Surveillance: **Central Venous Catheter (CVC) Infection and Ventilator Associated Pneumonia (VAP) in Critical Care**

Report: **Annual Report**

Time period: **1st January to 31st December 2012**

Health Board: **Aneurin Bevan Health Board**

Content:

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This report provides infection rates for all Wales, allowing comparisons to be made with critical care schemes in other countries. Care should be taken when interpreting such results due to the possible differences in methodology utilised. However, in Wales it is important to ensure that inter-unit comparisons are made over time utilising both bi-monthly and annual reports provided. This will ensure that the units can monitor their own performance over time.

INTRODUCTION

The Welsh Healthcare Associated Infection Programme (WHAIP) was established in 1996. The aims of the programme are to develop an evidential base for control of healthcare associated infections in Wales, identify preventable aspects and audit compliance with agreed practices.

In September 2004, the Welsh Assembly Government launched 'Healthcare Associated Infections – A strategy for hospitals in Wales'. One of the strategic objectives within this strategy was for Health Boards to adopt comprehensive surveillance programmes including infections in critical care (Part 2 – framework tables, page 14)[1]. Consequently, WAG instructed the WHAIP to develop and support the implementation of critical care infection surveillance in NHS hospitals in Wales. During 2005 – 2006, the National Leadership and Innovation Agency for Healthcare (NLIAH), through the Welsh Critical Care Improvement Programme (WCCIP), launched care bundles for the insertion and maintenance of central venous catheters on critical care and also care bundles to prevent ventilator associated pneumonia.

The surveillance of central venous catheter (CVC) related infections became mandatory in Wales on the 1st September 2007. The WHAIP team collaborated with the NLIAH group to develop critical care surveillance in Wales utilising HELICS defined infection criteria[2]. The surveillance will serve to provide useful infection data for critical care clinicians and infection control practitioners as well as serving as an outcome measure for the care bundles. Before being made mandatory, surveillance of CVC infections associated with critical care units was undertaken voluntary by all hospitals in Wales. In September 2008 critical care surveillance was extended to include the mandatory surveillance of ventilator associated pneumonia (VAP) infections. The latter part of 2008 was utilised to try and embed VAP surveillance in hospitals in Wales.

Patients admitted to critical care are at 5 to 10 times higher risk of acquiring a nosocomial infection due to both intrinsic and extrinsic risk factors, and because the critical care unit is often the epicentre of emerging nosocomial infection problems in the hospital[2]. CVC bloodstream infections and VAPs are the most common nosocomial infections in critical care, where they can prolong the critical care stay, be associated with substantial mortality and related costs (both financial and in quality of care)[3]. The mortality from VAP can range from 24 – 50%[4]. However, it is well known that many infections (both CVC and VAP) are preventable[5]. It has been suggested that by combining a number of evidence based interventions in a 'care bundle' and administering these interventions to every critical care patient (with a device in situ), these risks to the patient may be significantly lowered. Promotion of care bundles have been made by the Institute for Health Improvement and Centre for Disease Control in the USA and by the Modernisation Agency and Department of Health in the UK[3].

This is the third national report that combines both CVC and VAP infections associated with critical care units in Wales. The data presented here is a summary of information provided by the six Health boards for 2011 (1st January 2011 – 31st December 2011). CVC infection and VAP results provided in this 2011 report can be compared with previous annual reports. The report includes data captured using internationally agreed definitions (HELICS) and includes infections associated with critical care units only. The purpose of the surveillance in the early years of data collection is to provide an initial baseline infection rate to assist Health boards in monitoring both their system of data collection and to aid with reducing infection over time.

ALL WALES SUMMARY – Central Venous Catheter (CVC) Surveillance

- This report covers the mandatory central venous catheter (CVC) infection surveillance in critical care in Wales (2012). The report covers CVC related infections associated with critical care as defined utilising HELICS criteria.

- A total of 3421 forms were received for the period 01/01/2012 – 31/12/2012. 3382 (99%) of forms could be further analysed for determining the CVC infection rate.

- One health Board did not participate in the surveillance for this time period.

- The results provided for all Wales should be used for benchmarking with other European countries, whilst quarterly reports should be utilised for individual unit performance.

- A total of 15 infections were recorded by the surveillance meeting HELICS infection criteria. An overall infection rate of 0.7 per 1000 catheter days was noted for the period 01/01/2012 – 31/12/2012. The later rate was similar to that of 2011. The mean all Wales rate was 0.6 per 1000 catheter days with a median of 0.8 per 1000 catheter days (Health Board rates varied from 0.0 – 1.2 per 1000 catheter days).

- The overall infection rate broken down by infection type was 0.40, 0.00 and 0.27 per 1000 catheter days for CRI 1, CRI 2 and CRI 3 infections, respectively.

- The overall monthly CVC infection rate for all Wales varied from 0.0 to 1.5 per 1000 catheter days for the 12 month period.

- Approximately 63% of CVC lines were inserted on critical care and approximately 25% in theatre. The majority of line infections were associated with lines inserted on critical care for all Wales and at a Health board level. Of the 15 HELICS infections for Wales, 12 were attributed to critical care.

- 78% of lines were inserted in the jugular vein, 13% in the femoral vein and 10% in the subclavian vein. The majority of CVC infections were associated with the jugular vein (13). Similar results were also noted at a Health board level. Two infections were associated with the femoral vein.

- Candida, Coagulase negative *Staphylococci* and MRSA (flucloxacillin resistant) were associated with the highest number of HELICS defined CVC infections. A total of 3, 3 and 4 infections were noted, respectively.

ALL WALES RESULTS - Central Venous Catheter (CVC) Surveillance

The time period for this report is based on the date of insertion. Therefore only records with the insertion date completed have been included for analysis. Patients that have not been on critical care for over 48 hours have also been excluded.

A total of 3421 forms were received for 01/01/2012 – 31/12/2012. 3382 (99%) of forms could be utilised for data analysis.

SECTION 1. HELICS defined CVC infection rate

Overall HELICS CVC infection rate

Table 1.1 Overall HELICS defined CVC infection rate for All Wales for the period 01/01/2012 - 31/12/2012

Number of HELICS CVC infections	Number of critical care catheter days*	HELICS CVC infection rate** (per 1000 critical care catheter days)
15	22256	0.7

** Only catheter days up to discharge of patient from critical care are included. Number of critical care catheter days calculated = removal date - insertion date + 1 (unless the insertion date precedes the admission to critical care date i.e. insertion date is replaced by admission to critical care date, or if the removal date succeeds discharge date from critical care then removal date is replaced by discharge date)*
*** Calculation of HELICS CVC infection rate = total number of HELICS CVC infections / number of critical care catheter days * 1000*

The mean all Wales rate was 0.6 per 1000 catheter days with a median of 0.8 per 1000 catheter days (Health Board rates varied from 0.0 – 1.2 per 1000 catheter days).

Incidence of HELICS CVC infections by infection type

Table 1.2 Breakdown of HELICS defined CVC infection rate by infection type for All Wales for the period 01/01/2012 - 31/12/2012

Infection type	Number of HELICS CVC infections	HELICS CVC infection rate** (per 1000 critical care catheter days)
CRI 1	9	0.40
CRI 2	0	0.00
CRI 3	6	0.27

Incidence of HELICS CVC infections by month

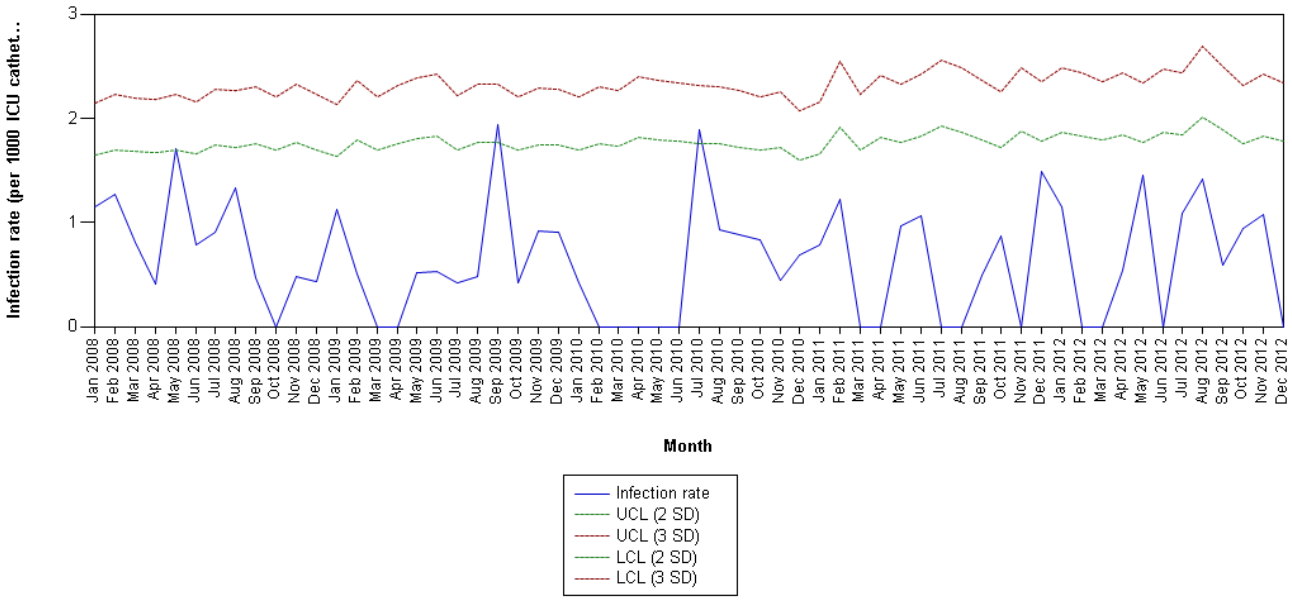


Figure 1.1 HELICS defined CVC infection rate by month for All Wales for the period 01/01/2008 - 31/12/2012

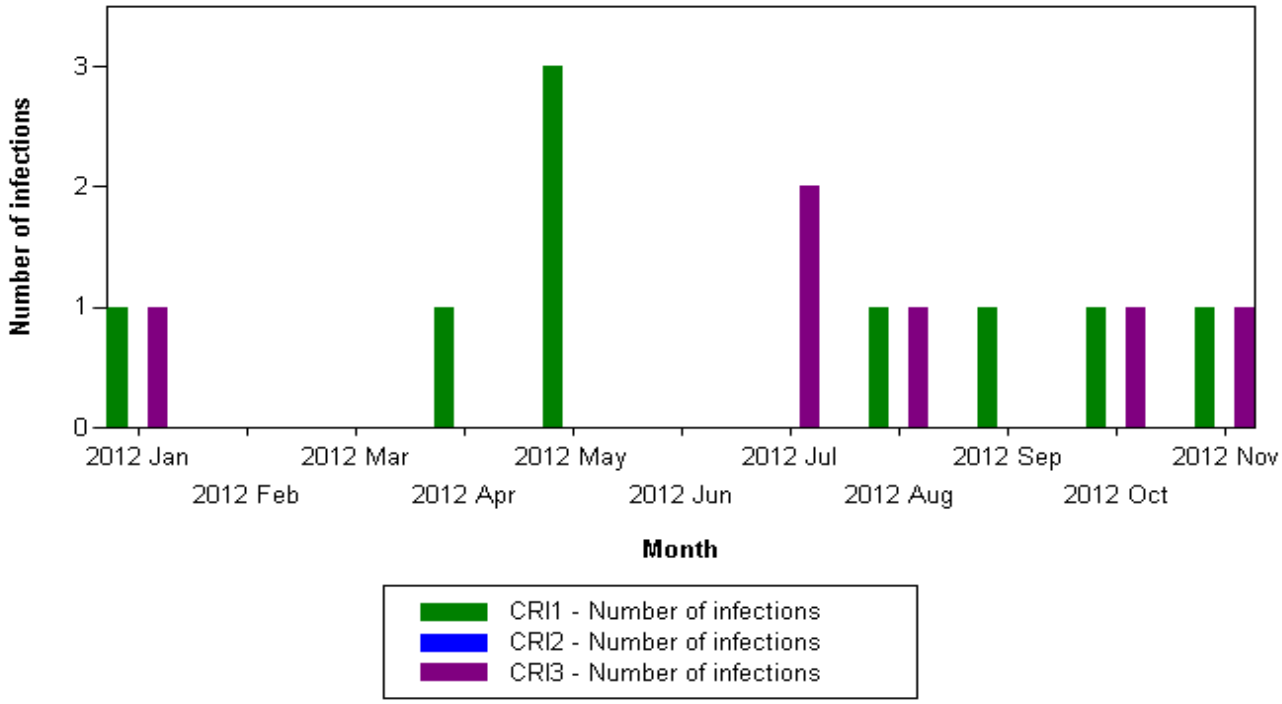


Figure 1.2 Numbers of HELICS defined CVC infections by month and infection type for All Wales for the period 01/01/2012 – 31/12/2012

Key summary points

- The total number of HELICS defined CVC infections recorded by the surveillance for the period 01/01/2012 – 31/12/2012 was 15 giving an infection rate of 0.7 per 1000 catheter days.
- The mean all Wales infection rates was 0.6 per 1000 critical care catheter days with a median of 0.8 per 1000 catheter days.
- 9 CRI 1 (local infections) and 6 CRI 3 (bloodstream infections) were noted providing a rate of 0.40 and 0.27 per 1000 critical care catheter days respectively.
- The number of days lines were in situ for patients with an infection ranged from 5 to 17 days.
- The overall monthly infection rate varied from 0.0 to 1.5 per 1000 critical care catheter days over the 12 month period. All infection rates remained 'in control' (below the upper control limits (UCL) at 2 standard deviations (2 SD) and 3 standard deviations (3 SD) above the mean rate) for 2012.

SECTION 2. Incidence of HELICS CVC infection by hospital location of line insertion and by line insertion site

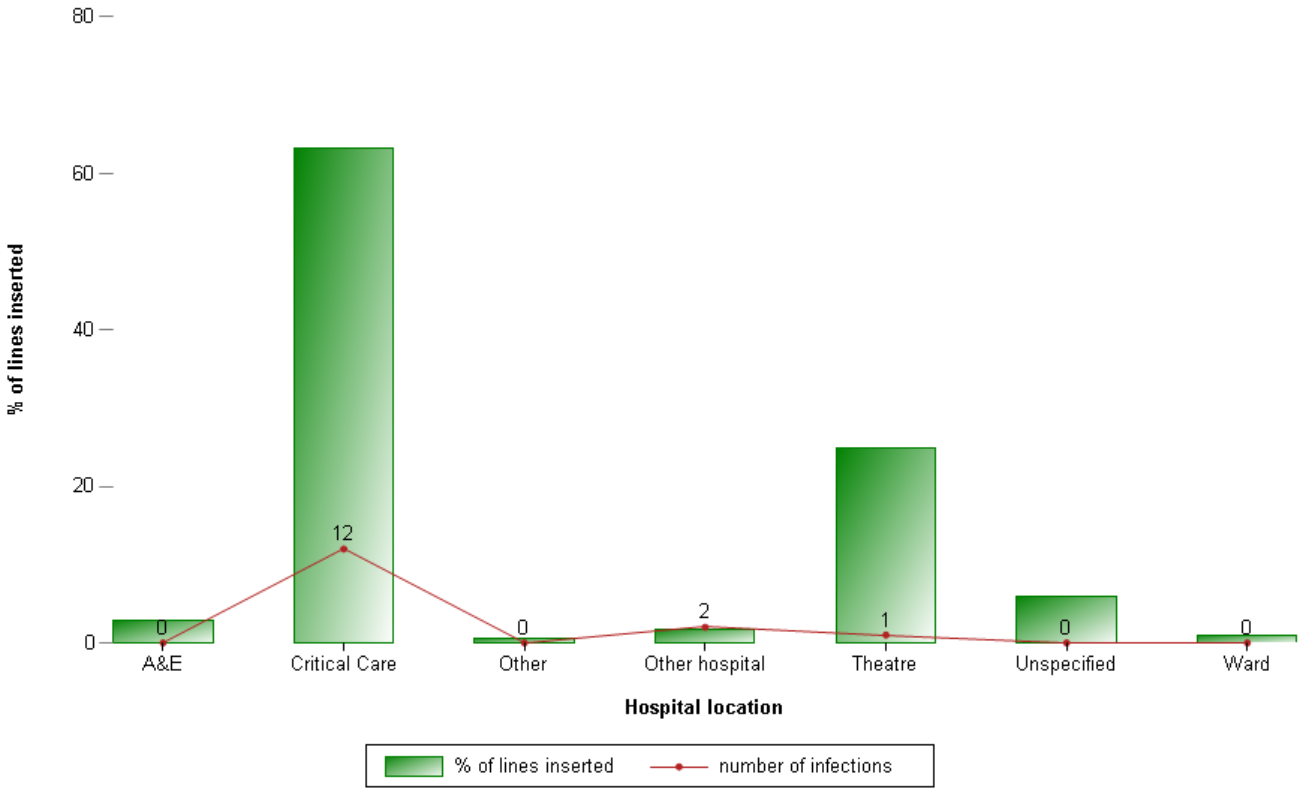


Figure 2.1 Percentage of CVC insertions and numbers of HELICS defined CVC infections by hospital location for All Wales for the period 01/01/2012 – 31/12/2012

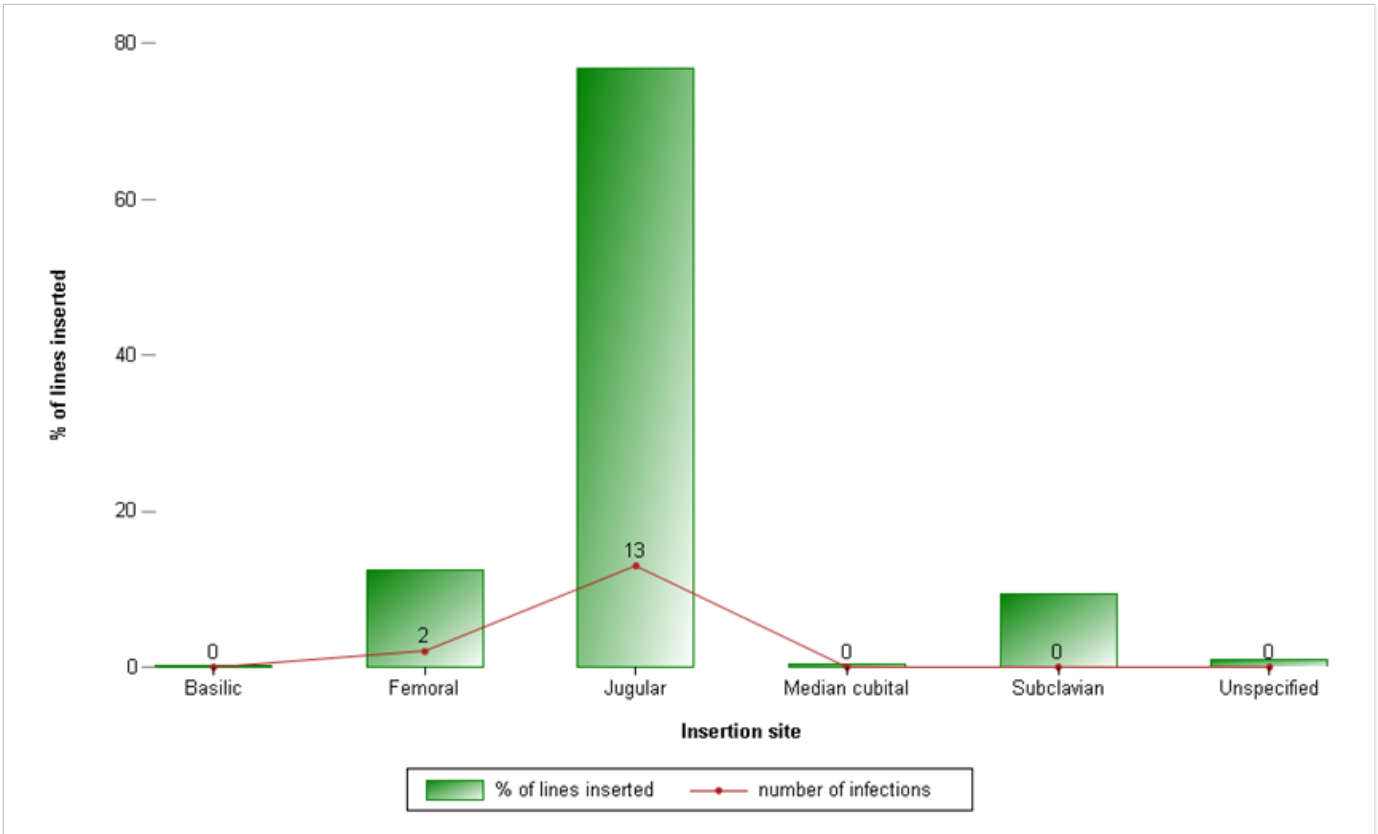


Figure 2.2 Percentage of CVC insertions and numbers of HELICS defined CVC infections by insertion site for All Wales for the period 01/01/2012 – 31/12/2012

Key summary points

- The majority of lines were inserted on critical care (approximately 67%) and in theatre (approximately 26%).
- The majority of HELICS defined CVC infections noted were attributed to lines inserted on critical care (12).
- The majority of lines were inserted in the jugular vein (78%) whilst 13% and 10% of lines were inserted into the femoral and subclavian veins, respectively.
- The majority of CVC infections were associated with lines inserted in the jugular vein (13). Insertion in the femoral vein was associated with 2 infections
- The results noted for Wales were also representative of results at a Health board level.

SECTION 3. Incidence of HELICS CVC infection by organism

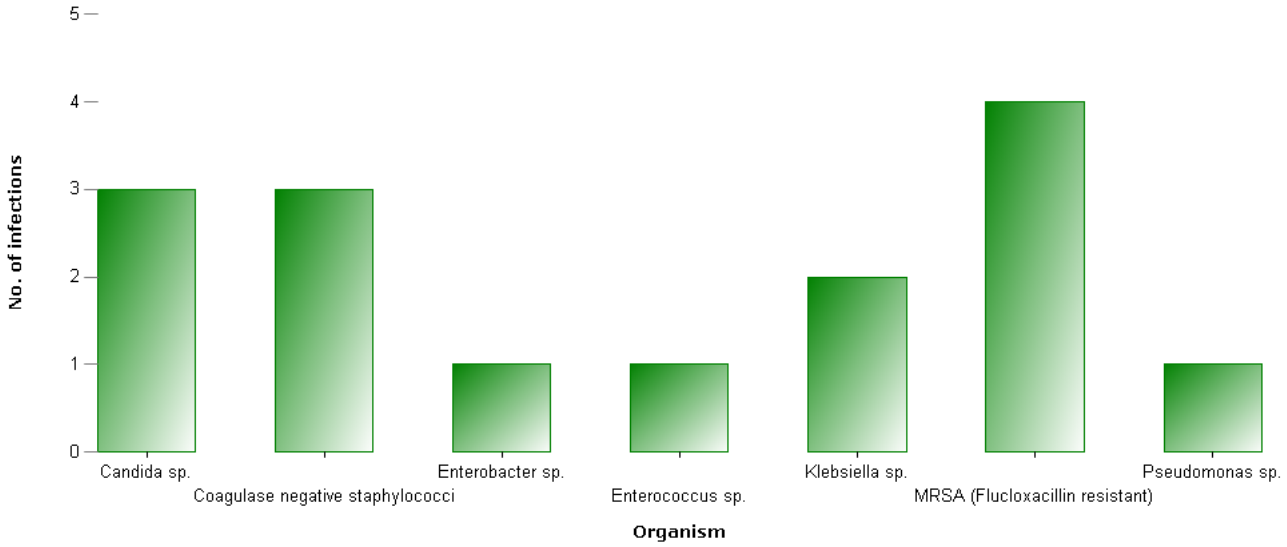


Figure 3.1 Numbers of HELICS defined CVC infections by organism for All Wales for the period 01/01/2012 – 31/12/2012

Key summary points

- Candida sp., Coagulase negative *Staphylococci* and MRSA (Flucloxacillin resistant) were associated with the highest number of HELICS defined CVC infections. A total of 3, 3 and 4 infections were noted, respectively.

ALL WALES SUMMARY - Ventilator Associated Pneumonia (VAP) Surveillance

- This report covers the mandatory ventilator associated pneumonia (VAP) infection surveillance in critical care in Wales (2012). The report covers VAPs associated with critical care as defined utilising HELICS criteria.

- A total of 2418 forms were received for the period 01/01/2012 – 31/12/2012. 2404 (99%) of forms could be further analysed for determining the VAP rate.

- The results provided for all Wales should be used for benchmarking with other European countries, whilst quarterly reports should be utilised for individual unit performance.

- A total of 52 VAPs were recorded by the surveillance. An overall VAP rate of 2.5 per 1000 ventilator days was noted for the period 01/01/2012 – 31/12/2012. The mean all Wales rate was 2.2 per 1000 ventilator days with a median of 1.0 per 1000 ventilator days (Health Board rates varied from 0.0 – 7.7 per 1000 ventilator days).

- The VAP rate has increased (2012) compared with 2011. All Wales data for 2012 may however be skewed by one hospital unit in particular and not representative of the other hospital units in Wales. WHAIP are aware that the unit with a higher rate is evaluating an electronic method of data collection and interpretation of the VAP definition which has led to an increase in compliance with the surveillance in the latter part of 2012.

- The overall VAP rate broken down by VAP type was 1.33, 0.57, 0.09, 0.24 and 0.24 per 1000 ventilator days for PN 1, PN 2, PN 3, PN 4 and PN 5 respectively. The majority of VAPs noted were categorised as PN 1.

- The overall monthly VAP rate for all Wales varied from 0.0 to 7.7 per 1000 ventilator days for the 12 month period. The highest number of infections occurred in August and this was attributed mainly to one hospital unit in particular.

- Approximately 52% of intubations were associated with medical cases and approximately 36% with surgical cases. The majority of VAPs were associated with medial cases. Of the 52 VAPs, 27 were associated with medical cases, 18 surgical and 4 with trauma.

- Approximately 25% of cases had a risk factor (12% chronic obstructive pulmonary disease (COPD); 13% diabetes mellitus). In addition 9 infections were associated with these cases (5 with COPD and 4 with diabetes mellitus).

- A total of 14 Candida *sp*. were associated with HELICS defined VAP for 2012. Further analysis of the data showed 6 infections were attributed to Candida *sp*. only with the remaining 8 infections including one or more organisms. It is likely that many of the infections are not 'true' Candida *sp*. and this requires investigation locally.

- Other organisms associated with higher numbers of infection included, *Escherichia coli,* MRSA*, Staphylococcus aureus* and Pseudomonas *sp.*

ALL WALES RESULTS - Ventilator Associated Pneumonia (VAP) Surveillance

The time period for this report is based on the date of intubation. Therefore only records with the date of intubation completed have been included for analysis. Patients that have not been on critical care for over 48 hours have also been excluded.

A total of 2418 forms were received for 01/01/2012 – 31/12/2012. 2404 (99%) of forms could be utilised for data analysis.

SECTION 1. HELICS defined VAP rate

Overall HELICS VAP rate

Table 1.1 Overall HELICS defined VAP rate for All Wales for the period 01/01/2012 - 31/12/2012

Number of HELICS VAP	Number of critical care ventilator days*	HELICS VAP rate** (per 1000 critical care ventilator days)
52	21074	2.5

** Only ventilator days up to discharge of patient from Critical Care are included. Number of Critical Care ventilator days calculated = extubation date - intubation date + 1 (unless the intubation date precedes the admission to critical care date i.e. intubation date is replaced by admission to critical care date, or if the extubation date succeeds discharge date from Critical Care then extubation date is replaced by discharge date)*
*** Calculation of HELICS VAP rate = total number of HELICS VAP / number of critical care ventilator days * 1000*

The mean all Wales rate was 2.2 per 1000 ventilator days with a median of 1.0 per 1000 ventilator days (Health Board rates varied from 0.0 – 7.7 per 1000 ventilator days).

Incidence of HELICS VAP by infection type

Table 1.2 Breakdown of HELICS defined VAP rate by infection type for All Wales for the period 01/01/2012 - 31/12/2012

Infection type	Number of HELICS VAP	HELICS VAP rate** (per 1000 critical care ventilator days)
PN 1	28	1.33
PN 2	12	0.57
PN 3	2	0.09
PN 4	5	0.24
PN 5	5	0.24

Incidence of HELICS VAP by month

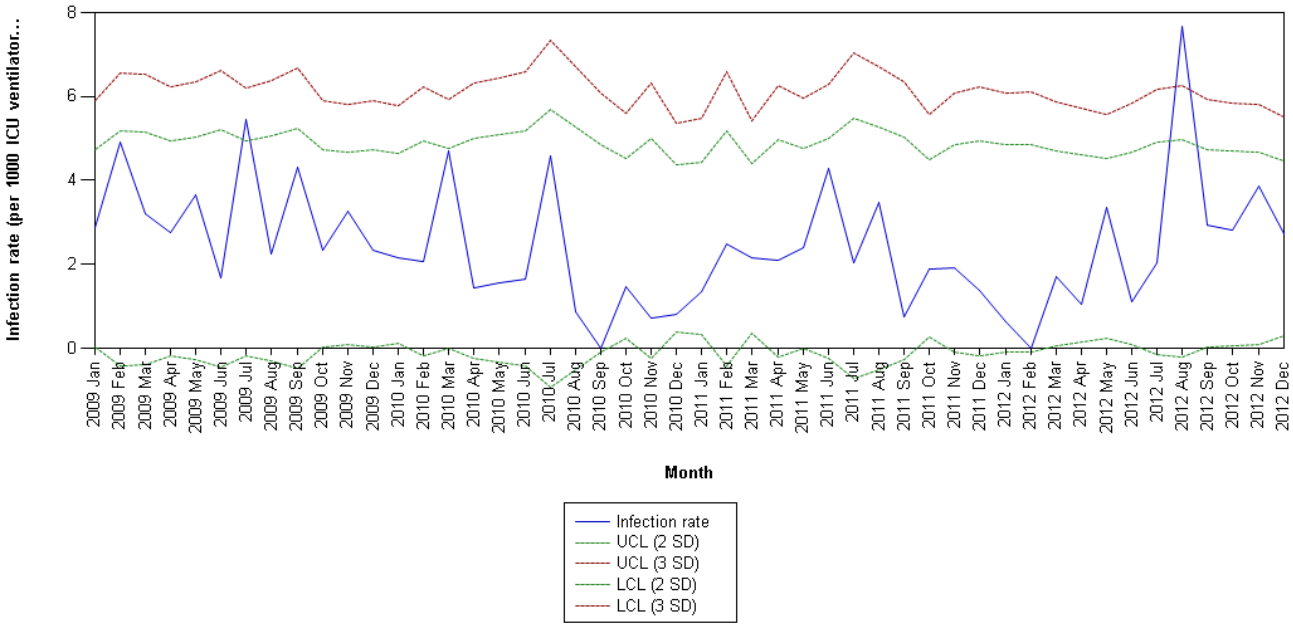


Figure 1.1 HELICS defined VAP rate by month for All Wales for the period 01/01/2009 – 31/12/2012

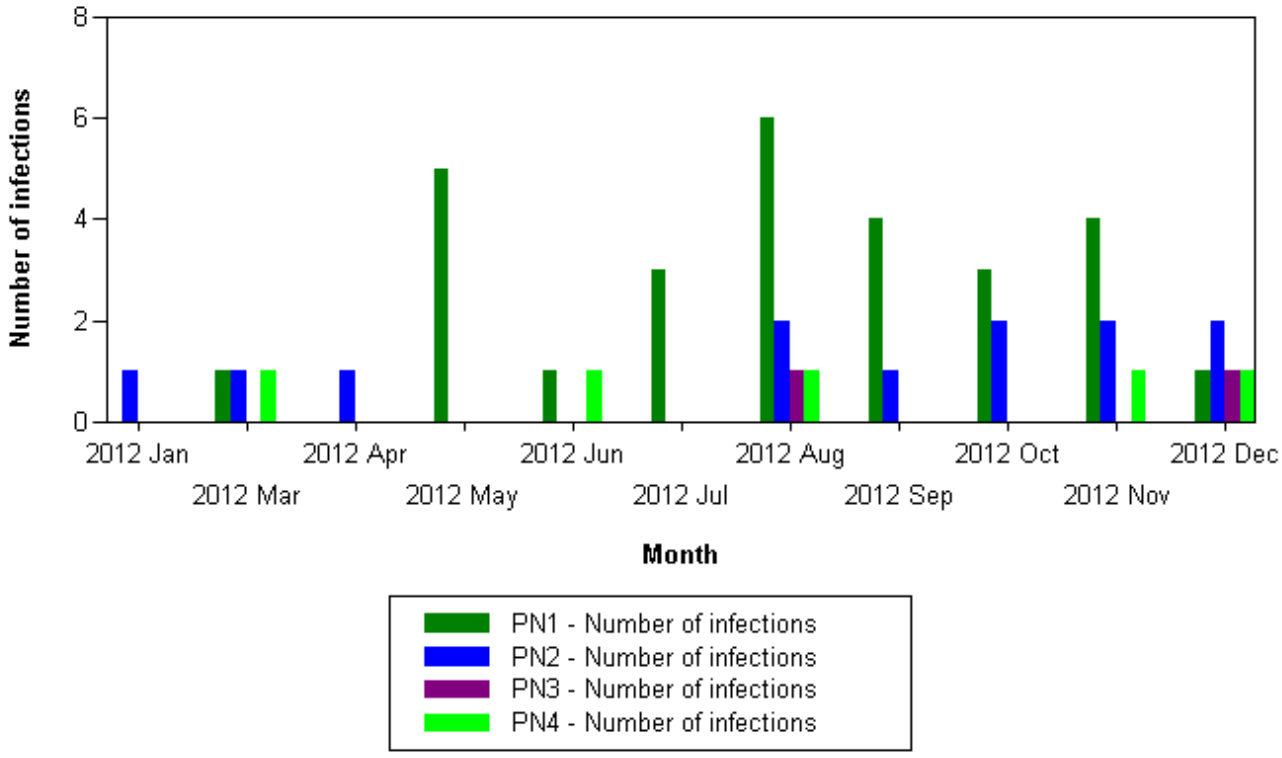


Figure 1.2 Numbers of HELICS defined VAP by month and infection type for All Wales for the period 01/01/2012 – 31/12/2012

Key summary points

- The total number of VAPs recorded by the surveillance for the period 01/01/2012 – 31/12/2012 was 52.
- A HELICS defined VAP rate of 2.5 per 1000 ventilator days was noted for the period 01/01/2012 – 31/12/2012.
- The mean all Wales infection rates was 2.2 per 1000 critical care ventilator days with a median of 1.0 per 1000 ventilator days.
- The majority of VAPs noted were categorised as PN 1 (28) with an infection rate of 1.33.
- The number of days a patient was ventilated ranged from 5-166 days for patients with an infection.

- The overall monthly infection rate varied from 0.0 to 7.7 per 1000 critical care ventilator days over the 12 month period. The latter rate of 7.7 per 1000 critical care ventilators was obtained during the month of August where the rate was above the upper control limit. On investigation this was attributed to one particular hospital where the unit had recently changed their data capture process, resulting in increased uptake of the surveillance.

SECTION 2. Incidence of HELICS VAP by case type and risk factor

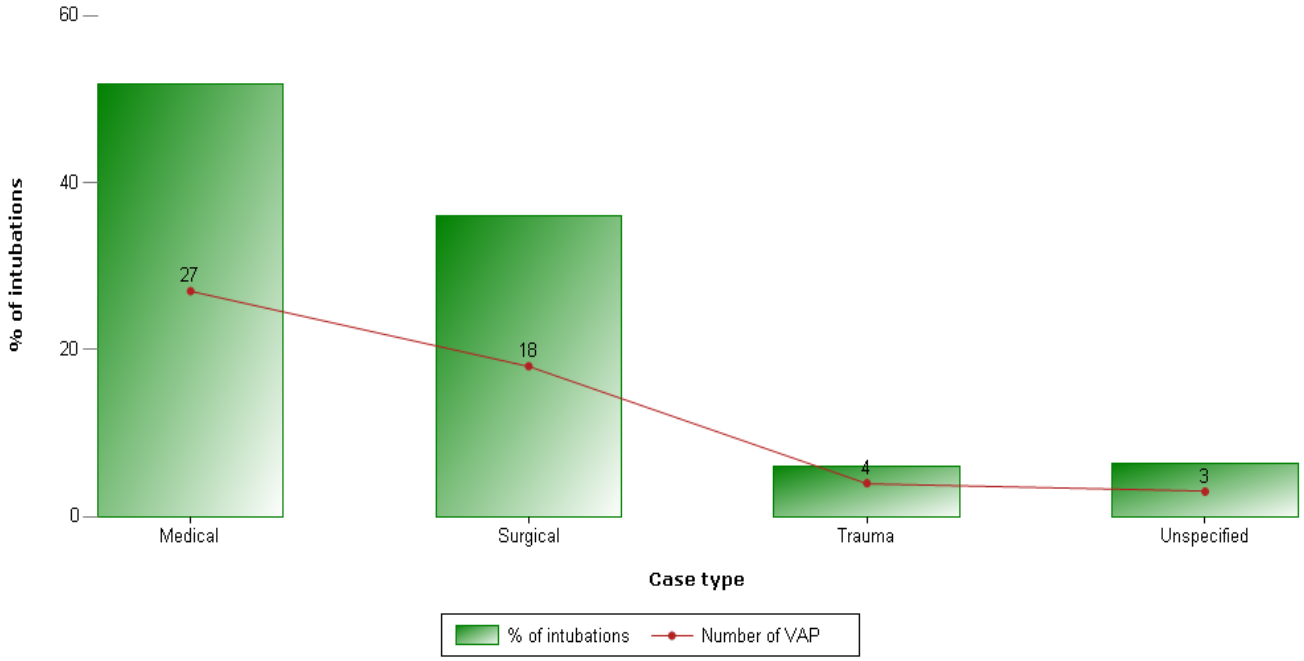


Figure 2.1 Percentage of intubations and HELICS defined VAP numbers by case type for All Wales for the period 01/01/2012 – 31/12/2012

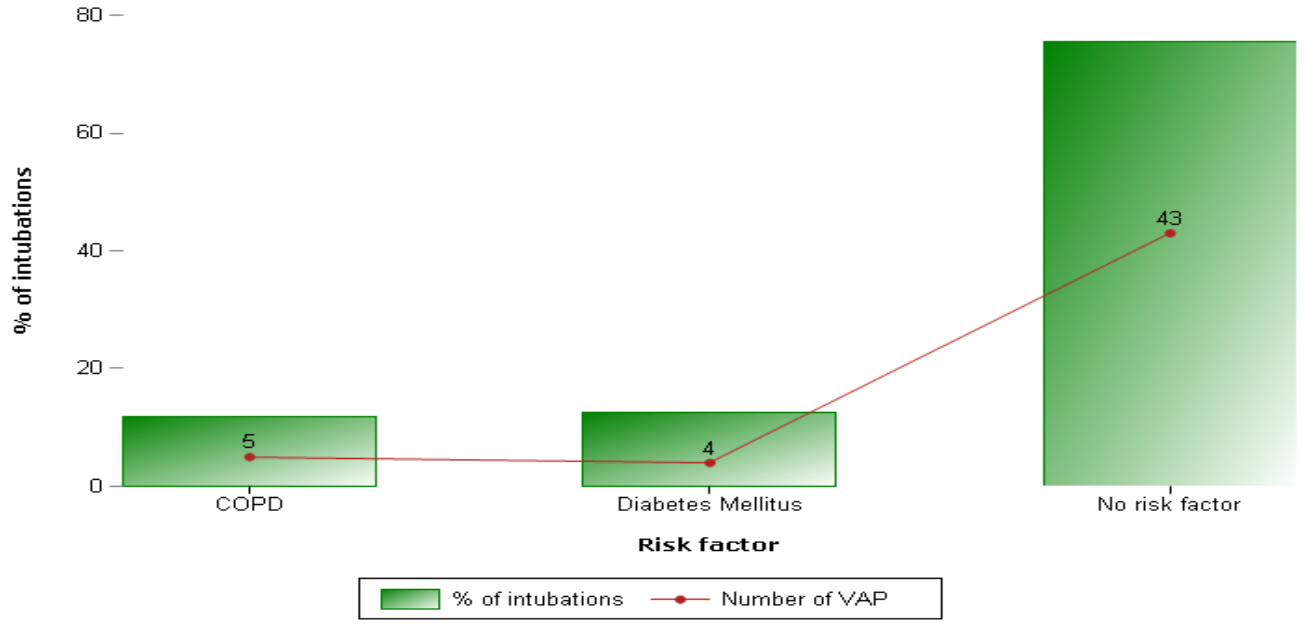
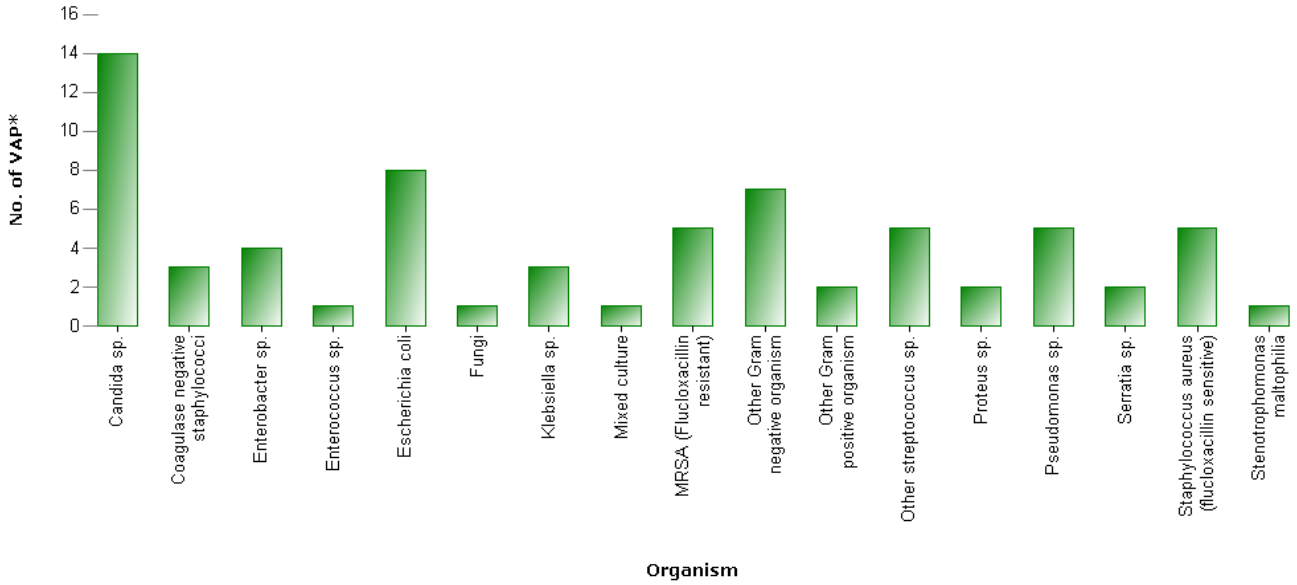


Figure 2.2 Percentage of intubations and HELICS defined VAP numbers by risk factor for All Wales for the period 01/01/2012 – 31/12/2012

Key summary points

- Approximately 52% of intubations were associated with medical cases and approximately 36% with surgical cases.
- The majority of VAPs were associated with medial cases. Of the 52 VAPs, 27 were associated with medical cases, 18 surgical and 4 with trauma. 3 infections did not have a case type identified.
- Approximately 25% of cases had a risk factor (12% COPD; 13% diabetes mellitus). In addition 9 infections were associated with these cases (5 with COPD and 4 with diabetes mellitus).

SECTION 3. Incidence of HELICS VAP by organism



** The VAP may include more than 1 result organism. Microbiological diagnosis allows for up to 3 positive organisms to be noted. The number of VAP may therefore not correspond to the number of organisms*

Figure 3.1 Numbers of HELICS defined VAP by organism for All Wales for the period 01/01/2012 – 31/12/2012

Key summary points

- A VAP infection may include more than 1 result organism. Microbiological diagnosis allows for up to 3 positive organisms to be noted. The number of infections may therefore not correspond to the number of organisms.
- A total of 14 Candida *sp*. were associated with HELICS defined VAP for 2012. Further analysis of the data showed 6 infections were attributed to Candida *sp*. only with the remaining 8 infections including one or more organisms. It is likely that many of the infections are not 'true' Candida *sp*. and this requires investigation locally.
- Other organisms associated with higher numbers of infection included, *Escherichia coli,* MRSA, *Staphylococcus aureus* and Pseudomonas *sp.*

CONCLUSION

The Welsh critical care infection surveillance scheme provides the critical care teams with an indication of the current Welsh CVC and VAP infection rate. The report also provides some possible risk factors associated with line insertion / line maintenance and mechanical ventilation. The data provided in this annual report highlights the main results obtained from the data collected and is intended to provide 'head-line' rates only.

Careful interpretation of the CVC / VAP results is required when comparing data from other countries. A full description of the methodology is required to eliminate differences in data collection methods and interpretation of infections (e.g. CDC definitions vs. HELICS). In addition, Health boards should utilise the quarterly and annual Health board reports to compare their own unit rates over time.

Central Venous Catheter (CVC) Surveillance

The overall CVC infection rate (utilising HELICS criteria) was 0.7 per 1000 catheter days for 2012. The rate of CVC infection was the same in 2011 and 2010 [6, 7]. The majority of infections noted for 2012 were categorised as either local or bloodstream.

The majority of lines were inserted on critical care where the highest infection rate was also noted (12 infections). The surveillance has provided an indication into the organisms associated with infection and this in turn may be linked with line insertion / maintenance locally as well as with antibiotic prescribing. The results show Candida *sp*., coagulase negative *staphylococci* and MRSA (flucloxacillin resistant) to be the main organisms associated with infection. The jugular was the vein most often utilised for inserting a line and associated with the highest infection numbers (13).

The all Wales rate provided in this report should be compared with other countries and used as a benchmark for Wales as more data are collected. However, the literature searched to date does not seem to provide many rates overall but instead concentrates on bloodstream infections and or rates by ICU specialty. Catheter-related bloodstream infections range from approximately 0.6 to 4.2 in the literature[8-11] with a rate of 0.6 per 1000 CVC days noted for Scotland in 2011[11].

Ventilator Associated Pneumonia (VAP) Surveillance

The overall VAP infection rate (utilising HELICS criteria) was 2.5 per 1000 ventilator days for 2012 compared with 1.2 and 0.9 per 1000 ventilator days for 2011 and 2010, respectively. The majority of VAPs captured were PN 1.The rates should be interpreted with some caution as we cannot be sure that all data is being collected and there is some variation in interpretation of the definition by unit.

Approximately 52% of intubations were associated with medical cases with 27 infections noted. The surveillance also provided the number of infections occurring in patients with risk factors such as COPD (5 infections) or diabetes mellitus (4 infections). The majority of infections were not linked to risk factors. The surveillance has also provided an indication into the organisms associated with infection and this in turn may be linked with the intubation / maintenance care bundle in place as well as with antibiotic prescribing / therapy. A total of 14 Candida *sp*. were associated with HELICS defined VAP for 2012. Further analysis of the data showed 6 infections were attributed to Candida *sp*. only with the remaining 8 infections including one or more organisms. It is likely that many of the infections are not 'true' Candida *sp*. and this requires investigation locally. Other organisms associated with higher numbers of infection included, *Escherichia coli,* MRSA*, Staphylococcus aureus* and Pseudomonas *sp.*

The all Wales rate provided in this report should be compared with other countries and used as a benchmark for Wales as more data are collected. Preliminary literature shows VAP rates from other countries to vary from 1.89 to 5.5 per 1000 ventilator days[11-14] with a rate of 5.2 per 1000 invasive respiratory days for Scotland in 2011[11].

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1. ANEURIN BEVAN HEALTH BOARD RESULTS - Central Venous Catheter (CVC) Surveillance

The time period for this report is based on the date of insertion. Therefore only records with the insertion date completed have been included for analysis. Patients that have not been on critical care for over 48 hours have also been excluded.

A total of 738 forms were received for 01/01/2012 – 31/12/2012. 731 (99%) of forms could be utilised for data analysis.

Table 1.1 Overall HELICS defined CVC infection rate for Aneurin Bevan Health Board for the period 01/01/2012 - 31/12/2012

Number of HELICS CVC infections	Number of critical care catheter days*	HELICS CVC infection rate** (per 1000 critical care catheter days)
1	4175	0.2

** Only catheter days up to discharge of patient from critical care are included. Number of critical care catheter days calculated = removal date - insertion date + 1 (unless the insertion date precedes the admission to critical care date i.e. insertion date is replaced by admission to critical care date, or if the removal date succeeds discharge date from critical care then removal date is replaced by discharge date)*
*** Calculation of HELICS CVC infection rate = total number of HELICS CVC infections / number of critical care catheter days * 1000*

Table 1.2 Breakdown of HELICS defined CVC infection rate by infection type for Aneurin Bevan Health Board for the period 01/01/2012 - 31/12/2012

Infection type	Number of HELICS CVC infections	HELICS CVC infection rate** (per 1000 critical care catheter days)
CRI 1	0	0.00
CRI 2	0	0.00
CRI 3	1	0.24

Table 1.3 Numbers of HELICS defined CVC infections by organism for Aneurin Bevan Health Board for the period 01/01/2012 – 31/12/2012

Organism	Number of HELICS CVC infections
MRSA (flucloxacillin resistant)	1

2. ANEURIN BEVAN HEALTH BOARD RESULTS – Ventilator Associated Pneumonia (VAP) Surveillance

The time period for this report is based on the date of intubation. Therefore only records with the date of intubation completed have been included for analysis. Patients that have not been on Critical Care for over 48 hours have also been excluded.

A total of 495 forms were received for 01/01/2012 - 31/12/2012. 490 (99%) of forms could be utilised for data analysis.

Table 2.1 Overall HELICS defined VAP rate for Aneurin Bevan Health Board for the period 01/01/2012 - 31/12/2012

Number of HELICS VAP	Number of critical care ventilator days*	HELICS VAP rate** (per 1000 critical care ventilator days)
2	3296	0.6

** Only ventilator days up to discharge of patient from Critical Care are included. Number of Critical Care ventilator days calculated = extubation date - intubation date + 1 (unless the intubation date precedes the admission to critical care date i.e. intubation date is replaced by admission to critical care date, or if the extubation date succeeds discharge date from Critical Care then extubation date is replaced by discharge date)*
*** Calculation of HELICS VAP rate = total number of HELICS VAP / number of critical care ventilator days * 1000*

Table 2.2 Breakdown of HELICS defined VAP rate by infection type for Aneurin Bevan Health Board for the period 01/01/2012 - 31/12/2012

Infection type	Number of HELICS VAP	HELICS VAP rate** (per 1000 critical care ventilator days)
PN 1	1	0.30
PN 2	1	0.30
PN 3	0	0.00
PN 4	0	0.00
PN 5	0	0.00

Table 2.3 Numbers of HELICS defined VAP by organism for Aneurin Bevan Health Board for the period 01/01/2012 – 31/12/2012

Organism	Number of HELICS VAP
Enterobacter sp.	1
Proteus sp.	2

** The VAP may include more than 1 result organism. Microbiological diagnosis allows for up to 3 positive organisms to be noted. The number of VAP may therefore not correspond to the number of organisms*