UK Health Security Agency

Surveillance of surgical site infections in NHS hospitals in England

April 2020 to March 2021

Contents

Main points

In financial year 2020 to 2021, 168 NHS hospitals representing 117 NHS trusts and 8 Independent Sector (IS) NHS treatment centres submitted surveillance data for 64,111 surgical procedures to the Public Health England (now UK Health Security Agency, UKHSA) Surgical Site Infection (SSI) Surveillance Service. Across 17 surgical categories, 591 SSIs were detected during the inpatient stay or on readmission.

A total of 49,519 procedures were submitted as part of mandatory surveillance for orthopaedics, a decrease of 54% from financial year 2019 to 2020 to financial year 2020 to 2021. Eleven trusts did not meet the mandatory surveillance requirements. A total of 14,592 procedures were submitted as part of voluntary surveillance spanning 13 other surgical categories, a decrease of 48% from the previous financial year (2019 to 2020). The decrease in procedures reflects the impact of coronavirus (COVID-19) on operational delivery within the NHS including deferral of elective surgery and reduced capacity for surveillance.

Cardiac surveillance (CABG and non-CABG) continued to have the highest degree of continuous surveillance (CABG: 79% and non-CABG: 100%).

Two trusts were notified as high outliers for the mandatory surveillance categories (one for hip replacement and one for reduction of long bone fracture).

Ten-year trends in the annual inpatient and readmission SSI risk varied by surgical category. Of 10 categories assessed, 7 saw decreases in SSI risk from the previous year, with hip replacement (down to 0.4%), knee replacement (0.4%), reduction of long bone fracture (0.4%), CABG (2.2%), and breast surgery (0.1%) categories all decreasing to the lowest risk in 10 years. The SSI risk for large bowel surgery saw the greatest increase (7.7% to 9.9% in financial year 2020 to 2021), reaching the highest SSI risk for that category since the 2012 to 2013 financial year. Repair of neck of femur was the only mandatory orthopaedic category that showed no change in SSI risk in financial year 2020 to 2021 compared to the previous financial year, although it did show a decreasing 10-year trend (from 1.5% to 0.7%).

During the COVID-19 pandemic, many elective surgeries were postponed or cancelled to allow prioritisation of more complex or emergency surgeries. Despite a higher proportion of complex surgeries compared to the previous financial year, most surgical categories saw a decrease in SSI risk in financial year 2020 to 2021. This may reflect augmented infection control precautions in hospitals implemented to control COVID-19 transmission.

Surgical Site Infection (SSI) Surveillance Service

Introduction

This report summarises data submitted by NHS hospitals and independent sector (IS) NHS treatment centres in England to the national SSI Surveillance Service (SSISS), Public Health England (now UKHSA). The aim of the national surveillance program is to enhance the quality of patient care by encouraging hospitals to use data obtained from surveillance to compare their rates of SSI over time and against a national benchmark by using this information to review and guide clinical practice.

The SSISS provides an infrastructure for hospitals to collect data on 17 surgical categories spanning general surgery, cardiothoracic, neurosurgery, gynaecology, vascular, gastroenterology, and orthopaedics. Surveillance is targeted at open surgical procedures, which carry a higher risk of infection than minimally invasive ('keyhole') procedures (1, 2), however laparoscopic assisted procedures are included for some categories.

The SSISS was established by the Public Health Laboratory Service (a predecessor of UKHSA) in 1997. From April 2004, NHS trusts performing orthopaedic surgery have been mandated by the Department of Health and Social Care to carry out surveillance for a minimum of 3 consecutive months per financial year in at least one of 4 orthopaedic categories: hip replacement, knee replacement, repair of neck of femur or reduction of long bone fracture (3). NHS hospital participation in other categories remains voluntary.

This report includes surveillance data submitted to the SSISS based on surgery which took place from 1 April 2011 to 31 March 2021, with a focus on the latest financial year (2020 to 2021), and a regular comparison to the previous financial year (2019 to 2020). The 2020 to 2021 financial year coincided with the first, second and third wave of the coronavirus (COVID-19) pandemic. Disruption to healthcare services that occurred during this time likely impacted the trends seen in this report.

Unfortunately, due to the COVID-19 pandemic, we were unable to produce and publish the annual report in December 2021. Local hospital reports with the national benchmark were available quarterly, as usual, from the web application.

Methods

SSISS data collection

The UKHSA SSISS surveillance protocol outlines a standard methodology, including case definitions and case finding methods which all participating hospitals must adhere to (4). To

maintain the quality of surveillance data, hospitals participating in UKHSA's national SSI surveillance programme are required to have staff trained by the UKHSA national co-ordinating centre in London before carrying out surveillance.

Surveillance data is collected prospectively on a quarterly basis and includes all eligible patients undergoing surgery in pre-selected surgical categories during each 3-month period (quarter). Patients are followed-up to identify SSIs for 30 days after surgery for non-implant procedures and for one year for procedures involving a prosthetic implant. A set of demographic and surgery-related data is collected for each eligible procedure and submitted to the UKHSA SSISS via a secure web-based application.

After each completed quarter, data is subject to quality assurance processes by the UKHSA SSISS to identify anomalies or missing data. Participating hospitals can download automated confidential reports securely from the web application for dissemination within their trust. These reports provide hospitals' crude and risk-stratified SSI incidence and the corresponding national benchmark by surgical category.

As part of ongoing support to help hospitals monitor SSI risk, the UKHSA SSISS team analyse submitted data at quarterly intervals to identify 'outliers', defined as hospitals whose SSI risk is above the national 90th percentile ('high outliers') or below the 10th percentile ('low outliers') for each surgical category. UKHSA alerts these hospitals of their outlier status and encourages them to investigate possible reasons. Hospitals identified as 'low outliers' are asked to investigate their case ascertainment methods, to ensure all cases are being reported, while hospitals identified as 'high outliers' are asked to examine their clinical practices and discuss their results at multidisciplinary team meetings so that possible reasons can be explored, and potential problems addressed at the earliest opportunity. UKHSA offers support to outlier hospitals to assist them with further investigations, including on-site visits to share in-depth local analyses and provide further surveillance advice.

Case finding

Active surveillance is undertaken by hospital surveillance staff to identify patients with SSIs during their initial inpatient stay. Hospitals are also required to have systems in place to identify patients subsequently readmitted to hospital with an SSI. SSIs identified on readmission are assigned to the hospital where the original operation took place. Other post-discharge surveillance (PDS) methods are recommended and strongly encouraged for short-stay procedures like breast surgery where the majority of patients are discharged on the day of surgery. They comprise: a) systematic review of patients attending outpatient clinics or seen at home by hospital clinical staff trained to apply the case definitions and b) wound healing questionnaires completed by patients 30 days after their operation (4). As these are optional, data derived from these optional post-discharge surveillance methods is not currently included in the national benchmarks or used for outlier assessment to ensure comparability of data. The results in this national report do not feature PDS data, but its use remains important at the local level to provide a sensitive measure of an individual hospital's infection risk.

Case definitions

The UKHSA SSISS protocol defines SSIs according to standard clinical criteria for infections that affect the superficial tissues (skin and subcutaneous layer) of the incision and those that affect the deeper tissues (deep incisional or organ/space). These are based on the definitions established by the US Centers for Disease Control and Prevention (CDC) (5) with minor modifications to 2 of the criteria, namely i) presence of pus cells for infections determined by positive microbiology without obvious clinical signs and symptoms and ii) at least 2 clinical signs and symptoms of infection to accompany a clinician's diagnosis for superficial incisional infections.

Analyses presented in this report

Surveillance data for surgical procedures for a 10-year period, between 1 April 2011 and 31 March 2021, was extracted on 24 March 2022 for this report. For procedures performed in the last week of the 2020 to 2021 financial year and subject to a one-year follow-up (prosthetic implant surgery), late onset infections reported after the data was extracted will not be captured, although these constitute very small numbers (6). Trust-level results for the mandatory orthopaedic categories were rerun for the previous financial year (2019 to 2020) to include updates reflecting any late onset infections reported since publication of the last annual report.

The SSI risk described in this report is the percentage of SSI per 100 operations measured by cumulative incidence. Incidence density was calculated to account for differences in the length of follow-up in hospital. Incidence density is presented as number of inpatient SSIs per 1,000 patient days of follow-up. Where applicable, exact 95% confidence intervals have been provided for results. A binomial distribution was assumed for SSI risk, with the exception of incidence density which used a Poisson distribution.

Where hospital level results are presented, a minimum volume threshold is applied. For hip or knee replacement and abdominal hysterectomy, any hospitals with less than 95 operations submitted over 5 years are excluded. For all other surgical categories, a threshold of 45 or more operations was used. At the national level, results are restricted to those surgical categories that meet a minimum threshold for hospital participation. For benchmarking purposes, the last 5 years of data including the current financial year is used (1 April 2016 to 31 March 2021).

Funnel plots were produced to compare SSI risk across NHS trusts and treatment centres for the most recent financial year for the mandatory orthopaedic categories. The plots account for differences in surgical volume and identify trusts that fall within the expected variation and those that are outliers (SSI incidence falling above or below the 95% confidence limits).

An additional supplement to this report contains SSI risk results from the financial years 2019 to 2020 and 2020 to 2021 by NHS trust or treatment centre.

SSISS operational overview

Hospital participation and surgical volumes

Overall, 168 NHS hospitals representing 117 NHS trusts and an additional 8 IS NHS treatment centres participated in the SSISS data collection in financial year 2020 to 2021. Surveillance data was submitted for 64,111 procedures. Of these, 49,519 were orthopaedic procedures submitted as part of mandatory surveillance and 14,592 procedures submitted as part of voluntary surveillance spanning 13 other surgical categories. Compared to financial year 2019 to 2020, the number of operations submitted for mandatory orthopaedic surveillance decreased by 53.6% in financial year 2020 to 2021, while voluntary surveillance showed a 47.7% decrease (Figure 1).

The average reduction in surgical volume submitted to UKHSA (50.6%) is slightly greater than seen in a study of surgical activity in England and Wales during the pandemic, which showed that surgical volume in 2020 was 33.6% lower than expected (7). During the COVID-19 pandemic, hospitals saw a decrease in surgical throughput due to a combination of deferral of non-urgent surgery, cancellations, staff sickness, reduced operating theatre capacity, and heightened infection prevention control precautions (8, 9).

Mandatory surveillance requirements mean hip and knee replacement surveillance had the highest number of participating hospitals in financial year 2020 to 2021 (127 and 116 hospitals, respectively). Participation in voluntary surgical categories in financial year 2020 to 2021 was highest for spinal surgery (17 hospitals), followed by large bowel surgery and coronary artery bypass graft (CABG) (both 11 hospitals). Due to the COVID-19 pandemic and its impact on healthcare delivery, participation across most surveillance categories decreased compared to last year. The greatest decrease in hospitals submitting data was seen for bile duct, liver, and pancreatic surgery (from 3 down to one hospital) and gastric surgery (from 5 down to 2 hospitals).

Figure 1. Annual participation in the SSISS, voluntary and mandatory surveillance, NHS hospitals England, April 2011 to March 2021

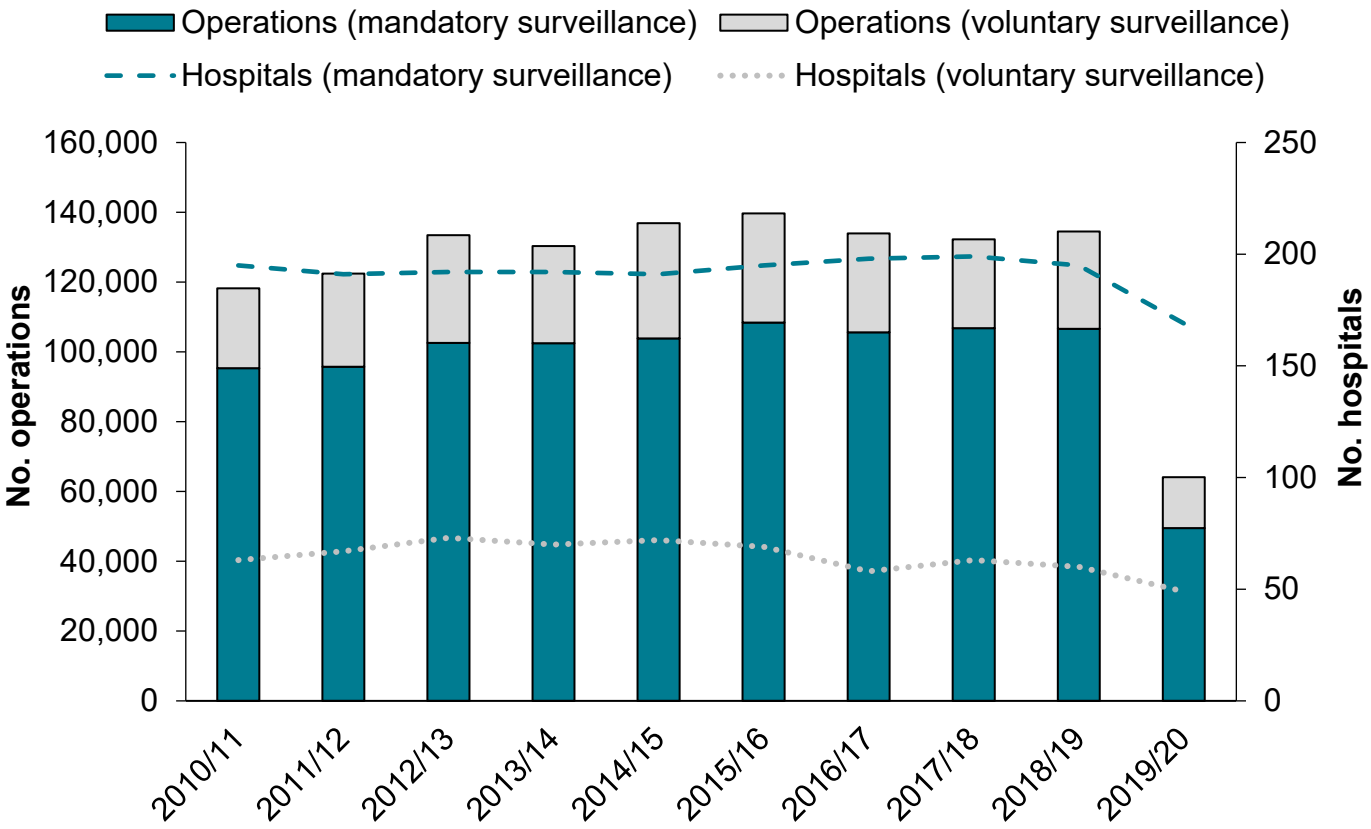
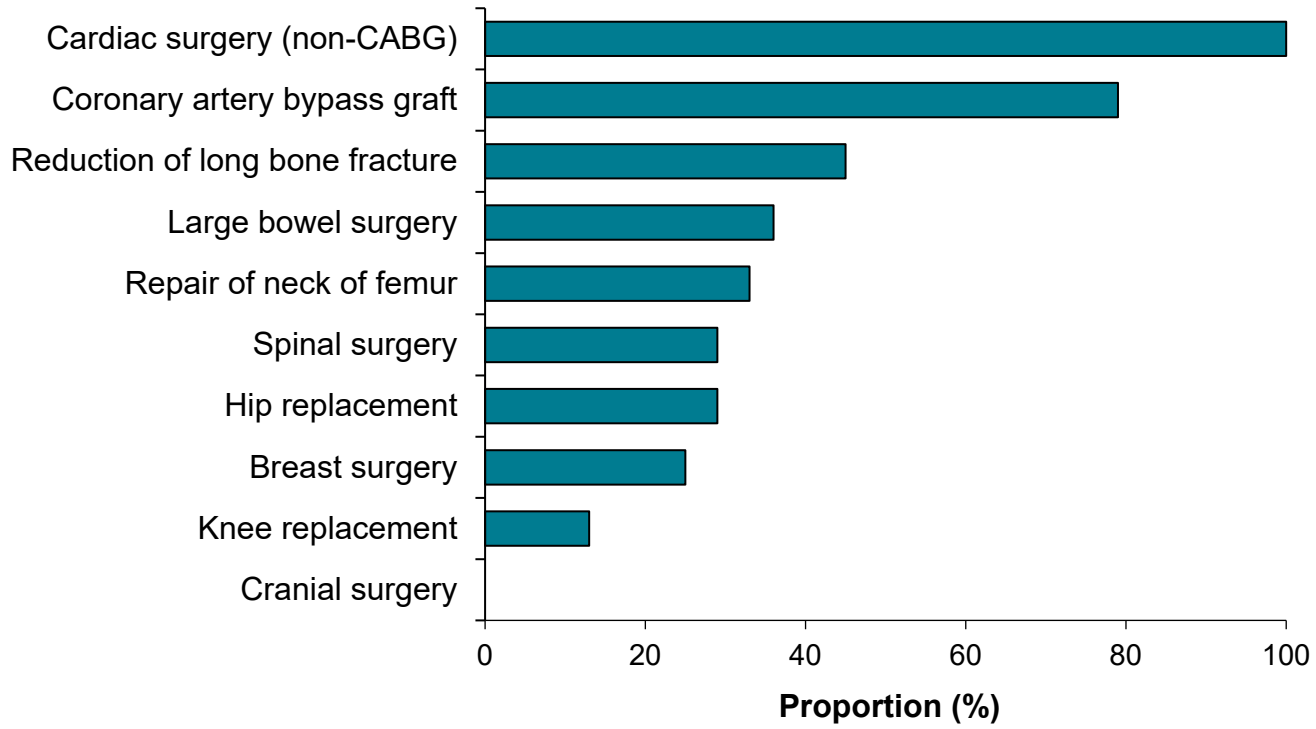


Figure 2 shows the proportion of hospitals carrying out continuous surveillance during financial year 2020 to 2021 by surgical category. There were 7 SSISS surgical categories with less than 5 participating hospitals (abdominal hysterectomy, cholecystectomy, limb amputation, gastric, small bowel, vascular, and bile duct, liver or pancreatic surgery) which were excluded from this analysis.

Cardiac procedures, non-CABG (open chest procedures on valves or septum of the heart) and CABG, had the highest proportion of hospitals carrying out continuous surveillance in financial year 2020 to 2021 (100.0% and 79.0%, respectively). For hip and knee replacement, subject to mandatory surveillance for a minimum of one 3-month surveillance period per financial year, less than a third of hospitals carried out continuous surveillance in financial year 2020 to 2021 (31.0% and 14.0%, respectively). This was much lower than the previous financial year where 60.4% of hospitals undertook continuous surveillance for either hip or knee replacement surgery.

While not all hospitals undertake continuous surveillance, and participation fluctuates, the large reduction in financial year 2020 to 2021 compared to previous years suggests that many hospitals were unable to conduct surveillance at that time, likely due to the disruption to surgical activity during the pandemic.

Figure 2. Proportion of hospitals undertaking continuous surveillance, by surgical category, NHS hospitals England, April 2020 to March 2021



Patient and surgical characteristics

Data completeness for the fields that inform key patient and surgical characteristics was high (equal to or greater than 90%), with most being mandated for collection (see Appendix 1 and Appendix 2). Data completeness was slightly lower than the previous financial year, likely due to limited staff time available for seeking out this information during the pandemic. Data completeness across all patient and surgical-related fields ranged from 83% to 97% in financial year 2020 to 2021, compared to 89% to 97% in financial year 2019 to 2020.

Some variability between categories occurs in the American Society of Anesthesiologists' (ASA) score, as hospitals may use an alternative assessment score for certain categories (for example cardiac and CABG). The height and weight fields are optional for collection, which means completeness of body mass index (BMI) information was low compared to mandatory fields and differed by category.

In financial year 2020 to 2021, BMI was available for 54% of procedures (7% lower than financial year 2019 to 2020). Eleven of 17 surgical categories had BMI data available for ≥50% of those submitted, 3 fewer than the previous year. As in the previous financial year, cardiac surgeries (CABG and non-CABG) were the categories with the most complete BMI information in financial year 2020 to 2021 (both categories 85%).

Table 1 shows the distribution of key patient and surgical characteristics. Collection of these characteristics is important to help hospitals better understand their results by identifying factors which might be contributing to an increased SSI risk.

In financial year 2020 to 2021 compared to financial year 2019 to 2020, surveillance data suggests that there were more complex surgeries performed. As a measure of complexity, we compared an ASA score of 3 or more, median surgery duration, median length of stay, and if multiple procedures were performed, between the current and previous financial years for categories with 5 or more participating hospitals in financial year 2020 to 2021.

Of the 10 categories assessed, 8 categories had an increased percentage of patients with an ASA score of 3 or more, 7 categories had an increased surgery duration, 5 categories had an increased percentage of patients undergoing multiple procedures and 2 categories had an increased length of stay. Three categories showed no change for patients undergoing multiple procedures, and 6 categories showed no change for increased length of stay. Both cardiac (non-CABG) and cranial surgery had an increase in all the fields indicating complex surgery. In addition, cardiac (non-CABG) and cranial surgery both showed an increase in pre-operative stay of more than one day (26% to 52% and 15% to 20%, respectively). While CABG only had increases in ASA score and pre-operative stay, both were large increases with an ASA of 3 or more increasing from 96.5% to 99.3% and pre-operative stay of more than 1 day increasing by 49% (41% to 61%).

In the previous financial year (2019 to 2020), knee replacement and abdominal hysterectomy had the highest proportion of obese (BMI greater than or equal to 30kg/m^2) patients among the 17 categories (55.8% and 44.5%, respectively). While knee replacement remained the highest in financial year 2020 to 2021 (55.1% obese), abdominal hysterectomy dropped to the fourth highest with 37.3% obese.

Within categories, patient BMI was also noted to vary at the hospital level in financial year 2020 to 2021. The proportion of obese patients undergoing hip replacement across hospitals, ranged from 0.0% to 43.2%. For knee replacement surgery, this range was between 0.0% to 100.0% of patients. The median patient BMI for hip replacement was 28.2 kg/m^2 (IQR=24.8-32.2 kg/m^2) and for knee replacement, 30.6 kg/m^2 (IQR=27.2 to 37.4 kg/m^2); decreasing slightly from the previous financial year. Categories with the highest proportion of paediatric (under 18 years) data submitted in financial year 2020 to 2021 continued to be small bowel (17.8% of procedures), with spinal surgery (10.6%) and cardiac (non-CABG) (6.0%) the next most common.

The primary indication for patients undergoing hip and knee replacement is shown in Figures 3a-b. Osteoarthritis continues to be the major reason why patients undergo joint replacement surgery (76.4% for hip; 89.2% for knee). The proportion of hip replacement surgeries carried out as a result of trauma or fracture increased by 50% from last year (9.0% versus 6.1%), a likely reflection of the reduction in elective surgeries during the COVID-19 pandemic.

Table 1. Patient and surgery-related characteristics by surgical category, NHS hospitals England, April 2020 to March 2021

Surgical category	Patient-related characteristics				Surgery-related characteristics							
	Median age, IQR	Male	BMI ≥ 30 kg/m^2	ASA ≥ 3	Wound contaminated or dirty	Median surgery duration, IQR	Median length of stay, IQR	Pre-op stay more than one day	Emergency surgery	Multiple procedures performed	Antibiotic prophylaxis not given	Implant present
	(years)	(%)	(%)	(%)	(%)	(minutes)	(days)	(%)	(%)	(%)	(%)	(%)
Abdominal hysterectomy*	56 (48-66)	-	37.3	22.0	0.0	143 (102-189)	2 (1-4)	4.0	0.0	29.0	3.0	0.0
Bile duct, liver or pancreatic surgery*	64 (57-71)	54.4	-	40.4	0.0	389 (284-457)	8 (5-14)	14.0	0.0	28.1	0.0	1.8
Breast surgery	58 (50-70)	0.9	33.2	14.6	0.0	75 (52-108)	0 (0-1)	0.6	0.1	14.4	52.9	6.6
Cardiac surgery (non-CABG)	65 (54-74)	66.4	27.8	98.7	0.0	245 (192-315)	10 (8-17)	52.1	3.0	41.7	0.4	92.1
Cholecystectomy*	67 (57-72)	43.8	-	37.5	0.0	397 (290-460)	10 (7-16)	31.3	0.0	75.0	0.0	6.3
Coronary artery bypass graft	66 (59-73)	82.4	31.4	99.3	0.0	231 (193-275)	9 (7-13)	61.0	1.3	22.3	0.6	62.9
Cranial surgery	57 (43-68)	53.6	28.6	28.0	2.4	129 (72-203)	6 (3-12)	19.5	6.2	0.8	4.5	45.1
Gastric surgery*	69 (60-75)	64.9	27.0	57.7	6.2	278 (161-388)	9 (25-17)	21.6	1.0	17.5	0.0	0.0
Hip replacement	71 (62-77)	39.8	37.9	28.0	0.1	85 (66-110)	3 (2-5)	6.6	0.4	-	0.5	100.0

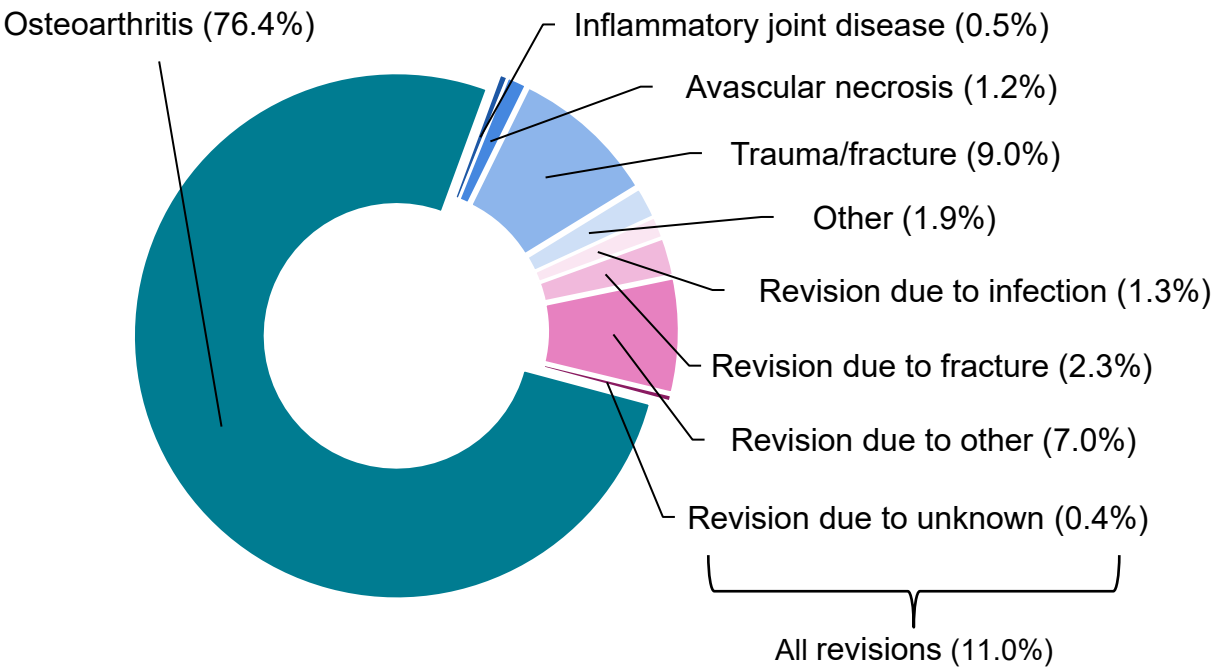
Surgical category	Patient-related characteristics				Surgery-related characteristics							
	Median age, IQR	Male	BMI ≥ 30 kg/m^2	ASA ≥ 3	Wound contaminated or dirty	Median surgery duration, IQR	Median length of stay, IQR	Pre-op stay more than one day	Emergency surgery	Multiple procedures performed	Antibiotic prophylaxis not given	Implant present
	(years)	(%)	(%)	(%)	(%)	(minutes)	(days)	(%)	(%)	(%)	(%)	(%)
Knee replacement	70 (62-76)	43.4	55.1	25.6	0.1	81 (63-103)	3 (2-4)	1.3	0.1	-	0.4	100.0
Large bowel surgery	68 (56-76)	50.3	25.7	47.9	18.3	180 (134-245)	7 (5-13)	14.7	6.7	18.2	1.0	1.2
Limb amputation*	68 (56-76)	64.4	20.0	88.6	0.0	63 (46-87)	20 (15-33)	82.2	0.0	4.4	0.0	0.0
Reduction of long bone fracture	68 (47-83)	37.7	20.7	46.6	1.6	90 (66-125)	5 (2-12)	22.8	0.7	3.5	0.8	99.8
Repair of neck of femur	84 (77-89)	32.2	11.1	80.5	0.1	70 (55-90)	12 (8-18)	28.8	3.0	0.8	3.9	100.0
Small bowel surgery*	58 (34-73)	51.5	20.0	54.3	38.1	130 (85-225)	10 (5-23)	35.1	12.9	27.2	4.1	1.5
Spinal surgery	54 (37-68)	46.7	38.1	26.3	0.4	135 (93-197)	3 (1-8)	13.2	1.5	1.0	2.0	45.8
Vascular surgery*	72 (65-78)	71.8	24.5	84.3	0.0	210 (145-311)	5 (2-13)	27.2	5.4	3.9	1.3	74.1

* Surgical categories with fewer than 5 participating hospitals (see Appendix 2). Results should be interpreted with caution.

Abbreviations

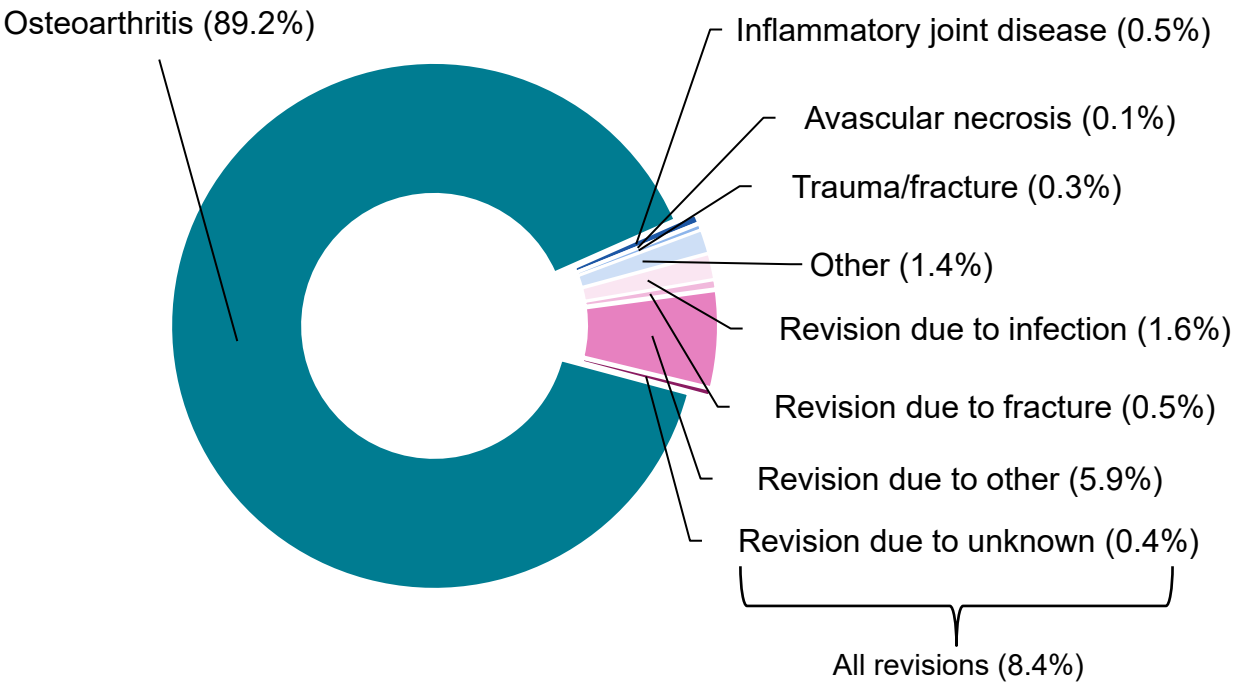
IQR = interquartile range; BMI = body mass index; ASA = American Society of Anesthesiologists

Figure 3a. Primary indication for hip replacement surgery, NHS hospitals England, April 2020 to March 2021 (N= 15,541*)



* Total does not include patients who had missing data for primary indication (n=161).

Figure 3b. Primary indication for knee replacement surgery, NHS hospitals England, April 2020 to March 2021 (N= 12,737*)



* Total does not include patients who had missing data for primary indication (n=145).

Assessing SSI risk

Inpatient and readmission SSI risk

Table 2 presents the cumulative SSI incidence (risk) and incidence density by surgical category. Five years of data (April 2016 to March 2021) was used to produce national benchmarks. Inpatient and readmission SSI risk varied greatly depending on the type of surgical procedure.

The highest risk was observed in bile duct, liver or pancreatic surgery at 11.3%, followed by large bowel surgery at 8.4%. These are both procedures carried out on surgical sites with high levels of bacterial contamination, contributing to a higher risk of SSI. Hip and knee replacement surgery carried the lowest SSI risk (0.5% and 0.4%, respectively).

As the national benchmarks are based on 5 years of data, they tend to be very robust year-to-year. However, due to COVID-19 disruptions to healthcare delivery, there were more categories with less than 5 participating hospitals in financial year 2020 to 2021, and therefore more fluctuation compared to previous years. Inpatient and readmission SSI risk for cholecystectomy surgery showed the greatest increase this financial year (from 2.9% in the previous financial year to 5.5%), however this surveillance category only had 3 participating hospitals.

Among the orthopaedic categories, the national benchmark for hip replacement and repair neck of femur both remained the same (0.5% and 0.9%, respectively), while both knee replacement and reduction of long bone fracture decreased (from 0.5% to 0.4% and 0.9% to 0.7%, respectively). For large bowel surgery, which historically ranked highest prior to financial year 2019 to 2020, the national benchmark increased by 1.2% in financial year 2020 to 2021 to 8.4%.

For short stay surgeries (0 to 3 days), such as hip or knee replacement, abdominal hysterectomy, breast, and spinal surgery, over half of SSIs were captured through readmission surveillance (range: 66.5% to 89.8%) in financial year 2020 to 2021, emphasising the importance of post-discharge surveillance. Cranial surgery, reduction of long bone fracture and vascular surgery also had high proportions of SSIs captured through readmission surveillance (63.5%, 51.0% and 57.9%, respectively), although these categories did not have as short a length of stay (5 to 6 days).

SSI incidence density accounts for the differences in length of hospital stay in capturing inpatient SSIs. The incidence density of in-hospital detected SSIs per 1,000 post-operative patient-days varied from 0.2 and 0.3 per 1,000 inpatient days (for knee and hip replacement, respectively) to 11.1 per 1,000 inpatient days for bile duct, liver or pancreatic surgery. Cholecystectomy had the second highest risk by incidence density (10.8 per 1,000 inpatient days) followed by large bowel surgery (7.1 per 1,000).

Table 2. Inpatient and readmission SSI risk by surgical category, NHS hospitals England, April 2016 to March 2021

			Inpatient and readmission				Inpatient only		
Surgical category	**Number of participating hospitals**	**Number of operations**	**Number of SSIs**	**SSI incidence (%)**	**95% CI**	**Median time to infection (days)**	**Number SSIs**	**Incidence density (per 1,000 patient days)**	**95% CI**
Abdominal hysterectomy	14	1,739	35	2.0	(1.4-2.8)	11	9	1.6	(0.7-3.0)
Bile duct, liver or pancreatic surgery	5	1,184	134	11.3	(9.6-13.3)	8	113	11.1	(9.2-13.4)
Breast surgery	32	15,370	127	0.8	(0.7-1.0)	18	13	0.7	(0.4-1.2)
Cardiac surgery (non-CABG)	13	18,124	237	1.3	(1.1-1.5)	15	160	0.7	(0.6-0.9)
Cholecystectomy	4	532	29	5.5	(3.7-7.7)	6	20	10.8	(6.6-16.7)
Coronary artery bypass graft	18	28,234	824	2.9	(2.7-3.1)	15	444	1.7	(1.6-1.9)
Cranial surgery	10	7,912	126	1.6	(1.3-1.9)	18	46	0.7	(0.5-0.9)
Gastric surgery	11	1,489	30	2.0	(1.4-2.9)	8	26	2.3	(1.5-3.4)
Hip replacement	187	181,410	909	0.5	(0.5-0.5)	20	249	0.3	(0.2-0.3)
Knee replacement	179	192,222	841	0.4	(0.4-0.5)	23	137	0.2	(0.1-0.2)
Large bowel surgery	40	12,811	1075	8.4	(7.9-8.9)	8	924	7.1	(6.7-7.6)
Limb amputation	9	985	24	2.4	(1.6-2.6)	13	17	1.2	(0.7-2.0)
Reduction of long bone fracture	36	13,108	96	0.7	(0.6-0.9)	20	47	0.4	(0.3-0.6)
Repair of neck of femur	115	90,238	786	0.9	(0.8-0.9)	18	481	0.3	(0.3-0.4)
Small bowel surgery	21	2,928	190	6.5	(5.6-7.4)	7	158	4.7	(4.0-5.5)
Spinal surgery	25	31,644	430	1.4	(1.2-1.5)	15	144	0.8	(0.7-0.9)
Vascular surgery	13	4,605	107	2.3	(1.9-2.8)	14	45	1.4	(1.0-1.9)

Risk factors for SSI

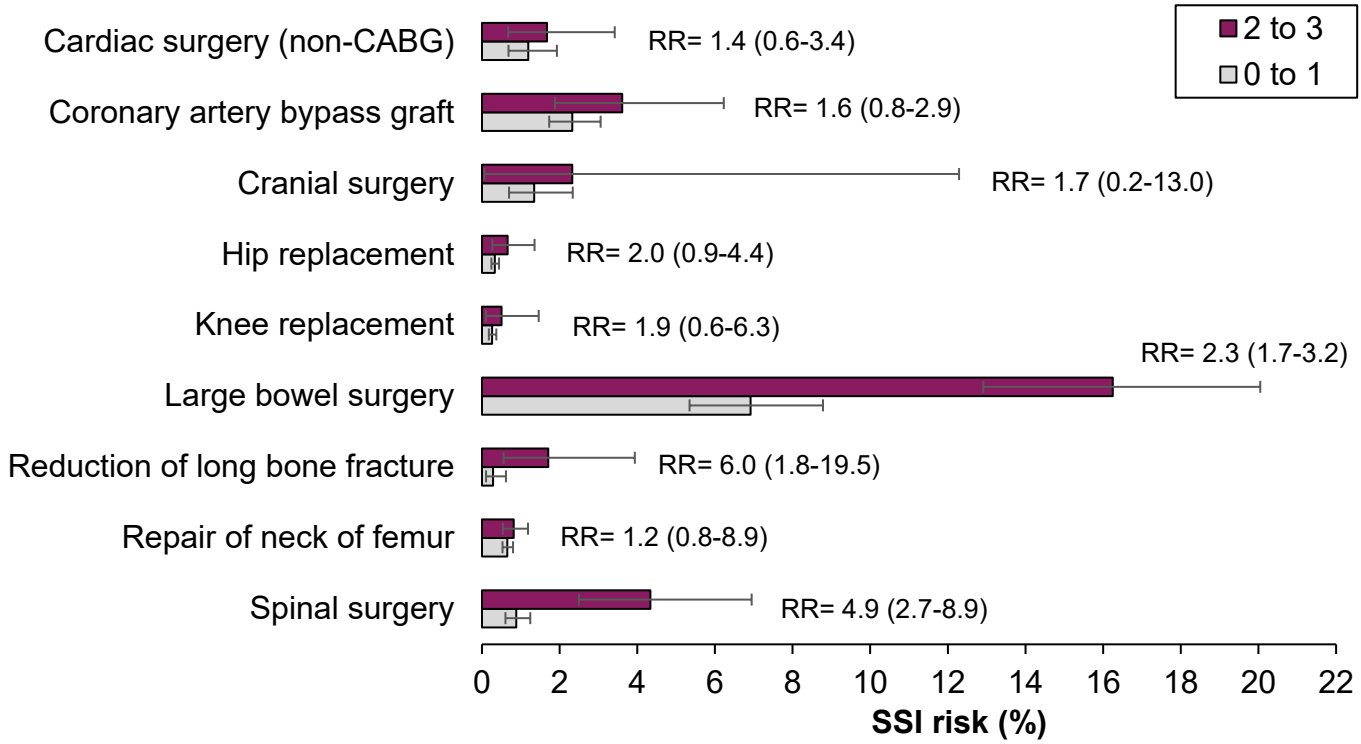
Participants are encouraged to assess their hospital's results stratified by important patient and surgery-related characteristics. The National Healthcare Safety Network (NHSN) risk index is used in particular to account for potentially important differences in patient population. The risk index assigns a cumulative score from 0 to 3 based on the presence of the following risk factors: American Society of Anesthesiology (ASA) score of 3 or higher, operation duration greater than 'T-time' (as defined by the 75th percentile), and a contaminated or dirty wound.

Figure 4 shows the SSI risk for financial year 2020 to 2021 across surgical categories for patients whose operation was deemed at low risk of SSI (NHSN risk index 0 or 1) compared to patients with a higher risk of SSI after surgery (risk index 2 or 3). Results confirm the importance of this stratification as we see an increased risk in all categories.

A risk ratio (RR) was calculated to compare the risk between the 2 groups. A RR greater than 1 suggests an increased SSI risk among those operations deemed high risk with a score of 2 or 3. Where the lower part of the range is also greater than 1 the difference between the 2 groups is considered significant. Within the reduction of long bone fracture and spinal surgical categories, patients who underwent operations with a higher risk index were more likely to experience infection than those with a lower risk index by 6 and 5 times respectively. The difference between the 2 groups was statistically significant for large bowel, reduction of long bone fracture, and spinal surgery.

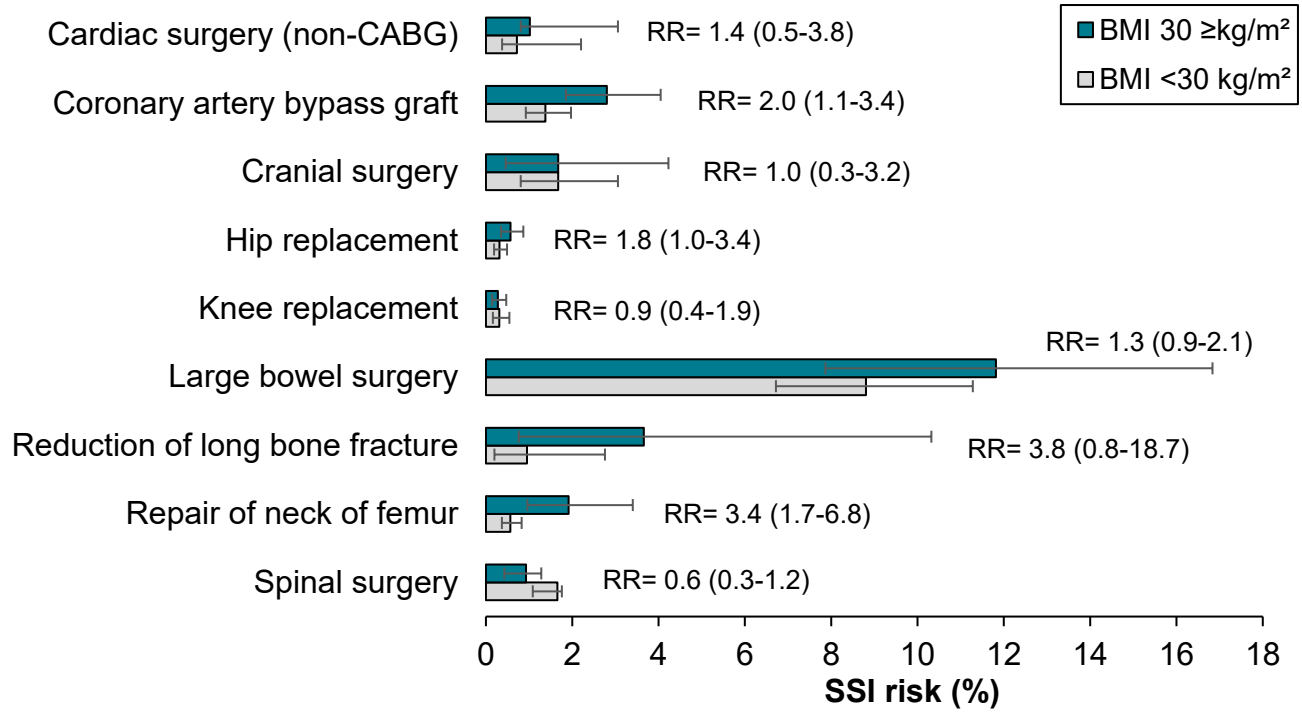
An elevated BMI has been shown to increase the likelihood of developing an SSI, particularly among CABG patients (9, 10). Figure 5 shows the SSI risk for financial year 2020 to 2021 across surgical categories for patients who are classed as obese (BMI equal to or greater than 30 kg/m^2) compared to non-obese patients. In all but 3 surgical categories (cranial, knee replacement and large bowel), an increased SSI risk was seen for the obese patient group. The difference in SSI risk between obese and non-obese patients was statistically significant for CABG, hip replacement and repair of neck of femur surgery.

Figure 4. Inpatient and readmission SSI risk adjusted for by NHSN risk index, NHS hospitals England, April 2020 to March 2021*



* Categories with less than 5 participating hospitals excluded.

Figure 5. Inpatient and readmission SSI risk adjusted for patient body mass index, NHS hospitals England, April 2020 to March 2021*



* Categories with less than 5 participating hospitals excluded.

Table 3 shows SSI risk by the primary indication for hip replacement and knee replacement surgery. For both hip and knee replacement surgery, revision procedures carried a higher SSI risk than primary procedures (7 and 4 times higher, respectively).

Table 3. Inpatient and readmission SSI risk by primary indication for joint replacement surgeries, NHS hospitals England, April 2020 to March 2021*

		Hip replacement				Knee replacement			
	Indication for surgery	**Number of operations**	**Number of SSI**	**SSI risk (%)**	**95% CI**	**Number of operations**	**Number of SSI**	**SSI risk (%)**	**95% CI**
Primary	Osteoarthritis	11,879	26	0.2	(0.1-0.3)	11,363	30	0.3	(0.2-0.4)
	Inflammatory joint disease	75	0	0.0	(0.0-4.8)	67	0	0.0	(0.0-5.4)
	Avascular necrosis	184	0	0.0	(0.0-2.0)	11	0	0.0	(0.0-28.5)
	Trauma or fracture	1,394	9	0.6	(0.3-1.2)	43	0	0.0	(0.0-8.2)
	Other	294	4	1.4	(0.4-3.4)	184	1	0.5	(0.0-3.0)
	Total	**13,826**	**39**	**0.3**	**(0.2-0.4)**	**11,668**	**31**	**0.3**	**(0.2-0.4)**
Revision	Infection	204	0	0.0	(0.0-1.8)	200	3	1.5	(0.3-4.3)
	Fracture	359	5	1.4	(0.5-3.2)	68	0	0.0	(0.0-5.3)
	Other	1,091	12	1.1	(0.6-1.9)	752	2	0.3	(0.0-1.0)
	Unknown	61	1	1.6	(0.0-8.8)	49	0	0.0	(0.0-7.3)
	Total	**1,715**	**18**	**1.0**	**(0.6-1.7)**	**1,069**	**5**	**0.5**	**(0.2-1.1)**

* Totals do not include patients who had missing data for primary indication.

Trends in SSI risk

Figure 6 shows 10-year trends in annual SSI incidence (risk) for all surgical categories. SSI incidence is broken down by detection method: inpatient, readmission and combined inpatient and readmission. Trend analyses were not performed for surgical categories with fewer than 5 participating hospitals in the most recent financial year. It is important to note that annual trends use crude SSI incidence and do not account for potential changes in risk factors for SSI over time or hospital participation.

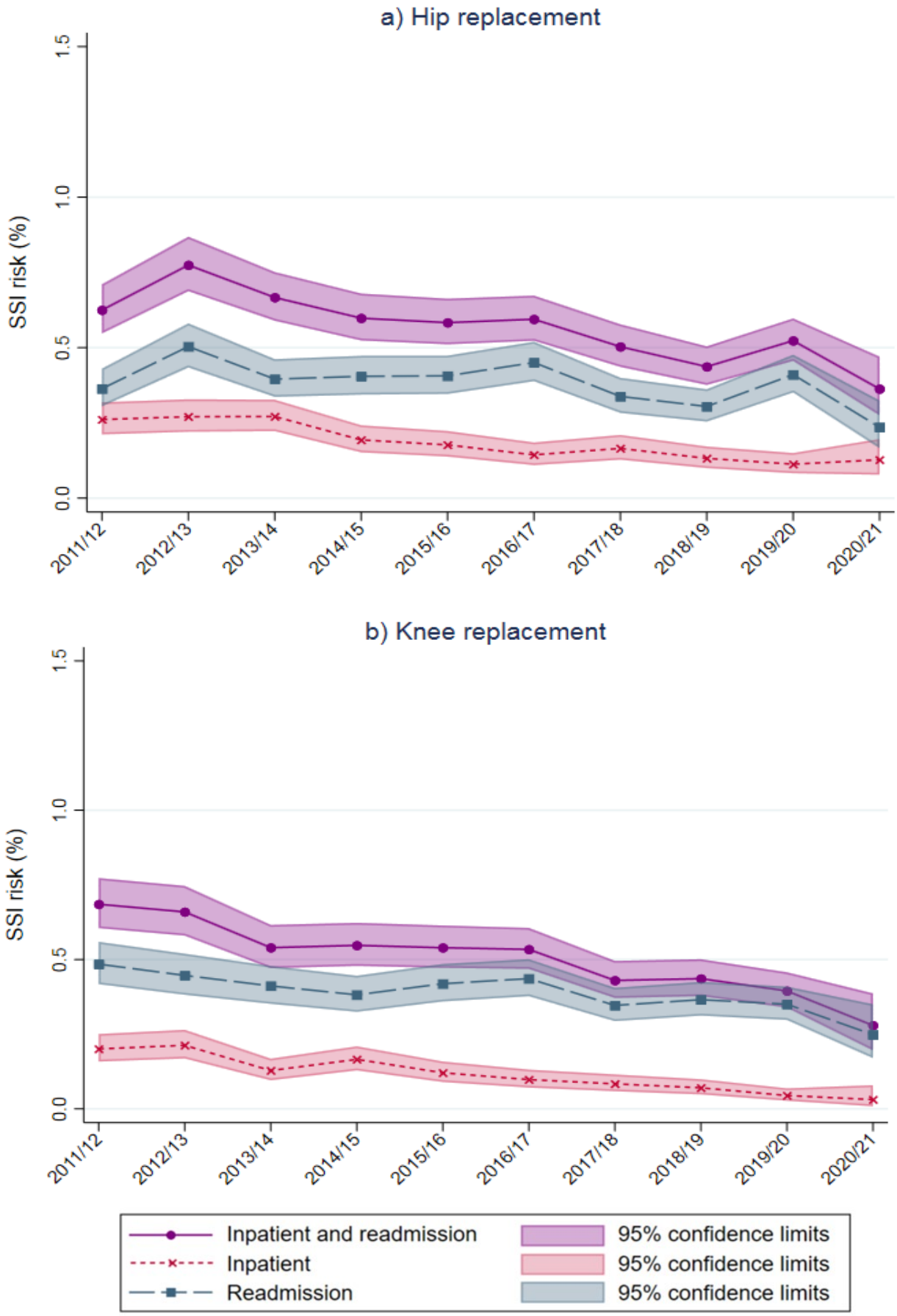
Over the past 10 years, inpatient and readmission SSI incidence following hip and knee replacement surgery has been relatively stable, with slight annual decreases from financial year 2012 to 2013. Annual inpatient and readmission SSI incidence for hip replacement reached its lowest point at 0.4% in financial year 2020 to 2021 (Figure 6a). Annual inpatient and readmission SSI incidence following knee replacement remained stable around 0.4% across the last 3 financial years before dropping to 0.3% in the 2020 to 2021 financial year (Figure 6b). This may be explained by the decrease in the length of stay in hospital for hip and knee replacement surgery over time (both hip/knee median length of stay was 5 days in financial year 2010 to 2011 compared to 3 days in financial year 2020 to 2021). The trend for the inpatient and readmission SSI risk following reduction of long bone fracture has shown greater variability over the years (Figure 6c). After a peak in financial year 2014 to 2015 at 1.4%, the rate showed a decreasing trend, reaching 0.4% in financial year 2020 to 2021, the lowest in 10 years. Although remaining at the same rate from the previous financial year to financial year 2020 to 2021, repair of neck of femur (Figure 6d) has seen an overall continuous decline in SSI incidence since financial year 2011 to 2012 (from 1.5% to 0.7%), despite no change in length of stay.

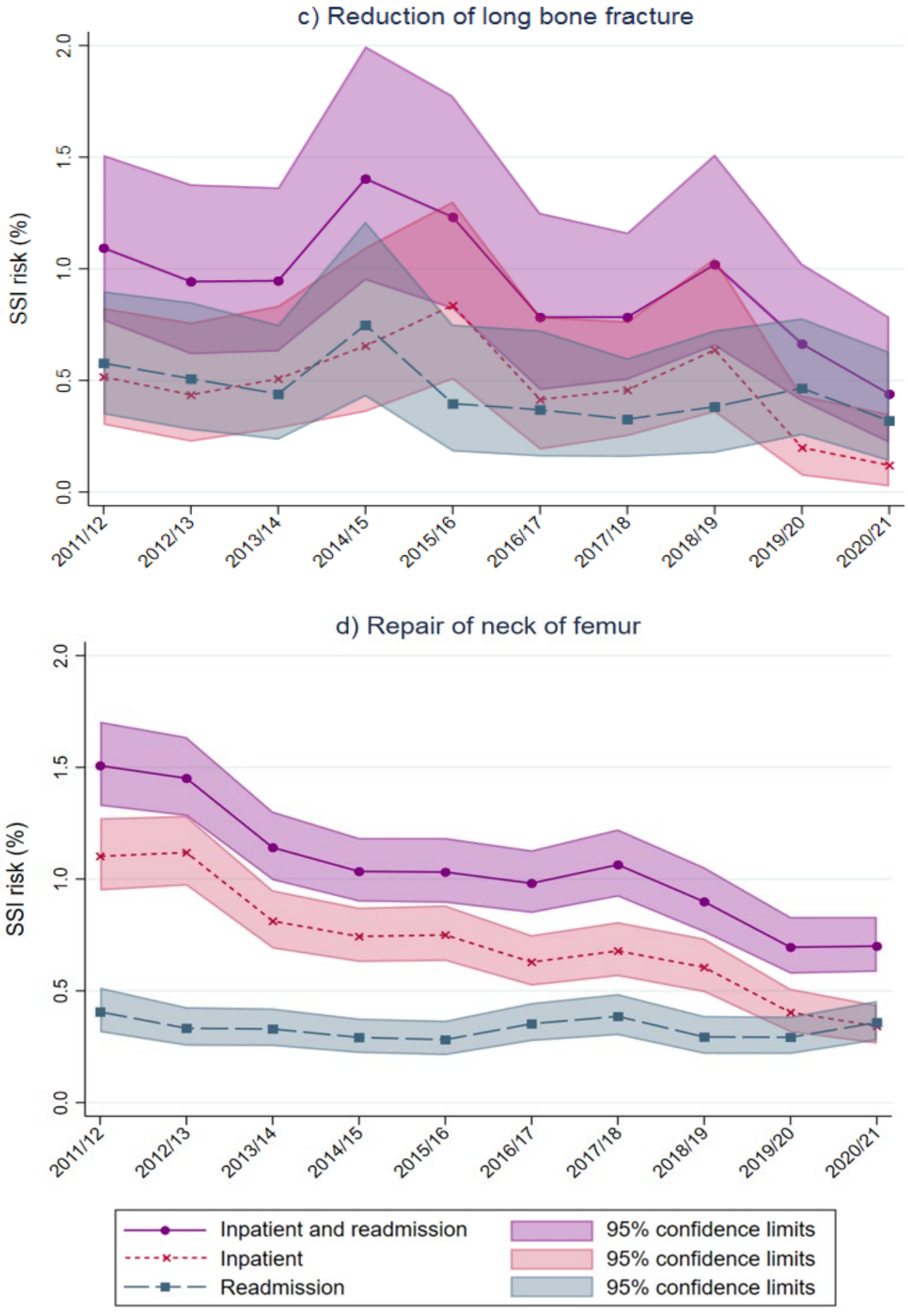
Despite an increase in SSI risk in the previous financial year, Figure 6e shows an overall decreasing 10-year trend for CABG, with the lowest SSI risk (2.2%) seen in financial year 2020 to 2021. This included infections at vein harvesting sites and the sternum. Cardiac surgery (non-CABG) shows greater variability than CABG around the calculated annual SSI risk (Figure 6f). However, cardiac (non-CABG) also saw a continued decrease in SSI risk (to 1.1%) for financial year 2020 to 2021.

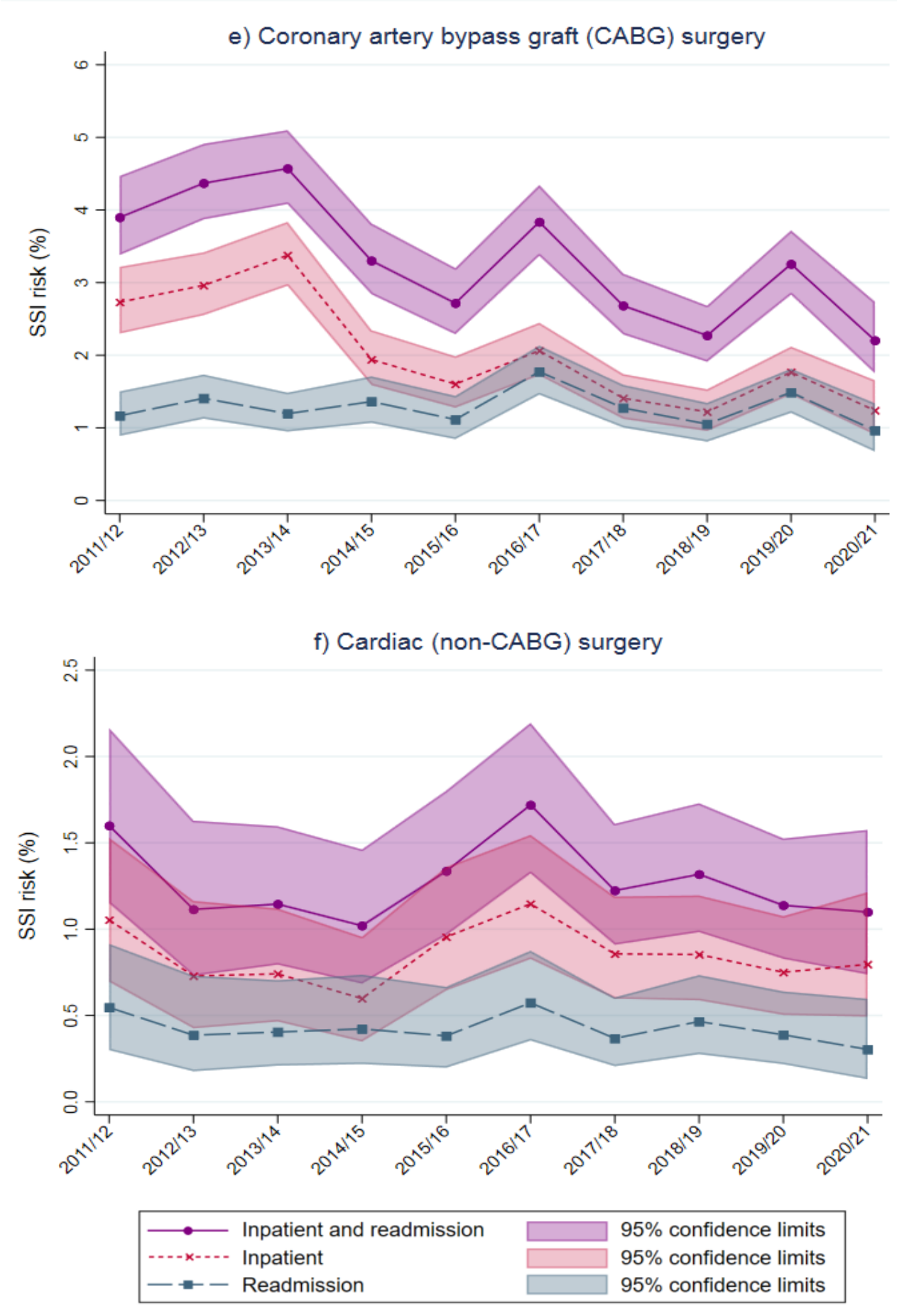
Of the gastrointestinal categories, only large bowel surgery had more than 5 participating hospitals in financial year 2020 to 2021. Large bowel surgery (Figure 6g) showed a differing trend in financial year 2020 to 2021 with the SSI risk increasing to 9.9% after reaching its lowest reported annual inpatient and readmission risk of 7.7% in the previous financial year.

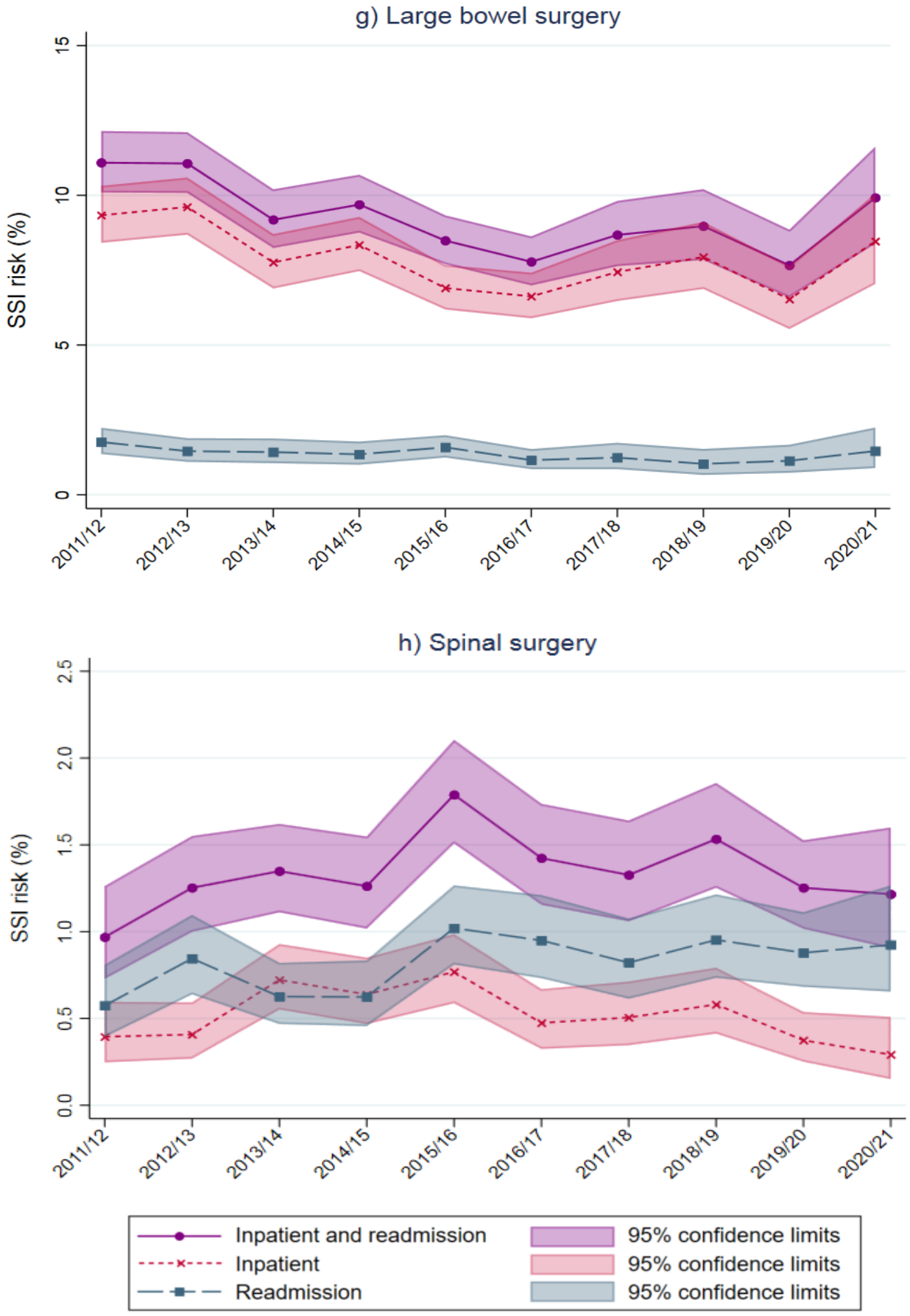
Since a peak in financial year 2015 to 2016 at 1.8%, SSI risk after spinal surgery has decreased in financial year 2020 to 2021 to the lowest SSI risk in 5 years (1.2%) (Figure 6h). The SSI risk following breast surgery (Figure 6i) was 0.1% in financial year 2020 to 2021, a continuation of a decline over the last 3 years. Cranial surgery (Figure 6j) was among the few categories that saw an increase in SSI risk in financial year 2020 to 2021 (1.1% increase to 1.3%).

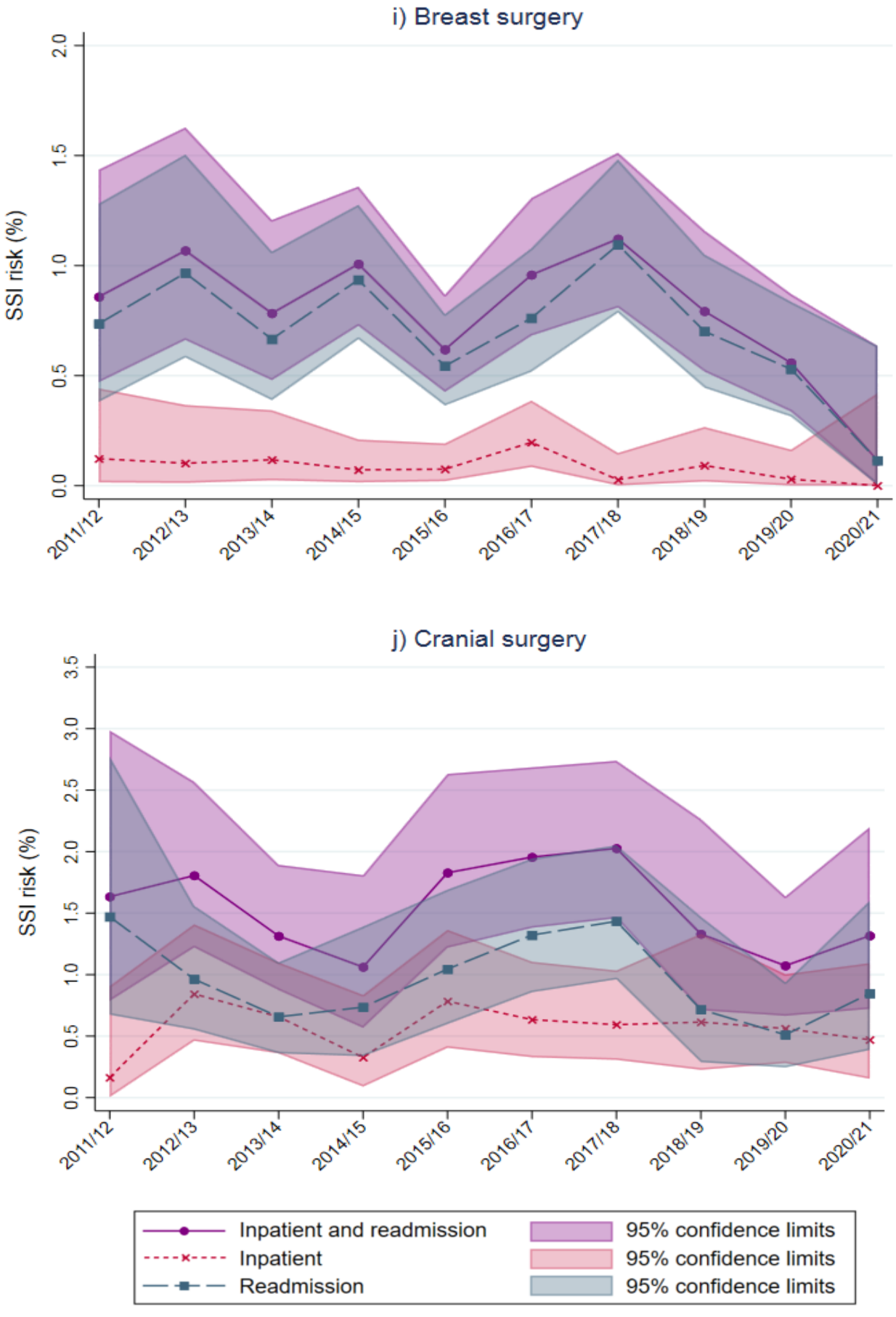
Figures 6a to 6j. Trends in annual SSI incidence for all surgical categories, NHS hospitals England, April 2011 to March 2021




c) Reduction of long bone fracture
SSI risk (%)
0.0
0.5
1.0
1.5
2.0
2011/12
2012/13
2013/14
2014/15
2015/16
2016/17
2017/18
2018/19
2019/20
2020/21
d) Repair of neck of femur
SSI risk (%)
0.0
0.5
1.0
1.5
2.0
2011/12
2012/13
2013/14
2014/15
2015/16
2016/17
2017/18
2018/19
2019/20
2020/21
Inpatient and readmission
Inpatient
Readmission
95% confidence limits
95% confidence limits
95% confidence limits


e) Coronary artery bypass graft (CABG) surgery
SSI risk (%)
0
1
2
3
4
5
6
2011/12
2012/13
2013/14
2014/15
2015/16
2016/17
2017/18
2018/19
2019/20
2020/21
f) Cardiac (non-CABG) surgery
SSI risk (%)
0.0
0.5
1.0
1.5
2.0
2.5
2011/12
2012/13
2013/14
2014/15
2015/16
2016/17
2017/18
2018/19
2019/20
2020/21
Inpatient and readmission
Inpatient
Readmission
95% confidence limits
95% confidence limits
95% confidence limits


g) Large bowel surgery
SSI risk (%)
0
5
10
15
2011/12
2012/13
2013/14
2014/15
2015/16
2016/17
2017/18
2018/19
2019/20
2020/21
h) Spinal surgery
SSI risk (%)
0.0
0.5
1.0
1.5
2.0
2.5
2011/12
2012/13
2013/14
2014/15
2015/16
2016/17
2017/18
2018/19
2019/20
2020/21
Inpatient and readmission
Inpatient
Readmission
95% confidence limits
95% confidence limits
95% confidence limits


i) Breast surgery
SSI risk (%)
0.0
0.5
1.0
1.5
2.0
2011/12
2012/13
2013/14
2014/15
2015/16
2016/17
2017/18
2018/19
2019/20
2020/21
j) Cranial surgery
SSI risk (%)
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
2011/12
2012/13
2013/14
2014/15
2015/16
2016/17
2017/18
2018/19
2019/20
2020/21
Inpatient and readmission
Inpatient
Readmission
95% confidence limits
95% confidence limits
95% confidence limits

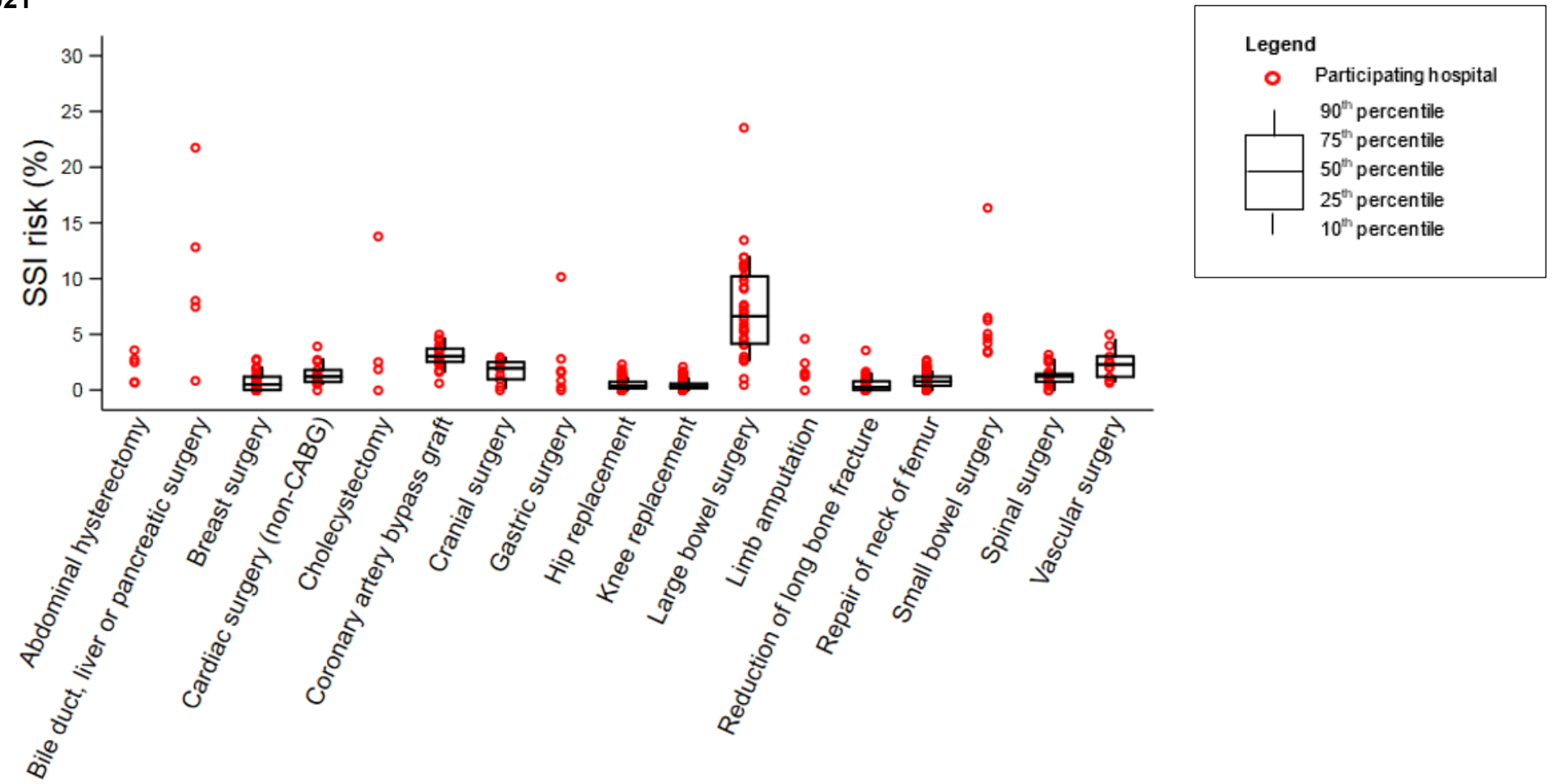
Variation in SSI risk between hospitals

Figure 7 shows the distribution of the SSI risk, based on 5 years of cumulative data, across participating hospitals by surgical category using box-and-whisker plots. The box is formed of a lower quartile (25th to 50th percentile) and an upper quartile (50th to 75th percentile), defining an expected range of results. The 'whiskers', which are used to indicate variability outside the upper and lower quartile, use the 10th and 90th percentile to represent the extreme ends of the distribution and highlight hospital outliers which fall outside this range. Each red dot represents a participating hospital.

Large bowel surgery continues to show the greatest variability, with hospital SSI risk ranging from 0.5% to 23.6%, which could in part be due to a high proportion of emergency surgeries, or may indicate room for improvement across hospitals in infection prevention, and possibly case ascertainment. Hip and knee replacement showed the least variation, with most hospitals hovering around the median. However, high outlier hospitals can still be identified for these categories.

Of the eleven surgical categories, 7 had a slightly narrower interquartile range (difference between the 25th and 75th percentiles) indicating less variation while 3 of the eleven surgical categories had a wider interquartile range. When the current interquartile range was compared to the previous year, reduction of long bone fracture had the greatest percentage decrease (27%) meaning there was less variation seen this year in the SSI risk across hospitals.

Figure 7. Distribution of inpatient and readmission SSI risk by surgical category*, NHS hospitals England†, April 2016 to March 2021



* Categories with fewer than 10 hospitals participating within this time period are presented as a distribution without a box plot.
† NHS hospitals with less than 95 operations for hip replacement, knee replacement or abdominal hysterectomy are excluded from analysis for that category. NHS hospitals with less than 45 operations for any other category are excluded from analysis for that category.

Outlier assessment

In financial year 2020 to 2021, there were 11 NHS Trusts performing orthopaedic surgery who did not comply with the mandatory requirements for participation in the SSISS and were notified by letter. For the mandatory orthopaedic categories, outliers are assessed at the end of each financial year across all NHS trusts and treatment centres using funnel plots to account for differences in surgical volume.

Figures 8a to 8d show funnel plots displaying variation in the SSI risk among trusts in financial year 2020 to 2021 for orthopaedic categories. The cumulative incidence of SSI per 100 procedures is plotted against the number of procedures for each participating NHS trust/treatment centre. The upper and lower 95% confidence limits (red lines) define the 'limits' of expected variation. Trusts lying outside these limits are outliers. The 99% confidence limits (dashed lines) are presented to represent the expected variation within which 99% of results should fall. The 95% confidence limits represent warning lines, whereas falling outside of the 99% confidence limits would signify the need for more immediate action.

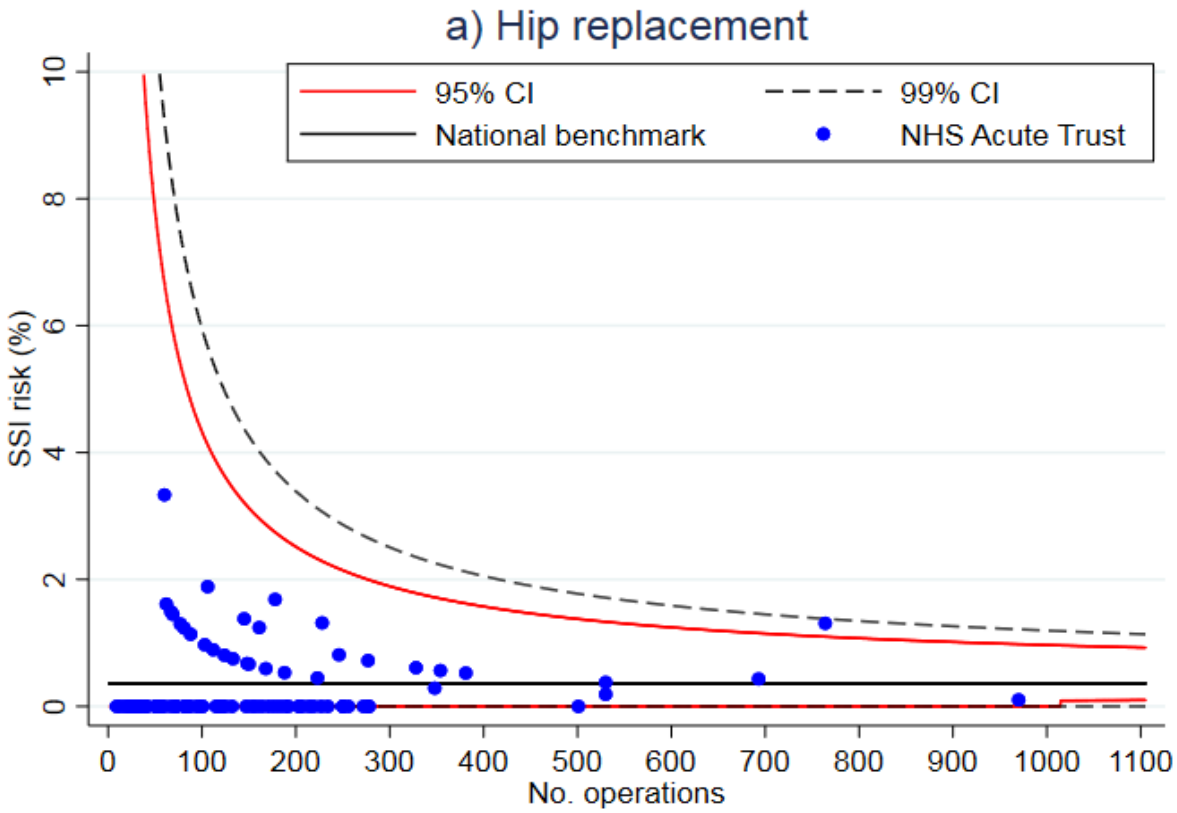
Results continue to show decreased variation across trusts and more consistent grouping around the national benchmark for hip and knee replacement surgery in financial year 2020 to 2021. Compared to financial year 2019 to 2020, there was also less spread in the results for the reduction of long bone fracture and repair of neck of femur surgery.

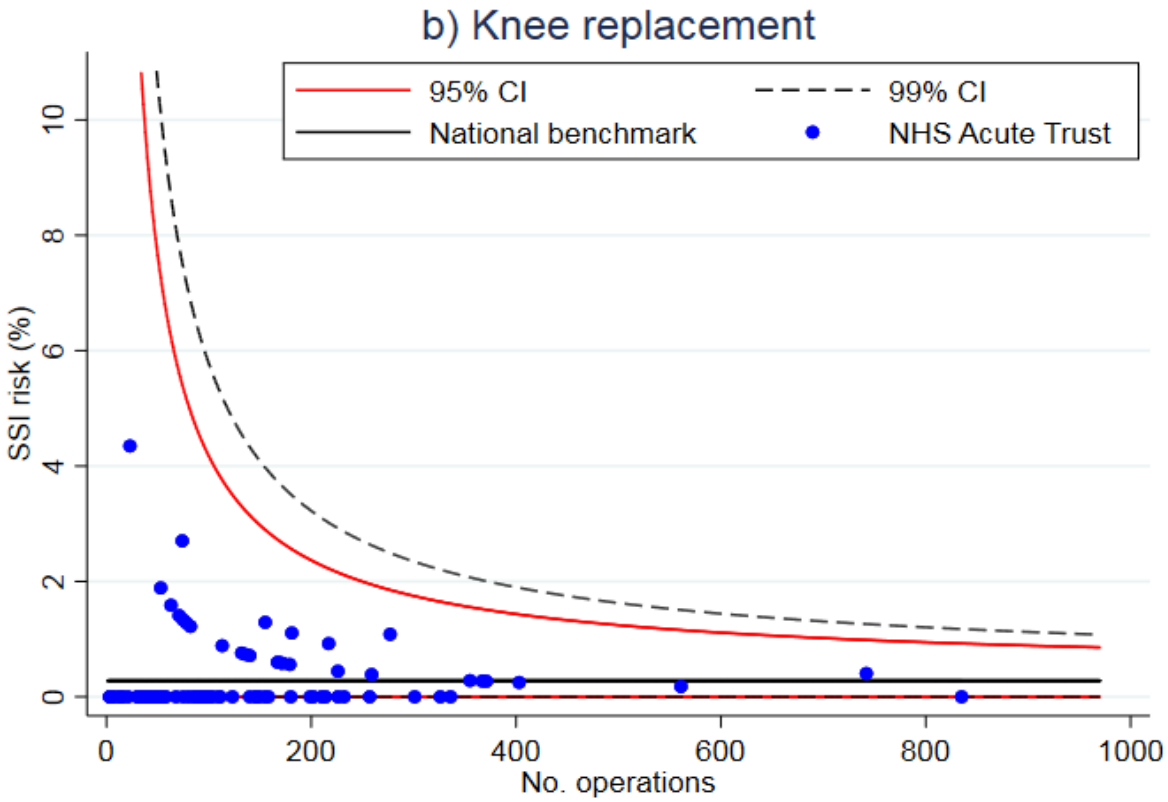
Two NHS acute trusts or treatment centres were identified as statistical high outliers (falling above the 95% upper confidence limits) across the 4 mandatory orthopaedic categories in financial year 2020 to 2021 (one for hip replacement, one for reduction of long bone fracture). One NHS acute trust or treatment centre was identified as a statistical low outlier (falling below the 95% lower confidence limits). One of the 2 providers notified as high outliers was a high outlier in the same category last financial year, and the provider deemed a low outlier was also a low outlier in the same category in the last financial year.

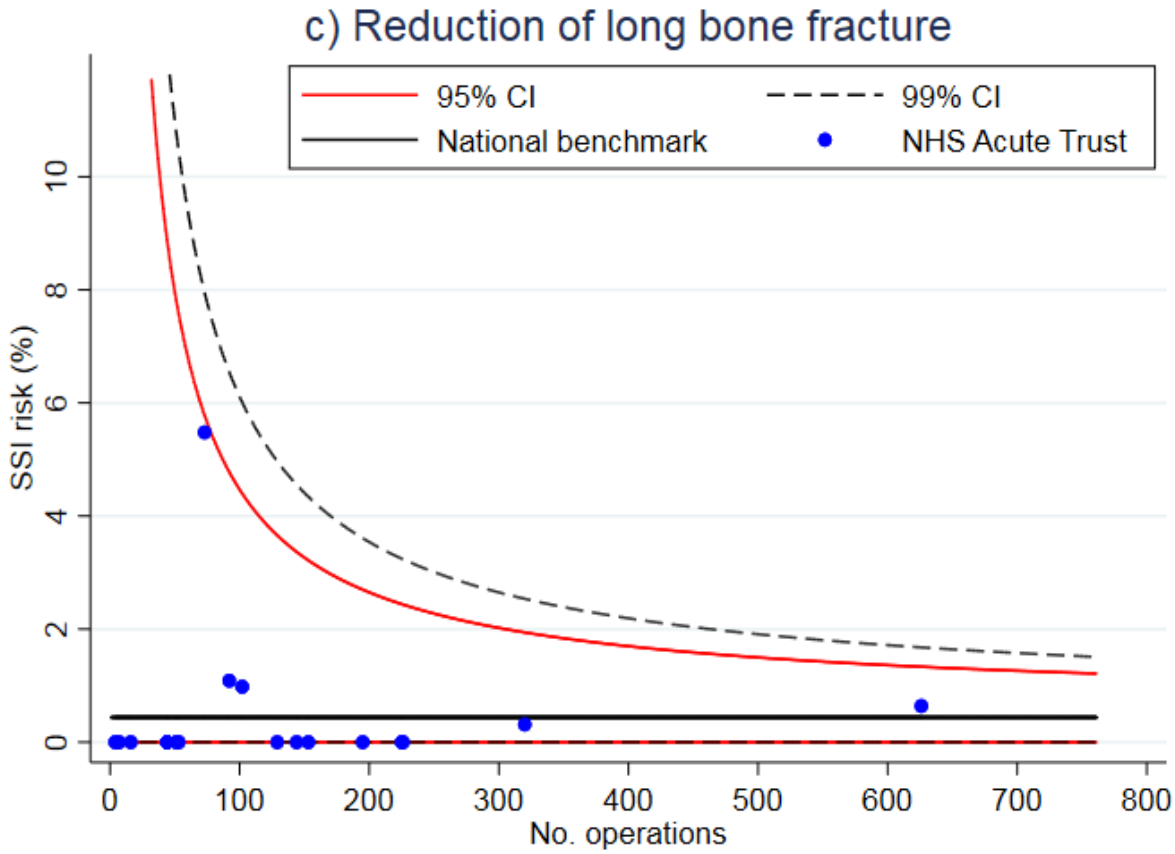
As part of this report, SSI risk results by NHS acute trust (and NHS treatment centre) for the last 2 financial years (2019 to 2020 and 2020 to 2021) are published in separate accompanying tables.

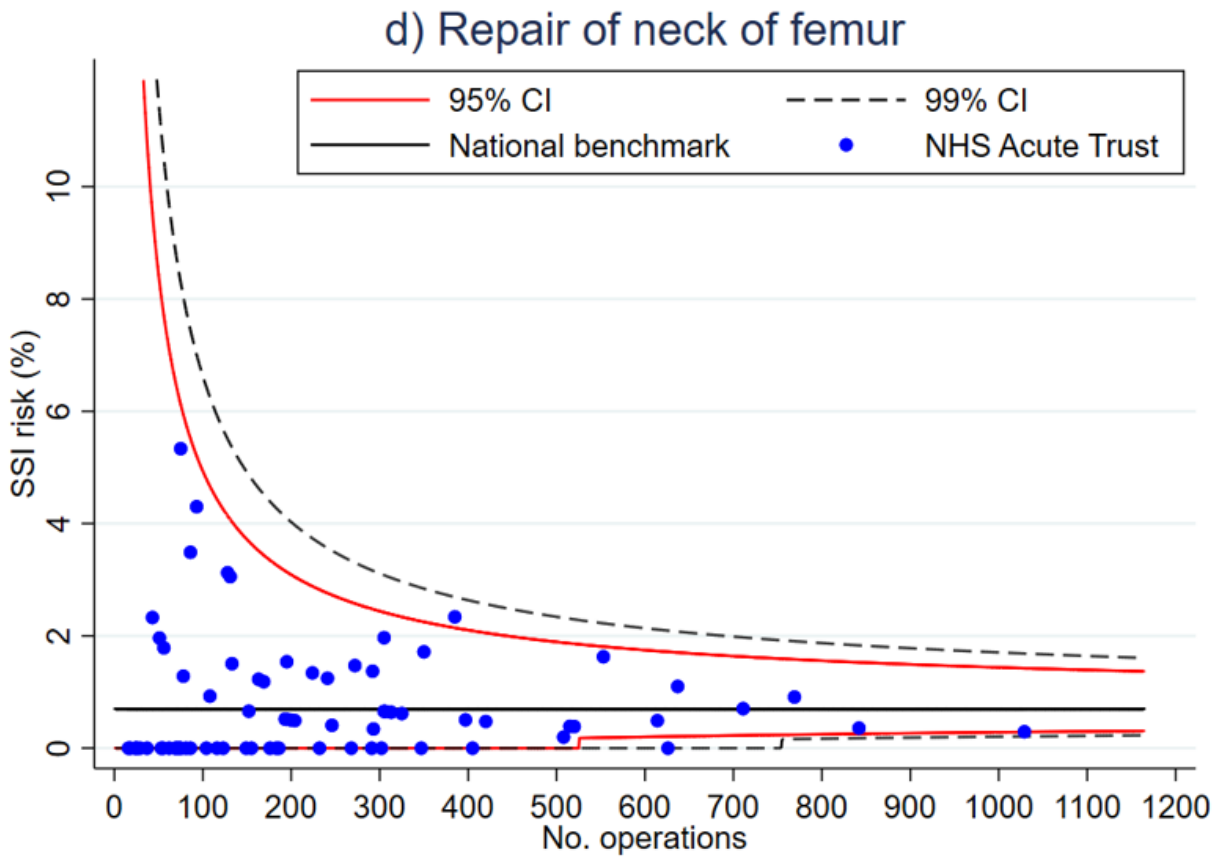
Annual trust-level results for hip and knee replacement surgery are also made available through UKHSA's public reporting tool, Fingertips. The tool also allows users to group results by trust type (namely, teaching, non-teaching, and specialty) or NHS sub-region and compare to a corresponding overall group average.

Figures 8a to 8d. Distribution of inpatient and readmission SSI risk, NHS acute trusts and treatment centres England, April 2020 to March 2021






c) Reduction of long bone fracture
95% CI
99% CI
National benchmark
NHS Acute Trust
SSI risk (%)
0
2
4
6
8
10
0
100
200
300
400
500
600
700
800
No. operations


d) Repair of neck of femur
95% CI
99% CI
National benchmark
NHS Acute Trust
SSI risk (%)
0
2
4
6
8
10
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
No. operations

Discussion

Through partnership working with NHS and independent sector healthcare providers, the UKHSA SSISS has amassed a wealth of information, having accumulated surveillance data for almost 2.5 million operations and 52,000 SSIs since its inception in 1997. In financial year 2020 to 2021, submissions of data for both mandatory and voluntary surgical categories were halved. This reduction was slightly higher than the 34% reduction in operations seen in England and Wales in 2020 (7). Reduced operating theatre capacity and postponement of non-urgent surgeries may have contributed to reduced surgical volume (8, 9). The greater decrease in submission of data to SSISS may be due to surveillance staff being re-allocated during the pandemic and high proportions of planned non-urgent surgeries in our data set.

While lower participation may have introduced more variability and mean that some results from financial year 2020 to 2021 need to be interpreted with caution, undertaking surveillance would have been very difficult for some hospitals during this time. We commend the hospitals for their persistence with surveillance during the pandemic.

Among the categories that had 5 or more hospitals participating, all 10 categories showed an increase in at least one field that indicates complex surgery (ASA score, surgery duration, length of stay, and multiple procedures). This increase in complex or more serious surgeries may be due to the proportionate decrease in non-urgent surgeries during COVID-19. Of 10 categories, 7 had an increase in the percentage of patients with a pre-operative stay of more than one day, although this may be due to delays other than surgical complexity such as triage of other patients or COVID-19 testing requirements.

Despite the increase in complex surgeries in financial year 2020 to 2021 compared to financial year 2019 to 2020, 10-year trends in the annual inpatient and readmission SSI risk showed that most surgical categories assessed (7 of 10) had an overall declining trend in risk, including all the mandatory orthopaedic categories. The decrease may reflect increased infection control procedures in hospitals due to COVID-19, including use of personal protective equipment, masks, social distancing and reduced patient visits from friends and family. The decrease may also in part be due to reduced application of case finding methodology due to reduced capacity for surveillance.

While annual inpatient and readmission SSI risk following large bowel surgery decreased to its lowest in 10 years in financial year 2019 to 2020 (7.7%), the risk increased to 9.9% in financial year 2020 to 2021. There is still a lot of inter-hospital variation in SSI risk following large bowel surgery, with 5-year hospital rates ranging from 0.5% to 23.6%. This indicates that there may be room for improvement through review of infection prevention control and case ascertainment practices, or there may be differences in the distribution of patient risk factors across hospitals.

Annual trust-level SSI risk funnel plots in financial year 2020 to 2021 continue to show less variation in the SSI risk across trusts and more consistent grouping around the national benchmark for the mandatory orthopaedic surveillance categories. Two high outlier notifications were sent out for the mandatory surveillance categories compared to 6 in the previous year. High outliers emphasize the importance of continued surveillance and monitoring as differences in the population at risk and risk factors at the time of surgery may result in periodic increases in infections regardless of a hospital's own prior history and the declining national benchmark. There was one low outlier notification and the trust was a low outlier in the same category the previous year. This may be indicative of low case ascertainment or true exceptional patient care. Annual trust outlier assessments are unadjusted for differences in the patient population and important risk factors. Hospitals who receive outlier notifications are encouraged to drill down further into their results through their web-based hospital reports which include risk-stratified data, and review their policies and practices, such as the use of prophylactic antimicrobials.

More than half of the patients undergoing a knee replacement procedure were obese (55.1% in financial year 2020 to 2021). An elevated BMI has been shown to increase the likelihood of developing an SSI (10, 11). However, a 2017 report found that 47% of Clinical Commissioning Groups (CCGs) in the United Kingdom have a BMI threshold in place for funding surgery (12). The majority of these CCGs apply a threshold of 35 kg/m^2 or more, however 10% set a threshold of 30 kg/m^2 ('obese') and 4% set a threshold of 25 kg/m^2 ('overweight'). In financial year 2020 to 2021, the median patient BMI decreased for half of the surgical categories, which may suggest selective access to elective surgery based on a lower patient BMI, especially for non-urgent surgeries. While completion of BMI had been increasing (61% in financial year 2019 to 2020), completion dropped to 54% in financial year 2020 to 2021. BMI information will be important to consider when assessing high hospital outliers given the potential impact of CCG thresholds.

In financial year 2020 to 2021, trends differed from those seen in the previous financial year in many areas including type of surgeries performed, complexity of surgeries, and trends in SSI. The annual report for financial year 2021 to 2022 will review the continuing effects of COVID-19 and provide an indication of whether trends return to those seen pre-pandemic, or if the changes have an ongoing impact on SSIs.

Glossary

ASA score

Patient's pre-operative physical status scored by the anaesthetist according to the American Society of Anesthesiologists' classification of physical status. There are 5 ASA scores, ranging from A1 denoting normally healthy patient to A5 denoting moribund patient with little chance of survival.

Confidence intervals

Confidence intervals are used to show where the true range of results might lie. 95% confidence intervals are used throughout to provide a guide to the precision of the estimate based on the denominator, number of operations (or days of follow-up). A 95% confidence interval can also be interpreted as a '1 in 20 chance that the observed estimate is due to chance alone'. The funnel plots use both 95% and 99% confidence limits to represent the limits of expected variation among trusts and establish a threshold for 'warning' of an unexpected result and needing to take 'action'. A 99% confidence range is wider but is offset with a lower margin of error (1%).

Cumulative incidence

The total number of SSIs as a proportion of the total number of patients undergoing a procedure in the same category of surgery per 100 procedures (%).

Incidence density

The total number of SSIs (identified through inpatient surveillance) divided by the total number of days of inpatient follow-up expressed as the number of SSIs per 1,000 days of patient follow-up.

Independent sector NHS treatment centres

Centres that provide services to NHS patients but are owned and run by organisations outside the NHS. They perform common elective (thatis, non-emergency) surgeries, diagnostic procedures and tests in an effort to help the NHS reduce waiting times.

NHSN Risk Index

The CDC National Healthcare Safety Network (NHSN) Risk Index assesses a patient's risk of developing an SSI based on the presence of 3 key risk factors (ASA score, duration of operation, and wound class). Patients are assigned a cumulative score from 0 to 3 based on the following: an ASA score of 3 or more, duration of surgery exceeding the 75th percentile, and a contaminated or dirty wound class. A score of 3 would indicate a high risk of SSI for a patient after an operation.

Risk ratio

A measure of the risk of a certain event happening in one group compared to the risk of the same event happening in another group. A risk ratio of one means there is no difference between the 2 groups in terms of their risk, based on whether or not they were exposed to a

certain factor or possess a certain risk factor. A risk ratio of less than 1 usually means that being exposed to a certain factor or possessing a certain risk factor increases the risk of infection. A risk ratio greater than 1 means that being exposed to a certain factor or possessing a certain risk factor decreases the risk of infection.

T time

T time represents the expected duration for a particular surgical procedure based on the 75th percentile for the duration of all such procedures, rounded to the nearest hour. T times for all surgical categories are as follows:

Surgical category	T Time (hours)
Abdominal hysterectomy	2
Bile duct, liver, or pancreatic surgery	5
Breast surgery	3
Cholecystectomy	2
Cardiac surgery (non-CABG)	5
Coronary artery bypass graft	5
Cranial surgery	4
Gastric surgery	3
Hip replacement	2
Knee replacement	2
Large bowel surgery	3
Limb amputation	1
Reduction of long bone fracture	2
Repair of neck of femur	1.5*
Small bowel surgery	3
Spinal surgery	3
Vascular surgery	3

* T time derived from SSISS data.

Wound class

This describes the degree of wound contamination at the time of the operation, based on an international standard classification system. The classification ranges from W1 denoting a clean uninfected wound outside the respiratory, alimentary, and genital or urinary tract to W4 denoting dirty or infected wounds and include operations in which acute inflammation with pus is encountered or in which perforated viscera are found.

Appendix 1

Table 9. Requirements for data fields that inform patient and surgery-related characteristics

Characteristic	Requirement
Patient age	Calculated from mandatory date of birth and date of operation data fields
Patient sex	Mandated for submission, however ‘unknown’ is an available response option
Patient BMI	Calculated from optional height and weight data fields
Patient ASA score	Mandated for submission, however ‘unknown’ is an available response option
Wound class	Mandated for submission, however ‘unknown’ is an available response option
Operation duration	Mandated for submission
Pre-operative stay	Calculated from mandatory date of admission and date of operation data fields
Elective surgery	Mandated for submission, however ‘missing’ is an available response option
Trauma surgery	Mandated for submission, however ‘missing’ is an available response option
Primary indication for surgery	Mandated for submission, however ‘unknown’ is an available response option
Antibiotic prophylaxis given	Mandated for submission, however ‘unknown’ is an available response option

Appendix 2

Table 10. Data completeness for patient and surgical characteristic variables, NHS hospitals England, April 2020 to March 2021

			Patient-related characteristics				Surgery-related characteristics						
Surgical category	**Number of hospitals**	**Number of operations**	**Age**	**Sex**	**BMI***	**ASA score**	**Wound class**	**Operation duration**	**Pre-op stay**	**Elective surgery**	**Trauma surgery***	**Primary indication**	**Antibiotic prophylaxis**
			(%)	**(%)**	**(%)**	**(%)**	**(%)**	**(%)**	**(%)**	**(%)**	**(%)**	**(%)**	**(%)**
Abdominal hysterectomy	3	100	100	100	83.0	100.0	100	100	100	100	100.0	-	100
Bile duct, liver or pancreatic surgery	1	57	100	100	0.0	100.0	100	100	100	100	82.5	-	47.4
Breast surgery	8	875	100	100	48.6	93.9	100	100	100	100	99.9	-	87.7
Cardiac surgery (non-CABG)	8	2,638	100	100	85.2	66.7	100	100	100	100	98.9	-	97.0
Cholecystectomy	1	16	100	100	0.0	100.0	100	100	100	100	100	-	68.8
Coronary artery bypass graft	11	3,630	100	100	84.6	68.3	100	100	100	100	99.1	-	98.4
Cranial surgery	5	1,063	100	100	81.6	88.0	100	100	100	100	99.5	-	99.3
Gastric surgery	2	97	100	100	76.3	100.0	100	100	100	100	94.8	-	83.5
Hip replacement	127	15,702	100	100	62.2	98.0	99.4	100	100	100	3.4	99.0	97.3
Knee replacement	116	12,882	100	100	66.6	97.7	99.3	100	100	100	3.4	98.9	97.4

			Patient-related characteristics				Surgery-related characteristics						
Surgical category	**Number of hospitals**	**Number of operations**	**Age**	**Sex**	**BMI***	**ASA score**	**Wound class**	**Operation duration**	**Pre-op stay**	**Elective surgery**	**Trauma surgery***	**Primary indication**	**Antibiotic prophylaxis**
			(%)	**(%)**	**(%)**	**(%)**	**(%)**	**(%)**	**(%)**	**(%)**	**(%)**	**(%)**	**(%)**
Large bowel surgery	11	1,371	100	100	63.1	97.3	100	100	100	100	96.9	-	93.4
Limb amputation	2	45	100	100	44.4	97.8	100	100	100	100	97.8	-	100
Reduction of long bone fracture	20	2,504	100	100	16.4	96.1	100	100	100	100	94.8	-	94.8
Repair of neck of femur	92	18,431	100	100	28.1	96.4	100	100	100	100	2.1	99.2	94.6
Small bowel surgery	4	202	100	100	53.3	93.1	100	100	100	100	90.1	-	83.7
Spinal surgery	17	4,112	99.9	100	66.9	97.9	99.1	99.9	100	100	79.9	-	87.1
Vascular surgery	4	386	100	100	64.5	99.0	100	100	100	100	100	-	99.7

* Optional data entry field.

References

1. Gandaglia G, Ghani KR, Sood A, Meyers JR, Sammon JD, Schmid M and others. 'Effect of minimally invasive surgery on the risk for surgical site infections: results from the National Surgical Quality Improvement Program (NSQIP) database'. JAMA Surgery 2014: volume 149, issue 10, pages 1,039 to 1,044
2. Caroff DA, Chan C, Kleinman K, Calderwood MS, Wolf R, Wick EC and others. 'Association of open approach versus laparoscopic approach with risk of surgical site infection after colon surgery'. JAMA Network Open 2019: volume 2, issue 10
3. Chief Medical Officer. 'Surveillance of Healthcare Associated Infections PL CMO' 2003(4). England: Department of Health (DH) 2003
4. Public Health England. 'Protocol for the surveillance of surgical site infection'. Version 6, June 2013. London, England 2013
5. Horan TC, Gaynes RP, Martone WJ, Jarvis WR, Emori TG. 'CDC definitions of nosocomial surgical site infections, 1992: a modification of CDC definitions of surgical wound infections'. Infection Control Hospital Epidemiology 1992: volume 13, issue 10, pages 606 to 608
6. Lamagni T. 'Epidemiology and burden of prosthetic joint infections'. Journal of Antimicrobial Chemotherapy 2014: volume 69, Suppliment 1, i5 to 10
7. Dobbs TD, Gibson JAG, Fowler AJ, Abbott TE, Shahid T, Torabi F and others. 'Surgical activity in England and Wales during the COVID-19 pandemic: a nationwide observational cohort study'. British Journal of Anaesthesiology 2021: volume 127, issue 2, pages 196 to 204
8. Royal College of Surgeons of England (2020). 'Clinical guide to surgical prioritisation during the coronavirus pandemic'
9. NHS (2022). 'Delivery plan for tackling the COVID-19 backlog of elective care'
10. Yuan K, Chen HL. 'Obesity and surgical site infections risk in orthopedics: a meta-analysis'. International journal of surgery (London, England) 2013: volume 11, issue 5, pages 383 to 388
11. Kocur E, Rozentryt P, Głogowska-Gruszka A. 'Risk factors for surgical site infection in patients after implant-related orthopedic procedures'. Przegląd epidemiologiczny 2021, volume 75, issue 3, pages 332 to 346
12. The UK Orthopaedics Industry Group. 'Hip and knee replacement: the hidden barriers'. England: Association British HealthTech Industries 2017

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