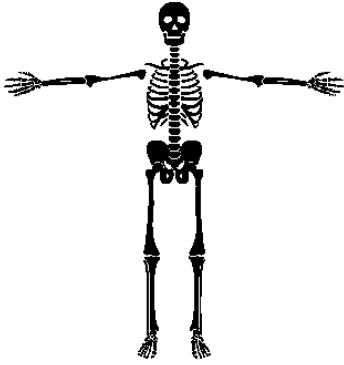


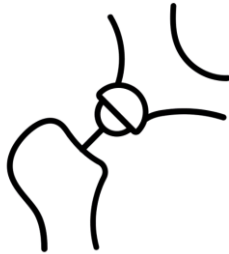
A photograph of surgeons in an operating room. The scene is dimly lit, with bright circular surgical lamps providing focused light. Several surgeons in blue scrubs, masks, and caps are visible, focused on a patient lying on the table. The patient is mostly obscured by white drapes. Surgical instruments are visible on a tray in the foreground.

Surgical Site Infection surveillance in Northern Ireland
Annual Report 2022

Executive Summary



In 2022, hip replacement surgeries comprised 14% of all orthopaedic procedures under surveillance. The overall SSI rate in 2022 for hip replacements was 0.73%.



Due to disruption in elective surgery during the COVID-19 pandemic the proportion of knee replacement surgeries under surveillance in 2021 was 3%, this increased to 7.9% in 2022. This compares to 13% of all orthopaedic surgeries under surveillance prior to the pandemic. The SSI rate for knee surgeries was 0.26% in 2022.

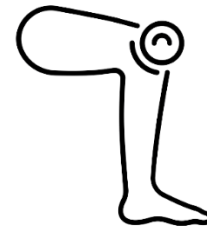


In adult critical care units, the cumulative incidence of central line associated blood stream infections was 1.09 per 1,000 central line days in 2021. In 2022, the cumulative incidence was 0.65 per 1,000 central line days. The cumulative incidence of ventilator associated pneumonia infections per 1,000 ventilator days was 0.55. The cumulative incidence of catheter related urinary tract infections was 0.04 per 1,000 urinary catheter days, the lowest recorded over the last 6 years.

The overall orthopaedic surgical site infection (SSI) rate was 0.57% in 2022, remaining below 1% for thirteen consecutive years. Since 2010, SSI surveillance has concentrated on infections diagnosed during the inpatient stay or following readmission. In 2022, one in five infections was diagnosed during the inpatient stay. The number of SSIs with index surgery noted outside HSC system was 12 in 2022.



Hemiarthroplasty and repair of neck of femur surgery comprised 13.5% of orthopaedic procedures under surveillance in 2022. The SSI rate was 0.46%.



In 2022, 4.9% of caesarean sections resulted in an SSI. Of these 89.6% were superficial incisional, 8.8% were deep incisional and 1.6% were organ space. In 2019-2022, the rates of SSI in patients undergoing caesarean section have ranged from 3.9% to 5.6%, decreasing from 15.8% observed when surveillance began in 2008.



Image credits Noun project (thenounproject.com)

Cover photo – Jacob Lund photography from Noun Project

Skeleton – Mark S Waterhouse from Noun Project

Hip and knee images - N. Style from the Noun Project

Knee image - Creative Mahire from Noun Project

Caesarean section – Eucalyp from Noun Project

Authors

Mark McConaghy, BSSc, MSc - Regional Surveillance Coordinator

Aoife Caffrey, BSc, PhD - Surveillance and Information Scientist

Tracey Bone, BA - Data Analyst

William Crowe, BSc, PhD - Senior Epidemiological Scientist

Judith Ewing, MB BChir, MPH, MFPH - Health Protection Consultant

Acknowledgements

We thank all of our surveillance and clinical colleagues for their time and effort in providing the data that is presented in this report. We also thank Public Health Agency (PHA) surveillance colleagues/analysts who have contributed to this report with valuable feedback and input.

During the final stages of producing this report we were extremely saddened by the death of our colleague and friend, Judith Ewing. Dr Ewing was an incredibly dedicated and inspirational Public Health Consultant who is greatly missed by her colleagues.

Date generated: April 2024

Introduction

Hospital acquired infections (HAIs) are responsible for extended hospital stays, morbidity, and disability. Those occurring after surgery have been shown to double the length of hospital stay, resulting in substantial financial costs. Given the impact on patient health and increased costs associated with infections after surgery, this is an important area for ongoing surveillance and benchmarking. Robust surveillance also permits assessment of changes to surgical practices and procedures, which should be used to improve safety and quality of care.

In 2017, a point prevalence survey (PPS) was published in Northern Ireland (NI).¹ This examined the rates of HAIs, including surgical site infections (SSIs) in Northern Ireland. A number of recommendations were made, with the aim of decreasing the number of SSIs. This included the need for more comprehensive surveillance across all surgical procedures.

The report highlighted that 1 in 16 acute patients had an HAI, the second most common being an SSI (16%). Active surveillance² is recommended for patients in hospital and following discharge for a period of 30 days for non-implant surgeries and up to a minimum of 90 days for those surgeries where an implant is used. This is due to it being more likely that SSIs in orthopaedic procedures will occur in the first 90 days post procedure. Our surveillance method includes infections reported after the 90 days and for up to five years following a procedure; an infection occurring after this time is rare, but possible if the infection can be linked to an index procedure.

Where possible, active surveillance should involve follow up in the community, return to outpatients as well as readmission for further treatment. As is the case with other parts of the UK, the NI Public Health Agency (PHA) is exploring extension of surveillance into other surgical specialities and reinforcing best practice for case ascertainment.

The focus of this report is the previous 5-year data between January 2018 and December 2022 contributed by Health and Social Care (HSC) Trusts. However, this annual report includes surveillance data for a 21-year period (from 1st January 2003 for orthopaedic procedures and 1st January 2008 for caesarean sections to 31st December 2022), reported to the PHA by 31st October 2023. The SSI surveillance team at the PHA undertakes surveillance which focusses on three key areas; orthopaedics, caesarean section, and device associated infections (DAI) in critical care settings.

¹ Northern Ireland Point Prevalence Survey of Hospital Associated Infections and Antimicrobial Use 2017. Available at: [Northern Ireland Point Prevalence Survey of Hospital Associated Infections and Antimicrobial Use 2017 | HSC Public Health Agency \(hscni.net\)](https://www.hscni.net/point-prevalence-survey-of-hospital-associated-infections-and-antimicrobial-use-2017)

² Active surveillance in epidemiology refers to additional measures taken to collect data and confirm diagnosis rather than relying on retrospective information or accounts.

Surveillance Methods

Totals and percentages are based on valid totals and percentages, i.e. excluding missing data. Incidence rates are presented with 95% confidence intervals (CIs) which were calculated using the Byar's method where O is the numerator number of observed events; n is the denominator population-years at risk³. The $100(1-\alpha)$ % confidence limits for the rate r are given by:

$$r_{lower} = \frac{O_{lower}}{n}$$

$$r_{upper} = \frac{O_{upper}}{n}$$

where: O_{lower} and O_{upper} are the lower and upper confidence limits for the incidence rate. For 95% confidence interval, $\alpha = 0.05$ and the corresponding z-value of approximately 1.96.

Graphs that display means have accompanying confidence intervals calculated using the Z interval method ($x \pm z(s/\sqrt{n})$). X represents the sample mean, Z represents the Z-value, S represents the standard deviation, and n is the sample size.

Orthopaedic infection surveillance

This report includes data collected from all hospitals in Northern Ireland that perform orthopaedic surgery. Infection rates are only based on surgeries conducted within the HSC system, the denominator is obtained from theatre management systems and numerator infections are reported via PHA website; this excludes procedures carried out in the private sector or outside Northern Ireland. Table 2 provides the total number of SSIs treated within HSC hospitals following surgeries outside the HSC system. The results presented contain data for all orthopaedic procedures as well as disaggregated information for arthroplasty of the hip, hemiarthroplasty of the hip, and arthroplasty of the knee.

An infection occurring within 30 days post-surgery is considered to be an SSI. An infection occurring within 12 months post-surgery is considered a SSI if a prosthetic joint or implant is left in situ. Post-discharge surveillance for orthopaedic procedures was confined to SSIs detected during the inpatient stay or for those patients who were readmitted after their initial hospital stay.

The following were excluded from the analysis:

- Procedures not undertaken in an operating theatre
- Day cases, i.e. patients that are admitted to hospital for a planned surgical procedure that does not involve an overnight stay in a hospital
- Procedures not conforming to National Healthcare Safety Network (NHSN) definition of operative procedure, e.g., debridement, procedure not involving a surgical incision (injections, aspirations, and imaging)⁴

³ Public Health England Technical Guide Confidence Intervals Appendix 1 Byar's Method 25 May 2018 page 6. Available at: <https://fingertips.phe.org.uk/documents/PHDS%20Guidance%20-%20Confidence%20Intervals.pdf>

⁴ National Healthcare Safety Network (NHSN) Patient Safety Component Manual; January 2024. Available at: https://www.cdc.gov/nhsn/pdfs/pscmanual/pscmanual_current.pdf

Caesarean section infection surveillance

Data from all hospitals⁵ performing caesarean section surgery in Northern Ireland are sent to the PHA for surveillance. Currently, each caesarean section is recorded with a unique individual physical paper form containing information on the time and date of the surgery, and sent to the PHA. This is also used to report infections, up to 30 days post-discharge, which are sent to the PHA for surveillance. In conjunction, each Trust provides the overall number of caesarean procedures undertaken using the Northern Ireland Maternity System (NIMATS) to monitor compliance rates.

Device associated infection surveillance

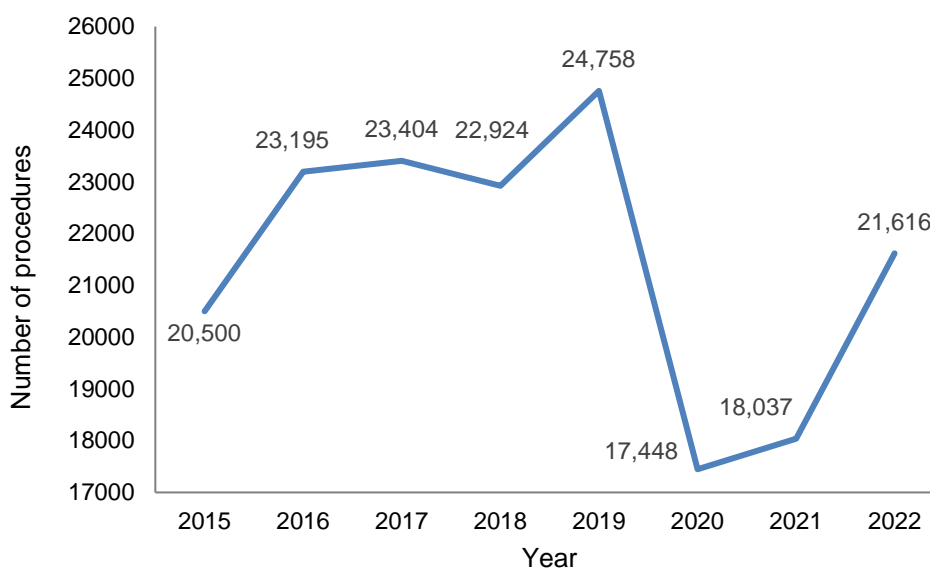
In conjunction with the mandatory surveillance of orthopaedic and caesarean section related SSIs, the SSI team also produce a monthly mandatory report for device-associated infections (DAIs) that outlines the rolling average from critical care units in hospitals across Northern Ireland. This report provides information on adult critical care units involving patients who have ventilators, urinary catheters and central lines in place. There is a bespoke system for the collection of DAIs called Medicus (formerly Wardwatcher). This follows a protocol developed using the Hospitals in Europe Link for Infection Control through Surveillance (HELICS) definitions.⁶ There are three infections that are reported on; ventilator-associated pneumonia (VAP), catheter-associated urinary tract infection (CAUTI), and central line-associated bloodstream infection (CLABSI).

⁵ Altnagelvin Hospital, Antrim Area Hospital, Causeway Hospital, Craigavon Area Hospital, Daisy Hill Hospital, Royal Jubilee Maternity Services, South West Acute Hospital and Ulster Hospital

⁶ European Centre for Disease Prevention and Control. Surveillance of healthcare-associated infections and prevention indicators in European intensive care units: HAI-Net ICU protocol, version 2.2. Stockholm: ECDC; 2017. Available at: https://www.ecdc.europa.eu/sites/default/files/documents/HAI-Net-ICU-protocol-v2.2_0.pdf

All procedures covered by SSI surveillance programme

Figure 1. The total number of procedures covered by the SSI surveillance program, Northern Ireland, 2015 - 2022.



The overall number of procedures included in SSI surveillance was relatively stable from 2016 to 2019. However, there was a noticeable drop in procedures occurring in 2020 and 2021 during the COVID-19 pandemic. In 2022, there was a partial recovery in the number of procedures under surveillance, approaching levels observed before the pandemic.

Orthopaedic SSI surveillance

As shown in Figure 2, in 2022 the SSI cumulative incidence per 100 orthopaedic procedures has been 0.57%. The type of SSI (superficial incisional, deep incisional and organ/space) diagnosed after orthopaedic procedures is shown in Figure 3.

Figure 2. SSI cumulative incidence for orthopaedic procedures, Northern Ireland, 2003 - 2022

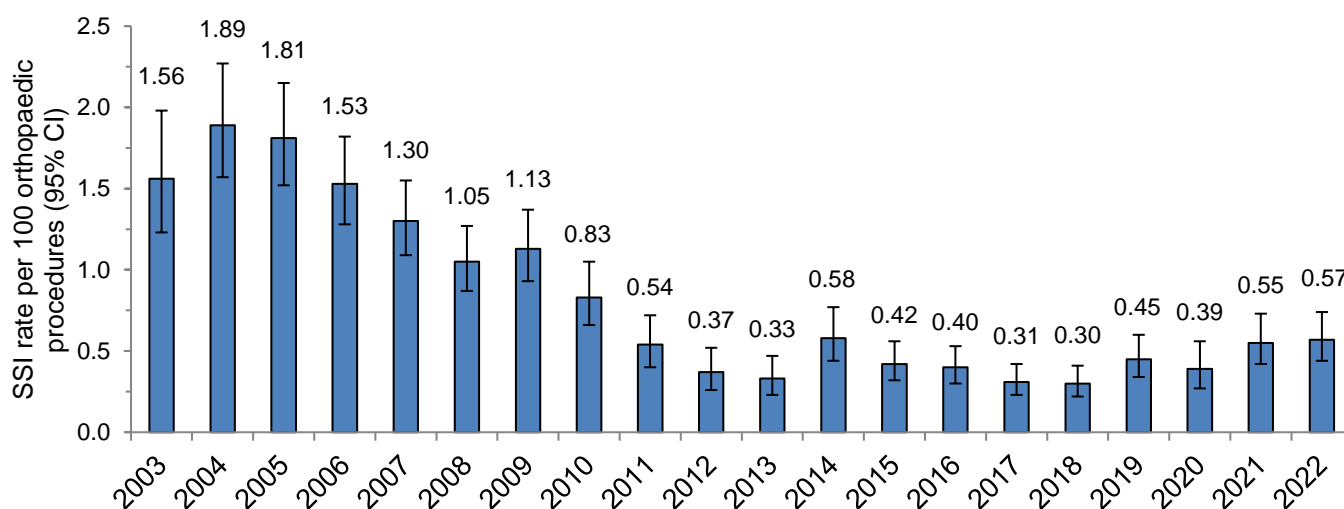
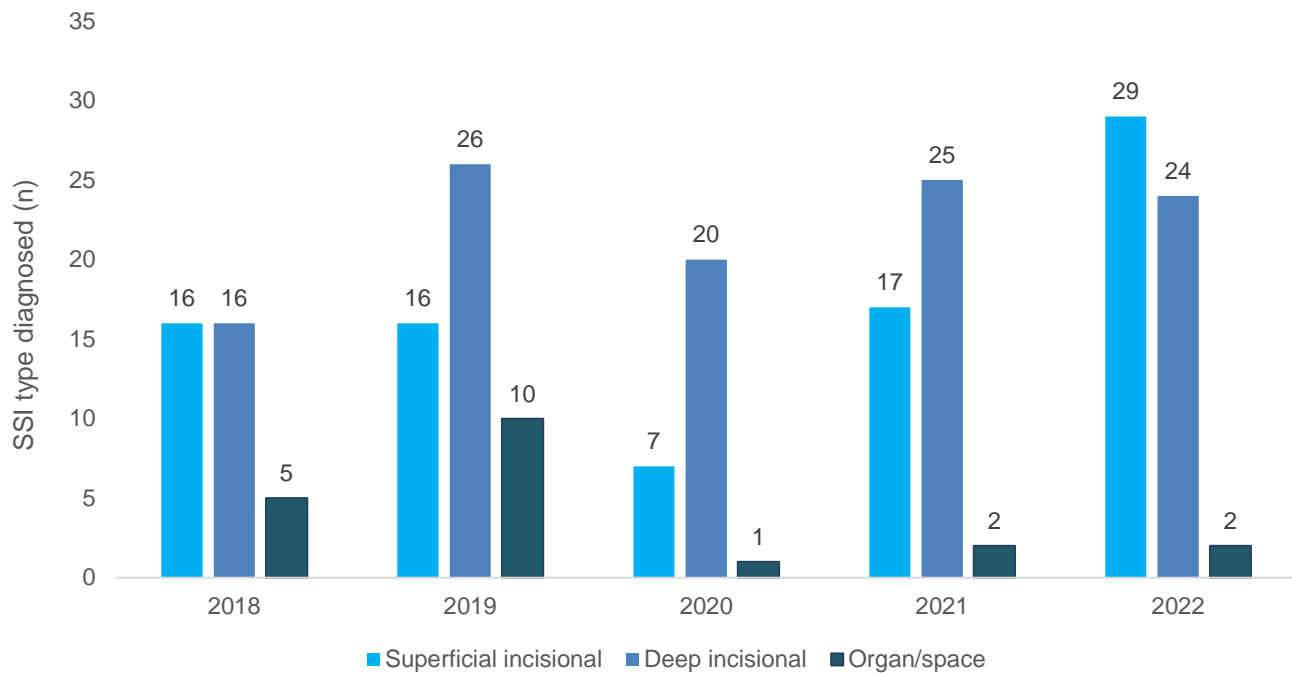
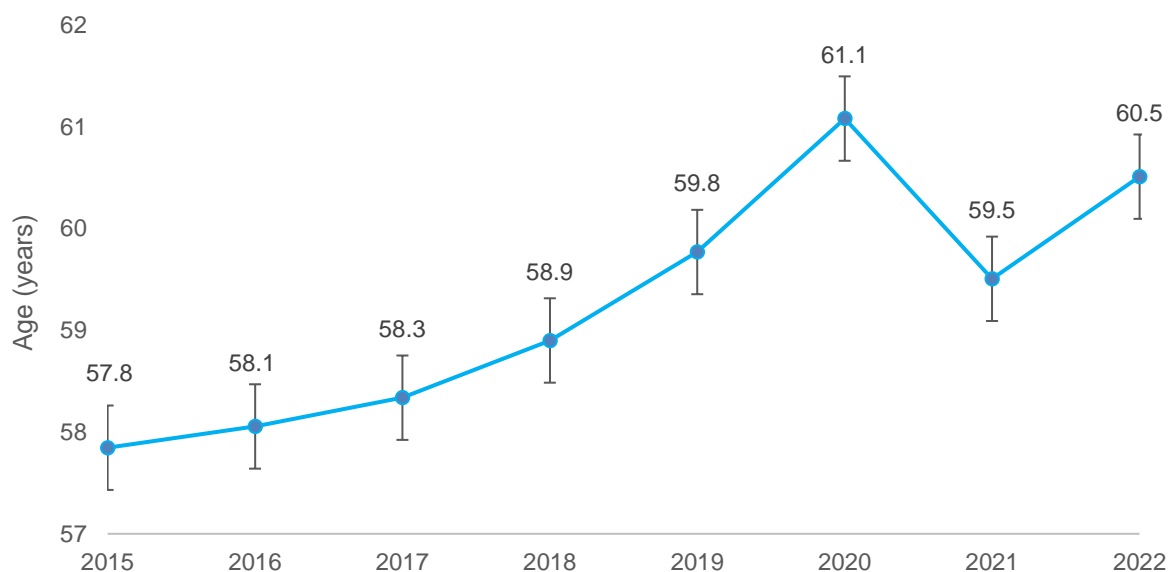


Figure 3. Number of SSIs reported for orthopaedic procedures by type, Northern Ireland, 2018 – 2022.



As shown in Figure 4, the average age of patients undergoing orthopaedic procedures increased steadily from 2015 to 2020. In 2021, there was a decrease in the average age of patients undergoing orthopaedic procedures to 59.5 years, which was lower than in the previous two years (61.1 and 59.8 years, respectively). The average age of patients undergoing orthopaedic procedures increased again in 2022 to 60.5 years in line with increasing volumes of elective surgery.

Figure 4. Average age of patients undergoing orthopaedic procedures, Northern Ireland, 2015 – 2022.



The number of orthopaedic procedures completed in NI from 2015-2022, categorised by age groups, is shown in Table 1. In 2022, approximately one-third of the procedures were completed in individuals aged between 18-54 years and those aged 75 years and above, whilst 4% of the procedures were carried out on patients under 18 years of age.

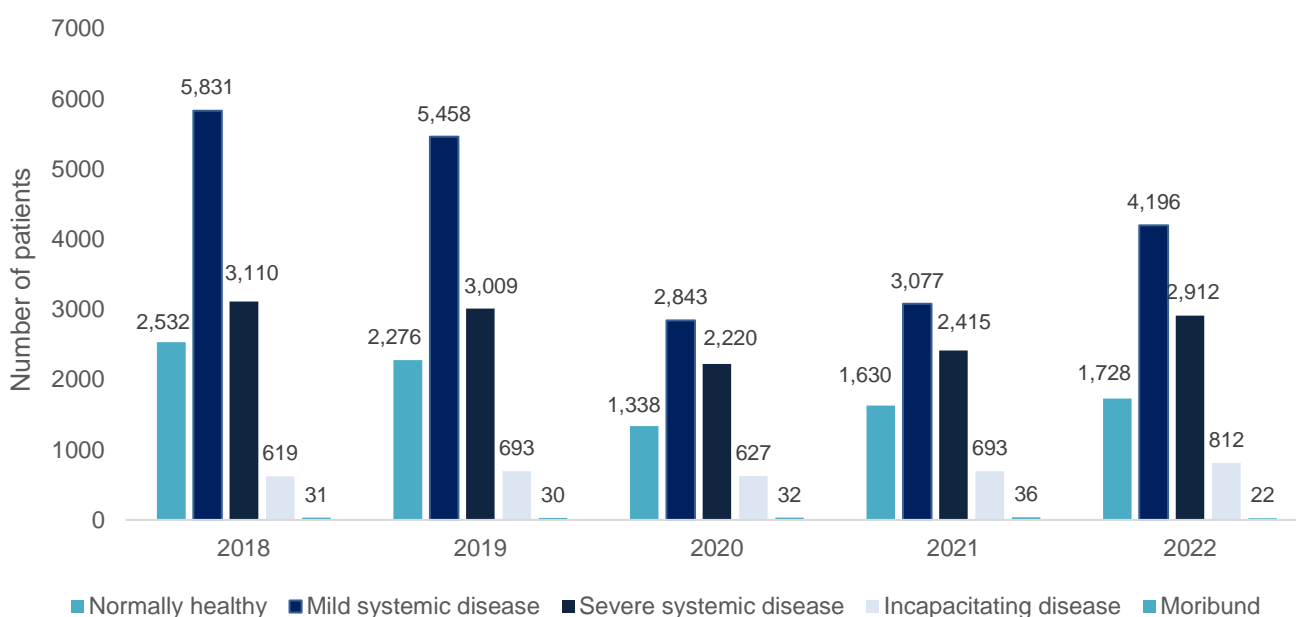
Table 1. Number of orthopaedic procedures reported by age group, Northern Ireland, 2015 – 2022.

Year	<18	18-54	55-64	65-74	75+	Total
2015	649 (5.8)	3,639 (32.3)	1,824 (16.2)	2,328 (20.6)	2,838 (25.2)	11,278
2016	767 (5.9)	4,092 (31.5)	2,058 (15.9)	2,722 (21.0)	3,337 (25.7)	12,976
2017	709 (5.5)	3,960 (31.0)	2,257 (17.6)	2,582 (20.2)	3,283 (25.7)	12,791
2018	597 (5.2)	3,494 (30.3)	2,036 (17.7)	2,277 (19.8)	3,115 (27.0)	11,519
2019	535 (4.6)	3,339 (28.9)	2,110 (18.3)	2,336 (20.2)	3,224 (27.9)	11,544
2020	330 (4.6)	2,025 (28.5)	1,104 (15.5)	1,242 (17.5)	2,405 (33.8)	7,116
2021	400 (5.0)	2,532 (31.8)	1,200 (15.1)	1,318 (16.6)	2,504 (31.5)	7,954
2022	388 (4.0)	2,902 (29.9)	1,564 (16.1)	1,849 (19.0)	3,010 (31.0)	9,713

Orthopaedic SSIs and ASA classification

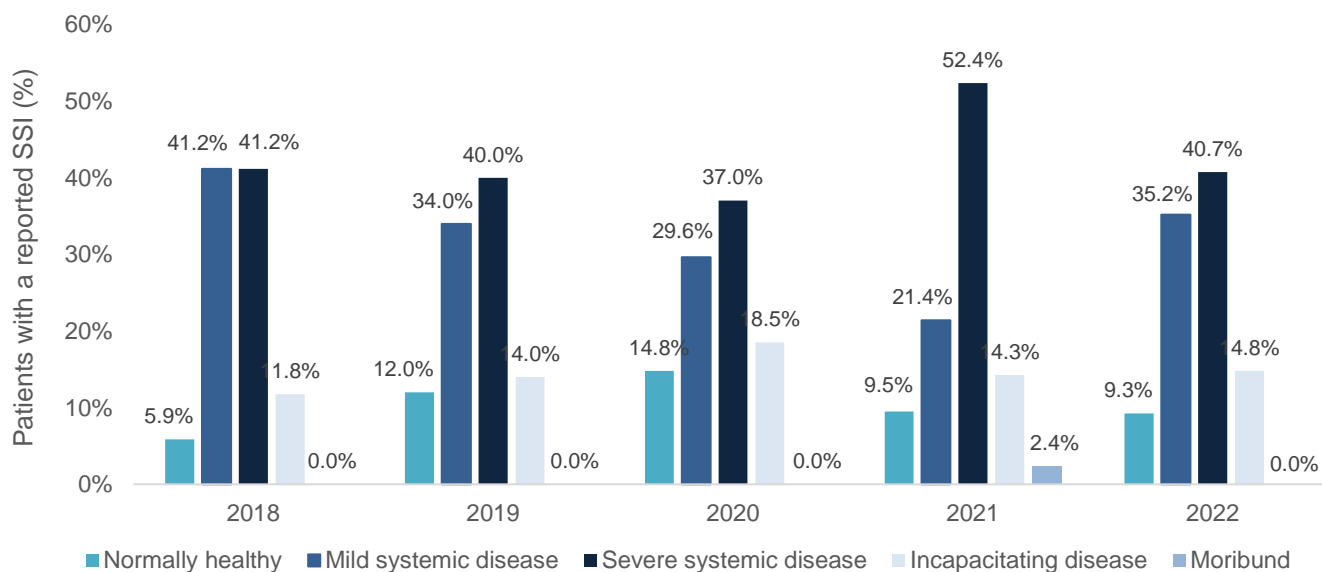
The American Society of Anesthesiologists (ASA) classification system, which consists of six categories, is commonly employed to classify patients undergoing surgery (see Appendix 1); there were no patients classified as ASA VI (a declared brain-dead person whose organs are being removed for donor purposes).⁷ The largest patient group consisted of those with mild systemic disease (ASA II). In 2018, this accounted for 5831 (48.1%) patients, decreasing to 4196 (43.4%) in 2022 (Figure 5). Overall, since the start of the COVID-19 pandemic, there has been a decrease in the volume of surgeries performed compared to pre-pandemic levels for ASA Patient Categories I-III. Furthermore, the highest percentage of orthopaedic SSIs occurred in patients with severe systemic disease (ASA III), accounting for approximately 40% of SSIs during the pre-pandemic period across all ASA categories (Figure 6). This decline is attributed to disruptions in the acute sector, including reprioritisation away from elective surgeries, staff redeployment, and changes in health-seeking behaviour.

Figure 5. The number of patients in each American Society of Anesthesiologists (ASA) category, Northern Ireland, 2018 – 2022.



⁷ Doyle DJ, Hendrix JM, Garmon EH. American Society of Anesthesiologists Classification [Updated 17 Aug 2023]. Available at: www.ncbi.nlm.nih.gov/books/NBK441940/.

Figure 6. Percentage of patients in each American Society of Anesthesiologists category where an SSI was reported, Northern Ireland, 2018 – 2022.



SSI rates for different orthopaedic surgery procedures

Table 2 shows the number of orthopaedic surgery procedures and their associated SSI rates in NI from 2018 to 2022. SSI rates varied across different orthopaedic procedures, ranging from 0% SSIs infection rate for skin graft procedures to 1.99% for amputation procedures over the five-year period from 2018 to 2022. The average time to report an infection ranged from 28 days for hemiarthroplasty/repair neck of femur surgeries to 117.2 days for knee prosthesis procedures. The average age of patients undergoing these surgeries varied across categories, with the average age of 56 years observed for patients undergoing open reduction internal fixation/reduction of fractures and 81.3 years for those undergoing hemiarthroplasty/repair neck of femur surgeries.

Table 2. Number of procedures and occurrences of SSIs across various orthopaedic surgery procedures, along with patient and surgery-related characteristics, Northern Ireland, 2018 – 2022.

Surgical category	Number of operations	Number of SSIs	SSI infection rate (%) over 5 years (2018-2022) ²	95% CI	Average time to reporting an infection (days)	Average age	Proportion female (%)	ASA class ≥3	Proportion elective surgery (NCEPOD; %)	SSI infection rate (%) for calendar year 2021	SSI infection rate (%) for calendar year 2022
Hip prosthesis	6,989	32 (11)	0.46	0.3-0.6	57.6	67.8	56.8	28.7	78.4	0.49	0.73
Knee prosthesis	4,581	18 (9)	0.39	0.2-0.6	117.2	68.8	58.6	23.8	98.6	0.0	0.26
Hemiarthroplasty/repair neck of femur	5,481	31	0.57	0.5-0.9	28.0	81.3	68.3	86.3	0.3	0.65	0.46
Open reduction internal fixation/open reduction of fracture	17,454	62 (1)	0.36	0.3-0.5	47.0	56.0	55.6	36.3	3.5	0.56	0.43
Other musculoskeletal	9,936	31	0.31	0.2-0.4	80.8	47.0	44.4	18.5	46.3	0.13	0.49
Other prosthesis	755	5	0.66	0.2-1.5	99.4	65.0	67.0	36.2	43.1	0.0	1.05
Amputation	251	5	1.99	0.6-4.6	31.0	55.5	36.3	47.9	48.6	2.17	0.0
Other nervous system	264	2	0.76	0.1-2.7	30.0	56.0	51.5	12.4	83.7	0.0	5.0
Laminectomy/Spinal fusion	2,693	30 (2)	1.11	0.8-1.6	47.7	53.0	49.1	32.8	28.2	0.98	1.99
Skin graft	53	0	0	0.0-7.0	-	51.0	35.8	51.9	3.8	0.0	0.0

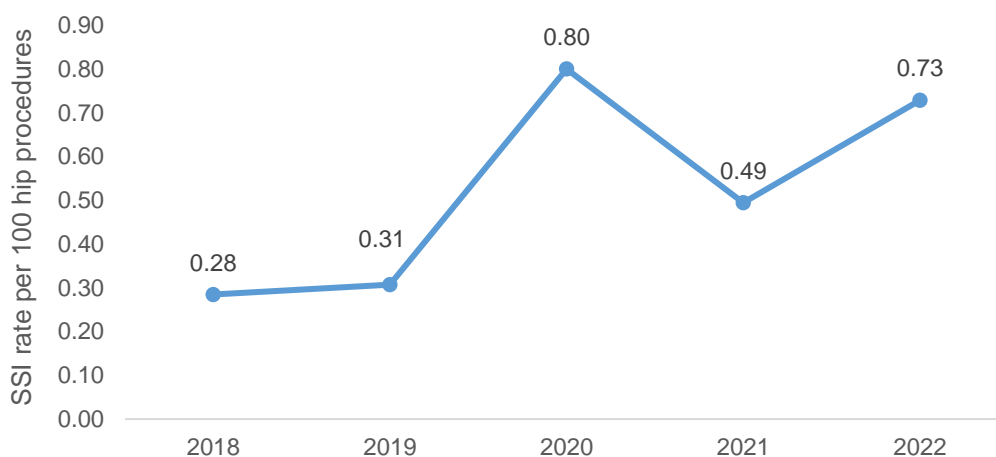
¹Values in brackets refer to additional SSI treated in HSC treated within HSC hospitals following surgeries outside the HSC system.

²Calculated SSI proportions exclude cases where index surgery was outside HSC public hospital system in Northern Ireland
SSI: Surgical site infection; ASA: American Society of Anesthesiologists; HSC: Health Social Care; CI: confidence interval.

Hip replacement procedures

Hip replacement is a frequently performed orthopaedic surgery. In 2022, it accounted for 1,372 (14.1%) of all orthopaedic surgeries under SSI surveillance. Osteoarthritis, also known as degenerative arthritis, is a leading cause for hip replacement surgery. The incidence of osteoarthritis tends to increase with age. The procedure often alleviates acute pain and contributes to overall improved health.

Figure 7. SSI cumulative incidence for hip replacement procedures, Northern Ireland, 2018 – 2022.



Between 2018 and 2020 there was an increase in SSI cumulative incidence from 0.3 to 0.8 infections per 100 hip procedures (Figure 7). In 2022, the SSI cumulative incidence for hip procedures was 0.73 per 100 hip procedures.

The rise in 2020 (7120 procedures) and 2022 (9713 procedures) may be attributed to several factors including the substantial decline in the number of procedures carried out in HSC due to the COVID-19 pandemic, this change in denominator may be influencing the rate of infections associated with emergency vs elective procedures.

Figure 8. Sex-related differences among individuals undergoing hip replacement procedures, Northern Ireland, 2018 – 2022.

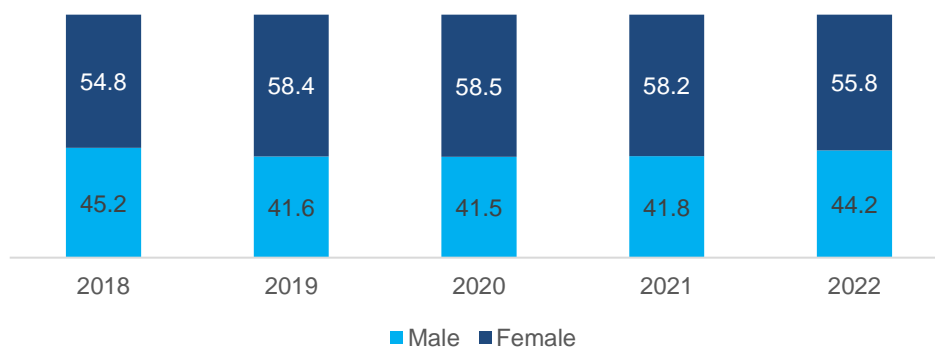
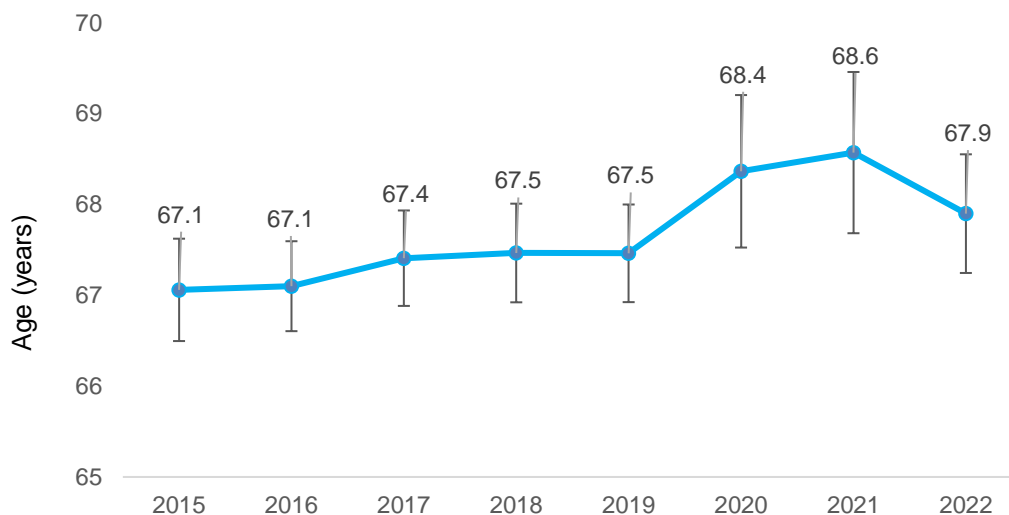


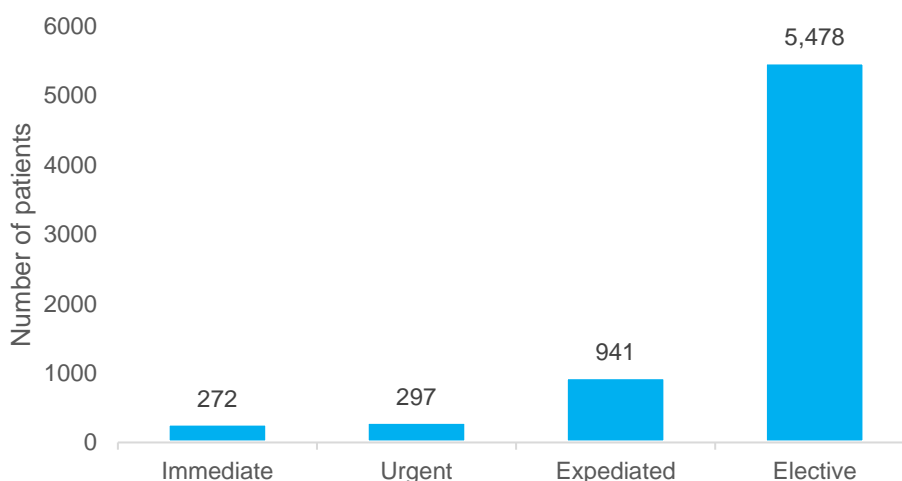
Figure 8 shows the sex-related differences among individuals undergoing hip replacement surgery. From 2018 to 2022, females consistently exhibited higher SSI infection rates than males. The mean age for patients undergoing hip replacement surgery in 2015-2022 ranged from approximately 67 to 69 years, showing only minor fluctuations within this range (Figure 9).

Figure 9. Average age of patients undergoing hip replacement surgery, Northern Ireland, 2015 – 2022.



A key priority in the ongoing surveillance of orthopaedic procedures is to determine if surgery was planned or unplanned. This assessment is conducted using the National Confidential Enquiry into Patient Outcome and Death (NCEPOD) classification which categorizes the procedures as immediate (life or limb saving), urgent (acute onset), expedited (requiring early intervention) or elective (planned).⁸ Figure 10 shows the total number and percentage of patients who underwent hip replacement surgery along with the NCEPOD classification for cases recorded between 2018-2022. The majority of procedures, accounting for 78.4%, were elective. The proportion of elective surgeries where an SSI was observed amounted to 67.7% (Figure 11). Among those who developed an infection 18 (56%) were 65 years old or older (Figure 12).

Figure 10. The number of hip replacement surgeries by NCEPOD classification, Northern Ireland, 2018 – 2022 combined.



⁸ The NCEPOD Classification of Intervention. Available at: www.ncepod.org.uk/classification.html

Figure 11. The number of SSIs for hip replacement procedures by NCEPOD classification, Northern Ireland, 2018 – 2022 combined.

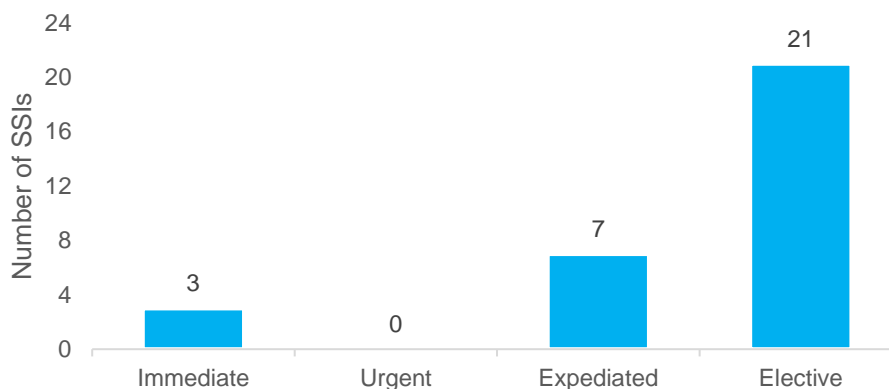
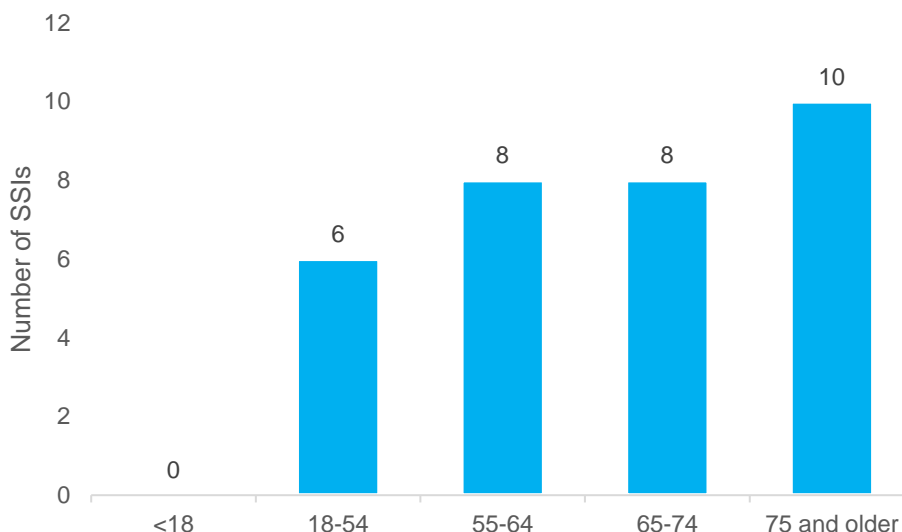


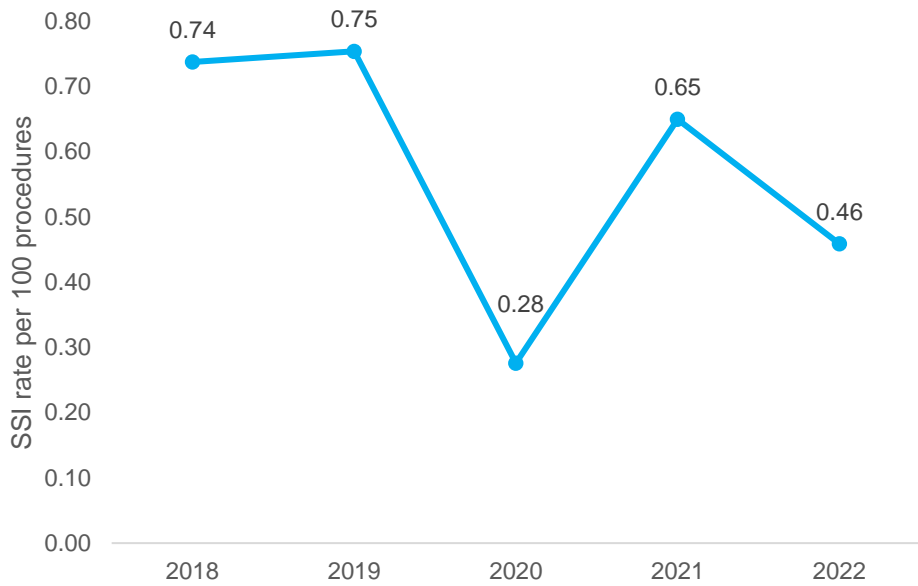
Figure 12. Number of SSIs by age category for patients who had hip replacement surgery, Northern Ireland, 2018 – 2022 combined.



Hemiarthroplasty procedures

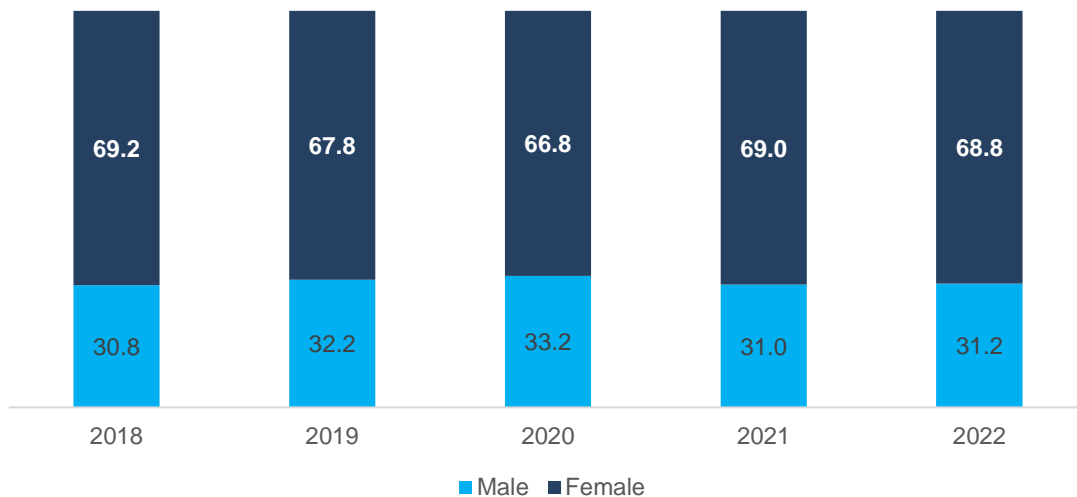
In 2022, there were 1,307 hemiarthroplasty procedures, which involve the replacement of the ball portion of the hip joint and repair to the neck of femur. This accounted for 13.5% of all orthopaedic procedures under surveillance. The SSI incidence rate per 100 hemiarthroplasty procedures was 0.46 in 2022 (Figure 13).

Figure 13. SSI cumulative incidence for hemiarthroplasty procedures, Northern Ireland, 2018 – 2022.



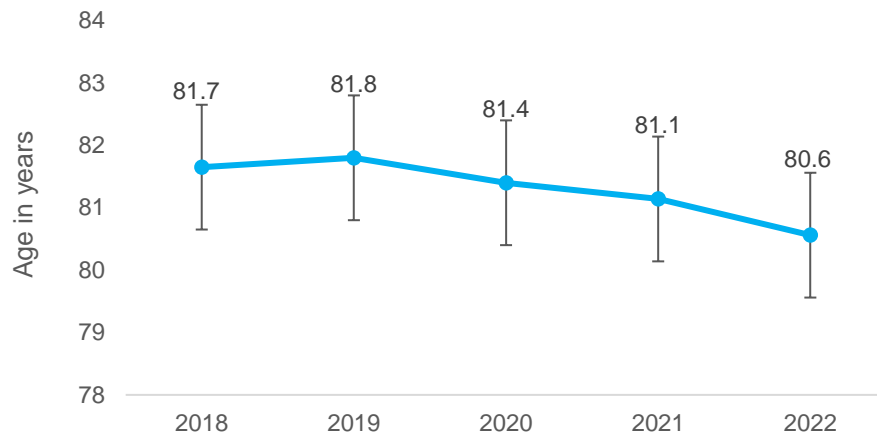
Females consistently accounted for the higher proportion of patients undergoing hemiarthroplasty procedures (66.8-69.2%) (Figure 14).

Figure 14. Sex distribution for patients undergoing hemiarthroplasty procedures, Northern Ireland, 2018 – 2022.



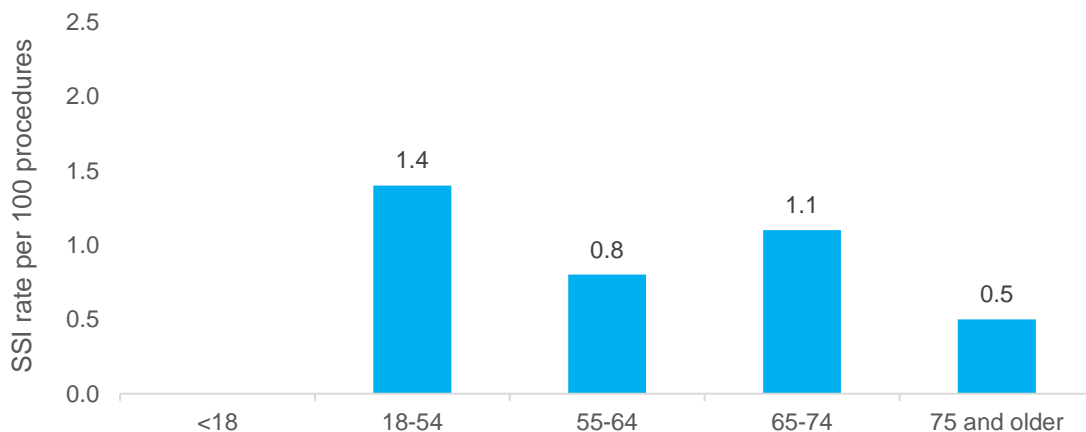
The average age of patients undergoing hemiarthroplasty procedures showed minimal variation, ranging from 81.7 years in 2018 to 80.6 years in 2022 (Figure 15). There were no procedures reported in patients under 18 years old (Figure 16).

Figure 15. Average age of patients undergoing hemiarthroplasty surgery, Northern Ireland, 2018 – 2022.



The SSI cumulative incidence was highest among patients aged between 18 to 54 years (1.11 per 100 procedures), and lowest among those aged 75 years and older (0.46 per 100 procedures).

Figure 16. SSI cumulative incidence by age category for patients undergoing hemiarthroplasty procedures, Northern Ireland, 2018 – 2022.



In the period 2018-22, the majority of hemiarthroplasty procedures were classified as expedited (61.3%), with 959 procedures (17.5%) categorised as urgent (Figure 17). The highest number of SSIs was reported following expedited procedures (51.6%) (Figure 18).

Figure 17. Number of hemiarthroplasty procedures by intervention type, Northern Ireland, 2018 – 2022.

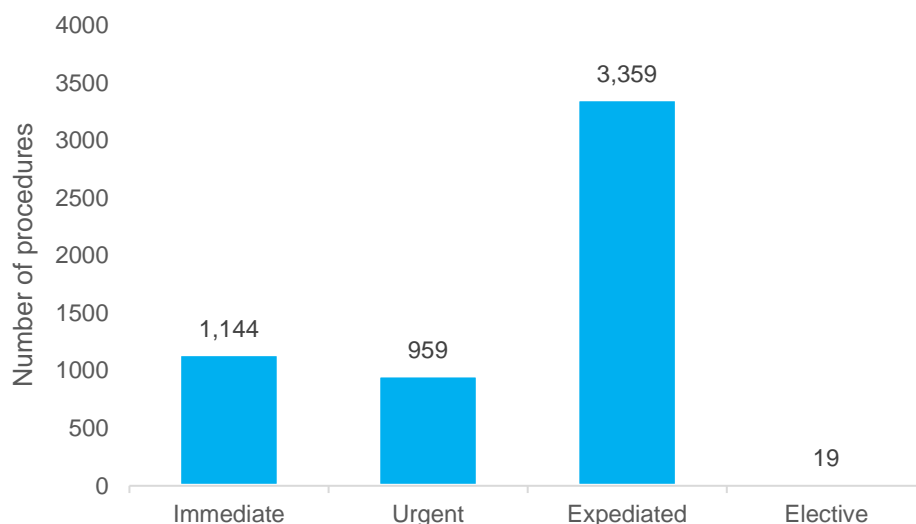
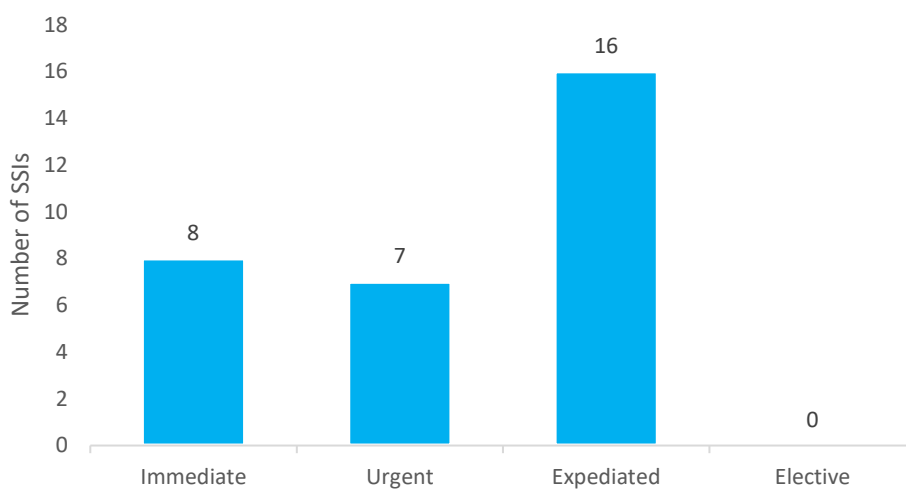


Figure 18. Number of SSIs for hemiarthroplasty procedures by intervention type, Northern Ireland, 2018 – 2022.



The majority of individuals undergoing hemiarthroplasty procedure were aged over 75 years (Figure 19). Those aged 75 or older also had the greatest share of SSIs (Figure 20)

Figure 19. Number of hemiarthroplasty procedures by age group, Northern Ireland, 2018 – 2022.

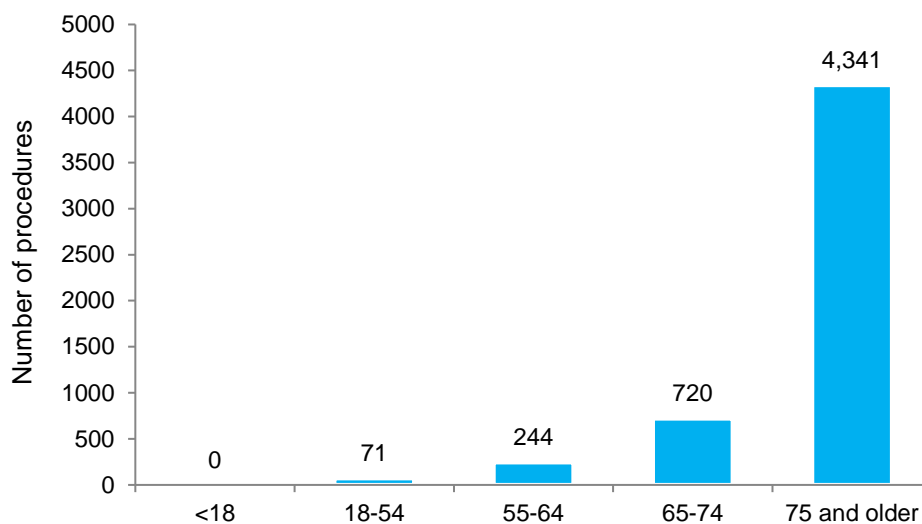
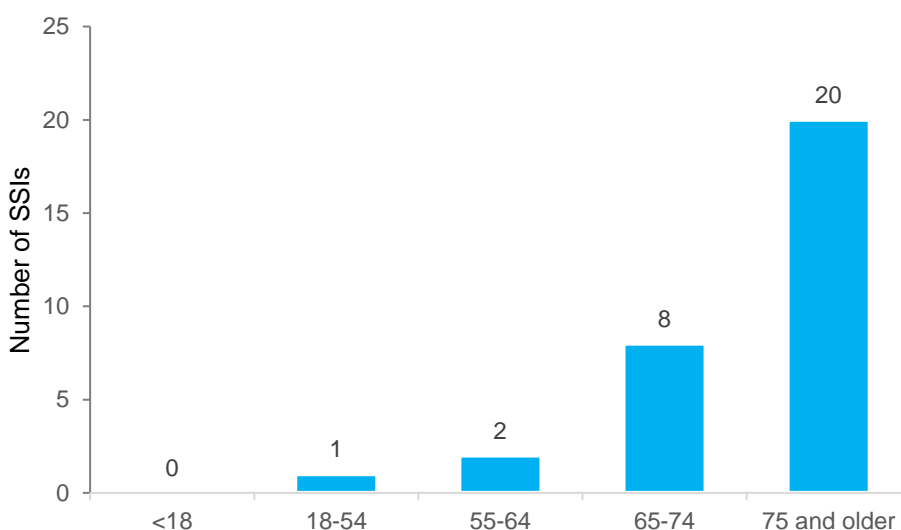


Figure 20. Number of SSIs for hemiarthroplasty procedures by age category, Northern Ireland, 2018 – 2022.



Knee Procedures

In 2022, knee replacement surgery accounted for 770 cases (7.9%) of the total orthopaedic surgeries under surveillance. This figure represents a significant decrease compared to the pre-pandemic period when the volume of procedures typically ranged between 1,500 and 1,600. The percentage of females undergoing surgery consistently exceeded that of males, rising from 57.3% in 2018 to 59.6% in 2022 (Figure 21).

Figure 21. Sex distribution for patients undergoing knee procedures, Northern Ireland, 2018 – 2022.

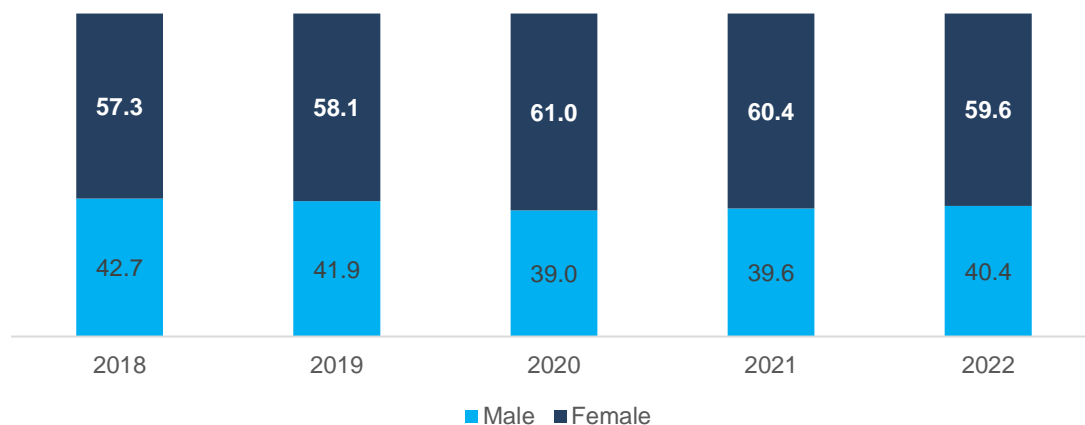
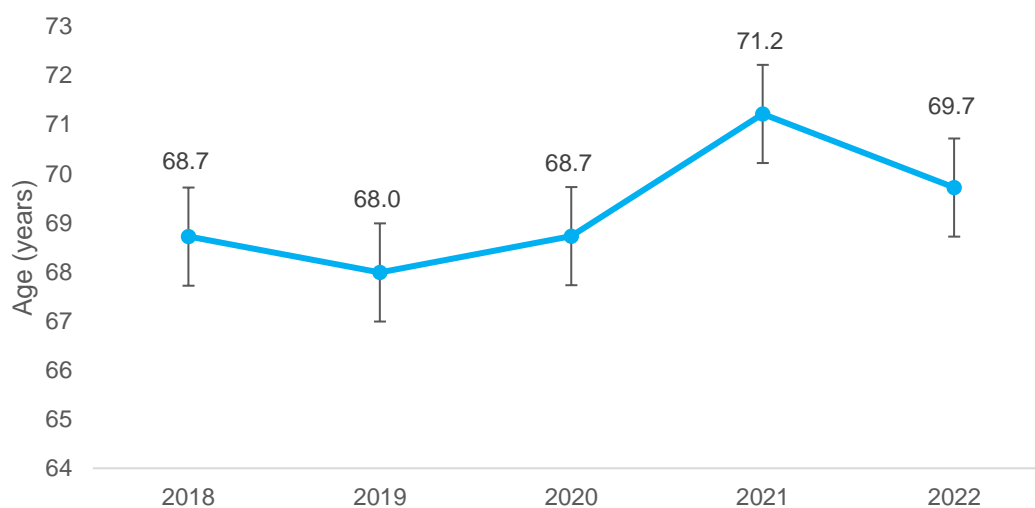


Figure 22. Average age of patient undergoing knee surgery, Northern Ireland, 2018 – 2022.



The average age of patients undergoing knee surgery ranged from 68.0 to 71.2 years (Figure 22). The highest SSI cumulative incidence was observed in people aged 65-74 years and the lowest in those aged 75 years and above (Figure 23).

Figure 23. SSI rate per 100 procedures for patients undergoing knee surgery by age category, Northern Ireland, 2018 – 2022.

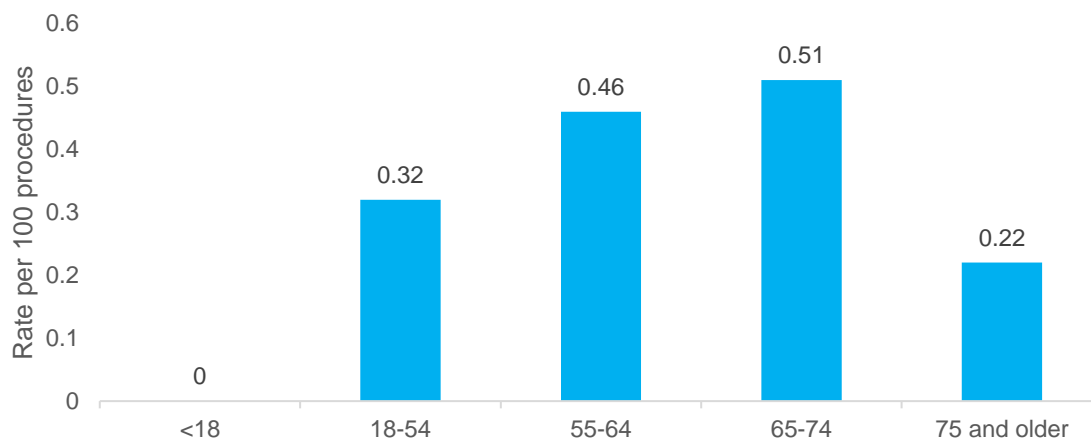
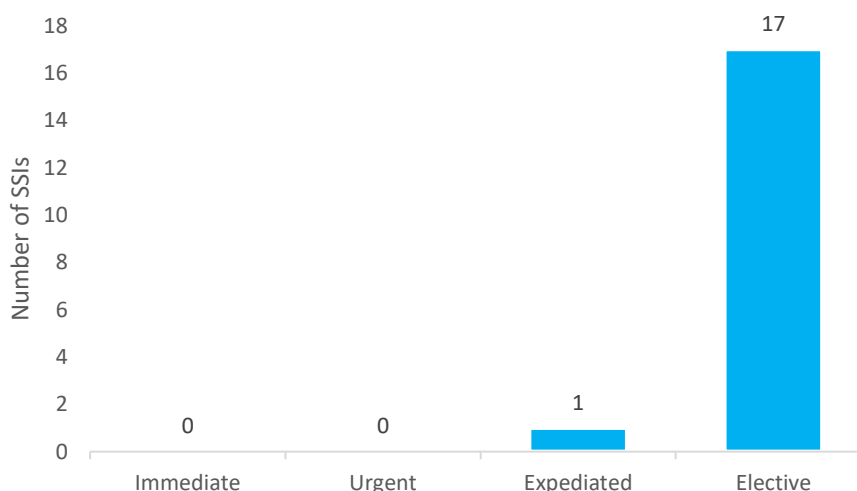


Table 3. Number of knee procedures by intervention type, Northern Ireland, 2018 – 2022.

Classification of intervention	Number of procedures (%)
<i>Elective</i>	4,516 (98.6)
<i>Immediate</i>	25 (0.5)
<i>Expedited</i>	26 (0.6)
<i>Urgent</i>	14 (0.3)

Elective knee procedures were dominant among the patients (Table 3), with the highest SSI cumulative incidence associated with this type of surgery (Figure 24). Between 2018 and 2022, 38.8% of knee surgeries were carried out on those aged 65 – 74 years. Of those that presented with an SSI 50% were in the 65-74 age group (data not shown).

Figure 24. Number of SSIs for knee procedures by intervention type, Northern Ireland, 2018-2022 combined.



Caesarean section SSI

The reporting of SSIs following caesarean sections is a part of a mandatory surveillance programme that commenced in 2008. PHA oversee this surveillance and produces quarterly reports to individual Trusts. Data from Northern Ireland Maternity System (NIMATS) indicates a rise in the proportion of women undergoing caesarean procedures in Northern Ireland, from 28.8% in 2010/11 to 31.2% in 2018/19.

The SSI rate per 100 procedures decreased steadily from 15.80 in 2008 to 4.93 in 2022 (Figure 25). SSI rates range from 3–15% worldwide⁹, the variation in SSI incidence may reflect differences in population characteristics, risk factors, peri-operative practices and post-discharge surveillance for infection.

Figure 25. SSI cumulative incidence for caesarean sections, Northern Ireland, 2008 – 2022.

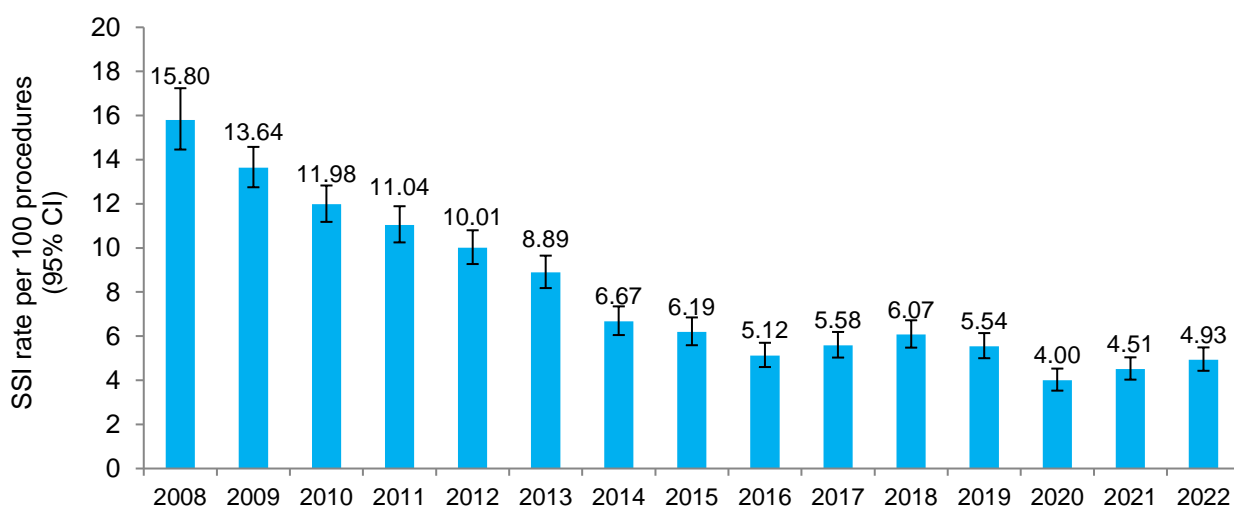
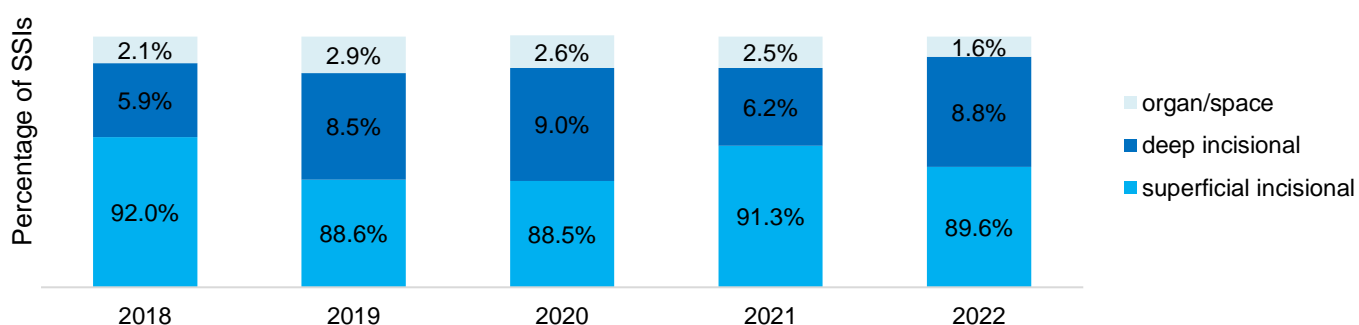


Figure 26. Percentage of SSIs for caesarean procedures by SSI type, Northern Ireland, 2018 – 2022.

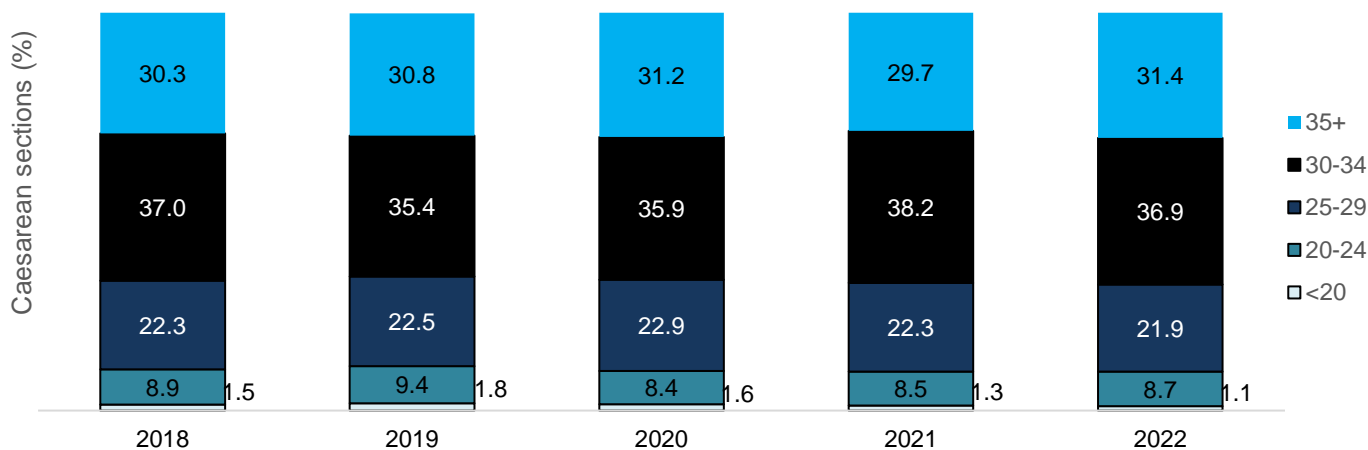


⁹ Suarez-Easton S, Zafran N, Garmi G, Salim R. Post-cesarean wound infection: prevalence, impact, prevention, and management challenges. *Int J Womens Health*. 2017 Feb 17;9:81-88. doi: 10.2147/IJWH.S98876.

The distribution of SSIs by SSI type (superficial, deep, and organ/space) is shown in Figure 26. Superficial incisional infections were the most prevalent, ranging from 92.0% in 2018 to 89.6% in 2022.

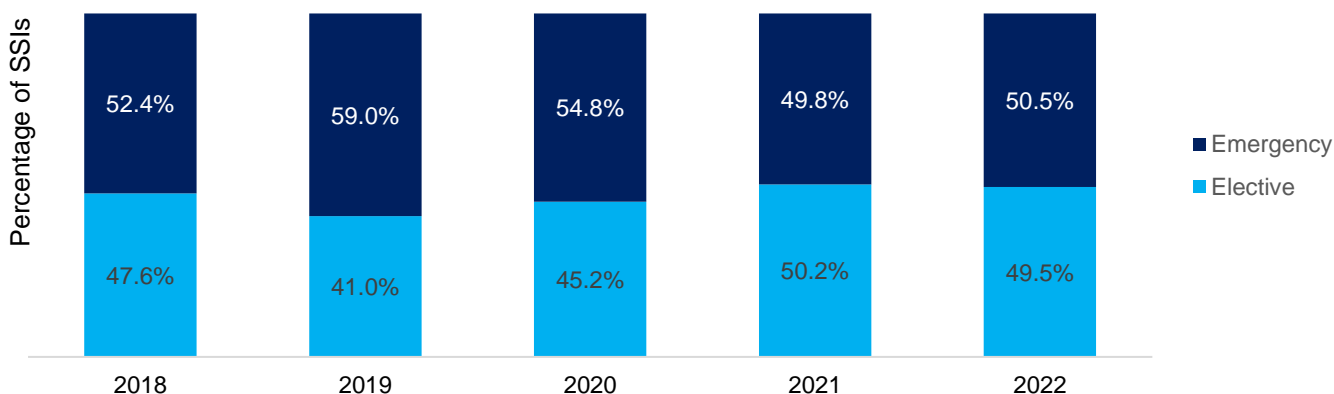
The highest percentage of caesarean deliveries was observed among women aged 30-34 years, followed by those aged 35 years and above (Figure 27).

Figure 27. Age group (years) of patients at time of caesarean section by year, Northern Ireland, 2018 – 2022.



The distribution of SSIs by intervention type shows no discernible pattern in the period 2018-2022, with the proportion of SSIs varying between 41.0% and 50.2% for elective interventions and 49.8% and 59.0% for emergency interventions (Figure 28).

Figure 28. Percentage of SSIs for caesarean procedures by intervention type, Northern Ireland, 2018 – 2022.

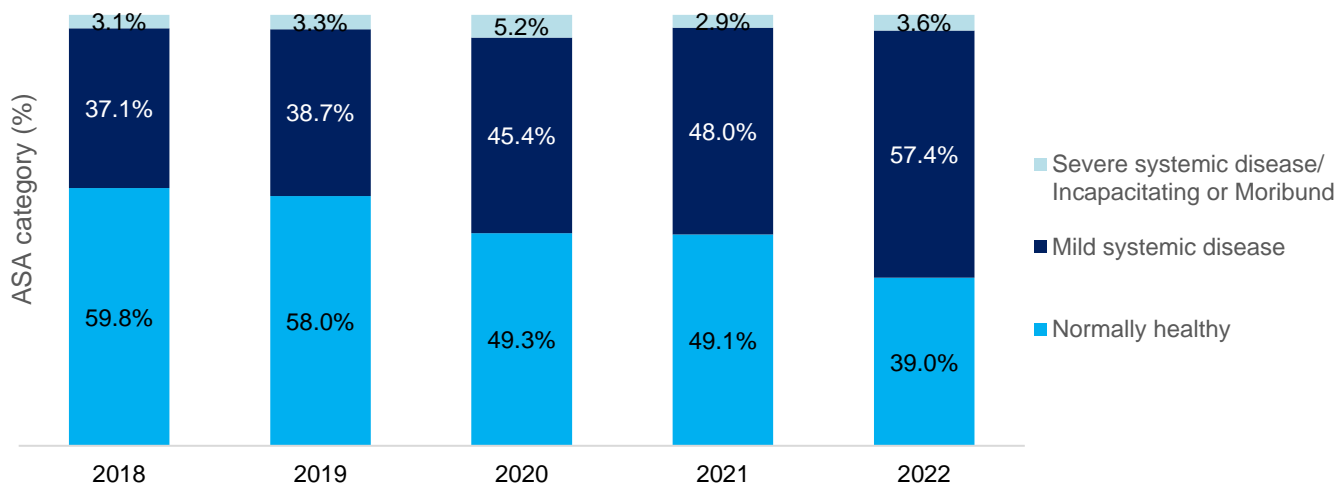


As previously defined, the ASA classification system ranges from 1-6.¹⁰ For the purpose of this analysis, ASA classification 1 and 2 are shown individually and the remaining codes have been aggregated as they have much smaller numbers. As shown in Figure 29, there has been a decrease in the proportion of patients classified as ‘normally healthy’, from 69.4% in 2018 to 44.8% in 2022.

¹⁰ Doyle DJ, Hendrix JM, Garmon EH. American Society of Anesthesiologists Classification [Updated 17 Aug 2023]. Available at: www.ncbi.nlm.nih.gov/books/NBK441940/

Given the distribution of SSIs following caesarean procedures by ASA category, the proportion of patients classified as "normally healthy" decreased notably from 59.8% in 2018 to 39.0% in 2022, while those categorized as having "mild systemic disease" increased from 37.1% to 57.4% during the same period (Figure 29).

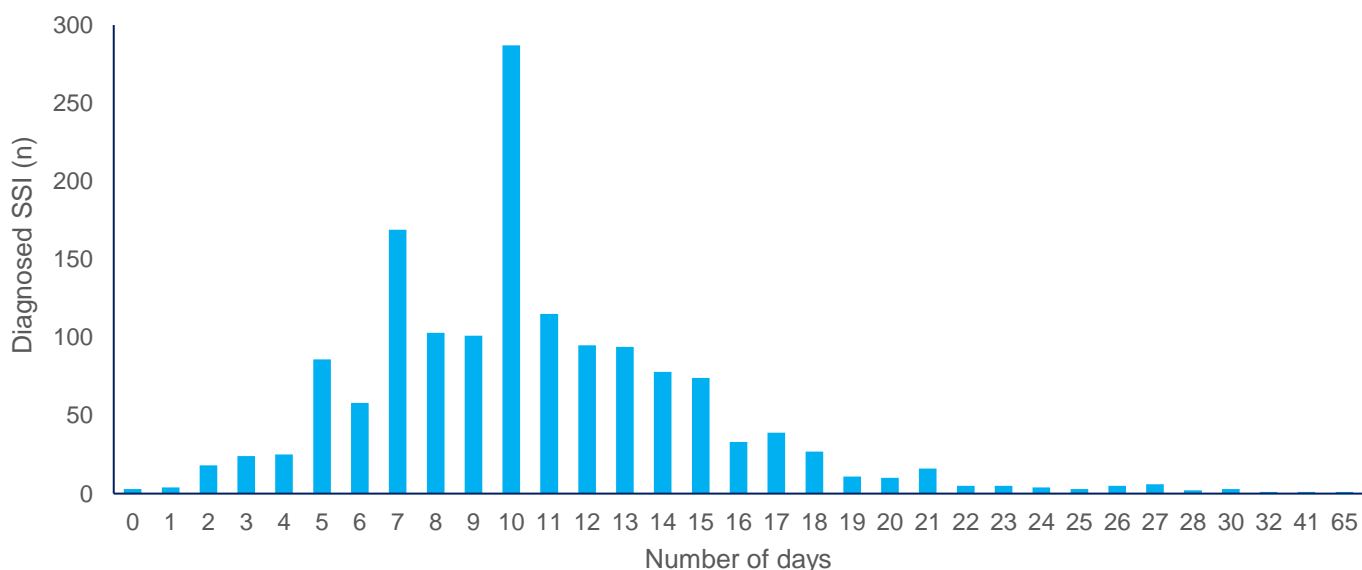
Figure 29. Percentage of SSIs following caesarean procedures by American Society of Anesthesiologists category, Northern Ireland, 2018 – 2022.



The average length of stay for a patient from admission to discharge who have a caesarean section has decreased from 3.5 days in 2007 to around 2.0 days in 2022. This implies that many SSIs will be reported by community midwives involved in the aftercare of women once they have been discharged to go home. In 2022, SSIs diagnosed in community represented 4.8% of all caesarean sections undertaken with only 0.1% of the total being diagnosed while the patient was in hospital (data not shown).

The median time between caesarean section and diagnosis of SSI is 10.0 days. Approximately one in six infections (16%) were diagnosed on day 14 or later indicating the importance of active follow up surveillance in the 30 days post-surgery (Figure 30).

Figure 30. Duration of time between procedure and diagnosis of SSI, Northern Ireland, 2018 – 2022 combined.



The characteristic data of caesarean section procedures by intervention type (elective or emergency) in Northern Ireland from 2018 to 2022 is shown in Table 4. SSI rates are consistently lower in elective surgeries compared to emergency (4.4% vs 5.6%) over the five-year period, and there was an average time to infection of 10.7 days. The average age of patients undergoing elective caesarean section was 32.6 years vs 30.6 years for emergency sections.

Table 4. Number of procedures and occurrences of SSIs (SSIs) by intervention type, along with patient and SSI-related characteristics. Number of procedures and SSI reported 2018 – 2022 combined, and in calendar year 2021 and 2022, patient and surgery related characteristics in HSC hospitals in Northern Ireland.¹

Surgical category	Number of operations	Number of SSIs	SSI proportion (%) over 5 years (2018-2022) ¹	95% CI	Average time to infection (days)	Average age (years)	ASA =1 'normally healthy patient'	SSIs reported in community (%)	SSIs in 2021 (%)	SSIs in 2022 (%)
All caesarean section	30,841	1,464	5.0	4.7-5.2	10.7	31.7	60.4	4.9	4.5	5.0
Caesarean section (elective)	15,485	683	4.4	4.1-4.8	11.1	32.6	62.6	4.3	4.3	4.7
Caesarean section (emergency)	13,902	781	5.6	5.2-6.0	10.2	30.6	58.0	5.4	4.7	5.3

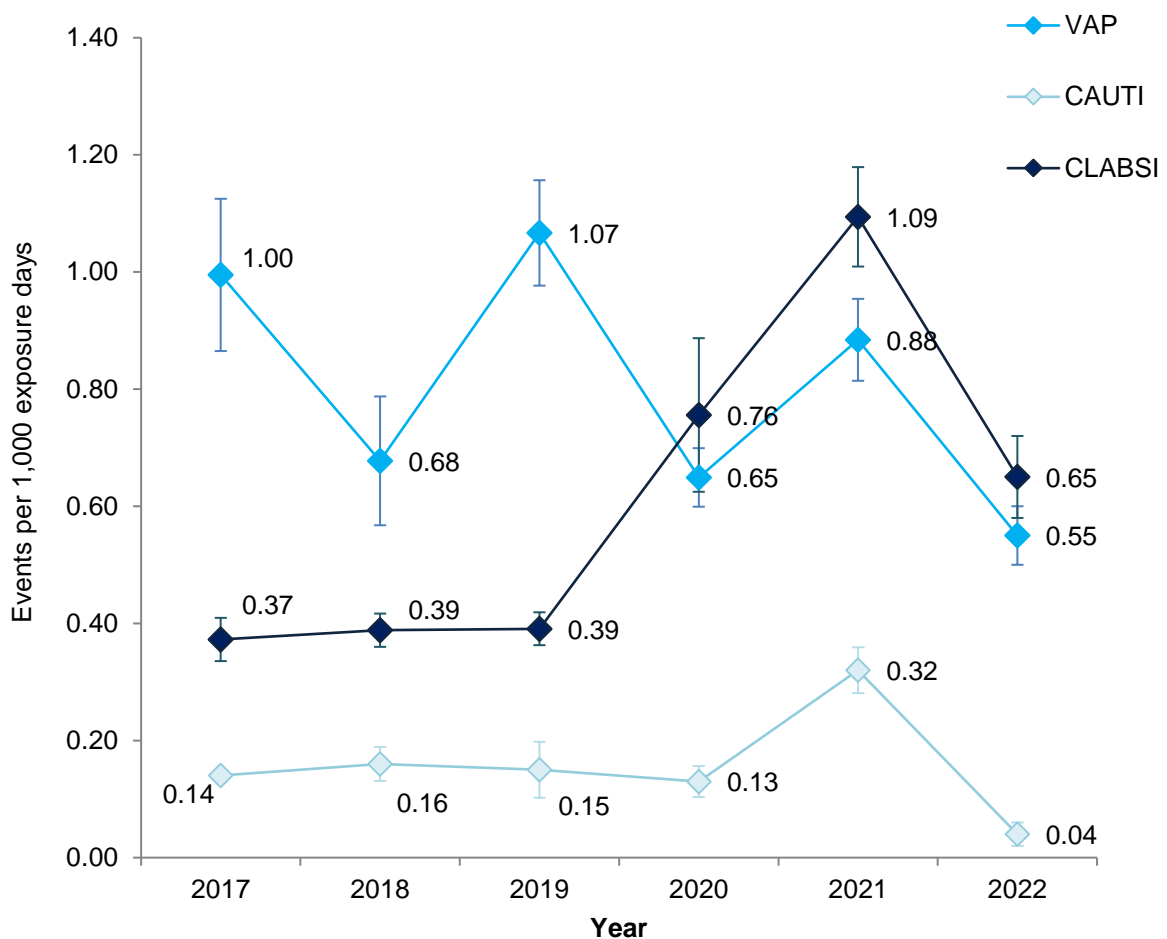
¹ Between 2018 and 2022, there were 1,454 surgical procedures categorised as 'unknown'.

ASA: American Society of Anesthesiologists; HSC: Health and Social Care; CI: confidence interval.

Device associated infections (DAIs)

In conjunction with the mandatory surveillance of orthopaedic and caesarean section related SSIs, the SSI team also produce a monthly mandatory report for device associated infections (DAIs) which outlines the rolling average from critical care units in hospitals across Northern Ireland. All DAIs should be recorded in accordance with the ECDC protocol for surveillance of DAIs.¹¹ Three types of DAIs are recorded 1) Ventilator-associated pneumonia (VAP), 2) Catheter-associated Urinary Tract Infection (CAUTI), and 3) Central Line-Associated Bloodstream Infection (CLABSI). In the period 2017-2022, the incidence rates per 1000 exposures days for VAPs, CAUTIs, and CLABSIs remained consistently low, with VAP rates ranging from 0.65 to 1.07 per 1,000 exposure days, CAUTI rates ranging from 0.13 to 0.32, and CLABSI rates ranging from 0.37 to 1.09 (Figure 39).

Figure 39. Cumulative incidence for ventilator associated pneumonia, catheter associated urinary tract infections, and central line associated blood stream infections in Northern Ireland, 2017 – 2022.



¹¹ ECDC Surveillance and disease data for infections acquired in adult critical care units. Available at: www.ecdc.europa.eu/en/infections-acquired-intensive-care-units/surveillance-and-disease-data

Discussion

The data presented offer valuable insights into the trends and effectiveness of infection control measures within healthcare systems (related to orthopaedic, caesarean section and device-associated) in Northern Ireland.

In 2022, the overall orthopaedic SSI rate remained below 1% for the thirteenth consecutive year, reflecting a sustained effort in infection surveillance and prevention strategies. One notable finding is the proportion of SSIs diagnosed during the inpatient stay, which accounted for one in five infections in 2022. Understanding the factors contributing to these inpatient-acquired infections is crucial for refining preventive measures and improving patient outcomes.

The COVID-19 pandemic offered an opportunity to standardise high quality infection control measures. Measures that have been implemented in surgical theatres are now being implemented in all areas of health care, these measures included; frequent hand washing, face covering, social distancing and self-testing.

The impact of the COVID-19 pandemic on surgical practices is evident in the shift in the proportion of knee replacement surgeries under surveillance. The increase in surgeries under surveillance went from 3.0% in 2021 to 7.9% in 2022, albeit remaining lower than pre-pandemic levels (at 13%), reflecting the disruption in elective procedures during the height of the pandemic. Despite this increase, the SSI rate for knee surgeries remained relatively low at 0.26% in 2022, indicating the resilience of infection control measures amidst challenging circumstances.

Hip replacement surgeries, comprising 14% of all orthopaedic procedures under surveillance, exhibited an SSI rate of 0.73% in 2022. In contrast, hemiarthroplasty and repair of neck of femur surgery, while representing a similar proportion of procedures (13.5%), showed a lower SSI rate of 0.46%. These disparities may warrant further investigation into the underlying factors influencing infection rates across different surgical interventions.

The findings related to caesarean sections highlight a significant improvement in SSI rates over the years, decreasing from 15.8% at the inception of surveillance in 2008 to 4.9% in 2022. This substantial reduction underscores the effectiveness of targeted interventions and quality improvement initiatives in maternal healthcare settings. In recent years (2019-2022), the SSI rate following caesarean section has remained stable between 3.9% to 5.6% and is comparable to rates in the rest of the UK and EU.

Transitioning to broader device-associated healthcare infections, data from adult critical care units reveal a decline in the cumulative incidence of CLABSI and VAP infections in 2022 compared to the previous year. Similarly, CAUTIs reached their lowest recorded incidence over the last six years. These findings suggest a positive trend in infection control practices within critical care settings, possibly attributed to enhanced protocols and heightened awareness among healthcare providers.

In conclusion, the surveillance data on orthopaedic SSIs and DAIs provide valuable benchmarks for evaluating infection control efforts and identifying areas for improvement within healthcare systems. Continued vigilance, coupled with targeted

interventions and ongoing compliance research, will be essential in assessing the burden of healthcare-associated infections and enhancing patient safety.

Future directions and challenges

Capturing SSIs and DAIs is a multifaceted process and relies on a high level of data accuracy as well as having excellent relationships with colleagues across the HSC Trusts to ensure that surveillance is active and cases are followed up after surgery takes place. As well as the mandatory and well-established surveillance programmes discussed above, the surveillance programmes which are currently in development are outlined below, and conclude with some challenges that may affect SSI surveillance.

Caesarean section modernisation

Since the commencement of caesarean section SSI monitoring in Northern Ireland, physical paper forms have been used to record patient details including infection status. The data entry process is labour intensive, and in an attempt to decrease this burden the PHA is piloting a 'light' or 'hybrid' approach to caesarean section SSI surveillance. Under the new surveillance system community midwives will complete an online web form, only when an infection has been diagnosed, which will eliminate a substantial amount of paperwork. Information on all procedures undertaken will be repurposed from the regional maternity information system. This new system reflects the approach being taken in other nations in the UK.

Currently, the PHA are conducting a pilot study in two Health Care Trusts in Northern Ireland, where the community midwives record caesarean section infections onto an electronic web form. The aim is to run a pilot of the electronic form in parallel with the existing system (paper form), which would enable comparisons to be made between both approaches in terms of content, coverage and results. If the pilot is successful, it will eliminate the need for the paper form completely.

Colorectal SSI surveillance

A key recommendation from the most recent PPS¹² was to expand SSI surveillance to colorectal and general surgery in order to capture a wider range of SSIs. Before the COVID-19 pandemic the SSI team began a pilot study in one Trust area in Northern Ireland. The aim was to use data for colorectal procedures over a six-month period to calculate a crude SSI rate for colorectal surgeries. The pilot was affected by the onset of the COVID-19 pandemic and analysis of the data was delayed by issues related to clinical coding. Initial results were issued to the Trust in 2022. Next steps would be a

¹¹ Northern Ireland Point Prevalence Survey of Hospital Associated Infections and Antimicrobial Use 2017. Available at: [Northern Ireland Point Prevalence Survey of Hospital Associated Infections and Antimicrobial Use 2017 | HSC Public Health Agency \(hscni.net\)](https://www.hscni.net/point-prevalence-survey-of-hospital-associated-infections-and-antimicrobial-use-2017)

consideration of future plans for this work with key stakeholders and resources needed to conduct the work.

Cardiac & Neurosurgery SSI surveillance

The SSI team in the PHA are also in the process of collating data from the regional centre for cardiac surgery. The long-term plan for the SSI team is to use the incoming data to produce an SSI rate for cardiac related surgeries. Moreover, the SSI team have been liaising with neurosurgeons in Northern Ireland to discuss future possibilities for monitoring neurosurgery related SSIs in Northern Ireland.

Ongoing challenges in SSI surveillance

Finally, the SSI team have also led the regional studies of HCAI in acute hospitals (Point Prevalence Survey of health care associated infection) and long-term care settings (HALT).¹³ The last studies in this series were undertaken in 2017 and there is a desire to begin planning to update this in tandem with other UK nations.

Within the Public Health Agency we are currently undergoing a transformation that aims to automate several steps within our surveillance systems, furthermore the five health and social care trusts will be adopting a new data collection tool “Encompass”, these changes will require significant input from our team and will likely have an impact on our routine work.

¹³ Healthcare-Associated Infections and Antimicrobial Use in Long-Term Care Facilities (HALT) 2017 Survey. Available at: www.publichealth.hscni.net/publications/healthcare-associated-infections-and-antimicrobial-use-long-term-care-facilities-halt

Appendix 1 - The American Society of Anesthesiologists (ASA) classification system

Code	Description of patient
1	A healthy patient e.g. fit, non-obese, a non-smoking patient with good exercise tolerance
2	A patient with mild systemic disease and code
3	A patient with severe systemic disease
4	A severe disease that is a threat to life
5	A moribund patient who is not expected to survive without the operation
6	A patient that is already brain dead (whose organs are being removed for donor purposes)