

**Report on Review
of *Clostridium difficile*
Associated Disease Cases
and Mortality
in all Acute Hospitals in Scotland
from December 2007 – May 2008**

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Executive Summary

- Following a report of an unexpectedly high number of deaths associated with *Clostridium difficile* Associated Disease (CDAD) at the Vale of Leven Hospital, the Scottish Government Health and Wellbeing Directorate (SGHD) required all NHS boards to retrospectively collect data on the numbers of cases and deaths due to CDAD by hospital and month for the period 1st December 2007 to 31st May 2008.
- Health Protection Scotland (HPS) was asked by the SGHD to collate these data and comment on whether there were other unidentified outbreaks and excess deaths associated with CDAD in acute hospitals in NHS Scotland.
- The total number of cases reported from all acute hospitals (including those in the 65 years and over and the under 65 age group) was 3174 in the 6-month period studied. The overall incidence rate was 1.52 per 1000 acute occupied bed days (AOBDs).
- CDAD in the under 65 age group accounted for 20% of cases of which the majority occurred in the 50-64 age group.
- One hospital, Aberdeen Royal Infirmary (ARI) in Grampian, had an overall higher than expected incidence rate of CDAD during the 6-month period, which exceeded the 95% confidence limit. Excess cases were also seen in the monthly breakdown of incidence which shows that the ARI exceeded the 99.8% confidence limit in February and the 95% confidence limit in March.
- The ARI had been aware at the time of a rise in diagnoses of CDAD associated with a large norovirus outbreak in the hospital. In its return to HPS, NHS Grampian indicated that appropriate control measures were put in place.
- There was no evidence of excess cases above the 99.8% confidence limit for any hospital when examined for the whole 6-month period.
- Two further hospitals, Victoria Hospital, Kirkcaldy and Wishaw General Hospital, Lanarkshire, were above the 95% confidence limit in February 2008. Both these hospitals identified the problem at the time. In their return to HPS, the local Infection Control Teams indicated that appropriate control measures were put in place.
- HPS was informed/aware of the outbreaks and clusters of CDAD in this period through notification from the relevant NHS boards.
- One hospital, Vale of Leven (VOL), was above the 95% confidence limit for both overall case fatality (where CDAD is mentioned) and underlying cause fatality. The excess mortality at the VOL is already the subject of an independent review and a local epidemiological investigation, so no further comment is made here.
- One hospital, Woodend Hospital in Grampian NHS Board, was above the 95% confidence limit for deaths with CDAD as a contributory factor and warrants further investigation. Grampian NHS Board have been provided with an algorithm by HPS to support further investigation into this situation.
- When case fatality rates (where CDAD is mentioned) were broken down by month, only VOL was above the 95% confidence limit in January and March.
- With the exception of the Vale of Leven and Woodend Hospitals there was no evidence of excess case fatality due to CDAD in Scottish acute hospitals.
- The variation in CDAD cases in some hospitals and excess mortality in other hospitals could be explained by inconsistencies with these data (particularly death certificates), demographics such as older patient populations or virulence of *C. difficile* strains, or variations in patient care practices.
- There are a number of limitations to this exercise. The timescales restricted the ability to test the study design and have necessitated the use of routinely available data. It has not been possible, and is not within the remit of this investigation, to evaluate the accuracy or comparability of these data between hospitals. There are particular concerns over the use of historic hospital activity data (from 2006 – 2007) for denominators and the attribution of cause of death from death certificates.
- National and local surveillance systems are designed to monitor trends over time at NHS board and Scotland wide level. Outputs are reported retrospectively in quarterly reports, is quality assured and acts as a back up to local surveillance.
- Local surveillance is required in addition to national surveillance in order that NHS boards identify trends and outbreaks at individual ward, specialty or hospital level. NHS boards in Scotland have local surveillance systems in place, however a variety of definitions and methods are used. It is therefore not possible to directly compare existing local data.
- There are no routine systems for monitoring deaths associated with HAI in Scotland other than the registration of death certificates by GROS. This is the same across the UK, and when mortality is investigated, special retrospective studies are required. No routine surveillance system in the UK would have identified this excess of mortality.

Recommendations

- Prospectively, efforts should be directed at reducing numbers of cases of CDAD by a combination of both national and local surveillance, infection prevention and control procedures, and antimicrobial stewardship as set out in a range of current national guidance (model policies on Standard Infection Precautions and Transmission-Based Precautions, and policy on Antimicrobial Prescribing and Practice), which are currently being summarised in the Scottish National Guidance on CDAD and are due for completion in September 2008.
- Consideration should be given to extending the national surveillance system for CDAD to those aged between 15 and 64 years. This should be done in a way that does not disrupt the current surveillance programme for those aged 65 years and older so that trends can continue to be monitored.
- Local surveillance is an important part of infection control. The structure for this needs to be defined by the NHS board to best reflect local reporting procedures for feedback of results. This should be by local hospital and by managerial arrangements.
- A framework for local surveillance should be produced by HPS including guidance on definitions, methods and how to identify triggers and monitor improvement.
- Where an excess in cases or mortality are identified locally, the HPS Algorithm for validation (Appendix 3) should be adopted to examine the reasons for variation.
- Prospectively, when there is a severe case of CDAD, such as a patient with pseudomembranous colitis, toxic megacolon or ileus; or who requires admission to intensive care for management of the infection; or who dies where CDAD is an underlying cause during an inpatient episode; further investigation (such as root cause analysis) is required. This should be undertaken by the clinical team responsible for the patient's care in line with local Clinical Governance procedures to establish possible reasons, and to identify any actions necessary to minimise risk in the future.
- Routine national monitoring of CDAD mortality is unlikely to be productive in informing action to reduce the incidence of CDAD. However, if there is a decision to collect mortality data in relation to CDAD this should be carefully designed and planned, and consideration given to data definitions and data collection criteria. Further discussion should take place on the most appropriate national agency to undertake these reviews.
- It is outwith the scope of this exercise to comment on actions in relation to death certification. However the quality of death certification with regard to recording of CDAD should be examined by the appropriate authority.

1. Introduction

In June 2008, the Scottish Government Health and Wellbeing Directorate (SGHD) requested a retrospective review of cases of CDAD and associated mortality in all acute hospitals in Scotland following a report of an outbreak of CDAD, with an apparently high number of deaths at the Vale of Leven Hospital (VOL). The outbreak at the VOL is the subject of an independent review and a local epidemiological investigation.

Each NHS board was asked to identify for each of their acute hospitals, the number of cases of CDAD and deaths associated with them in the period 1st December 2007 to 31st May 2008, during which time the outbreak at the VOL was occurring. HPS was asked by SGHD to collate the data collected by NHS boards on cases of CDAD and associated mortality and comment on the following:

- whether there were any hospitals that had unexpected numbers of cases or deaths in the period studied;
- if these events had been known about previously; and
- what action, if any, had been taken at the time.

This report describes the outcome of this review.

C. difficile is a bacterium which forms heat resistant spores that can survive for long periods in the environment. It is part of the normal gut flora in a small proportion of healthy adults. In certain circumstances it can also cause disease by damaging the gut wall. Strains of *C. difficile* that can cause disease produce toxins, which cause diarrhoea, inflammation and injury to the lining of the gut.

CDAD covers a range of symptoms from mild diarrhoea to severe disease, including colitis; the most severe of which is pseudomembranous colitis and toxic megacolon that can result in gut perforation and death. Severe cases of CDAD can be fatal in their own right. However it is more often the case that CDAD is a contributory factor in the death of an individual who is already very ill and weakened due to another underlying disease such as heart disease, cancer or stroke.

The two major risk factors for developing CDAD are increasing age and prior treatment with antibiotics for another infection.

Mandatory surveillance of healthcare associated CDAD, in those aged 65 years and over, was introduced in Scotland in October 2006 (SEHD 2006) reflecting the increased risk of infection in this patient group. The national surveillance programme is not designed to monitor outbreaks at individual hospital level but to look at overall trends in cases of CDAD across Scotland, and differences between NHS boards and the impact of interventions on these trends.

The national surveillance programme has been running less than two years. To date, it has focussed on harmonising data collection across the country, ensuring data quality and providing information to guide the key interventions being taken by hospitals to assist in reducing the number of cases, e.g. transmission based precautions model policies, the CDAD care bundle, and, more recently, guidance on antimicrobial prescribing. The system is being developed as part of a wider HPS project (ECOSS) to enhance the reporting with a web based approach.

It has always been the intention to link CDAD case data held by HPS to mortality data, and this was already highlighted as a step in the development of the surveillance system once the monitoring of CDAD cases was fully established.

National surveillance is an important activity allowing monitoring of trends over time and comparisons of boards with the Scottish average; however, it does not replace the need for supplementary local surveillance. Local surveillance allows NHS boards to monitor their own results over time, comparing their results with their own previous findings in order to identify outbreaks, or unusual clusters and drive quality improvement locally.

2. Aims

The aim of this review was to assess whether the reported rate of infection (i.e. incidence) or reported rate of death among patients with CDAD for any particular month within an acute hospital, or any particular acute hospital, differs from other months, other acute hospitals, or the national average in Scotland.

The objectives were to estimate:

1. The total number of new cases of CDAD reported for each acute hospital during the defined period 1st December 2007 – 31st May 2008 inclusive.
2. The incidence rate of new cases of CDAD (e.g. the number of cases per 1000 acute occupied bed days) per month per acute hospital during the defined period.
3. The number and proportion of cases (case fatality rate) of CDAD who died as a result of their infection.
4. The number of deaths (and the case fatality rate) for which CDAD was the underlying cause of death.
5. The number of deaths (and the case fatality rate) for which CDAD was a contributory factor of death.
6. If there were clusters of cases in any of the acute hospitals during the defined period.
7. If there were excess deaths due to CDAD in any of the acute hospitals during the defined period.

It was beyond the remit of this review to demonstrate why any difference between hospitals exist or if any such differences are real or artefactual.

3. Methods

3.1 Study design

This was a retrospective study of all cases of and deaths associated with CDAD in acute hospitals in Scotland diagnosed in the period 1st December 2007 to 31st May 2008, both days inclusive.

The study population included in this investigation was all inpatients in acute hospitals (as listed in appendix 2) of all ages diagnosed with CDAD regardless of time from admission.

3.2 Data definitions

Definition of a case (episode) of CDAD (from the national CDAD surveillance protocol) (HPA 2007a)

A case of CDAD 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 cases of whose stool *C. difficile* has been cultured at the same time as they have been diagnosed with PMC (pseudomembranous colitis).

Definition of underlying cause of death

The underlying cause is defined as the disease or injury which initiated the train of morbid events leading directly to death (WHO 2004).

Definition of contributory factor

A contributory factor is any other significant condition that contributed to the fatal outcome, but was not related to the disease or condition directly causing the death (WHO 2004).

Definition of acute hospitals

These were defined as per Information Services Division (ISD) classification of hospital type. 'Acute hospitals provide a wide range of specialist care and treatment for patients. Typically services offered in the NHS acute sector are diverse. They include consultation with specialist clinicians (consultants, nurses, dieticians, physiotherapists and a wide range of other professionals), emergency treatment following accidents; routine, complex and life saving surgery, specialist diagnostic procedures and close observation and short term care of patients with worrying health symptoms' (ISD 2007). A list of the hospitals included can be found at appendix 2.

Organisational changes in some NHS boards resulted in inclusion or exclusion of hospitals on the list of acute facilities (relative to the list used in the HAI prevalence study in 2007 (HPA 2007b)).

3.3 Data collection

The SGHD requested NHS boards to collect information on all new cases of CDAD and deaths due to CDAD in all acute hospitals in their areas for the period 1st December 2007 to 31st May 2008 broken down by hospital, month and age group (below 65 years and aged 65 years and over).

All data were entered on a spreadsheet supplied by HPS and returned to HPS for analysis. Table 1 is a simplified representation of this spreadsheet (see appendix 1).

For this review, all acute hospitals were requested to identify all new cases of CDAD identified in the period December 2007 – May 2008. The number of new cases, and deaths associated with, CDAD were to be reported by month, with cases further divided into age groups (below 65 years and aged 65 years and over).

3.3.1 Inclusion criteria for cases of CDAD

Cases of **all ages** in **all acute wards** (only in acute divisions) were included. All cases were recorded regardless of the time of onset of symptoms (i.e. both less and more than 48 hours after admission, which include both cases with onset in the community and in the healthcare setting).

Cases were categorised as either

- 1) **less than 65 years of age when the episode occurred, or**
- 2) **aged 65 and over when the episode occurred.**

Data were collected by month for the period of the investigation (**1 December 2007 – 31 May 2008**).

Only **new cases of CDAD** were included. A new case was defined as an individual who had not been diagnosed with CDAD within the previous 28 days.

3.3.2 Collection of hospital activity data (denominator data)

Information on the number of acute beds, and average bed occupancy rates by month and number of acute occupied bed days by month (if available) was requested for each hospital.

Shortly after the protocol was sent out it became apparent that the requested denominator data would not be available from several hospitals at such short notice. It was therefore decided to use historic (1-year old) quality checked bed data from ISD for all hospitals. A further advantage of using ISD data is that they are divided into age-groups below and above 65 years.

All NHS boards were informed that ISD bed days would be used for the statistical analyses of the data.

3.3.3 Collection of mortality data

For this review all acute hospitals were requested to identify a) the number of deaths with CDAD as underlying cause among the CDAD cases reported in December 2007 – May 2008, and b) the number of deaths with CDAD as a contributory factor among CDAD cases reported in December 2007 – May 2008. They were asked to report mortality data by month where CDAD was diagnosed divided into age groups (below 65 years and aged 65 years and over).

Identification of deaths from the General Register Office for Scotland records and death certificates

The General Register Office for Scotland (GROS) sends weekly electronic updates on all recorded deaths to all NHS boards. These records are extracts of the death certificates recorded centrally.

These were used by NHS boards to identify deaths potentially associated with CDAD. Where the GROS records were ambiguous the stubs of the death certificates were also reviewed.

In the GROS records, CDAD as cause of death is most commonly encoded as A04.7 ('enterocolitis due to *Clostridium difficile*') (WHO 2004). Deaths from CDAD may also be recorded under the code A49.8 ('other bacterial infections of unspecified site'). For this review it was assumed that both A04.7 and A49.8 could indicate CDAD.

The death certificate comprises two parts. Part 1 has 3 lines (a)-(c), used to record the underlying cause of death, which should appear in the lowest completed line of part 1, but can stand alone as the only completed line in part 1 (WHO 2004).

The GROS record only lists one underlying cause of death, even when more than one condition is entered on the lowest completed line of part 1. These other conditions, along with any further causes and contributory factors recorded on the death certificate appear elsewhere on the GROS record.

Where A04.7 was recorded as the underlying cause of death this was accepted as the underlying cause of death without further review of death certificate stubs. Where A49.8 was recorded as the underlying cause of death, this had to be further investigated since the pathogen is not specified in this code (listed as 'other bacterial infections of unspecified site') (WHO 2004).

Where A04.7 or A49.8 was mentioned in any other field of the GROS records, the death certificate stubs were also reviewed.

If the GROS record mentioned A49.8 as underlying cause and the death certificate had no further information on the pathogen causing the diarrhoea, these cases were recorded as 'CDAD as the underlying cause of death'. Experience from a recent case note review in Glasgow suggests that the majority of A49.8 records are CDAD.

Procedure for identification of deaths

Step 1

All GROS records with codes A04.7 or A49.8 listed as underlying cause of deaths were identified.

All GROS records with codes A04.7 or A49.8 listed as elsewhere (i.e. contributory factor) were identified (and listed for further investigation of death certificates).

Step 2

Names of all cases identified under 'step 1' were matched with names of CDAD cases recorded above (under section 3.3.1).

Deaths of persons whose names did not appear on the list of CDAD cases (from section 3.3.1) were excluded.

Step 3

All cases where death certificates were matched to names on the list of CDAD cases and that were encoded with A04.7 as underlying cause were included in the dataset.

In other circumstances the death certificate stubs were reviewed, when;

- a) A04.7 was recorded as a contributory factor (i.e. recorded elsewhere in the GROS record), or
- b) the code A49.8 was recorded as an underlying or contributory factor (i.e. recorded anywhere in the GROS record).

When the death certificates on cases with A49.8 as an underlying cause contained no specific information on the type of pathogen, CDAD was recorded as the underlying cause.

3.4 Data management and data validation

3.4.1 Completeness of datasets

HPS checked if all NHS boards had returned the required datasets for all acute hospitals listed in appendix 2. In cases where submissions were incomplete HPS contacted the NHS board to investigate why data had not been submitted.

3.4.2 Comparison of CDAD case data with national surveillance data (only in ≥ 65 years)

For each NHS board, case data for those aged 65 and over, from all acute hospitals, were summed and compared to national surveillance data collected for the same period.

The proportion of cases reported for this review compared to those reported to the national system were calculated for each month for each NHS board. If the proportion of cases in acute hospitals seemed reasonable for the NHS board in question, and if it stayed constant over the 6-month period, the dataset was deemed accurate. If the proportion of cases reported for this review seemed to vary unexpectedly for an NHS board this was noted and deemed a possible indicator of incomplete or erroneous data collection.

For this exercise it was assumed that the proportion of patients in acute care relative to the total number of patients in healthcare remained reasonably constant for the period of the review.

3.5 Analysis

Incidence of CDAD cases was calculated using AOBs as the denominator for both the total 6-month period and for each month within it. The case fatality rates due to CDAD were also calculated using both total deaths due to CDAD divided by total CDAD cases for the 6-months and for each month within the period. CDAD mortality rates in relation to hospital activity were calculated using AOBs as the denominator for the 6-months or for each month within the period.

Funnel plots were used to identify those hospitals that had excess rates of CDAD cases for the total period; excess cases in the age groups 65 years and over and under 65 years; incidence for all ages by month; case fatality for the total period; and case fatality by month. Funnel plots are a type of control chart in which the observed event, in this instance rates of CDAD cases and rates of CDAD deaths, is plotted against a measure of its precision, in this case the sample size as measured by acute occupied bed days or number of cases, depending on the analysis undertaken.

Each of the datasets used in funnel plots was first tested for excess variability to assess if this was greater than would be expected from chance alone. This was carried out using a generalised linear model (GLM) procedure in STATA. Where overdispersion existed (as identified by the Pearson statistic) it was corrected for by using the GLM scale option. (Spiegelhalter 2005a; Spiegelhalter 2005b).

Analyses of deaths for the over and under 65 years of age were combined because uncertainty over the consistency of completion of death certificates and coding protocols made more detailed analysis unreliable.

Definition of excess cases or deaths

An excess number of cases or deaths were identified when the rate (of cases or deaths) exceeded the 95% confidence limit (corresponding to 2 SD from the mean). In this study, this was deemed to be an outlier and warrants investigation as special case variation.

The funnel plots further identify a 99.8% confidence limit (corresponding to 3 SD from the mean).

3.6 Commentary from NHS boards

NHS boards were asked to provide a written commentary when submitting their CDAD case and mortality data. These comments were used to inform the discussion section within this report.

Some NHS boards further provided information from local case note review of CDAD associated deaths. Although case note review was not part of this investigation, comment is made on the findings.

4. Results

Explanatory notes for table interpretation

a) General notes (all tables)

Statistical analysis

2 SD (standard deviation) equates to the 95% limit, 3 SD equates to the 99.8% limit.

Falkirk District Royal Infirmary/Stirling Royal Infirmary

Since realignment of acute services within NHS Forth Valley in 2005, there has been one acute hospital operating on two sites. Therefore data for Falkirk and Stirling Royal Hospital are presented as one acute hospital.

Western Infirmary and Gartnavel General

Data for Western Infirmary and Gartnavel General are presented as one acute hospital.

For hospital size

Hospital size is indicated by a letter (L, M, S, VS) adjacent to the hospital name. Size is based on bed numbers: Large (L) >500 beds, Medium (M) 250-499 beds, Small (S) 50-249 beds, Very Small (VS) <50 beds.

b) For all case tables

Galloway Community Hospital

Due to recent opening of the Community Hospital, bed days for the review period are lower for some months compared to others, especially in December.

c) For all case fatality tables

Falkirk District Royal Infirmary/Stirling Royal Infirmary

Deaths for May 2008 have not been included as GROS data for this month were unavailable at the time of reporting. Therefore total rate is based on cases from December to April only.

d) For total rates

Total rates are based on all cases excluding Falkirk District Royal Infirmary/Stirling Royal Infirmary case data for May.

e) Case note review and analysis of death certificates

The retrospective review undertaken at the VOL for this same period was carried out over several months with extensive case note review. The methods used by the investigating team at the VOL were consequently more thorough and detailed than those used for this review. The VOL internal review recorded the number of patients with CDAD whereas the HPS protocol collects episodes of infection to allow some measure of comparison with the national dataset which is based on episodes. It is possible for one patient to have more than one episode of CDAD as described in the definitions section of this paper. Furthermore, given the limited time for the national retrospective review, the HPS protocol identified deaths due to CDAD through the General Register Office for Scotland (GROS) weekly reports to NHS boards. Due to coding protocols for death certification, CDAD can appear as an underlying cause in GROS figures when it is listed in the death certificate stub as a contributory factor. Consequently there is a discrepancy between the figures reported by the VOL outbreak team and those recorded in this report. The VOL figures are deemed more accurate as they are the result of a detailed review.

Although not required as part of this exercise, four NHS boards undertook detailed case note reviews to assess the validity of GROS weekly reports and death certificate stubs. No formal protocol was produced by HPS for this so methods varied.

All four NHS boards found marked discrepancies between the GROS data and actual cause of death. One NHS board that undertook an extensive case note review by independent clinicians found that of 36 reported deaths, 24 should not have had CDAD on the death certificate in any category. The second found that in 5 of 6 cases where CDAD was reported as the underlying cause of death, it should have been a contributory factor, and in 1 case it was not a cause of death in any category. The third reported that of the 6 deaths recorded, 1 should not have had CDAD on the death certificate. In the fourth NHS board, they reported that in 4 patients where CDAD was recorded as the underlying cause it should have been a contributory factor and in a further 3 cases where CDAD appeared in the GROS codes it was not on the original death certificate stub.

Section A – CDAD incidence rates for all ages (December 2007 – May 2008)

The total number of cases reported from all acute hospitals was **3174** in the period December 2007 – May 2008.

The overall incidence rate for all hospitals for all ages for the 6-month period was **1.52** per 1000 AOBs. The rate for each acute hospital varied from **0.23** to **4.04** per 1000 AOBs.

In plot A it can be seen that one hospital (Aberdeen Royal Infirmary) with a rate of **2.23** per 1000 AOBs is above the 95% confidence limit, which is significantly higher than expected.

Section A – Overall rates

Funnel plot/Table A1 – Rates of CDAD per 1000 acute occupied bed days by hospital (December 2007- May 2008)

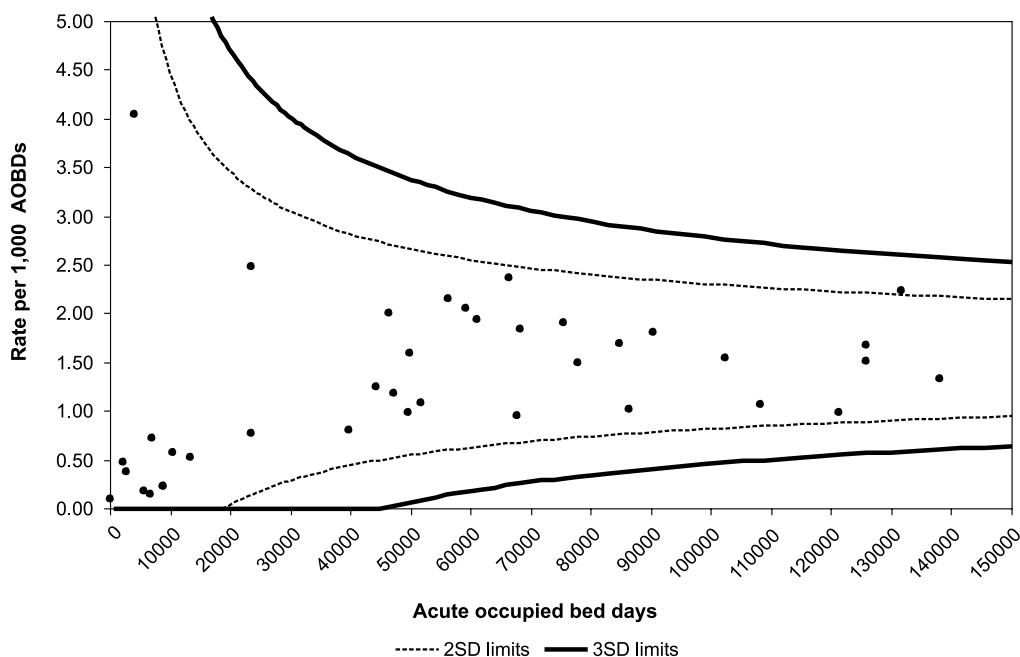


Table A1

NHS board	Hospital	Cases	Number of acute occupied bed days (AOBDs)	Rate per 1000 AOBDs
Ayrshire & Arran	Crosshouse Hospital (L)	143	84705	1.69
	Ayr Hospital (M)	79	49773	1.59
Borders	Borders General Hospital (M)	56	47097	1.19
Dumfries & Galloway	Dumfries & Galloway Royal Infirmary (M)	49	49508	0.99
	Galloway Community Hospital (S)	16	3956	4.04
Fife	Victoria Hospital (M)	93	46467	2.00
	Forth Park Hospital (S)	1	2087	0.48
	Queen Margaret Hospital (M)	126	68175	1.85
Forth Valley	Falkirk & District Royal Infirmary / Stirling Royal Infirmary (M)	158	102230	1.55
Grampian	Aberdeen Royal Infirmary (L)	294	131684	2.23
	Woodend General Hospital (M)	121	56223	2.15
	Dr Gray's Hospital (S)	18	23330	0.77
Greater Glasgow & Clyde	Glasgow Royal Infirmary (L)	120	121109	0.99
	Stobhill Hospital (L)	118	60964	1.94
	Victoria Infirmary (M)	122	59161	2.06
	Southern General Hospital (L)	115	108133	1.06
	Western Infirmary / Gartnavel General Hospital (L)	185	138025	1.34
	Vale of Leven General Hospital (M)	58	23412	2.48
	Inverclyde Royal Hospital (M)	56	51673	1.08
	Royal Alexandra Hospital (L)	88	86367	1.02
Highland	Caithness General Hospital (S)	6	10366	0.58
	Raigmore Hospital (L)	64	67646	0.95
	Belford Hospital (S)	5	6866	0.73
	Lorn & Islands District General Hospital (S)	2	8667	0.23
Lanarkshire	Monklands District General Hospital (L)	117	77883	1.50
	Hairmyres Hospital (L)	157	66208	2.37
	Wishaw General Hospital (L)	144	75438	1.91
Lothian	Western General Hospital (L)	163	90286	1.81
	St John's Hospital (L)	55	44185	1.24
	Royal Infirmary of Edinburgh at Little France (L)	210	125675	1.67
Orkney	Balfour Hospital (S)	1	6734	0.15
Shetland	Gilbert Bain Hospital (S)	1	5628	0.18
Tayside	Ninewells Hospital (L)	191	125674	1.52
	Perth Royal Infirmary (M)	32	39609	0.81
Western Isles	St Brendan's Cot Hospital (VS)	0	256	0.00
	Western Isles Hospital (VS)	7	13377	0.52
	Uist & Barra Hospital (VS)	1	2680	0.37
Other	Golden Jubilee National Hospital (S)	2	8878	0.23
TOTAL		3174	2090135	1.52

Notes: Hospital highlighted in YELLOW indicate those with rates which lie above the upper 2SD limit defined in the accompanying funnel plot. Those highlighted in RED indicate rates which lie above the upper 3SD range limit.

Section B – CDAD incidence rates by age group (December 2007 – May 2008)

The overall incidence rate for all hospitals in the 6-month period in those aged below 65 was **0.85** per 1000 AOBs, while that of those aged 65 and over was **1.87** per 1000 AOBs.

The rates for acute hospitals in those below 65 varied between **0** and **1.54** cases per 1000 AOBs, while those aged 65 and over, varied between **0** and **4.94** cases per 1000 AOBs.

In plot B1 (for those aged < 65 years) it can be seen that two hospitals (Royal Infirmary of Edinburgh and the Western General Hospital, Edinburgh) are above the 95% confidence limit with rates of **1.54** and **1.52** per 1000 AOBs, which are both significantly higher than expected.

In plot B2 (for those aged ≥ 65 years) it can be seen that one hospital (Aberdeen Royal Infirmary) is above the 95% confidence limit with a rate of **3.15** per 1000 AOBs, which is significantly higher than expected.

Section B – Rates by age group

Funnel plot/Table B1 – Rates of CDAD per 1000 acute occupied bed days by hospital (persons aged < 65 years)

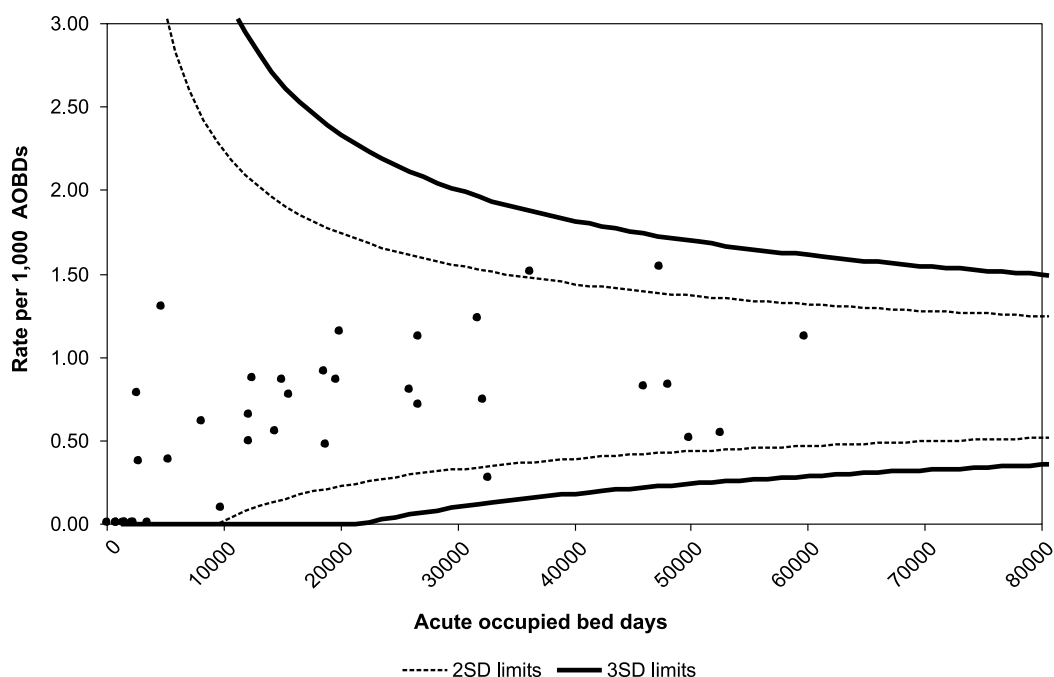


Table B1

NHS board	Hospital	Cases	Number of acute occupied bed days (AOBDs)	Rate per 1000 AOBDs
Ayrshire & Arran	Crosshouse Hospital (L)	39	31674	1.23
Borders	Borders General Hospital (M)	8	12144	0.66
Dumfries & Galloway	Dumfries & Galloway Royal Infirmary (M)	9	18661	0.48
	Galloway Community Hospital (S)	0	718	0.00
Fife	Victoria Hospital (M)	11	12472	0.88
	Forth Park Hospital (S)	0	1532	0.00
	Queen Margaret Hospital (M)	17	18481	0.92
Forth Valley	Falkirk & District Royal Infirmary / Stirling Royal Infirmary (M)	9	32541	0.28
Grampian	Aberdeen Royal Infirmary (L)	67	59665	1.12
	Woodend General Hospital (M)	2	5206	0.38
	Dr Gray's Hospital (S)	5	8052	0.62
Greater Glasgow & Clyde	Glasgow Royal Infirmary (L)	29	52441	0.55
	Stobhill Hospital (L)	13	14978	0.87
	Victoria Infirmary (M)	17	19661	0.86
	Southern General Hospital (L)	26	49835	0.52
	Western Infirmary / Gartnavel General Hospital (L)	38	45839	0.83
	Vale of Leven General Hospital (M)	6	4583	1.31
	Inverclyde Royal Hospital (M)	6	12132	0.49
	Royal Alexandra Hospital (L)	21	25866	0.81
Highland	Caithness General Hospital (S)	1	2618	0.38
	Raigmore Hospital (L)	19	26577	0.71
	Belford Hospital (S)	0	2165	0.00
	Lorn & Islands District General Hospital (S)	0	2202	0.00
Lanarkshire	Monklands District General Hospital (L)	24	32108	0.75
	Hairmyres Hospital (L)	23	19842	1.16
	Wishaw General Hospital (L)	30	26642	1.13
Lothian	Western General Hospital (L)	55	36234	1.52
	St John's Hospital (L)	8	14414	0.56
	Royal Infirmary of Edinburgh at Little France (L)	73	47288	1.54
Orkney	Balfour Hospital (S)	0	1360	0.00
Shetland	Gilbert Bain Hospital (S)	0	1554	0.00
Tayside	Ninewells Hospital (L)	40	47936	0.83
	Perth Royal Infirmary (M)	1	9688	0.10
Western Isles	St Brendan's Cot Hospital (VS)	0	44	0.00
	Western Isles Hospital (VS)	2	2542	0.79
	Uist & Barra Hospital (VS)	0	778	0.00
Other	Golden Jubilee National Hospital (S)	0	3497	0.00
TOTAL		611	719470	0.85

Notes: Hospital highlighted in YELLOW indicate those with rates which lie above the upper 2SD limit defined in the accompanying funnel plot. Those highlighted in RED indicate rates which lie above the upper 3SD range limit.

Funnel plot/Table B2 – Rates of CDAD per 1000 acute occupied bed days by hospital (persons aged > 65 years)

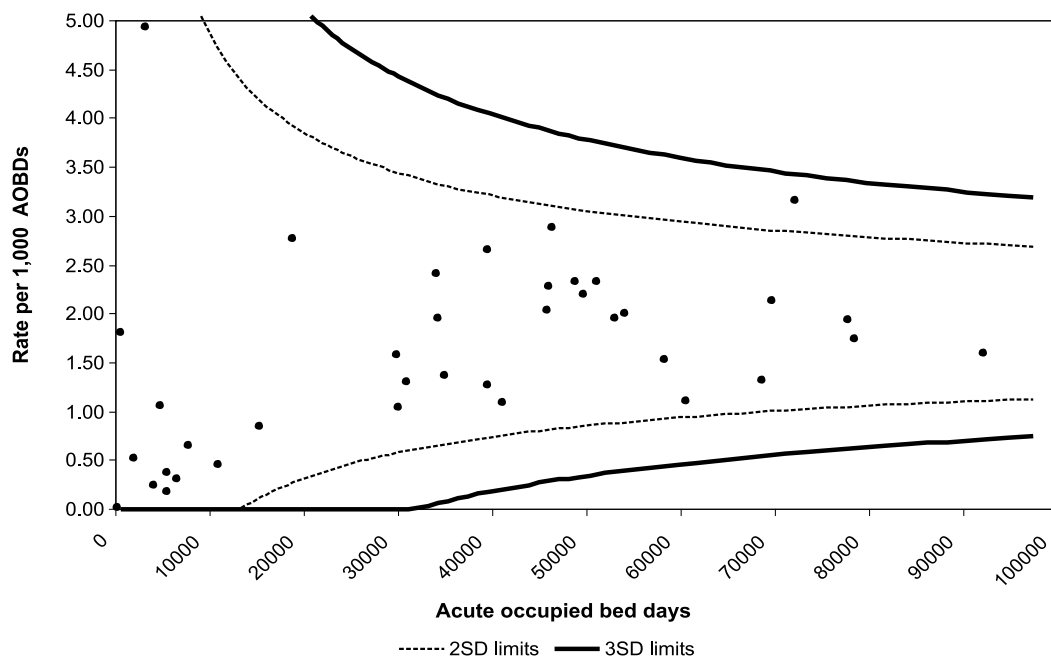


Table B2

NHS board	Hospital	Cases	Number of acute occupied bed days (AOBDs)	Rate per 1000 AOBDS
Ayrshire & Arran	Crosshouse Hospital (L)	104	53031	1.96
	Ayr Hospital (M)	67	34273	1.95
Borders	Borders General Hospital (M)	48	34953	1.37
Dumfries & Galloway	Dumfries & Galloway Royal Infirmary (M)	40	30847	1.30
	Galloway Community Hospital (S)	16	3238	4.94
Fife	Victoria Hospital (M)	82	33995	2.41
	Forth Park Hospital (S)	1	555	1.80
	Queen Margaret Hospital (M)	109	49694	2.19
Forth Valley	Falkirk & District Royal Infirmary / Stirling Royal Infirmary (M)	149	69689	2.14
Grampian	Aberdeen Royal Infirmary (L)	227	72019	3.15
	Woodend General Hospital (M)	119	51017	2.33
	Dr Gray's Hospital (S)	13	15278	0.85
Greater Glasgow & Clyde	Glasgow Royal Infirmary (L)	91	68668	1.33
	Stobhill Hospital (L)	105	45986	2.28
	Victoria Infirmary (M)	105	39500	2.66
	Southern General Hospital (L)	89	58298	1.53
	Western Infirmary / Gartnavel General Hospital (L)	147	92186	1.59
	Vale of Leven General Hospital (M)	52	18829	2.76
	Inverclyde Royal Hospital (M)	50	39541	1.26
	Royal Alexandra Hospital (L)	67	60501	1.11
Highland	Caitness General Hospital (S)	5	7748	0.65
	Raigmore Hospital (L)	45	41069	1.10
	Belford Hospital (S)	5	4701	1.06
	Lorn & Islands District General Hospital (S)	2	6465	0.31
Lanarkshire	Monklands District General Hospital (L)	93	45775	2.03
	Hairmyres Hospital (L)	134	46366	2.89
	Wishaw General Hospital (L)	114	48796	2.34
Lothian	Western General Hospital (L)	108	54052	2.00
	St John's Hospital (L)	47	29771	1.58
	Royal Infirmary of Edinburgh at Little France (L)	137	78387	1.75
Orkney	Balfour Hospital (S)	1	5374	0.19
Shetland	Gilbert Bain Hospital (S)	1	4074	0.25
Tayside	Ninewells Hospital (L)	151	77738	1.94
	Perth Royal Infirmary (M)	31	29921	1.04
Western Isles	St Brendan's Cot Hospital (VS)	0	212	0.00
	Western Isles Hospital (VS)	5	10835	0.46
	Uist & Barra Hospital (VS)	1	1902	0.53
Other	Golden Jubilee National Hospital (S)	2	5381	0.37
TOTAL		2563	1370665	1.87

Notes: Hospital highlighted in YELLOW indicate those with rates which lie above the upper 2SD limit defined in the accompanying funnel plot. Those highlighted in RED indicate rates which lie above the upper 3SD range limit.

Section C – CDAD incidence rates for all ages by month

The overall incidence rate (per 1000 AOBDS) for all hospitals for all ages was **1.46** for December 2007, **1.73** for January 2008, **1.50** for February 2008, **1.56** for March 2008, **1.45** for April 08 and **1.40** for May 08.

The overall incidence rate in January 2008 was higher than all other months.

In Table C1 (supporting plot C1) one hospital Galloway Community Hospital, Dumfries and Galloway, had possibly incomplete bed data for December 2007, and thus it was not possible to calculate a comparable rate for that month.

In plot C3 (February 2008) it can be seen that two hospitals (Victoria Hospital, Kirkcaldy and Wishaw General Hospital) were above the 95% confidence limit with rates of **2.95** and **2.70** per 1000 AOBDS, respectively, which are significantly higher than expected. Furthermore, it can be seen that one hospital (Aberdeen Royal Infirmary) was above the 99.8% confidence limit with a rate of **2.57** per 1000 AOBDS.

In plot C4 (March 2008), one hospital (Aberdeen Royal Infirmary) was above the 95% confidence limit with a rate of **2.83** per 1000 AOBDS.

In December 2007, January 2008, April 2008 and May 2008 no hospitals were above the 95% confidence limit of the funnel plots.

Section C – Rates by month

Funnel plot/Table C1 – Rates of CDAD per 1000 acute occupied bed days by hospital (December 2007)

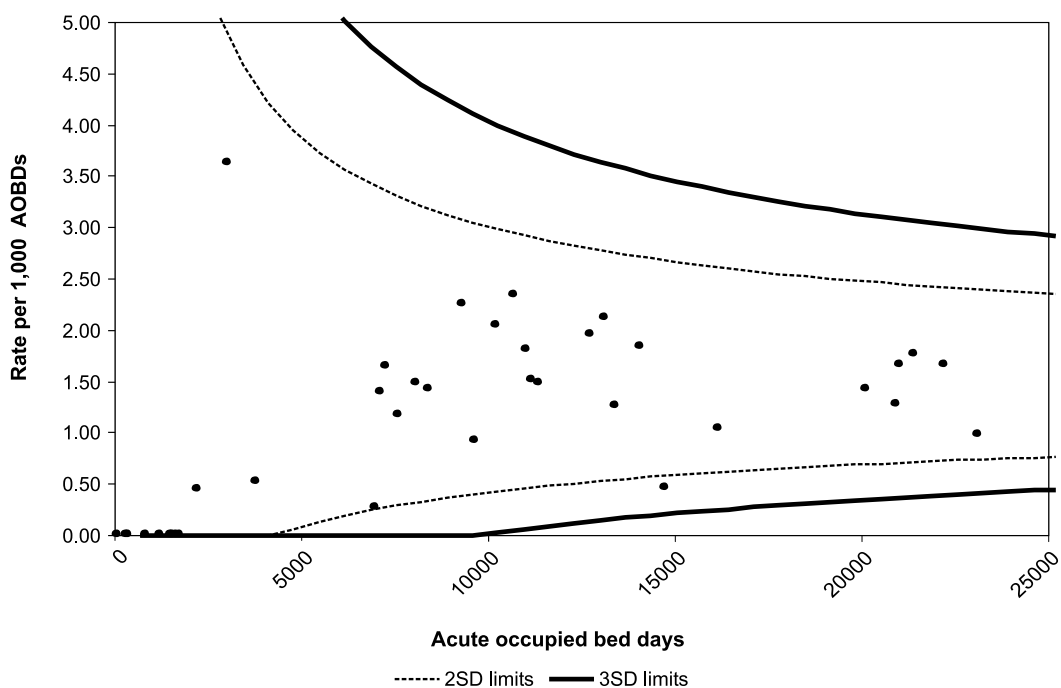


Table C1

NHS board	Hospital	Cases	Number of acute occupied bed days (AOBDs)	Rate per 1000 AOBDs
Ayrshire & Arran	Crosshouse Hospital (L)	17	13385	1.27
	Ayr Hospital (M)	12	8053	1.49
Borders	Borders General Hospital (M)	9	9615	0.94
Dumfries & Galloway	Dumfries & Galloway Royal Infirmary (M)	10	7109	1.41
	Galloway Community Hospital (S)	1	33	30.30
Fife	Victoria Hospital (M)	9	7591	1.19
	Forth Park Hospital (S)	0	324	0.00
	Queen Margaret Hospital (M)	17	11335	1.50
Forth Valley	Falkirk & District Royal Infirmary / Stirling Royal Infirmary (M)	17	16160	1.05
Grampian	Aberdeen Royal Infirmary (L)	37	22167	1.67
	Woodend General Hospital (M)	21	10204	2.06
	Dr Gray's Hospital (S)	2	3766	0.53
Greater Glasgow & Clyde	Glasgow Royal Infirmary (L)	29	20110	1.44
	Stobhill Hospital (L)	25	10651	2.35
	Victoria Infirmary (M)	21	9285	2.26
	Southern General Hospital (L)	27	20918	1.29
	Western Infirmary / Gartnavel General Hospital (L)	23	23079	1.00
	Vale of Leven General Hospital (M)	11	3022	3.64
	Inverclyde Royal Hospital (M)	12	8380	1.43
	Royal Alexandra Hospital (L)	7	14694	0.48
Highland	Caithness General Hospital (S)	0	1720	0.00
	Raigmore Hospital (L)	17	11131	1.53
	Belford Hospital (S)	0	1467	0.00
	Lorn & Islands District General Hospital (S)	0	1197	0.00
Lanarkshire	Monklands District General Hospital (L)	28	13115	2.13
	Hairmyres Hospital (L)	20	11020	1.81
	Wishaw General Hospital (L)	25	12699	1.97
Lothian	Western General Hospital (L)	26	14057	1.85
	St John's Hospital (L)	12	7221	1.66
	Royal Infirmary of Edinburgh at Little France (L)	38	21374	1.78
Orkney	Balfour Hospital (S)	0	1642	0.00
Shetland	Gilbert Bain Hospital (S)	0	794	0.00
Tayside	Ninewells Hospital (L)	35	20978	1.67
	Perth Royal Infirmary (M)	2	6960	0.29
Western Isles	St Brendan's Cot Hospital (VS)	0	41	0.00
	Western Isles Hospital (VS)	1	2212	0.45
	Uist & Barra Hospital (VS)	0	309	0.00
Other	Golden Jubilee National Hospital (S)	0	1542	0.00
TOTAL		511	349360	1.46

Notes: Hospitals highlighted in YELLOW indicate those with rates which lie above the upper 2SD limit defined in the accompanying funnel plot. Those highlighted in RED indicate rates which lie above the upper 3SD range limit. Due to scaling, the data point for Galloway Community Hospital doesn't appear on the funnel plot.

Funnel plot/Table C2 – Rates of CDAD per 1000 acute occupied bed days by hospital (January 2008)

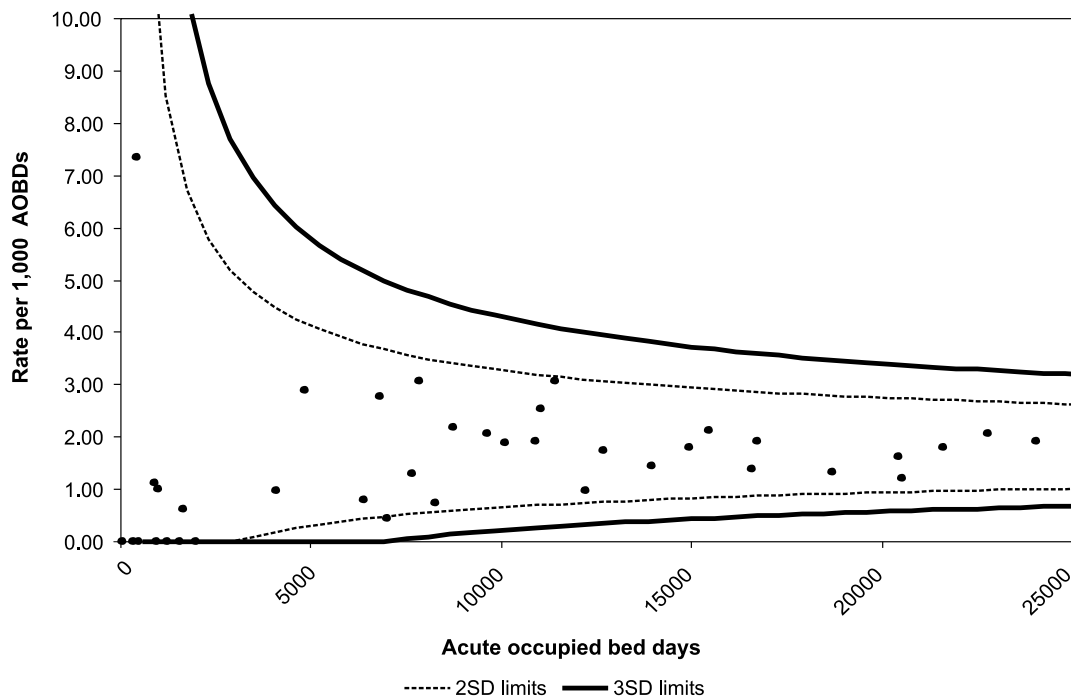


Table C2

NHS board	Hospital	Cases	Number of acute occupied bed days (AOBDs)	Rate per 1000 AOBDS
Ayrshire & Arran	Crosshouse Hospital (L)	33	15451	2.14
	Ayr Hospital (M)	19	8744	2.17
Borders	Borders General Hospital (M)	19	6835	2.78
Dumfries & Galloway	Dumfries & Galloway Royal Infirmary (M)	5	6380	0.78
	Galloway Community Hospital (S)	3	408	7.35
Fife	Victoria Hospital (M)	24	7835	3.06
	Forth Park Hospital (S)	0	328	0.00
	Queen Margaret Hospital (M)	28	11027	2.54
Forth Valley	Falkirk & District Royal Infirmary / Stirling Royal Infirmary (M)	32	16710	1.92
Grampian	Aberdeen Royal Infirmary (L)	47	22811	2.06
	Woodend General Hospital (M)	20	9625	2.08
	Dr Gray's Hospital (S)	4	4083	0.98
Greater Glasgow & Clyde	Glasgow Royal Infirmary (L)	25	20557	1.22
	Stobhill Hospital (L)	19	10124	1.88
	Victoria Infirmary (M)	21	10925	1.92
	Southern General Hospital (L)	25	18680	1.34
	Western Infirmary / Gartnavel General Hospital (L)	46	24064	1.91
	Vale of Leven General Hospital (M)	14	4836	2.89
	Inverclyde Royal Hospital (M)	6	8269	0.73
Royal Alexandra Hospital (L)	27	14956	1.81	
Highland	Caithness General Hospital (S)	1	1626	0.62
	Raigmore Hospital (L)	12	12225	0.98
	Belford Hospital (S)	1	985	1.02
	Lorn & Islands District General Hospital (S)	0	1548	0.00
Lanarkshire	Monklands District General Hospital (L)	20	13965	1.43
	Hairmyres Hospital (L)	35	11440	3.06
	Wishaw General Hospital (L)	22	12696	1.73
Lothian	Western General Hospital (L)	23	16571	1.39
	St John's Hospital (L)	10	7673	1.30
	Royal Infirmary of Edinburgh at Little France (L)	39	21636	1.80
Orkney	Balfour Hospital (S)	1	892	1.12
Shetland	Gilbert Bain Hospital (S)	0	957	0.00
Tayside	Ninewells Hospital (L)	33	20459	1.61
	Perth Royal Infirmary (M)	3	7008	0.43
Western Isles	St Brendan's Cot Hospital (VS)	0	34	0.00
	Western Isles Hospital (VS)	0	1977	0.00
	Uist & Barra Hospital (VS)	0	454	0.00
Other	Golden Jubilee National Hospital (S)	0	1207	0.00
TOTAL		617	356001	1.73

Notes: Hospital highlighted in YELLOW indicate those with rates which lie above the upper 2SD limit defined in the accompanying funnel plot. Those highlighted in RED indicate rates which lie above the upper 3SD range limit.

Funnel plot/Table C3 – Rates of CDAD per 1000 acute occupied bed days by hospital (February 2008)

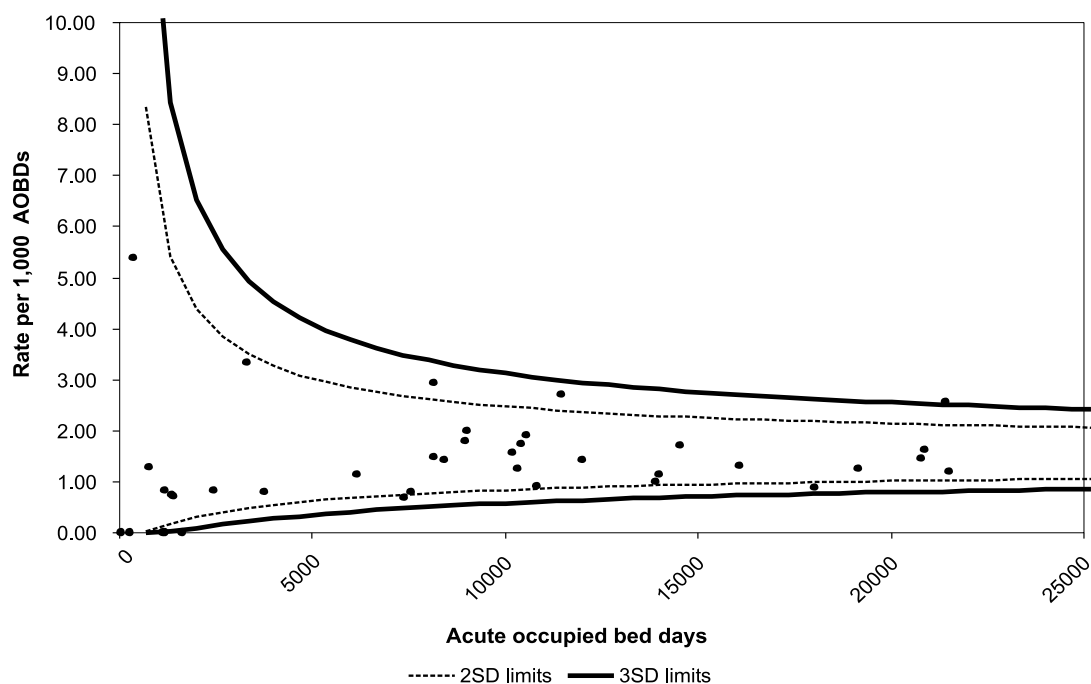


Table C3

NHS board	Hospital	Cases	Number of acute occupied bed days (AOBDs)	Rate per 1000 AOBDs
Ayrshire & Arran	Crosshouse Hospital (L)	16	13990	1.14
	Ayr Hospital (M)	12	8156	1.47
Borders	Borders General Hospital (M)	6	7564	0.79
Dumfries & Galloway	Dumfries & Galloway Royal Infirmary (M)	13	10331	1.26
	Galloway Community Hospital (S)	2	372	5.38
Fife	Victoria Hospital (M)	24	8145	2.95
	Forth Park Hospital (S)	0	292	0.00
	Queen Margaret Hospital (M)	18	10417	1.73
Forth Valley	Falkirk & District Royal Infirmary / Stirling Royal Infirmary (M)	21	16059	1.31
Grampian	Aberdeen Royal Infirmary (L)	55	21408	2.57
	Woodend General Hospital (M)	16	8972	1.78
	Dr Gray's Hospital (S)	3	3753	0.80
Greater Glasgow & Clyde	Glasgow Royal Infirmary (L)	24	19169	1.25
	Stobhill Hospital (L)	16	10184	1.57
	Victoria Infirmary (M)	18	9011	2.00
	Southern General Hospital (L)	16	18039	0.89
	Western Infirmary / Gartnavel General Hospital (L)	26	21533	1.21
	Vale of Leven General Hospital (M)	11	3304	3.33
	Inverclyde Royal Hospital (M)	12	8435	1.42
	Royal Alexandra Hospital (L)	14	13883	1.01
Highland	Caithness General Hospital (S)	1	1391	0.72
	Raigmore Hospital (L)	10	10805	0.93
	Belford Hospital (S)	0	1116	0.00
	Lorn & Islands District General Hospital (S)	1	1339	0.75
Lanarkshire	Monklands District General Hospital (L)	17	12001	1.42
	Hairmyres Hospital (L)	20	10541	1.90
	Wishaw General Hospital (L)	31	11479	2.70
Lothian	Western General Hospital (L)	25	14516	1.72
	St John's Hospital (L)	5	7384	0.68
	Royal Infirmary of Edinburgh at Little France (L)	30	20781	1.44
Orkney	Balfour Hospital (S)	0	1179	0.00
Shetland	Gilbert Bain Hospital (S)	1	1198	0.83
Tayside	Ninewells Hospital (L)	34	20879	1.63
	Perth Royal Infirmary (M)	7	6147	1.14
Western Isles	St Brendan's Cot Hospital (VS)	0	36	0.00
	Western Isles Hospital (VS)	2	2432	0.82
	Uist & Barra Hospital (VS)	1	773	1.29
Other	Golden Jubilee National Hospital (S)	0	1628	0.00
TOTAL		508	338642	1.50

Notes: Hospital highlighted in YELLOW indicate those with rates which lie above the upper 2SD limit defined in the accompanying funnel plot. Those highlighted in RED indicate rates which lie above the upper 3SD range limit.

Funnel plot/Table C4 – Rates of CDAD per 1000 acute occupied bed days by hospital (March 2008)

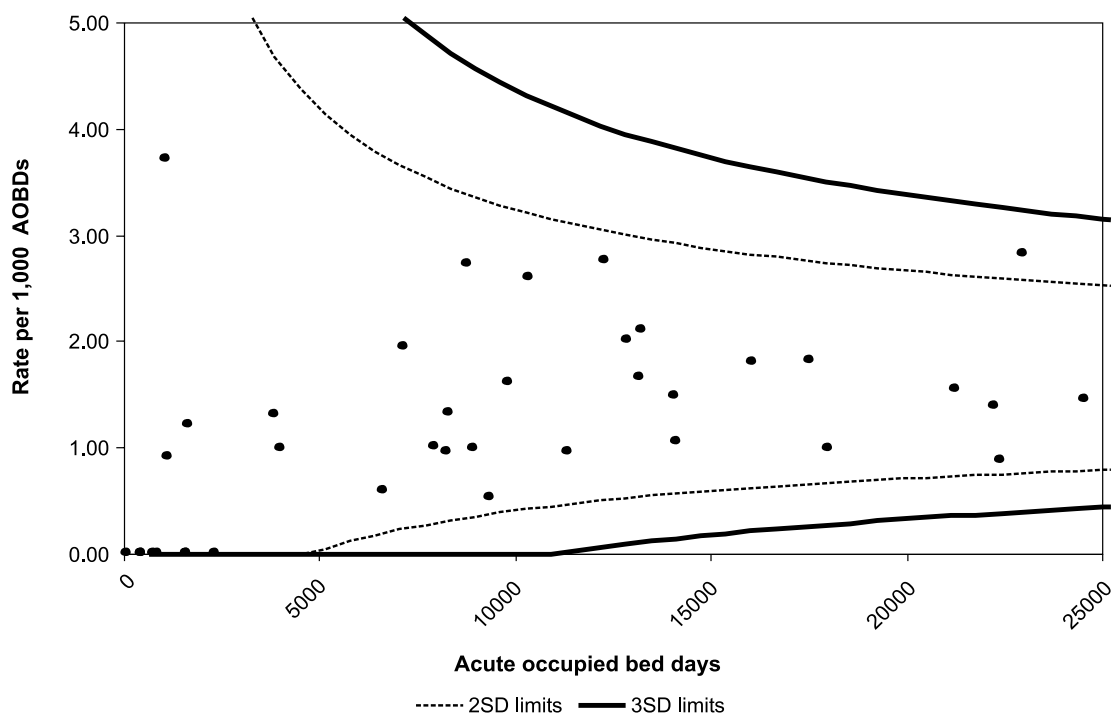


Table C4

NHS board	Hospital	Cases	Number of acute occupied bed days (AOBDs)	Rate per 1000 AOBDs
Ayrshire & Arran	Crosshouse Hospital (L)	28	13232	2.12
	Ayr Hospital (M)	8	8232	0.97
Borders	Borders General Hospital (M)	8	7896	1.01
Dumfries & Galloway	Dumfries & Galloway Royal Infirmary (M)	5	9318	0.54
	Galloway Community Hospital (S)	4	1073	3.73
Fife	Victoria Hospital (M)	14	7136	1.96
	Forth Park Hospital (S)	0	405	0.00
	Queen Margaret Hospital (M)	22	13165	1.67
Forth Valley	Falkirk & District Royal Infirmary / Stirling Royal Infirmary (M)	32	17495	1.83
Grampian	Aberdeen Royal Infirmary (L)	65	22978	2.83
	Woodend General Hospital (M)	24	8762	2.74
	Dr Gray's Hospital (S)	5	3804	1.31
Greater Glasgow & Clyde	Glasgow Royal Infirmary (L)	20	22369	0.89
	Stobhill Hospital (L)	16	9805	1.63
	Victoria Infirmary (M)	27	10322	2.62
	Southern General Hospital (L)	18	17990	1.00
	Western Infirmary / Gartnavel General Hospital (L)	36	24552	1.47
	Vale of Leven General Hospital (M)	4	3967	1.01
	Inverclyde Royal Hospital (M)	9	8929	1.01
	Royal Alexandra Hospital (L)	15	14101	1.06
Highland	Caithness General Hospital (S)	2	1636	1.22
	Raigmore Hospital (L)	11	11335	0.97
	Belford Hospital (S)	1	1089	0.92
	Lorn & Islands District General Hospital (S)	0	1579	0.00
Lanarkshire	Monklands District General Hospital (L)	26	12848	2.02
	Hairmyres Hospital (L)	34	12244	2.78
	Wishaw General Hospital (L)	21	14026	1.50
Lothian	Western General Hospital (L)	29	16028	1.81
	St John's Hospital (L)	11	8272	1.33
	Royal Infirmary of Edinburgh at Little France (L)	31	22242	1.39
Orkney	Balfour Hospital (S)	0	728	0.00
Shetland	Gilbert Bain Hospital (S)	0	814	0.00
Tayside	Ninewells Hospital (L)	33	21216	1.56
	Perth Royal Infirmary (M)	4	6621	0.60
Western Isles	St Brendan's Cot Hospital (VS)	0	56	0.00
	Western Isles Hospital (VS)	0	2311	0.00
	Uist & Barra Hospital (VS)	0	421	0.00
Other	Golden Jubilee National Hospital (S)	0	1550	0.00
TOTAL		563	360547	1.56

Notes: Hospitals highlighted in YELLOW indicate those with rates which lie above the upper 2SD limit defined in the accompanying funnel plot. Those highlighted in RED indicate rates which lie above the upper 3SD range limit.

Funnel plot/Table C5 – Rates of CDAD per 1000 acute occupied bed days by hospital (April 2008)

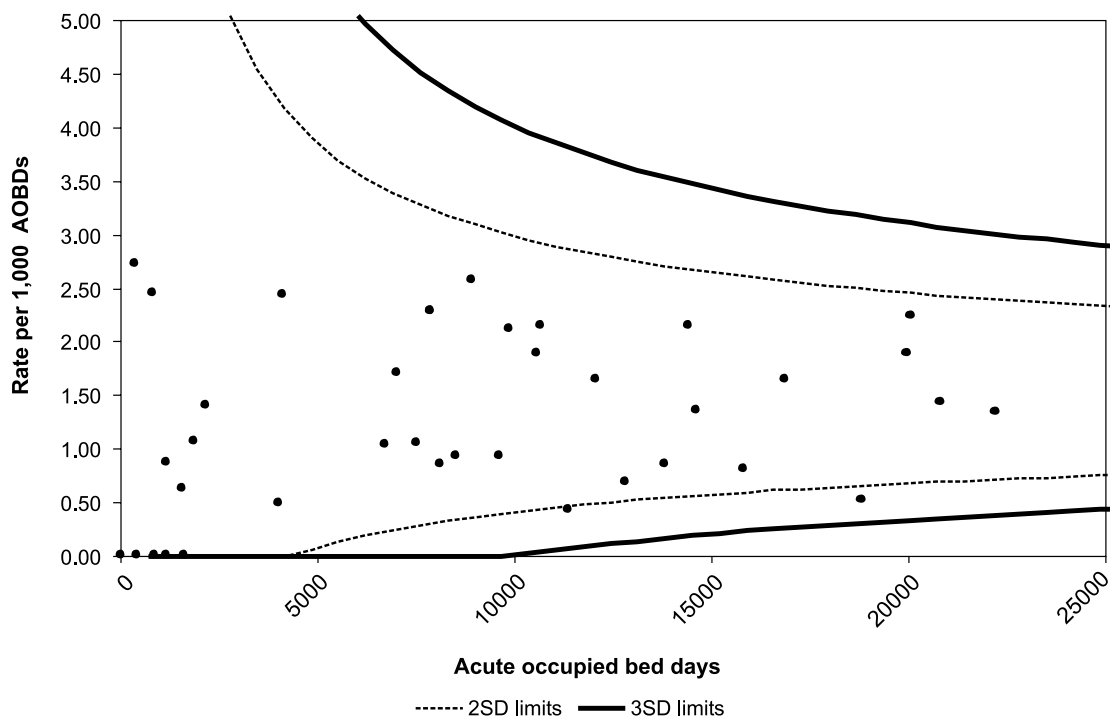


Table C5

NHS board	Hospital	Cases	Number of acute occupied bed days (AOBDs)	Rate per 1000 AOBDS
Ayrshire & Arran	Crosshouse Hospital (L)	20	14613	1.37
	Ayr Hospital (M)	18	7855	2.29
Borders	Borders General Hospital (M)	8	7508	1.07
Dumfries & Galloway	Dumfries & Galloway Royal Infirmary (M)	7	8092	0.87
	Galloway Community Hospital (S)	2	810	2.47
Fife	Victoria Hospital (M)	18	7839	2.30
	Forth Park Hospital (S)	1	365	2.74
	Queen Margaret Hospital (M)	20	10537	1.90
Forth Valley	Falkirk & District Royal Infirmary / Stirling Royal Infirmary (M)	28	16843	1.66
Grampian	Aberdeen Royal Infirmary (L)	45	20055	2.24
	Woodend General Hospital (M)	23	8920	2.58
	Dr Gray's Hospital (S)	2	3993	0.50
Greater Glasgow & Clyde	Glasgow Royal Infirmary (L)	10	18799	0.53
	Stobhill Hospital (L)	23	10675	2.15
	Victoria Infirmary (M)	9	9586	0.94
	Southern General Hospital (L)	13	15804	0.82
	Western Infirmary / Gartnavel General Hospital (L)	30	22206	1.35
	Vale of Leven General Hospital (M)	10	4076	2.45
	Inverclyde Royal Hospital (M)	8	8487	0.94
	Royal Alexandra Hospital (L)	12	13775	0.87
Highland	Caitness General Hospital (S)	2	1843	1.09
	Raigmore Hospital (L)	5	11326	0.44
	Belford Hospital (S)	1	1138	0.88
	Lorn & Islands District General Hospital (S)	0	1578	0.00
Lanarkshire	Monklands District General Hospital (L)	9	12778	0.70
	Hairmyres Hospital (L)	21	9848	2.13
	Wishaw General Hospital (L)	20	12050	1.66
Lothian	Western General Hospital (L)	31	14396	2.15
	St John's Hospital (L)	12	6988	1.72
	Royal Infirmary of Edinburgh at Little France (L)	38	19968	1.90
Orkney	Balfour Hospital (S)	0	1150	0.00
Shetland	Gilbert Bain Hospital (S)	0	837	0.00
Tayside	Ninewells Hospital (L)	30	20794	1.44
	Perth Royal Infirmary (M)	7	6706	1.04
Western Isles	St Brendan's Cot Hospital (VS)	0	4	0.00
	Western Isles Hospital (VS)	3	2129	1.41
	Uist & Barra Hospital (VS)	0	396	0.00
Other	Golden Jubilee National Hospital (S)	1	1557	0.64
TOTAL		487	336324	1.45

Notes: Hospitals highlighted in YELLOW indicate those with rates which lie outwith the upper 2SD limit defined in the accompanying funnel plot. Those highlighted in RED indicate rates which lie outwith the upper 3SD range limit.

Funnel plot/Table C6 – Rates of CDAD per 1000 acute occupied bed days by hospital (May 2008)

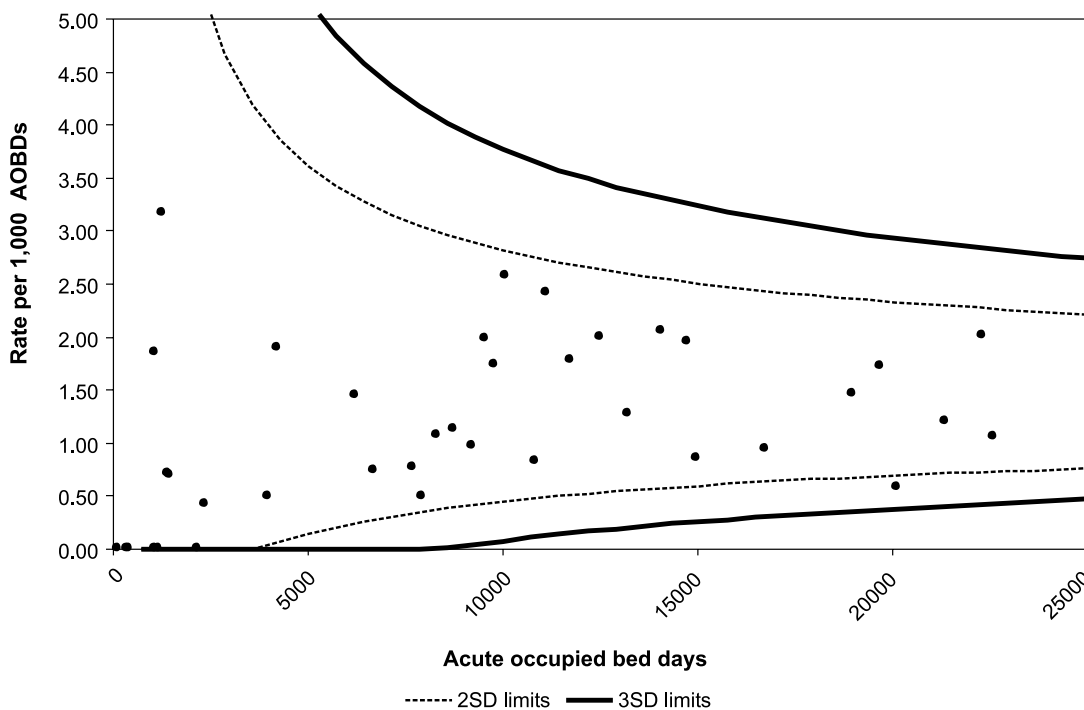


Table C6

NHS board	Hospital	Cases	Number of acute occupied bed days (AOBDs)	Rate per 1000 AOBDs
Ayrshire & Arran	Crosshouse Hospital (L)	29	14034	2.07
	Ayr Hospital (M)	10	8733	1.15
Borders	Borders General Hospital (M)	6	7679	0.78
Dumfries & Galloway	Dumfries & Galloway Royal Infirmary (M)	9	8278	1.09
	Galloway Community Hospital (S)	4	1260	3.17
Fife	Victoria Hospital (M)	4	7921	0.50
	Forth Park Hospital (S)	0	373	0.00
	Queen Margaret Hospital (M)	21	11694	1.80
Forth Valley	Falkirk & District Royal Infirmary / Stirling Royal Infirmary (M)	28	18963	1.48
Grampian	Aberdeen Royal Infirmary (L)	45	22265	2.02
	Woodend General Hospital (M)	17	9740	1.75
	Dr Gray's Hospital (S)	2	3931	0.51
Greater Glasgow & Clyde	Glasgow Royal Infirmary (L)	12	20105	0.60
	Stobhill Hospital (L)	19	9525	1.99
	Victoria Infirmary (M)	26	10032	2.59
	Southern General Hospital (L)	16	16702	0.96
	Western Infirmary / Gartnavel General Hospital (L)	24	22591	1.06
	Vale of Leven General Hospital (M)	8	4207	1.90
	Inverclyde Royal Hospital (M)	9	9173	0.98
	Royal Alexandra Hospital (L)	13	14958	0.87
Highland	Caithness General Hospital (S)	0	2150	0.00
	Raigmore Hospital (L)	9	10824	0.83
	Belford Hospital (S)	2	1071	1.87
	Lorn & Islands District General Hospital (S)	1	1426	0.70
Lanarkshire	Monklands District General Hospital (L)	17	13176	1.29
	Hairmyres Hospital (L)	27	11115	2.43
	Wishaw General Hospital (L)	25	12488	2.00
Lothian	Western General Hospital (L)	29	14718	1.97
	St John's Hospital (L)	5	6647	0.75
	Royal Infirmary of Edinburgh at Little France (L)	34	19674	1.73
Orkney	Balfour Hospital (S)	0	1143	0.00
Shetland	Gilbert Bain Hospital (S)	0	1028	0.00
Tayside	Ninewells Hospital (L)	26	21348	1.22
	Perth Royal Infirmary (M)	9	6167	1.46
Western Isles	St Brendan's Cot Hospital (VS)	0	85	0.00
	Western Isles Hospital (VS)	1	2316	0.43
	Uist & Barra Hospital (VS)	0	327	0.00
Other	Golden Jubilee National Hospital (S)	1	1394	0.72
TOTAL		488	349261	1.40

Notes: Hospitals highlighted in YELLOW indicate those with rates which lie above the upper 2SD limit defined in the accompanying funnel plot. Those highlighted in RED indicate rates which lie above the upper 3SD range limit.

Section D – CDAD associated case fatality rates for all ages (December 2007 – May 2008)

The number of deaths identified in this study during the period December 2007 – May 2008, where CDAD was mentioned as a cause anywhere on the death certificate (including underlying causes and contributory factors) was **285**. This corresponds to a case fatality rate of **9.0%** (i.e. percentage of all CDAD cases that died with CDAD either as an underlying factor or a contributory factor).

In plot D1 (on case fatality rates where CDAD is mentioned) it can be seen that one hospital (Vale of Leven Hospital) is above the 95% confidence limit with a rate of **31%**, which is significantly higher than expected.

Of those where CDAD was mentioned as a cause of death, **86** were classified as **CDAD as underlying causes corresponding to 2.7% of all CDAD cases**, and **199** were classified **CDAD as contributory factors, corresponding to 6.3% of all CDAD cases**.

In plot D2 (on case fatality rates with CDAD as underlying cause) it can be seen that one hospital (Vale of Leven Hospital) is above the 95% confidence limit with a case fatality rate (for underlying cause of death) of **22.4%**, which is significantly higher than expected.

In plot D3 (on case fatality rates with CDAD as contributory factor) it can be seen that one hospital (Woodend Hospital Aberdeen) hospitals was above the 95% confidence limit with a rate of **12.4%**, which is significantly higher than expected.

Section D – Case fatality

Funnel plot/Table D1 – Case fatality percentage by hospital (December 2007 – May 2008)

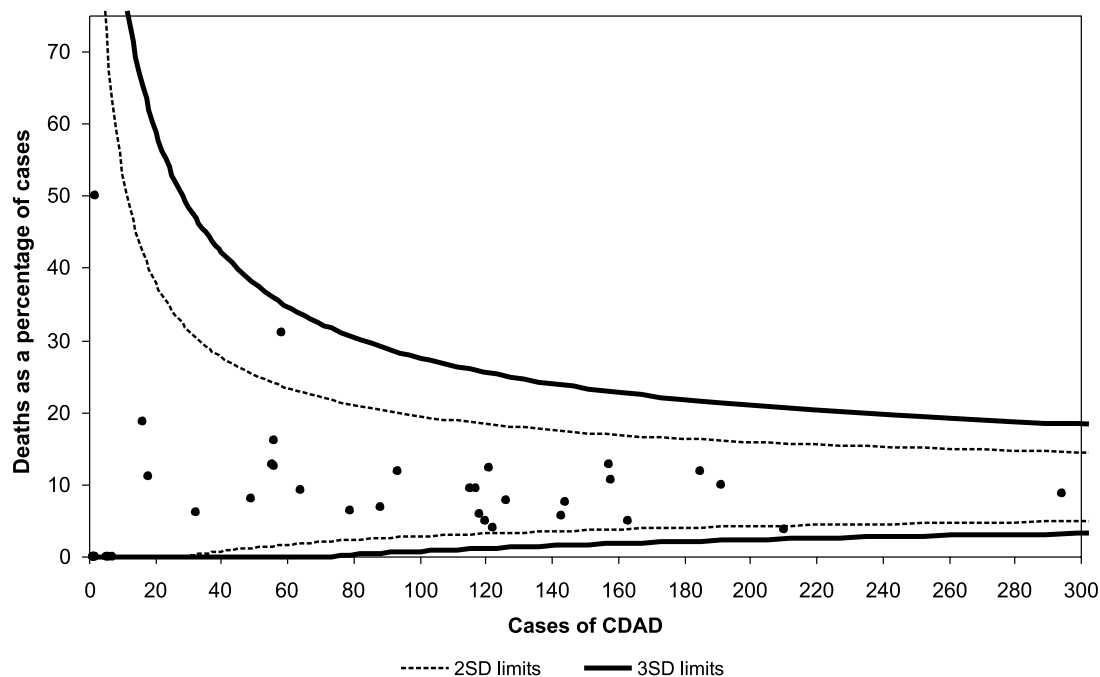


Table D1

NHS board	Hospital	C. diff associated deaths	% of deaths among all reported C. diff cases
Ayrshire & Arran	Crosshouse Hospital (L)	8	5.59
	Ayr Hospital (M)	5	6.33
Borders	Borders General Hospital (M)	7	12.50
Dumfries & Galloway	Dumfries & Galloway Royal Infirmary (M)	4	8.16
	Galloway Community Hospital	3	18.75
Fife	Victoria Hospital (M)	11	11.83
	Forth Park Hospital (S)	0	0.00
	Queen Margaret Hospital (M)	10	7.94
Forth Valley	Falkirk & District Royal Infirmary / Stirling Royal Infirmary (M)	17	10.76
Grampian	Aberdeen Royal Infirmary (L)	26	8.84
	Woodend General Hospital (M)	15	12.40
	Dr Gray's Hospital (S)	2	11.11
Greater Glasgow & Clyde	Glasgow Royal Infirmary (L)	6	5.00
	Stobhill Hospital (L)	7	5.93
	Victoria Infirmary (M)	5	4.10
	Southern General Hospital (L)	11	9.57
Highland	Western Infirmary / Gartnavel General Hospital (L)	22	11.89
	Vale of Leven General Hospital (M)	18	31.03
	Inverclyde Royal Hospital (M)	9	16.07
	Royal Alexandra Hospital (L)	6	6.82
	Caithness General Hospital (S)	0	0.00
Highland	Raigmore Hospital (L)	6	9.38
	Belford Hospital (S)	0	0.00
	Lorn & Islands District General Hospital (S)	1	50.00
Lanarkshire	Monklands District General Hospital (L)	11	9.40
	Hairmyres Hospital (L)	20	12.74
	Wishaw General Hospital (L)	11	7.64
Lothian	Western General Hospital (L)	8	4.91
	St John's Hospital (L)	7	12.73
	Royal Infirmary of Edinburgh at Little France (L)	8	3.81
Orkney	Balfour Hospital (S)	0	0.00
Shetland	Gilbert Bain Hospital (S)	0	0.00
Tayside	Ninewells Hospital (L)	19	9.95
	Perth Royal Infirmary (M)	2	6.25
Western Isles	St Brendan's Cot Hospital (VS)	0	NRC
	Western Isles Hospital (VS)	0	0.00
	Uist & Barra Hospital (VS)	0	0.00
Other	Golden Jubilee National Hospital (S)	0	0.00
TOTAL		285	9.0

Notes: Hospitals highlighted in YELLOW indicate those with rates which lie above the upper 2SD limit defined in the accompanying funnel plot. Those highlighted in RED indicate rates which lie above the upper 3SD range limit.

Funnel plot/Table D2 – Case fatality percentage with CDAD as underlying cause by hospital (December 2007 – May 2008)

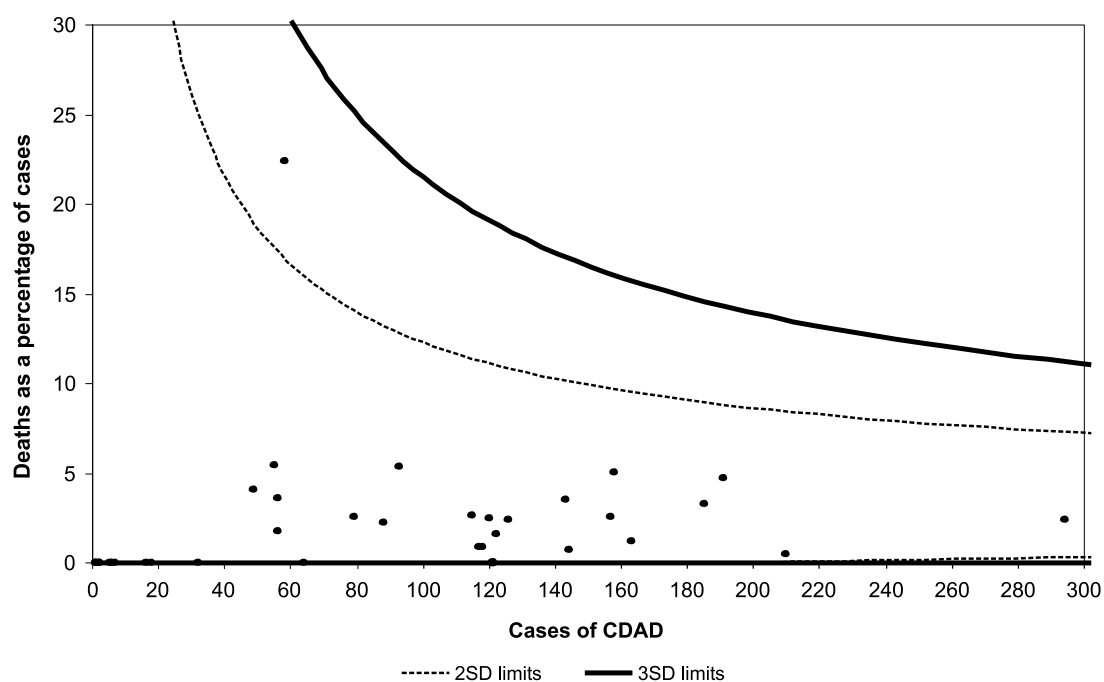


Table D2

NHS board	Hospital	Deaths with CDAD indicated as underlying cause	% of deaths among all reported CDAD cases
Ayrshire & Arran	Crosshouse Hospital (L)	5	3.50
	Ayr Hospital (M)	2	2.53
Borders	Borders General Hospital (M)	1	1.79
Dumfries & Galloway	Dumfries & Galloway Royal Infirmary (M)	2	4.08
	Galloway Community Hospital	0	0.00
Fife	Victoria Hospital (M)	5	5.38
	Forth Park Hospital (S)	0	0.00
	Queen Margaret Hospital (M)	3	2.38
Forth Valley	Falkirk & District Royal Infirmary / Stirling Royal Infirmary (M)	8	5.06
Grampian	Aberdeen Royal Infirmary (L)	7	2.38
	Woodend General Hospital (M)	0	0.00
	Dr Gray's Hospital (S)	0	0.00
Greater Glasgow & Clyde	Glasgow Royal Infirmary (L)	3	2.50
	Stobhill Hospital (L)	1	0.85
	Victoria Infirmary (M)	2	1.64
	Southern General Hospital (L)	3	2.61
	Western Infirmary / Gartnavel General Hospital (L)	6	3.24
	Vale of Leven General Hospital (M)	13	22.41
	Inverclyde Royal Hospital (M)	2	3.57
Royal Alexandra Hospital (L)	2	2.27	
Highland	Caithness General Hospital (S)	0	0.00
	Raigmore Hospital (L)	0	0.00
	Belford Hospital (S)	0	0.00
	Lorn & Islands District General Hospital (S)	0	0.00
Lanarkshire	Monklands District General Hospital (L)	1	0.85
	Hairmyres Hospital (L)	4	2.55
	Wishaw General Hospital (L)	1	0.69
Lothian	Western General Hospital (L)	2	1.23
	St John's Hospital (L)	3	5.45
	Royal Infirmary of Edinburgh at Little France (L)	1	0.48
Orkney	Balfour Hospital (S)	0	0.00
Shetland	Gilbert Bain Hospital (S)	0	0.00
Tayside	Ninewells Hospital (L)	9	4.71
	Perth Royal Infirmary (M)	0	0.00
Western Isles	St Brendan's Cot Hospital (VS)	0	NRC
	Western Isles Hospital (VS)	0	0.00
	Uist & Barra Hospital (VS)	0	0.00
Other	Golden Jubilee National Hospital (S)	0	0.00
TOTAL		86	2.71

Notes: Hospitals highlighted in YELLOW indicate those with rates which lie above the upper 2SD limit defined in the accompanying funnel plot. Those highlighted in RED indicate rates which lie above the upper 3SD range limit. NRC denotes No Reported Cases

Funnel plot/Table D3 – Case fatality percentage with CDAD as contributory cause by hospital (December 2007 – May 2008)

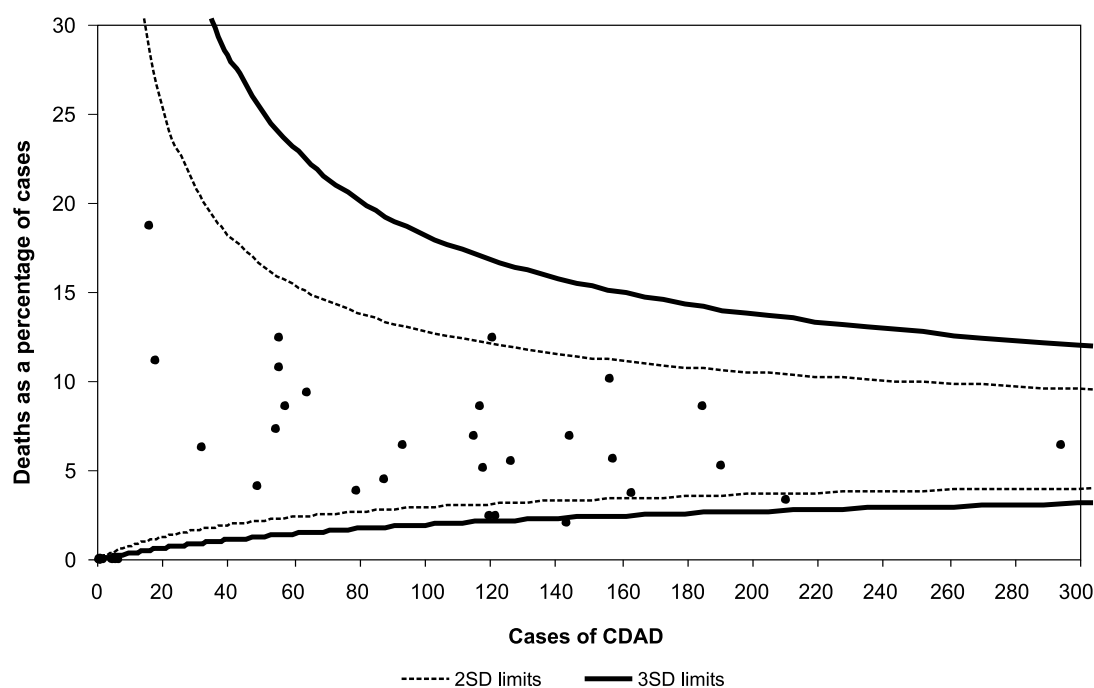


Table D3

NHS board	Hospital	Deaths with CDAD indicated as contributory cause	% of deaths among all reported CDAD cases
Ayrshire & Arran	Crosshouse Hospital (L)	3	2.10
	Ayr Hospital (M)	3	3.80
Borders	Borders General Hospital (M)	6	10.71
Dumfries & Galloway	Dumfries & Galloway Royal Infirmary (M)	2	4.08
	Galloway Community Hospital	3	18.75
Fife	Victoria Hospital (M)	6	6.45
	Forth Park Hospital (S)	0	0.00
	Queen Margaret Hospital (M)	7	5.56
Forth Valley	Falkirk & District Royal Infirmary / Stirling Royal Infirmary (M)	9	5.70
Grampian	Aberdeen Royal Infirmary (L)	19	6.46
	Woodend General Hospital (M)	15	12.40
	Dr Gray's Hospital (S)	2	11.11
Greater Glasgow & Clyde	Glasgow Royal Infirmary (L)	3	2.50
	Stobhill Hospital (L)	6	5.08
	Victoria Infirmary (M)	3	2.46
	Southern General Hospital (L)	8	6.96
	Western Infirmary / Gartnavel General Hospital (L)	16	8.65
	Vale of Leven General Hospital (M)	5	8.62
	Inverclyde Royal Hospital (M)	7	12.50
	Royal Alexandra Hospital (L)	4	4.55
Highland	Caitness General Hospital (S)	0	0.00
	Raigmore Hospital (L)	6	9.38
	Belford Hospital (S)	0	0.00
	Lorn & Islands District General Hospital (S)	1	50.00
Lanarkshire	Monklands District General Hospital (L)	10	8.55
	Hairmyres Hospital (L)	16	10.19
	Wishaw General Hospital (L)	10	6.94
Lothian	Western General Hospital (L)	6	3.68
	St John's Hospital (L)	4	7.27
	Royal Infirmary of Edinburgh at Little France (L)	7	3.33
Orkney	Balfour Hospital (S)	0	0.00
Shetland	Gilbert Bain Hospital (S)	0	0.00
Tayside	Ninewells Hospital (L)	10	5.24
	Perth Royal Infirmary (M)	2	6.25
Western Isles	St Brendan's Cot Hospital (VS)	0	NRC
	Western Isles Hospital (VS)	0	0.00
	Uist & Barra Hospital (VS)	0	0.00
Other	Golden Jubilee National Hospital (S)	0	0.00
TOTAL		199	6.27

Notes: Hospitals highlighted in YELLOW indicate those with rates which lie above the upper 2SD limit defined in the accompanying funnel plot. Those highlighted in RED indicate rates which lie above the upper 3SD range limit. NRC denotes No Reported Cases. Due to scaling, the data point for Lorn & Island District General doesn't appear on the funnel plot.

Section E – CDAD associated case fatality rates where CDAD is mentioned for all ages by month

The case fatality rate where CDAD was mentioned (i.e. percentage of all CDAD cases that died with CDAD either as an underlying factor or contributory factor) were estimated for each of the 6 months of the study.

The overall case fatality rate (for all hospitals) where CDAD was mentioned for all ages was **9.4%** for December 2007, **9.4%** for January 2008, **11.3%** for February 2008, **8.4%** for March 2008, **8.1%** for April 2008 and **7.4%** for May 2008 (all cases per 1000 AOBs).

In plot E2 (on case fatality rates, CDAD mentioned, all ages, January 2008) one hospital (Vale of Leven Hospital) is well above the 95% confidence limit (almost on the 99.8% limit) with a case fatality rate of **50%**, which is significantly higher than expected.

In plot E4 (on case fatality rates, CDAD mentioned, all ages, March 2008) one hospital (Vale of Leven Hospital) is well above the 95% confidence limit (on the 99.8% limit) with a case fatality rate of **75%**, which is significantly higher than expected.

In Table E6 (supporting plot E6) one hospital (Lorn and Islands District General Hospital, Highland) had a single case of CDAD and one death. This results in a 100% case fatality, but as it was based on only one case it was not considered an outlier.

In December, February, April and May no hospitals were above the 95% confidence limit.

Section E – Case fatality by month

Funnel plot/Table E1 – Case fatality percentage by hospital (December 2007)

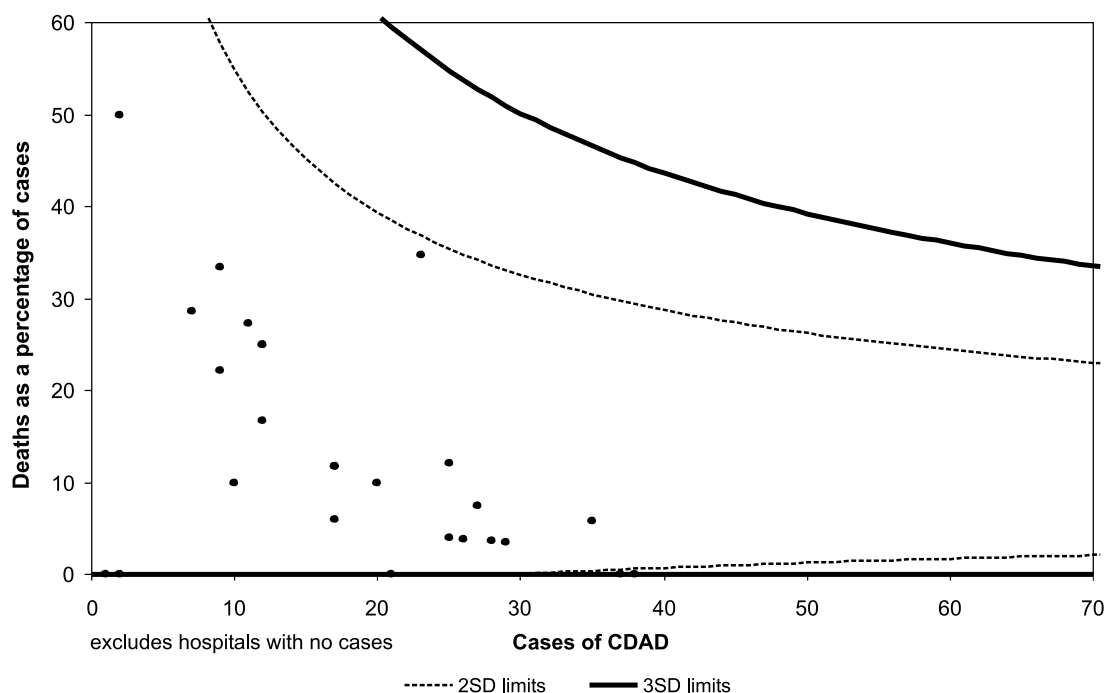


Table E1

NHS board	Hospital	C. diff associated deaths	% of deaths among all reported C. diff cases
Ayrshire & Arran	Crosshouse Hospital (L)	1	5.88
	Ayr Hospital (M)	2	16.67
Borders	Borders General Hospital (M)	2	22.22
Dumfries & Galloway	Dumfries & Galloway Royal Infirmary (M)	1	10.00
	Galloway Community Hospital	0	0.00
Fife	Victoria Hospital (M)	3	33.33
	Forth Park Hospital (S)	0	NRC
	Queen Margaret Hospital (M)	2	11.76
Forth Valley	Falkirk & District Royal Infirmary / Stirling Royal Infirmary (M)	2	11.76
Grampian	Aberdeen Royal Infirmary (L)	0	0.00
	Woodend General Hospital (M)	0	0.00
	Dr Gray's Hospital (S)	1	50.00
Greater Glasgow & Clyde	Glasgow Royal Infirmary (L)	1	3.45
	Stobhill Hospital (L)	1	4.00
	Victoria Infirmary (M)	0	0.00
	Southern General Hospital (L)	2	7.41
	Western Infirmary / Gartnavel General Hospital (L)	8	34.78
	Vale of Leven General Hospital (M)	3	27.27
	Inverclyde Royal Hospital (M)	3	25.00
Royal Alexandra Hospital (L)	2	28.57	
Highland	Caithness General Hospital (S)	0	NRC
	Raigmore Hospital (L)	2	11.76
	Belford Hospital (S)	0	NRC
	Lorn & Islands District General Hospital (S)	0	NRC
Lanarkshire	Monklands District General Hospital (L)	1	3.57
	Hairmyres Hospital (L)	2	10.00
	Wishaw General Hospital (L)	3	12.00
Lothian	Western General Hospital (L)	1	3.85
	St John's Hospital (L)	3	25.00
	Royal Infirmary of Edinburgh at Little France (L)	0	0.00
Orkney	Balfour Hospital (S)	0	NRC
Shetland	Gilbert Bain Hospital (S)	0	NRC
Tayside	Ninewells Hospital (L)	2	5.71
	Perth Royal Infirmary (M)	0	0.00
Western Isles	St Brendan's Cot Hospital (VS)	0	NRC
	Western Isles Hospital (VS)	0	0.00
	Uist & Barra Hospital (VS)	0	NRC
Other	Golden Jubilee National Hospital (S)	0	NRC
TOTAL		48	9.41

Notes: Hospitals highlighted in YELLOW indicate those with rates which lie above the upper 2SD limit defined in the accompanying funnel plot. Those highlighted in RED indicate rates which lie above the upper 3SD range limit. NRC denotes No Reported Cases.

Funnel plot/Table E2 – Case fatality percentage by hospital (January 2008)

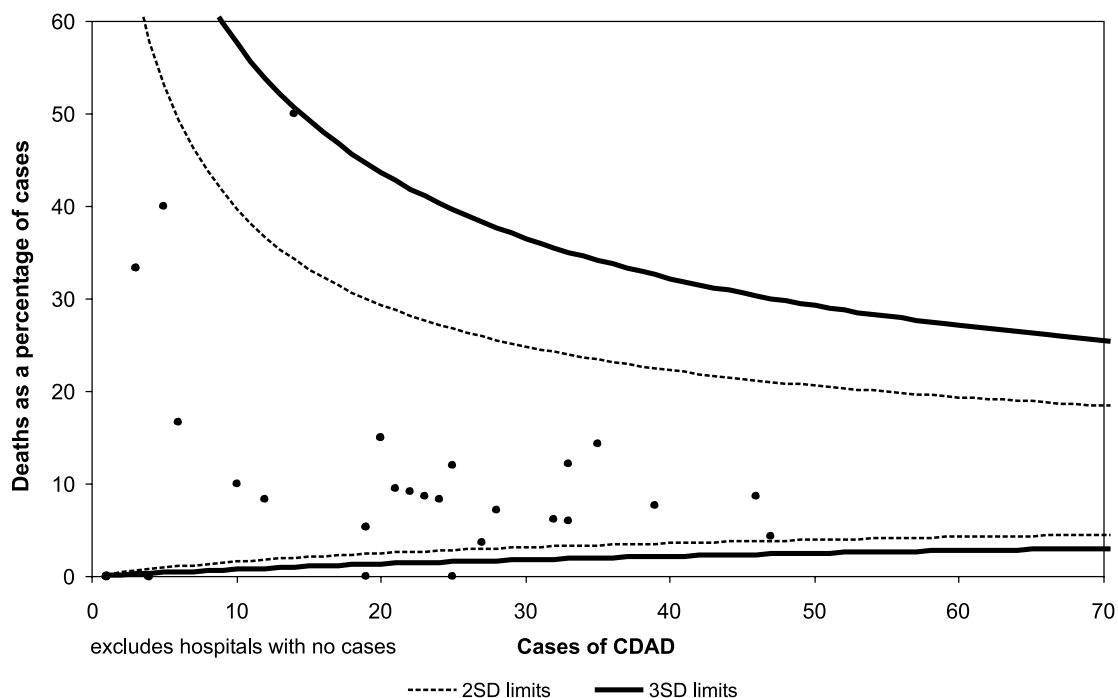


Table E2

NHS board	Hospital	C. diff associated deaths	% of deaths among all reported C. diff cases
Ayrshire & Arran	Crosshouse Hospital (L)	2	6.06
	Ayr Hospital (M)	0	0.00
Borders	Borders General Hospital (M)	1	5.26
Dumfries & Galloway	Dumfries & Galloway Royal Infirmary (M)	2	40.00
	Galloway Community Hospital	1	33.33
Fife	Victoria Hospital (M)	2	8.33
	Forth Park Hospital (S)	0	NRC
	Queen Margaret Hospital (M)	2	7.14
Forth Valley	Falkirk & District Royal Infirmary / Stirling Royal Infirmary (M)	2	6.25
Grampian	Aberdeen Royal Infirmary (L)	2	4.26
	Woodend General Hospital (M)	3	15.00
	Dr Gray's Hospital (S)	0	0.00
Greater Glasgow & Clyde	Glasgow Royal Infirmary (L)	0	0.00
	Stobhill Hospital (L)	1	5.26
	Victoria Infirmary (M)	2	9.52
	Southern General Hospital (L)	3	12.00
	Western Infirmary / Gartnavel General Hospital (L)	4	8.70
	Vale of Leven General Hospital (M)	7	50.00
	Inverclyde Royal Hospital (M)	1	16.67
Royal Alexandra Hospital (L)	1	3.70	
Highland	Caithness General Hospital (S)	0	0.00
	Raigmore Hospital (L)	1	8.33
	Belford Hospital (S)	0	0.00
	Lorn & Islands District General Hospital (S)	0	NRC
Lanarkshire	Monklands District General Hospital (L)	3	15.00
	Hairmyres Hospital (L)	5	14.29
	Wishaw General Hospital (L)	2	9.09
Lothian	Western General Hospital (L)	2	8.70
	St John's Hospital (L)	1	10.00
	Royal Infirmary of Edinburgh at Little France (L)	3	7.69
Orkney	Balfour Hospital (S)	0	0.00
Shetland	Gilbert Bain Hospital (S)	0	NRC
Tayside	Ninewells Hospital (L)	4	12.12
	Perth Royal Infirmary (M)	1	33.33
Western Isles	St Brendan's Cot Hospital (VS)	0	NRC
	Western Isles Hospital (VS)	0	NRC
	Uist & Barra Hospital (VS)	0	NRC
Other	Golden Jubilee National Hospital (S)	0	NRC
TOTAL		58	9.40

Notes: Hospitals highlighted in YELLOW indicate those with rates which lie above the upper 2SD limit defined in the accompanying funnel plot. Those highlighted in RED indicate rates which lie above the upper 3SD range limit. NRC denotes No Reported Cases

Funnel plot/Table E3 – Case fatality percentage by hospital (February 2008)

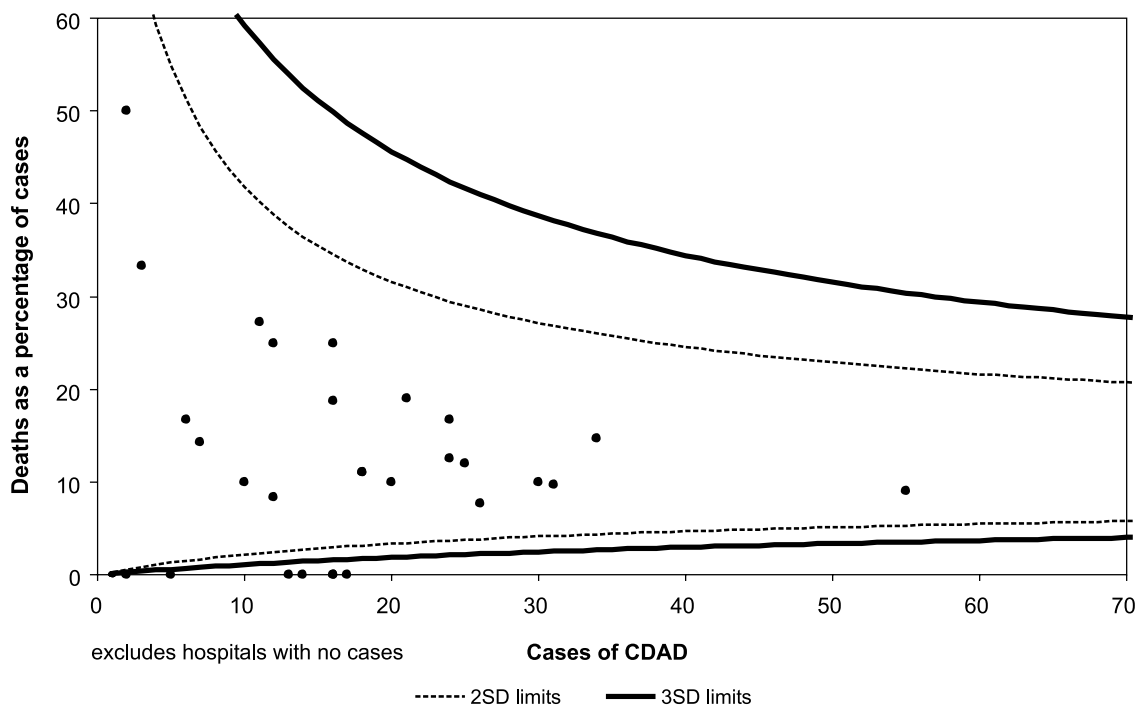


Table E3

NHS board	Hospital	C. diff associated deaths	% of deaths among all reported C. diff cases
Ayrshire & Arran	Crosshouse Hospital (L)	0	0.00
	Ayr Hospital (M)	1	8.33
Borders	Borders General Hospital (M)	1	16.67
Dumfries & Galloway	Dumfries & Galloway Royal Infirmary (M)	0	0.00
	Galloway Community Hospital	1	50.00
Fife	Victoria Hospital (M)	4	16.67
	Forth Park Hospital (S)	0	NRC
	Queen Margaret Hospital (M)	2	11.11
Forth Valley	Falkirk & District Royal Infirmary / Stirling Royal Infirmary (M)	4	19.05
Grampian	Aberdeen Royal Infirmary (L)	5	9.09
	Woodend General Hospital (M)	4	25.00
	Dr Gray's Hospital (S)	1	33.33
Greater Glasgow & Clyde	Glasgow Royal Infirmary (L)	3	12.50
	Stobhill Hospital (L)	0	0.00
	Victoria Infirmary (M)	2	11.11
	Southern General Hospital (L)	3	18.75
	Western Infirmary / Gartnavel General Hospital (L)	2	7.69
	Vale of Leven General Hospital (M)	3	27.27
	Inverclyde Royal Hospital (M)	3	25.00
	Royal Alexandra Hospital (L)	0	0.00
Highland	Caithness General Hospital (S)	0	0.00
	Raigmore Hospital (L)	1	10.00
	Belford Hospital (S)	0	NRC
	Lorn & Islands District General Hospital (S)	0	0.00
Lanarkshire	Monklands District General Hospital (L)	0	0.00
	Hairmyres Hospital (L)	2	10.00
	Wishaw General Hospital (L)	3	9.68
Lothian	Western General Hospital (L)	3	12.00
	St John's Hospital (L)	0	0.00
	Royal Infirmary of Edinburgh at Little France (L)	3	10.00
Orkney	Balfour Hospital (S)	0	NRC
Shetland	Gilbert Bain Hospital (S)	0	0.00
Tayside	Ninewells Hospital (L)	5	14.71
	Perth Royal Infirmary (M)	1	14.29
Western Isles	St Brendan's Cot Hospital (VS)	0	NRC
	Western Isles Hospital (VS)	0	0.00
	Uist & Barra Hospital (VS)	0	0.00
Other	Golden Jubilee National Hospital (S)	0	NRC
TOTAL		57	11.29

Notes: Hospitals highlighted in YELLOW indicate those with rates which lie above the upper 2SD limit defined in the accompanying funnel plot. Those highlighted in RED indicate rates which lie above the upper 3SD range limit. NRC denotes No Reported Cases

Funnel plot/Table E4 – Case fatality percentage by hospital (March 2008)

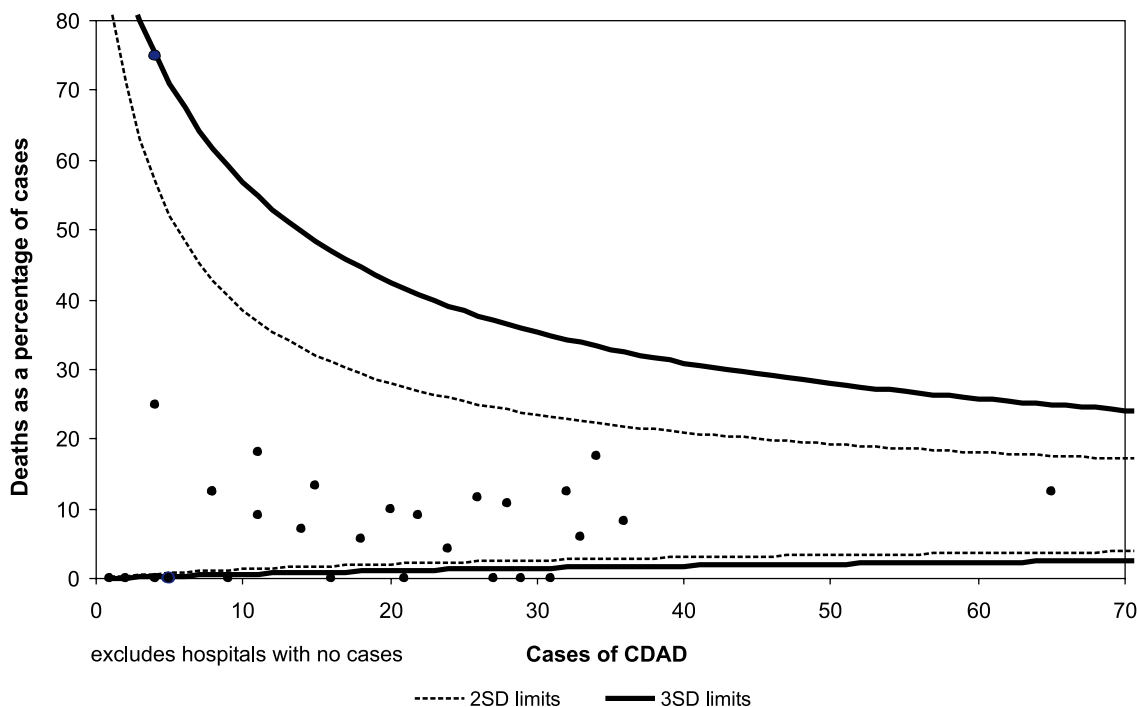


Table E4

NHS board	Hospital	C. diff associated deaths	% of deaths among all reported C. diff cases
Ayrshire & Arran	Crosshouse Hospital (L)	3	10.71
	Ayr Hospital (M)	1	12.50
Borders	Borders General Hospital (M)	1	12.50
Dumfries & Galloway	Dumfries & Galloway Royal Infirmary (M)	0	0.00
	Galloway Community Hospital	1	25.00
Fife	Victoria Hospital (M)	1	7.14
	Forth Park Hospital (S)	0	NRC
	Queen Margaret Hospital (M)	2	9.09
Forth Valley	Falkirk & District Royal Infirmary / Stirling Royal Infirmary (M)	4	12.50
Grampian	Aberdeen Royal Infirmary (L)	8	12.31
	Woodend General Hospital (M)	1	4.17
	Dr Gray's Hospital (S)	0	0.00
Greater Glasgow & Clyde	Glasgow Royal Infirmary (L)	2	10.00
	Stobhill Hospital (L)	0	0.00
	Victoria Infirmary (M)	0	0.00
	Southern General Hospital (L)	1	5.56
	Western Infirmary / Gartnavel General Hospital (L)	3	8.33
	Vale of Leven General Hospital (M)	3	75.00
	Inverclyde Royal Hospital (M)	0	0.00
Royal Alexandra Hospital (L)	2	13.33	
Highland	Caithness General Hospital (S)	0	0.00
	Raigmore Hospital (L)	2	18.18
	Belford Hospital (S)	0	0.00
	Lorn & Islands District General Hospital (S)	0	NRC
Lanarkshire	Monklands District General Hospital (L)	3	11.54
	Hairmyres Hospital (L)	6	17.65
	Wishaw General Hospital (L)	0	0.00
Lothian	Western General Hospital (L)	0	0.00
	St John's Hospital (L)	1	9.09
	Royal Infirmary of Edinburgh at Little France (L)	0	0.00
Orkney	Balfour Hospital (S)	0	NRC
Shetland	Gilbert Bain Hospital (S)	0	NRC
Tayside	Ninewells Hospital (L)	2	6.06
	Perth Royal Infirmary (M)	0	0.00
Western Isles	St Brendan's Cot Hospital (VS)	0	NRC
	Western Isles Hospital (VS)	0	NRC
	Uist & Barra Hospital (VS)	0	NRC
Other	Golden Jubilee National Hospital (S)	0	NRC
TOTAL		47	8.35

Notes: Hospitals highlighted in YELLOW indicate those with rates which lie above the upper 2SD limit defined in the accompanying funnel plot. Those highlighted in RED indicate rates which lie above the upper 3SD range limit. NRC denotes No Reported Cases

Funnel plot/Table E5 – Case fatality percentage by hospital (April 2008)

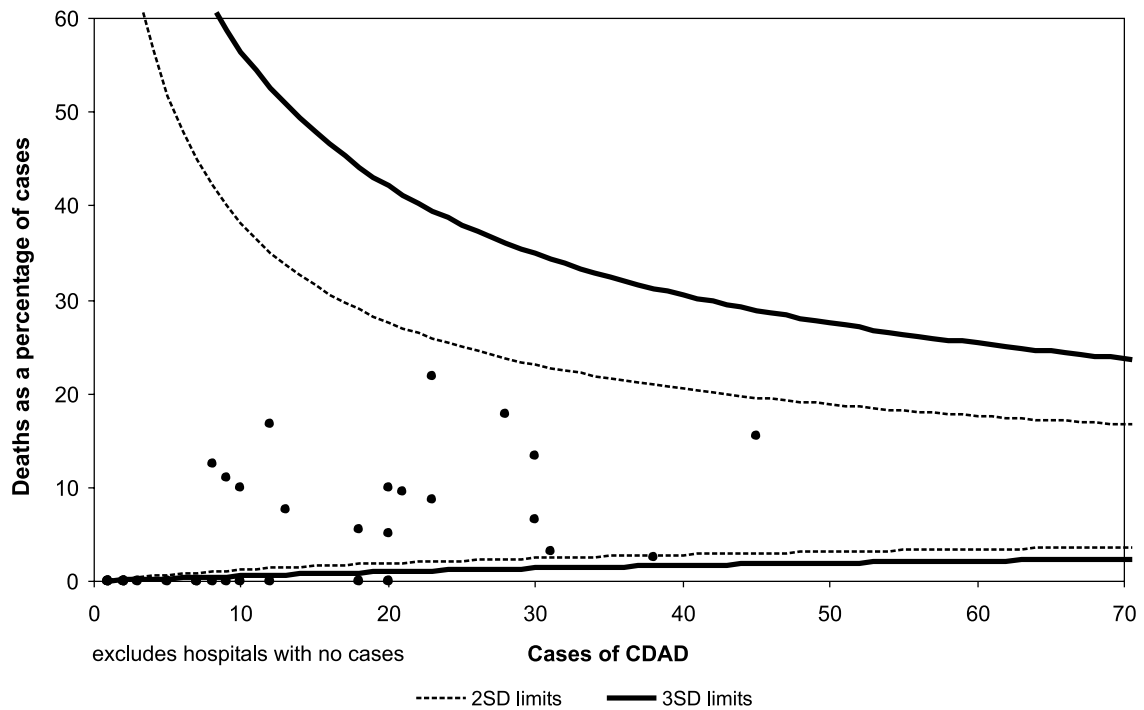


Table E5

NHS board	Hospital	C. diff associated deaths	% of deaths among all reported C. diff cases
Ayrshire & Arran	Crosshouse Hospital (L)	1	5.00
	Ayr Hospital (M)	0	0.00
Borders	Borders General Hospital (M)	1	12.50
Dumfries & Galloway	Dumfries & Galloway Royal Infirmary (M)	0	0.00
	Galloway Community Hospital	0	0.00
Fife	Victoria Hospital (M)	1	5.56
	Forth Park Hospital (S)	0	0.00
	Queen Margaret Hospital (M)	2	10.00
Forth Valley	Falkirk & District Royal Infirmary / Stirling Royal Infirmary (M)	5	17.86
Grampian	Aberdeen Royal Infirmary (L)	7	15.56
	Woodend General Hospital (M)	5	21.74
	Dr Gray's Hospital (S)	0	0.00
Greater Glasgow & Clyde	Glasgow Royal Infirmary (L)	0	0.00
	Stobhill Hospital (L)	2	8.70
	Victoria Infirmary (M)	0	0.00
	Southern General Hospital (L)	1	7.69
	Western Infirmary / Gartnavel General Hospital (L)	2	6.67
	Vale of Leven General Hospital (M)	1	10.00
	Inverclyde Royal Hospital (M)	0	0.00
	Royal Alexandra Hospital (L)	0	0.00
Highland	Caithness General Hospital (S)	0	0.00
	Raigmore Hospital (L)	0	0.00
	Belford Hospital (S)	0	0.00
	Lorn & Islands District General Hospital (S)	0	NRC
Lanarkshire	Monklands District General Hospital (L)	1	11.11
	Hairmyres Hospital (L)	2	9.52
	Wishaw General Hospital (L)	0	0.00
Lothian	Western General Hospital (L)	1	3.23
	St John's Hospital (L)	2	16.67
	Royal Infirmary of Edinburgh at Little France (L)	1	2.63
Orkney	Balfour Hospital (S)	0	NRC
Shetland	Gilbert Bain Hospital (S)	0	NRC
Tayside	Ninewells Hospital (L)	4	13.33
	Perth Royal Infirmary (M)	0	0.00
Western Isles	St Brendan's Cot Hospital (VS)	0	NRC
	Western Isles Hospital (VS)	0	0.00
	Uist & Barra Hospital (VS)	0	NRC
Other	Golden Jubilee National Hospital (S)	0	0.00
TOTAL		39	8.06

Notes: Hospitals highlighted in YELLOW indicate those with rates which lie above the upper 2SD limit defined in the accompanying funnel plot. Those highlighted in RED indicate rates which lie above the upper 3SD range limit. NRC denotes No Reported Cases

Funnel plot/Table E6 – Case fatality percentage by hospital (May 2008)

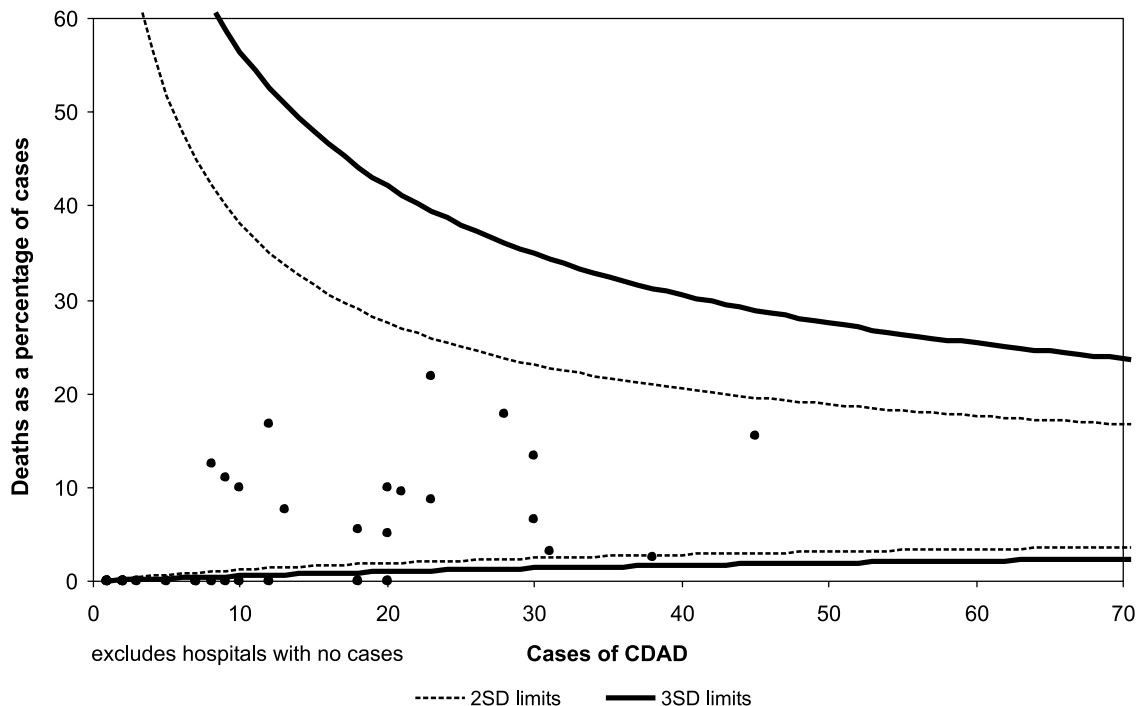


Table E6

NHS board	Hospital	<i>C. diff</i> associated deaths	% of deaths among all reported <i>C. diff</i> cases
Ayrshire & Arran	Crosshouse Hospital (L)	1	3.45
	Ayr Hospital (M)	1	10.00
Borders	Borders General Hospital (M)	1	16.67
Dumfries & Galloway	Dumfries & Galloway Royal Infirmary (M)	1	11.11
	Galloway Community Hospital	0	0.00
Fife	Victoria Hospital (M)	0	0.00
	Forth Park Hospital (S)	0	NRC
	Queen Margaret Hospital (M)	0	0.00
Forth Valley	Falkirk & District Royal Infirmary / Stirling Royal Infirmary (M)	0	0.00
Grampian	Aberdeen Royal Infirmary (L)	4	8.89
	Woodend General Hospital (M)	2	11.76
	Dr Gray's Hospital (S)	0	0.00
Greater Glasgow & Clyde	Glasgow Royal Infirmary (L)	0	0.00
	Stobhill Hospital (L)	3	15.79
	Victoria Infirmary (M)	1	3.85
	Southern General Hospital (L)	1	6.25
	Western Infirmary / Garthavel General Hospital (L)	3	12.50
	Vale of Leven General Hospital (M)	1	12.50
	Inverclyde Royal Hospital (M)	2	22.22
	Royal Alexandra Hospital (L)	1	7.69
Highland	Caithness General Hospital (S)	0	NRC
	Raigmore Hospital (L)	0	0.00
	Belford Hospital (S)	0	0.00
	Lorn & Islands District General Hospital (S)	1	100.00
Lanarkshire	Monklands District General Hospital (L)	3	17.65
	Hairmyres Hospital (L)	3	11.11
	Wishaw General Hospital (L)	3	12.00
Lothian	Western General Hospital (L)	1	3.45
	St John's Hospital (L)	0	0.00
	Royal Infirmary of Edinburgh at Little France (L)	1	2.94
Orkney	Balfour Hospital (S)	0	NRC
Shetland	Gilbert Bain Hospital (S)	0	NRC
Tayside	Ninewells Hospital (L)	2	7.69
	Perth Royal Infirmary (M)	0	0.00
Western Isles	St Brendan's Cot Hospital (VS)	0	NRC
	Western Isles Hospital (VS)	0	0.00
	Uist & Barra Hospital (VS)	0	NRC
Other	Golden Jubilee National Hospital (S)	0	0.00
TOTAL		36	7.39

Notes: Hospitals highlighted in YELLOW indicate those with rates which lie above the upper 2SD limit defined in the accompanying funnel plot. Those highlighted in RED indicate rates which lie above the upper 3SD range limit. NRC denotes No Reported Cases

Section F – CDAD associated mortality rates in relation to hospital activity for all ages

The overall mortality rate in relation to hospital activity (i.e. AOBs) for all hospitals where **CDAD was mentioned** was **0.14** per 1000 AOBs. For deaths where **CDAD was the underlying cause** it was **0.04** per 1000 AOBs, and for deaths where **CDAD was a contributory factor** it was **0.10** per 1000 AOBs.

In plot F1 (on deaths where CDAD was mentioned) one hospital (Vale of Leven Hospital) lies above the 95% confidence limit with a case fatality rate of **0.77** per 1000 AOBs, which is significantly higher than expected.

In plot F2 (on deaths where CDAD was the underlying cause) one hospital (Vale of Leven Hospital) is above the 95% confidence limit with a case fatality rate of **0.56** per 1000 AOBs, which is significantly higher than expected.

In plot F3 (on deaths where CDAD was a contributory cause) no outliers are seen.

Section F – Mortality rates

Funnel plot/Table F1 – Mortality rate per 1000 acute occupied bed days (all CDAD) by hospital (December 2007 – May 2008)

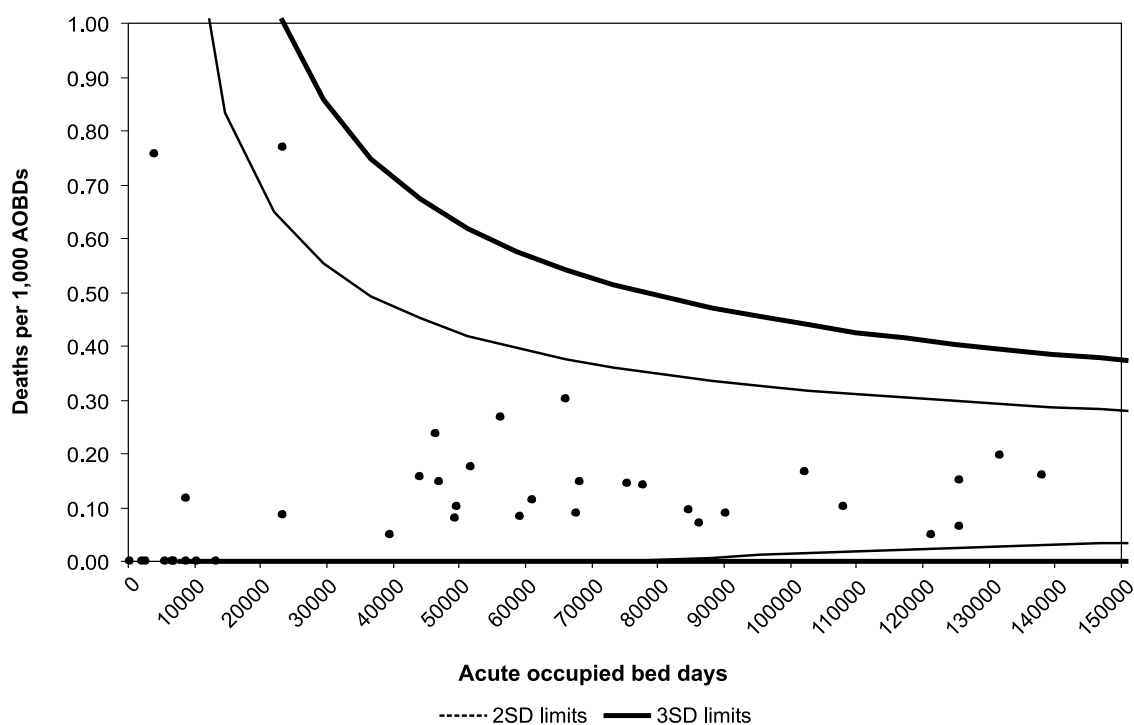


Table F1

NHS board	Hospital	CDAD associated deaths	Total acute occupied bed days (AOBD)	Mortality rate per 1000 AOBDS
Ayrshire & Arran	Crosshouse Hospital (L)	8	84705	0.09
	Ayr Hospital (M)	5	49773	0.10
Borders	Borders General Hospital (M)	7	47097	0.15
Dumfries & Galloway	Dumfries & Galloway Royal Infirmary (M)	4	49508	0.08
	Galloway Community Hospital	3	3956	0.76
Fife	Victoria Hospital (M)	11	46467	0.24
	Forth Park Hospital (S)	0	2087	0.00
	Queen Margaret Hospital (M)	10	68175	0.15
Forth Valley	Falkirk & District Royal Infirmary / Stirling Royal Infirmary (M)	17	102230	0.17
Grampian	Aberdeen Royal Infirmary (L)	26	131684	0.20
	Woodend General Hospital (M)	15	56223	0.27
	Dr Gray's Hospital (S)	2	23330	0.09
Greater Glasgow & Clyde	Glasgow Royal Infirmary (L)	6	121109	0.05
	Stobhill Hospital (L)	7	60964	0.11
	Victoria Infirmary (M)	5	59161	0.08
	Southern General Hospital (L)	11	108133	0.10
	Western Infirmary / Gartnavel General Hospital (L)	22	138025	0.16
	Vale of Leven General Hospital (M)	18	23412	0.77
	Inverclyde Royal Hospital (M)	9	51673	0.17
	Royal Alexandra Hospital (L)	6	86367	0.07
Highland	Caithness General Hospital (S)	0	10366	0.00
	Raigmore Hospital (L)	6	67646	0.09
	Belford Hospital (S)	0	6866	0.00
	Lorn & Islands District General Hospital (S)	1	8667	0.12
Lanarkshire	Monklands District General Hospital (L)	11	77883	0.14
	Hairmyres Hospital (L)	20	66208	0.30
	Wishaw General Hospital (L)	11	75438	0.15
Lothian	Western General Hospital (L)	8	90286	0.09
	St John's Hospital (L)	7	44185	0.16
	Royal Infirmary of Edinburgh at Little France (L)	8	125675	0.06
Orkney	Balfour Hospital (S)	0	6734	0.00
Shetland	Gilbert Bain Hospital (S)	0	5628	0.00
Tayside	Ninewells Hospital (L)	19	125674	0.15
	Perth Royal Infirmary (M)	2	39609	0.05
Western Isles	St Brendan's Cot Hospital (VS)	0	256	0.00
	Western Isles Hospital (VS)	0	13377	0.00
	Uist & Barra Hospital (VS)	0	2680	0.00
Other	Golden Jubilee National Hospital (S)	0	8878	0.00
TOTAL		285	2090135	0.14

Notes: Hospitals highlighted in YELLOW indicate those with rates which lie above the upper 2SD limit defined in the accompanying funnel plot. Those highlighted in RED indicate rates which lie above the upper 3SD range limit.

Funnel plot/Table F2 – Mortality rate per 1000 acute occupied bed days with CDAD as underlying cause by hospital (December 2007 – May 2008)

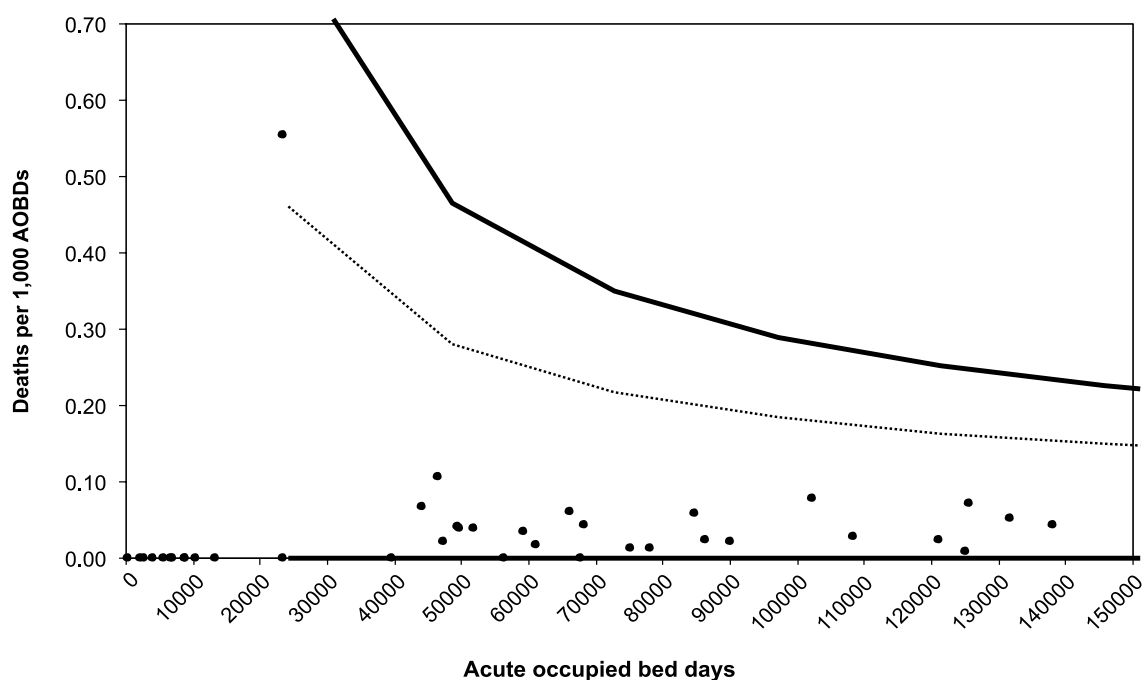


Table F2

NHS board	Hospital	Deaths among cases with CDAD indicated as underlying cause	Total acute occupied bed days (AOBD)	Mortality rate per 1000 AOBBD
Ayrshire & Arran	Crosshouse Hospital (L)	5	84705	0.06
	Ayr Hospital (M)	2	49773	0.04
Borders	Borders General Hospital (M)	1	47097	0.02
Dumfries & Galloway	Dumfries & Galloway Royal Infirmary (M)	2	49508	0.04
	Galloway Community Hospital (S)	0	3956	0.00
Fife	Victoria Hospital (M)	5	46467	0.11
	Forth Park Hospital (S)	0	2087	0.00
	Queen Margaret Hospital (M)	3	68175	0.04
Forth Valley	Falkirk & District Royal Infirmary / Stirling Royal Infirmary (M)	8	102230	0.08
Grampian	Aberdeen Royal Infirmary (L)	7	131684	0.05
	Woodend General Hospital (M)	0	56223	0.00
	Dr Gray's Hospital (S)	0	23330	0.00
Greater Glasgow & Clyde	Glasgow Royal Infirmary (L)	3	121109	0.02
	Stobhill Hospital (L)	1	60964	0.02
	Victoria Infirmary (M)	2	59161	0.03
	Southern General Hospital (L)	3	108133	0.03
	Western Infirmary / Gartnavel General Hospital (L)	6	138025	0.04
	Vale of Leven General Hospital (M)	13	23412	0.56
	Inverclyde Royal Hospital (M)	2	51673	0.04
Royal Alexandra Hospital (L)	2	86367	0.02	
Highland	Caithness General Hospital (S)	0	10366	0.00
	Raigmore Hospital (L)	0	67646	0.00
	Belford Hospital (S)	0	6866	0.00
	Lorn & Islands District General Hospital (S)	0	8667	0.00
Lanarkshire	Monklands District General Hospital (L)	1	77883	0.01
	Hairmyres Hospital (L)	4	66208	0.06
	Wishaw General Hospital (L)	1	75438	0.01
Lothian	Western General Hospital (L)	2	90286	0.02
	St John's Hospital (L)	3	44185	0.07
	Royal Infirmary of Edinburgh at Little France (L)	1	125675	0.01
Orkney	Balfour Hospital (S)	0	6734	0.00
Shetland	Gilbert Bain Hospital (S)	0	5628	0.00
Tayside	Ninewells Hospital (L)	9	125674	0.07
	Perth Royal Infirmary (M)	0	39609	0.00
Western Isles	St Brendan's Cot Hospital (VS)	0	256	0.00
	Western Isles Hospital (VS)	0	13377	0.00
	Uist & Barra Hospital (VS)	0	2680	0.00
Other	Golden Jubilee National Hospital (S)	0	8878	0.00
TOTAL		86	2090135	0.04

Notes: Hospitals highlighted in YELLOW indicate those with rates which lie above the upper 2SD limit defined in the accompanying funnel plot. Those highlighted in RED indicate rates which lie above the upper 3SD range limit.

Funnel plot/Table F3 – Mortality rate per 1000 acute occupied bed days with CDAD as contributory cause by hospital (December 2007 – May 2008)

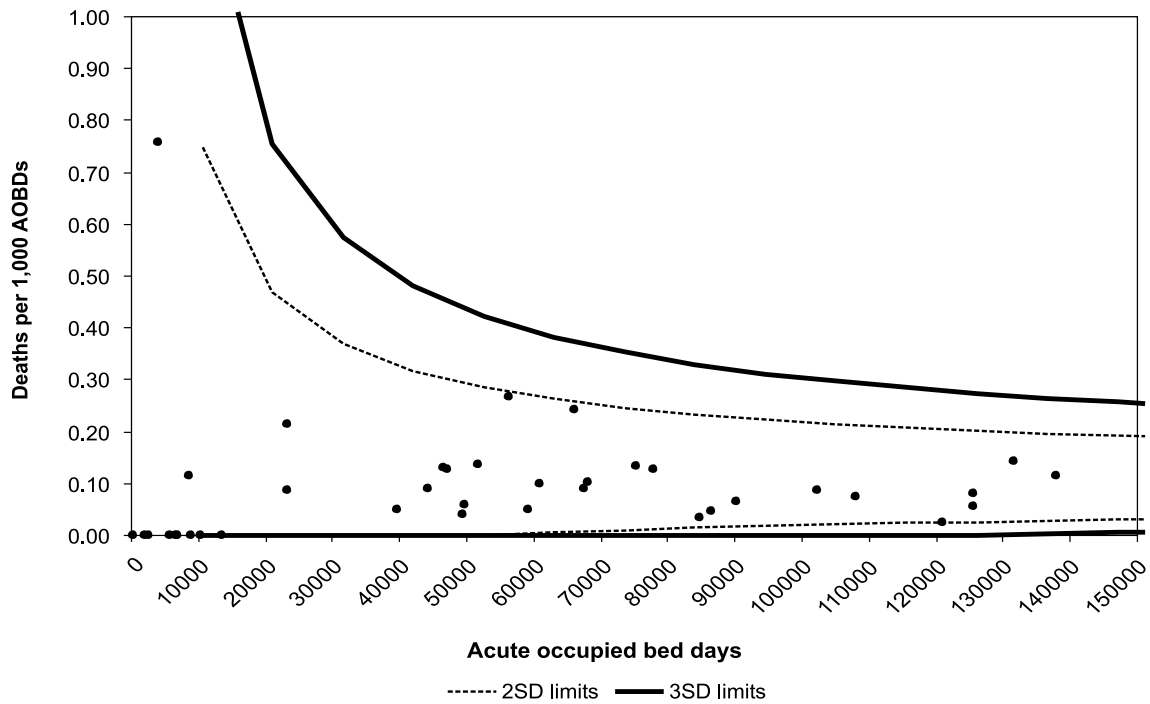


Table F3

NHS board	Hospital	Deaths among cases with CDAD indicated as contributory cause	Total acute occupied bed days (AOBD)	Mortality rate per 1000 AOB
Ayrshire & Arran	Crosshouse Hospital (L)	3	84705	0.04
	Ayr Hospital (M)	3	49773	0.06
Borders	Borders General Hospital (M)	6	47097	0.13
Dumfries & Galloway	Dumfries & Galloway Royal Infirmary (M)	2	49508	0.04
	Galloway Community Hospital (S)	3	3956	0.76
Fife	Victoria Hospital (M)	6	46467	0.13
	Forth Park Hospital (S)	0	2087	0.00
	Queen Margaret Hospital (M)	7	68175	0.10
Forth Valley	Falkirk & District Royal Infirmary / Stirling Royal Infirmary (M)	9	102230	0.09
Grampian	Aberdeen Royal Infirmary (L)	19	131684	0.14
	Woodend General Hospital (M)	15	56223	0.27
	Dr Gray's Hospital (S)	2	23330	0.09
Greater Glasgow & Clyde	Glasgow Royal Infirmary (L)	3	121109	0.02
	Stobhill Hospital (L)	6	60964	0.10
	Victoria Infirmary (M)	3	59161	0.05
	Southern General Hospital (L)	8	108133	0.07
	Western Infirmary / Gartnavel General Hospital (L)	16	138025	0.12
	Vale of Leven General Hospital (M)	5	23412	0.21
	Inverclyde Royal Hospital (M)	7	51673	0.14
	Royal Alexandra Hospital (L)	4	86367	0.05
Highland	Caithness General Hospital (S)	0	10366	0.00
	Raigmore Hospital (L)	6	67646	0.09
	Belford Hospital (S)	0	6866	0.00
	Lorn & Islands District General Hospital (S)	1	8667	0.12
Lanarkshire	Monklands District General Hospital (L)	10	77883	0.13
	Hairmyres Hospital (L)	16	66208	0.24
	Wishaw General Hospital (L)	10	75438	0.13
Lothian	Western General Hospital (L)	6	90286	0.07
	St John's Hospital (L)	4	44185	0.09
	Royal Infirmary of Edinburgh at Little France (L)	7	125675	0.06
Orkney	Balfour Hospital (S)	0	6734	0.00
Shetland	Gilbert Bain Hospital (S)	0	5628	0.00
Tayside	Ninewells Hospital (L)	10	125674	0.08
	Perth Royal Infirmary (M)	2	39609	0.05
Western Isles	St Brendan's Cot Hospital (VS)	0	256	0.00
	Western Isles Hospital (VS)	0	13377	0.00
	Uist & Barra Hospital (VS)	0	2680	0.00
Other	Golden Jubilee National Hospital (S)	0	8878	0.00
TOTAL		199	2090135	0.10

Notes: Hospitals highlighted in YELLOW indicate those with rates which lie above the upper 2SD limit defined in the accompanying funnel plot. Those highlighted in RED indicate rates which lie above the upper 3SD range limit.

5. Discussion

5.1 Discussion

HPS was asked by SGHD to analyse data collected by NHS boards on cases of CDAD and associated mortality by acute hospital for the period 1st December 2007 to 31st May 2008, and comment on the following:

Whether there were any hospitals that had unexpected numbers of cases or deaths in the period studied; if these events had been known about previously; and what action, if any, had been taken at the time.

There are a number of limitations in this study as detailed below, but from the returns received, and the limited quality checks carried out on the data submitted, it can be observed that all NHS boards completed returns for all the acute hospitals in their area within the time required by the SGHD. For the 6-month period covered, the number of cases reported for the acute hospitals, (for those aged 65 years and over), compared to the national dataset for mandatory surveillance, suggests that reporting has been consistent across all NHS boards, and is a reasonable reflection of the number of cases occurring. As this review only covers acute hospitals, the number of cases reported is lower than those reported for the national surveillance, which covers all healthcare settings. It is assumed that the proportion of acute cases remained constant for each NHS board across the 6-month period.

It was decided to use funnel plots to assess whether cases and deaths due to CDAD were greater than expected. Funnel plots are a type of control chart in which the observed event, in this instance rates of CDAD cases and rates of CDAD deaths, is plotted against a measure of its precision, in this case the sample size as measured by acute occupied bed days or number of cases, depending on the analysis undertaken.

The larger the number of acute occupied bed days or CDAD cases the less likelihood that a result is due to chance alone. This results in the distinctive appearance of a funnel plot, in which the 95% and 99.8% limits from the mean converge as the sample size increases. This is because the greater the sample size (e.g. the larger the hospital) the less any chance variation will affect the overall numbers. A small hospital with one case a month will double its rate if it has a second case that month, a hospital with 10 cases a month will only increase its rate by 10% if there is a further case.

If all the cases of CDAD and CDAD associated deaths are random (unlinked) then the data ought to fall mainly within the funnel. Only 5% of the values will fall outside the 95% limit (2.5% above and 2.5% below) and even fewer will fall outside the 99.8% limit (0.1% above and 0.1% below). For this study those values that exceed the 95% variation are deemed outliers and warrant further investigation.

Many datasets involving hospital information display more variability than would be expected by chance alone. This is because results are not truly random. Infections such as CDAD may be linked either through transmission, reinfection or relapse. In these situations it is reasonable to test for greater variation from the mean (average occupied bed days for Scotland) than would be expected if events were truly random (Spiegelhalter 2005c). This was done for all the analyses undertaken and corrected for as described in the methods section.

For incidence of CDAD cases for the whole 6-month period for all ages, only one hospital, Aberdeen Royal Infirmary (ARI), was higher than expected; therefore exceeding the 95% limit. This was also the case for those patients aged 65 years and over. The ARI Infection Control Team were aware of this at the time, and HPS had been in discussion with them when analyzing its quarterly figures. In its return to HPS, NHS Grampian indicated it had seen a rise in CDAD cases over the first quarter of 2008 which was compounded by an increased level of norovirus in the community and in the healthcare sector during the period surveyed. Despite major operational difficulties due to shortage of beds for acute admissions, NHS Grampian informed HPS that infection control measures and strict protocols for antimicrobial prescribing had been implemented under the instruction of the Infection Control Team and Antibiotic Pharmacists.

Two hospitals in Lothian, the Royal Infirmary of Edinburgh and Western General Hospital, showed an unexpected excess of CDAD cases in patients under the age of 65. Surveillance in this age group is not mandatory and therefore testing algorithms vary across Scotland. An internal survey carried out by HPS, as part of its monitoring of compliance with the national protocol, indicated that only 30% of laboratories test for *C. difficile* toxin in diarrhoeal samples for all age groups. It is known that Lothian NHS Board routinely test all diarrhoeal patients of all ages. It also provides some specialist national services, including Regional Colorectal Services, the Regional Renal Transplant Unit, and the National Liver and Pancreas Transplant Unit, whose patients are at risk of developing CDAD due to their underlying condition. The increase rate of CDAD compared to other acute hospitals is therefore probably artefactual and caused by higher testing rates. At the time of publication of this report, NHS Lothian are currently implementing an antimicrobial stewardship programme, which should have an impact on all CDAD cases.

When broken down by month, the overall incidence rates for CDAD cases was highest in January, with February and March the next highest. This reflects the findings of the national surveillance figures for that quarter (HPS quarterly report Jan – March 2008, available at <http://www.documents.hps.scot.nhs.uk/ewr/pdf2008/0827.pdf>). In February, three hospitals, the Victoria Hospital, Kirkcaldy, Wishaw General Hospital and Aberdeen Royal Infirmary (ARI) had rates higher than expected. In March, ARI remained above the confidence limit of 95%.

The Infection Control Team in Fife were aware of the rise in cases through their local surveillance systems. Investigations undertaken locally indicate that these were not linked cases and this was not an outbreak. Fife has been documenting CDAD locally for a number of years and has seen a seasonal rise in cases over the winter months.

NHS Lanarkshire were also aware of higher incidence of CDAD and are actively working to address this. They have introduced a weekly reporting structure to raise awareness of CDAD and other areas of HAI in NHS Lanarkshire. Furthermore, it is probable that rates for Wishaw General Hospital are artificially high. The hospital patient activity has risen 17% over the last year and the use of historical denominator data will therefore not reflect current AOBs.

ARI is the only hospital with the CDAD incidence rate above the upper confidence limit of the funnel plots for a single month. As indicated previously, both ARI and HPS were aware of the higher rates over this period, which appeared to be linked to a norovirus outbreak. It is documented in the literature that diagnosis of CDAD increases during norovirus outbreaks (Barrett, Holmes, et al. 2007; Wilcox and Fawley 2007; Martin, Collins, et al. 2008).

It is notable that 80% of cases occur in those aged 65 years and over. Of the remaining 20% reported, the majority are in the age group 50 - 64 years. Given that Lothian NHS Board is high compared to the rest of the country, and is known to test more extensively, inclusion of the age range 50 - 64 in the mandatory programme should be considered.

Although HPS have been able to establish the use of the Watt matrix (Watt, et al. 2002) to highlight outbreaks and escalate reporting through the system, some NHS boards have asked for further clarification about how local surveillance should identify trigger thresholds for investigation and reporting.

HPS does not collect data on CDAD deaths. This is undertaken by the General Register Office for Scotland (GROS), part of the devolved Scottish Administration. No assessment can be made on the reliability of the data collection for mortality. All NHS boards were however provided with the same protocol, and were advised this was the basis on which returns should be made, although further commentary on the process was accepted. These comments are covered in detail under the section 'Limitations of the review' (see below). In essence it was found that, in a noticeable number of cases where CDAD was recorded as the underlying cause of death on the death certificate it should have been recorded as a contributory factor of death. In a proportion of cases, CDAD should not have been included on the death certificate under either section. This demonstrates that although death certificates are a valuable source of data for national trends and international comparisons (WHO 2004), they are not designed for more detailed epidemiological investigations.

The protocol for this review used the national surveillance definition of a case of CDAD, to allow comparison with the national dataset. It is possible for a patient to be counted more than once under this definition. As a consequence, case fatalities may be an underestimate since number of cases of CDAD will be greater than actual numbers of patients infected. It has been reported in the literature that approximately 20% of patients relapse with CDAD after completion of antibiotic treatment (Kelly and LaMont 1998). An analysis of the national dataset held by HPS demonstrates that less than 5% of patients have more than one episode of CDAD, probably because the national definition captures relapses within its 28 day rule. Given the timescales for producing this report it has not been possible to correct for this bias.

In view of this, conclusions associated with mortality data presented in this report should be made with caution (see below for a detailed discussion of the caveats).

With these caveats in mind, the overall case fatality where CDAD is mentioned (i.e. proportion of CDAD cases that resulted in deaths) for the 6-month period, identified only one hospital, VOL, above the 95% confidence limit. In the monthly estimates of the overall fatality rates (where CDAD is mentioned), VOL was identified as an outlier in January and March 2008. For case fatality rates, where CDAD was the underlying cause of death, VOL was also identified as an outlier for the 6-month period. These findings warrant further investigation. The Vale of Leven Hospital incident is the subject of a separate investigation and no further comment is made here, however findings based on death certification without further follow-up must be interpreted with caution.

One other hospital, Woodend Hospital in Aberdeen, had an excess overall mortality where CDAD was a contributory factor over the 6-month period of this study. However, no excess mortality was observed for the individual months for Woodend Hospital. Again these results should be interpreted with due caution for the above noted reasons.

In most long-term planned epidemiological studies mortality rates are usually adjusted by inclusion of control groups for a number of factors including; sex, age, general health, other conditions and mortality due to other conditions. In planned studies each case patient would also be followed up over a specified time period (for example 30-days, 6 or 12 months after their episode of disease), whereas in this review only the cases that died were investigated.

The non-adjusted overall case fatality rate (where CDAD was mentioned) was 9% in this data review (i.e. 9% of reported CDAD cases died in the period December 2007 – May 2008). The corresponding figures for overall underlying case fatality was 2.7% and for contributory factors 6.3%.

Given the short time available to produce this report it was not possible to gather data in control groups and all mortality data in this report are therefore unadjusted. Furthermore, cases whose death were not picked up by the GROS record/ death certificate review could be missing.

In a recent study on ICU patients with CDAD, the overall adjusted mortality rate was 36.7% while the adjusted attributable mortality rate was 6.1% (Kenneally, et al, 2007). In another study where CDAD patients and matched control subjects were followed, 37% of the CDAD patients had died while 21% of the control subjects had died after a 12 months follow-up period, yielding a 12-month attributable mortality of 16.7% (Pepin, 2005). Further studies from the US and Canada estimate CDAD mortality rates of 6.9% and 5.7% (Loo 2005; Dubberke 2008).

In conclusion the overall case fatality rate of 9% (where CDAD was mentioned) obtained in this review of acute hospitals in Scotland is within the range of mortality rates obtained in other well-designed studies.

For the monthly analysis of the case fatality rates, only rates on deaths where CDAD is mentioned are included. Monthly overall case fatality rates (for all hospitals, for deaths where CDAD is mentioned) were in the range 7.4% to 11.3%.

When broken down by hospital by month February, with a rate of 11.3 %, showed the highest case fatality rate overall (of the 6-months). The VOL exceeded the 95% confidence limit in January and March. The deaths at the VOL are subject to a separate investigation so no further comment will be made here.

To get an additional quantitative measure of mortality, the number of deaths were assessed in relation to overall hospital activity; that is, acute occupied bed days. The overall mortality rate for all acute hospitals was 0.14 per 1000 AOBs for deaths where CDAD was mentioned, 0.04 per 1000 AOBs for deaths with CDAD as underlying cause and 0.10 per 1000 AOBs for CDAD as a contributory factor.

Again, only the VOL, with a rate of 0.77 per 1000 AOBs (for CDAD where CDAD is mentioned) exceeded the 95% confidence limit. VOL also exceeded the 95% confidence limit with a mortality rate of 0.56 per 1000 AOBs for deaths with CDAD as an underlying cause, but not for CDAD as contributory factor.

Given the timescales within which this report had to be produced, it has not been possible to review results for those hospitals that have exceeded the expected values for incidence or mortality to establish if the variation is due to data collection methods, variation in case mix, or other factors. An algorithm has been provided for those NHS boards that have outliers to further investigate why this should be (see appendix 3). As highlighted below, there are limitations in using unvalidated GROS data for recording deaths, and it is probable that some of the variation is due to inaccuracies in recording information on death certificates: a problem that has been identified in the literature (Luce, Sacranie, et al 2003).

5.2 Conclusions

1. Two hospitals, Victoria Hospital, Kirkcaldy and Wishaw General Hospital, showed a rate of CDAD that warranted further investigation. In both cases the local Infection Control Team (ICT) and NHS board were aware of the situation, and had instituted appropriate measures at the time. In neither situation was an outbreak identified.
2. One hospital, Aberdeen Royal Infirmary, showed special case variation as it was above the 99.8% (3 SD) confidence limit. The hospital ICT was aware of the excess numbers at the time. The rise was related to associated outbreaks of norovirus and the ICT instituted infection control measures to reduce the number of cases of CDAD. HPS was aware of the situation.
3. Two hospitals in Lothian, Western General Hospital and Royal Infirmary of Edinburgh, showed a rate of CDAD in the under 65 age group that warranted further investigation. This probably reflects the testing protocol used in Lothian laboratories rather than a true excess of the confidence limit.
4. One hospital, Woodend in Grampian, exceeded the confidence limit for deaths with CDAD only as a contributory factor, which warrants further investigation.
5. In a local epidemiological investigation, the Vale of Leven Hospital had previously been identified as having an unexpected number of deaths. The Vale of Leven was not identified higher than the rest of Scotland in terms of incidence of cases in this study.
6. The excess mortality at the VOL seems to be exceptional but caution must be taken in drawing conclusions on mortality data reported here due to the complexities of death certification.
7. Surveillance systems for CDAD are not designed to capture information on mortality and would therefore not have identified the problem at the VOL. The national CDAD surveillance system is deemed fit for purpose. National surveillance should be supplemented with local surveillance within NHS boards. A standardised approach to local surveillance would offer an additional degree of assurance that unusual clusters of cases would be rapidly and reliably detected and investigated.
8. The variation in CDAD cases in some hospitals and excess mortality in other hospitals could be explained by inconsistencies with these data (particularly death certificates), demographics such as older patient populations or virulence of *C. difficile* strains, or variations in patient care practices.
9. Overall, based on the findings of this review it appears that all NHS boards and Infection Control Teams have systems in place that alert them to rises in cases of CDAD. Greater clarity is sought on when to escalate incidents involving CDAD through the Watt matrix.

5.3 Limitations of the review

5.3.1 Limitations of study design

This review has been conducted retrospectively, and with a degree of urgency resulting in production of a protocol without proper piloting and review. There has been no thorough testing of the assumptions made regarding consistency of data collection or analysis.

5.3.2 Limitations of data collection and analysis

a) CDAD cases

Various groups of staff have been involved in data collection with no training so there is scope for inconsistency in reporting. Most co-ordinators were in contact with HPS on at least one occasion seeking clarification over the protocol.

Data quality is therefore a matter of concern. Numbers have not been subjected to the level of review that would normally be undertaken as part of an HPS surveillance report. We cannot comment therefore on the accuracy of the numbers or whether there has been over or undercounting of cases and/or deaths.

This review includes all cases of CDAD both those in individuals aged 65 years and over and those under 65 years. Surveillance is mandatory in individuals 65 years and over and consequently testing and reporting in this age group is subject to a standardised approach. It is not mandatory in those aged under 65, and therefore testing protocols differ across Scotland; some laboratories test on request; others all diarrhoeal samples; and yet others based on the clinical history provided. Results in the under 65 age group are therefore less reliable than in those aged 65 and over.

In children aged under 15, test kits for *C. difficile* toxin are unreliable (for most kits the quality assurance testing reports do not recommend the use in patients under 15). Furthermore the pathology of CDAD in children is not well described as symptoms and immune reactions towards *C. difficile* in children differ from those in adults. The majority of infants are in fact colonised with *C. difficile* but do not have any symptoms. This is speculated to be associated with lack of *C. difficile* toxin receptors in the gut of young children.

b) CDAD mortality

It was not possible to perform analyses on mortality trends because there was no standardised time component to the mortality data (e.g. within 30 days of diagnosis of CDAD). The study design of this exercise was chosen to match the methods used by the local epidemiological investigation of VOL. However, this leads to bias in the results. Those patients at the start of the 6-month review will have been followed up for longer, and therefore have a greater probability of having died than those in the latter months. NHS boards will have completed their analysis at different points over the period of data collection which could add further bias to case fatalities depending on the date they took as a cut-off for GROS data.

c) General limitations

The analysis is broken down by month and therefore will not necessarily identify outbreaks that span across 2 months.

The smaller the unit (hospital), the lower the observed number of events - in this case, cases and deaths due to CDAD. Several problems can arise in this situation including chance variability, regression to the mean and low power to detect genuine underlying changes. These problems are accentuated with an infectious disease since cases tend to cluster and, therefore rates are 'overdispersed' relative to chance variation (Spiegelhalter 2005a; Spiegelhalter 2005b). It is therefore very difficult to draw comparisons between hospitals when apparent rises in cases may be due to chance alone.

This HPS report is based on applying national (Scottish) average rates and national control limits. This approach and the subsequent finding within this report offer a broad level of assurance, but do not exclude the possibility that additional local clusters may be detected using local historical data to set local control limits which are likely to be tighter than the national average control limit. Given the current variety of local methodologies and definitions currently used, it is not possible to directly compare existing data using local control limits within the timescale of the current report.

5.3.3 Limitations of GROS weekly electronic reports to NHS boards

The codes (A04.7 and A49.8) against which NHS boards were asked to check for CDAD on death certificates are the two most likely to have been used. It was assumed that these two codes captured all deaths where CDAD is cited on the death certificate, but it is not possible to say if some cases were recorded using different codes. It is also assumed that patients who had CDAD and subsequently died (but where these codes are not recorded), the cause of death was not CDAD, and nor was it a contributory factor. For this exercise it was not practical to review every death certificate or case note for every patient with CDAD who died during this 6-month period to establish if the recorded cause of death was the infection.

During the data collection period it was discovered that there were potential errors in the GROS transcripts. Ideally all death certificates should have been reviewed.

Further problems were identified with the way death certificates are coded. According to guidance, the underlying cause of death is assumed to be the last completed line in part 1 of the death certificate, as required by the WHO standard, and in the instructions to doctors in the Medical Certificate of Cause of Death booklet (WHO 2004; Swift and West 2002). However, evidence from the literature shows that medical staff are not always aware of this protocol when completing death certificates, resulting in errors in identifying the underlying the cause of death (Maudsley 1993; Swift and West 2002).

The coding hierarchy within the system further complicates interpretation. Selection of another condition as the underlying cause of death (originating antecedent cause) may occur if there is more than one condition entered in successive lines of part 1. The condition entered on the lowest line should be selected only if it could have given rise to all the conditions entered above (WHO 2004). If this is not the case, there are a series of selection rules, whereby conditions added in part 2 (contributory factor) may be coded as the underlying cause (WHO 2004). In at least 3 of the cases reported at the Vale of Leven Hospital this led to CDAD being recorded as the underlying cause of death when this was not appropriate following case note review.

Therefore the true deaths where CDAD is an underlying or contributory factor is unknown. What we have is a best estimate without the means to assess the level of statistical error. Problems with death certification are well documented in the literature (Roulson, Benbow, et al. 2005)

5.3.4 Denominator data

The denominator data used for this review is acute occupied bed days for the equivalent period 2006-2007. This was to ensure consistency of analysis across Scotland as activity for the 6-months under review was not available in a consistent format for all hospitals. This reflects the time it takes to quality check occupied bed days. Bed day data from ISD are linked during the recording process with patient names and date of birth, and can therefore be divided into age groups (below and above 65). This is not done locally, and local data can therefore (usually) not be divided by age groups.

There is an assumption that there is no significant change year on year and for most cases this holds true. However, some NHS boards have undergone organisational change that has had an impact on activity in some acute hospitals. As a consequence, some boards may have an under or over estimate of activity for the period under investigation which will affect the rates calculated. Therefore comparisons between hospitals cannot be reliably made.

6. Recommendations

- Prospectively, efforts should be directed at reducing numbers of cases of CDAD by a combination of both national and local surveillance, infection prevention and control procedures, and antimicrobial stewardship as set out in a range of current national guidance (model policies on Standard Infection Precautions and Transmission-Based Precautions, and policy on Antimicrobial Prescribing and Practice), which are currently being summarised in the Scottish National Guidance on CDAD and are due for completion in September 2008.
- Consideration should be given to extending the national surveillance system for CDAD to those aged between 15 and 64 years. This should be done in a way that does not disrupt the current surveillance programme for those aged 65 years and older so that trends can continue to be monitored.
- Local surveillance is an important part of infection control. The structure for this needs to be defined by the NHS board to best reflect local reporting procedures for feedback of results. This should be by local hospital and by managerial arrangements.
- A framework for local surveillance should be produced by HPS including guidance on definitions, methods and how to identify triggers and monitor improvement.
- Where an excess in cases or mortality are identified locally, the HPS Algorithm for validation (Appendix 3) should be adopted to examine the reasons for variation.
- Prospectively, when there is a severe case of CDAD, such as a patient with pseudomembranous colitis, toxic megacolon or ileus; or who requires admission to intensive care for management of the infection; or who dies where CDAD is an underlying cause during an inpatient episode; further investigation (such as root cause analysis) is required. This should be undertaken by the clinical team responsible for the patient's care in line with local Clinical Governance procedures to establish possible reasons, and to identify any actions necessary to minimise risk in the future.
- Routine national monitoring of CDAD mortality is unlikely to be productive in informing action to reduce the incidence of CDAD. However, if there is a decision to collect mortality data in relation to CDAD this should be carefully designed and planned, and consideration given to data definitions and data collection criteria. Further discussion should take place on the most appropriate national agency to undertake these reviews.
- It is outwith the scope of this exercise to comment on actions in relation to death certification. However the quality of death certification with regard to recording of CDAD should be examined by the appropriate authority.

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APPENDIX 1 – Outline table completed by NHS boards

Table 1. Data collection

Row no.	Data item	Dec 07	Jan 08	Feb 08	Mar 08	Apr 08	May 08
1	Number of acute beds						
2	Bed occupancy (%)						
3	Number of acute occupied bed days						
4	Number of CDAD Cases $\geq 65^*$						
5	Number of CDAD Cases $< 65^*$						
6	Number of deaths with CDAD as underlying cause ≥ 65						
7	Number of deaths with CDAD as underlying cause < 65						
8	Number of deaths with CDAD as contributory Factor ≥ 65						
9	Number of deaths with CDAD as contributory Factor < 65						

*deduplicated data according to the 28-day criterion described above.

APPENDIX 2 – Acute hospitals in Scotland

1. Aberdeen Royal Infirmary
2. Ayr Hospital
3. Balfour Hospital
4. Belford Hospital
5. Borders General Hospital
6. Caithness General Hospital
7. Crosshouse Hospital
8. Dr Gray's Hospital
9. Dumfries & Galloway Royal Infirmary
10. Falkirk & District Royal Infirmary / Stirling Royal Infirmary
11. Forth Park Hospital
12. Gartnavel General Hospital
13. Gilbert Bain Hospital
14. Glasgow Royal Infirmary
15. Golden Jubilee National Hospital
16. Hairmyres Hospital
17. Inverclyde Royal Hospital
18. Lorn & Islands District Hospital
19. Monklands Hospital
20. Ninewells Hospital
21. Perth Royal Infirmary
22. Queen Margaret Hospital
23. Raigmore Hospital
24. Royal Alexandra Hospital
25. Royal Infirmary of Edinburgh
26. Southern General Hospital
27. St John's Hospital at Howden
28. Stobhill Hospital
29. Vale of Leven District Hospital
30. Victoria Infirmary, Glasgow
31. Victoria Hospital, Kirkcaldy
32. Western General Hospital, Edinburgh
33. Western Infirmary, Glasgow
34. Western Isles Hospital
35. Wishaw General Hospital
36. Woodend Hospital
37. Uist & Barra Hospital
38. St Brendan's Cot Hospital
39. Galloway Community Hospital

Note: The following hospitals have been removed from the list of acute hospitals since 2007 (from the HPS HAI Prevalence Study) as healthcare in these hospitals has changed to non-acute (or been terminated).

Aberdeen Maternity Hospital, Ayrshire Central Hospital, Garrick Hospital, Mackinnon Memorial Hospital, Princess Royal Maternity Hospital, Queen Mother's Hospital, Ross Memorial Hospital, Stracathro Hospital. Maternity hospitals were also excluded from this review.

Two hospitals (no. 38 and 39) have been included as acute hospitals since 2007.

APPENDIX 3 – Algorithm for validation of CDAD hospital data (national data review)

1) Overview of methodology for data collection:

CDAD cases

- How were cases included in the study (did you use laboratory records or infection control records)?
- What cross-checks were done between IC and lab records (are there any discrepancies)?
- Were data de-duplicated according to HPS protocol definition for an episode?
- Were cases recorded in the month the diagnosis was made?

CDAD deaths

- Were GROS records matched with names of CDAD cases for the 6-month period 1st December 07 to 31st May 08?
- Were deaths recorded under the month where the case was diagnosed?
- Were death certificate stubs reviewed in cases where A49.8 was the stated reason for either underlying or contributory factor of death?

Have errors in data collection been identified, and does this explain the excess of cases?

Denominators

- Has there been a change in hospital configuration in the past year (e.g. redistribution of specialties across hospitals in the NHS board)?
- Has this changed hospital activity (AOBD)?

Have changes in activity been identified, and does this explain the excess of cases?

2) Are there special demographic features that could affect the outcome of this study?

- Age of patient population
- Co-morbidity of patient population (Charlson index)
- Deprivation category of population
- Total Antibiotic Consumption in General Practise / The hospital

Are these sufficiently different from elsewhere in the NHS board or comparable hospitals across Scotland to explain the differences

- Is CDAD cause of death (underlying and contributory) as a proportion of all cause mortality the same for the outlier hospital as for other hospitals in the NHS board

3) Could the way healthcare is provided in these hospitals (NHS board) influence the number of cases and deaths?

- Division into acute and non-acute care
- Transfer patterns / delayed discharges
- Specialties provided within the hospital
- Provision of a national service eg transplant unit
- Diagnostic laboratory has a policy of testing for CDAD that results in more testing

4) Are excess cases associated with specific areas of the hospital?

- Specialties
- Wards
- Is there evidence that patients in these areas were more at risk?



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