AUSTRALIAN COMMISSION
ON SAFETY AND QUALITY IN HEALTH CARE

AURA
Antimicrobial Use and Resistance in Australia

Antimicrobial prescribing practice in Australian hospitals

Results of the 2016 Hospital National Antimicrobial Prescribing Survey

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HOSPITAL NAPS National Antimicrobial Prescribing Survey

NCAS National Centre for Antimicrobial Stewardship

GUIDANCE

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Summary

The National Safety and Quality Health Service (NSQHS) Preventing and Controlling Healthcare-Associated Infection Standard requires all Australian hospitals to implement an antimicrobial stewardship (AMS) program.

The Hospital National Antimicrobial Prescribing Survey (NAPS) is one of two antimicrobial usage surveillance programs supported by the Australian Commission on Safety and Quality (the Commission) to contribute data to the Antimicrobial Use and Resistance in Australia (AURA) Surveillance System. The other is the National Antimicrobial Utilisation Surveillance Program (NAUSP).

Whilst the 2016 NAUSP report identified a 12.6% reduction in the total volume of antimicrobial usage, measured in defined daily doses per 1,000 occupied bed days, in Australian hospitals from 2010 to 2016, the 2016 Hospital NAPS has identified minimal changes in the key indicators of appropriateness of antimicrobial prescribing from 2013 to 2016 in Australian hospitals.

This report presents data submitted for the 2016 Hospital NAPS by 320 public and private hospitals (229 public and 91 private), and analyses of the appropriateness of 25,661 prescriptions. All Australian states and territories were represented in the survey, and approximately one third of all eligible public and private hospitals participated. Analyses are also presented on changes in appropriateness of antimicrobial prescribing from 2013 to 2016.

The key indicators of appropriateness of antimicrobial prescribing in the Hospital NAPS from 2013 to 2016, and the changes in them over the four years from 2013, are as follows:

- Improvement in documentation of indication from 70.9% to 75.6%
- Improvement in documentation of review or stop date from 35.5% to 38.1%
- Improvement in the proportion of surgical prophylaxis given for greater than 24 hours from 41.8% to 31.1%
- A decline in compliance with *Therapeutic Guidelines: Antibiotic* or local guidelines from 72.2% to 65.4%
- A static rate of overall appropriateness of prescribing, of approximately 76% each year.

The best practice target for all of the above, except duration of surgical prophylaxis, is 95%. For surgical antimicrobial prophylaxis greater than 24 hours duration, the best practice target is 5%.

It is important to understand that the Hospital NAPS assessment of appropriateness incorporates directed therapy and optimal or adequate compliance with guidelines, including antimicrobial choice, dosage, route and duration. In contrast, the Hospital NAPS assessment of compliance with guidelines excludes directed therapy prescriptions that are informed by a microbiology result, and are therefore always appropriate, but not necessarily compliant with guidelines.

There are a number of possible explanations for the static rate of appropriateness and the decline in the rate of compliance with antimicrobial prescribing guidelines from 2013 to 2016. These include: an increase in directed therapy, and prescribers increasingly choosing second line therapy, rather than first line therapy in response to increasing antimicrobial resistance rates. It is also possible that established guidelines are not meeting the needs of clinicians, or that there is need for better dissemination and endorsement of these guidelines to increase awareness. Opportunities for further exploration of the reasons for the apparent anomaly will be considered for future surveys and by the Commission in collaboration with the states and territories, private health service organisations and experts in antimicrobial stewardship.

The five most commonly prescribed antimicrobials in Australian hospitals participating in NAPS in 2016 were: cefazolin, ceftriaxone, piperacillin–tazobactam, amoxicillin–clavulanate and metronidazole.

The antimicrobials with the highest rates of inappropriate prescribing in Australian hospitals participating in NAPS in 2016 were: cefalexin, amoxicillin–clavulanate and cefazolin.

The five most common indications for prescribing antimicrobials in Australian hospitals that contributed to NAPS in 2016 were: surgical prophylaxis, community-acquired pneumonia, medical prophylaxis, urinary tract infection and sepsis.

The highest proportions of prescriptions assessed as inappropriate in Australian hospitals participating in NAPS in 2016 were for: surgical prophylaxis, infective exacerbation of chronic obstructive pulmonary disease (COPD) and cholecystitis.

The 2016 Hospital NAPS analyses have identified the following priority areas for antimicrobial prescribing quality improvement initiatives by health service organisations:

- Documentation of indication, particularly in private hospitals
- Documentation of review or stop date, particularly in public hospitals
- Compliance with guidelines, particularly in very remote, public group D hospitals and private hospitals
- Appropriateness of prescribing, particularly inappropriate broad spectrum antimicrobial use and duration of therapy
- Improved prescribing, particularly for cefalexin, amoxicillin–clavulanate and cefazolin
- Improved prescribing for indications, particularly surgical prophylaxis, infective exacerbations of COPD and pneumonia.

An analysis by the Commission of improvements to patient safety and quality in health service organisations since the release of the first edition of the NSQHS Standards indicates that Australian health service organisations should be well placed to respond to these challenges.[1] The number of health service organisations with AMS programs increased from 36% in 2010 to 98% in 2015. AMS activities impacted by the Preventing and Controlling Healthcare-Associated Infection Standard from 2010 to 2015 include:

- Participation in regular audits of antimicrobial prescribing (from 32% to 97%)
- Provision of feedback to prescribers on audit results (from 22% to 88%)
- Review and point-of-care intervention and feedback to prescribers (from 29% to 86%)
- Formularies restricting use of broad-spectrum antimicrobial drugs (from 41% to 86%).

To address the priority areas for action, the Commission will:

- Work with states and territories and private hospital provider organisations to highlight the findings and priority areas for improvement identified by the 2016 Hospital NAPS for inclusion in their antimicrobial stewardship plans
- Encourage public and private health service organisations to routinely review their NAPS results, initiate targeted communication to departments with the highest percentage of inappropriate prescribing, and develop an action plan to improve the appropriateness of antimicrobial prescribing, in accordance with 3.16c of the NSQHS Standard
- Review the Commission's Antimicrobial Stewardship Clinical Care Standard and Antimicrobial Stewardship Advisory in regard to surgical prophylaxis as required
- Continue collaborative work with the Royal Australasian College of Surgeons to improve prescribing of antimicrobials for surgical prophylaxis and collaborate with experts in antimicrobial stewardship to identify additional resources that may be required to support practice improvement.

The Commission will also work with the states and territories and the private sector to promote the importance of ongoing monitoring of antimicrobial usage and appropriateness of use in Australian hospitals.

The Commission and National Centre for Antimicrobial Stewartship will examine strategies to enhance the number and representativeness of participants in the Hospital NAPS.

Introduction

The Australian Commission on Safety and Quality in Health Care (the Commission) provides funding for the Hospital National Antimicrobial Prescribing Survey (NAPS) for incorporation of data in the Antimicrobial Usage and Resistance in Australia (AURA) Surveillance System. The Hospital NAPS is a collaborative project between the National Centre for Antimicrobial Stewardship (NCAS) and the Guidance Group (Royal Melbourne Hospital).

The NAPS is a standardised auditing tool that is designed to assist health service organisations to assess the quality of their antimicrobial prescribing. It can also provide data on the quantity of prescriptions for antimicrobials for specific indications and by specialty groups.

The Hospital NAPS supports Australian health service organisations, states and territories and private sector organisations to develop and manage antimicrobial stewardship (AMS) programs by:

- Facilitating effective audit and review of antimicrobial use, 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 AMS practices across **all** hospitals
- Providing flexible and useful benchmarking within hospitals, across units and wards, and between hospitals and jurisdictions.

Since the launch of the web-based survey in 2013, the Hospital NAPS has grown and diversified into a program that supports the challenges of AMS across all Australian hospitals. The data available from the Hospital NAPS deliver insights into the appropriateness of antimicrobial prescribing and have contributed to local, state and territory and national antimicrobial prescribing strategies to improve the quality of care delivered to patients.

Participation in the Hospital NAPS has increased from 32 hospitals (30 public and 2 private) in the 2011 paper-based pilot survey to 320 hospitals (229 public and 91 private) in the 2016 web-based survey.

Hospital NAPS has consistently demonstrated that surgical prophylaxis is the most common indication for antimicrobial prescribing in Australian hospitals, and also has one of the highest percentages of inappropriateness.[2,3,4] To further investigate prescribing practices for surgical prophylaxis, the pilot Surgical NAPS module was launched in July 2016 with funding support from the Commission.[5]

This report focuses on the results of the 2016 Hospital NAPS, and includes analyses of trends from 2013 to 2016.

Methods

Timing

Data collection for the 2016 Hospital NAPS commenced on 1 March 2016, and closed on 2 February 2017. Hospitals were encouraged to conduct their survey before Antibiotic Awareness Week in November 2016, so that results would be available for discussion and education.

Recruitment

Drawing on the NAPS registration database, approximately 1,000 individuals across 450 hospitals were invited to participate in the 2016 Hospital NAPS. Further promotion by the Commission and the NCAS occurred throughout the year via their websites, Twitter® and the NAPS newsletter.

Early parenting centres, drug and alcohol hospitals, same day hospitals, outpatient only hospitals, sleep clinics and other private specialty clinics without overnight stay were excluded.

eLearning

An online eLearning module was available through the NAPS website. This provided information regarding setting up the survey, data collection and assessments of compliance with guidelines and appropriateness. An assessment quiz was also provided at the end of the module requiring participants to answer at least 80% of the questions correctly in order to pass. All participants were encouraged to perform the eLearning module prior to data collection, but at least one participant from each hospital was required to successfully pass the quiz in order to be able to finalise their patients' data.

Performing the survey

Participants were advised that both the data collection and assessments of guideline compliance and appropriateness should ideally be performed by multi-disciplinary teams. The members of each team were determined by each participating facility, depending on the staffing resources available and could consist of any combination of infectious diseases physicians, clinical microbiologists, other interested physicians, pharmacists, infection control practitioners and nurses.

Two or more auditors were suggested per site to facilitate discussion about difficult assessments. Participants were advised that, preferably, auditors should have sound clinical knowledge about antimicrobial prescribing and local prescribing guidelines. If an on-site assessing team was not available, participants were advised that the data should be reviewed by an external assessing team (for example, from within the hospital network or at a major city centre). The NAPS support team was available to provide additional clinical advice for facilities without infectious diseases expertise.

Data Collection Methodology

Option 1: Hospital-wide point prevalence study (preferred)

This methodology required all inpatients to be assessed so prevalence of antimicrobial use could be calculated. Data were collected on both the number of inpatients on antimicrobials (numerator) and the total number of inpatients (denominator). Surveys completed on a whole hospital within a defined narrow time window were promoted as the 'gold standard'. It was suggested that all inpatients be sampled on one calendar day. However if this was not possible, wards could be surveyed on separate days provided that all patients were surveyed once only.

Option 2: Repeat point prevalence surveys (for smaller hospitals)

While Option 1 (above) will provide an estimate of antimicrobial prevalence, for smaller hospitals it may not allow sufficient data to be collected to assess prescribing appropriateness. Small hospitals were able to choose to conduct repeat point prevalence surveys whereby a whole hospital survey is conducted multiple times, with surveys at least one week apart, until at least 30 antimicrobial prescriptions had been collected. Auditors were advised that all inpatients should be included in the repeat surveys, including those who had been surveyed previously, as the appropriateness of their respective antimicrobial prescriptions may change over time.

Option 3: Random sampling point prevalence study (for hospitals with ≥100 acute beds)

For larger hospitals where a whole hospital point prevalence survey was not possible, data could be collected from a random sample of inpatients; provided the following guidelines were adhered to:

- A random sampling method should only be used in hospitals with ≥ 100 acute beds
- The random sampling should include all wards within the hospital
- The proportion of inpatients sampled must be at least 50% of the inpatient population
- The random sampling is based on inpatients, not antimicrobial prescriptions.

Support for auditors

The NAPS support team provided email, telephone and online support to participating sites throughout the data collection period. Participants could also register to attend online training sessions which covered the basics of how to set-up and administer the Hospital NAPS.

Expert assessments

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

Development of templates to help hospitals communicate local survey results

A large number of regional, remote and private hospitals requested advice about the most effective method for presenting and sharing their results within their hospitals. A standardised reporting template and accompanying example report were developed as a guide, and additional links to useful presentations and posters were provided.

Analyses

Hospitals that conducted whole-hospital audits including single point prevalence surveys, serial point prevalent surveys and randomised sample surveys were included in the analyses. All other survey methodologies, including directed surveys of selected antimicrobials, indications, specialities or wards, were excluded because of the potential for systematic bias. The selected survey methodology used does not impact on the data in this report, as each individual prescription is analysed individually and independent of the data collection methodology.

De-identified hospital data is then analysed by sector (public or private), state or territory, the Australian Bureau of Statistics (ABS) remoteness classifications and the Australian Institute of Health and Welfare (AIHW) peer group classifications. Key performance indicators are analysed and reported for these reporting groups.

Australian Statistical Geography Standard

Contributor hospitals were categorised in terms of remoteness using the Australian Bureau of Statistics (ABS) Australian Statistical Geography Standard (ASGS).[6]

The Remoteness Areas Structure within the ASGS divides Australia into five categories of remoteness on the basis of a measure of relative access to services. The five Remoteness Areas for Australia are major cities, inner regional, outer regional, remote and very remote.

Australian Institute of Health and Welfare hospital peer group classifications

The AIHW peer group classifications have been developed in order to categorise hospitals, both public and private.[7] The peer groupings are based on data from a broad range of sources and service profile characteristics and are multipurpose. They do not target any particular reporting purpose and are intended to be stable over time, therefore groups have been defined by the type and nature of the services provided rather than by size-based characteristics, which can change through increases in activity.

Limitations

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

- **Sampling and selection bias:** The hospitals included were not a randomised sample because participation by healthcare facilities was voluntary. Hence, the results might not be representative of all Australian hospitals.
- **Comparison with previous surveys:** This report incorporates the results of the 2013, 2014, 2015 and 2016 Hospital NAPS. However, the ability to directly compare results with those from previous years is limited as a result of changes in the inclusion criteria, methodology, distribution, number and types of participating hospitals. Several modifications were made to the methodology and data specifications for the 2015 Hospital NAPS to help improve the robustness of the data collected, and allow improved auditing and benchmarking. There were minimal changes to the methodology for the 2016 survey.
- **Patients may be counted multiple times:** For facilities that conducted a repeat point prevalence survey, patients may be counted multiple times if they were still an inpatient on subsequent audit days. This may artificially inflate the prevalence of certain indications or antimicrobials that require longer durations of treatment.
- **Subjective nature of assessments:** Individual auditors at each participating facility were responsible for assessing the appropriateness of antimicrobial prescribing and compliance with guidelines, although remote expert assessments were conducted by the NAPS support team on request. These assessments are not completely objective and involve some degree of interpretation, despite being guided by a standardised appropriateness table (see Appendix 2).
- **Reason for a prescription being assessed as inappropriate:** The fields for 'reason for a prescription being assessed as inappropriate' are optional. Auditors may often only mark the 'yes' fields and leave the 'no' fields empty. As such the 'not specified' response would have a much higher proportion of true 'no' than 'yes' recorded. These fields will be made compulsory from 2019 to avoid this issue.
- **Option for hospitals to choose other audit tools:** Depending on local AMS issues, casemix and resources, hospitals may choose to use other audit mechanisms, such as Surgical NAPS, Quality Improvement NAPS or one of their own design. This may have impacted on the number of hospitals that chose to participate in the 2016 Hospital NAPS.

Findings

Participation

Data submitted from 320 hospitals (229 public and 91 private) that met the inclusion criteria were analysed for this report.

There has been an increase in participation each year since 2013; the greatest increase since 2013 has been in private hospitals (Figure 1). Details of hospital participation by state and remoteness classification are presented in Table 1. Participation according to peer group is presented in Table 2.
All Australian states and territories were represented in the 2016 Hospital NAPS. Approximately one third of all eligible public (33.7%) and private (30.7%) hospitals nationally participated.

There was representation from public hospitals across all remoteness classifications and peer groups, with participation from small, very small and subacute public hospitals being lower than that from larger hospitals. Participation by public hospitals from all remoteness classifications has increased since 2013 (Figure 2). Remoteness classifications for private hospitals were introduced in 2015. Most private hospitals in Australia are located in major cities, with none being classified as remote or very remote. Representation from private hospitals from ranged from 25.0% to 30.8%.

Figure 1 Number of public and private hospitals that have contributed to Hospital NAPS, 2013–2016

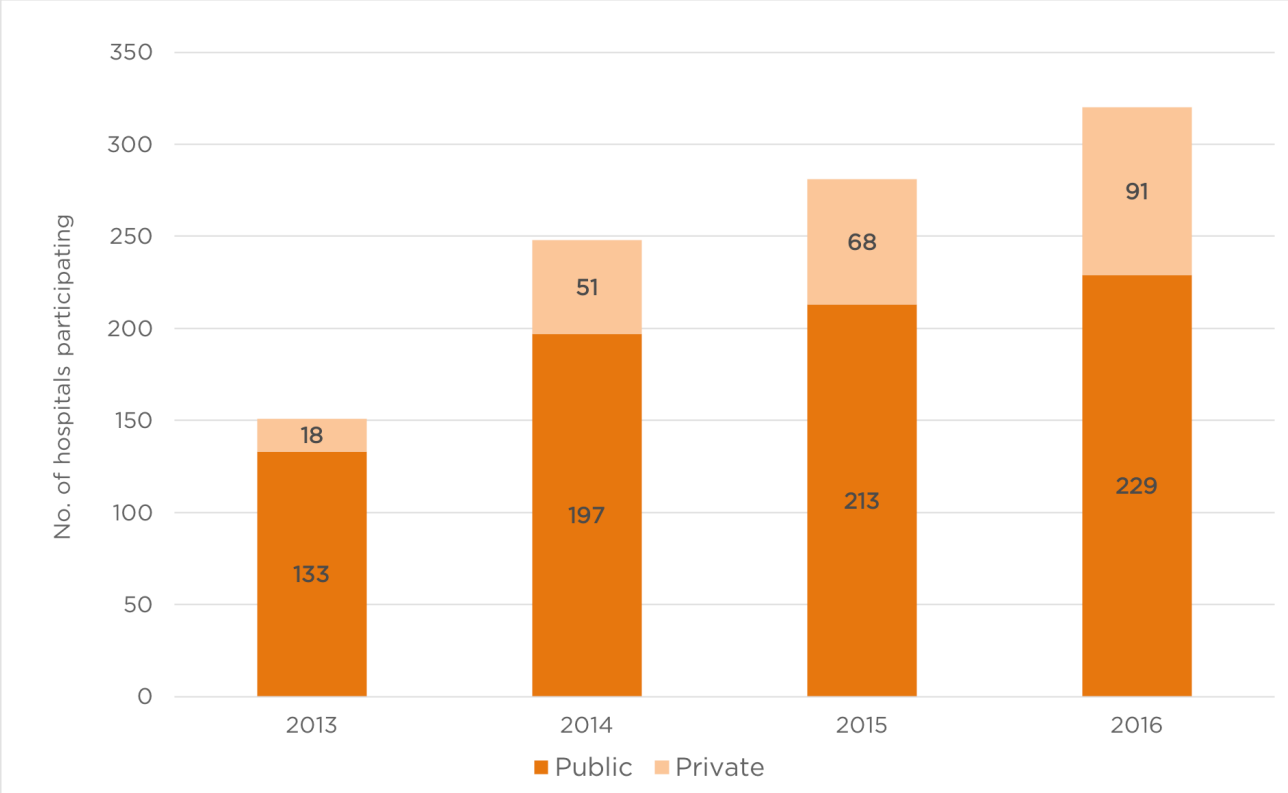


Table 1 Public and private hospitals that contributed to the 2016 Hospital NAPS by state, territory and remoteness area, 2016

Participating hospitals		Public / Private	Number of participating hospitals	Number of hospitals in reporting group*	Percent participation	Number of participating hospitals	Number of hospitals in reporting group*	Percent population
State or territory	NSW	Public	78	215	36.3	106	318	33.3
		Private	28	103	27.2			
	Vic	Public	71	144	49.3	97	215	45.1
		Private	26	71	36.6			
	Qld	Public	46	123	37.4	62	182	34.1
		Private	16	59	27.1			
	SA	Public	8	77	10.4	15	105	14.3
		Private	7	28	25.0			
	WA	Public	19	91	20.9	30	114	26.3
		Private	11	23	47.8			
	Tas	Public	3	23	13.0	5	30	16.7
		Private	2	7	28.6			
	NT	Public	2	5	40.0	2	6	33.3
		Private	0	1	0.0			
	ACT	Public	2	2	100.0	3	6	50.0
		Private	1	4	25.0			
Remoteness	Major cities	Public	92	168	54.8	160	389	41.1
		Private	68	221	30.8			
	Inner regional	Public	71	189	37.6	90	248	36.3
		Private	19	59	32.2			
	Outer regional	Public	49	213	23.0	53	229	23.1
		Private	4	16	25.0			
	Remote	Public	9	61	14.8	9	61	14.8
		Private	na†	na	na			
	Very remote	Public	8	49	16.3	8	49	16.3
		Private	na	na	na			
Total		**Public**	**229**	**680**	**33.7**	**320**	**976**	**32.8**
		Private	**91**	**296**	**30.7**			

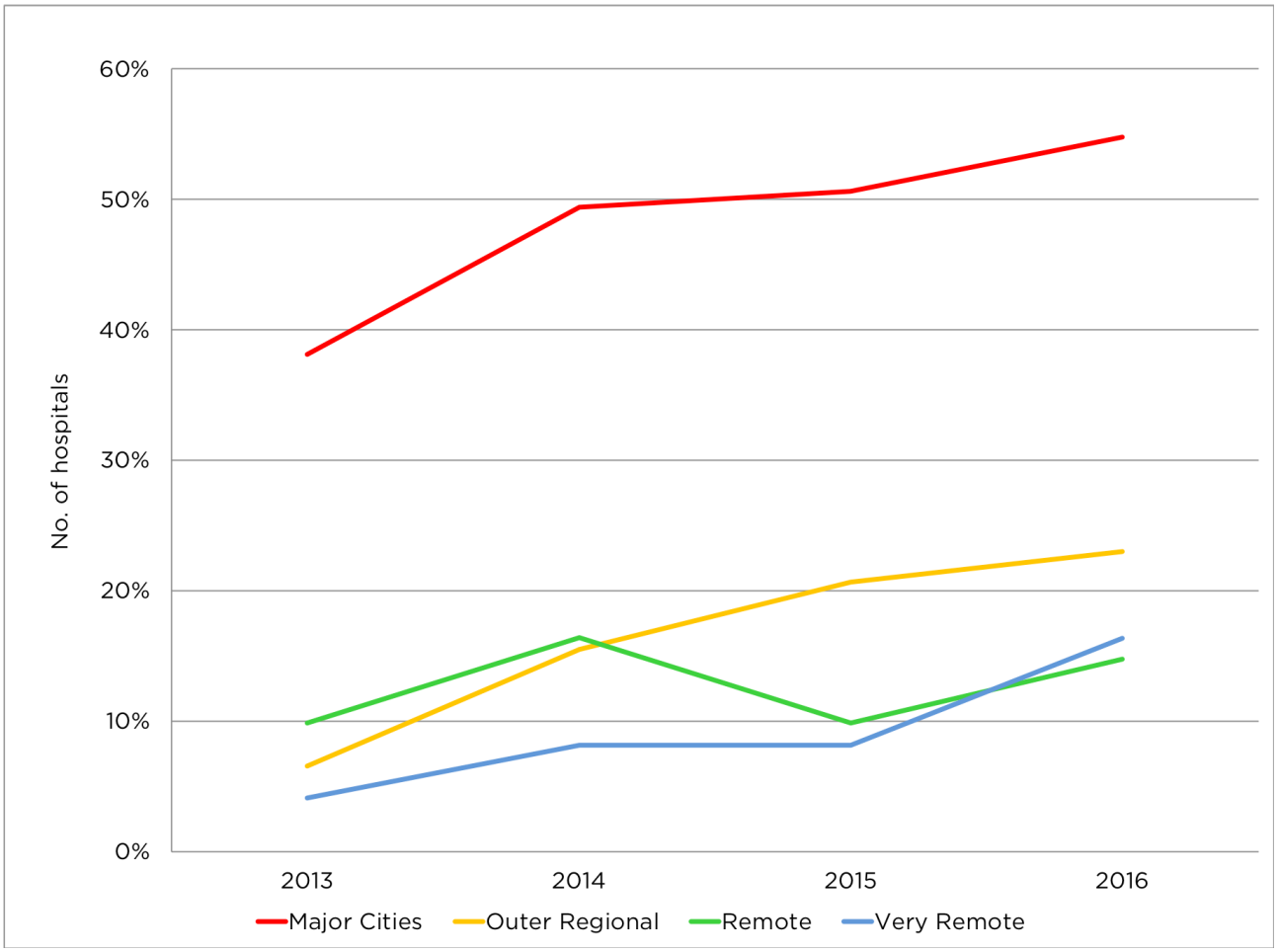
* Numbers represent all eligible hospitals in the AIHW reporting groups for public and private, states and territories, and remoteness classifications.
† Not applicable

Table 2 Public and private hospitals that contributed to the 2016 Hospital NAPS by AIHW peer group, 2016

Participating hospitals		Number of participating / total for each group		Percentage of participation
Public hospital peer group	Principal referral	27	30	90.0
	Public acute group A hospitals	49	62	79.0
	Public acute group B hospitals	27	45	60.0
	Public acute group C hospitals	51	143	35.7
	Public acute group D hospitals	45	190	23.7
	Other acute specialised hospitals	1	3	33.3
	Children's hospitals	5	7	71.4
	Women's hospitals	4	6	66.7
	Women's and children's hospitals	1	1	100.0
	Mixed subacute and non-acute hospitals	7	25	28.0
	Rehabilitation and GEM[§] hospitals	3	14	21.4
	Very small hospitals	6	122	4.9
	Psychiatric hospitals	2	22	9.1
	Unpeered hospitals	1	10	10.0
Private hospital peer group	Private acute group A hospitals	13	22	59.1
	Private acute group B hospitals	26	36	72.2
	Private acute group C hospitals	23	49	46.9
	Private acute group D hospitals	17	69	24.6
	Other acute specialised hospitals	2	15	13.3
	Mixed day procedure hospitals[#]	1	53	1.9
	Private rehabilitation hospitals	8	23	34.8
	Private acute psychiatric hospitals	1	29	3.4

* Excludes early parenting centres, drug and alcohol hospitals, same day hospitals, outpatient hospitals
† Excludes ineligible private hospitals
§ GEM – Geriatric Evaluation and Management
# The facility provided overnight services during 2016

Figure 2 Public hospitals that have contributed to Hospital NAPS by remoteness area, 2013-2016



Types of surveys performed

There were a total of 391 surveys conducted by the 320 participating facilities during the 2016 data collection period. Approximately half (48.8%) of all hospitals conducted a hospital-wide point prevalence survey, 34.3% conducted a repeat point prevalence survey and 16.9% conducted a randomised sample survey (Table 3). Major city hospitals performed mainly hospital-wide point prevalence surveys (namely principal referral, public group A and B and private group A, B and C hospitals). Inner and outer regional and remote hospitals mostly conducted repeat point prevalence surveys (namely public group C and D and private group D hospitals).

Of note, very remote hospitals that are usually small (<100 beds), mainly performed randomised sample surveys. This was not consistent with the recommended data collection methodology for this size hospital in the Hospital NAPS auditing guidelines. As each prescription is analysed separately and not dependant on the survey methodology, this would not have any impact on the data analysis.

Table 3 Survey methodology used by public and private hospitals that contributed to Hospital NAPS by remoteness area and AIHW peer group, 2016

Survey methodology		Hospital-wide point prevalence survey (%)	Repeat point prevalence surveys (%)	Randomised sample survey (%)	Total†
Remoteness	Major cities	129 (68.6)	32 (17.0)	27 (14.4)	188
	Inner regional	49 (38.6)	54 (42.5)	24 (18.9)	127
	Outer regional	12 (20.3)	41 (69.5)	6 (10.2)	59
	Remote	1 (11.1)	5 (55.6)	3 (33.3)	9
	Very remote	0 (0.0)	2 (25.0)	6 (75.0)	8
Public hospital peer group	Principal referral	25 (78.1)	1 (3.1)	6 (18.8)	32
	Public acute group A hospitals	50 (79.4)	5 (7.9)	8 (12.7)	63
	Public acute group B hospitals	19 (63.3)	9 (30.0)	2 (6.7)	30
	Public acute group C hospitals	7 (9.7)	47 (65.3)	18 (25.0)	72
	Public acute group D hospitals	10 (17.9)	37 (66.1)	9 (16.1)	56
	Other acute specialised hospitals	1 (100.0)	0 (0.0)	0 (0.0)	1
	Children's hospitals	9 (100.0)	0 (0.0)	0 (0.0)	9
	Women's hospitals	5 (100.0)	0 (0.0)	0 (0.0)	5
	Women's and children's hospitals	2 (100.0)	0 (0.0)	0 (0.0)	2
	Mixed subacute and non-acute hospitals	6 (85.7)	1 (14.3)	0 (0.0)	7
	Rehabilitation and GEM* hospitals	1 (33.3)	2 (66.7)	0 (0.0)	3
	Very small hospitals	1 (16.7)	3 (50.0)	2 (33.3)	6
	Psychiatric hospitals	3 (60.0)	2 (40.0)	0 (0.0)	5
	Unpeered hospitals	1 (50.0)	1 (50.0)	0 (0.0)	2
Private hospital peer group	Private acute group A hospitals	11 (84.6)	0 (0.0)	2 (15.4)	13
	Private acute group B hospitals	19 (70.4)	0 (0.0)	8 (29.6)	27
	Private acute group C hospitals	14 (58.3)	4 (16.7)	6 (25.0)	24
	Private acute group D hospitals	3 (14.3)	15 (71.4)	3 (14.3)	21
	Other acute specialised hospitals	2 (100.0)	0 (0.0)	0 (0.0)	2
	Mixed day procedure hospitals	0 (0.0)	1 (100.0)	0 (0.0)	1
	Private rehabilitation hospitals	2 (22.2)	5 (55.6)	2 (22.2)	9
	Private acute psychiatric hospitals	0 (0.0)	1 (100.0)	0 (0.0)	1
Sector	Public	140 (47.8)	108 (36.9)	45 (15.4)	293
	Private	51 (52.0)	26 (26.5)	21 (21.4)	98
Combined national result		**191 (48.8)**	**134 (34.3)**	**66 (16.9)**	**391**

* GEM – Geriatric Evaluation and Management
†Number of surveys completed by hospitals in each peer group

Number of prescriptions

In total, 25,661 prescriptions prescribed for 17,040 patients were included in the 2016 Hospital NAPS analyses. Public hospitals accounted for 71.6% of participating facilities and 79.7% of all prescriptions. More than 50% of prescriptions were from public principal referral or public acute group A hospitals.

Hospitals in major cities accounted for 50% of all participating facilities and 75.3% of total prescriptions. The full breakdown of the percentage of participating hospitals and numbers of prescriptions according to hospital groupings and key performance indicators are outlined in Tables 4 and 5.

Table 4 Results for key Hospital NAPS indicators, by state and territory, remoteness area, AIHW peer group and sector, 2016

Key Indicators		Number of hospitals (%)		Number of prescriptions (%)		Indication documented %	Review or stop date documented %	Surgical prophylaxis >24hrs %*
State or territory	NSW & ACT	109	34.1	9,142	35.6	74.4	34.4	30.7
	Vic	97	30.3	7,406	28.9	77.9	41.5	31.3
	Qld & NT	64	20.0	4,464	17.4	76.2	36.7	26.3
	SA	15	4.7	1,755	6.8	74.6	42.6	34.3
	WA	30	9.4	2,655	10.3	71.9	40.9	24.5
	Tas	5	1.6	239	0.9	84.5	33.1	30.8
Remoteness	Major Cities	160	50.0	18,443	71.9	75.3	39.3	31.4
	Inner regional	90	28.1	4,471	17.4	77.6	35.9	19.6
	Outer regional	53	16.6	2,247	8.8	72.5	33.2	31.6
	Remote	9	2.8	315	1.2	77.8	35.6	0.0
	Very remote	8	2.5	185	0.7	87.6	26.5	0.0
Public hospital peer group	Principal referral	27	8.4	7,836	30.5	78.0	36.3	41.5
	Public acute group A hospitals	49	15.3	5,872	22.9	80.2	34.5	32.9
	Public acute group B hospitals	27	8.4	1,407	5.5	80.1	29.5	26.4
	Public acute group C hospitals	51	15.9	2,348	9.2	79.5	38.4	13.2
	Public acute group D hospitals	45	14.1	922	3.6	76.4	26.6	0.0
	Other acute specialised hospitals	1	0.3	97	0.4	90.7	18.6	100.0
	Children's hospitals	5	1.6	850	3.3	91.2	32.5	41.7
	Women's hospitals	4	1.3	270	1.1	95.6	45.6	17.9
	Women's and children's hospitals	1	0.3	110	0.4	86.4	32.7	50.0
	Mixed subacute and non-acute hospitals	7	2.2	222	0.9	68.9	34.7	0.0
	Rehabilitation and GEM hospitals†	3	0.9	118	0.5	84.7	66.1	50.0
	Very small hospitals	6	1.9	31	0.1	80.6	41.9	0.0
	Psychiatric hospitals	2	0.6	178	0.7	89.9	55.1	0.0
	Unpeered hospitals	1	0.3	115	0.4	57.4	29.6	0.0
Private hospital peer group	Private acute group A hospitals	13	4.1	1,510	5.9	61.3	44.2	28.0
	Private acute group B hospitals	26	8.1	1,785	7.0	53.8	45.5	31.6
	Private acute group C hospitals	23	7.2	846	3.3	63.4	47.4	30.0
	Private acute group D hospitals	17	5.3	787	3.1	61.1	63.7	24.1
	Other acute specialised hospitals§	2	0.6	21	0.1	-	-	-
	Mixed day procedure hospitals	1	0.3	106	0.4	67.0	49.1	52.8
	Private rehabilitation hospitals	8	2.5	228	0.9	70.2	59.6	90.0
	Private acute psychiatric hospitals§	1	0.3	2	0.0	-	-	-
Sector	Public	229	71.6	20,376	79.4	79.7	35.3	33.3
	Private	91	28.4	5,285	20.6	59.7	48.8	29.5
Combined national result		**320**		**25,661**		**75.6**	**38.1**	**31.1**

* Where surgical prophylaxis was selected as the indication (n = 3,628)

† GEM – Geriatric Evaluation and Management

§ Results are not displayed if there are less than 30 prescriptions

Table 5 Compliance of Hospital NAPS contributors with guidelines and appropriateness of prescribing, by state and territory, remoteness area, AIHW peer group and sector, 2016

		% Compliance with guidelines					% Appropriateness		
Key Indicators		Compliant	Non-compliant	Directed therapy	Not available	Not assessable	Appropriate	Inappropriate	Not assessable
State or territory	NSW & ACT	51.0	27.7	13.0	4.1	4.2	70.2	25.1	4.7
	Vic	54.7	25.7	11.1	4.4	4.1	74.3	20.4	5.3
	Qld & NT	45.0	29.9	16.0	2.6	6.5	69.8	23.8	6.4
	SA	58.3	24.3	10.2	3.6	3.6	74.6	18.1	7.3
	WA	51.3	26.8	13.3	5.7	2.9	74.4	21.9	3.7
	Tas	49.0	33.5	8.4	2.1	7.1	74.9	18.8	6.3
Remoteness	Major Cities	51.4	25.7	13.9	4.4	4.6	72.6	21.8	5.6
	Inner regional	50.8	32.7	9.6	3.2	3.7	70.1	25.4	4.5
	Outer regional	54.6	28.1	10.5	2.1	4.6	73.3	22.6	4.2
	Remote	44.8	31.7	14.0	5.4	4.1	70.2	25.1	4.8
	Very remote	58.4	37.3	1.6	1.6	1.1	61.1	35.7	3.2
Public hospital peer group	Principal referral	53.3	20.3	17.3	5.2	4.0	76.4	19.1	4.6
	Public acute group A hospitals	50.6	28.5	12.6	4.5	3.8	71.5	23.7	4.8
	Public acute group B hospitals	51.0	33.0	9.0	3.4	3.5	71.7	24.0	4.3
	Public acute group C hospitals	56.9	29.1	8.3	2.8	2.9	71.9	23.6	4.6
	Public acute group D hospitals	50.0	36.8	9.4	1.3	2.5	69.6	28.1	2.3
	Other acute specialised hospitals	82.5	9.3	5.2	1.0	2.1	90.7	8.2	1.0
	Children's hospitals	57.8	18.6	16.4	5.6	1.6	80.2	18.9	0.8
	Women's hospitals	76.3	14.4	3.7	4.8	0.7	81.9	17.0	1.1
	Women's and children's hospitals	70.9	13.6	10.0	5.5	0.0	83.6	14.5	1.8
	Mixed subacute and non-acute hospitals	56.3	21.2	16.2	5.0	1.4	78.4	20.3	1.4
	Rehabilitation and GEM hospitals†	54.2	13.6	14.4	3.4	14.4	66.9	11.9	21.2
	Very small hospitals	64.5	29.0	6.5	0.0	0.0	67.7	32.3	0.0
	Psychiatric hospitals	50.0	26.4	11.8	1.1	10.7	74.2	13.5	12.4
	Unpeered hospitals	62.6	19.1	7.8	6.1	4.3	80.0	14.8	5.2
Private hospital peer group	Private acute group A hospitals	37.4	35.8	13.6	2.2	11.0	64.1	25.9	10.0
	Private acute group B hospitals	40.9	38.5	9.4	3.9	7.3	61.2	30.8	8.0
	Private acute group C hospitals	48.8	38.9	5.0	2.4	5.0	64.4	26.8	8.7
	Private acute group D hospitals	65.2	27.2	4.8	0.8	2.0	69.9	22.4	7.8
	Other acute specialised hospitals†	-	-	-	-	-	-	-	-
	Mixed day procedure hospitals	13.2	46.2	18.9	0.0	21.7	52.8	44.3	2.8
	Private rehabilitation hospitals	39.9	25.4	21.9	3.1	9.6	71.1	16.7	12.3
	Private acute psychiatric hospitals†	-	-	-	-	-	-	-	-
Sector	Public	53.4	25.1	13.5	4.4	3.6	74.1	21.5	4.4
	Private	44.2	35.6	10.0	2.7	7.5	64.2	27.1	8.7
Combined national result		**51.5**	**27.3**	**12.8**	**4.0**	**4.4**	**72.1**	**22.6**	**5.3**

* GEM – Geriatric Evaluation and Management

† Results are not displayed if there are less than 30 prescriptions

Key Performance Indicators: 2016

Documentation of indication

Overall, 75.6% of prescriptions from participating hospitals had the indication for antimicrobial prescribing documented. This result remains below the best practice target of 95%. For public hospital contributors, the rate was 79.7% compared with 59.7% of antimicrobial prescriptions in private hospitals. In general, specialised hospitals had a higher rate of documentation of the indication than non-specialised hospitals (Table 4). For example, the four women's hospitals that contributed to Hospital NAPS in 2016 reported a 95.6% compliance rate for documentation of indication. As more health service organisations introduce electronic medical records and electronic prescribing, documentation of indication may continue to improve, as it has done each year since 2013, when the rate was 70.9% (Table 9).

Documentation of review or stop date

In 2015, 'documentation of a review or stop date' was included in the NAPS as a quality indicator. As there was no published best practice target for review or stop date documentation, the decision was made to apply a target of 95% in line with the other NAPS key quality indicators. In 2016, 38.1% of all audited antimicrobial prescriptions had a documented review or stop date, (Table 4). Participating private hospitals performed better than public hospitals for this indicator with a documentation rate of 48.8% compared with 35.3% respectively.

Surgical prophylaxis greater than 24 hours

Surgical antimicrobial prophylaxis data is collected for any patient who has had a surgical procedure performed and has been prescribed an antimicrobial for prophylaxis since 8:00am on the previous day. This is to ensure that patients who have surgical prophylaxis appropriately prescribed and ceased within 24 hours are included in the data collection to attempt to avoid potential bias.

There was extremely wide variation in the proportion of antibiotic prescriptions for surgical prophylaxis (mostly cefalexin) being prescribed for greater than 24 hours, ranging from 0.0% to 100% across the hospital peer groups (Table 4). The hospitals with lower rates in this category were often smaller or more remote. The number of prescriptions assessed for these hospitals was low, and it is likely that very low numbers of surgical procedures, if any, are performed in these hospitals. Facilities with some of the highest percentages were the small number of rehabilitation and day procedure hospital contributors, although these reported on a low number of prescriptions, and small numbers of surgical prophylaxis prescriptions.

Non-compliance with guidelines

In the 2016 Hospital NAPS, 27.3% of the antimicrobial prescriptions assessed did not comply with either the *Therapeutic Guidelines*[8] or locally endorsed guidelines, (Table 5). There was substantial variation among the hospital peer groups (non-compliance ranging from 9.3% to 46.2%). Hospitals that were more specialised had lower rates of non-compliance than the general hospitals. The rate of non-compliance was lower in public hospitals (25.1%) than in private hospitals (35.6%). Major city hospitals had the lowest non-compliance rate (21.7%) compared with regional hospitals (inner regional – 32.7%; outer regional – 28.1%) and remote hospitals (remote – 31.7%; very remote – 37.3%).

Inappropriateness

Overall, 22.6% of antimicrobial prescriptions were assessed as 'inappropriate' in the 2016 Hospital NAPS (Table 5). There was a higher rate of inappropriate prescribing in private hospitals (27.1%) compared with public hospitals (21.5%); this gap has narrowed since 2015. Significant variation was noted between peer groups. Specialist hospitals had a lower percentage of inappropriate prescribing compared with general hospitals, and there was a low percentage of antimicrobial prescriptions assessed as inappropriate in public principal referral hospitals (19.1%).

Table 6 outlines the most common reasons for prescriptions being assessed as inappropriate. These included; 'spectrum too broad' (24.9%), 'incorrect duration' (20.3%) and 'antimicrobials not required' (19.1%). The greatest change has been in the 'incorrect duration' category, where the number of prescriptions being assessed as inappropriate increased from 17.8% in 2015 to 20.3% in 2016.

There were low percentages of antimicrobial prescriptions for which microbiology mismatches (1.4%) and allergy mismatches (0.5%) were identified (Table 7). The targets for these rates should ideally be 0%.

Table 6 Reasons for a prescription being assessed as inappropriate, Hospital NAPS contributors, 2016

Reason	Yes (%)	No (%)	Not specified (%)
Spectrum too broad	24.9	46.3	28.8
Incorrect duration	20.3	52.1	27.6
Antimicrobial not required	19.1	54.3	26.6
Incorrect dose or frequency	18.5	54.6	27.0
Spectrum too narrow	6.5	61.8	31.8
Incorrect route	3.9	65.6	30.5

n = 5,807

Table 7 Key indicators of quality prescribing as a percentage of total prescriptions, Hospital NAPS contributors, 2016

Reason	Yes (%)	No (%)
Microbiology mismatch	1.4	98.6
Allergy mismatch	0.5	99.5

n =25,661

Four year comparison of Hospital NAPS key performance indicators

The changes in compliance with guidelines and appropriateness of prescribing over the four years from 2013 to 2016 are shown in Table 8. Direct comparisons of performance of Hospital NAPS contributors over time cannot be made, as the participating hospitals varied from year to year. However, individual Hospital NAPS participants can review their own data and performance over time, and produce their own annual reports. Bearing that caveat regarding comparisons over time in mind, Table 9 and Figure 3 demonstrate the trends for some of the key performance indicators over the four years of the Hospital NAPS data collection.

In the 2016 Hospital NAPS, documentation of antimicrobial indication improved compared to previous years, with this indicator trending upwards over the four years and reaching more than 75% for the first time. There was a slight increase (2.6%) in documentation of review or stop date in 2016 compared with 2015. However, performance for these two quality indicators is lower than the best practice target of 95%.

Hospital NAPS results from 2013 to 2015 showed a downward trend in the proportion of surgical antimicrobial prophylaxis prescriptions prescribed for greater than 24 hours, and reached a low of 27.4% in 2015. In 2016, there was an increase to 31.1% for this indicator. Figure 4 shows the number of prescriptions and the percentage of surgical antimicrobial prophylaxis prescriptions prescribed for greater than 24 hours for public and private hospitals from 2013 to 2016.

There has been a reduction in the percentage of prolonged surgical antibiotic prophylaxis in public hospitals from 42.9% in 2013 to 33.3% in 2016. From 2015 to 2016, the percentage of prolonged surgical antibiotic prophylaxis prescriptions increased from 21.6% to 29.5% in private hospitals, which may account for the overall increase in 2016 for this indicator.

Over the four years of the Hospital NAPS, there has been a decrease in the proportion of prescriptions assessed as compliant with guidelines (73.7% to 65.4% for those prescriptions where compliance was assessable), but the appropriateness of prescribing remained relatively static (75.6% to 77.0% for those where appropriateness was assessable).

Reasons for this difference would be worth investigating in greater detail. The assessment of appropriateness includes both ‘optimal’ (as per guidelines) and ‘adequate’ (not in accordance with guidelines, but a reasonable choice) categories. It is possible that prescribers are increasingly choosing second line therapy, rather than first line therapy. For example, there may be a perception that, with increasing antimicrobial resistance rates, prescribers need to choose broader spectrum empiric therapy. Alternatively, their choice may be informed by a microbiology result (that is, directed therapy). It is also possible that established guidelines are not meeting the needs of clinicians which is important to recognise when updating guidelines. Alternatively, there may need for better dissemination and endorsement of these guidelines to increase awareness.

Table 8 Hospital NAPS contributors compliance with guidelines and appropriateness, 2013-2016

		Percentage of total prescriptions (%)			
		2013	2014	2015	2016
Compliance with Guidelines	Compliant with *Therapeutic Guidelines: Antibiotic* or local guidelines	59.7	56.2	55.9	51.5
	Non compliant	23.0	24.3	23.3	27.3
	Directed therapy	na	10.4	12.4	12.8
	No guideline available	11.0	4.6	3.8	4.0
	Not assessable	6.3	4.5	4.7	4.4
Appropriateness	Appropriate (optimal and adequate)	70.8	72.3	73.2	72.1
	Inappropriate (suboptimal and inadequate)	22.9	23.0	21.9	22.6
	Not assessable	6.3	4.7	5.0	5.3

na = not applicable

Table 9 Hospital NAPS key indicators, 2013-2016

Key Indicator	Percentage of total prescriptions (%)			
	2013	2014	2015	2016
Indication documented in medical notes (best practice >95%)	70.9	74.0	72.5	75.6
Review or stop date documented (best practice >95%)	na	na	35.5	38.1
Surgical prophylaxis given for >24 hours (best practice <5%)*	41.8	35.9	27.4	31.1
Compliant with *Therapeutic Guidelines: Antibiotic* or local guidelines†	72.2	73.7	70.6	65.4
Appropriate (optimal and adequate)§	75.6	75.9	77.0	76.1

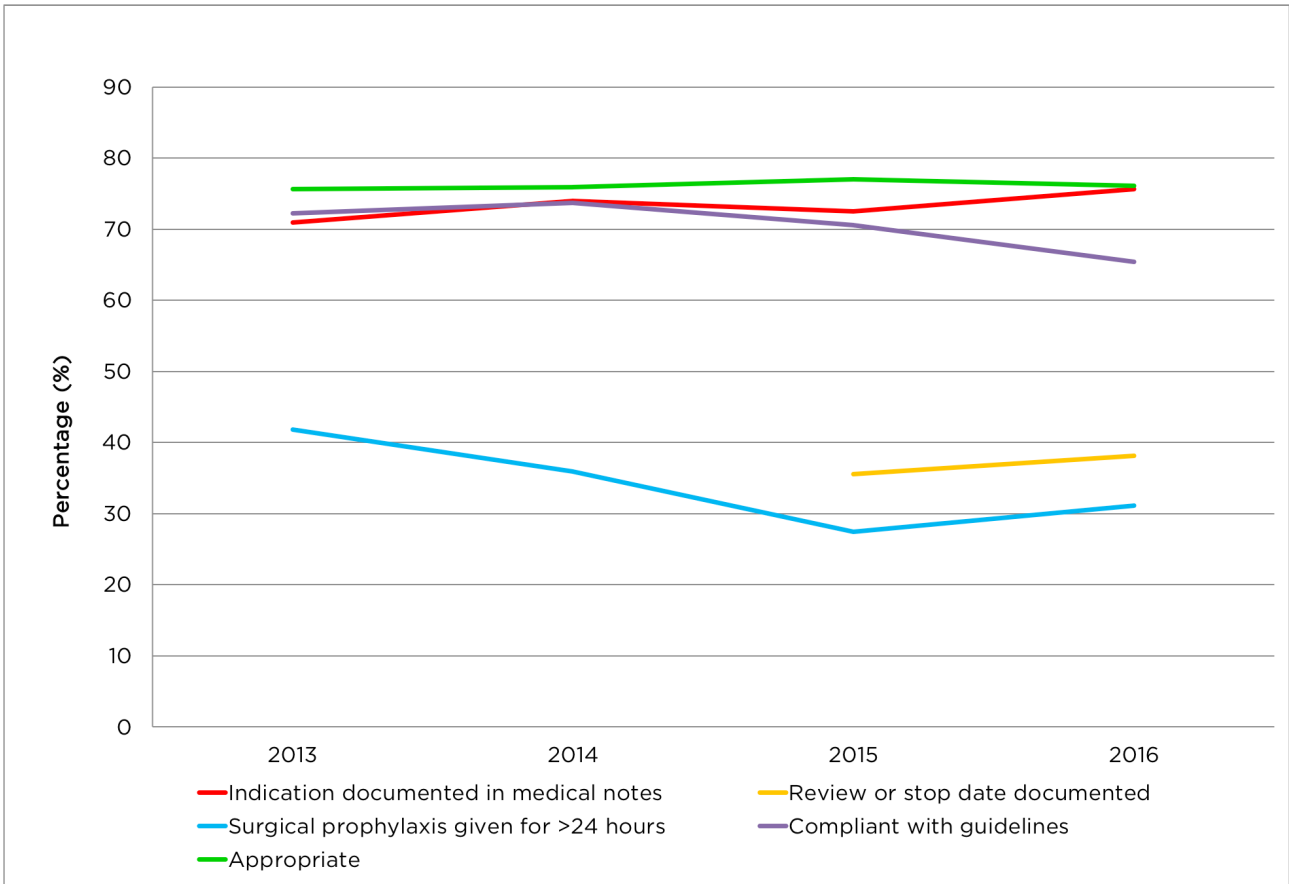
na = not applicable

* Where surgical prophylaxis was selected as the indication (*n* = 3,628)

† Percentage of prescriptions for which compliance was assessable, these exclude prescriptions determined to be 'directed therapy', 'not available' or 'not assessable', (*n* = 20,219 prescriptions in 2016).

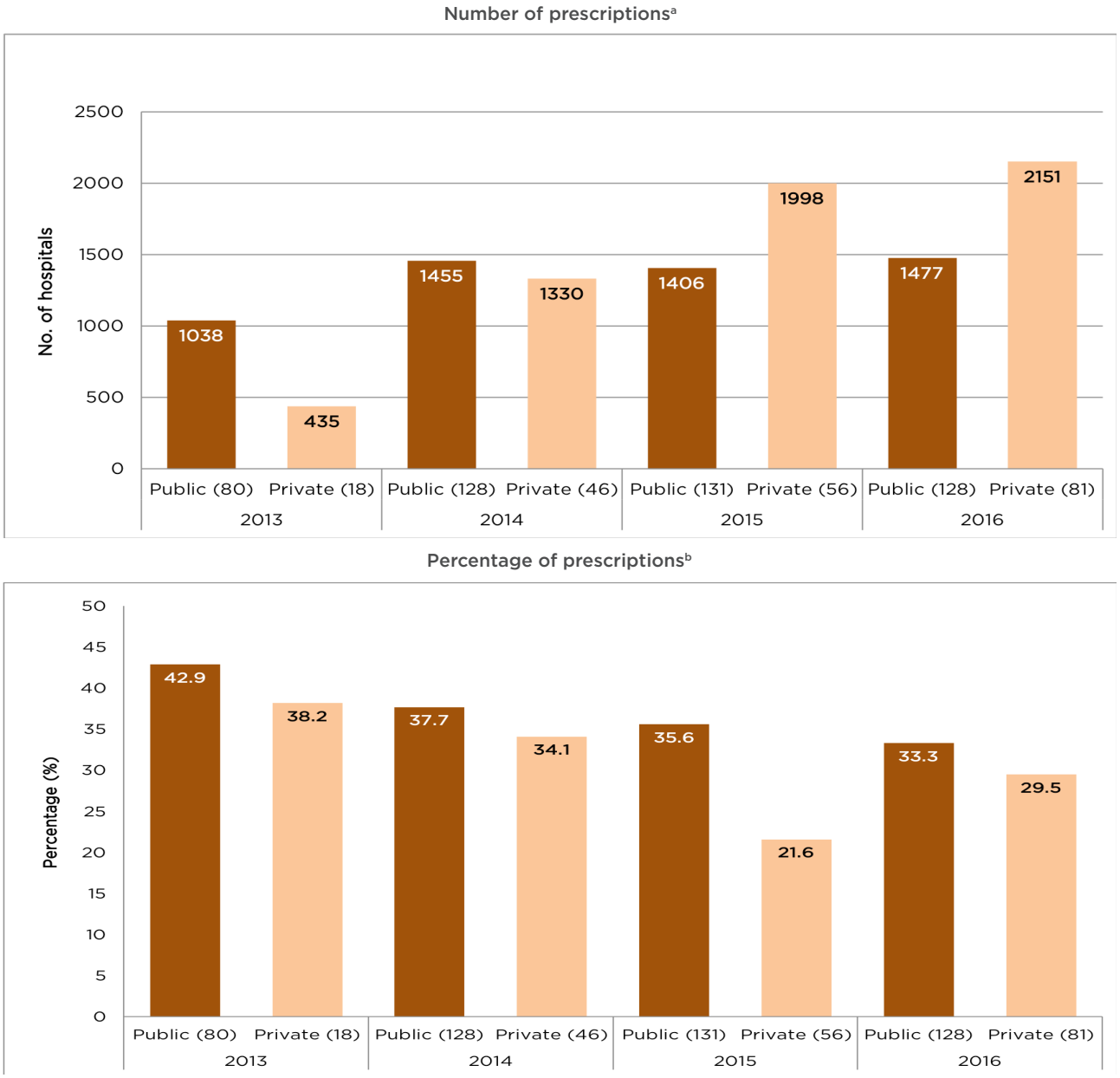
§ Percentage of prescriptions for which appropriateness was assessable, these exclude prescriptions determined to be 'not assessable', (*n* = 24,307 prescriptions in 2016).

Figure 3 Hospital NAPS key indicators by percentage, 2013–2016



Note: The line for "Review or stop date documented" begins at 2015 as that is when that indicator was introduced to the NAPS.

Figure 4 Surgical prophylaxis given for greater than 24 hours, public and private hospitals that have contributed to Hospital NAPS, 2013–2016



* Results are shown as the number of surgical prophylaxis prescriptions given for greater than 24 hours for public and private hospitals for each reporting year.

†b Results are shown as the percentage of all surgical prophylaxis prescriptions given for greater than 24 hours for public and private hospitals for each reporting year.

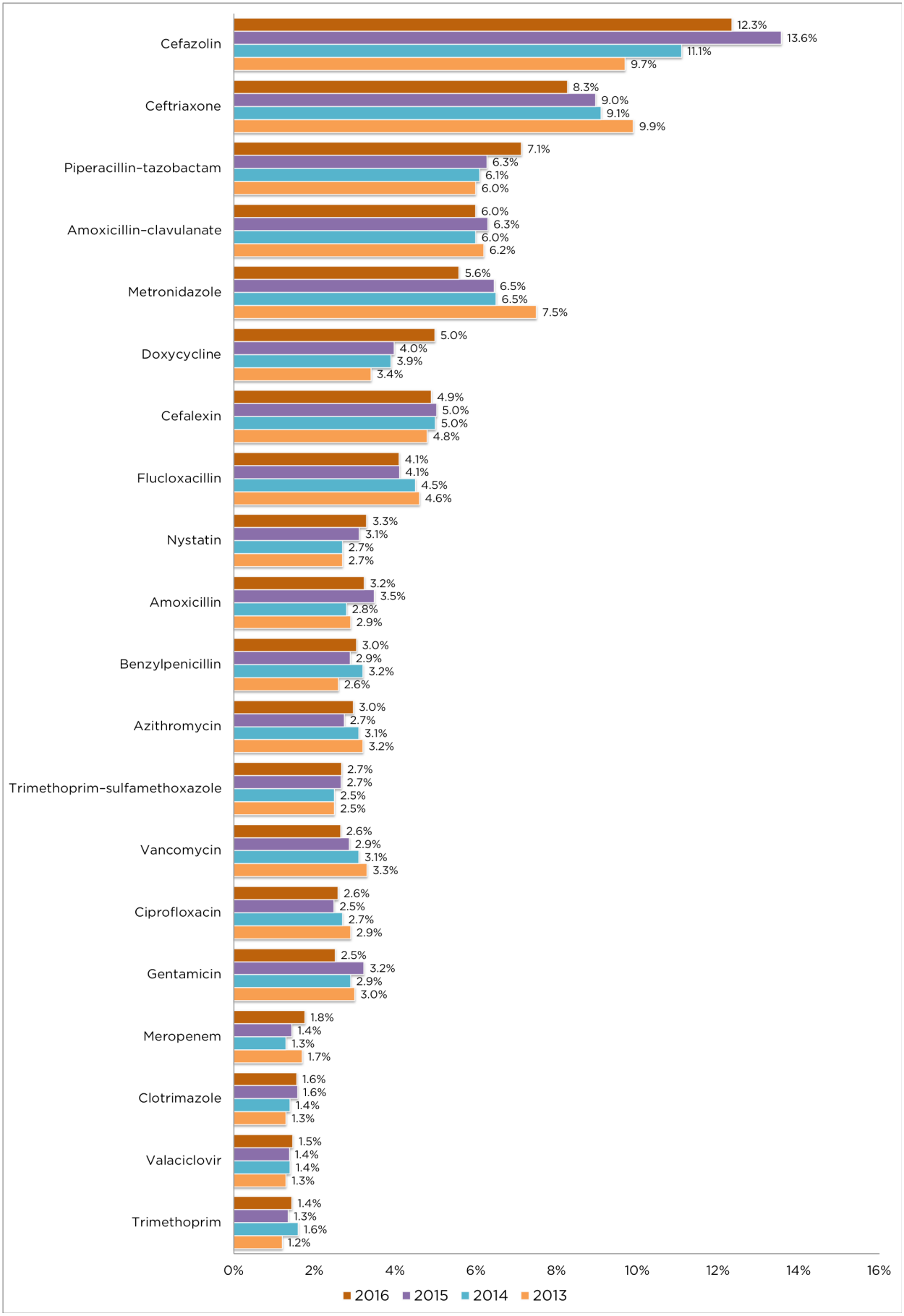
Note: the number of contributing hospitals is given in brackets next to the sector.

Most commonly prescribed antimicrobials

Figure 5 shows the 20 most commonly prescribed antimicrobials from 2013 to 2016. For the first time since 2013, the order of the five most commonly prescribed antimicrobials has changed, although the antimicrobials within the group have remained the same.

Piperacillin–tazobactam is one of the few antimicrobials with a continued upward trend in usage over the period and, as would be expected, metronidazole use has decreased in line with this change. Other trends of note have been continued decreasing ceftriaxone and vancomycin use, and increasing doxycycline use. There were a number of antimicrobial shortages in 2016 which may have influenced these data including vancomycin, metronidazole and ampicillin.[9]

Figure 5 The 20 most commonly prescribed antimicrobials in Hospital NAPS contributors, 2013–2016

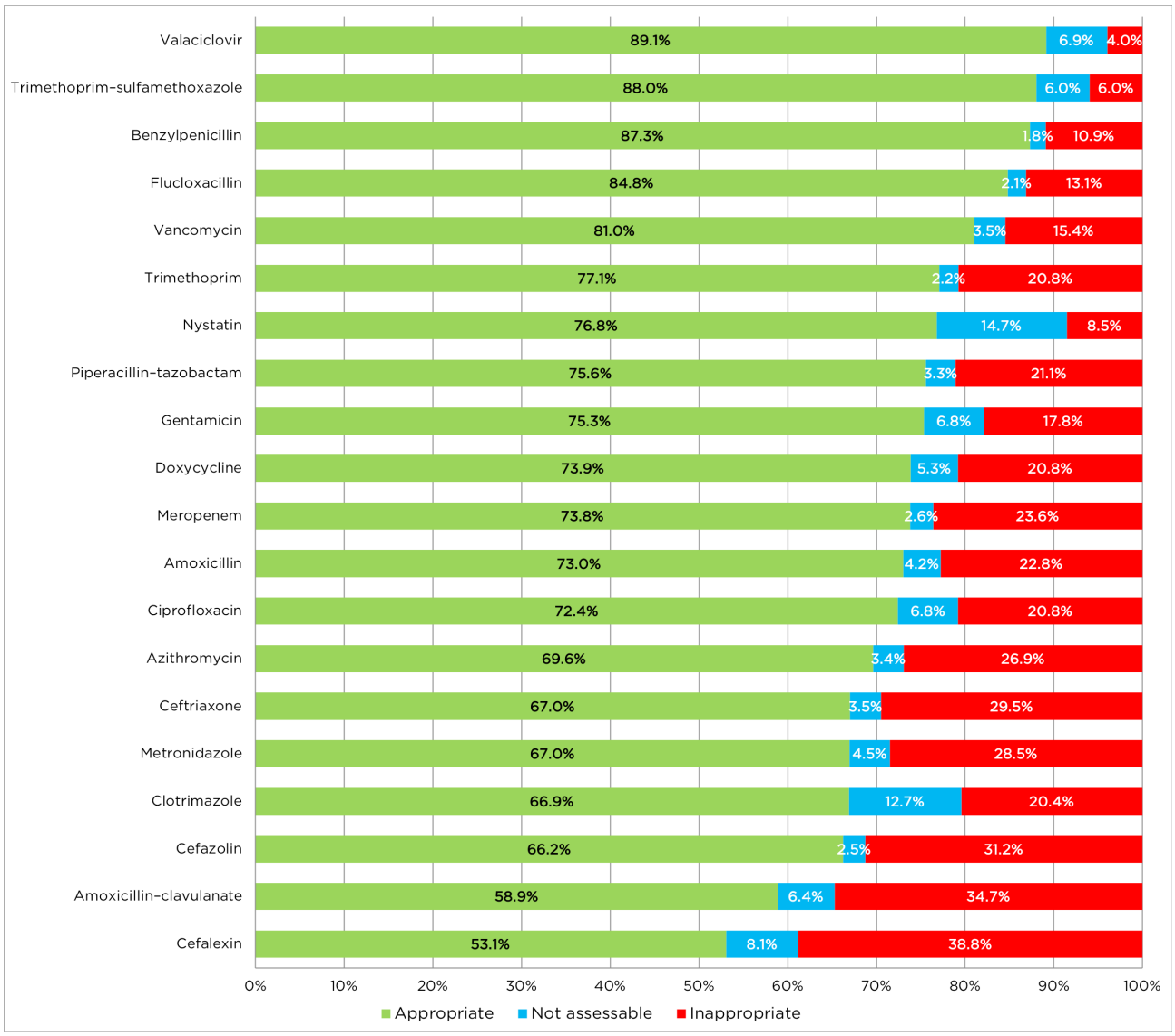


Appropriateness for the 20 most commonly prescribed antimicrobials

Of the 20 most commonly prescribed antimicrobials, the two that had the highest rate of assessment as appropriately prescribed were valaciclovir (89.1%) and trimethoprim–sulfamethoxazole (88.0%) (Figure 6). These antimicrobials, along with nystatin (76.8%), are most frequently used for medical prophylaxis in hospitals, and this use in accordance with protocols is likely to account for the high rate of prescribing appropriateness.

The narrow spectrum antimicrobials also tended to have higher rates of appropriate prescribing, including benzylpenicillin (87.3%), flucloxacillin (84.8%), trimethoprim (77.1%), doxycycline (73.9%) and amoxicillin (73.0%). The antimicrobials with the highest rates of inappropriate prescribing were cefalexin (38.8%), amoxicillin–clavulanate (34.7%) and cefazolin (31.2%). Of note, although piperacillin–tazobactam is now being more frequently prescribed, the rate of prescriptions being assessed as appropriate is 75.6%. This may be as a result of the agent being adopted into locally endorsed guidelines.

Figure 6 Appropriateness for the top 20 most commonly prescribed antimicrobials in Hospital NAPS contributors, 2016



Piperacillin–tazobactam

Prescribing rates have decreased for four of the five most commonly used antimicrobials, (Figure 5). Piperacillin-tazobactam prescribing rates go against this trend, having increased over the past four years. The top 15 indications for prescribing piperacillin–tazobactam and the rates of inappropriateness are presented in Table 10.

The indications with the highest rates of inappropriateness for piperacillin–tazobactam were surgical prophylaxis (77.4%), cellulitis/erysipelas (46.0%), community-acquired pneumonia (44.3%), surgical wound infection (22.6%), hospital-acquired pneumonia (18.6%) and aspiration pneumonia (18.5%). Targeting the use of piperacillin–tazobactam for these indications will improve prescribing. The *Therapeutic Guidelines* does not recommended piperacillin–tazobactam as empirical treatment for any of these conditions and its role is limited, except perhaps in severe cases.

Table 10 Top 15 indications and rate of prescribing inappropriateness for piperacillin–tazobactam in Hospital NAPS contributors, 2016

Indication	Prescribed (%)	Inappropriate (%)
Sepsis	11.1	14.8
Febrile neutropenia	10.5	11.9
Pneumonia: hospital acquired	9.1	18.6
Diabetic infection (including foot)	6.7	14.8
Pneumonia: community acquired	5.8	44.3
Pneumonia: aspiration	4.4	18.5
Surgical prophylaxis	2.9	77.4
Wound infection: surgical	2.9	22.6
Cellulitis/erysipelas	2.7	46.0
Osteomyelitis	2.7	10.0
Peritonitis	2.6	6.3
Abscess: skin and soft tissue	2.3	9.5
Cholecystitis	2.1	15.4
Diverticulitis	2.0	13.9
Cholangitis	1.8	12.1

n = 1,830

Amoxicillin–clavulanate

Amoxicillin–clavulanate was one of the five most commonly prescribed antimicrobials; 34.7% of prescriptions for this antimicrobial were assessed as inappropriate (Figure 6). Table 11 outlines the indications for which amoxicillin–clavulanate was prescribed and the rates of inappropriateness.

Key indications where reductions in amoxicillin–clavulanate prescribing are required include surgical prophylaxis (79.7% inappropriate), infective exacerbation of COPD (66.4% inappropriate), cellulitis/erysipelas (52.0% inappropriate), community-acquired pneumonia (50.9% inappropriate) and bronchitis (37.1% inappropriate). Amoxicillin–clavulanate is generally not recommended as empirical treatment for these indications in the *Therapeutic Guidelines*.

In 2017, the Therapeutic Goods Administration approved an intravenous formulation of amoxicillin–clavulanate for registration in Australia (it was previously available via the Special Access Scheme). Of the 1,538 prescriptions for amoxicillin–clavulanate, 1,499 (97.5%) were for oral administration, 36 (2.3%) were for intravenous administration and three (0.2%) were for intraoperative administration where the route was not otherwise specified.

The *Therapeutic Guidelines* do not as yet have any indications that recommend the use of intravenous amoxicillin–clavulanate. The most common indications for intravenous use were community-acquired pneumonia (11.1%), hospital-acquired pneumonia (11.1%) and aspiration pneumonia (11.1%). This may be an example of guidelines not meeting the needs of clinicians.

Table 11 Top 15 indications and rate of prescribing inappropriateness for amoxicillin–clavulanate in Hospital NAPS contributors, 2016

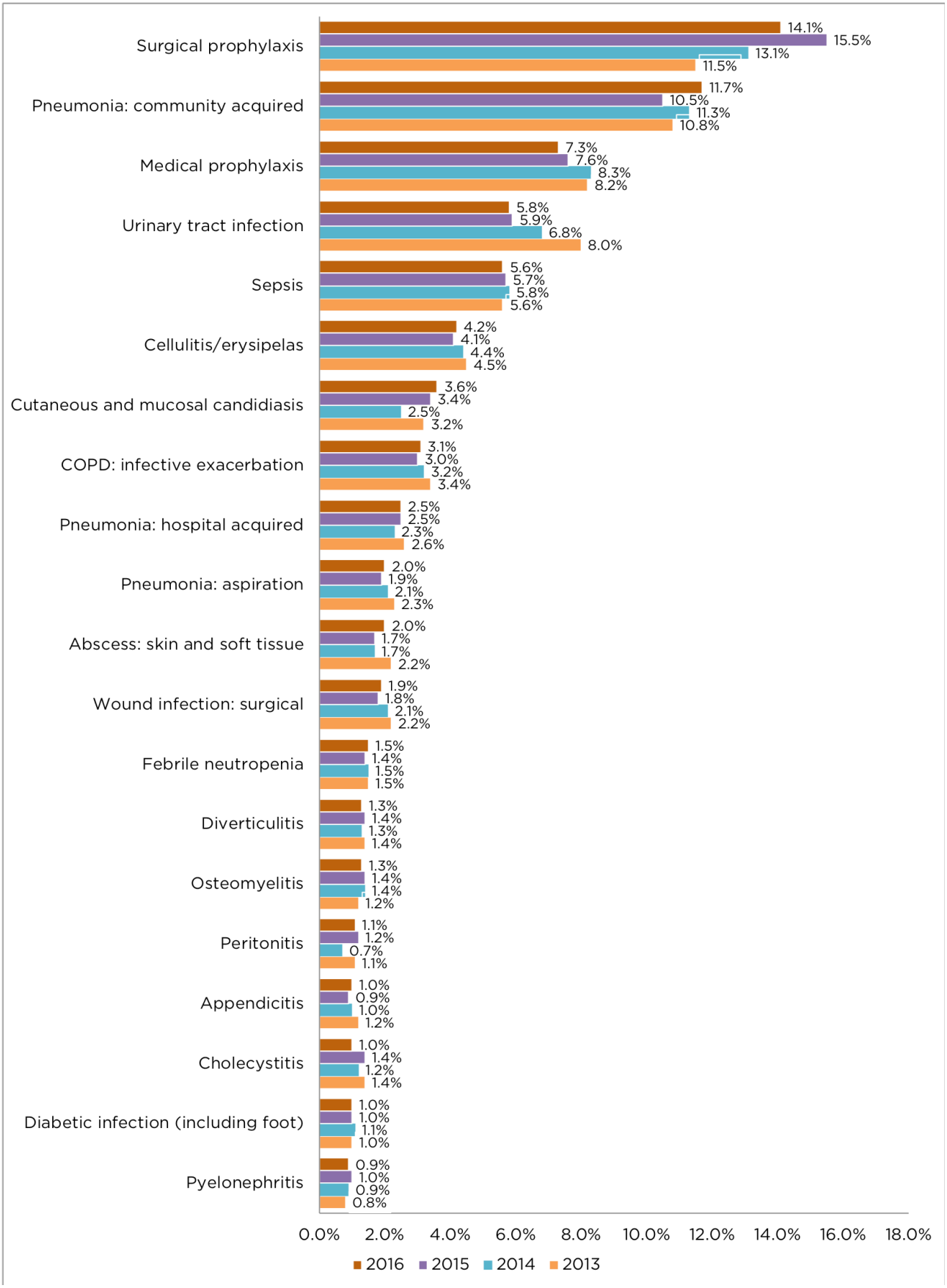
Indication	Prescribed (%)	Inappropriate (%)
Pneumonia: community acquired	18.8	50.9
Pneumonia: hospital acquired	11.9	18.6
Urinary tract infection	11.0	26.0
COPD: infective exacerbation	7.3	66.4
Pneumonia: aspiration	5.5	11.9
Surgical prophylaxis	4.5	79.7
Wound infection: surgical	2.7	26.8
Abscess: skin and soft tissue	2.5	18.4
Bronchitis	2.3	37.1
Diabetic infection (including foot)	2.0	6.7
Diverticulitis	1.7	19.2
Cellulitis/erysipelas	1.6	52.0
Abscess: intra-abdominal	1.4	0.0
Cholecystitis	1.2	15.8
Wound infection: non-surgical	1.2	26.3

n = 1,583
COPD = chronic obstructive pulmonary disease

Most common indications for antimicrobial prescribing

The five most common indications for antimicrobial use were similar to those found in the previous Hospital NAPS, (Figure 7). Prophylaxis still accounts for over one fifth of all antimicrobials prescribed, with surgical prophylaxis (14.1%) and medical prophylaxis (7.3%) being the first and third most common indications respectively. There has been a slight decrease in the percentage of surgical propTGhylaxis prescriptions since the 2015 NAPS, although it is still higher than the 2013 and 2014 results. This may be because there is a general trend to prescribe less surgical antibiotic prophylaxis. Alternatively, some of the hospitals with higher prescribing rates may have elected to perform the Surgical NAPS in 2016 instead of the Hospital NAPS; analyses have not been undertaken to determine if this is a factor. Community-acquired pneumonia (11.7%) remains the second most common indication for prescribing antimicrobials, with urinary tract infections (5.8%) and sepsis (5.6%), the fourth and fifth most common indications respectively.

Figure 7 The 20 most common indications for prescribing antimicrobials in Hospital NAPS contributors, 2013–2016



COPD = chronic obstructive pulmonary disease

Appropriateness of prescribing for the 20 most common indications

Of the 20 most common indications for prescribing antimicrobials, the conditions for which there were the highest proportions of prescriptions assessed as inappropriate were surgical prophylaxis (54.8%), infective exacerbation of COPD (57.7%) and cholecystitis (67.5%) (Figure 8).

In contrast, the indications with the highest rates of appropriate prescribing were: osteomyelitis (90.8%), medical prophylaxis (85.9%), febrile neutropenia (84.4%) and sepsis (84.1%).

These indications often either have well-embedded guidelines directing use (for example, protocols for prophylaxis or febrile neutropenia) or their use is often overseen by infectious diseases, microbiology or other specialty groups to guide therapy (for example, osteomyelitis).

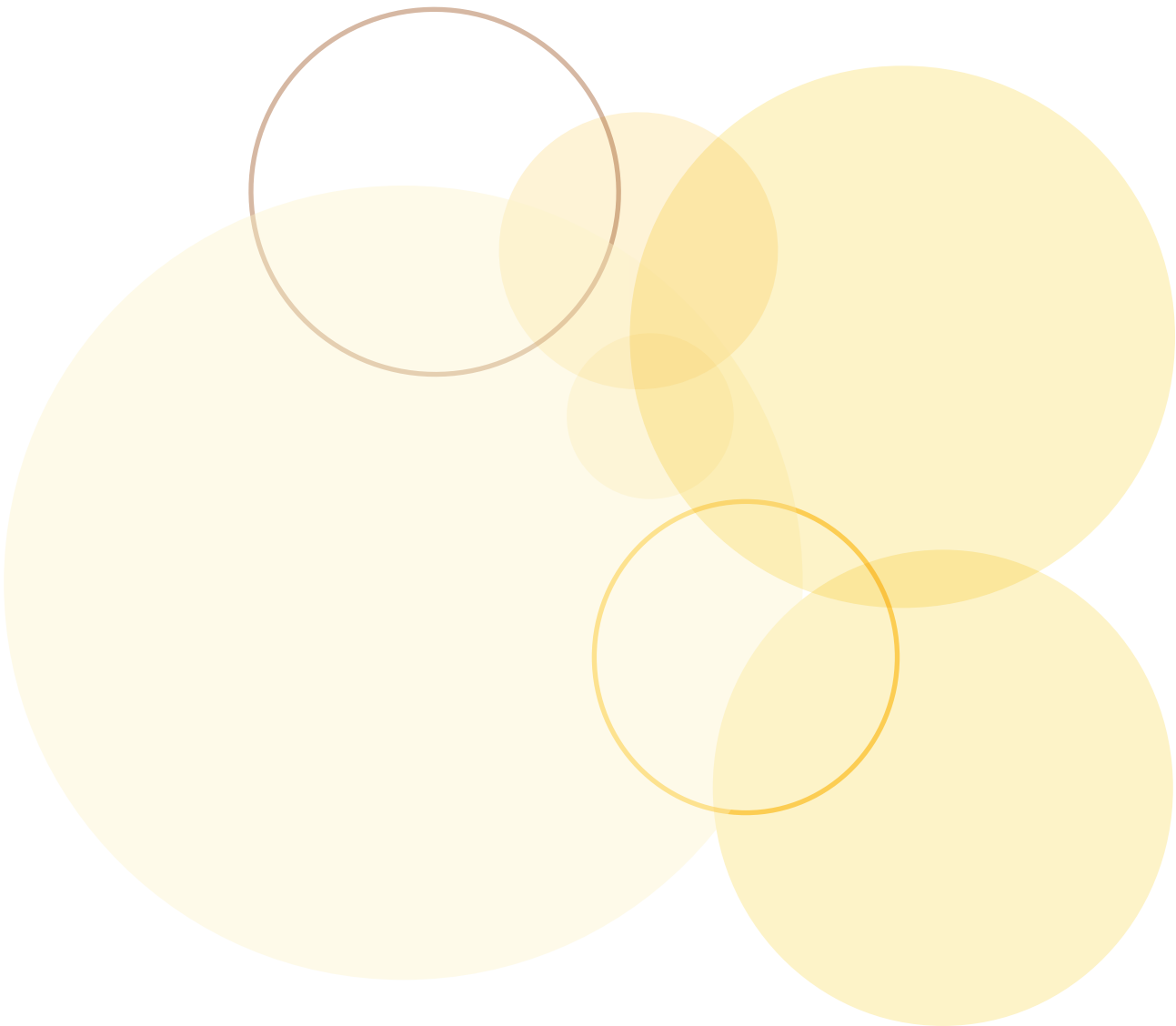
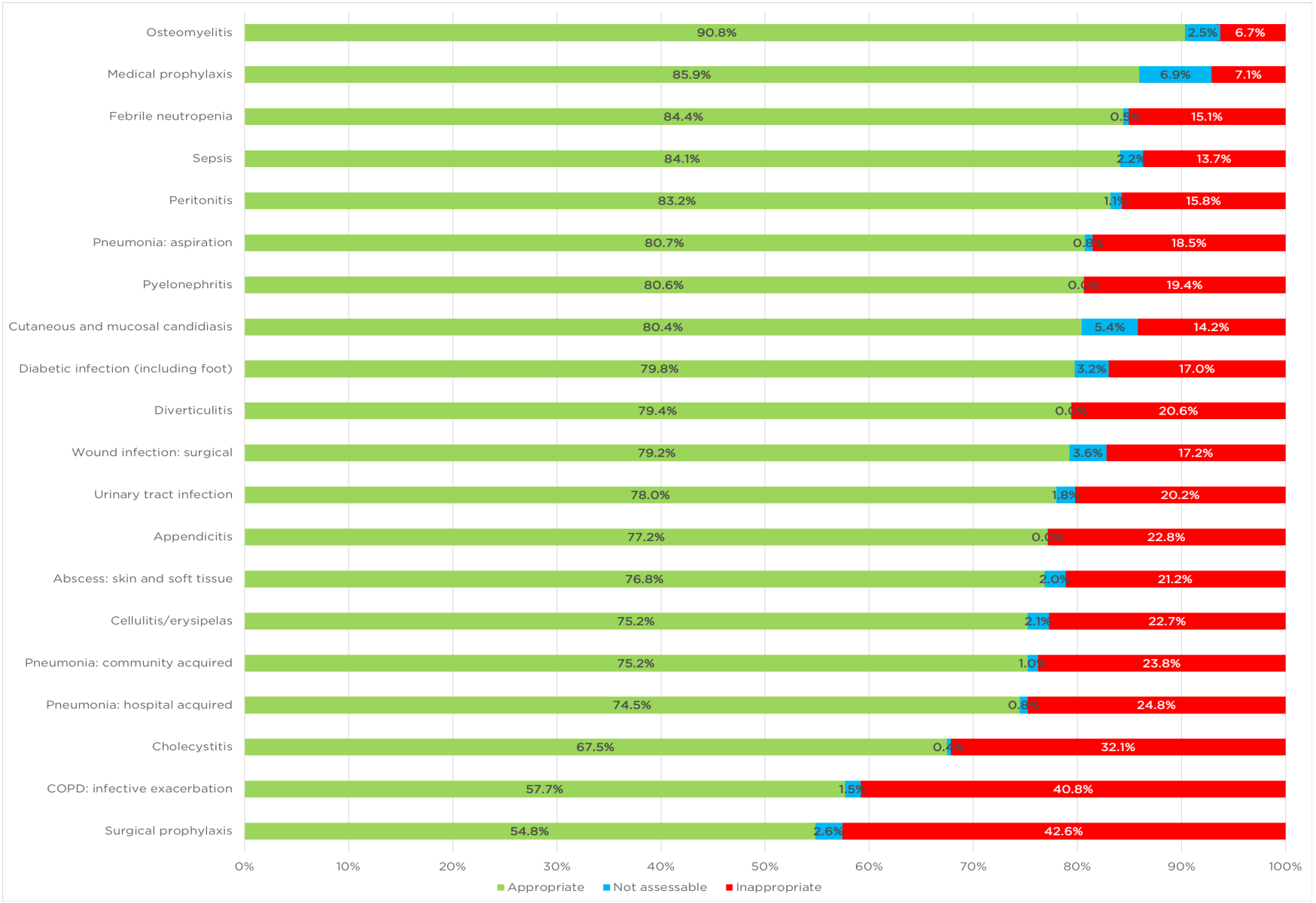


Figure 8 Appropriateness of prescribing for the 20 most common indications in Hospital NAPS contributors, 2016



Indications for which prescribing was most commonly assessed as inappropriate.

Table 12 shows the 20 indications for which prescribing was most commonly assessed to be inappropriate. The indications with the highest rate of inappropriate prescribing were asymptomatic bacteriuria (66.7%), surgical prophylaxis (42.6%) and bronchitis (42.1%). Both asymptomatic bacteriuria and bronchitis are indications for which antimicrobial therapy is not generally recommended in *Therapeutic Guidelines: Antibiotic*. Of the top 20 indications, six were for respiratory tract indications and three were for ear, nose and throat infections. As many of these indications are caused by viruses or do not require any antimicrobial therapy as per *Therapeutic Guidelines: Antibiotic*, these are target areas for intervention.

Indications with the highest rates of 'not assessable' appropriateness were those that may not have treatment guidelines that are as well-defined as for other indications, and the more complex infection diagnoses. Examples of these include fever of unknown origin, epididymo-orchitis and asthma: infective exacerbation. Indications with low rates of 'not assessable' appropriateness were those with well-defined treatment guidelines or less complex infection diagnoses. Examples of these include asymptomatic bacteriuria, diarrhoea, otitis media, influenza and *Mycobacterium avium* complex, many of which require no treatment as per *Therapeutic Guidelines: Antibiotic*.

Table 12 The 20 indications for which antimicrobials were most commonly prescribed inappropriately in Hospital NAPS contributors, 2016

Indication	Number of Prescriptions	Percentage appropriateness		
		Appropriate	Inappropriate	Not assessable
Asymptomatic bacteriuria	30	33.3	66.7	0.0
Surgical prophylaxis	3 628	54.8	42.6	2.6
Bronchitis	95	49.5	42.1	8.4
COPD: infective exacerbation	789	57.7	40.8	1.5
Pancreatitis	63	54.0	39.7	6.3
Gastroenteritis	31	58.1	38.7	3.2
Diarrhoea	30	63.3	36.7	0.0
Fever of unknown origin	171	51.5	35.1	13.5
Trauma	178	64.0	33.7	2.2
Sinusitis	36	58.3	33.3	8.3
Otitis media	31	67.7	32.3	0.0
Cholecystitis	249	67.5	32.1	0.4
Ulcers	154	61.7	30.5	7.8
Bronchiectasis	135	68.1	28.9	3.0
Influenza	119	73.1	26.9	0.0
Asthma: infective exacerbation	68	64.7	26.5	8.8
Tonsillitis	61	73.8	26.2	0.0
Epididymo-orchitis	32	65.6	25.0	9.4
Pneumonia: hospital acquired	654	74.5	24.8	0.8
Mycobacterium avium complex	33	75.8	24.2	0.0

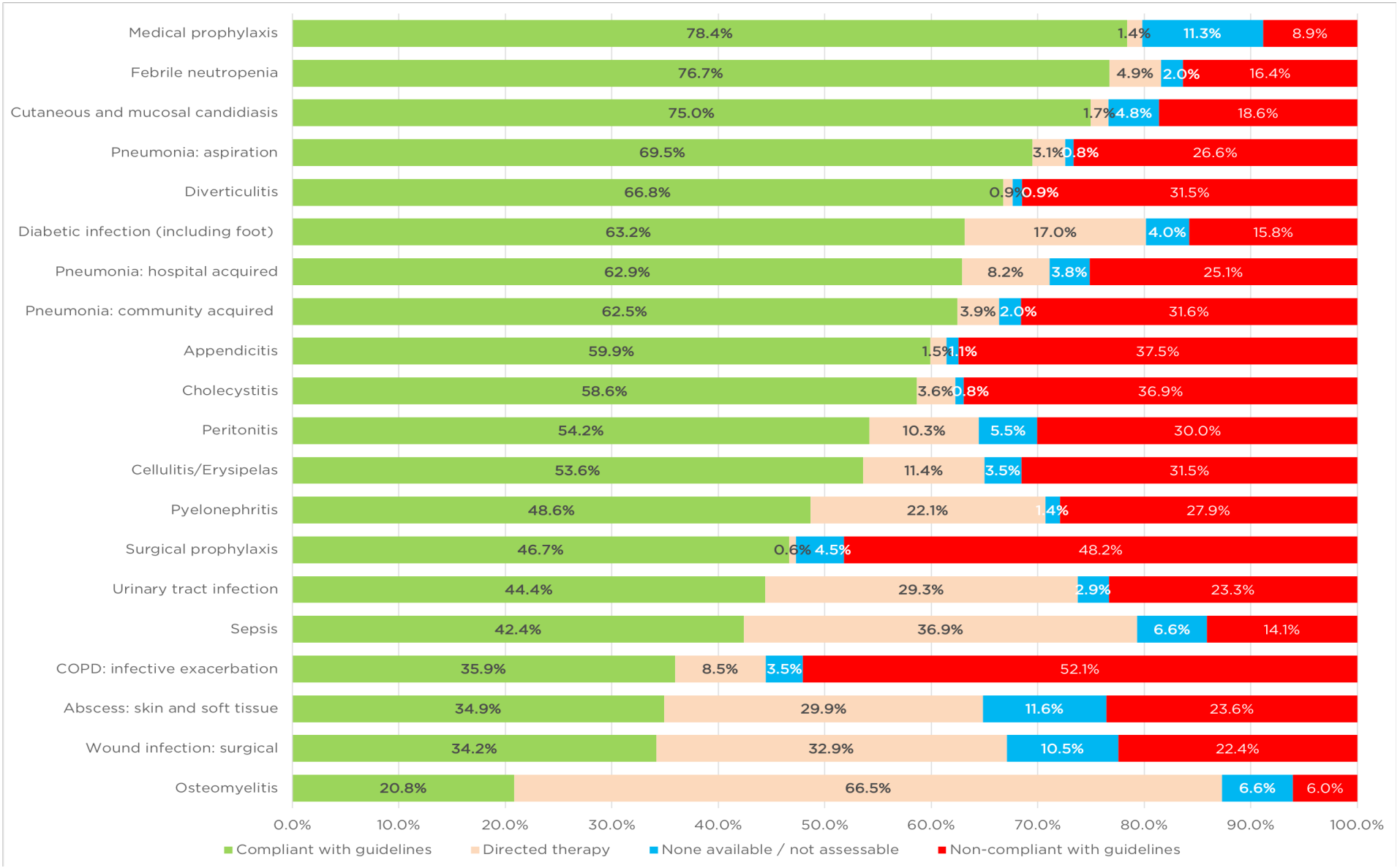
COPD = chronic obstructive pulmonary disease

Compliance with guidelines for the 20 most common indications for prescribing antimicrobials

Figure 9 shows the prescription rates assessed as compliant with guidelines for the 20 most common indications for prescribing antimicrobials. Indications with high levels of non-compliance with guidelines were similar to those with high levels of inappropriateness: infective exacerbation of COPD (52.1%), surgical prophylaxis (48.2%), appendicitis (37.5%) and cholecystitis (36.9%).

Those indications with low rates of non-compliance often had a high percentage of prescriptions with directed therapy as the reason for prescribing choice; osteomyelitis (66.5%), sepsis (36.9%) and surgical wound infection (32.9%). This highlights that, with good microbiological sampling, the ability to direct therapy and improve prescribing appropriateness is greatly increased. It may also be a contributing factor to the discordance between appropriateness and compliance to guidelines.

Figure 9 Compliance with guidelines for the 20 most common indications for prescribing antimicrobials in Hospital NAPS contributors, 2016



Pneumonia: community-acquired

Figure 7 shows that community-acquired pneumonia was the second most common indication for antimicrobial prescribing in the 2016 Hospital NAPS, following surgical prophylaxis, which is analysed in more depth in the Surgical NAPS. The 15 most common antimicrobials prescribed for community-acquired pneumonia and their appropriateness are presented in Table 13. These data show that five of the top six most commonly prescribed antimicrobials are those that are recommended in the *Therapeutic Guidelines*. Amoxicillin and doxycycline are recommended for mild disease; benzylpenicillin and doxycycline are recommended for moderate disease; and ceftriaxone or cefotaxime, plus azithromycin, are recommended for severe disease.

Amoxicillin–clavulanate was the fifth most commonly prescribed antibiotic for this indication, although it is not recommended in the *Therapeutic Guidelines* for community-acquired pneumonia, and therefore also has a high rate of inappropriateness (50.9%). Other antimicrobials with high rates of inappropriateness were cefalexin (52.0%) and piperacillin–tazobactam (44.3%). These are important targets for improvement as they are not recommended for this indication in current guidelines.

Table 13 Top 15 antimicrobials and rate of prescribing inappropriateness for community-acquired pneumonia in Hospital NAPS contributors, 2016

Antimicrobial	Prescribed (%)	Inappropriate (%)
Doxycycline	22.7	14.8
Ceftriaxone	18.8	27.2
Azithromycin	14.2	20.7
Benzylpenicillin	10.3	7.8
Amoxicillin–clavulanate	9.6	50.9
Amoxicillin	7.5	17.3
Piperacillin–tazobactam	3.5	44.3
Roxithromycin	2.8	34.5
Cefuroxime	2.3	17.4
Cefalexin	1.7	52.0
Moxifloxacin	1.0	12.9
Clarithromycin	0.9	25.9
Ciprofloxacin	0.9	11.5
Ampicillin	0.4	33.3
Cefotaxime	0.4	25.0

n = 3,005

Chronic obstructive pulmonary disease: infective exacerbation

Figure 8 shows that of the 20 most common indications, infective exacerbation of COPD had the highest rate of inappropriateness (52.1%). The recommendations from the *Therapeutic Guidelines: Antibiotic* is that antibiotics may not be required for many exacerbations. The 15 most common antimicrobials prescribed for infective exacerbation of COPD and their inappropriateness are presented in Table 14.

These data demonstrate that the *Therapeutic Guidelines: Antibiotic* recommended antimicrobials, doxycycline and amoxicillin, are the first and fourth most commonly prescribed and have lower rates of inappropriateness (23.2% and 16.7% respectively). All other antimicrobials had high rates if inappropriateness, particularly moxifloxacin (66.7%) and amoxicillin–clavulanate (66.0%). Infective exacerbation of COPD has consistently had poor rates of appropriateness in every year of the Hospital NAPS data collection. This demonstrates there is ongoing requirement to improve the management of this very common condition.

Table 14 Top 15 antimicrobials and rate of prescribing inappropriateness for infective exacerbation of chronic obstructive pulmonary disease in Hospital NAPS contributors, 2016

Antimicrobial	Prescribed (%)	Inappropriate (%)
Doxycycline	33.8	23.2
Amoxicillin–clavulanate	13.4	66.0
Ceftriaxone	12.9	54.9
Amoxicillin	9.1	16.7
Azithromycin	7.4	46.6
Benzylpenicillin	5.4	46.5
Ciprofloxacin	3.0	50.0
Roxithromycin	2.8	59.1
Piperacillin–tazobactam	2.5	45.0
Cefalexin	1.6	53.8
Clarithromycin	1.6	61.5
Cefuroxime	1.3	50.0
Ceftazidime	0.9	42.9
Moxifloxacin	0.8	66.7
Trimethoprim–sulfamethoxazole	0.5	50.0

n = 789

Antimicrobial Stewardship Clinical Care Standard: Using NAPS data to monitor how well the quality statements are met

The National Safety and Quality Health Service (NSQHS) Preventing and Controlling Healthcare-Associated Infection Standard[10] requires all Australian hospitals to implement an antimicrobial stewardship (AMS) program. This Standard encompasses the Antimicrobial Stewardship Clinical Care Standard.[11]

The Commission issued the Antimicrobial Stewardship Clinical Care Standard in 2014. The nine quality statements in this Clinical Care Standard describe the clinical care that patients should receive when they have, or are suspected of having, a bacterial infection.

The goal of this Clinical Care Standard is to ensure the appropriate use and review of antibiotics to optimise a patient's health outcomes, lessen the risks of adverse events and reduce the emergence of antibiotic resistance.

Monitoring how well the Antimicrobial Stewardship Clinical Care Standard is met is a key requirement of the NSQHS Standards, particularly the Preventing and Controlling Healthcare-Associated Infection Standard. In 2017 the Commission issued an Antimicrobial Stewardship Advisory[12] in regard to surgical prophylaxis

The NSQHS Standards (second edition) require health service organisations to have an AMS program which includes review of antimicrobial prescribing and use, evaluation of the performance of the program, identify areas for improvement, and take action to improve the appropriateness of antimicrobial prescribing and use.

The AMS program is also required to include reporting to clinicians and the governing body regarding:

- Compliance with the antimicrobial stewardship policy
- Antimicrobial use and resistance
- Appropriateness of prescribing and compliance with current evidence-based Australian therapeutic guidelines or resources on antimicrobial prescribing.

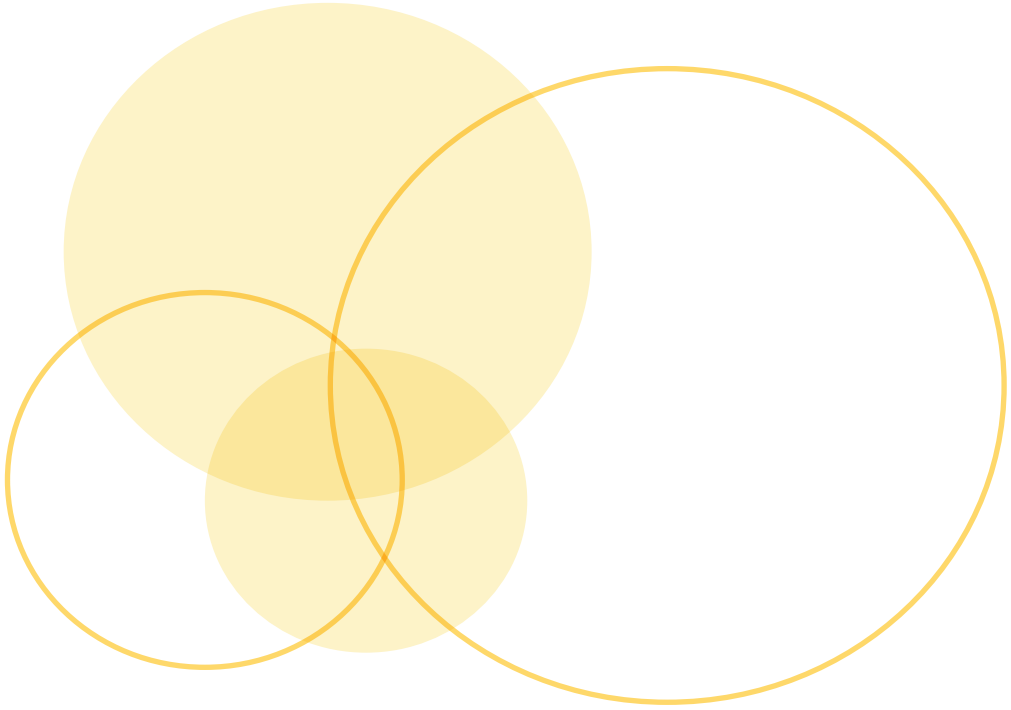
The Hospital NAPS is a tool that health service organisations can choose to use to assist them with monitoring how well they meet the antimicrobial stewardship actions in the Preventing and Controlling Healthcare-Associated Infection Standard, and the quality statements in the Antimicrobial Stewardship Clinical Care Standard.

A rudimentary assessment has been conducted of the way in which the 2016 Hospital NAPS data can be used to demonstrate how well the nine quality statements in the Antimicrobial Stewardship Clinical Care Standard are met.

As Table 15 shows, Hospital NAPS data are of assistance in relation to monitoring how well four of the nine quality statements are met. Figures 10-15 show how well hospitals are meeting these quality statements, where it was possible to use the 2016 Hospital NAPS data.

Table 15 Utility of Hospital NAPS data to monitor how well Antimicrobial Stewardship Clinical Care Standard quality statements are met

	Antimicrobial Stewardship Clinical Care Standard quality statements	NAPS data
1	A patient with a life-threatening condition due to a suspected bacterial infection receives prompt antibiotic treatment without waiting for the results of investigations.	✗
2	A patient with a suspected bacterial infection has samples taken for microbiology testing as clinically indicated, preferably before starting antibiotic treatment.	✓
3	A patient with a suspected infection, and/or their carer, receives information on their health condition and treatment options in a format and language that they can understand.	✗
4	When a patient is prescribed antibiotics, whether empirical or directed, this is done in accordance with the current version of the *Therapeutic Guidelines* (or local antibiotic formulary). This is also guided by the patient's clinical condition and/or the results of microbiology testing.	✓
5	When a patient is prescribed antibiotics, information about when, how and for how long to take them, as well as potential side effects and a review plan, is discussed with the patient and/or their carer.	✗
6	When a patient is prescribed antibiotics, the reason, drug name, dose, route of administration, intended duration and review plan is documented in the patient's health record.	✓
7	A patient who is treated with broad-spectrum antibiotics has the treatment reviewed and, if indicated, switched to treatment with a narrow-spectrum antibiotic. This is guided by the patient's clinical condition and the results of microbiology tests.	✗
8	If investigations are conducted for a suspected bacterial infection, the responsible clinician reviews these results in a timely manner (within 24 hours of results being available) and antibiotic therapy is adjusted taking into account the patient's clinical condition and investigation results.	✗
9	If a patient having surgery requires prophylactic antibiotics, the prescription is made in accordance with the current *Therapeutic Guidelines* (or local antibiotic formulary), and takes into consideration the patient's clinical condition.	✓



Quality Statement 2 – Microbiological testing

Quality Statement 2 recommends a patient with a suspected bacterial infection has samples taken for microbiology testing as clinically indicated, preferably before starting antibiotic treatment. The purpose of this statement is to support appropriate antibiotic selection.

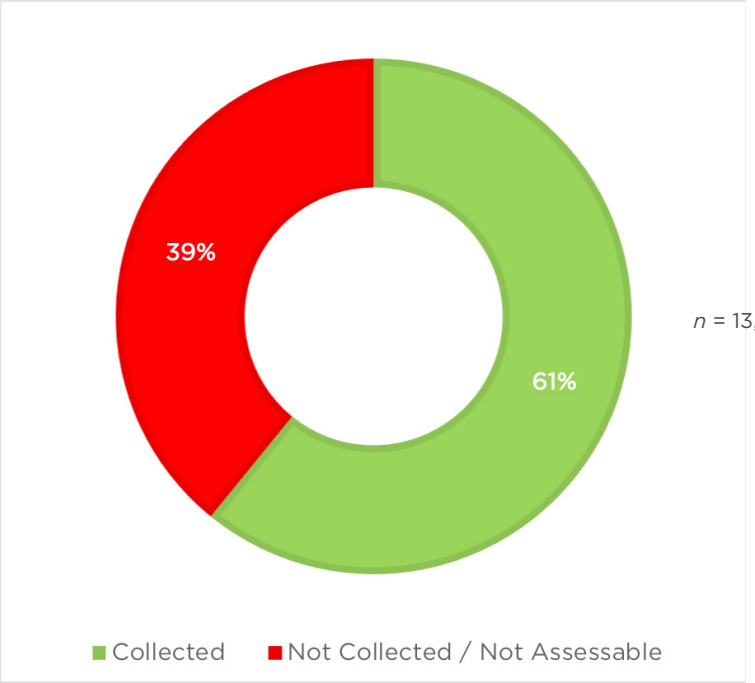
After excluding patients who were receiving an antimicrobial for medical or surgical prophylaxis, the 2016 Hospital NAPS dataset showed that 61% of patients had a microbiology sample recorded as 'collected', (Figure 10). This is defined in the Hospital NAPS auditing guidelines as, 'there has been relevant recent microbiology collected for the indication documented'.

There are several limitations of these data:

- While bacterial infections make up the vast majority of treatment indications in the Hospital NAPS, it is not possible to determine if a sample was collected specifically for a suspected bacterial infection as opposed to a viral, fungal, parasitic or other infection type, therefore data for all treatment indications have been included in the analysis
- Not all relevant microbiological samples would appear in the patient's notes or on the pathology system (for example, if these were collected by a private pathology provider or by another hospital)
- Not all indications require microbiological samples to be collected (for example, non-pregnant women who are suspected to have uncomplicated cystitis)
- There is no ability to determine if these specimens were taken prior to or after initiation of antimicrobial therapy.

Even with these limitations it is still possible to use these Hospital NAPS data to promote improved rates of microbiological samples being collected for admitted patients when antimicrobials are prescribed.

Figure 10 Quality Statement 2: microbiological testing, proportion of antimicrobial prescriptions where the patient had a microbiology sample collected in Hospital NAPS contributors, 2016



Quality Statement 4 – Use of guidelines and clinical condition

Quality Statement 4 requires that when a patient is prescribed antibiotics, whether empirical or directed, this is done in accordance with the current version of the *Therapeutic Guidelines: Antibiotic* (or local antibiotic formulary). This is also guided by the patient's clinical condition and/or the results of microbiology testing. The purpose of this quality statement is to ensure that the right antibiotic treatment is given.

Indicator 4a, proposed for monitoring adherence to Quality Statement 4, is the proportion of antibiotic prescriptions that are in accordance with guidelines. Analyses of the 2016 Hospital NAPS data found that that 70% of antimicrobial prescriptions were either compliant with the *Therapeutic Guidelines: Antibiotic* or locally endorsed guidelines or were directed therapy (Figure 11). Prescriptions where there were either guidelines were not available or the prescription was not assessable have been excluded.

Indicator 4b, proposed for monitoring adherence to this Quality Statement, is the rate of antibiotic-allergy mismatch in prescribing. Analyses of the 2016 Hospital NAPS data found that a known antimicrobial allergy mismatch was extremely rare (Figure 12). Ideally, antimicrobial allergy mismatches should never occur because of the patient safety implications. It is possible that the allergy status is incorrectly or incompletely documented which is why antibiotic-allergy mismatch may have occurred.

Figure 11 Quality Statement 4: Use of guidelines and clinical condition, proportion of antimicrobial prescriptions compliant with guidelines in Hospital NAPS contributors, 2016

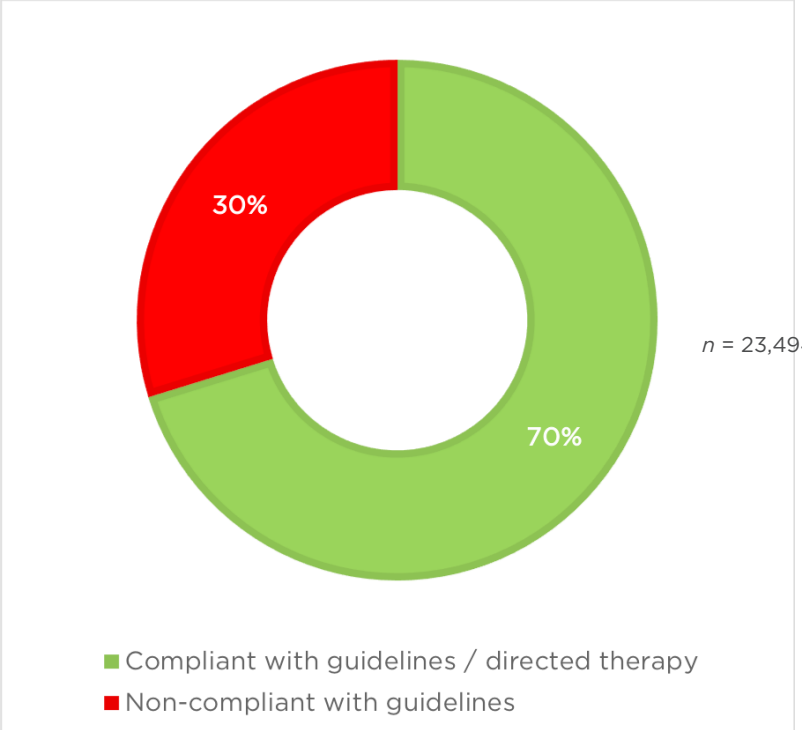
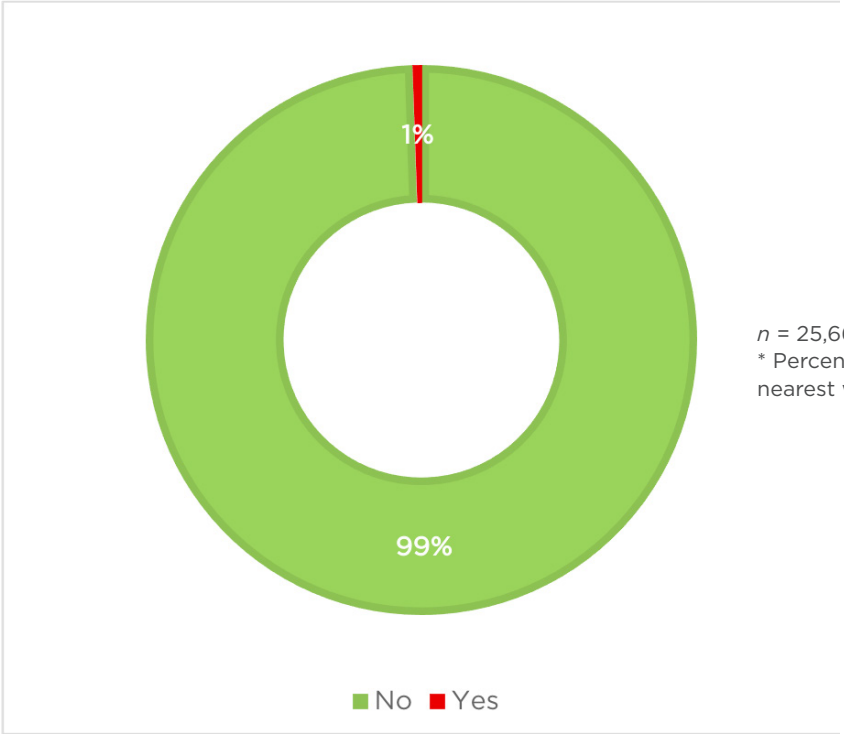


Figure 12 Quality Statement 4: Use of guidelines and clinical condition – proportion of antimicrobial prescriptions with an allergy mismatch in Hospital NAPS contributors, 2016*



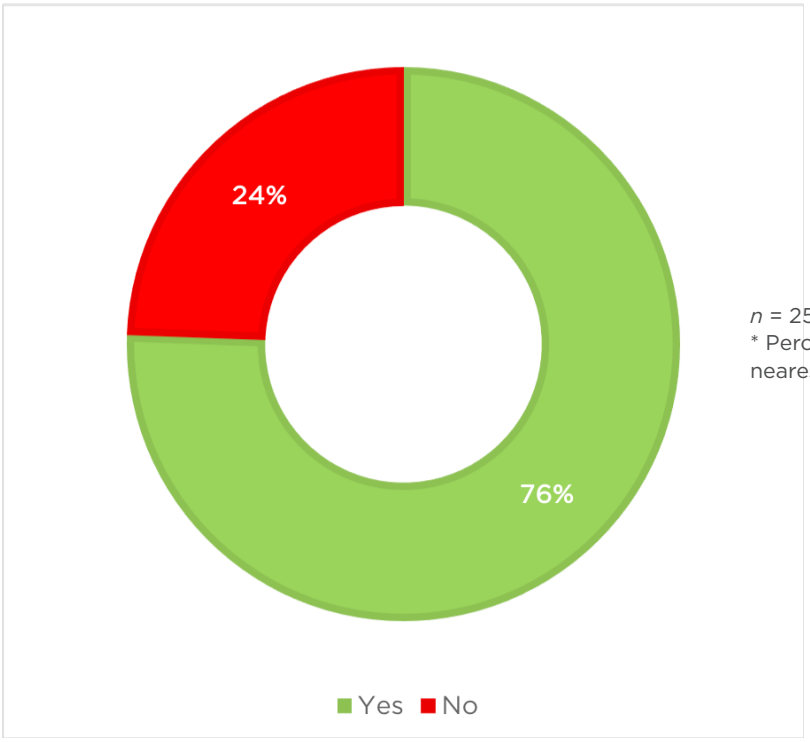
n = 25,661
* Percentages are rounded to the nearest whole number

Quality Statement 6 – Documentation

Quality Statement 6 requires that when a patient is prescribed antibiotics, the reason, drug name, dose, route of administration, intended duration and review plan is documented in the patient's health record. The purpose of this quality statement is to improve communication of antibiotic treatment between clinicians through a variety of mechanisms.

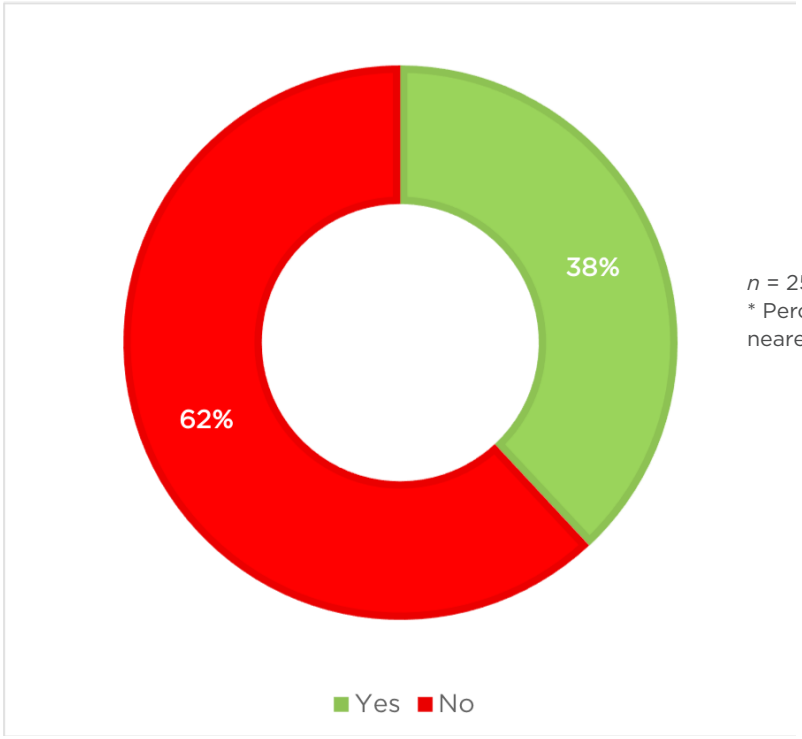
The recommended indicator for monitoring how well this quality statement is met is the rate of documentation of clinical reason (or indication) for prescribing antibiotics. The 2016 Hospital NAPS data showed that the overall rate of documentation of indication in patients' medical records or medication charts was 76% (Figure 13). A documented stop or review plan was present for only 38% of prescriptions (Figure 14). As these are such important requirements for antimicrobial prescribing there is substantial room for improvement. Best practice requires that the antimicrobial indication and review plan are documented for more than 95% of all antimicrobial prescriptions.

Figure 13 Quality Statement 6: documentation, proportion of antimicrobial prescriptions with indication documented in Hospital NAPS contributors, 2016*



n = 25,661
* Percentages are rounded to the nearest whole number

Figure 14 Quality Statement 6: documentation, proportion of antimicrobial prescriptions with review plan documented in Hospital NAPS contributors, 2016*



n = 25,661
* Percentages are rounded to the nearest whole number

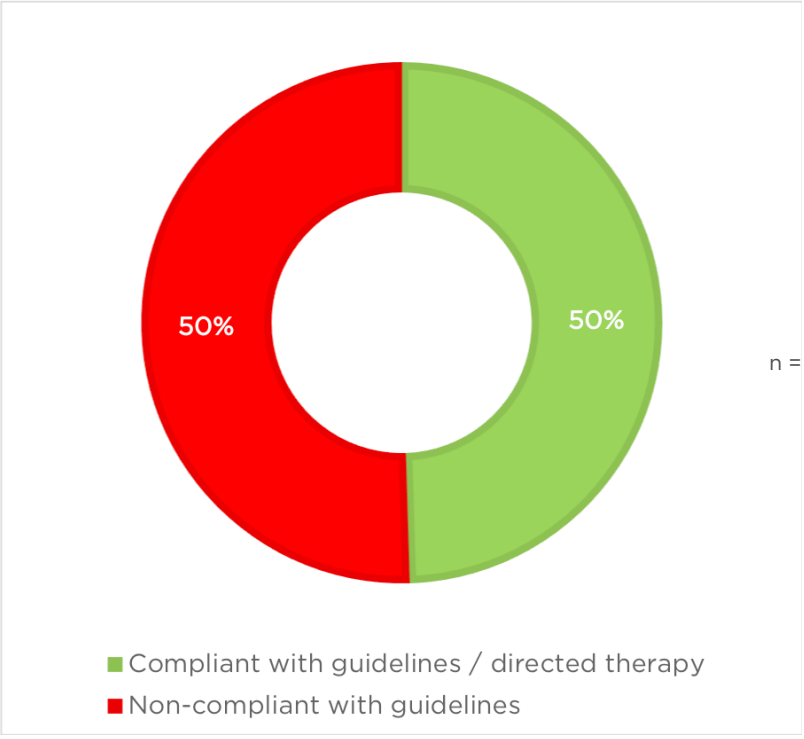
Quality Statement 9: Surgical prophylaxis

Quality Statement 9 is that if a patient having surgery requires prophylactic antibiotics, the prescription is made in accordance with the current *Therapeutic Guidelines: Antibiotic* (or local antibiotic formulary), and takes into consideration the patient's clinical condition. The purpose of this quality statement is to reduce unwarranted variation in the use of antibiotics for surgical prophylaxis. The Hospital NAPS data may be used for Indicator 9a of this quality statement, which is the proportion of patients for whom surgical prophylactic antibiotics were prescribed in accordance with guidelines.

Analyses of the 2016 Hospital NAPS data showed that when prescriptions deemed 'no guidelines available' or 'non-assessable' were excluded, only 50% of all surgical procedures where prophylactic antimicrobials were prescribed were compliant with the *Therapeutic Guidelines: Antibiotic*, or local guidelines or were assessed as directed therapy (Figure 15).

This is mainly because the duration of surgical prophylaxis extends beyond the recommended length of time. These findings demonstrate that there is an opportunity to improve adherence to the prescribing guidelines. These findings also highlight the importance of accreditation assessors and health care organisations focusing on the requirement set out in the Commission's Antimicrobial Stewardship Advisory, that health service organisations should ensure surgical prophylaxis is included and addressed as part of their antimicrobial stewardship program.[4]

Figure 15 Standard 9: surgical prophylaxis, compliance with guidelines prescribing in Hospital NAPS contributors, 2016



Discussion

Analyses of 2016 Hospital NAPS data identified that there have been minimal changes in the key indicators of appropriateness of antimicrobial prescribing from 2013 to 2016 in Australian hospitals.

The key indicators of appropriateness of antimicrobial prescribing in the Hospital NAPS from 2013 to 2016, and the changes in them over the four years from 2013, are as follows:

- Improvement in documentation of indication from 70.9% to 75.6%
- Improvement in documentation of review or stop date from 35.5% to 38.1%
- Improvement in the proportion of surgical prophylaxis given for greater than 24 hours from 41.8% to 31.1%
- A decline in compliance with *Therapeutic Guidelines: Antibiotic* or local guidelines from 72.2% to 65.4%
- A static rate of overall appropriateness of prescribing, of approximately 76% each year.

Antimicrobial prescribing for surgical prophylaxis requires ongoing monitoring and improvement, with almost a third (31.1%) of all prescriptions being prescribed for greater than 24 hours in 2016. The Surgical NAPS provides an option for targeted auditing of prescribing of surgical prophylaxis. The Commission is collaborating with the Royal Australasian College of Surgeons regarding opportunities to improve surgical prophylaxis prescribing practice.

In addition, there is scope to improve prescribing for selected antimicrobials, particularly cefalexin, amoxicillin–clavulanate and cefazolin, and for specific indications including infective exacerbations of COPD and pneumonia.

The analyses of the 2016 Hospital NAPS data also identified other opportunities for health service organisations to implement targeted quality improvement initiatives for antimicrobial prescribing including:

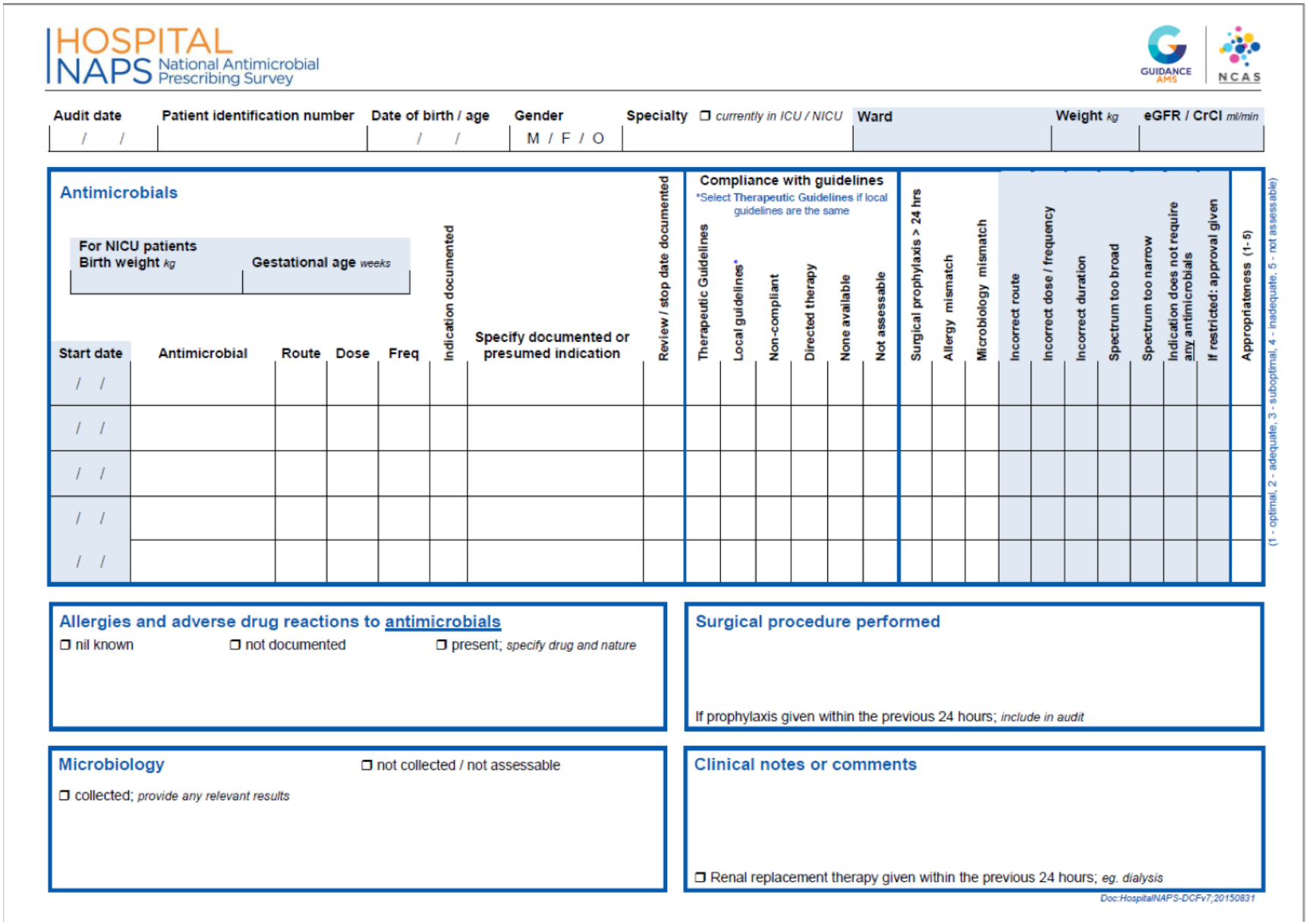
- Documentation of indication in private hospitals
- Documentation of review or stop date in public hospitals
- Compliance with guidelines in very remote, public group D hospitals and private hospitals
- Appropriateness of prescribing of broad spectrum antimicrobials and duration of therapy.

The 2016 Hospital NAPS results reinforce the importance of implementation of the NSQHS Standards (second edition). These Standards require health service organisations to have an AMS program that:

- Includes an antimicrobial stewardship policy
- Provides access to, and promotes the use of, current evidence-based Australian therapeutic guidelines and resources on antimicrobial prescribing
- Has an antimicrobial formulary that includes restriction rules and approval processes
- Incorporates core elements, recommendations and principles from the current Antimicrobial Stewardship Clinical Care Standard.

The Commission and NCAS will widely disseminate the results of the 2016 Hospital NAPS and examine strategies to enhance the number and representativeness of participants in the Hospital NAPS in future years.

Appendix 1: Hospital NAPS data collection form



HOSPITAL NAPS National Antimicrobial Prescribing Survey

GUIDANCE AMS · NCAS

Audit date	Patient identification number	Date of birth / age	Gender	Specialty ❒ currently in ICU / NICU	Ward	Weight kg	eGFR / CrCl ml/min
/ /		/ /	M / F / O				

Antimicrobials

For NICU patients: Birth weight kg | Gestational age weeks

Start date	Antimicrobial	Route	Dose	Freq	Indication documented	Specify documented or presumed indication	Review / stop date documented	Compliance with guidelines: Therapeutic Guidelines	Local guidelines*	Non-compliant	Directed therapy	None available	Not assessable	Surgical prophylaxis > 24 hrs	Allergy mismatch	Microbiology mismatch	Incorrect route	Incorrect dose / frequency	Incorrect duration	Spectrum too broad	Spectrum too narrow	Indication does not require any antimicrobials	If restricted: approval given	Appropriateness (1-5)
/ /																								
/ /																								
/ /																								
/ /																								
/ /																								

*Select Therapeutic Guidelines if local guidelines are the same

(1 - optimal, 2 - adequate, 3 - suboptimal, 4 - inadequate, 5 - not assessable)

Allergies and adverse drug reactions to antimicrobials

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

Surgical procedure performed

If prophylaxis given within the previous 24 hours; *include in audit*

Microbiology

❒ not collected / not assessable

❒ collected; *provide any relevant results*

Clinical notes or comments

❒ Renal replacement therapy given within the previous 24 hours; *eg. dialysis*

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Appendix 2: Hospital NAPS data definitions of appropriateness

HOSPITAL NAPS National Antimicrobial Prescribing Survey

Appropriateness definitions

GUIDANCE | NCAS

			If endorsed guidelines are present	If endorsed guidelines are absent
Appropriate	1	Optimal[1]	Antimicrobial prescription follows either the Therapeutic Guidelines[2] or endorsed local guidelines *optimally*, including antimicrobial choice, dosage, route and duration[3]	The antimicrobial prescription has been reviewed and endorsed by an infectious diseases clinician or a clinical microbiologist **OR** The prescribed antimicrobial will cover the likely causative or cultured pathogens ***and*** there is not a narrower spectrum or more appropriate antimicrobial choice, dosage, route or duration[3] available
	2	Adequate	Antimicrobial prescription does not optimally follow the Therapeutic Guidelines[2] or endorsed local guidelines, including antimicrobial choice, dosage, route or duration[3], however, is a ***reasonable*** alternative choice for the likely causative or cultured pathogens **OR** For surgical prophylaxis, as above ***and*** duration[3] is less than 24 hours	Antimicrobial prescription including antimicrobial choice, dosage, route and duration[3] is not the most optimal, however, is a ***reasonable*** alternative choice for the likely causative or cultured pathogens **OR** For surgical prophylaxis, as above ***and*** duration[3] is less than 24 hours
Inappropriate	3	Suboptimal	There may be a mild or non-life-threatening allergy mismatch **OR** Antimicrobial prescription including antimicrobial choice, dosage, route and duration[3], is an ***unreasonable*** choice for the likely causative or cultured pathogens, including: • spectrum excessively broad, unnecessary overlap in spectrum of activity, dosage excessively high or duration excessively long • failure to appropriately de-escalate with microbiological results	
	4	Inadequate	Antimicrobial prescription including antimicrobial choice, dosage, route or duration[3] is ***unlikely*** to treat the likely causative or cultured pathogens **OR** The documented or presumed indication does not require ***any*** antimicrobial treatment **OR** There may be a severe or possibly life-threatening allergy mismatch, or the potential risk of toxicity due to drug interaction **OR** For surgical prophylaxis, the duration[3] is greater than 24 hours (except where local guidelines endorse this)	
	5	Not assessable	The indication is not documented and unable to be determined from the notes **OR** The notes are not comprehensive enough to assess appropriateness **OR** The patient is too complex, due to multiple co-morbidities, allergies or microbiology results, *etc.*	

[1] Taking into account acceptable changes due to the patient's weight or renal function, if this information is available

[2] Antibiotic Expert Group. Therapeutic Guidelines: Antibiotic. Version 15 (2014), or online version

[3] Duration should only be assessed if the guidelines state a recommended duration and the antimicrobial has already been dispensed for longer than this, or if there is a clear planned 'end date' documented

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Appendix 3: Tables and figures

Tables

Figures

- Figure 10 - Quality Statement 2: microbiological testing, proportion of antimicrobial prescriptions where the patient had a microbiology sample collected in Hospital NAPS contributors, 2016
- Figure 11 - Quality Statement 4: Use of guidelines and clinical condition, proportion of antimicrobial prescriptions compliant with guidelines in Hospital NAPS contributors, 2016
- Figure 12 - Quality Statement 4: Use of guidelines and clinical condition – proportion of antimicrobial prescriptions with an allergy mismatch in Hospital NAPS contributors, 2016
- Figure 13 - Quality Statement 6: documentation, proportion of antimicrobial prescriptions with indication documented in Hospital NAPS contributors, 2016
- Figure 14 - Quality Statement 6: documentation, proportion of antimicrobial prescriptions with review plan documented in Hospital NAPS contributors, 2016
- Figure 15 - Standard 9: surgical prophylaxis, compliance with guidelines prescribing in Hospital NAPS contributors, 2016.

References

[1] Australian Commission on Safety and Quality in Health Care. Creating Safer, Better Health Care – The impact of the National Safety and Quality Health Service Standards. Sydney. ACSQHC, 2018.

[2] National Centre for Antimicrobial Stewardship and Australian Commission on Safety and Quality in Health Care. Antimicrobial prescribing practice in Australian hospitals: Results of the 2015 National Antimicrobial Prescribing Survey. Sydney: ACSQHC; 2016

[3] Australian Commission on Safety and Quality in Health Care (2015). Antimicrobial prescribing practice in Australian hospitals: results of the 2014 National Antimicrobial Prescribing Survey, ACSQHC, Sydney.

[4] Australian Commission on Safety and Quality in Health Care (2014). Antimicrobial prescribing practice in Australia: results of the 2013 National Antimicrobial Prescribing Survey, ACSQHC, Sydney.

[5] National Centre for Antimicrobial Stewardship and Australian Commission on Safety and Quality in Health Care. Surgical National Antimicrobial Prescribing Survey: results of the 2016 pilot. Sydney: ACSQHC; 2017.

[6] Australian Bureau of Statistics. Australian Statistical Geography Standard (ASGS): Volume 5 - Remoteness Structure, July 2016. Canberra: ABS; July 2016 (ABS Cat. No.1270.0.55.005) http://www.abs.gov.au/websitedbs/D3310114.nsf/home/remoteness+structure/ (accessed Mar 2018).

[7] Australian Institute of Health and Welfare 2015. Australian hospital peer groups. Health services series no. 66. Cat. no. HSE 170. Canberra: AIHW.

[8] eTG complete. Melbourne: Therapeutic Guidelines Limited; 2015 Jul. https://www.tg.org.au/

[9] The Society of Hospital Pharmacists Australia, Medicine Shortages in Australia – June 2017.

https://www.shpa.org.au/sites/default/files/uploaded-content/website-content/Fact-sheets-position-statements/medicines_shortages_in_australia-_shpa_snapshot_-_june_2017.pdf

[10] Australian Commission on Safety and Quality in Health Care. National Safety and Quality Health Service Standards. 2nd ed. Sydney: ACSQHC; 2017.

[11] Australian Commission on Safety and Quality in Health Care. Antimicrobial Stewardship Clinical Care Standard. Sydney: ACSQHC, 2014.