HPS Quarterly Epidemiological Commentary for the Surveillance of Healthcare Associated Infections in Scotland

Methods and Caveats

This document outlines the methodologies for each of the surveillance programmes that are included in the Quarterly Epidemiological Commentary.

The surveillance systems currently included in the commentary are:

- *Clostridioides difficile* infection (CDI)
- *Escherichia coli* bacteraemia (ECB)
- *Staphylococcus aureus* bacteraemia (SAB)
- Surgical site infection (SSI)

Assignment of cases to healthcare / community categories (excluding SSI)

In the Quarterly Epidemiological Commentaries, HPS report on two categories of cases with CDI, ECB and SAB:

- Healthcare associated infection reported by the NHS board of sample collection, or if this is not available, the NHS board of laboratory.
- Community associated infection by NHS board of residence for the case. This is where the case does not fulfil any of the criteria for a healthcare associated bloodstream infection as per protocol definitions. If the case is not a resident of Scotland, the NHS board of laboratory is used.

The assignment of cases to each category is described in the table in Appendix 1.

Calculation of incidence rates

Incidence rates of CDI or ECB or SAB are presented by NHS board and National level.

CDI or ECB or SAB Healthcare associated cases

The incidence rate of CDI or ECB or SAB per NHS board area for healthcare associated infection cases is calculated as follows:

Rate per 100,000 total occupied bed days (TOBDs) =

(Number of CDI or ECB or SAB healthcare associated infection cases / TOBDs in board area) x 100,000

The denominator for healthcare associated infection cases is 'total occupied bed days (TOBDs)' using ISDS1 data.

- The most recently available TOBDs data from the Information Services Division (ISD) is used to calculate the healthcare associated rates included in the report.
- The TOBDs data are updated for the last 12 quarters during each reporting cycle.

Full description of the ISDS1 data collection is available at: http://www.isdscotland.org/Products-and-Services/Data-Support-and-Monitoring/ISDS1/

CDI or ECB or SAB Community associated cases

The incidence rate of CDI or ECB or SAB per NHS board area for community associated cases is calculated as follows:

Rate per 100,000 population =

(Number of CDI or ECB or SAB community associated infection cases / mid-year Scottish population) x (number of days in year / number of days in period) x 100,000

The denominator for CDI or ECB or SAB community cases is 'National Records of Scotland (NRS) mid-year population estimates'.

- The most recently available population denominator from the National Records of Scotland website is used to calculate the community associated rates included in the report.
- As NRS population data is one year in arrears, 2017 population data is used for 2018 case data.
- The population estimate data is updated in the Excel appendix file for the previous year when the new population estimate becomes available (e.g. 2018 case data will be updated once the 2018 population estimate is published in April 2019).
- The number of days in the period and year are used within the rate to calculate an annualised population for quarterly data, so that quarterly rates and yearly rates are comparable.

Full description of the (NRS) population estimates data collection is available at: https://www.nrscotland.gov.uk/statistics-and-data/statistics/statistics-by-theme/population/population-estimates/mid-year-population-estimates

SSI Incidence

The cumulative incidence of SSI by category per NHS board is calculated as follows:

Incidence per 100 operations =

(Number of SSIs / number of procedures) x 100

Denominator for SSI incidence for each category is the total number of procedures under surveillance performed in a quarter per NHS board.

Interpretation of the Quarterly Epidemiological Commentary results

Although multiple surveillance programmes are included in the Quarterly Epidemiological Commentary the type of analysis applied to each is the same.

Quarterly and annual comparison of rates

Rates are compared quarterly at a national level only. Numbers at health board level by quarter are not robust enough to do quarterly comparisons. The current quarter is compared with the previous quarter using rate ratios and statistical significance is reported.

Rates are compared annually at national and health board level. The year ending the current quarter is compared with the previous year using rate ratios, and statistical significance is reported.

Quarterly SPC charts

National and health board level data for the last 3 years (12 quarters) are presented as u-charts (SAB, CDI, ECB rates) and p-charts (SSI). The mean, Trigger/warning lines (+2 standard deviations) and upper control limits (+3 standard deviations) presented, are calculated using the 12 quarters prior to the most recent quarter, as to compare the new rate against an existing baseline. Incidence rates for the current quarter that are above the 3rd standard deviation upper warning limit are considered exceptions. Further information on SPC charts can be found at: http://www.isdscotland.org/Health-Topics/Quality-Indicators/Statistical-Process-Control/

Funnel plot analysis

Funnel plots are presented for the current quarter. Funnel plots are a type of control chart in which the observed event (rates of cases) is plotted against a measure of its precision (total occupied bed days, population or number of procedures). The statistical analysis for SAB, CDI and ECB is based on an over-dispersed Poisson regression model with the logarithm of the total occupied bed days/population as an offset. The statistical analysis for SSI is based on an over-dispersed Binomial regression model with the logarithm of the number of procedures as an offset. In the funnel plot, the incidence rates are plotted against the number of bed days/population/number of procedures along with 95% confidence limits and a central line denoting the average rate. Incidence rates outside of the 95% confidence limits are considered exceptions.

General Caveats

a) Regional differences in healthcare provision and the age distribution of the population are factors likely to affect the number of persons acquiring CDI/ECB/SAB/SSI in each NHS board area.

b) The quarterly data produced by HPS are based on the currently available data for both bed occupancy and incidence. These data are subject to revision as additional information may become available at a later time. Therefore there may occasionally be minor numeric discrepancies between reports, reflecting the availability of such updated data.

c) Small numbers should be interpreted with caution.

d) No surveillance programme can have complete sensitivity (the ability to identify all true cases) or specificity (the ability to ensure all cases identified are true).

e) The need for consistency in a surveillance programme requires that some accuracy is sacrificed for the sake of consistency.

f) As a result of denominator changes, earlier published reports are not comparable with data published after Quarter 1 2017. Please refer to the HPS website for the most up-to-date data.

Clostridioides difficile infection (CDI)

Case definition

A case of CDI is someone in whose stool *C. difficile* toxin has been identified at the same time as they have experienced diarrhoea not attributable to any other cause, or from whose stool *C. difficile* has been cultured at the same time as they have been diagnosed with pseudomembranous colitis (PMC).

De-duplication procedure

Only persons that have not been diagnosed with CDI within the previous 28 days are counted as new cases. It is important that laboratories submit all toxin positive cases to HPS since all results are used to calculate the gap between two positive tests. De-duplication is carried out on a continuous basis and includes comparing duplicates across different quarters.

Surveillance protocol

Full details of methods and definitions for the surveillance can be found here: http://www.hps.scot.nhs.uk/haiic/sshaip/resourcedetail.aspx?id=678

Caveats

a) Data linkage between CDI surveillance data and the Scottish Morbidity Records (SMR01) is used to identify community and healthcare associated CDI cases. Some forms of interaction with the healthcare system may not be captured by linkage, and therefore the number of healthcare associated CDI cases may be underestimated. Furthermore, delays in SMR01 data availability at the time of report production means that some cases may be reassigned as either healthcare associated or community associated CDI at a later date. Not all cases may be successfully data linked in any one quarter. Therefore the sum total of the healthcare and community CDI cases may not equal the total number of CDI cases reported to HPS.

b) For the snapshot programme, laboratory issues may result in some sampling bias between laboratories.

Escherichia coli bacteraemia (ECB)

Case definition

A case of bacteraemia is a patient from whom *E. coli* has been isolated from the patient's blood, and who has not previously had the same organism isolated from blood within the same 14 day period (i.e. 14 days from date last positive sample obtained).

Definition notes

This surveillance includes all laboratory reported cases except –

- Pathology reports
- *E. coli* O157 or other serotype samples

The following blood specimens are excluded from the surveillance –

- Post mortem blood
- Clotted blood
- Plasma Serum
- Ascitic fluid

Surveillance protocol

Only cases of ECB that have been reviewed and confirmed by the NHS boards in the enhanced surveillance system are included in the quarterly commentaries.

Full details for the surveillance can be found here – https://www.hps.scot.nhs.uk/web-resources-container/protocol-for-national-enhanced-surveillance-of-bacteraemia/

Caveats

a) The number of healthcare associated cases may be underestimated as information may not have been present for all patients.

Staphylococcus aureus bacteraemia (SAB)

Case definition

A case of SAB is a patient whom *Staphylococcus aureus* has been isolated from the patient's blood, and who has not previously had the same organism isolated from blood within the same 14 day period (i.e. 14 days from the date last positive sample obtained).

Definition notes

This surveillance includes all laboratory reported cases except –

- Pathology reports

The following blood specimens are excluded from the surveillance –

- Post mortem blood
- Clotted blood
- Plasma Serum
- Ascitic fluid

Surveillance protocol

Full details for the surveillance can be found here – https://www.hps.scot.nhs.uk/web-resources-container/protocol-for-national-enhanced-surveillance-of-bacteraemia/

Caveats

a) The number of healthcare associated cases may be underestimated as information may not have been present for all patients.

Surgical site infection (SSI)

Case definition

Patients who have undergone a hip arthroplasty procedure are followed up for 30 days as an inpatient and for any readmission to hospital. Caesarean section patients are followed up for 10 days as an inpatient, post discharge in the community and on readmission to hospital. Trained staff members in the NHS boards report SSI based on the following signs and symptoms:

Superficial incisional

Infection occurs within 30 days after the operation and infection involves only skin and subcutaneous tissue of the incision and at least one of the following:

1. Purulent drainage with or without laboratory confirmation, from the superficial incision
2. Organisms isolated from an aseptically obtained culture of fluid or tissue from the superficial incision.
3. At least one of the following signs or symptoms of infection: pain or tenderness, localized swelling, redness, or heat and superficial incision is deliberately opened by surgeon, unless incision is culture-negative.
4. Diagnosis of superficial incisional SSI made by a surgeon or attending physician.

Deep incisional

Infection occurs within 30 days after the operation if no implant* is left in place or within 90 days if implant* is in place and the infection appears to be related to the operation and infection involves deep soft tissue (e.g. fascia, muscle) of the incision and at least one of the following:

1. Purulent drainage from the deep incision but not from the organ/space component of the surgical site.
2. A deep incision spontaneously dehisces or is deliberately opened by a surgeon when the patient has at least one of the following signs or symptoms: fever (>38°C), localized pain or tenderness, unless incision is culture-negative.
3. An abscess or other evidence of infection involving the deep incision is found on direct examination, during reoperation, or by histopathologic or radiologic examination.
4. Diagnosis of deep incisional SSI made by a surgeon or attending physician.

* Implant definition: a nonhuman-derived implantable foreign body (prosthetic heart valve, nonhuman vascular graft, mechanical heart or hip prosthesis) that is permanently placed in a patient during surgery.

Organ/Space

Infection occurs within 30 days after the operation if no implant* is left in place or within 90 days if implant* is in place and the infection appears to be related to the operation and infection involves any part of the anatomy (e.g., organs and spaces) other than the incision which was opened or manipulated during an operation and at least one of the following:

1. Purulent drainage from a drain that is placed through a stab wound into the organ/space .
2. Organisms isolated from an aseptically obtained culture of fluid or tissue in the organ/ space.
3. An abscess or other evidence of infection involving the organ/space that is found on direct examination, during reoperation, or by histopathologic or radiologic examination.
4. Diagnosis of organ/space SSI made by a surgeon or attending physician.

Surveillance protocol

Full details for the surveillance can be found here – http://www.hps.scot.nhs.uk/haiic/sshaip/resourcedetail.aspx?id=827

a) The incidence of SSI may be underestimated due to follow up method of SSI surveillance and local board's methods for identifying SSI ceases.

* Implant definition: a nonhuman-derived implantable foreign body (prosthetic heart valve, nonhuman vascular graft, mechanical heart or hip prosthesis) that is permanently placed in a patient during surgery.

Appendix 1: Relationship between the cases identified (and categorised) in the CDI[1] and enhanced ECB[2]/SAB[3] surveillance and the categories assigned in the Quarterly Epidemiological Commentaries

	Healthcare associated infection case	Community associated infection case
Hospital acquired infection (HAI)	X	
Healthcare associated infection (HCAI)	X	
Community infection (CA)		X
Not known (ECB / SAB)		X
Unknown (CDI)	X[1]	

1. CDI – categorised through data linkage between CDI surveillance data and the Scottish Morbidity Records (SMR01) using the following method:
   - **Healthcare associated CDI** is categorised as a patient with CDI onset on day 3 or later following a hospital admission on day one – or any patient with SMR01 record showing a hospital discharge within the 12 weeks prior to CDI onset date. This is an adaptation of the epidemiological definitions given in the Guidance on Prevention and Control of CDI in Healthcare Settings in Scotland. The 'Unknown' category has been included within healthcare associated and includes patients without valid CHI (Community Health Index) number for linkage and patients discharged from hospital between 4 and 12 weeks prior to onset.
   - **Community associated CDI** is categorised as a patient with CDI onset in the community and with no hospital discharges within the previous 12 weeks – or with CDI onset on the day of or day following admission to hospital and with no hospital discharges within the previous 12 weeks.
2. ECB – refer to protocol for further details on enhanced surveillance categories.
3. SAB – refer to protocol for further details on enhanced surveillance categories.