



Infection report

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Bacteraemia

Polymicrobial bacteraemia and fungaemia in England, Wales and Northern Ireland, 2012

These analyses are based on data extracted from the Public Health England (PHE) voluntary surveillance database, LabBase2, on 3 December 2013 for the period of January 2008 to December 2012 in England, Wales and Northern Ireland.

This report covers voluntary reports of poly- and monomicrobial bacteraemia and fungaemia made to Public Health England (PHE), the analysis is limited to blood culture specimens reported on LabBase2. The data presented here differ in some instances from data in earlier publications due to the inclusion of late reports. Rates were calculated using 2012 mid-year resident population estimates based on the 2011 census for England, Wales, and Northern Ireland [1][2].

Geographical analyses within this report break the English reports into Government Office regions rather than the Public Health Centre areas created in April 2013 when Public Health England was established; this is due to the availability of data in this breakdown at the time of producing the report.

The report includes analyses on the trends, age and sex distribution, geographical distribution in cases of bacteraemia caused by polymicrobial and fungaemia.

Key Points

- Trends in reporting are shown for 2008 to 2012 including total bacteraemia and fungaemia, total number of patient episodes and number of polymicrobial patient episodes.
- There were 95,647 patient episodes in 2012 reported in England, Wales and Northern Ireland, where 8,223 (8.6%) were identified as polymicrobial and 87,424 monomicrobial infections. This represented a 1.5% increase on the number of patient episodes reported in 2011 (94,166 episodes).
- Of 8,223 polymicrobial episodes reported, 7,185 (87.4%) involved two different organisms, 905 (11.0%) involved three different organisms and 133 (1.6%) involved four or more organisms.
- There were 8,101 polybacteraemia episodes reported, which accounts for 98.5% of the total polymicrobial episodes.
- The proportion and number of poly- and monomicrobial patient episodes seem to have fluctuated slightly in recent years. Between 2008 and 2012, there has been an overall decline of 0.3% in the number of patient episodes (total of 95,931 patient episodes in 2008, of which 8,439 (8.8%) were polymicrobial). However, there has been a slight increase in patient episodes since 2010 (total of 92,867 patient episodes in 2010, of which 7,550 (8.1%) were polymicrobial).

Methods

Episodes of polymicrobial bloodstream infections are defined as the isolation of two or more different organisms from the same blood culture. Data for this report were derived from PHE's national database ("LabBase2") on 3 December 2013. Microbiology laboratories in England, Wales and Northern Ireland voluntarily submit microbiology data to LabBase2 on an ongoing basis. Specimen data reported to LabBase2 are based on each individual organism that has been identified in the specimen. If more than one organism is identified from a single patient specimen then each organism is given a *different* unique identifying number in LabBase2; none of these records are linked. Consequently, the identification of patient episodes during which two or more different organisms are present requires identifying specimen records with the following identical variables: specimen date, laboratory, patient date of birth, gender and patient soundex code.

The incidence of polymicrobial episodes was calculated using mid-year 2012 residential population denominators for England, Wales, and Northern Ireland [1][2]. Regional analysis was performed with reference to the English boundaries introduced in April 2002. Confidence limits were calculated using commercial software (Stata Statistical software: v12, College Station, Texas, Stata Corporation).

The rates of polymicrobial episodes in this report should be interpreted with caution as the data are derived from voluntary reports. In addition it is possible that some of the episodes reported may reflect a contaminant in the cultures rather than a true polymicrobial infection, so the real rates may be lower than reported.

Trends in total reports: 2008 to 2012

- 95,647 patient episodes involving either bacteraemia and/or fungaemia were identified from reports received from laboratories in England, Wales, and Northern Ireland in 2012 (table 1). This represented an overall decrease of 0.3% in the number of patient episodes recorded in 2008 (95,931 episodes), but a steady increase (circa 1.5% each year) compared to 2010 and 2011 (92,867 and 94,166 patient episodes, respectively).
- Based on positive blood cultures reported in 2012, 8,223 patient episodes (8.6% of all patient episodes) were identified as polymicrobial and 87,424 were identified as monomicrobial.
- The highest percentage of all patient episodes considered as polymicrobial infections occurred in 2008 (8.8%) and after a slight decline to 8.1% of patient episodes in 2010, has risen again to 8.6% in 2012.

Table 1. Trends in reports of bacteraemia and fungaemia in England, Wales and Northern Ireland: 2008 to 2012*

	2008	2009	2010	2011	2012
Total reported bacteraemia†	103,800	101,848	99,737	101,316	103,236
Total reported fungaemia†	1,882	1,784	1,798	1,881	1,826
Number of patient episodes	95,931	94,190	92,867	94,166	95,647
Number of polymicrobial patient episodes	8,439	8,220	7,550	7,864	8,223
Percentage of patient episodes that are polymicrobial	8.8%	8.7%	8.1%	8.4%	8.6%

*Data extracted on 3 December, 2013.

†Total reports can include multiple records for one patient; i.e. a polymicrobial infection will be recorded for each organism for that one patient as separate reports.

Total reports: 2012

- Of the 8,223 polymicrobial patient episodes in 2012, 7,185 involved two different organisms, 905 involved three different organisms and 133 involved four or more organisms (table 2).
- The most frequently reported organism involved in polymicrobial infections were *Escherichia* species (table 3), 99.8% (2,813 reports) of which were *Escherichia coli*. This species continues to exceed coagulase-negative staphylococci, which were the most frequent organisms reported from 2007 to 2009 [3].
- The most frequently reported monomicrobial bloodstream infection was also caused by an *Escherichia* species, 99.9% (27,268 reports) of which were *Escherichia coli*.
- The 8,223 polymicrobial patient episodes involved 108 different genera (table 4).
- There were 8,101 polybacteraemia episodes reported, representing 98.5% of all polymicrobial patient episodes. 7,071 polybacteraemia episodes involved two different organisms, 897 involved three different organisms and 133 involved four or more organisms.

Table 2. Number of organisms involved in polymicrobial infectious episodes, 2012*

Number of organisms	Episodes	(%)
Two	7185	(87.4%)
Three	905	(11.0%)
Four	112	(1.4%)
Five	21	(0.3%)
More than five	0	(0.0%)

*Data extracted on 3 December, 2013.

Table 3. The 10 most frequently reported genera/organisms in polymicrobial and monomicrobial bacteraemic episodes, 2012*

Rank	Polymicrobial	Rank	Monomicrobial
1	<i>Escherichia</i>	1	<i>Escherichia</i>
2	<i>Staphylococcus, coagulase negative</i>	2	<i>Staphylococcus, coagulase negative</i>
3	<i>Streptococcus, non-pyogenic</i>	3	<i>Staphylococcus aureus</i>
4	<i>Enterococcus</i>	4	<i>Streptococcus, non-pyogenic</i>
5	<i>Klebsiella</i>	5	<i>Klebsiella</i>
6	<i>Coliform</i>	6	<i>Streptococcus, pyogenic</i>
7	<i>Pseudomonas</i>	7	<i>Enterococcus</i>
8	<i>Staphylococcus aureus</i>	8	<i>Pseudomonas</i>
9	<i>Proteus</i>	9	<i>Proteus</i>
10	<i>Enterobacter</i>	10	<i>Candida</i>

*Data extracted on 3 December, 2013.

Table 4. Organisms reported in monomicrobial and polymicrobial bacteraemia and fungaemia, England, Wales and Northern Ireland: 2012*

Organism	Bloodstream infection:					
	Monomicrobial			Polymicrobial		
	n [†]	(%) [§]	Rank	n [†]	(%) [§]	Rank
<i>Escherichia</i>	27,276	(31.2)	1	2,818	(34.27)	1
<i>Staphylococcus, coagulase negative</i>	13,048	(14.92)	2	2,788	(33.9)	2
<i>Staphylococcus aureus</i>	8,405	(9.61)	3	700	(8.51)	8
<i>Streptococcus, non-pyogenic</i>	7,163	(8.19)	4	1,993	(24.24)	3
<i>Klebsiella</i>	5,089	(5.82)	5	1,525	(18.55)	5
<i>Streptococcus, pyogenic</i>	4,003	(4.58)	6	382	(4.65)	11
<i>Enterococcus</i>	3,691	(4.22)	7	1,856	(22.57)	4
<i>Pseudomonas</i>	3,093	(3.54)	8	711	(8.65)	7
<i>Proteus</i>	1,960	(2.24)	9	560	(6.81)	9
<i>Candida</i>	1,462	(1.67)	10	257	(3.13)	13
<i>Enterobacter</i>	1,457	(1.67)	11	457	(5.56)	10
<i>Bacteroides</i>	932	(1.07)	12	253	(3.08)	14
<i>Micrococcus</i>	751	(0.86)	13	105	(1.28)	23
<i>Clostridium</i>	724	(0.83)	14	262	(3.19)	12
<i>Propionibacterium</i>	709	(0.81)	15	92	(1.12)	24
<i>Serratia</i>	684	(0.78)	16	143	(1.74)	19
<i>Diphtheroids</i>	572	(0.65)	17	181	(2.20)	17
<i>Haemophilus</i>	534	(0.61)	18	68	(0.83)	25
<i>Bordetella</i>	513	(0.59)	19	2	(0.02)	75
<i>Citrobacter</i>	493	(0.56)	20	210	(2.55)	15
<i>Acinetobacter</i>	474	(0.54)	21	208	(2.53)	16
<i>Salmonella</i>	459	(0.53)	22	14	(0.17)	45
<i>Corynebacterium</i>	394	(0.45)	23	114	(1.39)	22
<i>Stenotrophomonas</i>	330	(0.38)	24	124	(1.51)	21
<i>Coliform</i>	272	(0.31)	25	793	(9.64)	6
<i>Morganella</i>	266	(0.30)	26	149	(1.81)	18
<i>Bacillus</i>	238	(0.27)	27	129	(1.57)	20
<i>Mycobacterium</i>	175	(0.20)	28	8	(0.10)	52
<i>Moraxella</i>	145	(0.17)	29	39	(0.47)	28
<i>Listeria</i>	131	(0.15)	30	2	(0.02)	75
<i>Fusobacterium</i>	122	(0.14)	31	17	(0.21)	39
<i>Campylobacter</i>	117	(0.13)	32	7	(0.09)	54
<i>Peptostreptococcus</i>	115	(0.13)	33	24	(0.29)	34
<i>Aerococcus</i>	80	(0.09)	34	65	(0.79)	26
<i>Neisseria</i>	79	(0.09)	35	32	(0.39)	29
<i>Pantoea</i>	78	(0.09)	36	25	(0.30)	33
<i>Prevotella</i>	77	(0.09)	37	16	(0.19)	43
<i>Aeromonas</i>	75	(0.09)	38	59	(0.72)	27
<i>Streptococcus</i>	59	(0.07)	39	22	(0.27)	37
<i>Gemella</i>	58	(0.07)	40	32	(0.39)	30
<i>Achromobacter</i>	57	(0.07)	41	17	(0.21)	39
<i>Providencia</i>	54	(0.06)	42	28	(0.34)	32
<i>Pasteurella</i>	50	(0.06)	43	10	(0.12)	48
<i>Lactobacillus</i>	49	(0.06)	44	29	(0.35)	31
<i>Staphylococcus</i>	49	(0.06)	44	12	(0.15)	47
<i>Borrelia</i>	45	(0.05)	46	0	--	--

* Data extracted on 3 December, 2013.

† Number of reports.

§ As a percentage of polymicrobial episodes.

Table 4 – continued

Organism	Bloodstream infection:					
	Monomicrobial			Polymicrobial		
	n [†]	(%) [§]	Rank	n [†]	(%) [‡]	Rank
<i>Lactococcus</i>	44	(0.05)	47	24	(0.29)	34
<i>Actinomyces</i>	41	(0.05)	48	17	(0.21)	39
<i>Raoultella</i>	40	(0.05)	49	24	(0.29)	34
<i>Ochrobactrum</i>	37	(0.04)	50	16	(0.19)	43
<i>Burkholderia</i>	32	(0.04)	51	14	(0.17)	45
<i>Brevibacterium</i>	30	(0.03)	52	6	(0.07)	57
<i>Cryptococcus</i>	30	(0.03)	52	4	(0.05)	62
<i>Rothia</i>	28	(0.03)	54	10	(0.12)	48
<i>Chryseobacterium</i>	27	(0.03)	55	8	(0.10)	52
<i>Veillonella</i>	24	(0.03)	56	7	(0.09)	54
<i>Brevundimonas</i>	24	(0.03)	56	3	(0.04)	69
<i>Rhizobium</i>	23	(0.03)	58	10	(0.12)	48
<i>Leuconostoc</i>	21	(0.02)	59	21	(0.26)	38
<i>Eggerthella</i>	21	(0.02)	59	9	(0.11)	51
<i>Roseomonas</i>	21	(0.02)	59	2	(0.02)	75
<i>Hafnia</i>	20	(0.02)	62	17	(0.21)	39
<i>Kluyvera</i>	19	(0.02)	63	7	(0.09)	54
<i>Granulicatella</i>	18	(0.02)	64	6	(0.07)	57
<i>Abiotrophia</i>	17	(0.02)	65	6	(0.07)	57
<i>Alcaligenes</i>	16	(0.02)	66	5	(0.06)	61
<i>Peptococcus</i>	12	(0.01)	67	4	(0.05)	62
<i>Rhodotorula</i>	12	(0.01)	67	4	(0.05)	62
<i>Capnocytophaga</i>	12	(0.01)	67	1	(0.01)	86
<i>Rhodococcus</i>	12	(0.01)	67	0	--	--
<i>Shigella</i>	10	(0.01)	71	1	(0.01)	86
<i>Actinobacillus</i>	9	(0.01)	72	0	--	--
<i>Aspergillus</i>	9	(0.01)	72	0	--	--
<i>Kingella</i>	8	(0.01)	74	4	(0.05)	62
<i>Bifidobacterium</i>	8	(0.01)	74	3	(0.04)	69
<i>Brucella</i>	8	(0.01)	74	0	--	--
<i>Eubacterium</i>	7	(0.01)	77	6	(0.07)	57
<i>Erysipelothrix</i>	7	(0.01)	77	4	(0.05)	62
<i>Microsporium</i>	7	(0.01)	77	2	(0.02)	75
<i>Leptospira</i>	7	(0.01)	77	0	--	--
<i>Sphingobacterium</i>	7	(0.01)	77	0	--	--
<i>Arcanobacterium</i>	6	(0.01)	82	4	(0.05)	62
<i>Arthrobacter</i>	6	(0.01)	82	3	(0.04)	69
<i>Eikenella</i>	6	(0.01)	82	2	(0.02)	75
<i>Kocuria</i>	6	(0.01)	82	2	(0.02)	75
<i>Fusarium</i>	6	(0.01)	82	1	(0.01)	86
<i>Acremonium</i>	6	(0.01)	82	0	--	--
<i>Yersinia</i>	6	(0.01)	82	0	--	--
<i>Gardnerella</i>	5	(0.01)	89	1	(0.01)	86
<i>Ralstonia</i>	5	(0.01)	89	1	(0.01)	86
<i>Saccharomyces</i>	5	(0.01)	89	1	(0.01)	86
<i>Flavobacterium</i>	4	(0.00)	92	4	(0.05)	62
<i>Anaerococcus</i>	4	(0.00)	92	3	(0.04)	69
<i>Comamonas</i>	4	(0.00)	92	3	(0.04)	69
<i>Aggregatibacter</i>	4	(0.00)	92	1	(0.01)	86
<i>Pneumocystis</i>	4	(0.00)	92	0	--	--
<i>Delftia</i>	3	(0.00)	97	1	(0.01)	86

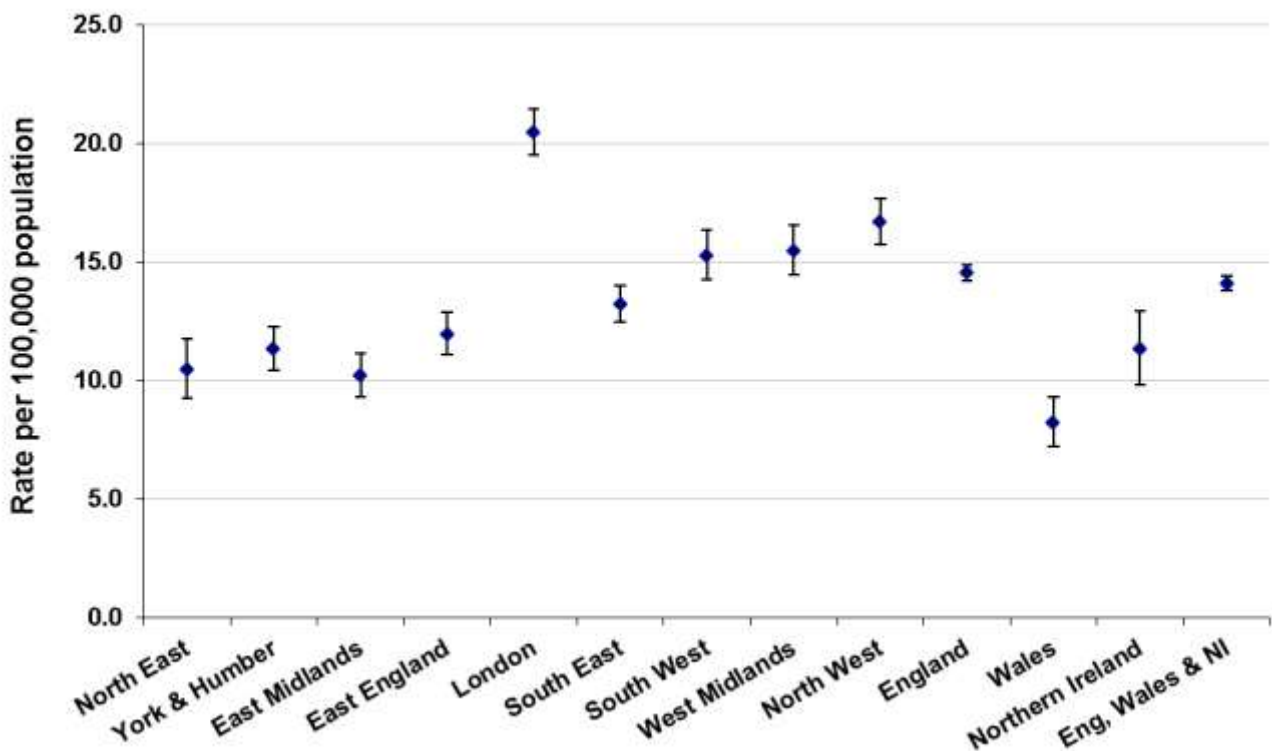
Table 4 - continued

Organism	Bloodstream infection:					
	Monomicrobial			Polymicrobial		
	n [†]	(%) [§]	Rank	n [†]	(%) [‡]	Rank
<i>Dermabacter</i>	3	(0.00)	97	1	(0.01)	86
<i>Leclercia</i>	3	(0.00)	97	1	(0.01)	86
<i>Sphingomonas</i>	3	(0.00)	97	1	(0.01)	86
<i>Trichophyton</i>	3	(0.00)	97	1	(0.01)	86
<i>Cardiobacterium</i>	3	(0.00)	97	0	--	--
<i>Dialister</i>	3	(0.00)	97	0	--	--
<i>Leptotrichia</i>	3	(0.00)	97	0	--	--
<i>Pediococcus</i>	3	(0.00)	97	0	--	--
<i>Stomatococcus</i>	2	(0.00)	106	3	(0.04)	69
<i>Chryseomonas</i>	2	(0.00)	106	2	(0.02)	75
<i>Agrobacterium</i>	2	(0.00)	106	1	(0.01)	86
<i>Branhamella</i>	2	(0.00)	106	1	(0.01)	86
<i>Parvimonas</i>	2	(0.00)	106	1	(0.01)	86
<i>Peptoniphilus</i>	2	(0.00)	106	1	(0.01)	86
<i>Porphyromonas</i>	2	(0.00)	106	1	(0.01)	86
<i>Pandora</i>	2	(0.00)	106	0	--	--
<i>Vibrio</i>	2	(0.00)	106	0	--	--
<i>Myroides</i>	1	(0.00)	115	2	(0.02)	75
<i>Chromobacterium</i>	1	(0.00)	115	1	(0.01)	86
<i>Chrysosporium</i>	1	(0.00)	115	1	(0.01)	86
<i>Actinobaculum</i>	1	(0.00)	115	0	--	--
<i>Arcobacter</i>	1	(0.00)	115	0	--	--
<i>Blastoschizomyces</i>	1	(0.00)	115	0	--	--
<i>Cedecea</i>	1	(0.00)	115	0	--	--
<i>Cladosporium</i>	1	(0.00)	115	0	--	--
<i>Desulfovibrio</i>	1	(0.00)	115	0	--	--
<i>Gordonia</i>	1	(0.00)	115	0	--	--
<i>Janibacter</i>	1	(0.00)	115	0	--	--
<i>Luteimonas</i>	1	(0.00)	115	0	--	--
<i>Malassezia</i>	1	(0.00)	115	0	--	--
<i>Nocardia</i>	1	(0.00)	115	0	--	--
<i>Oerskovia</i>	1	(0.00)	115	0	--	--
<i>Oligella</i>	1	(0.00)	115	0	--	--
<i>Phialophora</i>	1	(0.00)	115	0	--	--
<i>Prototheca</i>	1	(0.00)	115	0	--	--
<i>Psychrobacter</i>	1	(0.00)	115	0	--	--
<i>Rahnella</i>	1	(0.00)	115	0	--	--
<i>Rhizomucor</i>	1	(0.00)	115	0	--	--
<i>Scedosporium</i>	1	(0.00)	115	0	--	--
<i>Scopulariopsis</i>	1	(0.00)	115	0	--	--
<i>Trichosporon</i>	1	(0.00)	115	0	--	--
<i>Trueperella</i>	1	(0.00)	115	0	--	--
<i>Vagococcus</i>	1	(0.00)	115	0	--	--
<i>Weeksella</i>	1	(0.00)	115	0	--	--
<i>Anaerobiospirillum</i>	0	--	--	2	(0.02)	75
<i>Edwardsiella</i>	0	--	--	2	(0.02)	75
<i>Shewanella</i>	0	--	--	2	(0.02)	75
<i>Alloiococcus</i>	0	--	--	1	(0.01)	86
<i>Facklamia</i>	0	--	--	1	(0.01)	86
<i>Geotrichum</i>	0	--	--	1	(0.01)	86
<i>Paenibacillus</i>	0	--	--	1	(0.01)	86
Total	87,424			8,223	100	

Regional Distribution

- The overall rate of polymicrobial episodes in England, Wales and Northern Ireland is 14.08 per 100,000 population (figure 1). By country, the reported rates (per 100,000 population) were 14.52, 8.20, and 11.30 in England, Wales and Northern Ireland, respectively. The rates for England and Northern Ireland were higher than the 2011 rates of 13.79 and 10.42 per 100,000, respectively. The rate for Wales however was lower compared to data from 2011 (9.69 per 100,000). Notably, point estimates for Wales and Northern Ireland have relatively wide confidence intervals.
- Within England, the lowest rate of polymicrobial episodes was recorded for the East Midlands region (10.18 per 100,000). The highest rates was recorded for London (20.44 per 100,000), this is substantially higher than the rate in London in the previous year (2011; 18.23 per 100,000).

Figure 1. Regional distribution of polymicrobial bacteraemia/fungaemia episodes (per 100,000 population) in England, Wales and Northern Ireland: 2012*

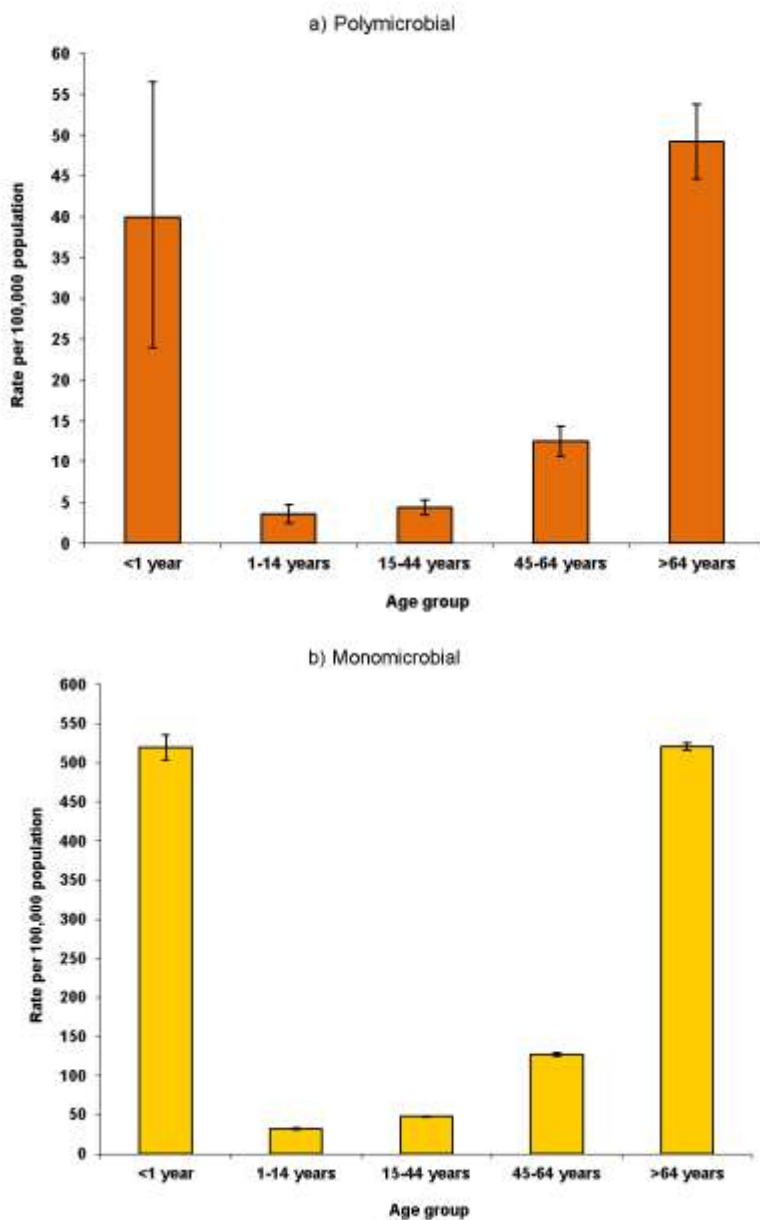


*Data extracted on 3 December, 2013.

Age Distribution

- The age distribution of poly- and monomicrobial bacteraemia and fungaemia for 2012 is presented in figure 2. The highest rate of polymicrobial bacteraemia was observed for those aged 65 years and over (49.22 per 100,000), followed by those aged less than one year (40.01 per 100,000). The age group with the lowest rates were recorded for those aged one to fourteen years (3.60 per 100,000), followed by those aged from 15 to 44 years (4.41 per 100,000). This is concordant with the pattern seen in previous years (2008-2011) [3].
- Rates of monomicrobial bacteraemia were also highest amongst the oldest and youngest age groups, with those aged 65 and greater and those aged less than one year having the highest rates at 521.30 and 519.74 per 100,000 respectively. The lowest rates were recorded for those aged from one to fourteen years (32.71 per 100,000), followed by those aged 15 to 44 years (48.01 per 100,000).

Figure 2. Age-specific rates of (a) polymicrobial and (b) monomicrobial episodes, England, Wales and Northern Ireland: 2012*



*Data extracted on 3 December, 2013.

Discussion

- The total numbers of patient episodes, bacteraemias, fungaemias and polymicrobial patient episodes was highest in 2008 (103,800; 1,882; 95,931 and 8,439, respectively) and have since fluctuated in a narrow band (table 1). The slight year-on-year increase in reports from 2010 to 2012 may be due an increase in reporting or increasing *Escherichia coli* [3] bloodstream infections.
- As with previous years, the majority of polymicrobial bloodstream infections this past year (2012) were due to bacterial infections (98.5%).
- The increasing importance of *Escherichia coli* bacteraemia [4] is emphasised by the increasing prominence of *Escherichia* spp. in polymicrobial bloodstream infections (see tables 3 and 4). *Escherichia* spp. have now become the most ubiquitous organisms found in polymicrobial bloodstream infections having previously been the third most common in 2007 and second most common in both 2008 and 2009 [3].
- The majority of regional rates as well as the overall rate of polymicrobial bloodstream infections in 2012 have shown a slight increase compared to 2011. The East of England region presented the greatest increase in rates between 2011 and 2012 from 9.36 per 100,000 population [2011] to 11.95 per 100,000 population [2012], whilst the reverse was evident in the East Midlands region (rate decreased from 12.57 per 100,000 population [2011] to 10.18 per 100,000 population [2012]). The East Midlands region now represents the lowest rate of polymicrobial infections in England, while the highest rate was recorded for London (20.44 per 100,000). Wales has also fluctuated in recent years (7.77 per 100,000 population [2010], 9.69 per 100,000 population [2011] and 8.20 per 100,000 population [2012]).
- As seen in previous years, the highest poly- and monomicrobial bloodstream infections were observed in the youngest (<1 year) and oldest age groups (those aged 65 years and greater) (figure 2). The reason for this age distribution requires further investigation.

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