AUSTRALIAN COMMISSION ON SAFETY AND QUALITY IN HEALTH CARE

Surgical National Antimicrobial Prescribing Survey:

Results of the 2016 pilot

November 2017

AURA Antimicrobial Use and Resistance in Australia

NCAS National Centre for Antimicrobial Stewardship

GUIDANCE

VICNISS HEALTHCARE ASSOCIATED INFECTION SURVEILLANCE

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Summary

The National Antimicrobial Prescribing Survey (NAPS) is a partnership between the National Centre for Antimicrobial Stewardship (NCAS) and the Antimicrobial Use and Resistance in Australia (AURA) Surveillance System. The AURA National Coordination Unit is part of the Australian Commission on Safety and Quality in Health Care (the Commission).

NAPS is an online tool to support healthcare organisations assess the quantity and quality of local antimicrobial prescribing. The Hospital NAPS and pilot Surgical NAPS (SNAPS) are part of the AURA Surveillance System.

Results from the Hospital NAPS have demonstrated that surgical prophylaxis is the most common indication for antimicrobial prescribing in participating acute care facilities. In recent surveys, around 40% of those prescriptions were assessed as having at least one inappropriate element.

SNAPS was developed to collect more detailed information about prescribing practices for surgical antimicrobial prophylaxis, and guide future quality improvement programs. The 2016 pilot SNAPS has identified a continuing high level of inappropriate prescribing of surgical antimicrobial prophylaxis of just over 43%.

Sixty-seven public and private hospitals participated in SNAPS. All states and the Australian Capital Territory were represented, as were a range of hospital peer groups and all categories of remoteness. A total of 4,507 surgical episodes were included in the analyses, of which 3,781 (93.2%) involved an incisional procedure.

In view of the ongoing high rate of inappropriate prescribing of surgical antimicrobial prophylaxis, the Commission has issued an advisory which provides guidance and direction on the interpretation and assessment of the National Safety and Quality Health Service Standards, Standard 3: Preventing and Controlling Healthcare Associated Infections. The advisory, which is supported by the Royal Australasian College of Surgeons, is specific to the antimicrobial stewardship criterion of the Standard. It requires health service organisations to ensure that surgical prophylaxis is included and addressed as part of their antimicrobial stewardship program.

To demonstrate that the requirement is met, organisations can monitor their performance using the indicators for quality statements 6 and 9 of the Commission's *Antimicrobial Stewardship Clinical Care Standard*[1].

Procedural prophylactic antimicrobials (administered either immediately prior to or during the surgical procedure) were prescribed in 2,641 surgical episodes with a total of 3,189 individual doses. Of these, 1,612 (50.5%) doses were deemed appropriate and 1,384 (43.4%) had at least one inappropriate prescribing element. The procedure groups (Appendix 1) most likely to have inappropriate antibiotic prescribing were vascular surgery (n=70, 57.9%), abdominal surgery (n=283, 44.6%) and urological surgery (n=171, 43.6%).

Where procedural antimicrobials were prescribed, 1,470 (46.1%) were compliant with the *Therapeutic Guidelines*[2], 264 (8.3%) were compliant with local guidelines, and 1,220 (38.3%) were non-compliant with any guidelines. The most common reason for inappropriate procedural antimicrobial prescribing was incorrect timing (n=481, 45.7%). An administration time was not documented for 515 (16%) of the 3,189 procedural antimicrobial doses.

Cefazolin was the most common antimicrobial prescribed procedurally, with 2,200 (69.0%) doses. Metronidazole and gentamicin were the next most commonly prescribed with 210 (6.6%) and 176 (5.5%) doses respectively.

Almost all procedure groups had high rates of overall inappropriateness. Only thoracic surgery, obstetrics, ophthalmology, gynaecological surgery and gastrointestinal endoscopic procedures had less than 40% of prescriptions with one or more elements of inappropriate antimicrobial prescribing.

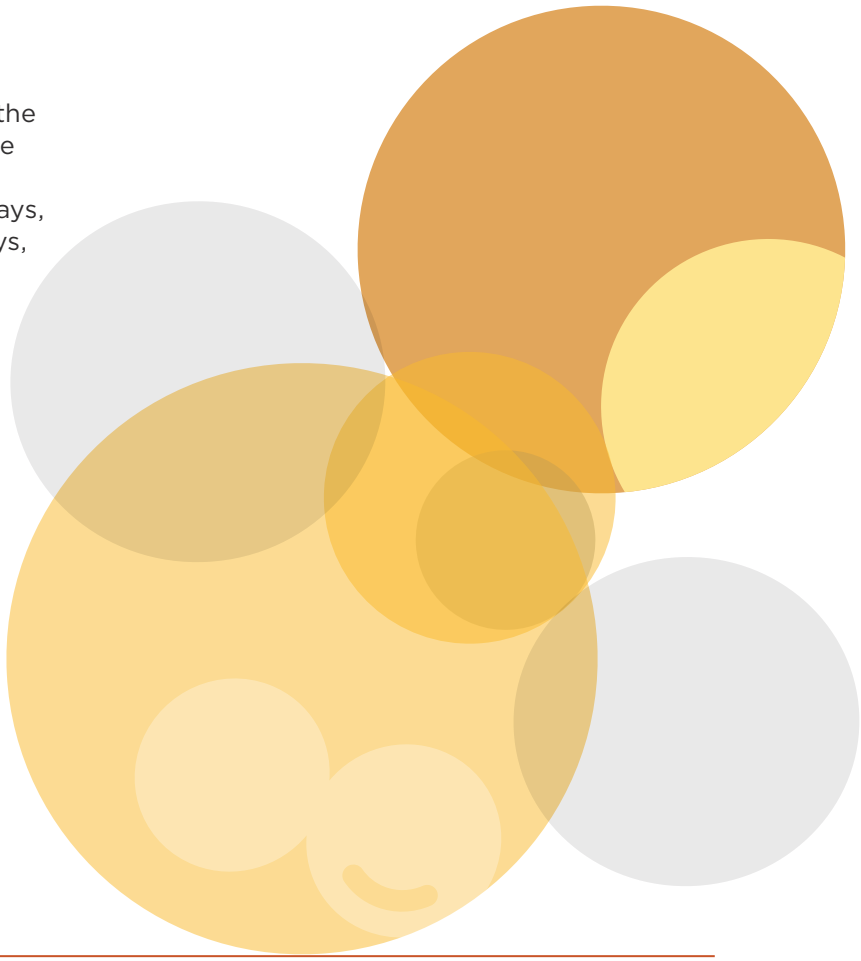
Post-procedural prophylactic antimicrobials were prescribed in 1,248 (27.7%) surgical episodes; 438 (38.7%) were deemed appropriate and 747 (59.9%) had at least one inappropriate prescribing element. The procedure groups with the highest overall rate of inappropriate post-procedural prescribing were cardiac surgery (n=116, 55.2%), neurosurgery (n=43, 43.3%) and thoracic surgery (n=12, 33.3%). Of the 1,515 antimicrobials prescribed for post-procedural prophylaxis; 408 (18.4%) were compliant with the *Therapeutic Guidelines*[2], 139 (9.2%) were compliant with local guidelines, and 895 (59.1%) were non-compliant with any guidelines

The most common reason for inappropriate post-procedural antimicrobial prescribing was that the surgical episode did not require any antimicrobial (n=503, 40.3%). Cefazolin was the most commonly prescribed post-procedural antimicrobial with 868 (57.3%) prescriptions; cefalexin and chloramphenicol were the next most commonly prescribed with 156 (10.3%) and 91 (6.0%) prescriptions respectively.

A wide range of prescribing durations were reported for the surgical procedure groups, with the median duration ranging from one to 11 days. The procedure groups with the greatest median duration were dentoalveolar surgery (median eight days, range 1–13 days), plastic and reconstructive surgery (median six days, range 1–65 days) and head and neck surgery (median six days, range 1–15 days). Of these, the antimicrobials with the greatest duration were topical chloramphenicol (median eight days, range 1–29 days), amoxicillin (median eight days, range 1–8 days) and cefalexin (median six days, range 1–37 days).

The 2016 SNAPS pilot was successful and uptake was encouraging. Feedback from participants indicated that the survey will play an important role in improving surgical antimicrobial prophylaxis in Australian hospitals. As it is further developed, the SNAPS has the potential to be a practical and useful tool for meaningful comparisons at a local and national level.

As the use of antimicrobials for surgical prophylaxis has been demonstrated to be suboptimal, and antimicrobials are used for longer than necessary in this setting, the Commission will continue to work with the Royal Australasian College of Surgeons to develop guidance in this area.



Introduction

Antimicrobial resistance is a major public health concern, contributing to poorer patient outcomes, morbidity, mortality and substantial costs to the healthcare system.

The development and implementation of the National Antimicrobial Prescribing Survey (NAPS) has been an ongoing collaborative partnership between the National Centre for Antimicrobial Stewardship (NCAS) and the Australian Commission on Safety and Quality in Health Care (the Commission) since 2013. The online NAPS database is developed and administered by the Guidance Group at Melbourne Health and provides data to the Commission's Antimicrobial Use and Resistance in Australia (AURA) Surveillance System.

In 2015, the Australian Government released Australia's first National Antimicrobial Resistance Strategy 2015–2019, which outlines a framework to address antimicrobial resistance using an integrated and coordinated One Health approach[3]. The NAPS program supports many of the core objectives of the national strategy through education and training of the healthcare workforce, and enabling antimicrobial audit and review to identify variation. The NAPS also supports implementation of antimicrobial stewardship programs to improve the appropriate and judicious use of antimicrobials.

There have been many studies demonstrating that appropriately administered surgical prophylaxis reduces surgical site and other post-procedural infections. Guidance for the appropriate use of surgical antimicrobial prophylaxis in Australia is available via the Therapeutic Guidelines.[2] The principles for antimicrobial prescribing regarding surgical procedures are:

- Only prescribe prophylaxis if there is a clear need
- Appropriately timed prophylaxis is crucial to have effective plasma and tissue concentrations at the time of incision and for the duration of the surgical procedure
- Intravenous antimicrobials should be administration within 60 minutes before surgical incision; optimally 15 to 30 minutes before
- A single dose of antimicrobial is enough for the majority of procedures, with a first-generation cephalosporin being the preferred drug for many procedures
- A repeat intra-operative dose may be needed for prolonged procedures or if the drug has a short half-life
- Post-procedural prophylaxis is only recommended in a few limited circumstances
- Prophylaxis should not be given for greater than 24 hours; extended prophylaxis is associated with an increased risk of adverse effects
- The use of topical antimicrobials is not recommended for surgical prophylaxis.

The 2013, 2014 and 2015 Hospital NAPS results showed that surgical prophylaxis accounts for 11–15% of all antimicrobial prescribing in Australian hospitals, of which approximately 40% was deemed inappropriate due to an element of prescribing such as incorrect drug choice, duration, dose or timing.[4,5,6]

Being a point prevalence survey, the Hospital NAPS does not allow for detailed examination of surgical antimicrobial prescribing practices. Many hospitals requested a dedicated Surgical NAPS (SNAPS) to support comparisons and benchmarking of antimicrobials prescribed for surgical prophylaxis. A paper-based SNAPS pilot was conducted in 11 hospitals around Australia in 2015; the findings assisted with the development of the electronic SNAPS database. The SNAPS online database was launched in 2016; this report focuses on the results of the 2016 SNAPS pilot.

The aim of the SNAPS is to develop a standardised online audit tool to allow facilities around Australia to audit and report antimicrobial use in incisional and non-incisional surgical procedures, and to investigate procedural and post-procedural prescribing practices for surgical prophylaxis. 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.

Methods

Timing

The 2016 Pilot SNAPS was conducted from the 18 April 2016 to 3 November 2016.

Recruitment

The SNAPS module was launched in April 2016. All registered Hospital NAPS users were notified, and it was also marketed on social media via Twitter by NCAS and the Commission. The Commission also placed notices promoting the SNAPS in the Royal Australasian College of Surgeons publication Surgical News.

Auditor education and support

A hard copy data collection form, user guide and a detailed appropriateness assessment guideline were made available to users through the resources section of the SNAPS module. Case examples and training videos were also developed to support auditors. The NAPS coordinating team provided telephone and email support during the pilot survey period.

Seven online training sessions were provided using GoToMeeting™ between June and August 2016; there were 95 participants. These sessions covered the methodology and reporting functions of SNAPS, and focused on the definitions used for the SNAPS module; targeting the differences between existing antimicrobials, procedural antimicrobials and post-procedural antimicrobials.

Three online videos were also developed and made available on the resources page for SNAPS. The videos covered required resources, creating a survey, data entry and reporting functionality. Based on early feedback regarding the complex nature of the reports, a written guide to interpreting SNAPS reports was also developed to assist users in understanding their results.

Expert assessments

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

Development of templates

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

Limitations

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

Sampling and selection bias

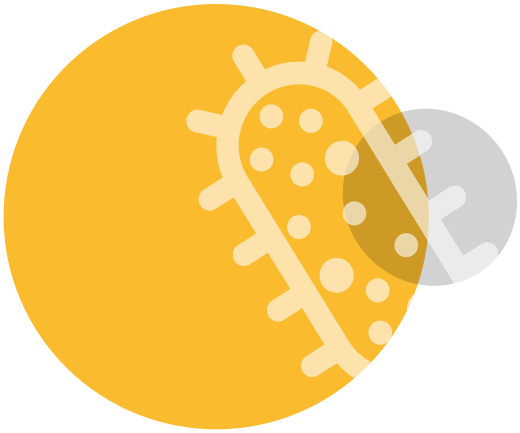
The hospitals that participated were not a randomised sample because participation was voluntary. Therefore, the results might not be representative of all Australian hospitals.

Survey scope was not defined

For this pilot study, each hospital could decide how they performed the survey and which patients or surgical units were audited. If targeted 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 appropriateness of antimicrobial prescribing and compliance with guidelines; remote expert assessments were conducted by the NAPS team on request. These assessments are not completely objective as they involve some degree of interpretation.



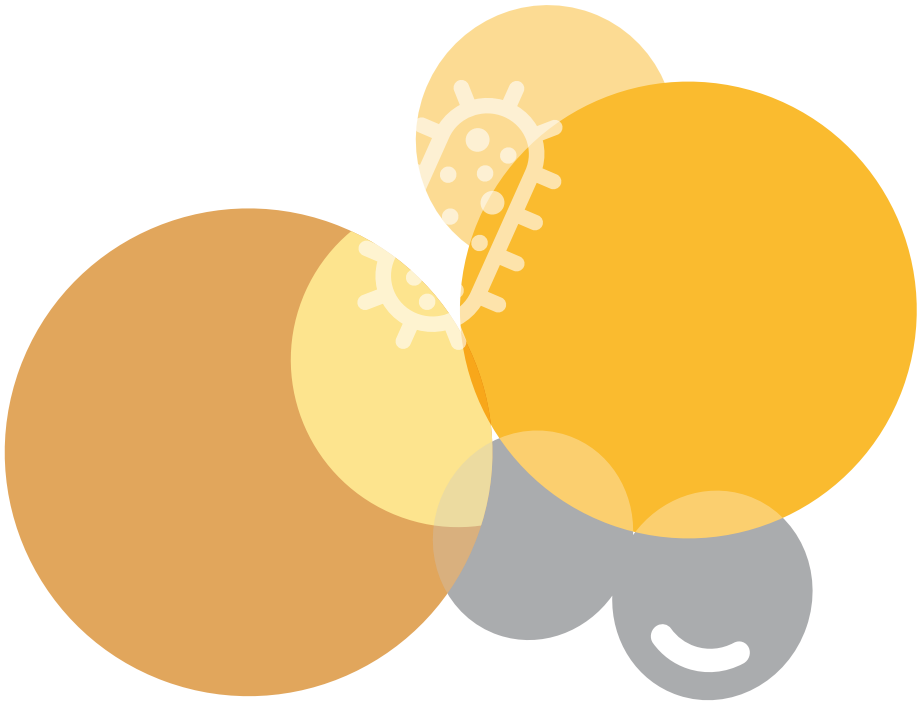
Lack of data-field entry validation

Due to time limitations during development of the survey, the database did not have inbuilt restrictions for some fields. This sometimes led to inconsistencies in data entry and recording of incongruous results. As a result, some data cleaning and validation were required. The database will be redesigned for future surveys and validation processes will be incorporated.

Misinterpretation of definitions

During the data analysis, potential inconsistencies were identified in how some facilities completed their survey, suggesting they may have misinterpreted some of the data-field definitions. Although it was recommended that all auditors read and comply with the methodology as set out in the User Guide, this was not enforceable and there was no mandatory training module prior to performing the survey as there now is for the Hospital NAPS.

The impact of some of the limitations was reduced by data exclusion and cleaning. A small validation study showed that there was a 6.7% rate of disagreement with the local auditors compared with assessments conducted by the NAPS support team. This rate of discrepancy was deemed acceptable by the SNAPS team for this type of self-auditing by non-experts.



Results

The results of analyses of the 2016 SNAPS pilot data are presented below.

Participating hospital demographics

Sixty-seven hospitals contributed data to the 2016 SNAPS pilot. Public and private hospitals from all states and the Australian Capital Territory took part in the survey.

Hospitals from a range of Australian Institute of Health and Welfare (AIHW) peer groups[7] and all Australian Bureau of Statistics (ABS) remoteness areas[8] participated in the pilot (Tables 1, 2 and 3). Figure 1 shows the breakdown of the workflow for data analysis of the SNAPS 2016 pilot survey results

Table 1: Number and percentage of participating public and private hospitals, by state and territory, SNAPS 2016

State	Number	%
ACT	1	1.5
NSW	11	16.4
Qld	16	23.9
SA	5	7.5
Tas	1	1.5
Vic	25	37.3
WA	8	11.9
Total	**67**	**100**

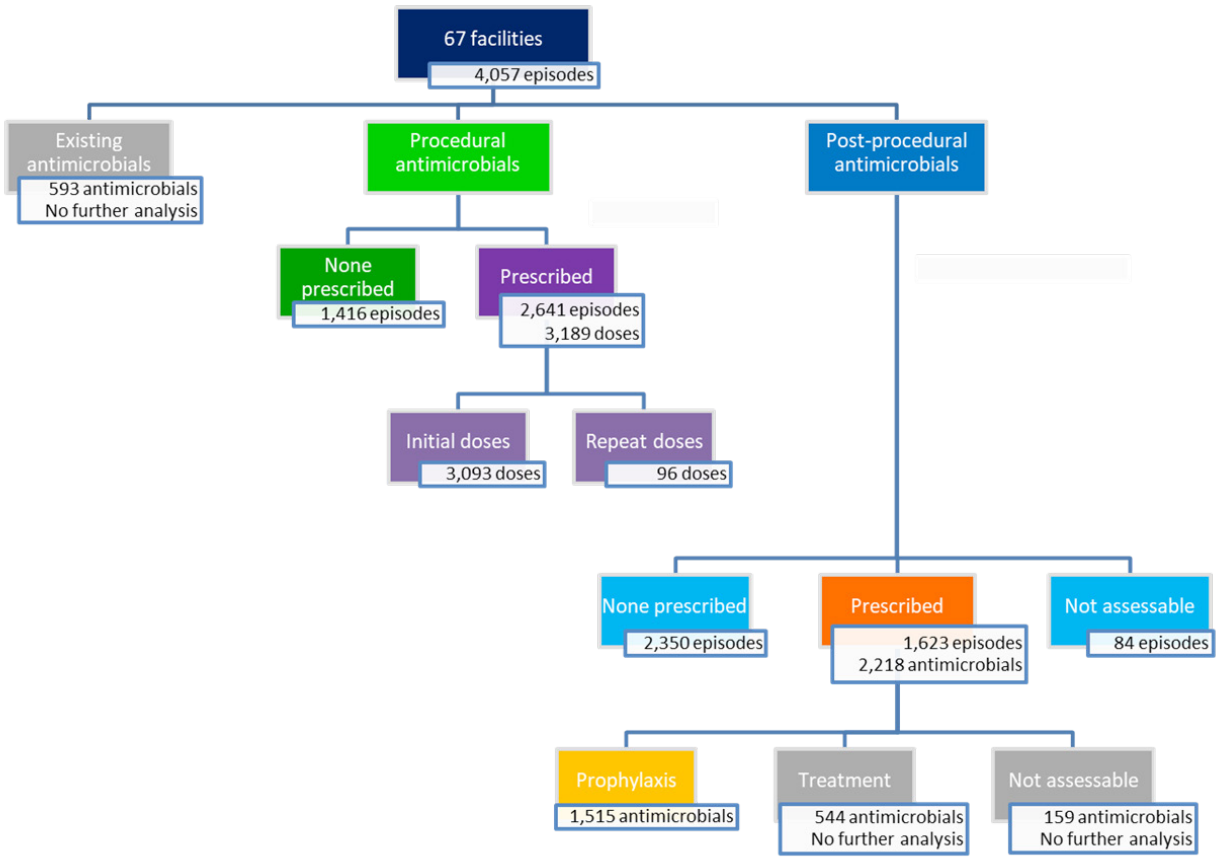
Table 2: Number and percentage of participating public and private hospitals, by AIHW peer group classification, SNAPS 2016

State	Number	%
Public hospitals	**39**	**58.2**
Principal referral hospitals	6	9.0
Public acute group A hospitals	13	19.4
Public acute group B hospitals	3	4.5
Public acute group C hospitals	11	16.4
Women's hospitals	2	3.0
Children's hospitals	1	1.5
Other acute specialised hospitals	1	1.5
Mixed day procedure hospital	1	1.5
Unpeered hospitals	1	1.5
Private hospitals	**28**	**41.8**
Private acute group A hospitals	4	6.0
Private acute group B hospitals	7	10.4
Private acute group C hospitals	8	11.9
Private acute group D hospitals	4	6.0
Mixed day procedure hospitals	2	3.0
Other acute specialised hospitals	3	4.5
Total	**67**	**100.0**

Table 3: **Number and percentage of participating public and private hospitals, by ABS remoteness area, SNAPS 2016**

Remoteness Area	Number	%
Major cities	42	62.7
Inner regional	16	23.9
Outer regional	6	9.0
Remote	2	3.0
Very remote	1	1.5
Total	**67**	**100**

Figure 1: Workflow diagram for the analysis of data, SNAPS 2016

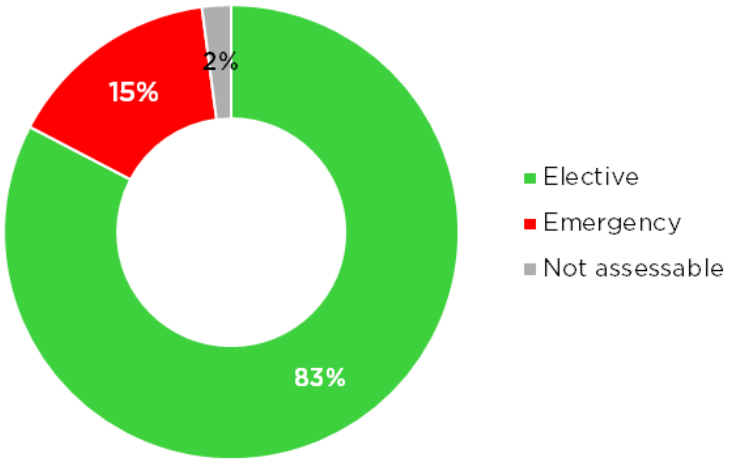


Overall findings

A total of 4,507 surgical episodes were included in the 2016 SNAPS pilot analyses. The characteristics of those episodes include the following:

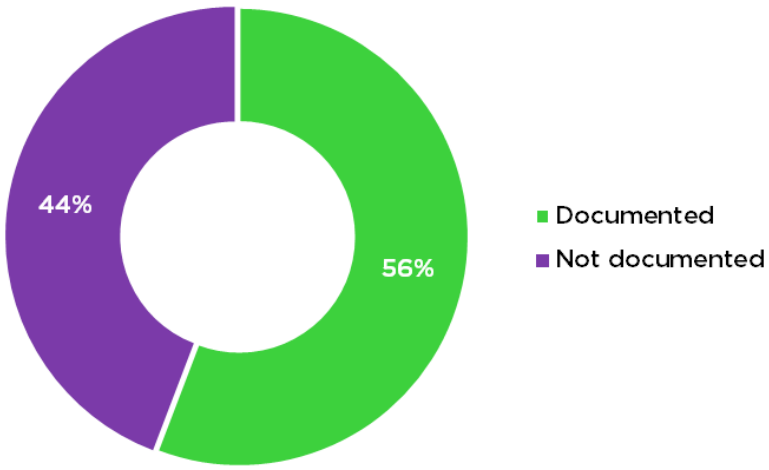
- Procedures were performed on 2,189 (54.0%) females, 1,867 (46.0%) males and one other
- There were 3,902 (96.2%) initial surgeries, and 155 (3.8%) subsequent surgeries
- There were 149 (3.7%) trauma-related episodes
- Insertion or removal of prosthetic material was performed for 1,035 (25.5%) episodes
- Excessive blood loss was documented for 45 (1.1%) episodes
- There were 3,354 (82.7%) elective procedures and 619 (15.3%) emergency procedures (Figure 2)
- There were 3,781 (93.2%) incisional procedures; of those 2,110 (55.8%) had a documented incision time (Figure 3).

Figure 2: Percentage of elective and emergency surgical procedures, SNAPS contributor hospitals, 2016#,



n = 4,057 surgical episodes

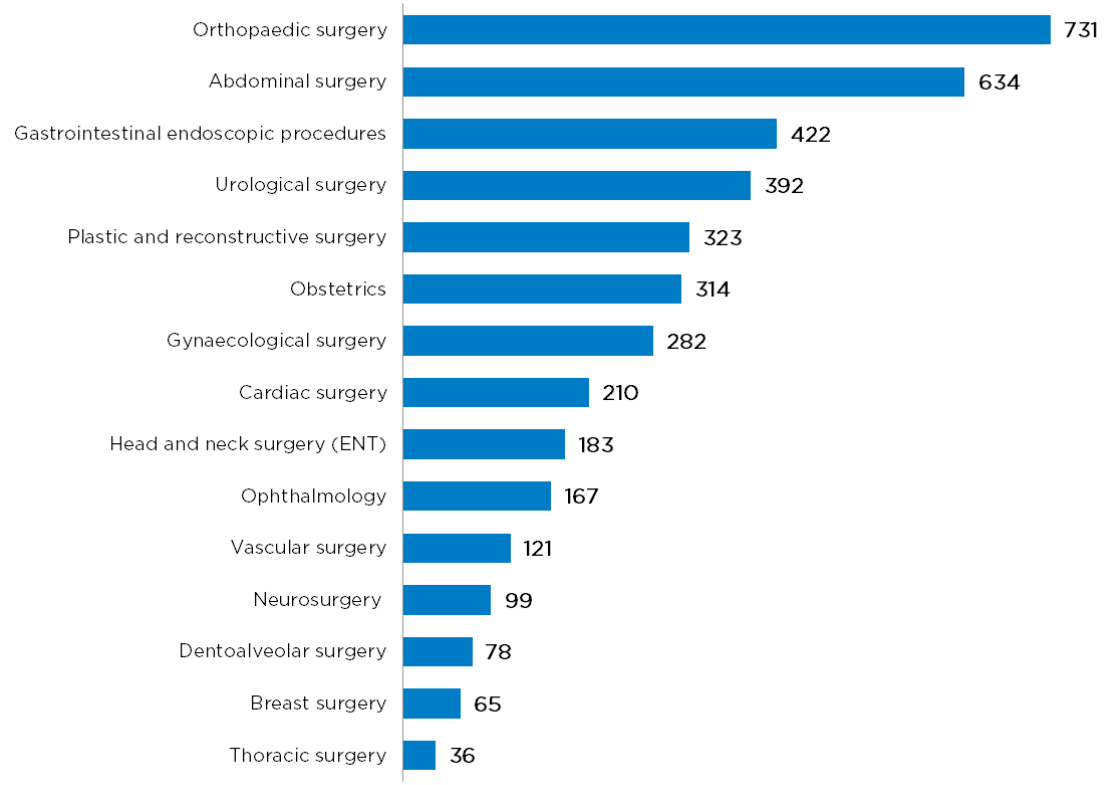
Figure 3: Percentage of surgical episodes with an incision time documented, SNAPS contributor hospitals, 2016#



n = 3,781 surgical episodes involving an incisional procedure

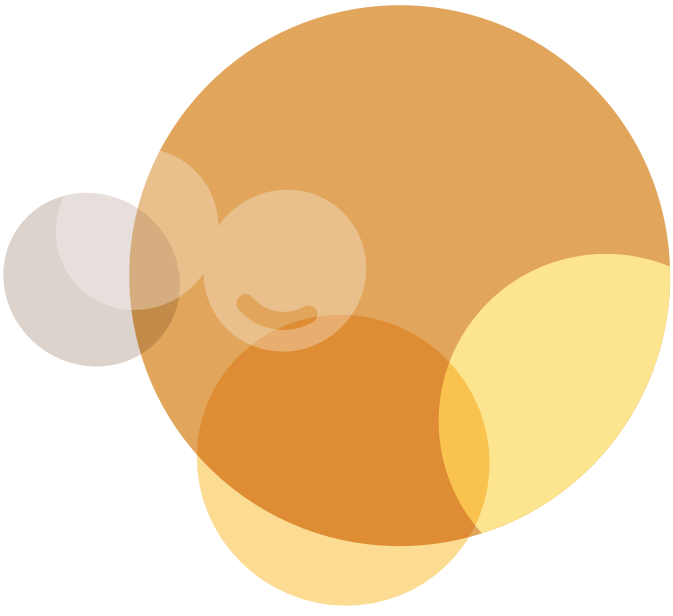
Each hospital could choose how to perform the SNAPS audit. Data were not collected on the type of audits performed. As these audits may have been prevalence surveys (consecutive or random patients), directed surveys or other types of audits, it is not possible to determine prevalence of the type of surgeries performed or antimicrobials prescribed. The number of surgical episode groups included in the 2016 SNAPS pilot data is shown in Figure 4.

Figure 4 Number of procedures for each surgical procedure group, SNAPS contributor hospitals, 2016 #



Note: where there were multiple procedures per surgical episode, only the primary procedure group was included

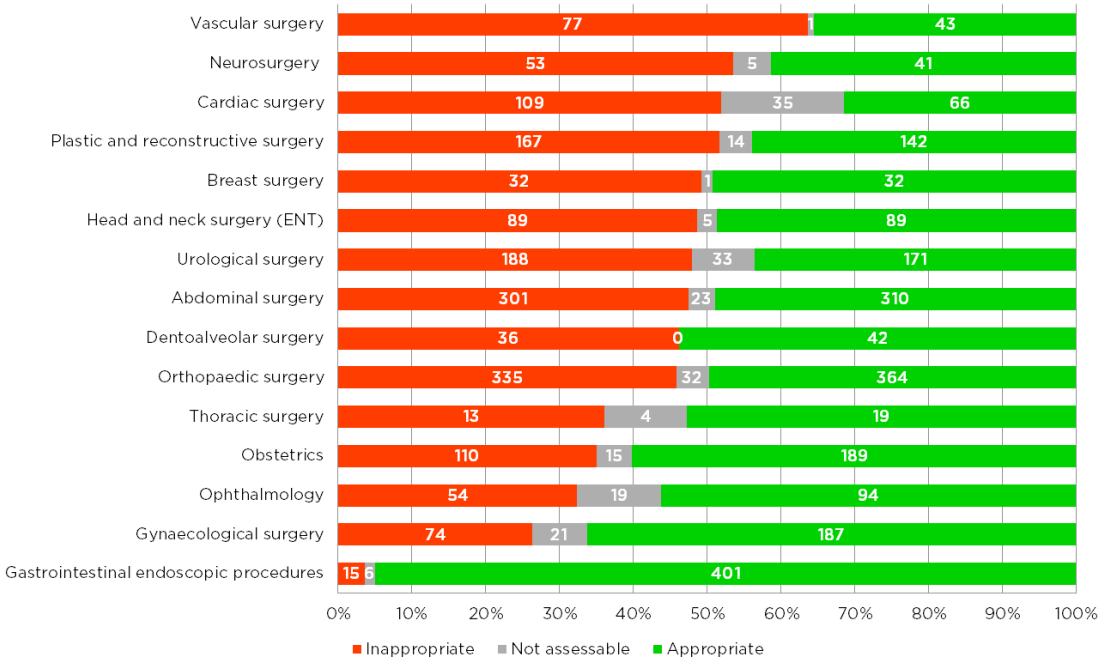
n=4,057 surgical episodes



The overall appropriateness of prescribing (procedural plus post-procedural) for each surgical group is shown in Figure 5. For reporting purposes, 'optimal' and 'adequate' are deemed to be appropriate, while 'suboptimal' and 'inadequate' are deemed to be inappropriate, (Appendix 3). For overall appropriateness, each surgical episode was deemed to be inappropriate if any part of the prescription (procedural or post-procedural prophylaxis) was deemed inappropriate, including allergy or microbiology mismatch, timing, dose, route, frequency, duration, spectrum too broad, spectrum too narrow or if the procedure did not require any antimicrobials.

Almost all procedure groups had high rates of overall inappropriateness, with only thoracic surgery, obstetrics, ophthalmology, gynaecological surgery and gastrointestinal endoscopic procedures having less than 40% of prescriptions with one or more elements of inappropriate antimicrobial prescribing.

Figure 5 Total number and percentage of episodes by appropriateness for each surgical procedure group, SNAPS contributor hospitals, 2016#



n=4,057 surgical episodes, including all episodes where antimicrobials were prescribed as well as when none were prescribed

Procedural prophylaxis

Procedural 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. This is due to each dose of antimicrobial being a discrete decision point during the procedure, so each dose was therefore assessed individually. The number of doses would exceed the number of procedures when the prophylaxis regimen required the administration of multiple antimicrobials, multiple doses or both. Although any existing antimicrobials were not analysed individually, these were able to be taken into account when assessing the appropriateness of whether procedural antimicrobials were given or not given.

Overall, procedural prophylaxis was inappropriate in 1,324 (32.6%) surgical episodes (Table 4). This included surgical episodes where no procedural antimicrobials were prescribed and episodes where procedural antimicrobials were prescribed.

The procedure groups with the most inappropriate prescribing overall were vascular surgery (n=70, 57.9%), abdominal surgery (n=283, 44.6%) and urological surgery (n=171, 43.6%) as shown in Figure 6.

There were 1,416 (34.9%) surgical episodes where there was no procedural antimicrobial prescribed. Of these, 1,258 (88.8%) were deemed to be appropriate and 129 (9.1%) deemed to have required procedural antimicrobials that had not been prescribed.

There were 2,641 (65.1%) surgical episodes where procedural antimicrobials were prescribed. Of these, 1,206 (45.7%) episodes were considered inappropriate and for 281 (10.6%) no procedural antimicrobials were required.

A total of 3,189 individual antimicrobial doses were given for procedural prophylaxis; 96 (3.0%) of these were repeat doses. Of all procedural antimicrobial doses, 1,384 (43.4%) were assessed as inappropriate for at least one reason, and there were 33 where repeat doses were required but not given.

Table 4: Appropriateness of the procedural prescribing of antimicrobials for surgical episodes * and antimicrobial doses, SNAPS contributor hospitals, 2016

Procedural antimicrobials		Appropriate (number and %)		Inappropriate (number and %)		Not assessable (number and %)	
Surgical episodes	n=4,057	2,540	62.6	1324	32.6	193	4.8
Episodes where no antimicrobial prescribed	n=1,416	1258	88.8	118	8.3	40	2.8
Antimicrobial not prescribed when required	n=129	See footnote (a)		112	86.8	6	4.7
Episodes where antimicrobial prescribed	n=2,641	1,282	48.5	1,206	45.7	153	5.8
Antimicrobial prescribed when not required	n=281	See footnote (b)		269	95.7	1	0.4
Antimicrobial doses							
Total doses prescribed	n=3,189	1,612	50.5	1384	43.4	193	6.1
Initial doses	n=3,093	1,553	50.2	1,348	43.6	192	6.2
Repeat doses	n= 96	59	61.5	36	37.5	1	1.0
Repeat dose not given when required	n=33	-	-	33	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; 'optimal' and 'adequate' are deemed as being appropriate, 'suboptimal' and 'inadequate' are deemed as being inappropriate.

a For 11 surgical episodes (8.5%), prescribing was assessed as being appropriate, even though the patient did not have procedural antimicrobial prophylaxis prescribed when it was required.

b For 11 surgical episodes (3.9%), prescribing was assessed as being appropriate, even though the patient was prescribed procedural antimicrobial prophylaxis when it was not required.

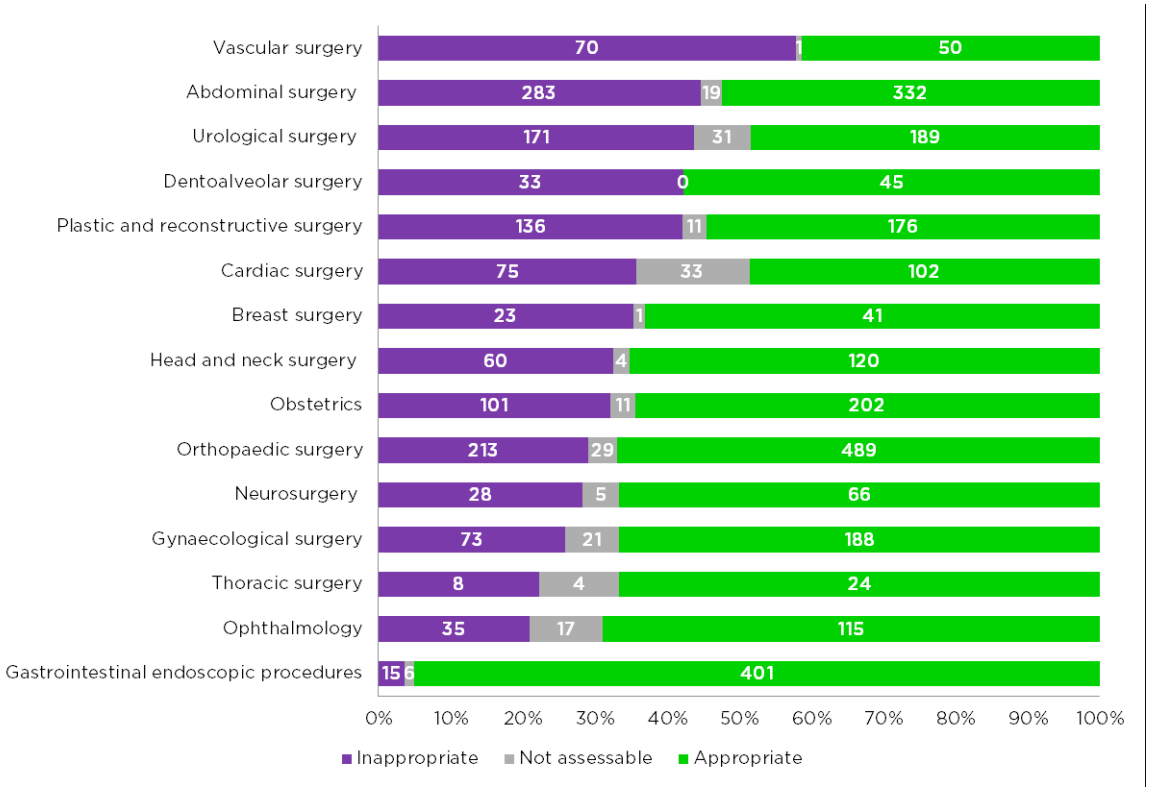
Regarding footnotes (a) and (b) in Table 4, several possible explanations exist for why an auditor may have assessed an antimicrobial order as being appropriate even though it was not prescribed when required, or conversely was prescribed when not required.

One option is that the patient may have been receiving antimicrobial treatment for a separate condition which negated the need for surgical prophylaxis.

Alternatively, the patient was receiving antimicrobial treatment even though the surgical procedure did not require it. In either case this was judged to be appropriate.

Other possible explanations could be either that surveyors misinterpreted these fields or that transcription errors occurred during the data collection and entry processes.

Figure 6 Total number of procedural antimicrobial doses * by appropriateness for each procedure group, SNAPS contributor hospitals, 2016 #

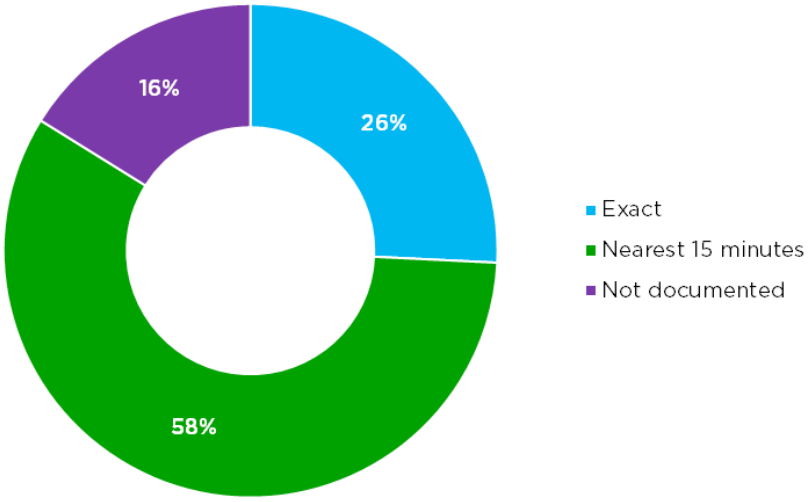


* Including each dose prescribed and when no antimicrobial was prescribed

\# n = 4,605

Of the 3,189 procedural antimicrobial doses prescribed, 2,674 (84%) had a documented administration time; of these 822 (25.8%) were recorded to the exact minute and 1,852 (58.1%) to the nearest 15 minutes (Figure 7).

Figure 7 **Percentage of procedural antimicrobial doses for which an administration time was documented, SNAPS contributor hospitals, 2016 #**



n = 3,189 doses of procedural antimicrobial prophylaxis

There was minimal difference between public and private hospitals in appropriateness of procedural prescribing of antimicrobials, with 42.7% and 44.4% inappropriateness respectively (Table 5).

Table 5: **Number and percentage of participating public and private hospitals, by AIHW peer group classification, SNAPS 2016**

Funding type	Surgical episodes (number)	At last one antimicrobial prescribed (number, %)		Total doses prescribed (number)	Inappropriate (number, %)	
Public hospitals	2,585	1,611	62	1,963	840	43
Private hospitals	1,472	1,030	70	1,226	544	44
Total	**4,057**	**2,641**	**65**	**3,189**	**1,384**	**43**

The surgical procedure groups that had the highest rate of antimicrobials prescribed procedurally were; breast surgery (n=60, 92.3%), obstetrics (n=279, 88.9%) and orthopaedic surgery (n=638, 87.3%).

The procedure groups with the highest rate of inappropriateness of antimicrobial prescribing were dentoalveolar surgery (n=32, 78.0%), head and neck surgery (n=57, 67.1%) and vascular surgery (n=76, 67.3%) as shown in Table 6.

Table 6 **Percentage prescribed an antimicrobial, number of doses prescribed and inappropriateness of procedural prescribing for surgical episodes by procedure group, SNAPS contributor hospitals, 2016**

Procedure group	Surgical episodes (number)	At least one antimicrobial prescribed (number, %)		Total doses prescribed (number)	Inappropriate (number, %)	
Orthopaedic surgery	731	638	87	717	229	32
Abdominal surgery	634	514	81	653	265	41
Gastrointestinal endoscopic procedures	422	20	5	28	18	64
Urological surgery	391	264	68	341	206	60
Plastic and reconstructive surgery	323	196	61	208	127	61
Obstetrics	314	279	89	305	99	32
Gynaecological surgery	282	132	47	170	80	47
Cardiac surgery	210	160	76	256	82	32
Head and neck surgery	184	78	42	85	57	67
Ophthalmology	167	71	43	90	46	51
Vascular surgery	121	97	80	113	76	67
Neurosurgery	99	74	75	86	28	33
Dentoalveolar surgery	78	41	53	41	32	78
Breast surgery	65	60	92	79	33	42
Thoracic surgery	36	17	47	17	6	35
Total	**4,057**	**2,641**	**65**	**3,189**	**1,384**	**43**

Of the 3,189 procedural antimicrobial doses that were administered, the most common routes of administration were:

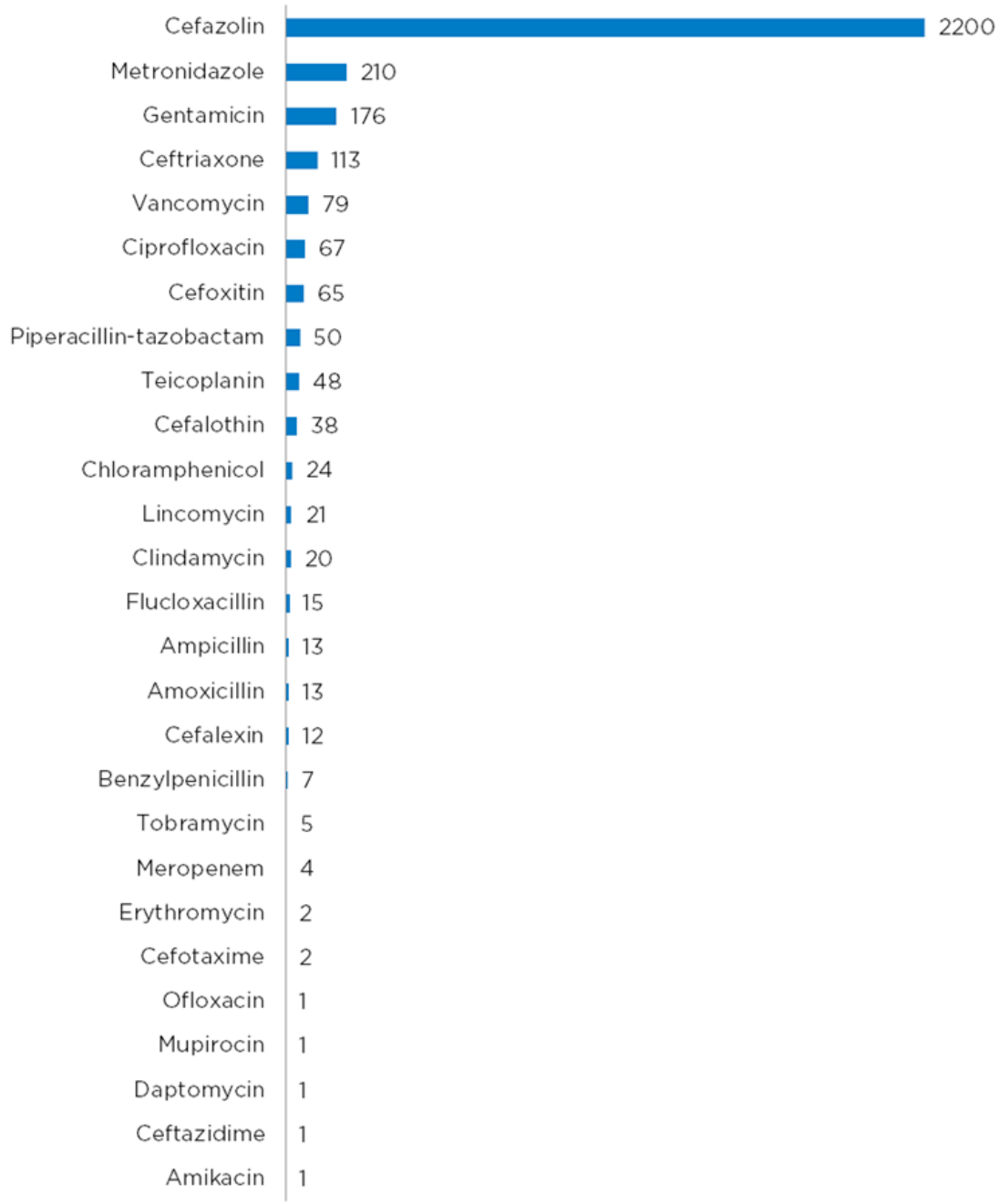
- Intravenous (n=3,005, 94.2%)
- Ocular (n=80, 2.5%)
- Topical (n=66, 2.1%).

Of the 66 doses that were administered topically, only five (7.6%) were deemed appropriate.

The most common antimicrobials prescribed procedurally are shown in Figure 8. Cefazolin was the most common antimicrobial prescribed (n=2,200, 69.0%), and metronidazole (n=210, 6.6%) and gentamicin (n=176, 5.5%) were the next most commonly prescribed respectively.

Table 7 shows the inappropriateness of the antimicrobials prescribed for procedural prophylaxis in SNAPS contributor hospitals. Some of the notable findings of inappropriate prescribing – albeit for antimicrobials for which a relatively small number of doses were prescribed overall – were for ciprofloxacin (67 doses, of which 95.5% were inappropriate), ceftriaxone (113 doses, of which 92.0% were inappropriate) and chloramphenicol (24 doses of which 83.3% were inappropriate).

Figure 8 **Number of antimicrobial doses given for procedural prophylaxis, by antimicrobial, SNAPS contributor hospitals, 2016 #**



n = 3,189 procedural antimicrobial doses

Table 7 **Number of doses, percentage and inappropriateness of antimicrobials prescribed for procedural prophylaxis, SNAPS contributor hospitals, 2016**

Antimicrobial	Number prescribed	% of total prescribed	Number inappropriate	% inappropriate #
Cefazolin	2,200	69.0	819	37.2
Metronidazole	210	6.6	85	40.5
Gentamicin	176	5.5	106	60.2
Ceftriaxone	113	3.5	104	92.0
Vancomycin	79	2.5	57	72.2
Ciprofloxacin	67	2.1	64	95.5
Cefoxitin	65	2.0	9	13.8
Piperacillin-tazobactam	50	1.6	20	40.0
Teicoplanin	48	1.5	15	31.3
Cefalothin	38	1.2	9	23.7
Chloramphenicol	24	0.8	20	83.3
Lincomycin	21	0.7	14	66.7
Clindamycin	20	0.6	16	80.0
Flucloxacillin	15	0.5	8	53.3
Ampicillin	13	0.4	13	100.0
Amoxicillin	13	0.4	3	23.1
Cefalexin	12	0.4	7	58.3
Benzylpenicillin	7	0.2	7	–
Tobramycin	5	0.2	1	–
Meropenem	4	0.1	1	–
Cefotaxime	2	0.1	2	–
Erythromycin	2	0.1	2	–
Ceftazidime	1	0.0	1	–
Ofloxacin	1	0.0	1	–
Amikacin	1	0.0	0	–
Daptomycin	1	0.0	0	–
Mupirocin	1	0.0	0	–
Total	**3,189**	**100.0**	**1,384**	**43.4**

Percentages are not shown for antimicrobials where n <10

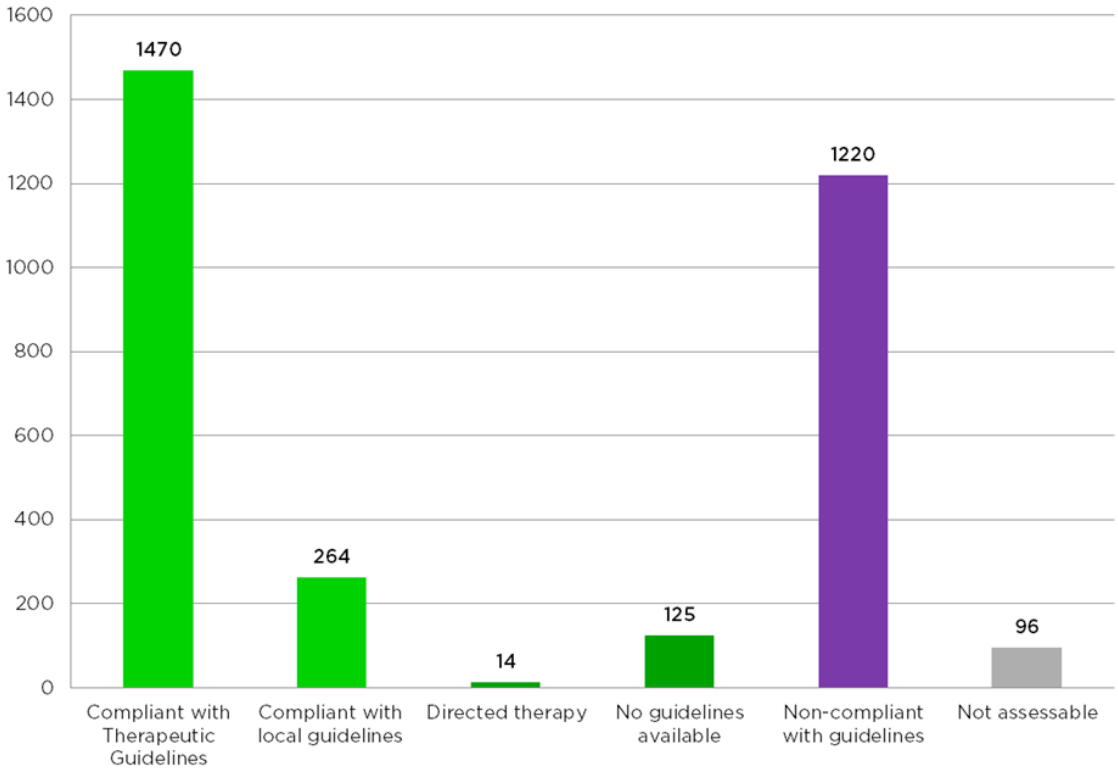
Where procedural antimicrobials were prescribed, 1,470 (46.1%) doses were compliant with the *Therapeutic Guidelines*[2], 264 (8.3%) doses were compliant with local guidelines and 1,220 (38.3%) doses were non-compliant with any guidelines (Figure 9).

The number of procedural antimicrobials being prescribed either for directed therapy or when there were no guidelines available or when compliance was not assessable, was very low. When these were excluded, the overall compliance with any guidelines for prescribing procedural antimicrobials was 59% (Figure 10).

The appropriateness of prescribed procedural antimicrobials was deemed optimal for 1,465 (45.9%) doses and adequate for 147 (4.6%) doses (Figure 11).

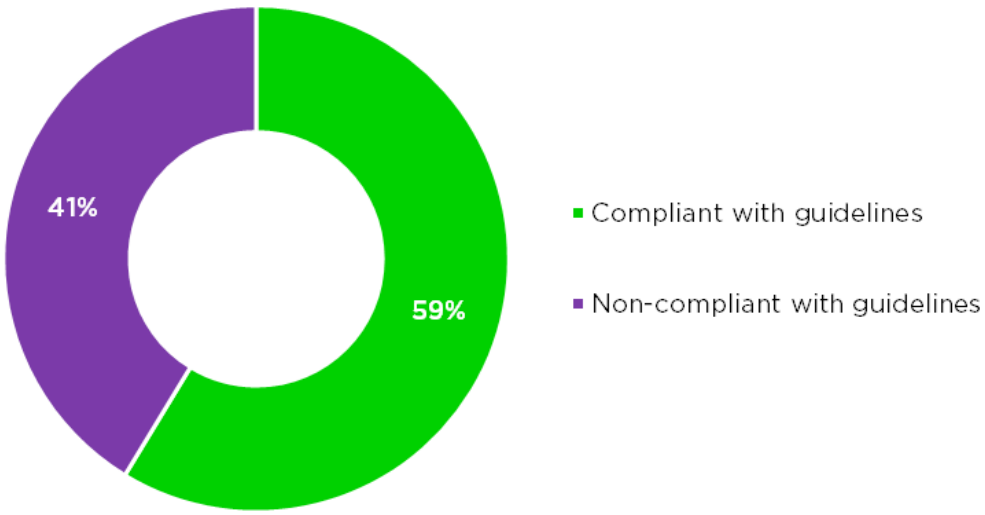
Where no procedural antimicrobials were prescribed, the compliance was high with 1,181 (83.4%) being compliant with the *Therapeutic Guidelines* and 44 (3.1%) being compliant with local guidelines. The appropriateness was also high with 1,234 (87.1%) deemed optimal.

Figure 9 Number of procedural antimicrobial doses and compliance with guidelines for antimicrobial dose, SNAPS contributor hospitals, 2016 #



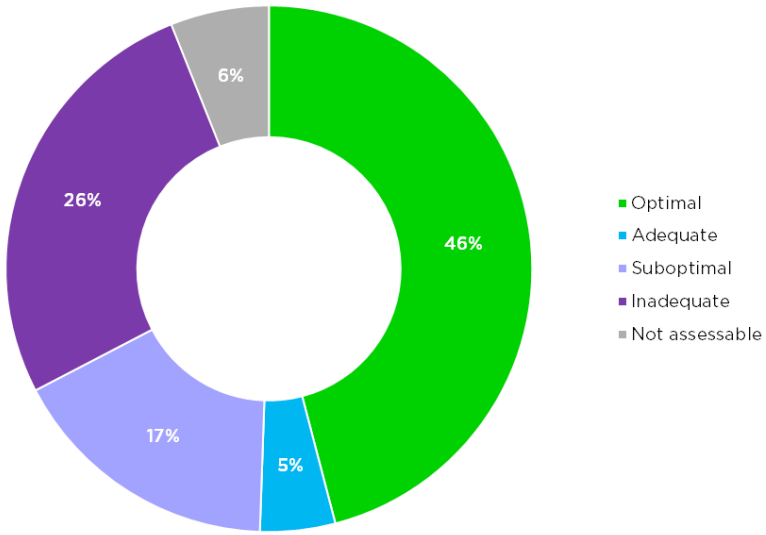
n = 3,189 procedural antimicrobial doses

Figure 10 Percentage compliance with guidelines, by prescribed procedural antimicrobial dose, where guidelines are available*, SNAPS contributor hospitals, 2016



* n=2,954 (includes prescribed procedural antimicrobial doses; excluding any assessed as directed therapy, no national or local guidelines available or not assessable)

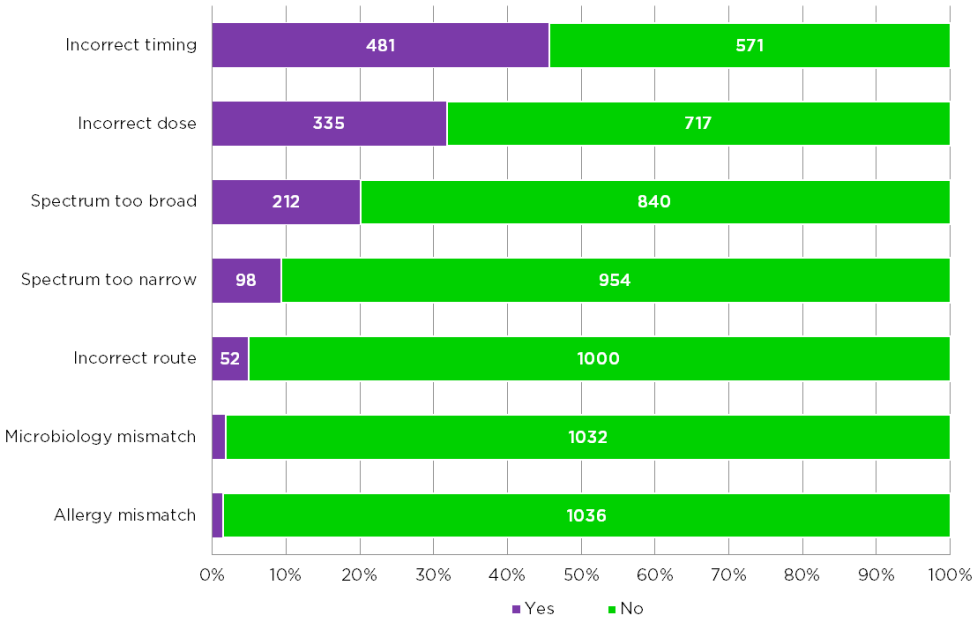
Figure 11 **Percentage appropriateness of prescribed procedural antimicrobial dose, SNAPS contributor hospitals, 2016 #**



n = 3,189 procedural antimicrobial doses

For surgical episodes where antimicrobials were required, the most common reasons for deeming the antimicrobial doses inappropriate were incorrect timing (n=481, 45.7%), incorrect dosage (n=335, 31.8%), and spectrum too broad (n=212, 20.2%) as shown in Figure 12.

Figure 12 **Reasons for inappropriateness, by number and percentage of required procedural antimicrobial doses, SNAPS contributor hospitals, 2016 #**



n = 1,052 procedural antimicrobial doses required by guidelines, but given inappropriately and reasons for inappropriate administration

Post-procedural prophylaxis

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

Overall, post-procedural prophylaxis was inappropriate in 771 surgical episodes (20.8%) as shown in Table 8. This included episodes where antimicrobials were prescribed specifically for prophylaxis and episodes where no antimicrobials were prescribed. Antimicrobials that were prescribed only for the treatment of infection were excluded. The procedure groups with the most inappropriate prescribing overall were cardiac surgery (n=116, 55.2%), neurosurgery (n=43, 43.3%) and thoracic surgery (n=12, 33.3%) as shown in Figure 13.

There were 2,350 (57.9%) surgical episodes where no post-procedural antimicrobials were prescribed, and 2,301 (97.9%) of these episodes were assessed as appropriate. There were 44 (18.7%) episodes where antimicrobials were required but not prescribed.

The remaining 1,248 (30.8%) episodes had at least one post-procedural antimicrobial prescribed for prophylaxis, of which 747 (59.9%) episodes involved a prescription with an element that was deemed inappropriate. There were 503 (12.4%) antimicrobials prescribed for post-procedural surgical prophylaxis when no post-procedural antimicrobials were required; a further 84 surgical episodes were unable to be assessed as to whether post-procedural antimicrobials had been prescribed.

A total of 2,218 antimicrobials were prescribed post-procedurally. Of the 1,515 (68.3%) prescribed for prophylaxis (Figure 14), 904 (59.7%) had at least one prescription element that was deemed inappropriate. There were 544 (35.9%) antimicrobial prescriptions for the treatment of infection, of which 128 (23.5%) were deemed inappropriate.

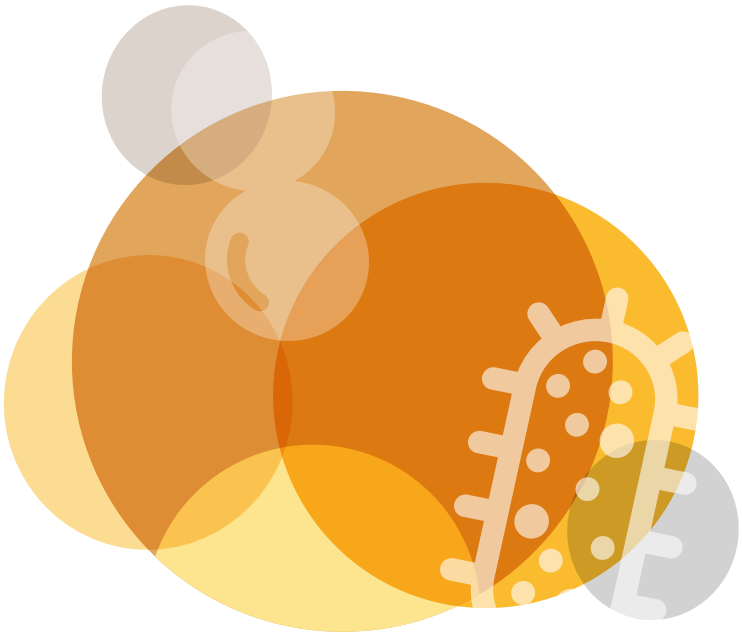


Table 8 **Appropriateness of post-procedural prescribing of antimicrobials for surgical episodes * and antimicrobial prescriptions, SNAPS contributor hospitals, 2016**

Procedural antimicrobials		Appropriate (number and %)		Inappropriate (number and %)		Not assessable (number and %)	
Surgical episodes	n=3,707 †	2,804	75.6	771	20.8	132	3.6
Episodes where no prophylaxis prescribed	n=2,350	2,301	97.9	19	0.8	30	1.3
Not prescribed when required	n=44	See footnote (a)		12	27.3	7	15.9
Episodes where prophylaxis prescribed	n=1,248	483	38.7	747	59.9	18	1.4
Prescribed when not required	n=503	See footnote (b)		448	89.1	2	0.4
Not assessable	n=84	-	-	-	-	84	100
Prescribed antimicrobials	n=2,218	970	43.7	1032	46.5	216	9.7
Prophylaxis	n=1,515	587	38.7	904	59.7	24	1.6
Treatment	n=544	383	70.4	128	23.5	33	6.1
Not assessable	n=159	-	-	-	-	159	100

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

† For 350 surgical episodes post-procedural antimicrobials were prescribed for treatment of infection only and were excluded from the analysis

a For 25 surgical episodes (56.8%) prescribing assessed as being appropriate even though the patient did not have post-procedural antimicrobial prophylaxis prescribed when it was warranted.

b For 53 surgical episodes (10.5%) prescribing was assessed as being appropriate even though the patient was prescribed post-procedural antimicrobial prophylaxis when it was not required.

Regarding footnotes (a) and (b) in Table 8, several possible explanations exist for why an auditor may have assessed an antimicrobial order as being appropriate even though it was not prescribed when required or conversely prescribed when not required.

One option is that the patient may have been receiving antibiotic treatment for a separate condition which negated the need for surgical prophylaxis. Alternatively, the patient was receiving antibiotics even though the surgical procedure did not require them. In either case this was judged to be appropriate. Other contributing factors could be either that surveyor misinterpreted these fields or that transcription errors occurred during the data collection and entry processes.

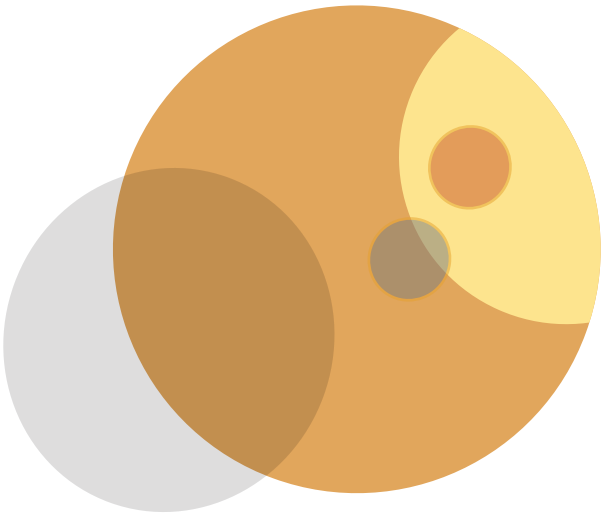
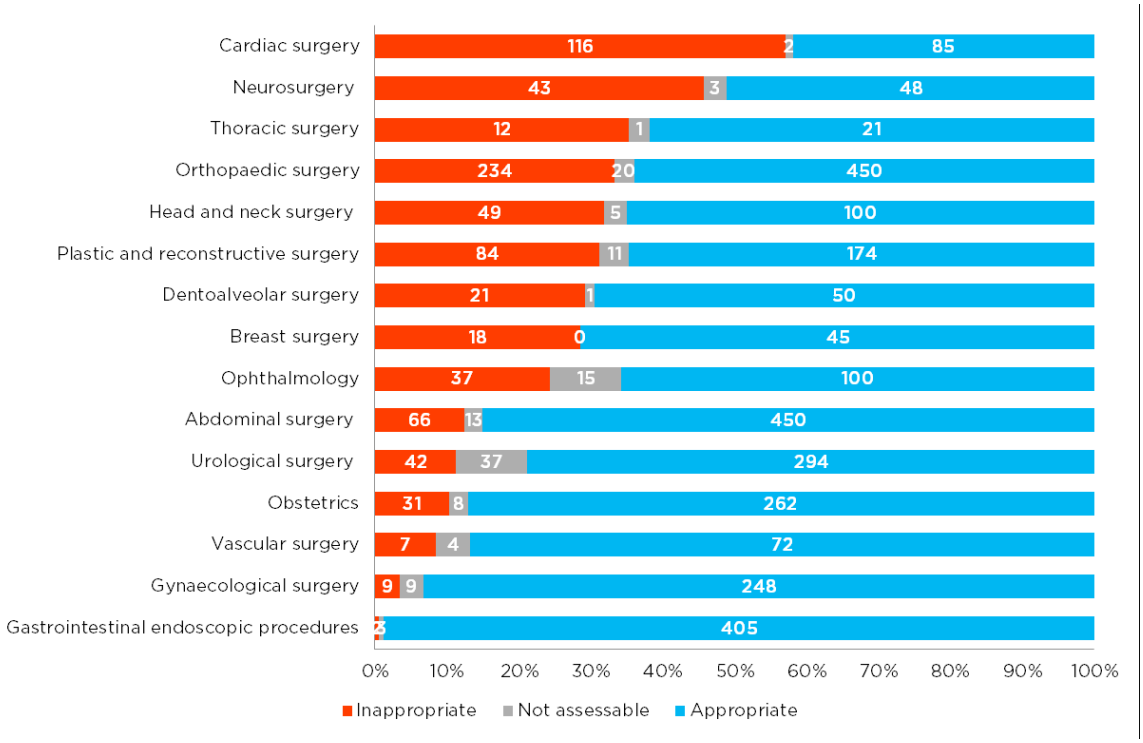
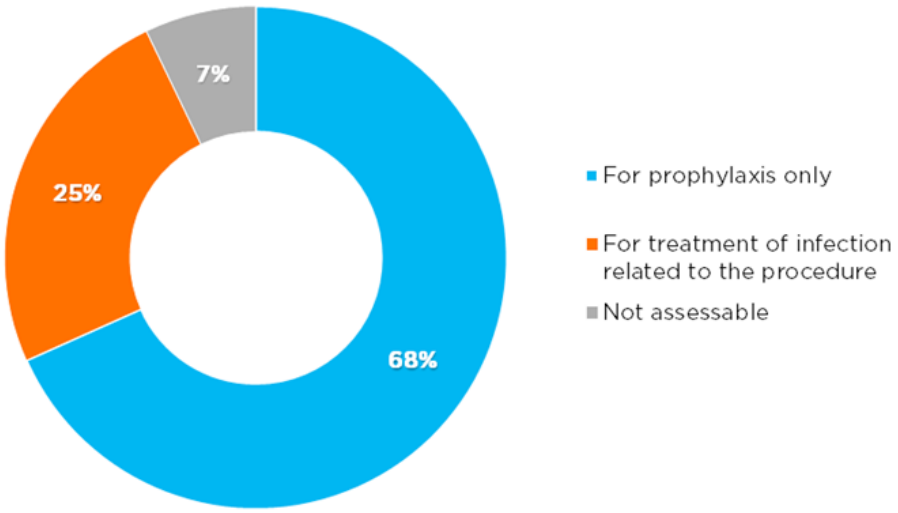


Figure 13 **Number of post-procedural antimicrobial prescriptions by percentage appropriateness for each surgical procedure group, SNAPS contributor hospitals, 2016 #**



n = 4,568 including each prescription course, and when no antimicrobial was prescribed

Figure 14 **Percentage of indications for prescribing post-procedural antimicrobials, SNAPS contributor hospitals, 2016 #**



n = 2,218 post-procedural antimicrobial prescriptions

There was minimal difference between public and private hospitals in post-procedural prescribing of antimicrobials, with 532 (60.5%) and 372 (58.4%) deemed inappropriate respectively.

There was a lower rate of antimicrobial prescribing in public hospitals, with 707 surgical episodes (27.4%) having at least one antimicrobial prescribed post-procedurally compared with 541 (36.8%) at private hospitals (Table 9).

Table 9 Post-procedural prescribing of antimicrobials for surgical episodes, by funding type, SNAPS contributor hospitals, 2016

Funding type	Surgical episodes (number)	At least one antimicrobial prescribed for prophylaxis (number, %)		Total prescribed for prophylaxis (number)	Inappropriate (number, %)	
Public hospitals	2,585	707	27	879	532	61
Private hospitals	1,472	541	37	636	372	58
Total	**4,057**	**1,248**	**31**	**1,515**	**904**	**60**

The surgical procedure groups that had the highest rate of antimicrobials prescribed post-procedurally were ophthalmology (n=124, 74.3%), cardiac surgery (n=148, 70.5%) and orthopaedic surgery (n=483, 66.1%).

The procedure groups with the highest rate of inappropriateness when post-procedural prophylaxis was prescribed were gastrointestinal endoscopic procedures (n=3, 100.0%), head and neck surgery (n=51, 85.0%) and dentoalveolar surgery (n=22, 78.6%) as shown in Table 10.

Table 10 Post-procedural prescribing of antimicrobials for surgical episodes, by procedure group and percentage inappropriate, SNAPS contributor hospitals, 2016

Procedure group	Surgical episodes (number)	At least one antimicrobial prescribed (number, %)		Total prescribed (number)	Inappropriate (number, %)	
Gastrointestinal endoscopic procedures	422	2	0	3	3	100
Head and neck surgery	184	55	30	60	51	85
Dentoalveolar surgery	78	26	33	28	22	79
Thoracic surgery	36	16	44	16	12	75
Plastic and reconstructive surgery	323	110	34	155	116	75
Breast surgery	65	27	42	38	28	74
Urological surgery	391	58	15	70	52	74
Obstetrics	314	42	13	82	61	74
Abdominal surgery	634	76	12	105	78	74
Gynaecological surgery	282	12	4	24	16	67
Cardiac surgery	210	148	70	197	131	66
Neurosurgery	99	56	57	59	39	66
Orthopaedic surgery	731	483	66	527	252	48
Vascular surgery	121	13	11	13	6	46
Ophthalmology	167	124	74	138	37	27
Total	**4,057**	**1,248**	**31**	**1,515**	**904**	**60**

Of the 1,515 antimicrobial prescriptions for post-procedural prophylaxis only, the most common routes of administration were:

- Intravenous (n=977, 64.5%)
- Oral (n=309, 20.4%)
- Topical (n=89, 5.9%).

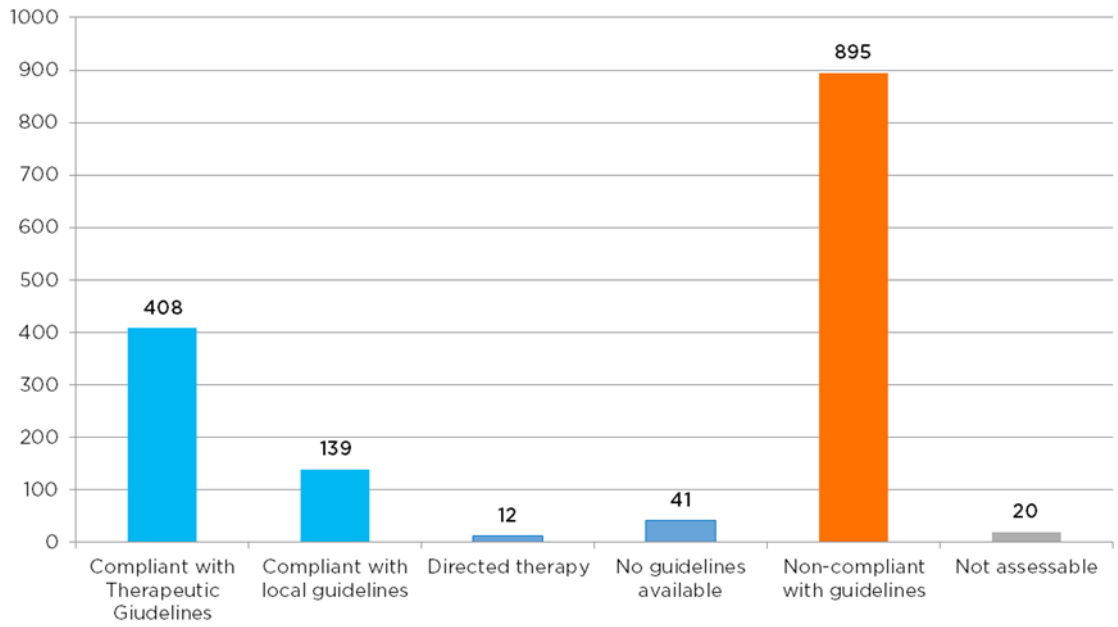
Of those doses that were administered orally, only 57 prescriptions (18.4%) were deemed appropriate and only 27 topical prescriptions (30.3%) were deemed appropriate.

Where post-procedural antimicrobials were prescribed for prophylaxis, 408 prescriptions (18.4%) were compliant with the *Therapeutic Guidelines*[2], 139 (9.2%) were compliant with local guidelines and 895 (59.1%) were non-compliant with any guidelines (Figure 15).

There were low rates of post-procedural antimicrobials being prescribed for directed therapy, where there were no guidelines available or where compliance was not assessable. When these were excluded, the overall compliance with any guidelines for prescribing post-procedural antimicrobials was 38% (Figure 16). The appropriateness of prescribed post-procedural antimicrobials was deemed optimal for 410 prescriptions (27.1%) and inadequate for 869 (57.4%), Figure 17.

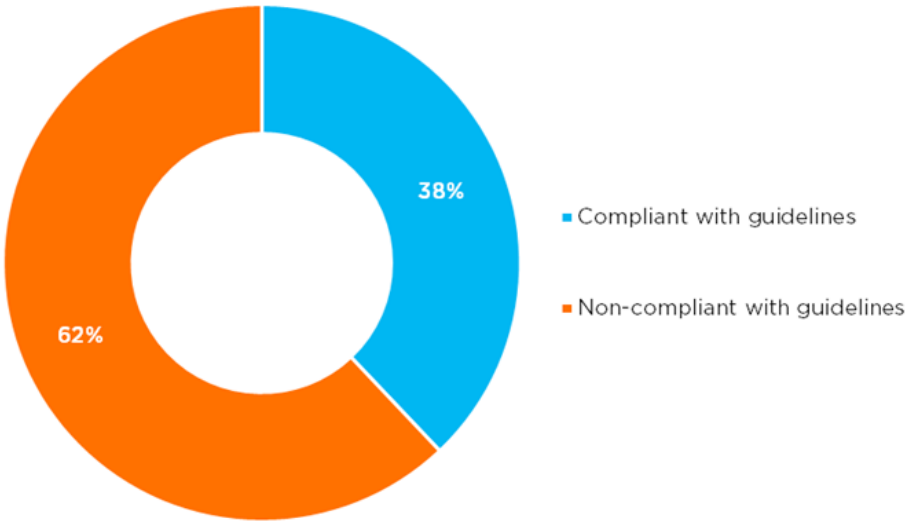
Where no post-procedural antimicrobials were prescribed, the compliance and appropriateness were very high – 2,179 (92.7%) were compliant with the *Therapeutic Guidelines*[2] and 93 (4.0%) were compliant with local guidelines, with all of these surgical episodes being deemed optimal.

Figure 15 Compliance with guidelines, number of prescriptions for post-procedural antimicrobial prophylaxis, SNAPS contributor hospitals, 2016 #



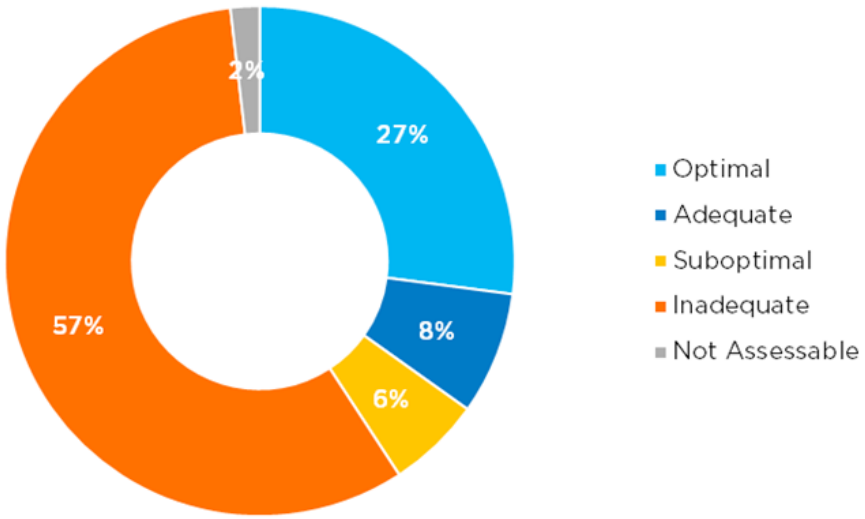
n = 1,515 prescriptions for post-procedural prophylaxis

Figure 16 **Percentage compliance with guidelines of post-procedural antimicrobial prophylaxis prescriptions, where guidelines were available, SNAPS contributor hospitals, 2016#**



n = 1,442, includes prescribed prophylactic post-procedural antimicrobials; excluding any assessed as directed therapy, no national or local guidelines available or not assessable

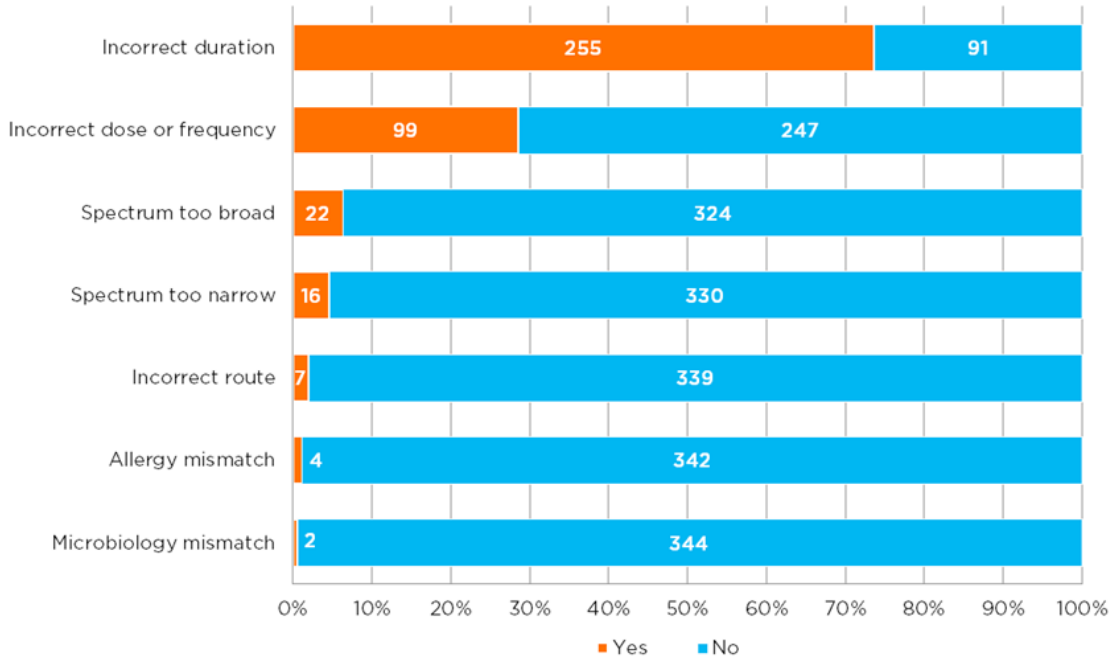
Figure 17 **Percentage appropriateness of post-procedural antimicrobial prophylaxis prescriptions, SNAPS contributor hospitals, 2016 #**



n = 1,515 prescriptions for post-procedural prophylaxis

For surgical episodes where a post-procedural antimicrobial was prescribed, 503 (40.3%) episodes did not require any post-procedural antimicrobial. For surgical episodes where post-procedural antimicrobials were required, the most common reasons for inappropriate antimicrobial prescribing were incorrect duration (n=255, 73.7%), incorrect dose or frequency (n=99, 28.6%) and spectrum too broad (n=22, 6.4%) as shown in Figure 18.

Figure 18 Reasons for inappropriateness, percentage and number of post-procedural antimicrobial prescriptions for prophylaxis#



(n = 346) where post-procedural antimicrobial prophylaxis was required

The most common post-procedural antimicrobials prescribed are displayed in Figure 19. The greatest number of prescriptions were for cefazolin (n=868, 57.3%); cefalexin and chloramphenicol were the next most commonly prescribed with 156 (10.3%) and 91 (6.0%) prescriptions respectively.

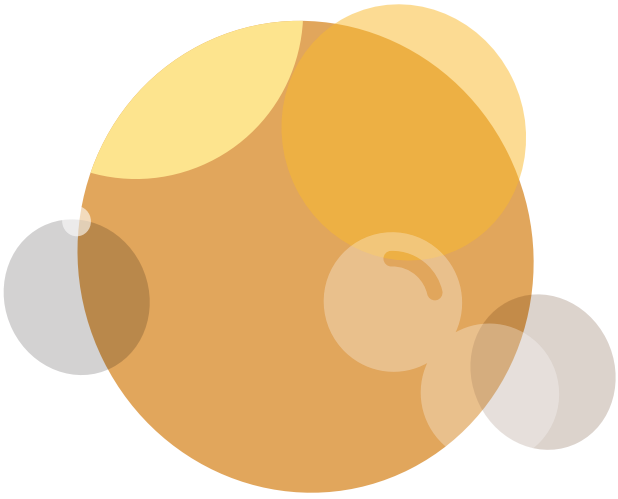
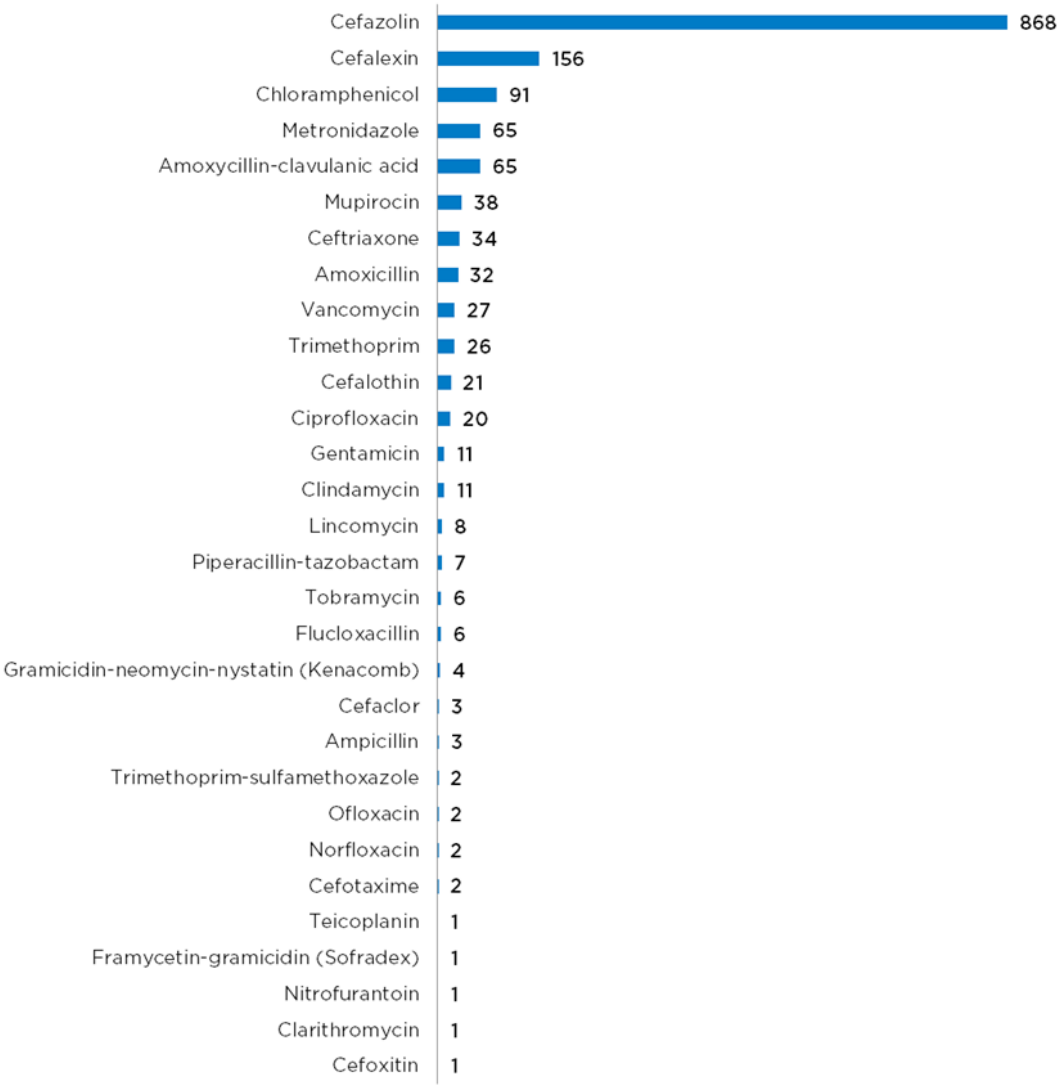
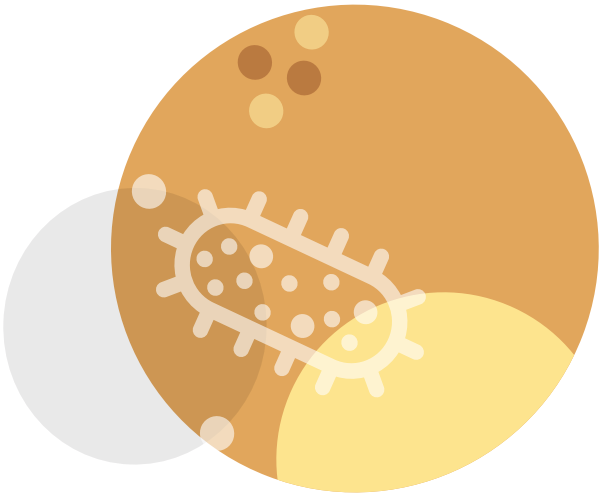


Figure 19 **Number of antimicrobials prescribed for post-procedural prophylaxis, SNAPS contributor hospitals, 2016 #**



n = 1,515 prescriptions for post-procedural prophylaxis



Duration of prophylaxis

The duration of post-procedural prophylaxis was based on the calendar days of prescribing and reflects days of antimicrobial therapy rather than exact durations of therapy. Antimicrobial use beyond 48 hours was used as a marker for prolonged post-procedural prescribing for the analyses of the 2016 SNAPS pilot data. The results are an under-representation of the true rate of prescribing for greater than 48 hours, due to use of days of therapy.

This variation from the approach used for the Hospital NAPS, where continuation of surgical prophylaxis beyond 24 hours is used as the determinant of appropriate duration of prescribing, was necessary because of poor documentation of administration time for the 2016 SNAPS pilot.

The Hospital NAPS includes a specific question on surgical prophylaxis prescribed for longer than 24 hours.

There was minimal difference in the duration of post-procedural surgical prophylaxis prescribed in either public or private hospitals (Table 11). Although there was a greater range in the duration of prescriptions for public hospitals, there was no difference in the median length of prescribing of two days. On average, 30% of total antimicrobial prescribing was for greater than 48 hours.

Table 11 Duration of post-procedural prophylaxis by funding type, SNAPS contributor hospitals, 2016

Funding type	Antimicrobial prescriptions (number)	Range (days)	Median (days)	>48 hours (number, %)	
Public hospitals	879	1–65	2	271	31
Private hospitals	**636**	**1–37**	**2**	**181**	**28**
Total	**1,515**	**1–65**	**-**	**452**	**30**

There was a wide range of prescribing durations for the various surgical procedure groups, with median days of duration ranging from 1–11 days (Table 12). The procedure groups with the greatest median duration were dentoalveolar surgery (median 8 days, range 1–13 days), plastic and reconstructive surgery (median 6 days, range 1–65 days), head and neck surgery (median 6 days, range 1–15 days) and breast surgery (median 5 days, range 1–37 days).

Gastrointestinal endoscopic procedures had the greatest median duration of antimicrobial prophylaxis (median 11 days, range 6–22 days) but this was only for 3 procedures out of a total of 422 procedures, so is not reflective of an otherwise highly guideline compliant procedure group where antimicrobials are rarely prescribed for prophylaxis.

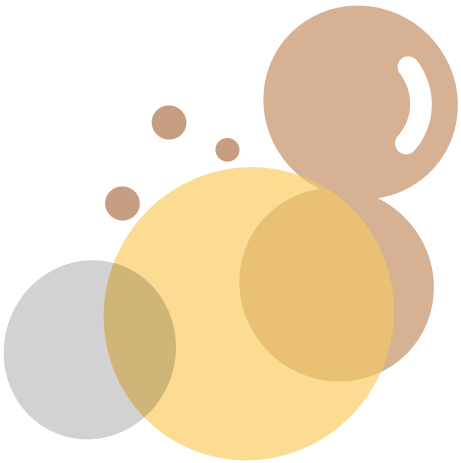


Table 12 **Duration of post-procedural prophylaxis, number of prescriptions by procedure group and percentage greater than 48 hours, SNAPS contributor hospitals, 2016**

Procedure group	Antimicrobial prescriptions (number)	Range (days)	Median (days)	>48 hours (number, %)#	
Orthopaedic surgery	527	1–12	2	35	7
Cardiac surgery	197	1–9	2	31	16
Plastic and reconstructive surgery	155	1–65	6	108	70
Ophthalmology	138	1–29	1	58	42
Abdominal surgery	105	1–15	3	42	40
Obstetrics	82	1–11	2	20	24
Urological surgery	70	1–31	3.5	35	50
Head and neck surgery	60	1–15	6	49	82
Neurosurgery	60	1–22	2	10	17
Breast surgery	38	1–37	5	22	58
Dentoalveolar surgery	28	1–13	8	26	93
Gynaecological surgery	24	1–16	2	6	25
Thoracic surgery	16	1–11	2	5	31
Vascular surgery	12	1–6	2	2	17
Gastrointestinal endoscopic procedures	3	6–22	11	3	–
Total	**1,515**	**1–65**	**-**	**452**	**30**

Percentages are not shown for antimicrobials where n <10

The route of administration also had an impact on duration of therapy. There was a median of two days of therapy for intravenously administered antimicrobials compared with eight days of therapy for antimicrobials administered via the ocular route. There were also prolonged durations for oral and topical administration, which both had a median of six days of therapy (Table 13).

Table 13 **Duration of post-procedural prophylaxis by route of administration, SNAPS contributor hospitals, 2016**

Route of administration	Antimicrobial prescriptions (number)	Range (days)	Median (days)	>48 hours (number, %)#	
Intravenous	977	1–19	2	54	6
Oral	309	1–37	6	273	88
Topical	89	1–65	6	68	76
Ocular	68	1–29	8	56	82
Intracameral	68	1	1	0	0
Intramuscular	2	1	-	0	–
Inhaled	1	8	-	1	–
Enteral	1	2	-	0	–
Total	**1,515**	**1–65**	**-**	**452**	**30**

Percentages are not shown for antimicrobials where n <10

Table 14 shows the antimicrobials that were prescribed for post-procedural surgical prophylaxis. Median days of duration were calculated only for those that were prescribed on greater than 20 occasions. Of these, the antimicrobials with the greatest duration were chloramphenicol (median 8 days, range 1–29 days), amoxicillin (median 8 days, range 1–8 days), cefalexin (median 6 days, range 1–37 days), amoxicillin–clavulanic acid (median 6 days, range 1–11 days) and trimethoprim (median 6 days, range 1–31 days).

Of note, the topical antimicrobial gramicidin–neomycin–nystatin (Kenacomb ®) had the longest duration of therapy for prophylaxis of 65 days. There were high rates of inappropriateness for many of the antimicrobials prescribed, with 19 (63.3%) having a rate of over 80%, although there were very low numbers of prescriptions for many of those. Other antimicrobials with high rates of inappropriateness were ceftriaxone (n=34, 91%), clindamycin (n=11, 91%) and trimethoprim (n=26, 85%).

Table 14 Number of prescriptions, duration of post-procedural prophylaxis and percentage inappropriate, by antimicrobial, SNAPS contributor hospitals, 2016

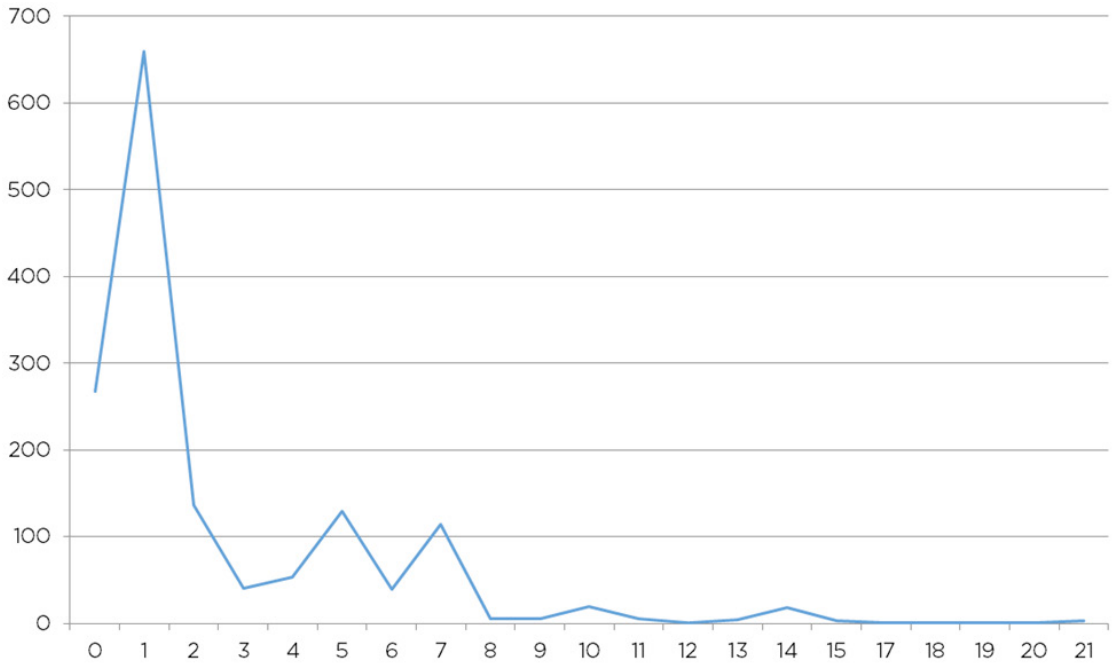
Antimicrobial	Number prescribed	Range (days)	Median (days)	Duration >48 hours (number, %)		Inappropriate (number, %)#	
Cefazolin	868	1–19	2	32	4	431	50
Cefalexin	156	1–37	6	141	90	118	76
Chloramphenicol	91	1–29	8	81	89	54	59
Amoxycillin–clavulanic acid	65	1–11	6	61	94	53	82
Metronidazole	65	1–22	2	16	25	50	77
Mupirocin	38	1–16	5	24	63	22	58
Ceftriaxone	34	1–12	2	6	18	31	91
Amoxicillin	32	1–8	8	26	81	26	81
Vancomycin	27	1–4	2	2	7	20	74
Trimethoprim	26	1–31	6	17	65	22	85
Cefalothin	21	1–6	2	3	14	5	24
Ciprofloxacin	20	1–14	5	11	55	12	60
Clindamycin	11	2–13	-	3	27	10	91
Gentamicin	11	1	-	0	0	9	82
Lincomycin	8	1–4	-	1	13	8	–
Piperacillin–tazobactam	7	2–4	-	2	29	2	–
Flucloxacillin	6	5–22	-	6	100	5	–
Tobramycin	6	8	-	6	100	6	–
Gramicidin–neomycin–nystatin (Kenacomb®)	4	1–65	-	3	75	3	–
Ampicillin	3	2	-	0	0	2	–
Cefaclor	3	6	-	3	100	3	–
Cefotaxime	2	1–2	-	0	0	2	–
Norfloxacin	2	4–8	-	2	100	2	–
Ofloxacin	2	1–14	-	1	50	1	–
Trimethoprim-sulfamethoxazole	2	6–9	-	2	100	2	–
Cefoxitin	1	3	-	0	0	1	–
Clarithromycin	1	8	-	1	100	1	–
Framycetin–gramicidin (Sofradex ™)	1	15	-	1	100	1	–
Nitrofurantoin	1	8	-	1	100	1	–
Teicoplanin	1	3	-	0	0	1	–
Total	**1,515**	**1–65**	**-**	**452**	**30**	904	60

Percentages are not shown for antimicrobials where n <10

When prescribing post-procedural prophylaxis, there is a propensity to prescribe for defined periods of time. This is evident in Figure 20, where the peaks correspond to the number of prescriptions prescribed for five, seven, 10 and 14 days of therapy.

These traditional treatment durations are commonly used for antimicrobial treatment. Their use for prophylaxis is not based on any formal evidence, have not been proven to be necessary for prophylaxis for any conditions, and are not recommended by any national guidelines.

Figure 20 Prescription duration, days of post-procedural prophylaxis up to 21 days, SNAPS contributor hospitals, 2016#



n = 1,511 prescriptions for post-procedural prophylaxis

Evaluation

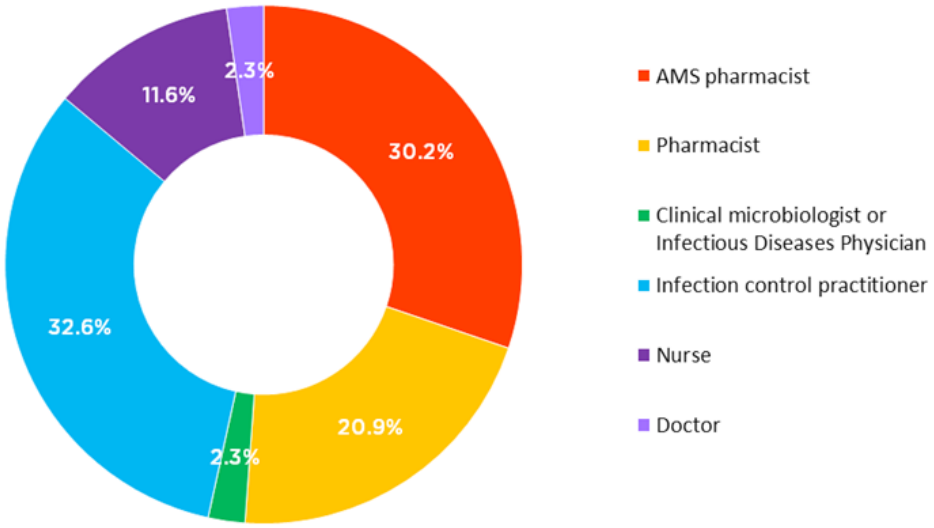
An evaluation survey was conducted using SurveyMonkey®. The results are presented below.

Evaluation respondents

A total of 43 responses were received, and 36 respondents fully completed the survey. The respondents were from a variety of professional backgrounds (Figure 21); 63% were from public health care facilities and 74% were from major metropolitan cities.

Sixty-three per cent of respondents were also Hospital NAPS registrants, 14% had heard about SNAPS from other clinicians and 14% had been asked to conduct the SNAPS by their manager.

Figure 21 Profession of respondents, percentage by healthcare worker category, SNAPS contributor hospitals, 2016 #



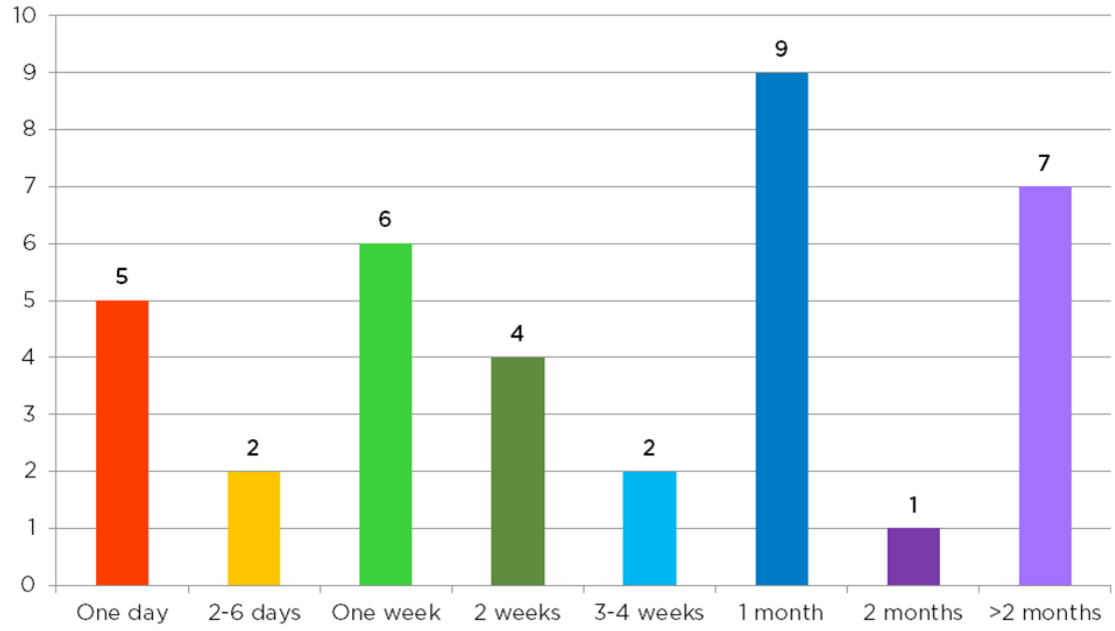
n = 43 respondents

SNAPS data collection and data entry

Approximately half of the responses indicated that two to three people were involved in conducting the SNAPS; at 30% of sites one person conducted the SNAPS.

Most participants used the retrospective methodology (80%). Seventy-two per cent were happy with the amount of information required to be collected for the SNAPS. The time frame during which procedures were audited varied between respondents (Figure 22).

Figure 22 Audit period for selected procedures, SNAPS contributor hospitals, 2016 #



n = 36 respondents

The majority of auditors (72%) used the paper forms and entered their data online at a later stage. On average, it took 17 minutes per patient (median 15 minutes) to collect the data, 12 minutes (median 10 minutes) to assess the data and seven minutes (median five minutes) to enter the data into the SNAPS database. Overall, it took an average of 36 minutes (median 30 minutes) per patient to use paper forms and enter the data at a later stage.

For auditors who entered data directly via the website, the average time to collect and enter the data was 14 minutes (median 13 minutes), and seven minutes (median nine minutes) to assess the data. Overall, it took an average of 21 minutes (median 22 minutes) to enter data directly into the website per patient.

Half of respondents felt that entering data into the website was difficult at first, but improved once they were familiar with the system. Auditors who had previously entered data for Hospital NAPS and Aged Care NAPS found the SNAPS database easy to use, as the layout was similar.

Seventy per cent of respondents believed that the surgical procedure list provided for SNAPS was adequate. However, for very specific investigative cardiac procedures and gynaecological procedures, many had to be listed as “other” which made interpretation of their reports difficult.

There were 30 respondents who used the appropriateness assessment guidelines, and all except one respondent strongly agreed or agreed that the appropriateness assessment guidelines were easy to follow. Eighty-two per cent of respondents felt that the appropriateness assessment guidelines encompassed the scenarios that were encountered during the SNAPS audit. Seventy per cent of respondents felt confident with their ability to assess appropriateness, and 82% with their ability to assess compliance with guidelines.

Respondents commented that it was often difficult to determine the necessity of prophylaxis for specific procedures due vague descriptions under general procedure groups within the *Therapeutic Guidelines*[2]. This made determining the appropriateness of these specific procedures difficult, especially when the auditors had minimal surgical experience.

SNAPS reports

Many of the respondents had not used the reporting functionality at the time they completed the survey and were unable to provide feedback regarding the reports. Of the 27 respondents who had used the reporting functionality, 96% found it easy to understand how to generate reports and also found the data in the reports useful. Seventy-eight per cent of those respondents who had used the reporting functionality felt that there was enough flexibility to generate the reports required. The main criticism of the SNAPS reports was that some users found the reporting functionality and graph titles confusing and difficult to understand.

Twelve (39%) of 31 respondents who answered the benchmarking section, stated that their hospital participated in benchmarking, with an additional 11 (36%) being unsure of their benchmarking status. Ten respondents had produced benchmarking reports and eight of them found these reports useful. Of the 10 respondents who did not participate in benchmarking, six would be interested in benchmarking for future surveys and four were undecided.

Future SNAPS participation

Of the 33 respondents who answered the future participation section, 100% indicated that they would be willing to participate in the SNAPS again. However, those respondents felt that inadequate staffing for both administering the survey and entering the data were the main potential barriers to participating in the SNAPS in the future.

Improvements to consider for future SNAPS

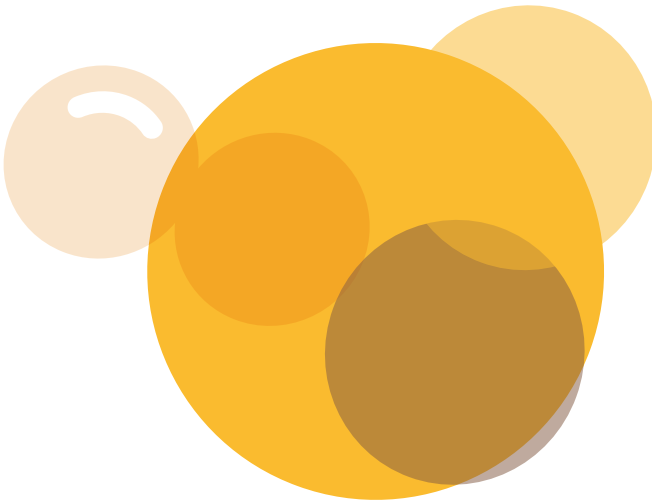
Based on participant feedback and the reflections of the project team, several improvements can be made for future surveys.

Clarification about how SNAPS can complement Hospital NAPS

Many hospitals asked whether they could replace the Hospital NAPS with SNAPS, presumably due to the resources required to conduct both audits. The surveys have different aims and collect different data. If both are to be recommended as annual surveys, this may significantly increase the workload for hospitals and discourage participation. Consideration of the recommended frequency for the SNAPS and Hospital NAPS would be worthwhile to provide clarity to hospitals.

Revision of survey content, including the procedure list, and additional validation capacity in the online data entry portal

Many procedures were listed as “other”, and there was no provision for free text data collection on “other” surgical procedures. The next version of the SNAPS should be modified to ensure frequently performed procedures are adequately captured in the SNAPS database. A revised and expanded procedure list is being developed by the NAPS team for inclusion in the next version of SNAPS.



Validation processes should be enhanced for data entry to minimise errors and ensure data quality.

1. Clear specification of data collection method

SNAPS pilot participants were required to specify whether they conducted the audit retrospectively or prospectively. This information was useful during the pilot phase to ascertain the preferred method for hospitals. In future it is proposed that hospitals also be asked to specify whether they perform a general audit of all procedures at their facility or a targeted audit. This is important for analysis of appropriateness at the national level. If hospitals perform a targeted audit of their problem surgical units, then bias is introduced into the national data on appropriateness.

2. Improve the layout and detail of the self-generated reports

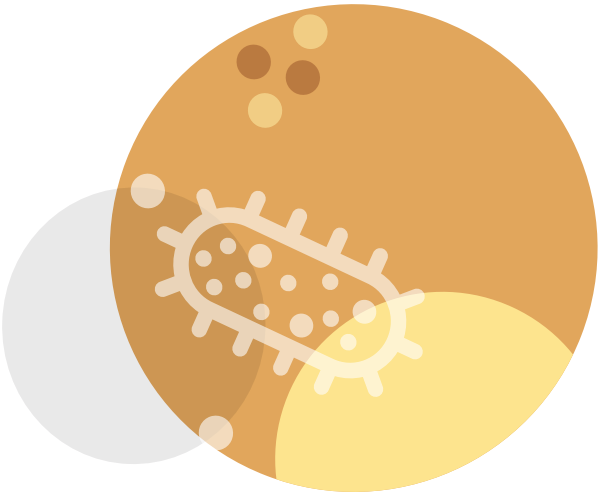
Many surveyors found the titles of the individual graphs in the dashboard and antimicrobial reports confusing. When the reports were exported as either a Word document or a PDF, the titles did not align appropriately which led to further confusion interpreting the results.

3. Provide more content in the benchmarking reports

There was limited ability to produce benchmarking reports in the 2016 pilot SNAPS, this will be improved with the feedback from the pilot evaluation survey respondents. Benchmarking will be promoted as an important feature of future SNAPS.

4. Provide feedback to the Therapeutic Guidelines Limited

Due to the comments regarding the difficulty in assessing appropriateness based on many of the *Therapeutic Guidelines* recommendations, there should be feedback provided for possible improved definitions for how to classify surgical procedures for subsequent versions. This will allow for less ambiguity in determining the procedure group and recommended prophylaxis for each surgical episode and improve the ease and accuracy of auditing for the SNAPS.



Conclusions

The SNAPS pilot confirmed the findings of previous Hospital NAPS and highlighted several areas for improvement of prescribing surgical antimicrobial prophylaxis. Areas where practice could be improved include:

- Documentation of incision time and administration time for antimicrobials
- Compliance with guidelines for surgical antimicrobial prophylaxis
- Timing of procedural antimicrobial administration
- Duration of therapy for post-procedural antimicrobials, when required

In view of the ongoing high rate of inappropriate prescribing of surgical antimicrobial prophylaxis, the Commission will issue an advisory to provide guidance and direction on the interpretation and assessment of the National Safety and Quality Health Service Standards, Standard 3: Preventing and Controlling Healthcare Associated Infections. The advisory, which is supported by the Royal Australasian College of Surgeons, is specific to the antimicrobial stewardship criterion of the Standard. It requires health service organisations to ensure that surgical prophylaxis is included and addressed as part of their antimicrobial stewardship program. To demonstrate that the requirement is met, organisations can monitor their performance using the indicators for quality statements 6 and 9 of the Commission's *Antimicrobial Stewardship Clinical Care Standard*.[1]

Given the resources and time available for its development, the 2016 SNAPS pilot was successful. There was encouraging uptake from public and private hospitals, feedback from participants was overwhelmingly positive, and the feasibility of such an audit was confirmed.

This suggests that the survey has the potential to play a key role in improving surgical antimicrobial prophylaxis in Australian hospitals. To do this, SNAPS must be a relevant, practical and useful tool at both the local facility level and nationally. The methodological and data validation issues identified during the pilot will assist with further development of the SNAPS and its role in national surveillance.

As the use of antimicrobials for surgical prophylaxis has been demonstrated to be suboptimal, and antimicrobials are used for longer than necessary in this setting, the Commission will continue to work with the Royal Australasian College of Surgeons to develop guidance in this area.

The SNAPS audit is more complex for participants than the Hospital NAPS, and that it has been designed to provide longitudinal data on a patient's surgical episode. The detailed data that the SNAPS provides means it is valuable for different surgical craft groups as well as hospital antimicrobial stewardship program managers. It has the potential to support enhanced education and practice improvement. The SNAPS may also play a particularly important role in the private hospital sector where surgery accounts for a high proportion of activity.

Definitions

Surgical episodes	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).
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 groups	The specialty groups under which each procedure is classed for reporting; see *Appendix 1*.
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 taken into account when assessing the appropriateness of whether procedural antimicrobials were given or not given.
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.
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.
Therapeutic Guidelines	The current paper or online version of the Therapeutic Guidelines; Antibiotic Expert Group. Therapeutic Guidelines. Version 15 (2014). Melbourne http://online.tg.org.au/ip/
Local guidelines	Local guidelines must be authorised by local or regional stewardship programs and readily available on wards or on the hospital intranet, they cannot be a web-link to international guidelines or other non-approved sites; exceptions include paediatric and neonatal guidelines from an Australian children's hospital and links to other official guidelines within a facility's network.

Appendix 1: Procedure groups

The procedures listed in the SNAPS database are text-searchable for ease of navigation.

These have been adopted from The Royal Australian College of Surgeons Morbidity Audit and Logbook tools.

The surgical procedure groups listed were:

- 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; including ear, nose and throat (ENT) surgery
  - head and neck/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 2: 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
			/ / :
			/ / :
			/ / :
			/ / :

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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

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Appendix 3: Appropriateness assessment guide

	Appropriateness		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 the 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	

Acknowledgements

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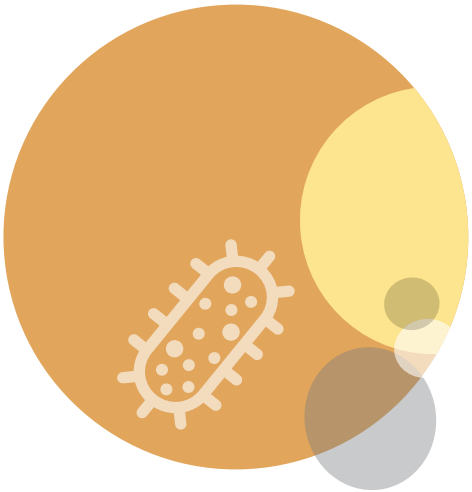

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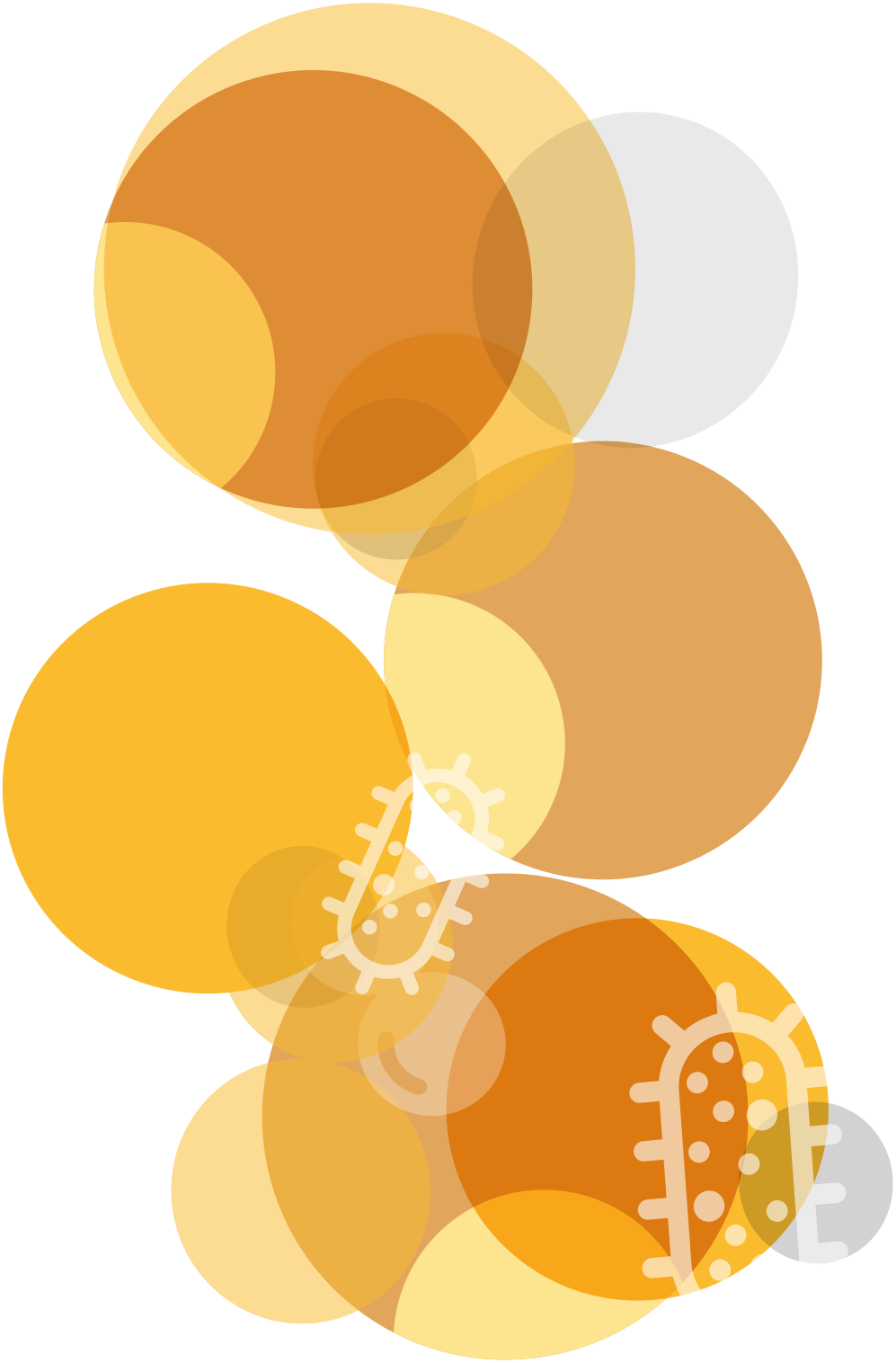

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