	9.7	9.3	1.7	9.6
C (105)	9.0	5.7	6.4	9.9	6.8	11.2
D (212)	5.0	9.8	11.3	5.9	6.6	10.9
E (98)	5.1	10.7	7.9	8.9	7.1	11.9
F (261)	10.2	8.1	6.7	8.3	5.7	6.2
G (58)	5.1	7.0	5.6	7.1	5.7	5.5
H (159)	17.0	20.7	12.0	10.5	15.7	13.9
J (138)	1.7	2.2	6.7	4.2	3.6	7.3
K (122)	4.2	14.3	7.3	7.3	15.0	8.2
L (149)	4.0	4.5	7.4	5.0	4.9	8.7
M (107)	14.4	3.7	4.9	9.2		10.4
N (83)	5.9		10.8	6.3	5.1	13.1
P (70)	6.2	12.7	14.5	7.1	7.2	5.8
Q (12)	0.0	0.0	18.2	15.4	0.0	9.1
R (48)	0.0	8.0	8.7	17.6	6.1	4.1
S (151)	3.9	3.6	7.2	6.1	13.3	8.1
T (33)	8.7	13.3	10.3	5.1	7.4	19.2

Table 10: Trends in imipenem/meropenem resistance for _E. coli_ (2010-2015)

AB Code / Year — IMI/MER

%R 0.0 ▭ 1.6

Hospital Cod..	2010	2011	2012	2013	2014	2015
A (54)	0.0	0.0	0.0	0.0	0.0	0.0
B (118)	0.0	0.0	0.0	0.0	0.0	0.0
C (117)	0.0	0.0	0.0	0.0	0.0	0.0
D (214)	0.0	0.0	0.0	0.0	0.0	0.0
E (98)	0.0	0.0	0.0	0.0	0.0	0.0
F (261)	0.0	0.0	0.0	0.4	0.0	0.0
G (58)	0.0	0.0	0.0	1.2	1.0	0.0
H (66)	0.0	0.0	0.0	0.0	0.0	0.0
J (139)	0.0	0.0	0.0	0.0	0.0	0.0
K (121)	0.0	0.0	0.0	0.0	0.0	0.7
L (149)	0.0	0.0	0.0	0.0	0.0	0.9
M (117)	0.0	0.0	0.0	0.0	0.0	0.0
N (94)	0.0	0.0	0.0	0.0	0.0	1.6
P (70)	0.0	0.0	0.0	0.0	0.0	0.0
Q (12)	0.0	0.0	0.0	0.0	0.0	0.0
R (49)	0.0	0.0	0.0	0.0	0.0	0.0
S (150)	0.0	0.0	0.0	0.0	0.0	0.0
T (33)	0.0	0.0	0.0	0.0	0.0	0.0

Key:
A = Bronglais
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D = Royal Gwent
E = Morriston
F = UHW
G = Withybush
J = Glangwili
K = Ysbyty Gwynedd
L = Ysbyty Glan Clwyd
M = Nevill Hall
N = Prince Charles
P = UHL
Q = Velindre
R = Prince Philip
S = Singleton
T = Neath Port Talbot

Klebsiella spp. (n=443 in 2015)

The All-Wales patterns of antimicrobial resistance in *Klebsiella* spp. are shown in **Figure 2** and **Table 12**; with no significant difference in resistance rates across time. Imipenem and meropenem resistance rates remain below 1% in the UK.
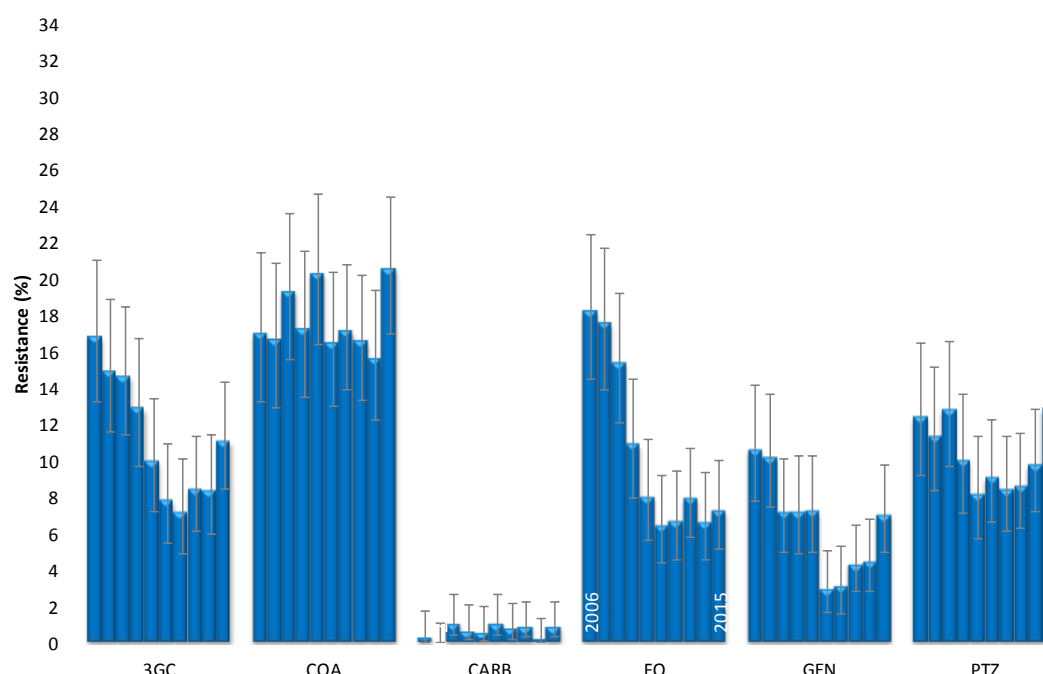
Figure 2: All-Wales antimicrobial resistance rates for *Klebsiella species;* isolated from blood culture (2006 to 2015)

There is currently no PHE data for the UK for 2015 so comparisons between the 2014 data sets have been made. The Welsh resistance rates for 2014 are is generally lower than the *Klebsiella spp.* bacteraemia data published by the PHE (see **Table 11** below).

Table 11: PHE data for *Klebsiella species* bacteraemia 2008-2014

Klebsiella spp.		2008	2009	2010	2011	2012	2013	2014
Total reports:		6,099	6,160	6,133	6,595	6,588	6,453	6,507
Piperacillin/ Tazobactam	% Non-susceptibility	**11%**	**10%**	**11%**	**12%**	**13%**	**15%**	**16%**
	Reports with susceptibility data	4,533	4,485	4,635	5,218	5,430	5,427	5,512
Imipenem/ Meropenem	% Non-susceptibility	**0.5%**	**0.3%**	**0.4%**	**0.8%**	**<1.0%**	**<1.0%**	**2.0%**
	Reports with susceptibility data	4,461	4,422	4,407	4,852	4,975	4,941	5,801
Cefotaxime	% Non-susceptibility	**10%**	**8%**	**9%**	**9%**	**10%**	**10%**	**10%**
	Reports with susceptibility data	2,984	3,132	3,061	3,393	3,487	3,373	3,490
Ceftazidime	% Non-susceptibility	**11%**	**9%**	**9%**	**9%**	**10%**	**10%**	**10%**
	Reports with susceptibility data	4,126	4,009	4,195	4,619	4,651	4,420	4,524
Ciprofloxacin	% Non-susceptibility	**11%**	**9%**	**8%**	**8%**	**8%**	**9%**	**9%**
	Reports with susceptibility data	4,887	4,743	4,897	5,375	5,526	5,440	5,525
Gentamicin	% Non-susceptibility	**7%**	**6%**	**6%**	**6%**	**6%**	**7%**	**6%**
	Reports with susceptibility data	5,333	5,198	5,276	5,860	5,934	5,859	5,598

Table 12: Klebsiella spp.

Klebsiella spp. from blood cultures
Resistance rates including (95% Confidence Intervals)
Duplicate Cut Off: ≤14 days
Time period: 1 January - 31 December 2015

Location Code (Number)	COA	(95% CI)	PTZ	(95% CI)	GEN	(95% CI)	PTZ+GEN	(95% CI)
A (n=10)	20.0	(5.7, 51.0)	10.0	(1.8, 40.4)	0.0	(0.0, 27.8)	0.0	(0.0, 27.8)
B (n=17)	11.8	(3.3, 34.3)	5.9	(1.0, 27.0)	0.0	(0.0, 18.4)	0.0	(0.0, 18.4)
C (n=23)	13.0	(4.5, 32.1)	13.0	(4.5, 32.1)	0.0	(0.0, 14.3)	0.0	(0.0, 14.3)
D (n=52)	17.3	(9.4, 29.7)	17.3	(9.4, 29.7)	7.7	(3.0, 18.2)	3.8	(1.1, 13.0)
E (n=41)	31.7	(19.6, 47.0)	29.3	(17.5, 44.5)	12.2	(5.3, 25.5)	9.8	(3.9, 22.5)
F (n=77)	18.2	(11.2, 28.2)	5.2	(2.0, 12.6)	9.1	(4.5, 17.6)	2.6	(0.7, 9.0)
G (n=13)	0.0	(0.0, 22.8)	0.0	(0.0, 22.8)	0.0	(0.0, 24.3)	0.0	(0.0, 24.3)
H (n=24)	29.2	(14.9, 49.2)	16.7	(6.7, 35.9)	16.7	(6.7, 35.9)	8.3	(2.3, 25.8)
J (n=28)	25.0	(12.7, 43.4)	14.3	(5.7, 31.5)	3.6	(0.6, 17.7)	0.0	(0.0, 12.1)
K (n=34)	26.5	(14.6, 43.1)	11.8	(4.7, 26.6)	5.9	(1.6, 19.1)	2.9	(0.5, 14.9)
L (n=32)	25.0	(13.3, 42.1)	12.5	(5.0, 28.1)	6.3	(1.7, 20.1)	3.1	(0.6, 15.7)
M (n=21)	19.0	(7.7, 40.0)	19.0	(7.7, 40.0)	4.8	(0.8, 22.7)	4.8	(0.8, 22.7)
N (n=19)	26.3	(11.8, 48.8)	21.1	(8.5, 43.3)	5.3	(0.9, 24.6)	0.0	(0.0, 16.8)
P (n=16)	25.0	(10.2, 49.5)	6.3	(1.1, 28.3)	12.5	(3.5, 36.0)	6.3	(1.1, 28.3)
R (n=13)	23.1	(8.2, 50.3)	7.7	(1.4, 33.3)	0.0	(0.0, 22.8)	0.0	(0.0, 22.8)
S (n=19)	5.3	(0.9, 24.6)	5.3	(0.9, 24.6)	10.5	(2.9, 31.4)	0.0	(0.0, 16.8)
All-Wales: Resistance rates	20.5	(17.0, 24.5)	12.9	(10.1, 16.3)	7.0	(5.0, 9.8)	3.2	(1.9, 5.2)
All-Wales: Number of isolates	443		443		442		442	

Location Code (Number)	AMO	(95% CI)	3GC	(95% CI)	AMI	(95% CI)	FQ	(95% CI)
A (n=10)		–	10.0	(1.8, 40.4)	0.0	(0.0, 27.8)	0.0	(0.0, 27.8)
B (n=17)		–	5.9	(1.0, 27.0)	5.9	(1.0, 27.0)	5.9	(1.0, 27.0)
C (n=23)		–	8.7	(2.4, 26.8)	4.3	(0.8, 21.0)	4.3	(0.8, 21.0)
D (n=52)		–	9.6	(4.2, 20.6)	0.0	(0.0, 6.9)	5.8	(2.0, 15.6)
E (n=41)		–	17.1	(8.5, 31.3)	0.0	(0.0, 8.6)	9.8	(3.9, 22.5)
F (n=77)		–	10.4	(5.4, 19.2)	0.0	(0.0, 4.8)	9.1	(4.5, 17.6)
G (n=13)		–	0.0	(0.0, 22.8)	0.0	(0.0, 22.8)	0.0	(0.0, 24.3)
H (n=24)		–	20.8	(9.2, 40.5)	0.0	(0.0, 13.8)	12.5	(4.3, 31.0)
J (n=28)		–	7.1	(2.0, 22.6)	0.0	(0.0, 12.1)	7.1	(2.0, 22.6)
K (n=34)		–	14.7	(6.4, 30.1)	0.0	(0.0, 10.2)	11.8	(4.7, 26.6)
L (n=32)		–	3.1	(0.6, 15.7)	3.1	(0.6, 15.7)	6.3	(1.7, 20.1)
M (n=21)		–	9.5	(2.7, 28.9)	0.0	(0.0, 15.5)	0.0	(0.0, 15.5)
N (n=19)		–	15.8	(5.5, 37.6)	5.3	(0.9, 24.6)	5.3	(0.9, 24.6)
P (n=16)		–	25.0	(10.2, 49.5)	0.0	(0.0, 19.4)	18.8	(6.6, 43.0)
R (n=13)		–	7.7	(1.4, 33.3)	0.0	(0.0, 22.8)	0.0	(0.0, 22.8)
S (n=19)		–	5.3	(0.9, 24.6)	5.3	(0.9, 24.6)	0.0	(0.0, 16.8)
All-Wales: Resistance rates			11.1	(8.5, 14.3)	1.1	(0.5, 2.6)	7.2	(5.2, 10.0)
All-Wales: Number of isolates			443		443		442	

Location Code (Number)	ERT	(95% CI)	IMI	(95% CI)	MER	(95% CI)	IMI or MER	(95% CI)
A (n=10)	0.0	(0.0, 27.8)	0.0	(0.0, 27.8)	0.0	(0.0, 27.8)	0.0	(0.0, 27.8)
B (n=17)	0.0	(0.0, 18.4)	0.0	(0.0, 18.4)	0.0	(0.0, 18.4)	0.0	(0.0, 18.4)
C (n=23)	4.3	(0.8, 21.0)	4.3	(0.8, 21.0)	4.3	(0.8, 21.0)	4.3	(0.8, 21.0)
D (n=52)	0.0	(0.0, 6.9)	0.0	(0.0, 6.9)	0.0	(0.0, 6.9)	0.0	(0.0, 6.9)
E (n=41)	0.0	(0.0, 8.6)	2.4	(0.4, 12.6)	2.4	(0.4, 12.6)	2.4	(0.4, 12.6)
F (n=77)	0.0	(0.0, 4.8)	0.0	(0.0, 4.8)	0.0	(0.0, 4.8)	0.0	(0.0, 4.8)
G (n=13)	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 (n=24)	0.0	(0.0, 13.8)	0.0	(0.0, 13.8)	0.0	(0.0, 13.8)	0.0	(0.0, 13.8)
J (n=28)	0.0	(0.0, 12.1)	0.0	(0.0, 12.1)	0.0	(0.0, 12.1)	0.0	(0.0, 12.1)
K (n=34)	0.0	(0.0, 10.2)	0.0	(0.0, 10.2)	0.0	(0.0, 10.2)	0.0	(0.0, 10.2)
L (n=32)	0.0	(0.0, 10.7)	3.2	(0.6, 16.2)	0.0	(0.0, 11.0)	3.2	(0.6, 16.2)
M (n=21)	0.0	(0.0, 15.5)	0.0	(0.0, 15.5)	0.0	(0.0, 15.5)	0.0	(0.0, 15.5)
N (n=19)	0.0	(0.0, 16.8)	0.0	(0.0, 16.8)	0.0	(0.0, 16.8)	0.0	(0.0, 16.8)
P (n=16)	0.0	(0.0, 19.4)	0.0	(0.0, 19.4)	0.0	(0.0, 19.4)	0.0	(0.0, 19.4)
R (n=13)	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 (n=19)	0.0	(0.0, 16.8)	0.0	(0.0, 16.8)	0.0	(0.0, 16.8)	0.0	(0.0, 16.8)
All-Wales: Resistance rates	0.5	(0.1, 1.6)	0.7	(0.2, 2.0)	0.5	(0.1, 1.6)	0.7	(0.2, 2.0)
All-Wales: Number of isolates	443		442		442		442	

Key: COA = co-amoxiclav, **PTZ** = piperacillin/tazobactam, **GEN** = gentamicin, **PTZ/GEN** = combined resistance to both agents, **AMO** = amoxicillin,
3GC = resistance to ceftazidime &/or cefotaxime, cefpodoxime, ceftriaxone, **AMI** = amikacin, **FQ** = resistance to ciprofloxacin &/or levofloxacin,
ERT = ertapenem, **IMI** = imipenem, **MER** = meropenem, **IMI or MER** = resistance to either or both agents

Note: Resistance rates are not recorded if the organisms are intrinsically resistant to an antibacterial agent e.g. for amoxicillin. The range of resistance is outlined with boxes e.g. the range for co-amoxiclav (COA) was 0.0% to 31.7%; individual hospital resistance rates statistically higher than the All-Wales rate are highlighted in blue.

Locally, co-amoxiclav and piperacillin/tazobactam resistance rates for Klebsiella spp. bacteraemia from Morriston hospital (E) were notably higher than the rest of Wales. Imipenem and/or meropenem resistant *Klebsiella spp.* were reported in Royal Glamorgan (C), Morriston (E) and Ysbyty Glan Clwyd (L).

ARHAI Primary data Set

Interpretation Tables 13-17: The tables show trends in resistance to drug/bug combinations in the ARHAI primary data set at hospital level, across time. The tables use a colour gradation based on the lowest resistance to the highest resistance figures, to highlight local patterns of resistance across time. **Note 1**: The data is different to that shown in Table 3 (page 11); Table 3 shows the rates for *Klebsiella pneumoniae* as per ARHAI instructions, but the following tables show the data for all Klebsiella species to allow comparisons with previous reports. **Note 2:** Individual hospital or laboratory resistance rates are only presented for organisms where ≥80% of such isolates from the given sample type was tested and where the number of isolates tested exceeds 9. It is important to remember when interpreting this data set that hospital level data often represents small numbers of organisms, and single isolate resistance within these numbers can produce misleadingly large changes in resistance.

Table 13: Trends in third generation cephalosporin resistance for *Klebsiella spp.* (2010-2015)

AB Code / Year

%R 0.0 ▨▨▨▨ 29.4

Hospital Cod..	3GC					
	2010	2011	2012	2013	2014	2015
A (10)				18.2	10.0	7.7
B (23)	12.0	14.3	5.6	17.2	8.3	5.9
C (23)	20.8	4.8	21.1	4.5	4.3	6.3
D (43)	2.4	2.2	4.9	4.7	3.0	5.4
E (34)	22.2	18.4	5.9	8.8	13.8	17.1
F (74)	10.4	4.8	5.6	10.4	10.5	10.4
G (11)				5.9	4.8	0.0
H (24)	29.4					20.8
J (28)	0.0	0.0	2.6	0.0	5.0	7.1
K (28)	12.5	24.0	13.3	18.8	11.1	14.7
L (31)	6.7	17.9	16.7	11.9	17.1	3.1
M (21)	14.3	0.0	6.7	0.0	7.1	9.5
N (21)	0.0	9.5	0.0	4.3	4.3	15.8
P (14)	20.0	0.0		0.0	13.3	25.0
R (9)				0.0	0.0	7.7
S (28)	8.3	4.0	3.3	5.7	6.5	5.3

Key:
A= Bronglais
B = Princess of Wales
C = Royal Glamorgan
D = Royal Gwent
E = Morriston
F = UHW
G = Withybush
H = Wrexham Maelor
J = Glangwili
K = Ysbyty Gwynedd
L = Ysbyty Glan Clwyd
M = Nevill Hall
N = Prince Charles
P = UHL
R = Prince Philip
S = Singleton

Table 14: Trends in fluoroquinolone resistance for *Klebsiella spp.* (2010-2015)

AB Code / Year — %R 0.0 — 25.0

Hospital Cod..	FQ 2010	2011	2012	2013	2014	2015
A (10)				9.1	15.4	0.0
B (22)	8.0	4.8	5.6	21.4	4.3	5.9
C (23)	25.0	4.8	21.1	0.0	8.7	3.6
D (44)	4.5	2.2	7.3	0.0	0.0	5.8
E (34)	14.8	7.9	2.9	0.0	3.4	9.8
F (74)	3.9	6.5	6.9	9.0	7.9	9.1
G (11)			10.0	0.0	4.8	0.0
H (25)	6.7	4.5	3.8	12.5	5.7	12.5
J (29)	4.8	0.0	2.6	0.0	0.0	7.1
K (28)	6.3	20.0	10.0	15.6	5.6	11.8
L (31)	6.7	17.9	13.3	16.7	17.1	6.3
M (21)	9.5	0.0	0.0	0.0	0.0	0.0
N (21)	0.0	9.5	0.0	8.7	8.7	5.3
P (14)	10.0	6.7		0.0	6.7	18.8
R (9)				0.0	9.1	0.0
S (28)	12.5	4.0	3.3	14.7	6.7	0.0

Table 15: Trends in gentamicin resistance for *Klebsiella spp.* (2010-2015)

AB Code / Year — %R 0.0 — 22.2

Hospital Cod..	GEN 2010	2011	2012	2013	2014	2015
A (10)				9.1	7.7	0.0
B (22)	12.5	5.0	0.0	17.2	4.2	0.0
C (23)	20.8	4.8	10.5	0.0	4.3	0.0
D (42)	2.3	2.2	2.5	2.3	6.1	7.7
E (34)	22.2	2.6	5.9	0.0	3.4	12.2
F (74)	9.1	0.0	1.4	4.5	6.6	9.1
G (11)			0.0	11.8	4.8	0.0
H (25)	0.0	9.1	3.8	0.0	0.0	16.7
J (29)	0.0	3.4	2.6	0.0	0.0	3.6
K (28)	0.0	0.0	13.3	6.3	5.0	5.9
L (31)	0.0	3.6	0.0	7.1	8.6	6.3
M (21)	0.0	0.0	0.0	4.5	0.0	4.8
N (21)	0.0	4.8	0.0	0.0	4.3	5.3
P (14)	10.0	6.7		0.0	6.7	12.5
R (9)				0.0	0.0	0.0
S (28)	8.3	4.0	3.3	5.7	3.2	10.5

Key:
A = Bronglais
B = Princess of Wales
C = Royal Glamorgan
D = Royal Gwent
E = Morriston
F = UHW
G = Withybush
H = Wrexham Maelor
J = Glangwili
K = Ysbyty Gwynedd
L = Ysbyty Glan Clwyd
M = Nevill Hall
N = Prince Charles
P = UHL
R = Prince Philip
S = Singleton

Table 16: Trends in piperacillin/tazobactam resistance for *Klebsiella spp.* (2010-2015)

AB Code / Year

%R 0.0 — 29.3

Hospital Cod..	2010	2011	2012	2013	2014	2015
			PTZ			
A (10)				18.2	15.4	8.2
B (23)	8.0	4.8	5.6	10.7	4.2	4.8
C (22)	20.8	9.5	21.1	4.5	13.6	8.5
D (42)	2.4	9.1	7.7	4.8	6.1	17.3
E (34)	11.1	21.1	0.0	11.8	21.4	29.3
F (74)	9.2	3.2	6.9	9.0	7.9	5.2
G (7)				6.3	4.8	0.0
H (25)	7.7	13.6	7.7	21.9	15.6	16.7
J (28)	9.5	3.6	10.5	0.0	10.5	14.3
K (28)	12.5	16.0	3.3	15.6	15.0	11.8
L (31)	0.0	10.7	16.7	2.4	2.9	12.5
M (20)	9.5	0.0	6.7	5.3	0.0	19.0
N (19)	6.7	16.7	9.5		8.7	21.1
P (14)	10.0	13.3		7.7	0.0	6.3
R (7)				0.0	9.1	7.7
S (28)	0.0	8.0	6.7	15.2	16.7	5.3

Table 17: Trends in imipenem/meropenem resistance for *Klebsiella spp.* (2010-2015)

AB Code / Year

%R 0.0 — 9.1

Hospital Cod..	2010	2011	2012	2013	2014	2015
			IMI/MER			
A (10)				9.1	0.0	0.0
B (23)	0.0	0.0	0.0	0.0	0.0	0.0
C (23)	0.0	0.0	5.3	0.0	0.0	3.6
D (43)	0.0	0.0	0.0	0.0	0.0	0.0
E (34)	0.0	5.3	0.0	0.0	3.4	2.4
F (74)	0.0	0.0	0.0	1.5	0.0	0.0
G (12)			0.0	0.0	0.0	0.0
H (24)					0.0	0.0
J (28)	4.8	0.0	0.0	0.0	0.0	0.0
K (28)	0.0	0.0	0.0	0.0	0.0	0.0
L (31)	0.0	0.0	0.0	0.0	0.0	3.2
M (21)	0.0	0.0	0.0	0.0	0.0	0.0
N (21)	0.0	0.0	0.0	0.0	0.0	0.0
P (14)	0.0	0.0		0.0	0.0	0.0
R (9)				0.0	0.0	0.0
S (28)	0.0	0.0	0.0	2.9	0.0	0.0

Key:

A= Bronglais
B = Princess of Wales
C = Royal Glamorgan
D = Royal Gwent
E = Morriston
F = UHW
G = Withybush
H = Wrexham Maelor
J = Glangwili
K = Ysbyty Gwynedd
L = Ysbyty Glan Clwyd
M = Nevill Hall
N = Prince Charles
P = UHL
R = Prince Philip
S = Singleton

Enterobacter spp., Serratia spp., Proteus spp., and Ps. aeruginosa

Table 18: *Enterobacter spp., Serratia spp., Proteus spp.,* and *Ps. aeruginosa*

Enterobacter spp., Serratia spp., Proteus spp., and *Pseudomonas aeruginosa* from blood cultures
Resistance rates including (95% Confidence Intervals)
Duplicate Cut Off: ≤14 days
Time period: 1 January - 31 December 2015

Organism	COA	(95% CI)	PTZ	(95% CI)	GEN	(95% CI)	PTZ+GEN	(95% CI)
Enterobacter spp.		–	10.9	(6.6, 17.5)	3.1	(1.2, 7.7)	1.6	(0.4, 5.5)
All-Wales: Number of isolates			128		129		128	
Serratia spp.		–	5.4	(2.3, 12.1)	0.0	(0.0, 4.0)	0.0	(0.0, 4.0)
All-Wales: Number of isolates			92		92		92	
Proteus spp.	13.0	(9.0, 18.4)	0.5	(0.1, 2.8)	7.0	(4.2, 11.4)	0.5	(0.1, 2.8)
All-Wales: Number of isolates	200		199		200		199	
Pseudomonas aeruginosa		–	5.8	(3.1, 10.6)	3.8	(1.8, 8.1)	1.3	(0.4, 4.6)
All-Wales: Number of isolates			156		156		156	
Location Code (Number)	AMO	(95% CI)	3GC	(95% CI)	AMI	(95% CI)	FQ	(95% CI)
Enterobacter spp.		–	18.0	(12.3, 25.5)	0.8	(0.1, 4.3)	3.1	(1.2, 7.8)
All-Wales: Number of isolates			128		128		128	
Serratia spp.		–	19.6	(12.7, 28.8)	0.0	(0.0, 4.0)	6.5	(3.0, 13.5)
All-Wales: Number of isolates			92		92		92	
Proteus spp.		–	3.0	(1.4, 6.4)	0.5	(0.1, 2.8)	4.0	(2.0, 7.7)
All-Wales: Number of isolates			200		199		200	
* *Pseudomonas aeruginosa*		–	7.8	(4.5, 13.1)	2.6	(1.0, 6.4)	3.8	(1.8, 8.1)
All-Wales: Number of isolates			154		155		156	
Location Code (Number)	ERT	(95% CI)	IMI	(95% CI)	MER	(95% CI)	IMI or MER	(95% CI)
Enterobacter spp.	7.0	(3.7, 12.8)	0.8	(0.1, 4.3)	0.8	(0.1, 4.3)	0.8	(0.1, 4.3)
All-Wales: Number of isolates	128		127		128		128	
Serratia spp.	0.0	(0.0, 4.0)	1.1	(0.2, 5.9)	0.0	(0.0, 4.0)	1.1	(0.2, 5.9)
All-Wales: Number of isolates	92		92		92		92	
Proteus spp.	0.0	(0.0, 1.9)	2.5	(1.1, 5.7)	0.0	(0.0, 1.9)	2.5	(1.1, 5.7)
All-Wales: Number of isolates	200		199		199		199	
Pseudomonas aeruginosa		–	5.1	(2.6, 9.8)	4.5	(2.2, 9.0)	7.1	(4.0, 12.2)
All-Wales: Number of isolates			156		156		156	

Key: **COA** = co-amoxiclav, **PTZ** = piperacillin/tazobactam, **GEN** = gentamicin, **PTZ/GEN** = combined resistance to both agents, **AMO** = amoxicillin,
3GC = resistance to ceftazidime &/or cefotaxime, cefpodoxime, ceftriaxone, **AMI** = amikacin, **FQ** = resistance to ciprofloxacin &/or levofloxacin (*Pseudomonas aeruginosa* **FQ** = ciprofloxacin)
ERT = ertapenem, **IMI** = imipenem, **MER** = meropenem, **IMI or MER** = resistance to either or both agents

Note: Resistance rates are not recorded if the organisms are intrinsically resistant to an antibacterial agent e.g. for amoxicillin.

Enterobacter spp. (n=129 in 2015)

The All-Wales patterns of antimicrobial resistance for *Enterobacter* spp. are shown in **Figure 3** & **Table 18**. There has been a statistically significant decrease in resistance rates for the third generation cephalosporins (3GC) and fluoroquinolones (FQ) across time (2006-2015).
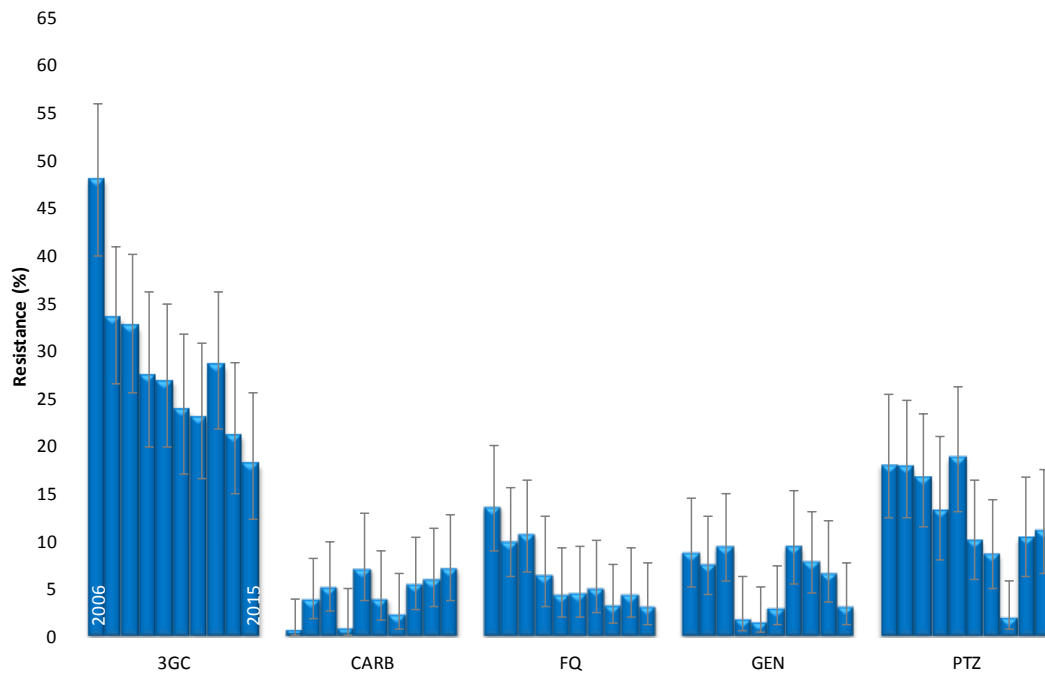
Figure 3: All-Wales antimicrobial resistance rates for *Enterobacter species;* isolated from blood culture (2006 to 2015)

Serratia spp. (n=92 in 2015)

The All-Wales patterns of antimicrobial resistance for *Serratia* spp. are shown in **Figure 4** and **Table 18**. There has been a statistically significant decrease in resistance rates for the third generation cephalosporins (3GC), fluoroquinolones (FQ), and piperacillin/tazobactam (PTZ) across time (2006-2015).
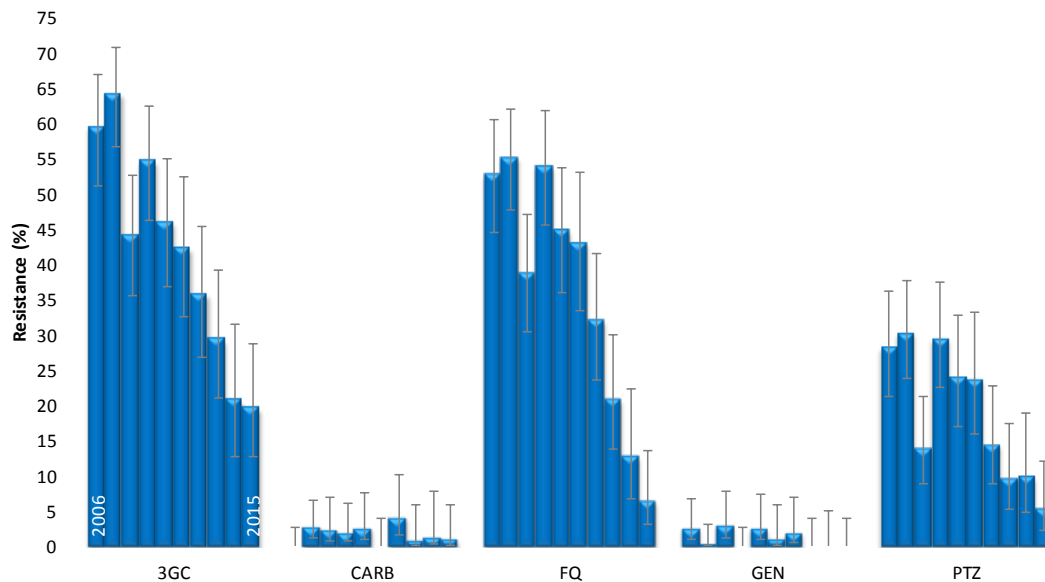
Figure 4: All-Wales antimicrobial resistance rates for *Serratia species;* isolated from blood culture (2006 to 2015)

Proteus spp. (n=200 in 2015)

The All-Wales patterns of antimicrobial resistance in *Proteus* spp. are shown in **Figure 5** & **Table 18**. There has been a statistically significant decrease in gentamicin resistance between 2012 and 2015. Note: Due to known issues with susceptibility testing of carbapenems with automated systems the reliability of the high carbapenem resistance is uncertain.
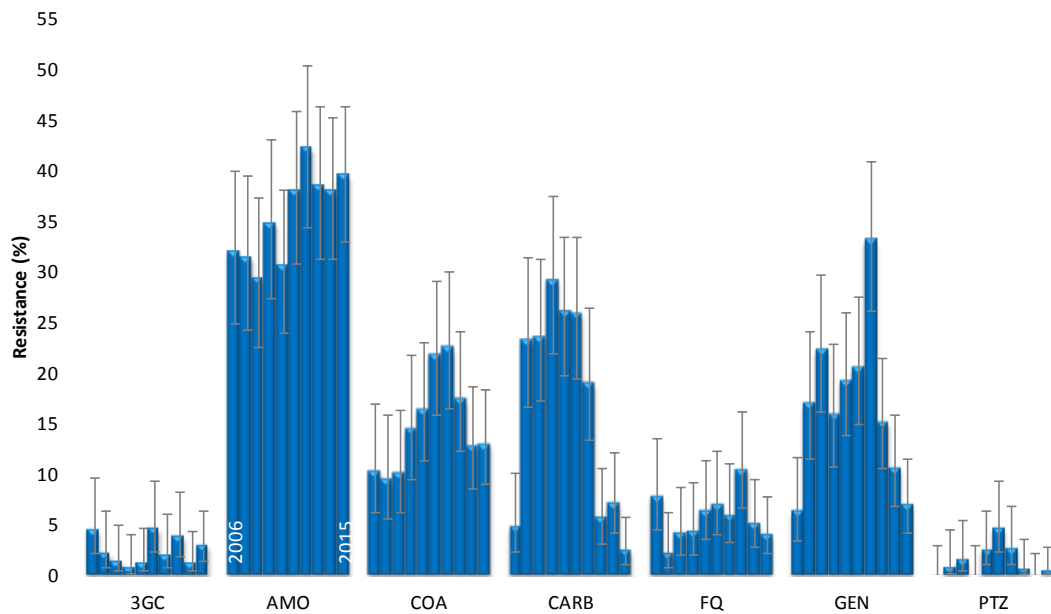
Figure 5: All-Wales antimicrobial resistance rates for *Proteus species;* isolated from blood culture (2005 to 2014)

Pseudomonas aeruginosa (n=156 in 2015)

The All-Wales patterns of antimicrobial resistance in *Pseudomonas aeruginosa* are shown in **Figure 6** & **Table 18**. The data is different to that shown in Table 3 (page 11); Table 3 shows the rates for *Pseudomonas spp* as per ARHAI instructions, but the following tables show the data for *Ps. aeruginosa* to allow comparisons with previous reports.
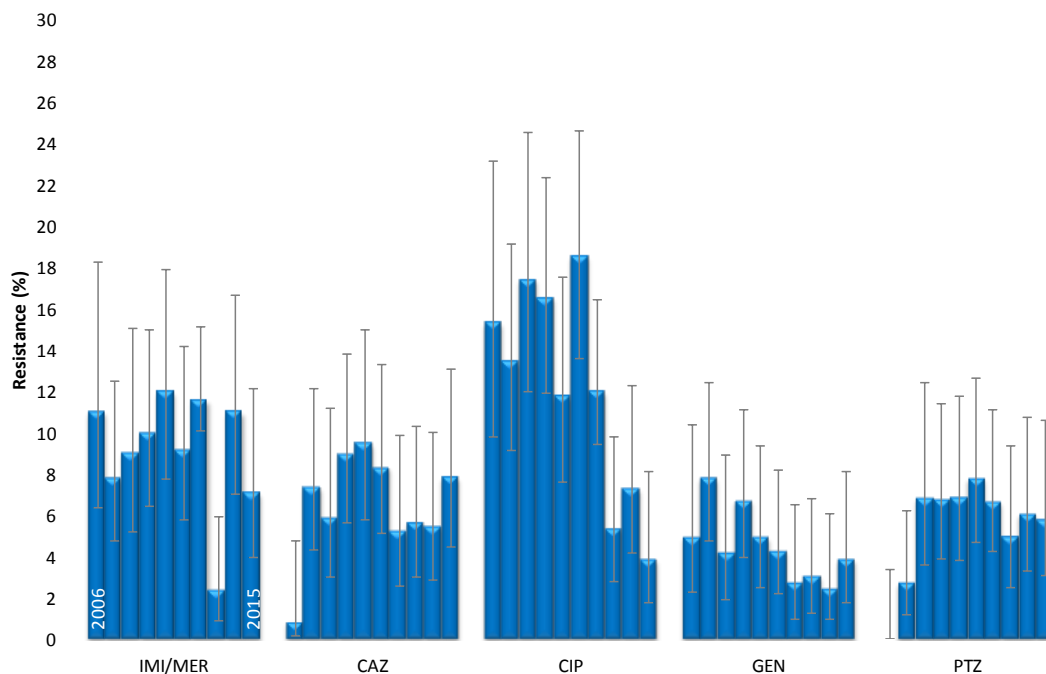
Figure 6: All-Wales antimicrobial resistance rates for *Pseudomonas aeruginosa;* isolated from blood culture (2006 to 2015)

There has been a statistically significant decrease in ciprofloxacin resistance in *Pseudomonas aeruginosa* from blood culture between 2011 and 2015.

Staphylococcus aureus

The All-Wales resistance rates for *Staphylococcus aureus* at hospital level are shown in **Table 19,** the data includes all *Staphylococcus aureus* both MSSA and MRSA. In 2015, flucloxacillin resistance rates for *S. aureus* bacteraemias in University Hospital Llandough are notably higher than the All-Wales rate, 30.0% compared with 12.7%. Flucloxacillin resistance reflects the proportion of *S. aureus* bacteraemias that were MRSA; the proportions of MRSA bacteraemias were notably higher in this locality than other acute hospitals in Wales.

Figure 7 shows the numbers of *Staphylococcus aureus* bacteraemias from 2005 to 2015**.** Across time both the number of *Staphylococcus aureus* (SAUR) and Meticillin Resistant *Staphylococcus aureus* (MRSA) bacteraemias has decreased, whilst the numbers of Meticillin Sensitive *Staphylococcus aureus* (MSSA) bacteraemias have increased.

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
MRSA	407	341	363	344	286	229	203	180	164	145	110
MSSA	632	682	658	638	681	664	661	701	759	717	758
SAUR	1039	1023	1021	982	967	893	864	881	923	862	868
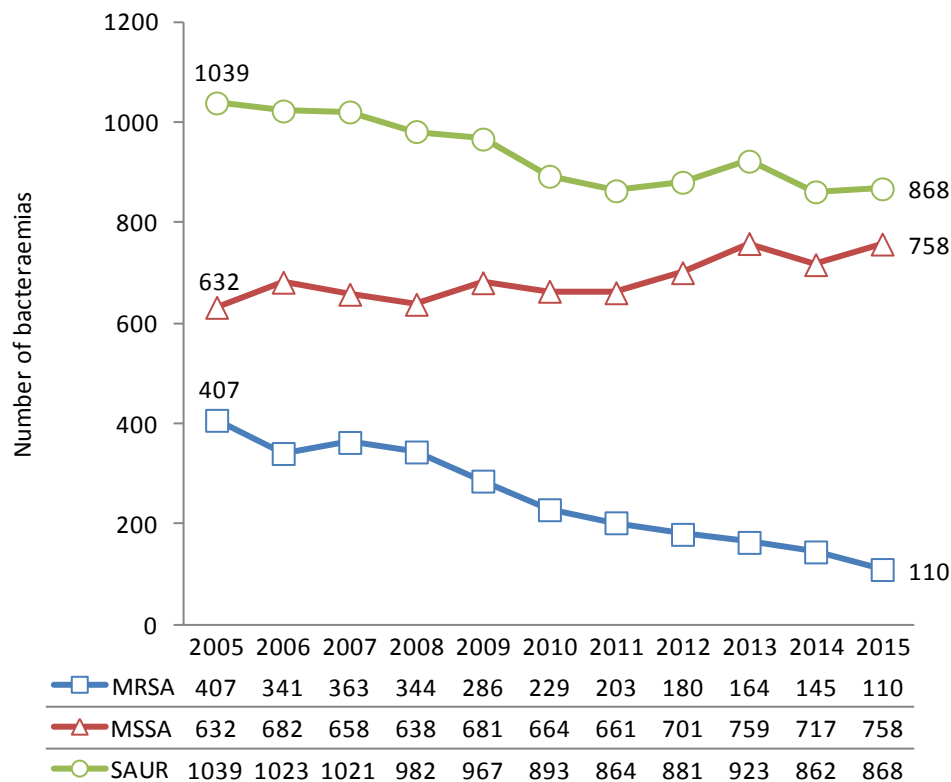
Figure 7: All-Wales *Staphylococcus aureus* bacteraemia numbers (2005 to 2015)

Table 19: *Staphylococcus aureus* (MSSA & MRSA)

Staphylococcus aureus from blood cultures (MSSA & MRSA)
Resistance rates including (95% Confidence Intervals)
Duplicate Cut Off: ≤14 days
Time period: 1 January - 31 December 2015

Location Code	CLI	(95% CI)	ERY	(95% CI)	FLU	(95% CI)
A (n=17)	5.9	(1.0, 27.0)	5.9	(1.0, 27.0)	0.0	(0.0, 18.4)
B (n=38)	10.5	(4.2, 24.1)	15.8	(7.4, 30.4)	10.5	(4.2, 24.1)
C (n=71)	2.8	(0.8, 9.7)	8.5	(3.9, 17.2)	4.2	(1.4, 11.7)
D (n=92)	14.1	(8.4, 22.7)	18.5	(11.9, 27.6)	18.5	(11.9, 27.6)
E (n=74)	8.2	(3.8, 16.8)	9.6	(4.7, 18.5)	4.1	(1.4, 11.3)
F (n=147)	20.4	(14.7, 27.6)	21.1	(15.3, 28.4)	10.9	(6.8, 16.9)
G (n=39)	5.1	(1.4, 16.9)	20.5	(10.8, 35.5)	5.1	(1.4, 16.9)
H (n=60)	21.7	(13.1, 33.6)	23.3	(14.4, 35.4)	21.7	(13.1, 33.6)
J (n=60)	18.3	(10.6, 29.9)	20.0	(11.8, 31.8)	11.7	(5.8, 22.2)
K (n=55)	18.2	(10.2, 30.3)	27.3	(17.3, 40.2)	21.8	(12.9, 34.4)
L (n=58)	19.0	(10.9, 30.9)	29.3	(19.2, 42.0)	20.7	(12.3, 32.8)
M (n=28)	25.0	(12.7, 43.4)	32.1	(17.9, 50.7)	21.4	(10.2, 39.5)
N (n=52)	3.9	(1.1, 13.2)	17.6	(9.6, 30.3)	3.8	(1.1, 13.0)
P (n=20)	35.0	(18.1, 56.7)	35.0	(18.1, 56.7)	30.0	(14.5, 51.9)
R (n=13)	7.7	(1.4, 33.3)	7.7	(1.4, 33.3)	0.0	(0.0, 22.8)
S (n=33)	12.1	(4.8, 27.3)	12.1	(4.8, 27.3)	9.1	(3.1, 23.6)
All-Wales: Resistance rates	**14.7**	(12.5, 17.2)	**19.3**	(16.8, 22.0)	**12.7**	(10.6, 15.1)
All-Wales: Number of isolates	**866**		**866**		**868**	

Location Code	FUS	(95% CI)	GEN	(95% CI)	LZD	(95% CI)
A (n=17)	0.0	(0.0, 18.4)	0.0	(0.0, 18.4)	0.0	(0.0, 18.4)
B (n=38)	15.8	(7.4, 30.4)	0.0	(0.0, 9.2)	0.0	(0.0, 9.2)
C (n=71)	15.5	(8.9, 25.7)	1.4	(0.2, 7.6)	0.0	(0.0, 5.2)
D (n=92)	10.9	(6.0, 18.9)	0.0	(0.0, 4.0)	0.0	(0.0, 4.0)
E (n=74)	14.5	(8.1, 24.7)	2.7	(0.8, 9.5)	0.0	(0.0, 5.1)
F (n=147)	15.0	(10.1, 21.6)	0.7	(0.1, 3.8)	0.0	(0.0, 2.6)
G (n=39)	0.0	(0.0, 9.0)	0.0	(0.0, 9.0)	0.0	(0.0, 9.0)
H (n=60)	11.7	(5.8, 22.2)	5.0	(1.7, 13.7)	0.0	(0.0, 6.0)
J (n=60)	10.0	(4.7, 20.1)	1.7	(0.3, 8.9)	0.0	(0.0, 6.0)
K (n=55)	7.3	(2.9, 17.3)	0.0	(0.0, 6.5)	0.0	(0.0, 6.5)
L (n=58)	20.7	(12.3, 32.8)	3.5	(1.0, 11.9)	0.0	(0.0, 6.2)
M (n=28)	21.4	(10.2, 39.5)	0.0	(0.0, 12.1)	0.0	(0.0, 12.5)
N (n=52)	21.6	(12.5, 34.6)	5.8	(2.0, 15.6)	0.0	(0.0, 7.1)
P (n=20)	5.0	(0.9, 23.6)	0.0	(0.0, 16.1)	0.0	(0.0, 16.1)
R (n=13)	0.0	(0.0, 22.8)	0.0	(0.0, 22.8)	0.0	(0.0, 22.8)
S (n=33)	6.1	(1.7, 19.6)	3.0	(0.5, 15.3)	0.0	(0.0, 10.4)
All-Wales: Resistance rates	**12.8**	(10.7, 15.2)	**1.7**	(1.1, 2.8)	**0.0**	(0.0, 0.4)
All-Wales: Number of isolates	**860**		**866**		**861**	

Location Code	MUP	(95% CI)	RIF	(95% CI)	TET	(95% CI)
A (n=17)	0.0	(0.0, 18.4)	0.0	(0.0, 18.4)	0.0	(0.0, 18.4)
B (n=38)	5.3	(1.5, 17.3)	0.0	(0.0, 9.2)	7.9	(2.7, 20.8)
C (n=71)	1.4	(0.3, 7.7)	0.0	(0.0, 5.2)	2.8	(0.8, 9.7)
D (n=92)	2.2	(0.6, 7.7)	0.0	(0.0, 4.0)	4.3	(1.7, 10.7)
E (n=74)	2.8	(0.8, 9.6)	0.0	(0.0, 5.0)	1.4	(0.2, 7.4)
F (n=147)	0.0	(0.0, 2.6)	0.7	(0.1, 3.8)	4.8	(2.3, 9.5)
G (n=39)	0.0	(0.0, 9.2)	0.0	(0.0, 9.0)	5.1	(1.4, 16.9)
H (n=60)	0.0	(0.0, 6.0)	0.0	(0.0, 6.0)	10.0	(4.7, 20.1)
J (n=60)	3.3	(0.9, 11.4)	0.0	(0.0, 6.0)	0.0	(0.0, 6.0)
K (n=55)	1.8	(0.3, 9.6)	1.8	(0.3, 9.6)	3.6	(1.0, 12.3)
L (n=58)	0.0	(0.0, 6.2)	0.0	(0.0, 6.2)	12.1	(6.0, 22.9)
M (n=28)	7.4	(2.1, 23.4)	3.8	(0.7, 18.9)	7.1	(2.0, 22.6)
N (n=52)	4.0	(1.1, 13.5)	0.0	(0.0, 7.0)	3.8	(1.1, 13.0)
P (n=20)	0.0	(0.0, 16.8)	0.0	(0.0, 16.1)	15.0	(5.2, 36.0)
R (n=13)	0.0	(0.0, 22.8)	0.0	(0.0, 22.8)	0.0	(0.0, 22.8)
S (n=33)	3.0	(0.5, 15.3)	0.0	(0.0, 10.4)	0.0	(0.0, 10.4)
All-Wales: Resistance rates	**1.8**	(1.1, 2.9)	**0.3**	(0.1, 1.0)	**4.7**	(3.5, 6.4)
All-Wales: Number of isolates	**856**		**862**		**867**	

Key: CLI = clindamycin, **ERY** = erythromycin, **FUS** = fusidic acid, **GEN** = gentamicin, **LZD** = linezolid, **MUP** = mupirocin, **RIF** = rifampicin, **TET** = tetracycline.

ARHAI Primary data Set

Interpretation Table 20: The table show trends in resistance to a drug/bug combination in the ARHAI primary data set at hospital level, across time. The tables use a colour gradation based on the lowest resistance to the highest resistance figures, to highlight local patterns of resistance across time.

Table 20: Trends in meticillin resistance for *Staphylococcus aureus* (2010-2015)

	AB Code / Year					
	FLU					
Hospital Cod..	2010	2011	2012	2013	2014	2015
A (13)	23.1		10.0	23.1	14.3	0.0
B (45)	27.8	15.6	13.0	11.8	20.5	10.5
C (46)	33.3	19.4	17.1	12.5	21.1	4.2
D (84)	16.1	20.5	18.1	21.2	16.0	18.5
E (64)	28.8	17.9	25.8	12.3	13.6	4.1
F (161)	27.0	19.1	20.1	16.0	17.6	10.9
G (36)	27.8	17.2	19.2	10.9	14.3	5.1
H (53)	14.5	20.0	25.0	25.0	12.2	21.7
J (50)	16.3	22.6	20.5	26.0	17.2	11.7
K (52)	34.0	42.6	38.0	32.7	31.4	21.8
L (54)	25.0	30.2	27.1	38.8	9.1	20.7
M (37)	14.3	24.3	10.2	5.7	16.2	21.4
N (39)	28.6	30.0	26.3	10.0	9.4	3.8
P (24)	32.4	26.1	12.0	3.3	40.9	30.0
R (17)	35.7		5.6	14.3	23.1	0.0
S (59)	29.2	20.0	11.3	14.1	9.7	9.1

%R
0.0 — 42.6

Key:
A= Bronglais
B = Princess of Wales
C = Royal Glamorgan
D = Royal Gwent
E = Morriston
F = UHW
G = Withybush
H = Wrexham Maelor
J = Glangwili
K = Ysbyty Gwynedd
L = Ysbyty Glan Clwyd
M = Nevill Hall
N = Prince Charles
P = UHL
R = Prince Philip
S = Singleton

Meticillin Sensitive Staphylococcus aureus *(n=758 in 2015)*

The All-Wales pattern of antimicrobial resistance in MSSA is shown in **Figure 8** and **Table 21**; with no statistically significant changes between 2006 and 2015.
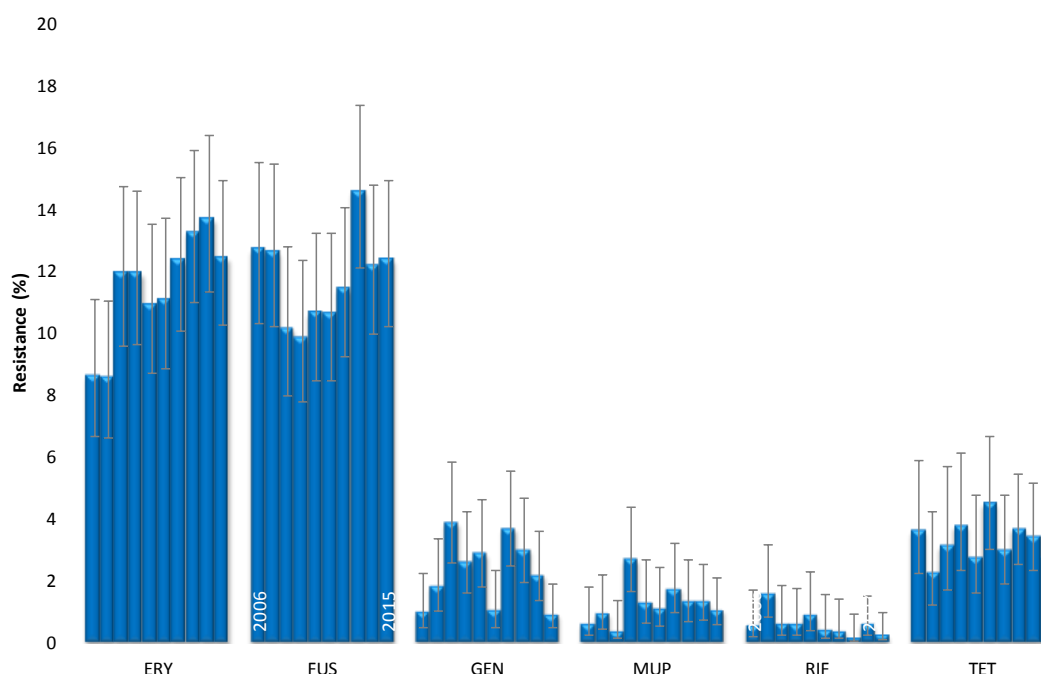
Figure 8: All-Wales antimicrobial resistance rates for Meticillin Sensitive *Staphylococcus aureus* (MSSA) isolated from blood culture (2006 to 2015)

The All-Wales antimicrobial resistance rates for MSSA for 2006 to 2014 are largely comparable to those published by BSAC for the UK except for clindamycin resistance which appears higher in Wales. In 2014 the All-Wales rate was 9.2% compared with the UK rate of 2.0%; and in 2015 the rate was slightly lower at 8.2%. BSAC have not yet been published the UK rates for 2015:
http://www.bsacsurv.org/reports/bacteraemia

In 2015, the All-Wales resistance rate for penicillin was 80.6%, and vancomycin remained undetected.

Table 21: Meticillin Sensitive *Staphylococcus aureus*

Meticillin Sensitive *Staphylococcus aureus* from blood cultures
Resistance rates including (95% Confidence Intervals)
Duplicate Cut Off: ≤14 days
Time period: 1 January - 31 December 2015

Location Code	CLI	(95% CI)	ERY	(95% CI)	FUS	(95% CI)
A (n=17)	5.9	(1.0, 27.0)	5.9	(1.0, 27.0)	0.0	(0.0, 18.4)
B (n=34)	2.9	(0.5, 14.9)	8.8	(3.0, 23.0)	11.8	(4.7, 26.6)
C (n=68)	2.9	(0.8, 10.1)	8.8	(4.1, 17.9)	16.2	(9.3, 26.7)
D (n=75)	2.7	(0.7, 9.2)	6.7	(2.9, 14.7)	12.0	(6.4, 21.3)
E (n=71)	7.0	(3.0, 15.4)	8.5	(3.9, 17.2)	13.4	(7.2, 23.6)
F (n=131)	16.8	(11.4, 24.1)	17.6	(12.0, 25.0)	14.5	(9.5, 21.5)
G (n=37)	5.4	(1.5, 17.7)	16.2	(7.7, 31.1)	0.0	(0.0, 9.4)
H (n=47)	6.4	(2.2, 17.2)	8.5	(3.4, 19.9)	10.6	(4.6, 22.6)
J (n=53)	13.2	(6.5, 24.8)	15.1	(7.9, 27.1)	9.4	(4.1, 20.3)
K (n=43)	4.7	(1.3, 15.5)	11.6	(5.1, 24.5)	7.0	(2.4, 18.6)
L (n=46)	13.0	(6.1, 25.7)	21.7	(12.3, 35.6)	19.6	(10.7, 33.2)
M (n=22)	9.1	(2.5, 27.8)	18.2	(7.3, 38.5)	22.7	(10.1, 43.4)
N (n=49)	4.1	(1.1, 13.7)	16.3	(8.5, 29.0)	20.4	(11.5, 33.6)
P (n=14)	7.1	(1.3, 31.5)	7.1	(1.3, 31.5)	7.1	(1.3, 31.5)
R (n=13)	7.7	(1.4, 33.3)	7.7	(1.4, 33.3)	0.0	(0.0, 22.8)
S (n=30)	10.0	(3.5, 25.6)	10.0	(3.5, 25.6)	6.7	(1.8, 21.3)
All-Wales: Resistance rates	**8.2**	(6.4, 10.4)	**12.4**	(10.3, 15.0)	**12.4**	(10.2, 14.9)
All-Wales: Number of isolates	**757**		**757**		**752**	

Location Code	GEN	(95% CI)	LZD	(95% CI)	MUP	(95% CI)
A (n=17)	0.0	(0.0, 18.4)	0.0	(0.0, 18.4)	0.0	(0.0, 18.4)
B (n=34)	0.0	(0.0, 10.2)	0.0	(0.0, 10.2)	2.9	(0.5, 14.9)
C (n=68)	1.5	(0.3, 7.9)	0.0	(0.0, 5.3)	1.5	(0.3, 7.9)
D (n=75)	0.0	(0.0, 4.9)	0.0	(0.0, 4.9)	0.0	(0.0, 4.9)
E (n=71)	1.4	(0.2, 7.6)	0.0	(0.0, 5.2)	1.4	(0.3, 7.7)
F (n=131)	0.0	(0.0, 2.8)	0.0	(0.0, 2.9)	0.0	(0.0, 2.9)
G (n=37)	0.0	(0.0, 9.4)	0.0	(0.0, 9.4)	0.0	(0.0, 9.6)
H (n=47)	0.0	(0.0, 7.6)	0.0	(0.0, 7.6)	0.0	(0.0, 7.6)
J (n=53)	0.0	(0.0, 6.8)	0.0	(0.0, 6.8)	0.0	(0.0, 6.8)
K (n=43)	0.0	(0.0, 8.2)	0.0	(0.0, 8.2)	2.3	(0.4, 12.1)
L (n=46)	2.2	(0.4, 11.6)	0.0	(0.0, 7.7)	0.0	(0.0, 7.7)
M (n=22)	0.0	(0.0, 14.9)	0.0	(0.0, 15.5)	4.8	(0.8, 22.7)
N (n=49)	4.0	(1.1, 13.5)	0.0	(0.0, 7.4)	4.2	(1.2, 14.0)
P (n=14)	0.0	(0.0, 21.5)	0.0	(0.0, 21.5)	0.0	(0.0, 22.8)
R (n=13)	0.0	(0.0, 22.8)	0.0	(0.0, 22.8)	0.0	(0.0, 22.8)
S (n=30)	3.3	(0.6, 16.7)	0.0	(0.0, 11.4)	3.3	(0.6, 16.7)
All-Wales: Resistance rates	**0.9**	(0.4, 1.9)	**0**	(0.0, 0.5)	**1.1**	(0.5, 2.1)
All-Wales: Number of isolates	**757**		**753**		**748**	

Location Code	PEN	(95% CI)	RIF	(95% CI)	TET	(95% CI)
A (n=17)	76.5	(52.7, 90.4)	0.0	(0.0, 18.4)	0.0	(0.0, 18.4)
B (n=34)	76.5	(60.0, 87.6)	0.0	(0.0, 10.2)	5.9	(1.6, 19.1)
C (n=68)	76.1	(64.7, 84.7)	0.0	(0.0, 5.3)	2.9	(0.8, 10.1)
D (n=75)	82.7	(72.6, 89.6)	0.0	(0.0, 4.9)	1.3	(0.2, 7.2)
E (n=71)	87.3	(77.6, 93.2)	0.0	(0.0, 5.1)	0.0	(0.0, 5.1)
F (n=131)	76.2	(68.1, 82.7)	0.8	(0.1, 4.2)	4.6	(2.1, 9.6)
G (n=37)	78.4	(62.8, 88.6)	0.0	(0.0, 9.4)	2.7	(0.5, 13.8)
H (n=47)	72.5	(57.2, 83.9)	0.0	(0.0, 7.6)	4.3	(1.2, 14.2)
J (n=53)	88.7	(77.4, 94.7)	0.0	(0.0, 6.8)	0.0	(0.0, 6.8)
K (n=43)	74.4	(59.8, 85.1)	2.3	(0.4, 12.1)	2.3	(0.4, 12.1)
L (n=46)	80.4	(66.8, 89.3)	0.0	(0.0, 7.7)	4.3	(1.2, 14.5)
M (n=22)	81.0	(60.0, 92.3)	0.0	(0.0, 16.1)	4.5	(0.8, 21.8)
N (n=49)	83.3	(70.4, 91.3)	0.0	(0.0, 7.3)	4.0	(1.1, 13.5)
P (n=14)	85.7	(60.1, 96.0)	0.0	(0.0, 21.5)	7.1	(1.3, 31.5)
R (n=13)	92.3	(66.7, 98.6)	0.0	(0.0, 22.8)	0.0	(0.0, 22.8)
S (n=30)	90.0	(74.4, 96.5)	0.0	(0.0, 11.4)	0.0	(0.0, 11.4)
All-Wales: Resistance rates	**80.6**	(77.6, 83.2)	**0.3**	(0.1, 1.0)	**2.8**	(1.8, 4.2)
All-Wales: Number of isolates	**746**		**755**		**758**	

Key: CLI = clindamycin, **ERY** = erythromycin, **FUS** = fusidic acid, **GEN** = gentamicin, **LZD** = linezolid,
MUP = mupirocin, **PEN** = penicillin, **RIF** = rifampicin, **TET** = tetracycline.

Meticillin Resistant Staphylococcus aureus (n=110 in 2015)

The All-Wales pattern of antimicrobial resistance in MRSA is shown in **Figure 9** & **Table 22**. There has been a statistically significant increase in tetracycline resistance across time (2006-2015).
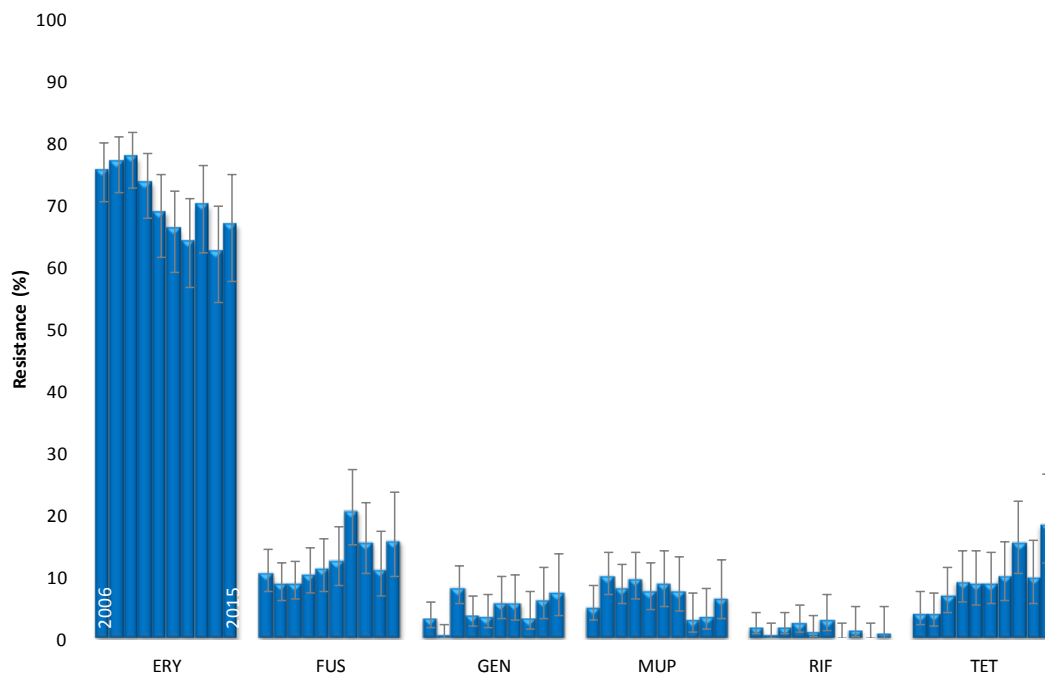
Figure 9: All-Wales antimicrobial resistance rates for Meticillin Resistant Staphylococcus aureus (MRSA) isolated from blood culture (2006 to 2015)

The All-Wales antimicrobial resistance rates for MSRA for 2006 to 2014 are largely comparable to those published by BSAC for the UK except for clindamycin resistance which appears higher in Wales. In 2014, the All-Wales clindamycin resistance rate was 54.5% compared with the UK rate of 7.7%; and in 2015 the All-Wales rate has increased to 59.6%. BSAC have not yet been published the UK rates for 2015: http://www.bsacsurv.org/reports/bacteraemia

Resistance to vancomycin and linezolid has remained undetected.

Table 22: Meticillin Resistant *Staphylococcus aureus*

Meticillin Resistant *Staphylococcus aureus* from blood cultures								
Resistance rates including (95% Confidence Intervals)								
Duplicate Cut Off: ?14 days								
Time period: 1 January - 31 December 2015								
Location Code	**CLI**	(95% CI)	**ERY**	(95% CI)	**FQ**	(95% CI)		
D (n=17)	64.7	(41.3, 82.7)	70.6	(46.9, 86.7)	82.4	(59.0, 93.8)		
F (n=16)	50.0	(28.0, 72.0)	50.0	(28.0, 72.0)	43.8	(23.1, 66.8)		
H (n=13)	76.9	(49.7, 91.8)	76.9	(49.7, 91.8)	100	(77.2, 100)		
K (n=12)	66.7	(39.1, 86.2)	83.3	(55.2, 95.3)	83.3	(55.2, 95.3)		
L (n=12)	41.7	(19.3, 68.0)	58.3	(32.0, 80.7)	91.7	(64.6, 98.5)		
All-Wales: Resistance rates	**59.6**	(50.2, 68.4)	**67.0**	(57.7, 75.1)	**73.8**	(64.8, 81.2)		
All-Wales: Number of isolates	**109**		**109**		**108**			
Location Code	**FUS**	(95% CI)	**GEN**	(95% CI)	**LZD**	(95% CI)		
D (n=17)	5.9	(1.0, 27.0)	0.0	(0.0, 18.4)	0.0	(0.0, 18.4)		
F (n=16)	18.8	(6.6, 43.0)	6.3	(1.1, 28.3)	0.0	(0.0, 19.4)		
H (n=13)	15.4	(4.3, 42.2)	23.1	(8.2, 50.3)	0.0	(0.0, 22.8)		
K (n=12)	8.3	(1.5, 35.4)	0.0	(0.0, 24.3)	0.0	(0.0, 24.3)		
L (n=12)	25.0	(8.9, 53.2)	8.3	(1.5, 35.4)	0.0	(0.0, 24.3)		
All-Wales: Resistance rates	**15.7**	(10.1, 23.8)	**7.3**	(3.8, 13.8)	**0.0**	(0.0, 3.4)		
All-Wales: Number of isolates	**108**		**109**		**108**			
Location Code	**MUP**	(95% CI)	**RIF**	(95% CI)	**TET**	(95% CI)		
D (n=17)	11.8	(3.3, 34.3)	0.0	(0.0, 18.4)	17.6	(6.2, 41.0)		
F (n=16)	0.0	(0.0, 19.4)	0.0	(0.0, 20.4)	6.3	(1.1, 28.3)		
H (n=13)	0.0	(0.0, 22.8)	0.0	(0.0, 22.8)	30.8	(12.7, 57.6)		
K (n=12)	0.0	(0.0, 24.3)	0.0	(0.0, 24.3)	8.3	(1.5, 35.4)		
L (n=12)	0.0	(0.0, 24.3)	0.0	(0.0, 24.3)	41.7	(19.3, 68.0)		
All-Wales: Resistance rates	**6.5**	(3.2, 12.8)	**0.9**	(0.2, 5.1)	**18.3**	(12.2, 26.6)		
All-Wales: Number of isolates	**108**		**107**		**109**			
Key:CLI = clindamycin, **ERY** = erythromycin, **FUS** = fusidic acid, **GEN** = gentamicin, **LZD** = linezolid, **MUP** = mupirocin, **PEN** = pencillin, **RIF** = rifampicin, **TET** = tetracycline.								

The number of MRSA bacteraemias has reduced markedly over the past few years and so the number of individual hospitals with 10 isolates or more has reduced, and so the table is small. When <80% of all isolates were tested, the All-Wales rate is shown in red.

Enterococcus spp. (n=430 in 2015)

The All-Wales pattern of antimicrobial resistance in *Enterococcus* spp. is shown in
Figure 10 and **Table 23**; with no statistically significant changes in resistance
between 2014 and 2015.
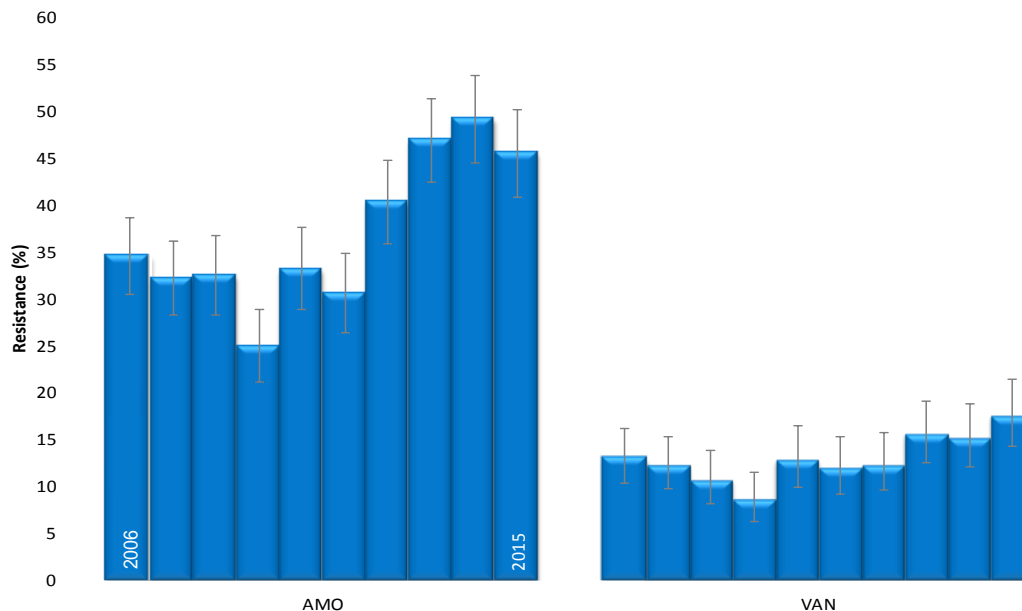
**Figure 10: All-Wales antimicrobial resistance rates for *Enterococcus spp*. isolated
from blood culture (2006 to 2015)**

In 2015, the All-Wales resistance rate for amoxicillin was 45.5% (40.8, 50.3).
Susceptibility to amoxicillin is a guide to speciation of the organism, *E. faecalis* being
normally susceptible and *E. faecium* being normally resistant, and suggests that in
2015, 54.5% of entercoccal bacteraemias were due to *E. faecalis.*

Table 23: *Enterococcus* spp.
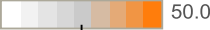
Enterococcus spp. from blood cultures Resistance rates including (95% Confidence Intervals) Duplicate Cut Off: ≤14 days Time period: 1 January - 31 December 2015				
Location Code	**AMO**	(95% CI)	**VAN**	(95% CI)
B (n=10)	28.6	(11.7, 54.6)	14.3	(4.0, 39.9)
C (n=24)	41.7	(24.5, 61.2)	25.0	(12.0, 44.9)
D (n=65)	53.2	(41.0, 65.1)	26.2	(17.0, 38.0)
E (n=35)	50.0	(34.1, 65.9)	25.7	(14.2, 42.1)
F (n=78)	48.1	(37.3, 59.0)	10.3	(5.3, 19.0)
G (n=10)	30.0	(10.8, 60.3)	0.0	(0.0, 27.8)
H (n=21)	28.6	(13.8, 50.0)	0.0	(0.0, 15.5)
J (n=32)	20.0	(9.5, 37.3)	15.6	(6.9, 31.8)
K (n=27)	51.9	(34.0, 69.3)	26.9	(13.7, 46.1)
L (=33)	39.4	(24.7, 56.3)	15.2	(6.7, 30.9)
M (n=14)	64.3	(38.8, 83.7)	50.0	(26.8, 73.2)
N (n=20)	70.0	(48.1, 85.5)	21.1	(8.5, 43.3)
R (n=22)	52.4	(32.4, 71.7)	4.5	(0.8, 21.8)
S (n=19)	42.1	(23.1, 63.7)	21.1	(8.5, 43.3)
All-Wales: Resistance rates	**45.5**	(40.8, 50.3)	**17.5**	(14.2, 21.4)
All-Wales: Number of isolates	**422**		**428**	
Key: AMO = amoxicillin, **VAN** = vancomycin.				

Note: Locally resistance rates for amoxicillin varied from 20.0% in Glangwili hospital (J) to 70.0% in Prince Charles hospital (N) and this may simply reflect variation in the proportion of *E. faecalis* to *E. faecium*. Vancomycin resistance varied from 0.0% to 50.0% in Nevill Hall (M).

ARHAI Primary data Set

Interpretation Table 24: The table show trends in resistance to a drug/bug combination in the ARHAI primary data set at hospital level, across time. The tables use a colour gradation based on the lowest resistance to the highest resistance figures, to highlight local patterns of resistance across time. The number following the hospital code e.g. (9) represents the median number of isolates per year over the data set. Resistance rates are only shown when the number of isolates were 10 or more for any one year e.g. for hospital A data is not shown for 2011, 2013, 2014 or 2015.

Table 24: Trends in vancomycin resistance for *Enterococcus spp.* (2010-2015)

AB Code / Year — VAN

%R 0.0 ▭ 50.0

Hospital Cod..	2010	2011	2012	2013	2014	2015
A (9)	10.0		0.0			
B (22)	0.0	17.6	4.8	9.1	13.0	14.3
C (23)	14.3	25.0	4.3	8.3	17.4	25.0
D (35)			11.1		21.6	26.2
E (37)	21.2	15.4	7.5	15.0	22.2	25.7
F (101)	23.9	17.9	15.0	14.2	22.4	10.3
G (9)				6.7	5.0	0.0
H (29)	10.0	0.0	20.7	16.0	20.7	0.0
J (33)	3.1	5.0	5.1	15.2	3.7	15.6
K (31)	4.0	6.7	32.3	33.3	25.8	26.9
L (28)	10.7	4.3	22.2	7.4	8.3	15.2
M (8)				37.5	11.8	50.0
N (17)	11.1	5.9	15.8	9.1	0.0	21.1
P (11)	0.0			5.9		
R (7)					0.0	4.5
S (27)	7.4	7.7	0.0	17.9	3.7	21.1

Key:

B = Princess of Wales
C = Royal Glamorgan
D = Royal Gwent
E = Morriston
F = UHW
G = Withybush
H = Wrexham Maelor
J = Glangwili
K = Ysbyty Gwynedd
L = Ysbyty Glan Clwyd
N = Prince Charles
P = UHL
S = Singleton

Streptococcus pneumoniae (n=333 in 2015)

The All-Wales pattern of antimicrobial resistance is shown in **Figure 11** & **Table 25**; with no statistically significant change in resistance across time.

	ERY	PEN	TET
2006	8.1	4.0	3.0
2007	8.5	3.5	3.0
2008	5.0	2.9	3.9
2009	4.7	2.1	3.5
2010	3.9	1.4	1.1
2011	6.5	2.7	5.2
2012	8.4	2.0	5.2
2013	7.6	4.5	6.0
2014	12.7	4.1	9.9
2015	5.2	5.1	4.9
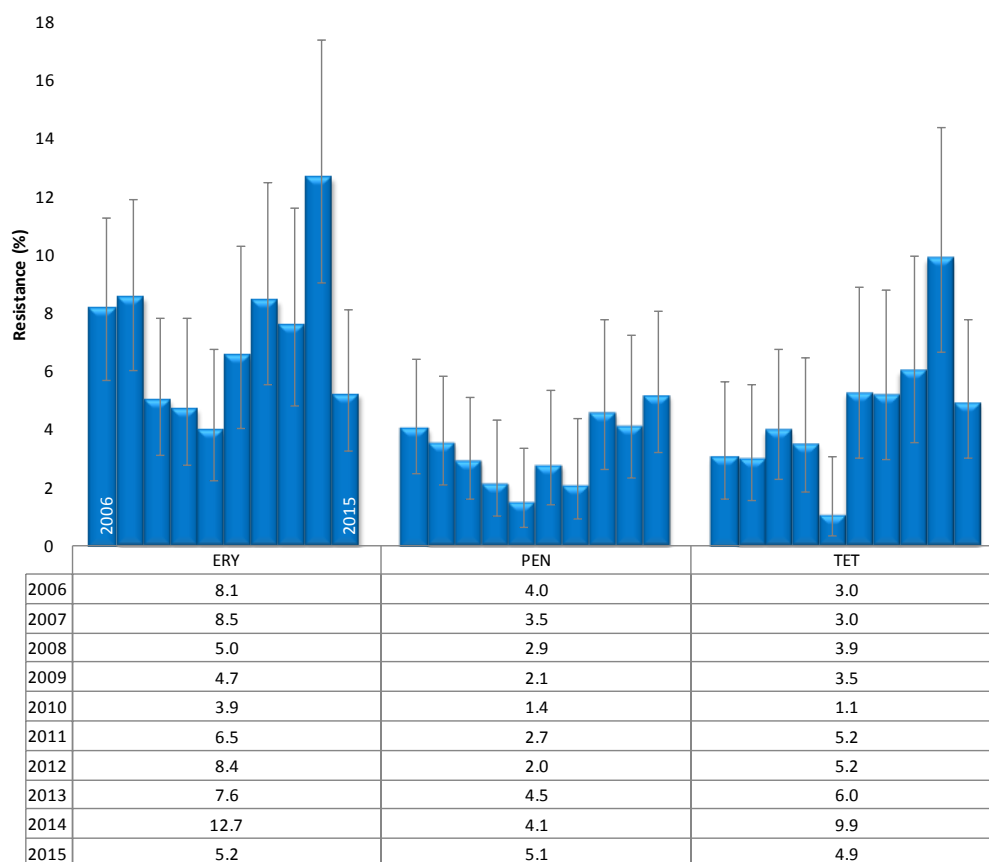
Figure 11: All-Wales antimicrobial resistance rates for *Streptococcus pneumoniae* isolated from blood culture (2006 to 2015)

Table 25: *Streptococcus pneumoniae*

Streptococcus pneumoniae from blood cultures
Resistance rates including (95% Confidence Intervals)
Duplicate Cut Off: ≤14 days
Time period: 1 January - 31 December 2015

Location Code	ERY	(95% CI)	PEN	(95% CI)	TET	(95% CI)
B (n=15)	0.0	(0.0, 20.4)	0.0	(0.0, 20.4)	6.7	(1.2, 29.8)
C (n=16)	6.3	(1.1, 28.3)	0.0	(0.0, 17.6)	0.0	(0.0, 19.4)
D (n=44)	6.8	(2.3, 18.2)	11.4	(5.0, 24.0)	2.3	(0.4, 11.8)
E (n=26)	11.5	(4.0, 29.0)	0.0	(0.0, 12.9)	7.7	(2.1, 24.1)
F (n=43)	7.0	(2.4, 18.6)	14.6	(6.9, 28.4)	4.7	(1.3, 15.5)
G (n=14)	0.0	(0.0, 21.5)	0.0	(0.0, 21.5)	0.0	(0.0, 21.5)
H (n=20)	10.0	(2.8, 30.1)	9.5	(2.7, 28.9)	9.5	(2.7, 28.9)
J (n=13)	7.7	(1.4, 33.3)	0.0	(0.0, 21.5)	7.7	(1.4, 33.3)
K (n=19)	0.0	(0.0, 16.8)	0.0	(0.0, 16.1)	15.8	(5.5, 37.6)
L (n=28)	3.6	(0.6, 17.7)	3.6	(0.6, 17.7)	3.6	(0.6, 17.7)
M (n=27)	3.7	(0.7, 18.3)	0.0	(0.0, 12.5)	3.7	(0.7, 18.3)
N (n=18)	0.0	(0.0, 17.6)	5.6	(1.0, 25.8)	0.0	(0.0, 17.6)
P (n=14)	0.0	(0.0, 21.5)	0.0	(0.0, 21.5)	7.1	(1.3, 31.5)
R (n=12)	8.3	(1.5, 35.4)	16.7	(4.7, 44.8)	8.3	(1.5, 35.4)
S (n=11)	9.1	(1.6, 37.7)	0.0	(0.0, 25.9)	0.0	(0.0, 27.8)
All-Wales: Resistance rates	**5.2**	(3.3, 8.1)	**5.1**	(3.2, 8.1)	**4.9**	(3.0, 7.8)
All-Wales: Number of isolates	**328**		**331**		**328**	

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

ARHAI Primary data Set

Interpretation Table 26: The table show trends in resistance to a drug/bug combination in the ARHAI primary data set at hospital level, across time. The tables use a colour gradation based on the lowest resistance to the highest resistance figures, to highlight local patterns of resistance across time.

Table 26: Trends in penicillin resistance for *S. pneumoniae* (2010-2015)

| Hospital Cod.. | PEN | | | | | |
	2010	2011	2012	2013	2014	2015
A (6)						
B (19)	0.0	0.0	0.0	0.0	0.0	0.0
C (19)	0.0	0.0	0.0	0.0	5.9	5.9
D (39)	2.6	5.1	5.9	3.0	2.6	11.4
E (10)	0.0			7.7		0.0
F (34)	0.0	2.9	7.7	14.7	11.5	14.6
G (14)	0.0	0.0	0.0		0.0	0.0
H (21)	0.0	4.8	0.0	0.0	0.0	9.5
J (18)	0.0	0.0	0.0		0.0	0.0
K (18)	0.0	9.1	6.3	21.4	5.3	0.0
L (24)	0.0	0.0	0.0	0.0	11.1	3.6
M (18)	4.8		0.0	0.0	7.7	0.0
N (17)	0.0	0.0	0.0	5.6	0.0	5.6
P (13)	5.9	5.6	0.0			0.0
R (7)					0.0	16.7
S (23)	4.5	0.0	3.4	4.3	0.0	0.0

AB Code / Year

%R 0.0 ▭▭▭▭▭ 21.4

Key:
A= Bronglais
B = Princess of Wales
C = Royal Glamorgan
D = Royal Gwent
E = Morriston
F = UHW
G = Withybush
H = Wrexham Maelor
J = Glangwili
K = Ysbyty Gwynedd
L = Ysbyty Glan Clwyd
M = Nevill Hall
N = Prince Charles
P = UHL
S = Singleton

Section 5.2: 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*
- *Serratia*
- *Yersinia*

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 27: Community Urinary Coliforms

Community Urinary Coliforms (*including E.coli and Proteus spp.*)									
Resistance rates including (95% Confidence Intervals)									
Duplicate Cut Off: ≤14 days									
Time period: 1 January - 31 December 2015									
Location Code (Number)	AMO	(95% CI)	COA	(95% CI)	IGC	(95% CI)	3GC	(95% CI)
A (n=2,407)	47.9	(45.9, 49.8)	8.2	(7.1, 9.3)	6.9	(6.0, 8.0)	5.2	(4.4, 6.2)
B (n=414)	61.4	(56.6, 65.9)	23.9	(20.1, 28.2)	11.6	(8.9, 15.0)	7.8	(5.6, 10.8)
C (n=4,341)	57.1	(55.7, 58.5)	18.9	(17.9, 20.1)	8.5	(7.7, 9.4)	6.5	(5.8, 7.2)
D (n=11,200)	55.5	(54.6, 56.4)	15.8	(15.1, 16.4)	8.2	(7.7, 8.7)	7.7	(7.3, 8.2)
E (n=526)	59.8	(55.6, 63.9)	24.8	(21.3, 28.7)	15.4	(12.6, 18.7)	11.0	(8.6, 14.0)
F (n=8,660)	55.2	(54.2, 56.3)	19.0	(18.2, 19.8)	11.3	(10.7, 12.0)	9.9	(9.3, 10.6)
G (n=3,104)	53.8	(52.1, 55.4)	14.1	(13.0, 15.3)	7.6	(6.8, 8.6)	4.8	(4.1, 5.6)
H (n=4,942)	58.9	(57.5, 60.3)	10.3	(9.4, 11.1)	10.3	(9.5, 11.2)	7.6	(6.8, 8.3)
J (n=6,132)	52.5	(51.2, 53.7)	11.4	(10.7, 12.2)	8.1	(7.4, 8.8)	6.5	(5.9, 7.1)
K (n=6,107)	57.6	(56.3, 58.8)	13.8	(13.0, 14.7)	13.1	(12.2, 13.9)	8.4	(7.7, 9.1)
L (n=16,200)	57.1	(56.3, 57.8)	11.9	(11.4, 12.4)	11.8	(11.4, 12.4)	8.4	(7.9, 8.8)
M (n=129)	53.5	(48.5, 58.3)	16.4	(13.0, 20.4)			5.1	(3.4, 7.8)
N (n=1,934)	57.9	(55.9, 60.0)	19.6	(18.0, 21.3)	9.1	(7.9, 10.5)	6.1	(5.2, 7.2)
P (n=73)	67.7	(62.1, 72.9)	29.8	(24.8, 35.4)			17.0	(13.1, 21.8)
R (199)	60.6	(54.6, 66.3)	15.9	(12.0, 20.8)			8.0	(5.3, 11.9)
S (12,825)	57.7	(56.8, 58.5)	18.2	(17.6, 18.9)	9.6	(9.1, 10.1)	6.9	(6.4, 7.3)
T (n=73)	68.5	(57.1, 78.0)	26.0	(17.3, 37.1)	17.8	(10.7, 28.1)	9.6	(4.7, 18.5)
All-Wales: Resistance rates	56.2	(55.9, 56.6)	15.1	(14.8, 15.3)	10.1	(9.9, 10.3)	7.6	(7.4, 7.8)
All-Wales: Number of isolates	82,229		82,220		79,266		82,025	
Location Code (Number)	FQ	(95% CI)	NIT	(95% CI)	TRI	(95% CI)		
A (n=2,407)	7.6	(6.6, 8.7)	6.9	(6.0, 8.0)	33.6	(31.8, 35.5)		
B (n=414)	11.8	(9.1, 15.3)	14.3	(11.2, 17.9)	37.7	(33.1, 42.4)		
C (n=4,341)	9.1	(8.3, 9.9)	9.3	(8.5, 10.2)	39.4	(38.1, 40.8)		
D (n=11,200)	9.7	(9.2, 10.2)	11.2	(10.7, 11.8)	37.9	(37.0, 38.7)		
E (n=526)	12.3	(9.8, 15.4)	11.0	(8.6, 14.0)	37.5	(33.5, 41.7)		
F (n=8,660)	13.0	(12.3, 13.7)	8.7	(8.1, 9.3)	41.4	(40.4, 42.5)		
G (n=3,104)	8.7	(7.8, 9.7)	9.8	(8.9, 10.8)	34.5	(32.9, 36.1)		
H (n=4,942)	10.8	(9.9, 11.7)	8.5	(7.8, 9.3)	36.8	(35.5, 38.1)		
J (n=6,132)	8.2	(7.6, 8.9)	11.3	(10.6, 12.2)	37.5	(36.3, 38.7)		
K (n=6,107)	11.6	(10.8, 12.5)	14.8	(13.9, 15.7)	38.3	(37.1, 39.5)		
L (n=16,200)	11.0	(10.6, 11.5)	12.7	(12.2, 13.2)	39.0	(38.3, 39.8)		
M (n=129)	8.4	(6.1, 11.6)	14.1	(11.0, 17.9)	32.2	(27.8, 37.0)		
N (n=1,934)	9.2	(8.0, 10.5)	8.3	(7.2, 9.5)	37.0	(35.0, 39.0)		
P (n=73)	23.8	(19.2, 29.1)	12.1	(8.8, 16.4)	50.7	(44.9, 56.5)		
R (199)	15.2	(11.3, 20.0)	16.3	(12.3, 21.2)	42.0	(36.2, 48.1)		
S (12,825)	10.0	(9.5, 10.5)	10.0	(9.5, 10.5)	37.3	(36.5, 38.2)		
T (n=73)	17.8	(10.7, 28.1)	15.1	(8.6, 25.0)	42.5	(31.8, 53.9)		
All-Wales: Resistance rates	10.4	(10.2, 10.6)	10.8	(10.6, 11.1)	38.2	(37.8, 38.5)		
All-Wales: Number of isolates	82,011		82,071		82,140			

Key: **AMO** = amoxicillin, **COA** = co-amoxiclav, **1GC** = first generation cephalosporin, **3GC** = third generation cephalosporin (cefpodoxime),
FQ = ciprofloxacin &/or levofloaxcin, or norfloxacin, NIT = nitrofurantoin, TRI = trimrthoprim

Note: The range of resistance is outlined with boxes e.g. the range of resistance to amoxicillin was 47.9% - 68.5%; individual hospital rates statistically higher than the All-Wales rate are highlighted in colour. Note: Patients attending A&E are included in the community data set.

Table 28: Hospital Out-Patient Urinary Coliforms

Out Patient Urinary Coliforms (*including E.coli and Proteus spp.*)
Resistance rates including (95% Confidence Intervals)
Duplicate Cut Off: ≤14 days
Time period: 1 January - 31 December 2015

Location Code (Number)	AMO	(95% CI)	COA	(95% CI)	IGC	(95% CI)	3GC	(95% CI)
A (n=80)	35.3	(26.0, 45.9)	1.2	(0.2, 6.4)	1.3	(0.2, 6.7)	1.2	(0.2, 6.4)
B (n=342)	53.6	(48.4, 58.9)	18.7	(14.9, 23.1)	8.2	(5.7, 11.6)	5.2	(3.3, 8.1)
C (n=225)	49.1	(43.3, 55.0)	14.1	(10.5, 18.7)	10.2	(6.9, 14.9)	5.5	(3.4, 8.9)
D (n=412)	53.3	(50.6, 56.1)	13.7	(12.0, 15.7)			7.1	(5.8, 8.6)
E (n=418)	64.0	(59.3, 68.4)	26.5	(22.5, 30.9)	16.7	(13.5, 20.6)	13.9	(10.9, 17.6)
F (n=909)	59.4	(56.7, 62.1)	22.9	(20.7, 25.3)			11.6	(10.0, 13.4)
G (n=264)	47.1	(41.5, 52.8)	11.9	(8.7, 16.1)	6.4	(4.1, 10.1)	3.4	(1.9, 6.1)
H (n=514)	54.7	(50.3, 58.9)	9.7	(7.5, 12.6)	11.1	(8.7, 14.1)	8.2	(6.1, 10.9)
J (n=346)	51.4	(46.5, 56.2)	9.5	(7.0, 12.8)	6.6	(4.5, 9.8)	6.3	(4.3, 9.1)
K (n=287)	58.8	(53.0, 64.3)	15.8	(12.1, 20.4)	14.6	(11.0, 19.2)	7.9	(5.3, 11.6)
L (n=1,375)	57.4	(54.9, 60.0)	13.9	(12.2, 15.7)	14.8	(13.0, 16.7)	8.8	(7.4, 10.3)
M (n=64)	52.8	(45.8, 59.6)	13.7	(9.6, 19.2)			5.1	(2.8, 9.1)
N (n=178)	49.6	(43.4, 55.8)	13.3	(9.6, 18.1)			3.7	(2.0, 6.9)
P (n=223)	50.7	(44.8, 56.7)	17.0	(13.0, 22.0)	15.2	(11.1, 20.6)	13.4	(9.8, 18.0)
Q (n=79)	68.3	(57.6, 77.4)	23.2	(15.4, 33.4)	16.5	(9.9, 26.1)	15.9	(9.5, 25.3)
R (n=148)	53.0	(45.4, 60.4)	14.9	(10.3, 21.0)	12.2	(7.8, 18.4)	8.9	(5.5, 14.2)
S (n=202)	49.5	(42.7, 56.3)	12.9	(8.9, 18.2)	6.4	(3.8, 10.7)	4.5	(2.4, 8.3)
T (n=321)	55.8	(50.3, 61.1)	15.3	(11.7, 19.6)	7.8	(5.3, 11.2)	5.0	(3.1, 7.9)
All-Wales: Resistance rates	55.2	(54.1, 56.3)	15.8	(15.0, 16.6)	12.7	(11.9, 13.5)	8.3	(7.7, 8.9)
All-Wales: Number of isolates	8,266		8,266		6,513		8,240	

Location Code (Number)	FQ	(95% CI)	NIT	(95% CI)	TRI	(95% CI)
A (n=80)	2.4	(0.6, 8.2)	8.2	(4.0, 16.0)	31.8	(22.8, 42.3)
B (n=342)	8.2	(5.7, 11.5)	8.7	(6.2, 12.2)	33.6	(28.8, 38.8)
C (n=225)	7.9	(5.3, 11.7)	12.0	(8.7, 16.4)	29.3	(24.3, 35.0)
D (n=412)	9.4	(7.9, 11.2)	12.6	(10.9, 14.5)	34.8	(32.3, 37.5)
E (n=418)	17.2	(13.9, 21.1)	10.8	(8.2, 14.1)	35.2	(30.7, 39.9)
F (n=909)	16.8	(14.9, 18.9)	10.6	(9.0, 12.4)	42.6	(39.3, 45.3)
G (n=264)	9.2	(6.4, 13.0)	13.6	(10.2, 18.0)	27.6	(22.8, 32.9)
H (n=514)	12.7	(10.1, 15.8)	9.5	(7.3, 12.4)	33.5	(29.5, 37.7)
J (n=346)	8.5	(6.2, 11.7)	11.8	(9.0, 15.3)	31.8	(27.5, 36.6)
K (n=287)	14.4	(10.9, 18.9)	15.8	(12.1, 20.4)	30.9	(25.9, 36.5)
L (n=1,375)	11.0	(9.5, 12.8)	16.7	(14.8, 18.7)	32.5	(30.1, 34.9)
M (n=64)	8.6	(5.5, 13.4)	10.7	(7.1, 15.7)	24.9	(19.4, 31.4)
N (n=178)	6.5	(4.0, 10.2)	8.6	(5.7, 12.8)	32.5	(27.0, 38.6)
P (n=223)	13.0	(9.5, 17.6)	5.6	(3.4, 9.0)	32.7	(27.4, 38.5)
Q (n=79)	12.2	(6.8, 21.0)	8.5	(4.2, 16.6)	48.8	(38.3, 59.4)
R (n=148)	7.1	(4.1, 12.1)	17.3	(12.3, 23.7)	38.7	(31.7, 46.2)
S (n=202)	7.4	(4.6, 11.9)	5.9	(3.4, 10.1)	30.8	(24.9, 37.5)
T (n=321)	10.9	(7.9, 14.8)	8.7	(6.1, 12.3)	28.0	(23.4, 33.2)
All-Wales: Resistance rates	11.4	(10.8, 12.2)	11.9	(11.2, 12.6)	34.4	(33.4, 35.4)
All-Wales: Number of isolates	8,254		8,251		8,254	

Key: AMO = amoxicillin, **COA** = co-amoxiclav, **1GC** = first generation cephalosporin, **3GC** = third generation cephalosporin (cefpodoxime),
FQ = ciprofloxacin &/or levofloaxcin, or norfloxacin, **NIT** = nitrofurantoin, **TRI** = trimrthoprim

The resistance rates for out-patient urinary coliforms for Morriston (E), UHW (F) and Velindre (Q) were statistically higher than the All-Wales rate for the agents as shown. **Note**: Individual hospital or laboratory resistance rates are only presented for organisms where ≥80%; when the All-Wales testing rate is <80% the figure is shown in **red**.

Table 29: Hospital In-Patient Urinary Coliforms

In Patient Urinary Coliforms (*including E.coli and Proteus spp.*)						
Resistance rates including (95% Confidence Intervals)						
Duplicate Cut Off: ≤14 days						
Time period: 1 January - 31 December 2015						
Location Code (Number)	AMO	(95% CI)	COA	(95% CI)	3GC	(95% CI)
A (n=171)	59.1	(51.6, 66.2)	11.7	(7.7, 17.4)	11.3	(7.5, 16.6)
B (n=942)	64.0	(60.9, 67.0)	23.9	(21.3, 26.7)	9.2	(7.2, 11.7)
C (n=652)	60.4	(56.6, 64.1)	22.2	(19.2, 25.6)	7.3	(5.7, 9.5)
D (n=2,086)	55.9	(53.8, 58.0)	16.9	(15.3, 18.5)	7.5	(6.4, 8.8)
E (n=1,304)	64.7	(62.1, 67.3)	26.9	(24.6, 29.4)	13.9	(11.9, 16.1)
F (n=1,849)	64.1	(61.9, 66.3)	29.5	(27.4, 31.6)	11.8	(10.4, 13.4)
G (n=383)	55.1	(50.1, 60.0)	18.5	(15.0, 22.7)	2.9	(1.7, 4.9)
H (n=1,895)	66.3	(64.1, 68.4)	15.8	(14.2, 17.5)	14.3	(11.2, 18.1)
J (n=443)	58.5	(53.8, 63.0)	14.2	(11.3, 17.8)	7.8	(5.8, 10.4)
K (n=680)	64.0	(60.3, 67.5)	19.1	(16.3, 22.2)	11.9	(10.3, 13.6)
L (n=1,550)	61.4	(58.9, 63.7)	16.3	(14.6, 18.2)	12.0	(10.3, 14.0)
M (n=803)	60.3	(56.8, 63.6)	20.7	(18.0, 23.6)	6.0	(4.5, 7.9)
N (n=416)	58.4	(53.6, 63.1)	21.6	(17.9, 25.8)	5.0	(3.4, 7.3)
P (n=546)	63.7	(59.6, 67.7)	36.6	(32.7, 40.8)	17.9	(15.1, 21.1)
Q (n=67)	62.7	(50.7, 73.3)	25.4	(16.5, 36.9)	7.1	(3.3, 14.7)
R (n=203)	62.6	(55.7, 68.9)	18.7	(14.0, 24.6)	9.6	(6.3, 14.3)
S (n=482)	66.4	(62.1, 70.5)	29.0	(25.2, 33.3)	12.9	(10.1, 16.3)
T (n=328)	72.6	(67.5, 77.1)	32.0	(27.2, 37.2)	20.0	(11.2, 33.0)
All-Wales: Resistance rates	62.3	(61.5, 63.0)	21.8	(21.1, 22.5)	10.4	(9.9, 10.9)
All-Wales: Number of isolates	14,875		14,874		13,218	
Location Code (Number)	FQ	(95% CI)	NIT	(95% CI)	TRI	(95% CI)
A (n=171)	8.8	(5.4, 14.0)	12.9	(8.7, 18.7)	36.3	(29.4, 43.7)
B (n=942)	14.6	(12.5, 17.0)	15.1	(12.9, 17.5)	40.4	(37.4, 43.6)
C (n=652)	13.2	(10.8, 16.0)	16.6	(13.9, 19.7)	42.9	(39.2, 46.8)
D (n=2,086)	11.4	(10.1, 12.8)	13.9	(12.4, 15.4)	36.1	(34.1, 38.2)
E (n=1,304)	13.8	(12.0, 15.8)	16.6	(14.6, 18.7)	37.5	(34.9, 40.1)
F (n=1,849)	20.8	(19.0, 22.7)	13.4	(11.9, 15.0)	44.8	(42.5, 47.1)
G (n=383)	9.4	(6.9, 12.7)	18.4	(14.8, 22.6)	31.8	(27.3, 36.6)
H (n=1,895)	16.5	(14.9, 18.2)	15.9	(14.3, 17.6)	42.3	(40.1, 44.6)
J (n=443)	10.4	(7.9, 13.6)	17.2	(13.9, 20.9)	33.0	(28.7, 37.5)
K (n=680)	12.2	(10.0, 14.9)	20.1	(17.3, 23.3)	34.4	(30.9, 38.1)
L (n=1,550)	14.3	(12.6, 16.2)	18.1	(16.3, 20.1)	40.5	(38.0, 42.9)
M (n=803)	10.3	(8.4, 12.6)	15.6	(13.2, 18.2)	34.9	(31.7, 38.2)
N (n=416)	11.6	(8.8, 15.0)	15.9	(12.7, 19.8)	43.0	(38.4, 47.8)
P (n=546)	28.2	(24.6, 32.1)	14.8	(12.1, 18.1)	53.4	(49.2, 57.5)
Q (n=67)	17.9	(10.6, 28.7)	13.4	(7.2, 23.6)	37.3	(26.7, 49.3)
R (n=203)	14.3	(10.1, 19.8)	17.2	(12.7, 23.0)	39.9	(33.4, 46.8)
S (n=482)	17.5	(14.3, 21.1)	17.6	(14.5, 21.3)	44.0	(39.6, 48.4)
T (n=328)	22.0	(17.8, 26.7)	13.5	(10.2, 17.6)	46.5	(41.1, 51.9)
All-Wales: Resistance rates	15.1	(14.5, 15.6)	15.8	(15.2, 16.4)	40.3	(39.5, 41.1)
All-Wales: Number of isolates	14,837		14,838		14,848	

Key: **AMO** = amoxicillin, **COA** = co-amoxiclav, **1GC** = first generation cephalosporin, **3GC** = third generation cephalosporin (cefpodoxime), **FQ** = ciprofloxacin &/or levofloaxcin, or norfloxacin, **NIT** = nitrofurantoin, **TRI** = trimrthoprim

In 2015, the All-Wales resistance rates for in-patients urinary coliforms were statistically higher for all the agents listed than those for community or out-patients (**Tables 27, 28 & 29**). In 2015, a number of hospitals had resistance rates for urinary coliforms that were statistically higher than the All-Wales rate; the most notable was Neath Port Talbot (T).

Community Urinary Coliforms (n=82,233 in 2015)

The All-Wales pattern of antimicrobial resistance for community urinary coliforms is shown in **Figure 12 & Table 27**.

	1GC	3GC	AMO	COA	FQ	NIT	TRI
2006	7.9	3.9	52.5	10.8	7.0	11.6	29.0
2007	9.4	4.4	53.1	12.3	8.0	11.3	30.5
2008	9.8	4.7	56.0	12.9	9.1	11.1	30.7
2009	10.2	4.7	57.0	14.0	9.5	10.8	30.9
2010	10.1	4.8	57.3	14.6	9.7	10.3	31.5
2011	9.8	4.3	58.4	17.2	9.9	10.7	32.5
2012	9.3	4.0	57.9	12.3	9.9	11.1	34.0
2013	9.8	5.0	57.6	10.5	9.8	11.8	34.8
2014	10.3	6.8	56.9	12.9	10.2	10.9	36.7
2015	10.1	7.6	56.2	15.1	10.4	10.8	38.2

Figure 12: All-Wales antimicrobial resistance rates for coliforms from community urine samples (2006 to 2015)

There has been a statistically significant increase in resistance to third generation cephalosporins, fluoroquinolones and trimethoprim across time. Co-amoxiclav resistance decreased in 2013, but has increased again in 2014 and 2015.

Figure 13 over page shows antimicrobial resistance in the 65-79 and 80+ age groups by gender for 2015. Resistance to trimethoprim has increased over time, with high resistance noted in the 80+ age group (47.8% in females and 47.5% in males). Whilst resistance to trimethoprim continues to rise the high rates of resistance may reflect an element of selective testing within the community. The true rate of resistance to trimethoprim in patients presenting with uncomplicated UTI in the community is likely to be considerably lower, and trimethoprim remains the suggested first-line empirical therapy for most of these patients.

However, in the elderly, or patients who have received antibiotics within the last 3 months, the likelihood of infection with a resistant organism is higher, and an alternative antibiotic should be considered. Alternatives include:
- o Nitrofurantoin 100mg m/r BD for 3 days in women and 7 days in men (not recommended if renal impairment with GFR <60mL/min).
- o Co-amoxiclav 625mg TDS for 3 days in women and 7 days in men.
- o Pivmecillinam 400mg initially, then 200mg TDS for 3 days in women and 7 days in men.

Figure 13: All-Wales trimethoprim resistance rates for coliforms from community urine samples from the elderly by age group and gender (2015)

	3GC	COA	FQ	NIT	TRI
65-79 F	7.2	14.8	10.1	5.2	37.5
80+ F	11.9	20.8	17.3	8.3	47.9
65-79 M	11.6	22.7	15.2	10.5	37.3
80+ M	14.5	25.8	19.7	13.5	47.5

Antibacterial
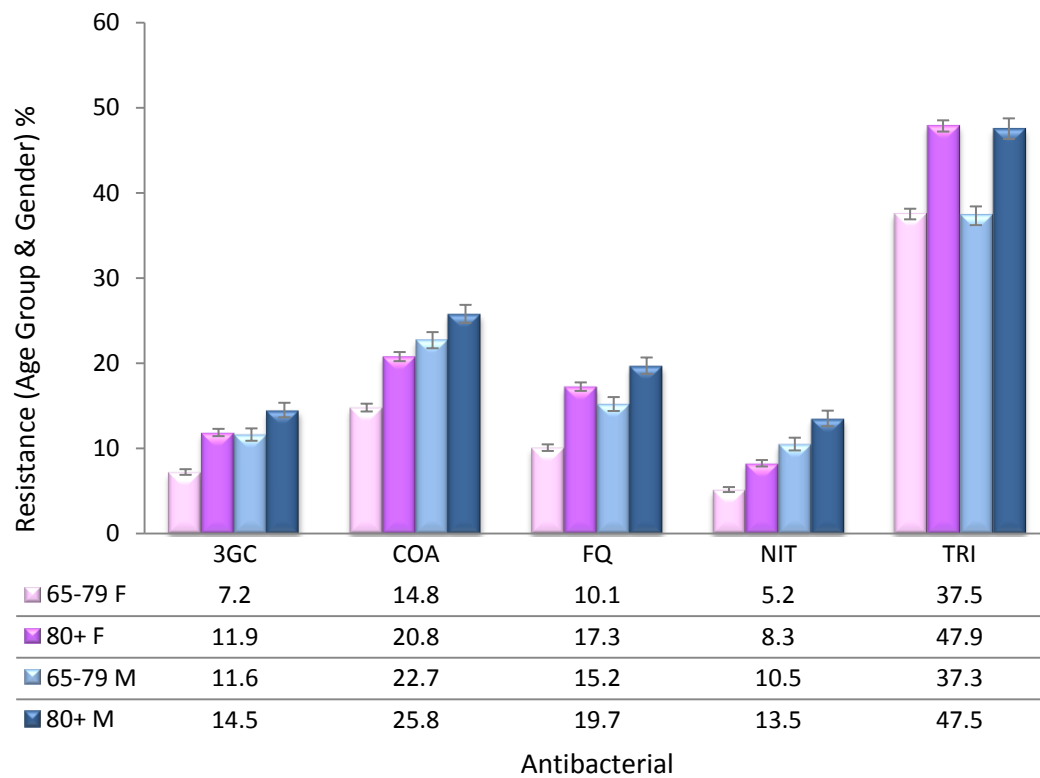
Out-patient Urinary Coliforms (n=8,266 in 2015)

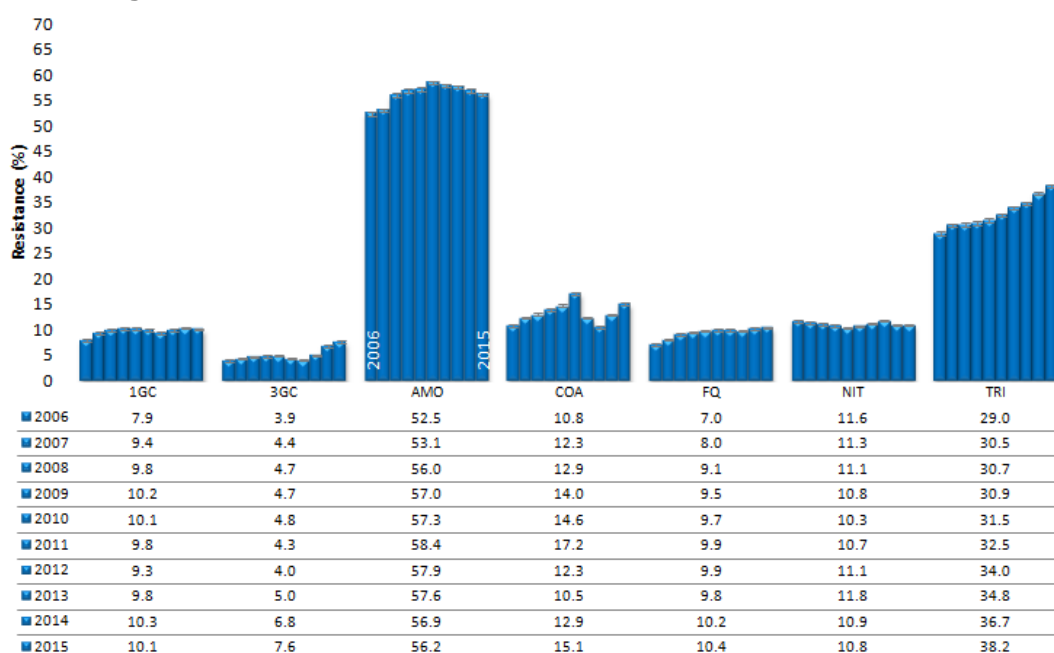The All-Wales pattern of antimicrobial resistance for out-patient urinary coliforms is shown in **Figure 14 & Table 28**. There has been a statistically significant increase in trimethoprim resistance across time, from 27.9% in 2006 to 34.4% in 2015.

	1GC	3GC	AMO	COA	FQ	NIT	TRI
2006	9.4	6.1	53.9	12.5	8.7	13.4	27.9
2007	12.2	7.2	55.2	15.8	10.4	14.6	30.5
2008	11.8	6.9	56.8	14.7	11.4	13.8	29.3
2009	10.9	5.1	57.3	14.7	9.2	12.3	28.6
2010	10.6	5.0	57.7	15.2	10.2	11.0	29.7
2011	10.6	4.7	58.5	17.1	11.0	11.6	30.1
2012	10.8	4.3	58.3	13.6	10.5	11.9	29.8
2013	11.8	5.5	59.4	11.9	11.0	12.9	31.3
2014	13.0	7.5	57.3	14.1	11.1	12.0	33.4
2015	12.7	8.3	55.2	15.8	11.4	11.9	34.4
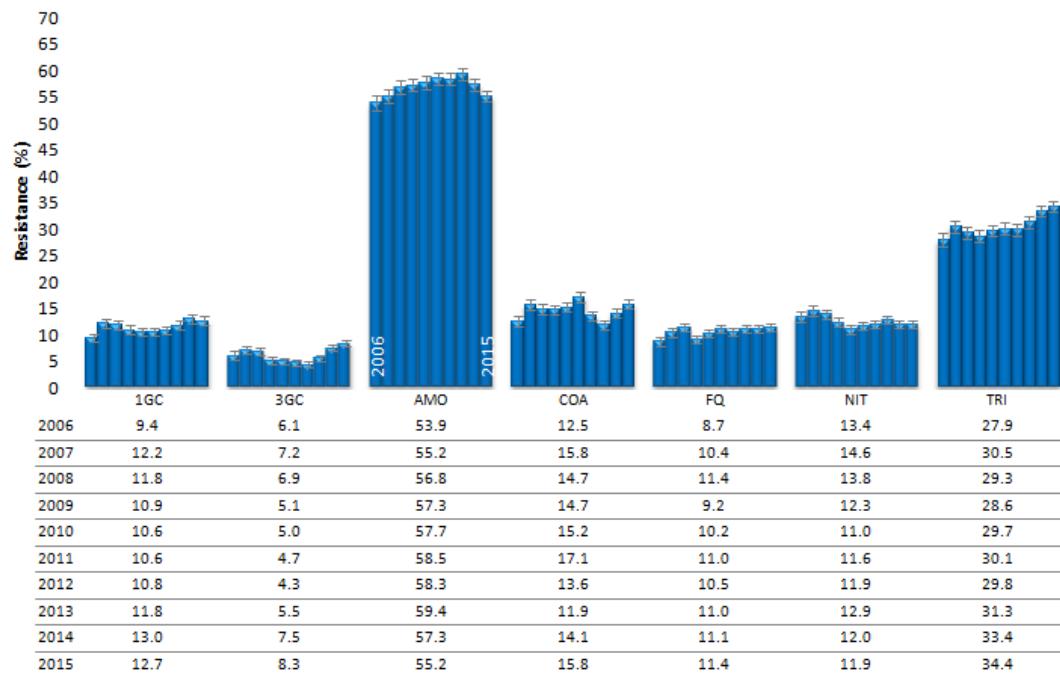
Figure 14: All-Wales antimicrobial resistance rates for coliforms from out-patient urine samples (2006 to 2015)

In-patient Urinary Coliforms (n=14,879 in 2015)

The All-Wales pattern of antimicrobial resistance for in-patient urinary coliforms is shown in **Figure 15 & Table 29**. There has been a statistically significant increase in trimethoprim resistance across time, from 32.3% in 2006 to 40.3% in 2015.

	3GC	AMO	COA	FQ	NIT	TRI
2006	10.5	59.6	18.6	14.0	18.3	32.3
2007	11.5	61.0	21.8	15.6	17.6	33.7
2008	10.1	63.3	21.5	15.5	17.6	34.2
2009	9.0	65.3	21.9	15.2	17.2	33.9
2010	7.9	65.3	21.7	14.5	16.6	34.1
2011	6.9	66.7	24.4	15.5	15.4	35.7
2012	6.2	66.2	18.0	14.4	15.4	36.7
2013	7.6	65.7	17.4	14.1	17.5	37.6
2014	10.4	63.5	20.7	15.1	16.4	39.1
2015	11.6	62.3	21.8	15.1	15.8	40.3
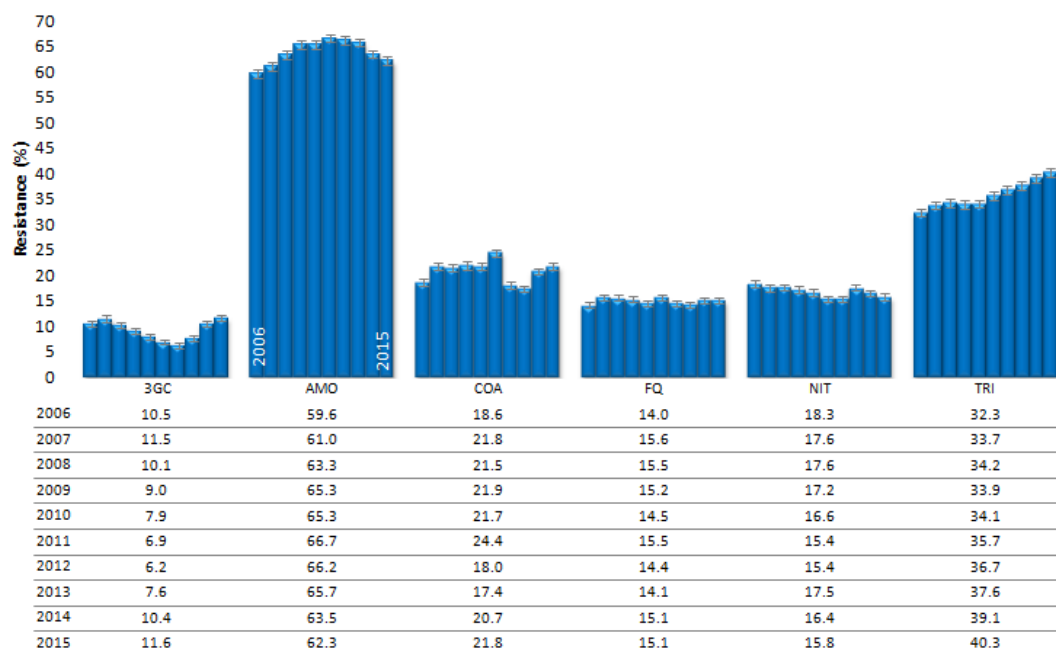
Figure 15: All-Wales antimicrobial resistance rates for coliforms from in-patient urine samples (2006 to 2015)

Section 5.3: Antimicrobial resistance rates for *Staphylococcus aureus*

The data in this section is presented to reflect the antimicrobial susceptibility of organisms causing skin and soft tissue infections occurring in the community, and is based on the specimen description 'wound swab'. However, it should be noted that there is a significant sampling bias in this data. Royal Gwent and Nevill Hall are not included in the MSSA or MRSA data sets as they do not use the specimen type description 'wound swab' in their laboratory management systems.

Tables 30: Meticillin Sensitive *Staphylococcus aureus* (MSSA) from community wound swabs

Meticillin Sensitive *Staphylococcus aureus* from community wound swabs
Resistance rates including (95% Confidence Intervals)
Duplicate Cut Off: ≤14 days
Time period: 1 January - 31 December 2015

Location Code (Number)	CLI	(95% CI)	ERY	(95% CI)	FUS	(95% CI)	TET	(95% CI)
A (n=611)	16.0	(13.3, 19.2)	17.7	(14.9, 20.9)	12.3	(9.9, 15.1)	8.8	(6.8, 11.4)
B (n=64)	12.5	(6.5, 22.8)	17.2	(9.9, 28.2)	11.1	(5.5, 21.2)	3.1	(0.9, 10.7)
C (n=751)	7.1	(5.4, 9.1)	15.8	(13.4, 18.6)	16.8	(14.3, 19.6)	8.4	(6.6, 10.6)
D (n=3,209)	11.9	(10.9, 13.1)	17.0	(15.8, 18.4)	14.7	(13.5, 15.9)	5.7	(5.0, 6.6)
E (n=102)	15.7	(9.9, 24.0)	18.6	(12.3, 27.3)	9.7	(5.2, 17.4)	1.9	(0.5, 6.8)
F (n=1,670)	15.4	(13.7, 17.2)	17.3	(15.6, 19.2)	13.5	(12.0, 15.2)	6.1	(5.1, 7.4)
G (n=566)	14.3	(11.7, 17.4)	23.3	(20.0, 27.0)	11.5	(9.1, 14.4)	8.8	(6.8, 11.6)
H (n=935)	12.6	(10.6, 14.9)	14.4	(12.3, 16.8)	16.3	(14.0, 18.8)	5.0	(3.8, 6.6)
J (n=1,220)	12.8	(11.0, 14.8)	15.2	(13.2, 17.3)	11.3	(9.7, 13.2)	5.6	(4.4, 7.0)
K (n=1,168)	15.8	(13.9, 18.0)	17.6	(15.5, 19.8)	17.3	(15.2, 19.6)	8.3	(6.9, 10.0)
L (n=1,080)	16.1	(14.0, 18.4)	18.7	(16.5, 21.1)	18.5	(16.3, 21.0)	6.4	(5.1, 8.0)
M (n=46)	6.5	(2.2, 17.5)	8.7	(3.4, 20.3)	21.7	(12.3, 35.6)	8.7	(3.4, 20.3)
N (n=447)	5.4	(3.6, 7.9)	16.7	(13.6, 20.5)	12.5	(9.8, 15.9)	6.5	(4.5, 9.1)
P (n=76)	17.1	(10.3, 27.1)	18.4	(11.3, 28.6)	18.4	(11.3, 28.6)	7.9	(3.7, 16.2)
R (n=60)	11.7	(5.8, 22.2)	15.0	(8.1, 26.1)	23.3	(14.4, 35.4)	0.0	(0.0, 6.0)
S (n=3,150)	14.1	(12.9, 15.3)	17.9	(16.6, 19.2)	16.2	(14.9, 17.6)	4.1	(3.4, 4.8)
All-Wales: Resistance rates	13.3	(12.8, 13.9)	17.3	(16.7, 17.9)	15.0	(14.4, 15.6)	6.0	(5.6, 6.3)
All-Wales: Number of isolates	15,161		15,170		15,007		15,167	

Key: **CLI** = clindamycin, **ERY** = erythromycin, **FUS** = fusidic acid, **TET** = tetracycline

Tables 31: Meticillin Sensitive *Staphylococcus aureus* (MSSA) from in-patient wound swabs

Meticillin Sensitive *Staphylococcus aureus* from In-Patient wound swabs
Resistance rates including (95% Confidence Intervals)
Duplicate Cut Off: ≤14 days
Time period: 1 January - 31 December 2015

Location Code (Number)	CLI	(95% CI)	ERY	(95% CI)	FUS	(95% CI)	TET	(95% CI)
A (n=40)	10.0	(4.0, 23.1)	10.0	(4.0, 23.1)	7.5	(2.6, 19.9)	10.0	(4.0, 23.1)
B (n=218)	4.1	(2.2, 7.7)	7.8	(4.9, 12.1)	16.1	(11.8, 21.5)	1.8	(0.7, 4.6)
C (n=156)	5.8	(3.1, 10.6)	14.7	(10.0, 21.2)	14.1	(9.5, 20.4)	6.4	(3.5, 11.4)
D (n=577)	10.6	(8.3, 13.3)	14.7	(12.1, 17.9)	15.4	(12.7, 18.6)	5.5	(4.0, 7.7)
E (n=507)	11.4	(9.0, 14.5)	13.6	(10.9, 16.9)	11.1	(8.6, 14.2)	3.6	(2.3, 5.5)
F (n=586)	11.3	(9.0, 14.1)	13.0	(10.5, 15.9)	11.6	(9.3, 14.5)	4.5	(3.1, 6.5)
G (n=80)	8.8	(4.3, 17.0)	17.5	(10.7, 27.3)	5.0	(2.0, 12.2)	2.5	(0.7, 8.7)
H (n=268)	13.8	(10.2, 18.5)	16.4	(12.5, 21.3)	13.1	(9.5, 17.6)	3.7	(2.0, 6.7)
J (n=160)	18.8	(13.5, 25.6)	20.6	(15.1, 27.5)	10.6	(6.7, 16.4)	8.8	(5.3, 14.2)
K (n=253)	12.6	(9.1, 17.3)	15.4	(11.5, 20.4)	16.2	(12.2, 21.2)	8.3	(5.5, 12.4)
L (n=217)	15.7	(11.4, 21.1)	17.5	(13.0, 23.1)	18.9	(14.2, 24.6)	6.0	(3.5, 10.0)
M (n=217)	9.2	(6.0, 13.8)	13.8	(9.9, 19.0)	12.0	(8.3, 17.0)	5.5	(3.2, 9.4)
N (n=127)	3.1	(1.2, 7.8)	15.0	(9.8, 22.2)	13.4	(8.5, 20.4)	4.7	(2.2, 9.9)
P (n=99)	22.2	(15.2, 31.4)	25.3	(17.7, 34.6)	16.2	(10.2, 24.7)	7.1	(3.5, 13.9)
Q (n=31)	6.5	(1.8, 20.7)	6.5	(1.8, 20.7)	12.9	(5.1, 28.9)	6.5	(1.8, 20.7)
R (n=46)	17.4	(9.1, 30.7)	21.7	(12.3, 35.6)	8.7	(3.4, 20.3)	2.2	(0.4, 11.3)
S (n=134)	14.2	(9.3, 21.1)	16.2	(10.9, 23.3)	9.7	(5.6, 16.2)	0.7	(0.1, 4.0)
T (n=78)	6.4	(2.8, 14.1)	7.7	(3.6, 15.8)	6.9	(3.0, 15.2)	3.8	(1.3, 10.7)
All-Wales: Resistance rates	11.3	(10.3, 12.3)	14.7	(13.6, 15.8)	13.1	(12.0, 14.2)	5.0	(4.3, 5.7)
All-Wales: Number of isolates	3,835		3,837		3,839		3,832	

Key: **CLI** = clindamycin, **ERY** = erythromycin, **FUS** = fusidic acid, **TET** = tetracycline

Table 32: Meticillin Sensitive *Staphylococcus aureus* (MSSA) from out-patient wound swabs

Meticillin Sensitive *Staphylococcus aureus* from Out-Patient wound swabs
Resistance rates including (95% Confidence Intervals)
Duplicate Cut Off: ≤14 days
Time period: 1 January - 31 December 2015

Location Code (Number)	CLI	(95% CI)	ERY	(95% CI)	FUS	(95% CI)	TET	(95% CI)
A (n=26)	15.4	(6.1, 33.5)	15.4	(6.1, 33.5)	3.8	(0.7, 18.9)	19.2	(8.5, 37.9)
B (n=86)	8.1	(4.0, 15.9)	10.5	(5.6, 18.7)	15.1	(9.1, 24.2)	3.5	(1.2, 9.8)
C (n=77)	6.5	(2.8, 14.3)	13.0	(7.2, 22.3)	19.5	(12.2, 29.7)	9.1	(4.5, 17.6)
D (n=447)	11.4	(8.8, 14.7)	15.7	(12.6, 19.3)	23.7	(20.0, 27.9)	4.3	(2.7, 6.5)
E (n=809)	9.5	(7.7, 11.7)	12.1	(10.0, 14.5)	11.5	(9.5, 14.0)	4.0	(2.8, 5.5)
F (n=414)	13.3	(10.4, 16.9)	16.4	(13.2, 20.3)	17.4	(14.0, 21.3)	4.0	(2.4, 6.3)
G (n=40)	12.5	(5.5, 26.1)	20.0	(10.5, 34.8)	17.5	(8.7, 32.0)	7.5	(2.6, 19.9)
H (n=174)	14.4	(9.9, 20.3)	17.2	(12.4, 23.5)	17.9	(12.9, 24.3)	5.2	(2.7, 9.5)
J (n=73)	15.1	(8.6, 25.0)	19.2	(11.8, 29.7)	13.7	(7.6, 23.4)	5.5	(2.2, 13.3)
K (n=189)	11.6	(7.8, 17.0)	13.8	(9.6, 19.4)	21.2	(15.9, 27.5)	11.1	(7.4, 16.4)
L (n=301)	14.6	(11.1, 19.1)	17.9	(14.0, 22.7)	19.6	(15.5, 24.5)	5.3	(3.3, 8.5)
M (n=102)	14.7	(9.1, 22.9)	20.6	(13.9, 29.4)	15.7	(9.9, 24.0)	2.0	(0.5, 6.9)
N (n=72)	5.6	(2.2, 13.4)	9.7	(4.8, 18.7)	23.6	(15.3, 34.6)	5.6	(2.2, 13.4)
P (n=66)	19.7	(11.9, 30.8)	21.2	(13.1, 32.5)	9.1	(4.2, 18.4)	0.0	(0.0, 5.5)
Q (n=32)	18.8	(8.9, 35.3)	25.0	(13.3, 42.1)	6.3	(1.7, 20.1)	0.0	(0.0, 10.7)
R (n=50)	12.0	(5.6, 23.8)	14.0	(7.0, 26.2)	14.0	(7.0, 26.2)	6.0	(2.1, 16.2)
S (n=164)	8.5	(5.2, 13.8)	9.8	(6.1, 15.3)	14.4	(9.7, 20.8)	5.5	(2.9, 10.1)
T (n=33)	3.0	(0.5, 15.3)	12.1	(4.8, 27.3)	6.7	(1.8, 21.3)	3.0	(0.5, 15.3)
All-Wales: Resistance rates	11.8	(10.7, 12.9)	15.0	(13.8, 16.3)	16.5	(15.3, 17.9)	5.0	(4.3, 5.8)
All-Wales: Number of isolates	3,119		3,199		3,137		3,190	

Key: **CLI** = clindamycin, **ERY** = erythromycin, **FUS** = fusidic acid, **TET** = tetracycline

MSSA (n=22,206 in 2015)

Community MSSA (n=15,171 in 2015)
The All-Wales pattern of antimicrobial resistance for MSSA from community wound swabs are shown in **Figure 16** and **Table 30** with a notable increase in trend for erythromycin resistance.
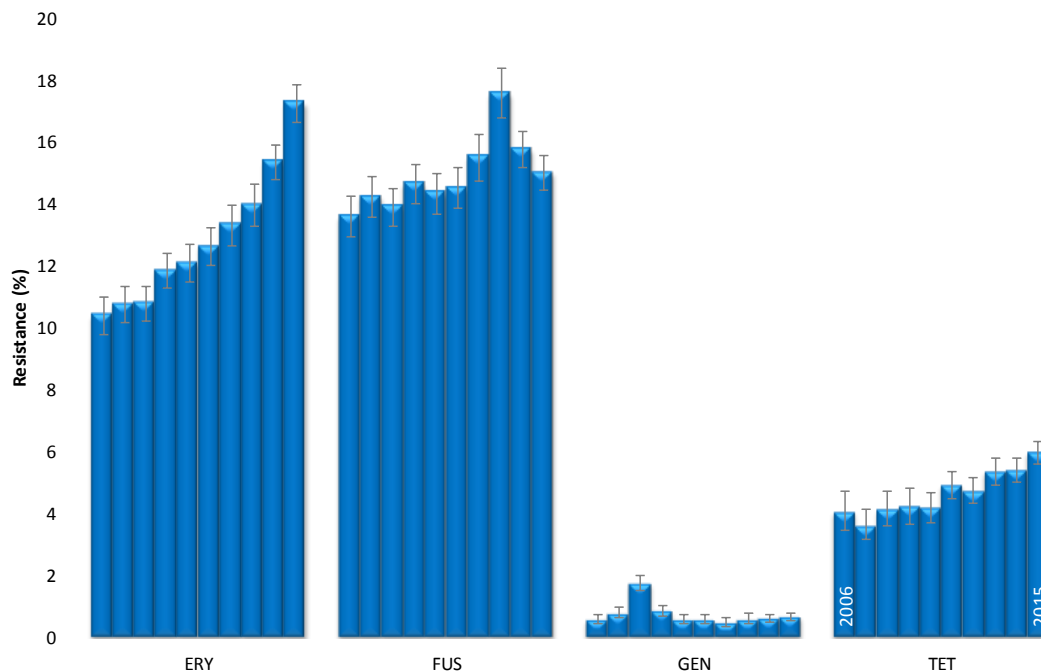

Figure 16: All-Wales antimicrobial resistance rates for MSSA from community Wound swabs (2006 to 2015)

In 2015, the All-Wales resistance rates for community, out-patients and in-patients MSSA were comparable for most of the antimicrobials listed: erythromycin (ERY), gentamicin (GEN), mupirocin (MUP), penicillin (PEN) and tetracycline (TET) see **Tables 30, 31** and **32**.

At different times in the ten year period 2006 to 2015, there were increases in resistance to different agents in different geographical areas, but there was no set pattern of increasing or high resistance in any particular community or hospital, and this probably reflects the varying presence of epidemic strains.

- Resistance to fusidic acid (FUS) was higher for out-patient MSSA compared to in-patient and community rates.
- Vancomycin resistance remained undetected in MSSA between 2006 & 2015.

Tables 33: Meticillin Resistant *Staphylococcus aureus* (MRSA) from community wound swabs

Meticillin Resistant *Staphylococcus aureus* from community wound swabs
Resistance rates including (95% Confidence Intervals)
Duplicate Cut Off: ≤14 days
Time period: 1 January - 31 December 2015

Location Code (Number)	CLI	(95% CI)	ERY	(95% CI)	FUS	(95% CI)	TET	(95% CI)
A (n=53)	58.5	(45.1, 70.7)	64.2	(50.7, 75.7)	15.1	(7.9, 27.1)	11.3	(5.3, 22.6)
C (n=79)	19.0	(11.9, 29.0)	63.3	(52.3, 73.1)	30.4	(21.3, 41.2)	24.1	(16.0, 34.5)
D (n=297)	54.5	(48.9, 60.1)	71.5	(66.1, 76.3)	15.4	(11.8, 20.0)	13.1	(9.7, 17.4)
F (n=192)	57.8	(50.7, 64.6)	61.5	(54.4, 68.1)	13.5	(9.4, 19.1)	18.8	(13.9, 24.9)
G (n=42)	47.6	(33.4, 62.3)	69.0	(54.0, 80.9)	7.1	(2.5, 19.0)	2.4	(0.4, 12.3)
H (n=119)	64.7	(55.8, 72.7)	70.6	(61.9, 78.0)	24.4	(17.5, 32.8)	34.5	(26.6, 43.4)
J (n=136)	54.4	(46.0, 62.5)	56.6	(48.2, 64.7)	9.6	(5.7, 15.7)	3.7	(1.6, 8.3)
K (n=201)	56.7	(49.8, 63.4)	67.2	(60.4, 73.3)	18.4	(13.7, 24.3)	15.9	(11.5, 21.6)
L (n=207)	64.3	(57.5, 70.5)	69.2	(62.7, 75.1)	39.4	(33.0, 46.2)	26.9	(21.4, 33.2)
N (n=56)	16.1	(8.7, 27.8)	66.1	(53.0, 77.1)	19.6	(11.3, 31.8)	17.9	(10.0, 29.8)
P (n=18)	72.2	(49.1, 87.5)	72.2	(49.1, 87.5)	27.8	(12.5, 50.9)	38.9	(20.3, 61.4)
S (n=258)	50.8	(44.7, 56.8)	60.5	(54.4, 66.2)	16.3	(12.2, 21.5)	5.8	(3.6, 9.4)
All-Wales: Resistance rates	53.6	(51.2, 56.0)	65.6	(63.3, 67.8)	19.6	(17.8, 21.6)	16.1	(14.4, 17.9)
All-Wales: Number of isolates	1,681		1,683		1,669		1,683	

Key: **CLI** = clindamycin, **ERY** = erythromycin, **FUS** = fusidic acid, **TET** = tetracycline

Tables 34: Meticillin Resistant *Staphylococcus aureus* (MRSA) from in-patient wound swabs

Meticillin Resistant *Staphylococcus aureus* from In-Patient wound swabs
Resistance rates including (95% Confidence Intervals)
Duplicate Cut Off: ≤14 days
Time period: 1 January - 31 December 2015

Location Code (Number)	CLI	(95% CI)	ERY	(95% CI)	FUS	(95% CI)	TET	(95% CI)
B (n=36)	58.3	(42.2, 72.9)	66.7	(50.3, 79.8)	13.9	(6.1, 28.7)	5.6	(1.5, 18.1)
C (n=20)	25.0	(11.2, 46.9)	55.0	(34.2, 74.2)	20.0	(8.1, 41.6)	30.0	(14.5, 51.9)
D (n=84)	59.5	(48.8, 69.4)	76.5	(66.4, 84.2)	10.7	(5.7, 19.1)	9.4	(4.8, 17.5)
E (n=56)	57.1	(44.1, 69.2)	62.5	(49.4, 74.0)	9.4	(4.1, 20.3)	8.9	(3.9, 19.3)
F (n=84)	53.6	(43.0, 63.8)	60.7	(50.0, 70.5)	8.3	(4.1, 16.2)	8.3	(4.1, 16.2)
G (n=15)	46.7	(24.8, 69.9)	66.7	(41.7, 84.8)	6.7	(1.2, 29.8)	6.7	(1.2, 29.8)
H (n=89)	82.0	(72.8, 88.6)	85.4	(76.6, 91.3)	31.5	(22.3, 41.7)	42.7	(32.9, 53.1)
J (n=22)	45.5	(26.9, 65.3)	45.5	(26.9, 65.3)	0.0	(0.0, 14.9)	9.1	(2.5, 27.8)
K (n=70)	71.4	(59.9, 80.7)	78.6	(67.6, 86.6)	10.0	(4.9, 19.2)	20.0	(12.3, 30.8)
L (n=63)	73.0	(61.0, 82.4)	76.6	(64.9, 85.3)	34.4	(23.9, 46.6)	32.8	(22.6, 45.0)
M (n=20)	80.0	(58.4, 91.9)	85.0	(64.0, 94.8)	0.0	(0.0, 16.1)	15.0	(5.2, 36.0)
N (n=15)	6.7	(1.2, 29.8)	46.7	(24.8, 69.9)	20.0	(7.0, 45.2)	6.7	(1.2, 29.8)
P (n=17)	52.9	(31.0, 73.8)	52.9	(31.0, 73.8)	11.8	(3.3, 34.3)	23.5	(9.6, 47.3)
S (n=10)	40.0	(16.8, 68.7)	60.0	(31.3, 83.2)	10.0	(1.8, 40.4)	0.0	(0.0, 27.8)
T (n=19)	42.1	(23.1, 63.7)	47.4	(27.3, 68.3)	35.3	(17.3, 58.7)	5.3	(0.9, 24.6)
All-Wales: Resistance rates	60.5	(56.6, 64.2)	69.2	(65.5, 72.6)	15.9	(13.2, 18.9)	17.8	(15.0, 20.9)
All-Wales: Number of isolates	640		642		636		642	

Key: **CLI** = clindamycin, **ERY** = erythromycin, **FUS** = fusidic acid, **TET** = tetracycline

Table 35: Meticillin Resistant *Staphylococcus aureus* (MRSA) from out-patient wound swabs

Meticillin Resistant *Staphylococcus aureus* from Out-Patient wound swabs
Resistance rates including (95% Confidence Intervals)
Duplicate Cut Off: ≤14 days
Time period: 1 January - 31 December 2015

Location Code (Number)	CLI	(95% CI)	ERY	(95% CI)	FUS	(95% CI)	TET	(95% CI)
D (n=21)	52.6	(31.7, 72.7)	73.7	(51.2, 88.2)	26.3	(11.8, 48.8)	15.8	(5.5, 37.6)
E (n=44)	34.6	(23.2, 48.2)	51.9	(38.7, 64.9)	19.6	(10.7, 33.2)	13.5	(6.7, 25.3)
F (n=32)	50.0	(33.2, 66.8)	53.3	(36.1, 69.8)	20.7	(9.8, 38.4)	26.7	(14.2, 44.4)
H (n=14)	80.0	(49.0, 94.3)	80.0	(49.0, 94.3)	30.0	(10.8, 60.3)	40.0	(16.8, 68.7)
K (n=45)	53.1	(36.4, 69.1)	59.4	(42.3, 74.5)	15.6	(6.9, 31.8)	34.4	(20.4, 51.7)
L (n=35)	61.2	(47.2, 73.6)	61.2	(47.2, 73.6)	36.7	(24.7, 50.7)	36.7	(24.7, 50.7)
All-Wales: Resistance rates	50.4	(44.2, 56.6)	60.2	(54.0, 66.2)	23.7	(18.7, 29.6)	23	(18.1, 28.6)
All-Wales: Number of isolates	244		244		244		244	

Key: **CLI** = clindamycin, **ERY** = erythromycin, **FUS** = fusidic acid, **TET** = tetracycline

There were no confirmed cases of vancomycin intermediate/resistant MRSA (VISA) between 2006 and 2015.

MRSA (n=2,603 in 2015)

Community MRSA (n=1,696 in 2015)
The All-Wales pattern of antimicrobial resistance for MRSA from community wound swabs is shown in **Figure 17** and **Table 33**, with no statistically significant changes in the resistance rates for any of the agents listed between 2014 and 2015.
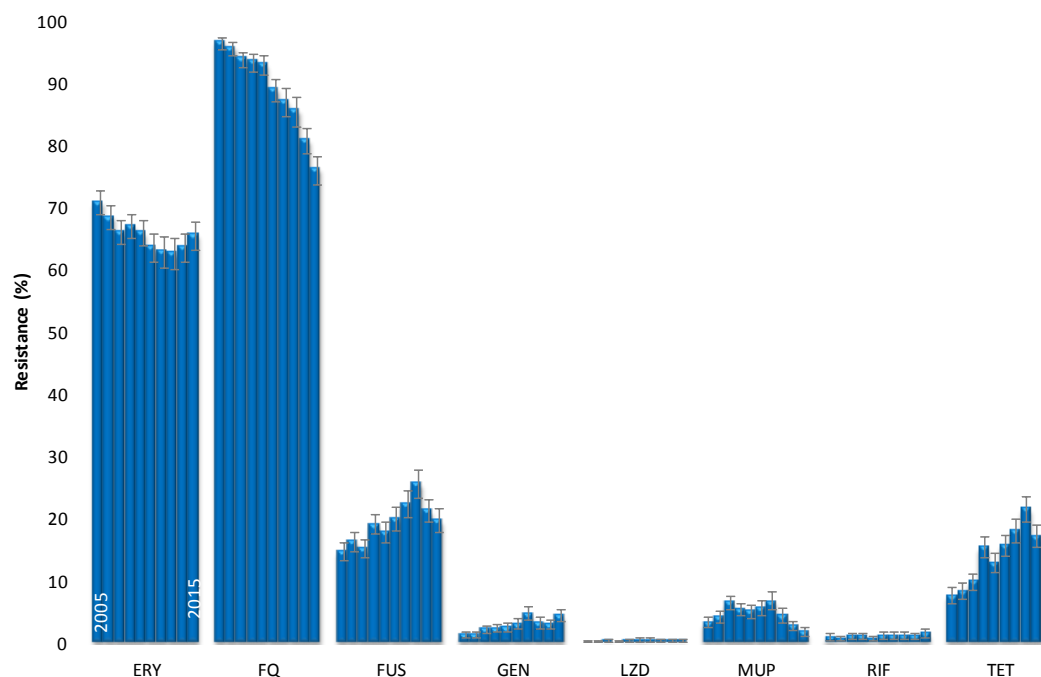

Figure 17: All-Wales antimicrobial resistance rates for MRSA from community Wound swabs (2006 to 2015)

Locally, there was wide variability in resistance rates within Wales; with notably high rates in some areas e.g. fusidic acid and tetracycline resistance in communities served by the laboratory in Ysbyty Glan Clwyd (L), see **Table 33.**

Hospital In-Patient and Out-Patient MRSA (n=907 in 2015)
The trends in antimicrobial resistance for both hospital in-patient and out-patient MRSA are similar to those seen in the community, with no statistically significant changes in the resistance rates for any of the agents listed between 2014 and 2015. Some of the same local patterns of resistance seen in the community were also reflected in hospital patients from the same geographical area, with notably high fusidic acid and tetracycline rates in patients from Wrexham Maelor (H) and Ysbyty Glan Clwyd (L): See **Tables 34** and **35**.

Section 5.4: Antimicrobial resistance rates for other pathogens.

The data in this section of the report comprises other pathogens which may commonly cause important infections other than bacteraemia. The data is for all specimens from all locations (community, in-patient and out-patient).

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

Table 36: *Haemophilus influenzae* - all specimens and all locations

Haemophilus influenzae, all specimens all locations
Resistance rates including (95% Confidence Intervals)
Duplicate Cut Off: ≤14 days
Time period: 1 January - 31 December 2015

Location Code (number)	AMO	(95% CI)	COA	(95% CI)	TET	(95% CI)
A (n=206)	33.0	(27.0, 39.7)	9.2	(6.0, 14.0)	0.0	(0.0, 1.8)
B (n=1466)	32.2	(25.2, 40.1)	17.8	(12.5, 24.8)	2.8	(1.1, 6.9)
C (n=567)	35.4	(31.6, 39.5)	22.3	(19.1, 25.9)	2.3	(1.3, 3.9)
D (n=2061)	31.1	(29.1, 33.1)	15.4	(13.9, 17.0)	0.5	(0.3, 1.0)
E (n=181)	41.4	(34.5, 48.7)	22.7	(17.2, 29.3)	0.6	(0.1, 3.1)
F (n=1080)	27.7	(25.1, 30.4)	12.5	(10.7, 14.7)	0.7	(0.4, 1.5)
G (n=151)	47.7	(39.9, 55.6)	32.5	(25.5, 40.3)	3.3	(1.4, 7.5)
H (n=808)	33.5	(30.4, 36.9)	20.6	(17.9, 23.5)	0.9	(0.4, 1.8)
J (n=592)	35.8	(32.1, 39.8)	18.4	(15.5, 21.8)	0.2	(0.0, 1.0)
K (n=707)	36.8	(33.3, 40.4)	18.8	(16.1, 21.9)	0.8	(0.4, 1.8)
L (n=744)	32.3	(29.0, 35.7)	16.8	(14.3, 19.7)	0.9	(0.5, 1.9)
M (n=169)	30.8	(24.3, 38.1)	14.9	(10.3, 21.0)	0.6	(0.1, 3.3)
N (n=389)	31.4	(27.0, 36.1)	20.6	(16.8, 24.9)	1.0	(0.4, 2.6)
P (n=290)	21.4	(17.1, 26.5)	12.4	(9.1, 16.7)	1.7	(0.7, 4.0)
Q (n=28)	32.1	(17.9, 50.7)	21.4	(10.2, 39.5)	0.0	(0.0, 12.1)
R (n=70)	37.1	(26.8, 48.9)	21.4	(13.4, 32.4)	0.0	(0.0, 5.2)
S (n=1301)	34.0	(31.5, 36.6)	20.0	(17.9, 22.2)	1.1	(0.6, 1.8)
T (n=67)	26.9	(17.7, 38.5)	19.4	(11.7, 30.4)	3.0	(0.8, 10.2)
All-Wales: Resistance rates	32.6	(31.7, 33.5)	17.6	(16.8, 18.4)	0.9	(0.8, 1.2)
All-Wales: Number of isolates	9576		9554		9560	

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

Note: The range of resistance is outlined with boxes e.g. the range of resistance to amoxicillin was 21.4% - 47.4%; individual location rates statistically higher than the All-Wales rate are highlighted in colour.

Haemophilus influenzae (n=9,582 in 2015)

The All-Wales pattern of antimicrobial resistance for *Haemophilus influenzae* from all specimens/locations is shown in **Figure 18** & **Table 36**; with a statistically significant increase in resistance to co-amoxiclav, and a notable trend in increasing amoxicillin resistance across time.
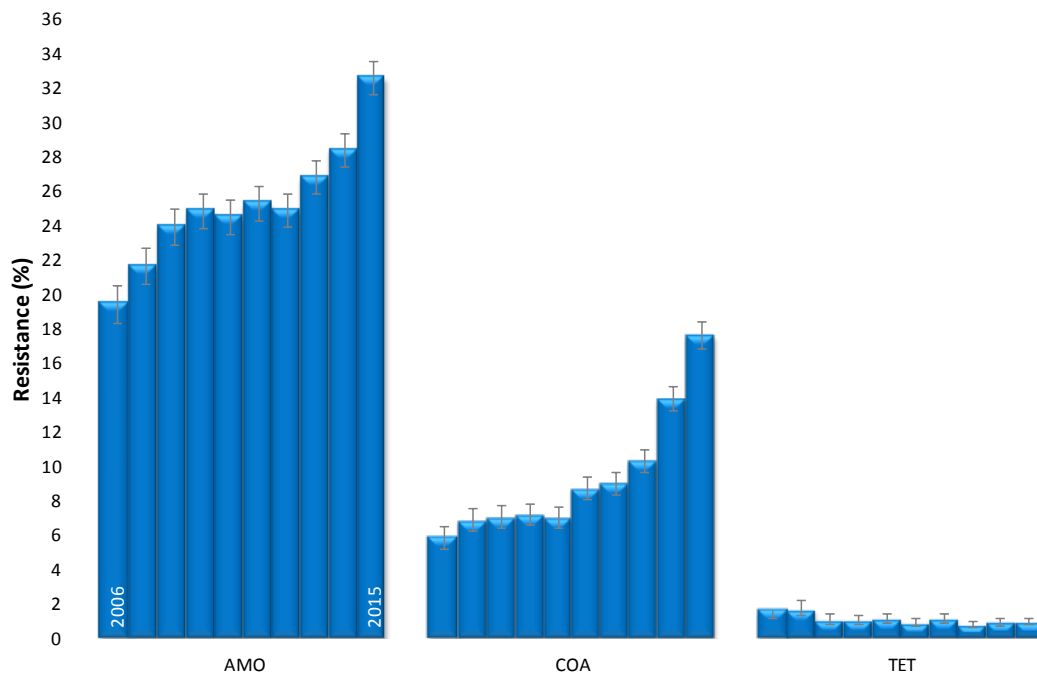
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Figure 18: All-Wales antimicrobial resistance rates for *H. influenzae*; all specimens and all locations (2006 to 2015)

Locally, there was variability in amoxicillin and co-amoxiclav resistance rates within Wales with higher rates of resistance being seen in the hospital and the community served by the laboratory at Withybush hospital (G).

Table 37: *Streptococcus pneumoniae* - all specimens and all locations

Streptococcus pneumoniae, all specimens all locations
Resistance rates including (95% Confidence Intervals)
Duplicate Cut Off: ?14 days
Time period: 1 January - 31 December 2015

Location Code	ERY	(95% CI)	PEN	(95% CI)	TET	(95% CI)
A (n=75)	5.3	(2.1, 12.9)	1.3	(0.2, 7.2)	4.0	(1.4, 11.1)
B (n=42)	2.1	(0.4, 10.9)	0.0	(0.0, 7.4)	8.3	(3.3, 19.6)
C (n=112)	11.6	(6.9, 18.9)	4.4	(1.9, 9.9)	5.4	(2.5, 11.2)
D (n=543)	12.7	(10.2, 15.8)	5.0	(3.4, 7.1)	8.1	(6.1, 10.7)
E (n=75)	14.8	(8.7, 24.1)	4.9	(1.9, 12.0)	11.1	(6.0, 19.8)
F (n=422)	9.0	(6.6, 12.1)	9.1	(6.7, 12.2)	6.6	(4.6, 9.4)
G (n=64)	7.8	(3.4, 17.0)	1.5	(0.3, 8.2)	0.0	(0.0, 5.6)
H (n=280)	10.7	(7.6, 14.8)	7.4	(4.9, 11.0)	8.2	(5.5, 11.9)
J (n=216)	9.3	(6.1, 13.9)	3.7	(1.9, 7.1)	6.0	(3.6, 10.0)
K (n=291)	11.3	(8.1, 15.4)	8.5	(5.8, 12.3)	9.2	(6.4, 13.1)
L (n=256)	10.5	(7.3, 14.9)	4.3	(2.4, 7.5)	10.1	(7.0, 14.4)
M (n=68)	7.4	(3.2, 16.1)	2.9	(0.8, 10.1)	5.9	(2.3, 14.2)
N (n=81)	6.2	(2.7, 13.6)	4.9	(1.9, 11.9)	7.4	(3.4, 15.2)
P (n=62)	12.9	(6.7, 23.4)	8.1	(3.5, 17.5)	12.9	(6.7, 23.4)
R (n=37)	10.8	(4.3, 24.7)	10.8	(4.3, 24.7)	8.1	(2.8, 21.3)
S (n=315)	11.2	(8.3, 14.9)	4.8	(3.0, 7.6)	7.8	(5.4, 11.1)
T (n=10)	40.0	(16.8, 68.7)	10.0	(1.8, 40.4)	20.0	(5.7, 51.0)
All-Wales: Resistance rates	**10.5**	(9.5, 11.7)	**5.8**	(5.0, 6.7)	**7.7**	(6.8, 8.8)
All-Wales: Number of isolates	**3017**		**3017**		**3010**	

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

Streptococcus pneumoniae (n=3,022 in 2015)

The All-Wales pattern of antimicrobial resistance for *Streptococcus pneumoniae* from all specimens and all locations is shown in **Figure 19** & **Table 37**; with no statistically significant differences in resistance rates between 2014 and 2015, but with a notable trend in increasing resistance to all agents from 2009 onwards.
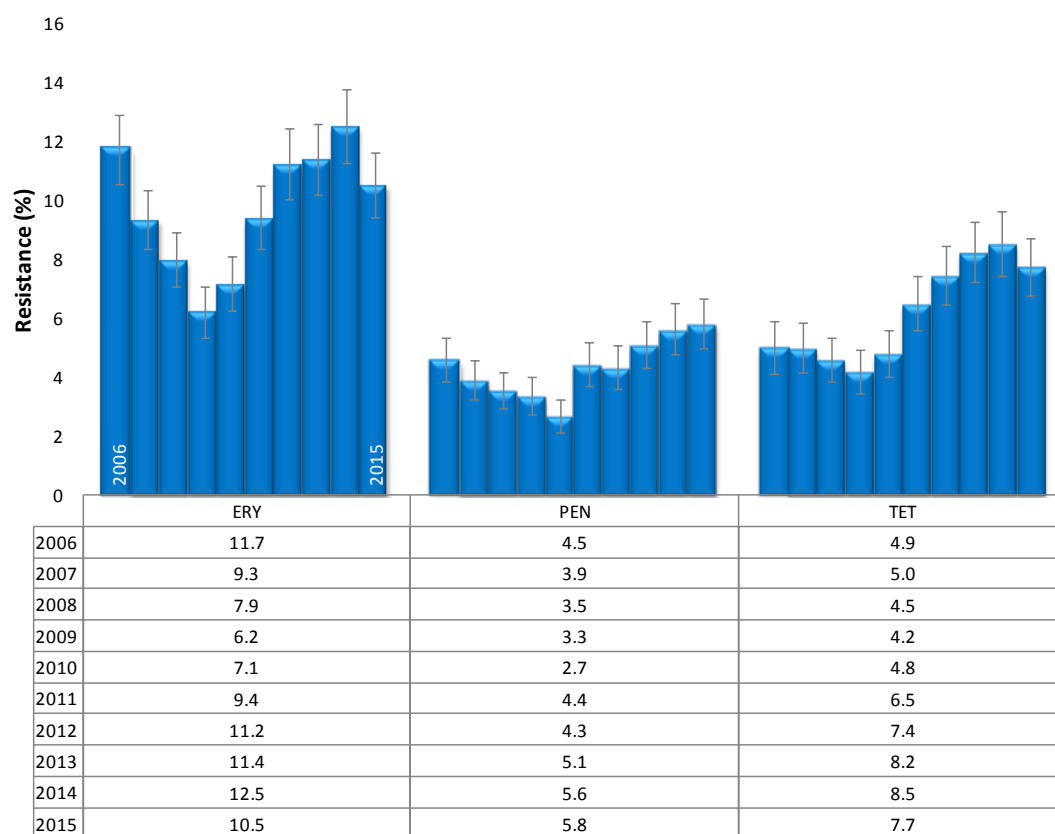.

	ERY	PEN	TET
2006	11.7	4.5	4.9
2007	9.3	3.9	5.0
2008	7.9	3.5	4.5
2009	6.2	3.3	4.2
2010	7.1	2.7	4.8
2011	9.4	4.4	6.5
2012	11.2	4.3	7.4
2013	11.4	5.1	8.2
2014	12.5	5.6	8.5
2015	10.5	5.8	7.7

Figure 19: All-Wales antimicrobial resistance rates for *S. pneumoniae*;
All specimens and all locations (2005 to 2014)

The rates for all three agents are higher than the rates for *S. pneumoniae* isolates from blood culture: See **Figure 11**.There was some variation in the penicillin resistance across Wales with higher rates being seen in Prince Philip hospital (R).

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Streptococcus pyogenes (n=5,210 in 2015)

The All-Wales pattern of antimicrobial resistance for *Streptococcus pyogenes* from all specimens/locations is shown in **Figure 20**; with statistically significant changes in resistance between 2014 and 2015 (reduction in erythromycin and tetracycline rates).
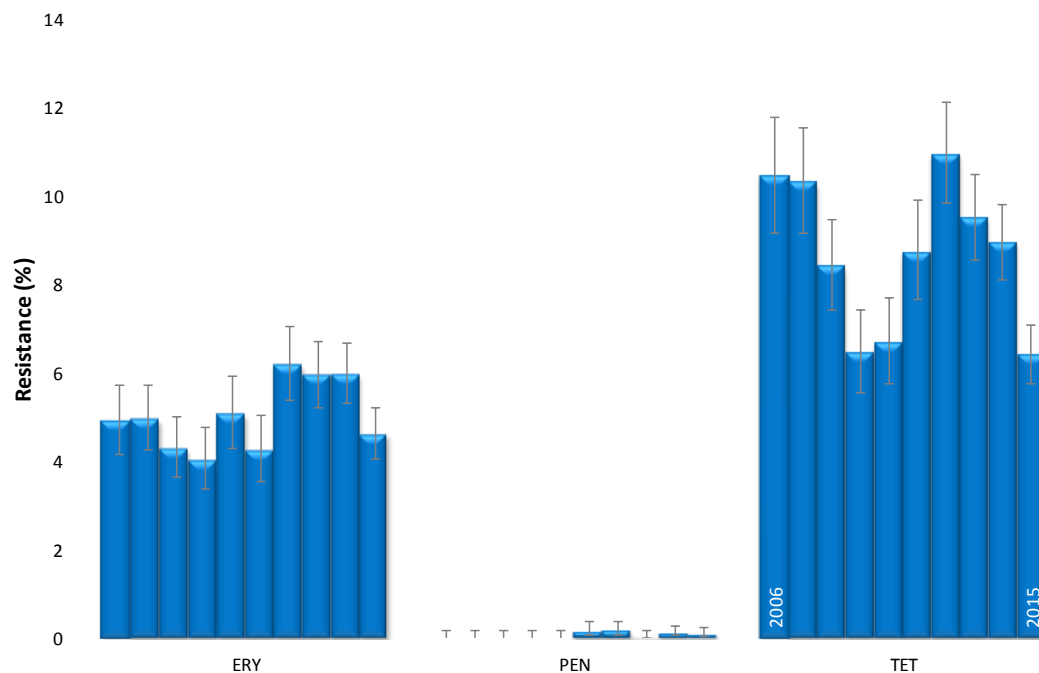

Figure 20: All-Wales antimicrobial resistance rates for *S. pyogenes*; all specimens and all locations (2005 to 2014)

There were no validated cases of penicillin resistant *S. pyogenes* in Wales from 2006 to 2015.

Campylobacter species (n=3,635 in 2014)

The All-Wales pattern of antimicrobial resistance for *Campylobacter spp.* from all locations is shown in **Figure 21**; with a statistically significant increase in ciprofloxacin resistance across time (2006-2015).
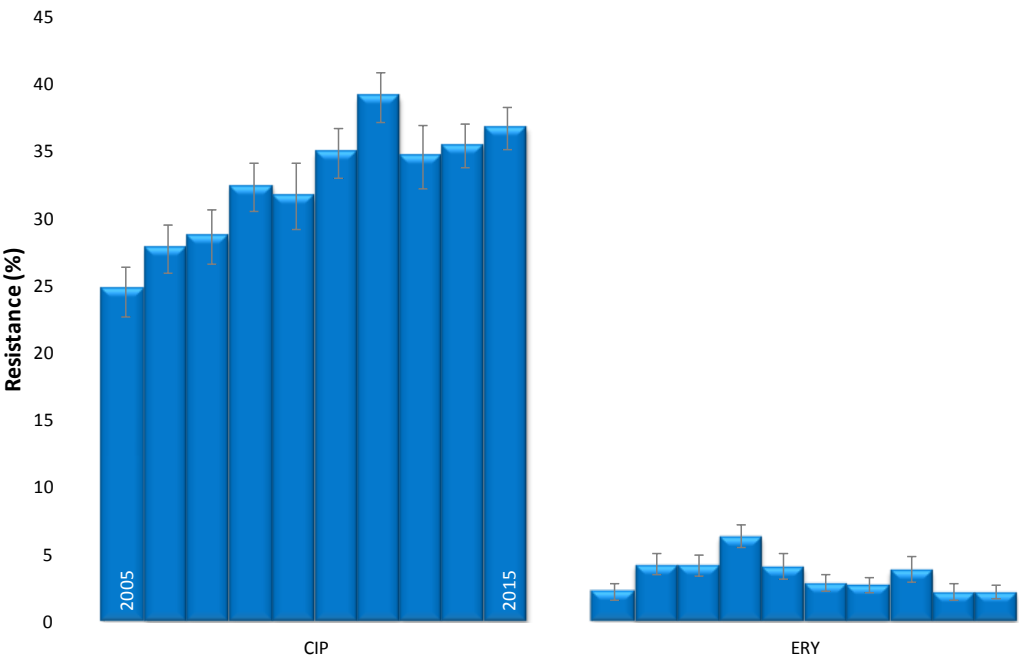

Figure 21: All-Wales antimicrobial resistance rates for *Campylobacter spp.*; all specimens and all locations (2006 to 2015)

Neisseria gonorrhoeae (n=564 in 2015)

The All-Wales pattern of antimicrobial resistance for *Neisseria gonorrhoeae* from all specimens and all locations is shown in **Figure 22**; with a statistically significant increase in ciprofloxacin resistance between 2014 and 2015.
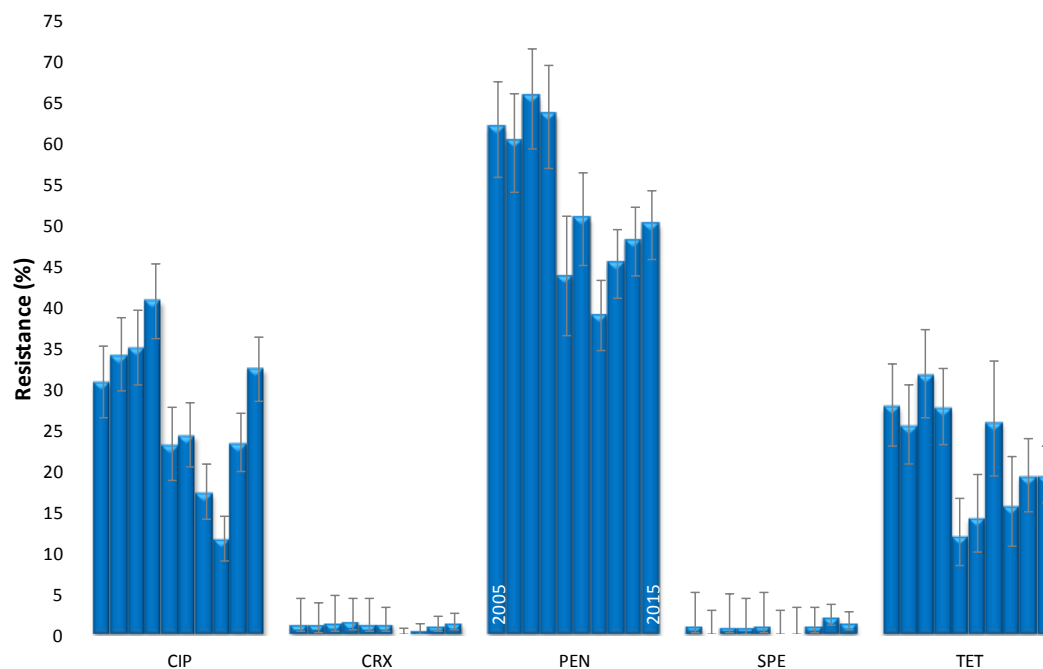

Figure 22: All-Wales antimicrobial resistance rates for *N. gonorrhoeae*; all specimens and all locations (2006 to 2015)

Note: GRASP (Gonococcal Resistance to Antimicrobials Surveillance Programme) is a national sentinel surveillance programme which has monitored trends and drifts in susceptibility in gonococcal isolates since 2000. It collects isolates from consecutive patients attending a network of 26 genitourinary medicine (GUM) clinics that give regional representation in England and Wales.

The 2014 GRASP report published by the Public Health England reported the following antimicrobial susceptibility Overview:

Susceptibility to first line antimicrobials, ceftriaxone and azithromycin:

- There were no gonococcal isolates resistant to ceftriaxone in GRASP in 2014; 0.3% of gonococcal isolates routinely tested in primary diagnostic laboratories in 2014 were reported as resistant to ceftriaxone

- Resistance to azithromycin in GRASP isolates decreased from 1.6% in 2013 to 1.0% in 2014; three isolates had high-level resistance to azithromycin (MIC >256 mg/L)

- In 2015, the STBRU reference service detected an outbreak of 14 cases of high-level azithromycin resistant *N. gonorrhoeae* in heterosexual

Other antimicrobial susceptibility data:

- In GRASP, resistance to cefixime declined across all sexual orientation sub-groups from 5.1% in 2013 to 1.4% in 2014

- 0.4% of isolates reported in SGSS were resistant to cefixime in 2014

- 37.3% of isolates in GRASP and 29.6% of isolates reported in SGSS were resistant to ciprofloxacin in 2014

- 22.6% of isolates in GRASP and 25.9% of isolates in SGSS were resistant to penicillin in 2014

- No isolates in GRASP and 0.4% of isolates reported in SGSS were resistant to spectinomycin in 2014

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/476582/GRASP_2014_report_final_111115.pdf