



# Surveillance of Healthcare Associated Infections in Northern Ireland Annual Report

2017

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## Executive summary



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For Northern Ireland in 2017, the rate of *C. difficile* in inpatients increased by 3% to 0.21 cases per 1000 occupied bed days compared to 2016.

The **overall** rate of *S. aureus* bloodstream infections decreased in 2017 by 3% to 0.26 cases per 1000 occupied bed days compared to 2016

- The MRSA rate decreased by 25% to 0.03
- The MSSA rate increased by 1% to 0.23



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The **overall** rate of Gram-negative bloodstream infections\* increased in 2017 by 18% to 1.18 cases per 1000 population compared to 2016

- The *E.coli* rate increased by 18% to 0.945
- The *Klebsiella* species rate increased by 26% to 0.18
- The *Pseudomonas aeruginosa* rate increased by 4% to 0.05

During 2017, 13 *Pseudomonas* colonisations from 9 infants were reported from neonatal units across Northern Ireland. No infections were reported.



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\*Data sourced from voluntary laboratory reporting (CoSurv)

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We also thank Eileen Corey for her assistance and support in the development of this report.

## Image credits

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## Background

The Public Health Agency's Health Protection Surveillance Team is mandated by the Department of Health to undertake surveillance of healthcare-associated infections (HCAI). The surveillance of HCAs has a number of goals:

1. **Detection** of changes in the temporal, geographic and age distribution of new and known diseases, or changes in the pattern of diseases and their risk factors
2. **Analysis** which can determine the exposure, prevalence, burden, morbidity, mortality, carriage and long term trends of HCAI
3. **Timely action** to protect the public's health
4. Building **information** on the temporal, geographic and population distribution and epidemiology of new, poorly-understood and well-understood diseases for information public health decision-making, health service planning, risk management, research and infection control programmes
5. **Informing** the public about the risk of communicable diseases
6. **Contributing** to European and International efforts to protect health

Mandatory surveillance for Meticillin-sensitive and Meticillin-resistant *Staphylococcus aureus* (MSSA and MRSA, respectively) bloodstream infection was introduced in April 2001. *Staphylococcus aureus* (*S. aureus*) is a round shaped bacterium which commonly colonises the nose, respiratory tract, gut mucosa and the skin usually without causing any problems. It can also cause disease, particularly if there is an opportunity for the bacteria to enter the body, for example through broken skin or a medical procedure (including operations and intravenous lines). If these bacteria enter the body, illnesses which range from mild to life threatening may develop. These can include skin and wound infections, abscesses, endocarditis, pneumonia and bacteraemia (blood stream infection). Most strains of *S. aureus* are sensitive to the more commonly used antibiotics, and infections can be effectively treated. Some *S. aureus* bacteria are more resistant to the antibiotic meticillin. These are more difficult to treat and are termed meticillin resistant *S. aureus* (MRSA).

Mandatory surveillance of *Clostridium difficile* infection (CDI) in hospitals Northern Ireland was introduced in January 2005, with enhanced surveillance of **community-onset** CDI following in 2011. *C. difficile* is a bacterium that can infect the bowel and cause diarrhoea. The infection most commonly affects people who have recently been treated with antibiotics,

and can spread by spores found within faeces. Infections can occur where many people take antibiotics and are in close contact with each other, such as hospitals and care homes.

Gram-negative bacteria (specifically in blood) continue to be an emerging threat to health worldwide and are therefore a priority.

In July 2014, the then-UK Prime Minister commissioned the economist Jim O'Neill to analyse the problem of antimicrobial resistance and propose concrete actions to tackle it. The final report [1] was published in May 2016. The UK Government produced a response to this report in September 2016 which stated a number of objectives. One key objective was:

*We will reduce healthcare associated Gram-negative bloodstream infections in England by 50% by 2020.*

In April 2017, this was endorsed by the Chief Medical Officer indicating a commitment to reduce Gram-negative bloodstream infections in Northern Ireland (HSS(MD) 6/2017) [2].

In response, the PHA introduced mandatory surveillance for Gram-negative bloodstream infection (to include *E. coli*, *Klebsiella* species and *P. aeruginosa*) in April 2018. New programmes were required as there were no sources currently available to PHA that would supply the required data. These data will feature in future reports.

The enhanced surveillance programme of *Pseudomonas* colonisations in neonatal units commenced in January 2013 following a recommendation [3] arising after outbreaks in neonatal units. *Pseudomonas* is an important cause of healthcare-associated infection, particularly in patients who are very ill or immunocompromised. Individuals may be colonised on the skin surface, nose and throat, usually without problems. Infections of the bloodstream are, however, particularly serious.

The aim of the report is to describe the epidemiology and trends in selected healthcare associated infections in Northern Ireland (specifically *S. aureus*, *C. difficile*, *E. coli*, *Klebsiella* species, and *P. aeruginosa*)

## Method

### Healthcare associated infections

Testing for bacteria in human biological specimens is conducted in laboratories in five Health and Social Care Trusts in Northern Ireland. Data were extracted from each of the data sources below and analysed using R version 1.0.143.

The data included in this report includes selected organisms that were reported to the PHA during 2010 - 2017 (presented by calendar year).

#### Data sources

##### *S. aureus* and *C. difficile* infection

All toxin positive *C. difficile* inpatient cases and all *S. aureus* cases with specimen dates between 01/01/2017 and 31/12/2017 were extracted from the HCAI Data Collection Web System.

Currently in Northern Ireland, all cases of *C. difficile* and *S. aureus* are reported to the PHA by HSC Trusts to be included as part of enhanced surveillance arrangements under the following definitions:

##### *C. difficile*

Any of the following in patients aged 2 years and above:

1. Diarrhoeal stools (Bristol Stool types 5-7) where the specimen is *C. difficile* toxin positive
2. Toxic megacolon or ileostomy where the specimen is *C. difficile* toxin positive
3. Pseudomembranous colitis revealed by lower gastro-intestinal endoscopy or Computed Tomography
4. Colonic histopathology characteristic of *C. difficile* infection (with or without diarrhoea or toxin detection) on a specimen obtained during endoscopy or colectomy
5. Faecal specimens collected post-mortem where the specimen is *C. difficile* toxin positive or tissue specimens collected post-mortem where pseudomembranous colitis is revealed or colonic histopathology is characteristic of *C. difficile* infection
6. In contrast to other collections, *C. difficile* infections identified post-mortem are included
7. Current guidelines recommend a combination of two tests (first; toxin gene detection by NAAT or GDH EIA, second; a sensitive toxin EIA test) for the diagnosis of CDI.

If a positive isolate is cultured from the same patient more than 28 days apart they are considered as reflecting different episodes.

For the purposes of this report, only inpatient episodes are presented (i.e. the specimen has been taken in an acute setting).

### *S. aureus*

A laboratory confirmed blood culture of *S. aureus* - whether clinically significant or not, whether treated or not, whether acquired in the Trust or not. This includes positive blood cultures taken within 48 hours of admission to hospital. If a positive blood culture is collected from the same patient more than 14 days apart they are considered as reflecting different episodes.

## **Gram-negative Bacteraemias**

Infections that meet certain criteria, usually the most severe that occur in the blood (bacteraemias), are reported voluntarily to the Public Health Agency's CoSurv Information System from each Trust's microbiology and/or virology laboratories. For the calendar year 2017, no **enhanced** surveillance arrangements were in place for Gram-negative bacteraemias, so line listings were generated using the regional voluntary laboratory database, CoSurv. Admission dates were added to each case individually by HSC Trusts to facilitate attribution.

## ***Pseudomonas* colonisations and infections in neonatal units**

Once HSC Trusts receive laboratory confirmation of a *Pseudomonas* colonisation or infection (from a sterile site), an enhanced surveillance form is submitted to PHA. This is stored and maintained within the Northern Ireland *Pseudomonas* Database.

## **Denominator**

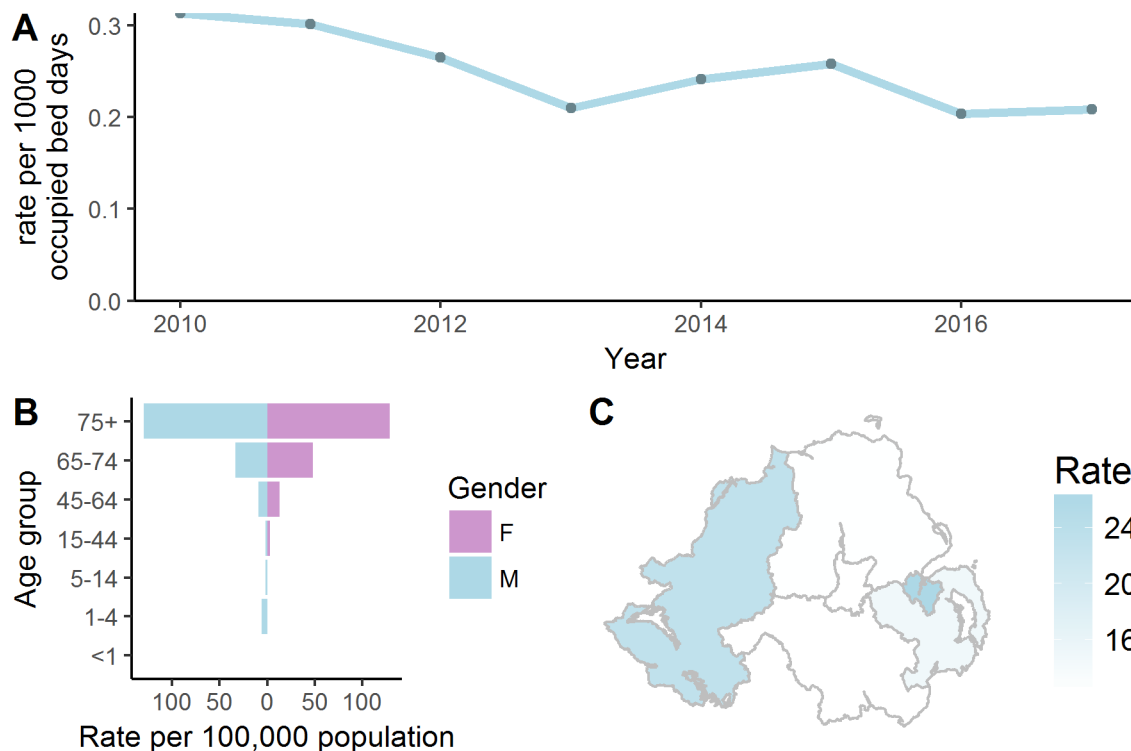
Mid-year population estimates for the most recent year (2017) were obtained from the Northern Ireland Statistics and Research Agency (NISRA) and used to express infections per 100,000 population. Hospital occupancy statistics were obtained from the Department of Health published data and are expressed as per 1000 occupied bed days.



## Results

### *C. difficile*

The annual regional rate per 1000 occupied bed days for inpatient CDI between 2010 and 2017 is presented below. Since reporting began there have been significant reductions in CDI rates for inpatients. For 2017, the inpatient CDI rate (for those over the age of 2) increased by 3% to **0.21** per 1000 bed days in Northern Ireland compared to 2016. The highest rates were identified in males over the age of 75 (rate 129.59, 22% of all CDIs), followed by females over the age of 75 (Rate 128.86, 32% of all CDIs). The highest rates per 100,000 population were observed in the Belfast Trust (26.43), followed by Western Trust (23.22).

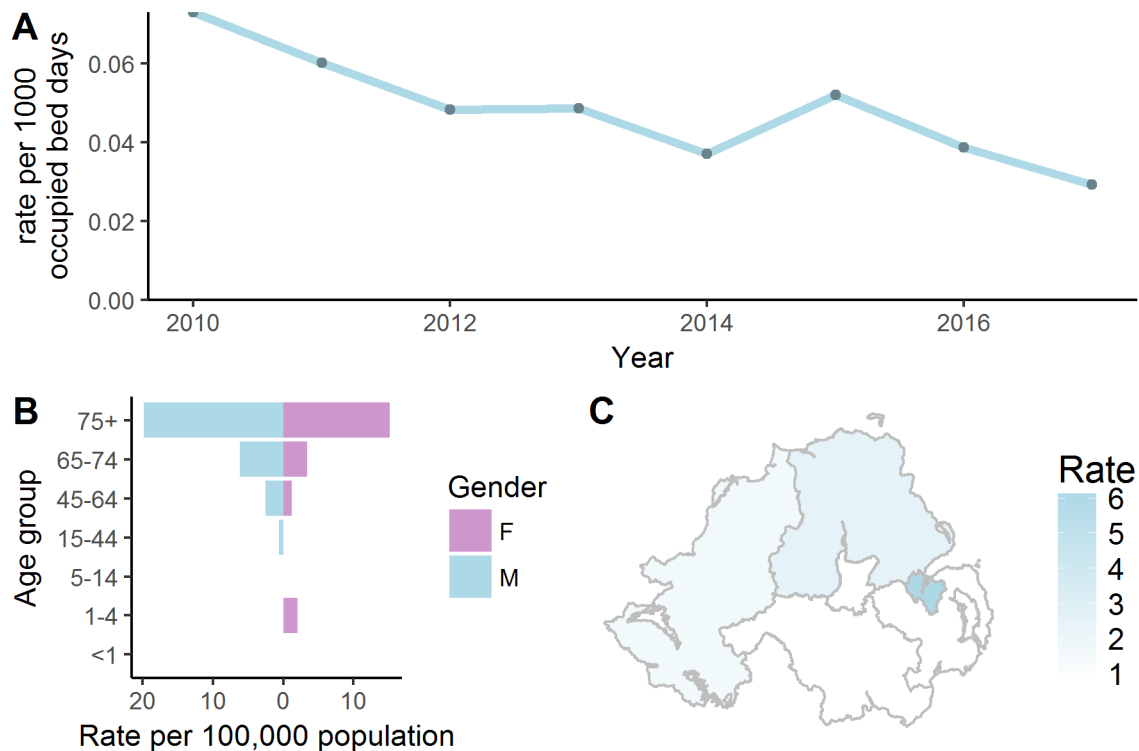


### Figure legend

- **Figure A)** Rate of inpatient CDI per 1000 bed days in Northern Ireland, 2010 - 2017
- **Figure B)** Age and gender distribution of inpatient CDI rate (> 2 years of age) per 100,000 population in Northern Ireland, 2017
- **Figure C)** Map of CDI Rate per 100,000 population with HSC Trust Boundaries, 2017

## Meticillin-resistant *S. aureus* (MRSA)

The annual regional rate per 1000 occupied bed days for MRSA between 2010 and 2017 is presented below. For 2017, the MRSA rate decreased by 25% to **0.03** per 1000 bed days in Northern Ireland (45 cases) compared to 2016 - the lowest rate observed in Northern Ireland since surveillance began. The highest rates were identified in males over the age of 75 (rate 19.80, 24% of all MRSA), followed by females over the age of 75 (rate 15.16, 27% of all MRSA). The highest rates per 100,000 population were observed in the Belfast Trust (6.19), followed by Northern Trust (2.53).

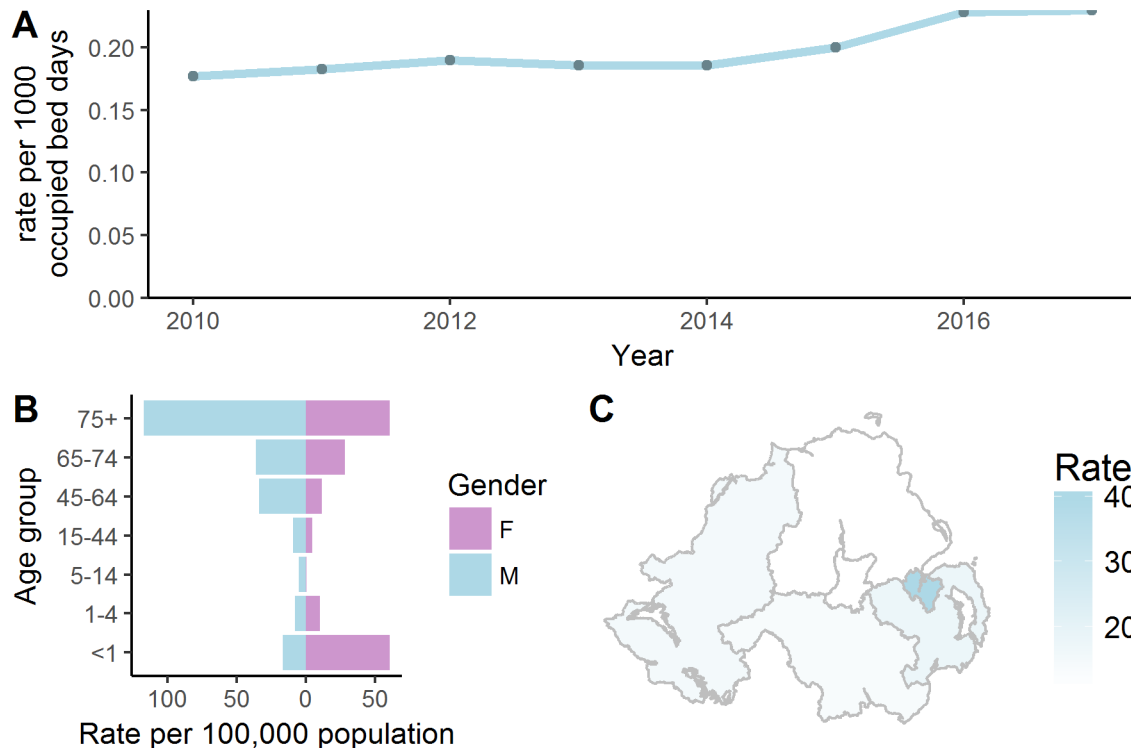


### Figure legend

- **Figure A)** Rate of MRSA per 1000 bed days in Northern Ireland, 2010 - 2017
- **Figure B)** Age and gender distribution of MRSA rate per 100,000 population in Northern Ireland, 2017
- **Figure C)** Map of MRSA rate per 100,000 population with HSC Trust Boundaries, 2017

### Meticillin-sensitive *S. aureus* (MSSA)

The annual regional rate per 1000 occupied bed days for MSSA between 2010 and 2017 is presented below. The rate of MSSA has been gradually increasing since 2010, with a steeper increase between 2014 and 2016. In 2017, the MSSA rate increased slightly again by 0.7% to **0.23** per 1000 bed days in Northern Ireland (354 cases) compared to 2016. The highest rates were identified in males over the age of 75 (rate 116.99, 18% of all MSSA), followed by females over the age of 75 (rate 60.64, 14% of all MSSA). Increased rates were also seen in female patients under the age of 1 with a rate of 60.92 (2% of all MSSA). The highest population rates were observed in the Belfast Trust (40.50 per 100,000), followed by South Eastern Trust (17.56 per 100,000).

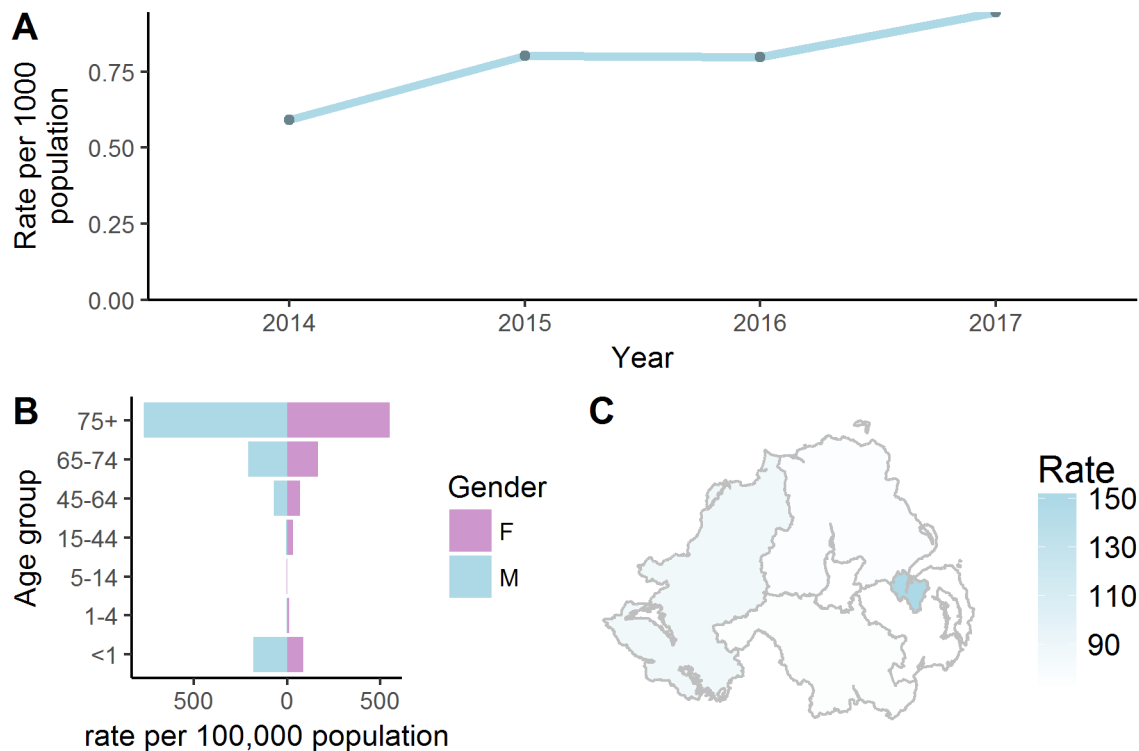


#### Figure legend

- **Figure A)** Rate of MSSA per 1000 bed days in Northern Ireland, 2010 - 2017
- **Figure B)** Age and gender distribution of MSSA rate per 100,000 population in Northern Ireland, 2017
- **Figure C)** Map of MSSA rate per 100,000 population with HSC Trust Boundaries, 2017

## ***Escherichia coli***

The annual regional rate per 1000 population for *E. coli* between 2014 and 2017 is presented below. Since 2014, there has been a year on year increase in the rate of these bloodstream infections. For 2017, the *E. coli* rate increased by 18% to **0.95** per 1000 population in Northern Ireland (1705 cases) compared to 2016. In males, highest rates were seen in those over the age of 75 (rate 770.35, 25% of all *E. coli*) and those under 1 year of age (rate 180.40, 1% of all *E. coli*). Similarly, for females, higher rates were observed in those over the age of 75 (rate 552.09, 26%) and in the under 1 year olds (rate 87.03, 0.6% of all *E. coli*). Rates were also higher in the 64-74 age group (rate 164.86, 8% of all *E. coli*). The highest rates per 100,000 population were observed in Belfast Trust (150.45) and Western Trust (86.91).

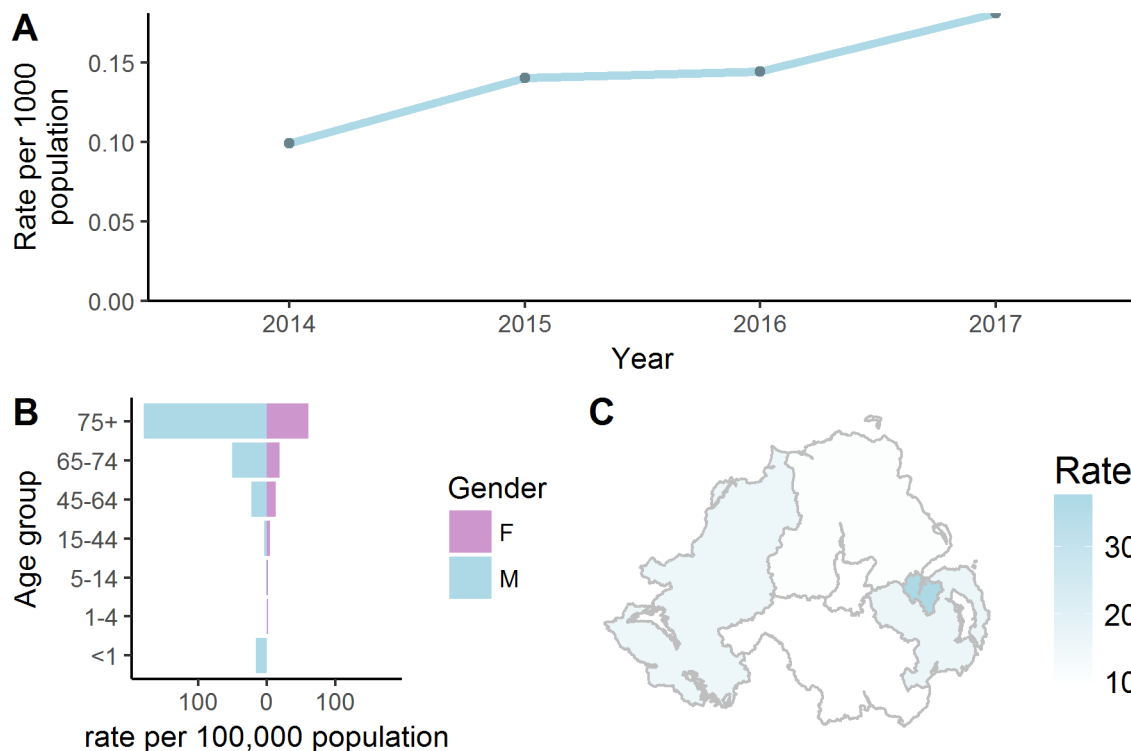


### **Figure legend**

- **Figure A)** Rate of *E. coli* per 1000 population in Northern Ireland, 2014 - 2017
- **Figure B)** Age and gender distribution of *E. coli* rate per 100,000 population in Northern Ireland, 2017
- **Figure C)** Map of *E. coli* rate per 100,000 population with HSC Trust Boundaries, 2017

### ***Klebsiella* species**

The annual regional rate per 1000 population for *Klebsiella* species between 2014 and 2017 is presented below. There has been a gradual year on year increase in the rate of these infections. For 2017, the *Klebsiella* species rate increased by 26% to **0.18** per 1000 population in Northern Ireland (327 cases) compared to 2016. The highest rates were seen in males and females over the age of 75 (rate 179.99 and 60.61 respectively, 45% of all *Klebsiella* species). Rates were also higher in males between the ages of 65 and 74 (rate 50.67, 13% of all *Klebsiella* species). The highest rates per 100,000 population were observed in the Belfast Trust (37.4), followed by South Eastern Trust (16.1).

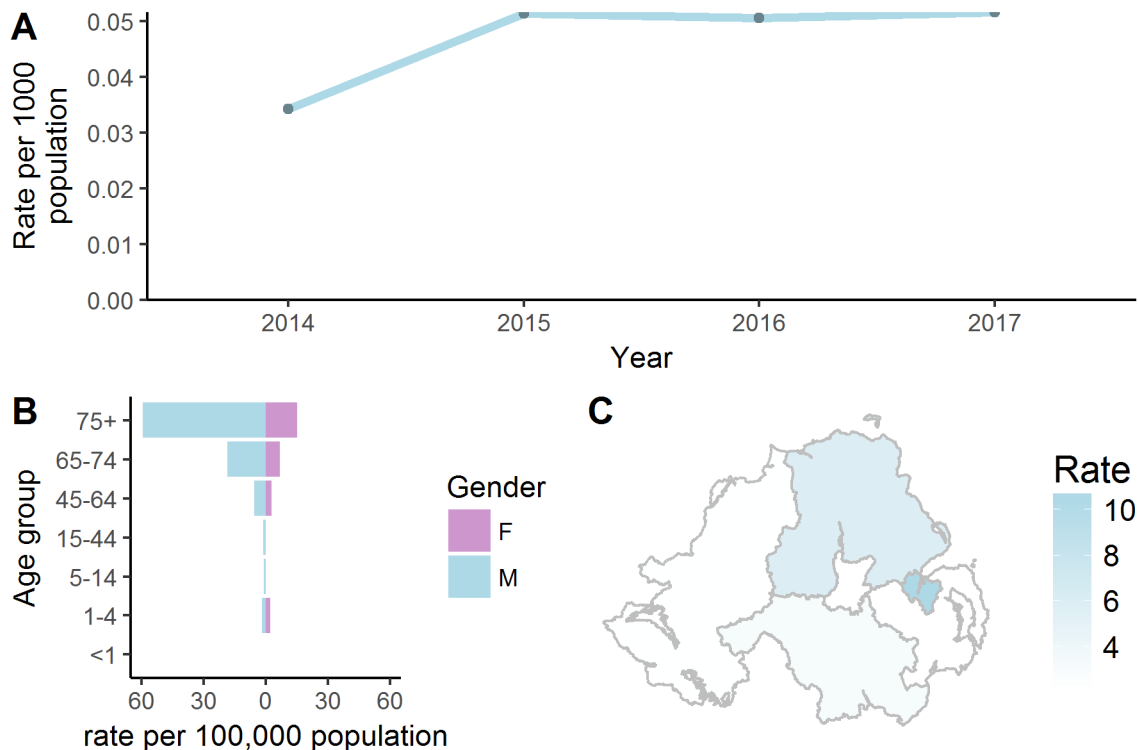


### **Figure Legend**

- **Figure A)** Rate of *Klebsiella* species per 1000 population in Northern Ireland, 2014 - 2017
- **Figure B)** Age and gender distribution of *Klebsiella* species rate per 100,000 population in Northern Ireland, 2017
- **Figure C)** Map of *Klebsiella* species rate per 100,000 population with HSC Trust Boundaries, 2017

### *Pseudomonas aeruginosa*

The annual regional rate per 1000 population for *Pseudomonas aeruginosa* bloodstream infections between 2014 and 2017 is presented below. In recent years, the rate has remained relatively stable. For 2017, the *P. aeruginosa* rate slightly increased by 4% to **0.05** per 1000 population in Northern Ireland (93 cases) compared to 2016. The highest rates were observed in males and females over the age of 75 (rate 59.39 and 15.16 respectively, 48% of all *P. aeruginosa* species). Rates were also higher in males between the ages of 65 and 74 (rate 18.54, 16% of all *P. aeruginosa* species). The highest rates per 100,000 population were observed in the Belfast Trust (10.68), followed by Northern Trust (5.90).



#### Figure Legend

- **Figure A)** Rate of *P. aeruginosa* per 1000 population in Northern Ireland, 2014 - 2017
- **Figure B)** Age and gender distribution of *P. aeruginosa* rate per 100,000 population in Northern Ireland, 2017
- **Figure C)** Map of *P. aeruginosa* rate per 100,000 population with HSC Trust Boundaries, 2017

### ***Pseudomonas* in Neonatal Settings**

During 2017, 13 *Pseudomonas* colonisations from 9 neonates were reported to the HCAI team through the *Pseudomonas* Surveillance Programme in Neonatal Units. This is a reduction of 22.5% compared to 2016. The majority of reported positive specimens were of species *P aeruginosa* (92.3%), followed by *P. putida* (7.7%). Multiple isolates of a single strain were not detected between patients. No environmental/water links were reported to the HCAI Team.

The most recent neonatal *Pseudomonas* blood stream infection occurred within quarter 4 of 2016.

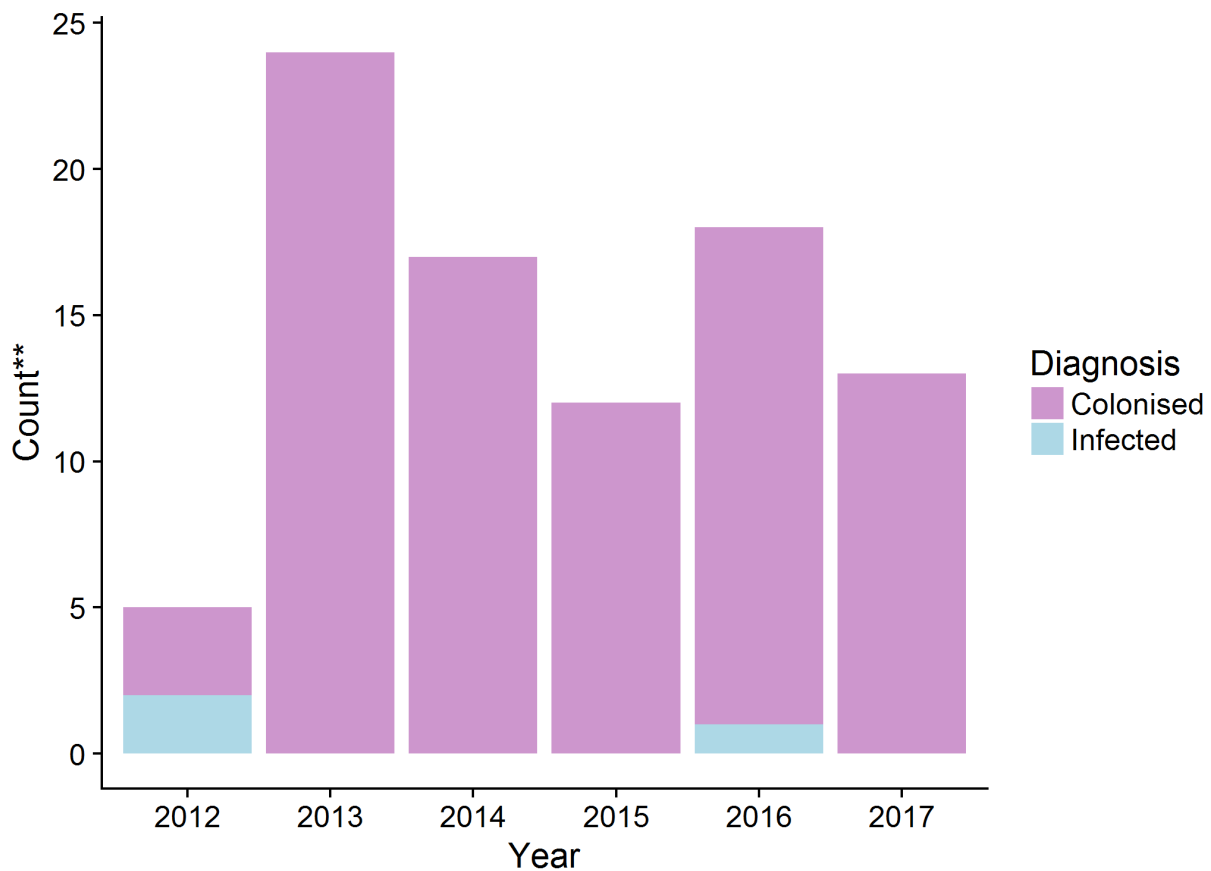


Figure 1. Count of *Pseudomonas* isolates, by diagnosis, 2012-2017.

\*\*Note - illustrates count of isolates only. Patients may have had one colonisation reported.

## Discussion

This is the first annual report of HCAI in Northern Ireland describing trends of *C. difficile*, *S. aureus* and Gram-negative bacteraemias. In general, there have been encouraging reductions in the rates of infection for CDI and MRSA organisms which reflects the hard work of infection control teams in preventing transmission and the prioritisation of timely data through enhanced surveillance. In contrast, the rates of Gram-negative bacteraemias, particularly *E.coli* and *Klebsiella* species have continued to increase.

In response to this, mandatory surveillance will be introduced in 2018. Reductions in rates have been observed since the establishment of enhanced surveillance programmes with a focus on CDI and *S. aureus*. With this in mind, we will continue to review the incidence of Gram-negative bacteraemias as part of the overall ambition to reduce rates by 2020.

The inpatient rate of *C. difficile* infection in those over the age of 2 has generally been decreasing since 2010 with slight increases observed in 2014 and 2015. This largely reflects trends observed in England[4] where small increases were also observed in the financial years 2013/14 and 2014/15 for hospital-onset cases[4]. While reductions were observed in NI during 2016, 2017 saw a small increase in the rate of CDI inpatients to 0.21 per 1000 bed days (a 2% increase). Age-specific rates of CDI, as expected, are epidemiologically similar to England, with highest rates observed in older populations in both males and females, particularly in those over 75. Altogether, these cases accounted for 55% of total cases, with those aged between 65 and 74 being the next largest group at 22%.

In keeping with the UK-wide trend, we have observed a steep decline in the number of MRSA bacteraemias in NI since 2015 (a 44% reduction)[5]. With regard to age-specific rates of MRSA, NI appears to be epidemiologically similar to the overall UK data [5]. Higher rates are observed in patients over the age of 75, particularly in males. In contrast to UK data, there was a notable absence of cases in the age categories of 5-14 years and in the under 1s.

There has been a gradual year on year increase in the number of MSSA bacteraemias reported to the PHA since 2014, despite a slight decline observed between 2012 and 2014. This is reflective of the trend observed in the UK figures [5]. As in previous years, age-specific rates in those over the age of 65 have continued to be higher. This is epidemiologically similar to the overall age-specific rates observed in UK data [5]. Females under the age of one had a higher rate than males.



This is the first report containing data related to trends of Gram-negative bacteraemias in Northern Ireland. In England, mandatory reporting of *E. coli* bloodstream infections began in 2011. Since then, there has been a general year on year increase of all *E. coli* (both hospital and community onset) in England [4]. This trend is also reflected in NI data, with Northern Ireland seeing increase in the voluntary reporting cases of 59% since 2014. Similarly, the epidemiological trends mirror what is observed in England, with dramatically higher rates observed in both males and females over the age of 75. Increases in the rate in the under 1s were also seen (particularly in males), however, this relates to only 1% of total *E. coli* cases reported. Similar trends in age-specific rates have also been observed for *Klebsiella* species and *P. aeruginosa*, with higher rates observed in the over 75s.

While increases have been observed in these infections, they have now been targeted as part of the UK governments ambition to reduce healthcare-associated cases by 50% by 2020. Continual monitoring of these infections through surveillance will inform progress towards this target.

It is reassuring to note that no bloodstream infections were reported from neonates (those under 1 year of age) through the *Pseudomonas* surveillance programme, as well as the reduction in the number of colonisations of *Pseudomonas* picked up through routine screening in neonatal units. During 2017, the HCAI team did not identify multiple isolates of a single strain, indicating there has been limited patient to patient transmission of colonisations. Similarly, there had been no reports of colonisation as a result of the clinical environment or water.

## Developments During 2017

There have been a number of developments during 2017 for the HCAI Team work plan. The new focus on Gram-negative bacteraemias arose from a recommendation in the review on antimicrobial resistance [1]. Prior to 2017, there was no enhanced surveillance programme in place to gather such information relating to these infections.

With potential improvement targets aimed at tackling Gram-negative infections (those occurring on day two or later after admission), there was a need to be able to identify these cases. To do this, existing HCAI data flows needed to be changed in order to accommodate further data collection to include information relating to patient admissions and risk factors. This was also an opportunity to streamline and improve current enhanced surveillance arrangements to create a single data repository for all mandatory infections.

During 2017, we also incorporated basic laboratory-reported information related to Gram-negative bacteraemias into regular reporting streams.

To address the need for collecting more enhanced surveillance information and more organisms, the team began the development of our new online data capture and reporting tool, HI-Surv. The new system allows inpatient and community cases of HCAI to be entered in real time as they occur, giving HSC Trusts access to timely surveillance information in order to inform action. Given the increased complexity of reporting, the HCAI team introduced the first HCAI and Antimicrobial Use and Resistance Surveillance Protocol.

The full enhanced surveillance programme for Gram-negative bacteraemias began in April 2018. Having access to these new data, including identifying potential risk factors, will be an important source of intelligence for HSC Trusts in order to ensure quality and safety in their care.

The introduction of a harmonised HCAI surveillance programme for *C. difficile*, *S. aureus* and Gram-negative bacteraemias will be an important source of business intelligence for HSC Trusts, and will inform action on infection prevention and control programmes in order to improve patient safety and quality of care.

## **Actions to Reduce Healthcare-associated Infection**

During 2017, the PHA hosted a number of events to raise awareness of healthcare-associated infection. In September 2017, we hosted a Regional HCAI and Antimicrobial Stewardship (AMS) Quality Improvement Sharing Event where HSC Trust teams shared their learning through presentations on quality improvement and learning from adverse incidents relating to HCAI and AMS. The HCAI team, along with the wider Health Protection team and Queen's University Belfast, also delivered an event at the W5 Interactive Science Centre as part of Antibiotic Awareness Day in November. This was a great opportunity to communicate with the public around general hand hygiene and the principles of infection prevention and control.

The HCAI and AMS Improvement Board established a number of new subgroups to lead on collaborative projects to prevent healthcare-associated infections, as well as reduce inappropriate antibiotic prescribing.

The Infection Prevention and Control Lead Nurse Forum continued to support Higher Education Institutes (HEIs) to facilitate the integration of good standards of infection

prevention and control practice within patient care delivery across healthcare settings. Material was shared with the HEIs which will be included in the nursing curriculum and used in the teaching of undergraduate nursing students. The forum has also supported further development of the Regional Infection Prevention and Control Manual.

Proposed objectives to reduce healthcare-associated infections in 2018 include:

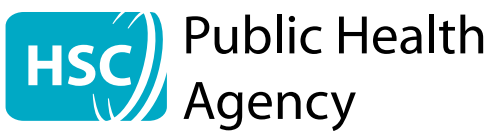
- Establish an Education subgroup on the HCAI and AMS Improvement Board to coordinate efforts in undergraduate, postgraduate and staff training related to Infection Prevention and Control
- Develop new reports for the monitoring of Gram-negative bacteraemia to allow HSC Trusts to monitor their progress towards DOH targets
- Launch a new public-facing website to facilitate the publication of HCAI rates against a number of indicators
- Roll out the new HCAI data collection and reporting tool, Hi-Surv, to all HSC Trusts in NI
- Lead by the IPC Lead Nurse Forum, provide infection prevention and control support and education to healthcare professionals in Primary Care

## Limitations

While this report makes reference to general comparisons between NI and UK wide data, care should be taken to avoid direct comparison/benchmarking. There may be differences in case mix, populations sampled and time periods used. Some UK-wide age-specific rates only include data submitted by England and Northern Ireland and exclude Scotland and Wales. Since Gram-negative bacteremias reported through Cosurv could not be attributed to being “hospital onset” or from inpatients, rates were calculated using a population denominator.

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