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# Caesarean Section Surgical Site Infection Surveillance

## 2018 Annual Report: All Wales

Includes data from 01/01/2018 – 31/12/2018

Version 1

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### **Reference this document as:**

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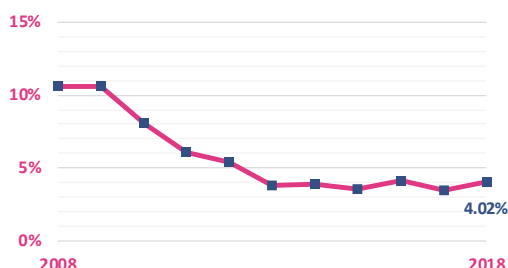
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## Summary

**NOTE: The information in this annual report may differ from that found in the C section quarterly reports. This annual report should be used when quoting annual figures and for comparison across countries.**

### SSI rate



**1 in 25**

mothers had an SSI attributable to their C section procedure



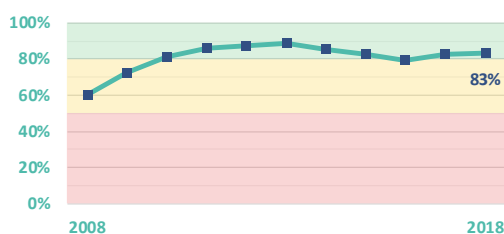
**62%**

reduction in SSI rate since 2008, which equates to

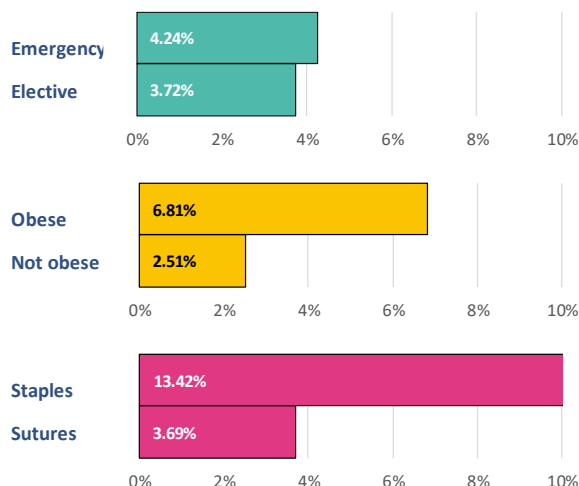
**2842**

infections prevented (based on 2008 rates)

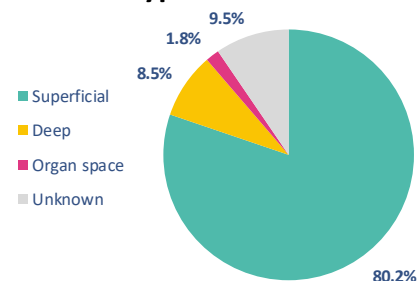
### Compliance



### Risk factors



### Infection type



8865 C section procedures were captured by the surveillance in 2018 and forms were completed for 85% of these procedures (n=7563). Of these forms, 97% were valid forms that could be used for analysis (n=7358).

There were 296 SSIs up to 14 days post procedure captured in 2018, which equates to an SSI rate of 4.0%. 29 of these were complicated infections (deep or organ space), approximately 10% of all infections.

53% of procedures performed in 2018 were emergencies. The SSI rate in emergency procedures was not significantly higher than elective procedures.

The SSI rate when using staples still remains significantly higher than the rate when sutures are used for post-operative wound closure.

## Introduction

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The Healthcare Associated Infections team at Public Health Wales Health Protection were instructed by the Welsh Government to develop and support the implementation of surveillance following Caesarean section procedures undertaken in NHS hospitals in Wales. This process has been mandatory since January 2006.

Surgical Site Infection (SSI) is an important area for surveillance and remains a complication of surgery where human and financial costs are high (Plowman, 2000) (Jenks, Laurent, McQuarry, & Watkins, 2014). Additionally, most infections are preventable (National Institute for Health and Care Excellence, 2019). An SSI is the second most common infection following a C section, within a group of patients who are generally young, fit and well females (Sykes, Brodribb, McLaws, & McGregor, 2005).

Serious patient consequences can result from SSIs, including pain, suffering and, on some occasions, they require additional surgical interventions (Sykes, Brodribb, McLaws, & McGregor, 2005). It is important to recognise that SSIs can range from a relatively trivial wound discharge with no other complications, to a life-threatening condition. Other clinical outcomes of SSIs include poor scars that are cosmetically unacceptable, persistent pain and itching, restriction of movement and a significant impact on emotional wellbeing.

This report includes data captured both during hospital stay and post-discharge within the community. The surveillance incorporates data collected by clinical teams and midwives and uses internationally agreed definitions (Horan, Gaynes, Martone, Jarvis, & Emori, 1992), allowing Welsh data to be compared with and incorporated into other international databases, such as the ECDC European SSI database. This report details results obtained for surveillance data capture in 2018.

## Data interpretation

---

Surgical site infection (SSI) rates in this report are calculated as the number of infections (inpatient and post-discharge) as a proportion of valid procedures. This is reported as a rate per 100 procedures.

$$SSI\ rate = \frac{number\ of\ SSI}{number\ of\ valid\ procedures} \times 100\%$$

A valid procedure is one where an SSI is recorded, or one where there is confirmation of no SSI on both inpatient and post-discharge forms. "Number of procedures" refers only to valid procedures, unless otherwise specified.

In keeping with the regular reports, all SSI rates reported in this document are those that occurred up to 14 days post-procedure. Due to the different discharge policies and treatment plans in place at all health boards, we are confident in the consistency of rates up to 14 days, but we are unable to guarantee consistency between hospitals after this point.

## Section 1: Data completeness

### Compliance

The proportion of valid forms being returned has remained stable compared to 2017, with 83% of the expected number of forms being valid, this makes up 97% of all forms received. This is still not as high as the peak of 95% achieved in 2013. Due to less hospitals directly reporting procedure numbers for compliance purposes we have had to move back to PEDW figures as the denominator for the majority of our compliance rates.

$$\text{Compliance rate} = \frac{\text{number of returned forms}}{\text{number of procedures reported to PEDW}} \times 100\%$$

$$\begin{aligned} \text{If Compliance rate} > 1 \text{ then Compliance rate} \\ &= \frac{\text{number of returned forms}}{\text{mean(number of procedures reported in previous 3 years)}} \times 100\% \end{aligned}$$

Table 1 – Coverage of the C section SSI surveillance compared to the expected number of forms.

|                             | 2016 | 2017 | 2018 |
|-----------------------------|------|------|------|
| Expected number of forms*   | 8847 | 8266 | 8865 |
| Surveillance forms returned | 7346 | 7062 | 7563 |
| Valid surveillance forms    | 7021 | 6810 | 7359 |
| Forms returned              | 83%  | 85%  | 85%  |
| Valid forms returned        | 79%  | 82%  | 83%  |

\*Total number of procedures performed at hospital, irrespective of whether or not a form was received.

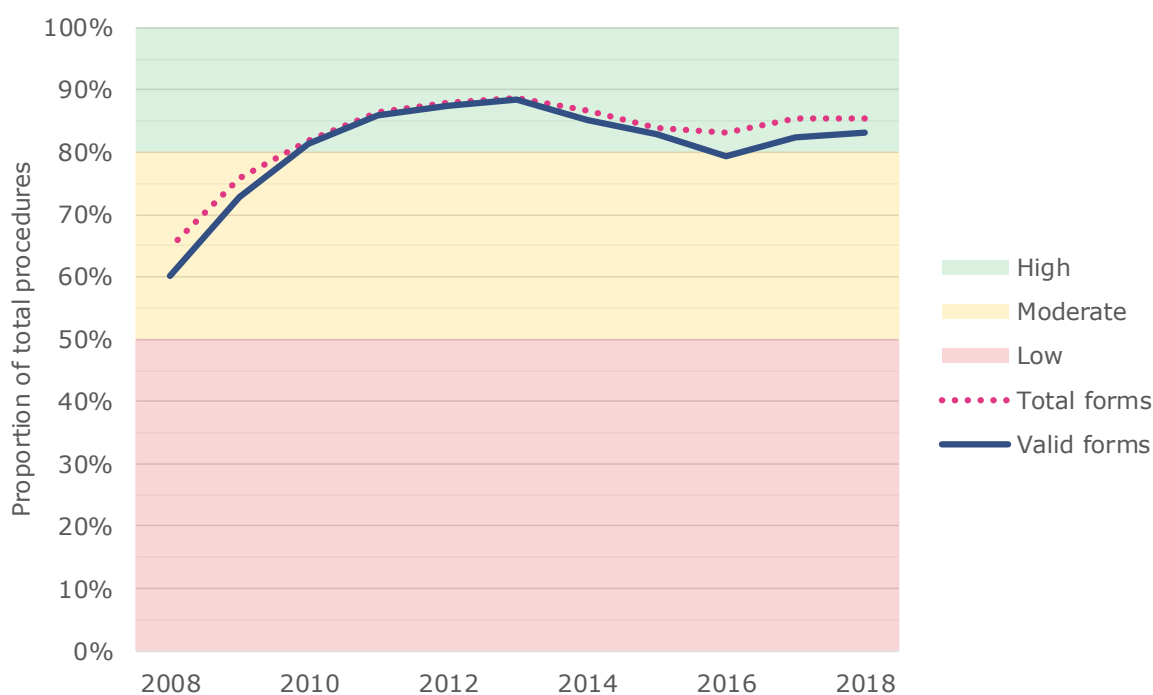


Figure 1 – Trend rate for compliance over the last 10 years 2008-2018.

## Completion rates of surveillance forms

The vast majority of inpatient forms received at Public Health Wales have a completed SSI status field (where either yes or no are selected), with 7481 of forms having a completed SSI field (of 7563 forms, 98.9%). Following on from these inpatient forms, 99.5% of post-discharge forms were received (7357/7391) with the remaining 0.5% either not sent in at all, or being sent in blank. Of the post discharge forms that were sent in, over 99% had a completed SSI field.

The additional information on post-discharge SSIs (type and date) is provided in most cases, with only a small number of forms missing this information. The additional information is provided less often in the case of inpatient SSIs, however, the numbers involved are too small to extrapolate any real meaning from them.

*Table 2 – Completion rates of the SSI field (along with its associated type and infection date fields) 2018.*

| Data Item                    | Expected | Completed | Proportion |
|------------------------------|----------|-----------|------------|
| Inpatient SSI (Yes/No)       | 7563     | 7481      | 98.9%      |
| If yes, SSI type             | 28       | 15        | 53.6%      |
| If yes, infection date       | 28       | 28        | 100.0%     |
| Post-discharge SSI* (Yes/No) | 7391     | 7357      | 99.5%      |
| If yes, SSI type             | 438      | 395       | 90.2%      |
| If yes, infection date       | 438      | 423       | 96.6%      |



## Section 2: SSI rate

### Incidence of inpatient, post-discharge and overall SSI

The following table provides the SSI rates separated out as an inpatient and a post-discharge rate. A total of 27 inpatient SSIs were recorded, giving an inpatient SSI rate of 0.37%. The vast majority of SSIs (91%) occurred following hospital discharge, giving a rate of 3.66%.

The length of hospital stay is shorter now than it was at the start of the surveillance period as more of an emphasis is being placed on community midwifery care. As a result, fewer inpatient SSIs are being identified than previously, and these are instead being picked up in the community.

All SSIs are captured up to 14 days post procedure.

Table 3 – Incidence of inpatient and post-discharge SSIs 2018.

|                | No. of procedures | SSI | SSI rate (95% CI) |
|----------------|-------------------|-----|-------------------|
| Inpatient      | 7357              | 27  | 0.37% (0.23-0.51) |
| Post-discharge | 7357              | 269 | 3.66% (3.23-4.09) |
| Overall        | 7357              | 296 | 4.02% (3.59-4.50) |

### Annual SSI rates

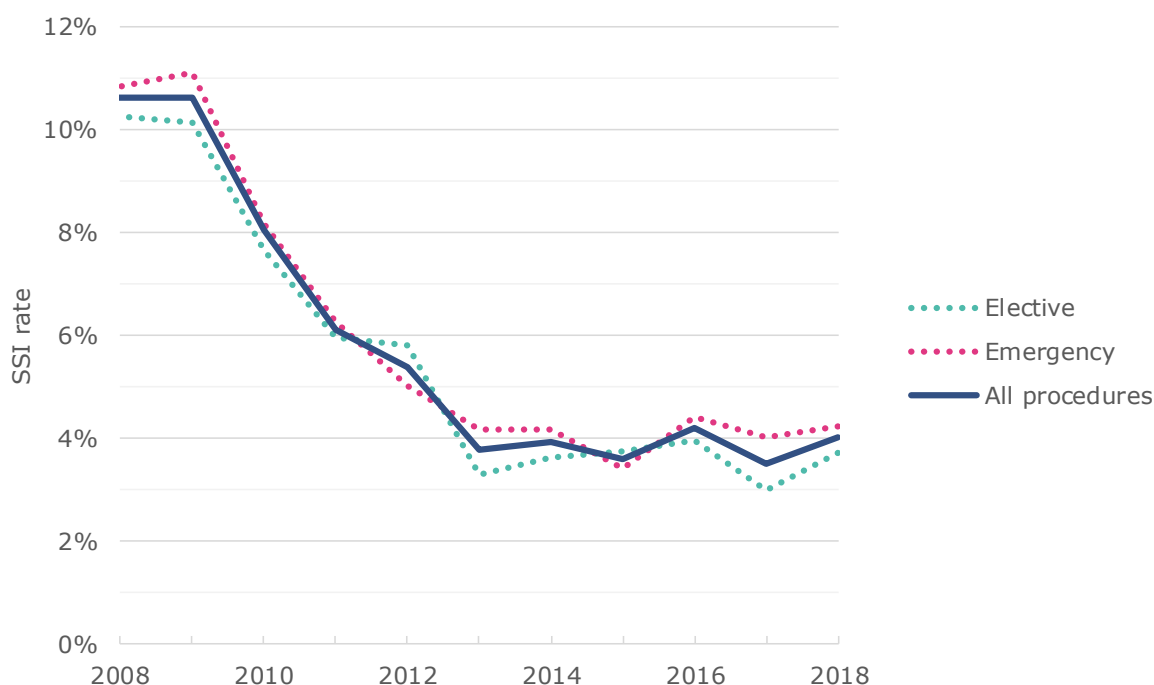


Figure 2 – Overall, elective and emergency SSI rates for 2008-2018

Table 4 – Overall, elective and emergency SSI rates for the last five years. (Unknowns excluded).

| Operation type           | Year | No. of procedures | SSI | SSI rate (95% CI) |
|--------------------------|------|-------------------|-----|-------------------|
| All C-section procedures | 2018 | 7357              | 296 | 4.02% (3.57-4.47) |
|                          | 2017 | 6700              | 235 | 3.51% (3.07-3.95) |
|                          | 2016 | 7007              | 294 | 4.20% (3.73-4.67) |
|                          | 2015 | 7217              | 260 | 3.60% (3.17-4.03) |
|                          | 2014 | 7551              | 296 | 3.92% (3.48-4.36) |
| Elective                 | 2018 | 3411              | 127 | 3.72% (3.09-4.36) |
|                          | 2017 | 3150              | 94  | 2.98% (2.39-3.58) |
|                          | 2016 | 3283              | 130 | 3.96% (3.29-4.63) |
|                          | 2015 | 3229              | 121 | 3.75% (3.09-4.40) |
|                          | 2014 | 3174              | 115 | 3.62% (2.97-4.27) |
| Emergency                | 2018 | 3891              | 165 | 4.24% (3.61-4.87) |
|                          | 2017 | 3457              | 139 | 4.02% (3.37-4.68) |
|                          | 2016 | 3626              | 160 | 4.41% (3.74-5.08) |
|                          | 2015 | 3909              | 133 | 3.40% (2.83-3.97) |
|                          | 2014 | 4283              | 179 | 4.18% (3.58-4.78) |

The SSI rate across Wales has increased this year from 3.51% in 2017 to 4.02% in 2018, nearing the reported 2016 SSI rate of 4.20% (Table 4). The SSI rate back in 2008 was 10.61% and, when using this rate as a baseline, there has been a reduction of 62% in the years following. This represents an estimated 2,842 mothers who have been saved from an infection (Figure 2).

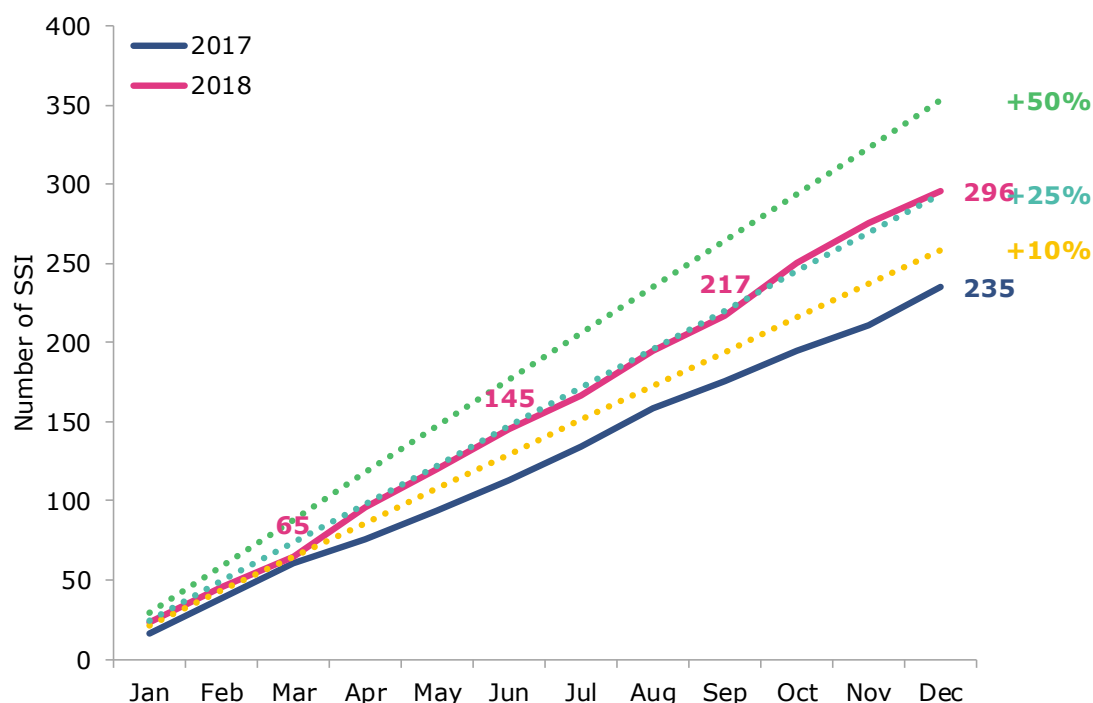


Figure 3 – Cumulative SSI number for 2018, and their relative change compared to the previous year.

Throughout Wales, there were 296 SSIs reported in 2018. When compared to the previous year's 235 SSIs, this is an increase of 26% in raw SSI numbers (i.e. without factoring in the denominator) and means there were 61 more infections in 2018 than in 2017. Cumulative SSI numbers for 2017 and 2018 are found in Figure 3.

## Incidence of SSI by infection type

The type of SSI recorded on the surveillance form can be categorised into either superficial, deep seated or organ space infections. These all have specific definitions and diagnostic criteria and remain standardised across Europe. The following tables show the split between different SSI types, and their corresponding rates.

Table 5 – Types of SSI in C section procedures by proportion 2018.

| SSI type              | n   | %     |
|-----------------------|-----|-------|
| Superficial infection | 227 | 80.2% |
| Deep infection        | 24  | 8.5%  |
| Organ space infection | 5   | 1.8%  |
| Unknown               | 27  | 9.5%  |

Table 6 – SSI rates broken down by type 2018.

| SSI type              | No. of procedures | SSI | SSI rate (95% CI) |
|-----------------------|-------------------|-----|-------------------|
| Superficial infection | 7357              | 227 | 3.09% (2.69-3.48) |
| Deep infection        | 7357              | 24  | 0.33% (0.20-0.46) |
| Organ space infection | 7357              | 5   | 0.07% (0.01-0.13) |
| Unknown               | 7357              | 27  | 0.37% (0.23-0.51) |

The split between different types of infection is as expected – the vast majority of infections reported are superficial (3.09%), with a small number of deep infections (0.33%), and even fewer organ space infections (0.07%).

## Section 3: Demographics

This section provides information about the mother which is not affected by the current procedure itself and is known beforehand; namely age, BMI and the number of prior C section procedures.

### Incidence of SSI by age

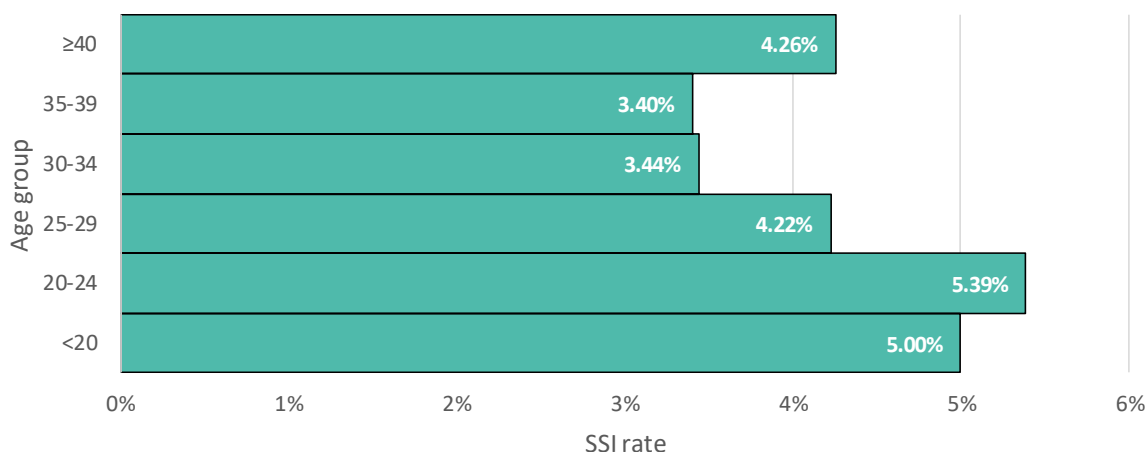


Figure 4 – Graph showing the incidence of SSI by age group 2018.

Table 7 – Incidence of SSI by age group 2018.

| Age group | No. of procedures | SSI | SSI rate (95% CI)  |
|-----------|-------------------|-----|--------------------|
| <20       | 160               | 8   | 5.00% (2.18-9.61)  |
| 20-24     | 965               | 52  | 5.39% (4.05-7.01)  |
| 25-29     | 2012              | 85  | 4.22% (3.39-5.20)  |
| 30-34     | 2296              | 79  | 3.44% (2.73-4.27)  |
| 35-39     | 1410              | 48  | 3.40% (2.52-4.49)  |
| ≥40       | 376               | 16  | 4.26% (2.45-6.82)  |
| Unknown   | 138               | 8   | 5.80% (2.54-11.10) |

In 2018, there was a substantially higher SSI rate in women between the ages of 20-24 (5.39%), which is an increase from the <20 bracket which had the highest rate in 2017 (6.55%). Nevertheless, age appears to be a factor in the probability of having an SSI. The mean age for all procedures was 30.5 (30.4 in 2017), but this reduced to 29.7 when only those with an SSI were included (P=0.016).

## Incidence of SSI by BMI

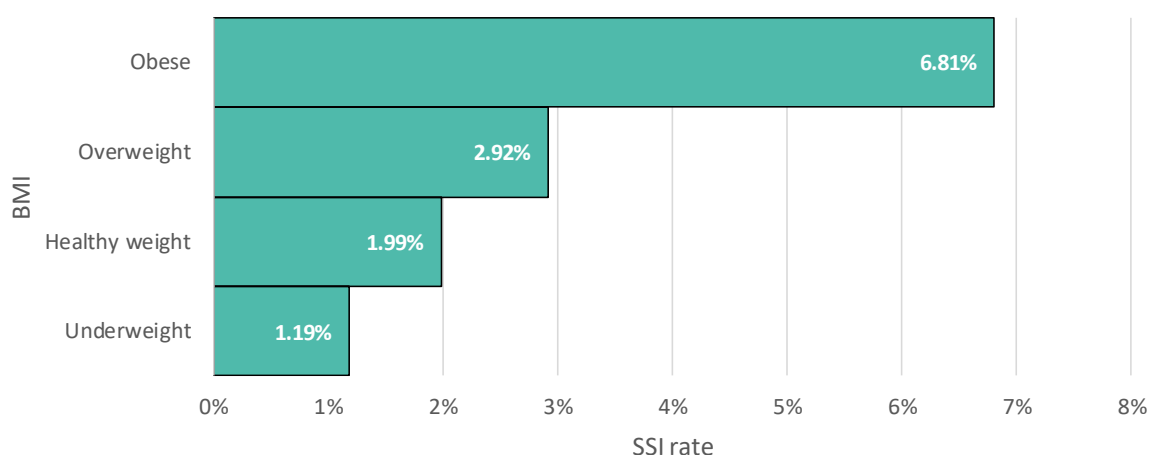


Figure 5 – Graph showing the incidence of SSI by BMI category 2018.

Table 8 – Incidence of SSI by BMI category 2018.

| BMI            | No. of procedures | SSI | SSI rate (95% CI) |
|----------------|-------------------|-----|-------------------|
| Underweight    | <18.5             | 84  | 1.19% (0.03-6.46) |
| Healthy weight | 18.5-24.9         | 45  | 1.99% (1.45-2.65) |
| Overweight     | 25.0-29.9         | 63  | 2.92% (2.25-3.72) |
| Obese          | ≥30.0             | 176 | 6.81% (5.87-7.85) |
| Unknown        |                   | 271 | 4.06% (2.04-7.15) |

In 2018, there was a very clear association between BMI and the probability of having an SSI. The mean BMI for all procedures was 28.8 (median 27.3), but this went up to 32.4 (median 32) when only those with an SSI were included. When comparing BMI groups, the SSI rate in overweight mothers (including obese mothers) was significantly higher ( $P < 0.001$ ), and this was also true when comparing obese mothers to all other BMI groups ( $P < 0.001$ ). While the SSI rate in underweight mothers was substantially lower, this group was very small compared to the other groups, so this was not significant ( $P = 0.184$ ) and differs with findings from previous years.

## Incidence of SSI by number of previous C sections

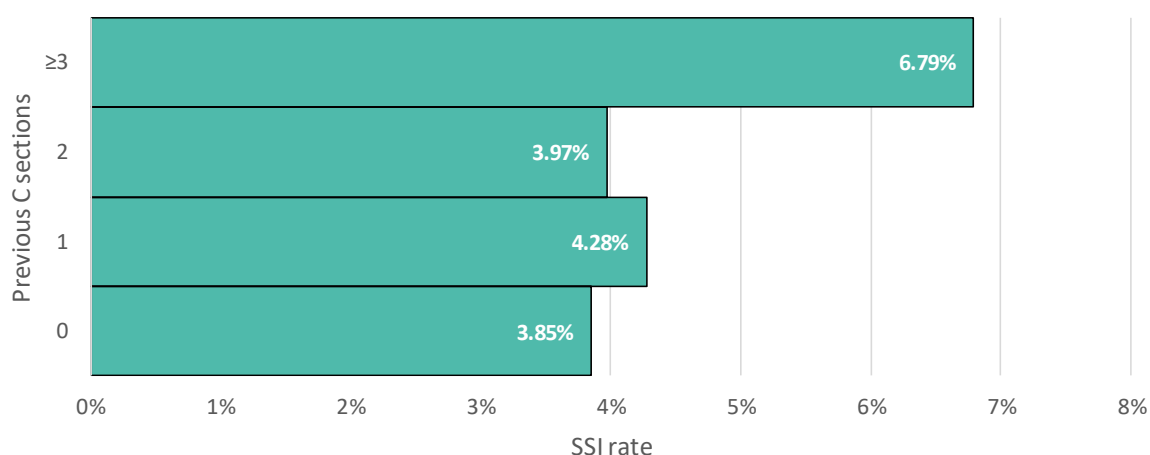


Figure 6 – Graph showing incidence of SSI by the number of previous C sections 2018.

Table 9 – Incidence of SSI by the number of previous C sections 2018.

| Previous C sections | No. of procedures | SSI | SSI rate (95% CI)  |
|---------------------|-------------------|-----|--------------------|
| 0                   | 4542              | 175 | 3.85% (3.31-4.45)  |
| 1                   | 2035              | 87  | 4.28% (3.44-5.25)  |
| 2                   | 579               | 23  | 3.97% (2.53-5.90)  |
| ≥3                  | 162               | 11  | 6.79% (3.44-11.82) |
| Unknown             | 37                | 0   | 0.00% (0.00-9.49)  |

When comparing the number of C sections a mother has undergone prior to the current procedure, there are no apparent trends and the SSI rate is fairly consistent across these groups. It should be noted there is a peak at >3 C-Sections but this could be due to the smaller sample size of this group.

## Section 4: Details of the surgical procedure

The following section provides information on the variables relating to the procedure itself (including procedure type, prophylaxis and skin closure).

### SSI risk score

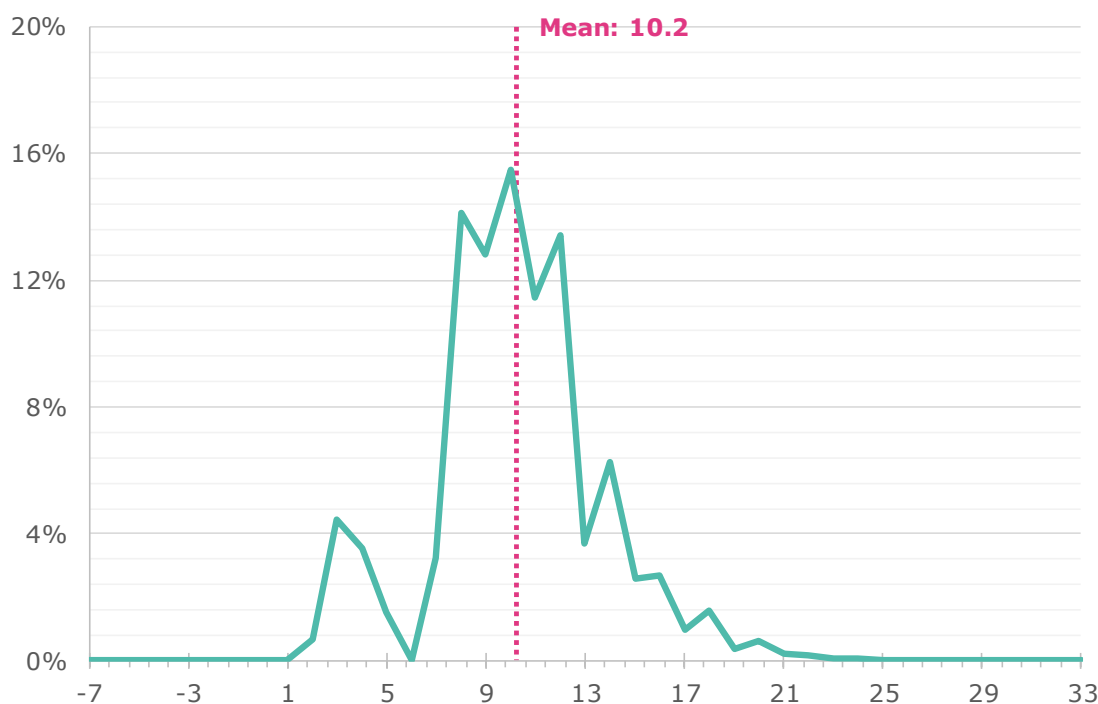


Figure 7 – Graph showing spread of risk score across all procedures (as percentage of all procedures reported). The score has a theoretical range of -7 to 33 for C section procedures in Wales.

The SSI risk score (van Walraven & Musselman, 2013) is based on a number of different factors; including procedure type, wound type, ASA class, BMI and procedure duration<sup>1</sup>. This yields a score that categorises mothers by their risk of developing an SSI (with higher scores equating to higher risk).

In 2018, the mean risk score for all mothers undergoing C section was 10.2 (median 10). When counting only those who have developed an SSI, the mean risk score increases to 11.3 (median 11), which means that mothers who developed an SSI had a significantly higher aggregate risk score than those who did not ( $P < 0.001$ ), although this risk is lower than in 2017 (11.9, median 11).

While we can see that presence of a combination of risk factors evidently increases risk for the development of an SSI, no individual risk factor is associated with an increased risk of SSI.

<sup>1</sup> There are additional metrics used in the calculation of this score which we are unable to use since they are not reported as part of our surveillance. These are the number of concurrent procedures, type of anaesthetic, smoking status, presence of metastatic cancer or peripheral vascular disease, and use of steroids.



## Incidence of SSI by procedure type

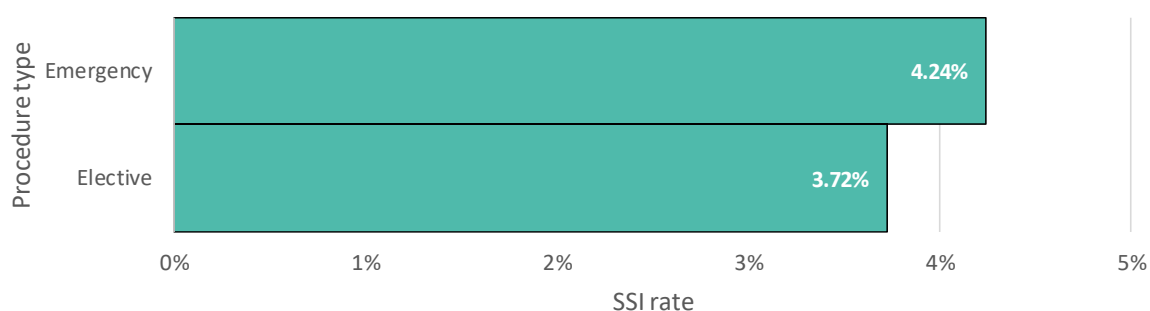


Figure 8 – Graph showing incidence of SSI by type of procedure 2018.

Table 10 – Incidence of SSI by procedure type 2018.

| Age group | No. of procedures | SSI | SSI rate (95% CI)  |
|-----------|-------------------|-----|--------------------|
| Elective  | 3411              | 127 | 3.72% (3.11-4.41)  |
| Emergency | 3891              | 165 | 4.24% (3.63-4.92)  |
| Unknown   | 55                | 4   | 7.27% (2.02-17.59) |

In 2018, the SSI rate in emergency procedures was not significantly higher than in elective procedures (14% increase,  $P=0.26039$ ). The split of procedures is also fairly even, with 53.3% of procedures being classed as emergencies (CS1, CS2 and CS3) and the remaining 46.7% being classed as elective (CS4).<sup>2</sup>

<sup>2</sup> CS1 – Immediate threat to life of woman or foetus, e.g. cord prolapse, significant placental abruption or maternal cardiorespiratory distress.

CS2 – Late foetal heart rate decelerations, CS pre-booked to avoid vaginal delivery but woman presents in advanced labour.

CS3 – Deteriorating but compensated maternal medical condition.

CS4 – Operation at short notice but no clinical urgency, Elective.

## Incidence of SSI by antibiotic prophylaxis

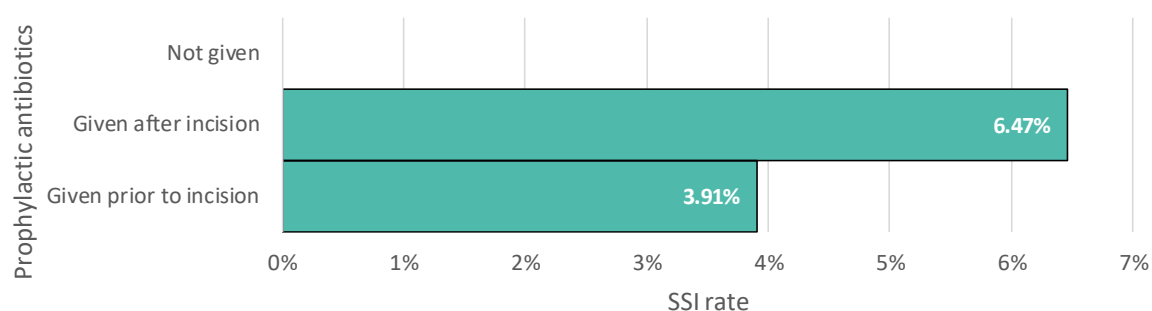


Figure 9 – Graph showing incidence of SSI by timing of prophylactic antibiotics 2018.

Table 11 – Incidence of SSI by timing of prophylactic antibiotics 2018.

| Prophylactic antibiotics | No. of procedures | SSI | SSI rate (95% CI)  |
|--------------------------|-------------------|-----|--------------------|
| Given prior to incision  | 6820              | 267 | 3.91% (3.47-4.40)  |
| Given after incision     | 232               | 15  | 6.47% (3.66-10.44) |
| Not given                | 21                | 0   | 0.00% (0.00-16.11) |
| Unknown                  | 284               | 14  | 4.93% (2.72-8.13)  |

99.7% of mothers were given prophylactic antibiotics and, of these, 96.7% were given prior to surgical incision. There is a higher SSI rate when antibiotics are administered after incision, but this was not significant (65% increase,  $P=0.0512$ ).

While this increase is not statistically significant, it is large, therefore we continue to recommend that antibiotics are administered prior to incision where possible, in accordance with NICE guidelines (National Institute for Health and Care Excellence, 2019). It is also worth taking into consideration that the serum half-life of Cefuroxime is 80 minutes, and NICE recommend that a repeat dose is administered when the length of the procedure exceeds this time. (In the case of mothers on second line antibiotics, both Clindamycin and Gentamicin have a serum half-life of two hours).

| 1st line               | If allergic to penicillin |
|------------------------|---------------------------|
| Cefuroxime 1.5g IV     | Clindamycin 600mg IV/PO   |
| +                      | +                         |
| Metronidazole 500mg IV | Gentamicin 1.5mg/kg IV    |

## Incidence of SSI by skin closure type

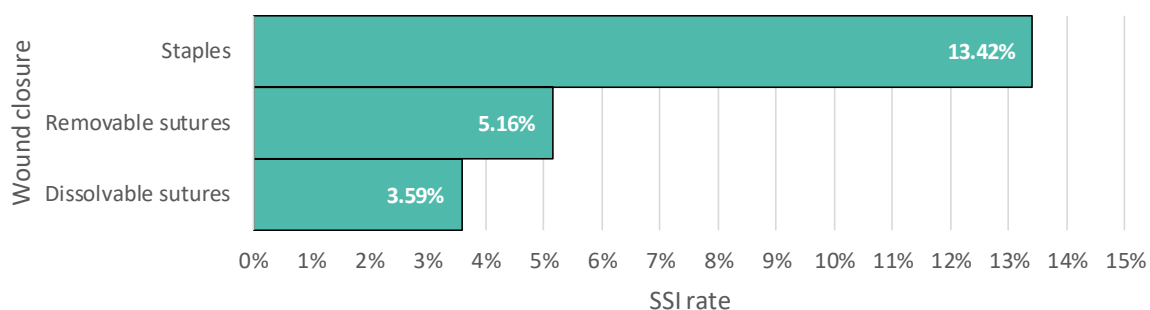


Figure 10 – Graph showing incidence of SSI by type of skin closure used, 2018.

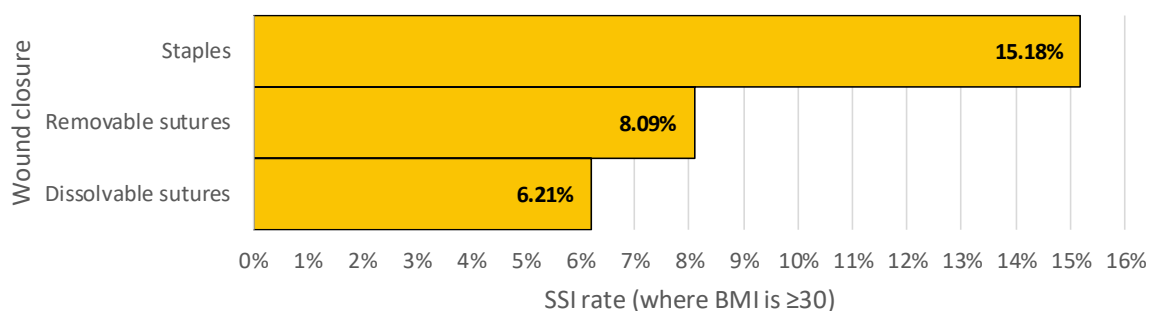


Figure 11 – Graph showing the incidence of SSI by skin closure in mothers with BMI ≥ 30, 2018.

Table 12 – Incidence of SSI by type of skin closure, 2018.

| Type of wound closure | No. of procedures | SSI       | SSI rate (95% CI)          |
|-----------------------|-------------------|-----------|----------------------------|
| Sutures (all types)   | 6968              | 257       | 3.69% (3.25-4.13)          |
| Dissolvable sutures   | 6542              | 235       | 3.59% (3.15-4.07)          |
| Removable sutures     | 426               | 22        | 5.16% (3.26-7.71)          |
| <b>Staples</b>        | <b>231</b>        | <b>31</b> | <b>13.42% (9.30-18.50)</b> |
| Unknown               | 158               | 8         | 5.06% (2.21-9.73)          |

Table 13 – Incidence of SSI by type of skin closure in mothers with BMI≥30, 2018.

| Type of wound closure | No. of procedures | SSI | SSI rate (95% CI)   |
|-----------------------|-------------------|-----|---------------------|
| Sutures (all types)   | 2411              | 153 | 6.35% (5.37-7.32)   |
| Dissolvable sutures   | 2238              | 139 | 6.21% (5.25-7.29)   |
| Removable sutures     | 173               | 14  | 8.09% (4.49-13.21)  |
| Staples               | 112               | 17  | 15.18% (9.10-23.19) |
| Unknown               | 61                | 6   | 9.84% (3.70-20.19)  |

In 2018, the SSI rate when staples were used as a method of skin closure was 264% higher than when sutures were used ( $p=0.00$ ). This trend is less pronounced when the mother is obese ( $BMI \geq 30$ ), with the SSI rate being 139% higher when staples are used, while this is a reversal of last year's trend, it should be noted that this is still a significantly higher SSI rate when staples are used instead of sutures in Mother's whose  $BMI \geq 30$  ( $P=0.00026$ ). The overall SSI rate for the use of staples is 13.42% in 2018, whereas the SSI rate for removable sutures is 5.18%.

While it may be argued that staples provide an opportunity for the wound to be inspected as they are being removed, this does not sufficiently explain the relationship with SSI rate as we would expect to see the same pattern with the removable sutures.

## Section 5: Post-procedure details and onset of infection

This section deals with the time period after the procedure has occurred and the time to onset of infection.

### Length of stay in hospital

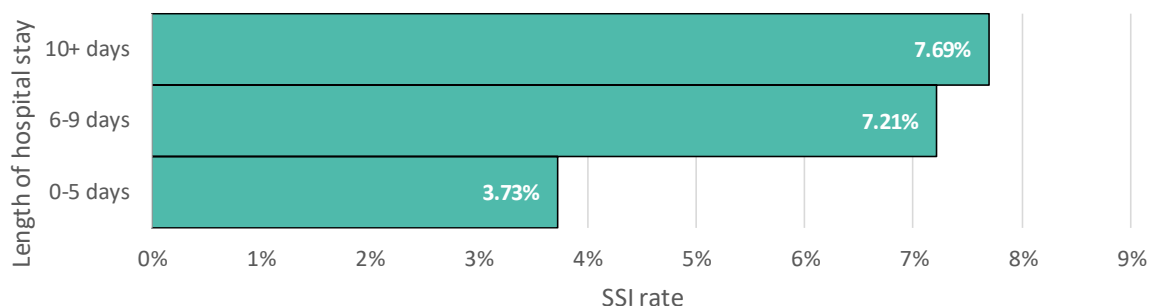


Figure 12 – Graph showing incidence of SSI by length of hospital stay, 2018.

Table 14 – Incidence of SSI by length of hospital stay, 2018.

| Length of hospital stay | No. of procedures | SSI | SSI rate (95% CI)  |
|-------------------------|-------------------|-----|--------------------|
| 0-5 days                | 6520              | 243 | 3.73% (3.28-4.22)  |
| 6-9 days                | 416               | 30  | 7.21% (4.92-10.14) |
| 10+ days                | 130               | 10  | 7.69% (3.75-13.69) |
| Unknown                 | 291               | 13  | 4.47% (2.40-7.52)  |

For all patients undergoing a C section, the mean hospital stay following the procedure is 2.6 days (median of 2). When only mothers who have had an SSI are included, this increases to a mean of 2.7 days (median 2). This would suggest that those who have been discharged from the hospital later are more likely to develop an SSI, not because of the length of stay itself, but due to the same factors that resulted in the extended stay. The trend between the two is weak however, and the length of stay is not an accurate predictor of SSI rate on its own (P=0.511).

## Length of midwifery care

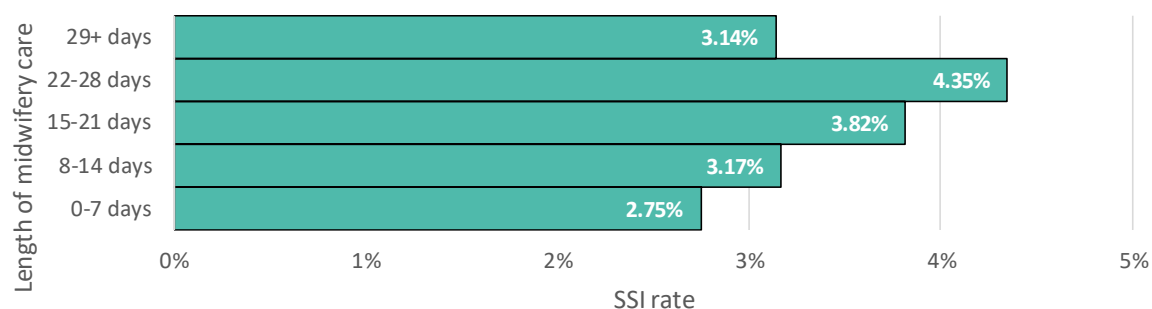


Figure 13 – Graph showing incidence of SSI by length of midwifery care post-procedure, 2018.

Table 15 – Incidence of SSI by length of midwifery care post-procedure, 2018.

| Length of midwifery care | No. of procedures | SSI | SSI rate (95% CI)  |
|--------------------------|-------------------|-----|--------------------|
| 0-7 days                 | 182               | 5   | 2.75% (0.90-6.29)  |
| 8-14 days                | 2053              | 65  | 3.17% (2.45-4.02)  |
| 15-21 days               | 1887              | 72  | 3.82% (3.00-4.78)  |
| 22-28 days               | 1886              | 82  | 4.35% (3.47-5.37)  |
| 29+ days                 | 892               | 28  | 3.14% (2.10-4.50)  |
| Unknown                  | 457               | 44  | 9.63% (7.08-12.71) |

**NOTE: All SSIs in this report occurred in the first 14 days post-procedure. Even in mothers who spent 29 or more days in care, the SSI rate does not include any SSIs occurring day 15 or later.**

Following the procedure, women spend a mean length of 20.0 days under the care of a midwife (median of 19), including both the time spent in the hospital and the time spent at home with regular visits from a community midwife. If there has been an SSI, this rises to a mean of 20.3 days (median of 20), in a change from previous years, this is no longer a significant relationship (P=0.551).

## Time to onset of infection

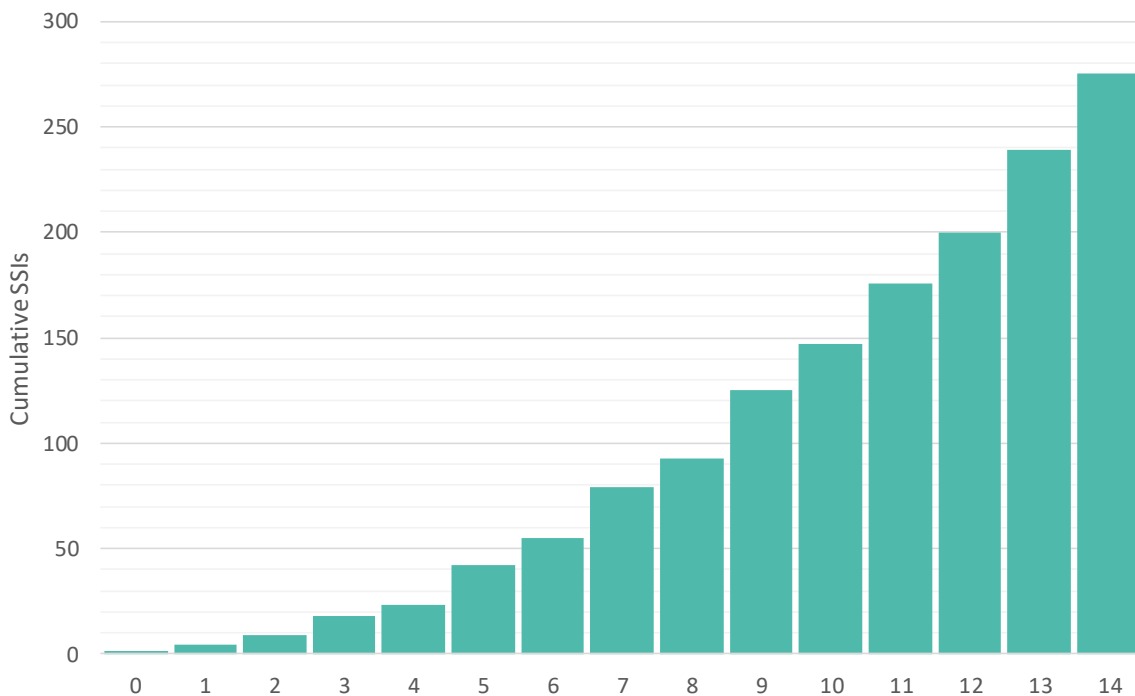


Figure 14 – Graph showing cumulative SSIs up to 14 days post-procedure. Blank infection dates excluded, 2018.

While SSIs can be reported on our forms up to 30 days post-procedure, we are only including those up to 14 days for consistency across Wales. Despite this, we do request that hospitals continue reporting up to 30 days as normal, as infections occurring on days 15-30 are still counted and reported to the European Centre for Disease Prevention and Control (ECDC).

Any SSIs reported without an infection date are counted as occurring on day 0 and are included in the SSI rates. There were 21 (7%) infections where the date of onset was not recorded. Within the first 14 days, the mean time to infection was 9.6 days, with a median of 10. The greatest number of infections were reported on day 13 (n=39).

## Anonymised Hospital SSI rates

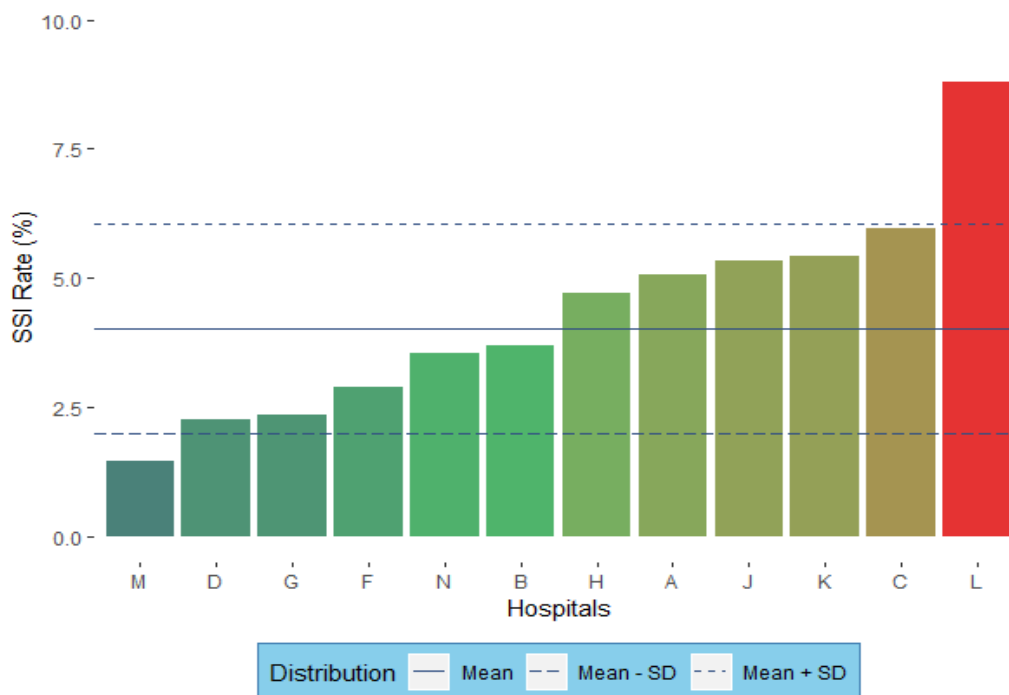


Figure 15 - Anonymised SSI rates for each Hospital participating in the C section surveillance scheme as of 2018. Hospitals M and L can be seen as outliers at the upper and lower ends of the spectrum respectively.

In Figure 15 we can see the SSI rates for each hospital reporting C section procedures in 2018, the two outlying hospitals at each end of the graph are Hospital M at the lowest end and Hospital L at the highest. Having two outliers effects the all Wales SSI rate and the standard deviation from this SSI rate. A reduction in SSI rate for hospital L and allowing for an increase in SSI rate from hospital M would not only lower the Wales wide SSI rate but also make this rate more representative of the overall state of SSIs in Wales (Fig. 16).



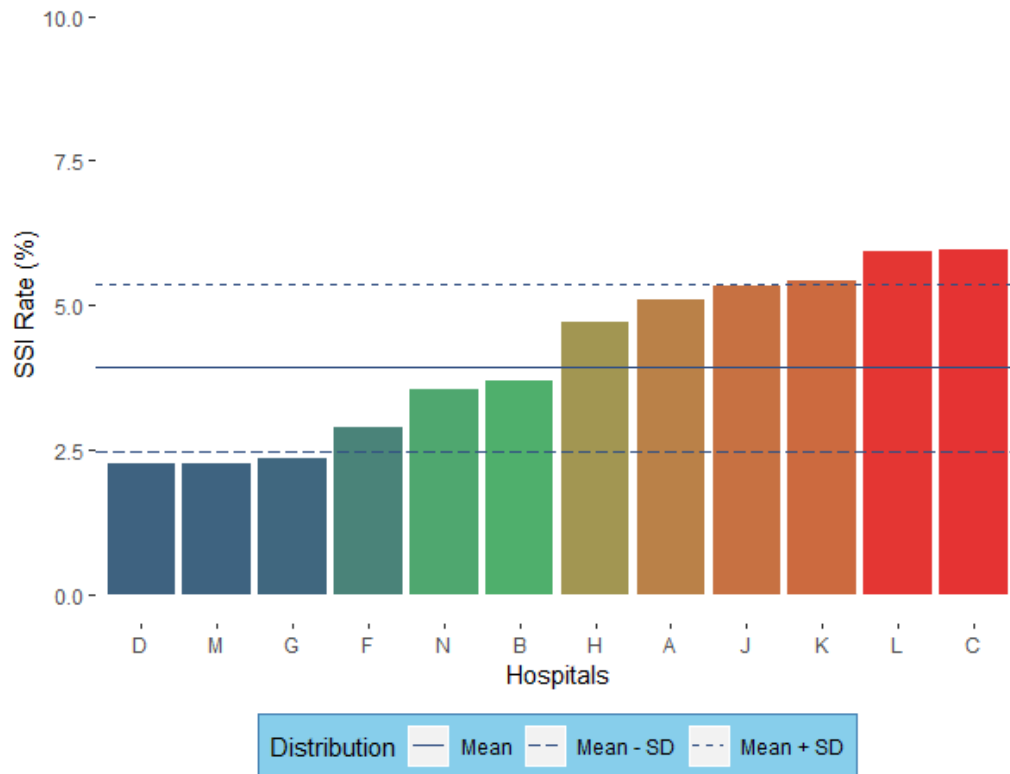


Figure 16 - Anonymised SSI rates for each Hospital participating in the C section surveillance scheme as of 2018. Hospital L and M rates have been changed to reflect the overall change in the Wales mean SSI rate if hospital rates were evenly distributed.

## Discussion

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Compliance with the C section SSI surveillance has remained steady in 2018 with 85% of expected forms being returned (85% in 2017) with a slight increase in the proportion of valid forms at 83% (82% in 2017). As explained in last year's report, these rates are lower than those in the period 2010-2015, due to a change in the data source for the denominator, with hospitals now self-reporting procedure numbers due to the inaccuracies identified in the PEDW dataset, therefore, comparisons of 2016-2018 compliance data to previous years is difficult.

The overall SSI rate for 2018 was 4.02%, higher than in 2017, which was 3.51%. 2017 was a historic low for C section SSI rates, where 2016 reported an SSI rate of 4.2%, it is likely the rate in 2017 was abnormally low and doesn't necessarily represent the true trend. Due to the higher SSI rate, the overall reduction over time has decreased to 62% (73% in 2017) but increased in real numbers, representing 2842 infections being prevented for mothers (2804 in 2017). As with last year, not all health boards follow the trend, with two health boards having SSI rates lower than the 3.51% rate seen in 2017. Both Elective and Emergency procedures have seen an increase in SSI rates, with Elective procedures seeing the greatest increases (2.82% to 3.72%) compared to Emergency procedures (3.97% to 4.24%) in 2018.

Across all patient demographics, the one factor which still has the largest impact on SSI rates is BMI. Across the years, a general trend has been observed in which higher BMIs are associated with an increased risk of SSI. In 2018, the mean BMI for all procedures was 28.8, when including only procedures that had an SSI associated with them, this increased to 32.4. Obese mothers have an SSI rate of 6.81% while healthy weight mothers have an SSI rate of 1.99%. There is also an association between age and risk of SSI, with younger mothers having a higher risk, those under 20 having an SSI rate of 5% and those between 20 and 24 having an SSI rate of 5.39%. The SSI rate decreases in each age bracket until we reach the above 40 bracket where the SSI rate is 4.26%. This compares to 4.22%, 3.44% and 3.40% for 25-29, 30-34 and 35-39 respectively. It should be noted that the above 40 age group is also one of the smallest age groups.

Since 2015, Public Health Wales has been monitoring the use of staples in post procedure closure. While usage has been decreasing over the last three years, there is still localised pockets of heavy usage. Our data indicated a strong risk of SSI associated with the usage of staples instead of sutures. This increased risk is even more apparent when stratified by BMI. Obese mothers see an SSI rate of 15.18% when staples are used, compared to 6.35% for all types of sutures. While we do acknowledge sutures are a more time consuming process, ***we recommend that staples are not used as a routine method of closure.***

Similar to 2017, 99.7% of mothers in Wales were given antibiotic prophylaxis for their procedure, again with 96.7% having it administered prior to incision. As mentioned in last year's report, hospitals are adopting the recommending antibiotics and those hospitals that differed in dosage of the recommended antibiotics have adopted the recommendation in full. Continuing with the adoption of these recommendations in line with NICE and AWMSG is encouraged.

Inpatient SSIs are still relatively uncommon, increasing from 7% of all infections in 2017 (n = 16) to 9.1% in 2018 (n = 27). Deep and organ space infections continue to be rare, with deep SSIs making up 8.5% of all infections (n = 24) and organ space SSIs making up 1.8% (n = 5), while the proportion of organ space SSIs has increased this year, we have seen similar fluctuations across the years and is of little concern.

In terms of time spent in hospital, the mean time that mothers spend under the care of a midwife is 20 days. This mean increases to 20.3 days in the event of an SSI occurrence. In a change from previous years, this marginal increase in added time spent under the care of a midwife is no longer significant ( $P = 0.551$ ). As always, infection data is captured up to and including 14 days post-operatively. The mean time to infection is 9.6 days, with the most infections reported on day 13 ( $n = 39$ ).

In conclusion, there was an increase in SSI rate in 2018 compared to 2017, (4.02% from 3.51%), this is still a 62% reduction in infection numbers from 2008. The 2018 rate is still a reduction compared to 2016. In order to maintain these SSI rates, health boards in Wales have continued their excellent work in local infection prevention and the introduction of novel interventional methods. Despite still seeing a regular occurrence of SSIs (1 in 25) in mothers post-surgery, these rates are far below those in 2007/2008. Public Health Wales will continue to work together with all hospitals in Wales to strive to continue the progress we have made and reduce infections further.

## References

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- Horan, T. C., Gaynes, R. P., Martone, W. J., Jarvis, W. R., & Emori, T. G. (1992). CDC definitions of nosocomial surgical site infections, 1992: A modification of CDC definitions of surgical wound infections. *Infection Control & Hospital Epidemiology*, 13(10), 606-608.
- Jenks, P. J., Laurent, M., McQuarry, S., & Watkins, R. (2014). Clinical and economic burden of surgical site infection (SSI) and predicted financial consequences of elimination of SSI from an English hospital. *Journal of Hospital Infection*, 86(1), 24-33.
- National Institute for Health and Care Excellence. (2019). Retrieved August 27, 2019, from Surgical site infections: prevention and treatment: <https://www.nice.org.uk/guidance/ng125>
- Plowman, R. (2000). The socioeconomic burden of hospital acquired infection. *Euro surveillance: bulletin Européen sur les maladies transmissibles*, 5(4).
- Sykes, P. K., Brodribb, R. K., McLaws, M. L., & McGregor, A. (2005). When continuous surgical site infection surveillance is interrupted: The Royal Hobart Hospital experience. *American Journal of Infection Control*, 60(2), 422-427.
- van Walraven, C., & Musselman, R. (2013). The Surgical Site Infection Risk Score (SSIRS): A Model to Predict the Risk of Surgical Site Infections. *PLoS One*, 8(6), e67167.

