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Acronyms

ABHR  Alcohol Based Hand Rubs
AMR  Antimicrobial Resistance
AMT  Antimicrobial Management Team
AOBDs  Acute Occupied Bed Days
ATP  Adenosine Triphosphate
BSI  Bloodstream Infection
CARS  Controlling Antimicrobial Resistance in Scotland
CAUTI  Catheter Associated Urinary Tract Infection
CEL  Chief Executive Letter
CDI  Clostridium difficile Infection
CI  Confidence Intervals
CRA  Clinical Risk Assessment
CMO  Chief Medical Officer
CNO  Chief Nursing Officer
CPE  Carbapenemase-producing Enterobacteriaceae
CPO  Chief Pharmacy Officer
CRI  Catheter-Related Infection
CR-BSI  CVC-Related Bloodstream Infection
ICT  Infection Control Team
CVC  Central Vascular Catheter
EARS-Net  European Antimicrobial Resistance Surveillance Network
ECDC  European Centre for Disease Prevention and Control
ECOSS  Electronic Communication of Surveillance in Scotland
EMRSA  Epidemic Meticillin Resistant Staphylococcus aureus
ESBL  Extended Spectrum Beta-lactamase
EuSCAPE  European Survey on Carbapenemase-producing Enterobacteriaceae
FFP  Filtering Face Piece
HAI  Healthcare Associated Infection
HAIRT  Healthcare Associated Infection Reporting Templates
HAITF  HAI Task Force
HAI-ORT  Healthcare Associated Infection – Outbreak Reporting Template
HCW  Healthcare Worker
HDU  High Dependency Unit
HDL  Health Department Letter
HEI  Healthcare Environment Inspectorate
HELICS  Hospitals in Europe Link for Infection Control through Surveillance
HIIAT  Hospital Infection Incident Assessment Tool
HINS  High Intensity Narrow Spectrum
HPS  Health Protection Scotland
ICU  Intensive Care Unit
IPC  Infection Prevention and Control
IPCT  Infection Prevention and Control Team
ISD  Information Services Division
KPC  Klebsiella pneumoniae Carbapenemase
KPI  Key Performance Indicator
MDR  Multidrug Resistant
MRSA  Meticillin Resistant *Staphylococcus aureus*
MSSA  Meticillin Sensitive *Staphylococcus aureus*
nCoV  Novel Coronavirus
NDM  New Delhi Metallo-Beta-lactamase
NES  National Education for Scotland
NHS  National Health Service
NNU  Neonatal Units
NP  National Procurement
NWTC  National Waiting Times Centre
OPCS  Office of Population Censuses and Surveys
PCR  Polymerase Chain Reaction
PDS  Post Discharge Surveillance
PHE  Public Health England
PIS  Prescribing Information System
PPDM  Preparedness Detection and Management
PPE  Personal Protective Equipment
PPS  Point Prevalence Survey
PVC  Peripheral Vascular Catheter
PVL  Panton-Valentine Leukocidin
QIT  Quality Improvement Tools
RPE  Respiratory Protective Equipment
SAPG  Scottish Antimicrobial Prescribing Group
SCN  Senior Charge Nurse
ScotMARAP  Scottish Management of Antimicrobial Resistance Action Plan
SEHD  Scottish Executive Health Department
SGHSCD  Scottish Government Health and Social Care Directorate
SICPs  Standard Infection Control Precautions
SICSAAG  Scottish Intensive Care Society Audit Group
SIGN  Scottish Intercollegiate Guideline Network
SIRN  Scottish Infection Research Network
SMRSARL  Scottish MRSA Reference Laboratory
SMVN  Scottish Microbiology and Virology Network
SPSP  Scottish Patient Safety Programme
SSHAIP  Scottish Surveillance of HAI Programme
SSI  Surgical Site Infection
SSSCDRL  Scottish *Salmonella, Shigella* and *Clostridium difficile* Reference Laboratory
SUTIN  Scottish UTI Network
TBP  Transmission Based Precautions
UTI  Urinary Tract Infection
WHO  World Health Organisation
WSG  Water Safety Group
WSP  Water Safety Plans
VAP  Ventilator Associated Pneumonia
VHF  Viral Haemorrhagic Fever
Executive Summary

Healthcare associated infections (HAIs) continue to represent a threat to patient safety in NHSScotland and to safe care, wherever that is delivered. In addition to this the threat of AMR is highlighted in this report and will be a key focus for health protection in the coming years.

Escherichia coli Bacteraemia

*E. coli* is the most common pathogen causing bacteraemia in community and healthcare settings. Bacteraemia develops usually as a complication of other infections, such as urinary tract infections.

- Incidence rate of *E. coli* bacteraemias in patients aged 65 years and above was 90.9 per 100 000 acute bed days.
- Incidence rate of *E. coli* bacteraemias in all ages was 88.2 per 100 000 acute bed days.

Clostridium difficile Infection

CDI is an important HAI which usually causes diarrhoea and contributes to a significant burden of morbidity and mortality. Prevention of CDI is therefore essential and an important patient safety issue.

- Incidence rate in patients aged 15-64 years was 33.8 per 100 000 acute bed days.
- Incidence rate in patients aged 65 years and above was 34.5 per 100 000 total bed days.

Surgical Site Infection

SSIs are one of the most common HAIs, and can cause excess morbidity and mortality as well as doubling the cost of treatment. SSIs can result in increased pain and suffering in patients and may lead to additional surgical intervention.

- Caesarean Section: Overall incidence to day 10 Inpatient SSI was 1.41%.
- Hip Arthroplasty: Overall incidence of Inpatient SSI was 0.69%.

Urinary Tract Infections

Urinary tract infections (UTI) and catheter associated-UTI (CAUTI) are a patient safety concern in acute and non-acute hospitals, care homes and care at home.

The most common organisms causing UTIs were *E. coli* and *K. pneumoniae*. *E. coli* antimicrobial resistance to the third generation cephalosporins, carbapenems and nitrofurantoin increased significantly.

There were no statistically significant changes to *K. pneumoniae* antimicrobial resistance proportions.

Staphylococcus aureus Infection

When *S. aureus* breaches the body’s defence systems it can cause a range of illnesses from minor skin infections to serious systemic infections such as bacteraemia.

- Incidence rate of *S. aureus* bacteraemias was 30.4 per 100 000 acute bed days.
- Incidence rate of MRSA was 2.7 per 100 000 acute bed days.
- Incidence rate of MSSA was 27.7 per 100 000 acute bed days.

Norovirus

Norovirus spreads very easily and there is a risk of outbreaks in shared living spaces such as in hospitals. There is no lasting immunity following norovirus infection so every year everyone is vulnerable to this infection.

There were eight ward closures in the 2013 – 2014 season. This was considerably lower than all previous seasons.

HAIs in Intensive Care Units

The prevalence of HAIs in ICUs is higher than in other areas of the hospital. Multiple co-morbidities and the delivery of complex medical treatments increase the risk of developing HAI, making this a priority for surveillance.

Incidence of HAI in ICU was 3.0%.

Carbapenemase-producing bacteria

Multidrug resistance among Gram-negative bacteria has been increasingly reported in the last ten years and continues to be a major threat to both public health and patient safety.

The emergence of carbapenemase-producing bacteria is of particular concern as it leaves very few therapeutic options for infections with these types of bacteria.

In Scotland, a total of 26 carbapenemase producing Gram-negative organisms were reported from the AMRHAIR Reference Unit Public Health England (PHE). This is the same level as 2013.

† Statistically significant increase
↔ No change
↓ Statistically significant decrease
Surgical Site Infection
The incidence of SSI following hip arthroplasty surgery did not change significantly between 2013 and 2014 though there was a significant decrease in SSI incidence among C-section procedures. Continued surveillance and implementation of improvement tools is necessary to reduce these clinically significant infections further.

Healthcare Associated Infections in Intensive Care Units
The incidence of HAI in Scottish ICUs remains at a similar level to that reported in 2012 (2014 data currently unavailable). Continued collaboration with the Scottish Intensive Care Society Audit Group ensures that HAI continues to be a priority for patient safety in ICU.

Clostridium difficile Infections
The trend in annual incidence rates over the last five years for CDI has been one of almost continuous decline between 2010 and 2014. However, the trend has been flat between 2013 and 2014. Further work is being undertaken to identify additional interventions to reduce CDI rates in both hospitals and community settings.

Staphylococcus aureus Infection
The annual incidence rates for SAB, MRSA and MSSA have not changed compared to the previous year. Further investigations into the differences in epidemiology between MRSA and MSSA bacteraemias are necessary to support continued reductions in S. aureus infections in Scotland.

Escherichia coli
The incidence of E. coli bacteraemia has continued to increase year on year in Scotland. A pilot study has been undertaken to describe the epidemiology of E. coli infection and elucidate which interventions are likely to be most effective.

Urinary Tract Infections
Urinary tract infections (UTIs) are among the most commonly encountered infections in healthcare. Increasing trends in resistance were observed among E. coli urinary isolates. The Scottish UTI Network (SUTIN) has been established to enable a coordinated approach to improve the management of UTI.

Carbapenemase-producing Bacteria
Resistance to carbapenems in 2014 remained low, as did reports of carbapenemase producing Gram-negative organisms in Scotland. However, further development of resistance to carbapenems and spread of carbapenemase producing organisms remains a serious concern in Scotland and across Europe.

Norovirus outbreaks
The impact of norovirus as measured by ward closures has been lower in the 2013/14 season compared to previous seasons. HPS works with IPC Ts in all boards to minimise the incidence and impact of norovirus outbreaks.

Hospital HAI Outbreaks and Provision of Support to Boards
HPS works to support local IPC Ts to prevent, prepare for and manage outbreaks. HPS also works to share lessons learned throughout Scotland. In the last year HPS have produced reports and guidance; developed tools and crib cards and provided support as required for 49 outbreaks and incidents.

Hand hygiene
This year, HPS Infection Control Team and National Procurement colleagues worked together to progress the development of a commodity indicator for hand hygiene product consumption that could be used nationally as a baseline proxy indicator for hand hygiene compliance across NHSScotland. This work is still in the early stages and HPS and NP will continue to refine this in coming year.

Development of Guidance
HPS collaborate with local Infection Prevention and Control and Health Protection Teams in the development and review of guidance documents for the prevention and control of infection across all care settings. Key documents produced last year include: guidance on care of the deceased added to Chapter two of the National Infection Prevention and Control Manual, and infection prevention and control precautions for viral haemorrhagic fever (Ebola) added to the HAI Compendium of Guidance.

Decontamination
Decontamination failures continue to represent a threat to patient safety. Further work to monitor decontamination failures and their impact on health outcomes is required. In the last year HPS have: undertaken a pilot study of surgical instrument decontamination in two NHS boards; and published an A to Z template for the decontamination of reusable patient care equipment.

An infographic to accompany the Executive Summary of the HAI Annual Report is available to download.
Surgical Site Infection

Surgical site infection (SSI) is one of the most common Healthcare Associated Infections (HAIs), estimated to account for 18.6% of inpatient HAI within NHSScotland.1 SSI can cause excess morbidity and mortality and are estimated on average to double the cost of treatment, mainly due to the resultant increase in length of stay.2 SSI can have serious consequences for patients affected as they can result in increased pain, suffering and in some cases require additional surgical intervention.3

Epidemiological Data

The Scottish Surveillance of HAI Programme (SSHAIP) within Health Protection Scotland (HPS) coordinates the SSI surveillance programme that is mandatory across all NHS boards in Scotland. All NHS boards participate in SSI surveillance for at least two procedures from a list of twelve.4 Prospective inpatient and readmission surveillance for hip arthroplasty, for 30 post operative days, and post discharge surveillance (PDS) for caesarean section procedures, for 10 post operative days, is mandatory as per the requirements of HDL 2006 (38) and CEL (11) 2009.5,6 SSI surveillance is conducted according to the HPS SSI surveillance protocol.4

Caesarean Section

A total of 238 cases of SSI following caesarean section procedures (n=16 925) were reported during 2014. Thirty-eight of these SSIs were diagnosed during the inpatient stay. The majority of SSIs (n=200, 84.0%) were diagnosed following discharge from hospital using post-discharge surveillance (PDS) methods up to 10 days post operative.

The incidence of inpatient SSI was 0.22% (95% CI: 0.16 to 0.31) and the overall incidence for inpatient and PDS to day 10 SSI was 1.41% (95% CI: 1.24 to 1.59). The incidence of SSI decreased between 2010 and 2014 (Figure 1) for inpatient SSI (year on year decrease of 10.1%, p=0.023) and inpatient and PDS to day 10 SSI (year on year decrease of 15.3%, p<0.001). The incidence of inpatient and PDS to day 10 SSI decreased from 1.74% in 2013 to 1.41% in 2014 (p=0.015).
The majority of SSI occurring following caesarean section surgery were superficial though 52.6% of SSI diagnosed during the inpatient stay were deep or organ space (n=20) (Figure 2).
Hip Arthroplasty

A total of 57 cases of SSI following hip arthroplasty procedures (n=8 303) were reported in 2014. Thirty-five percent of these SSIs were reported during the inpatient stay (n=20) and the remainder were identified when the patient was readmitted to hospital in the 30 days following the procedure (n=37). The inpatient incidence of SSI was 0.24% (95% CI: 0.16 to 0.37) and the overall incidence of SSI was 0.69% (95% CI: 0.53 to 0.89). The incidence of SSI for inpatient and readmission to day 30, for hip arthroplasty, remained stable between 2010 and 2014 (p=0.227) however there was a decrease between 2010 and 2014 for inpatient SSI (year on year decrease of 13.4%, p=0.024) (Figure 3). The SSI incidence for hip arthroplasty, for both inpatient and inpatient and readmission to day 30, remained stable between 2013 and 2014.

Figure 3: Incidence of SSI following hip arthroplasty procedures in Scotland (inpatient and readmission to day 30), 2010 to 2014.

The proportion of SSI that were deep and organ space identified post discharge was higher for hip arthroplasty than for caesarean section though this is likely due to the post discharge method of case ascertainment; only SSI where the patient is readmitted to hospital are captured post discharge following hip arthroplasty thus the proportion of more severe SSI will be higher (Figure 4). The number of SSI following hip arthroplasty is small therefore these data should be interpreted with due caution.
Figure 4: Proportion of SSI following hip arthroplasty procedures (inpatient and readmission to day 30) in Scotland by SSI type, 2014.

Interventions and Quality Improvement to Reduce SSI

HPS monitor the SSI incidence within each NHS board on a quarterly basis and feedback is provided to each individual Infection Prevention and Control Team (IPCT). Whilst national surveillance systems do not replace the need for local surveillance, these data may assist IPCT with analysis of local results, assist in the identification of potential issues and identify areas for investigation and process improvement.

Quarterly exception reports are issued to boards where the incidence of SSI is higher than expected based on the national data and HPS ask the board to provide an action plan outlining measures they will be taking to reduce the incidence of SSI. In 2014, there were four exception reports issued to three NHS boards in order to alert them to an increased incidence of SSI relative to the national incidence. All four exception reports during 2014 were for caesarean section procedures with no exception reports issued for hip arthroplasty. Reasons for these increases in SSI were investigated by local IPCTs with support provided by HPS which included local data analysis, hospital visits and review of action plans supplied by NHS boards. Individually these NHS boards returned to within expected limits having implemented the changes identified within their action plans.

Continuing surveillance after the patient has been discharged from hospital is important for procedures with a short length of hospital stay. The proportion of caesarean section SSI detected by PDS to day 10, not including inpatient infections, accounted for 84.0% of all the SSI detected for caesarean section during 2014 within NHSScotland. As part of ongoing work to assess and improve PDS for caesarean section procedures within NHSScotland a number of initiatives have been introduced by HPS. In 2014, the PDS return rate for NHSScotland was 90.5% (range: 67.9% to 100%) depending on the hospital. These data allows HPS to determine where patients were lost to follow up and if the percentage of patients being followed up post discharge is comparable between boards.
In November 2014, HPS organised an SSI surveillance training session for both new and existing SSI surveillance staff. The purpose of this training was to ensure that the quality of the information collected by surveillance staff was robust and consistent across all NHS boards, providing confidence for clinical staff implementing improvement changes based on these data. Evaluation of the training was extremely positive. In 2014-15, HPS have been working in collaboration with NHS Education for Scotland (NES) to develop an online surveillance training module that is based on the content and feedback of previous training sessions. This training module will be available later this year.

In 2014, HPS began the collection of SSI organism and antimicrobial resistance data across NHSScotland in order to benchmark and align with national and international surveillance centres, and to further understand the epidemiology of SSI. SSI organism and antimicrobial resistance data for 2014 will be included in the SSI annual report that will be published in July 2015.

SSI surveillance data are currently collected by HPS using the web based system SSIRS (Scottish Surgical Site Infection Reporting System). However the majority of data recorded on SSIRS is also collected by NHS boards using a variety of local software systems. At the request of the boards HPS have collaborated to develop a method to export the data to SSIRS that would prevent the need for manually entering the same data twice. The SSI module has been developed based on the data collection forms within SSIRS. This SSI module can then be automatically populated with data already collected within the boards e.g. software systems such as local theatre systems. A mechanism was then developed to export the SSI data from the boards to SSIRS. Three NHS boards have been involved in a pilot study to test the validation rules and the import and export features. The results will be available in Quarter three, 2015.

In 2014, as part of the Infection Intelligence Platform (IIP), a study was conducted to assess the feasibility of using linked Scottish Morbidity Record (SMR) 01 data to identify SSIs and therefore replace the need for the manual data collection done within SSIRS. Unfortunately this method is currently not suitable for infection surveillance due to the extended length of time before SMR01 data becomes available, as surveillance needs timely data to be effective. However data from SSIRS will be included with other relevant datamarts, links, extracts and views in the Corporate Data Warehouse (CDW) to underpin IIP. Further information on the SSI study or IIP is available from: http://www.isdscotland.org/Health-Topics/Health-and-Social-Community-Care/Infection-Intelligence-Platform/.

The last point prevalence survey (PPS)1 in Scotland demonstrated that there is a continuing burden of SSI in the acute inpatient population particularly in vascular and gastrointestinal surgery. In 2015, HPS will be facilitating a short life working group (SLWG) to engage with clinicians and local IPCTs to scope colorectal and vascular SSI surveillance.

An infographic to accompany Surgical Site Infection of the HAI Annual Report is available to download
Healthcare Associated Infections in Intensive Care Units

The prevalence of HAI in intensive care units (ICUs) is higher than in other areas of the hospital. Multiple co-morbidities and the delivery of complex medical treatments put this patient population at increased risk of developing HAI and therefore they are a priority for surveillance.

Epidemiological Data

During 2013, all 23 adult ICUs across Scotland collected data for a voluntary surveillance programme (data from 2014 are not yet available for publication in this report. These data will be published separately in August 2015). Data relating to bloodstream infection (BSI), central vascular catheter (CVC) related infection (CRI), CVC-related bloodstream infection (CR-BSI) and pneumonia were collected. All data were collected in accordance with the European Centre for Disease Prevention and Control (ECDC) protocol for Surveillance of Healthcare-Associated Infections in Intensive Care Units.

In total, 224 HAIs were reported from 206 patients during 2013. The incidence of HAI was 3.0% (95% CI: 2.7 to 3.5). Of the 224 HAI, 112 (50.0%) were pneumonia, 92 (41.1%) were BSI (including CR-BSI) and 20 (8.9%) were CRI-1 and CRI-2. Figure 5 shows the incidence rates for Ventilator Associated Pneumonia (VAP), BSI and CR-BSI for the period 2010 to 2013.

Figure 5: Incidence rates of VAP, BSI and CR-BSI for 2010-2013.

* Data from 2014 are not yet available for publication in this report. This data will be published separately in August 2015.
The overall findings indicated that HAI in the critical care setting during 2013 remained at a similar level to that reported in 2012. Whilst there has been a decrease in infection incidence since the outset of the surveillance programme, there was no significant change in the infection rates in the year 2012-13 and this reflects the findings from other surveillance programmes across Scotland, where a plateau in infection rates during 2013 was evident.9

Interventions and Quality Improvement to Reduce HAI in ICUs

HPS and the Scottish Intensive Care Society Audit Group (SICSAG) continue to work in partnership to reduce HAI in the critical care setting. SICSAG support the surveillance programme within the context of the Quality Indicators for Critical Care in Scotland,10 which requires that units have a local HAI surveillance programme in place and monthly reporting of HAI to the Scottish Patient Safety Programme (SPSP).

SICSAG actively supports activities to promote and enhance engagement with surveillance and quality improvement at unit level. A collaborative paper which focused on the critical elements of integrating surveillance into a clinical care electronic system was published earlier this year.11 This paper indicates that since establishing the system in 2010, there has been a notable local success in the implementation of interventions and reduction of the incidence of VAP. Nationally, there have also been reductions in bloodstream infections and VAP. The paper concluded that integration of technology in surveillance has enabled clinicians to spend more time using data to improve patient care, rather than collecting data.11

Work in the coming year will focus on refinement of linkage of HAI data collected for this surveillance programme to the Electronic Communication of Surveillance in Scotland (ECOSS) dataset for laboratory data. This will facilitate assessment of the feasibility of producing an extended dataset for HAI surveillance in ICU, relative to micro-organisms and antimicrobial resistance. Work is also ongoing with NHS Lothian to evaluate the definitions for Ventilator Associated Events that have been developed by the Centers for Disease Control and Prevention.12 This study will compare these definitions to the European definition and will evaluate the feasibility of applying this in the Scottish setting.

An infographic to accompany HAI in Intensive Care Units of the HAI Annual Report is available to download.
Clostridium difficile Infection

*Clostridium difficile* infection (CDI) is an important HAI which usually causes diarrhoea and contributes to a significant burden of morbidity and mortality. Prevention of CDI is therefore essential and an important patient safety issue.

Mandatory surveillance of CDI in Scotland has been carried out in patients aged 65 or older since October 2006. This was extended to include patients aged 15-64 years in April 2009. Full details of the methods may be obtained from the CDI surveillance protocol.13

Epidemiological Data

In Scotland, the trend in annual incidence rates over the last five years for CDI has been one of almost continuous decline between 2010 and 2014 in both age groups under surveillance. However, the trend has flattened between 2013 and 2014 in patients aged 15 to 64 and was flat in patients aged equal and greater than 65 years compared to the sharper decline observed between 2010 and 2012 (Figure 6).

![Figure 6: Annual CDI incidence rates in patients aged 65 years and above and 15 to 64 years in Scotland per 100 000 bed days (2010 to 2014).](image)

The annual incidence rate for 2014 in patients aged 65 was 34.5 per 100 000 total bed days, which is unchanged compared to 2013. There were 1235 cases of CDI in 2014 compared to 1246 cases in 2013. Between 2010 and 2014, there has been an overall 38.2% decrease in the annual incidence rate, with a year on year reduction of 11.1% (p<0.001).
In patients aged 15 to 64 years, the annual incidence rate for 2014 was 33.8 per 100 000 acute bed days compared to 35.0 per 100 000 acute bed days in 2013. There were 475 cases of CDI in 2014 compared to 485 cases in 2013. Between 2010 and 2014, there has been an overall 24.5% decrease in the annual incidence rate, with a year on year reduction of 7.1% (p<0.001).

**Molecular Epidemiological Data**

Polymerase chain reaction (PCR) ribotyping of \textit{C. difficile} isolates has been carried out by the Scottish Salmonella, Shigella and \textit{Clostridium difficile} Reference Laboratory since November 2007. Initially, isolates were typed from severe cases and/or outbreaks. This was followed by the introduction of a snapshot programme in 2009 in which isolates were typed regardless of the severity of disease in order to get a representative sample for characterisation of the distribution of ribotypes among Scottish CDI cases.

In 2014, the most common ribotype isolated in Scotland in the snapshot and severe cases and/or outbreaks was 078 (12.7% and 11.1%, respectively). Other common ribotypes included 002, 005, 014, and 015. Compared to 2013, the prevalence of 014 in 2014 increased among isolates from severe cases and/or outbreaks (5.3% to 9.3%). There was also an increase in ribotype 020 between 2013 and 2014 among snapshot isolates (3.5% to 7.8%). Those designated ‘others’ include 102 different ribotypes which have a frequency less than 3% (Table 1). Previously predominant ribotypes 001, 027 and 106 remain at low levels in Scotland. These three types accounted for more than 50% of all types isolated in 2009. A similar pattern has been reported from England with 001, 027 and 106 almost disappearing and 078 emerging.\(^\text{14}\) In Europe, ribotypes 001, 014, 027 and 078 are commonly found,\(^\text{15}\) with ribotype 027 recently being reported as re-emerging in Germany\(^\text{16}\) and predominating in eastern European countries including Hungary, Poland and Romania.\(^\text{17}\)

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<tr>
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Antimicrobial Use and Resistance

To date, all isolates of *C. difficile* have been reported as susceptible to metronidazole and vancomycin, the two antibiotics used to treat CDI. However, resistance to other commonly used antibiotics is common among the Scottish *C. difficile* isolates.

Cefotaxime resistance remained high (more than 84.0%) in all major ribotypes. Overall resistance to levofloxacin was unchanged compared to 2013 at 29.0%, whereas there was a decrease in overall resistance to moxifloxacin (10.4% to 6.2%). However the pattern was not the same across the major ribotypes with around half of ribotypes 001, 002 and 014 being resistant to levofloxacin, whereas this was 18.0% for ribotypes 015 and 078. Only in ribotypes 001, 016 and 027 was resistance to moxifloxacin more than 10.0% (33.3%, 40.0% and 85.7% respectively). However, overall resistance to the fluoroquinolones continued to decrease in ribotypes 001, 027 and 106 compared to previous years when the majority of these three types were often resistant to these antibiotics. The decrease in resistance to the fluoroquinolones may reflect patterns of prescribing in which the use of fluoroquinolones has decreased (see below), and may also be partly explained by the further reduction in the occurrence of ribotypes 001, 027 and 106. Almost all isolates tested were resistant to clindamycin (more than 98.0%).

Good antimicrobial stewardship is one of the key factors in controlling CDI as the use of any antimicrobial agent is a risk factor for the development of disease due to disturbance of the natural gut flora. Resistance to certain antibiotics has also been suggested to give *C. difficile* an advantage to spread in healthcare environments. In order to further reduce the risk of CDI through prudent use of antimicrobials, HPS continues to work with NHS boards via the Scottish Antimicrobial Prescribing Group (SAPG).

A key priority for SAPG, since its establishment in 2008, has been to drive a reduction in the use of broad-spectrum antimicrobials associated with a high risk of CDI (including clindamycin, co-amoxiclav, cephalosporins and ciprofloxacin, also referred to as the ‘4Cs’). Recently published primary care data shows there has been continued progress towards reduction in the use of the 4Cs, potentially reducing the risk of developing CDI. In 2013, there was a 12.7% reduction in the primary care use of these high-risk antibiotics compared to 2012. There were reductions in use of co-amoxiclav (9.2%), fluoroquinolones (10.1%) and cephalosporins (17.9%), while clindamycin showed no change in 2013. In secondary care, there was a 0.3% increase in use of high-risk antibiotics in 2013. This overall increase in use of 4C antibiotics was driven by a 4.5% increase in co-amoxiclav use, whereas there were reductions in the use of cephalosporins (20.0%) and fluoroquinolones (1.3%).

There may be the potential to reduce the burden of CDI further as a result of decreasing the use of high-risk antibiotics in primary and secondary care through a range of initiatives such as implementation of the Scottish Reduction in Antimicrobial Prescribing (ScRAP) Programme, Scottish Government level three quality indicators on total antimicrobial use in primary care, and application of National Therapeutic Indicators.

CDI in the Community

In March 2013, a one-year sentinel community surveillance programme was initiated by HPS in collaboration with five Scottish NHS boards (representing 36% of all CDI cases reported in Scotland), to help understand the burden of disease and the relationship with the hospital/healthcare setting. NHS boards participating in the study were NHS Ayrshire and Arran, NHS Dumfries and Galloway, NHS Highland, NHS Lanarkshire and NHS Tayside.
Overall, 25.7% of all cases reported during the surveillance period by the participating NHS boards (n=614) were identified as true community-associated cases (CA-CDI) – defined as no previous discharge from a hospital in the 12 weeks preceding CDI diagnosis. This represented an overall CA-CDI incidence rate of 9.9 per 100,000 population per year which is lower than CA-CDI incidence rates reported in the UK previously. This is not surprising given the substantial decrease in CDI incidence rates in Scotland since 2006 within a relatively stable population. Furthermore, the CA-CDI incidence rate reported in this study is counter to the suggestion that CA-CDI is increasing, albeit this was according to a review carried out in 2010.

A high proportion of CDI cases had onset in the community (27.0%) which adds to the burden in this sector. Among the cases with onset in the community, the majority were true CA-CDI (64.5%) whereas 19.3% were healthcare-associated CDI (HA-CDI) cases and the remainder unknown.

In this study, ribotypes 015, 002, 078 and 005 were the most common types isolated from both CA-CDI and HA-CDI cases. These types currently predominate in Scotland (see Table 1) and the results suggest that there are close links between hospital and community CDI.

CDI has mainly been considered an HAI, and most of the interventions, implemented in Scotland and elsewhere to prevent and control the disease, have been focused in the healthcare area. The HPS study showed that a substantial proportion of CDI cases (26%) reported in Scotland are community associated and there is variation among the NHS boards. The sentinel study also highlights the need to examine the feasibility for development of interventions to reduce the burden in the community in addition to hospitals.

Future annual reports will include CDI trends and strain typing data for both community and healthcare settings.

**Outcome of CDI**

National surveillance enables the monitoring of trends in the incidence rates of CDI but does not provide any information on the survival of patients. To improve understanding of CDI mortality trends, CDI case patient data from the national surveillance programme were linked to hospital episode and mortality data between 2009 and 2013 (8323 cases linked in total).

There was a decrease in the number of patients dying within 30 days of diagnosis of CDI (all-cause mortality) from 19.8% to 17.0% between 2009 and 2013, with a year on year decrease in case-fatality of 5.6% (p=0.001). Thirty day survival was much higher in CA-CDI patients at 89.2% survival after 30 days compared to 73.4% in HA-CDI patients. Thirty day mortality was highest among patients with ribotypes 027, 001, 106 and 023, though no association with mortality for any one ribotype was observed.

This study highlights that survival of CDI patients has improved since the introduction of mandatory national surveillance, which may be due to the extensive efforts within NHSScotland to improve CDI patient care through the introduction of tools, policies and guidance including: care bundles, trigger tools, local surveillance, antimicrobial stewardship initiatives and the provision of guidance on prevention and control of CDI in Scotland.

An infographic to accompany *Clostridium difficile* Infection of the HAI Annual Report is available to download.
**Staphylococcus aureus Infection**

*Staphylococcus aureus* (*S. aureus*) is a Gram-positive bacterium that colonises the nasal cavity of about a quarter of the healthy population. This colonisation is usually harmless. However, infection can occur if *S. aureus* breaches the body’s defence systems and can cause a range of illnesses from minor skin infections to serious systemic infections such as bacteraemia. Some strains of *S. aureus* produce toxins or show resistance to first line treatments, which makes them more complicated to treat.

HPS monitor and report on the national incidence of *S. aureus* bacteraemia on a quarterly basis. Toxin producing strains and antimicrobial resistance patterns of *S. aureus* are also monitored and reported on an annual basis.

**Epidemiological Data**

When this bacterium infects the bloodstream, it is known as a bacteraemia. *S. aureus* bacteraemias are serious, often life-threatening infections. Scotland has had a mandatory meticillin resistant *S. aureus* (MRSA) bacteraemia surveillance programme since 2001, that publishes quarterly reports of the numbers and rates of MRSA bacteraemias. In 2006, this programme was extended to include meticillin sensitive *S. aureus* (MSSA) bacteraemias. The Scottish *S. aureus* bacteraemia (SAB) surveillance programme differs from similar programmes in many other countries by including both MRSA and MSSA bacteraemias and also by reporting on all SABs, rather than only those presumed to be associated with delivery of healthcare. Full details of the surveillance methods may be found in the protocol.

There has been a reduction in the overall incidence of SABs in Scotland since 2010 (*p*<0.001) (Figure 6). A total of 1567 cases of SAB were reported in Scotland during 2014; 141 (9.0%) were MRSA bacteraemias and the remaining 1426 (91.0%) were MSSA bacteraemias. Between 2010 and 2014, there has been an overall 14.4% decrease in the annual SAB incidence rate, with a significant year on year reduction of 3.3% (*p*<0.001).

The annual incidence of SAB for Scotland in 2014 was 30.4 per 100 000 acute occupied bed days (AOBDs). This was not significantly different compared to the previous year (*p*=0.55). The annual incidences of MRSA and MSSA bacteraemia in 2014 were 2.7 per 100 000 AOBDs and 27.7 per 100 000 AOBDs, respectively. Neither of these incidence rates had changed significantly between 2013 and 2014 (*p*>0.05).

Figure 7 describes the national incidence rates of MRSA, MSSA and *S. aureus* bacteraemia. The incidence rate of MRSA and MSSA infection has declined at a varying rate over time and now appears to have reached a plateau.
Outcome of SAB

A study linking outcome data (all cause mortality at 30 days) with SAB case data has been completed for all MRSA and MSSA bacteraemias reported by HPS between 2009 and 2013. This showed a year on year significant decrease for MRSA and MSSA case fatality of 9.4% (p=0.02) and 5.4% (p=0.01), respectively. The case fatality for MRSA bacteraemias was 24.6% in 2013 compared to 34.8% in 2009. MSSA bacteraemias case fatality was 19.3% in 2013 compared to 22.3% in 2009.

Survival has improved over the five years and this is thought to be due to a number of quality improvement initiatives across multiple agencies within NHSScotland e.g. Local NHS boards many of whom have initiated root cause analysis for each individual SAB episode; SAPG who have continuously worked in the field of reviewing treatment plans for improved outcomes in patients with S. aureus infections; and the SPSP programme has embedded safe infection control practices.

Antimicrobial Use and Resistance

The antimicrobial resistance (AMR) programme monitors mupirocin use and resistance following implementation of the MRSA screening policy in Scotland. Mupirocin use in both primary and secondary care has generally decreased between 2010 and 2013. (As antimicrobial use data for 2014 are currently incomplete, consumption between 2010 and 2013 is given.)
High level and low level resistance to mupirocin are monitored by HPS, as both are likely to result in treatment failure. The resistance results presented here are only for bacteraemia-related isolates, as submission of *S. aureus* bacteraemia isolates to the Scottish MRSA Reference Laboratory (SMRSARL) is mandatory. During 2014, high level resistance was observed in 2.4% (n=3) of MRSA isolates, with low level resistance in 0.8% (n=1). Decreases in both high level and low level resistance were observed from 2013 to 2014 although only the decrease in HL resistance was significant (Figure 9).
Panton Valentine Leukocidin-positive S. aureus

Panton Valentine Leukocidin (PVL) is a toxin produced by some strains of S. aureus which has the potential to confer a degree of increased virulence. PVL-positive S. aureus are a common cause of skin and soft tissue infections, however, they can occasionally be implicated in more serious conditions such as necrotising pneumonia. The SMRSARL has tested all S. aureus isolates for the presence of the PVL gene since mid-2012. HPS routinely monitors the numbers of PVL positive S. aureus isolates.

In 2014, a total of 307 PVL-positive S. aureus were reported to HPS, the majority of which were MRSA (n=201, 65.5%). More isolates were reported for males (n=159; 51.8%) than females (n=148; 48.2%). The isolates were distributed across numerous specimen sites: wound samples (n=191), while less than 1% of isolates originated from skin swabs (28), 28 were from bloodstream infections and 24 from upper respiratory tract and a range of other specimens. The remaining isolates were from the genitals, eyes, lower respiratory tract and cerebrospinal fluid.

Interventions and Quality Improvement to Reduce S. aureus Infection

Research and Surveillance

HPS, in conjunction with the Infection Control Network, is in the process of a two year project to undertake enhanced SAB surveillance across NHSScotland. The main aim of this project is to further describe the epidemiology of SAB and to use the data to increase the awareness of the clinical risk factors associated with SAB. These data will provide an evidence base for development of healthcare quality improvements and interventions to reduce SAB.

HPS is also participating in a case-control study which has been funded by the Scottish Infection Research Network (SIRN), with colleagues at the University of Glasgow. This study aims to further identify risk factors for patients developing S. aureus bacteraemias in Scotland. This study will lead to a better description of risk factors for SAB.

MRSA Acute Admission Screening in Scotland

The Scottish national MRSA acute hospital admission screening programme identifies patients who are colonised or infected with MRSA and ensures that they are identified early and are managed effectively to prevent transmission of MRSA to other patients. A national MRSA screening policy has been in place in Scotland since March 2012.25 This clinical risk assessment (CRA) based screening policy identifies a subset of patients at high risk of MRSA colonisation or infection on admission to hospital who are then tested for MRSA. This method of screening reduces the number of patients who require to be tested for MRSA and allows high risk patients to be pre-emptively isolated or cohorted whilst the results of the test are awaited.

Compliance with application of the CRA is a level 3 HAI Key Performance Indicator.26 During 2014, 78% of eligible admissions to Scottish acute hospitals were risk assessed in line with
national MRSA screening policy. This was below the KPI of 90% and remains unchanged from 2013. The current screening policy with this level of compliance remains clinically and cost-effective when compared with universal MRSA screening. Nonetheless, improvements are necessary to maximise the number of MRSA positive patients identified on admission to hospital allowing them to be managed appropriately. HPS will continue to work with boards to provide support in facilitating improvement with compliance during 2015/16.

An infographic to accompany *Staphylococcus aureus* Infection of the HAI Annual Report is available to download.
Escherichia coli Bacteraemia

In Scotland, *Escherichia coli* (*E. coli*) is the most common pathogen causing bacteraemia in community and healthcare settings. Bacteraemia develops usually as a complication of other infections, including urinary tract infection (UTI), surgery and use of medical devices including vascular access devices.

**Epidemiological Data**

During 2014, there were 4540 cases of *E. coli* bacteraemia in Scotland compared to 4321 in 2013. The incidence rate increased each year from 69.8 per 100 000 bed days in 2010 to 88.2 per 100 000 bed days in 2014. There was an increasing year on year trend of 6.1% in the incidence rate in this period (p<0.05). The change in the rates between 2013 and 2014 was 4% (p=0.066). The incidence rates per 100 000 population are higher in Scotland than England (who reported an incidence rate of 64.1 per 100,000 population for 2013/14).

Numbers of *E. coli* bacteraemia increased with increasing patient age with the majority of bacteraemia occurring in the older age groups. The incidence rate in those aged 65 and above increased each year from 62.5 per 100 000 bed days in 2010 to 90.9 per 100 000 bed days in 2014. There was an increasing year on year trend of 9.7% in the incidence rate in this five-year period (p<0.05). The change in the rates between 2013 and 2014 was 9% (p=0.001)

More females than males developed *E. coli* bacteraemia over the five-year period, however this is probably due to primary infections (e.g. UTIs) being more common in females.

There is regional variations in *E. coli*. *E. coli* bacteraemia rates between 2013 and 2014 increased in the majority of NHS boards with significant increases in NHS Dumfries and Galloway and NHS Shetland although the clinical significance of these increases is uncertain. *E. coli* bacteraemia rates between 2013 and 2014 in those aged 65 and above increased in nearly all of NHS boards with significant increases in NHS Borders, NHS Lothian and NHS Shetland; again the clinical significance of these increases is uncertain.

Funnel plots are used to identify statistical outliers and compare NHS boards of similar size (Figure 10 & 11); in this case comparing the incidence rates between NHS boards. When including cases of all ages, there were three NHS boards (NHS Borders, NHS Forth Valley, NHS Lanarkshire) identified as outliers (having an incidence rate above the 95% confidence limits) (Figure 10).

In patients aged 65 years and above there were two NHS boards (NHS Forth Valley and NHS Lanarkshire) identified as outliers (Figure 11).
Figure 10: Funnel plot of *E. coli* bacteraemia for Scotland (all ages) by NHS board in 2014.

Figure 11: Funnel plot of *E. coli* bacteraemia for Scotland (aged 65 and above) by NHS board in 2014.
Interventions and Quality Improvement to Reduce *E. coli* Bacteraemia

The current literature suggests that the increase in *E. coli* bacteraemia could be attributed to a number of factors including an older population with an increased number of underlying health issues, advancements in medical invasive procedures (e.g. urinary, intravascular and biliary instrumentation) and increases in resistant strains of *E. coli*. However, several studies have suggested that *E. coli* bacteraemia are not adequately controlled using current infection prevention and control strategies. Other studies have indicated that interventions should focus on the medical devices and improvement in compliance with standard infection prevention and control precautions and not on the specific organisms causing the infections. To this end HPS have the SSI and UTI programmes.

A 3-month pilot study including 8 volunteering NHS boards was reported in 2014 which estimated the burden of *E. coli* bacteraemia; characterised the epidemiology including patient characteristics and risk factors. The pilot study findings have highlighted population characteristics that are associated with patients in NHS Scotland who have an *E. coli* bacteraemia. The majority of patients were elderly with a median age of 74 years, and 60% were female. More than 50% had a urinary tract infection as their primary infection cause (i.e. the infection that is thought to have caused the bacteraemia), and nearly 75% of cases (including 25% associated with receiving healthcare in the community) had acquired the primary infection in the community leading to a bacteraemia. Due to the increasing burden of disease and the findings of this report it was recommended that more detailed epidemiological information should be collected on a routinely basis.

To further identify ways of preventing and controlling *E. coli* bacteraemia further studies required to be conducted. These studies should be focused on prevention and improvement of clinical management of the primary infections (specifically UTI) that occur in the community setting and the devices associated with these.

As the number of *E. coli* bacteraemias continue to rise in Scotland it is crucially important to address the risks associated with the primary *E. coli* infections occurring in community settings. Only this will reduce the occurrence of *E. coli* bacteraemia admissions to secondary healthcare settings.

An infographic to accompany *Escherichia coli* Bacteraemia of the HAI Annual Report is available to download
Urinary Tract Infections

National UTI Programme

Urinary tract infections (UTI) and catheter associated-UTI (CAUTI) are a patient safety concern in acute and non-acute hospitals, care homes and care at home.

In the HAI Point Prevalence Survey 2012, the population at risk were found to be predominantly older people (greater than 75 years) and in care of the elderly and medical specialties within hospitals. Around one in five of these patients had a catheter in-situ at any one point in time (catheters were predominantly found in the medical and surgical specialties). A quarter of the bloodstream infections in hospitals were secondary to a UTI and 14% of antimicrobials prescribed were for a UTI. *E. coli* was found to be a common causative organism for HAI and there were growing antimicrobial resistance concerns which present a threat to treatment and therefore patient safety.

In the intervening period, a number of initiatives have been developed by respective national organisations in response to the emerging threat of HAI UTIs. In response to this, a Scottish UTI Network (SUTIN) has been established with representation across the health and social care settings in Scotland. The aim of this network is to achieve a strategically joined-up approach to all strands of UTI reduction work across Scotland; including surveillance, guidance and improvement initiatives, education and training, and research. An initial meeting of the SUTIN took place on 5th March 2015 with future meetings planned to take place on a quarterly basis.

UTI AMR Surveillance

National surveillance of antimicrobial resistance in Scotland is generally focused around bloodstream infections as this is the most consistently tested and reported type of infection due to its clinical importance. However an earlier indication of emerging resistance may be obtained from surveying organisms from other body sites other than the bloodstream. In particular urinary isolates are likely to reflect resistance to commonly prescribed oral antimicrobials in hospitals and the community.

AMR in urinary pathogens is increasing worldwide. In 2012, surveillance of AMR in a representative sample of all urinary isolates was introduced in Scotland in order to detect the emergence, cause and spread of resistance. To date, 53,350 reports have been received from 13 NHS boards. *E. coli* accounted for the majority of the reports (70.4%) and the numbers reported have remained high throughout the surveillance period.

Resistance to the majority of antimicrobials tested increased from 2012 to 2013 (resistance data is not yet available for 2014).

Antimicrobial resistance profiles among *E. coli* urine isolates (Table 2) were similar to those observed in *E. coli* bacteraemia, but while trends were mostly stable in the bacteraemias increasing trends in resistance were observed among the urinary isolates, including increases
in resistance to third generation cephalosporins (ceftaxime from 8.2% to 9.6%) and carbapenems (ertapenem from 0.1% to 0.2%, and meropenem from 0% to 0.03%) from 2012 to 2013. The increase in resistance among *E. coli* urinary isolates is of particular concern as this could be an early indication of evolution of resistance in a range of other organisms and isolate types.

Among *K. pneumoniae* urinary isolates there were no significant changes (Table 3), although resistance to nitrofurantoin (32.1%), trimethoprim (36.0%), the cephalosporins (ceftaxime 13.7%) and fluoroquinolones (ciprofloxacin 10.0%) remains high.

Table 2: Resistance (%) in *E. coli* urinary isolates from 2012 and 2013.

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<tr>
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<td>% resistant</td>
<td>Number tested</td>
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Table 3: Resistance (%) in *K. pneumoniae* urinary isolates from 2012 and 2013.

<table>
<thead>
<tr>
<th>Antimicrobial</th>
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<th></th>
<th>2013</th>
<th></th>
<th>Statistical significance of % change</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td>Number tested</td>
<td>% resistant</td>
<td>Number tested</td>
<td></td>
</tr>
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</table>
UTIs are a common reason for consultation within primary care and, after respiratory tract infection, are the second most common indication for empirical antibiotic use in primary care. Trimethoprim and nitrofurantoin are recommended for the empirical treatment of UTI. In 2013, there were increases in trimethoprim use in primary (1.6%) and secondary care (1.1%). Similarly, there were increases in nitrofurantoin use in primary (11.1%) and secondary care (3.5%) in 2013. In both cases, the increases continue the upward trend observed in previous years. These increases are likely to reflect the ongoing initiatives to increase compliance with local prescribing guidelines.

National guidelines state that non-pregnant women of all ages with signs and symptoms of acute lower UTI should be treated empirically with trimethoprim or nitrofurantoin for three days. The number of prescriptions with a three-day duration as a proportion of total prescriptions of trimethoprim or nitrofurantoin may be a useful measure of prescribing quality in UTI in adult females. To support NHS boards, this information is available as standard reports within the Prescribing Information System (PIS) maintained by Information Services Division (ISD). In 2013-14, the use of three-day duration trimethoprim as a proportion of all trimethoprim use increased by 2.4% from 2012-13. Three-day courses represented 60.0% of all trimethoprim items in 2013-14. Use of three-day nitrofurantoin as a proportion of all nitrofurantoin items increased by 4.5% from 2012-13 to 2013-14. Three-day courses represented 29.3% of all nitrofurantoin items for adult females.

An infographic to accompany Urinary Tract Infection of the HAI Annual Report is available to download.
Carbapenemase-producing Bacteria

Multidrug resistance among Gram-negative bacteria has been increasingly reported in the last ten years and continues to be a major threat to both public health and patient safety. The emergence of carbapenemase-producing bacteria is of particular concern as it leaves very few therapeutic options for infections with these types of bacteria.

Carbapenemase-producing Enterobacteriaceae (CPEs) have been reported worldwide in both healthcare and community settings and are mainly attributable to the acquisition of carbapenemase genes and the dissemination of successful clones. Increased intercontinental travel has contributed to the spread of CPEs. The detection of these isolates is necessary for the prevention of spread of CPEs.

In Scotland, a total of 26 carbapenemase producing Gram-negative organisms (including Enterobacteriaceae and non-fermenters) were reported from the Antimicrobial Resistance and Healthcare Associated Infections (AMRHAI) Reference Unit Public Health England (PHE) in 2014, which was at the same level as 2013 (Figure 12). The stable numbers of carbapenemase producers is reassuring especially in the light of a substantial quarterly increase in recent submissions to the AMRHAI Reference Unit for carbapenemase identification and typing as a result of increased awareness among the Scottish diagnostic laboratories. However, there could still be under-ascertainment. Although spread of Klebsiella pneumoniae carbapenemase (KPC)-producing clones of K. pneumoniae (ST258) has been reported world-wide, often in association with spread in healthcare settings, this organism was only detected once in Scotland in 2014.

New Delhi metallo-beta-lactamase (NDM)-producers were reported on eight occasions in 2014, including E. coli (n=5), Enterobacter cloacae complex (n=1), K. pneumoniae (n=1) and Proteus mirabilis (n=1), with all but two detected in urinary isolates.

NDM is disseminated via conjugative plasmids that can be exchanged between different bacterial species often within the Gram-negative gut flora of persons both in the community and healthcare settings, and can therefore spread via multiple routes. There have been instances where E. coli NDM-producers have been detected in the community in Scotland. On these occasions, there was no history of travel however healthcare had been administered. The occurrence of these isolates in the community is concerning. There have been reports of non-travel related community NDM-producers throughout the world however this still remains a rare event.

Rapid identification of colonised or infected patients is essential and screening of carriers should be implemented to prevent an epidemic situation from developing. According to previous reports, NDM-producers have been reported more frequently in the UK than in the rest of Europe, but this may partly be due to under-ascertainment in some countries.

Epidemiological stages, ranging from sporadic to endemic spread of carbapenemase producers, are used to compare the spread of carbapenemase producers in European countries. In the previous AMR annual report (for 2012), the spread of carbapenemase producers in Scotland was reported as sporadic. However, two incidents of local spread
have now been reported to HPS and possible links between different NHS boards have been suggested, which results in Scotland now being reported as a country with ‘regional spread’ similar to the situation in England.

Due to the recent developments in the epidemiology the need for collecting more robust and detailed information on individual cases and incidents has been identified. Different options for collecting detailed patient-level information relating to all identified (or suspected) carbapenemase producers are currently being explored in Scotland and wider in the UK.

In 2013, a joint Chief Medical Officer (CMO)/Chief Nursing Officer (CNO)/Chief Pharmacy Officer (CPO) letter described the emerging threat from CPE and the requirements for an acute hospital admission screening programme for CPE. The two step clinical risk assessment based screening policy identifies a subset of patients at high risk of CPE colonisation who are then tested for CPE. Identification of patients who are colonised with CPE or have a high risk of colonisation on admission to hospital and their appropriate management is an essential contribution to preventing the spread of CPE in Scottish hospitals.

HPS is supporting boards to implement CPE screening using intelligence gathered following the successful roll out of MRSA screening in 2012. Standardised national staff and patient information leaflets on CPE screening and an educational resource will be developed to support frontline staff and ensure patients can make informed decisions about giving consent to screening.

A review of new published evidence on CPE epidemiology, screening and testing will be undertaken in 2015/16 and will inform a review of the Interim Guidance for Non-prescribing Control Measures to Prevent the Cross Transmission of CPE in Acute Settings. A research study to understand the barriers and drivers to the implementation of acute hospital admission screening and staff and patient acceptability study for acute hospital admission screening for CPE will also inform the review of the guidance ensuring that all existing and future HAI screening programmes are based on best available evidence.

Figure 12: Carbapenemase producers reported in Scotland by AMRHAI (PHE).
Carbapenems are used almost exclusively in the hospital setting for the treatment of suspected or confirmed multi-resistant Gram-negative infections. Due to the lack of new antibacterials under development they are considered to be a critically important group of agents whose effectiveness must be preserved. The Scottish Antimicrobial Prescribing Group has developed guidance to support Antimicrobial Management Teams (AMTs) through recommendations for empirical and targeted use of alternative antibacterials, to reduce the use of and thereby preserve the effectiveness of carbapenems.

In 2013, the use of carbapenems was 2.2% higher than in 2012. Although this continues the upward trend observed in previous years the increase in 2013 was lower than in the any of the previous three years. There was a steady increase in use up to a peak in quarter four 2012 after which there was a trend toward a reduction in use. It remains to be seen whether this is the start of a sustained reduction in use of carbapenems. 2014 data are due to be published in Quarter three, 2015.

An infographic to accompany Carbapenemase-producing bacteria of the HAI Annual Report is available to download
Norovirus Outbreaks

Norovirus, like influenza, comes every year at winter time. There is no lasting immunity following norovirus infection so every year everyone is vulnerable to this infection. As norovirus spreads very easily there is a risk of outbreaks in all places where there are shared living spaces, e.g. hospitals and care homes. When norovirus is detected in more than one patient in a hospital ward, a bay or even the whole ward itself may be closed to minimise transmission. As a consequence, hospital outbreaks result in inconvenience and suffering to patients and can significantly disrupt the smooth running of services.

All NHS boards in Scotland take part in an annual review of the norovirus season to identify and share lessons learned and to enhance preparedness for the next season.

Epidemiology Data

As norovirus peaks during the winter months the chart measures norovirus from mid-year to mid-year (week 27 to week 26). Figure 13 presents the data for norovirus for each season from week 1, 2008 to week 1, 2015.

What can be seen for the current season is that the impact of norovirus as measured by ward closures was much lower than in any previous season. Some of this may be the result of the preparedness and response activity in NHS boards, but undoubtedly some will be due to the lower virulence of the circulating virus.

Figure 13: Wards closed in NHS Scotland due to presumed or confirmed norovirus 2008 to 2014 by season (week 27 - week 26).

All the HPS norovirus materials (including the updated guidance) are available from the norovirus page [http://www.hps.scot.nhs.uk/giz/norovirus.aspx](http://www.hps.scot.nhs.uk/giz/norovirus.aspx)
Interventions and Quality Improvement to Control Norovirus

During 2014 HPS, in partnership with Health Scotland, produced the Norovirus ‘Stay at Home Campaign’ in preparation for the norovirus season. A digital social media toolkit sent to NHS boards included prepared tweets, tweet posters and other materials that can be used throughout the season to remind the general public about the importance of norovirus and of staying away from care facilities when they have symptoms and for 48 hours after last symptoms.

An infographic to accompany Norovirus of the HAI Annual Report is available to download
Hospital HAI Outbreaks

Hospital outbreaks are reported to HPS for expert advice and/or as part of the Hospital Infection Incident Assessment Tool (HIIAT) reporting system.\(^{39}\) HIIAT reporting is triggered when outbreaks and incidents are assessed as being either amber or red. However, the outbreak programme of work at HPS is about more than just reporting and supporting incidents and outbreaks. The information received is assessed and considered as part of an overarching programme that has a goal of supporting NHSScotland to achieve optimal outbreak prevention, preparedness, detection and management. To achieve this goal it is essential that lessons are learned from previous outbreaks, i.e. from the epidemiology of outbreaks (which organisms are causing which outbreaks in what clinical areas) as well as the outbreak provoking conditions that gave rise to the outbreak. Sharing the lessons learned throughout NHSScotland is central to attaining effective prevention. In addition, to optimise preparedness, HPS alerts NHSScotland as to what outbreaks are arising in other NHS boards.

This section of the annual report provides an overview of the epidemiology of outbreaks that have been reported to HPS and the activity to support prevention, preparedness, detection and management in 2014.

HAI Outbreaks and Incidents in Scotland (Non-Norovirus) in 2014

In 2014 a total of 49 outbreaks and incidents were reported, of which 12 were HIIAT red, 21 were HIIAT amber and 13 HIIAT green (three had no HIIAT completed). This is a similar number to 2013.

Figure 14 shows the most common outbreaks reported to HPS during 2014. The most common types of infections caused in these outbreaks were gastrointestinal infections (n=16), and respiratory infections (n=10). For the respiratory outbreaks there were nine different clinical settings involved. Medical/Care of the Elderly units were involved in six of the gastrointestinal infections and the remaining ten were all from different areas.
Prevention, Preparedness Detection & Management (Outbreak PPDM)

To help NHSScotland learn lessons and optimise outbreak PPDM, a variety of activities are ongoing. Below are some examples.

**Prevention:** Outbreak prevention is improved by sharing intelligence on when, where and how outbreaks are arising in Scotland and beyond. HPS produces and disseminates a quarterly Current and Emerging Threats Assessment report.

**Preparedness:** Is supported by having tools ready for outbreaks that may arise and informing people how best to use them. In 2014, two crib cards were produced for outbreaks that rarely happen, but for which preparedness is essential, i.e. *Aspergillus* and *Bacillus* species.40,41 HPS continues to work with National Education for Scotland (NES) on projects to provide outbreak training.

**Detection:** To support detection in 2014 HPS updated guidance on local surveillance which included an alert organism list specifying which organisms should be monitored for early detection of an outbreak.42

**Management:** Tools produced to aid in the management of outbreaks in 2014 included: An updated Generic Trigger Tool,43 a Group A *Streptococcus* Trigger Tool44 as well as guidance on respiratory outbreaks which are available for testing over the winter period.

In 2015, webinars on outbreak lessons learned will commence and the Current and Emerging Threats report will include a section on lessons learned.

The tools that are available for using during outbreaks are available at [http://www.hps.scot.nhs.uk/haiic/ic/toolkits.aspx](http://www.hps.scot.nhs.uk/haiic/ic/toolkits.aspx)

An infographic to accompany [Hospital HAI outbreaks](#) of the HAI Annual Report is available to download.
Ebola Response

In August 2014, the World Health Organisation (WHO) declared the outbreak of Ebola in West Africa to be a public health emergency of international concern, necessitating an international response and global preparedness planning. HPS played a key role in preparedness for the possibility of an Ebola case in Scotland, and in supporting boards and wider stakeholders in their increased need for infection control support.

The priority of the HPS ICT in the rapidly developing outbreak situation in West Africa was to ensure that there was up-to-date, evidence-based guidance for Scotland, clearly outlining the infection prevention and control precautions that must be implemented in addition to Standard Infection Control Precautions (SICPs), when caring for a person with suspected or confirmed Ebola virus disease. As such, Ebola-specific infection prevention and control guidance for both hospital and primary care settings was developed and published in September 2014.

An integral part of Ebola preparedness for Scotland was the availability of an adequate supply of appropriate personal protective equipment (PPE). The HPS ICT worked with colleagues from National Procurement (NP) to develop guidance, published in September 2014, outlining the required PPE product specifications and recommended purchasing volumes to support healthcare facilities in their preparedness activities.

The increased demand for PPE, particularly coveralls, due to global Ebola preparedness activities required a coordinated effort to ensure there was an adequate supply for NHSScotland. The HPS ICT worked closely with colleagues from the Scottish Government and PHE to secure a central stockpile of coveralls, which were made available to NHS boards as required.

PPE which is appropriate for caring for a patient with Ebola virus disease is not routinely used by healthcare workers, creating a requirement to support healthcare workers’ training needs. The HPS ICT collaborated with colleagues at NES and NHS Greater Glasgow and Clyde to develop a short educational film demonstrating the correct order for donning, removal and disposal of PPE in the context of caring for a patient with Ebola or other viral haemorrhagic fever. This was made available in October 2014.

The HPS ICT also responded to the significantly increased number of enquiries from boards and wider stakeholders generated as a result of the Ebola outbreak in West Africa. During the peak period of enquiries, a dedicated Ebola enquiries telephone number and mailbox were set up to facilitate timely and efficient responses, and a document outlining the answers to frequently asked questions was disseminated to relevant stakeholders, including infection prevention and control teams and health protection teams, on a weekly basis.

HPS contribution to Ebola preparedness was significant. This earned a commendation from Shona Robison, the Cabinet Secretary for Health, Wellbeing and Sport.

Hand Hygiene

NHS board hand hygiene data collection and monitoring concluded on 25th September 2013 with publication of the final bi-monthly hand hygiene report. Since 1st October 2013 individual NHS boards have been monitoring and reporting local hand hygiene compliance data via the healthcare associated infection – outbreak reporting template (HAI-ORT).

In 2014, HPS ICT collaborated with colleagues in National Procurement (NP) to develop a commodity indicator for hand hygiene product consumption that could be used nationally as a baseline proxy indicator for hand hygiene compliance within NHSScotland. The hand hygiene products used to provide this baseline data were alcohol based hand rubs (ABHR) and soap products. Using ABHR consumption data as a proxy measure for hand hygiene is supported in the literature and is undertaken in many European countries.\textsuperscript{45,46}

This work is still in the early stages; however NP has provided HPS with an ‘ABHR dashboard’ which shows the average consumption of ABHR across NHS boards. This dashboard can be provided to individual boards and in the future could be used to give a board wide picture of all products procured via NP. This would allow boards to monitor their expenditure and consumption of nationally procured products. This could also be of benefit at a national level enabling assessment of care products in use across NHSScotland.

HPS and NP will continue to supplement this work, refining the scope of the project to deliver a proxy measure for hand hygiene compliance by 2015/16.

HPS has worked in partnership with key stakeholders to sustain improvements in hand hygiene and highlight importance of these IPC measure. In the last year activities have included collaborating on a Guinness World Record attempt for the biggest simultaneous hand hygiene lesson involving 5400 pupils from 62 primary schools in Glasgow.

In partnership with GCU we contributed to a research study funded by SIRN on the best technique for ABHR hygiene.

An infographic to accompany Hand Hygiene of the HAI Annual Report is available to download
Development of Guidance

Infection prevention and control is a constantly changing field dealing with current and emerging threats. Standard Infection Control Precautions (SICPs) and Transmission Based Precautions (TBPs) help prevent HAIs occurring, and enable preparation for emerging threats and multi-drug resistant organisms. Infection prevention and control is an essential part of the infrastructure of healthcare in keeping patients, staff and visitors safe. However, inconsistent implementation of SICPs continues to be reported in hospitals across Scotland.¹⁷


The National Manual is an evidence-based practice guide intended for use by frontline healthcare staff supported when necessary by specialist infection prevention and control teams and health protection teams. The National Manual is mandatory for NHSScotland under the auspices of two letters from the CNO.⁴⁸⁴⁹

Chapter 1 of the National Manual: Standard Infection Control Precautions (SICPs) was published in January 2012 followed by Chapter 2: Transmission Based Precautions (TBPs) in April 2014.

A campaign to promote SICPs was launched by the Scottish Government in May 2014. The campaign features the slogan ‘The 10 must dos to prevent infection’, as well as graphics representing the ten elements of SICPs. Campaign materials, including posters and credit card sized handy reminder cards, were distributed to healthcare facilities across Scotland. Electronic versions of the campaign materials are available to download from the HPS website, and are intended for use in health and care settings to promote SICPs implementation.

A new section on infection prevention and control during care of the deceased has recently been added to the chapter on TBPs. This new section is based on a comprehensive review of the scientific evidence undertaken in 2014 and was developed in conjunction with an expert steering group that includes stakeholders from health and social care settings across Scotland.

Healthcare workers may be exposed to airborne pathogens in the course of their work, and it is crucial that they wear appropriate respiratory protective equipment (RPE) to protect themselves from the risk of infection. Chapter 2 of the National Manual outlines recommendations on the use of RPE, including filtering face piece (FFP3) respirators.

Following on from an open forum in 2013 with the Health and Safety Executive to discuss the challenges around the use of RPE in NHS Scotland, HPS continues to work closely with colleagues in health boards, NHS National Procurement and Scottish Government to ensure that suitable RPE is available for healthcare workers across NHS Scotland, and to address some of the key barriers to its use. This includes work to align the FFP3 respirators in the national pandemic stockpile with those used locally in health boards.
Supporting Tools

In 2012 HPS produced the quality improvement data collection tool to support SICPs implementation at a local level. This tool can be used by staff in any healthcare environment to assess compliance with the 10 SICPs elements, identify critical elements that are in need of improvement and identify system changes that can help the clinical team ensure SICPs compliance within their respective care area. In late 2014, HPS developed a similar tool for TBPs. A patient placement risk assessment tool incorporating TBPs is now available.

Posters on contact, droplet and airborne precautions have been developed in collaboration with colleagues from the Scottish Infection Control Network. The posters are intended to be used, where appropriate, to remind frontline healthcare staff of the infection prevention and control precautions they must follow when caring for patients with a suspected or known infection.


An external evaluation of Chapters 1 and 2 of the National Infection Prevention and Control Manual will be undertaken in 2015-2016. The evaluation is intended to determine the applicability and utility of the National Manual for staff across health and social care services in Scotland and to evaluate implementation. The outcomes of this evaluation will be used to inform future development of the manual and identify areas for improvement.


National Infection Prevention and Control Manual Website

Frontline NHS staff were the initial users of the National Manual, but the changing nature of healthcare delivery and the integration of health and social care have opened it up to a more diverse audience.

To ensure that the National Manual is accessible for this more diverse user base, work is underway to create a separate website to make it easier to find information and resources. The new website will have its own identity and will mirror the current chapter structure of the National Manual. It will contain the literature reviews, appendices, supporting tools and resources. The website will be accessible by mobile devices, e.g. smartphones and tablets, to reflect the variety of ways that information is now accessed.

The development of this new website will be managed by the National Manual Steering Group to ensure that it is suitable for all user groups. The website will be an evolving resource, taking user feedback into account and providing new information on infection prevention and control.
HAI Compendium of Guidance

The HAI Compendium provides a single location to easily access all guidance and supporting materials relevant to infection prevention and control in Scotland. The Compendium is updated whenever new guidance and supporting materials are published. Changes made to each version are listed in the front of the Compendium making it easy for users to identify new publications, and publications are listed by date order with the most recent displayed first.

In 2014 new guidance and materials on Ebola were published by HPS and these were added to the Compendium. These included the following:

- Viral haemorrhagic fever (VHF) infection prevention and control precautions summary for the hospital setting.
- Advice for purchase of required PPE for VHF preparedness.
- Summary of VHF precautions for general practitioners in Scotland.

Following the annual review of the norovirus season for 2013-2014 the following updated documents were added to the Compendium in September 2014:

- Norovirus outbreak guidance 2014: preparedness, control measures and practical considerations for optimal patient safety and service continuity in hospitals.
- General information and infection prevention and control precautions to prepare for and manage norovirus in care homes.

Quality Improvement Tools

HAI quality improvement tools (QITs) contain a number of evidence-based interventions that can be used in healthcare settings across NHSScotland to support organisations in reducing HAI and improving patient outcomes.

In 2014 the following QITs were updated:

- Preventing contamination when taking a blood sample for culture.
- Preventing catheter associated urinary tract infections (CAUTI) – acute.
- Preventing catheter associated urinary tract infections (CAUTI) – community.
- Preventing infections when inserting and maintaining central vascular catheters (CVC).
- Preventing infections when inserting and maintaining peripheral vascular catheters (PVC).
- Preventing surgical site infection (SSI).

These are available to view at: http://www.hps.scot.nhs.uk/haiic/ic/qualityimprovement.aspx
All QITs recommending the use of antiseptics such as chlorhexidine gluconate in 70% isopropyl alcohol now state that these products should be ‘single-use’. These are strong recommendations based on high to moderate quality evidence. Following a review, it is now recommended that a chlorhexidine-impregnated sponge is considered when inserting CVCs.

From 2015 the evidence base for all HPS QITs will be monitored routinely, ensuring that the recommendations are based on the most up-to-date evidence available.

An infographic to accompany Development of Guidance of the HAI Annual Report is available to download.
Decontamination

Decontamination is a term which includes cleaning, disinfection and sterilisation. Decontamination is undertaken to reduce the risk of infections associated with the healthcare environment and equipment e.g. reusable medical devices and communal reusable patient care equipment. Whilst there is no definitive method of assessing the quantitative impact decontamination failures may have on HAIs, outbreak intelligence and the scientific literature have highlighted the importance of decontamination in reducing the risk of HAI.

HPS provides expert advice related to the public health, infection control, clinical and scientific aspects of decontamination and works in partnership with Health Facilities Scotland to deliver the NHSScotland decontamination agenda.

Endoscope and Surgical Instrument Incident Surveillance

A pilot study of surgical instrument decontamination in theatre and decontamination units in two NHS boards was undertaken by HPS in January and February 2014 to identify the data available on decontamination failures. The results of this study have highlighted the challenges associated with initiating new national surveillance in this area. Based on the results from this pilot study, the expert advisory steering group agreed that the implementation of national surveillance would not be cost effective and developing a national minimum dataset that can be managed locally would be more efficient. Further work on the development and implementation of this dataset will continue into 2015.

A literature review looking at the harms associated with unsuccessful or inappropriate decontamination of reusable surgical instruments and endoscopes has been undertaken. The results have informed the development of the minimum dataset and a new data linkage exercise to identify infection risks associated with endoscopy procedures.

A short life working group will be established in 2015 to review the findings from the literature review and data linkage and develop clinical recommendations for the management of endoscopy final rinse water testing.

Decontamination of Reusable Non-Invasive Patient Care Equipment (Communal Equipment)

An A to Z template for the decontamination of reusable patient care equipment was published on the HPS website in March 2014. This template allows local adaptation by boards to include relevant items of equipment and allocation of responsibilities.
Compliance Monitoring of Communal Reusable Patient Care Equipment

The Healthcare Environment Inspectorate (HEI) reports have highlighted ongoing decontamination issues relating to beds, mattresses, bedrails, bed controls and trolleys. Other items of patient equipment such as fans, IV stands and blood pressure monitors have also had decontamination issues reported, available from: http://www.healthcareimprovementscotland.org/programmes/inspecting_and_regulating_care/environment_inspectorate_hei/hei_reports.aspx. The National Infection Prevention and Control Manual includes equipment and the environment within their compliance monitoring tool, however this tool focuses on the process, i.e. whether staff clean appropriately rather than the outcome, i.e. a visual inspection of the equipment. To address this a tool devised for senior charge nurses (SCNs) to inspect items of equipment and areas of the environment has been piloted in five NHS boards. The pilot study and monitoring tool are available from: http://www.documents.hps.scot.nhs.uk/hai/decontamination/publications/compliance-summary-2015-04.pdf and http://www.hps.scot.nhs.uk/pubs/Publication_Detail.aspx.

Bed Space Cleaning: Time to Clean

HPS held a series of focus groups with senior charge nurses between 2012 and 2014 to evaluate the barriers to undertaking effective decontamination. Equipment cleaning was identified as being labour intensive and requiring resources that have not been quantified within workforce planning tools. As medical treatment and care has evolved there has been an increase in the amount of equipment used, however the frequency of decontamination and resource required to ensure that equipment remains clean and safe for use has not been taken into account.

The two key barriers consistently identified by the SCNs in the focus groups were:

- insufficient time to clean communal reusable patient care equipment between use;
- insufficient time to adequately decontaminate discharge or transfer beds between patients.

There is no published literature demonstrating the time required by nursing staff to clean a bed space. HPS carried out a study in five NHSScotland boards from July to November 2014 and concluded that the mean time to clean a general bed space following discharge of a patient across medical and surgical wards was 40 minutes. In specialty areas such as renal or neonatal units the mean time was 60 minutes. This report is available from: http://www.documents.hps.scot.nhs.uk/hai/decontamination/publications/bedspace-time-2015-03.pdf.

Alternative Approaches to Equipment and Environmental Decontamination

The predominant approach to equipment and environmental decontamination across NHSScotland is to use domestic and nursing staff from core funded resources, however some alternative approaches are also being used. In 2014, HPS started reviewing the alternative
approaches to equipment and environmental decontamination used across the UK in an attempt to identify suitable alternative approaches to pilot in NHSScotland. This is due to be completed in mid 2015.

**Environment and equipment decontamination**

HPS has carried out literature reviews to identify existing evidence for the following:

- existing and emerging technologies for environmental decontamination. These technologies include microfibre, steam, ultraviolet light, electrolysed water and hydrogen peroxide,
- isolation, cohort and terminal cleans.

The findings from these reviews and recommendations for practice will be considered by the equipment and environment decontamination steering group prior to wider dissemination. The literature reviews and recommendations will be published in 2015.

The next group of technologies to be reviewed in 2015/2016 include ozone, antimicrobial copper and silver, high intensity narrow spectrum (HINS) light, chlorine dioxide, wipes and bioluminescence to assess effectiveness of cleaning using adenosine triphosphate (ATP).

An infographic to accompany Decontamination of the HAI Annual Report is available to download
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