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# Caesarean Section Surgical Site Infection Surveillance

**2017 Annual Report:**

**All Wales**

Includes data from 01/01/2017 – 31/12/2017

Version 1

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**Report authors:** Christopher Roberts, Wendy Harrison

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

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### **Data requests and queries should be addressed to:**

Public Health Wales NHS Trust  
HCAI and AMR Programme  
4<sup>th</sup> floor, No. 2 Capital Quarter  
Tyndall Street  
Cardiff CF10 4BZ

Email: [harp@wales.nhs.uk](mailto:harp@wales.nhs.uk)

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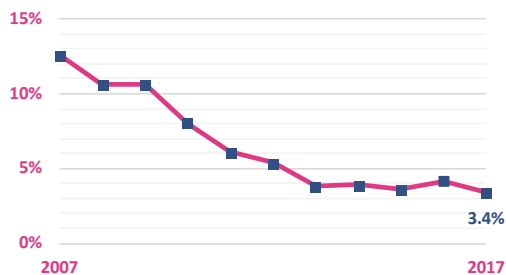
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## Summary

**NOTE: The information in this annual report may differ from that found in the quarterly report due to delays in data arriving at Public Health Wales and amendments being made following the publication of the quarterly reports.**

### SSI rate

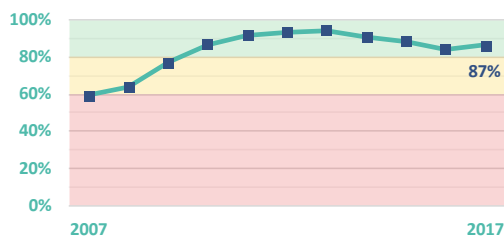


**1 in 30** mothers had an SSI attributable to their C section procedure

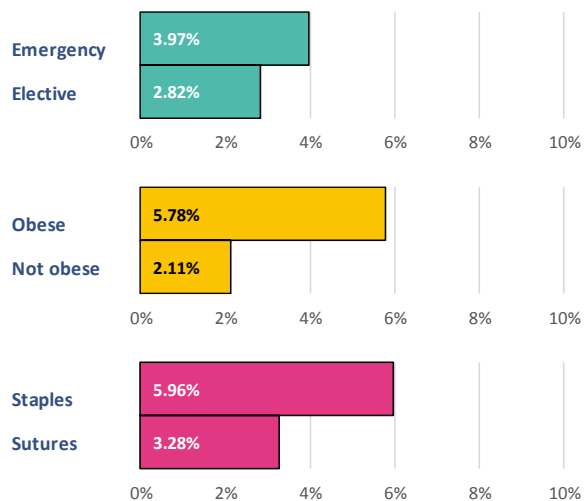


**73%** reduction in SSI rate since 2007, which equates to **2804** infections prevented (based on 2007 rates)

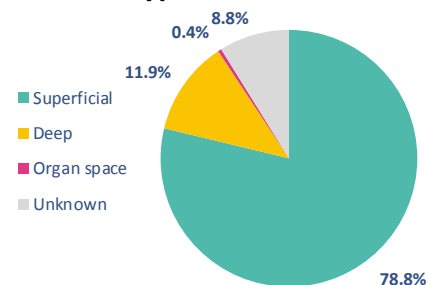
### Compliance



### Risk factors



### Infection type



7810 procedures were performed in 2017 and forms were completed for 90% of these procedures (n=7006). Of these forms, 96% were valid forms that could be used for analysis (n=6757).

There were 226 SSIs reported in 2017, which equates to an SSI rate of 3.4%. 28 of these were complicated infections (deep or organ space), approximately 12% of all infections.

52% of procedures performed in 2017 were emergencies. The SSI rate in emergency procedures was significantly higher than elective procedures.

## 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, 2017). 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 2017.

## Data interpretation

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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.

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

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

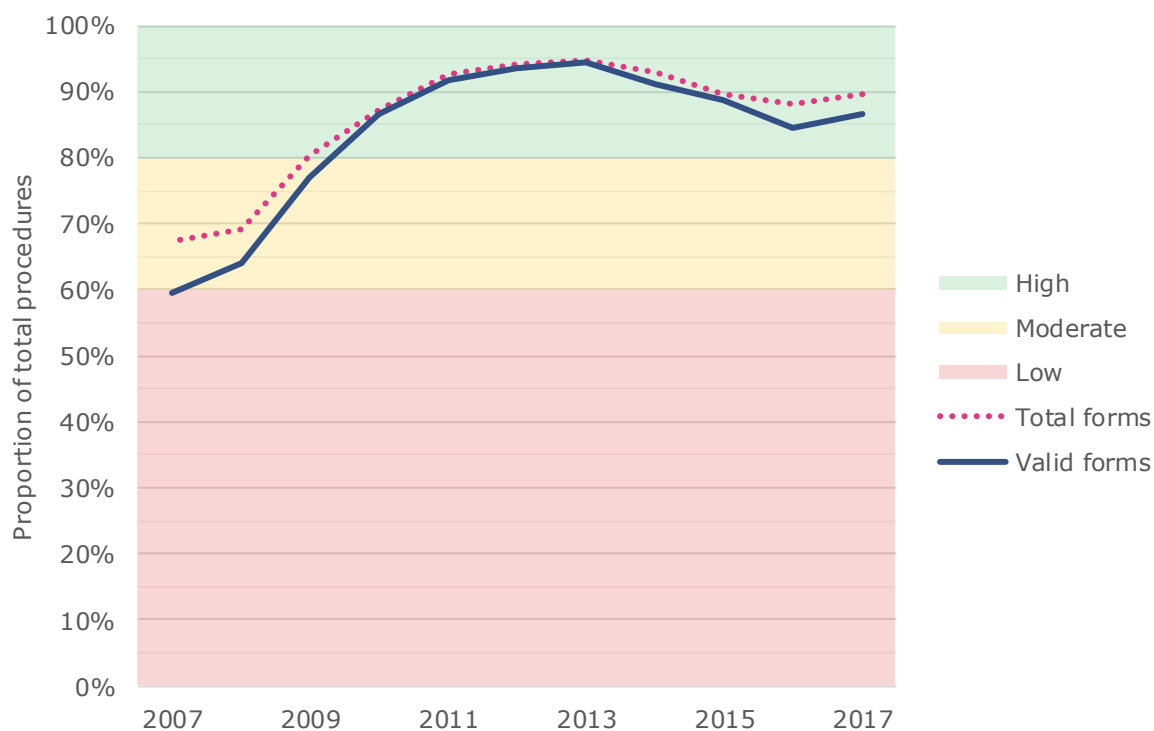
Following a few years of a downward trend, the compliance is increasing again, with the proportion of valid forms returned to Public Health Wales going up to 87% (compared to 84% in 2016). This is still not as high as the peak of 95% achieved in 2013, however, there has been a change in the denominator for compliance, with the majority of hospitals providing their own procedure numbers.

As the previous denominator was less accurate, it means that a lot of hospitals in previous years were reporting as over compliant (i.e. more forms were being submitted than the number of procedures alleged to have occurred) due to the inaccuracy of the PEDW dataset.

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

	2015	2016	2017
Expected number of forms*	8141	8316	7810
Surveillance forms returned	7311	7339	7006
Valid surveillance forms	7217	7023	6757
Forms returned	90%	88%	90%
Valid forms returned	89%	84%	87%

\*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.*

## 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 6869 of forms having a completed SSI field (of 7006 forms, 98.0%). Following on from these inpatient forms, 95.1% of post-discharge forms were received (6661/7006) with the remaining 4.9% 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).*

Data Item	Expected	Completed	Proportion
Inpatient SSI (Yes/No)	7006	6869	98.0%
If yes, SSI type	18	14	77.8%
If yes, infection date	18	12	66.7%
Post-discharge SSI* (Yes/No)	6661	6647	99.8%
If yes, SSI type	368	347	94.3%
If yes, infection date	368	353	95.9%



## 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 16 inpatient SSIs were recorded, giving an inpatient SSI rate of 0.24%. The vast majority of SSIs (93%) occurred following hospital discharge, giving a rate of 3.16%.

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.

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

	No. of procedures	SSI	SSI rate (95% CI)
Inpatient	6647	16	0.24% (0.12-0.36)
Post-discharge	6647	210	3.16% (2.74-3.58)
Overall	6647	226	3.40% (2.96-3.84)

### Annual SSI rates

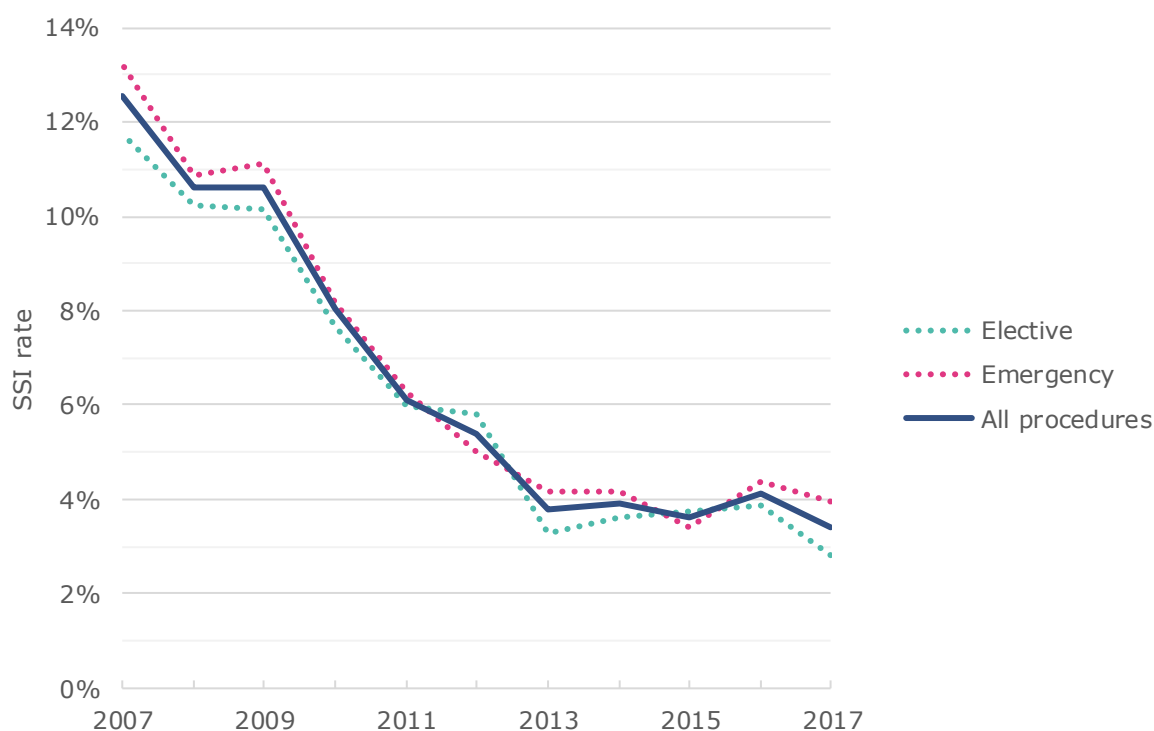


Figure 2 – Overall, elective and emergency SSI rates for 2007-2017

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	2017	6647	226	3.40% (2.96-3.84)
	2016	7009	290	4.14% (3.67-4.60)
	2015	7217	260	3.60% (3.17-4.03)
	2014	7551	296	3.92% (3.48-4.36)
	2013	8051	304	3.78% (3.36-4.19)
Elective	2017	3125	88	2.82% (2.24-3.40)
	2016	3281	127	3.87% (3.21-4.53)
	2015	3229	121	3.75% (3.09-4.40)
	2014	3174	115	3.62% (2.97-4.27)
	2013	3393	111	3.27% (2.67-3.87)
Emergency	2017	3430	136	3.97% (3.31-4.62)
	2016	3630	159	4.38% (3.71-5.05)
	2015	3909	133	3.40% (2.83-3.97)
	2014	4283	179	4.18% (3.58-4.78)
	2013	4523	189	4.18% (3.60-4.76)

The SSI rate across Wales decreased this year and, barring a few exceptions, this follows the general downward trend in rates that has occurred since the start of surveillance in 2007. The SSI rate back in 2007 was 12.57% and, when using this rate as a baseline, there has been a reduction of 73% in the years following. This represents an estimated 2,804 mothers who have been saved from an infection.

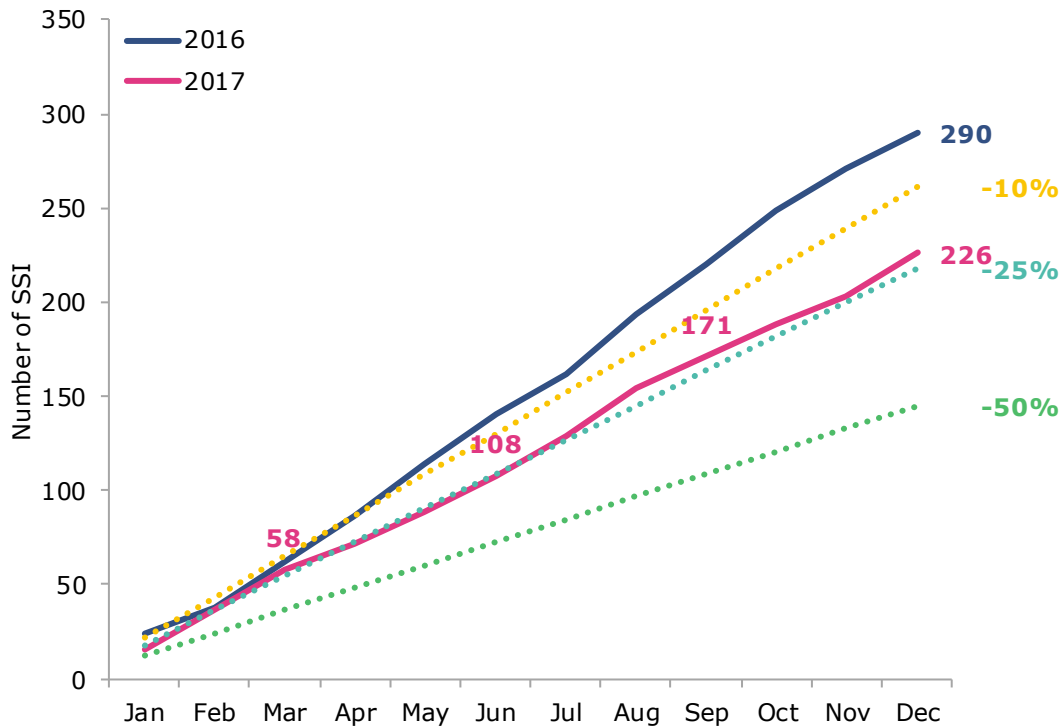


Figure 3 – Cumulative SSI number for the year, and their relative change compared to the previous year.

Throughout Wales, there were 226 SSIs reported in 2017. When compared to the previous year's 290 SSIs, this is a reduction of 22% in raw SSI numbers (i.e. without factoring in the denominator) and means there were 64 fewer infections in 2017 than in 2016.

## 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.

SSI type	n	%
Superficial infection	178	78.8%
Deep infection	27	11.9%
Organ space infection	1	0.4%
Unknown	20	8.8%

Table 6 – SSI rates broken down by type.

SSI type	No. of procedures	SSI	SSI rate (95% CI)
Superficial infection	6647	178	2.68% (2.29-3.07)
Deep infection	6647	27	0.41% (0.25-0.56)
Organ space infection	6647	1	0.02% (0.00-0.04)
Unknown	6647	20	0.30% (0.17-0.43)

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

## Section 3: Demographics

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

### Incidence of SSI by age

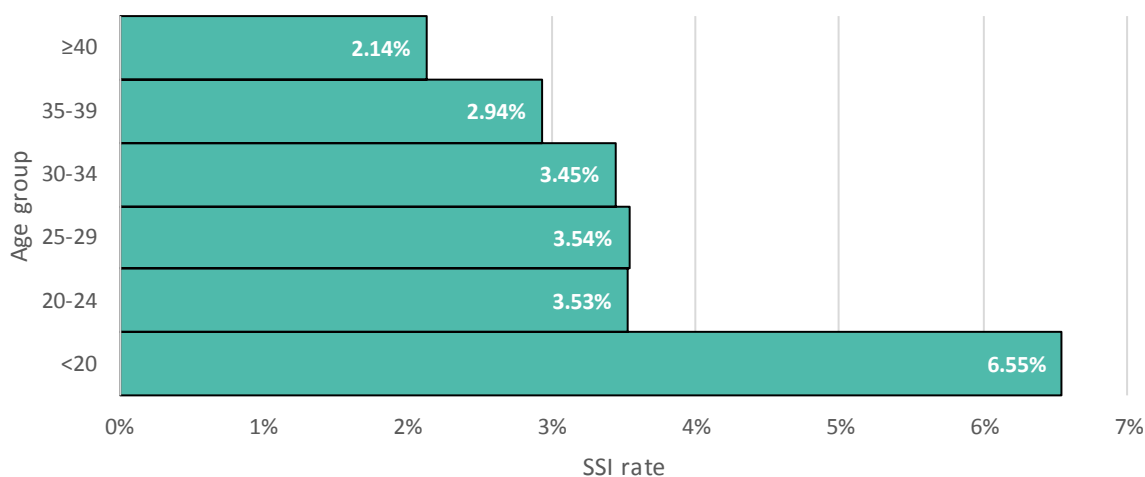


Figure 4 – Graph showing the incidence of SSI by age group.

Table 7 – Incidence of SSI by age group

Age group	No. of procedures	SSI	SSI rate (95% CI)
<20	168	11	6.55% (3.31-11.41)
20-24	934	33	3.53% (2.44-4.93)
25-29	1781	63	3.54% (2.73-4.50)
30-34	2031	70	3.45% (2.70-4.33)
35-39	1225	36	2.94% (2.07-4.05)
≥40	374	8	2.14% (0.93-4.17)
Unknown	134	5	3.73% (1.22-8.49)

In 2017, there was a substantially higher SSI rate in women under the age of 20, however, this age group is the smallest and the sample size could be a contributory factor. Nevertheless, age appears to be a factor in the probability of having an SSI. The mean age for all procedures was 30.4, but this reduced to 29.5 when only those with an SSI were included (P=0.029).

## Incidence of SSI by BMI

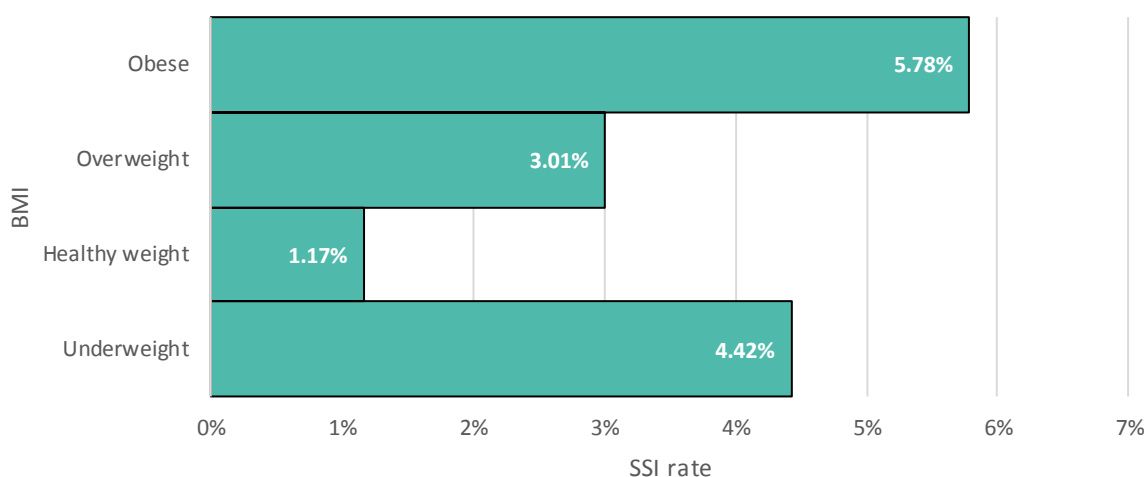


Figure 5 – Graph showing the incidence of SSI by BMI category.

Table 8 – Incidence of SSI by BMI category.

BMI	No. of procedures	SSI	SSI rate (95% CI)	
Underweight	<18.5	113	5	4.42% (1.45-10.02)
Healthy weight	18.5-24.9	2051	24	1.17% (0.75-1.74)
Overweight	25.0-29.9	1861	56	3.01% (2.28-3.89)
Obese	≥30.0	2334	135	5.78% (4.87-6.81)
Unknown		288	6	2.08% (0.77-4.48)

In 2017, there was a very clear association between BMI and the probability of having an SSI. The mean BMI for all procedures was 29.1 (median 27.1), but this went up to 33.4 (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 higher, this group was very small compared to the other groups, so this was not significant ( $P = 0.573$ ).

## Incidence of SSI by number of previous C sections

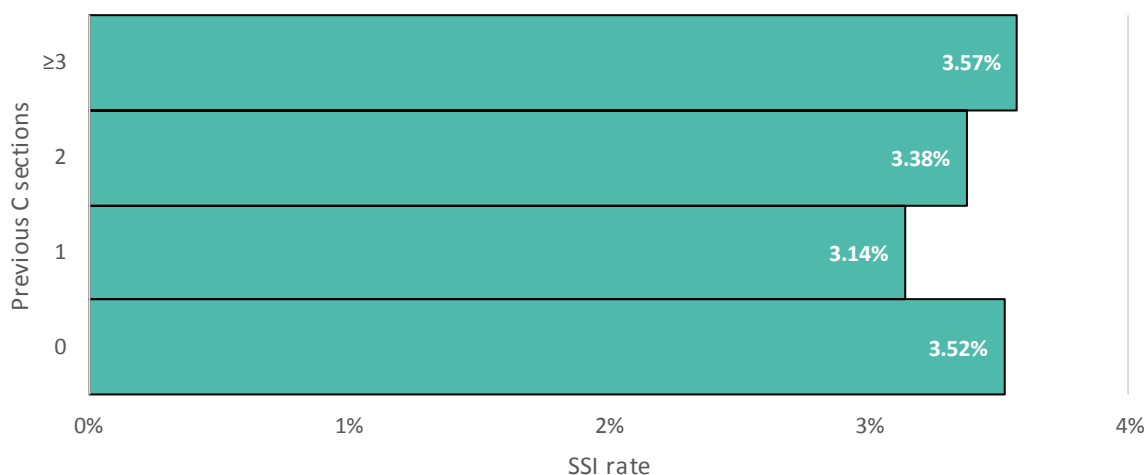


Figure 6 – Graph showing incidence of SSI by the number of previous C sections.

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

Previous C sections	No. of procedures	SSI	SSI rate (95% CI)
0	3920	138	3.52% (2.97-4.15)
1	1880	59	3.14% (2.40-4.03)
2	622	21	3.38% (2.10-5.11)
≥3	168	6	3.57% (1.32-7.61)
Unknown	57	2	3.51% (0.43-12.11)

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.

## 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

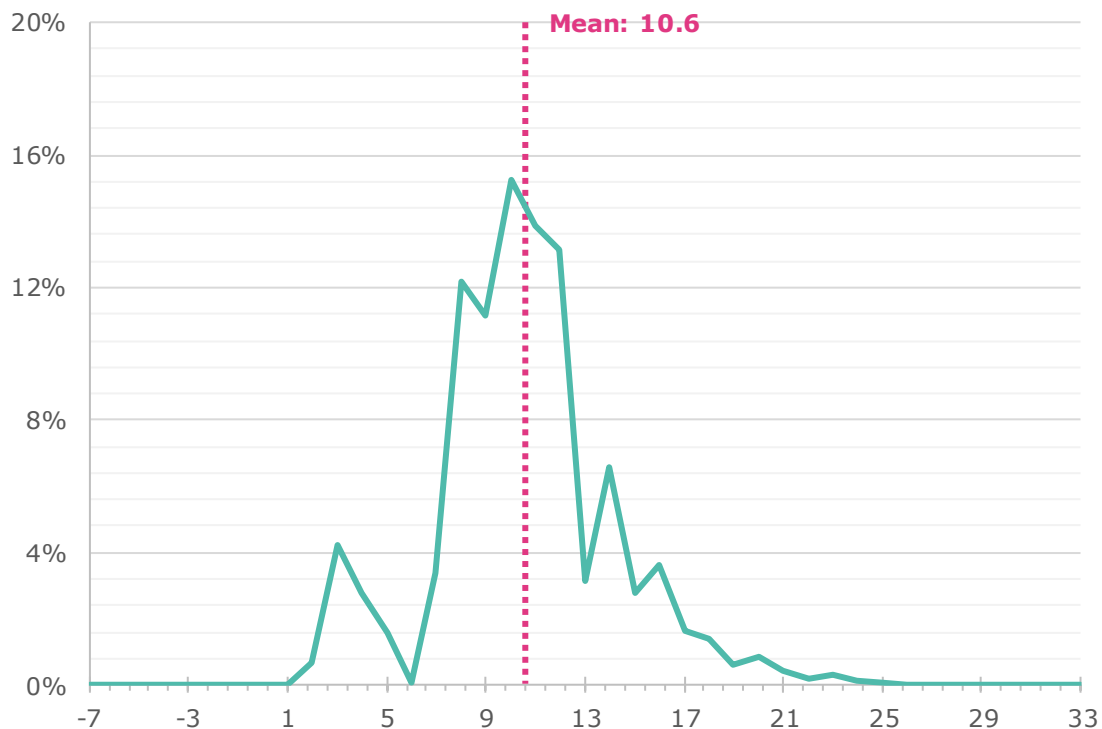


Figure 7 – Graph showing spread of risk score across all procedures (as percentage of all procedures reported). The score has a theoretical range of -7 to 33 for C section procedures in Wales.

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 2017, the mean risk score for all mothers undergoing C section was 10.6 (median 10). When counting only those who have developed an SSI, the mean risk score increases to 11.9 (median 12), which means that mothers who developed an SSI had a significantly higher aggregate risk score than those who did not ( $P < 0.001$ ).

<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

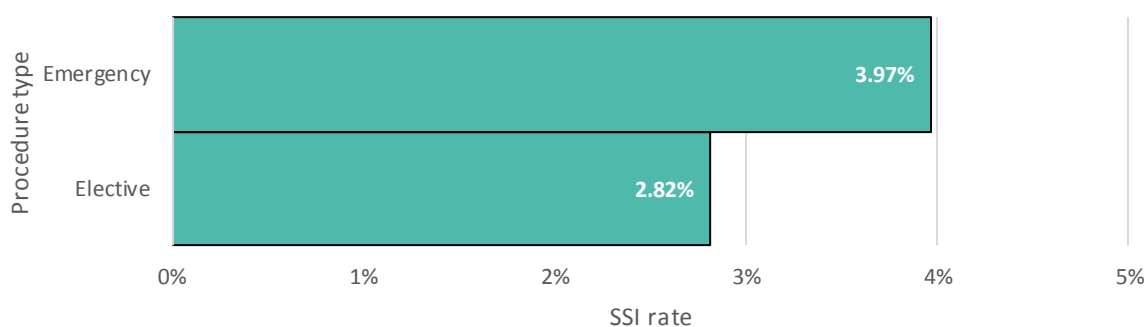


Figure 8 – Graph showing incidence of SSI by type of procedure.

Table 10 – Incidence of SSI by procedure type.

Age group	No. of procedures	SSI	SSI rate (95% CI)
Elective	3125	88	2.82% (2.26-3.46)
Emergency	3430	136	3.97% (3.34-4.67)
Unknown	92	2	2.17% (0.26-7.63)

In 2017, the SSI rate in emergency procedures was significantly higher than in elective procedures (41% increase,  $P=0.010$ ). The split of procedures is also fairly even, with 52.3% of procedures being classed as emergencies (CS1, CS2 and CS3) and the remaining 47.7% being classed as elective (CS4).

## Incidence of SSI by antibiotic prophylaxis

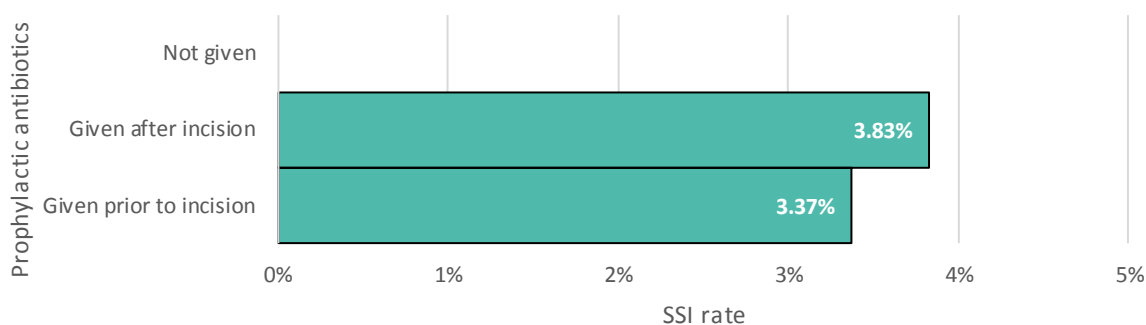


Figure 9 – Graph showing incidence of SSI by timing of prophylactic antibiotics.

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

Prophylactic antibiotics	No. of procedures	SSI	SSI rate (95% CI)
Given prior to incision	6050	204	3.37% (2.93-3.86)
Given after incision	209	8	3.83% (1.67-7.40)
Not given	21	0	0.00% (0.00-16.11)
Unknown	367	14	3.81% (2.10-6.32)

99.7% of mothers were given prophylactic antibiotics and, of these, 96.7% were given prior to surgical incision. There is a slightly higher SSI rate when antibiotics are administered after incision, but this was not significant (14% increase,  $P=0.723$ ).

Despite this increase being only slight and not statistically significant, 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, 2017). 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

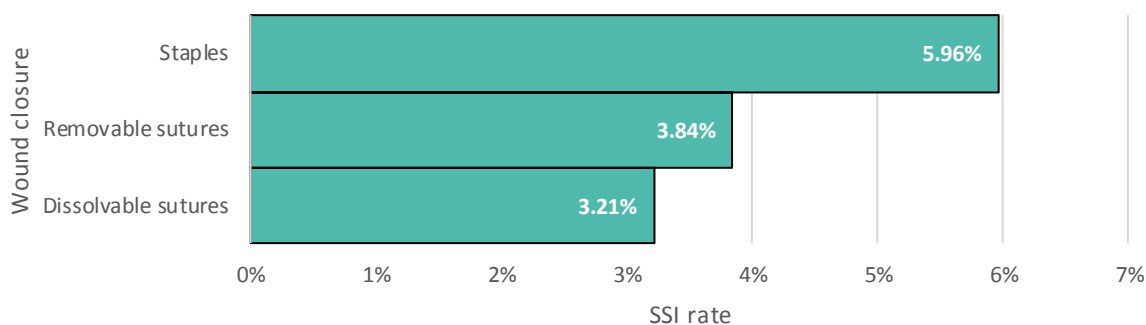


Figure 10 – Graph showing incidence of SSI by type of skin closure used.

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

Type of wound closure	No. of procedures	SSI	SSI rate (95% CI)
Sutures (all types)	6258	205	3.28% (2.83-3.72)
Dissolvable sutures	5633	181	3.21% (2.77-3.71)
Removable sutures	625	24	3.84% (2.48-5.66)
<b>Staples</b>	<b>235</b>	<b>14</b>	<b>5.96% (3.29-9.79)</b>
Unknown	154	7	4.55% (1.85-9.14)

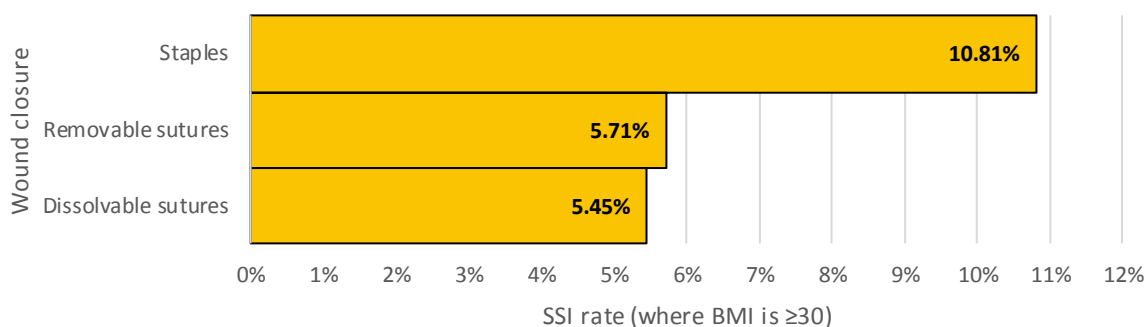


Figure 11 – Graph showing the incidence of SSI by skin closure in mothers with BMI ≥ 30.

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

Type of wound closure	No. of procedures	SSI	SSI rate (95% CI)
Sutures (all types)	2170	119	5.48% (4.53-6.44)
Dissolvable sutures	1925	105	5.45% (4.48-6.56)
Removable sutures	245	14	5.71% (3.16-9.40)
<b>Staples</b>	<b>111</b>	<b>12</b>	<b>10.81% (5.71-18.12)</b>
Unknown	53	4	7.55% (2.09-18.21)

In 2017, the SSI rate when staples were used as a method of skin closure was 82% higher than when sutures were used ( $p=0.025$ ). This trend becomes even more pronounced when the mother is obese ( $BMI \geq 30$ ), with the SSI rate being 97% higher when staples are used ( $P=0.018$ ).

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

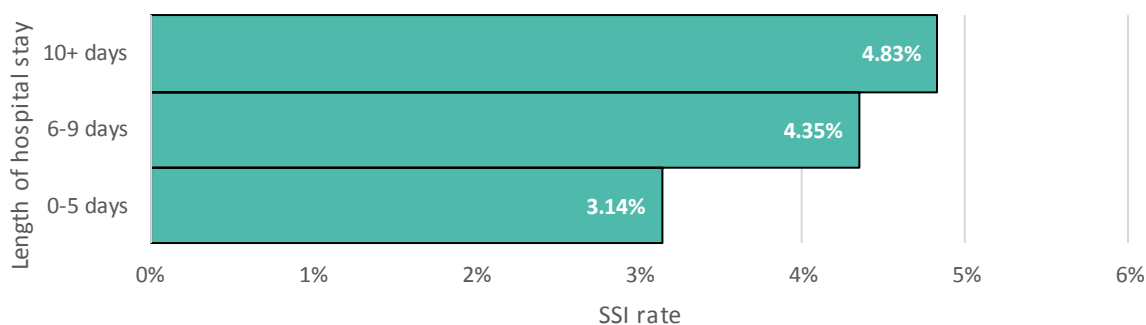


Figure 12 – Graph showing incidence of SSI by length of hospital stay.

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

Length of hospital stay	No. of procedures	SSI	SSI rate (95% CI)
0-5 days	4714	148	3.14% (2.66-3.68)
6-9 days	460	20	4.35% (2.68-6.64)
10+ days	290	14	4.83% (2.66-7.97)
Unknown	1183	44	3.72% (2.72-4.96)

For all patients undergoing a C section, the mean hospital stay following the procedure is 4.3 days (median of 2). When only mothers who have had an SSI are included, this increases to a mean of 5.2 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=0.213).

## Length of midwifery care

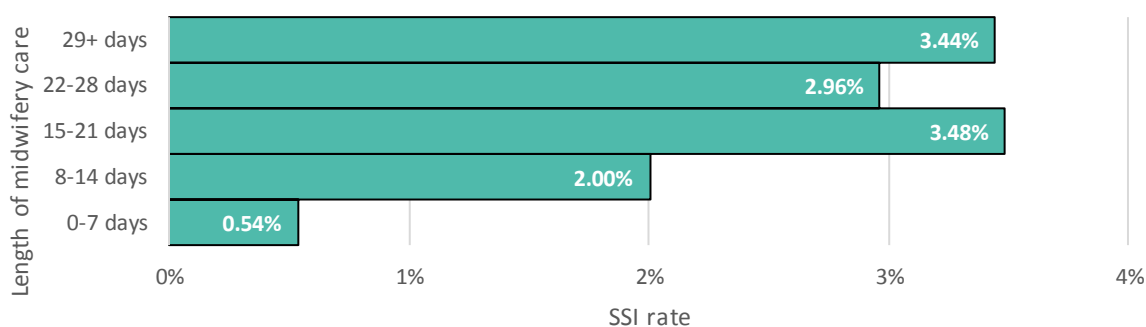


Figure 13 – Graph showing incidence of SSI by length of midwifery care post-procedure.

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

Length of midwifery care	No. of procedures	SSI	SSI rate (95% CI)
0-7 days	186	1	0.54% (0.01-2.96)
8-14 days	1399	28	2.00% (1.33-2.88)
15-21 days	1349	47	3.48% (2.57-4.61)
22-28 days	1417	42	2.96% (2.14-3.99)
29+ days	668	23	3.44% (2.19-5.12)
Unknown	1628	85	5.22% (4.19-6.42)

**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 20.1 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 21.8 days (median of 21) indicating that SSIs are causing women to be under midwifery care for significantly longer than they would be otherwise ( $P=0.031$ ). In 2017, having an SSI meant that a mother spent on average an additional 1.7 days in the care of a midwife.

## Time to onset of infection

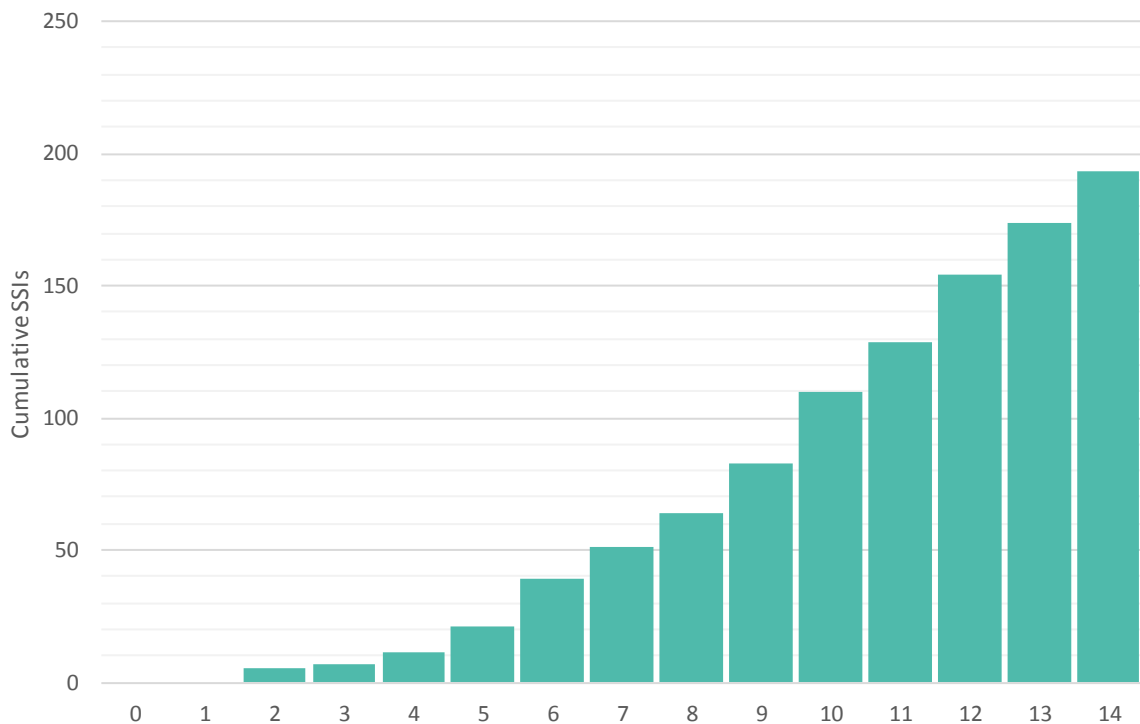


Figure 14 – Graph showing cumulative SSIs up to 14 days post-procedure. Blank infection dates excluded.

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 33 (15%) 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 10 (n=27).

## Discussion

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Compliance with the C section SSI surveillance has increased from 84% in 2016 to 87% this year. While these rates are lower than those in the period 2010-2015, there has been a change in data source for the denominator, with the majority of hospitals self-reporting procedure numbers due to previous inaccuracies in the PEDW dataset. This means that comparing the 2016-17 compliance rates with previous years is difficult.

The overall SSI rate for 2017 was 3.4%, which, as well as being lower than the 2016 rate of 4.1%, represents a historic low in terms of overall infection rate. In addition, the 73% reduction over time has led to 2804 infections being prevented for mothers. As with previous years, this trend is not reflected across all health boards, with two health boards showing increases compared to 2016, however, these were only slight increases. This overall reduction can be seen in both elective and emergency procedures, with elective procedures showing the greatest reductions (3.9% in 2016 to 2.8% in 2017) compared to emergency procedures (4.4% to 4.0%).

In terms of patient demographic data being recorded in our surveillance, the one that most significantly affects the SSI rate is BMI. In general, higher BMIs are associated with an increased risk of SSI. The mean BMI for all procedures was 29.1, but this increased to 33.4 when only including those who had an SSI, indicating that there is a relationship between the two factors. This can be seen in the SSI rates across the various groups - obese mothers have an SSI rate of 5.8%, but healthy weight mothers only have a rate of 1.2%. The SSI rate in underweight mothers is high, but this is a very small group compared to all other BMI categories and, as such, this is not significant. An increase in age was associated with a decrease in SSI rate, with women 40 or over having a rate of 2.1% compared to the rate of 6.6% in women under 20. There were no trends based on the number of previous C sections.

Public Health Wales were alerted in 2015 to an increased use of staples, and we have continued to monitor its use since. Usage has been decreasing over the last two years, and heavy usage appears to be localised to the same areas as in previous years. Based on our data, staples represent a significantly higher risk of infection than sutures, and the trend is even more apparent when stratified by BMI, with obese mothers seeing an SSI rate of 10.8% when staples are used. As always, while we do acknowledge that suturing is a more time consuming process, ***we recommend that staples are not used as a routine method of closure.***

A total 99.7% of mothers in Wales were given antibiotic prophylaxis for their procedure, with 96.7% of those given antibiotics having it administered prior to incision (improvement from 94.8% in 2016). Hospitals are continuing to adopt the recommended antibiotics, and those using the same drugs as the recommendation but at different doses have now adopted the recommendation in full. We would like to encourage hospitals to continue following NICE and AWMSG (All Wales Medicines Strategy Group) recommendations.

As with previous years, inpatient infections continue to be uncommon, with only 7% of all infections (n=16) occurring prior to hospital discharge. Complicated infections (deep and organ space) are also uncommon, with only 12% of infections being deep, and less than 1% classified as organ space. The proportion of infections being reported as complicated has fluctuated slightly from year to year, but there have been no major changes of concern.

Following the C section procedure, mothers spend a mean length of 20 days under the care of a midwife overall and this significantly increases by approximately 2 days if an SSI develops. As noted, infection data were captured up to and including 14-day post



operatively. The mean time to infection was 9.6 days, with the greatest number of infections reported on day 10.

In conclusion, the SSI rate for 2017 has decreased to a rate 3.4% with a 73% reduction in infection numbers since 2007. To achieve such rates, health boards in Wales have continued to work hard locally in infection prevention and introducing interventional measures. Although 1 in 30 mothers still develop an infection post-surgery this is considerably less than in 2007 when approximately 1 in 8 developed an infection. Public Health Wales will continue to work together with all hospitals in Wales and strive to reduce infections further.

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