Healthcare Associated Infections: Northern Ireland 2007

CDSC (NI)

Health Protection Agency

Contents

List of Figures/Tables

Executive Summary

Rates of *Staphylococcus aureus* bacteraemias, both MSSA and MRSA, remained relatively stable in Northern Ireland from 2006 to 2007. During 2007, 565 patient episodes of *S. aureus* were reported, a rate of 0.321 per 1,000 occupied bed days. This compares with 583 patient episodes and a rate of 0.319 per 1,000 occupied bed days in 2006. Therefore, the number of cases has decreased 3% over this period.

229 Meticillin Resistant *S. aureus* (MRSA) patient episodes were reported in 2007, a rate of 0.130 per 1,000 occupied bed days. This is a 7% reduction from 2006 when 245 episodes were reported, a rate of 0.134 per 1,000 occupied bed days.

The slight changes in the rates reported in Northern Ireland are not statistically significant and are most likely due to natural variation.

The number of *C. difficile* reported in hospital inpatients aged 65 years decreased by 8% from 2006 (982 compared to 1068), a rate of 1.017 per 1,000 bed days, (2006 rate of 1.040). This slight reduction was not statistically significant as indicated by the SPC charts for Northern Ireland.

1. Healthcare Associated Infections

1.1 Introduction

Healthcare Associated Infections (HCAI) are caused by a variety of microorganisms and, as the term suggests, are associated with a health care intervention. They can cause a number of conditions which can vary in severity according to the type of organism and vulnerability of the patient. HCAIs may occur in hospital inpatients, outpatients, as well as in individuals who undergo treatment or a medical investigation in any healthcare setting, including primary care. Hospitals experience the largest burden of HCAIs as it is usually in this setting where there are more vulnerable patients, often undergoing complex and intensive treatment and in whom more serious infections are seen. In 2006, a survey of hospital inpatients in Northern Ireland indicated that the prevalence of HCAI among patients in acute hospitals was 5.4% (further details available at: www.hisc.n-i.nhs.uk).

Infections can be contracted through contact with other people (patients, staff or hospital visitors), from the environment or from a patient's own natural flora. Indeed, many of the microorganisms which cause HCAIs are commonly found on the skin or in the human body, for example, the intestinal tract. For a healthy adult, these organisms make up the normal 'flora' and so usually pose no great risk. HCAIs occur when the normal flora is disturbed (i.e. the balance is altered) or if the body's natural defence mechanisms are breached, for example through a wound, when these organisms may gain access to another area of the body. As more invasive procedures, such as minor surgery, are offered in primary care, the numbers of HCAIs which are acquired outside the hospital setting may increase.

The number of infections associated with health care facilities will never be reduced to zero for several reasons:

- *The vulnerability of the person who is undergoing treatment*: for example, the elderly and immunocompromised are more susceptible to infection, as well as being at a greater risk from complications should one occur.
- *The use of antibiotic therapy*: antibiotics can disturb the balance of the normal body flora, making patients more vulnerable to infection. Widespread use of antibiotics also leads to the development of antimicrobial resistance in previously susceptible organisms.
- *The range of treatments available are often invasive and complicated*: for example some surgical and cancer procedures.

However, by better application of existing knowledge and good practice, as well as strengthening arrangements for prevention and control, many HCAIs can be avoided. It is estimated that between 15 - 30% of HCAI can be prevented.

It is not possible to constantly monitor all HCAIs, thus ongoing surveillance activities are focussed on selected organisms and infections in accordance with the Department of Health, Social Services and Public Safety (DHSSPS) HCAI Action Plan[1]. However, it should be noted that interventions put into place to prevent and control these organisms/infections will also have an impact on other HCAIs.

Mandatory HCAI surveillance activities carried out by CDSC (NI) include two of the most commonly detected organisms, *Staphylococcus aureus* and *Clostridium difficile.* This report details the incidence or new cases of *S. aureus* bacteraemia (the presence of bacteria in the blood) and *C. difficile* associated disease (CDAD) within Acute and Specialist Trusts in Northern Ireland, up to and including December 2007. In contrast to previous reports, this year's report is according to the configuration of Trusts during the 2007 calendar year, following the Review of Public Administration and the reconfiguration of Trusts on 1 April 2007.

2. *Staphylococcus aureus*

2.1 Introduction

Staphylococcus aureus is a gram positive bacterium commonly found in the nose and on the skin of healthy individuals. As a part of the normal flora, *S. aureus* often has no impact on a person's health. If an infection does occur it is usually localised, particularly on the skin, resulting in boils, abscesses or wound infections. Occasionally, *S. aureus* can cause a blood stream infection (bacteraemia) which can be life threatening.

Antibiotics have been used to successfully treat infections caused by many different bacteria. However, as the use of antibiotics has become more widespread so bacteria have developed resistance to them. Following the introduction of penicillin in the 1940s, most strains of *S. aureus* were susceptible. However, over the following 20-30 years the majority became resistant. Meticillin was then developed as a new antibiotic treatment for penicillin resistant *S. aureus*, but within a year of its introduction strains in England were found to be resistant. These strains are no more virulent or life threatening than sensitive strains, but they are not susceptible to meticillin and the family of antibiotics to which it belongs. The majority of Meticillin Resistant *S. aureus* (MRSA) isolates, however, are sensitive to other antibiotics; therefore other treatment options are available.

S. aureus bacteraemia surveillance was initiated in Northern Ireland in April 2001 and became mandatory in April 2002. The surveillance scheme includes patient episodes of blood stream infection caused by both MRSA and Meticillin Sensitive *Staphylococcus aureus* (MSSA) from patients tested in the five Trusts in Northern Ireland. Surveillance is limited to bacteraemias, the most severe type of infection, in line with other parts of the UK.

A description of the data sources and rate calculations can be found in Appendix A and B. Further details on *S. aureus* are available at www.hpa.org.uk.

Please note: meticillin was formerly known as methicillin. This name change has taken place in accordance with the requirements of European Law covering the use of Recommended International Non-proprietary Name (rINN)[2].

2.2 Results

Previous reporting has been focussed on the annual rates of *S. aureus* for, both individual Trusts and Northern Ireland as a whole[3-8]. There have been fluctuations in the NI annual rates of MRSA and MSSA, with MSSA rates noticeably higher than MRSA rates every year (figure 1). The NI annual MRSA rate peaked in 2003, and has since declined, MSSA rates by comparison have remained relatively constant and at a higher level (Figure 1). Some natural variation in the rates, year on year, is to be expected and does not necessarily indicate a true change. Variation is much more apparent when considering an individual Trust as the population under surveillance is relatively small. In many instances, a relatively small change in the number of patient episodes results in a large increase/decrease in the rate (Appendix C).

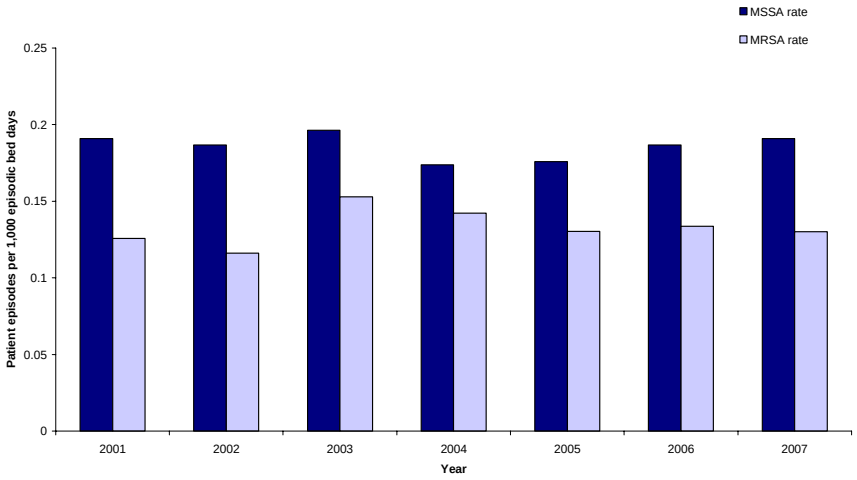

Figure 1: Annual MSSA and MRSA bacteraemia rates, Northern Ireland, 2001-2007

Statistical Process Control (SPC) charts are used in the mandatory *S. aureus* bacteraemia surveillance schemes throughout the UK. SPC charts allow the distinction to be made between natural variation and "special cause variation", where something unusual is occurring. The following criteria are used to assess the significance of any apparent changes. If any of these conditions are met then a statistically significant change has occurred:

- 1 value above the upper action limit or below the lower action limit
- 3 consecutive values between the upper warning limit and upper action limit (or between lower limits)
- 8 consecutive values on the same side of the mean (either above or below)
- Any 12 of 14 consecutive values on the same side of the mean (either above or below)
- 8 consecutive values either increasing or decreasing

The warning limit is set at two standard deviations from the mean, whilst the action limit is set at three standard deviations from the mean. These limits vary slightly each quarter because of the varying bed occupancy within each Trust. The reason for any special cause variation could be an outbreak, the introduction of new testing methods, different reporting strategies or the impact of infection prevention and control strategies.

The rates of *S. aureus* reported in Northern Ireland on a quarterly basis through this reporting scheme are displayed below using SPC chart methodology, along with a summary of the annual rates for 2007.

2.2.1 Meticillin Sensitive *Staphylococcus aureus* (MSSA)

During the surveillance period January – December 2007, 336 Meticillin Sensitive *S. aureus* (MSSA) patient episodes were reported, a slight decrease (0.6%) from the previous calendar year (338). The 2007 rate of MSSA bacteraemia was 0.191 patient episodes per 1,000 occupied bed days.

Three of the five Trusts reported fewer numbers and lower rates of MSSA patient episodes than in the previous calendar year. The actual annual number of episodes and rate reported for each Trust, 2001-2007, can be found in Appendix C.

Since the beginning of this scheme, the reported rates of MSSA have been within the warning limits, and have not met any of the criteria for special cause variation, as shown in figure 2. This indicates that the levels of MSSA have remained relatively stable over the surveillance period and any fluctuations represent natural variation and are not statistically significant.

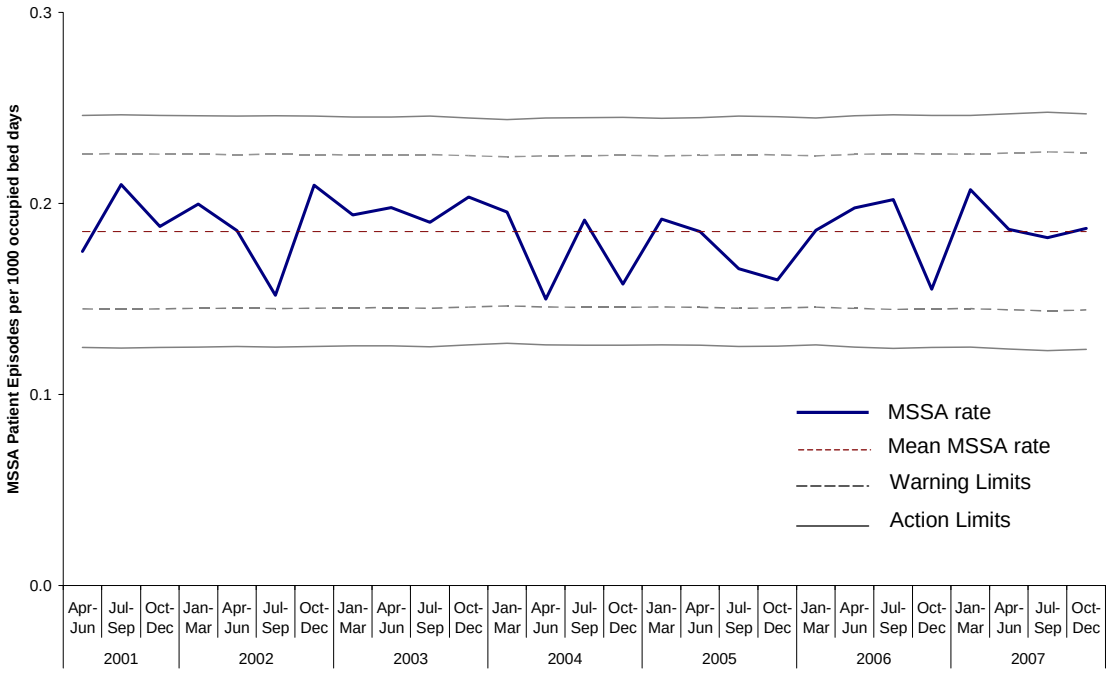

Figure 2: SPC of quarterly MSSA rates, Northern Ireland, April 2001 – December 2007

2.2.2 Meticillin Resistant *Staphylococcus aureus* (MRSA)

During the 2007 surveillance period, 229 Meticillin Resistant *S. aureus* (MRSA) patient episodes were reported. This is 6.5% less than the number of MRSA episodes reported the previous year (245). The 229 cases of MRSA represented 40.5% of all *S. aureus* cases reported (565 episodes) (Figure 3). This is a slight decrease from 2006, when the number of MRSA cases represented 42% of all *S. aureus* episodes (245/583 episodes). In 2007, an annual rate of 0.130 MRSA patient episodes per 1,000 occupied bed days was reported, the same rate as recorded in 2005 and 2006.

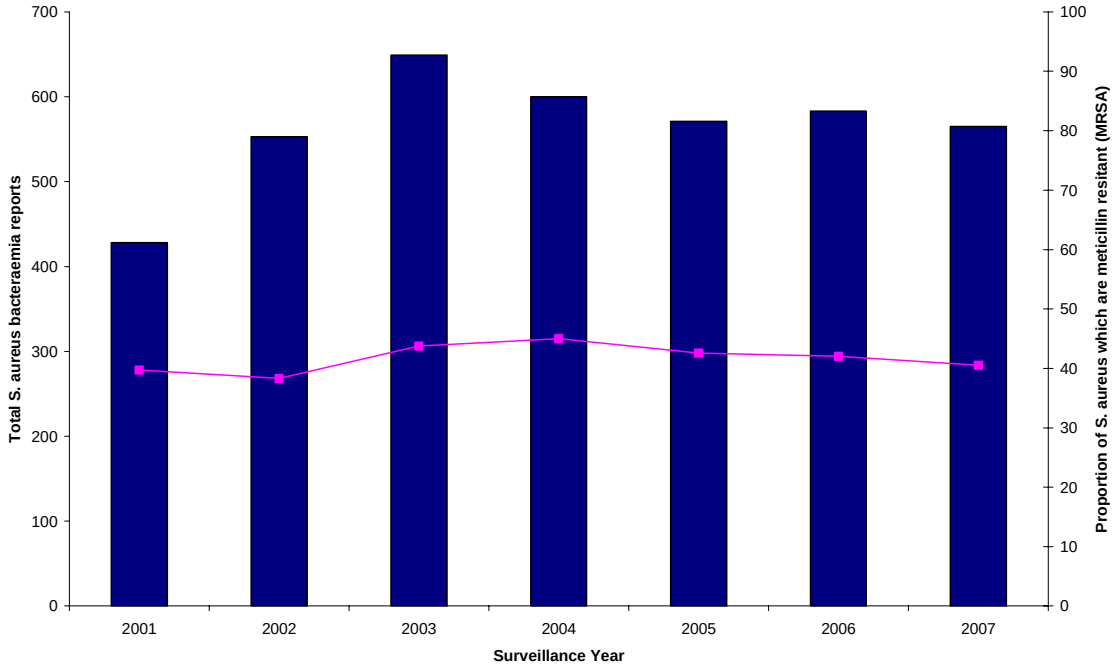

Figure 3: Total number of *S. aureus* bacteraemias (bars) and the proportion of Meticillin resistant S. aureus (line), Northern Ireland, 2001 – 2007.

Four out of five Trusts reported fewer numbers and lower or equal rates of MRSA patient episodes when compared to the previous calendar year (Figures 4 and 5; Appendix C). It is important to note that differences in the numbers between Trusts may be partly attributed to the differences in the size of the inpatient population and the mix of patients and specialties served. Thus, when the rates per 1,000 bed days are compared, figure 5, the marked difference in the number of MRSA bacteraemias shown in figure 4 is not as apparent.

Age and gender information was available for all MRSA bacteraemia patients for 2007 (n=229). The number of reported cases increased with age and was greater in males than females (Figure 6). Seventy-three per cent of cases occurred in individuals aged 60 years and over (Figure 7).

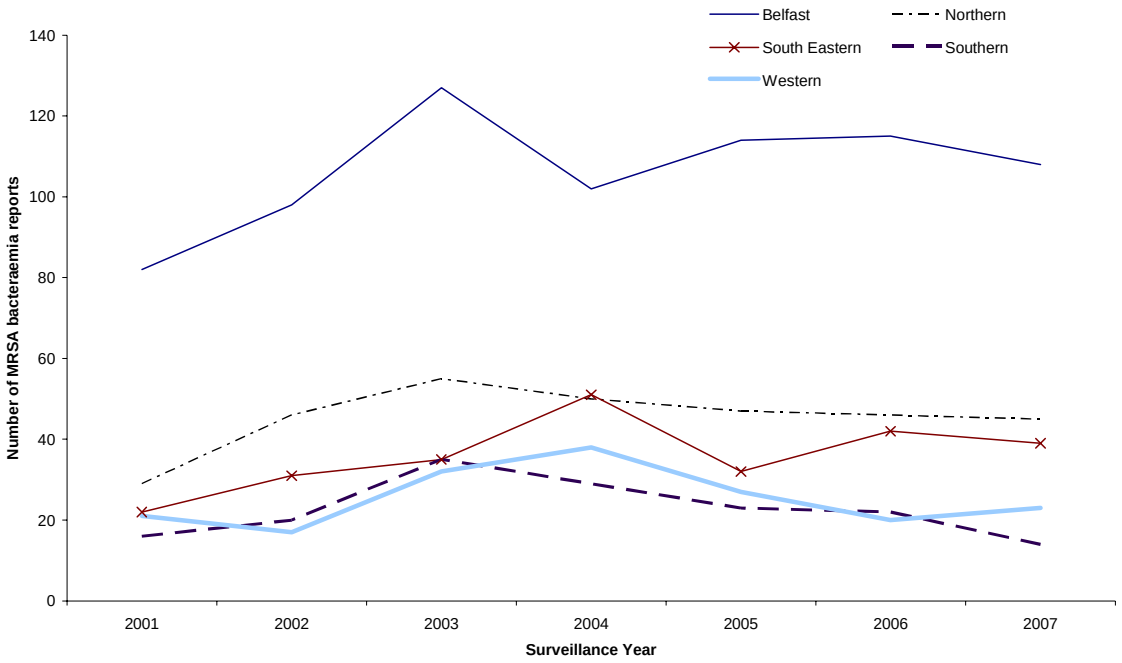

Figure 4: Distribution of MRSA bacteraemia reports (number of isolates) by Trust, Northern Ireland, 2001 – 2007.

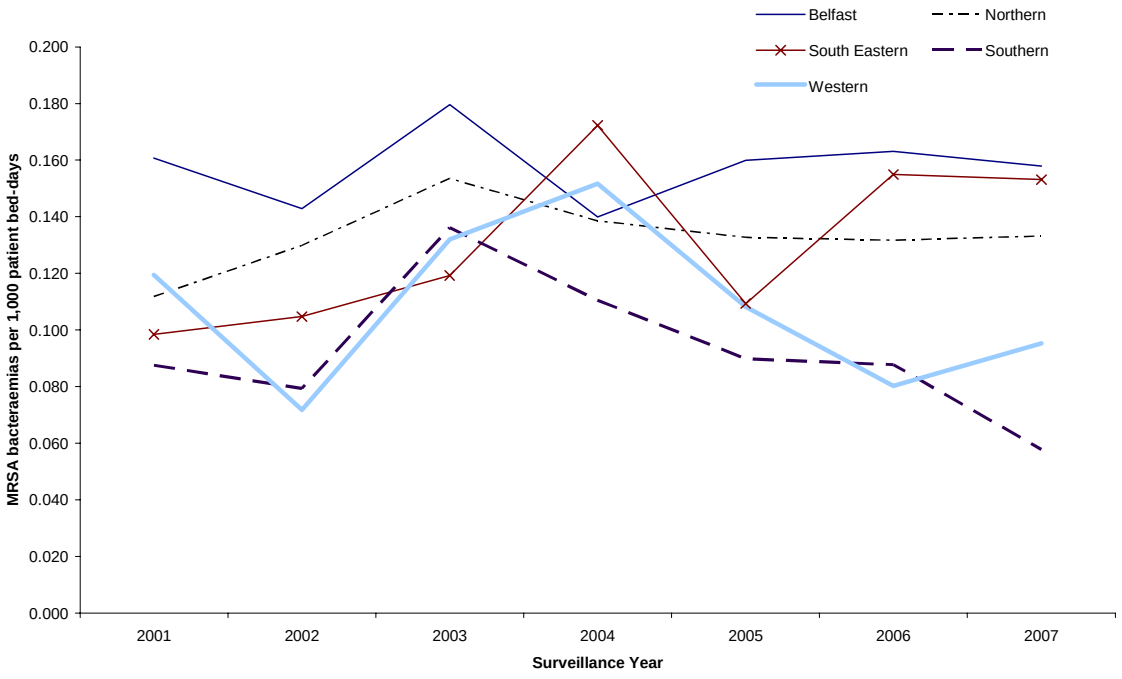

Figure 5: Distribution of MRSA bacteraemia rates per 1,000 occupied bed-days by Trust, Northern Ireland, 2001 – 2007.

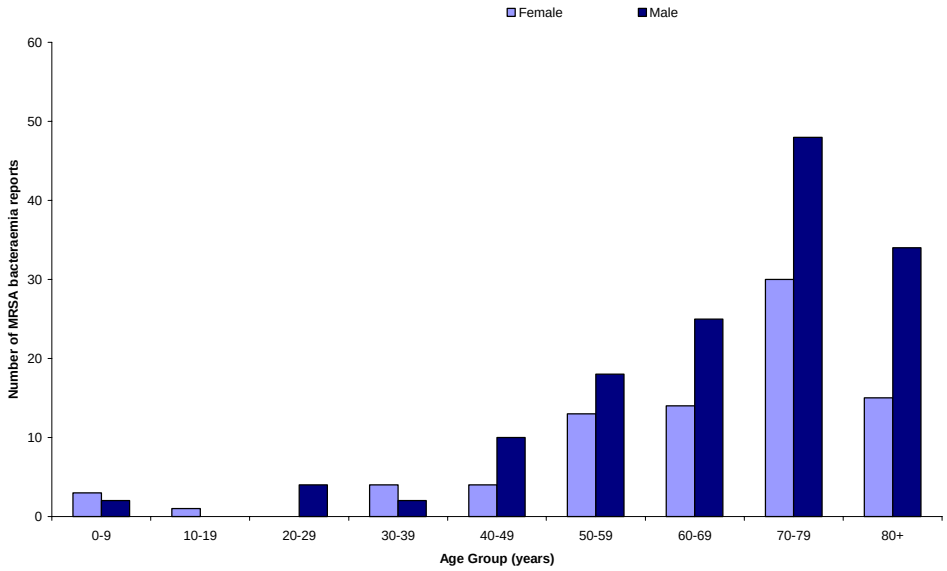

Figure 6: The gender and age distribution of MRSA bacteraemias, Northern Ireland, 2001 – 2007.

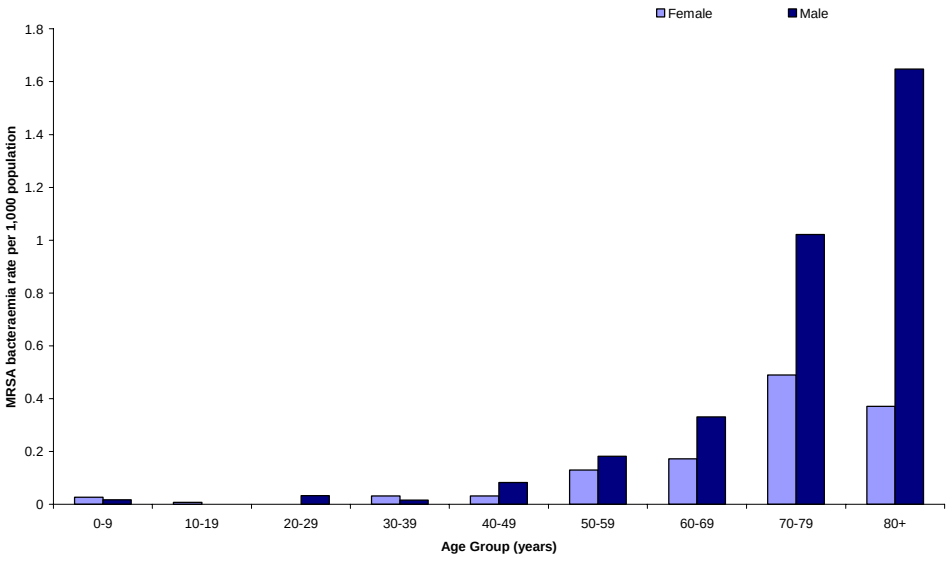

Figure 7: Gender and age specific rates, using 2006 mid year population estimates, of MRSA bacteraemias, Northern Ireland, 2001 – 2007.

Since the beginning of the scheme the reported rates of MRSA have been within the control limits for all but one quarter when they remained within the action limit. None of the criteria for special cause variation has occurred at any point, as shown in figure 8. This indicates that the levels of MRSA have remained relatively stable over the surveillance period with no statistically significant difference between quarters.

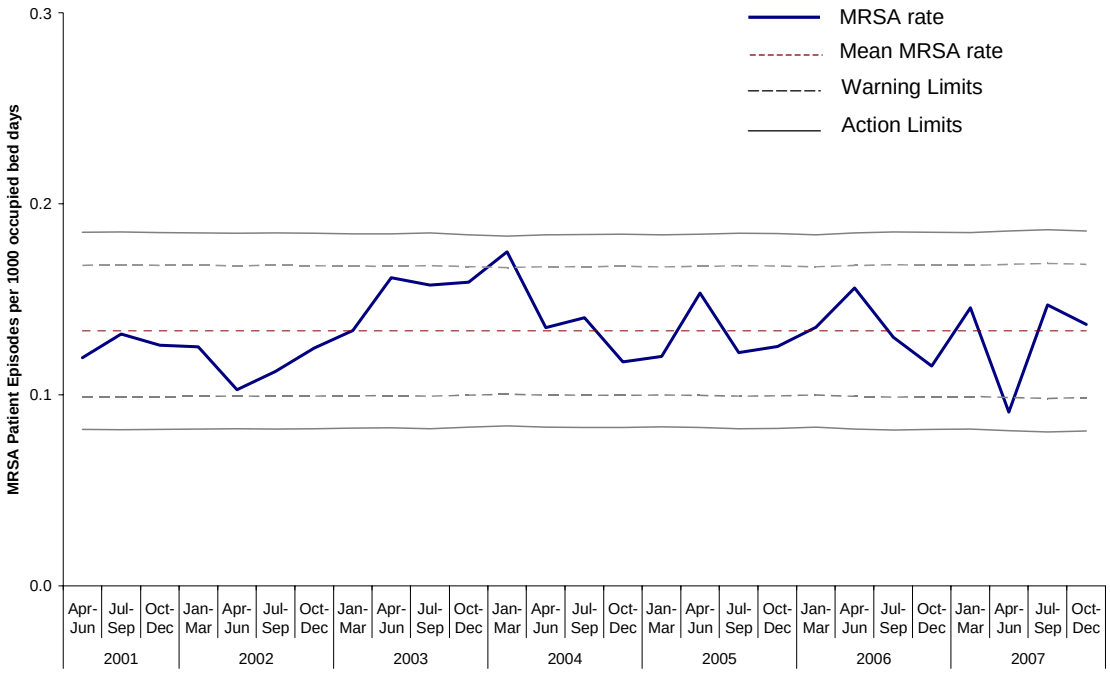

Figure 8: SPC of quarterly MRSA rates, Northern Ireland, April 2001 – December 2007

2.2.3 *Staphylococcus aureus* (MSSA and MRSA combined)

565 *S. aureus* patient episodes were reported during 2007. This figure includes all *S. aureus* reports, both MSSA and MRSA. The overall rate of *S. aureus* patient episodes was 0.321 per 1,000 occupied bed days. In 2007, the number of *S. aureus* episodes was reduced by 3% when compared to 2006; 583 patient episodes and a rate of 0.319 per 1,000 occupied bed days.

Three of the five Trusts reported lower numbers and rates for all *S. aureus* bacteraemias when compared to the previous calendar year (Appendix C).

Since the beginning of this scheme, the reported rates of all *S. aureus* have been within the control limits for all but one quarter, when it remained within the action limit (Figure 9). As described earlier for MSSA and MRSA individually, none of the criteria for special cause variation has been met at any time for all *S. aureus*. This implies that the levels of all *S. aureus* have also remained relatively stable over the surveillance period with no statistically significant difference in *S. aureus* episodes between quarters.

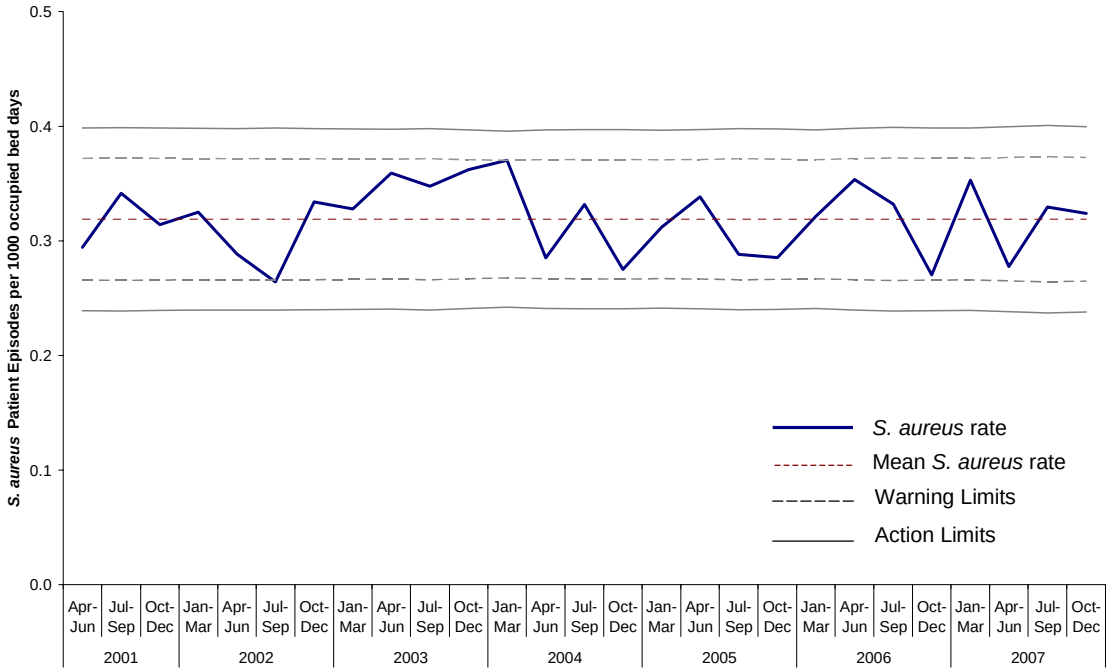

Figure 9: SPC of quarterly *S. aureus* rates (MSSA and MRSA combined), Northern Ireland, April 2001 – December 2007

2.3 Discussion

S. aureus bacteraemia surveillance, both MRSA and MSSA, was initiated in April 2001 and became mandatory in April 2002, 2002 represented the first full year of data. In 2003 there was a distinct rise in the number of MRSA bacteraemia reports (212 cases in 2002 compared to 284 cases in 2003). However, since 2003 the number of MRSA bacteraemias has steadily declined, 229 reports in 2007 representing a decrease of 55 episodes (19% reduction compared to 2003). In contrast, the number of MSSA patient episodes reported since 2002 shows no appreciable trend.

In 2007, there was a slight decrease in the number of MSSA bacteraemias (0.6% reduction on 2006 data; 336 episodes in 2007 compared to 338 in 2006) with a rate of 0.191 patient episodes per 1,000 occupied bed days (compared to a 0.185 in 2006). Statistical Process Control charts are used to present the data, and it is clear that the NI rates of MSSA continue to rise and fall either side of the mean rate indicative of natural variation and are not statistically significant.

229 MRSA bloodstream infections were reported in 2007, marking a 7% reduction from 2006. These 229 cases represent 40.5% of all *S. aureus* episodes, which is slightly higher than the latest figures reported in England for the financial year 2006/07 where 36.7% of all *S. aureus* cases were MRSA[9]. The 2007 NI annual rate for MRSA bacteraemias was 0.130 patient episodes per 1,000 occupied bed days, with quarterly rates ranging between 0.09 and 0.15 over the year. This compares favourably with the most recent annual rate of 0.17 MRSA bacteraemias per 1,000 occupied bed days reported for England[10] for the period April 2006 – March 2007. The Scottish[11] MRSA bacteraemia rate ranged from 0.17 – 0.19 per 1000 acute occupied bed days over all four quarters of 2007 whilst the Welsh[12] rate reportedly ranged from 0.07 – 0.11 during the January – September quarters of 2007. The most recent rate reported for the Republic of Ireland was also similar (0.15 during 2006[13]). However, there is a slight difference in the case definition, in that in the RoI only the first report from each patient within a quarter is counted. In contrast, in NI, if there has been more than 14 days between reports from any one patient, it is considered to be more than one episode, regardless of the quarter in which the testing took place. This case definition emulates that used in England.

In 2007, four out of five Trusts reported fewer numbers and lower or equal rates of MRSA bloodstream infections when compared with the previous year.

Overall in 2007, more than 70% of cases were in the over 60 year olds, with a higher proportion of infections occurring in males.

The SPC charts for MRSA and *S. aureus* rates in Northern Ireland show natural variation with no significant trends.

As in previous years, the results presented here should be viewed with caution, taking the following into account:

- Natural variation, with both rises and falls, in rates is to be expected.
- The results presented are of infections which have been identified by testing within a hospital. No distinction can made between where the infection was actually acquired i.e. hospital or community setting.
- The data includes all reports of *Staphylococcus aureus* isolated from blood cultures, with no indication of the clinical significance of the isolate.
- Reports of *S. aureus* (MSSA and MRSA) patient episodes from a Trust may relate to patients who became infected in, and were also reported by, another Trust. Since data are collected without patient identifiers, the removal of duplicates when a patient has been transferred is not possible.
- Episodes of bacteraemia relating to patients resident in non-acute Trusts, e.g. in long-stay facilities in Community Trusts, may have been omitted from these analyses. However, it is likely

that they will have been included in the figures for an Acute Trust, since a person with *S. aureus* bacteraemia is likely to be sufficiently ill to warrant transfer to a an acute facility for treatment.

- Trusts with different clinical mixes and specialties will have differing proportions of patients at high risk of *S. aureus* infection.
- Figures for individual Trusts should be viewed with caution. In some instances, the large fluctuations in rates are due to relatively small changes in the number of patient episodes.
- In the absence of specialty information and other risk-factor data, it is not possible to comment on inter-Trust variations.
- This dataset contains no information relating to patient outcome.
- It is not possible to comment on the individual impact of any Trust and Regional initiatives to prevent and control HCAI.

The Northern Ireland Statistics and Research Agency (NISRA) have carried out a separate analysis of death certificates where *S. aureus* and MRSA are mentioned. (see http://www.nisra.gov.uk).

3. *Clostridium difficile*

3.1 Introduction

Clostridium difficile is an anaerobic, gram positive spore forming bacterium, found in the intestinal tract of around 3% of healthy adults and up to two thirds of babies. In many people the presence of *C. difficile* does not result in illness. Indeed, in babies it is part of the normal flora of the gut and rarely causes disease. However, in some people the organism can multiply in the intestinal tract and produce toxins resulting in diarrhoea (*Clostridium difficile* associated diarrhoea – CDAD) or a more serious condition called pseudomembranous colitis.

The association between CDAD and antibiotic therapy, which can alter the balance of the intestinal flora, means that *C. difficile* tends to be found in a higher proportion of elderly hospitalised adults when compared to the rest of the population in whom the exposure to antibiotics is far less.

***Clostridium difficile* in Northern Ireland**

Surveillance of CDAD in Northern Ireland prior to 2005 relied on laboratory reports of *C. difficile* toxin detected in patients of all ages. This surveillance was part of the routine laboratory based surveillance programme, which covers many organisms, but as it was run on a voluntary basis, reporting of CDAD may have been incomplete. The potential for data gaps and the fact that testing was not standardised throughout Northern Ireland initiated the planning of a formal, mandatory surveillance scheme.

CDAD poses the greatest risk to persons aged 65 years and over where there is a higher probability of it causing a more serious illness. Of the voluntarily reported data from patients in Northern Ireland prior to 2005, only 22% were reported in those aged less than 65 years. Also, from the reporting period 1999-2004, it was noted that of those for whom their location was known, 96% were hospital inpatients at the time of testing.

Using the laboratory testing methods recommended by the National *Clostridium difficile* Standards Group [14], mandatory surveillance began on 1 January 2005 with only hospitalised patients over 65 years of age included in the target population for surveillance. A similar scheme commenced in England in 2004.

This report describes data from CDAD surveillance in Northern Ireland up to and including, December 2007. A description of the data sources and rate calculations can be found in Appendix A and B. Further details on *C. difficile* are available at www.hpa.org.uk.

3.2 Results

CDAD data is collected by CDSC (NI) on a quarterly basis, from the five Trusts in the province. During the surveillance period January – December 2007, 982 episodes of CDAD were reported in hospital inpatients aged over 65 (Figure 10). This figure equates to a rate of 1.017 patient episodes per 1,000 occupied bed days (calculated for patients 65 years and over). This is an 8% reduction in the number of episodes reported in 2006 (1068 episodes), a rate of 1.040.

In addition, a further 164 episodes were reported from patients in this age group known not to have been inpatients in a hospital in one of the Trusts at the time of testing (Figure 10). This marked a large increase (36.7%) on the 2006 numbers (120). These "community" based patient samples may have come from a variety of settings including primary care, elderly care homes and community inpatient facilities.

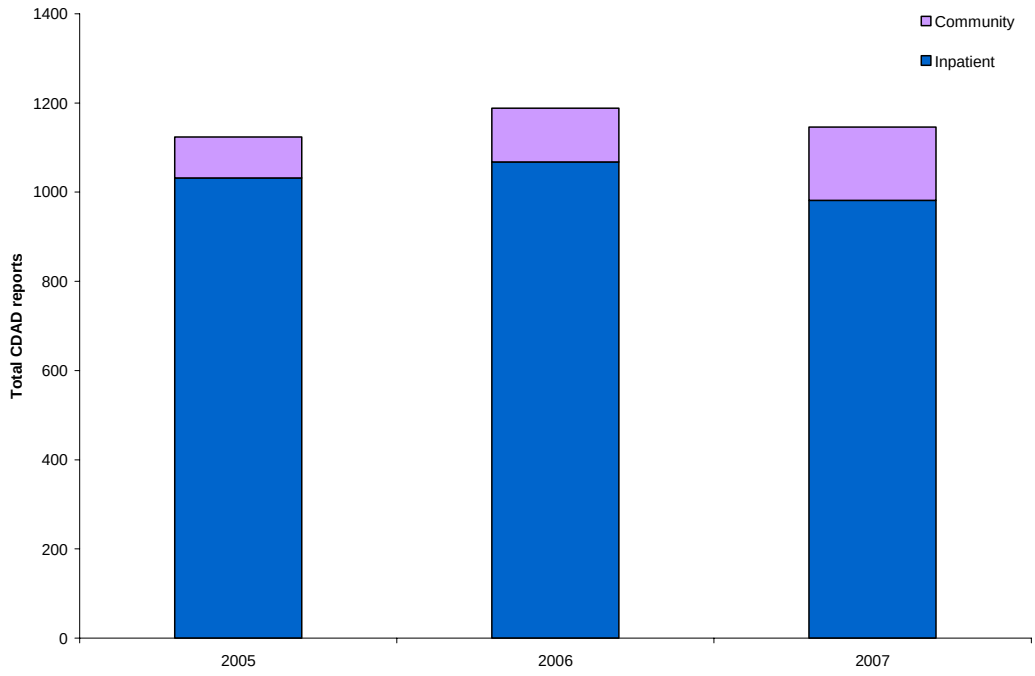

Figure 10: Annual *C. difficile* episodes, inpatient and community, Northern Ireland, 2005 – 2007

The year 2007 represented the third year of mandatory *C. difficile* surveillance but is only the second full year in which all laboratories followed the same testing criteria for *C. difficile.* Statistical Process Control (SPC) charts have now been introduced for *C. difficile* surveillance to emulate the current practice for *S. aureus* reporting. SPC charts allow the distinction to be made between natural variation and "special cause variation" where something unusual may be occurring. Using quarterly figures, from July 2005 to present, an SPC chart has been created to help monitor if *C. difficile* rates are in control (Figure 11).

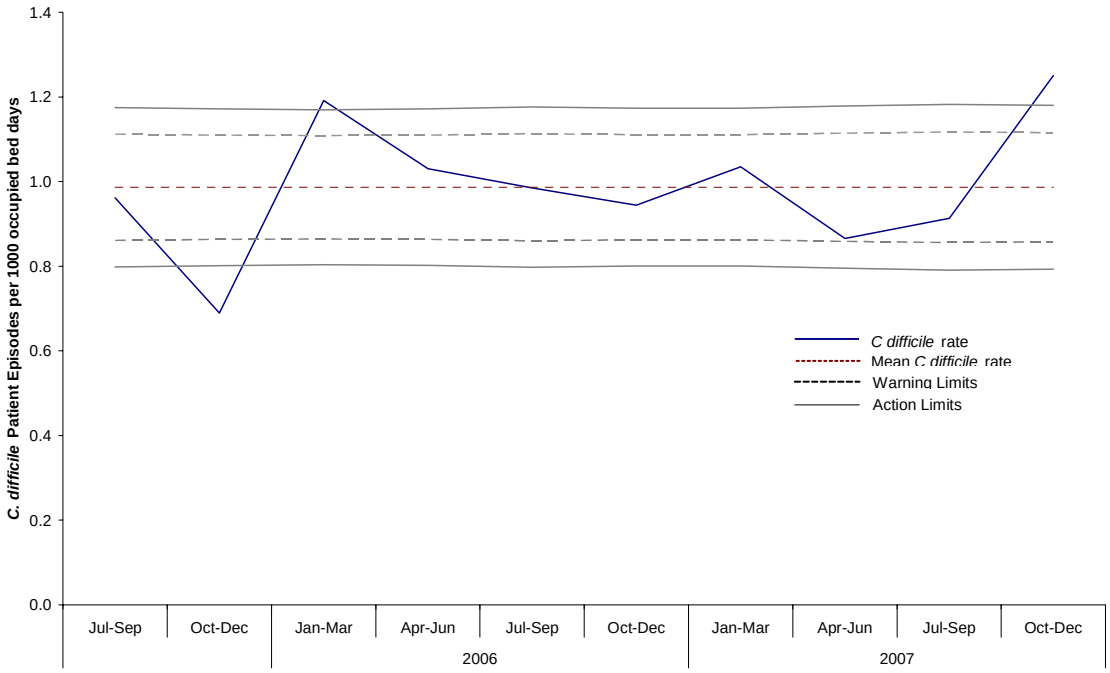

Figure 11: SPC of quarterly *C. difficile* rates, Northern Ireland, July 2005 – December 2007

In Northern Ireland, during 2007, the rate of *C. difficile* patient episodes breached the action limits of the chart indicating that the rates were no longer fluctuating within normal limits (Figure 11). This increase has been driven by a particularly large number of cases in the Northern Trust. However, during the final quarter of 2007 a rise in cases was also recorded in the Belfast, South Eastern and Western Trusts but these increases did not breach the SPC warning limits at the individual Trust level.

The actual number of episodes reported and rates calculated for each Trust during 2005, 2006 and 2007 can be found in Appendix D.

3.3 Discussion

The absolute numbers of *C. difficile* reported through this scheme have decreased slightly from the previous year. Indeed, during the first three quarters of 2007 the numbers of *C. difficile* episodes were markedly down. However, a rise in the number of cases during the final quarter of 2007 was enough to force the Northern Ireland total of CDAD past the action limits established by SPC methodology. This confirmed that the rate of *C. difficile* patient episodes was outside normally expected limits and gave evidence for special cause variation. As mentioned, this could be attributed to a number of factors including the emergence of the epidemic strain 027 within the Northern Trust and norovirus activity.

Quarterly reports from the CDAD mandatory surveillance programme are distributed to Trusts, Boards and DHSSPS and are also available from the CDSC (NI) website. These feedback reports have been used within Trusts to aid their infection control work leading to a reduction in CDAD incidence.

A similar *C. difficile* surveillance scheme has been running in England since January 2004. The most recent report from this scheme indicated an overall rate of 2.39 per 1,000 occupied bed days for patients aged 65 years or over in English Trusts during 2006[10]. This is higher than the rate for NI over the same period (1.02). However, until recently the English scheme did not differentiate between community and hospital specimens, whereas the NI rates are derived from hospital inpatients only. Thus, the NI figures would be expected to be slightly lower. The Scottish scheme is similar to that of England as no differentiation is made between patient sources. However, like the NI scheme, the denominator used includes all patients in non-acute geriatric medicine and geriatric long-term stay wards. Taking these points into consideration the provisional rate for Scotland in 2007 was 2.03[15]. Wales have also recently begun reporting on a similar mandatory surveillance scheme[16], however, the rate calculations are based on the number of patient admissions and so are not comparable to the rates reported here.

The data should be viewed with caution taking the following into account:

- The mandatory surveillance of *C. difficile* is currently restricted to patients aged 65 years and over at the time of the sample being taken, although the normal voluntary reporting from all laboratories continues to include all patients.
- Episodes of CDAD relating to patients resident in non-acute Trust settings, e.g. in long-stay psychiatric and learning disability facilities and in other community residential facilities, may have been omitted from these analyses.
- Laboratory testing practices came into line with the testing guidelines over the course of 2005, so the 2007 calendar year is only the second full year of the new practices being used.
- This dataset contains no information relating to patient outcome.

The Northern Ireland Statistics and Research Agency (NISRA) have carried out an analysis of death certificates where *Clostridium difficile* is mentioned (see http://www.nisra.gov.uk).

4. Acknowledgements

The collection and validation of reports for the surveillance of Health Care Associated Infections performed by CDSC (NI) (*S. aureus* bacteraemias and *C. difficile* associated disease) is undertaken by Trust microbiologists, laboratory staff and infection control teams throughout Northern Ireland. We are grateful for their significant ongoing help in collecting the data required for this surveillance.

5. Abbreviations

C. difficile	*Clostridium difficile*
CDAD	*Clostridium difficile* Associated Disease
CDSC (NI)	Communicable Disease Surveillance Centre (Northern Ireland)
DHSSPS	Department of Health, Social Services and Public Safety
EARSS	European Antimicrobial Resistance Surveillance Scheme (www.rivm.nl/earss)
HCAI	Healthcare Associated Infection
HISC	Hospital Infection Surveillance Centre (www.hisc.n-i.nhs.uk)
HSS Trust	Health and Social Services Trust
KH03a	DHSSPS dataset which includes the number of beds occupied in each hospital in Northern Ireland on a quarterly basis
MRSA	Meticillin Resistant *Staphylococcus aureus*
MSSA	Meticillin Sensitive *Staphylococcus aureus*
NI	Northern Ireland
NISRA	Northern Ireland Statistics and Research Agency (www.nisra.gov.uk)
RoI	Republic of Ireland
S. aureus	*Staphylococcus aureus*

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Appendix A

Data Sources

The five Trusts in Northern Ireland participate in the DHSSPS mandatory surveillance of HCAI facilitated by CDSC (NI).

Staphylococcus aureus

During 2007 *S. aureus* diagnostic testing was carried out in 10 laboratories in Northern Ireland. Each of these laboratories serves one or more Trusts, which in turn, are made up of one or more healthcare facilities, as detailed in table A1. The *S. aureus* bacteraemia scheme is achieved through the submission of data to CDSC (NI) on an ongoing basis through standard laboratory reporting procedures. This information is validated quarterly.

Any patient tested as an outpatient, or regular attender of one of the hospitals detailed in table A1 (such as those undergoing dialysis) is included in these data, as the blood cultures have been requested in a hospital setting.

Any patient attending an emergency department who is identified as having a *S. aureus* blood stream infection is included in these data, however, the source of the infection may in fact be the community or potentially acquired during admission to another health care facility.

Surveillance of *S. aureus* bacteraemias is limited solely to patient episodes identified within a hospital setting and does not include any specimens sent from patients sampled whilst in the community (this limitation excludes facilities under the control of Community HSS Trusts). This scheme also does not include any patients in psychiatric facilities at the time of testing. However, due to the nature of this infection, any patient within one of these facilities requiring a blood sample to be taken for suspected bacteraemia infection is likely to be ill and so transferred to an acute hospital, which would then report the episode of bacteraemia.

Clostridium difficile

C. difficile diagnostic testing is performed by 6 hospital laboratories in Northern Ireland, which between them provide testing facilities for the whole province. Each of these laboratories serve one or more Trusts, made up of one or more healthcare facilities, as detailed in table A2. The *C. difficile* scheme is achieved through the submission of data to CDSC (NI) on an ongoing basis through standard laboratory reporting procedures. This information is validated quarterly.

Surveillance of patient episodes of *C. difficile* includes all persons identified with *C. difficile* associated disease (CDAD) aged 65 years and over. This scheme includes all CDAD in Northern Ireland within this age group, although rates are only given for hospital inpatients within the Trusts, as for *S. aureus*.

Although a small number of laboratories provide testing services, each patient testing positive for *C. difficile* can be identified according to their age and their location at the time of testing. In this way it is possible to exclude community patients from the acute/specialist Trust data.

Patients within the community (including those in facilities under the control of community HSS Trusts) are included in the annual report solely to provide the Northern Ireland total, as the relevant Trust cannot be identified for all of these patients.

Appendix A

Table A1: Laboratories, Trusts and hospitals included in the mandatory *S. aureus* scheme

New Trust	Laboratory	Legacy Trust(s)	Hospitals Served (including acute and 'community' type)				
Western	Altnagelvin	**ALT:** Altnagelvin Group HSS Trust	Altnagelvin Area Hospital	Waterside (Ward 5)			
	Tyrone County	**SLT:** Sperrin Lakeland HSS Trust	Erne Hospital	Tyrone County Hospital			
Northern	Antrim	**UTD:** United Hospitals HSS Trust	Antrim Area Hospital	Braid Valley Hospital	Mid-Ulster Hospital	Moyle Hospital	Whiteabbey Hospital
	Causeway	**CWY:** Causeway HSS Trust	Causeway Hospital	Dalriada Hospital	Robinson Memorial		
Belfast	BCH	**BCH:** Belfast City Hospital HSS Trust	Belfast City Hospital	Belvoir Park NICCO			
	Musgrave Park	**GPT:** GreenPark HSS Trust	Forster Green Hospital	Musgrave Park Hospital			
	Mater	**MIH:** Mater Infirmorum Hospital HSS Trust	Mater Hospital				
	Royal	**RVH:** Royal Group of Hospitals HSS Trust	Royal Victoria Hospital	RJMH	RBHSC		
Southern	Craigavon	**CAH:** Craigavon Area Hospital Group HSS Trust	Craigavon Area Hospital	Lurgan General Hospital	South Tyrone Hospital	Mullinure*	
		NMT: Newry and Mourne HSS Trust	Daisy Hill Hospital				
South Eastern	BCH	**DLT:** Down Lisburn HSS Trust	Down Hospital	Lagan Valley Hospital			
	Ulster	**ULS:** Ulster Community and Hospitals HSS Trust	Ulster Hospital	Ards Hospital	Bangor Hospital		

*Mullinure was added to the Southern Trust group during 2007

Appendix A

Table A2: Laboratories, Trusts and hospitals included in the mandatory *C. difficile* scheme

New Trust	Laboratory	Legacy Trust(s)	Hospitals Served (including acute and 'community' type)				
Western	Altnagelvin	**ALT:** Altnagelvin Group HSS Trust	Altnagelvin Area Hospital	Waterside (Ward 5)			
		SLT: Sperrin Lakeland HSS Trust	Erne Hospital	Tyrone County Hospital			
Northern	Antrim	**UTD:** United Hospitals HSS Trust	Antrim Area Hospital	Braid Valley Hospital	Mid-Ulster Hospital	Moyle Hospital	Whiteabbey Hospital
	Causeway	**CWY:** Causeway HSS Trust	Causeway Hospital	Dalriada Hospital	Robinson Memorial		
Belfast	Belfast City Hospital	**BCH:** Belfast City Hospital HSS Trust	Belfast City Hospital	Belvoir Park NICCO			
		GPT: GreenPark HSS Trust	Forster Green Hospital	Musgrave Park Hospital			
		MIH: Mater Infirmorum Hospital HSS Trust	Mater Hospital				
		RVH: Royal Group of Hospitals HSS Trust	Royal Victoria Hospital				
		DLT: Down Lisburn HSS Trust	Down Hospital	Lagan Valley Hospital			
Southern	Craigavon	**CAH:** Craigavon Area Hospital Group HSS Trust	Craigavon Area Hospital	Lurgan General Hospital	South Tyrone Hospital	Mullinure*	
		NMT: Newry and Mourne HSS Trust	Daisy Hill Hospital				
South Eastern	Ulster	**ULS:** Ulster Community and Hospitals HSS Trust	Ulster Hospital	Ards Hospital	Bangor Hospital		

*Mullinure was added to the Southern Trust group during 2007

Appendix B

Rate Calculations

Staphylococcus aureus

The rates described in this report are patient episodes per 1,000 occupied bed days, calculated using the formula below. The denominator used for this calculation is derived from the KH03a dataset, overnight bed occupancy data (including all hospital inpatients) as supplied by DHSSPS on a quarterly basis. All rates have been calculated for both individual Trusts and Northern Ireland as a whole.

$$\text{Trust rate} = \left(\frac{\text{Number of } \textit{S. aureus} \text{ bacteraemias in time period}}{\text{Number of occupied bed days in time period}} \right) \times 1000$$

Number of MSSA patient episodes is defined as the total number of patients from whom Blood Culture set(s) collected during the reporting period grew Meticillin Sensitive *Staphylococcus aureus*. If positive blood culture sets are collected from the same patient more than 14 days apart, they should be considered as reflecting different episodes.

Number of MRSA patient episodes is defined as the total number of patients from whom Blood Culture set(s) collected during the quarter grew Meticillin Resistant *Staphylococcus aureus*. If positive blood culture sets are collected from the same patient more than 14 days apart, they should be considered as reflecting different episodes.

Number of *S. aureus* patient episodes is defined as the total number of patients from whom Blood Culture set(s) collected during the quarter grew *S aureus* (including MSSA and MRSA). If positive blood culture sets are collected from the same patient more than 14 days apart, they should be considered as reflecting different episodes.

Any reports of MRSA must include all MRSA positive blood culture episodes detected by the laboratories, whether clinically significant or not, whether treated or not, whether acquired in your Trust or elsewhere. This includes positive blood cultures taken within 48 hours of admission to hospital.

Clostridium difficile

The rates described in this report are patient episodes per 1,000 occupied bed days (patients aged 65 years and over), calculated using the formula below. The denominator used for this calculation is derived from patient episode statistics obtained from each Trust individually on a quarterly basis. All rates have been calculated for both individual Trusts and Northern Ireland as a whole.

$$\text{Trust rate} = \left(\frac{\text{Number of CDAD patient episodes (patients 65 years and over in time period}}{\text{Number of occupied bed days (patients 65 years and over) in time period}} \right) \times 1000$$

The number of CDAD patient episodes is defined as the total number of patients aged 65 years and over from whom a diarrhoeal specimen tested positive for *C. difficile* toxins A and toxin B. If repeat specimens were collected from a single patient at least 28 days apart, the patient is considered to have had two episodes of CDAD and is counted as two patient episodes.

Appendix C

Number of MSSA patient episodes by Trust, Northern Ireland 2001-2007

Trust	2001*	2002	2003	2004	2005	2006	2007
Western	34	50	38	47	52	51	40
Northern	51	73	79	67	50	73	54
Belfast	124	122	158	138	150	119	153
Southern	22	49	41	37	33	50	39
South Eastern	27	47	49	41	43	45	50
Northern Ireland	258	341	365	330	328	338	336

Number of MRSA patient episodes by Trust, Northern Ireland 2001-2007

Trust	2001*	2002	2003	2004	2005	2006	2007
Western	21	17	32	38	27	20	23
Northern	29	46	55	50	47	46	45
Belfast	82	98	127	102	114	115	108
Southern	16	20	35	29	23	22	14
South Eastern	22	31	35	51	32	42	39
Northern Ireland	170	212	284	270	243	245	229

Number of *S. aureus* (MSSA & MRSA) patient episodes by Trust, Northern Ireland 2001-2007

Trust	2001*	2002	2003	2004	2005	2006	2007
Western	55	67	70	85	79	71	63
Northern	80	119	134	117	97	119	99
Belfast	206	220	285	240	264	234	261
Southern	38	69	76	66	56	72	53
South Eastern	49	78	84	92	75	87	89
Northern Ireland	428	553	649	600	571	583	565

(* 2001 not a complete calendar year, Apr-Dec only)

Appendix C

Rate of MSSA patient episodes per 1,000 occupied bed days by Trust, Northern Ireland 2001-2007

Trust	2001*	2002	2003	2004	2005	2006	2007
Western	0.193	0.211	0.157	0.188	0.208	0.205	0.166
Northern	0.197	0.206	0.221	0.186	0.141	0.209	0.160
Belfast	0.243	0.178	0.223	0.189	0.210	0.169	0.224
Southern	0.120	0.194	0.160	0.141	0.129	0.199	0.161
South Eastern	0.121	0.159	0.167	0.139	0.147	0.166	0.196
Northern Ireland	0.191	0.187	0.196	0.174	0.176	0.185	0.191

Rate of MRSA patient episodes per 1,000 occupied bed days by Trust, Northern Ireland 2001-2007

Trust	2001*	2002	2003	2004	2005	2006	2007
Western	0.119	0.072	0.132	0.152	0.108	0.080	0.095
Northern	0.112	0.130	0.154	0.139	0.133	0.132	0.133
Belfast	0.161	0.143	0.180	0.140	0.160	0.163	0.158
Southern	0.088	0.079	0.136	0.110	0.090	0.088	0.058
South Eastern	0.098	0.105	0.119	0.172	0.109	0.155	0.153
Northern Ireland	0.126	0.116	0.153	0.142	0.130	0.134	0.130

Rate of *S. aureus* (MSSA & MRSA) patient episodes per 1,000 occupied bed days by Trust, Northern Ireland 2001-2007

Trust	2001*	2002	2003	2004	2005	2006	2007
Western	0.313	0.283	0.289	0.339	0.317	0.285	0.261
Northern	0.308	0.336	0.374	0.324	0.274	0.341	0.293
Belfast	0.404	0.321	0.403	0.329	0.370	0.332	0.382
Southern	0.208	0.274	0.296	0.251	0.219	0.287	0.219
South Eastern	0.219	0.264	0.286	0.311	0.256	0.321	0.349
Northern Ireland	0.317	0.303	0.349	0.316	0.306	0.319	0.321

(* 2001 not a complete calendar year, Apr-Dec only)

Appendix D

Number of *C. difficile* patient episodes, patients 65 years and over, by Trust, Northern Ireland 2005 - 2007

	2005*	2006	2007
Western	86	110	135
Northern	178	183	247
Belfast	318	385	265
Southern	215	138	116
South Eastern	235	252	219
Northern Ireland	1032	1068**	982

**4 additional episodes due to the inclusion of Mullinure in the Southern Trust.

Rates of *C. difficile* patient episodes per 1,000 occupied bed days, patients 65 years and over, by Trust, Northern Ireland 2005 - 2007

	2005*	2006	2007
Western	0.668	0.831	1.098
Northern	0.797	0.859	1.219
Belfast	0.880	1.074	0.767
Southern	1.490	0.929	0.843
South Eastern	1.288	1.444	1.392
Northern Ireland	0.992	1.040	1.017

Number of *C. difficile* patient episodes, patients 65 years and over, reported in community patients Northern Ireland 2005 - 2007

	2005*	2006	2007
Northern Ireland	92	120	164

*laboratory testing in NI came into line over the course of 2005; therefore, 2006 is the first complete calendar year with all laboratories using same methods