AUSTRALIAN COMMISSION ON SAFETY AND QUALITY IN HEALTH CARE

AURA
Antimicrobial Use and Resistance in Australia

SURGICAL NAPS National Antimicrobial Prescribing Survey

SURGICAL PROPHYLAXIS PRESCRIBING IN AUSTRALIAN HOSPITALS

Results of the 2019 Surgical National Antimicrobial Prescribing Survey

October 2020

NCAS National Centre for Antimicrobial Stewardship

GUIDANCE

Published by the Australian Commission on Safety and Quality in Health Care
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ISBN: 978-1-925948-78-3

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> National Centre for Antimicrobial Stewardship and Australian Commission on Safety and Quality in Health Care. Surgical prophylaxis prescribing in Australian Hospitals Results of the 2019 Surgical National Antimicrobial Prescribing Survey. Sydney: ACSQHC; 2020

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Contents

1 Summary

Surgical antimicrobial prophylaxis is important for the safe care to patients who undergo surgical procedures, because used appropriately it can reduce the risk of infection after surgery. As the appropriate use of antimicrobials is also a key factor for the prevention and control of antimicrobial resistance, improving antimicrobial use for surgical prophylaxis should be a key focus area. The Surgical National Antimicrobial Prescribing Survey (Surgical NAPS) is a standardised audit that Australian health service organisations can use to monitor and report on the appropriateness of antimicrobial use for surgical prophylaxis. In 2019, 144 public and private facilities contributed data for the Surgical NAPS.

Over the four years that the Surgical NAPS has been conducted, there has been an increase in the appropriateness of procedural prescribing, which may be due to improved timing of administration and dosage of antimicrobials. The Hospital NAPS has also identified an improvement in the proportion of surgical prophylaxis given for greater than 24 hours from 41.0% in 2013 down to 30.0% in 2019. This may be in response to the focus on surgical prophylaxis hospital antimicrobial stewardship programs. The Australian Commission on Safety and Quality in Healthcare (the Commission) has also strongly promoted surgical prophylaxis as a priority for improvement action during that period, and undertaken collaborative work with the Royal Australasian College of Surgeons (RACS) since 2018. The Commission and RACS have produced a series of co-badged resources promoting appropriate prescribing of surgical prophylaxis.

Consistent with findings from previous surveys of surgical prophylaxis, the 2019 Surgical NAPS identified ongoing concerning inappropriate use of surgical prophylaxis in contributor hospitals. These issues, which require urgent, and specific attention, include:

- Sub-optimal documentation of the time of antimicrobial administration (77.4%) and incision time (66.1%)
- Low rates of compliance with prescribing guidelines for procedural (62.7%) and post-procedural (31.4%) antimicrobial prophylaxis in relation to timing, dosage and duration of use
- Inappropriate procedural prescribing for orthopaedic surgery, urological surgery, abdominal surgery, and plastic and reconstructive surgery, in particular
- Inappropriate post-procedural prescribing for orthopaedic surgery, plastic and reconstructive surgery, and head and neck surgery, in particular.

Other key findings from the 2019 Surgical NAPS include:

- Antimicrobial prescribing was assessed as appropriate in 56.7% of all surgical episodes
- Reasons for inappropriate procedural prescribing were most commonly incorrect timing (37.4%) and incorrect dosage (23.3%). Post-procedurally, the most common reasons were incorrect duration (55.9%) and incorrect dose or frequency (25.5%)
- Antimicrobials prescribed post-procedurally continued for greater than 24 hours for 61.4% of prescriptions and 42.8% continued for greater than 48 hours
- Three procedure groups accounted for 56.5% of all surgical prophylaxis for up to, or greater than, 48 hours: ophthalmology, plastic and reconstructive surgery, and head and neck surgery.

Reports for 14 procedural specialty groups are included in Appendix 5. These reports, which have been produced for the first time in this format for reporting of Surgical NAPS findings, will assist the development of targeted improvement programs by these specialties.

IMPLICATIONS FOR PATIENT SAFETY

Suboptimal documentation

Documentation is an important part of comprehensive medical care as it allows timely and accurate communication between members of the clinical care team and contributes to effective safety and quality of patient care. Failure to document important components of surgical care was reported for between 1 in 3 surgical procedures for incision time, and 1 in 5 surgical procedures for administration time. Correct timing of antimicrobial administration ensures a high concentration of antimicrobial at the time of surgical incision, which reduces the risk of surgical site infection and the need for post-operative antimicrobials. Improving documentation is an important step in ensuring appropriate timing of antimicrobial administration, and should be addressed in targeted improvement strategies.

The progressive implementation of electronic medical records in Australian hospitals may support improvement of this aspect of prescribing, as systems can be designed to prompt and require information to be entered.

Compliance with guidelines and appropriateness of prescribing

Compliance with guidelines for surgical antimicrobial prophylaxis, and consequently appropriateness of prescribing, continues to be poor post-procedurally. This relates to prescription of antimicrobials that are not required and the prolonged duration of antimicrobial use. Procedurally, inappropriate antimicrobial use is primarily due to suboptimal timing of administration.

In practice, there is no evidence of benefit for many procedures that prophylactic antimicrobial use, either procedurally or post-procedurally, reduces post-operative infections. Unnecessary surgical antimicrobial prophylaxis has been shown to cause harms to patients such as renal failure and other adverse reactions; and likely contributes to antimicrobial resistance.

Reducing inappropriate surgical antimicrobial prophylaxis balances the unintended harms of antimicrobial use with the benefits of evidence-based care.

Surgical specialty specific issues

There are specific patterns of inappropriate prescribing for some surgical specialities, such as prolonged duration of use, or choice of antimicrobials. Targeting specialties with the highest rates of inappropriate prescribing, such as orthopaedic surgery, urological surgery, abdominal surgery, and plastic and reconstructive surgery is a priority for antimicrobial stewardship programs. Ensuring that these specialties have patient care aligned with prescribing guidelines, and are supported to improve prescribing, will help to deliver consistent high quality care and improve use of surgical antimicrobial prophylaxis in Australian health service organisations.

What action will be taken?

To address the ongoing patient safety issues relating to inappropriate prescribing of surgical antimicrobial prophylaxis, the Commission will:

- Continue to collaborate with the RACS, and commence work with surgical specialty societies and other key stakeholders to develop improvement strategies for prescribing of surgical antimicrobial prophylaxis
- Provide colleges, surgical specialty societies, states and territories and private health service providers with specific information on appropriateness of prescribing for selected procedural specialties
- Continue to promote compliance with Australian prescribing guidelines
- Work with the states, territories and the private sector to promote ongoing surveillance of appropriateness of surgical antimicrobial prophylaxis in Australian health service organisations
- Continue to promote use of surveillance data to develop and implement targeted improvement programs.

2 Introduction

The Surgical National Antimicrobial Prescribing Survey (Surgical NAPS) is a standardised tool that allows Australian health service organisations to audit and report antimicrobial use in incisional and non-incisional surgical procedures, and to investigate procedural and post-procedural surgical prophylaxis prescribing practices. It is designed to be a useful, practical and generalisable audit tool, providing some flexibility to fit the workflow of different facilities, and to suit a range of surveyors including pharmacists, nurses and medical practitioners.

The Surgical NAPS supports Australian health service organisations, states and territories and private health service provider organisations to develop and conduct antimicrobial stewardship (AMS) programs by:

- Facilitating effective audit and review of antimicrobial use associated with surgical procedures, including compliance with prescribing guidelines and prescribing appropriateness
- Facilitating effective communication regarding antimicrobial use and identifying key targets for interventions
- Supporting workforce education and training
- Supporting the implementation of antimicrobial stewardship practices across facilities where surgical procedures are performed.

Participation in the Surgical NAPS may assist health service organisations to demonstrate that they meet the antimicrobial stewardship actions of the National Safety and Quality Health Service (NSQHS) Preventing and Controlling Healthcare-Associated Infection Standard.[1]

Since 2016, the Australian Commission on Safety and Quality in Health Care (the Commission) and the Australian Government Department of Health have provided funding for the National Centre in Antimicrobial Stewardship (NCAS) to conduct the Surgical NAPS and contribute data to the Antimicrobial Use and Resistance in Australia (AURA) Surveillance System.[2,3] Funding for AURA is provided by the Australian Government Department of Health and state and territory health departments.

The Surgical NAPS methods are described in Appendix 1, and the limitations and considerations for interpretation of results are outlined in Appendix 2.

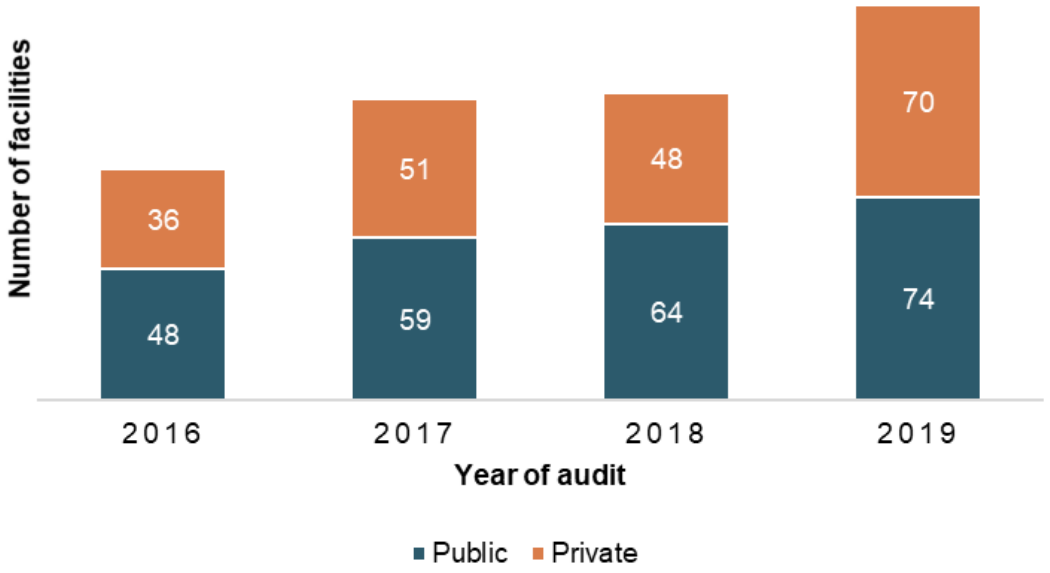
3 Key Results

Analyses of the 2019 Surgical NAPS data are presented below.

Participating facilities

There were 144 contributors to the 2019 Surgical NAPS, an increase of 38 facilities compared to 2018 (Figure 3.1). Participants included public and private facilities from all states and territories, except Tasmania (Table 3.1), a range of hospital peer groups,[4] and all remoteness classifications[5] (Tables A3.1 and A3.2).

Figure 3.1: Surgical NAPS participation by public and private facilities, 2016–2019



Over time, participation in the Surgical NAPS has either been stable or increased for all states and territories, except Tasmania (Figure A3.1). The greatest increase in participation from 2016 to 2019 has been by facilities from Western Australia and Victoria, and Principal Referral and Private Acute Group B hospitals (Figure A3.2). There was a notable increase in contributions by eye surgery centres in 2019. Overwhelmingly, participants are from Major City and Inner Regional areas (Figure A3.3), which is expected because this is where facilities that offer surgical procedures are most likely to be located.

Table 3.1: Number and percentage of participating public and private facilities, by state and territory, Surgical NAPS 2019

State/ Territory	Participating public facilities (n)	Participating private facilities (n)	Total (n)	Percentage of contributing facilities (%)	Number in reporting group nationally (n)	Percentage of reporting group (%)
ACT	1	–	1	0.7	10	10.0
NSW	23	22	45	31.3	281	16.0
NT	1	–	1	0.7	7	14.3
Qld	6	14	20	13.9	179	11.2
SA	2	7	9	6.3	95	9.5
Tas	–	–	–	–	20	–
Vic	28	18	46	31.9	197	23.4
WA	13	9	22	15.3	82	26.8
Total	**74**	**70**	**144**	**100**	**871**	**16.5**

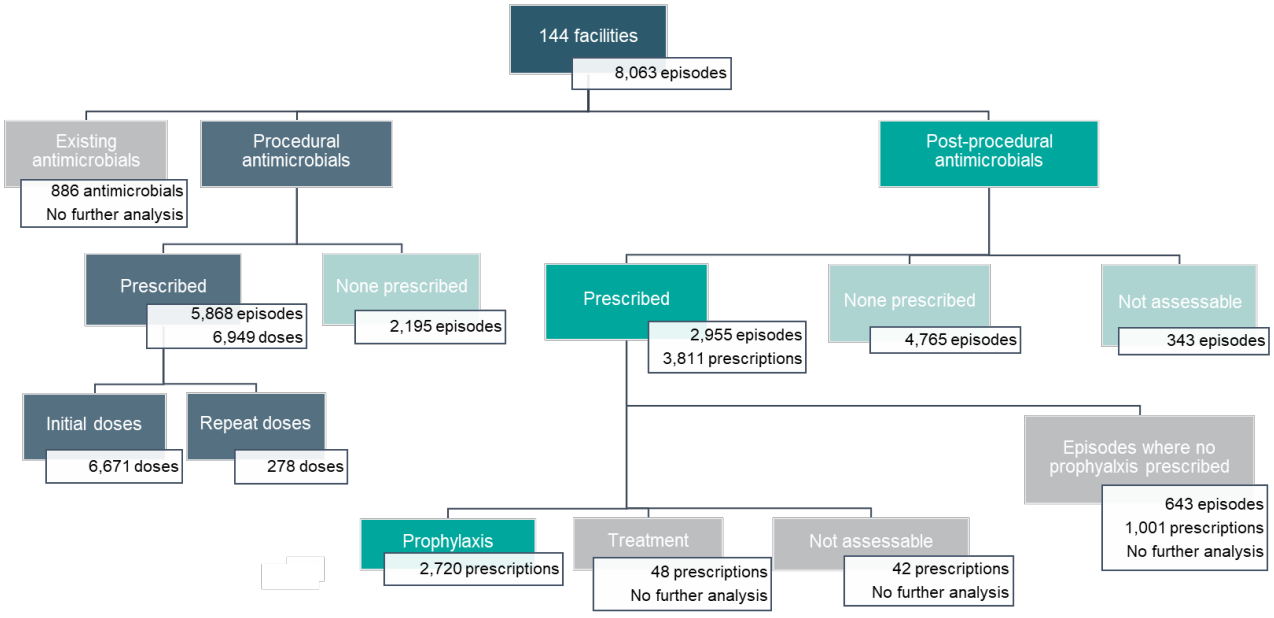
Surgical episodes

A total of 8,063 surgical episodes were included in the 2019 Surgical NAPS analyses. Characteristics of those episodes included:

- Slightly more episodes were analysed for females (*n* = 4,256, 52.8%) compared to males (*n* = 3,804, 47.2%)
- The majority (*n* = 7,784; 96.5%) were initial surgeries, and 279 (3.5%) were subsequent surgeries
- Most (*n* = 7,376; 91.5%) involved an incisional procedure.
- More elective procedures were performed (*n* = 7,092; 88.0%) than emergency procedures (*n* = 915; 11.4%)
- Almost one third (*n* = 2,459; 30.5%) were for insertion or removal of prosthetic material
- A very small number (*n* = 295; 3.7%) were trauma related.

Figure 3.2 shows the breakdown of antimicrobial prescribing for surgical episodes reported to the 2019 Surgical NAPS, by procedural and post–procedural characteristics, to assist with understanding the analyses presented.

Figure 3.2: Surgical episodes by procedural and post-procedural prescribing characteristics, Surgical NAPS 2019



LEGEND

Episode – an individual procedure or set of multiple procedures performed together during the one surgical session and the subsequent post-procedural care associated with the procedure(s)

Dose – an individual antimicrobial dose administered either immediately prior to or during or after the surgical procedure

Prescription – any antimicrobial prescribed as either a single dose or as a course following the surgical procedure

Existing antimicrobial – an antimicrobial prescribed for treatment or prophylaxis in the 24 hours prior (72 hours if on dialysis) to the procedure, used to determine the appropriateness of whether procedural antimicrobials were given or not given

Procedural antimicrobial – an antimicrobial administered either immediately prior to or during the surgical procedure for the purpose of prophylaxis; each initial and repeat dose of the antimicrobial administered is recorded individually

Post-procedural antimicrobial – an antimicrobial prescribed following, but directly relating to, the procedure; each prescription of the antimicrobial is recorded, including any inpatient or discharge scripts

Initial dose – the first dose of an antimicrobial administered either immediately prior to or during the surgical procedure for the purpose of prophylaxis

Repeat dose – any subsequent dose of an antimicrobial administered during the surgical procedure for the purpose of prophylaxis

Prophylaxis – an antimicrobial prescribed for the prevention of surgical related infection

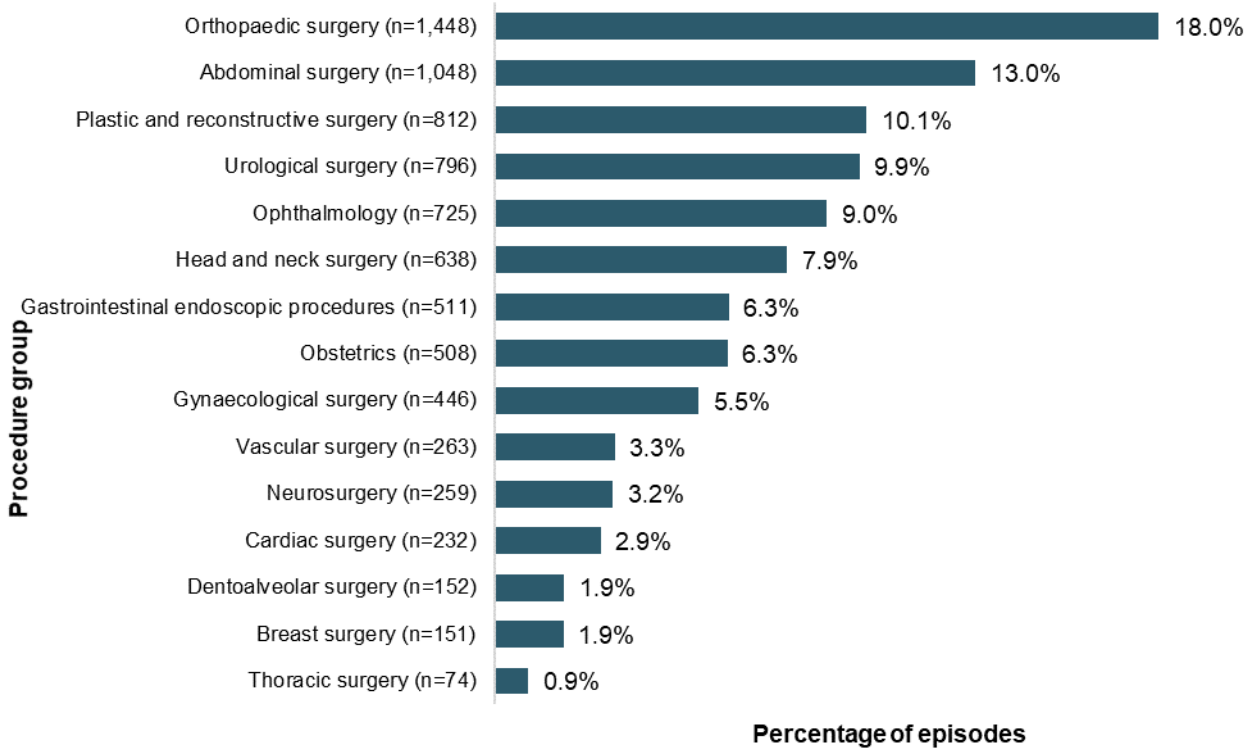
Treatment – an antimicrobial prescribed for the treatment of infection related to the procedure

Episodes where no prophylaxis prescribed – any episode where all prescribed antimicrobials are recorded as for ‘treatment’ and/or ‘not assessable’

Procedure groups

The highest number of procedures reported to Surgical NAPS in 2019 were for orthopaedic surgery (Figure 3.3). Ophthalmology procedures accounted for 9.0% of reported procedures, and the largest change for a specialty since the 2016 pilot, with an increase of 3.4% (Figure A6.1). The proportion of facilities contributing data for procedure groups ranged from 13.2% (19 facilities) for thoracic surgery to 70.8% (102 facilities) for plastic and reconstructive surgery (Table A3.3).

Figure 3.3: Percentage of surgical episodes for each surgical procedure group, Surgical NAPS contributor facilities, 2019*



Note: Where there were multiple procedures per surgical episode, only the primary procedure group was included
* *n* = 8,063 surgical episodes

Key Performance Indicators

DOCUMENTATION

Of the 7,367 incisional procedures reported, two thirds had a time of incision documented, (*n* = 4,875; 66.1%).

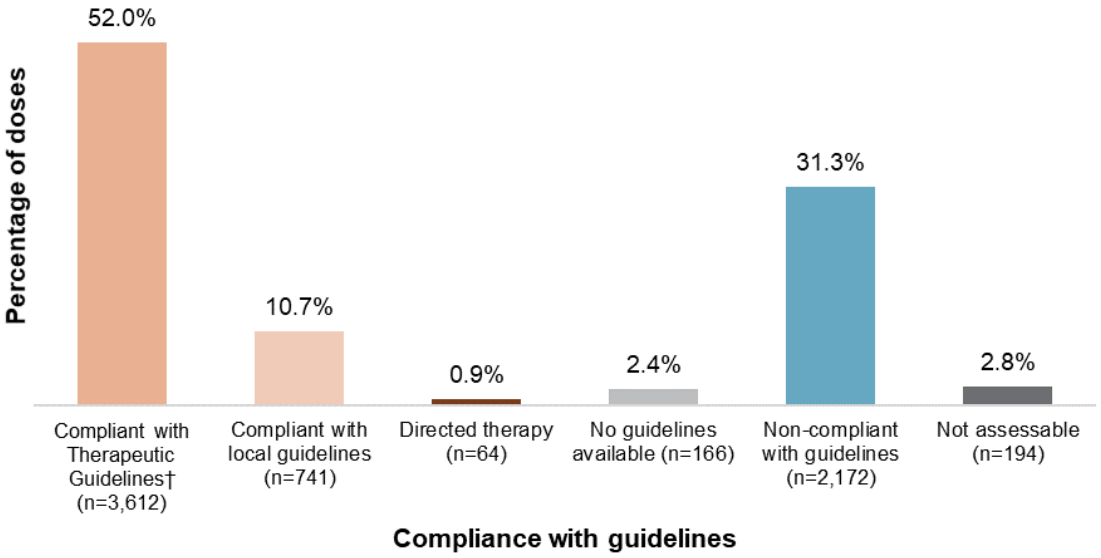
Of the 6,671 initial procedural doses prescribed, 26.9% were recorded to the exact minute, and 50.5% to the nearest 15 minutes. The remainder (22.6%) did not have a documented administration time.

COMPLIANCE WITH PRESCRIBING GUIDELINES

Procedural prescribing

When no procedural antimicrobials were prescribed, guideline compliance (either with *Therapeutic Guidelines*[6] or local guidelines), was high (85.8%). Compliance with prescribing guidelines was lower when antimicrobials were prescribed (62.7%), (Figure 3.4). Non-compliance increased to 66.7% when directed therapy, no guidelines available and not assessable doses were excluded.

Figure 3.4: Percentage of compliance with guidelines for procedural antimicrobial doses, Surgical NAPS contributor facilities, 2019*

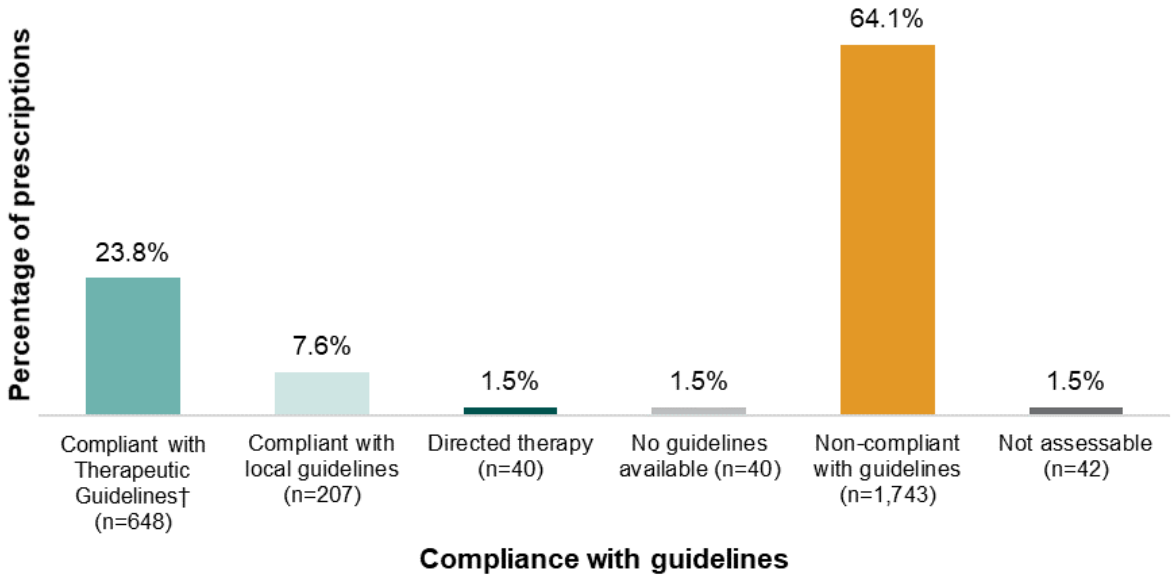


* *n* = 6,949 procedural antimicrobial doses
† Antibiotic Expert Group. *Therapeutic Guidelines: Antibiotic*. Version 16. Melbourne: Therapeutic Guidelines Limited; 2019. https://www.tg.org.au/

Post-procedural prescribing

When no post-procedural antimicrobials were prescribed, non-compliance with guidelines was infrequent (0.9%). When prescribed, the majority (64.1%) of post-procedural antimicrobial prophylaxis was non-compliant with guidelines (Figure 3.5). Non-compliance increased to 67.1%, when directed therapy, no guidelines available and not assessable prescriptions were excluded.

Figure 3.5: Percentage of compliance with guidelines for post-procedural prophylactic antimicrobial prescriptions, Surgical NAPS contributor facilities, 2019*

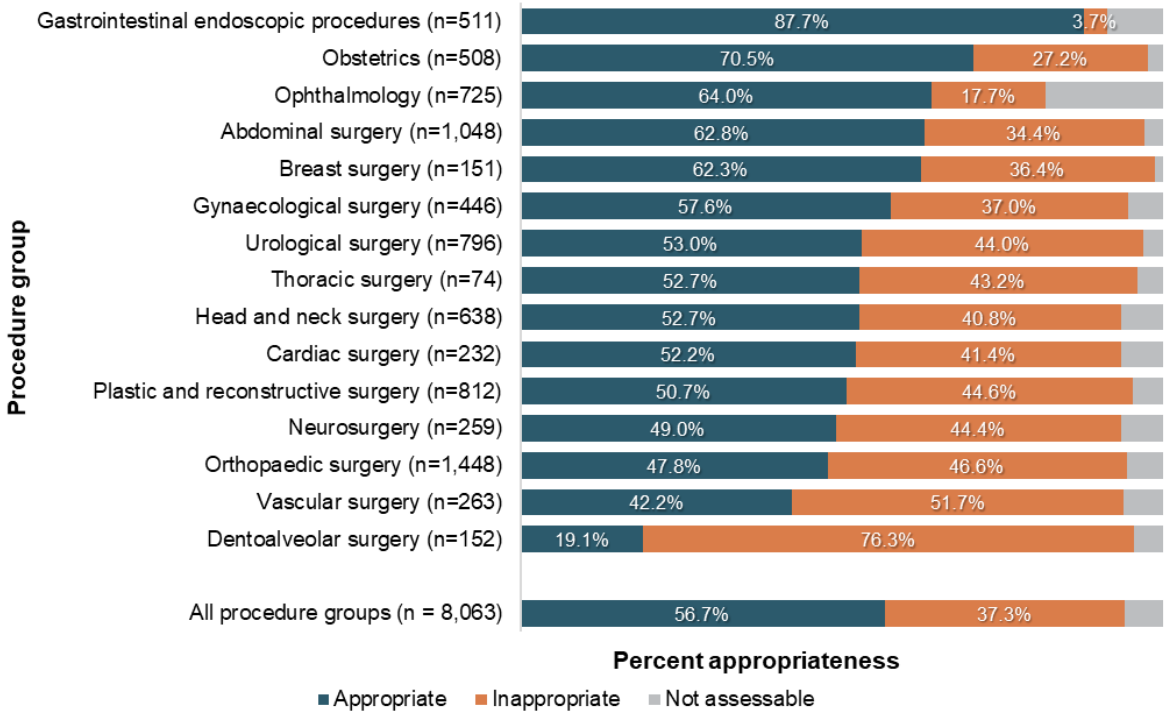


* *n* = 2,720 prescriptions for post-procedural prophylaxis
† Antibiotic Expert Group. *Therapeutic Guidelines: Antibiotic*. Version 16. Melbourne: Therapeutic Guidelines Limited; 2014. https://www.tg.org.au/

APPROPRIATENESS OF PRESCRIBING

Prescribing was assessed as inappropriate for 37.3% of all surgical episodes (Figure 3.6). The percentage of episodes deemed inappropriate varied by procedure group, ranging from 3.7% for gastrointestinal endoscopic procedures, to 76.3% for dentoalveolar surgery. For the majority of procedure groups, inappropriateness was greater than 25%. Rates of inappropriateness were lower for ophthalmology (17.7%) and gastrointestinal endoscopic procedures (3.7%); however, these procedure groups also had higher rates of episodes deemed not assessable (8.6% and 18.3%, respectively).

Figure 3.6: Percentage of episodes by appropriateness* of prescribing for each surgical procedure group, Surgical NAPS contributor facilities, 2019



* The overall appropriateness considers each antimicrobial prescribed, including all procedural doses and all post-procedural prophylaxis prescriptions, and taking the most inappropriate assessment as the overall appropriateness for that surgical episode.

Procedural prescribing

Over a quarter (27.4%) of all procedural prescribing was assessed as inappropriate (Table 3.2). The proportion of episodes deemed inappropriate was higher when antimicrobials were prescribed, than when they were not prescribed (34.2% and 9.2%, respectively). Antimicrobials were prescribed when not required in 11.4% of episodes.

When procedural antimicrobials were prescribed, appropriateness was higher, with 59.9% deemed optimal (Figure A3.4). When no procedural antimicrobials were prescribed, inappropriateness was low (9.6%). Overall, 33.6% of all procedural prescribing was deemed inappropriate when non-assessable doses were excluded.

Table 3.2: Appropriateness of procedural prescribing of antimicrobials for surgical episodes and antimicrobial doses, Surgical NAPS contributor facilities, 2019*

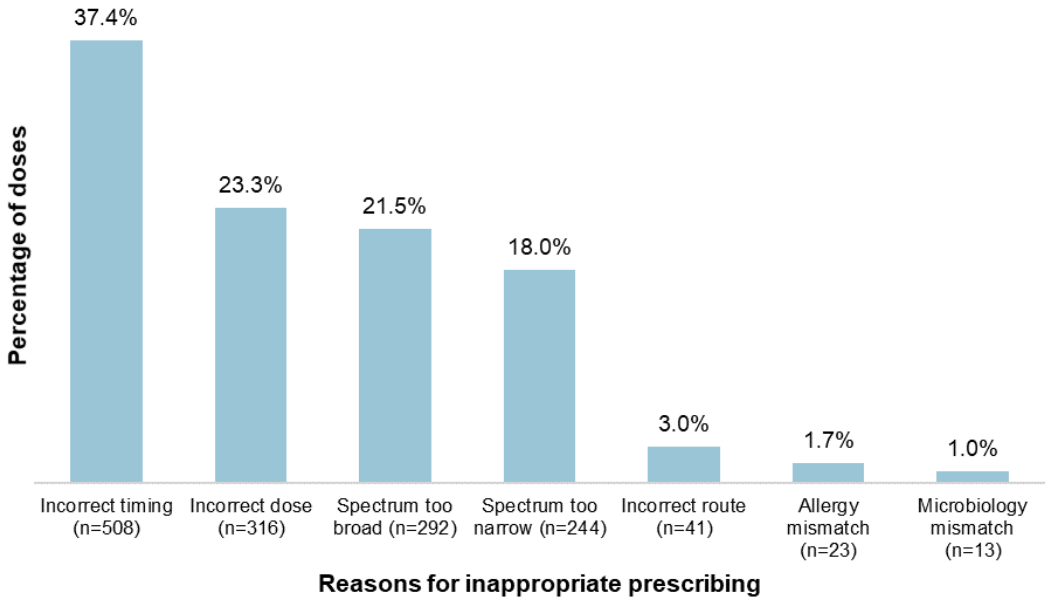
	Total (n)	Appropriate (n)	(%)	Inappropriate (n)	(%)	Not assessable (n)	(%)
Surgical episodes	**8,063**	**5,469**	**67.8**	**2,206**	**27.4**	**388**	**4.8**
Antimicrobial prescribed	5,868	3,566	60.8	2,005	34.2	297	5.1
↳ when required	*5,056*	*3,523*	*69.7*	*1,250*	*24.7*	*283*	*5.6*
↳ when not required	*917*	*47*	*5.13*	*849*	*92.6*	*21*	*2.3*
No antimicrobial prescribed	2,195	1,903	86.7	201	9.2	91	4.2
↳ when required	*251*	*66*	*26.3*	*182*	*72.5*	*3*	*1.2*
↳ when not required	*1944*	*1,837*	*94.5*	*19*	*1.0*	*88*	*4.5*
Antimicrobial doses	**6,949**	**4,411**	**63.5**	**2,226**	**32.0**	**312**	**4.5**
Initial dose	6,671	4,202	63.0	2,164	32.4	305	4.6
↳ when required	*5,740*	*4,153*	*72.4*	*1,303*	*22.7*	*284*	*5.0*
↳ when not required	*931*	*49*	*5.3*	*861*	*92.5*	*21*	*2.3*
Repeat dose	278	209	75.2	62	22.3	7	2.5
↳ when required	*270*	*208*	*77.0*	*56*	*20.7*	*6*	*2.2*
↳ when not required	*8*	*1*	*12.5*	*6*	*75.0*	*1*	*12.5*
↳ not given when required	*29*	*–*	*–*	*29*	*100*	*–*	*–*

* The overall appropriateness of prescribing for a surgical episode was determined by taking the lowest ranked assessment of the individual doses, including all episodes where antimicrobials were prescribed as well as when none were prescribed.

Reasons for inappropriate prescribing

For procedural doses, where antimicrobials were recommended by guidelines, 22.6% were deemed inappropriate. The most common reasons for this inappropriate prescribing were incorrect timing, incorrect dosage, and spectrum too broad (37.4%, 23.3% and 21.5%, respectively) (Figure 3.7).

Figure 3.7: Reasons for inappropriateness, by percentage of required procedural antimicrobial doses, Surgical NAPS contributor facilities, 2019*



* *n* = 1,359 antimicrobial doses

Timing of administration

Incorrect timing was the reason for 37.4% of required procedural doses being deemed inappropriate (Figure 3.7). As 22.6% of procedural doses did not have a recorded administration time, when these were excluded, incorrect timing accounted for 10.4% of all required procedural doses.

Post-procedural prescribing

Post-procedural prophylaxis was deemed inappropriate in 19.8% of the 7,420 surgical episodes audited, (Table 3.3). For the 64.2% of episodes where no post-procedural antimicrobials were prescribed, these were almost universally deemed appropriate (99.0%). Of the surgical episodes that had at least one post-procedural antimicrobial prescribed for prophylaxis, 61.5% were deemed inappropriate. Antimicrobials were prescribed when not required for 13.2% of episodes.

The majority of post-procedural antimicrobial prophylaxis prescriptions were deemed inadequate (50.7%), while approximately one quarter were assessed as optimal (26.6%), (Figure A3.5). Post-procedural prophylaxis was deemed inappropriate in 65.1% of prescriptions, when the non-assessable prescriptions were excluded.

Table 3.3: Appropriateness of post-procedural prophylactic prescribing of antimicrobials for surgical episodes and antimicrobial prescriptions*, Surgical NAPS contributor facilities, 2019#

Post–procedural prophylaxis	Total (n)	Appropriate (n)	(%)	Inappropriate (n)	(%)	Not assessable (n)	(%)
Surgical episodes	**7,420**	**5,412**	**72.9**	**1,468**	**19.8**	**548**	**7.4**
Antimicrobial prescribed	2,312	806	34.9	1,421	61.5	85	3.7
↳ *when required*	*1,332*	*727*	*51.3*	*527*	*43.1*	*78*	*5.6*
↳ *when not required*	*980*	*79*	*8.1*	*894*	*91.2*	*7*	*0.7*
No antimicrobial prescribed	4,765	4,606	96.7	47	1.0	112	2.4
↳ *when required*	*116*	*96*	*82.8*	*19*	*16.4*	*1*	*0.9*
↳ *when not required*	*4,694*	*4,510*	*97.0*	*28*	*0.6*	*1*	*2.4*
Not assessable	343	–	–	–	–	343	100
Antimicrobial prescriptions	**2,810**	**956**	**34.0**	**1,735**	**61.7**	**119**	**4.2**
Prophylaxis	2,720	918	33.8	1,713	63.0	89	3.3
↳ *when required*	*1,585*	*835*	*52.7*	*666*	*42.0*	*84*	*5.3*
↳ *when not required*	*1,135*	*83*	*7.3*	*1,047*	*92.3*	*5*	*0.4*
Treatment	48	32	66.7	7	14.6	9	18.8
Not assessable	42	6	14.3	15	35.7	21	50.0

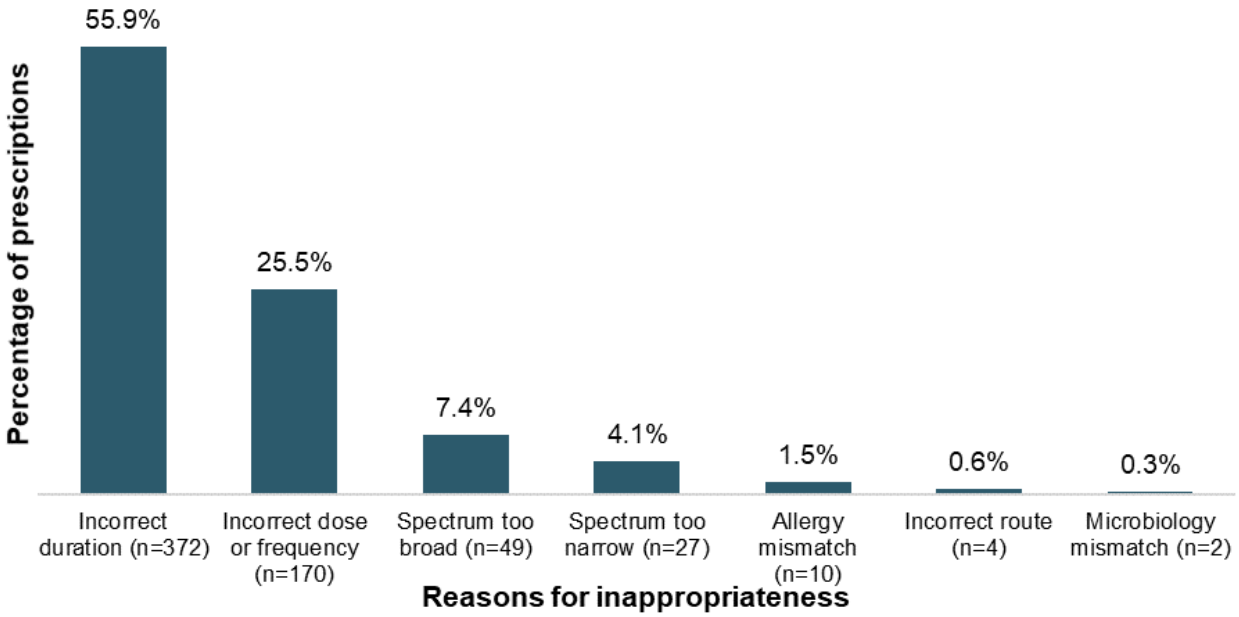
* The overall appropriateness of prescribing for a surgical episode was determined by taking the lowest ranked assessment of the individual post-procedural prescriptions

643 surgical episodes had only post-procedural antimicrobials prescribed for treatment of infection or were not assessable and were excluded from the analysis

Reasons for inappropriate prescribing

For post-procedural prophylactic prescriptions, where prophylaxis was recommended by guidelines, 42.0% were deemed inappropriate. The majority of inappropriate prescriptions were due to incorrect duration (55.9%); dose and frequency inconsistencies were the next most common reason (25.5%) (Figure 3.8).

Figure3.8: Reasons for inappropriateness, by percentage of required post-procedural prophylactic antimicrobial prescriptions, Surgical NAPS contributor facilities, 2019*



* *n* = 666, prescriptions where post-procedural antimicrobial prophylaxis was required and deemed inappropriate

Duration greater than 24 hours

Of all post-procedural prescriptions, 61.4% involved prophylaxis for up to or greater than 24 hours, and 42.8% up to or greater than 48 hours (Table 3.4). The procedural specialties for which this occurred most frequently were, dentoalveolar surgery, ophthalmology, head and neck surgery and breast surgery (95.1%, 90.9% 76.8% and 63.5%, respectively). When burden of episodes audited is considered, 56.5% of all prescriptions up to or greater than 48 hours are accounted for by three procedure groups: ophthalmology (*n* = 299 prescriptions), plastic and reconstructive surgery (*n* = 187 prescriptions) and head and neck surgery (*n* = 172 prescriptions).

Table 3.4: Duration of surgical prophylaxis and percentage prescribed for greater than 24 and 48 hours, by procedure group, Surgical NAPS contributor facilities, 2019

Procedure group	Antimicrobial Prescriptions (n)	Duration range (days)	Duration median (days)	Duration > 24 hours (n)	(%)	Duration > 48 hours (n)	(%)
Orthopaedic surgery	920	1–21	1	336	36.5	92	10.0
Ophthalmology	329	1–40	8	304	92.4	299	90.9
Plastic and reconstructive surgery	281	1–37	4	205	73.0	187	66.5
Head and neck surgery	224	1–48	5	181	80.8	172	76.8
Abdominal surgery	173	1–14	2	126	72.8	94	54.3
Urological surgery	167	1–62	2	129	77.2	98	58.7
Cardiac surgery	165	1–14	1	104	63.0	47	28.5
Neurosurgery	125	1–20	1	58	46.4	27	21.6
Gynaecological surgery	75	1–8	1	47	62.7	20	26.7
Obstetrics	69	1–29	1	40	58.0	20	29.0
Breast surgery	63	1–18	5	46	73.0	40	63.5
Vascular surgery	51	1–20	1	34	66.7	20	39.2
Dentoalveolar surgery	41	2–9	5	41	100	39	95.1
Thoracic surgery	34	1–4	1	16	47.1	6	17.6
Gastrointestinal endoscopic procedures	<5	5–6	6	<5	–	<5	–
Grand Total	**2,720**	**1–62**	**2**	**1,670**	**61.4**	**1,164**	**42.8**

4 Discussion

Surgical prophylaxis, when prescribed appropriately, has the benefit of reducing the development of post-operative infections, including surgical site infections, pneumonia, and urinary tract infections.[6] Use of antimicrobials for the prevention of such infections must be balanced against complications associated with their use, including allergic and adverse drug reactions, and the development of antimicrobial resistance. Surgical antimicrobial prophylaxis should be reserved for procedures or clinical situations where there is strong evidence that the benefit outweighs potential harm.

For the 2019 Surgical NAPS, which was the fourth year the audit has been conducted, the increase in uptake, compared with 2018, was extremely encouraging. As the survey is voluntary, and resource intensive compared with Hospital NAPS and Quality Improvement NAPS, this increase suggests that the survey is regarded as a valuable tool to identify opportunities to improve surgical antimicrobial prophylaxis. Despite variation in participation rates and the specialty focus between contributors, consistent themes for quality improvement are evident.

There is suboptimal documentation of surgical incision and antimicrobial administration times. Incision time was not documented for 1 in 3 procedures, and administration time was not documented for 1 in 5 procedures for which data were submitted to the 2019 Surgical NAPS. The timing of surgical prophylaxis is important to ensure high concentrations of antimicrobials at time of surgical incision. Ensuring documentation of both incision and antimicrobial administration times may improve antimicrobial administration times and help prevent surgical site infections. Implementation of electronic medical records creates an opportunity to support improvements in surgery documentation.

Compliance with national prescribing guidelines[6] continues to be poor, generally due to prolonged durations of oral, ocular, and topical antimicrobials post-procedurally. Post-procedural extended use of oral or topical antimicrobials is not recommended by these guidelines, and should be discouraged. Antimicrobials should only be prescribed when the evidence supports their use. In the absence of other nationally or locally endorsed guidelines, optimal use of surgical antimicrobial prophylaxis in Australia is available in the *Therapeutic Guidelines: Antibiotic.*[6]

The antimicrobial stewardship criterion of the National Safety and Quality Health Service (NSQHS) Preventing and Controlling Healthcare-Associated Infection Standard[1] requires health service organisations to provide access to, and promote use of, evidence-based Australian therapeutic guidelines. This Standard also requires antimicrobial stewardship programs to take action to improve prescribing, and to report to clinicians on appropriateness of prescribing and compliance with guidelines.

Longitudinal trend analysis of the Surgical NAPS needs to be undertaken with due consideration to the variation in the cohort that occurs each year in relation to procedure groups audited, the peer groups that voluntarily contribute data and intermittent participation in Surgical NAPS by individual facilities. However, over the four years that the Surgical NAPS has been conducted, there has been an increase in the appropriateness of procedural prescribing, which may be due to improved timing of administration and dosage of antimicrobials. There have been no discernible changes in appropriateness of post-procedural prescribing over the four years, as evidenced by high rates of extended post-procedural antimicrobial prophylaxis.

Given the small improvement in appropriateness of procedural prescribing over time, a focus on practical and effective interventions is needed to sustain and enhance these changes. Simple processes implemented consistently by health service organisations, such as a focus on improved documentation and timing of incision and antimicrobial administration, could lead to improvements in surgical site infections and reduced complications from antimicrobial use. These interventions do not require complex antimicrobial stewardship or infectious diseases advice, so should be feasible to implement rapidly for most health service organisations that perform surgical procedures.

Improvements in post-procedural prescribing may be more challenging to achieve, without engagement with the surgical specialties, including co-design and leadership of these initiatives. Peer review of prescribing practices and benchmarking of outcomes may contribute to changes in practice. Nurse or pharmacist led automatic stop orders, may be useful if extended duration of antimicrobial use is impacted by the frequency of antimicrobial review. Antimicrobial stewardship programs in Surgical NAPS contributor organisations can develop targeted initiatives informed by analyses of their own data. Local evaluation will assist antimicrobial stewardship programs to identify which specialties they should target to improve surgical prophylaxis, and where return on investment is likely to be greatest based on volume of procedures and the rate of appropriateness.

The summary analyses included in this report for specific procedure groups (see Appendix 5), are intended to support focussed quality improvement approaches, such as local benchmarking of surgical antimicrobial prophylaxis by specialty and targeted interventions. These include orthopaedic surgery, abdominal surgery, plastic and reconstructive surgery, and urological surgery, because of either increased surgical loads in these specialties, or high rates of inappropriate prescribing in specific circumstances.

For many procedures, there is no evidence that prophylactic antimicrobial use procedurally or post-procedurally is of benefit in reducing post-operative infections and, as such, it is not recommended by guidelines for these procedures. There are very few procedures or clinical situations where available evidence supports antimicrobial use for other than a single pre-operative dose. Even in these situations, the total duration of antimicrobial prophylaxis should not exceed 24 hours. An exception to this is ophthalmic surgery, for which use of chloramphenicol for up to a week post-procedurally may be considered.[6]

In summary, and consistent with findings from previous surveys of surgical prophylaxis, the 2019 Surgical NAPS identified ongoing concerning inappropriate use of surgical prophylaxis in contributor hospitals. These issues require urgent attention.

Appendix 1: Methodology

Data collection

DATA COLLECTION PERIOD

Data submitted through the online data entry portal from 1 January to 31 December 2019 were eligible for inclusion in the 2019 public report.

RECRUITMENT

The Surgical NAPS module was available to all users registered for the NAPS. All registered users of NAPS program were notified, and it was also marketed on social media via Twitter by NCAS and the Commission.

INCLUSION CRITERIA

Any procedure type could be audited, including incisional or non-incisional procedures.

AUDIT METHODOLOGY

Auditors could choose a variety of methods to perform the survey, depending on the size of the facility and available resources. Data were able to be collected on paper data collection forms then entered into the online portal (see Appendix 8 for data fields), or could be entered directly into the online portal.

Retrospective audit

Retrospective audit was the recommended methodology, where possible. This survey could be performed over any chosen timeframe, however a minimum of one week or 30 consecutive procedures or surgical episodes was recommended. Ideally, theatre lists were obtained for each day to capture all procedures during this timeframe. For those wanting to collect 30-day outcome follow-up data, it was recommended to perform retrospective chart and record review at least 30 days after the theatre list date.

Prospective audit

This survey can be performed over any chosen timeframe, however a minimum of one week or 30 consecutive procedures or surgical episodes was recommended. To capture all procedures during this timeframe, a theatre list was obtained for each day during the selected audit timeframe. Patients who underwent a procedure or surgical episode were followed prospectively for data collection purposes. This process began once the patient left the operation suite/theatre and continued until postoperative antimicrobials had been ceased, or at 30-day follow-up (if collecting 30-day outcome follow-up data).

Other audit types

Smaller, directed surveys are useful to examine the routine practice of a surgical specialty or for a particular procedure. This may be particularly relevant following a survey where an issue has been identified, such as over-prescription of an antimicrobial agent when compared to the national average, or when a specialty is not prescribing in accordance with guidelines.

Auditor education and support

A data collection form (see Appendix 4), user guide, Surgical NAPS appropriateness assessment guideline (see Appendix 5) and worked case examples were made available to users through the resources page of the Surgical NAPS module. The NAPS support team provided telephone and email support during the survey period, as it does for all NAPS programs.

Three online videos were also developed and made available on the resources page. The videos covered utilising the resources and creating a survey, data entry and reporting functionality. A written guide to interpreting Surgical NAPS reports was also developed to assist users to understand their results, based on early feedback regarding the complex nature of the reports.

DEVELOPMENT OF TEMPLATES

A standardised reporting template and an example report were developed as a guide to help facilities communicate local survey results. Links to useful presentations and posters were also provided.

EXPERT ASSESSMENTS

An expert assessment service was provided by the NAPS support team. Facilities without access to infectious diseases specialists were offered assistance with the assessment of guideline compliance and prescription appropriateness. All facilities could request assessment support if they felt it would improve the quality of their audit.

Data cleaning

To ensure data accuracy with this new duration of surgical prophylaxis calculation methodology, there was extensive data cleaning performed prior to the 2019 data analysis. This mainly involved dates being entered incorrectly resulting in prolonged on negative durations of therapy. The data were carefully examined for errors, and 632 patient records were identified for review. From this review there were 498 records observed to have data entry errors, with 155 records requiring changes to admission or discharge dates, 160 records requiring changes to dates of antimicrobial administration, 35 records requiring changes to date of surgery and 148 records requiring changes to antimicrobial/route combinations. The majority of these changes were able to be identified and amended by the NAPS support team following internal review and discussion, with six facilities needing to be contacted directly to review and amend their records. This data cleaning process resulted in some survey data moving into alternate audit years resulting in a decrease in total facility participation in some years when compared to previous Surgical NAPS public reports.

Data analysis

PROCEDURAL ANTIMICROBIAL PROPHYLAXIS

Procedural antimicrobial prophylaxis was defined as any antimicrobial administered either immediately prior to or during the procedure for purposes of prophylaxis. Throughout this report, for procedural antimicrobials, each dose of the antimicrobial administered is recorded and reported individually.

POST-PROCEDURAL ANTIMICROBIAL PROPHYLAXIS

Post-procedural antimicrobial prophylaxis was defined as any antimicrobial given immediately following the surgical procedure for the purpose of surgical prophylaxis. Throughout this report, for post–procedural antimicrobials, each prescription course of the antimicrobial is recorded and reported, including any inpatient or discharge scripts.

From the 8,063 surgical episodes audited, 643 had post–procedural antimicrobials prescribed only for treatment of infection or were not assessable. These were excluded from the post-procedural prophylaxis analysis, leaving 7,420 surgical episodes.

APPROPRIATENESS ASSESSMENTS

For reporting purposes, 'optimal' and 'adequate' are deemed to be appropriate, while 'suboptimal' and 'inadequate' are deemed to be inappropriate, (see Appendix 9 for more information on definitions of appropriateness). Each surgical episode was given an overall assessment of inappropriate if any single aspect of the procedural or post-procedural prescribing was deemed inappropriate by the surveyor. This included allergy or microbiology mismatch; incorrect antimicrobial timing, dose, route, frequency or duration; if the antimicrobial spectrum was too broad or too narrow; or if the procedure did not require any antimicrobials.

CALCULATION OF DURATION OF SURGICAL PROPHYLAXIS

Duration of surgical prophylaxis was calculated from the surgical incision date and time, if recorded, otherwise the surgery start date and time was used. These dates and times were used as a surrogate measure to the more acute measure of administration date and time of the first procedural antimicrobial prescribed, which was not able to be determined for 1,510 (22.6%) of the prescribed initial procedural doses. The end date and time for the last prophylactic antimicrobial prescribed was then used to determine the end date and time of surgical prophylaxis. For calculation of duration of surgical prophylaxis greater than 24 and 48 hours, the required dates and times were consistently completed, and these were able to be calculated accurately. For days of therapy calculations, any incomplete administration time for the last dose of therapy did not affect these overall calculations.

CALCULATION OF PARTICIPATION RATES

In order to define the denominator for participation rates by different reporting groups (states and territories, peer groups and remoteness classifications), the Australian Institute of Health and Welfare peer group classification system was used.[4] Hospital peer groups that would not be expected to perform surgical procedures were excluded from the denominator calculation.

The peer groups **included** for determination of denominator numbers for rates of participation were:

Public facilities

Children's hospitals
Combined women's & children's hospitals
Mixed day procedure hospitals
Other day procedure hospitals
Principal referral hospitals
Public acute group A hospitals
Public acute group B hospitals
Public acute group C hospitals
Public acute group D hospitals
Women's hospitals
Women's and children's hospitals

Private facilities

Combined women's & children's hospitals
Endoscopy centres
Eye surgery centres
Gynaecology day hospitals
Mixed day procedure hospitals
Oral & maxillofacial surgery centres
Other acute specialised hospitals
Other specialist day hospitals
Other women's & children's hospitals
Plastic & reconstructive surgery centres
Private acute group A hospitals
Private acute group B hospitals
Private acute group C hospitals
Private acute group D hospitals
Women's hospitals

The peer groups **excluded** for determination of denominator numbers for rates of participation were:

Public facilities	**Private facilities**
Drug and alcohol hospitals	Cardiovascular health centres
Early parenting centres	Dialysis clinics
Mixed subacute and non–acute hospitals	Drug & alcohol hospitals
Other acute specialised hospitals	Fertility clinics
Other public acute specialised hospitals	Haematology & oncology clinics
Outpatient hospitals	Hyperbaric health centres
Public acute psychiatric hospitals	Mixed sub– & non–acute hospitals
Public child, adolescent & young adult psychiatric hospitals	Private acute psychiatric hospitals
Public forensic psychiatric hospitals	Private rehabilitation hospitals
Public rehabilitation hospitals	Reproductive health centres
Public sub– & non–acute psychiatric hospitals	Same day hospitals
Unpeered hospitals	Sleep centres
Very small hospitals	Unpeered hospitals
	Very small hospitals

Appendix 2: Limitations and considerations for interpretation of results

The results presented in this report should be interpreted in the context of the following limitations and considerations:

SAMPLING AND SELECTION BIAS

The facilities that participated were not a randomised sample because participation was voluntary. Therefore, the results might not be representative of all Australian facilities where surgery is performed. Each hospital could choose how to perform the Surgical NAPS audit. Audits may have been conducted as prevalence surveys (consecutive or random patients), directed surveys (particular surgical specialties or procedures) or other types of audits, therefore it is not possible to determine the prevalence of the surgical procedures or antimicrobials prescribed.

SURVEY METHODOLOGY WAS NOT DEFINED

For the Surgical NAPS, each hospital could decide how they performed the survey and which patients, or surgical specialties, were audited. If directed surveys were performed, patient sampling may not have been random, and auditors may have targeted problem or higher volume surgical units.

SUBJECTIVE NATURE OF ASSESSMENTS

Individual auditors at each participating facility were responsible for assessing the compliance with guidelines and appropriateness of antimicrobial prescribing. These assessments are not completely objective, as they involve some degree of interpretation; remote expert assessments were conducted by the NAPS support team on request.

LACK OF DATA FIELD ENTRY VALIDATION

To maintain strict timelines during the initial software development of the online survey, data validation or restrictions were not included for some fields. This allowed some data entry inconsistencies and the recording of incongruous results. Prior to compiling the 2019 results extensive data cleaning was performed, and the database was redesigned for the 2020 audit period to incorporate validation processes.

COMPARISON OF DATA OVER TIME

Care is required in relation to comparisons of Surgical NAPS data from one year to another, as the cohort of contributors varies from year to year, along with the proportions of surgical procedure groups represented.

Appendix 3: Supplementary data

Table A3.1: Number and percentage of participating public and private facilities, by remoteness classification,* Surgical NAPS 2019

Remoteness classification	Public (n)	Private (n)	Total (n)	Percentage of participating facilities (%)	Number in reporting group (n)	Percentage of reporting group (%)
Major cities	33	58	91	63.2	417	21.8
Inner regional	28	10	38	26.4	216	17.6
Outer regional	7	2	9	6.3	166	5.4
Remote	5	–	5	3.5	45	11.1
Very remote	1	–	1	0.7	27	3.7
Total	**74**	**70**	**144**	**100**	**871**	**16.5**

* Australian Bureau of Statistics. 1270.0.55.005 – Australian Statistical Geography Standard (ASGS): Volume 5 – Remoteness Structure, July 2016. AMS; Canberra 2018

Table A3.2: Number and percentage of Surgical NAPS contributor facilities by funding type, by surgical procedure group, 2019*

Procedure group	Public facilities (n)	Private facilities (n)	Contributing Facilities (n)	(%)
Plastic and reconstructive surgery	57	45	102	70.8
Orthopaedic surgery	48	47	95	66.0
Abdominal surgery	57	37	94	65.3
Urological surgery	49	39	88	61.1
Head and neck surgery	43	34	77	53.5
Gynaecological surgery	36	33	69	47.9
Obstetrics	42	26	68	47.2
Gastrointestinal endoscopic procedures	39	22	61	42.4
Ophthalmology	20	26	46	31.9
Vascular surgery	26	19	45	31.3
Neurosurgery	20	23	43	29.9
Breast surgery	15	26	41	28.5
Cardiac surgery	13	20	33	22.9
Dentoalveolar surgery	5	25	30	20.8
Thoracic surgery	10	9	19	13.2

* *n* = 144 facilities

Figure A3.1: Percentage of participating facilities, by state and territory, Surgical NAPS 2019

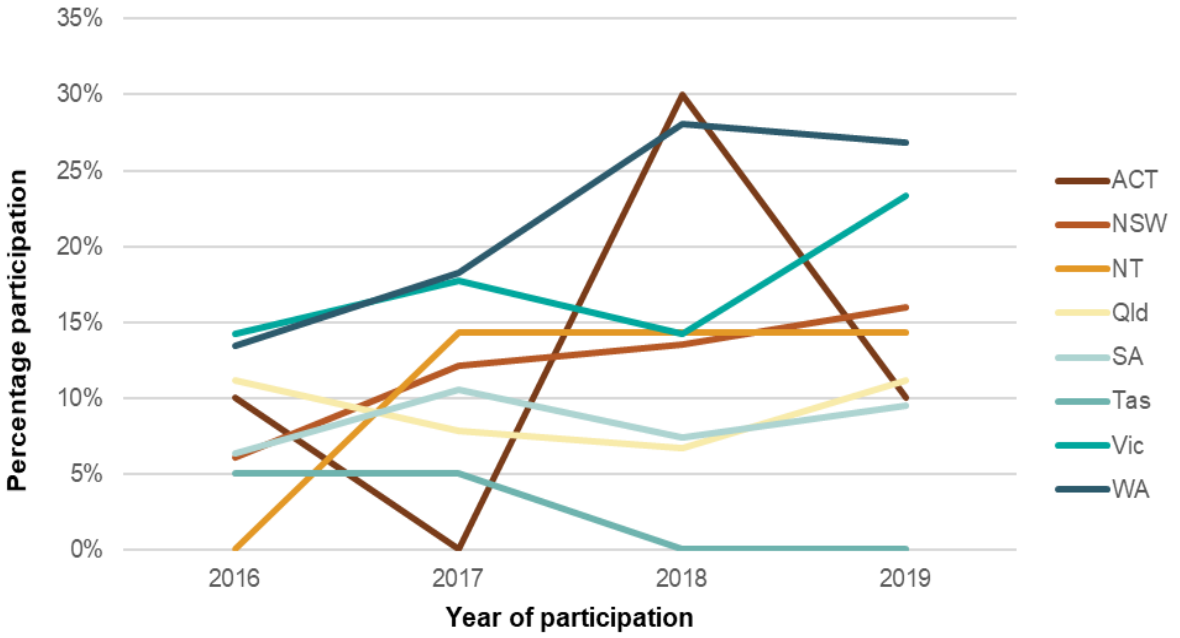
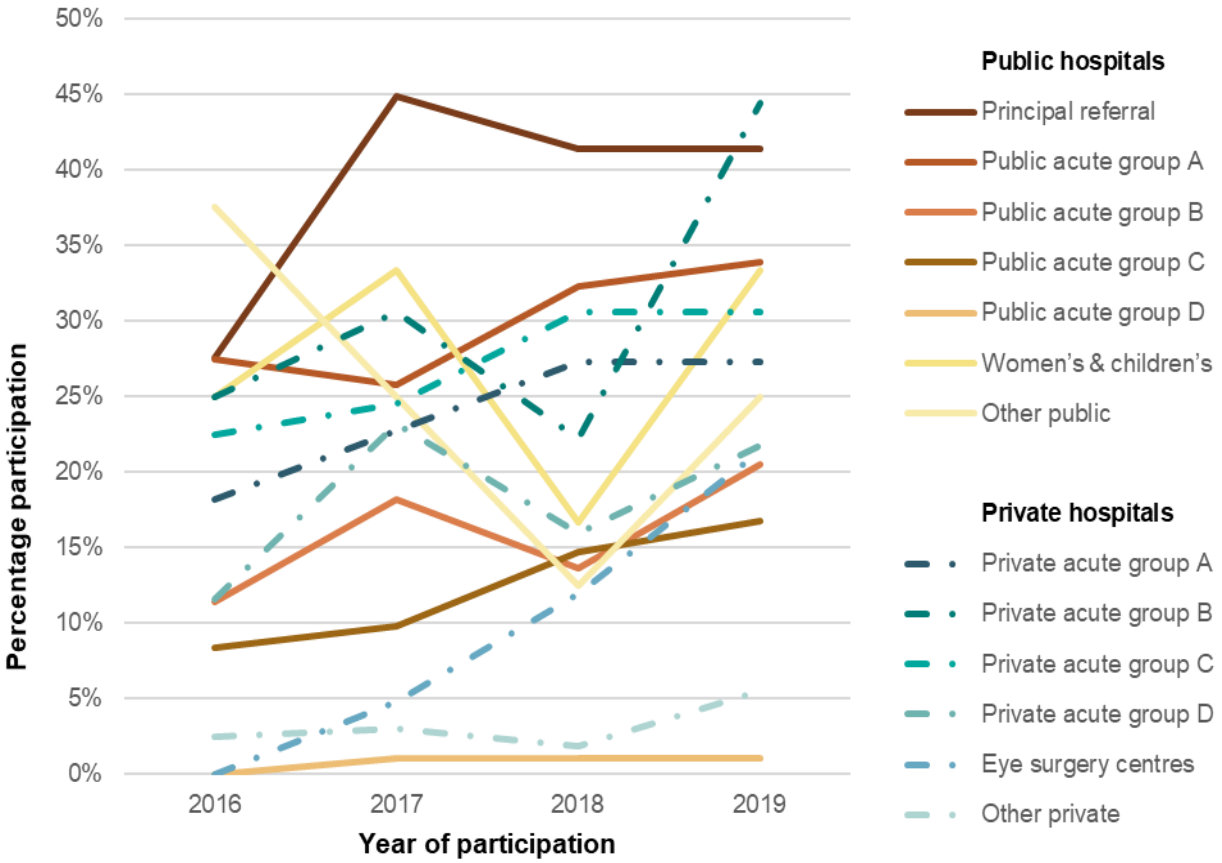
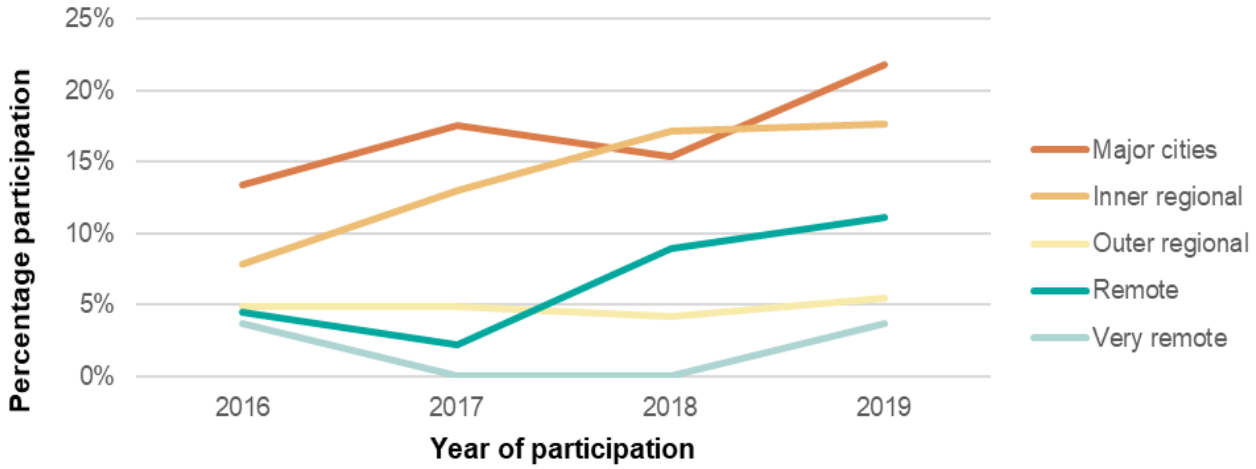


Figure A3.2: Percentage of participating facilities, by peer group classification*, Surgical NAPS 2019



* Australian Institute of Health and Welfare 2015. Australian hospital peer groups. Health services series no. 66. Cat. no. HSE 170. AIHW; Canberra 2015

Figure A3.3: Percentage of participating facilities, by remoteness classification*, Surgical NAPS, 2019



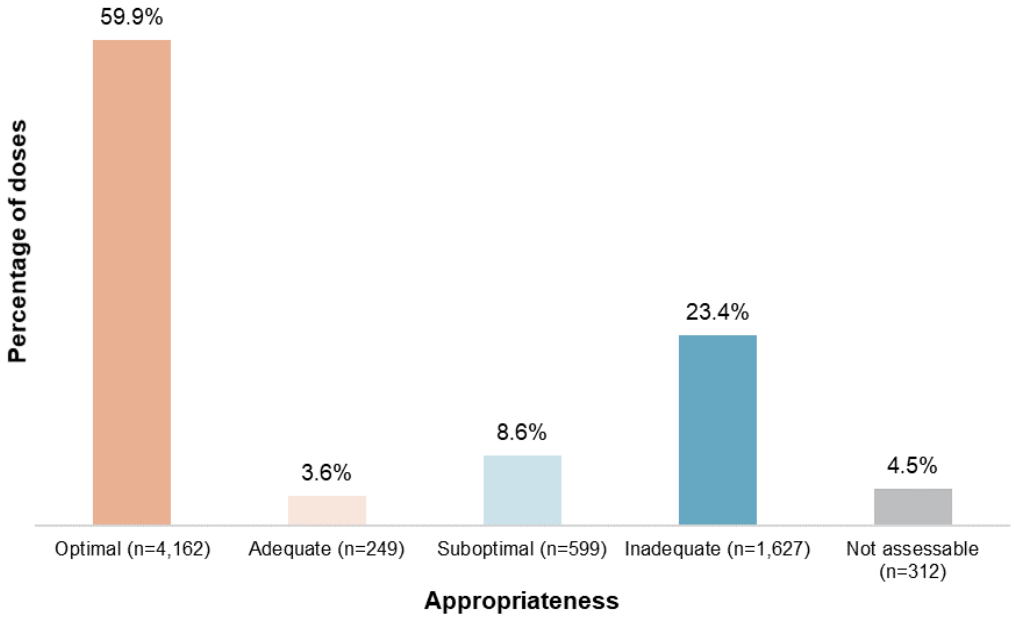
* Australian Bureau of Statistics. 1270.0.55.005 – Australian Statistical Geography Standard (ASGS): Volume 5 – Remoteness Structure, July 2016. AMS; Canberra 2018

Table A3.3: Number and percentage of participating public and private facilities, by peer group classification,* Surgical NAPS 2019

Peer group classification	Number (n)	Percentage of participating facilities (%)	Number in reporting group (n)	Percentage of reporting group (%)
Public facilities	**74**	**51.4**	**493**	**15.0**
Principal referral hospitals	12	8.3	29	41.4
Public acute group A hospitals	21	14.6	62	33.9
Public acute group B hospitals	9	6.3	44	20.5
Public acute group C hospitals	24	16.7	143	16.8
Public acute group D hospitals	2	1.4	191	1.0
Women's hospitals	2	1.4	5	40.0
Children's hospitals	2	1.4	6	33.3
Other acute specialised hospitals	1	0.7	3	33.3
Unpeered hospitals	1	0.7	10	10.0
Private facilities	**70**	**48.6**	**316**	**22.2**
Private acute group A hospitals	6	4.2	22	27.3
Private acute group B hospitals	16	11.1	36	44.4
Private acute group C hospitals	15	10.4	49	30.6
Private acute group D hospitals	15	10.4	69	21.7
Mixed day procedure hospitals	4	2.8	53	7.5
Other day procedure hospital	1	0.7	4	25.0
Eye surgery centres	9	6.3	42	21.4
Plastic & reconstructive surgery centres	1	0.7	26	3.8
Other acute specialised hospitals	3	2.1	15	20.0
Total	**144**	**100**	**809**	**17.8**

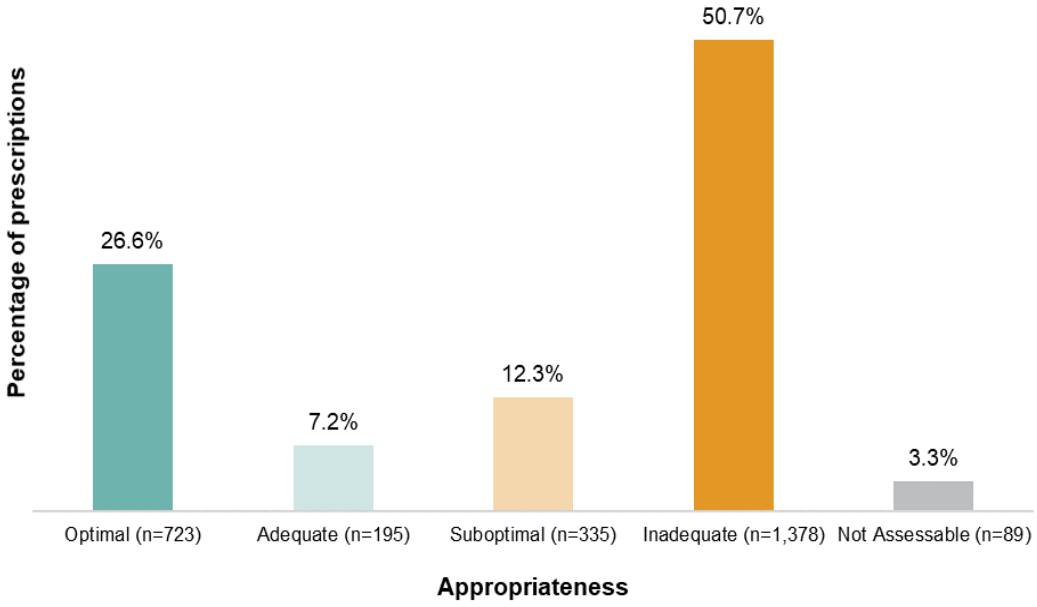
* Australian Institute of Health and Welfare 2015. Australian hospital peer groups. Health services series no. 66. Cat. no. HSE 170. AIHW; Canberra 2015

Figure A3.4: Percentage of appropriateness for procedural antimicrobial doses, Surgical NAPS contributor facilities, 2019*



* *n* = 6,949 procedural antimicrobial doses

Figure A3.5: Percentage of appropriateness for post-procedural prophylactic antimicrobial prescriptions, Surgical NAPS contributor facilities, 2019*



* *n* = 2,720 prescriptions for post-procedural prophylaxis

Appendix 4: Additional analyses

Antimicrobial choice

Cefazolin was the most commonly prescribed antimicrobial accounting for 77.5% of prescriptions of procedural and 51.8% of post–procedural prescriptions.

Procedural prescribing

The top five procedural antimicrobials prescribed accounted for 91.8% of all antimicrobials: cefazolin (77.5%), metronidazole (5.5%), gentamicin (3.9%), chloramphenicol (3.0%) and ceftriaxone (1.9%), as shown in Table A4.1. The rates of prescribing deemed inappropriate for cefazolin and metronidazole were the lowest, and occurred in more than 1 in 4 doses, (28.0% and 28.3%, respectively); rates of prescribing deemed inappropriate were greater than 65% for amoxicillin, ceftriaxone and clindamycin.

Table A4.1: Percentage and inappropriateness of procedural antimicrobial doses,* Surgical NAPS contributor facilities, 2019

Antimicrobial	Total doses prescribed (n)	(%)	Inappropriate (n)	(%)
Cefazolin	5,388	77.5	1,507	28.0
Metronidazole	385	5.5	109	28.3
Gentamicin	273	3.9	116	42.5
Chloramphenicol	205	3.0	96	46.8
Ceftriaxone	131	1.9	97	74.1
Vancomycin	121	1.7	75	62.0
Clindamycin	99	1.4	65	65.7
Amoxicillin	59	0.9	47	79.7
Ofloxacin	41	0.6	3	7.3
Ciprofloxacin	38	0.6	19	50.0
Ampicillin	37	0.5	14	37.8
Piperacillin–tazobactam	36	0.5	19	52.8
Tobramycin	17	0.2	0	0.0
Flucloxacillin	16	0.2	10	62.5
Lincomycin	15	0.2	7	46.7
Cefalothin	12	0.2	2	16.7
Teicoplanin	11	0.2	3	27.3
Amoxicillin–clavulanic acid	11	0.2	6	54.6
Meropenem	10	0.1	6	60.0
Total	**6,949**	**100**	**2,226**	**32.0**

* Data are not shown for antimicrobials where n <10

Post-procedural prescribing

The five most frequently prescribed post-procedural antimicrobials accounted for 82.0% of all antimicrobials prescribed: cefazolin (51.8%), chloramphenicol (10.6%), cefalexin (10.4%), metronidazole (4.9%), and ciprofloxacin, (4.3%), as shown in Table A4.2. All antimicrobials had relatively high rates of prescribing deemed inappropriate. The antimicrobials with lower rates of prescriptions deemed inappropriate were ciprofloxacin, ofloxacin and chloramphenicol (31.0%, 33.3% and 33.9%, respectively). These agents are generally associated with ophthalmic procedures, where post-procedural prophylaxis may be appropriate.

Table A4.2: Post-procedural prophylactic prescribing of antimicrobials and percentage inappropriate,* Surgical NAPS contributor facilities, 2019

Antimicrobial	Total prescriptions (n)	(%)	Inappropriate (n)	(%)
Cefazolin	1,408	51.8	840	59.7
Chloramphenicol	289	10.6	98	33.9
Cefalexin	283	10.4	239	84.5
Metronidazole	133	4.9	106	79.7
Ciprofloxacin	116	4.3	36	31.0
Amoxicillin–clavulanic acid	102	3.8	83	81.4
Ceftriaxone	59	2.2	51	86.4
Vancomycin	44	1.6	38	86.4
Clindamycin	44	1.6	36	81.8
Amoxicillin	35	1.3	29	82.9
Trimethoprim	33	1.2	32	97.0
Gentamicin	26	1.0	24	92.3
Ampicillin	22	0.8	19	86.4
Tobramycin	17	0.6	16	94.1
Ofloxacin	15	0.6	5	33.3
Piperacillin–tazobactam	14	0.5	9	64.3
Cefalothin	14	0.5	6	42.9
Total	**2,720**	**100**	**1,713**	**63.0**

* Data are not shown for antimicrobials where n <10

Route of administration

Procedural prescribing

Procedural antimicrobial doses were predominantly administered by the intravenous (86.4%) and ocular routes (10.5%). Topical antimicrobials accounted for 2.7% of prescribing, despite not being recommended as an appropriate route for use in procedural surgical antimicrobial prophylaxis. More than three quarters (75.5%) of prescriptions for topical antimicrobial use were deemed inappropriate.

Post-procedural prescribing

Post-procedural antimicrobial prescriptions were predominantly for intravenous (64.0%) and oral (19.5%) administration. As for procedural prescribing, if post-procedural prophylaxis is required, guidelines almost always recommend intravenous administration and therefore a large proportion of post-procedural oral antimicrobials (84.9%) were deemed inappropriate. As topical antimicrobials for ophthalmic procedures may be appropriately prescribed post-procedurally, when these were excluded, almost two thirds of all topical antimicrobials (65.2%) were deemed inappropriate.

The route of administration also had an impact on duration of therapy. There was a median of one day of therapy for intravenously administered antimicrobials, compared to 13 days of therapy administered via the ocular route. There were also prolonged durations for topical and oral administration, which had a median of seven and five days of therapy respectively, (Table A4.3). Episodes where antimicrobials were prescribed for up to or greater than 24 hours generally continued past 48 hours for all administration routes, except for those prescribed intravenously.

Table A4.3: Duration of surgical prophylaxis and percentage prescribed for greater than 24 and 48 hours, by route of administration, Surgical NAPS contributor facilities, 2019*

Route of administration	Antimicrobial Prescriptions (n)	Duration range (days)	Duration median (days)	Duration > 24 hours (n)	(%)	Duration > 48 hours (n)	(%)
Intravenous	1,741	1–29	1	765	43.9	281	16.1
Oral	531	1–62	5	484	91.1	470	88.5
Ocular	246	1–36	13	224	91.1	222	90.2
Topical	199	1–48	7	195	98.0	190	95.5
Total	**2,717**	**1–71**	**2**	1,667	61.4	1,161	42.7

* Data are not shown for routes where n < 10

Prescribing by facility funding type

Procedural prescribing

The rate of prescribing for procedural antimicrobials was higher in private facilities than public facilities (74.4% and 71.3%, respectively). This was reflected in rates of inappropriate procedural antimicrobial prescribing between private and public facilities, with 37.4% and 35.7% being deemed inappropriate respectively (Table A4.4).

Table A4.4: Appropriateness of procedural antimicrobial prescribing, by funding type, Surgical NAPS contributor facilities, 2019

Funding type	Surgical episodes (n)	At least one antimicrobial prescribed (n)	(%)	Total Doses (n)	Inappropriate (n)	(%)
Public facilities	4,211	3,002	71.3	3,674	1,311	35.7
Private facilities	3,852	2,866	74.4	3,275	1,226	37.4
Total	**8,063**	**5,865**	**72.7**	**6,949**	**2,537**	**36.5**

Post-procedural prescribing

The rate of prescribing at least one post-procedural antimicrobial was higher in private facilities than public facilities (34.9% and 27.6%, respectively). Although a higher proportion of prescriptions were deemed inappropriate in public facilities (70.3%), compared to private facilities (56.2%) (Table A4.5).

Table A4.5: Post-procedural prophylactic antimicrobials by funding type, Surgical NAPS contributor facilities, 2019*

Funding type	Surgical episodes (n)	At least one prophylactic antimicrobial prescribed (n)	(%)	Total Doses (n)	Inappropriate (n)	(%)
Public facilities	3,812	1,052	27.6	1,311	921	70.3
Private facilities	3,608	1,260	34.9	1,409	792	56.2
Total	**7,420**	**2,312**	**31.2**	**2,720**	**1,713**	**63.0**

The range for the duration of surgical prophylaxis prescribing was greater for public facilities (1–62 days) compared to private facilities (1–39 days); the corresponding median duration of prescribing was two and one day/s, respectively (Table A4.6). This was also demonstrated by the proportion of surgical prophylaxis prescribed for greater than 24 hours in in public and private facilities (64.5% and 58.6%, respectively).

Table A4.6: Duration of surgical prophylaxis and percentage prescribed for greater than 24 and 48 hours, by funding type, Surgical NAPS contributor facilities, 2019

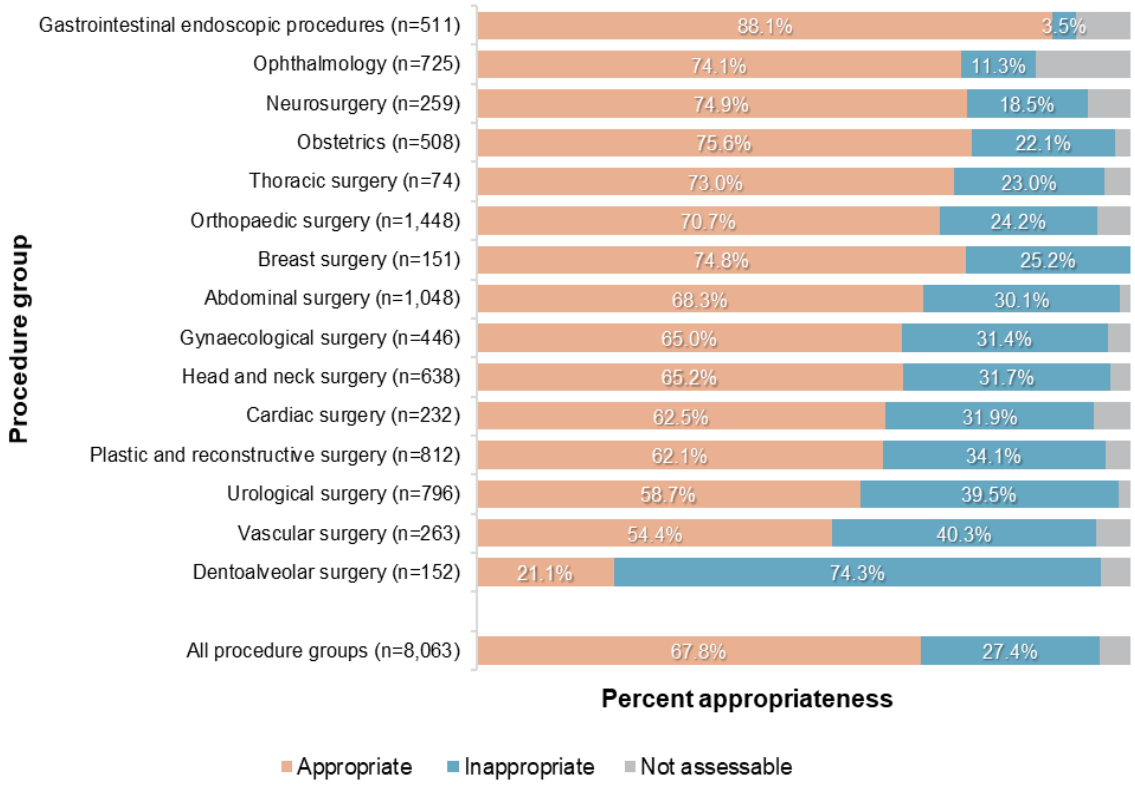
Funding type	Antimicrobial Prescriptions (n)	Duration range (days)	Duration median (days)	Duration > 24 hours (n)	(%)	Duration > 48 hours (n)	(%)
Public facilities	1,311	1–62	2	845	64.5	612	46.7
Private facilities	1,409	1–39	1	825	58.6	552	39.2
Total	2,720	1–62	2	1,670	61.4	1,164	42.8

Procedure group analysis

Procedural prescribing

Over a quarter (27.4%) of all procedural prescribing for surgical episodes were assessed as inappropriate, regardless of whether or not antimicrobials were prescribed (Figure A4.1). Dentoalveolar surgery, vascular surgery and urological surgery, had the highest proportions of surgical episodes deemed inappropriate (74.3%, 40.3% and 39.5%, respectively).

Figure A4.1: Percentage of procedural prescribing appropriateness for surgical episodes by procedure group, Surgical NAPS contributor facilities, 2019



The procedure groups with the highest rates of prescribing at least one procedural antimicrobial were breast surgery, orthopaedic surgery and dentoalveolar surgery, (91.4%, 90.3% and 86.8%, respectively), as shown in Table A4.7. Despite, in some cases, lower overall proportions of antimicrobial doses deemed inappropriate, the majority of inappropriate prescribing was for orthopaedic surgery (*n* = 343 doses), urological surgery (*n* = 324 doses), abdominal surgery (*n* = 295 doses) and plastic and reconstructive surgery (*n* = 269 doses). These four procedure groups accounted for 55.3% of all inappropriate prescriptions.

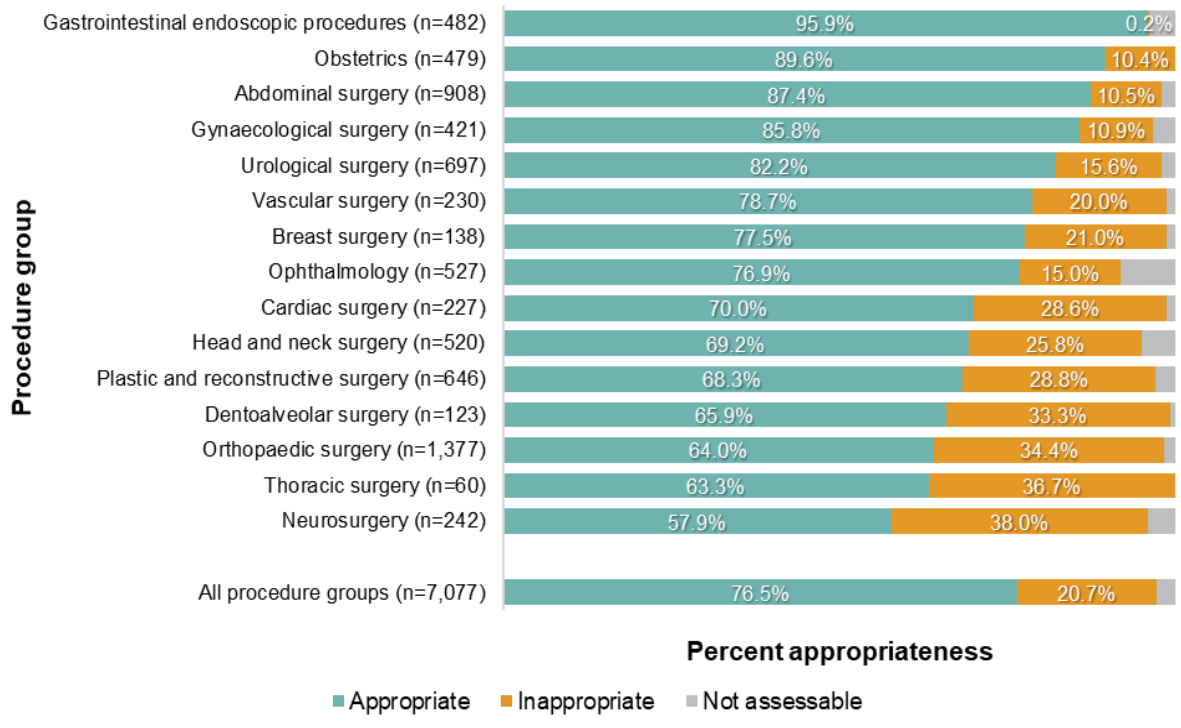
Table A4.7: Percentage of surgical episodes prescribed an antimicrobial, number of doses prescribed and inappropriateness of procedural prescribing by procedure group, Surgical NAPS contributor facilities, 2019

Procedure group	Surgical episodes (n)	At least one antimicrobial prescribed (n)	(%)	Total doses (n)	Inappropriate (n)	(%)
Orthopaedic surgery	1,448	1,307	90.3	1,420	343	24.2
Abdominal surgery	1,048	905	86.4	1,110	295	26.6
Plastic and reconstructive surgery	812	526	64.8	558	269	48.2
Urological surgery	796	604	75.9	742	324	43.7
Ophthalmology	725	567	78.2	765	112	14.6
Head and neck surgery	638	340	53.3	412	207	50.2
Gastrointestinal endoscopic procedures	511	24	4.7	32	20	62.5
Obstetrics	508	406	79.9	432	98	22.7
Gynaecological surgery	446	284	63.7	386	143	37.0
Vascular surgery	263	223	84.8	239	102	42.7
Neurosurgery	259	186	71.8	206	49	23.8
Cardiac surgery	232	172	74.1	289	99	34.3
Dentoalveolar surgery	152	132	86.8	134	111	82.8
Breast surgery	151	138	91.4	160	36	22.5
Thoracic surgery	74	54	73.0	64	18	28.1
Total	**8,063**	**5,868**	**72.8**	**6,949**	**2,226**	**32.0**

Post-procedural prescribing

Just over a fifth (20.7%) of all episodes were assessed as inappropriate, including when antimicrobials were prescribed and not prescribed post-procedurally, (Figure A4.2). The procedure groups with the most post-procedural prescribing deemed inappropriate overall were neurosurgery, thoracic surgery and orthopaedic surgery, (38.0%, 36.7% and 34.4%, respectively).

Figure A4.2: Percentage of post-procedural prophylactic prescribing appropriateness for surgical episodes by procedure group, Surgical NAPS contributor facilities, 2019



The procedure groups with the highest rates of prescribing at least one post-procedural antimicrobial for prophylaxis were orthopaedic surgery, thoracic surgery, and cardiac surgery, (62,9%, 54.8% and 52.0%, respectively), as shown in Table A4.8. Orthopaedic surgery (*n* = 506 prescriptions), plastic and reconstructive surgery (*n* = 228 prescriptions) and head and neck surgery (*n* = 162 prescriptions) accounted for over half (52.3%) of all inappropriate post-procedural antimicrobial prescriptions.

Table A4.8: Post-procedural prophylactic prescribing of antimicrobials and percentage inappropriate, by procedure group, Surgical NAPS contributor facilities, 2019*

Procedure group	Surgical episodes (n)	At least one antimicrobial prescribed (n) (%)		Total doses (n)	Inappropriate (n) (%)	
Orthopaedic surgery	1,387	872	62.9	920	506	55.0
Abdominal surgery	925	112	12.1	173	137	79.2
Urological surgery	724	127	17.5	167	138	82.6
Ophthalmology	700	315	45.0	329	79	24.0
Plastic and reconstructive surgery	674	213	31.6	281	228	81.1
Head and neck surgery	558	177	31.7	224	162	72.3
Gastrointestinal endoscopic procedures	506	2	0.4	3	–	–
Obstetrics	481	50	10.4	69	56	81.2
Gynaecological surgery	424	46	10.8	75	68	90.7
Neurosurgery	244	111	45.5	125	103	82.4
Vascular surgery	234	48	20.5	51	42	82.4
Cardiac surgery	229	119	52.0	165	90	54.6
Breast surgery	140	48	34.3	63	42	66.7
Dentoalveolar surgery	132	38	28.8	41	39	95.1
Thoracic surgery	62	34	54.8	34	22	64.7
Total	**7,420**	**2,312**	**31.2**	**2,720**	**1,713**	**63.0**

* Percentages are not shown for antimicrobials where n <10

DURATION OF PROPHYLAXIS

Of all surgical episodes, prophylaxis was prescribed in 17.8% for up to or greater than 24 hours, and in 12.9% for up to or greater than 48 hours (Table A4.9). Five procedure groups accounted for 72.2% of all episodes with prescriptions up to or greater than 24 hours: orthopaedic surgery (*n* = 308 episodes), ophthalmology (*n* = 301 episodes), plastic and reconstructive surgery (*n* = 171 episodes), head and neck surgery (*n* = 152 episodes) and urological surgery (*n* = 104 episodes). Of these, the greatest reduction in episodes where prophylaxis was prescribed was for orthopaedic surgery, from 21.3% at 24 hours to 5.5% at 48 hours.

Table A4.9: Percentage of surgical prophylaxis prescribed for equal to or greater than 24 and 48 hours, by surgical episode, Surgical NAPS contributor facilities, 2019

Procedure group	Surgical episodes (n)	Duration ≥ 24 hours (n)	(%)	Duration ≥ 48 hours (n)	(%)
Orthopaedic surgery	1,448	308	21.3	79	5.5
Abdominal surgery	1,048	86	8.2	69	6.6
Plastic and reconstructive surgery	812	171	21.1	161	19.8
Urological surgery	796	104	13.1	89	11.2
Ophthalmology	725	301	41.5	296	40.8
Head and neck surgery	638	152	23.8	147	23.0
Gastrointestinal endoscopic procedures	511	2	0.4	2	0.4
Obstetrics	508	30	5.9	18	3.5
Gynaecological surgery	446	29	6.5	15	3.4
Vascular surgery	263	33	12.5	19	7.2
Neurosurgery	259	53	20.5	24	9.3
Cardiac surgery	232	73	31.5	40	17.2
Dentoalveolar surgery	152	38	25.0	38	25.0
Breast surgery	151	38	25.2	37	24.5
Thoracic surgery	74	16	21.6	6	8.1
Grand Total	**8,063**	**1,434**	**17.8**	**1,040**	**12.9**

There was wide variation in prescribing of post-procedural antimicrobials by procedure group, reflecting the differences between specialties in the characteristics of procedures and risks of post-operative infection. There were three main groupings associated with frequency of prescribing and rates of appropriateness for post-procedural antimicrobial prescribing:

- Antimicrobials were prescribed uncommonly, but were almost always deemed inappropriate: abdominal surgery, urological surgery, plastic and reconstructive surgery, head and neck surgery, obstetrics, and gynaecological surgery
- Antimicrobials were prescribed commonly, with moderate to high proportions of prescriptions deemed inappropriate; these were often the procedure groups where post–procedural antimicrobials are acceptable, but likely deemed inappropriate due to extended durations of antimicrobials: orthopaedic surgery, cardiac surgery, and thoracic surgery
- Antimicrobials were commonly prescribed, mostly assessed as appropriate and prolonged post-procedural antimicrobial use is acceptable: ophthalmology.

Appendix 5: Procedural specialty reports

The themes for improving antimicrobial prescribing are common to all procedural groups. For procedural prescribing, these include only prescribing antimicrobials for prophylaxis when recommended by guidelines, and improving the timing of administration. For post-procedural prescribing, this includes only prescribing antimicrobials for prophylaxis when recommended by guidelines, and reducing the duration of antimicrobial prescribing.

The contributions of these factors for the different procedural groups can inform quality improvement initiatives. However, the relative importance of these factors varies for surgical procedural groups.

Analyses relating to each procedural group are shown in this Appendix. These individual reports are designed to inform procedural groups of prescribing practices, and support directed quality assurance activities. For example, in relation to orthopaedic surgery, concentrating on activities to improve surgical prophylaxis for total knee and hip replacements could have a large effect on the appropriateness of prescribing. These two procedures accounted for almost half of the orthopaedic episodes deemed inappropriate.

Data are not presented for gastrointestinal endoscopic procedures due to the small number of prescriptions reported to Surgical NAPS.

5.1. Abdominal surgery

Representation of abdominal surgery in the 2019 Surgical NAPS analysis

Of all surgical episodes audited (*n* = 8,063)

- Abdominal surgery contributed to 13.0% of all episodes, (*n* = 1,048)
- Abdominal procedures were included from 65.3% of the 144 participating facilities, (*n* = 94)
- Data was submitted by 57 public and 37 private facilities

Figure 5.1.1: Summary of key findings for antimicrobial prophylaxis for abdominal episodes, Surgical NAPS contributor facilities, 2019

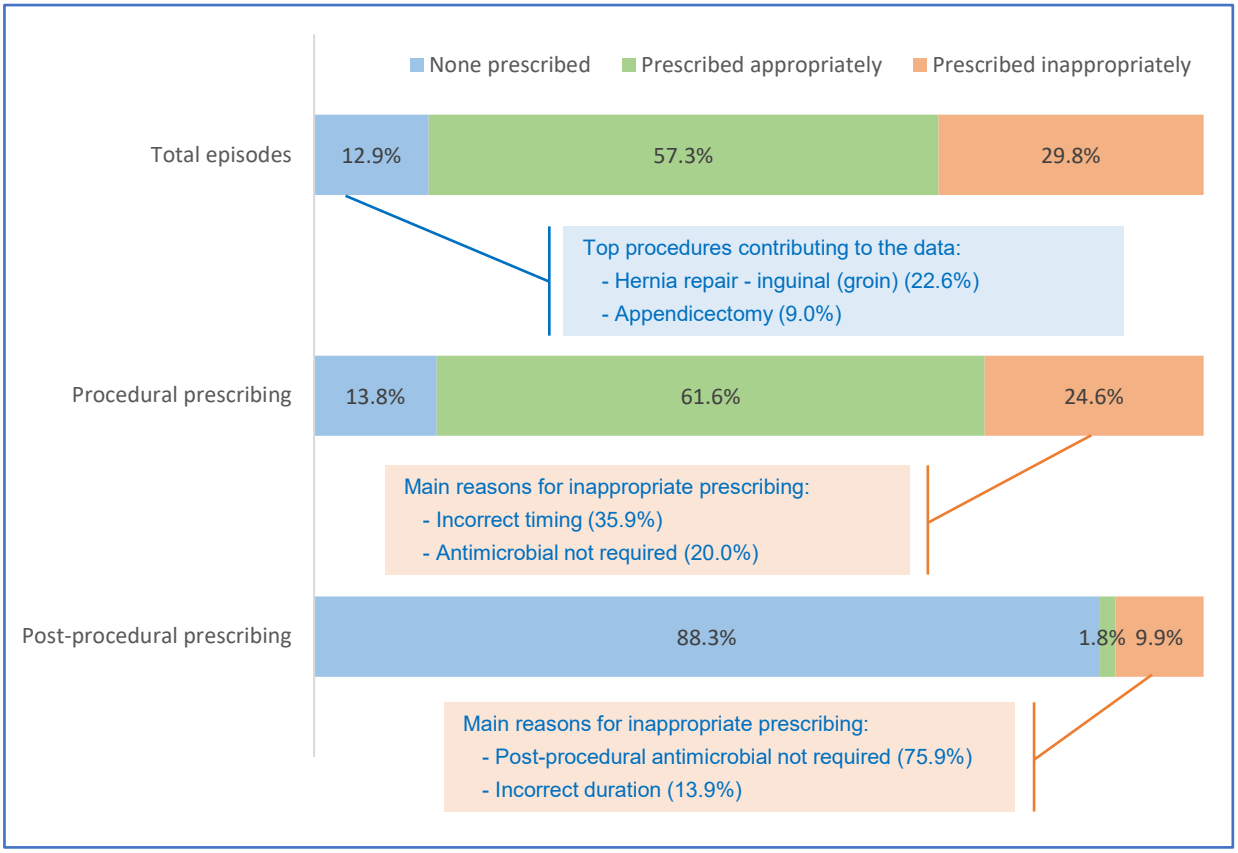


Table 5.1.1: Top ten abdominal procedures and inappropriateness, Surgical NAPS contributor facilities, 2019

Procedure type	Included procedures (n)	(%)	Inappropriate (%)
Hernia repair – inguinal (groin)	237	22.6	18.1
Appendicectomy	94	9.0	61.7
Hernia repair – umbilical	90	8.6	17.8
Cholecystectomy – laparoscopic	67	6.4	41.8
Cholangiogram + cholecystectomy – laparoscopic	55	5.2	38.2
Major ventral hernia repair	39	3.7	41.0
Cholecystectomy + intraoperative cholangiography – laparoscopic	27	2.6	37.0
Haemorrhoidectomy – open/closed	25	2.4	36.0
Banding of haemorrhoids	20	1.9	5.0
Hernia repair – epigastric	17	1.6	17.7

Procedural antimicrobial prescribing

There were 1,110 procedural antimicrobial doses prescribed

- 23.4% were **non-compliant** with guidelines (*n* = 260)
- 1,081 were prescribed as **initial** doses, of which 10.1% did not have a documented administration time (*n* = 199)
- 29 were **repeat** intra-operative doses

Reasons for inappropriateness (*n* = 303 doses)

- 35.9% incorrect **timing**
- 20.0% antimicrobial **not required**
- 18.0% incorrect **dose**
- 12.5% spectrum **too broad**
- 15.3% spectrum **too narrow**
- 0.7% incorrect **route**

Table 5.1.2: Top four procedural antimicrobials used in abdominal episodes and inappropriateness, Surgical NAPS contributor facilities, 2019

Antimicrobial	Antimicrobial doses (n)	(%)	Inappropriate (%)
Cefazolin	832	74.9	61.7
Metronidazole	196	17.7	23.4
Ceftriaxone	21	1.9	3.4
Clindamycin / lincomycin	15	1.4	3.4
Piperacillin–tazobactam	12	1.1	2.4

Post–procedural antimicrobial prescribing

There were 173 post-procedural prophylactic antimicrobial prescriptions

- 75.1% were **non-compliant** with guidelines, (*n* = 130)

Reasons for inappropriateness (*n* = 137 prescriptions)

- 75.9% antimicrobial **not required**
- 13.9% incorrect **duration**
- 2.9% incorrect **dose or frequency**
- 2.2% spectrum **too narrow**
- 1.5% spectrum **too broad**

Duration of therapy

- Duration ranged from 1–14 days of therapy
- The median duration was 2 day of therapy
- 72.8% of prescriptions were for **≥ 24 hours**, (*n* = 126)
- 54.3% of prescriptions were for **≥ 48 hours**, (*n* = 94)

Table 5.1.3: Top five post-procedural prophylactic antimicrobials used in abdominal episodes and inappropriateness, Surgical NAPS contributor facilities, 2019

Antimicrobial	Antimicrobial prescriptions (n)	(%)	Inappropriate (%)
Metronidazole	55	31.8	34.3
Cefazolin	29	12.8	19.0
Ceftriaxone	23	13.3	13.1
Amoxicillin–clavulanic acid	18	10.4	9.5

5.2. Breast surgery

Representation of breast surgery in the 2019 Surgical NAPS analysis

Of all surgical episodes audited (*n* = 8,063)

- Breast surgery contributed to 1.9% of all episodes (*n* = 151)
- Breast procedures were included from 28.5% of the 144 participating facilities (*n* = 41)
- Data was submitted by 15 public and 26 private facilities

Figure 5.2.1: Summary of key findings for antimicrobial prophylaxis for breast episodes, Surgical NAPS contributor facilities, 2019

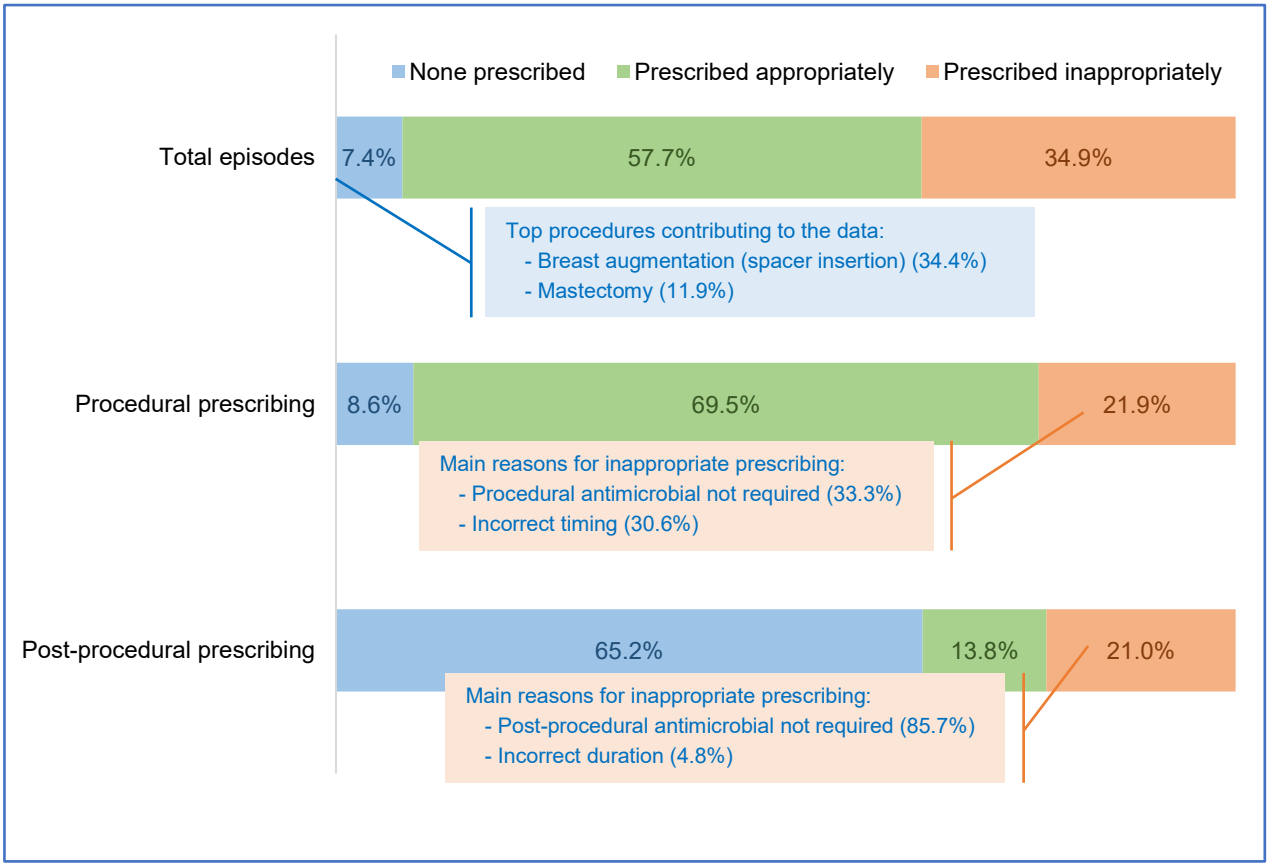


Table 5.2.1: Top ten breast procedures and inappropriateness, Surgical NAPS contributor facilities, 2019

Procedure type	Included procedures (n)	(%)	Inappropriate (%)
Breast augmentation (spacer insertion)	52	34.4	28.9
Mastectomy	18	11.9	50.0
Excision following needle localisation	18	11.9	27.8
Breast reduction/mastopexy	18	11.9	61.1
Wide excision/quadrantectomy	14	9.3	21.4
Breast reconstruction	12	7.9	58.3
Breast biopsy	<5	–	–
Axillary lymph node biopsy	<5	–	–
Subareolar excision of ducts	<5	–	–
Nipple reconstruction (theleplasty)	<5	–	–

Procedural antimicrobial prescribing

There were 160 procedural antimicrobial doses prescribed

- 20.6% were **non-compliant** with guidelines (*n* = 33)
- 157 were prescribed as **initial** doses, of which 33.1% did not have a documented administration time (*n* = 51)
- 3 were **repeat** intra-operative doses

Reasons for inappropriateness (*n* = 36 doses)

- 33.3% antimicrobial **not required**
- 30.6% incorrect **timing**
- 16.7% incorrect **dose**
- 8.3% incorrect **route**

Table 5.2.2: Top two procedural antimicrobials used in breast episodes and inappropriateness, Surgical NAPS contributor facilities, 2019

Antimicrobial	Antimicrobial doses (n) (%)		Inappropriate (%)
Cefazolin	136	85.0	19.1
Gentamicin	17	10.6	23.5

Post-procedural antimicrobial prescribing

There were 63 post-procedural prophylactic antimicrobial prescriptions

- 66.7% were **non-compliant** with guidelines, (*n* = 42)

Reasons for inappropriateness (*n* = 42 prescriptions)

- 85.7% antimicrobial **not required**
- 4.8% incorrect **duration**
- 2.4% incorrect **dose or frequency**

Duration of therapy

- Duration ranged from 1–18 days of therapy
- The median duration was 5 days of therapy
- 73.0% of prescriptions were for **≥ 24 hours**, (*n* = 46)
- 63.5% of prescriptions were for **≥ 48 hours**, (*n* = 40)

Table 5.2.3: Top two post-procedural prophylactic antimicrobials used in breast episodes and inappropriateness, Surgical NAPS contributor facilities, 2019

Antimicrobial	Antimicrobial prescriptions (n) (%)		Inappropriate (%)
Cefalexin	34	54.0	58.8
Cefazolin	25	39.7	76.0

5.3. Cardiac surgery

Representation of cardiac surgery in the 2019 Surgical NAPS analysis
Of all surgical episodes audited (*n* = 8,063) • Cardiac surgery contributed to 2.9% of all episodes (*n* = 232) • Cardiac procedures were included from 22.9% of the 144 participating facilities (*n* = 33) • Data was submitted by 13 public and 20 private facilities

Figure 5.3.1: Summary of key findings for antimicrobial prophylaxis for cardiac episodes, Surgical NAPS contributor facilities, 2019

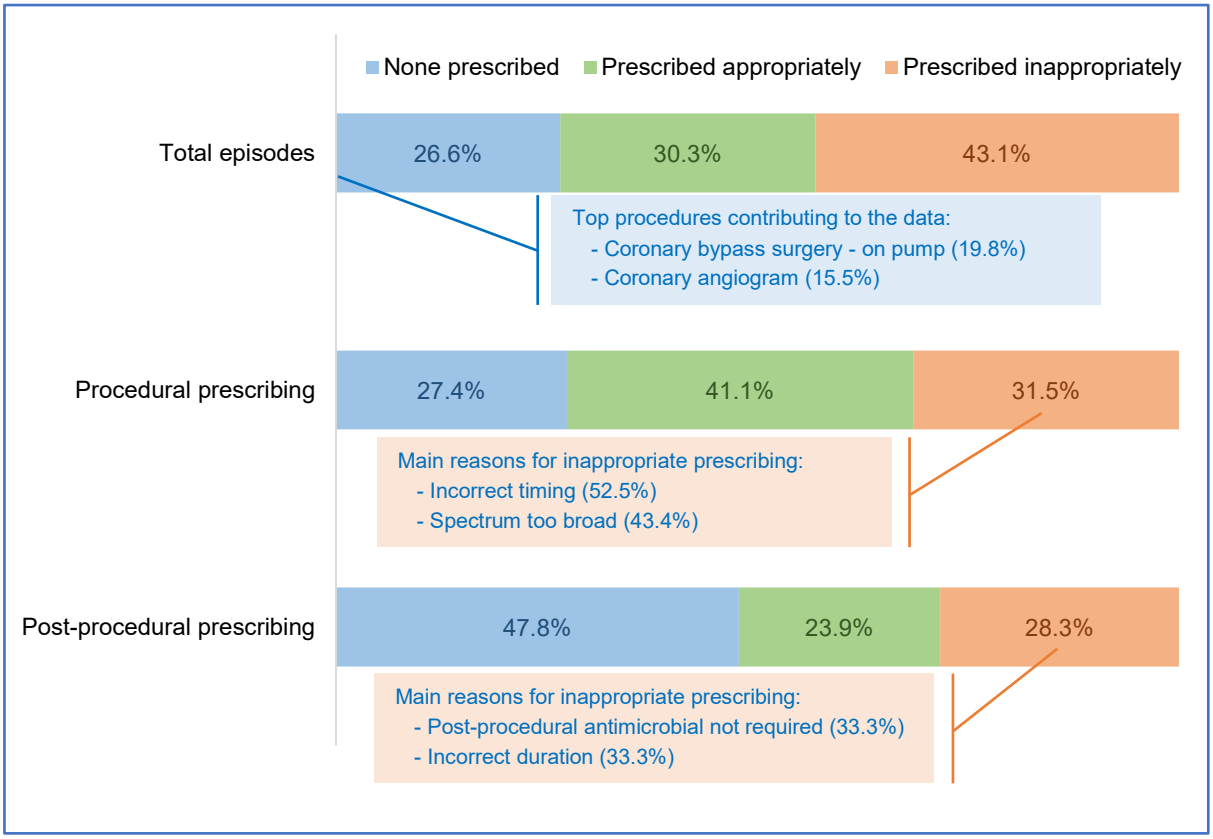


Table 5.3.1: Top ten cardiac procedures and inappropriateness, Surgical NAPS contributor facilities, 2019

Procedure type	Included procedures (n)	(%)	Inappropriate (%)
Coronary bypass surgery – on pump	46	19.8	43.5
Coronary angiogram	36	15.5	5.6
Permanent pacemaker or defibrillator insertion	27	11.6	48.2
Permanent pacemaker or defibrillator – change or removal	16	6.9	56.3
Coronary bypass surgery – off pump	12	5.2	50.0
Percutaneous transluminal coronary angioplasty	11	4.7	0.0
Implantable cardioverter defibrillator insertion	11	4.7	54.6
Aortic valve replacement – mechanical prosthesis	10	4.3	50.0
Transcatheter aortic valve implantation	6	2.6	50.0
Mitral valve replacement – bioprosthesis	5	2.2	80.0

Procedural antimicrobial prescribing

There were 289 procedural antimicrobial doses prescribed

- 31.1% were **non-compliant** with guidelines (*n* = 90)
- 236 were prescribed as **initial** doses, of which 12.3% did not have a documented administration time (*n* = 29)
- 53 were **repeat** intra-operative doses

Reasons for inappropriateness (*n* = 99 doses)

- 52.5% incorrect **timing**
- 43.4% spectrum **too broad**
- 12.1% incorrect **dose**
- 7.1% antimicrobial **not required**
- 2.0% incorrect **route**

Table 5.3.2: Top three procedural antimicrobials used in cardiac episodes and inappropriateness, Surgical NAPS contributor facilities, 2019

Antimicrobial	Antimicrobial doses (n)	(%)	Inappropriate (%)
Cefazolin	216	74.7	21.8
Vancomycin	42	14.5	69.1
Ceftriaxone	19	6.6	100

Post-procedural antimicrobial prescribing

There were 165 post-procedural prophylactic antimicrobial prescriptions

- 50.3% were non-compliant with guidelines (*n* = 83)

Reasons for inappropriateness (*n* = 90 prescriptions)

- 33.3% antimicrobial **not required**
- 33.3% incorrect **duration**
- 26.7% spectrum **too broad**
- 18.9% incorrect **dose or frequency**

Duration of therapy

- Duration ranged from 1–14 days of therapy
- The median duration was 1 day of therapy
- 63.0% of prescriptions were for **≥ 24 hours**, (*n* = 104)
- 28.5% of prescriptions were for **≥ 48 hours**, (*n* = 47)

Table 5.3.3: Top four post-procedural prophylactic antimicrobials used in cardiac episodes and inappropriateness, Surgical NAPS contributor facilities, 2019

Antimicrobial	Antimicrobial prescriptions (n)	(%)	Inappropriate (%)
Cefazolin	112	67.9	36.6
Vancomycin	25	15.2	88.0
Cefalexin	12	7.3	100
Ceftriaxone	10	6.1	100

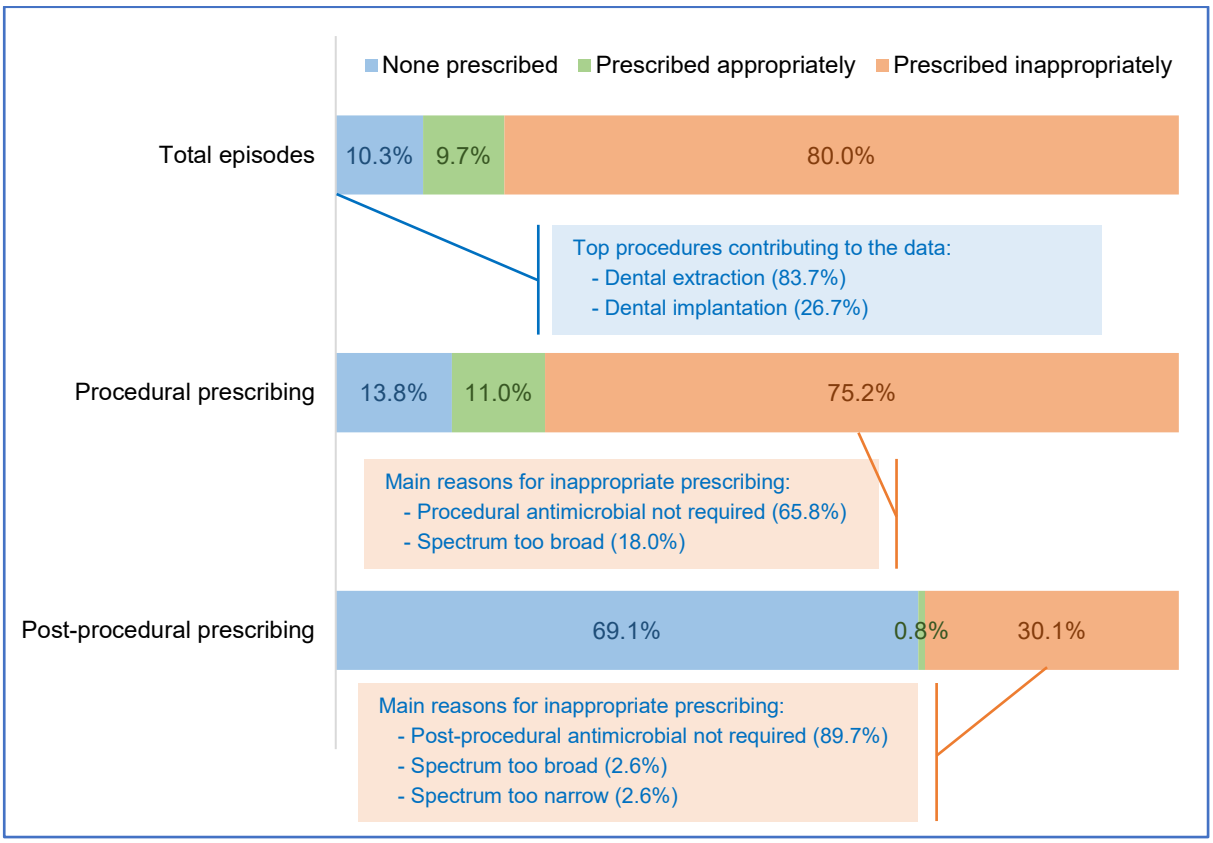
5.4. Dentoalveolar surgery

Representation of dentoalveolar surgery in the 2019 Surgical NAPS analysis

Of all surgical episodes audited (*n* = 8,063)

- Dentoalveolar surgery contributed to 1.9% of all episodes (*n* = 152)
- Dentoalveolar procedures were included from 20.8% of the 144 participating facilities (*n* = 30)
- Data was submitted by 5 public and 25 private facilities

Figure 5.4.1: Summary of key findings for antimicrobial prophylaxis for dentoalveolar episodes, Surgical NAPS contributor facilities, 2019



Procedural antimicrobial prescribing

There were 134 procedural antimicrobial doses prescribed

- 80.6% were **non–compliant** with guidelines (*n* = 108)
- 134 were prescribed as **initial** doses, of which 15.7% did not have a documented administration time (*n* = 21)
- 0 were **repeat** intra-operative doses

Reasons for inappropriateness, (*n* = 99 doses)

- 65.8% antimicrobial **not required**
- 18.0% spectrum **too broad**
- 7.2% incorrect **dose**
- 2.7% spectrum **too narrow**
- 1.8% incorrect **timing**

Table 5.4.1: Top two dentoalveolar procedures and inappropriateness, Surgical NAPS contributor facilities, 2019

Procedure type	Included procedures (n) (%)		Inappropriate (%)
Dental extraction	123	80.9	83.7
Dental implantation	15	9.9	26.7

Table 5.4.2: Top two procedural antimicrobials used in dentoalveolar episodes and inappropriateness, Surgical NAPS contributor facilities, 2019

Antimicrobial	Antimicrobial doses (n) (%)		Inappropriate (%)
Cefazolin	86	64.2	81.4
Amoxicillin	38	28.4	81.6

Post-procedural antimicrobial prescribing

There were 41 post-procedural prophylactic antimicrobial prescriptions

- 92.7% were **non-compliant** with guidelines (*n* = 38)

Reasons for inappropriateness (*n* = 41 prescriptions)

- 89.7% antimicrobial **not required**
- 2.6% spectrum too **broad**
- 2.6% spectrum too **narrow**

Duration of therapy

- Duration ranged from 2–9 days of therapy
- The median duration was 5 day of therapy
- 100% of prescriptions were for **≥ 24 hours** (*n* = 41)
- 95.1% of prescriptions were for **≥ 48 hours** (*n* = 39)

Table 5.4.3: Top two post-procedural prophylactic antimicrobials used in dentoalveolar episodes and inappropriateness, Surgical NAPS contributor facilities, 2019

Antimicrobial	Antimicrobial prescriptions (n) (%)		Inappropriate (%)
Cefalexin	16	39.0	100
Amoxicillin–clavulanic acid	11	26.8	100

5.5. Gynaecological surgery

Representation of gynaecological surgery in the 2019 Surgical NAPS analysis

Of all surgical episodes audited (*n* = 8,063)

- Gynaecological surgery contributed to 5.5% of all episodes (*n* = 446)
- Gynaecological procedures were included from 47.9% of the 144 participating facilities (*n* = 69)
- Data was submitted by 36 public and 33 private facilities

Figure 5.5.1: Summary of key findings for antimicrobial prophylaxis for gynaecological episodes, Surgical NAPS contributor facilities, 2019

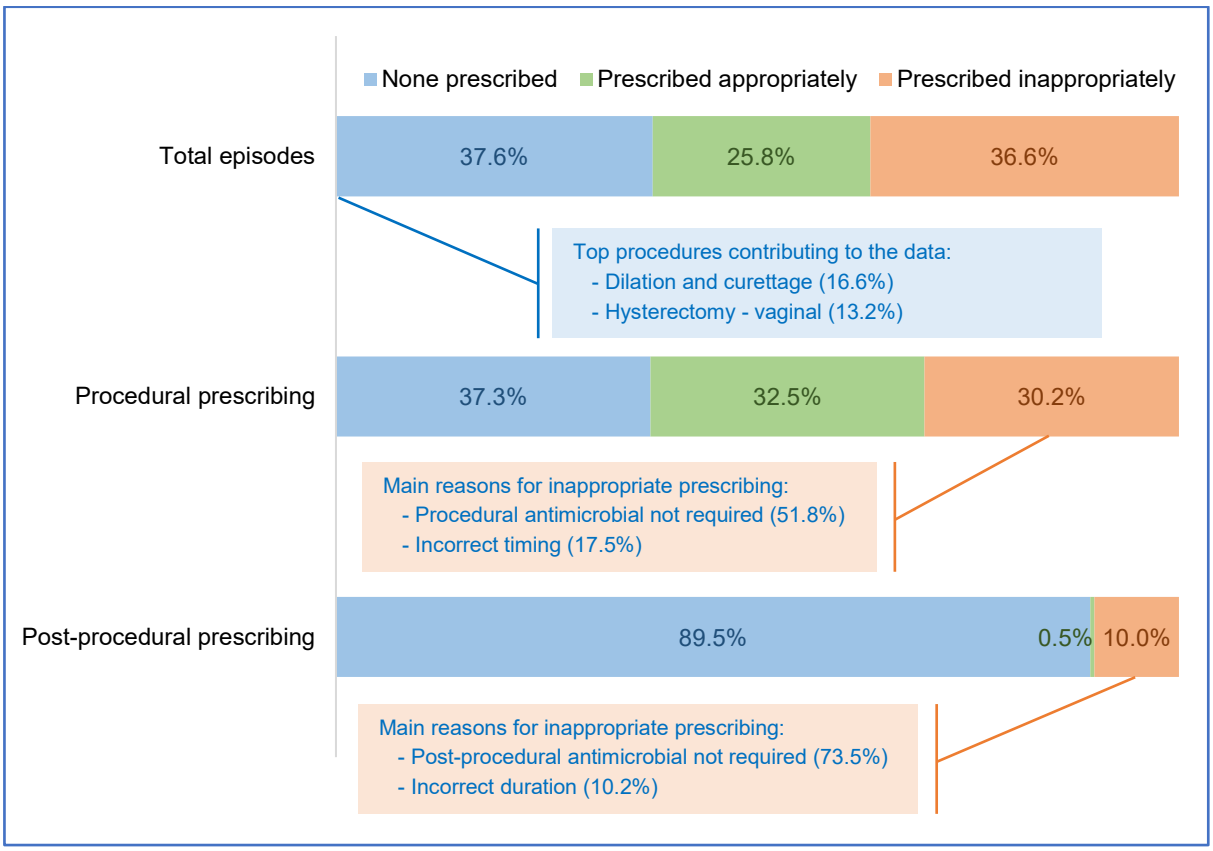


Table 5.5.1: Top ten gynaecological procedures and inappropriateness, Surgical NAPS contributor facilities, 2019

Procedure type	Included procedures (n)	(%)	Inappropriate (%)
Dilation and curettage	74	16.6	14.9
Hysterectomy – vaginal	59	13.2	47.5
Hysterectomy – laparoscopic	53	11.9	47.2
Hysterectomy – abdominal	34	7.6	50.0
In vitro fertilisation	32	7.2	34.4
Large loop excision of the transformation zone	20	4.5	10.0
Diagnostic laparoscopy	20	4.5	50.0
Resection of endometriosis	19	4.3	36.8
Salpingo–oophorectomy	18	4.0	44.4
Endometrial ablation	18	4.0	50.0

Procedural antimicrobial prescribing

There were 386 procedural antimicrobial doses prescribed

- 36.8% were **non–compl**iant with guidelines (*n* = 142)
- 384 were prescribed as **initial** doses, of which 13.0% did not have a documented administration time (*n* = 50)
- 2 were **repeat** intra–operative doses

Reasons for inappropriateness (*n* = 143 doses)

- 51.8% antimicrobial **not required**
- 17.5% spectrum **too narrow**
- 16.8% incorrect **timing**
- 10.5% incorrect **dose**
- 3.5% spectrum **too broad**

Table 5.5.2: Top three procedural antimicrobials used in gynaecological episodes and inappropriateness, Surgical NAPS contributor facilities, 2019

Antimicrobial	Antimicrobial doses (n)	(%)	Inappropriate (%)
Cefazolin	259	67.1	42.9
Metronidazole	101	26.2	14.9
Clindamycin / lincomycin	12	3.1	58.3

Post-procedural antimicrobial prescribing

There were 75 post-procedural prophylactic antimicrobial prescriptions

- 93.3% were **non-compliant** with guidelines (*n* = 70)

Reasons for inappropriateness (*n* = 75 prescriptions)

- 73.5% antimicrobial **not required**
- 10.2% incorrect **duration**
- 2.9% incorrect **dose or frequency**
- 1.5% spectrum **too narrow**

Duration of therapy

- Duration ranged from 1–8 days of therapy
- The median duration was 1 day of therapy
- 62.7% of prescriptions were for **≥ 24 hours** (*n* = 47)
- 26.7% of prescriptions were for **≥ 48 hours** (*n* = 20)

Table 5.5.3: Top two post-procedural prophylactic antimicrobials used in gynaecological episodes and inappropriateness, Surgical NAPS contributor facilities, 2019

Antimicrobial	Antimicrobial prescriptions (n)	(%)	Inappropriate (%)
Cefazolin	32	42.7	96.9
Metronidazole	24	32.0	87.5

5.6. Head and neck surgery

Representation of head and neck surgery in the 2019 Surgical NAPS analysis
Of all surgical episodes audited (*n* = 8,063) • Head and neck surgery contributed to 7.9% of all episodes (*n* = 638) • Head and neck procedures were included from 53.5% of the 144 participating facilities (*n* = 77) • Data was submitted by 43 public and 34 private facilities

Figure 5.6.1: Summary of key findings for antimicrobial prophylaxis for head and neck episodes, Surgical NAPS contributor facilities, 2019

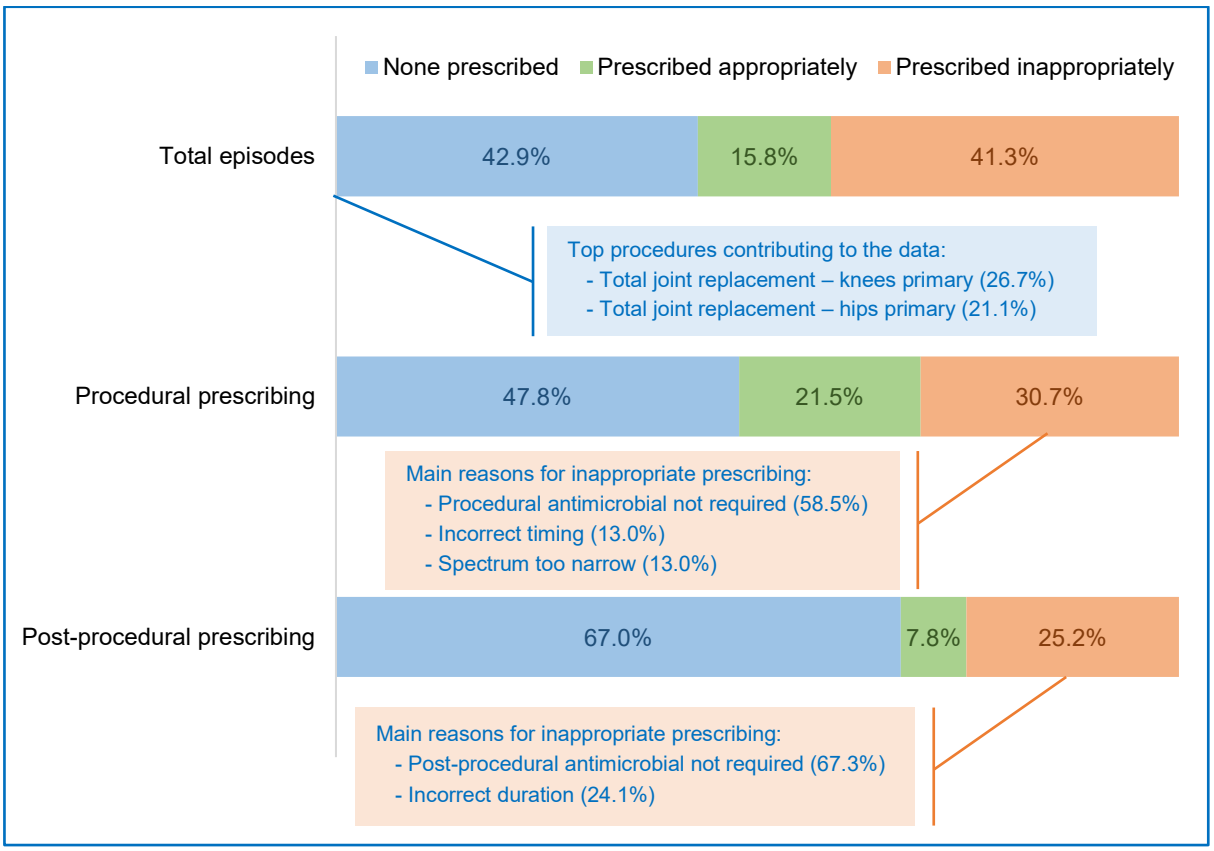


Table 5.6.1: Top ten head and neck procedures and inappropriateness, Surgical NAPS contributor facilities, 2019

Procedure type	Included procedures (n)	(%)	Inappropriate (%)
Adenotonsillectomy	51	14.7	14.7
Tonsillectomy	49	14.2	14.2
Excision benign or malignant skin tumour	41	11.8	11.8
Wide excision of malignant skin tumour	32	9.2	9.2
Hemithyroidectomy	22	6.4	6.4
Excision sebaceous cyst	20	5.8	5.8
Excision simple lipoma	18	5.2	5.2
Total thyroidectomy	16	4.6	4.6
Parathyroidectomy	12	3.5	3.5
Microlaryngoscopy +/– biopsy	12	3.5	3.5

Procedural antimicrobial prescribing

There were 412 procedural antimicrobial doses prescribed

- 51.2% were **non–compliant** with guidelines (*n* = 211)
- 361 were prescribed as **initial** doses, of which 32.4% did not have a documented administration time (*n* = 117)
- 51 were **repeat** intra-operative doses

Reasons for inappropriateness (*n* = 207 doses)

- 58.5% antimicrobial **not required**
- 13.0% incorrect **timing**
- 13.0% spectrum **too narrow**
- 11.1% incorrect **dose**
- 2.4% spectrum **too broad**

Table 5.6.2: Top four procedural antimicrobials used in head and neck episodes and inappropriateness, Surgical NAPS contributor facilities, 2019

Antimicrobial	Antimicrobial doses (n)	(%)	Inappropriate (%)
Cefazolin	300	72.8	57.7
Ofloxacin	40	9.7	5.0
Metronidazole	21	5.1	9.5
Ciprofloxacin	20	4.9	55.0
Clindamycin / lincomycin	13	3.2	61.5

Post–procedural antimicrobial prescribing

There were 224 post–procedural prophylactic antimicrobial prescriptions

- 70.1% were **non–compliant** with guidelines, (*n* = 157)

Reasons for inappropriateness, (*n* = 162 prescriptions)

- 67.3% antimicrobial **not required**
- 24.1% incorrect **duration**
- 17.0% incorrect **dose or frequency**
- 1.9% spectrum **too broad**
- 1.2% spectrum **too narrow**

Duration of therapy

- Duration ranged from 1–48 days of therapy
- The median duration was 5 days of therapy
- 80.8% of prescriptions were for **≥ 24 hours** (*n* = 181)
- 76.8% of prescriptions were for **≥ 48 hours** (*n* = 172)

Table 5.6.3: Top five post–procedural prophylactic antimicrobials used in head and neck episodes and inappropriateness, Surgical NAPS contributor facilities, 2019

Antimicrobial	Antimicrobial prescriptions (n)	(%)	Inappropriate (%)
Cefalexin	53	23.7	90.6
Ciprofloxacin	49	21.9	36.7
Cefazolin	45	20.1	68.9
Amoxicillin–clavulanic acid	22	9.8	90.9
Amoxicillin	15	6.7	100
Metronidazole	14	6.3	71.4

5.7. Neurosurgery

Representation of neurosurgery in the 2019 Surgical NAPS analysis

Of all surgical episodes audited (*n* = 8,063)

- Neurosurgery contributed to 3.2% of all episodes (*n* = 259)
- Neurosurgery procedures were included from 29.9% of the 144 participating facilities (*n* = 43)
- Data was submitted by 20 public and 23 private facilities

Figure 5.7.1: Summary of key findings for antimicrobial prophylaxis for neurosurgery episodes, Surgical NAPS contributor facilities, 2019

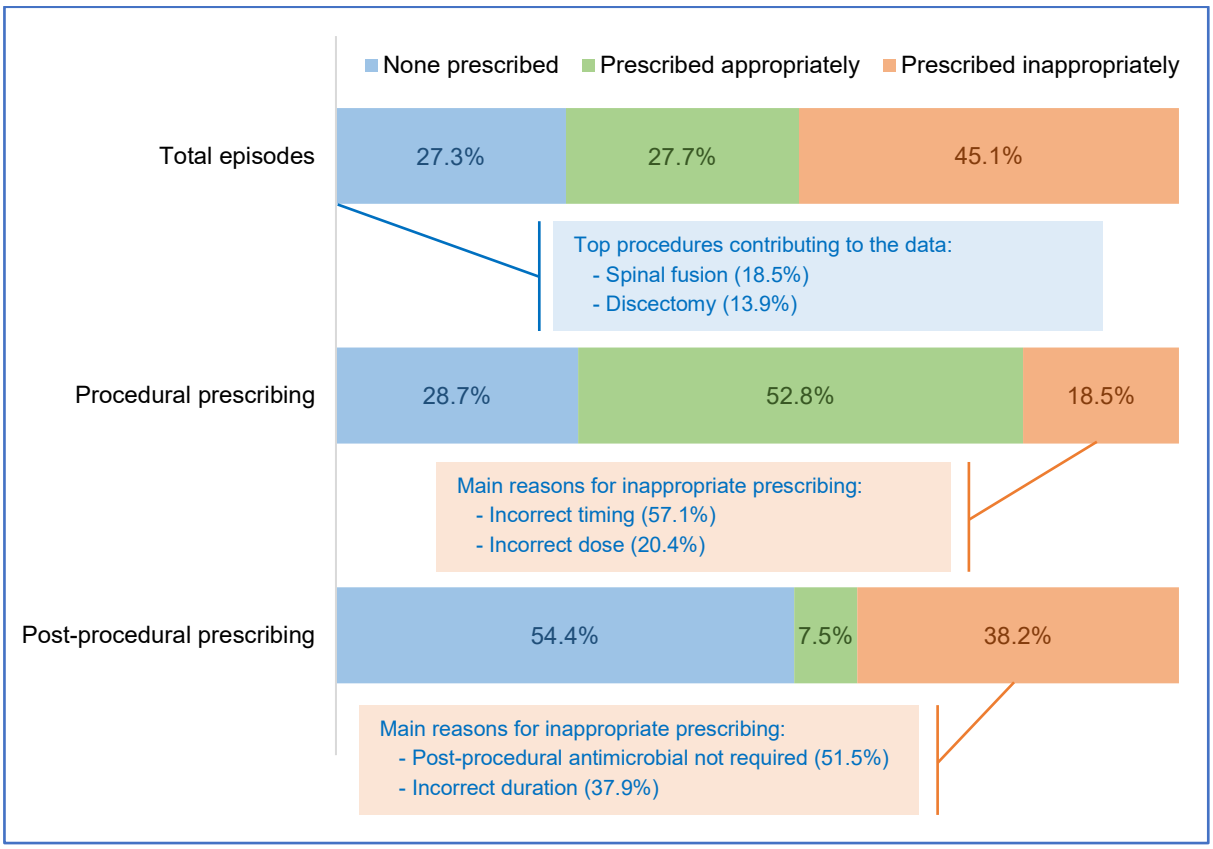


Table 5.7.1: Top ten neurosurgery procedures and inappropriateness, Surgical NAPS contributor facilities, 2019

Procedure type	Included procedures (n)	(%)	Inappropriate (%)
Spinal fusion	48	18.5	75.0
Discectomy	36	13.9	61.1
Laminectomy/laminoplasty	27	10.4	59.3
Wound debridement/washout	18	6.9	44.4
Spinal rhizotomy	18	6.9	0.0
Craniotomy	12	4.6	25.0
Carotid endarterectomy	11	4.2	72.7
Posterior decompression/Chiari decompression	8	3.1	50.0
Tumour excision	<5	–	–
Biopsy	<5	–	–

Procedural antimicrobial prescribing

There were 206 procedural antimicrobial doses prescribed

- 21.4% were **non-compliant** with guidelines (*n* = 44)
- 194 were prescribed as **initial** doses, of which 16.5% did not have a documented administration time (*n* = 32)
- 12 were **repeat** intra-operative doses

Reasons for inappropriateness (*n* = 49 doses)

- 57.1% incorrect **timing**
- 20.4% incorrect **dose**
- 16.3% spectrum **too broad**
- 8.2% antimicrobial **not required**
- 2.0% spectrum **too narrow**
- 2.0% incorrect **route**

Table 5.7.2: Top procedural antimicrobial used in neurosurgery episodes and inappropriateness, Surgical NAPS contributor facilities, 2019

Antimicrobial	Antimicrobial doses (n) (%)	Inappropriate (%)
Cefazolin	183 88.8	20.2

Post–procedural antimicrobial prescribing

There were 125 post-procedural prophylactic antimicrobial prescriptions

- 84.0% were **non-compliant** with guidelines, (*n* = 105)

Reasons for inappropriateness (*n* = 125 prescriptions)

- 51.5% antimicrobial **not required**
- 37.9% incorrect **duration**
- 17.5% incorrect **dose or frequency**
- 1.0% spectrum **too broad**

Duration of therapy

- Duration ranged from 1–20 days of therapy
- The median duration was 1 day of therapy
- 46.4% of prescriptions were for **≥ 24 hours** (*n* = 58)
- 21.6% of prescriptions were for **≥ 48 hours** (*n* = 27)

Table 5.7.3: Top post-procedural prophylactic antimicrobial used in neurosurgery episodes and inappropriateness, Surgical NAPS contributor facilities, 2019

Antimicrobial	Antimicrobial prescriptions (n) (%)	Inappropriate (%)
Cefazolin	104 83.2	82.7

5.8. Obstetric surgery

Representation of obstetric surgery in the 2019 Surgical NAPS analysis
Of all surgical episodes audited (*n* = 8,063) • Obstetric surgery contributed to 6.3% of all episodes (*n* = 508) • Obstetric procedures were included from 47.2% of the 144 participating facilities (*n* = 68) • Data was submitted by 42 public and 26 private facilities

Figure 5.8.1: Summary of key findings for antimicrobial prophylaxis for obstetric episodes, Surgical NAPS contributor facilities, 2019

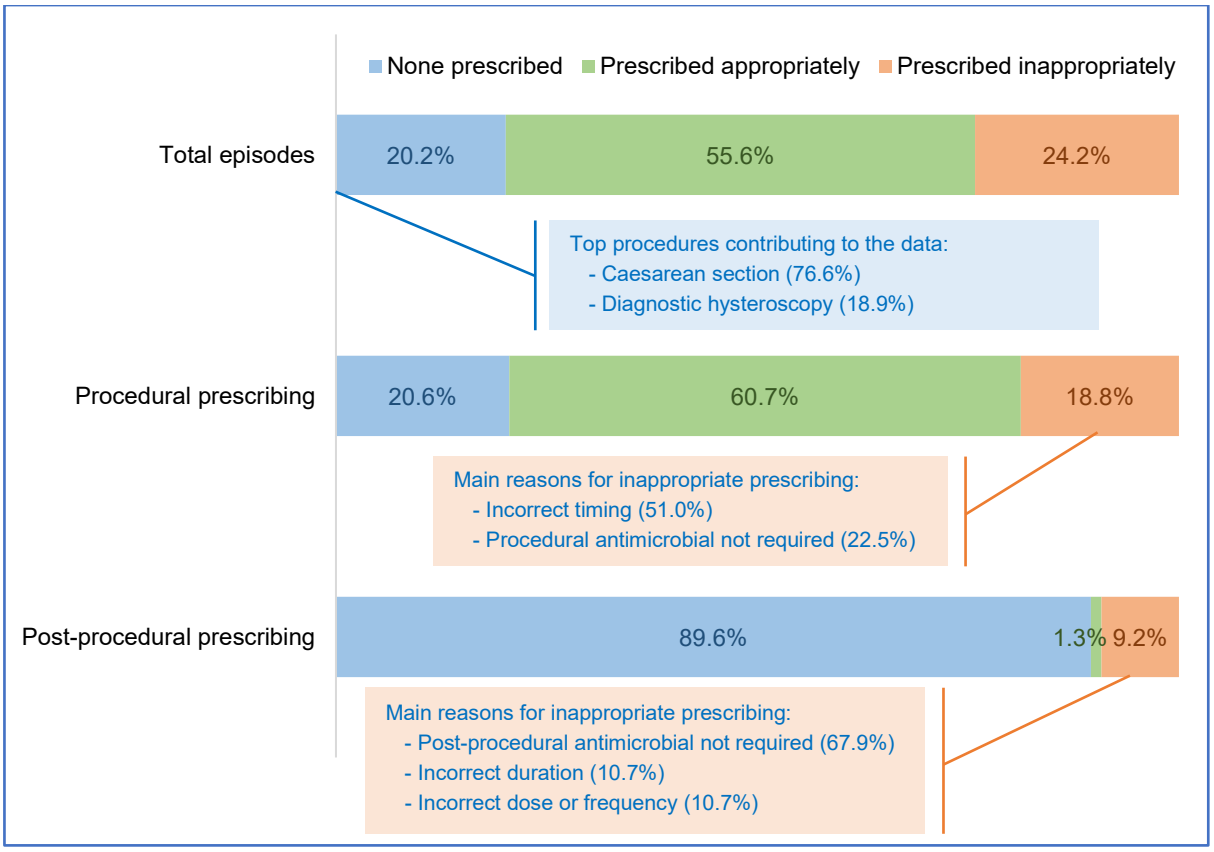


Table 5.8.1: Top ten obstetric procedures and inappropriateness, Surgical NAPS contributor facilities, 2019

Procedure type	Included procedures (n)	(%)	Inappropriate (%)
Caesarean section	384	76.6	25.7
Diagnostic hysteroscopy	304	18.9	24.7
Termination of pregnancy	115	1.2	66.7
Evacuation of incomplete miscarriage	90	0.8	50.0
Manual removal of the placenta	69	0.6	100
Vaginal examination under anaesthesia	64	0.4	0
Perineal repair	43	0.4	100
Suturing of vaginal vault	32	0.2	100
Removal of intrauterine device	28	0.2	0
Perineal tear	28	0.2	0

Procedural antimicrobial prescribing

There were 432 procedural antimicrobial doses prescribed

- 22.2% were **non-compliant** with guidelines (*n* = 96)
- 427 were prescribed as **initial** doses, of which 20.6% did not have a documented administration time (*n* = 88)
- 5 were **repeat** intra-operative doses

Reasons for inappropriateness (*n* = 98 doses)

- 51.0% incorrect **timing**
- 22.5% antimicrobial **not required**
- 8.2% spectrum **too narrow**
- 7.1% incorrect **dose**
- 5.1% spectrum **too broad**
- 1.0% incorrect **route**

Table 5.8.2: Top two procedural antimicrobials used in obstetric episodes and inappropriateness, Surgical NAPS contributor facilities, 2019

Antimicrobial	Antimicrobial doses (n)	(%)	Inappropriate (%)
Cefazolin	390	90.3	20.3
Metronidazole	23	5.3	39.1

Post-procedural antimicrobial prescribing

There were 69 post-procedural prophylactic antimicrobial prescriptions

- 82.6% were **non-compliant** with guidelines, (*n* = 57)

Reasons for inappropriateness (*n* = 56 prescriptions)

- 67.9% antimicrobial **not required**
- 10.7% incorrect **duration**
- 10.7% incorrect **dose or frequency**

Duration of therapy

- Duration ranged from 1–29 days of therapy
- The median duration was 1 day of therapy
- 58.0% of prescriptions were for **≥ 24 hours** (*n* = 40)
- 29.0% of prescriptions were for **≥ 48 hours** (*n* = 20)

Table 5.8.3: Top two post-procedural prophylactic antimicrobials used in obstetric episodes and inappropriateness, Surgical NAPS contributor facilities, 2019

Antimicrobial	Antimicrobial prescriptions (n)	(%)	Inappropriate (%)
Cefazolin	36	52.2	88.9
Metronidazole	12	17.4	75.0

5.9. Ophthalmology

Representation of ophthalmology in the 2019 Surgical NAPS analysis

Of all surgical episodes audited (*n* = 8,063)

- Ophthalmology contributed to 9.0% of all episodes (*n* = 725)
- Ophthalmology procedures were included from 31.9% of the 144 participating facilities (*n* = 46)
- Data was submitted by 20 public and 26 private facilities

Figure 5.9.1: Summary of key findings for antimicrobial prophylaxis for ophthalmology episodes, Surgical NAPS contributor facilities, 2019

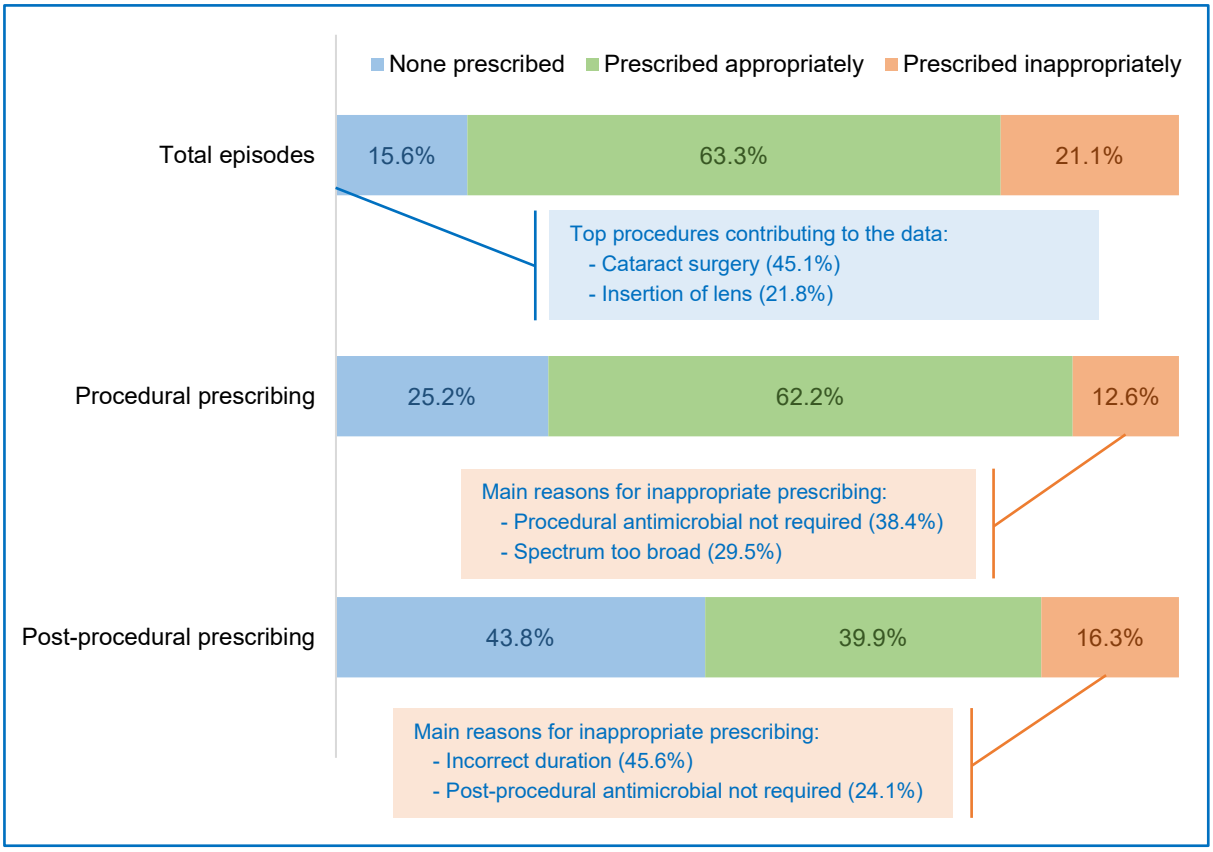


Table 5.9.1: Top ten ophthalmology procedures and inappropriateness, Surgical NAPS contributor facilities, 2019

Procedure type	Included procedures (n)	(%)	Inappropriate (%)
Cataract surgery	327	45.1	17.1
Insertion of lens	158	21.8	24.1
Phacoemulsification	89	12.3	13.5
Intravitreal injection	52	7.2	0.0
Vitrectomy	41	5.7	24.4
Pterygium excision	14	1.9	7.1
Trabeculotomy	6	0.8	0.0
Epiretinal membrane peel	6	0.8	16.7
Glaucoma shunt implant	5	0.7	0.0
Scleral patch graft	<5	–	–

Procedural antimicrobial prescribing

There were 765 procedural antimicrobial doses prescribed

- 17.5% were **non-compliant** with guidelines (*n* = 134)
- 711 were prescribed as **initial** doses, of which 20.0% did not have a documented administration time (*n* = 142)
- 54 were **repeat** intra-operative doses

Reasons for inappropriateness (*n* = 112 doses)

- 38.4% antimicrobial **not required**
- 29.5% spectrum **too broad**
- 8.0% incorrect **timing**
- 8.0% incorrect **dose**
- 6.3% spectrum **too narrow**
- 6.3% incorrect **route**

Table 5.9.2: Top three procedural antimicrobials used in ophthalmology episodes and inappropriateness, Surgical NAPS contributor facilities, 2019

Antimicrobial	Antimicrobial doses (n)	(%)	Inappropriate (%)
Cefazolin	537	70.2	2.1
Chloramphenicol	186	24.3	44.6
Gentamicin	12	1.6	58.3

Post-procedural antimicrobial prescribing

There were 329 post-procedural prophylactic antimicrobial prescriptions

- 30.7% were **non-compliant** with guidelines (*n* = 101)

Reasons for inappropriateness (*n* = 79 prescriptions)

- 45.6% incorrect **duration**
- 24.1% antimicrobial **not required**
- 8.9% spectrum too **narrow**
- 3.8% spectrum too **broad**

Duration of therapy

- Duration ranged from 1–40 days of therapy
- The median duration was 8 days of therapy
- 92.4% of prescriptions were for **≥ 24 hours** (*n* = 304)
- 90.9% of prescriptions were for **≥ 48 hours** (*n* = 299)

Table 5.9.3: Top five post-procedural prophylactic antimicrobials used in ophthalmology episodes and inappropriateness, Surgical NAPS contributor facilities, 2019

Antimicrobial	Antimicrobial prescriptions (n)	(%)	Inappropriate (%)
Chloramphenicol	344	71.1	21.4
Ciprofloxacin	53	16.1	15.1
Tobramycin	16	4.9	100
Ofloxacin	14	4.9	35.7

5.10. Orthopaedic surgery

Representation of orthopaedic surgery in the 2019 Surgical NAPS analysis

Of all surgical episodes audited (*n* = 8,063)

- Orthopaedic surgery contributed to 18.0% of all episodes (*n* = 1,448)
- Orthopaedic procedures were included from 66.0% of the 144 participating facilities (*n* = 95)
- Data was submitted by 48 public and 47 private facilities

Figure 5.10.1 Summary of key findings for antimicrobial prophylaxis for orthopaedic episodes, Surgical NAPS contributor facilities, 2019

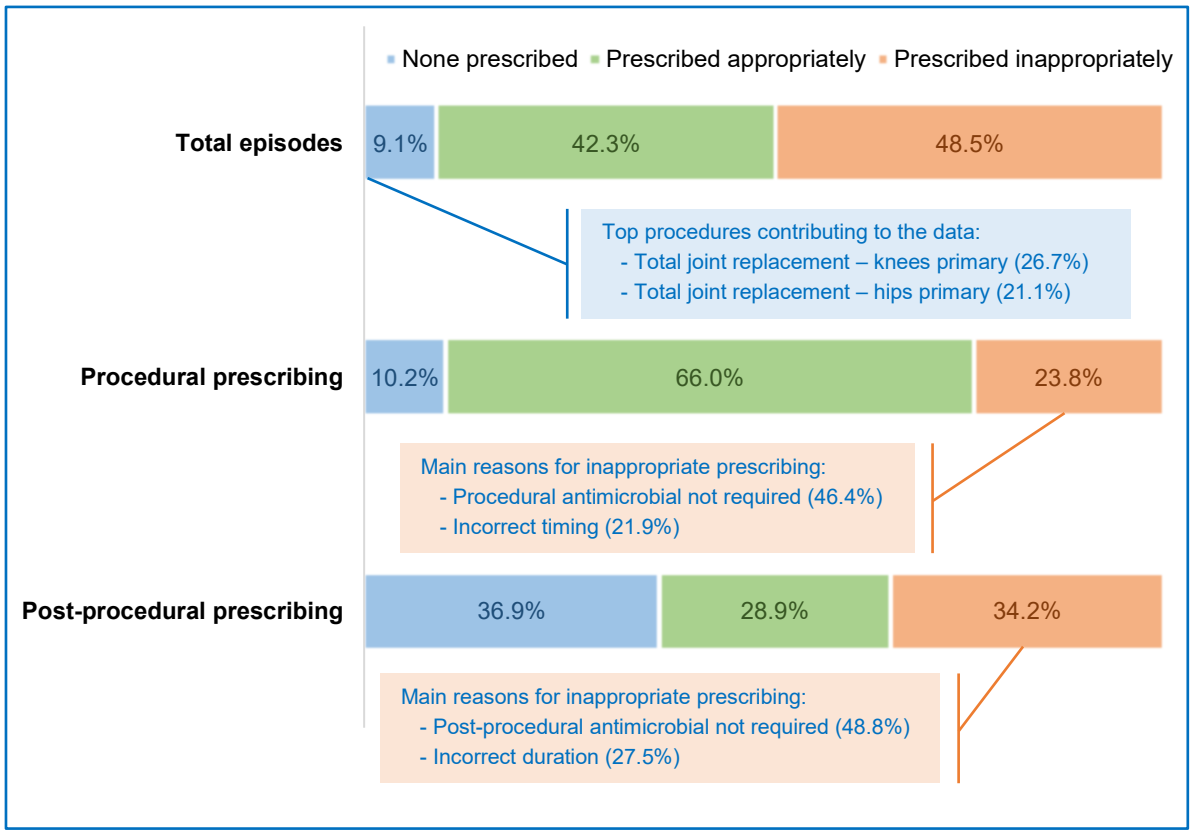


Table 5.10.1: Top ten orthopaedic procedures and inappropriateness, Surgical NAPS contributor facilities, 2019

Procedure type	Included procedures (n)	(%)	Inappropriate (%)
Total joint replacement – knees primary	384	26.5	45.8
Total joint replacement – hips primary	304	21.0	48.3
Knee surgery – arthroscopy therapeutic	115	7.9	61.7
Open reduction internal fixation – upper limb	90	6.2	40.5
Open reduction internal fixation – lower limb	69	4.8	59.1
Knee surgery – ligament	64	4.4	62.7
Knee surgery – arthroscopy diagnostic	43	3.0	31.6
Foot and ankle surgery – minor	32	2.2	55.2
Shoulder surgery – arthroplasty	28	1.9	44.4
Hand surgery – minor	28	1.9	33.3

Procedural antimicrobial prescribing

There were 1,420 procedural antimicrobial doses prescribed

- 23.7% were **non–compliant** with guidelines (*n* = 337)
- 1,400 were prescribed as **initial** doses, of which 15.8% did not have a documented administration time (*n* = 221)
- 20 were **repeat** intra-operative doses

Reasons for inappropriateness (*n* = 343 doses)

- 46.4% antimicrobial **not required**
- 21.9% incorrect **timing**
- 14.0% incorrect **dose**
- 10.2% spectrum **too broad**
- 5.3% spectrum **too narrow**
- 3.5% incorrect **route**

Table 5.10.2: Top four procedural antimicrobials used in orthopaedic episodes and inappropriateness, Surgical NAPS contributor facilities, 2019

Antimicrobial	Antimicrobial doses (n)	(%)	Inappropriate (%)
Cefazolin	1,271	89.5	19.9
Vancomycin	48	3.3	62.5
Gentamicin	40	2.8	75.0
Clindamycin / lincomycin	27	1.9	63.0

Post-procedural antimicrobial prescribing

There were 920 post-procedural prophylactic antimicrobial prescriptions

- 58.4% were **non-compliant** with guidelines (*n* = 537)

Reasons for inappropriateness (*n* = 506 prescriptions)

- 48.8% antimicrobial **not required**
- 27.5% incorrect **duration**
- 18.6% incorrect **dose of frequency**
- 1.2% spectrum **too broad**
- 1.0% spectrum **too narrow**
- 0.2% incorrect **route**

Duration of therapy

- Duration ranged from 1–21 days of therapy
- The median duration was 1 day of therapy
- 36.5% of prescriptions were for **≥ 24 hours** (*n* = 336)
- 10.0% of prescriptions were for **≥ 48 hours** (*n* = 92)

Table 5.10.3: Top five post-procedural prophylactic antimicrobials used in orthopaedic episodes and inappropriateness, Surgical NAPS contributor facilities, 2019

Antimicrobial	Antimicrobial prescriptions (n)	(%)	Inappropriate (%)
Cefazolin	835	90.8	52.1
Cefalexin	28	3.0	89.3
Vancomycin	15	1.6	80.0
Clindamycin / lincomycin	12	1.3	75.0
Gentamicin	10	1.1	100

5.11. Plastic and reconstructive surgery

Representation of plastic and reconstructive surgery in the 2019 Surgical NAPS analysis
Of all surgical episodes audited (*n* = 8,063) • Plastic and reconstructive surgery contributed to 10.1% of all episodes (*n* = 812) • Plastic and reconstructive procedures were included from 70.8% of the 144 participating facilities (*n* = 102) • Data was submitted by 57 public and 45 private facilities

Figure 5.11.1: Summary of key findings for antimicrobial prophylaxis for plastic and reconstructive episodes, Surgical NAPS contributor facilities, 2019

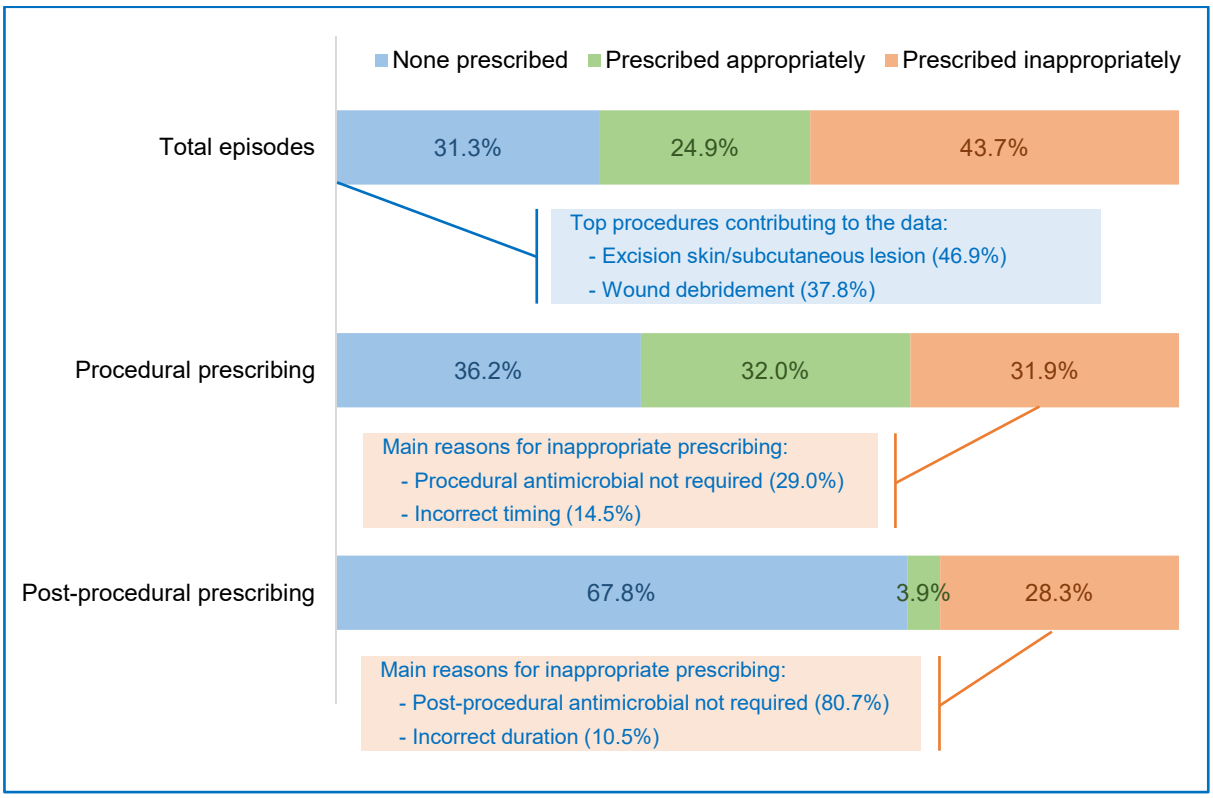


Table 5.11.1: Top ten plastic and reconstructive procedures and inappropriateness, Surgical NAPS contributor facilities, 2019

Procedure type	Included procedures (n)	(%)	Inappropriate (%)
Excision skin/subcutaneous lesion (superficial lesion)	113	13.9	46.9
Wound debridement	90	11.1	37.8
Decompression of median nerve (Carpal tunnel release/decompression)	82	10.1	22.0
Full thickness skin graft	44	5.4	59.1
Drainage of abscess	37	4.6	43.2
Wide excision of skin lesion	36	4.4	58.3
Nasal septoplasty	22	2.7	54.6
Excision of large and/or deep lesion	20	2.5	40.0
Split skin graft	17	2.1	58.8
Bone graft	17	2.1	41.2

Procedural antimicrobial prescribing

There were 558 procedural antimicrobial doses prescribed

- 44.6% were **non-compliant** with guidelines (*n* = 249)
- 539 were prescribed as **initial** doses, of which 16.9% did not have a documented administration time (*n* = 91)
- 19 were **repeat** intra-operative doses

Reasons for inappropriateness (*n* = 343 doses)

- 60.2% antimicrobial **not required**
- 14.5% incorrect **timing**
- 9.3% incorrect **dose**
- 8.2% spectrum **too narrow**
- 1.9% incorrect **route**
- 1.5% spectrum **too broad**

Table 5.11.2: Top three procedural antimicrobials used in plastic and reconstructive episodes and inappropriateness, Surgical NAPS contributor facilities, 2019

Antimicrobial	Antimicrobial doses (n)	(%)	Inappropriate (%)
Cefazolin	491	88.0	47.5
Clindamycin / lincomycin	15	2.7	53.3
Chloramphenicol	12	2.2	75.0

Post–procedural antimicrobial prescribing

There were 281 post–procedural prophylactic antimicrobial prescriptions

- 79.0% were **non–compliant** with guidelines (*n* = 222)

Reasons for inappropriateness (*n* = 228 prescriptions)

- 80.7% antimicrobial **not required**
- 10.5% incorrect **duration**
- 3.1% incorrect **dose or frequency**
- 2.6% spectrum **too narrow**
- 1.3% spectrum **too broad**
- 0.9% incorrect **route**

Duration of therapy

- Duration ranged from 1–37days of therapy
- The median duration was 4 day of therapy
- 73.0% of prescriptions were for **≥ 24 hours** (*n* = 205)
- 66.5% of prescriptions were for **≥ 48 hours** (*n* = 187)

Table 5.11.3: Top five post–procedural prophylactic antimicrobials used in plastic and reconstructive episodes and inappropriateness, Surgical NAPS contributor facilities, 2019

Antimicrobial	Antimicrobial prescriptions (n)	(%)	Inappropriate (%)
Cefalexin	82	29.2	91.5
Cefazolin	76	27.1	71.1
Chloramphenicol	45	16.0	88.9
Amoxicillin–clavulanic acid	26	9.3	92.3
Metronidazole	15	5.3	60.0

5.12. Thoracic surgery

Representation of thoracic surgery in the 2019 Surgical NAPS analysis
Of all surgical episodes audited (*n* = 8,063) • Thoracic surgery contributed to 0.9% of all episodes (*n* = 74) • Thoracic procedures were included from 13.2% of the 144 participating facilities (*n* = 19) • Data was submitted by 10 public and 9 private facilities

Figure 5.12.1: Summary of key findings for antimicrobial prophylaxis for thoracic episodes, Surgical NAPS contributor facilities, 2019

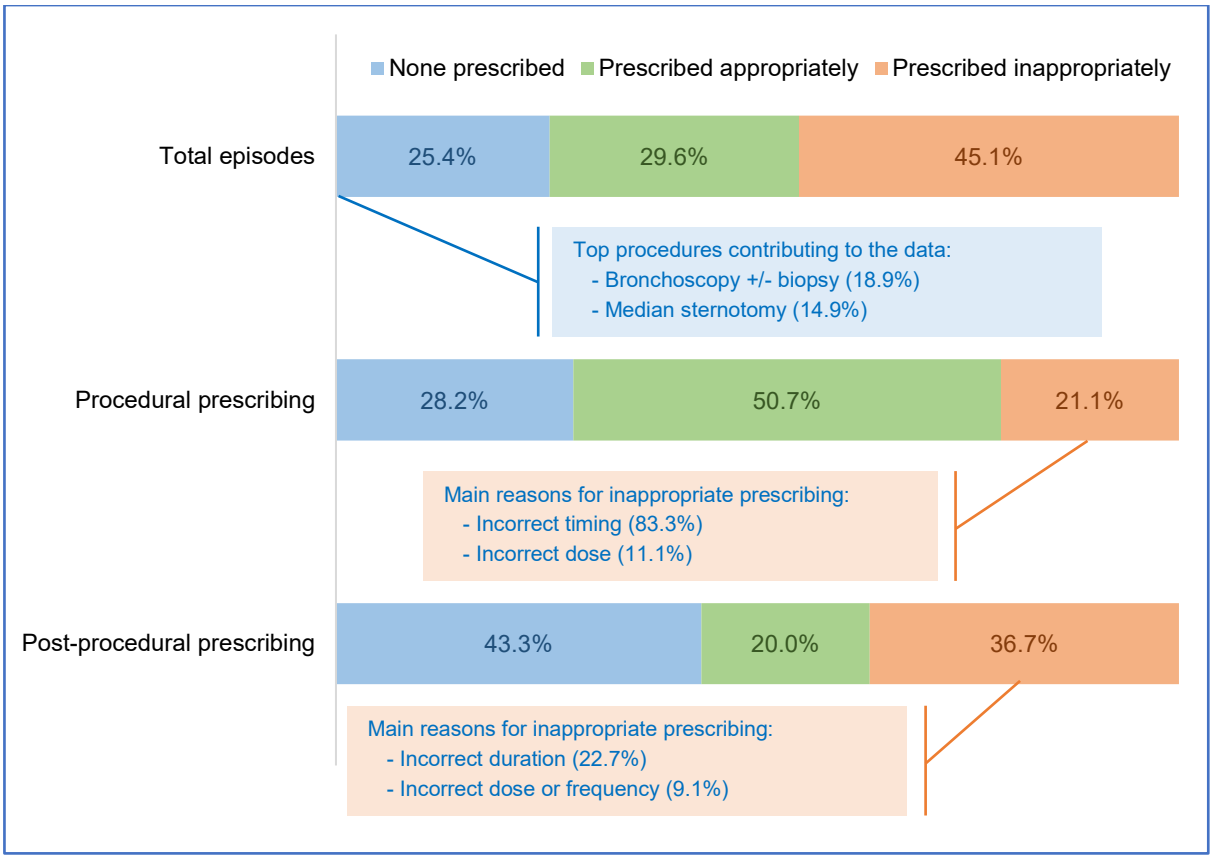


Table 5.12.1: Top ten thoracic procedures and inappropriateness, Surgical NAPS contributor facilities, 2019

Procedure type	Included procedures (n)	(%)	Inappropriate (%)
Bronchoscopy +/– biopsy	14	18.9	0.0
Median sternotomy	11	14.9	72.7
Video assisted thoracic surgery – wedge resection	9	12.2	33.3
Lobectomy	8	10.8	62.5
Video assisted thoracic surgery – diagnostic procedure	<5	–	–
Thoracotomy	<5	–	–
Video assisted thoracic surgery – pleurodesis	<5	–	–
Video assisted thoracic surgery – other	<5	–	–
Thoracoscopy	<5	–	–
Sleeve resection	<5	–	–

Procedural antimicrobial prescribing

There were 64 procedural antimicrobial doses prescribed

- 29.7% were **non-compliant** with guidelines (*n* = 19)
- 60 were prescribed as **initial** doses, of which 5.0% did not have a documented administration time (*n* = 3)
- 4 were **repeat** intra-operative doses

Reasons for inappropriateness (*n* = 18 doses)

- 83.3% incorrect **timing**
- 11.1% incorrect **dose**
- 5.6% antimicrobial **not required**

Table 5.12.2: Top procedural antimicrobial used in thoracic episodes and inappropriateness, Surgical NAPS contributor facilities, 2019

Antimicrobial	Antimicrobial doses (n) (%)		Inappropriate (%)
Cefazolin	55	85.9	27.3

Post-procedural antimicrobial prescribing

There were 34 post-procedural prophylactic antimicrobial prescriptions

- 58.8% were **non-compliant** with guidelines (*n* = 20)

Reasons for inappropriateness (*n* = 34 prescriptions)

- 22.7% incorrect **duration**
- 9.1% incorrect **dose**
- 8.3% antimicrobial **not required**
- 4.6% spectrum **too broad**

Duration of therapy

- Duration ranged from 1–4 days of therapy
- The median duration was 1 day of therapy
- 47.1% of prescriptions were for **≥ 24 hours** (*n* = 16)
- 17.6% of prescriptions were for **≥ 48 hours** (*n* = 6)

Table 5.12.3: Top post–procedural prophylactic antimicrobial used in thoracic episodes and inappropriateness, Surgical NAPS contributor facilities, 2019

Antimicrobial	Antimicrobial prescriptions (n) (%)		Inappropriate (%)
Cefazolin	33	97.1	63.6

5.13. Urological surgery

Representation of urological surgery in the 2019 Surgical NAPS analysis

Of all surgical episodes audited (*n* = 8,063)

- Urological surgery contributed to 9.9% of all episodes (*n* = 796)
- Urological procedures were included from 61.1% of the 144 participating facilities (*n* = 88)
- Data was submitted by 49 public and 39 private facilities

Figure 5.13.1: Summary of key findings for antimicrobial prophylaxis for urological episodes, Surgical NAPS contributor facilities, 2019

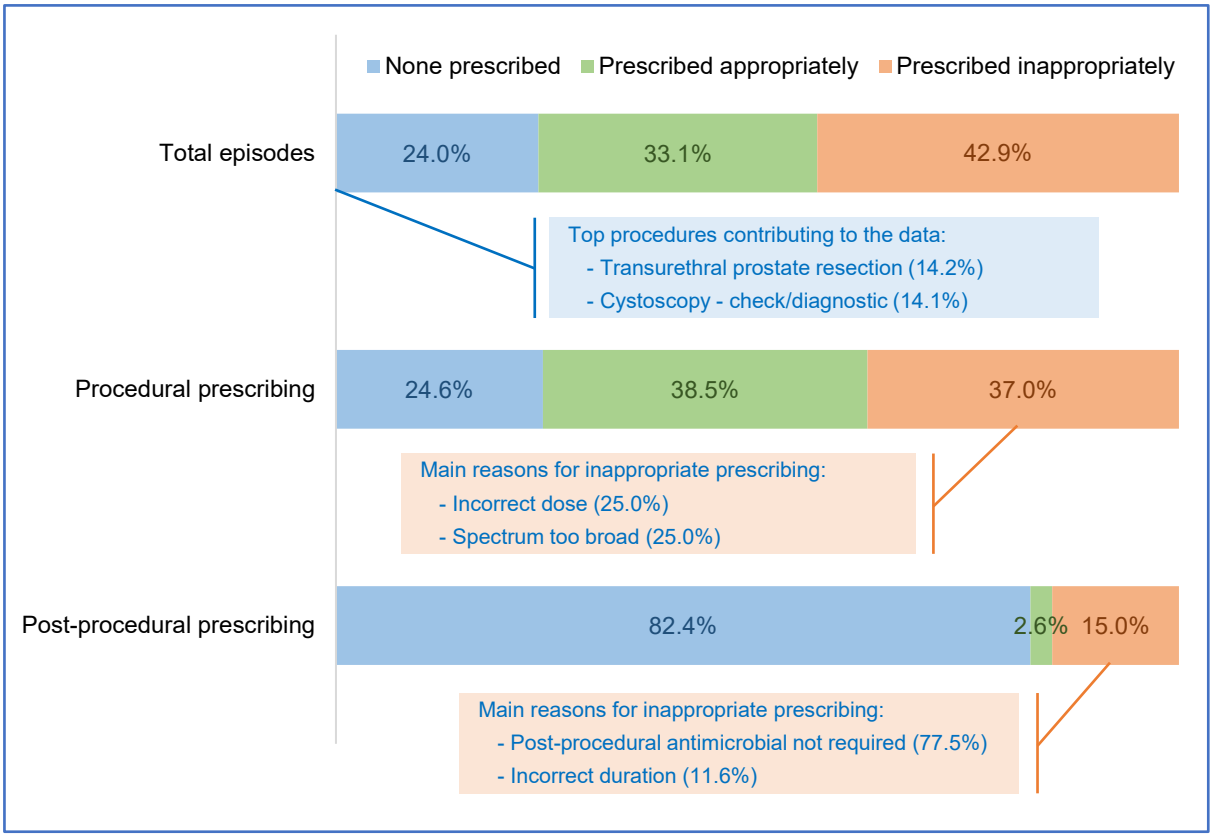


Table 5.13.1: Top ten urological procedures and inappropriateness, Surgical NAPS contributor facilities, 2019

Procedure type	Included procedures (n)	(%)	Inappropriate (%)
Transurethral prostate resection	113	14.2	49.6
Cystoscopy – check/diagnostic	112	14.1	40.2
Cystoscopy and cannulation of ureter and procedure	85	10.7	47.1
Flexible cystoscopy	76	9.5	27.6
Cystoscopy ± hydrodilation or stent removal	45	5.7	42.2
Cystoscopy	33	4.1	48.5
Vasectomy	30	3.8	26.7
Transperineal prostate biopsy	30	3.8	26.7
Cystoscopy and removal of bladder tumour with resectoscope	25	3.1	32.0
Transrectal ultrasonography biopsy of prostate	17	2.1	52.9

Procedural antimicrobial prescribing

There were 742 procedural antimicrobial doses prescribed

- 45.1% were **non–compliant** with guidelines (*n* = 335)
- 731 were prescribed as **initial** doses, of which 19.2% did not have a documented administration time (*n* = 140)
- 11 were **repeat** intra-operative doses

Reasons for inappropriateness (*n* = 324 doses)

- 25.0% incorrect **dose**
- 25.0% spectrum **too broad**
- 24.7% spectrum **too narrow**
- 20.7% antimicrobial **not required**
- 12.4% incorrect **timing**
- 1.2% incorrect **route**

Table 5.13.2: Top five procedural antimicrobials used in urological episodes and inappropriateness, Surgical NAPS contributor facilities, 2019

Antimicrobial	Antimicrobial doses (n)	(%)	Inappropriate (%)
Cefazolin	409	55.1	44.5
Gentamicin	176	23.7	34.1
Ceftriaxone	66	8.9	69.7
Ampicillin / amoxicillin	39	5.3	51.2
Metronidazole	23	3.1	17.4

Post-procedural antimicrobial prescribing

There were 167 post-procedural prophylactic antimicrobial prescriptions

- 82.0% were **non-compliant** with guidelines (*n* = 137)

Reasons for inappropriateness (*n* = 138 prescriptions)

- 77.5% antimicrobial **not required**
- 11.6% incorrect **duration**
- 3.6% spectrum **too broad**
- 2.9% incorrect **dose or frequency**
- 0.7% spectrum **too narrow**
- 0.7% incorrect **route**

Duration of therapy

- Duration ranged from 1–62 days of therapy
- The median duration was 2 day of therapy
- 77.2% of prescriptions were for **≥ 24 hours** (*n* = 129)
- 58.7% of prescriptions were for **≥ 48 hours** (*n* = 98)

Table 5.13.3: Top six post-procedural prophylactic antimicrobials used in urological episodes and inappropriateness, Surgical NAPS contributor facilities, 2019

Antimicrobial	Antimicrobial prescriptions (n)	(%)	Inappropriate (%)
Cefazolin	34	20.4	88.2
Trimethoprim	32	19.2	96.9
Cefalexin	29	17.4	72.4
Ceftriaxone	17	10.2	100
Gentamicin	10	6.0	80.0
Ciprofloxacin	10	6.0	70.0

5.14. Vascular surgery

Representation of vascular surgery in the 2019 Surgical NAPS analysis
Of all surgical episodes audited (*n* = 8,063) • Vascular surgery contributed to 3.3% of all episodes (*n* = 263) • Vascular procedures were included from 31.5% of the 144 participating facilities (*n* = 45) • Data was submitted by 26 public and 19 private facilities

Figure 5.14.1: Summary of key findings for antimicrobial prophylaxis for vascular episodes, Surgical NAPS contributor facilities, 2019

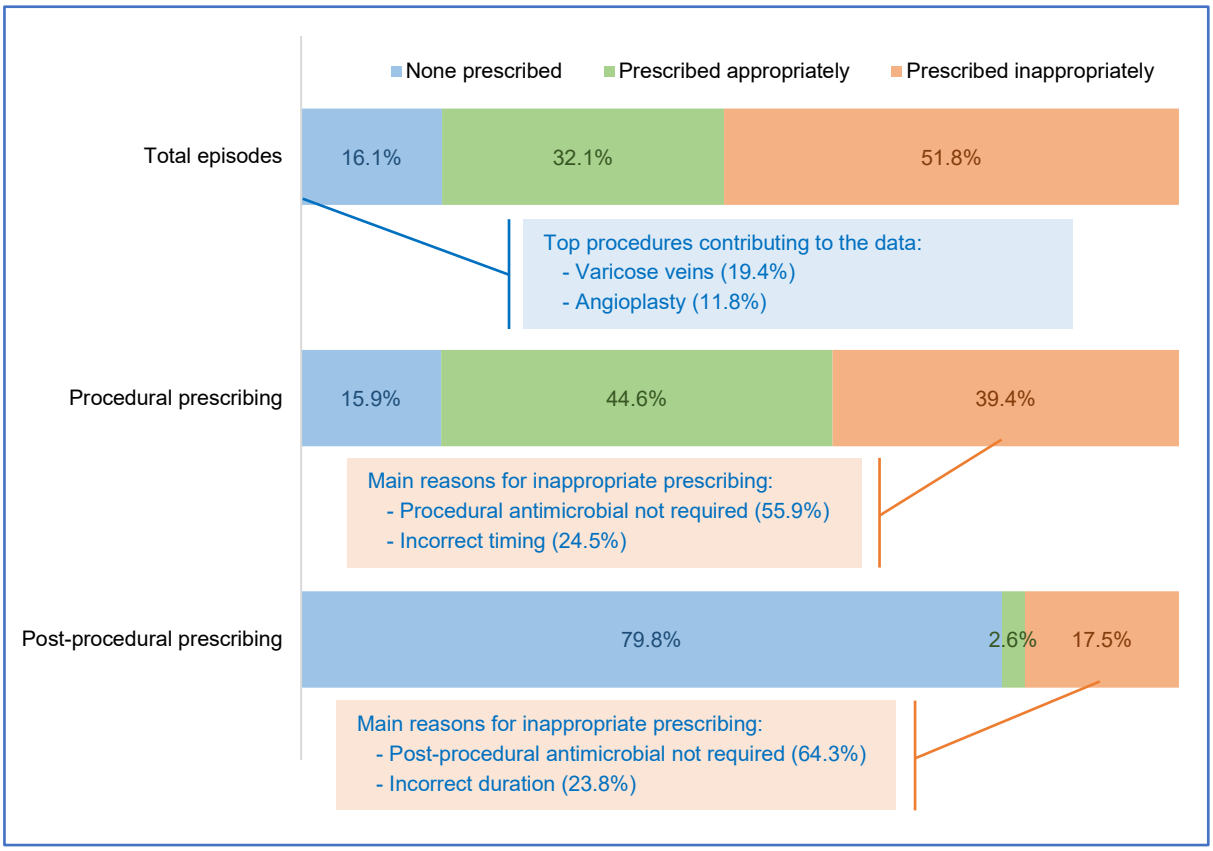


Table 5.14.1: Top ten vascular procedures and inappropriateness, Surgical NAPS contributor facilities, 2019

Procedure type	Included procedures (n)	(%)	Inappropriate (%)
Varicose veins	51	19.4	76.5
Angioplasty	31	11.8	25.8
Digital amputations	23	8.7	56.5
Radiofrequency ablation	20	7.6	45.0
Abdominal aortic aneurysm repair	14	5.3	71.4
Femoral popliteal bypass	13	4.9	69.2
Peripheral endovascular stent	9	3.4	44.4
Arteriovenous fistula – autogenous	8	3.0	25.0
Ilio–femoral endarterectomy	6	2.3	50.0
Thoracic endovascular aortic aneurysm repair	5	1.9	60.0

Procedural antimicrobial prescribing

There were 239 procedural antimicrobial doses prescribed

- 38.5% were **non–compliant** with guidelines (*n* = 92)
- 227 were prescribed as **initial** doses, of which 23.3% did not have a documented administration time (*n* = 53)
- 12 were **repeat** intra-operative doses

Reasons for inappropriateness (*n* = 102 doses)

- 55.9% antimicrobial **not required**
- 24.5% incorrect **timing**
- 13.7% incorrect **dose**
- 7.8% spectrum **too narrow**
- 6.9% spectrum **too broad**
- 3.9% incorrect **route**

Table 5.14.2: Top procedural antimicrobial used in vascular episodes and inappropriateness, Surgical NAPS contributor facilities, 2019

Antimicrobial	Antimicrobial doses (n) (%)		Inappropriate (%)
Cefazolin	209	87.5	39.7

Post-procedural antimicrobial prescribing

There were 51 post-procedural prophylactic antimicrobial prescriptions

- 84.3% were **non-compliant** with guidelines, (*n* = 43)

Reasons for inappropriateness (*n* = 51 prescriptions)

- 64.3% antimicrobial **not required**
- 23.8% incorrect **duration**
- 14.3% incorrect **dose or frequency**
- 2.4% spectrum **too narrow**

Duration of therapy

- Duration ranged from 1–20 days of therapy
- The median duration was 1 day of therapy
- 66.7% of prescriptions were for **≥ 24 hours** (*n* = 34)
- 39.2% of prescriptions were for **≥ 48 hours** (*n* = 20)

Table 5.14.3: Top five post–procedural prophylactic antimicrobials used in vascular episodes and inappropriateness, Surgical NAPS contributor facilities, 2019

Antimicrobial	Antimicrobial prescriptions (n) (%)		Inappropriate (%)
Cefazolin	40	78.4	85.0

Appendix 6: Comparative data analysis

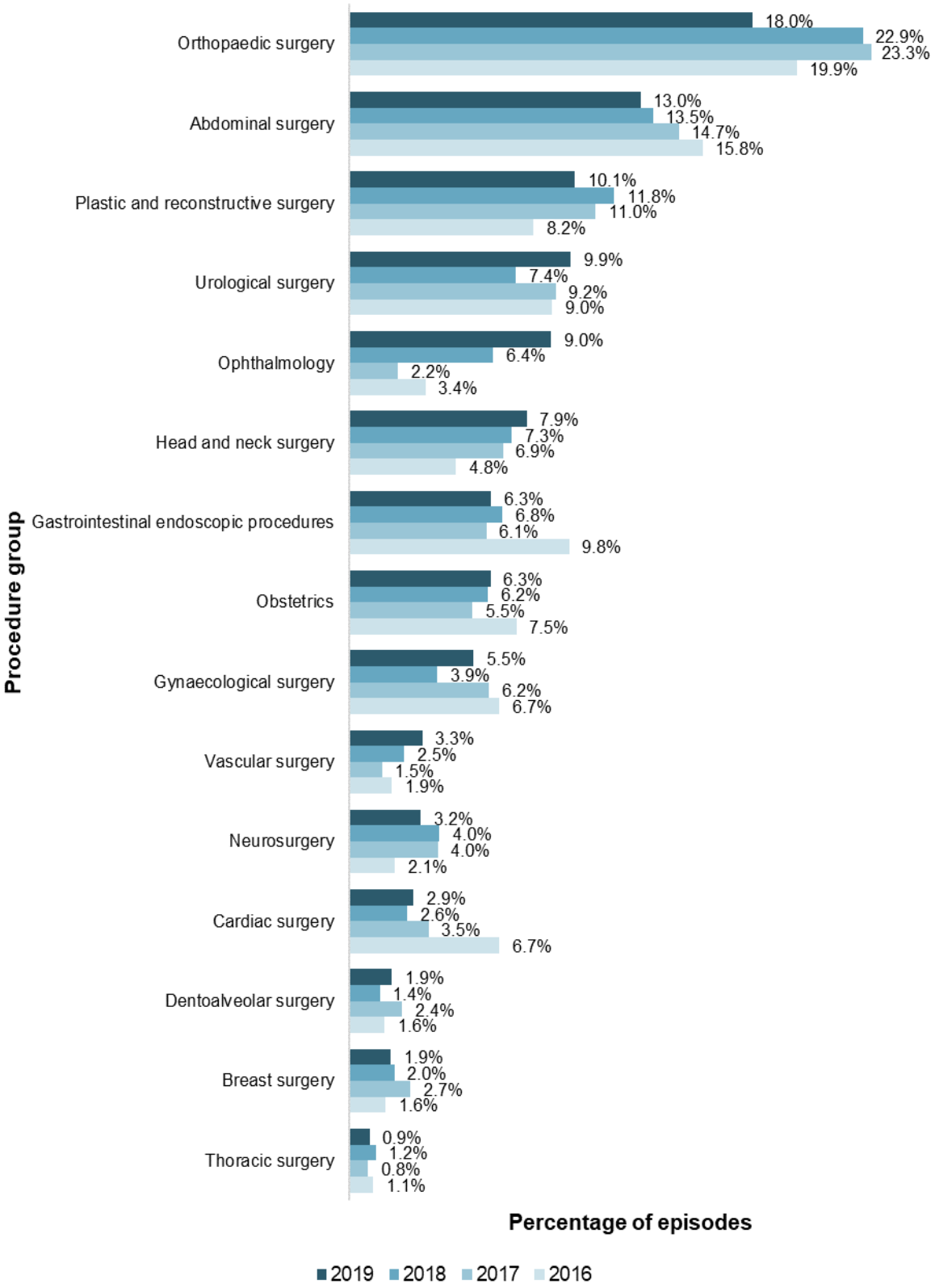
COMPARISONS TO PREVIOUS SURGICAL NAPS DATA: 2016 TO 2019

Caution is required when comparing the results of analyses from year to year, (see Appendix 2), as each dataset may comprise different proportions of surgical procedure groups, which have different requirements for surgical antimicrobial prescribing. This is influenced by the facility participation rates and survey methodologies auditors have chosen to employ. Overall comparisons should be limited to within specific surgical procedure groups, (see Appendix 7), although some comparative analysis between the 2016 to 2019 datasets have been provided below.

PROCEDURE GROUP PARTICIPATION

Overall, the proportional contribution of procedure groups to the Surgical NAPS dataset was relatively stable from 2016 to 2019 (Figure A6.1). The highest proportion of audits have been completed for orthopaedics each year since 2016, although this contribution slightly reduced in 2019. Consistently, the smallest proportion of data has been submitted for thoracic surgery. There were also reductions in the contribution over time for cardiac surgery and gastrointestinal endoscopic procedures. Contribution of data increased from 2016 for head and neck surgery and ophthalmology.

Figure A6.1: Percentage of surgical episodes for each surgical procedure group, Surgical NAPS contributor facilities, 2016–2019*

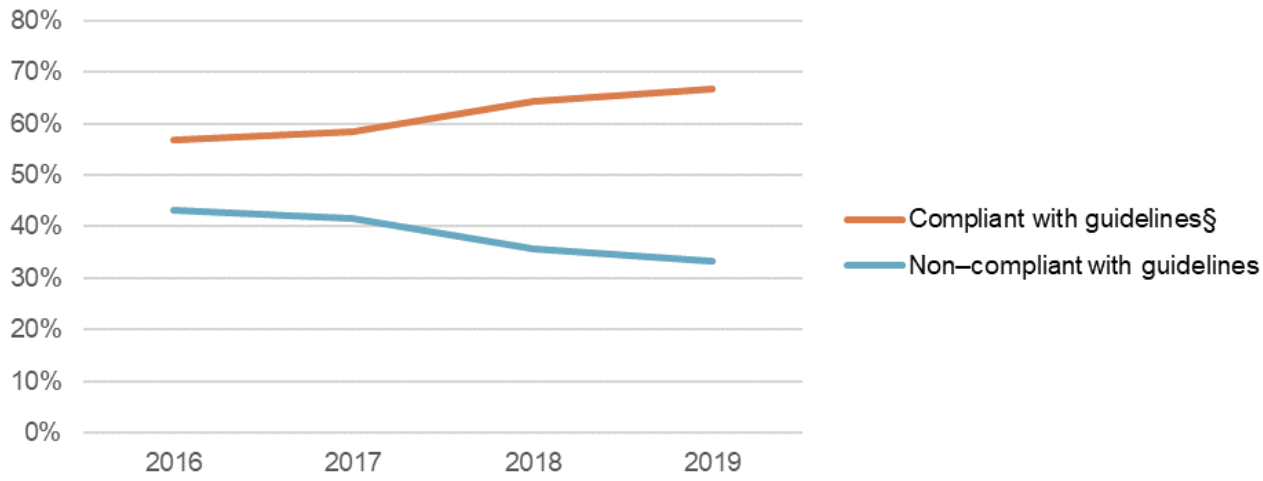


Note: Where there were multiple procedures per surgical episode, only the primary procedure group was included
* *n* = 8,063 surgical episodes in 2019

COMPLIANCE WITH GUIDELINES

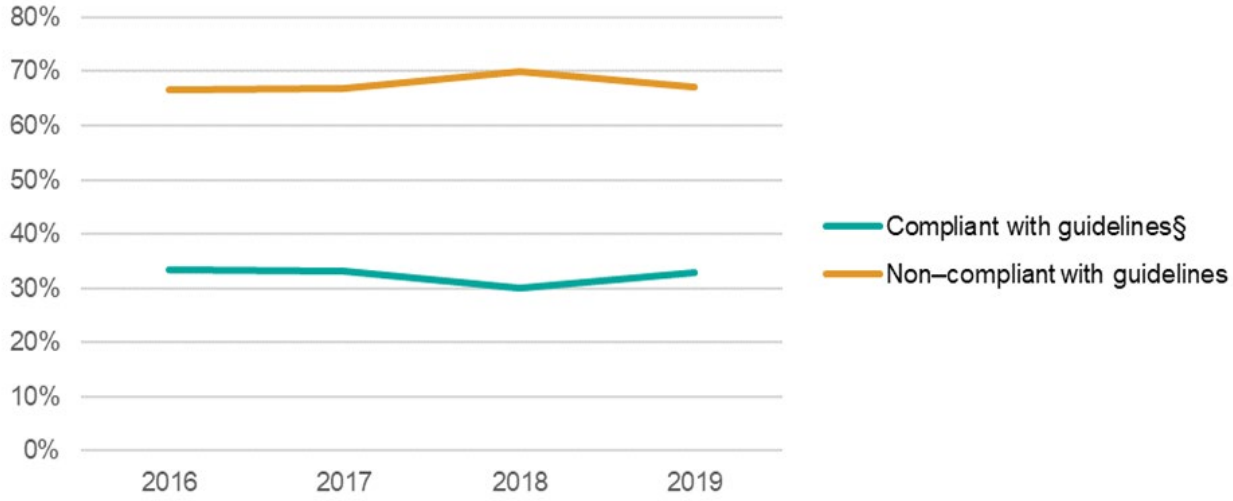
Compliance with guidelines when procedural antimicrobials were prescribed improved from 2016 to 2019 by approximately 10% (Figure A6.2). For antimicrobials prescribed post-procedurally, there has been no discernible change in compliance, which has remained very low (Figure A6.3).

Figure A6.2: Percentage of compliance with guidelines, when available, for procedural antimicrobial doses, Surgical NAPS contributor facilities, 2016–2019*



* *n* = 6,525 procedural antimicrobial doses in 2019, excluding 'directed theory', 'no guidelines available' and 'not assessable' options
† Antibiotic Expert Group. *Therapeutic Guidelines: Antibiotic. Version 16*. Melbourne: Therapeutic Guidelines Limited; 2019. https://www.tg.org.au/
§ Includes 'compliant with *Therapeutic Guidelines*' and 'compliant with local guidelines'

Figure A6.3: Percentage of compliance with guidelines, when available, for post–procedural prophylactic antimicrobial prescriptions, Surgical NAPS contributor facilities, 2016–2019*

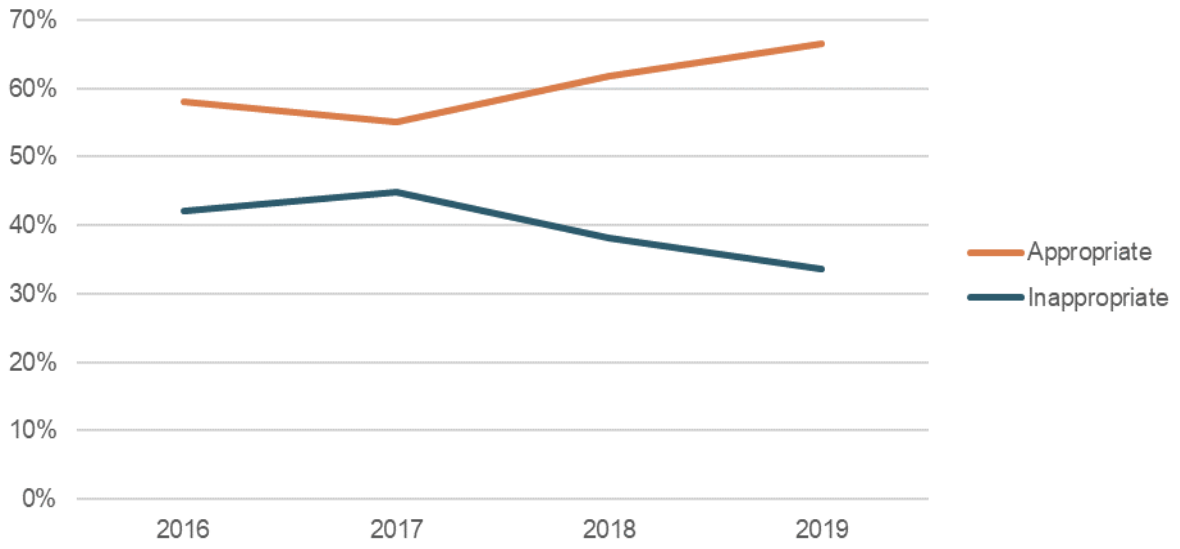


* *n* = 2,598 post–procedural prophylactic antimicrobial prescriptions in 2019, excluding 'directed theory', 'no guidelines available' and 'not assessable' options
† Antibiotic Expert Group. *Therapeutic Guidelines: Antibiotic. Version 16*. Melbourne: Therapeutic Guidelines Limited; 2019. https://www.tg.org.au/
§ Includes 'compliant with *Therapeutic Guidelines*' and 'compliant with local guidelines'

APPROPRIATENESS

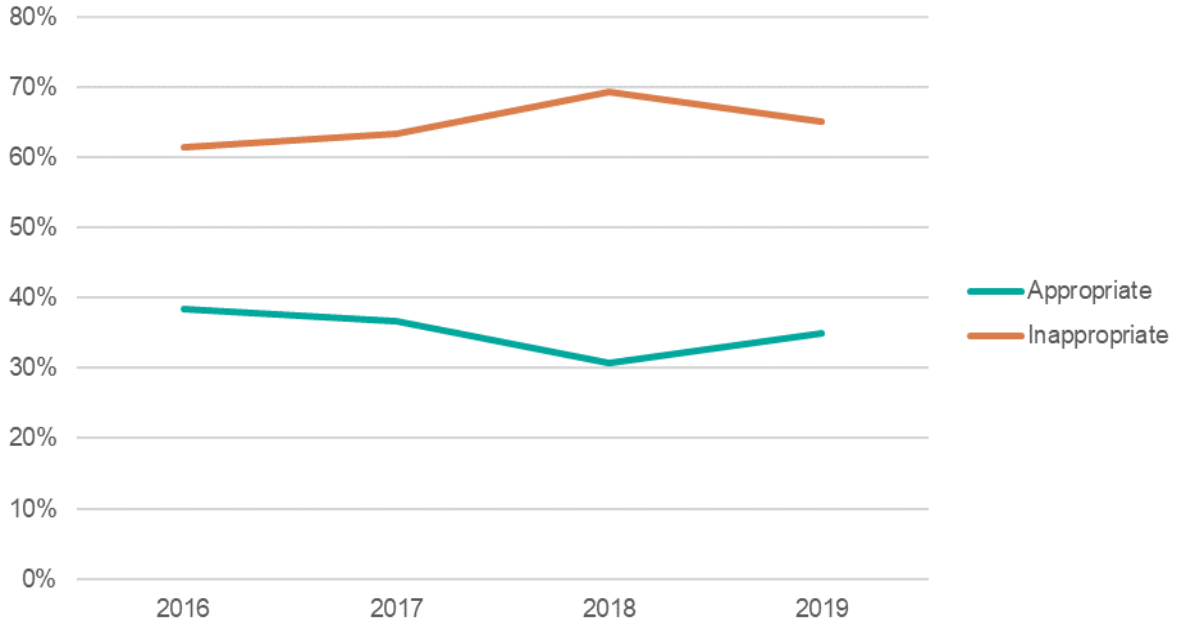
For procedural antimicrobials, from 2016 to 2019, there was a 10% increase in prescriptions deemed appropriate (Figure A6.4). This reflects the similar improvement in the compliance with guidelines. For post-procedurally prescribed antimicrobials, appropriateness decreased by nearly 5% from 2016 to 2019 (Figure A6.5).

Figure A6.4: Percentage of appropriateness for procedural antimicrobial doses, when assessable, Surgical NAPS contributor facilities, 2016–2019*



* *n* = 6,637 procedural antimicrobial doses in 2019, excluding 'not assessable' option

Figure A6.5: Percentage of appropriateness, when assessable, for post-procedural prophylactic antimicrobial prescriptions, Surgical NAPS contributor facilities, 2016–2019*



* *n* = 2,631 post-procedural prophylactic antimicrobial prescriptions in 2019, excluding the 'not assessable' option

REASONS FOR INAPPROPRIATENESS

The reasons for deeming procedural antimicrobials inappropriate have changed over time. Since 2018, incorrect timing has decreased by approximately 15%; and there was a decrease of almost 10% in incorrect dose from 2016 to 2019 (Figure A6.5). There were also increases in 'spectrum too broad' and 'spectrum too narrow'.

The reasons for deeming post-procedural antimicrobials inappropriate have not changed over time (Figure A6.6). The exception is duration of therapy, for which there was an approximate 20% decrease from 2016 to 2019, primarily from 2016 to 2017.

Figure A6.6: Reasons for inappropriateness, by percentage of required procedural antimicrobial doses, Surgical NAPS contributor facilities, 2016–2019*

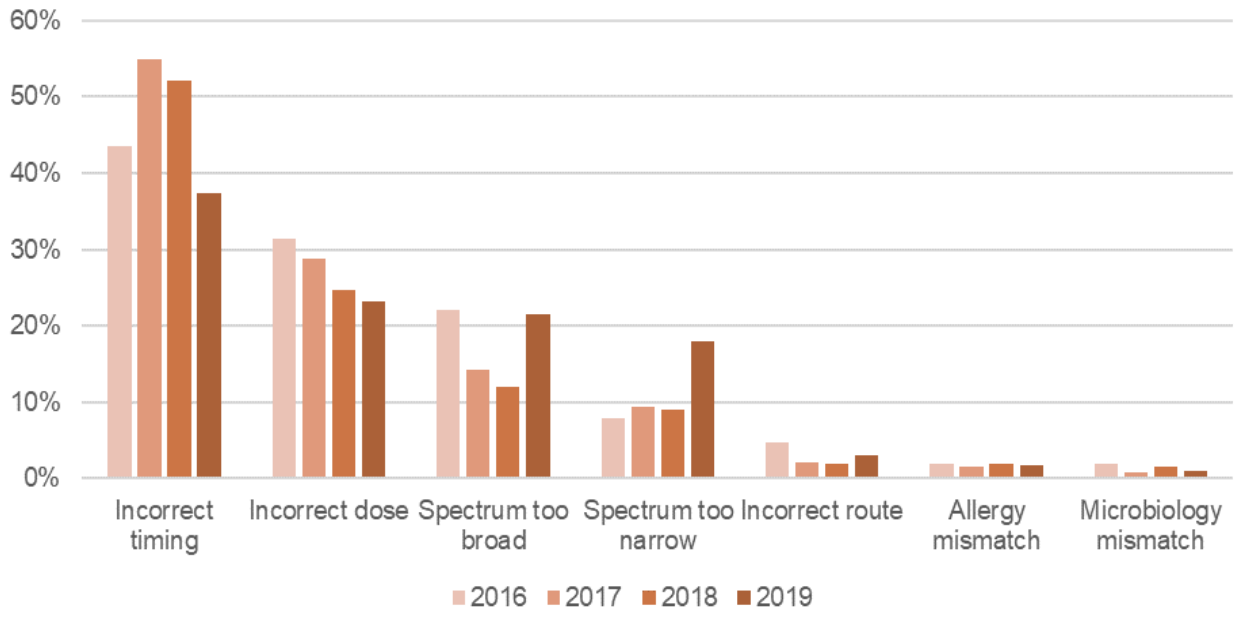
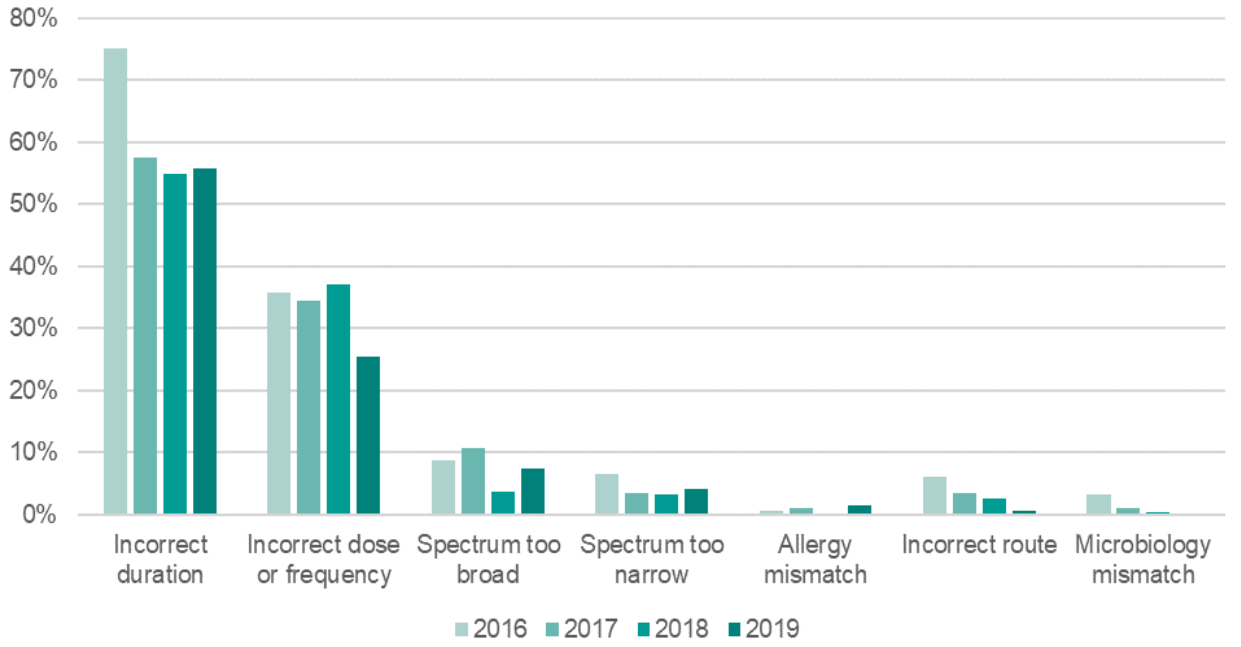


Figure A6.7: Reasons for inappropriateness, by percentage of required post-procedural antimicrobial doses, Surgical NAPS contributor facilities, 2016 – 2019*



Appendix 7: Procedure groups

The procedures listed in the Surgical NAPS database have been adopted from The Royal Australasian College of Surgeons Morbidity Audit and Logbook tools.[7]

The surgical procedure groups listed are:

- Abdominal surgery
  – anorectal
  – bariatric and other
  – biliary
  – colorectal
  – gastro–oesophageal
  – hepatic
  – pancreas and duodenum
- Breast surgery
- Cardiac surgery
- Dentoalveolar surgery
- Gastrointestinal endoscopic procedures
- Gynaecological surgery
- Head and neck surgery
  – laryngology
  – otology
  – rhinology
- Neurosurgery
  – cerebrovascular
  – peripheral nerve
  – spinal
  – other
- Obstetrics
- Ophthalmology
- Orthopaedic surgery
- Plastic and reconstructive surgery
- Thoracic surgery
- Urological surgery
  – endoscopic procedures
  – laparoscopic procedures
  – open procedures
  – other
- Vascular surgery

  – dialysis access

Appendix 8: Surgical NAPS data collection form

SURGICAL NAPS National Antimicrobial Prescribing Survey

GUIDANCE NCAS

Patient identification Number	Date of birth / age	Gender	Date of admission	Date of discharge	Specialty	Height *cm*	Weight *kg*	eGFR / CrCl *ml/min*
	/ /	M / F / O	/ /	/ /				

Surgical details

Surgery date / / **Surgery this admission** ❒ Initial ❒ subsequent

Procedures ❒ emergency ❒ elective ❒ not assessable

❒ trauma ❒ removal/insertion of prosthetic material ❒ excessive blood loss

Surgeon code

Anaesthetist code

Time of first incision : ❒ not documented ❒ not applicable

If not documented or not applicable; surgery start time *(or estimated)* :

End time *(or estimated)* :

Wound classification

❒ clean ❒ clean-contaminated ❒ contaminated ❒ dirty ❒ unknown ❒ not applicable

ASA score ❒ 1 ❒ 2 ❒ 3 ❒ 4 ❒ 5 ❒ 6 ❒ unknown

Risk factors

❒ none identified

All procedures

❒ current smoker
❒ diabetes
❒ peritoneal or haemodialysis
❒ obesity (BMI>30)
❒ pregnancy
❒ rheumatoid arthritis
❒ current malignancy
❒ previous radiation therapy
❒ immunocompromised
❒ systemic corticosteroids
❒ other immunosuppressive treatments
❒ presence of prostheses
❒ MRSA colonisation
❒ MDR Gram negative colonisation
❒ one or more of:
- prosthetic cardiac valve
- previous infective endocarditis
- congenital heart disease with defects
- rheumatic heart disease in Aboriginal/Torres Strait Islanders

Transrectal prostatic biopsy

❒ quinolone therapy in preceding 3 months
❒ recent travel to Asia or Southern Europe in preceding 6 months

Gastroduodenal or oesophageal procedures

❒ reduced gastric acidity or motility
❒ gastrointestinal bleeding
❒ gastric outlet obstruction
❒ perforation

Biliary surgery

❒ acute cholecystitis
❒ obstructive jaundice
❒ common bile duct stones
❒ non-functioning gallbladder

Allergies and adverse drug reactions to antimicrobials

❒ nil known ❒ not documented ❒ present; *specify drug and nature*

Surgical or clinical notes, microbiology, radiology

Existing antimicrobial therapy

Any antimicrobial for treatment or medical prophylaxis or another condition. Prescribed in the 24 hours prior (72 hours if on dialysis) to the procedure

❒ none prescribed ❒ not assessable

Antimicrobial	Route	Dose	Date and time of last dose
			/ / :
			/ / :
			/ / :
			/ / :

Doc:SurgicalNAPS-DCFv7;20160413

Peri-operative doses

Include all antimicrobials commenced for the purpose of prophylaxis.

Record each dose on a separate line, including any repeat doses. Include any documented topical antimicrobials (e.g. cement beads, soaks, sponges, irrigations, etc.)

Antimicrobial	Route	Dose	Documented administration time: Not assessable	Nearest 15 minutes	Exact time	Start time	End time	Was this a repeat dose?	Guideline compliance (1-6)	Allergy mismatch	Microbiology mismatch	Incorrect dose	Incorrect route	Incorrect timing	Spectrum too broad	Spectrum too narrow	Peri-operative antimicrobials not required	Procedure requires antimicrobials	Appropriateness (1-5)
						:	:												
						:	:												
						:	:												
						:	:												
❒ *Repeat dose required, but not given*									4										4
❒ *No antimicrobial prescribed*																			

Post-operative antimicrobials

Record those only relating to the procedure, including any inpatient or discharge scripts

Start date and time*	End date and time*	Antimicrobial	Route	Dose	Freq	Indication: For prophylaxis only	For treatment of infection related to the procedure	Not assessable	Guideline compliance (1-6)	Allergy mismatch	Microbiology mismatch	Incorrect dose / frequency	Incorrect route	Incorrect duration	Spectrum too broad	Spectrum too narrow	Post-operative antimicrobials not required	Procedure requires antimicrobials	Appropriateness (1-5)
/ / :	/ / :																		
/ / :	/ / :																		
/ / :	/ / :																		
/ / :	/ / :																		
/ / :	/ / :																		
If time unknown, write unknown		❒ *None prescribed*																	

30 Day follow up

Surgical site infection ❒ none identified ❒ not assessable

❒ identified; *select one type and list any relevant microbiology*

- ❒ superficial
- ❒ deep incisional
- ❒ organ space
- ❒ prosthesis

Microbiology

Clostridium difficile infection	❒ yes	❒ no	❒ unknown
MDR organism	❒ yes	❒ no	❒ unknown
Unplanned ICU admission	❒ yes	❒ no	❒ unknown
Unplanned hospital readmission	❒ yes	❒ no	❒ unknown
Death	❒ yes	❒ no	❒ unknown
Other morbidity *(if yes, specify)*	❒ yes	❒ no	❒ unknown

Guideline compliance

1. Compliant with Therapeutic Guidelines
2. Compliant with locally endorsed guidelines
3. Directed therapy
4. Non-compliant with guidelines
5. No guidelines available
6. Not assessable

Appropriateness

1. Optimal
2. Adequate
3. Sub-optimal
4. Inadequate
5. Not assessable

Appendix 9: Surgical NAPS appropriateness assessment guide

	Appropriate		Inappropriate		
	1 - Optimal	2 - Adequate	3 - Suboptimal	4 - Inadequate	5 - Not assessable
Allergy mismatch	Where antimicrobials are prescribed exactly according to Therapeutic Guidelines or local guidelines – antimicrobial choice, dose, route, timing and duration; or where there is an appropriate reason for deviation from guidelines *If any reason is selected for incorrect prescribing, the prescription will no longer be optimal.*		Mild or non-life threatening allergy mismatch	Life threatening allergy mismatch	Where there is insufficient information available or the case is too complex for assessment.
Microbiology mismatch				Antimicrobial used is too narrow (where sensitivity results available)	
Incorrect dose or frequency			Dose or frequency too high (with exception of gentamicin)	Dose or frequency too low Gentamicin dose too high or too frequent	
Incorrect route			An intravenous antimicrobial has been prescribed when the patient is able to safely take it orally	The prescribed route does not reach the site of infection or surgery	
Incorrect timing		Repeat dose given too soon (including patients who were already on existing antimicrobial therapy) *taking into consideration patients with renal impairment*	Antimicrobial prophylaxis given less than 15 minutes before surgical incision (with exception of vancomycin) Vancomycin started less than 30 minutes before surgical incision	Antimicrobial prophylaxis given greater than 60 minutes before surgical incision (with exception of vancomycin) Vancomycin started greater than 120 minutes before surgical incision Repeat dose given too late (including patients already on existing antimicrobial therapy) *taking into account renal impairment*	
Incorrect duration				Surgical prophylaxis greater than 24 hours (except where guidelines endorse this)	
Spectrum too broad			Choice of antimicrobial is too broad Additional antimicrobial added unnecessarily		
Spectrum too narrow				Choice of antimicrobial does not cover likely organisms	
Procedure does not require any antimicrobials				Procedure does not require any antimicrobials, but antimicrobials were still prescribed	
Procedure requires antimicrobials		Patient already on existing antimicrobials where last dose would have provided sufficient prophylaxis for the duration of the procedure		Procedure requires antimicrobials but no antimicrobials were prescribed AND there were no existing antimicrobials	
Repeat dose required, but not given				This will automatically be selected for auditors	
No antimicrobial prescribed	No antimicrobial required			Procedure requires antimicrobials but no antimicrobials were prescribed and there were no pre-existing antimicrobials	

Glossary

Adequate prescribing	A prescription that is deemed adequate by the Surgical NAPS Appropriateness Assessment Guide; see Appendix 9.
Appropriate prescribing	A prescription that is deemed **appropriate** (optimal or adequate) by the Surgical NAPS Appropriateness Assessment Guide; see Appendix 9.
Directed therapy	There are microbiology culture and susceptibility results available to guide prophylaxis or treatment.
Dose	An individual antimicrobial dose administered either immediately prior to or during the surgical procedure.
Elective surgery	Surgery that can be booked in advance as a result of a specialist clinical assessment resulting in placement on an elective surgery waiting list.
Emergency surgery	Surgery to treat trauma or acute illness subsequent to an emergency presentation; including unplanned surgery for admitted patients and unplanned surgery for patients already awaiting an elective surgery.
Episode	An individual procedure or set of multiple procedures performed together during the one surgical session and the subsequent post–procedural care associated with the procedure(s).
Episode where no prophylaxis prescribed	Any episode where all prescribed antimicrobials are recorded as for 'treatment' and/or 'not assessable'.
Existing antimicrobial therapy	Any antimicrobial prescribed for treatment or prophylaxis in the 24 hours prior (72 hours if on dialysis) to the procedure; these are not analysed individually but are able to be considered when assessing the appropriateness of whether procedural antimicrobials were given or not given.
Inadequate prescribing	A prescription that is deemed inadequate by the Surgical NAPS Appropriateness Assessment Guide; see Appendix 9.
Inappropriate prescribing	A prescription that is deemed inappropriate (suboptimal or inadequate) by the Surgical NAPS Appropriateness Assessment Guide; see Appendix 9.
Initial dose	The first dose of an antimicrobial administered either immediately prior to or during the surgical procedure for the purpose of prophylaxis.
Local guidelines	Local guidelines must be authorised and readily available on wards or on the hospital intranet; exceptions include paediatric and neonatal guidelines from an Australian children's hospital and links to other official guidelines within a facility's network.
Not assessable prescribing	A prescription that is deemed **not assessable** by the Surgical NAPS Appropriateness Assessment Guide; see Appendix 9.
Optimal prescribing	A prescription that is deemed **optimal** by the Surgical NAPS Appropriateness Assessment Guide; see Appendix 9.
Peer group[1]	A hospital peer group supports comparisons that reflect the purpose, resources and role of each hospital and is defined by the type and nature of the services provided; based on data from a broad range of sources; intended to be multipurpose and stable over time.
Post-procedural antimicrobial	An antimicrobial prescribed following, but directly relating to, the procedure; each prescription of the antimicrobial is recorded, including any inpatient or discharge scripts.
Post-procedural antimicrobial prophylaxis	All antimicrobials prescribed following, but directly relating to, the procedure for the purposes of prophylaxis; each prescription course of the antimicrobial is recorded and reported, including any inpatient or discharge scripts.

Prescription	Any antimicrobial prescribed as either a single dose or as a course following the surgical procedure.
Procedural antimicrobial	An antimicrobial administered either immediately prior to or during the surgical procedure for the purpose of prophylaxis; each initial and repeat dose of the antimicrobial administered is recorded individually.
Procedural antimicrobial prophylaxis	All antimicrobials administered either immediately prior to or during the surgical procedure for the purpose of prophylaxis; each dose of the antimicrobial administered is recorded and reported individually.
Procedure	The procedure(s) performed during the surgical episode, as documented on the procedure form or in the medical record; any procedure can be included, e.g. colonoscopies, radiological procedures, etc.
Procedure group	The specialty group under which each procedure is classed for reporting; *see* Appendix 7.
Prophylaxis	An antimicrobial prescribed for the prevention of surgery–related infections.
Remoteness classification[2]	The Australian Standard Geographical Classification Remoteness Area was developed in 2001 by the Australian Bureau of Statistics as a statistical geography that allows quantitative comparisons based on remoteness of a point based on the physical road distance to the nearest Urban Centre.
Repeat dose	Any subsequent dose of an antimicrobial administered during the surgical procedure for the purpose of prophylaxis.
Suboptimal prescribing	A prescription that is deemed **suboptimal** by the Surgical NAPS Appropriateness Assessment Guide; see Appendix 9.
Surgical episode	Any individual procedure or set of multiple procedures performed together during the one session and the subsequent post–procedural care associated with the procedure(s).
Therapeutic Guidelines[6]	Antibiotic Expert Group. Therapeutic Guidelines: Antibiotic. Version 16. Melbourne: Therapeutic Guidelines Limited; 2019. https://www.tg.org.au/
Treatment	An antimicrobial prescribed for the treatment of infection related to the procedure.

Abbreviations

AURA	Antimicrobial Use and Resistance in Australia
NAPS	National Antimicrobial Prescribing Survey
NCAS	National Centre for Antimicrobial Stewardship
Surgical NAPS	Surgical National Antimicrobial Prescribing Survey

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Acknowledgements

National Centre for Antimicrobial Stewardship and the Guidance Group

Professor Karin Thursky – Director NCAS

A/Professor Kirsty Buising – Deputy Director NCAS

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Participating facilities

On behalf of the NCAS and the Commission, we would like to thank all participating facilities and auditors for their time and effort in collecting and entering the data, in contributing to the AURA Surveillance System report and to their continued commitment to improving safety and quality across the Australian healthcare system.

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