

Protecting and improving the nation's health

Quarterly epidemiological commentary

Mandatory MRSA, MSSA, Gram-negative bacteraemia and *C. difficile* infections data (up to July to September 2019)

December 2019

About Public Health England

Public Health England exists to protect and improve the nation's health and wellbeing, and reduce health inequalities. We do this through world-leading science, research, knowledge and intelligence, advocacy, partnerships and the delivery of specialist public health services. We are an executive agency of the Department of Health and Social Care, and a distinct delivery organisation with operational autonomy. We provide government, local government, the NHS, Parliament, industry and the public with evidence-based professional, scientific and delivery expertise and support.

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Data included in this quarterly epidemiological commentary

This document contains quarterly, national-level epidemiological commentaries for Methicillin-resistant *Staphylococcus aureus* (MRSA), Methicillin-sensitive *Staphylococcus aureus* (MSSA), *Escherichia coli*, *Klebsiella* spp. and *Pseudomonas aeruginosa* bacteraemia and *Clostrioides difficile* (CDI) infections. This includes analyses on counts and incidence rates of all cases and hospital-onset (previously referred to as trust-apportioned) cases of MRSA, MSSA, *E. coli*, *Klebsiella* spp. and *P. aeruginosa* bacteraemia and *C. difficile* infection.

The terminologies; 'trust-apportioned' and 'not trust-apportioned' have been updated to 'hospital-onset' and 'community-onset' respectively. Please note that this is only a change in the description of those terms and not a change in the methodology for apportionment.

All data tables associated with this report are included in the accompanying OpenDocument spreadsheet.

Revisions to data included are covered by a data-specific revisions and correction policy.

Citation to PHE, HCAI & AMR division is required. Citation: Public Health England. Quarterly epidemiology commentary: mandatory MRSA, MSSA and Gram-negative bacteraemia and *C. difficile* infection in England (up to July to September 2019) London: Public Health England, December 2019.

Further information

This publication forms part of the range of National Statistics outputs routinely published by Public Health England (PHE) which include monthly and annual reports on the mandatory surveillance of MRSA, MSSA and *E. coli, Klebsiella* spp. and *P. aeruginosa* bacteraemia and *C. difficile* infections (CDI).

Annual report output

Further epidemiological analyses by financial year can be found in PHE's annual epidemiological commentary.

Monthly report outputs

The following reports are produced by PHE on a monthly basis.

MRSA bacteraemia:

 counts of all reported, hospital and community-onset cases of MRSA bacteraemia by organisation

MSSA bacteraemia:

 counts of all reported, hospital and community-onset cases of MSSA bacteraemia by organisation

E. coli bacteraemia:

 counts of all reported, hospital and community-onset cases of E. coli bacteraemia by organisation

Klebsiella spp. bacteraemia:

 counts of all reported, hospital and community-onset cases of Klebsiella spp. bacteraemia by organisation

P. aeruginosa bacteraemia:

 counts of all reported, hospital and community-onset cases of P. aeruginosa bacteraemia by organisation Mandatory MRSA, MSSA, Gram-negative bacteraemia and *C. difficile* infections data (up to July to September 2019)

CDI:

• counts of all reported, hospital and community-onset cases of CDI by organisation

Data for this report was extracted from PHE's healthcare associated infections data capture system (HCAI DCS) on 4 November 2019.

Epidemiological analyses of Gram-negative bacteraemia data

E. coli bacteraemia

The incidence rate of all reported *E. coli* bacteraemia has continued to increase each year since the initiation of the mandatory surveillance in July 2011 (figure 1a). This is primarily driven by the increase in the rate of community-onset cases (table S1a). In contrast, the incidence rate of hospital-onset cases has remained relatively stable within the same period (figure 1b).

Between July to September 2011 and July to September 2019, the count of cases and the incidence rate of all reported cases of *E. coli* bacteraemia increased by 42.8% from 8,275 cases to 11,815 and from 61.8 to 83.7 cases per 100,000 population. Similarly, over the same period, the count of community-onset cases increased by 55.9% from 6,279 to 9,787, while the incidence rate increased 47.9% from 46.9 cases per 100,000 population to 69.4.

The incidence rate of hospital-onset cases increased 1.6% between July to September 2011 and July to September 2019 from 23.7 per 100,000 bed-days (n=1,996) to 23.9 per 100,000 bed-days (n=2,028).

Comparing the most recent quarter (July to September 2019) to the same period in the previous year (July to September 2018) there has been a 1.6% increase in the count of all reported cases from 11,629 to 11,815, while the incidence rate increased 1.6% from 82.4 per 100,000 population to 83.7. Hospital-onset *E. coli* bacteraemia cases increased 2.1% from 1,986 to 2,028 which corresponded to an incidence rate increase of 2.1% from 23.4 to 23.9 per 100,000 bed-days. Community-onset *E. coli* bacteraemia cases increased 1.5% from 9,643 to 9,787 per 100,000 bed-days, while the community-onset incidence rate increased 1.5% from 68.3 per 100,000 population to 69.4 (figure 1a and 1b, table S1).

There is a strong seasonality to the incidence of all-reported *E. coli* bacteraemia cases, with the highest rates observed between July to September of each year. There is less evidence of the same seasonality among hospital-onset cases, though a summer peak is observed in financial years 2015/16, 2016/17 and 2018/19.

Figure 1a: Quarterly rates of all reported *E. coli* bacteraemia: July to September 2011 to July to September 2019

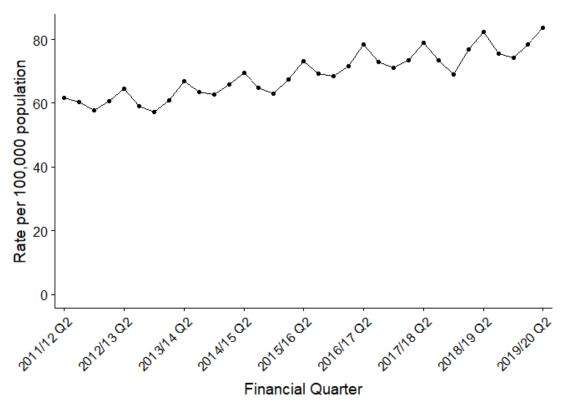
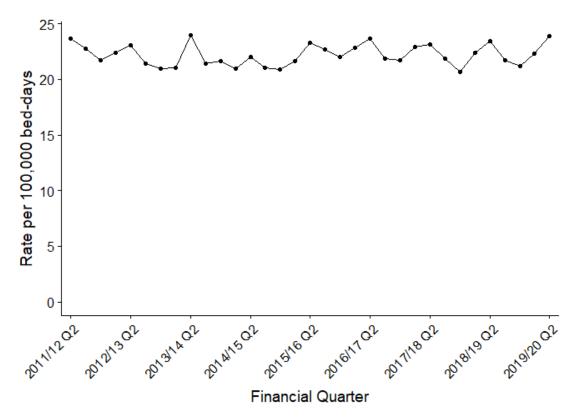


Figure 1b: Quarterly rates of hospital-onset *E. coli* bacteraemia: July to September 2011 to July to September 2019



Klebsiella spp. bacteraemia

Between April to June 2017 and July to September 2019, there was a 26.8% increase in the count of all reported *Klebsiella* spp. bacteraemia cases from 2,346 to 2,974 and a 24.6% increase in the incidence rate of all reported *Klebsiella* spp. bacteraemia cases from 16.9 to 21.1 cases per 100,000 population respectively (figure 2a). The count and incidence rate of community-onset cases also increased by 24.0% from 1,676 to 2,079 cases and by 21.9% from 12.1 to 14.7 cases per 100,000 population respectively. Over the same period, the count and incidence rate of hospital-onset cases increased by 33.6% from 670 to 895 cases and by 35.5% from 7.8 cases per 100,000 bed-days to 10.5 respectively (figure 2b).

Comparing the most recent quarter (July to September 2019) to the same period in the previous year (July to September 2018) shows a 4.0% increase in the count of all reported cases from 2,860 to 2,974, while the incidence rate increased by 4.0% from 20.3 per 100,000 population to 21.1. Hospital-onset *Klebsiella* spp. bacteraemia cases decreased 1.1% from 905 to 895 which corresponds to a decrease of 1.1% from 10.7 to 10.5 per 100,000 bed-days. Community-onset *Klebsiella* spp. cases increased by 6.3% from 1,955 to 2,079, while the community-onset incidence rate increased by 6.3% from 13.9 to 14.7 per 100,000 population (table S2).

In the most recent quarter, 72.8% (2,165/2,974) of all reported *Klebsiella* spp. bacteraemia were caused by *K. pneumoniae*, a decrease from 73.6% in the same quarter in the previous year (July to September 2018). In the same period, 17.0% (506/2,974) were caused by *K. oxytoca*, which was similar to that observed in the same quarter of the previous year (16.7%).

Figure 2a: Quarterly rates of all reported *Klebsiella* spp. bacteraemia by species: April to June 2017 July to September 2019

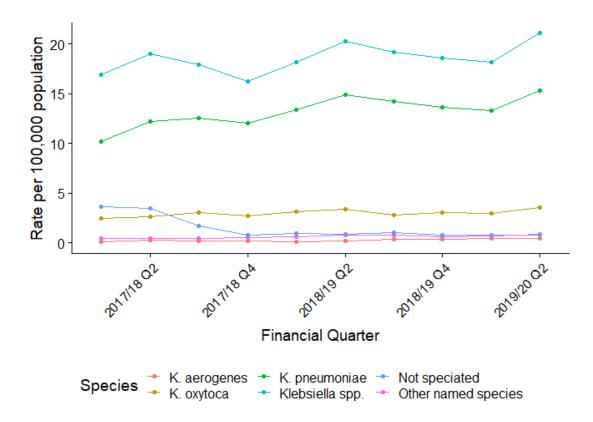
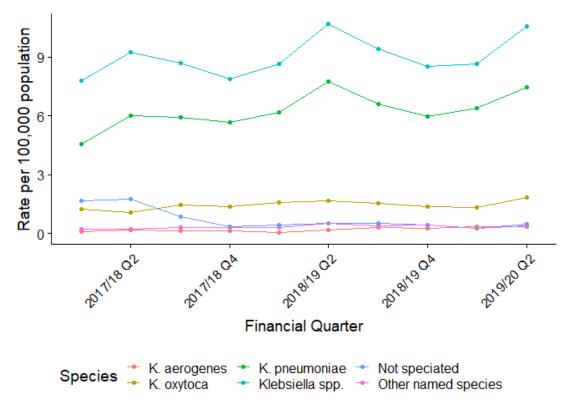


Figure 2b: Quarterly rates of hospital-onset *Klebsiella* spp. bacteraemia: April to June 2017 to July to September 2019



Pseudomonas aeruginosa bacteraemia

Between April to June 2017 and July to September 2019, there was an 18.2% increase in the count, and a 16.2% increase in the incidence rate of all reported *P. aeruginosa* bacteraemia cases from 1,011 to 1,195 and from 7.3 to 8.5 cases per 100,000 population respectively (figure 3a). The count and the incidence rate of community-onset cases also increased by 24.5% from 637 to 793 cases and by 22.3% from 4.6 to 5.6 cases per 100,000 population respectively. Over the same period, the count and the incidence rate of hospital-onset cases increased by 7.5% from 374 to 402 cases and by 9.0% from 4.3 to 4.7 cases per 100,000 bed-days respectively (figure 3b).

Comparing the most recent quarter (July to September 2019) to the same period in the previous year (July to September 2018) shows a 0.8% increase in the count of all reported cases from 1,186 to 1,195, while the incidence rate increased 0.8% from 8.4 to 8.5. Hospital-onset *P. aeruginosa* bacteraemia cases decreased by 4.5% from 421 to 402 which corresponds to a 4.5% decrease in the incidence rate from 5.0 to 4.7 per 100,000 bed-days. Community-onset *P. aeruginosa* bacteraemia cases increased by 3.7% from 765 to 793 per 100,000 population, while the incidence rate of community-onset cases increased by 3.7% from 5.4 to 5.6 per 100,000 population (table S3).

There is evidence of seasonality to the incidence of all-reported *P. aeruginosa* bacteraemia cases, with the highest rates observed in July to September of each year. Due to this seasonality, trends of *P. aeruginosa* and the limited data points available the results need to be interpreted with caution.

Figure 3a: Quarterly rates of all reported *P. aeruginosa* bacteraemia: April to June 2017 to July to September 2019

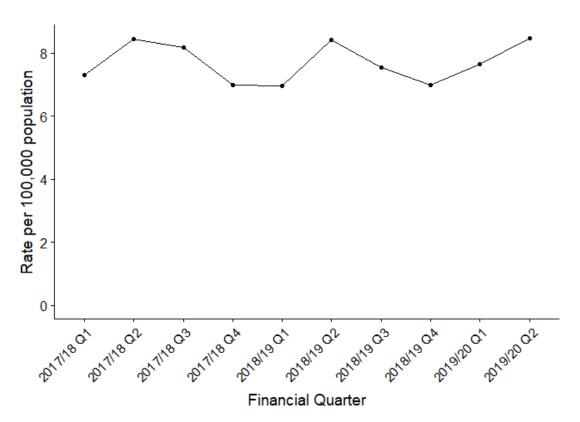
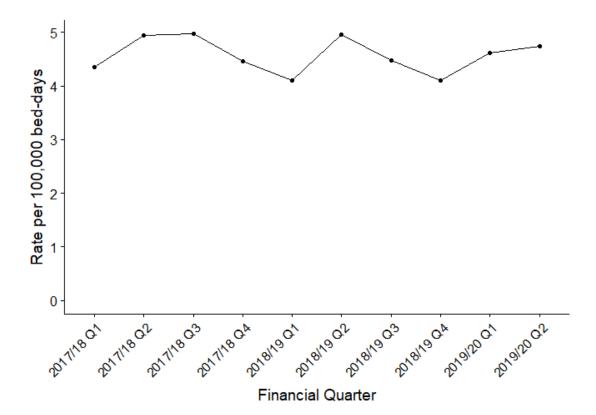


Figure 3b: Quarterly rates of hospital-onset *P. aeruginosa* bacteraemia: April to June 2017 to July to September 2019



Epidemiological analyses of Staphylococcus aureus bacteraemia data

MRSA bacteraemia

There has been a considerable decrease in the incidence rate of all reported MRSA bacteraemia since the enhanced mandatory surveillance of MRSA bacteraemia began in April 2007 (figures 4a, table S4a). The incidence rate of all reported cases fell by 85% from 10.2 cases per 100,000 population in April to June 2007 to 1.5 cases per 100,000 in January to March 2014. The rate has subsequently decreased to 1.4 cases per 100,000 population between January to March 2014 and July to September 2019.

A similar trend was observed with the incidence rate of hospital-onset cases (figures 4b, table S4a). There was a steep decrease of 79% from 4.9 cases per 100,000 bed-days in April to June 2008 to 1.0 January to March 2014. Subsequently, between January to March 2014 and July to September 2019, the rate has subsequently decreased to 0.8 cases per 100,000 bed-days.

Comparing the most recent quarter (July to September 2019) to the same period in the previous year (July to September 2018) shows a 3.4% decrease in the count of all reported cases from 208 to 201, while the incidence rate decreased by 3.4% from 1.5 to 1.4 cases per 100,000 population. The count of hospital-onset MRSA bacteraemia cases decreased 4.3% from 69 to 66 while the incidence rate remained unchanged at 0.8 per 100,000 bed-days in both quarters. Counts of community-onset MRSA bacteraemia cases decreased 2.9% from 139 to 135, while the incidence rates of community-onset cases remained unchanged at 1.0 cases per 100,000 population in both quarters (table 4a).

Figure 4a: Quarterly rates of all reported MRSA bacteraemia: April to June 2007 to July to September 2019

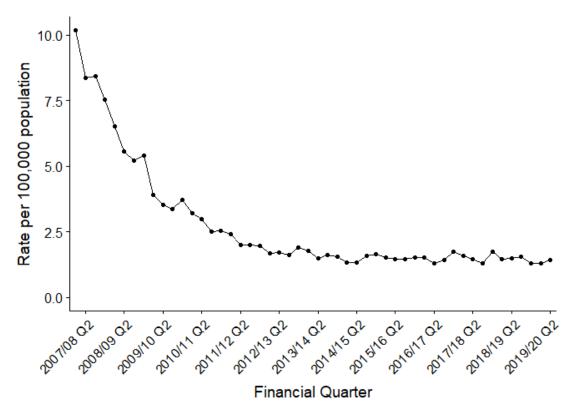
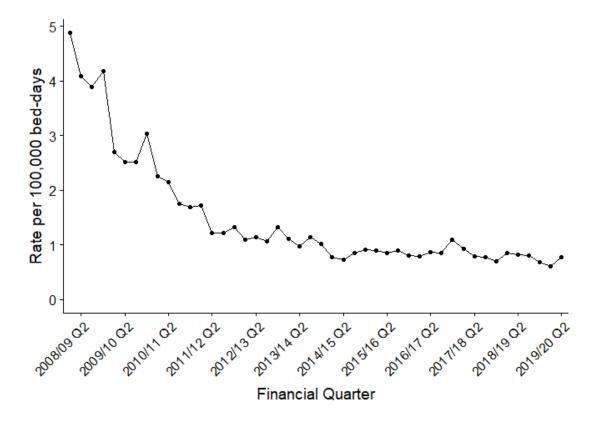


Figure 4b: Quarterly rates of hospital-onset MRSA bacteraemia: April to June 2008 to July to September 2019



MSSA bacteraemia

Since the mandatory reporting of MSSA bacteraemia began in January 2011 there has been a general trend of increasing counts and incidence rates of infection. The count of all reported cases of MSSA bacteraemia increased by 43.7% from 2,199 to 3,161 between January to March 2011 and July to September 2019. This was accompanied by a 33.4% increase in incidence rate from 16.8 per 100,000 population to 22.4 (figure 5a, table S5).

These increases are primarily driven by the increase in community-onset cases. Between January 2011 and July to September 2019, the count and the incidence rate of community-onset cases increased by 57.9% and 46.6% respectively from 1,464 to 2,312 cases and from 11.2 to 16.4 cases per 100,000 population. Over the same period, the count of hospital-onset cases increased by 15.5% from 735 to 849 cases, while the incidence rate increased 19.7% from 8.4 to 10.0 cases per 100,000 bed-days (figure 5a and 5b, table S5a).

Comparing the most recent quarter (July to September 2019) to the same period in the previous year (July to September 2018) shows a 5.6% increase in the count of all reported cases from 2,994 to 3,161, while the incidence rate increased 5.6% from 21.2 to 22.4. Hospital-onset MSSA bacteraemia cases increased by 3.4% from 821 to 849 which corresponds to a 3.4% increase in incidence rates from 9.7 to 10.0 per 100,000 bed-days. Community-onset MSSA bacteraemia cases increased 6.4% from 2,173 to 2,312, while the community-onset incidence rate increased by 6.4% from 15.4 to 16.4 per 100,000 population.

Figure 5a: Quarterly rates of all reported MSSA bacteraemia: January to April 2011 to July to September 2019

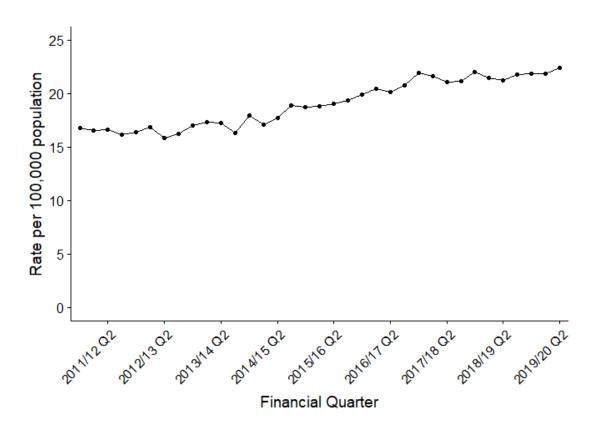
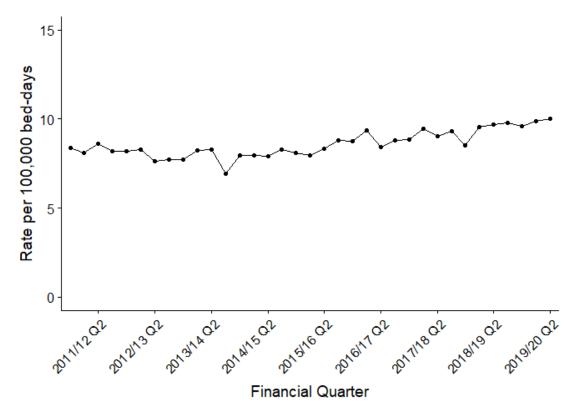


Figure 5b: Quarterly rates of hospital-onset MSSA bacteraemia: January to April 2011 to July to September 2019



Epidemiological analyses of *Clostridiodies* difficile infection data

Since the initiation of *C. difficile* (CDI) surveillance in April 2007, there has been an overall decrease in the count and associated incidence rate of both all-reported and hospital-onset cases of CDI (figure 6a, 6b and table S6).

Most of the decrease in the incidence rate occurred between April to June 2007 and January to March 2012 with a 78% decrease in all-reported cases of CDI from 16,864 to 3,711 cases and an associated 79% reduction in incidence rate from 131.6 cases per 100,000 population to 27.9. Subsequently, between January to March 2012 and July to September 2019, the count of all-reported cases decreased 1.9% from 3,711 to 3,640 cases and the incidence rate reduced by 7.5% from 27.9 cases per 100,000 population to 25.8.

There were similar, but greater, reductions among hospital-onset CDI cases with an 85% reduction in count of cases between April to June 2007 and January to March 2012 from 10,436 to 1,613 cases and 84% reduction in the incidence rate from 112.5 per 100,000 bed-days to 18.2. This was followed by a further 24.9% decrease in the count of cases from 1,613 to 1,211 cases and a decrease of 21.5% in the incidence rate from 18.2 cases per 100,000 bed-days to 14.3 between January to March 2012 and July to September 2019.

Comparing the most recent quarter (July to September 2019) to the same period in the previous year (July to September 2018) shows a 1.2% increase in the count of all reported cases from 3,597 to 3,640, while the incidence rate increased by 1.2% from 25.5 cases per 100,000 population to 25.8. Hospital-onset CDI cases decreased by 1.3% from 1,227 to 1,211 which corresponds to an incidence rate decrease of 1.3% from 14.5 cases per 100,000 bed-days to 14.3. Community-onset CDI cases increased by 2.5% from 2,370 to 2,429, while the community-onset incidence rate increased by 2.5% from 16.8 per 100,000 population to 17.2.

Figure 6a: Quarterly rates of all reported *C. difficile:* April to June 2007 to July to September 2019

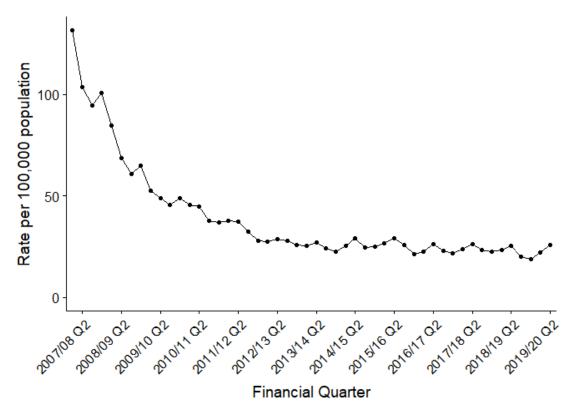
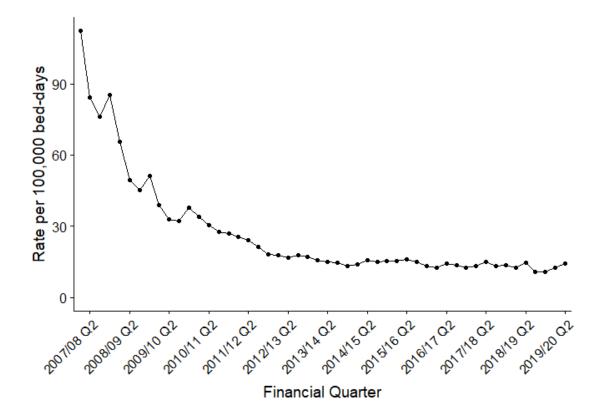


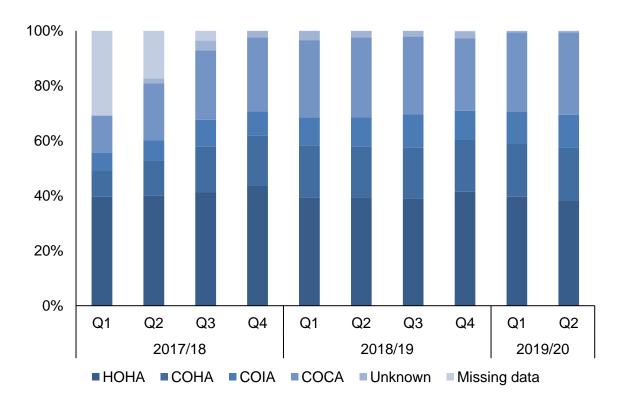
Figure 6b: Quarterly rates of hospital-onset *C. difficile*: April to June 2007 to July to September 2019



From April 2017, the HCAI DCS has included questions relating to prior admissions to the same acute trust reporting the CDI case. These additional, mandatory, items will help align English CDI surveillance with definitions used by the European Centre for Disease Prevention and Control (ECDC) and Centers for Disease Control and Prevention (CDC) in the USA. Cases are now categorised as; Healthcare-Onset, Healthcare Associated (HOHA), Community-Onset, Healthcare Associated (COHA), Community-Onset, Indeterminate Association (COIA) or Community-Onset, Community Associated (COCA). Cases where prior admission details were recorded as 'Don't know', are assigned as 'Unknown' and those with missing information as 'missing information'.

Between April to June 2017 and July to September 2019 the largest proportion of cases were HOHA and this has remained stable at around 40% of all cases. Over the same period, COCA cases increased from 13.4% to 30.0% of all CDI, although most of this increase was observed during 2017/18. Similarly, COHA cases have increased from 9.7% to 19.5% of all CDI, with most of the increase being observed during 2017/18. COIA cases have increased from 6.3% to 11.8% of all CDI. It should be noted much of the increase observed is likely due to an increase in data quality as shown by the sharp decline of cases with missing data (figure 6b Table S6b).

Table S6b: CDI rates by prior trust exposure April 2017 - September 2019



Appendix

Bed-day data

For bacteraemia and CDI, the average bed-day activity reported by acute trusts via KH03 returns is used to derive the bed-day denominator for acute trust incidence rate rates (assigned and apportioned). As of Q1 2011/12, bed-day data has been available on a quarterly basis and has been used as such for Q2 2011/12 to Q1 2019/20. This data is available at nhs uk.

Amendments to the published figures on KH03 included the following.

Q2 2019/20 bed-day data was not available at the time of writing this report; therefore, bed-day data for the same quarter of the previous year (Q2 2018/19) was used as a proxy for this quarter.

In Quarterly Epidemiological Commentaries published prior to 1 December 2015, April to June 2014 to October to December 2014 quarterly KH03 figures for one acute trust (RWD) had a percentage change of more than 20% compared with the previous quarter and the same quarter in the previous year. As a result, it was replaced with the KH03 data of the same quarter in the previous year (April to June 2013 to October to December 2013).

However, PHE has reviewed its policy for processing KH03 data. Data irregularities identified have been flagged with colleagues at NHS England (data owners of the KH03 dataset). Until we receive confirmation that any identified change in the occupied overnight bed-days for an acute trust is anomalous, PHE now uses the data as published in the KH03 dataset. This affects all reports published since 1 December 2015 and incidence rate rates published prior that time will differ slightly as a result. For the KH03 data used to calculate rates included in this report to be consistent over the full-time period, previously amended KH03 data for trust United Lincolnshire Hospitals (RWD) for FY 2014/2015 has been altered to reflect that published in the KH03 dataset. Please note that this could lead to slight differences in hospital- onset/assigned rates when compared with publications prior to 1 December 2015.

Missing data for acute trusts in the KH03 returns will continue to be processed as before, where the KH03 return for the same quarter from the previous year will be used as a proxy.

The following acute trusts were thus affected:

- Moorfields Eye Hospital NHS Foundation Trust (RP6) 2007/08 and 2008/09 KH03 figures: replaced with 2006/07 KH03 figure
- Rotherham NHS Foundation Trust (RFR): 2009/10 and April-June 2010 to April-June 2011 KH03 figures: replaced with 2008/09 KH03 figure
- Sheffield Teaching Hospitals NHS Foundation Trust (RHQ) April-June 2010 to April-June 2011 KH03 figures: replaced with 2009/10 KH03 data
- The Princess Alexandra Hospital NHS Trust (RQW) April-June 2014 and October-December 2014 KH03 figures: replaced with April-June 2013 to October- December 2013 KH03 figures, respectively
- Ipswich Hospital NHS Trust (RGQ) January-March 2016 KH03 figure: replaced with January-March 2015 figures
- West Suffolk NHS Foundation Trust (RGR) April-June 2016 to October-December 2016 and April-June 2017 KH03 figures: replaced with April-June 2015 to October-December 2015 KH03 figures
- Gloucestershire Hospitals NHS Foundation Trust (RTE) October-December 2016 to January-March 2017 KH03 figures: replaced with October-December 2015 to January-March 2016 KH03 figures

The KH03 data used for this report was published on 22 August 2019. This includes revisions of previously published KH03 data and so these data may differ from those used in earlier reports.

Population data

National incidence rates are calculated using 2007 to 2018 mid-year resident population estimates which are based on the 2011 census for England (2019 estimates are based on 2018 mid-year estimates).

Definitions

Bacteraemia hospital-onset (trust-apportioned) cases: SEC2

Include patients who are (i) in-patients, day-patients, emergency assessment patients or not known; AND (ii) have had their specimen taken at an acute trust or not known; AND (iii) specimen was taken on or after day 3 of the admission (admission date is considered day 'one'). Cases that do not meet these criteria are categorised as community-onset (not-trust apportioned).

CDI hospital-onset (trust-apportioned) cases:

Include patients who are (i) in-patients, day-patients, emergency assessment patients or not known; AND (ii) have had their specimen taken at an acute trust or not known; AND (iii) specimen was taken on or after day 4 of the admission (admission date is considered day 'one'). Cases that do not meet these criteria are categorised as community-onset (not-trust apportioned).

Historically, report published before September 2017 have used the term 'trust-apportioned' to describe cases meeting the above conditions for apportionment and 'not trust-apportioned' for those that do not. Moving forward, these terminologies have been updated to 'hospital-onset' and 'community-onset' respectively. Please note that this is simply a change in terminology and does not constitute a change in the methodology for apportionment.

Prior Trust exposure:

From April 2017, reporting trusts were asked to provide information on whether patients with CDI had been admitted to the reporting trust within the 3 months prior to the onset of the current case. This allows a greater granulation of the healthcare association of cases.

Cases are split into one of 6 groups:

- hospital-onset healthcare-associated date of onset is > 2 days after admission (where day of admission is day 1)
- community-onset healthcare-associated date of onset is ≤ 2 days after admission and the patient was admitted to the trust in the 4 weeks prior to the current episode
- community-onset indeterminate association date of onset is ≤ 2 days after admission and the patient was admitted in the previous 12 weeks, but not the previous 4 weeks prior to the current episode
- community-onset community-associated date of onset is ≤ 2 days after admission and the patient had not been admitted to the trust in the previous 12 weeks prior to the current episode
- unknown 3 months the reporting trust answered "Don't know" to the question regarding admission in the 3 months prior to the current episode
- all unknown the reporting trust did not provide any answer for questions on prior admission.

Total reported cases:

This is the total count of infections for each organism as of the date of extraction. Please note that for *C. difficile*, this count excludes those from patients less than 2 years old.

Episode duration:

The length of an infection episode is defined as 14 days for MRSA, MSSA and *E. coli* bacteraemia and 28 days for CDI, with the date of specimen being considered day 'one'.

Incidence rate calculations:

MRSA, MSSA and *E. coli, Klebsiella* spp., *P. aeruginosa* bacteraemia, and CDI population incidence rate (episodes per 100,000):

This incidence rate is calculated using the mid-year England population and is

$$= \frac{\text{n episodes}}{\left(\frac{\text{mid-year population for England}}{\text{days in quarter}}\right)} \times 100,000$$

MRSA, MSSA and *E. coli, Klebsiella* spp., *P. aeruginosa* and CDI hospital-onset incidence:

This incidence rate is calculated using KH03 average bed-day activity (see bed-day data above) and is calculated as follows:

$$= \frac{\text{n episodes}}{\text{average KH03 beds per day} \times \text{days in quarter}} \times 100,000$$

Graphs and percentage change calculation:

Please note that percentage changes in rate have been calculated using raw rate figures while those presented in the tables and commentary have been rounded to one decimal place. Similarly, graphs included in this report were plotted using raw rates figures. The raw rate figures are included in the accompanying Quarterly Epidemiological Commentary's accompanying data.

Quarters:

In publications prior to March 2016, all references to quarterly data are based on calendar year definitions and NOT financial year definitions, that is:

- Q1 2014: January to March 2014
- Q2 2014: April to June 2014
- Q3 2014: July to September 2014
- Q4 2014: October to December 2014

However, for all subsequent publications, including this one, all references to quarterly data are based on financial year definitions and NOT calendar year definitions, that is:

- Q1 2014/15: April to June 2014
- Q2 2014/15: July to September 2014
- Q3 2014/15: October to December 2014
- Q4 2014/15: January to March 2015