



National Public Health
Service for Wales
Gwasanaeth Iechyd Cyhoeddus
Cenedlaethol Cymru

Welsh Healthcare Associated Infections
Programme (WHAIP)
Rhaglen Heintiau sy'n Gysylltiedig a Gofal
Iechyd Cymru (RHGGIC)

ALL WALES

Caesarean Section Site Infection Report

January – December 2007



The Temple of Peace & Health, Cathays Park, Cardiff, CF10 3NW
Y Deml Heddwch ac Iechyd, Parc Cathays, Caerdydd, CF10 3NW
Tel/Ffon: 029 2040 2473
Fax:/Ffacs: 029 2040 2526



Index

<u>Summary</u>	3
<u>Introduction</u>	5
<u>All Wales Results</u>	7
Questionnaire returns	7
Completion Rates	8
Surveillance Compliance	8
SECTION 1. All Wales SSI rate	10
Incidence of SSI by infection type	11
SSI incidence density	12
SECTION 2. Incidence of SSI by patient risk index	14
Breakdown of C-section procedures by wound class and ASA classification	14
SSI incidence by wound class and ASA scoring	15
Risk index details	15
Duration of procedure	16
SECTION 3. General demographics	18
Incidence of SSI by age category	18
Incidence of SSI by BMI category	18
Incidence of SSI with previous C-sections	18
Incidence of SSI with labour details	19
SECTION 4. Details of the surgical procedure	20
Incidence of SSI following elective and emergency procedures	20
Incidence of SSI by timing of antibiotic prophylaxis	20
Incidence of SSI by skin closure type	20
SECTION 5. Duration of stay and onset of infection	22
Average length of stay (hospital and post-discharge)	22
Onset of infection	25
SECTION 6. Elective procedures versus emergency C-section procedures	27
Incidence of SSI by infection type	27
Incidence of SSI by risk index	27
Incidence of SSI by BMI category	28
Incidence of SSI with labour details	28
Incidence of SSI by skin closure type	29
Length of midwifery care	29
SECTION 7. Incidence of SSI over time	30
SECTION 8. Comparative results	31
<u>Conclusions</u>	32
<u>References</u>	33
<u>Acknowledgements</u>	35

Summary

- This is the second annual report covering the mandatory surveillance of C-section procedures in Wales (2007). The report covers both lower and upper uterine segment procedure categories and excludes C-section hysterectomy.
- A total of 4540 questionnaires were received for 2007. Only 3308 (73%) of forms could be further analysed for determining SSI rates (this compares with 65% for 2006).
- Compliance with the surveillance varied with Trusts reporting between 0% and 99% of C-section procedures and the overall Wales compliance was 41% (or 49% when excluding the non-complying Trust).
- Overall 665 infections were detected either during the hospital stay or more likely post-discharge, giving a crude inpatient SSI rate of 2.1% and a crude overall SSI rate of 20.1% (compared with 21.5% 2006). Trust overall rates varied from 12.8% to 48.1%. The rates should be treated with caution due to the low compliance with the surveillance coupled with some data being invalid.
- The overall SSI rate broken down by type was 15.6% superficial infections and 2.8% deep seated infections, with 1.7% unknown. A similar trend was also noted for post-discharge SSIs.
- An increase in the all Wales infection rate occurred between the months of May and June and a later peak in October 2007.
- Overall a post discharge form was received for 88% of procedures but this varied from 48% to 100% of records by Trust. To take into account the variation in follow up, rates were calculated by 1000 days of patient follow up. The overall SSI rate was 9.7 per 1000 days followed. Trust rates by length of follow up varied from 6.2 – 34.2 per 1000 days followed up.
- The wound class for approximately 90% of 2007 procedures were clean-contaminated and approximately 90% of patients were classed as normally healthy. However, an SSI rate of 19.1% was calculated for patients in the above lower risk categories.
- The risk of a SSI significantly ($p < 0.05$) increased with increased BMI, particular in obese patients.
- The SSI rate increased for patients having had 2 or more C-sections, patients in active labour and for patients with ruptured membranes.
- Antibiotic prophylaxis was given to 99% of patients with 78% of patients receiving their antibiotics after incision, 22% prior to incision. Data has so far shown that the SSI rate decreased when antibiotics were given prior to incision.

- Use of dissolvable sutures significantly ($p < 0.05$) increased the rate of SSI compared with removable sutures as the skin closure type. Use of staples also increased the SSI rate but more data is required for statistical analysis.
- When the type of procedure (emergency or elective) was taken into consideration a significant difference ($p < 0.05$) was noted in the SSI rate for patient in active labour compared with those not in active labour and for ruptured versus no ruptured membranes (following emergency procedures).
- The majority of mothers were discharge from hospital in the first 5 days after the procedure. The mean length of midwifery care following a C-section procedure was approximately 22-24 days.
- The mean onset of infection was 11 days with the greatest number of infections captured between days 5 to 11.
- The all Wales 2007 data indicates that a 28 day follow-up post surgery is required to capture the greatest number of SSI. 21 days, 14 days and 10 days follow-up allowed for 95%, 80% and 50% of infections to be captured, respectively. It is however difficult to determine if all SSIs were captured in the dataset due to variance in midwifery length of stay by Trusts.
- In general, in patient SSI rates in Wales are comparable with data from other countries. Wales does appear to have a higher overall SSI rate but comparisons are few due to the lack of post-discharge surveillance carried out in and outside of Europe.
- Wales remains one of the few countries to carry out continuous post-discharge surveillance, where the majority of infection data will be collected.

Introduction

In September 2004, the Welsh Assembly Government launched 'Healthcare Associated Infections – 'A Strategy for Hospitals in Wales', stating that current mandatory surgical site infection surveillance involving orthopaedic surgery would be extended to other specialities (section 5.8, page 30). Consequently, the Welsh Healthcare Associated Infection Programme (WHAIP) was instructed to develop and support the implementation of surveillance of infections following Caesarean section procedures undertaken in NHS Trusts in Wales. A Welsh Health Circular was issued to Chief Executives informing them of this (WHC (2005) 093).

Before being made mandatory, surveillance of infections following C- sections in Wales was undertaken voluntarily by three hospital Trusts. Through surveillance these Trusts were able to obtain an insight into their local infection rates and thus demonstrate the usefulness of surveillance as a basis for further investigations.

Surgical Site Infection (SSI) is an important area for surveillance and remains an important complication of surgery with both human and financial costs being high¹. SSI is the second most common infection following a C-section within a group of patients who are generally considered to be young, fit and well females².

The surveillance scheme for SSI in C-sections was made mandatory in Wales in January 2006. This is the second national report on SSI following C-section procedures in Wales. The data presented here is a summary of information provided by eleven out of twelve Trusts. One Trust did not contribute data for this calendar year. The report includes data captured both during the hospital stay and post-discharge within the community. The surveillance incorporates data collected by clinical teams and midwives and uses internationally agreed definitions³, allowing Welsh data to be compared with and be incorporated into other international databases, such as the HELICS European SSI database⁴. The purpose of the surveillance in the early years of data collection is to provide an initial baseline infection rate to assist Trusts in monitoring both their system of data collection and to aid with reducing infection over time. In particular, a clear understanding of how to diagnose an SSI is crucial to accurate data collection. In addition the surveillance relies heavily on post-discharge surveillance to capture the majority of infections. This increases the complexity of the surveillance carried out and is an area that requires additional research.

In September 2007, following discussions with Welsh obstetricians and midwives and through the C-section Steering Group, it was decided that the number of data items collected should be reduced or changed. It was hoped that this would make completion of the forms less time consuming and provide relevant data that would be utilised by the surgical and midwifery teams. All data items removed had previously been shown to be poorly completed by the majority of Trusts. From January 2008 a new form was launched for the C-section surveillance across Wales and as a consequence data items available within the C-section database for analysis (2006 onwards) were restricted to those present on the new form.

In addition a web based reporting system enabling Trusts to view their data will be available in the autumn of 2008. The reporting system will enable surgical and

midwifery teams to access their data more regularly and use the pre-defined tabulated and graphical reports available when producing presentations and for meetings locally.

All Wales Results

Questionnaire returns

Table 1. Number of inpatient, post-discharge and valid questionnaires returned for the surveillance in 2007.

No. of in-patient forms returned	No. of expected post-discharge forms	No. of expected post-discharge forms returned	No. of valid forms used for data analysis*	% of valid forms for data analysis*
4540	4540	4009 (88%)	3308	73.0 (3308/4540)

The SSI rate provided throughout this report is based on an overall infection rate (infections captured pre-discharge or post-discharge), unless otherwise stated. To obtain the overall SSI rate only valid forms could be utilised in data analysis.

*Valid forms include procedure records with an SSI complete on the main form or where infection data could be updated by the completion of a post-discharge form.

% of valid forms = no. forms analysed / no. of main forms received x 100.

For example, a pre-discharge SSI (noted on the main form) or post-discharge SSI (noted on the post-discharge form) will be a valid questionnaire. However, if a main form has 'no' to an SSI but the post-discharge form SSI question is blank then this patient record is not valid. We cannot assume overall that the patient did not have an SSI. A blank on the form is not assumed to be a 'no'.

Of the 4540 forms returned for 2007, 88% (4009 / 4540) had a corresponding post-discharge form. This reduced the number of valid forms for data analysis initially. In addition many of the forms had an incomplete SSI field, especially on the main form thus reducing the number of valid forms overall for inclusion in data analysis to 73.0%. However, the % of valid forms in 2007 was greater than 2006, 73% compared with 65% in 2006. Details on the questionnaire return for individual Trusts in Wales is tabulated in Appendix B. Details on the completion of the SSI field on the main and post-discharge form for all Wales (2007) is shown in table 2. Completion of all other data items on the main and post-discharge form is shown in table 3.

The procedure date has not been included as a data item in table 2 and 3 since all data extractions are based on a record having a procedure date.

Table 2. Percentage completion of the SSI field on the C-section questionnaire (main and post-discharge) for Wales (2007).

Data Item	No. completed	No. expected	% Complete
Inpatient SSI (Yes/No):	3619	4540	79.7
If Yes, SSI type	54	71	76.1
If Yes, Infection date	41	71	57.7
Post-discharge SSI* (Yes/No):	3697	4009	92.2
If Yes, Infection date	564	594	94.9
If Yes, SSI type	555	594	93.4
Overall SSI**	3308	4540	72.9

* Number expected is based on the number of post-discharge forms received.

** Includes procedures with an SSI complete on the main form or updated by completion of the SSI field on a post-discharge form.

From table 2 it is evident that there is a need to increase completion of the SSI field on the inpatient form and ensure that the date of the infection is always noted.

Table 3. Percentage completion of data items on the C-section SSI questionnaires for Wales in 2007. Data pertains to the main form apart from the date of discharge from midwifery care which is present on the post-discharge form.

Data Item	No. completed	No. expected	% Complete
Age	4377	4540	96.4
BMI	3693	4540	81.3
Previous C-sections	4503	4540	99.2
Active labour	4420	4540	97.4
Membrane rupture	4358	4540	96.0
Wound class	4173	4540	91.9
ASA classification	4304	4540	94.8
Operation type	4439	4540	97.8
Prophylaxis timing	4352	4540	95.9
Operating surgeon code	3582	4540	78.9
Skin closure type	4223	4540	93.0
Incision time	4202	4540	92.6
Closure time	4109	4540	90.5
Date of discharge from hospital	3268	4540	72.0
Date of discharge from midwifery care*	3656	4009	91.2

* Number expected is based on the number of post-discharge forms received.

It can be observed from table 3 that all questions on the C-section forms (excluding SSI question) are completed well, the exception being the date of discharge from hospital and operating surgeon code.

The percentage completion of the SSI field on the C-section questionnaire for individual Trusts in Wales is tabulated in Appendix B.

Surveillance Compliance

Table 4 shows the compliance of Wales in the mandatory C-section surveillance for 2007. Compliance for the individual Trusts in Wales can be found in Appendix B.

The table includes the number of questionnaires returned to WHAIP for 2007 and the number of valid questionnaires returned (as previously detailed in table 1.). The compliance figure is derived from the number of valid questionnaires returned to WHAIP divided by the number of C-sections reported to the Patient Episode Database for Wales (PEDW) at Health Solutions Wales (HSW). One Trust has not contributed data to the surveillance for 2007. For this reason two figures are provided for the compliance.

Table 4 Coverage of the C section SSI Surveillance compared to procedures reported to the PEDW database at HSW for Wales in 2007

	No. of questionnaires returned to WHAIP	No. of valid questionnaires returned to WHAIP*	No. of C sections reported to HSW*	% Compliance (all Trusts in Wales)	% Compliance (excluding the non-complying Trust)
All Wales	4540	3308	8069	41	49

* valid questionnaires – procedures with an SSI complete on the main form or where infection data could be updated post-discharge

Procedure codes reported to HSW included R171, R172, R181 and R182.

The All Wales compliance with the C-section surveillance has increased to 41% for 2007. This compares with 34% for 2006 (when basing compliance on valid forms returned to WHAIP). The compliance for 2007 increased when the non-complying trust was removed. The number of C-sections reported to HSW was 6716 when the non-complying trust was removed.

Key Summary Points

- Completion of the SSI question has improved in 2007 compared with 2006 with the % of valid forms increasing from 65% to 73% for 2007.
- All data items on the form were completed well apart from the inpatient SSI and date of discharge from hospital.
- All Wales surveillance compliance for 2007 was 41%. This compares with 34% for 2006.
- All Wales compliance increased to 49% for 2007 when HSW data for the non-complying Trust was removed.

SECTION 1. All Wales SSI rate

Table 1.1 provides the inpatient SSI rate post C-section surgery. A total of 71 SSI were identified giving an inpatient rate of 2.1%. Table 1.2 provides the number and SSI for infections identified after discharge of the patient from hospital only. A post-discharge rate of 16.1% was noted with 594 SSI identified. Table 1.3 provides the overall SSI rate post C-section surgery and includes all SSI identified either pre or post-discharge from hospital. A total of 665 SSI were captured during the surveillance with an overall SSI rate of 20.1% for 2007. All rates are based on valid forms only. The SSI rates calculated and provided in the remainder of this report are based on an overall rate unless otherwise stated. As the length of hospital stay after such a procedure has been reduced the majority of SSIs will be captured post-discharge in the community.

Table 1.1 Incidence of inpatient SSI in Wales for 2007

	No. of procedures analysed	No. of SSI*	Overall SSI rate (%)*(95% CI)
All Wales	3308	71	2.1 (1.7-2.7)

Table 1.2 Incidence of post-discharge SSI in Wales for 2007

	No. of procedures analysed	No. of SSI*	Overall SSI rate (%)*(95% CI)
All Wales	3697	594	16.1 (14.8-17.4)

Table 1.3 Incidence of overall SSI in Wales for 2007

	No. of procedures analysed	No. of SSI*	Overall SSI rate (%)*(95% CI)
All Wales	3308	665	20.1** (18.6-21.7)

*Figures based on valid questionnaires only. This only includes procedures with either an SSI field completed on the main form or where infection data could be updated post-discharge.

** **Note:** the overall SSI rate (%) is based on the valid forms rule previously described and is not based on the inpatient SSI rate combined with the post-discharge SSI rate.

Although the majority of trusts in Wales have similar SSI rates, 3 out of 12 trusts have rates above 40%. If an average of the trust rates were calculated then the SSI rate quoted for Wales in 2007 would be 25.5% with a median of 19.3%. The overall SSI

rate for all trusts in Wales is tabulated in Appendix A. The overall and post-discharge SSI rate for individual trusts in Wales is tabulated in Appendix B.

Graphical representation of the monthly SSI rate with monthly C-section procedure numbers for 2007 is shown in Figure 1.1. The graph includes the number of procedures reported to WHAIP and also the number reported to HSW. The SSI rates provided in the graph are based on the number of SSI and procedures reported to WHAIP only.

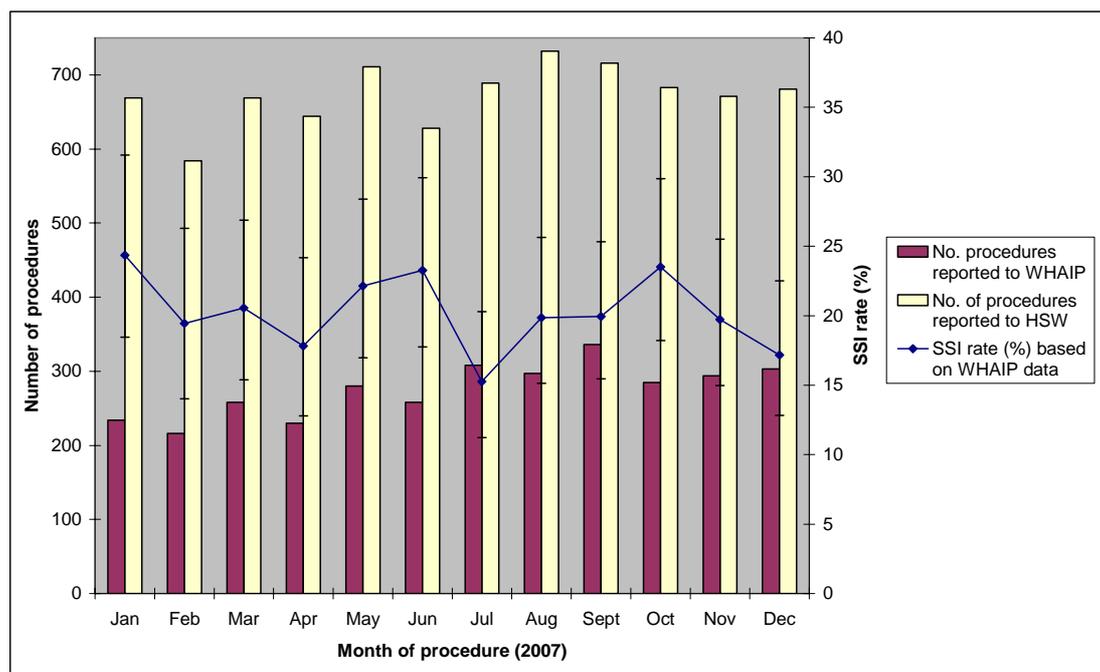


Figure 1.1 Number of procedures reported to WHAIP compared with C-section procedures reported to HSW for all Wales 2007. The graph also includes the overall SSI rate calculated using WHAIP data

No specific trend could be determined from the monthly figures shown above (i.e. increase in the SSI rate with increased procedure numbers). However, an increase in the SSI rate was observed during the months of May and June with a sharp drop in the rate for July. An increase in the rate, similar to that in May and June was also noted in October.

Incidence of SSI by infection type

The type of SSI recorded on the questionnaire could be categorised into either superficial, deep or organ/space infections. Table 1.5 details the percentage of infections by type of SSI. The SSI are categorised into superficial infections and deep seated infections. The latter includes deep and organ / space infections. Table 1.6 and 1.7 provides the overall SSI rate and post-discharge SSI rate, respectively, broken down by SSI type in 2007. The overall and post-discharge SSI rate broken down by SSI type for all trusts in Wales is tabulated in Appendix B.

Table 1.5 Type of SSI, specifically superficial and deep seated infections (deep, organ/space) for C-section procedures carried out in Wales for 2007

SSI type	%
Superficial infections	77
Deep seated infections	14
Unknown	9

Table 1.6 Overall SSI rate (%) broken down by SSI type for Wales in 2007

SSI type	No. SSI	% SSI (95% CI)
Superficial infections	515	15.6 (14.3-17.0)
Deep seated infections	94	2.8 (2.3-3.5)
Unknown	56	1.7 (1.3-2.2)

Table 1.7 Post-discharge SSI rate (%) broken down by SSI type, specifically superficial and deep seated infections (deep, organ/space) for Wales in 2007

SSI type	No. SSI	% SSI (95% CI)
Superficial infections	481	13.0 (11.9-14.2)
Deep seated infections	74	2.0 (1.6-2.5)
Unknown	39	1.1 (0.8-1.4)

SSI incidence density

The infection rates based on the number of SSI per 100 procedures calculated do not take into account the length of time the patients are followed up. Post-discharge follow up vary between trusts and in some instances the inpatient length of stay. The following table therefore provides an incidence density rate, based on a denominator of 1000 days followed up.

Table 1.4 Total SSI rate/1000 days followed up in Wales in 2007

	Valid Records	SSI	Days followed up	SSI/1000 days followed	95% CI
All Wales	3258	663	68034	9.7	9.0-10.5

Note there were fewer numbers of valid records and SSI utilised for the incidence density analysis compared with the overall SSI rate calculation. The mean number of days followed was 21 (median 23; mode 28). From the table it is evident that the rate is reduced when the number of days followed up is included. The incidence density SSI rate for individual trusts in Wales is tabulated in Appendix B.

Key Summary Points

- The All Wales SSI rate following a C-section procedure in Wales for 2007 was 20.1% compared with a rate of 21.5% for 2006.
- The overall SSI rate broken down by SSI type was 15.6% superficial infections and 2.8% deep seated infections.
- The post-discharge SSI rate broken down by SSI type was 13.0% superficial infections and 2.0% deep seated infections.
- An increase in the SSI rate occurred between the months of May and June and a later peak in October 2007.
- To take into account the variation in post-discharge follow-up, rates were calculated by 1000 days of patient follow-up. The overall rate was 9.7 per 1000 days followed.

SECTION 2. Incidence of SSI by patient risk index

The following tables take into account factors that may influence the risk of infection. The American National Nosocomial Infections Surveillance (NNIS) system risk index is the most widely used method internationally of risk adjusting surgical patients^{5, 6, 7}. The risk index uses three risk factors to score each patient from 0 to 3, namely the American Society of Anaesthesiologists (ASA) pre-operative assessment score, the wound classification and the duration of surgery. The procedure is scored from 0 to 3 according to how many of the factors were present at the time of surgery. Tables 2.1 to 2.4 provide details on both the wound class and ASA classification whilst tables 2.5 and 2.6 provide details specific to risk index. In addition table 2.7 provides a breakdown of the duration of C-section procedures in Wales (2007).

Breakdown of C-section procedures by wound class and ASA classification

The following tables provide the percentage of procedures for each categorised wound class (table 2.1) and ASA classification (table 2.2) for C-section procedures in Wales (2007).

Table 2.1 Percentage (%) of C-section procedures for each wound class in Wales in 2007

Wound class	No. Procedures	%
Clean-contaminated ¹	2992	90.4
Dirty or infected ²	69	2.1
Blanks	247	7.5

1. Operative wounds in which the genital or urinary tracts are entered under controlled conditions without unusual contamination. Specifically, includes C-section procedures, operations involving the biliary tract, appendix, vagina, and oropharynx, provided no evidence of infection or major break in sterile technique is encountered.
2. Includes C-section procedures where prolonged membrane rupture of 24hrs or more occurs or the presence of an abscess.

Table 2.2 Percentage (%) of C-section procedures by ASA classification in Wales in 2007

ASA classification	No. Procedures	%
1. Normally healthy patient	2973	89.9
2. Patient with mild systemic disease	162	4.9
3. Patient with severe systemic disease that is not incapacitating	28	0.8
4. Patient with incapacitating systemic disease that is a constant threat to life and	1	0.03
5. Moribund patient not expected to survive for 24hr with or without operation		
Blanks	144	4.4

SSI incidence by wound class and ASA scoring

The following tables provide the number of SSI and % SSI associated with each wound class (table 2.3) and ASA scoring category (table 2.4) for C-section procedures in Wales (2007).

Table 2.3 C-section SSI with wound class in Wales in 2007

Wound class	No. Procedures*	No. SSI	% SSI (95% CI)
Clean-contaminated	2992	601	20.1 (18.5-21.8)
Dirty or infected	69	8	11.6 (5.0-22.8)

*247 procedures have been excluded because the wound class was not completed

Table 2.4 C-section SSI with ASA score in Wales in 2007

ASA score	No. Procedures*	No. SSI	% SSI (95% CI)
1. Normally healthy patient	2973	574	19.3 (17.8-21.0)
2. Patient with mild systemic disease	162	40	24.7 (17.6-33.6)
3. Patient with severe systemic disease that is not incapacitating	28	4	14.3 (3.9-36.6)
4. Patient with incapacitating systemic disease that is a constant threat to life and	1	0	0**
5. Moribund patient not expected to survive for 24hr with or without operation			

*144 procedures have been excluded because the ASA score was not completed

** 95% CI not included

Risk index details

A total of 462 procedures have been excluded from the risk index analysis because one or more of the risk index component fields have not been completed and the risk index could therefore not be calculated. Table 2.5 gives the proportion of records scoring 0 or 1 for each of the components of the risk index. Table 2.6 shows the numbers of records falling into each risk index category for C-section procedures and with the SSI rate.

Table 2.5 Proportion of procedures scoring 0 or 1 for each of the components making up the NNIS system risk index in Wales in 2007

Risk Factor (score 1 if equal to the following, score 0 if not equal to the following)	Proportion of Procedures scoring 0	Proportion of Procedures scoring 1
ASA of 3,4,5	99.1	0.9
Wound class Dirty/Infected	97.7	2.3
Duration of surgery over T value*	92.4	7.6

* T-value for C-section procedure = 1 hr⁶

Table 2.6 Surgical Site Infections by Patient Risk Index for C-section procedures in Wales in 2007

Patient Risk Index	No. of Procedures	Number of SSI	% SSI (95% CI)
0	2512	479	19.1 (17.4-20.9)
1	291	64	22.0 (16.9-28.1)
2	11	1	9.1*

* 95% Confidence intervals not included

Duration of Procedure

Table 2.7 provides details of the mean duration of C-section procedures for all patients and provides a comparison of procedure duration with patients who developed an SSI post surgery compared to those without an SSI. Only those procedures with a start and end time to the procedure could be utilised in the calculation (n=3031).

Table 2.7 Duration of All Wales C-section procedures in minutes in Wales in 2007

	No. with procedure start and end times	Mean	Median	Mode	Range
All patients	3031	39	36	30	2-345
Patients without an SSI	2438	39	36	30	2-345
Patients with SSI	593	41	37	35	2-215

The duration of surgery is also used to calculate the patient risk index. Each surgical procedure has been assigned a T-value; procedures that take longer than the T-value for that procedure are assigned a point towards their risk index total. The T-values are calculated as the 75th percentile of duration of the surgical procedure, based on surgeon performance in the United States⁶. For C-section procedures, the T-value is 1 hour. It would be expected that 25% of the procedures should lie above the T-value, but in Wales only 8% of procedures took longer than the T value. The 75th percentile of Welsh data for 2007 was **45** minutes (compares with all Wales report for 2006). This value is comparable with the distribution of operations in European hospitals with a T time (75th percentile) of 48 mins⁸. Utilising the Welsh T value of 45 minutes, the percentage of procedures exceeding the T time increased to 24%.

Table 2.8 Proportion of procedures scoring 0 or 1 for each of the components making up the NNIS system risk index in Wales in 2007 using the revised procedure T-value

Risk Factor (score 1 if equal to the following, score 0 if not equal to the following)	Proportion of Procedures scoring 0	Proportion of Procedures scoring 1
ASA of 3,4,5	99.1	0.9
Wound class Dirty/Infected	97.7	2.3
Duration of surgery over T value*	75.6	24.4

* Revised T-value for C-section procedure = 45 min

Table 2.9 Surgical Site Infections for C-section procedures in Wales in 2007 using the revised Patient Risk Index

Revised Patient Risk Index	No. of Procedures	No. of SSI	% SSI (95% CI)
0	2057	377	18.3 (16.5-20.3)
1	729	164	22.5 (19.2-26.2)
2	25	3	12.0 (2.5-35.1)

Key Summary Point

- 90% of procedures wound class were clean-contaminated and approximately 90% of patients were classed as normally healthy.
- However an SSI rate of 19.1% was calculated for patients in the above lower risk categories.
- The mean duration of a C-section procedure in Wales (2007) was 39 mins and the T-value for Wales was 45 mins.
- UK and European surgeons perform operations in a shorter time than their US counterparts. There is a need to produce a UK T – value for such procedures as this will have a substantial bearing on SSI rates stratified by risk.
- When utilising the Wales T – value the number of procedures and number of SSI with a risk index of 0 decreased and the number with a risk index of 1 and 2 increased.
- However, the SSI rate decreased with the revised risk index of 0, remained the same for the revised risk index of 1 and increased with the revised risk index of 2.

SECTION 3. General demographics

This section gives information about the age groups, BMI, previous C-sections and labour details, in particular SSIs associated with each category.

Incidence of SSI by age category

Table 3.1 C-section SSI with age in Wales in 2007 (specific age bands based on those utilised by The National Sentinel Caesarean section Audit report)⁹

Age group	No. of procedures*	No. of SSI	% SSI (95% CI)
<20	207	40	19.3 (13.8-26.3)
20-24	577	117	20.3 (16.8-24.3)
25-29	844	176	20.9 (17.9-24.2)
30-34	869	175	20.1 (17.3-23.4)
35-39	580	111	19.1 (15.7-23.0)
≥40	127	24	18.9 (12.1-28.1)

*104 procedures have been excluded because the age question was not completed

Incidence of SSI by BMI category

Table 3.2 C-section SSI with BMI in Wales in 2007 (Specific BMI categories based on those utilised by The World Health Organisation)¹⁰

BMI	No. of procedures*	No. of SSI	% SSI
Underweight <18.5	33	3	9.1 (1.9-26.6)
Healthy weight 18.5 – 24.9	896	129	14.4 (12.0-17.1)
Overweight 25 – 29.9	929	152	16.4 (13.9-19.2)
Obese ≥30	939	275	29.3 (25.9-33.0)

*511 procedures have been excluded because the BMI question was not completed

Incidence of SSI with previous C-sections

Table 3.3 C-section SSI with patients having had no previous C-sections or one or more previous C-sections for Wales in 2007

No. of previous C-sections	No. of procedures*	No. of SSI	% SSI
0	2047	409	20.0 (18.1-22.0)
1	928	182	19.6 (16.9-22.7)
2	258	62	24.0 (18.4-30.8)
3 or more	48	9	18.8 (8.6-35.6)

*27 procedures have been excluded because the previous number of C-sections question was not completed

Incidence of SSI with labour details

Duration of patient in active labour before the procedure

Table 3.4(a) C-section SSI with duration patient in active labour in Wales in 2007

Duration in active labour (hrs)	No. of procedures	No. of SSI	% SSI
0	1779	330	18.5 (16.6-20.7)
Up to 12	1133	253	22.3 (19.7-25.3)
>12	324	68	21.0 (16.3-26.6)

*72 procedures have been excluded because the duration was not completed

Ruptured membranes before the procedure

Table 3.4(b) C-section SSI with ruptured membranes before the procedure in Wales in 2007

Ruptured membranes	No. of procedures	No. of SSI	% SSI
No	1698	319	18.8 (16.8-21.0)
Yes – for more than 24hrs	263	62	23.6 (18.1-30.2)
Yes – for less than 24 hrs	1219	257	21.1 (18.6-23.8)

*128 procedures have been excluded because the ruptured membrane question was not completed

Key Summary Points

- The risk of SSI increased with increased BMI, particularly in obese patients. There was a significant ($P < 0.05$) increase in the SSI rate for obese patients compared with healthy or overweight patients.
- It appears that the SSI rate increases for patients that have had 2 or more C-sections. However, more operative data is required to verify this.
- The SSI rate increased for patients in active labour compared to patients not in active labour.
- The SSI rate increased for patients with ruptured membranes before the procedure compared to patients without ruptured membranes.

SECTION 4. Details of the surgical procedure

The following section provides SSI rates associated with specific operation variables such as the type of operation (elective, emergency), use of and timing of antibiotic prophylaxis and skin closure type.

Incidence of SSI following elective and emergency Procedures

Table 4.1 C-section SSI in elective and emergency surgical procedures in Wales in 2007

Operation Type	No. Procedures*	No. SSI	% SSI (95% CI)
Elective Procedure	1303	255	19.6 (17.2-22.1)
Emergency Procedure	1950	397	20.4 (18.4-22.5)

*55 procedures have been excluded because the operation type was not completed

Although no difference was noted in the SSI rate for elective procedures compared to emergency C-section procedures in general, Section 6 provides the all Wales C-section SSI rate broken down into elective and emergency procedures combined with other variables such as skin closure type, ruptured membranes, BMI etc.

Incidence of SSI by timing of antibiotic prophylaxis

Table 4.2(a) Percentage (%) of C-section procedures by timing of antibiotic prophylaxis in Wales in 2007

Timing of antibiotic prophylactic	No. Procedures*	%
Prior to incision	691	22
After incision	2474	78

*104 procedures have been excluded because the prophylactic antibiotic question was not completed

Table 4.2(b) C-section SSI with antibiotic prophylaxis in Wales in 2007

Was prophylactic antibiotic given?	No. Procedures*	No. SSI	% SSI (95% CI)
Yes prior to incision	691	127	18.4 (15.3-21.9)
Yes after incision	2474	482	19.5 (17.8-21.3)
No	39	20	51.3 (31.3-79.2)

*104 procedures have been excluded because the prophylactic antibiotic question was not completed

Incidence of SSI by skin closure type

Table 4.3 C-section SSI with type of skin closure used in Wales in 2007

Type of skin closure	No. Procedures*	No. SSI	% SSI (95% CI)
Dissolvable suture	1839	385	20.9 (18.9-23.1)
Removable suture	899	151	16.8 (14.2-19.7)
Staples	370	83	22.4 (17.9-27.8)
Glue	3	1	33.3**

*197 procedures have been excluded because the type of skin closure utilised was not completed

** 95% confidence intervals not included

Key Summary Points

- No difference in SSI rates were noted for elective versus emergency procedures, however there is a need to determine if SSI rates differ when other variables are combined with these type of procedures, e.g. ruptured membranes, skin closure type, risk index etc (see section 6).
- Antibiotic prophylaxis was given to 99% of patients.
- 78% of patients received their antibiotic after incision, 22% prior to incision.
- From the combined data collected in 2006 and 2007 a decrease in the SSI rate was noted when the antibiotic was given prior to incision versus after incision. More data on antibiotics given prior to incision is required.
- Use of dissolvable sutures increased the rate of SSI compared with removable sutures as a skin closure type. The difference noted was significant ($p < 0.05$) for the 2007 data collected and when 2006 and 2007 data were combined.
- Use of staples as the skin closure type increases the risk of SSI, however more data is required for statistical analysis.

SECTION 5. Duration of stay and onset of infection

The following section provides details on the post operative length of hospital stay. In addition data are provided on midwifery care and onset of infection. Only valid records are included in the analysis (i.e. records with completed SSI question).

Average length of stay (hospital and post-discharge)

Hospital stay

Table 5.1 Mean post-operative length of hospital stay for C-section procedures in Wales in 2007.

Length of stay	mean	median	mode
All mothers (n= 2649)	3.2	3.0	3.0
Mothers with an SSI (n= 65)	4.8	3.0	3.0
Mothers without an SSI (n= 2584)	3.1	3.0	3.0

Post-operative stay = discharge from hospital date – procedure date

The post-operative length of hospital stay increased for mothers with an SSI compared with mothers who did not develop an SSI post surgery during their hospital stay.

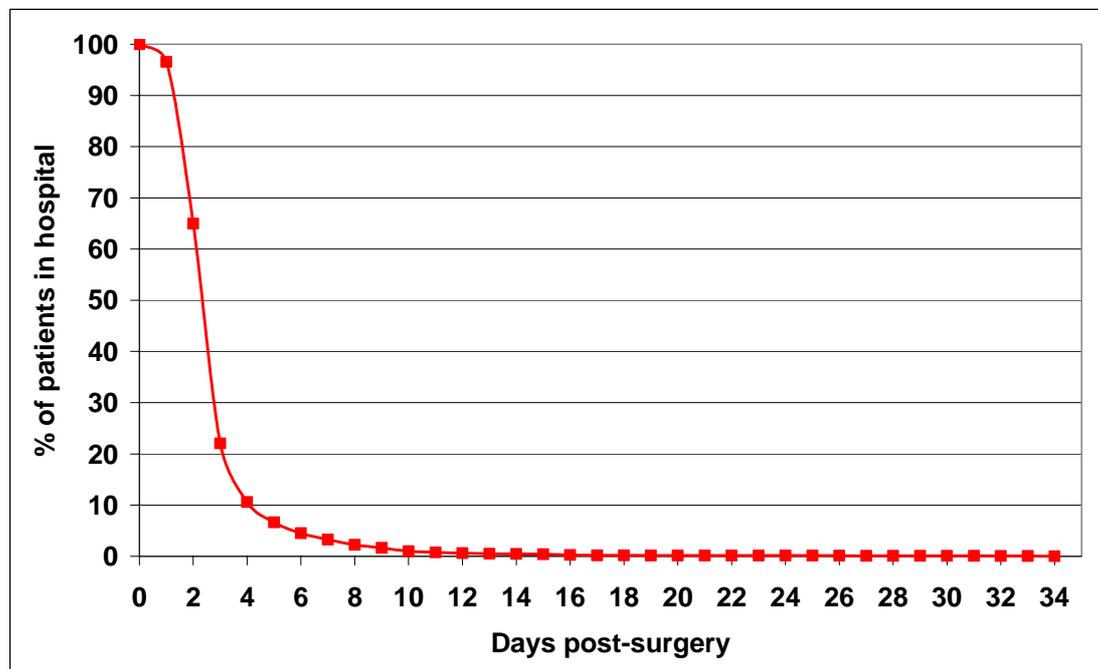


Figure 5.1 Proportion of patients in hospital by days post surgery for C-section procedures in Wales in 2007

From the graph it can be observed that overall, only 22% of patients remained in hospital by day 3 post surgery. By day 4 this was reduced to 11%. By day 13 less than 1% of patients remained in hospital up until (and including) day 33. From table 5.1 it was noted that post-operative stay increased for patients with an SSI. For patients with an SSI, 43% remained in hospital 3 days post surgery and 35% by day 4. Above 1% remained in hospital up until 26 days post-surgery. For patients without an SSI, only 22% and 10% remained in hospital 3 and 4 days post-surgery, respectively. Less than 1% of mothers remained in hospital 10 days post-surgery in the absence of an SSI.

Post-discharge

Table 5.2(a) Mean post-operative length of midwifery stay following a C-section procedure in Wales in 2007 categorised by all mothers, mothers with an SSI and mothers without an SSI. This table includes all valid records

Length of stay	mean	median	mode
All mothers (n= 3147)	23.9	25.0	28.0
Mothers with an SSI (n= 625)	25.4	26.0	28.0
Mothers without an SSI (n= 2522)	23.5	25.0	28.0

Table 5.2(b) Mean post-operative length of midwifery stay following a C-section procedure in Wales in 2007 categorised by all mothers, mothers with an SSI and mothers without an SSI. This table only includes records where the post-operative length of stay is up to 30 days

Length of stay	mean	median	mode
All mothers (n= 2688)	22.2	24.0	28.0
Mothers with an SSI (n= 523)	23.6	25.0	28.0
Mothers without an SSI (n= 2165)	21.9	24.0	28.0

The mean post-operative length of midwifery stay was longer for mothers with an SSI compared to mothers without an SSI (table 5.2 (a) and (b)).

The following graph provides an insight into length of midwifery care post-surgery.

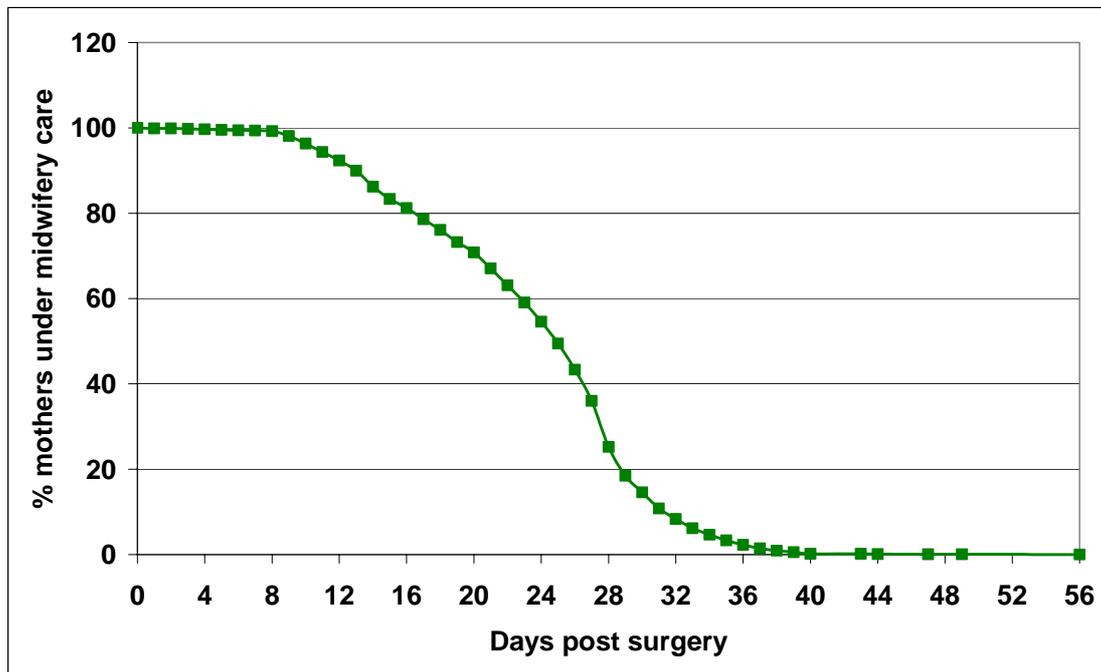


Figure 5.2 Proportion of mothers under midwifery care by days post-discharge from hospital for C-section procedures in Wales in 2007

From individual Trust data for Wales it appears that all hospitals discharge mothers at various time intervals. Only 25% of mothers were under midwifery care 28 days post-surgery. There does not seem to be a specific pattern where by a hospital follows all midwifery care up to day 14, for example. Instead discharge from midwifery care is dependent on many factors such as whether the mother develops an infection or not or perhaps discharge is delayed for other reasons which may pertain to the mother or the baby. In addition, it is difficult to make conclusions as there maybe some inaccuracies with the date of discharge provided on the questionnaire. The graph shows that some mothers were still under midwifery care after 49 days post-surgery.

Onset of infection

Figure 5.3 provides a breakdown of the onset of infection following a C-section procedure and provides the frequency of this occurring. Figure 5.4 shows the percentage of mothers with an SSI by days post surgery and the cumulative percentage of mothers with an SSI.

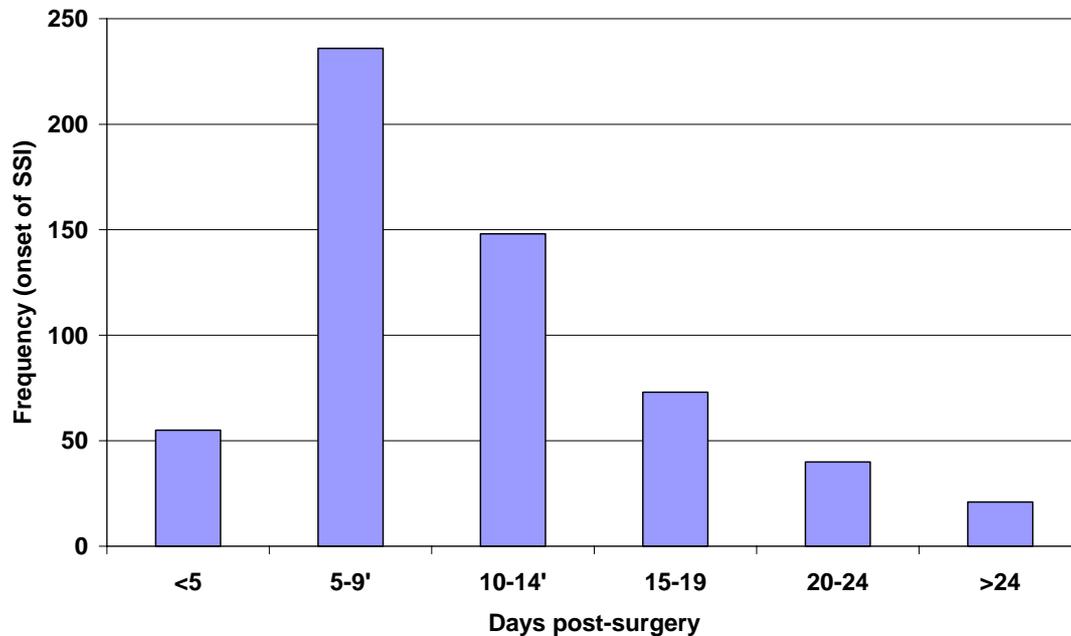


Figure 5.3 Number of days from procedure date to onset of surgical site infection following C-section procedures in Wales (2007)

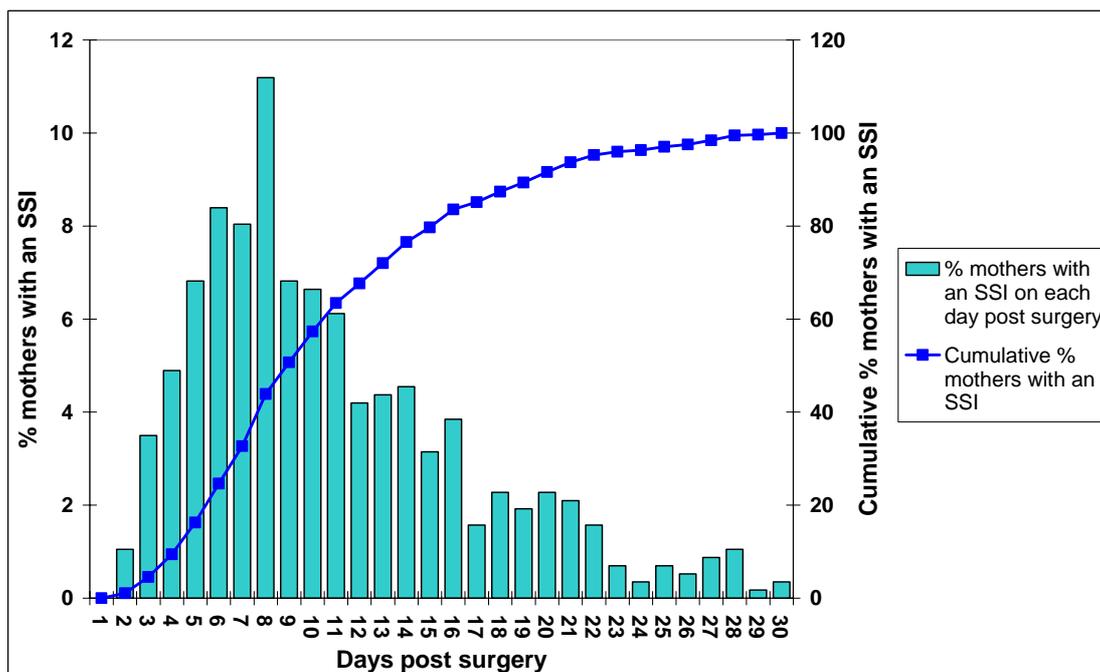


Figure 5.4 % of mothers with an SSI by days post surgery and cumulative % of mothers with an SSI in Wales (2007)

Note: The mean onset of surgical site infection following a C-section procedure was 11 days. From figure 5.4 a greater % of SSIs were captured between day 5 and 11 post-surgery (highest number on day 8). As the mean length of hospital stay following the procedure is 3 days, the majority of SSIs (90%) will be picked up post-discharge (mean of 11 days into midwifery care). However, from Figure 5.4 SSIs continued to be diagnosed up to 30 days post-surgery, especially day 12 to day 22. To ensure that the majority of SSIs are captured and treatment provided, the surveillance indicates that mothers should not be discharged from midwifery care until 28 days. Currently, in theory, this practice is wide-spread within Wales. However, some Trusts discharge mothers from midwifery care on day 10 and 14. From Figure 5.4 only 50% of SSIs were detected by day 10 post-op. If 28 days follow-up can not occur in Wales, then 14 days would enable approximately 80% of SSIs to be captured and 95% with a 21 day follow-up. From this surveillance data there is no clear correlation between the number of days post-surgery and discharge from midwifery care with or without an SSI, i.e. some data shows shorter discharge for mothers with an SSI compared to mothers without an SSI. A collaborative Pan Celtic analysis is required to compare the onset of infection in mother's who are discharged at 28 days midwifery care compared with those discharged at 14 days and below.

Key Summary Points

- Development of an SSI post-surgery increased the length of stay of the mother in hospital.
- Majority of mothers were discharged from hospital in the first 5 days after the procedure.
- Mean length of midwifery care following a C-section procedure was approximately 22 - 24 days.
- The length of discharge from midwifery care was increased with the mother having an SSI.
- Mean onset of infection was 11 days after a C-section procedure.
- The greatest numbers of infections were captured between days 5 to day 11, with the highest number on day 8.
- The all Wales 2007 data indicates that a 28 day follow-up post surgery is required to capture the greatest number of SSI.
- From the 2007 data, 21 days, 14 days and 10 days follow-up allowed 95%, 80% and 50% infections to be captured, respectively.
- Due to differences in the length of midwifery stay by trusts in Wales, it is difficult to determine whether all SSIs are captured in the dataset for 2007.

SECTION 6. Elective procedures versus emergency C-section procedures

Although no difference in the SSI rate was noted between elective and emergency C-section procedures, the following section examines whether differences occur in the rate when other variables are also taken into consideration. The variables chosen included SSI type, risk index, BMI, duration of active labour, ruptured membranes, skin closure type and length of midwifery care.

Table 6.1 C-section SSI in Elective and Emergency Surgical Procedures in Wales in 2007

Operation Type	No. Procedures*	No. SSI	% SSI (95% CI)
Elective Procedure	1303	255	19.6 (17.2-22.1)
Emergency Procedure	1950	397	20.4 (18.4-22.5)

*55 procedures have been excluded because the operation type was not completed

Incidence of SSI by infection type

Table 6.2 Overall SSI rate (%) by SSI type and operation type (elective; emergency) in Wales in 2007

Operation type	SSI type	No. SSI	% SSI (95% CI)
Elective	Superficial infections	203	15.6 (13.5-17.9)
	Deep seated infections	26	2.0 (1.3-2.9)
	Unknown	26	2.0 (1.3-2.9)
Emergency	Superficial infections	301	15.4 (13.7-17.3)
	Deep seated infections	68	3.5 (2.7-4.4)
	Unknown	28	1.4 (1.0-2.1)

Incidence of SSI by risk index

Table 6.3 Overall SSI rate (%) by patient risk index and operation type (elective; emergency) for C-section procedures in Wales in 2007

Operation type	Patient Risk Index	No. of Procedures	No. of SSI	% SSI (95% CI)
Elective	0	1009	187	18.5 (16.0-21.4)
	1	107	28	26.2 (17.4-37.8)
	2	2	0	0
Emergency	0	1518	300	19.8 (17.6-22.1)
	1	183	35	19.1 (13.3-26.6)
	2	9	1	11.1*

* 95% confidence intervals not included

Incidence of SSI by BMI category

Table 6.4 C-section SSI with BMI in Wales in 2007 (Specific BMI categories based on those utilised by The World Health Organisation)¹⁰

	BMI	No. of procedures*	No. of SSI	% SSI
Elective	Underweight <18.5	8	1	12.5*
	Healthy weight 18.5 – 24.9	329	43	13.1 (9.5-17.6)
	Overweight 25 – 29.9	354	56	15.8 (11.9-20.5)
	Obese ≥30	415	117	28.2 (23.3-33.8)
Emergency	Underweight <18.5	24	1	4.2 (0.1-23.2)
	Healthy weight 18.5 – 24.9	552	81	14.7(11.7-18.2)
	Overweight 25 – 29.9	566	95	16.8 (13.6-20.5)
	Obese ≥30	514	156	30.4 (25.8-35.5)

*95% confidence intervals not included

Incidence of SSI with labour details

Duration of patient in active labour before the procedure

Table 6.5 C-section SSI with duration patient in active labour in Wales in 2007

Operation type	Duration in active labour (hrs)	No. of procedures	No. of SSI	% SSI
Elective	0	1250	246	19.7 (17.3-22.3)
	Up to 12	27	4	14.8 (4.0-37.9)
	>12	4	1	25.0*
Emergency	0	503	80	15.9 (12.6-19.8)
	Up to 12	1095	245	22.4 (19.7-25.4)
	>12	315	64	20.3 (15.6-25.9)

*95% confidence intervals not included

Ruptured membranes before the procedure

Table 6.6 C-section SSI with ruptured membranes before the procedure in Wales in 2007

Operation type	Ruptured membranes	No. of procedures	No. of SSI	% SSI
Elective	No	1201	240	20.0 (17.5-22.7)
	Yes – for more than 24hrs	18	3	16.7 (3.4-48.7)
	Yes – for less than 24 hrs	41	3	7.3 (1.5-21.4)
Emergency	No	473	74	15.6 (12.3-19.6)
	Yes – for more than 24hrs	243	59	24.3 (18.5-31.3)
	Yes – for less than 24 hrs	1164	248	21.3 (18.7-24.1)

Incidence of SSI by skin closure type

Table 6.7 C-section SSI with type of skin closure used in Wales in 2007

Operation type	Type of skin closure	No. Procedures	No. SSI	% SSI (95% CI)
Elective	Dissolvable suture	709	144	20.3 (17.1-23.9)
	Removable suture	364	57	15.7 (11.9-20.3)
	Staples	151	36	23.8 (16.7-33.0)
Emergency	Dissolvable suture	1111	238	21.4 (18.8-24.3)
	Removable suture	529	94	17.8 (14.4-21.7)
	Staples	212	45	21.2 (15.5-28.4)

Glue was utilised as the skin closure type in 3 procedures

Length of midwifery care

The length of midwifery care was similar for both elective and emergency C-section procedures (mean of 24 days).

Key Summary Points

- A greater number of deep seated infections were noted after emergency C-section procedures were carried out.
- The number of elective procedures with a risk index of 1 was greater than emergency procedures; however, no elective procedures had a risk index of 2 (compared with 9 emergency procedures).
- The elective and emergency SSI rates were similar by BMI category and provided the same significance ($p < 0.05$) as previously noted between obese and healthy / overweight patients.
- There was a significant difference ($p < 0.05$) between SSI rates for patients in active labour compared with those not in active labour for emergency procedures.
- A significant difference ($p < 0.05$) was also noted when comparing patients with ruptured membranes and no ruptured membranes following emergency procedures.
- SSI rates were similar for elective and emergency procedures when comparing skin closure types.

SECTION 7. Incidence of SSI over time

Data on C-section SSI surveillance have been collected since 2006. It is important to note that not all hospital trusts were participating in the surveillance from this time. Comparison of 2006 data with 2007 data should thus be interpreted with caution. Table 7.1 provides the overall SSI rate for 2006 and 2007 and provides the SSI rate broken down by elective versus emergency procedures.

Table 7.1 Overall SSI rate and SSI rate broken down by elective and emergency procedures in Wales for 2006 and 2007

Operation type	Year	No. Procedures	No. SSI	% SSI (95% CI)
All C-section procedures	2007	3308	665	20.1 (18.6-21.7)
	2006	2352	505	21.5 (19.6 – 23.4)
Elective	2007	1303	255	19.6 (17.2-22.1)
	2006	1014	210	20.7 (18.0 – 23.7)
Emergency	2007	1950	397	20.4 (18.4-22.5)
	2006	1274	283	22.2 (19.7-25.0)

Key Summary Points

- The overall C-section SSI rate for 2007 decreased by 1.4% compared to 2006 rates.
- The elective and emergency rates also decreased in 2007 compared with 2006 data. Emergency rates decreased by over 2% in 2007.

SECTION 8. Comparative results

Wales is the first European country to carry out continuous surveillance of SSI associated with C-section procedures by considering both SSIs occurring during the hospital stay and post-discharge (up to 30 days after the operation). For this reason it is difficult to make a direct comparison with other surveillance schemes. However, post-discharge surveillance has become mandatory in Scotland since 2007. Comparison with the latter surveillance scheme will be available for the next annual report. The overall SSI rate for Wales (2007) was 20.1% whilst the inpatient SSI rate was 2.1%.

The following table provides an insight into C-section SSI data collected within other countries. In many of the reported studies / surveillances the data capture was not extended outside of hospital discharge.

Table 8.1 Comparison of C-section SSI rates within other countries

Country	Year	SSI rate (%)	Inpatient SSI (I), post-discharge SSI (PD) or combination of both (B) surveyed
America ¹¹ (NNIS) [*]	1992 - 2004	3.1	I
America ¹² (NHSN) ^{**}	2006 - 2007	1.5 ^{***}	I
America ¹³	2002	2.8 and 17	First figure I; second figure B
Canada ¹⁴	1996 - 2002	9.9	PD
Europe wide ⁸ (HELICS) ^{****}	2004	2.7	I (with some post-discharge)
Germany ¹⁵ (KISS) ^{*****}	1997 - 2003	1.9 – 2.4	I
Hungary ¹⁶	2004 - 2006	1.31	I
Scotland ¹⁷ (SSHAIP) ^{*****}	2006 - 2007	1.3	I
Scotland ¹⁸ (SSHAIP) ^{*****}	2002 - 2003	11.2	B

* NNIS – National Nosocomial Infections Surveillance

** NHSN – National Healthcare Safety Network

*** The report provided a pooled mean and procedures were surveyed for varying lengths of time (e.g. 1 month, 3 months etc.)

**** HELICS – Hospitals in Europe Link for Infection Control through Surveillance

***** KISS – Krankenhaus Infektions Surveillance System

***** Scottish Surveillance of Healthcare Associated Infection Programme

Key Summary Points

- In general, in patient SSI rates in Wales in 2007 post C-section surgery were comparable with data from other countries.
- Wales has a higher overall SSI rate when comparing the rate with the other two countries carrying out both inpatient and post-discharge surveillance.
- Wales is still, however one of the few countries to carry out continuous post-discharge surveillance, where the majority of infection data is collected.

Conclusions

The Welsh C-section surgical site infection surveillance scheme provides surgical teams with an indication of the current Welsh infection rate and, details of possible risk factors associated with post surgical infection.

In particular, the surveillance for 2007 has identified obesity as a significant ($p < 0.05$) risk factor of increased infection post surgery (this compares with data from Scotland)¹⁸. This significance was also noted for both elective and emergency procedures in Wales. A significant ($p < 0.05$) increase in the SSI rate was noted when dissolvable sutures were used compared to removable sutures as the skin closure type. Use of staples also increased the SSI rate but more data is required to confirm this. A significant ($p < 0.05$) increase in the SSI rate was noted for patients in active labour compared to patients not in active labour following emergency procedures. The same was noted for patients with ruptured membranes compared to patients without ruptured membranes. Prolonged membrane rupture and the method of skin closure has also been shown to increase infection rates in other studies^{18, 19}. Interestingly, combination of the 2006 and 2007 data demonstrated a decrease in the SSI rate when antibiotics were given prior to incision compared to after incision. Collection of more data for antibiotics given prior to incision is however required. Investigations into the timing of antibiotic prophylaxis have become an increasingly debated topic of interest and Wales has the opportunity to survey such a potential risk factor.

Overall, the rates of infection in general, should be interpreted with caution since for some Trusts; there are still concerns about the reliability of the surveillance, in terms of returning data for all the procedures. The surveillance is currently running at 41 – 49% compliance. However, there has been an improvement in the number of forms available for data analysis. This has increased to 73% compared with 65% in 2006. The overall SSI rate has decreased by 1.4% and in particular, SSI rates following an emergency procedure have decreased by 2%. However, those sites with higher form returns and valid forms will have a disproportionate influence on the overall figures.

There are differences between sites in the degree of post-discharge surveillance undertaken, and the length of post-discharge surveillance impacts on their infection rates. From the 2007 data the mean onset of infection was 11 days after a C-section procedure and the surveillance has demonstrated the importance of carrying out post-discharge surveillance for up to 28 days. Only 50% of infections were captured after 10 days follow-up. This increased to 80% and 95% after 14 days and 21 days follow-up, respectively. It is however difficult to determine if all SSIs were captured in the dataset due to the variance in trust midwifery length of stay. The importance of carrying out post-discharge surveillance has thus been highlighted in this report and is increasingly essential due to the continual decrease in the hospital stay following a C-section procedure. Comparison of SSI rates in other countries within and outside of Europe is difficult as the majority do not have continuous post-discharge surveillance.

This all-Wales report should be used in conjunction with hospital/Trust specific reports and alongside reports from SSI schemes in other countries (with post-discharge surveillance). Continuation of this scheme is required with increased compliance, form completion and 28 days follow-up, to ensure an accurate all Wales infection rate is calculated and for comparison of rates over time.

References

1. Plowman *et al.* The Socio-economic Burden of Hospital Acquired Infection .Public Health Laboratory Service 1999, London.
2. Sykes *et al.* When continuous surgical site infection surveillance is interrupted: the Royal Hobart Hospital experience. *American Journal of Infection Control* 2005; 33: 422-427
3. Horan T *et al.* CDC Definitions of Surgical Site Infections, 1992: A modification of CDC Definitions of Surgical Wound Infections. *Infection Control & Hospital Epidemiology* 1992; 13: 606-608.
4. Hospitals in Europe Link for Infection Control through Surveillance (HELICS). Available at:
www.helics.univ-lyon1.fr/home.htm
5. Health Protection Agency. Second report of the mandatory surveillance of surgical site infection in orthopaedic surgery. April 2004 to Mar 2006. London: Health Protection Agency, Jan 2007. Available at:
http://www.hpa.org.uk/infections/topics_az/surgical_site_infection/documents/SSI2ndMandatory29-01-07.pdf
6. Culver *et al.* Surgical wound infection rates by wound class, operative procedure and patient risk index. *American Journal of Medicine* 1991; 91 (Suppl B): 3B-152S – 157S.
7. National Nosocomial Infections Surveillance (NNIS) System Report, data January 1992 to October 2004. *American Journal of Infection Control* 2004; 32: 470-485.
8. Hospitals in Europe Link for Infection Control through Surveillance (HELICS). Surveillance of surgical site infections. Surgical site infections 2004. HELICS, March 2006. Available at:
www.helics.univ-lyon1.fr/home.htm
9. Thomas J *et al.* Royal College of Obstericians and Gynaecologists Clinical Effectiveness Support Unit. National Sentinel Caesarean Section Audit Report. London: Royal College of Obstericians and Gynaecologists, October 2001.
10. World Health organization. Available at:
www.who.int/bmi/index.jsp?introPage=intro_3.htm
11. National Nosocomial Infections Surveillance (NNIS). NNIS system report, data summary from January 1992 through June 2004, issued October 2004. *American Journal of Infection Control special article* 2004; 32: 470-485.
12. Edwards J *et al.* National Healthcare Safety Network (NHSN) report, data summary for 2006 through 2007, issued November 2008. *American Journal of Infection Control major articles* 2008; 36: 609-626.

13. Noy D *et al.* Postdischarge surveillance of surgical site infections: a multi-method approach to data collection. *American Journal of Infection Control* 2002; 30: 417-424.
14. Griffiths J *et al.* Surgical site infection following elective Caesarean section: a case-control study of postdischarge surveillance. *Journal of Obstetrics & Gynaecology Canada* 2005; 27: 340-344.
15. Bärwolff S *et al.* Reduction of surgical site infections after Caesarean delivery using surveillance. *Journal of Hospital Infection* 2006; 64: 156-161.
16. Szilágyi E *et al.* The national nosocomial surveillance network in Hungary: results of two years of surgical site infection surveillance. *Journal of Hospital Infection* 2009; 71: 74-80.
17. Scottish Surveillance of Healthcare Associated Infection Programme (SSHAIP). Surveillance of surgical site infection for procedures carried out from 1/04/02 – 30/06/07. SSHAIP, Health Protection Scotland, 2007.
18. Johnson A *et al.* Caesarean section surgical site infection surveillance. *Journal of Hospital Infection* 2006; 64: 30-35.
19. Killian C *et al.* Risk factors for surgical-site infections following caesarean section. *Infection Control & Hospital Epidemiology* 2001; 22: 613-617.

Acknowledgements

The Welsh Healthcare Associated Infection Programme Team members are grateful to the obstetric clinical teams, midwifery teams, infection control teams and audit teams from the participating hospitals for providing the data for this report. We are also grateful for the support and advice from the Scottish Surveillance of Healthcare Associated Infection Programme and the Northern Ireland Healthcare Associated Infection Surveillance Centre.