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Laboratory surveillance of polymicrobial bacteraemia and fungaemia in England, Wales and Northern Ireland: 2018

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These analyses are based on laboratory reported bacteraemia and fungaemia (bloodstream infections) in England, Wales and Northern Ireland from 2010 to 2018. Data for laboratories in England were extracted on 22 August 2019 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 30 April) used by all microbiology laboratories, with all positive blood cultures extracted, including those not thought to be clinically significant. Data for Northern Ireland were extracted separately (CoSurv on 30 April 2019).

Rates of bloodstream infection were calculated using mid-year resident population estimates for the respective year and geography [1]. Geographical analyses were based on residential postcode, if known (otherwise GP postcode, or failing that the postcode of the reporting laboratory) with cases in England being assigned to one of 9 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 has been made available featuring the findings of this report including only data submitted via SGSS from laboratories in England.

It is important to note that there are differences in the way data are collected between the three countries. In England and Northern Ireland, microbiology laboratories electronically report clinically significant isolates to SGSS or CoSurv, respectively. In Wales, data are collected by extraction from a single laboratory information system used by all the microbiology laboratories. The system extracts all positive blood cultures, including those not thought to be clinically significant.

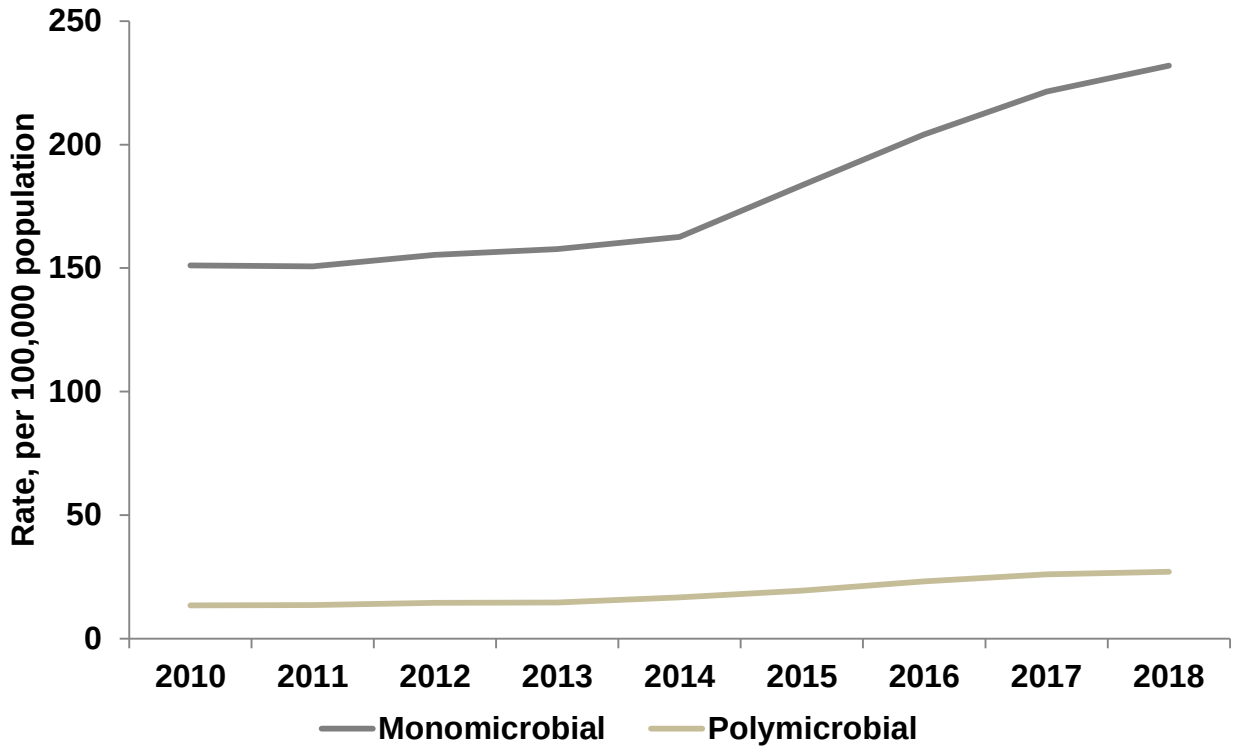
The data presented here may differ in some instances from data in earlier publications due to the change in surveillance systems and the inclusion of late reports.

Key points

- the total number of bacterial and fungal bloodstream infection reports from England, Wales, and Northern Ireland increased by 44.3% between 2014 and 2018 (115,293 to 166,472)
- in 2018, 16,521 (9.9%) of 166,472 bloodstream infection episodes were identified as polymicrobial
- 643 distinct species were isolated from polymicrobial bloodstream infections with 14,173 (85.8%) episodes involving two different species, 1,941 (11.7%) three species, 319 (1.9%) four and 88 (0.5%) five or more distinct species
- the population rates (per 100,000 population) of polymicrobial infections in 2018 were 28.4 for England, 14.7 for Wales and 14.4 for Northern Ireland
- in England, the highest rates of polymicrobial bacteraemia/fungaemia were observed in Yorkshire & Humber (46.5/100,000), and the South West (42.8); the lowest rates were observed in the North East (24.1), and London (22.4)
- the highest rate of polymicrobial bacteraemia/fungaemia was observed for in those aged 75 years and over (170.1 and 94.1/100,000, males and females respectively), and less than one year (87.2 and 59.9/100,000, males and females 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: 2009-2018



In 2018, 157,990 patient episodes of 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 65.7% increase in patient episodes since 2009 (95,337 episodes).

The rate of laboratory reports of bloodstream infection between 2009 and 2018 increased from 153.0 to 231.9 per 100,000 population for monomicrobial infections and 14.2 to 27.1 for polymicrobial, respectively (Figure 1). Between 2009 and 2014, there was a slight increase of 6.3% (from 152.9 to 162.6/100,000) for monomicrobial episodes, and 18.4% (from 14.1 to 16.7 /100,000) for polymicrobial episodes. Thereafter the increase accelerated with a 26.4% rise in monomicrobial episodes (183.5 to 231.9/100,000) between 2015 and 2018 and 39.7% (from 19.4 to 27.1/100,000) for polymicrobial episodes. The percentage of polymicrobial reports increased from 9.3 to 11.0%, from 2014 to 2018, respectively.

The observed increase in bacteraemia and fungaemia episodes (44.4%) between 2014 and 2018 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: 2014-2018

	2014	2015	2016	2017	2018
Total reported bacteraemia†	115,305	131,959	150,214	165,536	166,473
Total reported fungaemia†	1,822	2,048	2,251	2,337	2,180
No. patient bacteraemia episodes	104,543	119,355	134,938	148,120	148,828
No. patient fungaemia episodes	1,687	1,842	1,943	1,941	1,805
No. polymicrobial patient episodes‡	9,876	11,579	13,954	15,827	16,521
(% polymicrobial)‡?	(9.3%)	(9.6%)	(10.2%)	(10.5%)	(11.0%)

† Total reported can include more than one report per patient as in the case of a polymicrobial infection.
‡ Polymicrobial defined as an infection with two or more organisms (bacteria or fungi) with a positive blood culture sample on the same day

Of the 16,521 patient episodes of polymicrobial bloodstream infection in 2018, 14,173 involved two different species, 1,941 involved three species, 319 involved four and 88 involved five or more distinct species (**Table 2**).

Table 2. Number of species involved in polymicrobial bacteraemia and/or fungaemia patient episodes, England, Wales and Northern Ireland: 2018

No. organisms	No. episodes	(%)
Two	14,173	(85.8%)
Three	1,941	(11.7%)
Four	319	(1.93%)
Five	65	(0.4%)
More than five	23	(0.1%)
Total	**16,521**	**100.00%**

The most frequently reported organisms involved in polymicrobial bloodstream infections were *Escherichia coli* (15.4%), followed by coagulase-negative staphylococci (CoNS) (13.5%) and coliforms not further identified (5.6%; **Table 3**). A total of 643 distinct species were isolated from patients with polymicrobial infections in 2018 (Table 4). 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 bacteraemia were *Escherichia coli* (25.7%) followed by CoNS (23.7%) and *Staphylococcus aureus* (8.0%; **Table 3**). A total of 896 distinct species were isolated from patients with monomicrobial infections in 2018 (Table 4; online appendix for full table).

The increasing number of different species identified, 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 ten most frequently reported species or organism category in polymicrobial and monomicrobial bacteraemia and/or fungaemia, England, Wales and Northern Ireland: 2018

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

Table 4. Reports of monomicrobial and polymicrobial bacteraemia and fungaemia by species or organism category, England, Wales and Northern Ireland: 2018

	Bacteraemia / fungaemia					
	Monomicrobial			Polymicrobial		
Organism	n†	%‡	Rank	n†	%‡	Rank
Escherichia coli	36,354	25.7	1	5,400	15.4	1
Staphylococcus coagulase negative	33,566	23.7	2	4,740	13.5	2
Staphylococcus aureus	11,330	8.0	3	1,451	4.1	6
Klebsiella pneumoniae	5,746	4.1	4	1,757	5.0	4
Streptococcus pneumoniae	5,425	3.8	5	285	0.8	18
Pseudomonas aeruginosa	2,872	2.0	6	845	2.4	9
Streptococcus group A	2,720	1.9	7	285	0.8	18
Enterococcus faecalis	2,605	1.8	8	1,557	4.5	5
Proteus mirabilis	2,596	1.8	9	838	2.4	10
Streptococcus group B	2,160	1.5	10	275	0.8	19
Enterococcus faecium	1,945	1.4	11	1,010	2.9	8
Streptococcus group C	1,385	1.0	12	200	0.6	26
Streptococcus group G	1,276	0.9	13	138	0.4	39
Enterobacter cloacae	1,172	0.8	14	468	1.3	14
Micrococcus luteus (sarcina)	1,146	0.8	15	125	0.4	41
Klebsiella oxytoca	1,025	0.7	16	683	2.0	12
Cutibacterium acnes (Propionibacterium acnes)	831	0.6	17	150	0.4	34
Serratia marcescens	796	0.6	18	199	0.6	27
Bacteroides fragilis	756	0.5	19	270	0.8	20
Streptococcus mitis group	722	0.5	20	513	1.5	13
Borrelia burgdorferi	658	0.5	21	0	0.0	104
Diphtheroids	655	0.5	22	260	0.7	22
Candida albicans	655	0.5	23	149	0.4	35
Haemophilus influenzae	623	0.4	24	63	0.2	56
Propionibacterium freudenreichii	564	0.4	25	108	0.3	44
Total *	**141,475**	**100.0%**		**35,017**	**100.0%**	

†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/fungaemia in 2018 were similar in Wales and Northern Ireland at 14.7 and 14.4 per 100,000 population, respectively, and rate for England at 28.4 per 100,000 population (Figure 2). Among England's PHE Centres, the lowest rates were observed in London (22.4 per 100,000 population) and the South East (23.2) and highest rates in the South West (42.8), and Yorkshire and Humber (46.5).

Compared to 2014, the rate of polymicrobial bacteraemia and fungaemia episodes increased by 67.1% in England, and 7.5% in Northern Ireland in 2018 (Table 5). The rate in Wales has remained relatively stable between 2014-2018 (14.5-14.7 per 100,000 population). Of note, both Wales and Northern Ireland observed a decline in the rate in 2018 compared to 2017.

Figure 2. Regional distribution of polymicrobial bacteraemia and/or fungaemia episodes per 100,000 population in England, Wales and Northern Ireland: 2018

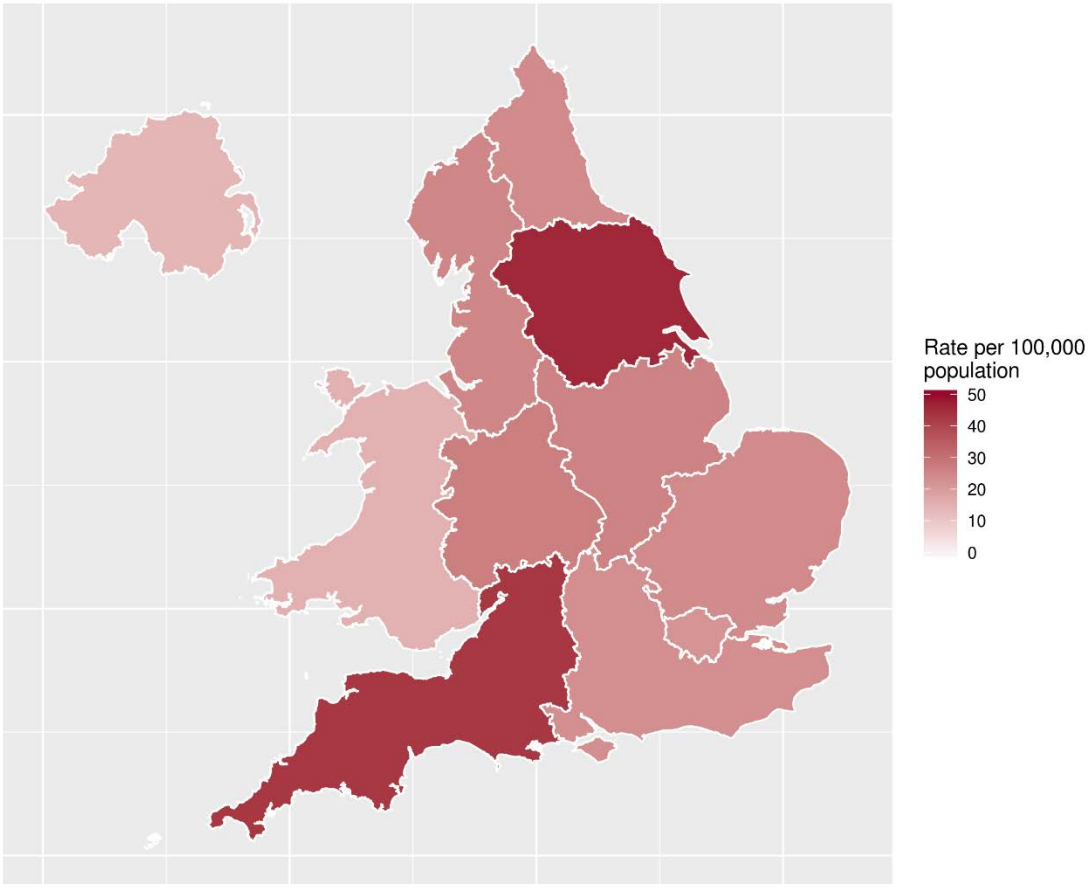


Table 5. Polymicrobial bacteraemia and/or fungaemia episodes per 100,000 population by region (England, Wales and Northern Ireland): 2014 to 2018

		Rate, per 100,000 population				
Region	**PHE Centre**	**2014**	**2015**	**2016**	**2017**	**2018**
North of England	North East	16.4	14.1	19.4	21.2	24.1
	North West	19.7	22.1	27.3	25.4	25.3
	Yorkshire and Humber	11.9	19.6	21.6	36.1	46.5
Midlands and East of England	East Midlands	13.6	17.9	21.6	25.5	26.3
	East of England	13.9	17.2	21.7	27.4	23.9
	West Midlands	19.9	23.3	26.2	26.0	27.0
London	London	20.1	18.6	20.6	21.5	22.4
South of England	South East	13.5	15.3	19.8	22.1	23.2
	South West	23.3	30.7	38.7	43.2	42.8
England		17.0	19.9	24.0	27.2	28.4
Wales		14.5	15.0	16.6	16.3	14.7
Northern Ireland		13.4	16.7	16.4	16.1	14.4
England, Wales and Northern Ireland		**16.8**	**19.5**	**23.4**	**26.3**	**27.3**

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

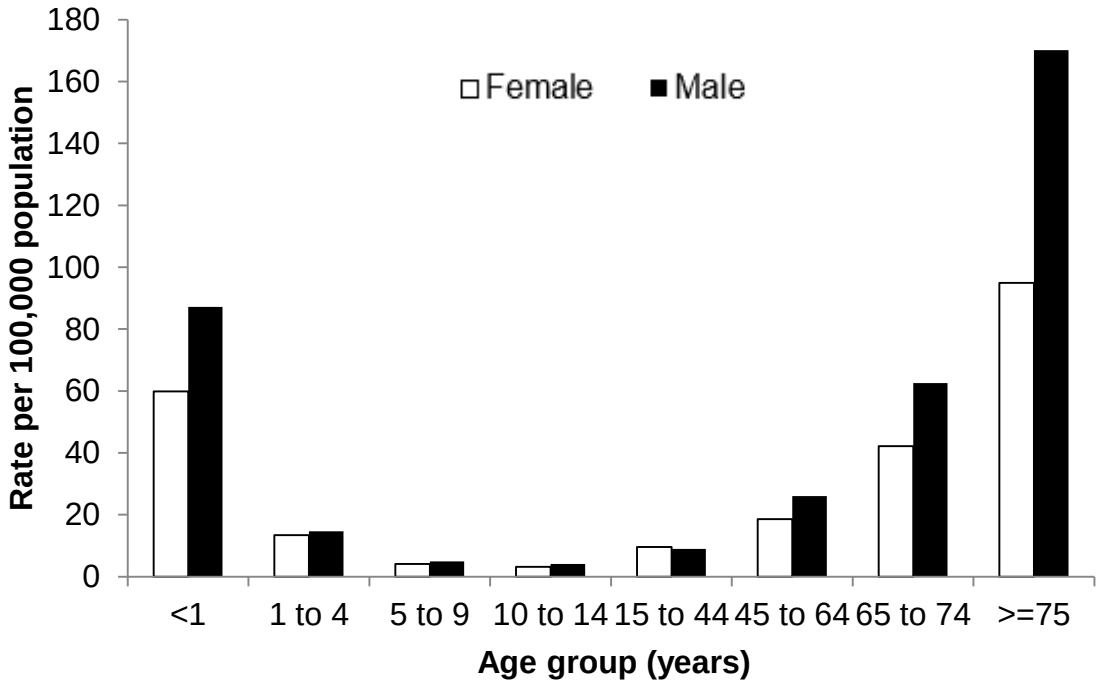
Age and sex distribution

The highest rate of polymicrobial bloodstream infection in England, Wales and Northern Ireland was observed in those aged 75 years and older for both males and females (170.1 and 94.9 per 100,000 population respectively), followed by infants less than one year of age (87.2 and 59.9, males and females respectively) (Figure 3a). These are similar to the age-specific patterns observed in 2017 [5].

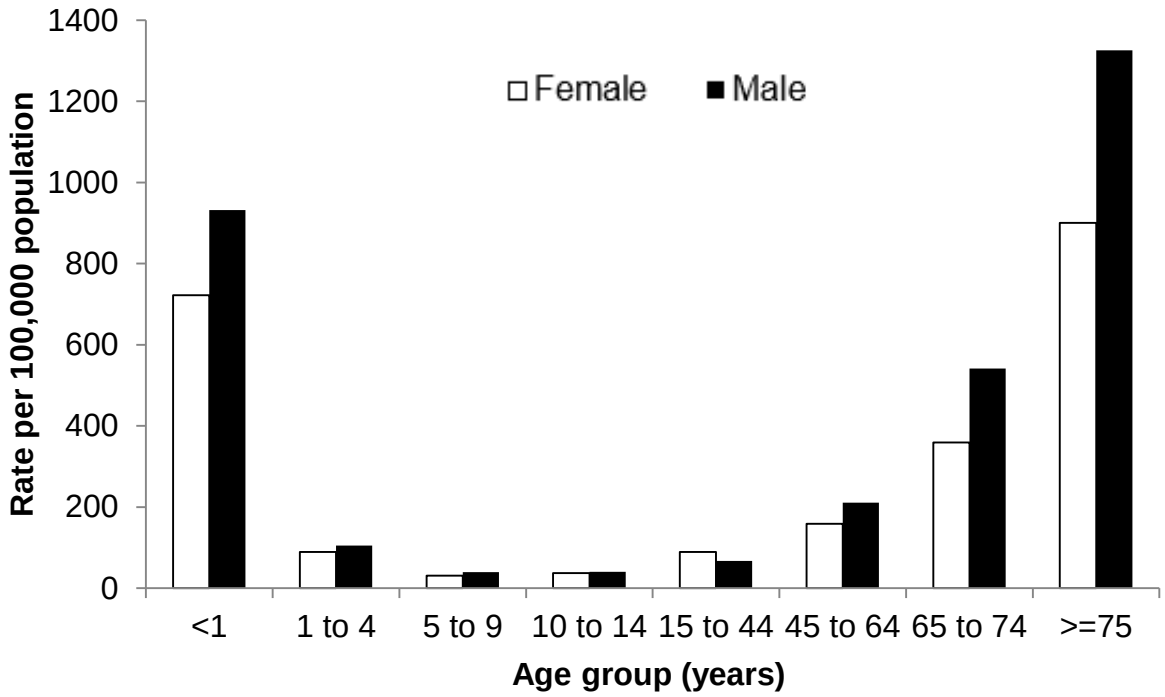
Age and sex-specific rates of monomicrobial bloodstream infections followed the same pattern being highest in those aged 75 years and over (1325.9 males; 900.5 females /100,000) and those aged less than one year (830.2 males; 932.5 females /100,000) (Figure 3b).

Figure 3. Polymicrobial, and monomicrobial episode rate by age and sex (England, Wales and Northern Ireland): 2018

(a) Polymicrobial bloodstream infection



(b) Monomicrobial bloodstream infection



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Health Protection Report is a national public health bulletin for England and Wales, published by Public Health England. It is PHE's principal channel for the dissemination of laboratory data relating to pathogens and infections/communicable diseases of public health significance and of reports on outbreaks, incidents and ongoing investigations.

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