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Bacteraemia

Polymicrobial bacteraemia and fungaemia in England, Wales and Northern Ireland, 2014

These analyses are based on data extracted from the Public Health England (PHE) voluntary surveillance database, the Second Generation Surveillance System (SGSS), on 21 May 2015 for the five-year period 2010-2014. To put these analyses in context, the longitudinal trend for the incidence of polymicrobial and monomicrobial bacteraemia incorporates data for the seven-year period 2008-2014, extracted on the same date. The data presented here may differ in some instances from data in earlier publications due to the change in surveillance systems and the 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 were made based on the residential location of the patient with reference PHE Centres.

Episodes of polymicrobial bloodstream infections were defined as the isolation of two or more different organisms (bacterial and/or fungal) from the same blood specimen. Specimen data reported to SGSS 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 SGSS; these records are not 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 NHS number.

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 specimens rather than a true polymicrobial infection, so the real rates may be lower than reported.

The report includes analyses on the trends, age and sex distribution and geographical distribution of cases of polymicrobial and monomicrobial bloodstream infections.

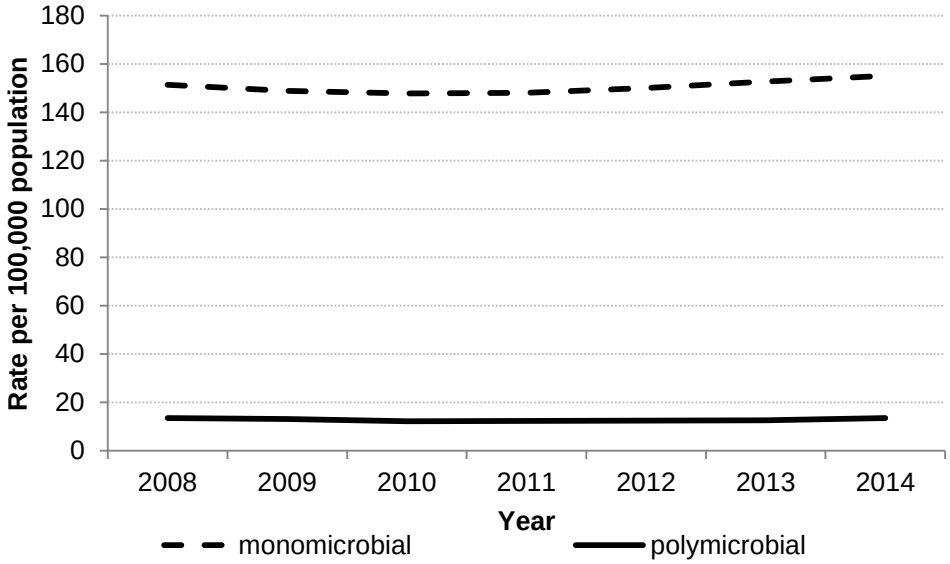
Key points

- overall, the number of patient episodes of bloodstream infections increased by 7.7% between 2010 and 2014 in England, Wales, and Northern Ireland (92,014 episodes in 2010 and 99,191 episodes in 2014)
- the number of polymicrobial patient episodes increased between 2010 and 2014, from 7,025 in 2010 to 8,005 in 2014
- in 2014, 8,005 (8.1%) of the 99,191 patient episodes were identified as polymicrobial and 91,186 (91.9%) monomicrobial infections
- of the 8,005 polymicrobial episodes reported in 2014, a total of 17,052 organisms were isolated, where 7,112 (88.8%) episodes involved two different organisms, 766 (9.6%) episodes involved three different organisms, and 127 (1.6%) episodes involved four or more organisms
- of the 17,052 organisms isolated in the reported polymicrobial episodes, 16,887 (99.0%) were bacterial and 165 (1.0%) were fungal
- the reported national rates (per 100,000 population) of polymicrobial infections were 14.1 for England, 6.7 for Wales and 10.1 for Northern Ireland
- the highest rates were observed in Avon, Gloucestershire and Wiltshire (20.2 per 100,000 population), and Devon, Cornwall and Somerset (18.6 per 100,000 population)
- the highest rate of polymicrobial bloodstream infection was observed for males and females aged 75 years and over (97.1 and 51.4 per 100,000 population respectively), and males and females aged less than one year (37.4 and 28.8 per 100,000 respectively).

Trends in episode numbers and rates

Between 2008 and 2010, the incidence rate of monomicrobial and polymicrobial caused by bloodstream infection and/or fungaemia fell from 151.3 to 147.8 per 100,000 population, and 13.5 to 12.2 per 100,000 population respectively (figure 1). From 2010 onwards, both the rate of monomicrobial and polymicrobial infections has steadily increased from 147.8 to 155.1 per 100,000, and 12.2 to 13.6 per 100,000 respectively. The observed year-on-year increase in reports from 2010 onwards may be due an increase in reporting or increasing *Escherichia coli* bloodstream infections [3, 4].

Figure 1. Trends of monomicrobial and polymicrobial bacteraemia and/or fungaemia patient episodes in England, Wales and Northern Ireland: 2008-2014



In 2014, 99,191 patient episodes involving either bacteraemia and/or fungaemia were identified from reports received from laboratories in England, Wales, and Northern Ireland (table 1). This represented a 5-year increase of 7.7% since 2010 (92,014 episodes).

Based on the positive blood specimens reported in 2014, 8,005 patient episodes (8.1% of all patient episodes) were identified as polymicrobial and 91,186 were identified as monomicrobial. The proportion of polymicrobial patient episodes was highest in 2014, where the proportion between 2010 and 2013 had been steady between 7.6-7.7%.

Table 1. Trends in reports of bacteraemia and fungaemia in England, Wales and Northern Ireland: 2010-2014

	2010	2011	2012	2013	2014
Total reported bacteraemia†	98,352	99,459	101,537	103,808	106,708
Total reported fungaemia†	1,692	1,784	1,704	1,713	1,597
Number of patient episodes	92,014	93,031	94,912	97,122	99,191
Number of polymicrobial patient episodes	7,025	7,192	7,310	7,391	8,005
Percentage of patient episodes that are polymicrobial	7.6%	7.7%	7.7%	7.6%	8.1%

† 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: 2014

Of the 8,005 polymicrobial patient episodes, 7,112 involved two different organisms, 766 involved three different organisms, and 127 involved four or more organisms (table 2). There were 17,052 organisms isolated from the reported 8,005 polymicrobial episodes, of which 16,887 (99.0%) were bacterial and 165 (1.0%) were fungi.

The most frequently reported organisms involved in polymicrobial infections were *Escherichia* species (39.0%), followed by coagulase-negative staphylococci (28.6%), and Enterococcus species (22.3%; table 3). This is a change to the previous year, when coagulase-negative staphylococci were the most commonly reported pathogen in polymicrobial infections [2]. A total of 146 and 116 different genera were isolated from patients with monomicrobial or polymicrobial infections respectively (table 4).

The most frequently reported organisms in the 91,186 monomicrobial patient episodes (table 3) were *Escherichia* species (30.0%) (of which 99.9% were *Escherichia coli)* followed by coagulase-negative staphylococci (17.4%) and *Staphylococcus aureus* (8.9%).

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 laboratory methodology used to identify organisms.

Table 2. Number of organisms involved in polymicrobial infectious episodes, 2014

Number of organisms	Episodes	%
Two	7112	88.8%
Three	766	9.6%
Four	109	1.4%
Five	14	0.2%
More than five	4	0.0%

Table 3. The ten most frequently reported genera/organisms in polymicrobial and monomicrobial bloodstream infection episodes: 2014

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

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

Table 4. Reports of monomicrobial and polymicrobial bacteraemia and fungaemia by genera or species, England, Wales, and Northern Ireland: 2014

	Bloodstream infections					
	Monomicrobial			Polymicrobial		
Organism	n†	%‡	Rank	n†	%‡	Rank
*Escherichia***	27,335	29.96	1	3,128	39.08	1
Staphylococcus, coagulase negative	15,884	17.41	2	2,286	28.56	2
Staphylococcus aureus	8,090	8.87	3	784	9.79	7
Streptococcus, non-pyogenic	7,135	7.82	4	1,325	16.55	5
Klebsiella	5,107	5.60	5	1,623	20.27	4
Streptococcus, pyogenic	4,547	4.98	6	315	3.94	11
Enterococcus	3,818	4.18	7	1,787	22.32	3
Pseudomonas	2,865	3.14	8	654	8.17	8
Proteus	1,951	2.14	9	578	7.22	9
Enterobacter	1,416	1.55	10	436	5.45	10
Candida	1,334	1.46	11	154	1.92	17
Bacteroides	932	1.02	12	212	2.65	14
Micrococcus	932	1.02	12	126	1.57	21
Propionibacterium	824	0.90	13	126	1.57	21
Serratia	688	0.75	14	143	1.79	18
Neisseria	652	0.71	15	45	0.56	25
Clostridium	640	0.70	16	259	3.24	12
Diphtheroids	567	0.62	17	185	2.31	16
Citrobacter	549	0.60	18	216	2.7	13
Haemophilus	521	0.57	19	43	0.54	27
Acinetobacter	519	0.57	20	188	2.35	15
Corynebacterium	464	0.51	21	129	1.61	20
Salmonella	398	0.44	22	15	0.19	38
Bacillus	357	0.39	23	141	1.76	19
Stenotrophomonas	349	0.38	24	141	1.76	19
Coliform	334	0.37	25	1,153	14.4	6
Bordetella	293	0.32	26	1	0.01	51
Morganella	278	0.30	27	123	1.54	22
Moraxella	209	0.23	28	49	0.61	24
Fusobacterium	139	0.15	29	30	0.37	32
Campylobacter	139	0.15	29	7	0.09	45

Organism	Bloodstream infections					
	Monomicrobial			Polymicrobial		
	n†	%‡	Rank	n†	%‡	Rank
Borrelia	131	0.14	30	0	-	-
Mycobacterium	124	0.14	31	6	0.07	46
Listeria	111	0.12	32	5	0.06	47
Pasteurella	76	0.08	33	8	0.1	44
Actinomyces	75	0.08	34	33	0.41	30
Peptostreptococcus	74	0.08	35	23	0.29	35
Aeromonas	72	0.08	36	65	0.81	23
Gemella	71	0.08	37	36	0.45	28
Achromobacter	67	0.07	38	18	0.22	36
Prevotella	65	0.07	39	16	0.2	37
Lactobacillus	64	0.07	40	44	0.55	26
Providencia	58	0.06	41	35	0.44	29
Rothia	55	0.06	42	27	0.34	33
Pantoea	54	0.06	43	31	0.39	31
Raoultella	49	0.05	44	26	0.32	34
Brevundimonas	38	0.04	45	3	0.04	49
Lactococcus	34	0.04	46	18	0.22	36
Veillonella	34	0.04	46	16	0.2	37
Ochrobactrum	34	0.04	46	9	0.11	43
Capnocytophaga	30	0.03	47	2	0.02	50
Brevibacterium	29	0.03	48	10	0.12	42
Granulicatella	26	0.03	49	14	0.17	39
Hafnia	26	0.03	49	11	0.14	41
Eggerthella	26	0.03	49	9	0.11	43
Burkholderia	26	0.03	49	2	0.02	50
Roseomonas	25	0.03	50	3	0.04	49
Bifidobacterium	24	0.03	51	3	0.04	49
Phialophora	24	0.03	51	0	-	-
Chryseobacterium	22	0.02	52	11	0.14	41
Rhizobium	19	0.02	53	10	0.12	42
Cryptococcus	19	0.02	53	0	-	-
Kocuria	17	0.02	54	7	0.09	45
Aspergillus	17	0.02	54	0	-	-
Arcanobacterium	15	0.02	55	9	0.11	43
Kluyvera	15	0.02	55	8	0.1	44
Eikenella	14	0.02	56	4	0.05	48
Peptococcus	14	0.02	56	3	0.04	49
Dermabacter	13	0.01	57	8	0.1	44
Gardnerella	13	0.01	57	3	0.04	49
Kingella	13	0.01	57	1	0.01	51
Rhodococcus	12	0.01	58	6	0.07	46
Leuconostoc	11	0.01	59	12	0.15	40
Anaerococcus	10	0.01	60	0	-	-
Brucella	10	0.01	60	0	-	-
Anaerobiospirillum	8	0.01	61	5	0.06	47
Arthrobacter	8	0.01	61	3	0.04	49
Leptospira	8	0.01	61	2	0.02	50
Yersinia	8	0.01	61	2	0.02	50
Rhodotorula	8	0.01	61	1	0.01	51
Sphingobacterium	8	0.01	61	1	0.01	51
Sphingomonas	8	0.01	61	0	-	-
Pediococcus	7	0.01	62	4	0.05	48
Leclercia	7	0.01	62	1	0.01	51
Alcaligenes	6	0.01	63	9	0.11	43

Organism	Bloodstream infections					
	Monomicrobial			Polymicrobial		
	n†	%‡	Rank	n†	%‡	Rank
Peptoniphilus	6	0.01	63	4	0.05	48
Aggregatibacter	6	0.01	63	1	0.01	51
Collinsella	6	0.01	63	1	0.01	51
Shigella	6	0.01	63	1	0.01	51
Eubacterium	6	0.01	63	0	-	-
Comamonas	5	0.01	64	5	0.06	47
Ralstonia	5	0.01	64	4	0.05	48
Parvimonas	5	0.01	64	3	0.04	49
Leptotrichia	5	0.01	64	1	0.01	51
Epidermophyton	5	0.01	64	0	-	-
Parabacteroides	5	0.01	64	0	-	-
Delftia	4	0.00	65	6	0.07	46
Saccharomyces	4	0.00	65	3	0.04	49
Cardiobacterium	4	0.00	65	1	0.01	51
Finegoldia	4	0.00	65	1	0.01	51
Nocardia	4	0.00	65	1	0.01	51
Paenibacillus	4	0.00	65	0	-	-
Pneumocystis	4	0.00	65	0	-	-
Gordonia	3	0.00	66	2	0.02	50
Microbacterium	3	0.00	66	2	0.02	50
Flavobacterium	3	0.00	66	1	0.01	51
Trichosporon	3	0.00	66	1	0.01	51
Coccidioides	3	0.00	66	0	-	-
Globicatella	2	0.00	67	3	0.04	49
Agrobacterium	2	0.00	67	2	0.02	50
Stomatococcus	2	0.00	67	2	0.02	50
Actinobacillus	2	0.00	67	1	0.01	51
Erysipelothrix	2	0.00	67	1	0.01	51
Geotrichum	2	0.00	67	1	0.01	51
Psychrobacter	2	0.00	67	1	0.01	51
Rahnella	2	0.00	67	1	0.01	51
Actinobaculum	2	0.00	67	0	-	-
Atopobium	2	0.00	67	0	-	-
Fusarium	2	0.00	67	0	-	-
Legionella	2	0.00	67	0	-	-
Oligella	2	0.00	67	0	-	-
Shewanella	2	0.00	67	0	-	-
Alloiococcus	1	0.00	68	1	0.01	51
Malassezia	1	0.00	68	1	0.01	51
Streptobacillus	1	0.00	68	1	0.01	51
Aurantimonas	1	0.00	68	0	-	-
Bilophila	1	0.00	68	0	-	-
Butyribacterium	1	0.00	68	0	-	-
Calymmatobacterium	1	0.00	68	0	-	-
Capnocytophagia	1	0.00	68	0	-	-
Dermacoccus	1	0.00	68	0	-	-
Desulfovibrio	1	0.00	68	0	-	-
Dialister	1	0.00	68	0	-	-
Facklamia	1	0.00	68	0	-	-
Massilia	1	0.00	68	0	-	-
Methylobacterium	1	0.00	68	0	-	-
Mucor	1	0.00	68	0	-	-
Neoscytalidium	1	0.00	68	0	-	-
Paecilomyces	1	0.00	68	0	-	-

Organism	Bloodstream infections					
	Monomicrobial			Polymicrobial		
	n†	%‡	Rank	n†	%‡	Rank
Pandoraea	1	0.00	68	0	-	-
Porphyromonas	1	0.00	68	0	-	-
Rhizomucor	1	0.00	68	0	-	-
Rhizopus	1	0.00	68	0	-	-
Ruminococcus	1	0.00	68	0	-	-
Sneathia	1	0.00	68	0	-	-
Trichophyton	1	0.00	68	0	-	-
Brevibacillus	0	-	-	2	0.02	50
Exophiala	0	-	-	2	0.02	50
Myroides	0	-	-	2	0.02	50
Vibrio	0	-	-	2	0.02	50
Absidia	0	-	-	1	0.01	51
Chryseomonas	0	-	-	1	0.01	51
Empedobacter	0	-	-	1	0.01	51
Herbasprillum	0	-	-	1	0.01	51
Leminorella	0	-	-	1	0.01	51
Paracoccidioides	0	-	-	1	0.01	51
Total	**91,253**	**100**		**8,005**	**100**	

Geographic distribution

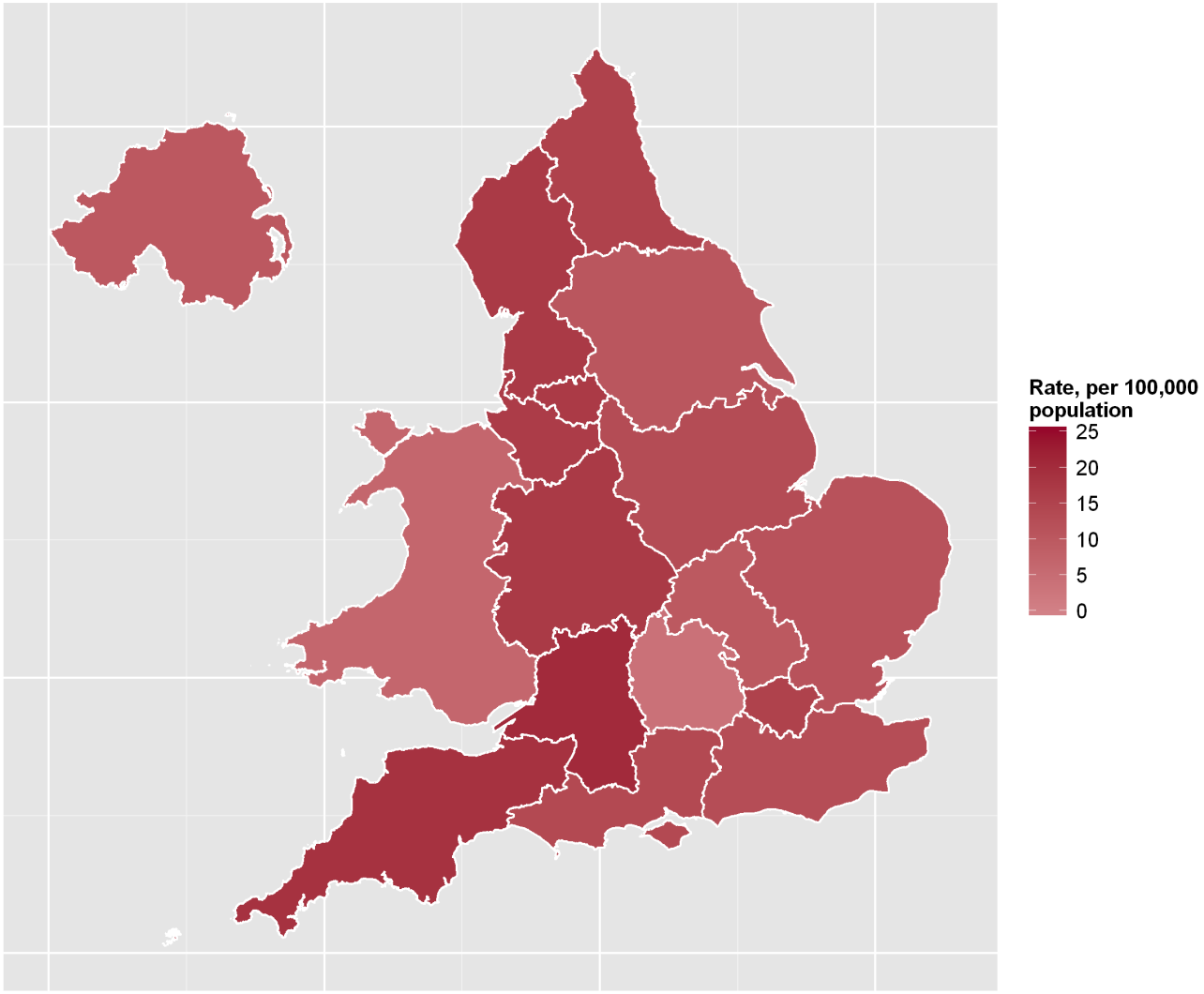
The overall rate of polymicrobial episodes in England, Wales, and Northern Ireland was 13.6 per 100,000 population in 2014 (table 5). By country, the reported rates (per 100,000 population) were 14.1, 6.7 and 10.1 respectively.

Only the English rates increased compared to the previous year (12.9 to 14.1 per 100,000), while the rate decreased in Wales (7.3 to 6.7 per 100,000) and Northern Ireland (12.0 to 10.1 per 100,000). Similar pattern was described in the previous report [2]. Within England in 2014, the lowest rate of polymicrobial episodes was recorded for the Thames Valley (3.9 per 100,000), South Midlands and Hertfordshire (10.0 per 100,000), and Yorkshire and Humber (10.5 per 100,000) (figure 1). The highest rates were observed in Avon, Gloucestershire and Wiltshire (20.2 per 100,000), and Devon, Cornwall and Somerset (18.6 per 100,000). 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).

Table 5. Regional distribution of polymicrobial bacteraemia and/or fungaemia episodes (per 100,000 population) in England, Wales and Northern Ireland: 2010-2014

Region	PHE Centre	Rate, per 100,000 population				
		2010	2011	2012	2013	2014
North of England	Cheshire and Merseyside	15.0	18.1	16.3	16.5	16.6
	Cumbria and Lancashire	10.5	9.7	12.4	14.1	17.1
	Greater Manchester	15.7	14.4	15.2	14.9	17.0
	North East	9.4	9.6	9.2	12.0	15.3
	Yorkshire and Humber	13.4	11.0	10.3	9.8	10.5
Midlands and East of England	South Midlands and Hertfordshire	7.8	9.3	11.2	9.7	10.0
	East Midlands	15.2	13.2	12.3	12.1	13.1
	Anglia and Essex	9.4	10.2	10.2	9.4	11.5
	West Midlands	12.3	12.8	13.4	14.5	17.1
London	London	14.0	14.9	15.2	15.3	15.3
South of England	Avon, Gloucestershire and Wiltshire	11.7	12.8	15.4	15.4	20.2
	Devon, Cornwall and Somerset	16.5	15.3	15.9	17.3	18.6
	Wessex	15.1	15.7	14.9	13.2	13.7
	Kent, Surrey and Sussex	12.8	12.7	13.0	12.7	12.7
	Thames Valley	4.5	6.1	4.8	4.9	3.9
England		12.5	12.6	12.8	12.9	14.1
Wales		8.1	9.9	8.6	7.3	6.7
Northern Ireland		10.2	9.9	10.3	12.0	10.1
England, Wales and Northern Ireland		12.2	12.4	12.5	12.6	13.6

Figure 2. Regional distribution of polymicrobial bacteraemia and/or fungaemia episodes (per 100,000 population) in England, Wales and Northern Ireland: 2014



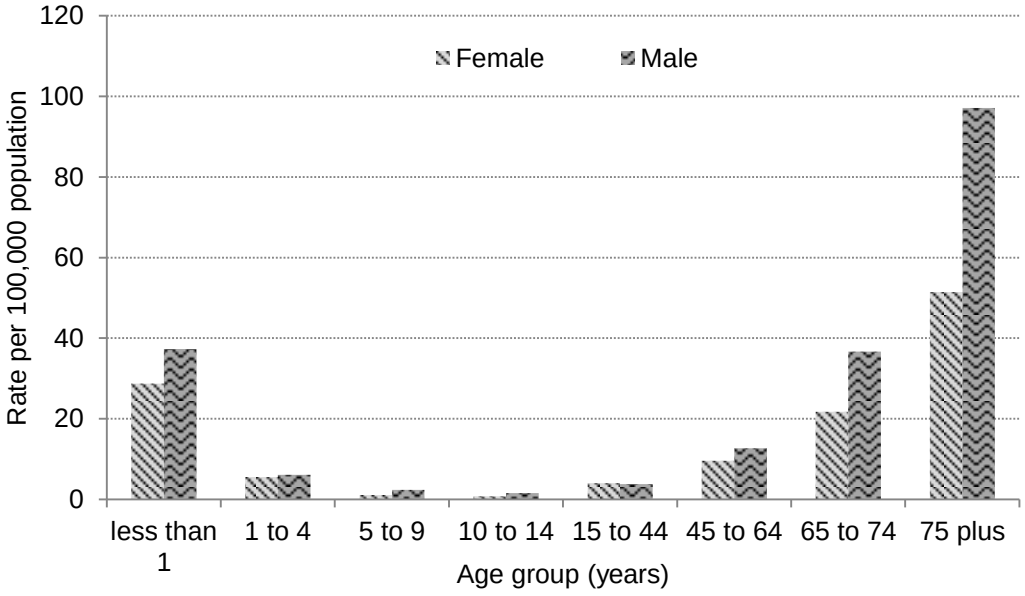
Age and sex distribution

The age distribution of polymicrobial and monomicrobial bacteraemia and/or fungaemia for 2014 is presented in figure 3. The highest rate of polymicrobial bloodstream infection was observed for males and females aged 75 years and over (97.1 and 51.4 per 100,000 respectively), followed by males and females aged less than one year (37.4 and 28.8 per 100,000 respectively). The lowest rate for both sexes was recorded for those aged ten to fourteen years (1.6 and 0.8 per 100,000 respectively). This is similar to the pattern observed previously [2].

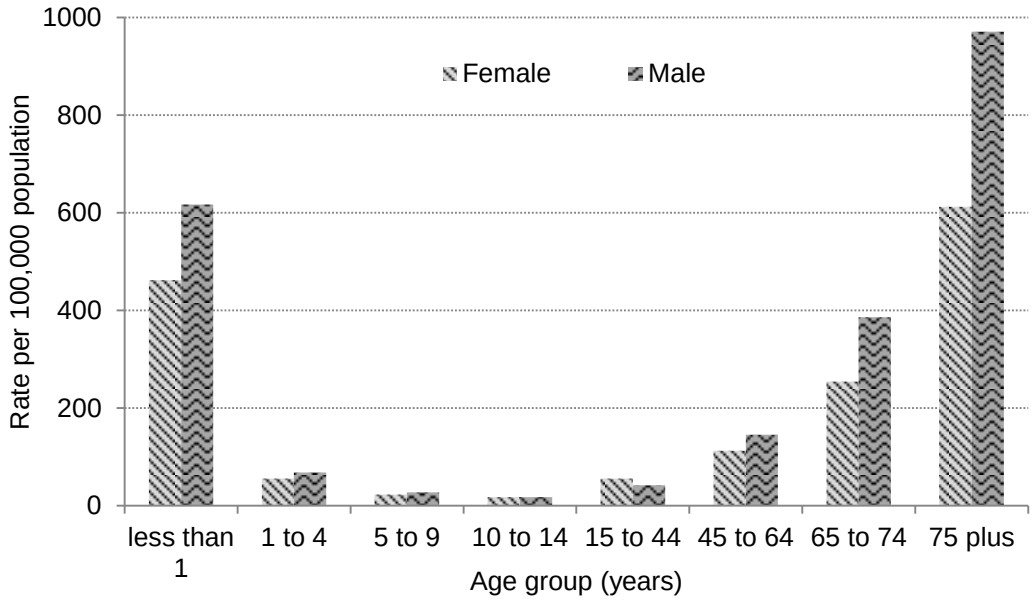
Similarly, rates of monomicrobial bloodstream infections were also highest amongst the oldest and youngest age groups, with those aged 75 and over (male: 971.2 per 100,000; female: 612.5 per 100,000) and those less than one year (male: 616.7 per 100,000; female: 462.2 per 100,000) having the highest rates for both sexes. The lowest rates were recorded for those aged 10 to 14 years (17.7 per 100,000 for both males and females).

Figure 3. Age-specific rates of (a) polymicrobial, and (b) monomicrobial episodes, England, Wales, and Northern Ireland: 2014

(a) Polymicrobial episodes



(b) Monomicrobial episodes



Acknowledgements

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