Infection reports

Pyogenic and non-pyogenic streptococcal bacteraemia, England, Wales and Northern Ireland: 2010

Volume 5 Number 46 Published on: **18 November 2011**

Introduction

These data are based on records extracted from the voluntary routine surveillance database (LabBase2) on the 5th October 2011 for the period 2006-2010. The exception to this is group A streptococcal (GAS) infection for which data on isolates submitted to the Streptococcus and Diphtheria Reference Unit (SDRU) are merged with routine laboratory reports. From October 2010, microbiological diagnoses of invasive GAS infection must be notified by law [1]. This facilitates local health protection units in undertaking public health action as outlined in national guidance. Owing to the new legislation taking effect part-way through the year, statutory notifications were not analysed for this report.

Population rates for 2010 were calculated using 2010 mid year resident population estimates based on the 2001 census for England, Wales and Northern Ireland. Rates of GBS bacteraemia in infants were calculated using 2010 live birth denominators. Regional analyses were made according to the Government Office Regions introduced in April 2002.

The data presented here differ in some instances from data in earlier publications due to the addition of late reports to the database and due to the refinement of the automated de-duplication process for the merged GAS reports.

Group A streptococci

Data from laboratory reports and isolate referrals showed an 7% decrease in the number of reports of GAS bacteraemia in 2010 compared with 2009, from 1694 to 1574 (Table 1).

Table 1 **Number of laboratory reports of streptococcal bacteraemia, England, Wales and Northern Ireland, 2006-2010**

	2006	2007	2008	2009	2010
Pyogenic streptococci	**3837**	**3873**	**4214**	**4479**	**4580**
Group A streptococci	1350	1328	1375	1694	1574
Group B streptococci	1442	1401	1550	1571	1610
Group C streptococci	292	320	390	378	474
Group G Streptococci	753	824	866	836	922
Non-pyogenic streptococci	**2838**	**3083**	**3232**	**3182**	**3185**
Anginosus group	**728**	**771**	**842**	**842**	**827**
Streptococcus anginosus	175	222	261	276	305
Streptococcus constellatus	203	201	198	224	201
Streptococcus intermedius	93	93	89	83	86
"Streptococcus milleri group"	214	219	246	197	205
Streptococcus group F	43	36	48	62	30
Bovis group	**253**	**264**	**290**	**288**	**285**
Streptococcus bovis (untyped)	214	217	223	223	223
Streptococcus bovis biotype I	12	20	24	34	18
Streptococcus bovis biotype II	17	14	27	17	25
Streptococcus equinus	7	8	10	9	8
Streptococcus alactolyticus	3	5	6	5	11
Mitis group	**1177**	**1260**	**1196**	**1191**	**1162**
Streptococcus mitior	8	14	13	13	20
Streptococcus mitis	45	111	125	116	80
Streptococcus oralis	366	409	358	353	357
"*Streptococcus mitis* group"	758	726	700	709	705
Mutans group	**44**	**53**	**58**	**64**	**61**
Streptococcus mutans	44	53	56	62	58
Streptococcus sobrinus	0	0	2	2	3
Salivarius group	**295**	**334**	**333**	**323**	**337**
Streptococcus salivarius	263	302	300	294	314
Streptococcus vestibularis	32	32	33	29	23
Sanguinis group	**341**	**401**	**513**	**474**	**513**
Streptococcus gordonii	23	43	53	61	58
Streptococcus sanguinis	16	25	44	31	21
Streptococcus parasanguinis	85	112	146	141	184
"*Streptococcus sanguinis* group"	217	221	270	241	250
Other streptococci	**1724**	**2053**	**2031**	**1872**	**1855**
Streptococcus acidominimus	53	26	20	13	12

Streptococcus suis	3	1	7	1	2
Streptococcus uberis	8	9	5	6	7
"Anaerobic streptococcus"	37	55	47	21	37
Streptococci not fully identified	1623	1962	1952	1831	1797
Total:	**8399**	**9009**	**9444**	**9533**	**9620**
Genera closely related to streptococci:	**518**	**555**	**480**	**476**	**417**
Abiotrophia spp	34	28	25	24	17
Aerococcus spp	134	152	123	153	125
Gemella spp	111	139	123	115	118
Globicatella sanguis	2	3	0	2	4
Leuconostoc spp	43	39	38	38	34
Pediococcus spp	3	6	6	1	6
Peptostreptococcus spp	191	188	165	143	113

** Group D streptococci were excluded from the analysis. Please refer to the entrococcus surveillance reports for further information.*

Group D streptococci	78	118	100	87	70

The rate of GAS bacteraemia reported in England, Wales and Northern Ireland for 2010 was 2.8 (95% CI 2.6-2.9) per 100,000 population (Table 2). The rates in England was 2.8, a decrease from 2009 (3.1), whereas rates in both Northern Ireland (1.7 to 1.9) and Wales (2.3 to 2.6) increased between 2009 and 2010. There was a wide variation in rates of reports within England from 2.0 in the London to 3.6/100,000 in the West Midlands.

Table 2 **Region-specific rates (per 100,000 population) of pyogenic streptococcal bacteraemia: England, Wales and Northern, 2010**

	Rate per 100,000 population			
Region	**Group A**	**Group B**	**Group C**	**Group G**
East Midlands	2.1	3.1	0.8	1.6
East of England	3.3	2.6	0.8	2.0
London	2.0	3.1	0.4	1.2
North East	2.6	2.0	1.0	0.5
North West	3.3	3.1	1.0	2.2
South East	2.3	2.0	0.6	1.2
South West	3.4	3.0	0.8	1.8
West Midlands	3.6	3.3	0.9	2.4
Yorkshire & Humber	3.0	2.9	1.3	1.5
England	**2.8**	**2.8**	**0.8**	**1.7**
Wales	**2.6**	**2.8**	**1.3**	**1.7**
Northern Ireland (N.I.)	**1.9**	**3.4**	**0.7**	**0.3**
England, Wales and N.I.	**2.8**	**2.8**	**0.8**	**1.6**

Rates of GAS bacteraemia reports were higher in males than females across most age groups, the exceptions being in the 10-15 years and 15-44 years age groups. The highest rates were in adults aged 75 and over (13.4/100,000) whose rates increased substantially compared to 2009 (8.8/100,000) (Figure 1). Rates of disease in other

age groups remained relatively stable between the two years. Although an increase in invasive GAS infection due to co-infection with influenza was noted towards the end of 2010 [2,3,4], this seems an unlikely reason for the marked increase in GAS bacteraemia in the elderly given that the circulating influenza virus (H1N1v) primarily affected the young [5,6].

Figure 1 **Age-specific rates of group A streptococcal bacteraemia reports: England, Wales and Northern Ireland, 2010**

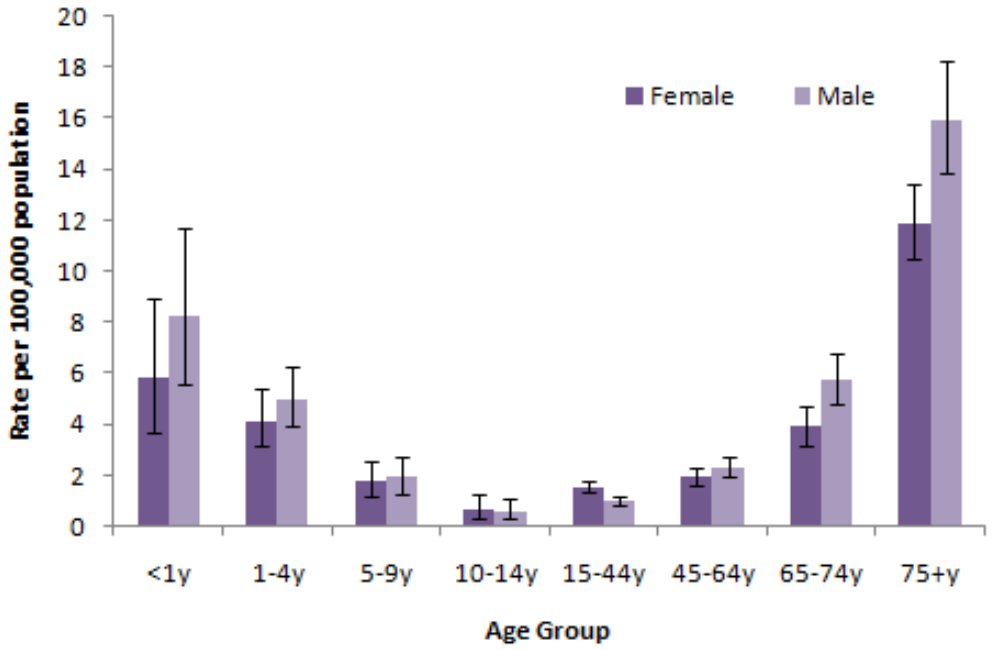


Table 3 **Antibiotic resistance data for streptococcal bacteraemia reports: England, Wales and Northern Ireland, 2006-2010**

		2006		2007		2008		2009		2010	
		No. tested	(% resistant)	No. tested	(% resistant)	No. tested	(% resistant)	No. tested	(% resistant)	No. tested	(% resistant)
Group A	clindamycin	171	(4%)	216	(4%)	318	(3%)	335	(3%)	375	(2%)
	erythromycin	698	(5%)	787	(6%)	896	(5%)	821	(5%)	847	(5%)
	tetracycline	448	(17%)	569	(15%)	615	(11%)	561	(9%)	663	(9%)
Group B	clindamycin	210	(9%)	255	(7%)	358	(8%)	398	(10%)	464	(9%)
	erythromycin	1016	(11%)	1025	(11%)	1095	(12%)	1058	(14%)	1128	(15%)
	tetracycline	695	(80%)	798	(83%)	832	(82%)	814	(79%)	916	(82%)
Group C	clindamycin	38	(8%)	56	(5%)	82	(11%)	83	(4%)	129	(12%)
	erythromycin	195	(8%)	217	(9%)	260	(11%)	247	(13%)	334	(13%)
	tetracycline	127	(24%)	164	(17%)	214	(24%)	187	(24%)	263	(26%)
Group G	clindamycin	115	(6%)	152	(10%)	226	(12%)	192	(8%)	228	(9%)
	erythromycin	540	(19%)	590	(23%)	624	(22%)	547	(24%)	656	(26%)
	tetracycline	381	(47%)	465	(46%)	461	(46%)	421	(49%)	515	(46%)
"Anginosus"	erythromycin	453	(9%)	528	(10%)	579	(8%)	550	(9%)	533	(9%)
	penicillin	556	(4%)	641	(4%)	710	(3%)	713	(3%)	675	(1%)
	tetracycline	311	(15%)	382	(15%)	390	(21%)	390	(19%)	400	(24%)
"Bovis"	erythromycin	148	(21%)	160	(19%)	183	(21%)	169	(23%)	171	(29%)
	penicillin	180	(9%)	197	(5%)	236	(5%)	220	(4%)	227	(4%)
	tetracycline	106	(60%)	122	(66%)	133	(65%)	143	(65%)	132	(60%)
"Mitis"	erythromycin	687	(43%)	814	(41%)	816	(40%)	741	(43%)	731	(43%)
	penicillin	854	(24%)	1009	(23%)	1003	(25%)	961	(23%)	943	(21%)
	tetracycline	459	(32%)	575	(28%)	580	(29%)	554	(28%)	557	(24%)
"Salivarius"	erythromycin	185	(33%)	210	(31%)	229	(37%)	225	(36%)	218	(38%)
	penicillin	216	(27%)	262	(26%)	256	(22%)	254	(22%)	264	(17%)
	tetracycline	125	(17%)	136	(23%)	150	(21%)	156	(21%)	145	(19%)
"Sanguinis"	erythromycin	229	(33%)	272	(35%)	364	(34%)	310	(40%)	340	(42%)
	penicillin	276	(20%)	326	(29%)	412	(27%)	354	(30%)	404	(22%)
	tetracycline	154	(28%)	195	(29%)	237	(30%)	222	(32%)	239	(34%)

Antimicrobial resistance

Reported rates of resistance to clindamycin, erythromycin and tetracycline for GAS bacteraemic isolates were 2%, 5% and 9% respectively in 2010 (Table 3). Resistance to clindamycin and erythromycin has remained stable since 2006, whilst prevalence of tetracycline resistance has declined over recent years. Rates of erythromycin and clindamycin resistance were lower in Northern Ireland and Wales than for England. Within England, rates of erythromycin resistance varied geographically, ranging between 2% in the Yorkshire and Humber region to 8% in London (Table 4). Substantial variation was also evident for tetracycline resistance, from 1% in the South West to 21% in the London region.

Table 4 **Region-specific antibiotic susceptibility data for pyogenic streptococcal bacteraemia reports: England, Wales, and Northern Ireland, 2010**

Group A streptococci

	clindamycin		**erythromycin**		**tetracycline**	
Region	no. tested	(% resistant)	no. tested	(% resistant)	no. tested	(% resistant)
East Midlands	11	(0%)	62	(3%)	34	(9%)
East of England	76	(1%)	116	(3%)	117	(3%)
London	36	(8%)	80	(8%)	48	(21%)
North East	19	(0%)	39	(5%)	35	(6%)
North West	70	(3%)	144	(6%)	94	(13%)
South East	52	(4%)	115	(5%)	59	(14%)
South West	42	(0%)	64	(5%)	73	(1%)
West Midlands	27	(0%)	112	(6%)	106	(10%)
Yorkshire & Humber	16	(6%)	50	(2%)	33	(6%)
England	**349**	**(3%)**	**782**	**(5%)**	**599**	**(9%)**
Wales	**5**	**(0%)**	**47**	**(2%)**	**37**	**(11%)**
Northern Ireland (N.I.)	**21**	**(0%)**	**18**	**(0%)**	**27**	**(4%)**
England, Wales and N.I.	**375**	**(2%)**	**847**	**(5%)**	**663**	**(9%)**

Group B streptococci

	clindamycin		**erythromycin**		**tetracycline**	
Region	no. tested	(% resistant)	no. tested	(% resistant)	no. tested	(% resistant)
East Midlands	12	(0%)	114	(13%)	62	(76%)
East of England	72	(6%)	107	(13%)	106	(77%)
London	81	(10%)	196	(17%)	124	(84%)
North East	28	(7%)	40	(20%)	39	(79%)
North West	88	(7%)	170	(14%)	129	(77%)
South East	58	(9%)	150	(14%)	91	(87%)
South West	34	(15%)	89	(16%)	112	(86%)
West Midlands	44	(7%)	119	(18%)	91	(85%)
Yorkshire & Humber	16	(6%)	51	(8%)	47	(72%)
England	**433**	**(8%)**	**1036**	**(15%)**	**801**	**(81%)**
Wales	**2**	**(0%)**	**63**	**(16%)**	**57**	**(88%)**
Northern Ireland (N.I.)	**29**	**(21%)**	**29**	**(14%)**	**58**	**(84%)**

England, Wales and N.I.	**464**	**(9%)**	**1128**	**(15%)**	**916**	**(82%)**

Group C streptococci

	clindamycin		erythromycin		tetracycline	
Region	no. tested	(% resistant)	no. tested	(% resistant)	no. tested	(% resistant)
East Midlands	8	(13%)	31	(10%)	24	(13%)
East of England	26	(27%)	37	(24%)	31	(39%)
London	7	(0%)	22	(14%)	14	(29%)
North East	12	(25%)	19	(16%)	18	(39%)
North West	25	(0%)	59	(12%)	36	(19%)
South East	19	(5%)	45	(9%)	17	(24%)
South West	11	(9%)	22	(18%)	24	(21%)
West Midlands	1	(0%)	35	(3%)	34	(26%)
Yorkshire & Humber	12	(8%)	25	(20%)	34	(12%)
England	**121**	**(12%)**	**295**	**(13%)**	**232**	**(24%)**
Wales	**1**	**(0%)**	**31**	**(6%)**	**22**	**(41%)**
Northern Ireland (N.I.)	**7**	**(14%)**	**8**	**(13%)**	**9**	**(44%)**
England, Wales and N.I.	**129**	**(12%)**	**334**	**(13%)**	**263**	**(26%)**

Group G streptococci

	clindamycin		erythromycin		tetracycline	
Region	no. tested	(% resistant)	no. tested	(% resistant)	no. tested	(% resistant)
East Midlands	4	(0%)	56	(25%)	29	(59%)
East of England	53	(6%)	88	(25%)	84	(39%)
London	29	(14%)	76	(26%)	48	(58%)
North East	1	(100%)	7	(14%)	5	(60%)
North West	37	(14%)	126	(32%)	85	(54%)
South East	55	(5%)	96	(27%)	42	(36%)
South West	19	(16%)	59	(17%)	73	(41%)
West Midlands	15	(7%)	80	(28%)	81	(47%)
Yorkshire & Humber	11	(0%)	25	(24%)	26	(42%)
England	**224**	**(9%)**	**613**	**(26%)**	**473**	**(47%)**
Wales	**1**	**(0%)**	**39**	**(15%)**	**36**	**(36%)**
Northern Ireland (N.I.)	**3**	**(0%)**	**4**	**(25%)**	**6**	**(50%)**
England, Wales and N.I.	**228**	**(9%)**	**656**	**(26%)**	**515**	**(46%)**

Erythromycin resistance was commonly associated with resistance to other antibiotics (Table 7), with 41% and 45% of erythromycin resistant isolates also being resistant to clindamycin or tetracycline respectively. Of the 236 isolates reported as having been tested against all three agents, five (2%) were reported as resistant to all three. This is a slight increase from that seen in 2009 where only 1% showed multiple resistances to the three antibiotics (2 cases).

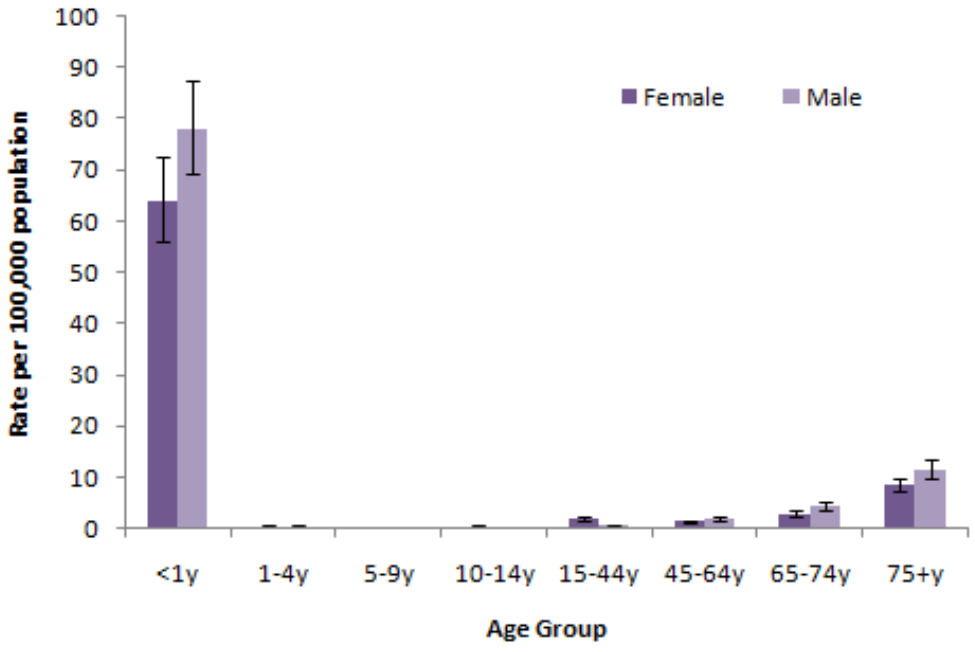
Group B streptococci

Having increased substantially between 2006 and 2008 (Table 1), from 1250 to 1550 (24% increase), reports of bacteraemia due to group B streptococcus (GBS) in England, Wales and Northern Ireland have showed more modest increases of 4% (1610) between 2008 and 2010.

The overall rate of GBS bacteraemia in 2010 for England, Wales and Northern Ireland was 2.8 per 100,000 population (Table 2). Rates were the same in England and Wales (2.8/100,000) and lower than in Northern Ireland (3.4/100,000 population).

Rates of GBS bacteraemia remain highly concentrated in infants, 64 and 78 per 100,000 population in females and males <1y, an increase on the previous year where (59 and 65/100,000 respectively). Rates of GBS bacteraemia are generally higher in males than females across most age groups, with the notable exception of 15-44 year olds (2.0 and 0.6 in females and males respectively) (Figure 2).

Figure 2 **Age-specific rates of group B streptococcal bacteraemia reports: England, Wales and Northern Ireland, 2010**



Rates of GBS bacteraemia in 0-90 day old infants, 0.67 per 1000 live births, increased slightly from 2009 (0.64) (Table 5), accounted for by increases in early (0-6 days) onset disease from 0.37 to 0.40. Rates of late (7-90 days) onset infant disease decreased slightly between 2009 and 2010 (0.28 to 0.27).

Table 5 **Number and rate (per 1000 live births) of group B streptococcal bacteraemia reports in infants 0-90 days old in England, Wales and Northern Ireland, 2010**

Country	All cases (0-90 days old)			Early onset (0-6 days old)			Late onset (7-90 days old)		
	number	rate	(95% CI)	number	rate	(95% CI)	number	rate	(95% CI)
England	452	0.67	(0.61 - 0.74)	271	0.40	(0.36 - 0.45)	181	0.27	(0.23 - 0.31)
Northern Ireland (N.I.)	26	1.04	(0.68 - 1.53)	17	0.68	(0.40 - 1.09)	9	0.36	(0.17 - 0.69)
Wales	28	0.80	(0.53 - 1.16)	14	0.40	(0.22 - 0.67)	14	0.40	(0.22 - 0.67)
England, Wales & N.I.	506	0.69	(0.63 - 0.76)	302	0.41	(0.37 - 0.46)	204	0.28	(0.24 - 0.32)

Antimicrobial resistance

The proportion of GBS bacteraemia reports accompanied by susceptibility data has increased since 2005 although only 29% reports included results for clindamycin in 2010. Resistance of GBS blood culture isolates to clindamycin, erythromycin and tetracycline was recorded in 9%, 15% and 82% of laboratory reports respectively (Table 3). Resistance to erythromycin in GBS increased from 11% of isolates (in 2005) to 15% of isolates (in 2010). All countries and regions except Yorkshire and Humber reported erythromycin resistance in over 10% of isolates (Table 4).

Of the erythromycin-resistant GBS isolates tested against clindamycin, 58% were reported to be resistant (Table 8). Of the 276 isolates reported as being tested against all three agents, 23 (8%) were found to be resistant to all three.

Group C & G streptococci

Voluntary reporting has shown a general increase in the numbers of reports of bacteraemia caused by group C streptococci (GCS) from 292 in 2006 to 474 in 2010 (Table 1), with reports increasing by 25% between 2009 and 2010. Reports of bacteraemia due to group G streptococci (GGS) increased by 10% in 2010 from 2009 (836 to 922; Table 1). Population rates of GCS bacteraemia were similar in England (0.8/100,000) and Northern Ireland (0.7), with Wales seeing an increase to 1.3 from 0.6 in 2009 (Table 2).

The age distributions of rates of both GCS and GGS bacteraemia reports were concentrated in the elderly, with rates tending to be higher in males than females in all age groups (Figures 3, 4).

Figure 3 **Age-specific rates of group C streptococcal bacteraemia reports: England, Wales and Northern Ireland, 2010**

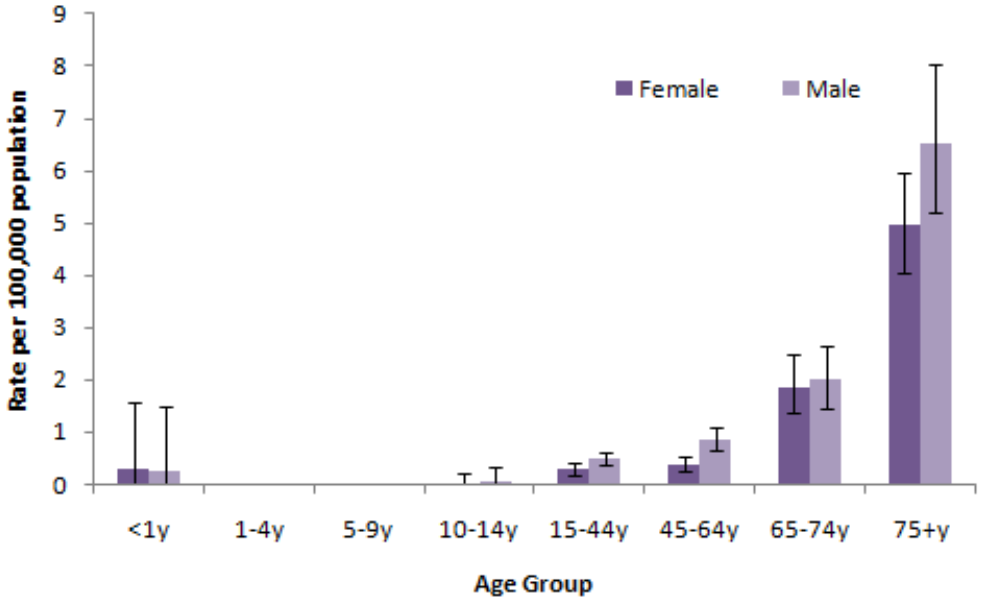
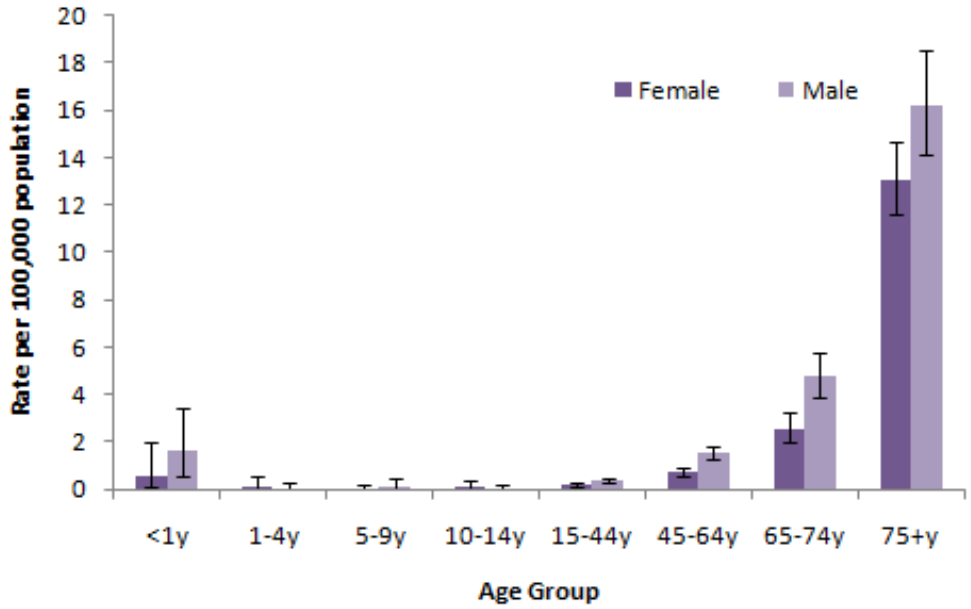


Figure 4 **Age-specific rates of group G streptococcal bacteraemia reports: England, Wales and Northern Ireland, 2010**



Antimicrobial resistance

For both GGS and GCS bacteraemia, resistance to clindamycin, erythromycin and tetracycline showed some changes between 2005 and 2009. After a decrease in clindamycin resistance between 2008 and 2009 (11% to 4%), resistance increased to 12% in 2010 (Table 3). In contrast, prevalence of clindamycin resistance showed little change for GGS bacteraemia between 2009 (8%) and 2010 (9%). Resistance of GGS isolates to erythromycin did however continue to increase in 2010 reaching 26%.

Small numbers of reports preclude analysis of antibiotic resistance by region for GCS bacteraemia. For GGS bacteraemic isolates, erythromycin resistance was lower in Wales (15%) than for England (26%) (Table 4). Within England substantial variation in erythromycin resistance was evident, from 14% in the North East to 32% in the North West.

Multidrug resistance patterns for GCS and GGS are given in Tables 9-10. Three per cent of GCS bacteraemia reports indicated multiple resistance to clindamycin, erythromycin and tetracycline; the same was seen for GGS bacteraemia reports (3%).

Non-pyogenic streptococci

Reports of bacteraemia due to non-pyogenic streptococci remained stable between 2009 and 2010 with 3185 reports for all groups combined (Table 1). 'Anginosus' group streptococci reports have decreased slightly between 2009 and 2010, from 842 to 827 reports, compared with the steady increase seen in earlier years. Bacteraemia reports for both the 'Bovis' group and 'Mitis' group streptococci have remained steady.

Table 6 **Region-specific rates (per 100,000 population) of non-pyogenic streptococcal bacteraemia: England, Wales and Northern Ireland, 2010**

	Rate per 100,000 population				
Region	**"Anginosus Group"**	**"Bovis Group"**	**"Mitis Group"**	**"Salivarius Group"**	**"Sanguinis Group"**
East Midlands	1.7	0.4	1.5	0.7	0.7
East of England	1.3	0.4	1.9	0.4	1.1
London	1.4	0.4	2.0	0.6	0.7
North East	1.3	0.7	1.3	0.5	1.3
North West	1.5	0.7	2.4	0.7	1.0
South East	1.9	0.5	2.0	0.6	0.9
South West	1.3	0.5	2.3	0.6	1.3
West Midlands	1.2	0.8	3.0	0.8	0.9
Yorkshire & Humber	1.6	0.4	2.3	0.6	0.6
England	**1.6**	**0.5**	**2.2**	**0.6**	**1.0**
Wales	**1.0**	**0.5**	**0.7**	**0.1**	**0.3**
Northern Ireland (N.I.)	**1.1**	**0.2**	**0.9**	**0.4**	**1.1**
England, Wales and N.I.	**1.4**	**0.4**	**2.0**	**0.6**	**0.7**

Reporting rates for England, Wales and Northern Ireland in 2010 ranged from 0.4 per 100,000 population (95% CI 0.44-0.56) for bacteraemia due to 'bovis group' streptococci to 2.0/100,000 (95% CI 1.89-2.12) for the 'mitis group' (Table 6).

Distribution of non-pyogenic streptococcal bacteraemia reports by age group and sex showed a concentration in the youngest and oldest age groups, and in most instances among males compared to females (Figures 5-9). For the 'mitis' and 'salivarius' streptococcal groups the rates in 2010 were highest in infants. The 'sanguinis' streptococcal group age distribution changed in 2010, with higher rates in the ≥75y age group compared with previous years where rates were highest in infants.

Figure 5 **Age specific rates of 'anginosus group' streptococcal bacteraemia reports: England, Wales and Northern Ireland, 2010**

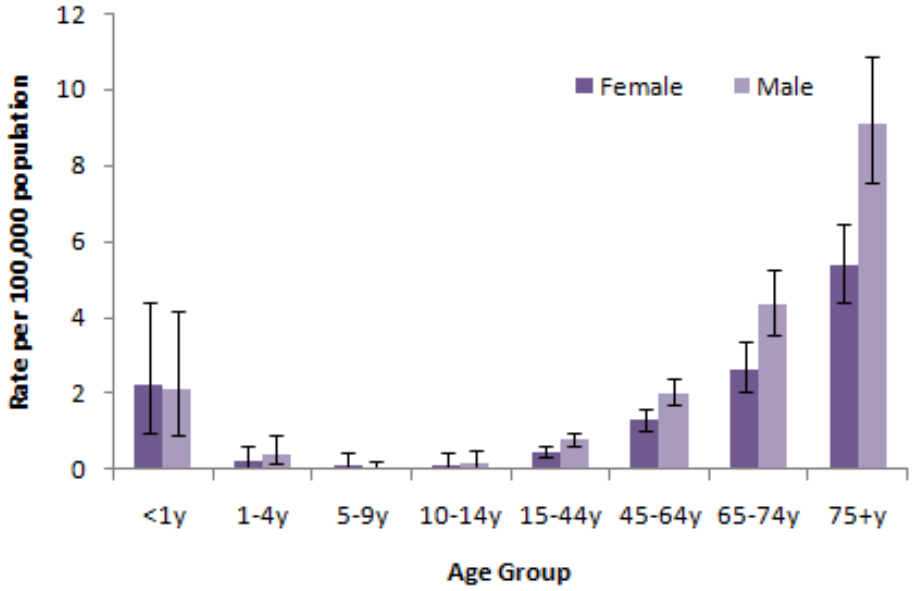


Figure 6 **Age-specific rates of 'bovis group' streptococcal bacteraemia reports: England, Wales and Northern Ireland, 2010**

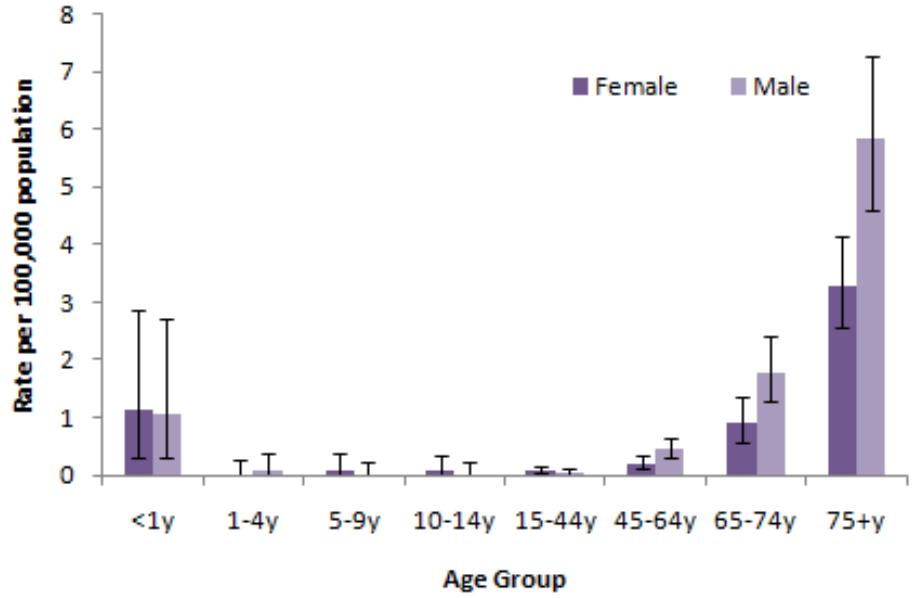


Figure 7 **Age-specific rates of 'mitis group' streptococcal bacteraemia reports: England, Wales and Northern Ireland, 2010**

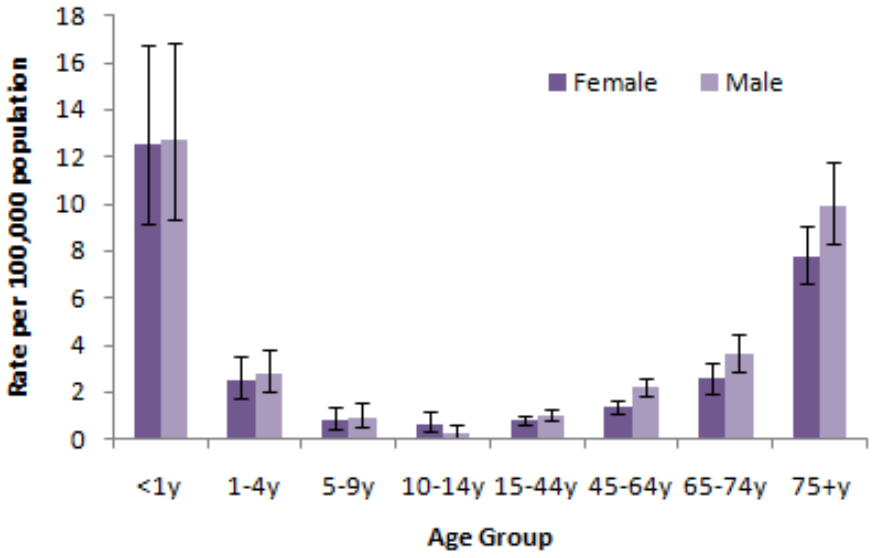


Figure 8 **Age-specific rates of 'salivarius group' streptococcal bacteraemia reports: England, Wales and Northern Ireland, 2010**

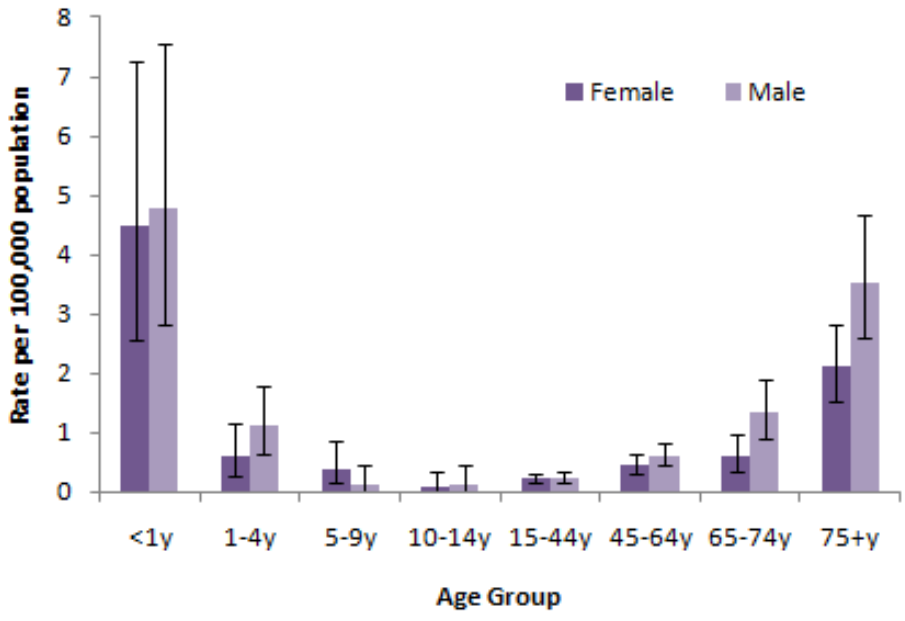
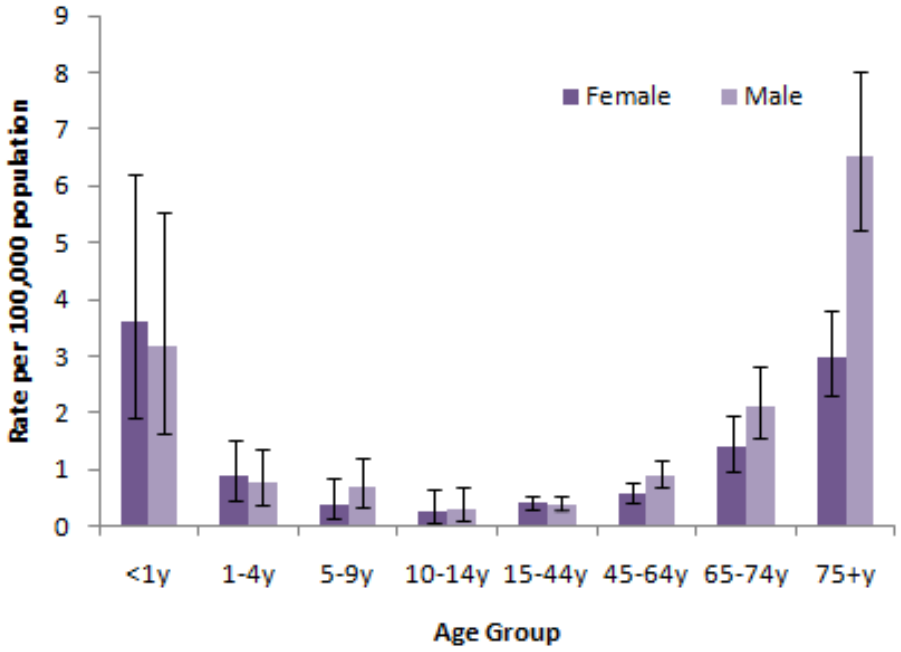


Figure 9 **Age-specific rates of 'sanguinis group' streptococcal bacteraemia reports: England, Wales and Northern Ireland, 2010**



Antimicrobial resistance

Since 2005, the proportion of non-pyogenic streptococcal bacteraemia reports accompanied by susceptibility data has increased markedly for all non-pyogenic groups, with over 75% including information on susceptibility to penicillin.

In contrast to the pyogenic streptococci, where penicillin resistance is undocumented in the UK, between 1% and 22% of isolates from non-pyogenic groups were reported as penicillin resistant, the highest frequency being observed in the 'sanguinis group'. Erythromycin resistance was also high in the non-pyogenic groups compared to the pyogenic groups, with between 29% and 43% of isolates reported as resistant, with the exception of the 'anginosus group' (9%; Table 3). The highest levels of tetracycline resistance were observed in the 'bovis group' where 60% isolates were reported as resistant.

Reference microbiology service

In 2010, the proportion of reports of streptococcal bacteraemia in which the organism was not fully identified remained the same as 2009 at 19%. Precise species identification of isolates would improve the monitoring of trends in non-pyogenic streptococci and related genera in particular. The Streptococcus and Diphtheria Reference Unit offers a referred (charged for) taxonomic identification service for streptococci and other related Gram-positive, catalase-negative genera from systemic and other significant infections. However, a free-of-charge reference

service will continue to be available for urgent public health investigations, outbreaks and incident management, either hospital or community based.

Laboratories are requested to send any pyogenic streptococcal isolates exhibiting a decreased sensitivity to penicillin to the Antibiotic Resistance Monitoring and Reference Laboratory (ARMRL) for confirmation. Both laboratories are based at the Health Protection Agency in Colindale. In addition, any streptococci (pyogenic or non-pyogenic) with suspected glycopeptide or linezolid resistance should be referred for further investigation.

E-Table 7 **Multiple antibiotic resistance patterns for group A streptococcal bacteraemia reports: England, Wales, and Northern Ireland, 2010**

				erythromycin				clindamycin				tetracycline			
				resistant	(%)	sensitive	no info	resistant	(%)	sensitive	no info	resistant	(%)	sensitive	no info
erythromycin															
	resistant	(n=	40)					7	(41%)	10	23	13	(45%)	16	11
	sensitive	(n=	807)					1	(0%)	294	512	35	(7%)	469	303
clindamycin															
	resistant	(n=	9)	7	(88%)	1	1					5	(83%)	1	3
	sensitive	(n=	366)	10	(3%)	294	62					15	(6%)	255	96
tetracycline															
	resistant	(n=	57)	13	(27%)	35	9	5	(25%)	15	37				
	sensitive	(n=	606)	16	(3%)	469	121	1	(0%)	255	350				

E-Table 8 **Multiple antibiotic resistance patterns for group B streptococcal bacteraemia reports: England, Wales, and Northern Ireland, 2010**

				erythromycin				clindamycin				tetracycline			
				resistant	(%)	sensitive	no info	resistant	(%)	sensitive	no info	resistant	(%)	sensitive	no info
erythromycin															
	resistant	(n=	168)					31	(62%)	19	118	95	(90%)	10	63
	sensitive	(n=	960)					1	(0%)	348	611	508	(81%)	122	330
clindamycin															
	resistant	(n=	40)	31	(97%)	1	8					31	(91%)	3	6
	sensitive	(n=	424)	19	(5%)	348	57					278	(82%)	62	84
tetracycline															
	resistant	(n=	748)	95	(16%)	508	145	31	(10%)	278	439				
	sensitive	(n=	168)	10	(8%)	122	36	3	(5%)	62	103				

E-Table 9 **Multiple antibiotic resistance patterns for group C streptococcal bacteraemia reports: England, Wales, and Northern Ireland, 2010**

				erythromycin				clindamycin				tetracycline			
				resistant	(%)	sensitive	no info	resistant	(%)	sensitive	no info	resistant	(%)	sensitive	no info
erythromycin															
	resistant	(n=	42)					12	(63%)	7	23	10	(40%)	15	17
	sensitive	(n=	292)					3	(3%)	85	204	51	(27%)	140	101
clindamycin															
	resistant	(n=	15)	12	(80%)	3	0					3	(38%)	5	7
	sensitive	(n=	114)	7	(8%)	85	22					15	(17%)	74	25
tetracycline															
	resistant	(n=	68)	10	(16%)	51	7	3	(17%)	15	50				
	sensitive	(n=	195)	15	(10%)	140	40	5	(6%)	74	116				

E-Table 10 **Multiple antibiotic resistance patterns for group G streptococcal bacteraemia reports: England, Wales, and Northern Ireland, 2010**

				erythromycin				clindamycin				tetracycline			
				resistant	(%)	sensitive	no info	resistant	(%)	sensitive	no info	resistant	(%)	sensitive	no info
erythromycin															
	resistant	(n=	168)					16	(40%)	24	128	49	(48%)	54	65
	sensitive	(n=	488)					3	(2%)	164	321	140	(44%)	177	171
clindamycin															
	resistant	(n=	20)	16	(84%)	3	1					6	(38%)	10	4
	sensitive	(n=	208)	24	(13%)	164	20					67	(45%)	82	59
tetracycline															
	resistant	(n=	237)	49	(26%)	140	48	6	(8%)	67	164				
	sensitive	(n=	278)	54	(23%)	177	47	10	(11%)	82	186				

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