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Laboratory surveillance of polymicrobial bacteraemia and fungaemia in England, Wales and Northern Ireland: 2017

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These analyses are based on all laboratory reports bacteraemia and fungaemia (bloodstream infections) in England, Wales and Northern Ireland from 2010 to 2017. Data for laboratories in England were extracted on 13 February 2018 from Public Health England's voluntary surveillance database, the Second Generation Surveillance System (SGSS), communicable disease module (CDR; formerly CoSurv/LabBase2). Data from Wales are extracted from a single laboratory information system (DataStore on 6 February) used by all microbiology laboratories, where all positive blood cultures are extracted, including those not thought to be clinically significant. Data for Northern Ireland was extracted separately (CoSurv on 7 February 2018).

Rates of bloodstream infection were calculated using mid-year resident population estimates for the respective year and geography with the exception of 2017 rates, which were based on 2016 estimates as 2017 data were not available at the time of producing this report [1]. Geographical analyses were based on residential postcode, if known (otherwise GP postcode if known, or failing that the postcode of the reporting laboratory) with cases in England being assigned to one of nine local PHE Centres (PHECs) formed from administrative local authority boundaries.

Bacteraemia and fungaemia episodes for a given species were calculated using a 14-day rolling window whereby successive laboratory identifications of the same species within 14 days of the last identification are grouped into a single episode. These within-species episodes are then grouped into monomicrobial or polymicrobial patient episodes.

Patient episodes of polymicrobial bacteraemia and/or fungaemia were defined as the isolation of two or more different bacterial and/or fungal species isolated from the same patient, on the same day. Therefore, bacteraemia and/or fungaemia from a patient with three distinct bacterial species (A, B and C) identified from positive blood cultures taken on the same day will be as a single polymicrobial patient episode (A + B + C).

The rates of bacteraemia and fungaemia episodes in this report should be interpreted with caution as the data are derived from largely voluntary reports, but also includes notifiable diseases [2]. In addition, it is possible that some reports may reflect the reporting of potential skin commensals/contaminants.

The report includes analyses on the trends, age and sex distribution and geographical distribution of cases of polymicrobial and monomicrobial bloodstream infections. [A web appendix is available](#) featuring the findings of this report including only data submitted via SGSS from laboratories in England.

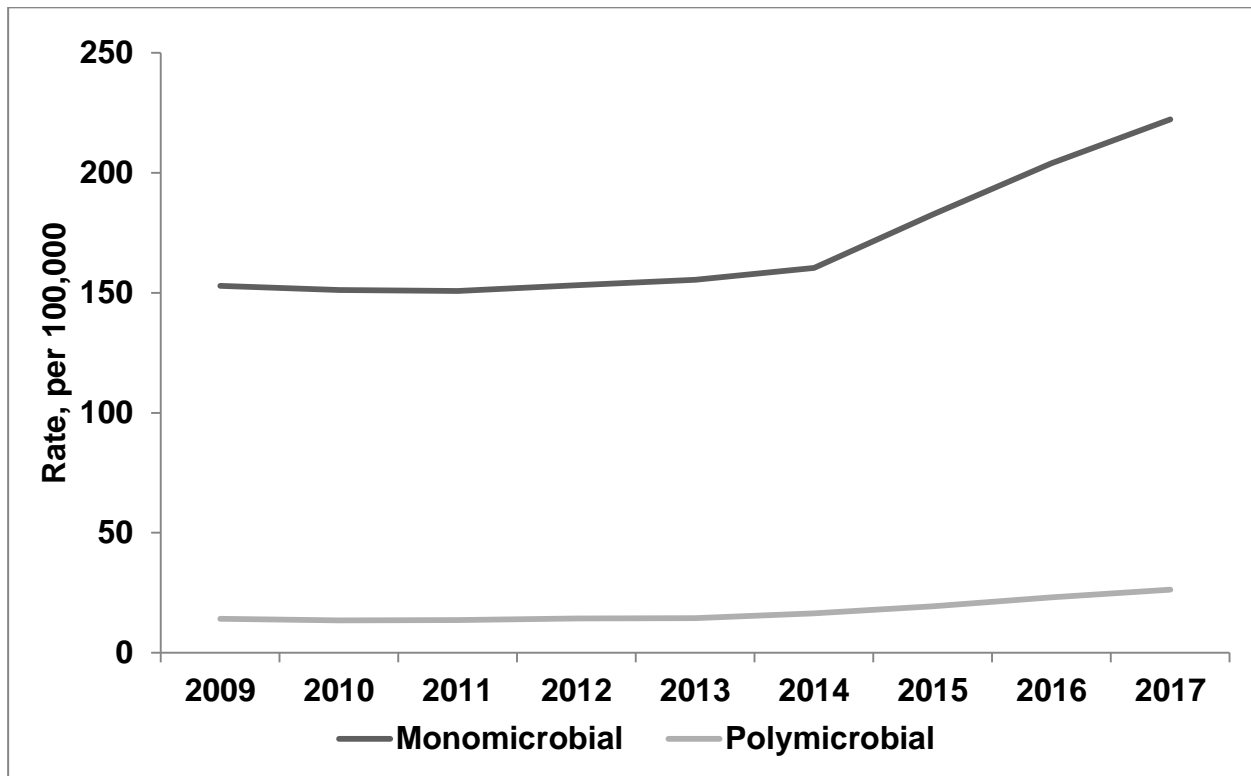
The data presented here may differ in some instances from data in earlier publications due to the change in surveillance systems and the inclusion of late reports.

Key points

- the total number of bacterial and fungal bloodstream infection reports from England, Wales, and Northern Ireland increased by 53.7% between 2013 and 2017 (n=107,566 in 2013 and n= 165,362 in 2017)
- in 2017, 15,868 (10.6%) of the 149,823 bloodstream infection episodes were identified as polymicrobial
- there were 474 organisms isolated from polymicrobial bloodstream infections, of which 454 (95.8%) were bacteria and 20 (4.2%) were fungi
- 13,562 (85.5%) of polymicrobial bloodstream infection involved two different species, 1,932 (12.2%) involved three species, 298 (1.8%) involved four and 73 (0.5%) involved five or more distinct species
- 627 (4.0%) of the 15,868 polymicrobial patient episodes in 2017 involved both bacterial and fungal isolates
- the population rates (per 100,000 population) of polymicrobial infections in 2017 were 27.2 for England, 16.3 for Wales and 16.1 for Northern Ireland
- in England, the highest rates of polymicrobial bacteraemia/fungaemia were observed in the South West (43.1 per 100,000 population), and Yorkshire & Humber (36.2); the lowest rates were observed in the North East (21.2), and London (21.4)
- the highest rate of polymicrobial bacteraemia/fungaemia was observed for males and females aged 75 years and over (175.8 and 94.4 per 100,000 population, respectively), and males and females aged less than one year (73.2 and 63.8 per 100,000, respectively).

Trends in episode numbers and rates

Figure 1. Trends in the rate of monomicrobial and polymicrobial bacteraemia and/or fungaemia (per 100,000 population) in England, Wales and Northern Ireland: 2009-2017



In 2017, 149,823 patient episodes with a monomicrobial or polymicrobial bacteraemia and/or fungaemia (bloodstream infection) were identified from reports received from laboratories in England, Wales and Northern Ireland (table 1). This represented a 57.2% increase in patient episodes since 2009 (95,303 episodes).

The rate of laboratory reports of bloodstream infection between 2009 and 2017 increased from 153.0 to 222.4 per 100,000 population (monomicrobial) and 14.2 to 26.3 per 100,000 population (polymicrobial), respectively (figure 1). Between 2009 and 2014, there was a slight increase of 4.8% (from 153.0 to 160.4/100,000) for monomicrobial episodes, and 21.5% (from 13.5 to 16.4 /100,000) for polymicrobial episodes. Thereafter the increase accelerated with a 38.7% rise in monomicrobial episodes (160.4 to 222.4/100,000) between 2014 and 2017 and 60.5% (from 16.4 to 26.4/100,000) for polymicrobial episodes.

The observed increase in bacteraemia and fungaemia episodes (38.7%) between 2014 and 2017 may be partly due to more extensive laboratory reporting to PHE following the switch from LabBase2 to SGSS in October 2014. Other relevant and potentially

contributory laboratory changes included the widespread adoption of MALDI-TOF, changes in PCR testing in a number of laboratories and, national policy changes and public health interventions resulting in an increase in blood cultures being taken [3,4,5].

Table 1. Trends in reports of bacteraemia and fungaemia in England, Wales and Northern Ireland: 2013-2017

	2013	2014	2015	2016	2017
Total reported bacteraemia [†]	107,566	113,688	131,358	150,224	165,362
Total reported fungaemia [†]	1,870	1,805	2,032	2,244	2,319
Number of patient bacteraemia episodes	98,184	103,087	118,786	134,941	147,871
Number of patient fungaemia episodes	1,719	1,671	1,846	1,946	1,952
Number of polymicrobial patient episodes [‡]	8,514	9,726	11,536	13,958	15,868
Percentage of patient episodes that are polymicrobial	8.5%	9.3%	9.6%	10.2%	10.6%

[†] 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.

[‡] Defined as an infection with two or more organisms (bacteria or fungi) with a positive blood culture sample on the same day

Of the 15,868 patient episodes with a polymicrobial bloodstream infection, 13,562 involved two different species, 1,932 involved three species, 298 involved four and 73 involved five or more distinct species (table 2); 627 polymicrobial patient episodes involved both bacterial and fungal isolates, an increase of 41% compared with 2016. There were 474 organisms isolated from the reported 15,868 polymicrobial bloodstream infections, of which 454 (95.8%) were bacteria and 20 (4.2%) were fungi.

Table 2. Number of species involved in polymicrobial bacteraemia and/or fungaemia patient episodes, England, Wales and Northern Ireland: 2017

No. organisms	No. episodes	Percent (%)
Two	13,562	85.5%
Three	1,935	12.2%
Four	298	1.9%
Five	54	0.3%
More than five	19	0.1%
Total	15,868	100.0%

The most frequently reported organisms involved in polymicrobial bloodstream infections were *Escherichia coli* (15.4%) followed by coagulase-negative staphylococci (CONS) (13.1%) then coliforms not further identified (6.4%; table 3 Table 3).

A total of 621 different species were isolated from patients with polymicrobial infections in 2017. The top 25 organisms, as ranked by their monomicrobial episode counts are presented in table 4; a [comprehensive species/organism level table is available online in full as a web appendix](#).

For comparison, the dominant agents of monomicrobial bacteraemias were *Escherichia coli* (26.4%) followed by CONS (22.2%) and, *Staphylococcus aureus* (8.2%; table 3) with a total of 857 different species isolated from patients with monomicrobial infections in 2016 (table 4; [see online appendix for full table](#)).

The identification of the different species, including those less well known, is in part a likely reflection of changing laboratory technology and the widespread use of MALDI-TOF. The changing relative frequency of the various species may therefore be influenced by the laboratory methodology used to identify organisms.

Table 3. The 10 most frequently reported species or organism category in polymicrobial and monomicrobial bacteraemia and/or fungaemia, England, Wales and Northern Ireland: 2017

Rank	Polymicrobial	Rank	Monomicrobial
1	<i>Escherichia coli</i>	1	<i>Escherichia coli</i>
2	<i>Staphylococcus</i> coagulase negative	2	<i>Staphylococcus</i> coagulase negative
3	Coliforms	3	<i>Staphylococcus aureus</i>
4	<i>Klebsiella pneumoniae</i>	4	<i>Klebsiella pneumoniae</i>
5	<i>Staphylococcus aureus</i>	5	<i>Streptococcus pneumoniae</i>
6	<i>Enterococcus faecalis</i>	6	<i>Pseudomonas aeruginosa</i>
7	<i>Enterococcus faecium</i>	7	<i>Enterococcus faecalis</i>
8	<i>Pseudomonas aeruginosa</i>	8	<i>Proteus mirabilis</i>
9	<i>Proteus mirabilis</i>	9	<i>Streptococcus</i> group A
10	<i>Bacillus</i> sp	10	<i>Streptococcus</i> group B

Table 4. Reports of monomicrobial and polymicrobial bacteraemia and fungaemia by species or organism category, England, Wales and Northern Ireland: 2017

Organism	Bacteraemia / fungaemia					
	Monomicrobial			Polymicrobial		
	n [†]	%	Rank	n [†]	%	Rank
<i>Escherichia coli</i>	35,414	26.4%	1	5,199	15.4%	1
<i>Staphylococcus coagulase negative</i>	29,716	22.2%	2	4,401	13.1%	2
<i>Staphylococcus aureus</i>	10,989	8.2%	3	1,454	4.3%	5
<i>Klebsiella pneumoniae</i>	5,501	4.1%	4	1,742	5.2%	4
<i>Streptococcus pneumoniae</i>	5,165	3.7%	5	244	0.7%	23
<i>Pseudomonas aeruginosa</i>	3,063	2.3%	6	913	2.7%	8
<i>Enterococcus faecalis</i>	2,509	1.9%	7	1,453	4.3%	6
<i>Proteus mirabilis</i>	2,505	1.9%	8	904	2.7%	9
<i>Streptococcus group A</i>	2,105	1.6%	9	240	0.7%	24
<i>Streptococcus group B</i>	1,911	1.4%	10	277	0.8%	19
<i>Enterococcus faecium</i>	1,801	1.3%	11	937	2.8%	7
<i>Streptococcus group G</i>	1,216	0.9%	12	144	0.4%	38
<i>Enterobacter cloacae</i>	1,157	0.9%	13	454	1.4%	14
<i>Streptococcus group C</i>	1,154	0.9%	14	175	0.5%	32
<i>Klebsiella oxytoca</i>	1,093	0.8%	15	610	1.8%	12
<i>Micrococcus luteus (sarcina)</i>	972	0.7%	16	127	0.4%	41
<i>Serratia marcescens</i>	804	0.6%	17	188	0.6%	30
<i>Candida albicans (stellatoidea)</i>	738	0.6%	18	164	0.5%	36
<i>Bacteroides fragilis</i>	724	0.5%	19	220	0.7%	26
<i>Streptococcus mitis group</i>	723	0.5%	20	488	1.5%	13
<i>Bordetella pertussis</i>	722	0.5%	21	0	0.0%	108
Diphtheroids	697	0.5%	22	249	0.7%	22
<i>Haemophilus influenzae</i>	662	0.5%	23	62	0.2%	57
<i>Micrococcus sp</i>	650	0.5%	24	101	0.3%	45
<i>Propionibacterium acnes</i>	601	0.5%	25	117	0.4%	43
Total *	133,961	100%		33,720	100%	

†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.

* Represents the full total, the remaining results can be found on the online appendix

NB: *Treponema* and *Helicobacter* have been removed from the analysis.

Geographic distribution

The rates of laboratory reports of polymicrobial bacteraemia and/or fungaemia in 2017 were similar in Wales and Northern Ireland at 16.3 and 16.1 per 100,000 population, respectively, whereas rates were substantially higher in England at 27.2 per 100,000 population (figure 2). Among England's PHE Centres, the lowest rates were observed in the North East (21.2 per 100,000 population), and London (21.4) and highest rates in the South West (43.1), and Yorkshire and Humber (36.2).

Compared to 2013, the rate of polymicrobial bacteraemia and fungaemia episodes increased by 88.3% in England, and 28.7% in Northern Ireland in 2017 (table 5).

The rate in Wales has remained relatively stable between 2013-2017 (15.9-16.3 per 100,000 population). Of note, both Wales and Northern Ireland observed a decline in the rate in 2017 compared to 2016.

Figure 2. Regional distribution of polymicrobial bacteraemia and/or fungaemia episodes per 100,000 population in England, Wales and Northern Ireland: 2017

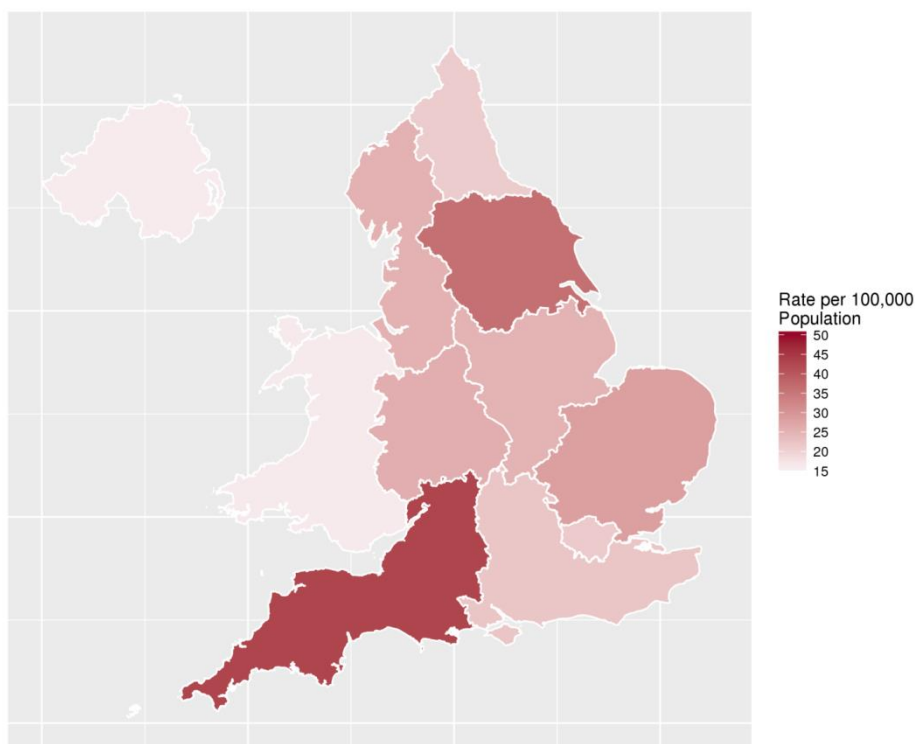


Table 5. Polymicrobial bacteraemia and/or fungaemia episodes per 100,000 population by region (England, Wales and Northern Ireland): 2013 to 2017

Region	PHE Centre	Rate, per 100,000 population				
		2013	2014	2015	2016	2017
North of England	North East	12.7	16.3	14.1	19.3	21.2
	North West	17.2	19.6	21.9	27.1	25.5
	Yorkshire and Humber	10.7	11.8	19.6	21.5	36.2
Midlands and East of England	East Midlands	12.9	13.5	17.7	21.4	25.2
	East of England	10.1	13.7	17.0	21.5	28.3
	West Midlands	16.3	19.7	23.2	25.9	26.0
London	London	18.5	19.8	18.3	20.3	21.4
South of England	South East	11.5	11.8	14.6	19.6	22.0
	South West	18.6	23.0	30.4	38.3	43.1
England		14.5	16.6	19.6	23.8	27.2
Wales		15.9	14.5	15.2	16.7	16.3
Northern Ireland		12.5	13.3	16.6	16.3	16.1
England, Wales and Northern Ireland		14.5	16.4	19.3	23.2	26.3

These rates should be interpreted with caution, as they may reflect changes in laboratory reporting or diagnostic methods in addition to increases in incidence

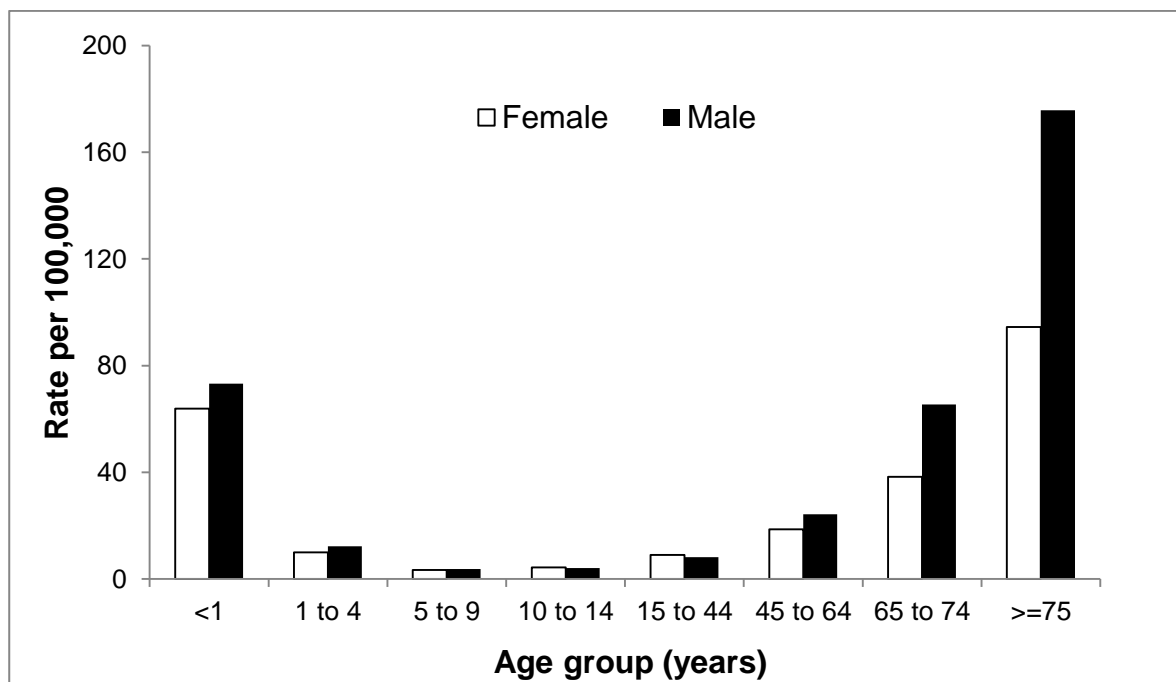
Age and sex distribution

The highest rate of polymicrobial bloodstream infection in England, Wales and Northern Ireland was observed for males and females aged 75 years and older (175.8 and 94.4 per 100,000 population respectively), followed by males and females less than one year of age (73.2 and 63.8/100,000 respectively) (figure 3a). These are similar to the age-specific patterns observed in 2016 [5].

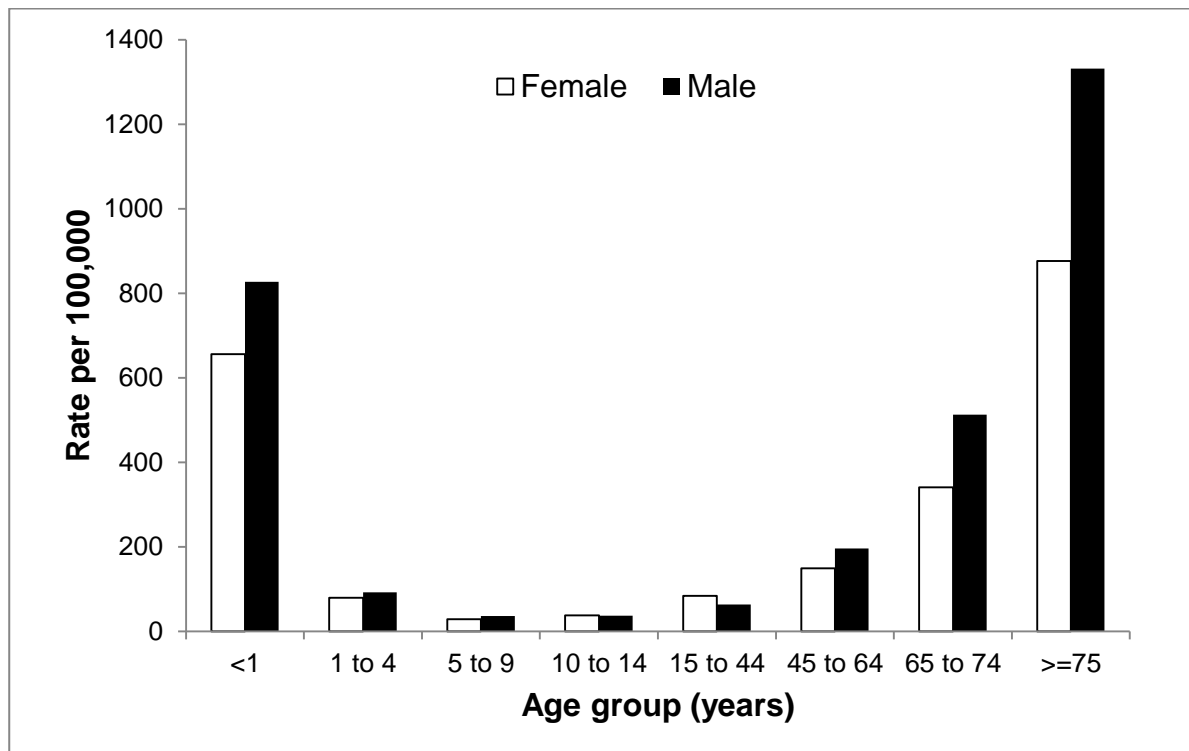
Age and sex-specific rates of monomicrobial bloodstream infections followed the same pattern being highest in those aged 75 years and over (1,331.5 males; 876.4 females/100,000) and those aged less than one year (827.0 males; 655.6 females/100,000) (figure 3b).

Figure 3. Polymicrobial, and monomicrobial episode rate by age and sex (England, Wales and Northern Ireland): 2017

(a) Polymicrobial bloodstream infection



(b) Monomicrobial bloodstream infection



Acknowledgements

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