



UK Health
Security
Agency

Quarterly epidemiological commentary

Mandatory Gram-negative bacteraemia,
MRSA, MSSA and *C. difficile* infections
(data up to October to December 2021)

7 April 2022

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Data included in this quarterly epidemiological commentary

This document contains quarterly, national-level epidemiological commentaries for Meticillin-resistant *Staphylococcus aureus* (MRSA), Meticillin-sensitive *Staphylococcus aureus* (MSSA), *Escherichia coli* (*E. coli*), *Klebsiella* spp. and *Pseudomonas aeruginosa* (*P. aeruginosa*) bacteraemia and *Clostridioides difficile* infection (CDI). This includes analyses on counts and incidence rates of all reported, hospital-onset (previously referred to as trust-apportioned) and community-onset (previously referred to as non trust-apportioned) cases of MRSA, MSSA, *E. coli*, *Klebsiella* spp. and *P. aeruginosa* bacteraemia and CDI. All data tables associated with this report are included in an [OpenDocument spreadsheet](#).

Revisions to data included are covered by a data-specific [revisions and correction policy](#).

Citation to UK Health Security Agency (UKHSA), healthcare associated infections (HCAI) and antimicrobial resistance (AMR) division is required.

Citation: UK Health Security Agency. Quarterly epidemiology commentary: mandatory MRSA, MSSA and Gram-negative bacteraemia and *C. difficile* infection in England (up to October to December 2021) London: UK Health Security Agency, April 2022.

COVID-19 and this data

The coronavirus (COVID-19) pandemic appears to have impacted the number of cases of both bacteraemia (particularly due to *E. coli*) and CDI. In general, counts of all reported cases during the financial year April 2020 to March 2021 were lower than would be expected, while counts of hospital-onset *Klebsiella* spp. and *P. aeruginosa* cases increased and exceeded previous counts observed in this setting. Analysis of voluntary laboratory surveillance data also showed a reduction in the total number of cases of other bloodstream infections during this period, so the phenomenon was not limited to the species covered by the mandatory surveillance. As the voluntary laboratory surveillance shows similar trends to the mandatory surveillance scheme, these changes do not appear to be specific ascertainment problem in the mandatory programme.

In response to the pandemic, elective procedures in hospitals were initially cancelled or delayed, although some activity resumed between COVID-19 waves. As a result, the beds occupied overnight – the denominator used for hospital-onset infection rates – was much lower than would otherwise be expected during these periods. Therefore, in some instances increased rates of hospital-onset infection have been observed, despite a decrease in the counts of infections.

Further information

This publication forms part of the range of National Statistics outputs routinely published by UKHSA which include monthly and annual reports on the mandatory surveillance of MRSA, MSSA and *E. coli*, *Klebsiella* spp. and *P. aeruginosa* bacteraemia and CDI.

Annual report output

Further epidemiological analyses by financial year can be found in UKHSA's [annual epidemiological commentary](#).

Monthly report outputs

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

[MRSA bacteraemia](#) – counts of all reported, hospital-onset cases, community-onset cases, healthcare associated and community associated MRSA bacteraemia by organisation.

[MSSA bacteraemia](#) – counts of all reported, hospital-onset cases, community-onset cases, healthcare associated and community associated MSSA bacteraemia by organisation.

[E. coli bacteraemia](#) – counts of all reported, hospital-onset cases, community-onset cases, healthcare associated and community associated *E. coli* bacteraemia by organisation.

[Klebsiella spp. bacteraemia](#) – counts of all reported, hospital-onset cases, community-onset cases, healthcare associated and community associated *Klebsiella* spp. bacteraemia by organisation.

[P. aeruginosa bacteraemia](#) – counts of all reported, hospital-onset cases, community-onset cases, healthcare associated and community associated *P. aeruginosa* bacteraemia by organisation.

[CDI](#) – counts of all reported, hospital-onset cases, community-onset cases, healthcare associated and community associated CDI by organisation.

Data for this report was extracted from UKHSA's HCAI data capture system (DCS) on 21 February 2022.

Epidemiological analyses of Gram-negative bacteraemia data

E. coli bacteraemia

The incidence rate of all reported *E. coli* bacteraemia increased each year between the initiation of the mandatory surveillance of *E. coli* bacteraemia in July 2011 and the start of the COVID-19 pandemic (January to March 2020, [Figure 1a](#)). This increase was primarily driven by community-onset cases (Table S1). The number and incidence rates of all reported and community-onset cases declined after the start of the pandemic but remain higher than observed at the start of *E. coli* surveillance ([Figure 1a](#)). In contrast, the incidence rate of hospital-onset cases remained relatively stable during the same period, except for a sharp reduction observed in April to June 2021 ([Figure 1b](#)).

Between July to September 2011 and October to December 2021, the count and the incidence rate of all reported cases of *E. coli* bacteraemia increased by 10.8% from 8,275 cases to 9,166 and from 61.8 to 64.5 cases per 100,000 population, respectively. Similarly, over the same period, the count of community-onset cases increased by 16.3% from 6,279 to 7,300, while the incidence rate increased by 9.5% from 46.9 to 51.4 cases per 100,000 population. Concurrently, the count of hospital-onset cases decreased by 6.5% from 1,996 to 1,866 cases. This corresponded to a decrease in the incidence rate of hospital-onset cases by 6.2% from 23.6 per 100,000 bed-days to 22.1 per 100,000 bed-days.

When comparing the most recent quarter (October to December 2021) to the same period in the previous year (October to December 2020) there was a 1.6% decrease in the count of all reported cases from 9,313 to 9,166 and a 1.6% decrease in the rate of all reported cases from 65.5 to 64.5 per 100,000 population ([Figure 1a](#)). Community-onset *E. coli* bacteraemia cases decreased by 2.9% from 7,520 to 7,300, with the community-onset incidence rate decreasing by the same percentage (2.9% from 52.9 to 51.4 per 100,000 population, Table S1).

In October to December 2021, hospital-onset *E. coli* bacteraemia cases increased by 4.1% from 1,793 to 1,866 compared to October to December 2020 ([Figure 1b](#)). However, over the same period the incidence rate decreased by 6.4% from 23.6 to 22.1 per 100,000 bed-days. It is important that these figures are interpreted with caution. Fluctuations in the level of hospital admissions during the pandemic has affected the total count of overnight patient bed-days in 2020, which as the denominator for the calculation of hospital-onset rates. Overnight bed-days were 14.6% lower in October to December 2020 when compared to the same quarter in 2019. There has been a slow return to more typically counts of overnight beds-days in the current quarter (October to December 2021), which is 11.2% higher than the same quarter in 2020. The decline in incidence rates but not counts of cases is due to a steady return to the typical number of overnight bed-days in October to December 2021

compared to the unusually low levels in October to December 2020. While hospital admissions were lower during the pandemic, over the same period, between October to December 2020 and October to December 2021, there has been a slow increase in hospital admissions. However, this is happening at a greater magnitude than the increase in cases, which is why a decline in incidence rate is observed.

In the period since January to March 2020, the total count of hospital-onset *E. coli* bacteraemia cases has been lower than what was observed in the pre-pandemic period, this was most obvious in April to June 2020 (n= 8,411). During this period the incidence rate of hospital-onset cases remained relatively stable, suggesting the rate of declines in the numbers of both overnight bed-days (hospital activity) and hospital-onset cases was similar.

When comparing the most recent quarter with October to December 2019, which is a more typical period prior to the COVID-19 pandemic, there is a 14.3% decrease in total cases from 10,690 to 9,166 and a 14.4% decrease in the incidence rate from 75.3 to 64.5 cases per 100,000 population ([Figure 1a](#)). Community-onset cases decreased by 16.0% from 8,692 to 7,300; similarly, the incidence rate of community-onset cases declined by 16.2% from 61.3 to 51.4 cases per 100,000 population. Finally, hospital-onset cases decreased by 6.6% compared over the same period from 1,998 to 1,866, while the hospital-onset incidence rate fell by 1.7% from 22.5 to 22.1 cases per 100,000 bed-days ([Figure 1b](#)). These highlights the decline reports of *E. coli* bacteraemia cases since the starts of the COVID-19 pandemic.

There appears to be a seasonality to the incidence of all-reported *E. coli* bacteraemia cases, with the highest rates observed between July to September of each year, although care is required in interpreting data for financial year April 2020 to March 2021 and April 2021 to March 2022 due to the reduction in cases and hospital activity.

Figure 1a. Quarterly rates of all reported *E. coli* bacteraemia: July to September 2011, to October to December 2021

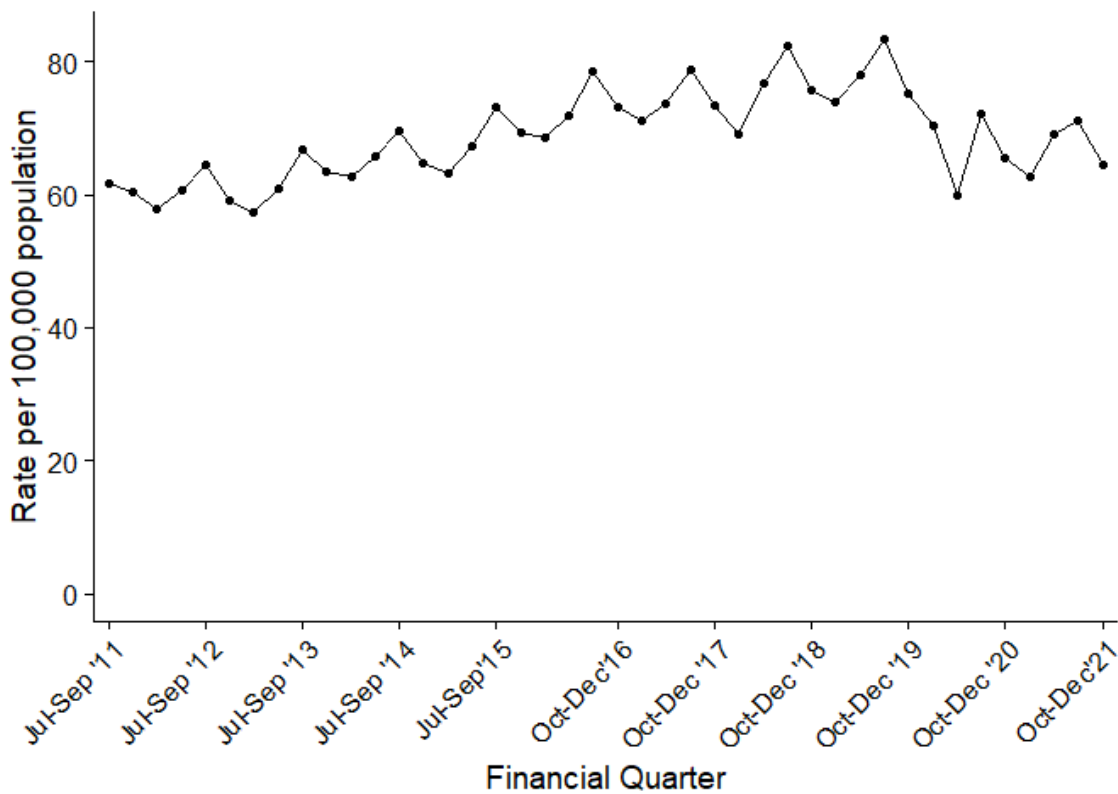
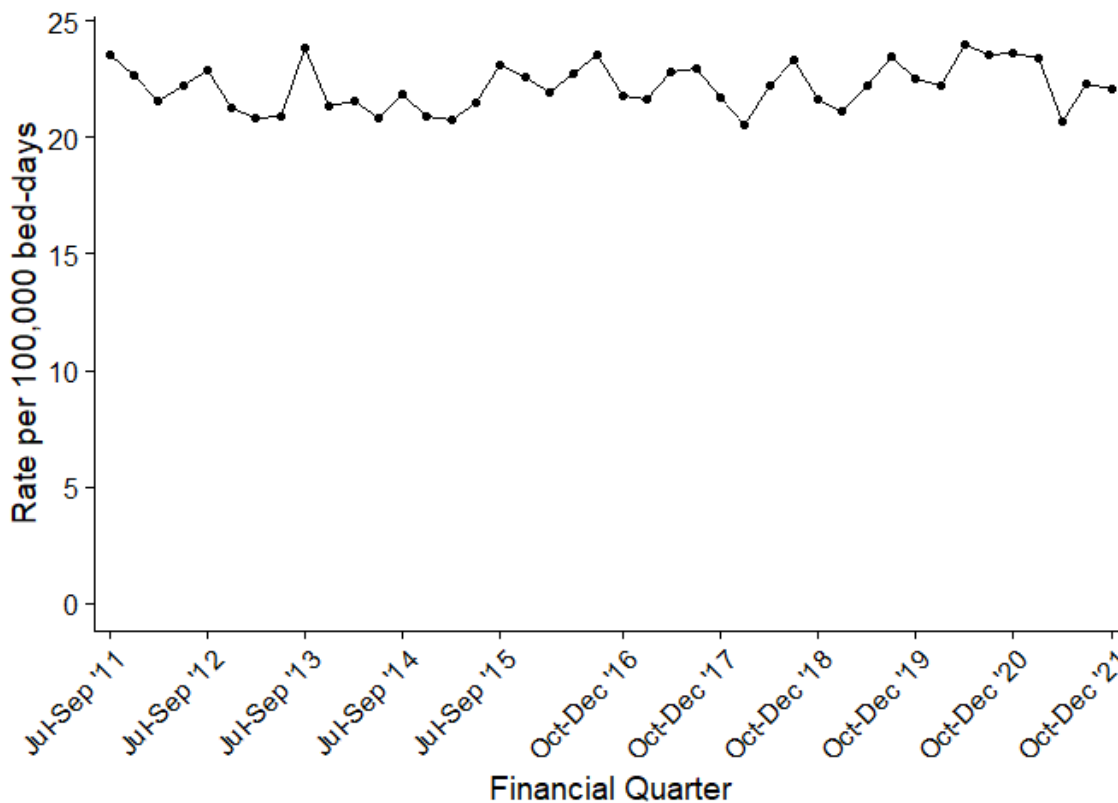


Figure 1b. Quarterly rates of hospital-onset *E. coli* bacteraemia: July to September 2011, to October to December 2021

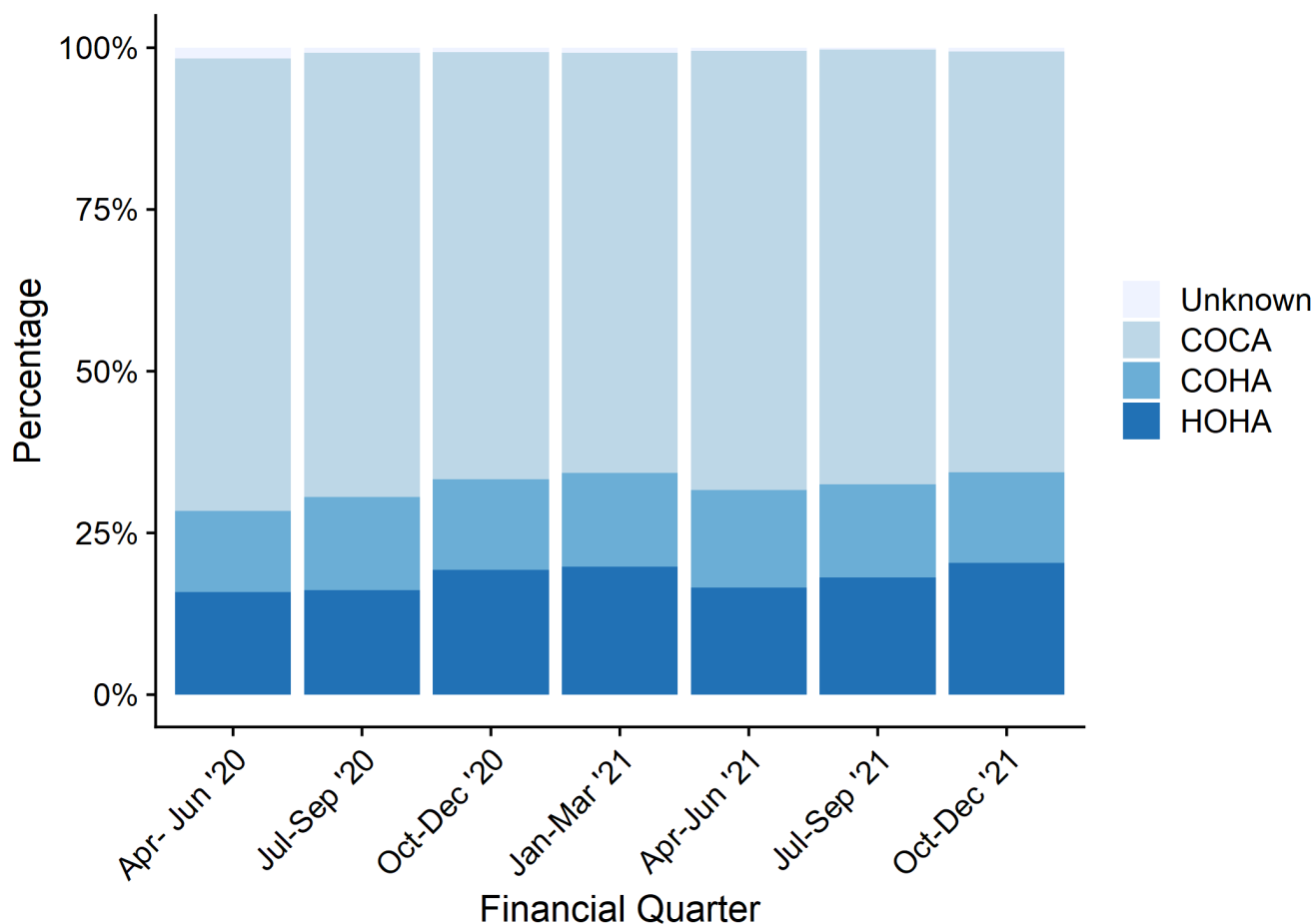


Since April 2020, community-onset cases *E. coli* bacteraemia cases have been further categorised based on previous discharge from the same reporting trust within 28 days. Community Onset-Community Associated (COCA) cases accounted for the majority of reported *E. coli* bacteraemia, between April to June 2020 and October to December 2021.

While there have been some fluctuations, the percentage has remained similar at around two-thirds of all cases. Overall, the percentage between April to June 2020 and October to December 2021, decreased slightly from 69.9% to 65.1% over this period (Figure 1c, Table S1a). During the same time period, the percentage of Healthcare Onset – Healthcare Associated (HOHA) and Community Onset – Healthcare Associated (COHA) cases increased from 15.9% to 20.4% and 12.5% to 14.0% of all *E. coli* bacteraemia cases respectively (Figure 1c, Table S1a).

Although the percentages of cases by prior trust exposure remained broadly stable, when comparing the number of HOHA cases from the current quarter to the same quarter in 2020 (October to December 2020), HOHA cases increased from 19.3% to 20.4%. Little change was seen in the percentages of COHA and COCA.

Figure 1c. Count of *E. coli* bacteraemia cases by prior trust exposure: April to June 2020, to October to December 2021



Klebsiella spp. bacteraemia

Between April to June 2017 and October to December 2021, there was a 33.3% increase in the count of all reported *Klebsiella* spp. bacteraemia cases from 2,348 to 3,131 and a 30.1% increase in the incidence rate from 16.9 to 22.0 cases per 100,000 population, the highest levels seen since surveillance began ([Figure 2a](#)).

The count of community-onset cases also increased by 22.6% from 1,678 to 2,057 cases, while the incidence rate increased by 19.6% from 12.1 to 14.5 cases per 100,000 population. Over the same period, the count of hospital-onset cases increased by 60.3% from 670 to 1,074 cases, while the rate increased by 64.2% from 7.8 to 12.7 cases per 100,000 bed-days ([Figure 2b](#), Table S2). Counts and rates of hospital-onset *Klebsiella* spp. peaked between July to September 2020 and January to March 2021. Since the start of the pandemic, both counts and rates hospital-onset cases increased to levels which were the highest observed since the inception of *Klebsiella* spp. surveillance. The hospital-onset incidence rate peaked at 15.5 cases per 100,000 bed-days during January to March 2021. The specific drivers of this increase are still being investigated, but we do know these trends coincided with increased incidence of COVID-19, Slood and others 2021 ([1](#)).

In October to December 2021, the number of hospital-onset *Klebsiella* spp. bacteraemia cases increased by 4.0% and the incidence rate decreased by 6.5%, when compared with the same quarter in the previous year (October to December 2020). Compared to the same period in 2019 (October to December 2019), a more typical year prior to the pandemic, the counts and the incidence rate of hospital-onset cases increased by 24.3% and 30.9% respectively. The number of all reported cases in the current quarter compared to the same period in 2019 (October to December 2019) increased by 6.0% from 2,955 to 3,131 cases, with a corresponding increase in the incidence rate of 5.8% from 20.8 to 22.0 per 100,000 population ([Figure 2a](#), Table S2). The number of community-onset *Klebsiella* spp. cases remained broadly similar (absolute change 2,091 to 2,057) and the infection rate decreased from 14.7 to 14.5 per 100,000 population (Table S2).

During October to December 2021, 71.6% (2,241 of 3,131) of all reported *Klebsiella* spp. bacteraemia were caused by *Klebsiella pneumoniae*, a decrease from 72.3% in the same quarter in the previous year (October to December 2020). Over the same period, the percentage of cases identified as *Klebsiella oxytoca* was 17.5% (548 of 3,131) in October to December 2021, which is similar to what was reported in October to December 2020 (17.2%).

The incidence rate of all species increased approximately proportionally, broadly following the same overall trend. The exception to this was the incidence rate of *K. oxytoca*, which increased within hospital-onset cases around the start of the pandemic and subsequently stabilised at between 1.9 to 2.1 per 100,000 bed days until the current quarter.

There is evidence of seasonality in the incidence trends of all-reported *Klebsiella* spp. bacteraemia cases, with the highest rates normally observed in July to September of each year, although it is important to evaluate financial year April 2020 to March 2021 and financial year April 2021 to March 2022 with caution.

Figure 2a. Quarterly rates of all reported *Klebsiella* spp. bacteraemia by species: April to June 2017, to October to December 2021

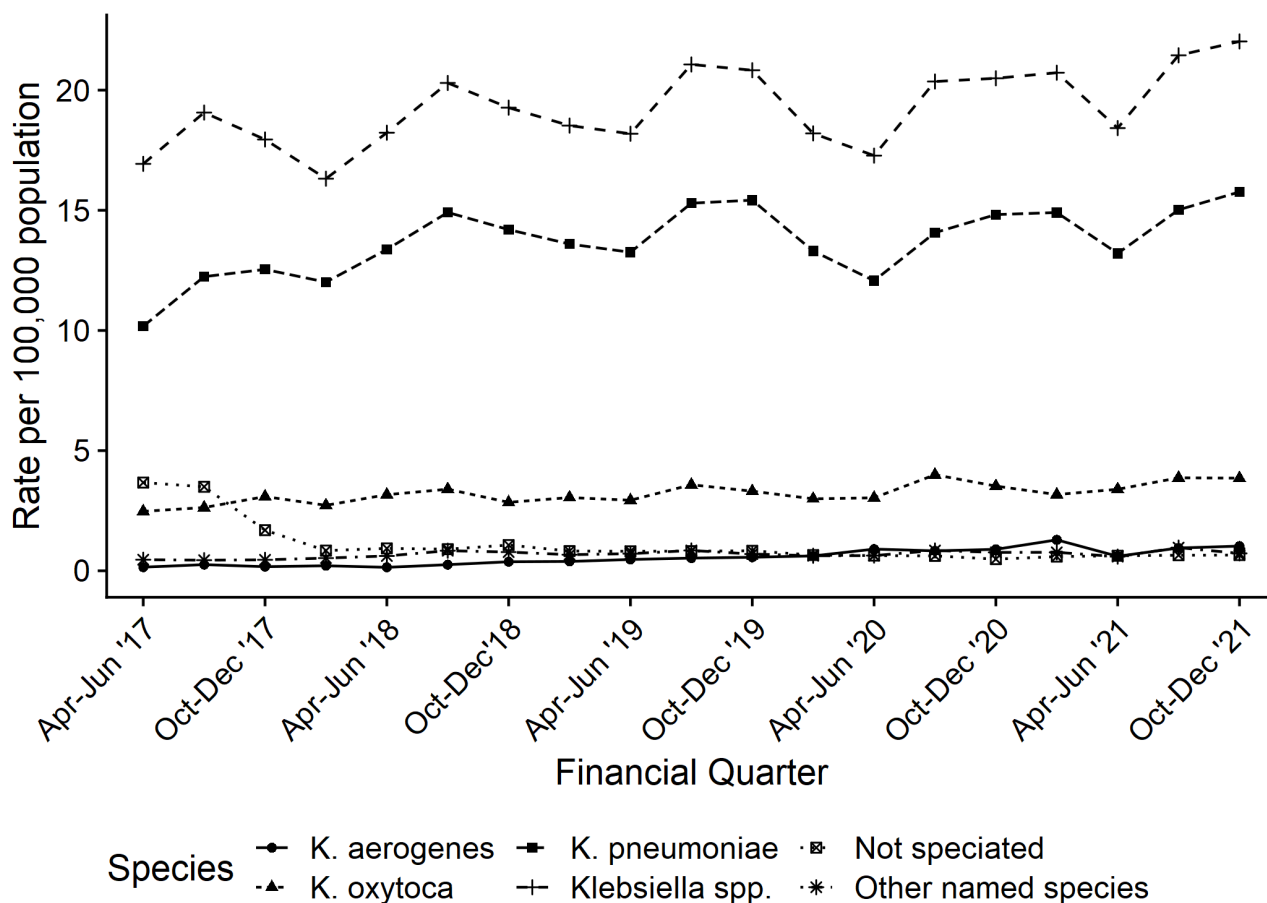
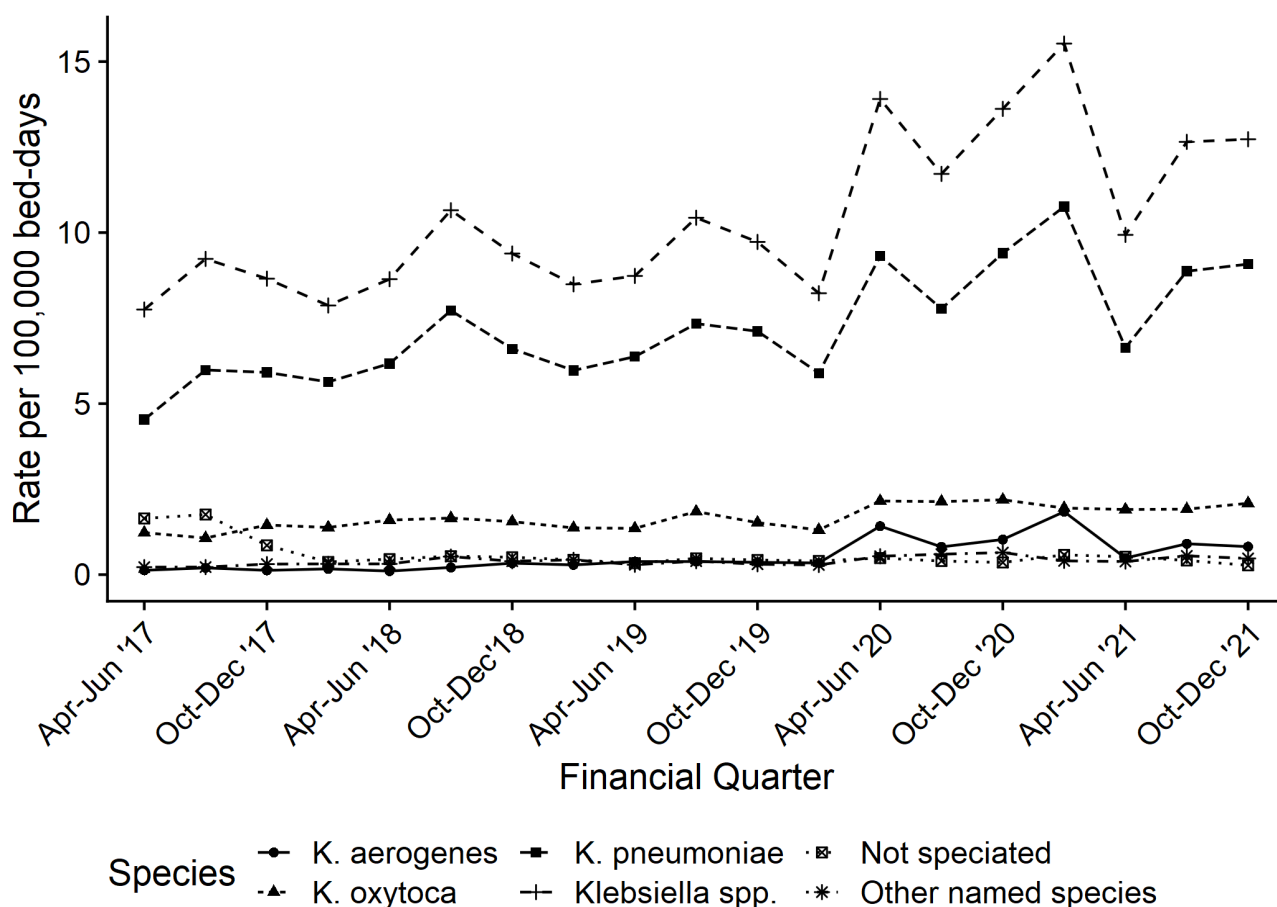


Figure 2b. Quarterly rates of hospital-onset *Klebsiella* spp. bacteraemia: April to June 2017, to October to December 2021

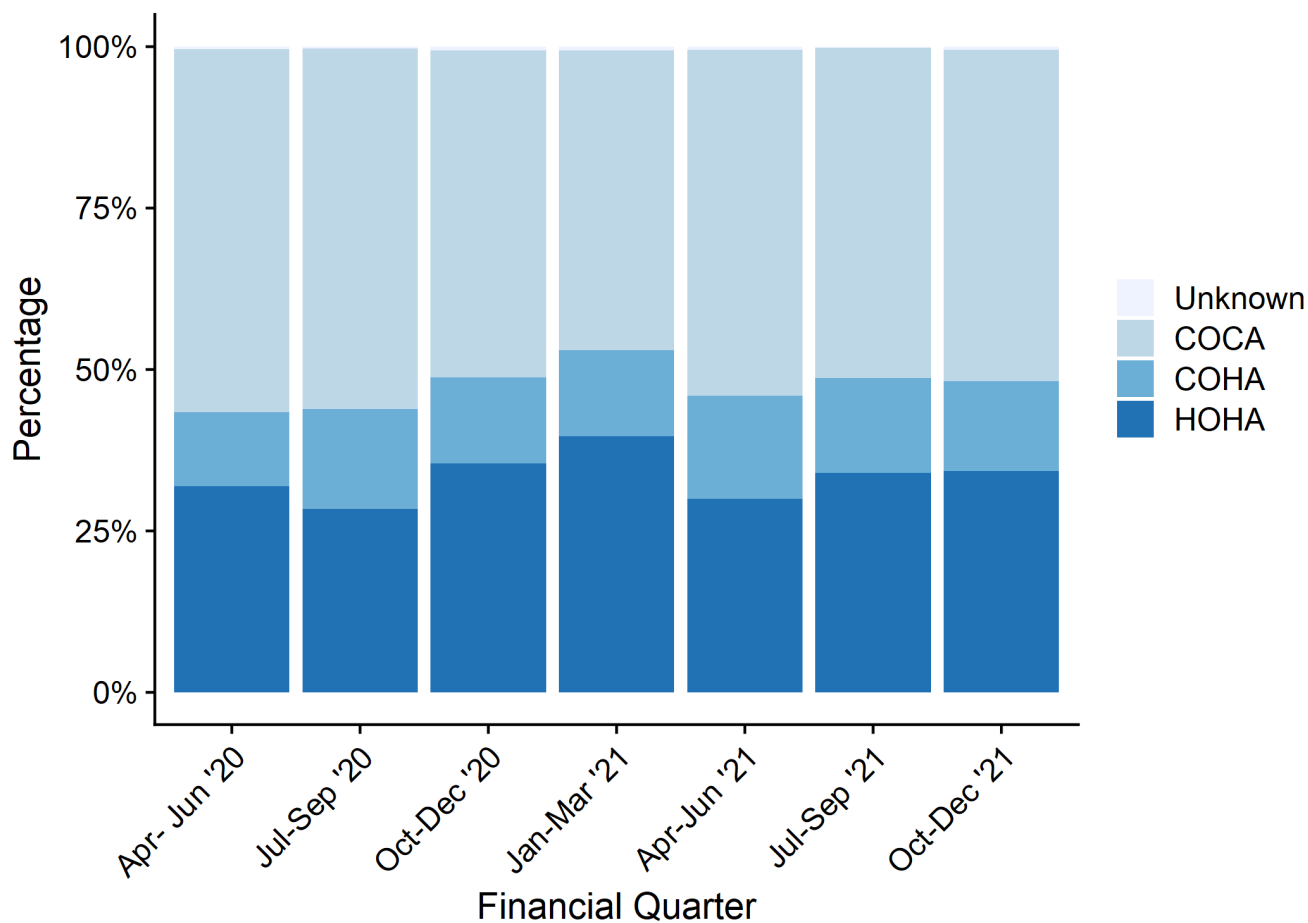


Similar to *E. coli* bacteraemia, between April to June 2020 and October to December 2021, COCA cases comprise the largest percentage of all *Klebsiella* spp. bacteraemia, accounting for around half (Figure 2c).

HOHA cases peaked at 39.7% in January to March 2021 alongside a decline in COCA cases to 46.4%. The increase in HOHA cases coincided with the second lockdown and has been investigated by Sloot and others, 2021. They found that this peak corresponded with an increase in patients with co or secondary COVID-19 infections in intensive care settings.

Compared to the same quarter in 2020, a small decrease is seen in HOHA cases from 35.5% to 34.3% of all cases. The percentage of COHA cases remained broadly similar at 13.3% of all *Klebsiella* spp. bacteraemia cases compared to 13.9% in the same period in the previous year. The number of COCA cases has slightly increased from 50.6% to 51.4% of all reported cases. (Figure 2c, Table S2a).

Figure 2c. Count of *Klebsiella* spp. bacteraemia cases by prior trust exposure: April to June 2020, to October to December 2021



Pseudomonas aeruginosa bacteraemia

Between April to June 2017 and October to December 2021, there was a 10.1% increase in the count of all reported *P. aeruginosa* bacteraemia cases from 1,015 to 1,118, and a 7.5% increase in the incidence rate from 7.3 to 7.9 cases per 100,000 population ([Figure 3a](#)). The count and the incidence rate of community-onset cases increased by 6.1% from 639 to 678 cases and by 3.5% from 4.6 to 4.8 cases per 100,000 population respectively. Over the same period, the count and the incidence rate of hospital-onset cases increased by 17.0% from 376 to 440 cases and by 19.9% from 4.3 to 5.2 cases per 100,000 bed-days respectively ([Figure 3b](#), Table S3).

Like *Klebsiella* spp. cases, increases in counts and rates of hospital-onset *P. aeruginosa* were also observed during the second wave of the pandemic. The counts and rates of hospital-onset *P. aeruginosa* increased between July to September 2020 and January to March 2021. During this period, both the counts and rates of hospital-onset cases increased to levels not seen since the initiation of mandatory surveillance of *P. aeruginosa* bacteraemia. The incidence rate of hospital-onset cases peaked at 7.0 cases per 100,000 bed-days in January to March 2021. The reasons for this increase have been investigated by Sloom and others, 2021, and it was observed that this increase coincided with a rise in the percentage of hospital-onset bacteraemia cases who were also positive for COVID-19.

When comparing similar quarters since the beginning of the surveillance, data from the current quarter for total and hospital-onset counts are still higher than pre-pandemic counts, with corresponding incidence rates. Whereas, counts and rates of community-onset cases are at the average expected figures.

Care should be taken when comparing October to December 2021 with the same period in the previous year (October to December 2020) which was largely affected by the COVID-19 pandemic. Both the total reported and community-onset counts and rates remained broadly the same. A slight change was seen in the hospital-onset counts which dropped from 444 to 440. However, hospital-onset rates decreased by 11.0% from 5.9 to 5.2 cases per 100,000 bed-days. This decrease in rate is due to the fact the bed-days data for the current quarter is 11.2% higher than it was in October to December 2020.

A comparison to the same period in 2019 (October to December 2019), which was a more typical year before the pandemic, shows little change in the count of all reported cases from 1,110 to 1,118 with a corresponding change in rate from 7.8 to 7.9 cases per 100,000 population ([Figure 3a](#), Table S3). Counts of community-onset *P. aeruginosa* cases decreased by 2.7% from 697 to 678, with a corresponding decline in the community-onset incidence rate of 2.9% from 4.9 to 4.8 per 100,000 population (Table S3). Counts of hospital-onset *P. aeruginosa* case increased 6.5% from 413 to 440, which corresponds to an increase in the incidence rate of 12.2% from 4.6 to 5.2 per 100,000 bed-days ([Figure 3b](#), Table S3).

There is evidence of seasonality in the incidence of all-reported *P. aeruginosa* bacteraemia cases, with the highest rates normally observed in July to September of each year.

Figure 3a. Quarterly rates of all reported *P. aeruginosa* bacteraemia: April to June 2017, to October to December 2021

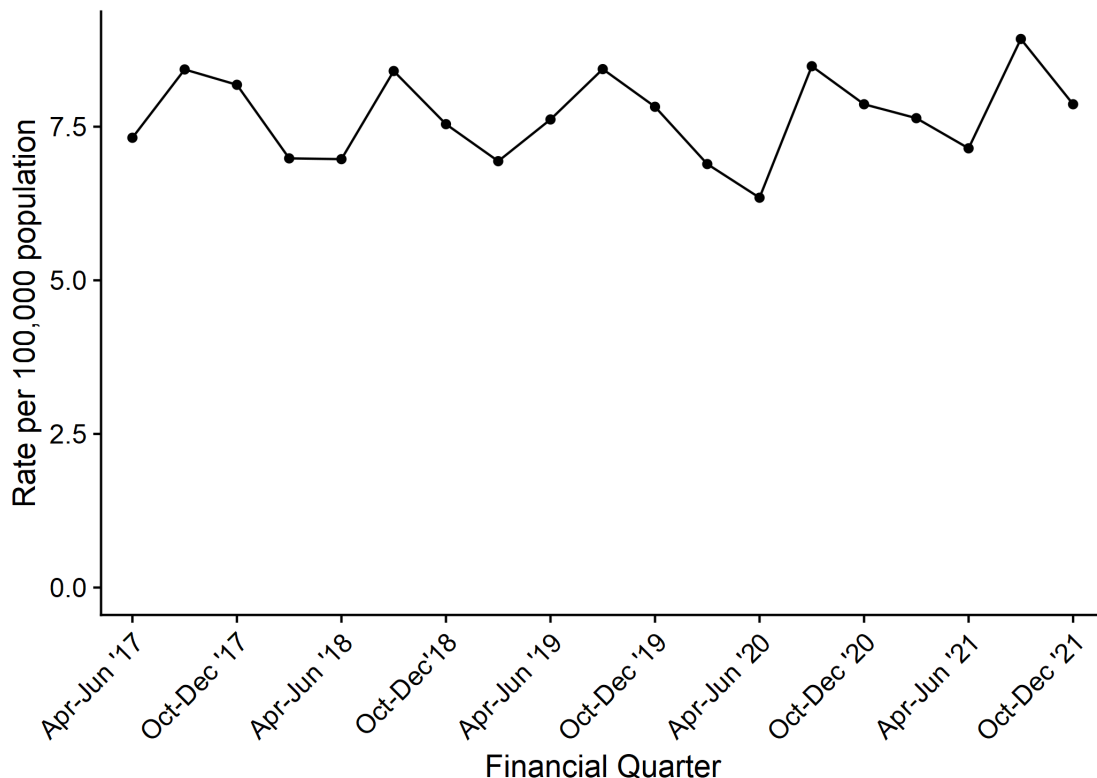
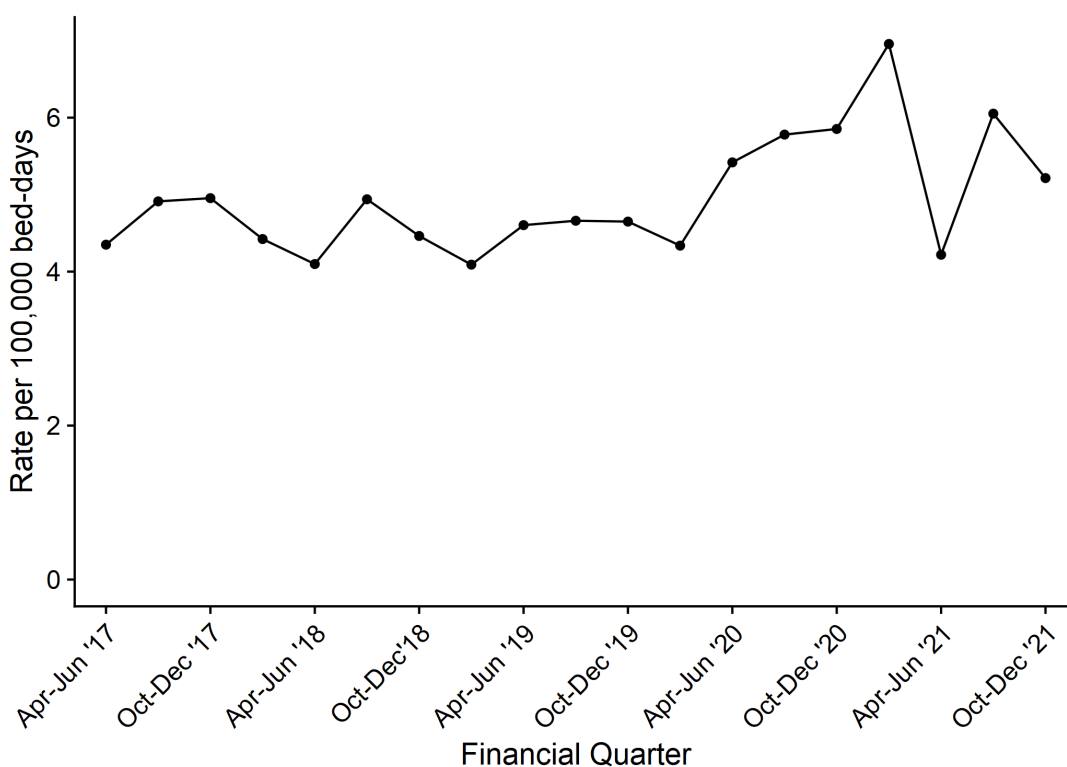


Figure 3b. Quarterly rates of hospital-onset *P. aeruginosa* bacteraemia: April to June 2017, to October to December 2021

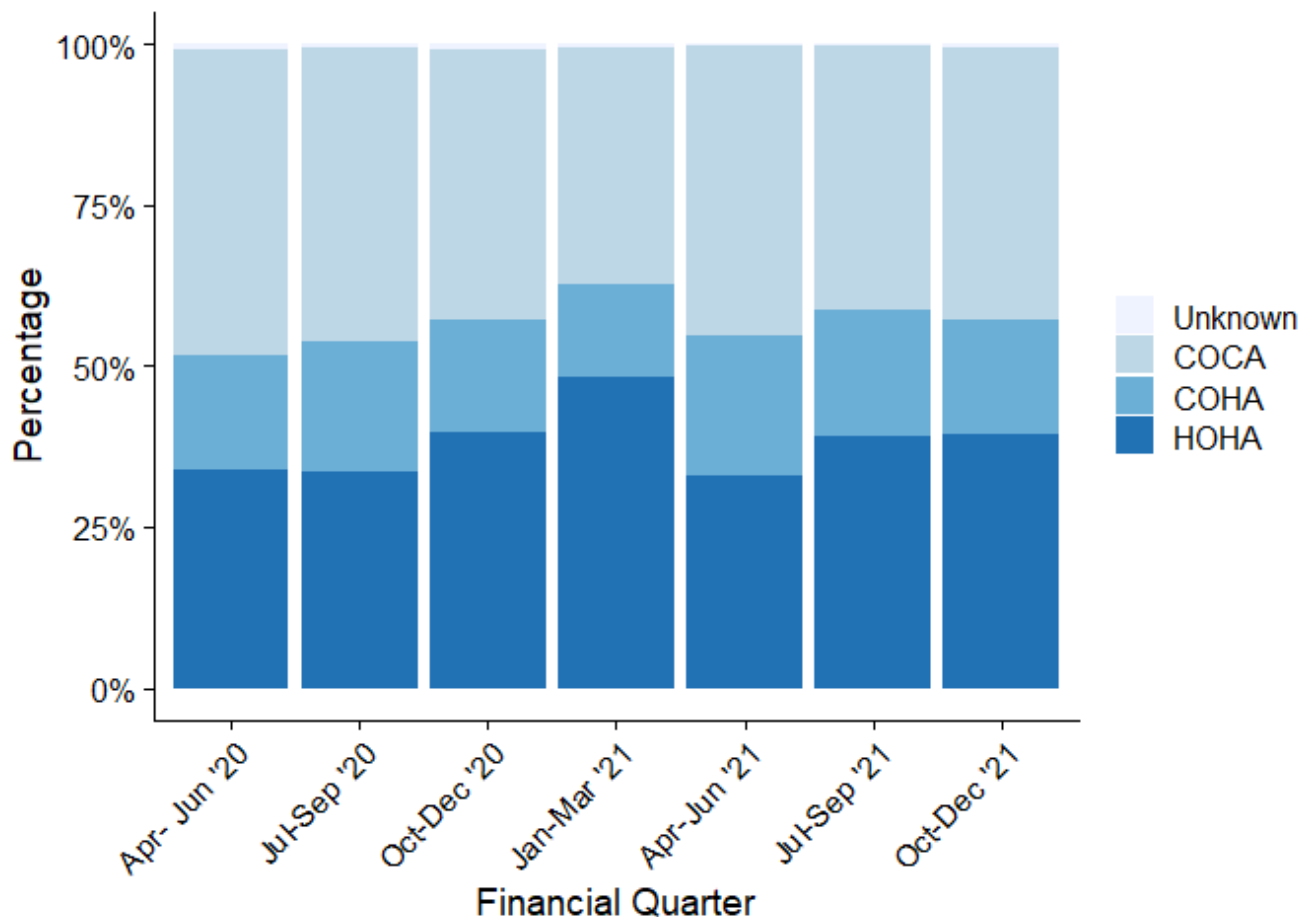


Similarly, to *E. coli* and *Klebsiella* spp., COCA cases (around 50%) tend to dominate *P. aeruginosa* bacteraemia cases between April to June 2020 and October to December 2021. In January to March 2021, HOHA cases surpassed COCA cases for the first time since April 2020 coinciding with the peak of the second wave of the COVID-19 pandemic.

The percentage of HOHA cases increased from 33.9% in April to June 2020 to 39.4% in October to December 2021. Over the same period, COCA cases decreased from 47.5% to 42.4% and COHA cases remained the same at 17.7%.

Comparing October to December 2021 to the same quarter in 2020 (October to December 2020), there was little change in HOHA cases, which decreased from 39.7% to 39.4% of all *P. aeruginosa* bacteraemia cases. The percentage of COHA cases increased slightly from 17.4% to 17.7%. COCA cases have increased from 41.9% to 42.4%. (Figure 3c, Table S3a).

Figure 3c. Count of *P. aeruginosa* bacteraemia cases by prior trust exposure: April to June 2020, to October to December 2021



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 ([Figure 4a](#), Table S4). The incidence rate of all reported cases fell by 85.0% 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 fluctuated between 0.6 and 1.8 since then and is currently at 1.2 cases per 100,000 population in October to December 2021.

A similar trend was observed with the incidence rate of hospital-onset cases ([Figure 4b](#), Table S4). There was a steep decrease of 79.3% from 4.9 cases per 100,000 bed-days in April to June 2008 to 1.0 case per 100,000 bed-days in January to March 2014.

Subsequently, between January to March 2014 and October to December 2021, the rate has decreased to 0.7 cases per 100,000 bed-days. Since January to March 2014 there have been fluctuations in both the number of hospital-onset infections and the hospital-onset incidence rate, although it has remained broadly stable.

Like *Klebsiella* spp. and *P. aeruginosa*, the incidence rate of hospital-onset MRSA bacteraemia peaked at 1.4 cases per 100,000 bed-days in January and March 2021 ([Figure 4b](#), Table S4). This was the highest rate seen for hospital-onset MRSA bacteraemia since April to June 2011. The reasons for this increase are still being investigated, although it has been observed that this increase coincided with a rise in the percentage of hospital-onset bacteraemia cases who were also positive for COVID-19.

A comparison to the same period in 2019 (October to December 2019), which was a more typical year before the COVID-19 pandemic, shows a 24.0% decrease in total counts from 233 to 177 in October to December 2021, and a similar decline in the incidence rate of 24.2% from 1.6 to 1.2 cases per 100,000 population ([Figure 4a](#), Table S4). Community-onset MRSA bacteraemia cases decreased by 28.4% from 162 to 116, while the incidence rate decreased by 28.5% from 1.1 to 0.8 cases per 100,000 population (Table S4). During the same quarter in 2019, the count of hospital-onset MRSA bacteraemia cases decreased by 14.1% from 71 to 61, with a 9.6% decrease in incident rate from 0.8 to 0.7 per 100,000 bed-days ([Figure 4b](#), Table S4).

Figure 4a. Quarterly rates of all reported MRSA bacteraemia: April to June 2007, to October to December 2021

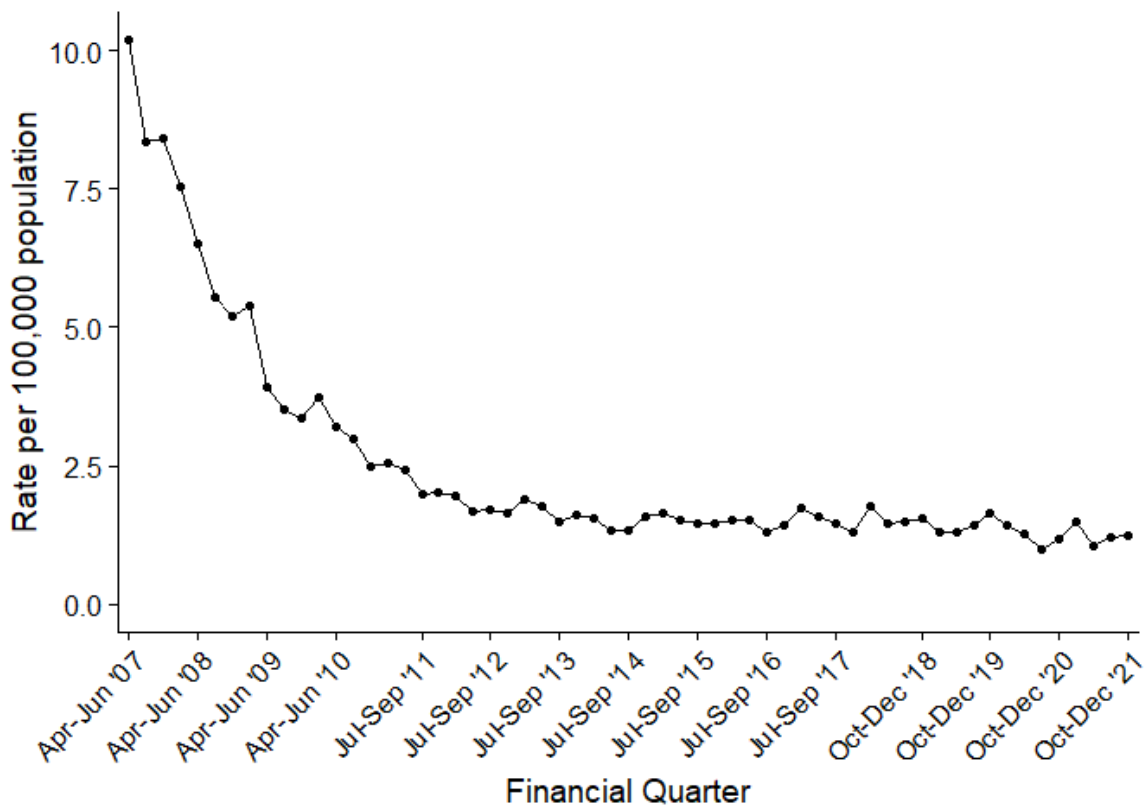
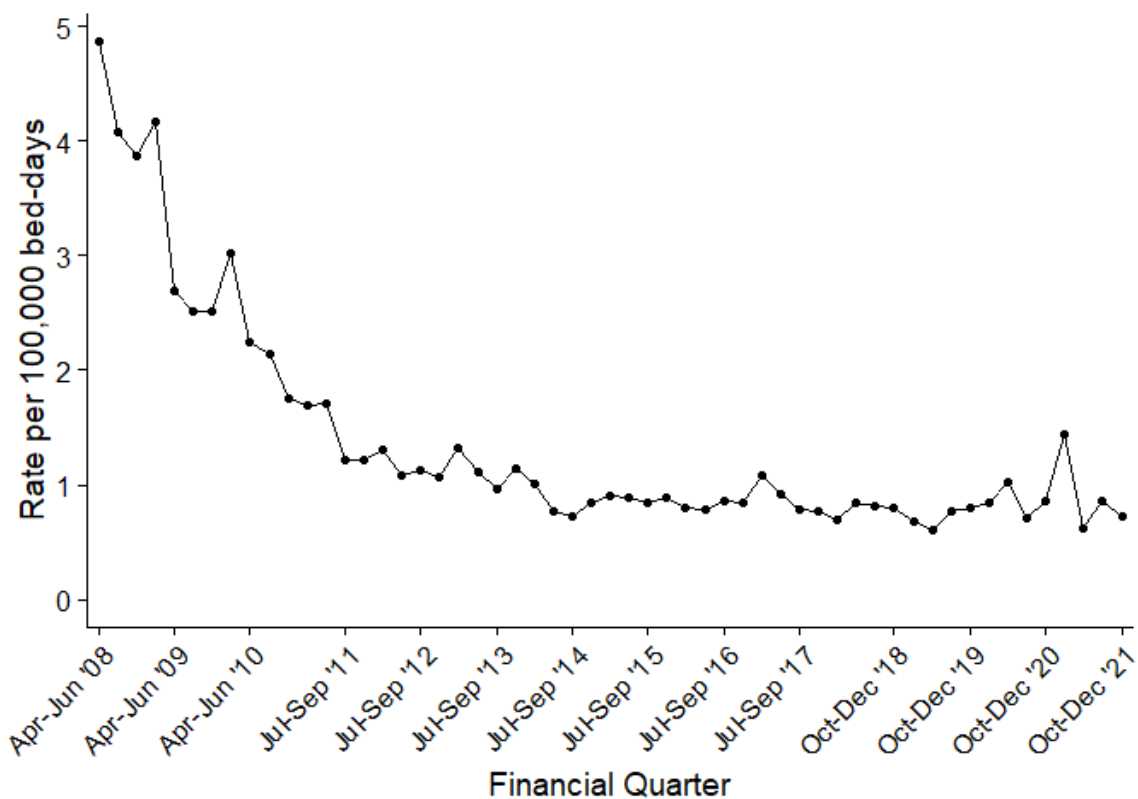


Figure 4b. Quarterly rates of hospital-onset MRSA bacteraemia: April to June 2008, to October to December 2021



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 cases. The count of all reported cases of MSSA bacteraemia increased by 43.7% from 2,199 to 3,160 between January to March 2011 and October to December 2021. This was accompanied by a 32.4% increase in incidence rate from 16.8 to 22.2 per 100,000 population ([Figure 5a](#), Table S5).

These increases are primarily driven by increases in community-onset cases. Between January to March 2011 and October to December 2021, the count and the incidence rate of community-onset cases increased by 49.1% and 37.4% respectively from 1,464 to 2,183 cases and from 11.2 to 15.4 cases per 100,000 population (Table S5). Over the same period, the count of hospital-onset cases increased by 32.9% from 735 to 977 cases, while the hospital-onset incidence rate increased 38.9% from 8.3 to 11.6 cases per 100,000 bed-days ([Figure 5a](#) and [Figure 5b](#), Table S5a). Since the beginning of the COVID-19 pandemic, the numbers of all reported MSSA cases are generally lower than in previous years.

Since April to June 2020, there has been an increase in the incidence rate of hospital-onset MSSA bacteraemia cases. The overall growth is, in part, a result of reduced hospital admissions and overnight bed-days. This has caused a large increase in the rate of hospital-onset cases over a relatively short time since overnight bed-days is used as a denominator for rate calculations. This culminated in a peak during January to March 2021 of 13.4 cases per 100,000 bed-days and 998 cases, which was the highest MSSA hospital-onset rate and count that has been observed since the inception of MSSA surveillance. This pattern is comparable to that observed in both *Klebsiella* spp. and *P. aeruginosa*. Furthermore, MSSA hospital-onset cases in October to December 2021 are at their highest since the beginning of surveillance when compared to the same quarters in previous years, October to December 2020 when the incidence rate was comparable.

In comparison to the same period in 2019 (October to December 2019), which is a more typical year prior to the first wave of the pandemic, there is a 0.8% increase in the counts of all reported cases from 3,134 to 3,160 and a 0.6% increase in the rate from 22.1 to 22.2 cases per 100,000 population in the current quarter (October to December 2021). Over this same period, hospital-onset MSSA bacteraemia cases have increased by 15.3% from 847 to 977, which corresponds to a 21.4% increase in the incidence rate from 9.5 to 11.6 per 100,000 bed-days. Community-onset MSSA bacteraemia cases decreased by 4.5% from 2,287 to 2,183, while the rates decreased by 4.7% from 16.1 to 15.4 per 100,000 population over the same period.

Figure 5a. Quarterly rates of all reported MSSA bacteraemia: January to March 2011, to October to December 2021

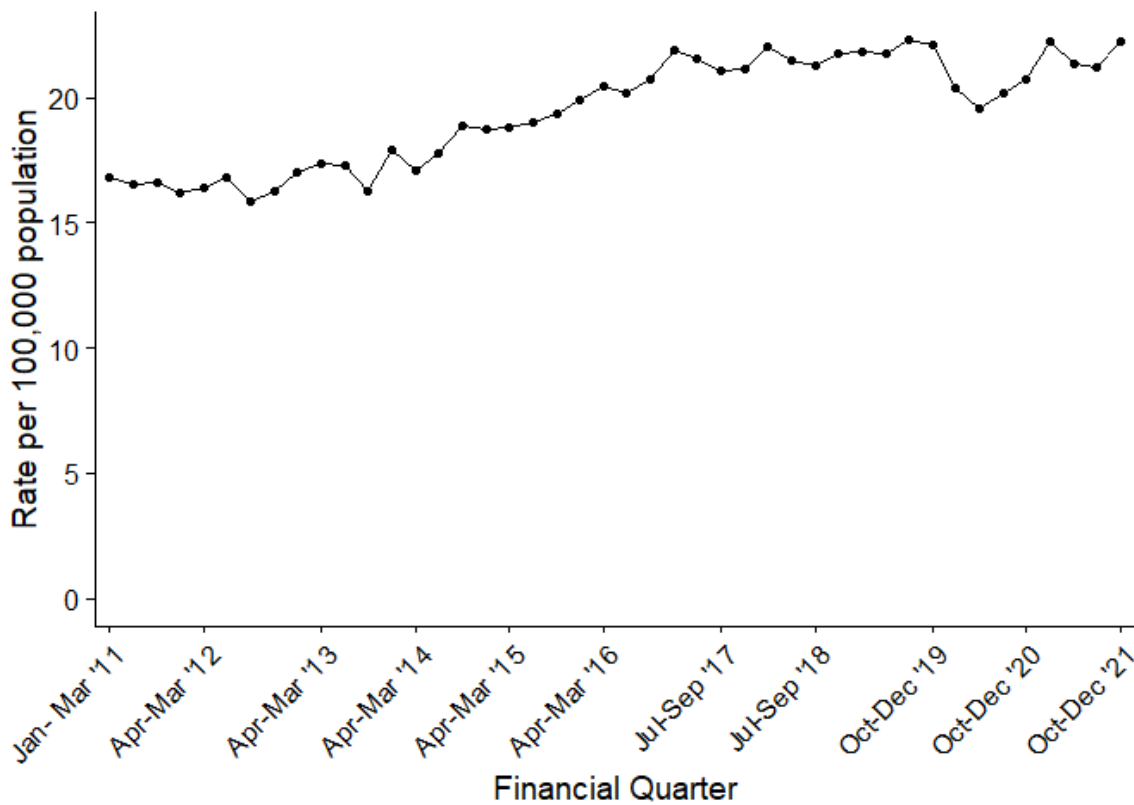
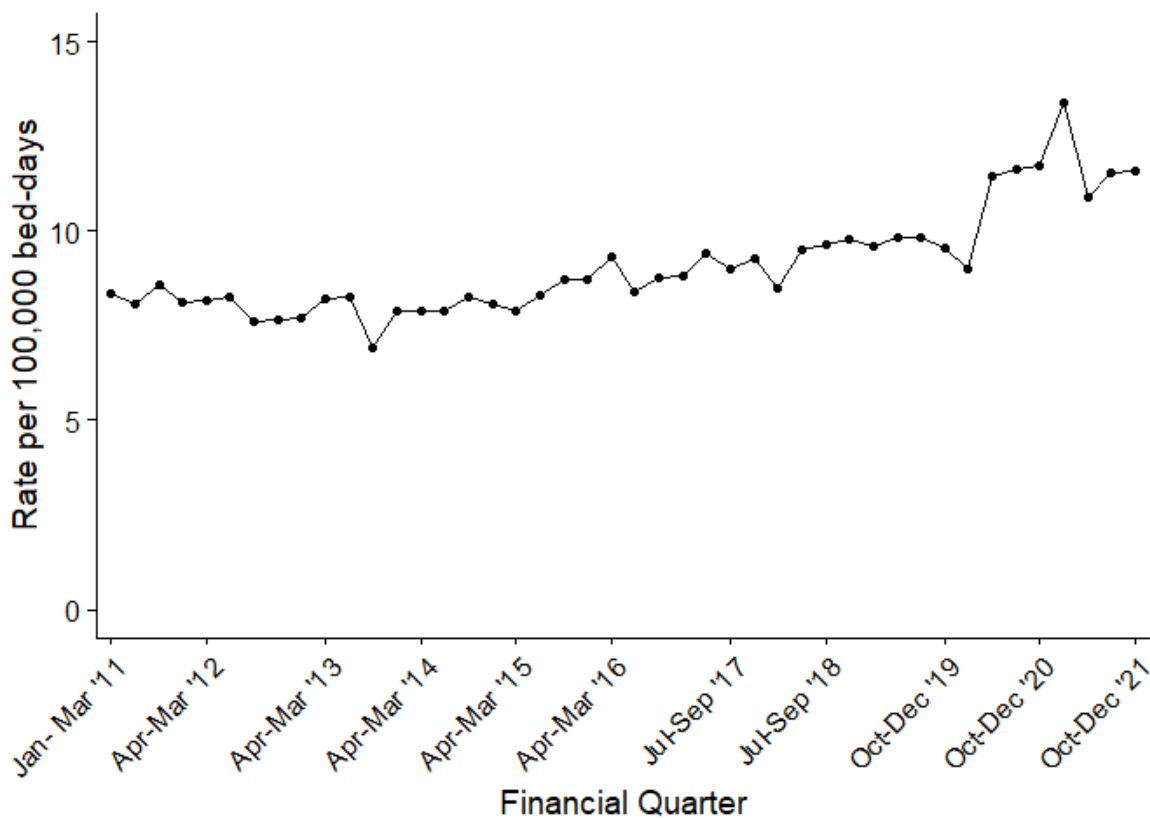


Figure 5b. Quarterly rates of hospital-onset MSSA bacteraemia: January to March 2011 to October to December 2021



Epidemiological analyses of *Clostridioides difficile* infection data

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

A large part of the decrease in the incidence rate occurred between April to June 2007 and January to March 2012, with a 78.0% decrease in all-reported cases of CDI from 16,864 to 3,711 cases and an associated 78.8% reduction in incidence rate from 131.6 cases per 100,000 population to 27.9 cases per 100,000 population. Subsequently, between January to March 2012 and October to December 2021, the count of all-reported cases decreased by 5.3% from 3,711 to 3,516 cases, with the incidence rate reduced by 11.3% from 27.9 to 24.7 cases per 100,000 population.

There were similar, but greater, reductions among hospital-onset CDI cases with an 84.5% reduction in count of cases between April to June 2007 and January to March 2012 from 10,436 to 1,613 cases and an 83.9% reduction in the incidence rate from 112.1 to 18.2 per 100,000 bed-days. This was followed by a further 16.0% decrease in the count of cases from 1,613 to 1,355 cases and a decrease of 11.2% in the incidence rate from 18.1 to 16.1 cases per 100,000 bed-days between January to March 2012 and October to December 2021. When comparing the most recent quarter (October to December 2021) to the same period prior to the start of the pandemic (October to December 2019) there is a 3.2% increase in the count of all reported cases from 3,407 to 3,516, corresponding to an increase in the incidence rate from 24.0 to 24.7 cases per 100,000 population ([Figure 6a](#), Table S6).

Community-onset CDI cases increased by 1.6% from 2,128 to 2,161 while the rate increased from 15.0 to 15.2 per 100,000 population (Table S6, Table S6). Hospital-onset CDI cases increased by 5.9% from 1,279 to 1,355 which corresponds to an incidence rate increase of 11.5% from 14.4 to 16.1 cases per 100,000 bed-days ([Figure 6b](#), Table S6).

Figure 6a. Quarterly rates of all reported *C. difficile*: April to June 2007, to October to December 2021

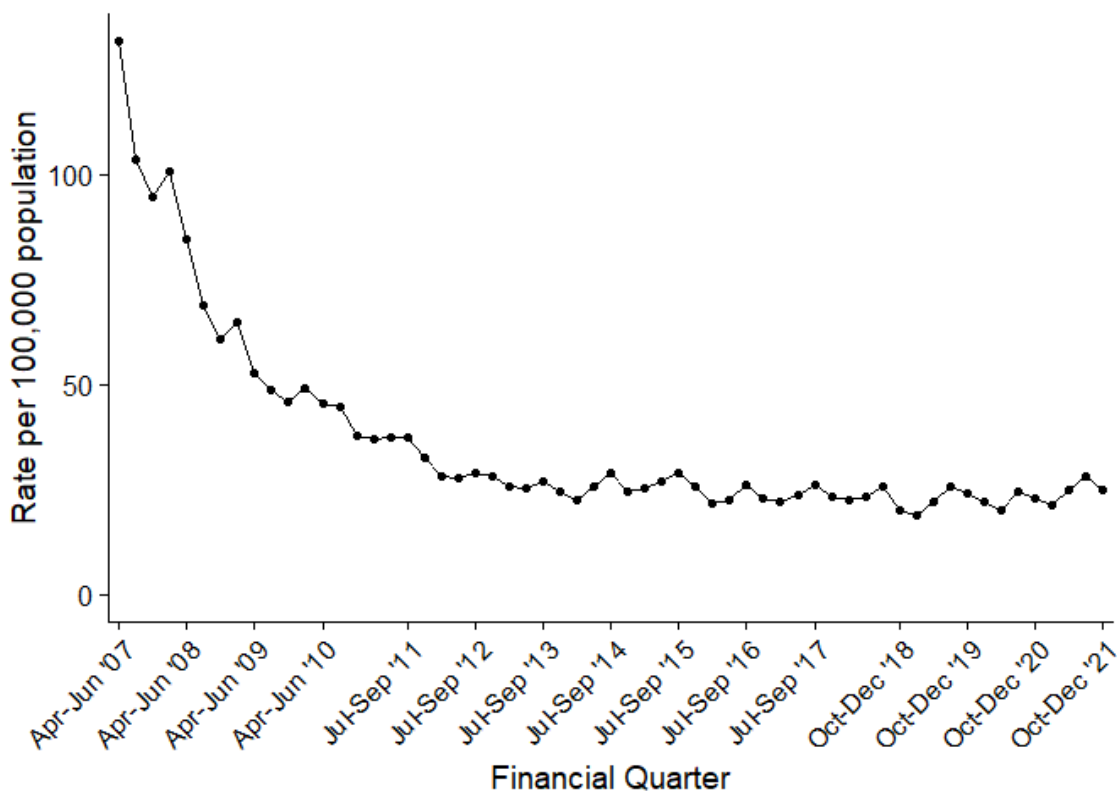
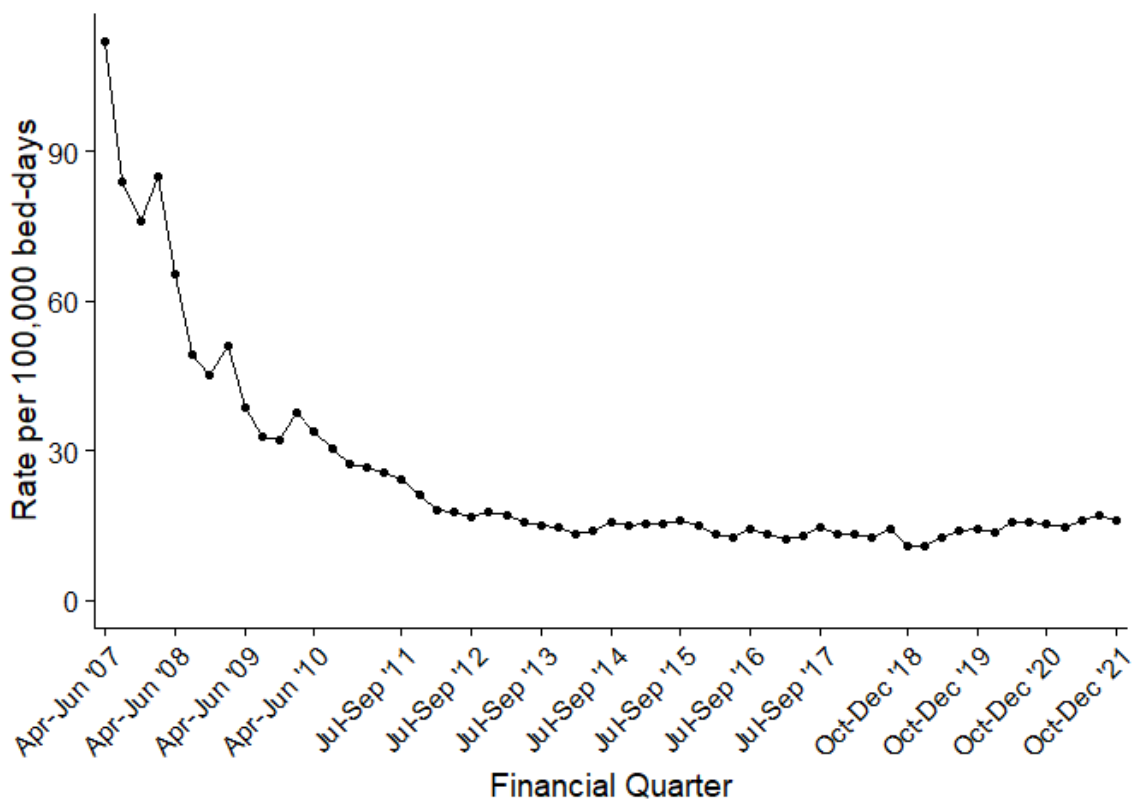
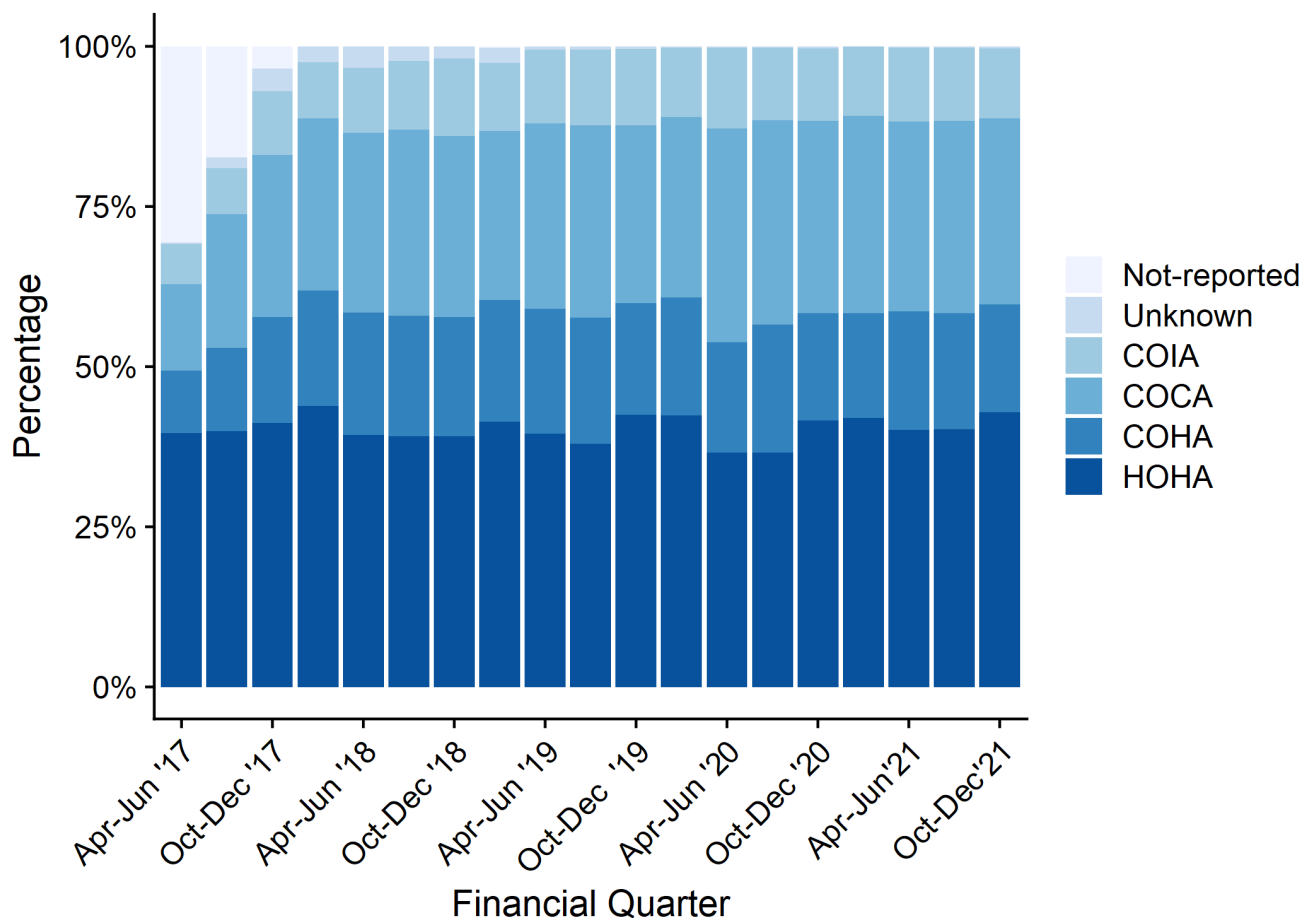


Figure 6b. Quarterly rates of hospital-onset *C. difficile*: April to June 2007, to October to December 2021



Between April to June 2017 and October to December 2021 the largest percentage of cases were HOHA. While there have been some fluctuations, the percentage has remained broadly stable at around 40% of all cases. Over the same period, COCA cases increased from 13.4% to 29.0% of all CDI, while COHA cases have increased from 9.7% to 16.8% of all CDI. Community Onset Indeterminate Association (COIA) cases have increased from 6.3% to 10.9% of all CDI. Much of the increase observed is likely due to improved data quality as shown by the sharp decline of cases with missing data (Figure 7, Table S7).

Figure 7. CDI rates by prior trust exposure April to June 2017, to October to December 2021



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 to 2012, [bed-day data](#) has been available on a quarterly basis and has been used as such for Q2 2011 to 2012, to Q3 2021 to 2022.

However, UKHSA has reviewed its policy for processing KH03 data. Data irregularities identified have been flagged with colleagues at NHS England (data owners of the KH03 data set). Until we receive confirmation that any identified change in the occupied overnight bed-days for an acute trust is anomalous, UKHSA now uses the data as published in the KH03 data set. 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 financial year 2014 to 2015, has been altered to reflect that published in the KH03 data set. 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 to 2008, and 2008 to 2009 KH03 figures: replaced with 2006 to 2007 KH03 figure
- Rotherham NHS Foundation Trust (RFR): 2009 to 2010 and from April to June 2010, to April to June 2011 KH03 figures: replaced with 2008 to 2009 KH03 figure
- Sheffield Teaching Hospitals NHS Foundation Trust (RHQ) from April to June 2010, to April to June 2011 KH03 figures: replaced with 2009 to 2010 KH03 data
- The Princess Alexandra Hospital NHS Trust (RQW) April to June 2014, and October to December 2014 KH03 figures: replaced with April to June 2013, to October to December 2013 KH03 figures, respectively
- Ipswich Hospital NHS Trust (RGQ) January to March 2016 KH03 figure: replaced with January to March 2015 figures

- West Suffolk NHS Foundation Trust (RGR) April to June 2016, to October to December 2016 and April to June 2017 KH03 figures: replaced with April to June 2015, to October to December 2015 KH03 figures
- Gloucestershire Hospitals NHS Foundation Trust (RTE) October to December 2016, to January to March 2017 KH03 figures: replaced with October to December 2015, to January to March 2016 KH03 figures

The KH03 data used for this report was published on 25 February 2022. This may include revisions of previously published KH03 data used in earlier reports.

Population data

National incidence rates are calculated using 2007 to 2020 mid-year resident population estimates which are based on the 2011 census for England (2021 estimates are based on 2020 mid-year estimates).

Definitions

Bacteraemia 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 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, reports 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. This was extended to all other data collections in 2019.

Cases are split into one of 6 groups for CDI and 5 groups for the bacteraemias:

CDI prior trust exposure categories

1. Hospital-onset healthcare-associated: date of onset is greater than 2 days after admission (where day of admission is day 1).
2. Community-onset healthcare-associated: is not categorised HOHA and the patient was most recently discharged from the same reporting trust in the 28 days prior to the specimen date (where day 1 is the specimen date).
3. Community-onset indeterminate association: is not categorised HOHA and the patient was most recently discharged from the same reporting trust between 29 and 84 days prior to the specimen date (where day 1 is the specimen date).
4. Community-onset community-associated: is not categorised HOHA and the patient has not been discharged from the same reporting organisation in the 84 days prior to the specimen date (where day 1 is the specimen date)
5. Unknown: the reporting trust answered 'Don't know' to the question regarding previous discharge in the 3 months prior to CDI case.
6. No Information: the reporting trust did not provide any answer for questions on prior admission.

Bacteraemia prior trust exposure categories

April 2020, the HCAI DCS has included questions relating to prior trust exposure to the same acute trust reporting Gram-negative bacteraemia cases. These additional mandatory items were developed to assist the UK governments ambition to reduce healthcare-associated Gram-negative BSI and CDI from a 2019 baseline to threshold levels. This supports the intention to reduce Gram-negative BSI by 25% by March 2022, and by 50% by March 2024.

Cases since April 2020 have also been categorised as:

1. Hospital-onset healthcare-associated: date of onset is greater than 2 days after admission (where day of admission is day 1).
2. Community-onset healthcare-associated: is not categorised HOHA and the patient was most recently discharged from the same reporting trust in the 28 days prior to the specimen date (where day 1 is the specimen date).
3. Community-Onset, Community Associated: is not categorised HOHA and the patient has not been discharged from the same reporting organisation in the 28 days prior to the specimen date (where day 1 is the specimen date).

4. Unknown: the reporting trust answered 'Don't know' to the question regarding previous discharge in the month prior to the current episode.
5. No Information: 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, *E. coli*, *Klebsiella* spp. and *P. aeruginosa* bacteraemia and 28 days for CDI, where the specimen date is 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 number of episodes and the mid-year population for England:

$$= \frac{n \text{ episodes}}{\left(\frac{\text{mid-year population for England} \times \text{no. of days in quarter}}{\text{days in year}} \right)} \times 100,000$$

That is: the number of episodes is multiplied by 100,000, then multiplied by the number of days in the year, then divided by the mid-year of population for the same year for England, then divided by the number of days in the quarter.

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

This incidence rate is calculated using the number of episodes and the KH03 average bed-day activity (see [bed-day data](#) above) and is calculated as follows:

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

That is: the number of episodes is multiplied by 100,000, then divided by the average number of beds occupied-overnight in a quarter, then divided by the number of days in the same quarter.

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 [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: April to June 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 to 2015: April to June 2014
- Q2 2014 to 2015: July to September 2014
- Q3 2014 to 2015: October to December 2014
- Q4 2014 to 2015: April to June 2015

References

1. Sloat R, Nsonwu O, Chudasama D, Rooney G, Pearson C, Choi H, Mason E, Springer A, Gerver S, Brown C, Hope R. 'Rising rates of hospital-onset *Klebsiella* spp. and *Pseudomonas aeruginosa* bacteraemia in NHS acute trusts in England: a review of national surveillance data.' August 2020 to February 2021. *Journal of Hospital Infection* 2021: September 2020

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