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Bacteraemia

Polymicrobial bacteraemia and fungaemia in England, Wales and Northern Ireland, 2013

The analyses presented in this report are based on data extracted from the Public Health England (PHE) voluntary surveillance database, LabBase2, on 4 November 2014 for the period between 1 January 2009 to 31 December 2013 in England, Wales, and Northern Ireland.

This report covers voluntary reports of poly- and monomicrobial bacteraemia and fungaemia made to PHE, and the analyses are limited to blood culture specimens reported on LabBase2.

The data presented here differ in some instances from data in earlier publications due to inclusion of late reports. Rates were calculated using 2013 mid-year resident population estimates based on the 2011 census for England, Wales, and Northern Ireland [1].

Geographical analyses of cases are presented at the level of the Public Health Centre areas (15) created in April 2013 when Public Health England was established rather than the Government Office regions (9) used on in previous reports.

This report contains analyses on 5-year trends, age and sex distribution, and geographical distribution of cases of polymicrobial bacteraemia and fungaemia.

Key points

- Trends in reporting are shown from 2009 to 2013 including total bacteraemia and fungaemia, total number of patient episodes, and number of polymicrobial patient episodes.
- There were 97,699 patient episodes in 2013 reported in England, Wales, and Northern Ireland, of which 8,509 (8.7%) were identified as polymicrobial and 89,190 (91.3%) monomicrobial infections. This represents 2.3% increase in the total number of patient episodes of bacteraemia compared to 2012 (95,515).
- Of 8,509 polymicrobial episodes reported, 7,414 (87.1%) involved two different organisms, 954 (11.2%) involved three different organisms, and 141 (1.6%) involved four or more organisms.
- There were 8,509 polymicrobial episodes reported, of which 8,375 (98.4%) were polybacteraemia, and 134 (1.6%) polyfungaemia reports.

- Overall, the number of patient episodes of bloodstream infections increased by 3.7% between 2009 and 2013 (94,190 episodes in 2009 and 97,699 episodes in 2013), although there was a dip in 2010, when 92,867 episodes were reported (1.4% decrease between 2009 and 2010).The number of polymicrobial patient episodes fluctuated between 2009 and 2013; there has been a decline between 2009 (8,220 episodes (8.7% of total number of patient episodes)) and 2010 (7,550 episodes (8.1% of total number of patient episodes)), and the numbers increased thereafter (7,864 episodes in 2011, 8,221 episodes in 2012, and 8,509 episodes in 2013; 8.4%, 8.6%, and 8.7% of total number of patient episodes, respectively)

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 obtained from PHE's national database ("LabBase2") on 4 November 2014. 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 identical values for the following variables: specimen date, laboratory, patient date of birth, gender, and patient soundex code.

The incidence of polymicrobial episodes was calculated using estimated mid-year 2013 residential population denominators for England, Wales, and Northern Ireland [1]. Regional analysis was performed with reference to the PHE centres boundaries introduced on 1 April 2012. Confidence limits were calculated using commercial software Stata™ [3].

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 reports 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: 2009 to 2013

- 97,699 patient episodes involving either bacteraemia and/or fungaemia were identified from reports received from laboratories in England, Wales, and Northern Ireland in 2013 (Table 1). This represented an overall increase of 3.7% in the number of patient episodes recorded in 2009 (94,190 episodes), and steady increase (1.4% between 2010 and 2011, and 2011 and 2012, and 2.3% between 2012 and 2013) from 2010 onwards (92,867, 94,165, and 96,515 episodes in 2010, 2011, and 2012, respectively).
- Based on positive blood cultures reported in 2013, 8,509 patient episodes (8.7% of all patient episodes) were identified as polymicrobial and 89,190 were identified as monomicrobial.
- The highest percentage of all patient episodes considered as polymicrobial infections occurred in 2009 and 2013 (8.7% both), with steady increasing trend between 2010 and 2013 (8.1% in 2010, 8.4% in 2011, and 8.6% in 2012).

Table 1. Trends in reports of bacteraemia and fungaemia in England, Wales and Northern Ireland: 2009 to 2013*

	2009	2010	2011	2012	2013
Total reported bacteraemia†	101,848	99,737	101,315	103,101	105,686
Total reported fungaemia†	1,784	1,798	1,881	1,826	1,785
Number of patient episodes	94,190	92,867	94,165	95,515	97,699
Number of polymicrobial patient episodes	8,220	7,550	7,864	8,221	8,509
Percentage of patient episodes that are polymicrobial	8.7	8.1	8.4	8.6	8.7

* Data extracted on 4 November, 2014.

†Total reports can include multiple records for individual patient; i.e. in a polymicrobial infection, there is a separate record for each organism isolated from that patient.

Total reports: 2013

- Of the 8,509 polymicrobial patient episodes in 2013, 7,414 involved two different organisms, 954 involved three different organisms, and 141 involved four or more organisms (Table 2).
- The most frequently reported organisms involved in polymicrobial infections were coagulase-negative staphylococci (Table 3) comprising 38.1% of these infections, followed by *Escherichia* species (34.1%), and non-pyogenic streptococci (25.2%). This is a change to previous year, when *Escherichia* species were the most commonly reported pathogen in polymicrobial infections [2].
- The most frequently reported pathogen in monomicrobial bloodstream infections (Table 3) belonged to *Escherichia* genus, of which 99.97% (28,117 reports) were *Escherichia coli*, 0.02% (5 reports) to *Escherichia* sp unclassified, 0.01% (2 reports) to *Escherichia vulneris*, and <0.01% (1 report) *Escherichia hermanni*.
- The 8,509 polymicrobial patient episodes involved 105 different genera (Table 4).
- There were 8,375 polybacteraemia episodes reported, representing 98.4% of all polymicrobial patient episodes, of which 7,298 involved two different organisms, 942 involved three different organisms, and 135 involved four or more organisms.

Table 2. Number of organisms involved in polymicrobial infectious episodes, 2013*

Number of organisms	Episodes	%
Two	7,414	87.1
Three	954	11.2
Four	118	1.4
Five	19	0.2
More than five	4	0.0

* Data extracted on 4 November, 2014.

Table 3. The 10 most frequently reported genera/organisms in polymicrobial and monomicrobial bacteraemic episodes, 2013*

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

* Data extracted on 4 November, 2014.
** *Escherichia coli* in at least 99% of patient episodes

Table 4. Organisms reported in monomicrobial and polymicrobial bacteraemia and fungaemia, England, Wales, and Northern Ireland: 2013*

	Bloodstream infections					
	Monomicrobial			Polymicrobial		
Organism	n†	%‡	Rank	n†	%‡	Rank
*Escherichia***	28,125	31.53	1	2,902	34.11	2
Staphylococcus, coagulase negative	13,202	14.80	2	3,239	38.07	1
Staphylococcus aureus	8,595	9.64	3	808	9.50	7
Streptococcus, non-pyogenic	6,921	7.76	4	2,142	25.17	3
Klebsiella	5,151	5.78	5	1,423	16.72	5
Streptococcus, pyogenic	4,383	4.91	6	380	4.47	11
Enterococcus	3,818	4.28	7	1,786	20.99	4
Pseudomonas	2,953	3.31	8	697	8.19	8
Proteus	2,036	2.28	9	526	6.18	9
Enterobacter	1,491	1.67	10	464	5.45	10
Candida	1,451	1.63	11	252	2.96	13
Bacteroides	947	1.06	12	193	2.27	16
Micrococcus	797	0.89	13	114	1.34	22
Propionibacterium	740	0.83	14	120	1.41	21
Serratia	703	0.79	15	130	1.53	19
Clostridium	687	0.77	16	258	3.03	12
Citrobacter	569	0.64	17	200	2.35	15
Acinetobacter	537	0.60	18	214	2.51	14
Haemophilus	534	0.60	19	74	0.87	25
Diphtheroids	451	0.51	20	174	2.04	17
Corynebacterium	444	0.50	21	148	1.74	18
Salmonella	423	0.47	22	10	0.12	47
Coliform	371	0.42	23	858	10.08	6
Bordetella	369	0.41	24	0	-	-
Stenotrophomonas	329	0.37	25	123	1.45	20
Bacillus	275	0.31	26	107	1.26	24
Morganella	249	0.28	27	113	1.33	23
Moraxella	178	0.20	28	34	0.40	30

Organism	Bloodstream infections					
	Monomicrobial			Polymicrobial		
	n†	%‡	Rank	n†	%‡	Rank
Campylobacter	159	0.18	29	10	0.12	47
Neisseria	150	0.17	30	47	0.55	28
Mycobacterium	144	0.16	31	11	0.13	46
Fusobacterium	128	0.14	32	22	0.26	38
Listeria	121	0.14	33	7	0.08	50
Peptostreptococcus	99	0.11	34	25	0.29	36
Aerococcus	85	0.10	35	63	0.74	27
Staphylococcus	76	0.09	36	17	0.20	42
Aeromonas	73	0.08	37	67	0.79	26
Lactobacillus	71	0.08	38	26	0.31	35
Pasteurella	69	0.08	39	9	0.11	48
Achromobacter	66	0.07	40	11	0.13	46
Prevotella	65	0.07	41	21	0.25	39
Pantoea	63	0.07	42	22	0.26	38
Actinomyces	59	0.07	43	30	0.35	32
Gemella	58	0.07	44	38	0.45	29
Providencia	58	0.07	44	28	0.33	33
Streptococcus	54	0.06	45	32	0.38	31
Rothia	51	0.06	46	24	0.28	37
Lactococcus	48	0.05	47	27	0.32	34
Borrelia	47	0.05	48	0	-	-
Burkholderia	44	0.05	49	6	0.07	51
Raoultella	36	0.04	50	19	0.22	41
Ochrobactrum	36	0.04	50	14	0.16	44
Brevibacterium	33	0.04	51	8	0.09	49
Veillonella	28	0.03	52	20	0.24	40
Leuconostoc	26	0.03	53	15	0.18	43
Rhizobium	25	0.03	54	7	0.08	50
Hafnia	23	0.03	55	12	0.14	45
Kluyvera	23	0.03	55	7	0.08	50
Chryseobacterium	22	0.02	56	10	0.12	47
Eggerthella	21	0.02	57	11	0.13	46
Brevundimonas	21	0.02	57	9	0.11	48
Cryptococcus	17	0.02	58	2	0.02	55
Capnocytophaga	16	0.02	59	4	0.05	53
Granulicatella	16	0.02	59	4	0.05	53
Roseomonas	15	0.02	60	6	0.07	51
Bifidobacterium	15	0.02	60	5	0.06	52
Kingella	14	0.02	61	2	0.02	55
Abiotrophia	13	0.01	62	4	0.05	53
Shigella	13	0.01	62	2	0.02	55
Alcaligenes	12	0.01	63	5	0.06	52
Gardnerella	12	0.01	63	3	0.04	54
Dermabacter	10	0.01	64	6	0.07	51
Cardiobacterium	10	0.01	64	1	0.01	56
Kocuria	9	0.01	65	4	0.05	53

Organism	Bloodstream infections					
	Monomicrobial			Polymicrobial		
	n†	%‡	Rank	n†	%‡	Rank
Rhodococcus	9	0.01	65	1	0.01	56
Yersinia	9	0.01	65	1	0.01	56
Arcanobacterium	8	0.01	66	6	0.07	51
Flavobacterium	8	0.01	66	0	-	-
Rhodotorula	7	0.01	67	5	0.06	52
Anaerobiospirillum	7	0.01	67	2	0.02	55
Phialophora	7	0.01	67	0	-	-
Ralstonia	6	0.01	68	2	0.02	55
Psychrobacter	5	0.01	69	1	0.01	56
Arthrobacter	5	0.01	69	0	-	-
Fusarium	5	0.01	69	0	-	-
Leptospira	5	0.01	69	0	-	-
Microsporum	4	0.00	70	5	0.06	52
Eubacterium	4	0.00	70	4	0.05	53
Peptococcus	4	0.00	70	2	0.02	55
Exophiala	4	0.00	70	1	0.01	56
Anaerococcus	4	0.00	70	0	-	-
Brucella	4	0.00	70	0	-	-
Shewanella	4	0.00	70	0	-	-
Trichosporon	4	0.00	70	0	-	-
Aggregatibacter	3	0.00	71	4	0.05	53
Eikenella	3	0.00	71	4	0.05	53
Leptotrichia	3	0.00	71	2	0.02	55
Peptoniphilus	3	0.00	71	2	0.02	55
Sphingobacterium	3	0.00	71	2	0.02	55
Globicatella	3	0.00	71	1	0.01	56
Leclercia	3	0.00	71	1	0.01	56
Microbacterium	3	0.00	71	1	0.01	56
Actinobacillus	3	0.00	71	0	-	-
Delftia	3	0.00	71	0	-	-
Erysipelothrix	3	0.00	71	0	-	-
Myroides	3	0.00	71	0	-	-
Nocardia	3	0.00	71	0	-	-
Pediococcus	3	0.00	71	0	-	-
Comamonas	2	0.00	72	4	0.05	53
Saccharomyces	2	0.00	72	3	0.04	54
Chryseomonas	2	0.00	72	1	0.01	56
Dialister	2	0.00	72	1	0.01	56
Geotrichum	2	0.00	72	1	0.01	56
Parvimonas	2	0.00	72	1	0.01	56
Aspergillus	2	0.00	72	0	-	-
Chromobacterium	2	0.00	72	0	-	-
Gordonia	2	0.00	72	0	-	-
Helcococcus	2	0.00	72	0	-	-
Pneumocystis	2	0.00	72	0	-	-
Rahnella	2	0.00	72	0	-	-

Organism	Bloodstream infections					
	Monomicrobial			Polymicrobial		
	n†	%‡	Rank	n†	%‡	Rank
Ruminococcus	2	0.00	72	0	-	-
Stomatococcus	1	0.00	73	3	0.04	54
Sphingomonas	1	0.00	73	2	0.02	55
Acremonium	1	0.00	73	1	0.01	56
Rhizopus	1	0.00	73	1	0.01	56
Actinobaculum	1	0.00	73	0	-	-
Agrobacterium	1	0.00	73	0	-	-
Alistipes	1	0.00	73	0	-	-
Atopobium	1	0.00	73	0	-	-
Bilophila	1	0.00	73	0	-	-
Buttiauxella	1	0.00	73	0	-	-
Edwardsiella	1	0.00	73	0	-	-
Elizabethkingia	1	0.00	73	0	-	-
Ewingella	1	0.00	73	0	-	-
Facklamia	1	0.00	73	0	-	-
Malassezia	1	0.00	73	0	-	-
Mobiluncus	1	0.00	73	0	-	-
Paecilomyces	1	0.00	73	0	-	-
Paenibacillus	1	0.00	73	0	-	-
Paracoccus	1	0.00	73	0	-	-
Penicillium	1	0.00	73	0	-	-
Pseudallescheria	1	0.00	73	0	-	-
Streptobacillus	1	0.00	73	0	-	-
Streptomyces	1	0.00	73	0	-	-
Trichoderma	1	0.00	73	0	-	-
Vibrio	1	0.00	73	0	-	-
Wolinella	1	0.00	73	0	-	-
Collinsella	0	-	-	1	0.01	56
Desulfovibrio	0	-	-	1	0.01	56
Janthinobacterium	0	-	-	1	0.01	56
Slackia	0	-	-	1	0.01	56
Total	**89,190**	**100**		**8,509**	**100**	

* Data extracted on 4 November, 2014.

** *Escherichia coli* in at least 99% of patient episodes

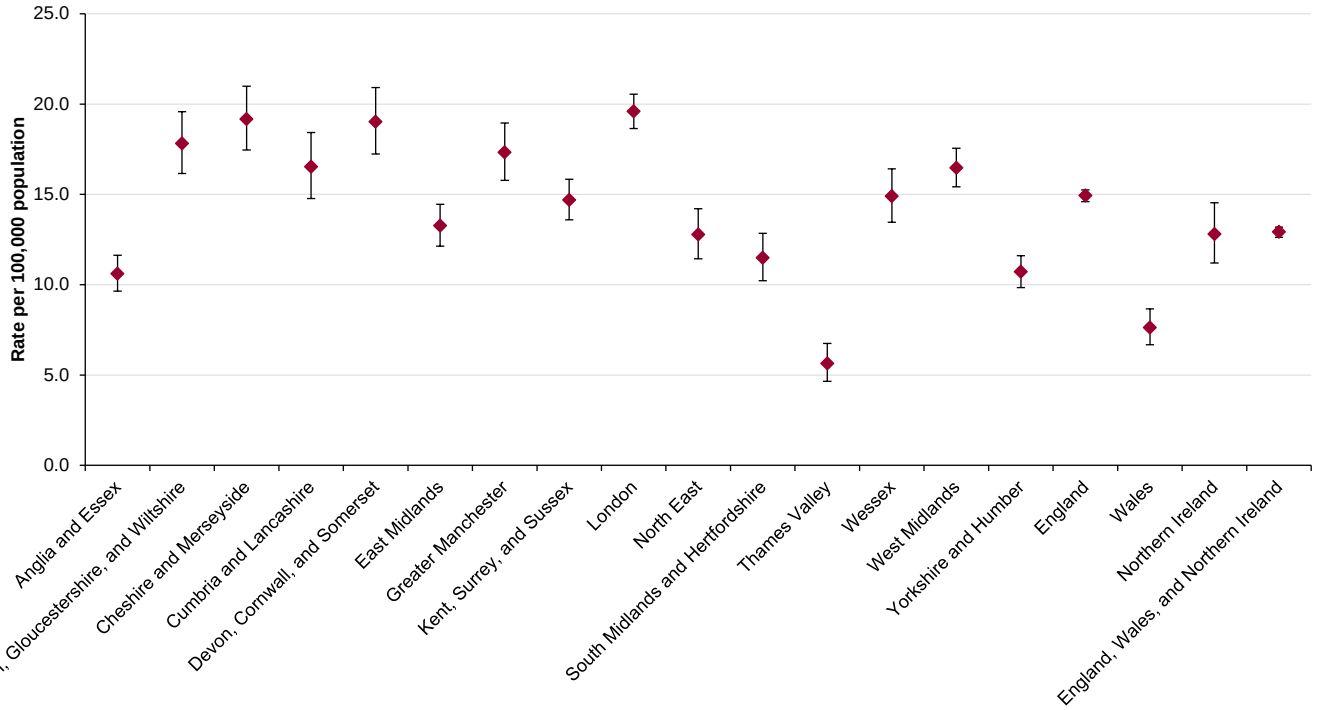
† Number of reports.

‡Percentage of total number of monomicrobial or polymicrobial episodes

Regional distribution

- The overall rate of polymicrobial episodes in England, Wales, and Northern Ireland was 12.91 per 100,000 population in 2013 (Figure 1). By country, the reported rates (per 100,000 population) were 14.92, 7.62, and 12.79, respectively. The rates in England and Northern Ireland were higher than those in 2012 of 14.52 (albeit this was a small increase) and 11.30, respectively, while the rate in Wales was lower in comparison to 2012 (8.20 per 100,000). Notably, point estimates for Wales and Northern Ireland have relatively wide confidence intervals. Similar pattern was described in the previous report [2].
- Within England, the lowest rate of polymicrobial episodes was recorded for the Thames Valley, Anglia and Essex, and Yorkshire and Humber (5.63, 10.60, and 10.70 per 100,000) PHE centres. The highest rates were observed in London, Cheshire and Merseyside, and Devon, Cornwall, and Somerset (19.58, 19.16, and 19.01 per 100,000, respectively) PHE centres. Caution should be taken when comparing these infection rates with those in previous reports due to differences in geographical distribution of reporting laboratories (only concerns PHE centres infection rates).

Figure 1. Regional distribution of polymicrobial bacteraemia/ fungaemia episodes (per 100,000 population) in England, Wales, and Northern Ireland: 2013*

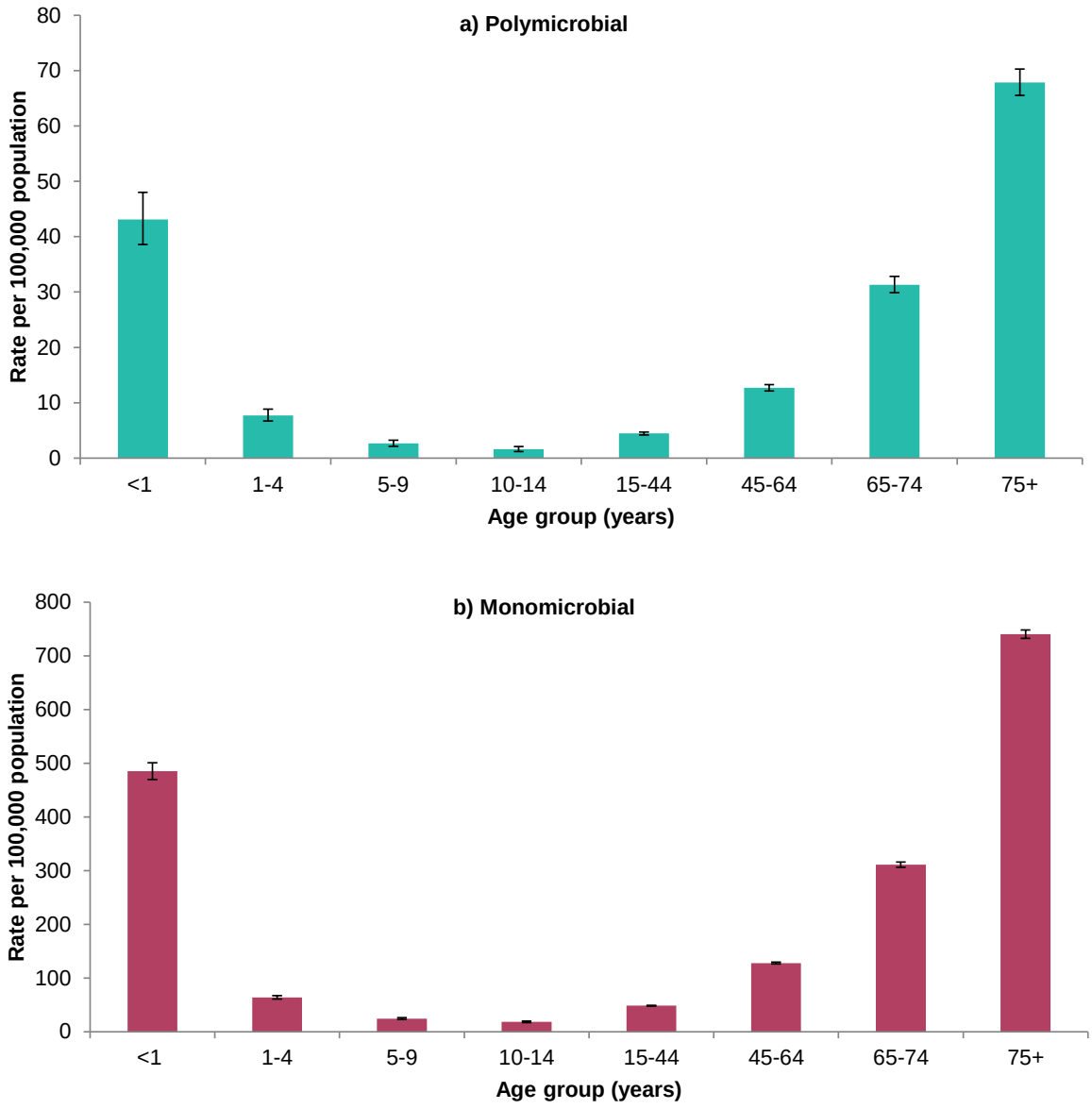


*Data extracted on 4 November, 2014.

Age distribution

- The age distribution of poly- and monomicrobial bacteraemia and fungaemia for 2013 is presented in Figure 2. The highest rate of polymicrobial bacteraemia was observed for those aged 75 years and over (67.87 per 100,000), followed by those aged less than one year (43.11 per 100,000). The lowest rate was recorded for those aged ten to fourteen years (1.60 per 100,000), followed by those aged five to nine years (2.64 per 100,000). This is broadly similar to the pattern observed previously [2].
- Similarly, rates of monomicrobial bacteraemia were also highest amongst the oldest and youngest age groups, with those aged 75 and over and those less than one year having the highest rates at 740.24 and 485.07 per 100,000, respectively. The lowest rates were recorded for those aged ten to fourteen years and five to nine years at 18.36 and 24.38 per 100,000, respectively.

Figure 2. Age-specific rates of polymicrobial (a) and monomicrobial (b) episodes, England, Wales, and Northern Ireland: 2013*



*Data extracted on 4 November, 2014.

Discussion

- The total numbers of patient episodes, bacteraemias, and polymicrobial patient episodes was highest in 2013 (97,699; 105,686; 8,509, respectively). The steady increase in these reports was observed from 2010. The number of fungaemia reports was lower than in the previous year by 2.2% (1,826 and 1,785 in 2012 and 2013, respectively), and the lowest in the four consecutive years (Table 1). The observed year-on-year increase in reports from 2010 onwards may be due an increase in reporting or increasing *Escherichia coli* bloodstream infections [4, 5].
- Similarly to previous years, the majority of polymicrobial bloodstream infections in 2013 were due to bacterial infections (98.4%).
- *Escherichia* spp were the most common organisms found in monomicrobial, and second most common organisms found in polymicrobial infections, after being the most common organisms found in the latter in 2012 [2]. Coagulase-negative staphylococci were the most ubiquitous organisms found in polymicrobial infections in 2013, with the total reports increasing by 16.18% from the previous year.
- The country level rates for England and Northern Ireland shown increase compared to 2012 (14.92 and 12.79 per 100,000, and 14.52 and 11.30 per 100,000, respectively), with the former being on steady increase since 2010 and the latter since 2011 (13.60 and 13.89 per 100,000 in 2010 and 2011, and 11.5 and 10.52 per 100,000 in 2010 and 2011, respectively). The polymicrobial bloodstream infection rates in Wales were the lowest since 2010 at 7.62 per 100,000.
- As seen in previous years, the highest poly- and monomicrobial bloodstream infections were observed in the youngest (<1 year) and the oldest (74 years and over) age groups (Figure 2). This may to a certain degree reflect the susceptibility of the very young and the elderly to infection, however further investigation is required,

It should be borne in mind that the incidence of the different genera and lately the less well known genera is the reflection of changing laboratory technology and the widespread use of MALDI-TOF. The incidence of the various genera may be therefore biased by the lab methodology used to identify organisms.

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