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 2014 National Antimicrobial Prescribing Survey

July 2015

Doherty Institute
A joint venture between the University of Melbourne and Melbourne Health

The Royal Melbourne Hospital

NAPS
National Antimicrobial Prescribing Survey

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Abbreviations

AAW	Antibiotic Awareness Week
COPD	chronic obstructive pulmonary disease
NAPS	National Antimicrobial Prescribing Survey
PePS	period prevalence survey
PoPS	point prevalence survey

Executive summary

The National Antimicrobial Prescribing Survey (NAPS) is a standardised auditing tool designed to assist healthcare facilities to assess the quantity and quality of antimicrobial prescribing. It provides unique insight into antimicrobial prescribing practices at a national level and plays an important role in improving antimicrobial stewardship across Australian healthcare facilities.

The 2014 NAPS saw substantial increases in participation compared with 2013. A total of 248 hospitals (197 public and 51 private) participated, representing a 64% increase compared with the 2013 survey. The total dataset comprised 19 944 prescriptions (55.9% increase) for 12 634 patients (64.1% increase). There was good representation across most states and territories.

One-quarter of all Australian public hospitals participated in the 2014 NAPS, representing 44.2% of all public hospitals beds nationally. Approximately three-quarters of all large facilities contributed data. The largest increases in participation compared with 2013 were from public regional and remote hospitals, and private facilities.

Most hospitals (70.9%) conducted a whole-hospital point prevalence survey or whole-hospital period prevalence survey. This survey method was followed by surveys of particular wards or specialties (10.5%), randomly selected patients (9.3%), selected antimicrobials or indications (5.6%), and others (3.6%).

Most auditors (60.8%) were pharmacists, followed by infection control practitioners or nurses (18.8% combined), and doctors (16.1%).

The prevalence of antimicrobial use among inpatients in hospitals that conducted a whole-hospital point prevalence survey in 2014 was 38.4%.

The findings for key indicators were similar between the 2014 and 2013 surveys. In 2014, approximately one-quarter (24.3%) of prescriptions were noncompliant with guidelines, and 23.0% were deemed to be inappropriate. An indication was documented in the medical notes for 74.0% of antimicrobial prescriptions (more than 95% is considered best practice). Of surgical prophylaxis prescriptions, 35.9% were continued beyond 24 hours (less than 5% is considered best practice).

The most commonly prescribed antimicrobials in 2014 were cephazolin (11.1%), ceftriaxone (9.1%), metronidazole (6.5%), piperacillin–tazobactam (6.1%) and amoxycillin–clavulanic acid (6.0%). The appropriateness of prescribing for these antimicrobials ranged from 63.1% to 76.9%. The prescribing of oral and intravenous cephalosporins was relatively poor, with 39.9% of cephalexin prescriptions (the sixth most commonly prescribed antimicrobial), 31.6% of cephazolin prescriptions and 30.6% of ceftriaxone prescriptions assessed to be inappropriate. However, narrow-spectrum antimicrobials tended to be very well prescribed, with high rates of appropriateness.

The most common indications were surgical prophylaxis (13.1%), community-acquired pneumonia (11.3%), medical prophylaxis (8.3%), urinary tract infections (6.7%) and cellulitis/erysipelas (4.4%). Surgical prophylaxis remains a significant concern, with 40.2% of these prescriptions assessed as inappropriate, mainly due to incorrect duration and dose, and absence of an indication for an antimicrobial. As in 2013, infective exacerbation of chronic obstructive pulmonary disease was also poorly prescribed (36.8% deemed to be inappropriate), as were other respiratory tract infections such as bronchitis (50.7% inappropriate) and exacerbation of asthma (70.0% inappropriate).

The Australian Commission on Safety and Quality in Health Care is working with the National Centre for Antimicrobial Stewardship to expand NAPS into other health sectors. The first step will be development and piloting of a dedicated aged care module, with the aim of improving antimicrobial stewardship activities in residential aged care facilities.

Background

Development of antimicrobial resistance in bacteria is increasingly recognised, nationally and globally, as a threat to public health. Preventing and containing the spread of resistance requires accurate surveillance of antimicrobial use and antimicrobial resistance. The World Health Organization has identified this issue as critical and has called on all countries to control antimicrobial use. Australian governments have recognised the importance of encouraging the appropriate use of antimicrobials to minimise the development of resistance, and the Australian Government has developed Australia's first National Antimicrobial Resistance Strategy.

Antimicrobial stewardship is the coordinated effort to improve the quality and safety of use of antimicrobial medicines. In 2011, the Australian Commission on Safety and Quality in Health Care (the Commission) recommended that antimicrobial stewardship programs be established in all hospitals.[1] In 2013, antimicrobial stewardship became a criterion in the National Safety and Quality Health Service Standards. All hospitals in Australia are now required to audit and monitor antimicrobial prescribing under Standard 3: Preventing and Controlling Healthcare Associated Infections.

The National Antimicrobial Prescribing Survey (NAPS) commenced in 2011, and has developed each year since, with increasing numbers of hospitals participating.[2] It is a standardised auditing tool that is designed to assess the quantity and quality of antimicrobial prescribing in Australian hospitals. It is intended to be flexible and practical to suit the needs of auditors with differing levels of expertise. A core principle is that the act of auditing encourages reflection, leading to improved practice, safety and patient care.

NAPS underpins our AMS [antimicrobial stewardship] program as, being a small rural hospital group, we have little other means of getting robust data in a meaningful way. It has changed the way I view our AMS program and will be a much bigger part of the program in the future. Thank you so much to the NAPS team!!!

– response from feedback questionnaire

1 Duguid M & Cruickshank M (eds) (2010). *Antimicrobial stewardship in Australian hospitals*, Australian Commission on Safety and Quality in Health Care, Sydney.

2 James R, Upjohn L, Cotta M, Luu S, Marshall C, Buising K & Thursky K (2015). Measuring antimicrobial prescribing quality in Australian hospitals: development and evaluation of a national antimicrobial prescribing survey tool. *Journal of Antimicrobial Chemotherapy*, doi:10.1093/jac/dkv047.

NAPS has three key aims:

- Provide a tool to assist healthcare facilities to audit antimicrobial prescribing and facilitate local quality improvement.
- Provide data on antimicrobial prescribing behaviour in Australian healthcare facilities.
- Assist in identifying problematic areas where prescribing frequently varies from guidelines (*Therapeutic Guidelines: Antibiotic*, or locally endorsed guidelines).

NAPS is conducted by the National Centre for Antimicrobial Stewardship in Melbourne. The centre is partnering with the Doherty Institute for Infection and Immunity, and the Royal Melbourne Hospital to provide a coordinated approach to antimicrobial stewardship across a range of settings, including tertiary hospitals, rural and regional health care, aged care, and general practice.

NAPS was developed by a multidisciplinary team comprising infectious diseases physicians, clinical microbiologists and specialist pharmacists. The Commission provided resources in 2013 for development and piloting of a new web-based survey. Further support was provided in 2014–15 to support activities in the following areas:

- Priority area 1 – increased recruitment of acute healthcare facilities, with a focus on regional and remote sites. Larger metropolitan hospitals participated in the 2013 NAPS at a higher rate (48–51%) than smaller, regional and remote hospitals (8–17%).[3] Local research has found that substantially less review and auditing of antimicrobial prescribing occurs in regional facilities than in metropolitan facilities, largely because of a lack of specialist infectious diseases support and other resources.[4]
- Priority area 2 – development of an aged care NAPS (acNAPS) to assess antimicrobial prescribing practices in residential aged care facilities. Antimicrobial stewardship programs and associated governance structures have not progressed in the residential aged care setting to the same extent as in the acute healthcare setting.

Limitations in methodology

The results in this report should be interpreted in the context of the following limitations associated with the survey methodology:

- **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.
- **Subjective nature of assessments.** Individual auditors at each participating facility were responsible for assessing the appropriateness of antimicrobial prescribing and compliance with guidelines, although the NAPS team provided assistance with assessments on request. These assessments are not completely objective, and some degree of interpretation is involved; an inter-rater study suggested variability between auditor types. Results should therefore be interpreted with caution.
- **Comparison with previous surveys.** Some changes in methodology occurred between the 2013 and 2014 surveys, and not all data fields were the same in the two surveys. Amendments were made to the categories for assessment of compliance with guidelines and assessment of prescription, and in the requirement for users to select their survey methodology. These differences are described further in the relevant sections of this report.

3 Unpublished data from the 2013 National Antimicrobial Prescribing Survey

4 James RS, Mcintosh KA, Luu SB, Cotta MO, Marshall C, Thursky KA & Buising KL (2013). Antimicrobial stewardship in Victorian hospitals: a statewide survey to identify current gaps. *Medical Journal of Australia* 199(10):692–695.

The 2014 NAPS

Methods

The 2014 NAPS was launched in October 2014, and data entry closed in February 2015. However, the NAPS web site and data collection resources can be accessed at any time, and users are encouraged to perform smaller, more directed surveys throughout the year to address any areas of concern identified in the annual NAPS.

Timing

In previous years, participants have been encouraged to incorporate NAPS auditing into their Antibiotic Awareness Week (AAW) activities, which take place in November each year. However, the results of the 2013 feedback questionnaire revealed that almost half of all facilities – especially regional and remote hospitals with smaller numbers of patients – required more than a week to conduct the survey, and more than 20% required more than a month. Participants were therefore encouraged to conduct the 2014 audit early so that results would be available for local feedback and discussion during AAW.

Recruitment

All hospitals that had previously registered on the NAPS web site were invited to participate in the 2014 survey. The Commission also used its networks, web site and social media (Twitter) to recruit hospitals, with a particular focus on rural areas. Communications were sent to jurisdictional leaders, individual hospitals and key rural health organisations.

NAPS was also advertised through professional society forums, including the Society of Hospital Pharmacists Australia, the Australian College for Infection Prevention and Control, and the Australasian Society for Infectious Diseases.

Survey types

Users were encouraged to use one of the following methodologies for the 2014 survey, and to collect data on at least 30 prescriptions, as the minimum number required to detect performance against key indicators:[5]

- whole-hospital point prevalence survey (PoPS) – recommended for facilities with more than 100 beds
- whole-hospital period prevalence survey (PePS) – recommended for facilities with 100 beds or fewer, or where there was likely to be only a small number of patients on antimicrobials
- random sample – recommended for very large facilities, or where resourcing did not allow a whole-hospital survey to be conducted.

Other types of survey, such as directed surveys of particular wards, specialties, antimicrobials or indications, were provided as options. However, users were advised to conduct these other surveys outside the annual national survey period to address particular target areas. Although the inclusion of these methodologies is unlikely to have an impact on the results of key indicators, they have been excluded from calculations of prevalence (e.g. the most commonly prescribed antimicrobials and indications).

Auditors

The majority of auditors were pharmacists (60.8%), followed by infection control practitioners (ICPs) and nurses (18.8% combined), and doctors (16.1%). Most auditors in public hospitals (including in regional, rural and remote areas) were pharmacists, whereas nurses and ICPs comprised the majority of auditors in private hospitals.

Inter-rater study

An inter-rater study was conducted to examine the level of agreement between different types of auditors in the assessment of compliance with guidelines and appropriateness. Overall, higher levels of agreement were observed for compliance assessments than for appropriateness assessments. Antimicrobial teams (comprising an infectious diseases physician and specialist pharmacist) and clinical pharmacists had high

5 Cusini A, Rampini SK, Bansal V, Ledergerber B, Kuster SP, Ruef C & Weber R (2010). Different patterns of inappropriate antimicrobial use in surgical and medical units at a tertiary care hospital in Switzerland: a prevalence survey. *PLoS One* 5:e14011.

levels of agreement. Poor agreement was observed between ICPs and antimicrobial teams.

Support for auditors

The NAPS team provided email, telephone and online assistance to participating sites throughout the data collection period. Participants could attend a one-hour online training session for general hospitals, or a modified session for hospitals without infectious diseases support.

Expert assessments

The expert assessment service provided by the NAPS team was an enhanced feature of the 2014 NAPS. Hospitals without access to infectious diseases specialists were offered assistance in the assessment of compliance and appropriateness. Other hospitals could request such assessment, if they felt it would improve the quality of the audit.

Other communications

A bi-monthly NAPS newsletter (*NAPS News*) was developed and is now sent to all registered users. The newsletter contains information on changes to the survey and web site, other NAPS projects, and interim results.

A post-NAPS feedback questionnaire was sent to all registered survey managers who participated in the 2014 NAPS; 58.6% responded.

Changes in data fields in 2014

Most data collection requirements remained the same as for the 2013 NAPS. However, in response to 2013 user feedback, web site layout, data entry fields and reporting functionality were improved for the 2014 survey. The updated data collection form, guidelines to assist with assessment of appropriateness and definitions to assess compliance with guidelines are in Appendixes 1–3, respectively.

The major changes were as follows.

Requirement for users to indicate their survey methodology

The 2014 survey required users to specify their survey methodology from the following options: whole-hospital PoPS, whole-hospital PePS, random sample survey, surveys of selected wards or specialties, and directed surveys of particular antimicrobials or indications. This information allowed more robust data analysis and provided the NAPS team with a better understanding of the way in which hospitals conducted the survey.

Classification of compliance with guidelines

The 'directed therapy' category for compliance with guidelines encompasses scenarios in which a microbiology test has identified a likely bacterial pathogen, and laboratory susceptibility information is available to guide antimicrobial use. This was added to the 2014 survey to enable more accurate classification of compliance with guidelines.

A new, more extensive version of *Therapeutic Guidelines: Antibiotic* (version 15) was issued during the survey period. Users were given the option of assessing compliance with either version of the guidelines.

Addition of 'antimicrobial not indicated' to assessment of prescription

Users of the 2013 survey encountered difficulty classifying indications for which antimicrobial therapy was not recommended at all. Anecdotally, many of these antimicrobials were classified as 'spectrum too broad' as the closest alternative. An 'antimicrobial not indicated' category was therefore added to differentiate between the two situations.

Ability to enter more detailed denominator information

Users were provided with the option to enter additional denominator information for individual specialties and wards. Amendments were made to the 'Antimicrobial usage by specialty' and 'Antimicrobial usage by ward' reports to reflect these new data. An example is provided in Appendix 4.

Provision of new time-series reports

A time-series report was developed to allow users to compare their hospital's data over time. The report provides a graphical display of results of key indicators for any combination of surveys over any time period. An example of this report is provided in Appendix 5.

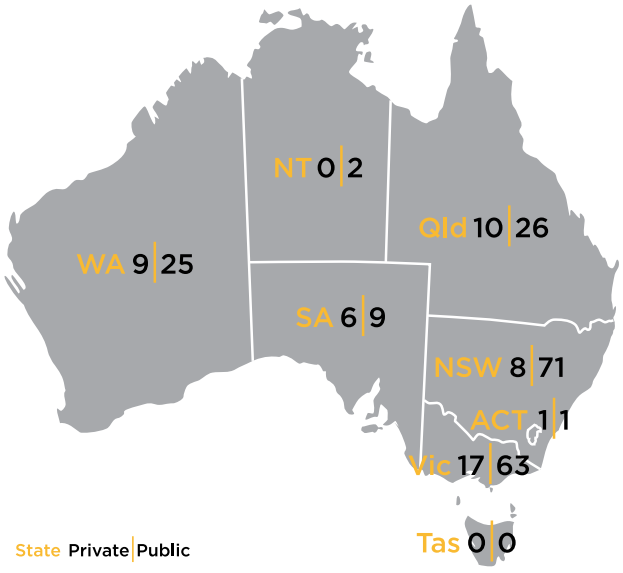
General findings

Participation

A total of 248 hospitals (197 public and 51 private) participated, constituting a 64% increase compared with 2013 (151 hospitals). Of these, 163 hospitals agreed to participate in benchmarking, compared with 100 hospitals in 2013.

Seven of the eight states and territories were represented by participating hospitals (Figure 1). In 2013, all states and territories were represented. No Tasmanian facilities participated in 2014, and the number of participating facilities in the Northern Territory decreased from five in 2013 to two in 2014.

Figure 1 Numbers of private and public participating hospitals, by jurisdiction



Public hospitals

Of the 197 public hospitals that participated, there was representation across every peer group (Table 1) and remoteness classification (Table 2). In both these categories, participation was higher than in 2013.

Overall, one-quarter of all public hospitals in Australia participated, representing 44.2% of public beds. The highest rates of participation were in principal referral (A1), specialist women's and children's (A2), and large major city hospitals (B1), where around three-quarters of hospitals contributed.

Encouraging levels of participation were also observed from large regional and remote (B2), and some medium-sized hospitals (C1), with responses from approximately half of all facilities in these categories. Although the overall representation from smaller regional and remote hospitals (D1–3) was lower, there was a large relative increase compared with 2013. This is likely to have resulted from the targeted promotion of NAPS to rural and regional hospitals, and the increased support offered to these facilities.

A small number of other facility types participated, including multipurpose health services (E2), rehabilitation hospitals (E4), a mental health hospital (F) and other facility types (E9, G).

A full list of peer group definitions is provided in Appendix 6. A breakdown of peer groups by state and territory is in Appendix 7.

When conducting NAPS, we were aware that we have no local guidelines for antimicrobial use for particular indications … our hospital now has a working party developing guidelines for these indications.

– response from feedback questionnaire

Table 1 Participating public hospitals in 2013 and 2014, by peer group classification

Peer group[a]	Number of hospitals participating		Total number in each category nationally[b]	% of all hospitals in category, 2014	% change from 2013	
	2013	2014			Absolute	Relative
A1	48	61	93	65.6	+14.0	+27.1
A2	6	8	11	72.7	+18.2	+33.3
B1	11	18	23	78.3	+30.4	+63.6
B2	9	11	20	55.0	+10.0	+22.2
C1	12	17	30	56.7	+16.7	+41.7
C2	13	22	58	37.9	+15.5	+69.2
D1	9	25	117	21.4	+13.7	+177.8
D2	6	7	65	10.8	+1.5	+16.7
D3	7	10	41	24.4	+7.3	+42.9
E2	5	5	79	6.3	0.0	0.0
E4	2	2	8	25.0	0.0	0.0
E9	3	3	12	25.0	0.0	0.0
F	0	1	19	5.3	+5.3[c]	na[c]
G	2	7	201	3.5	+2.5	+250.0
Total	133	197	777	25.4	+8.2	+48.1

na = not applicable

a Peer group codes are defined in Appendix 6.

b Source: Australian Institute of Health and Welfare (2013). *Australian hospital statistics 2011–12*, www.aihw.gov.au/publication-detail/?id=60129543133.

c No group F facilities participated in 2013.

Although participation was encouraged from as many healthcare facilities as possible, NAPS is less relevant for facilities in group G, a large proportion of which are outpatient and day-stay facilities. Hence, these have been removed from the results in Table 3.

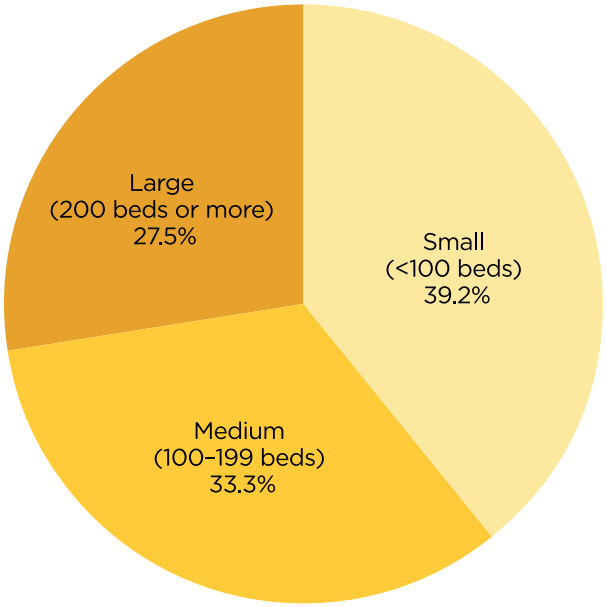
Table 2 shows that a substantial relative increase (135.7%) was observed in the number of outer regional facilities that participated. Participation by remote and very remote facilities also increased, although numbers were low.

Private hospitals

There was a substantial increase in the number of participating private hospitals, from 19 in 2013 to 51 in 2014. Many of the participating hospitals were in New South Wales, Queensland, Victoria and Western Australia.

Roughly equal numbers of participants were from small (<100 beds), medium (100–199 beds) and large (≥200 beds) private hospitals (Figure 2).

Figure 2 Participating private hospitals, by average number of available beds



Note: *n* = 51
Source for number of beds: National Health Performance Authority 2015, www.myhospitals.gov.au

Table 2 Participating public hospitals in 2013 and 2014, by remoteness classification

Remoteness	Number of hospitals participating		Total number in each category[a]	% of all hospitals in category, 2014	% change from 2013	
	2013	2014			Absolute	Relative
Major cities	64	83	175	47.4	+10.3	+27.7
Inner regional	45	60	163	36.8	+8.6	+30.4
Outer regional	14	33	159	20.8	+11.9	+135.7
Remote	6	10	56	17.9	+7.1	+66.7
Very remote	2	4	31	12.9	+6.5	+100.0
Total	131	190	584	32.5	+10.1	+45.0

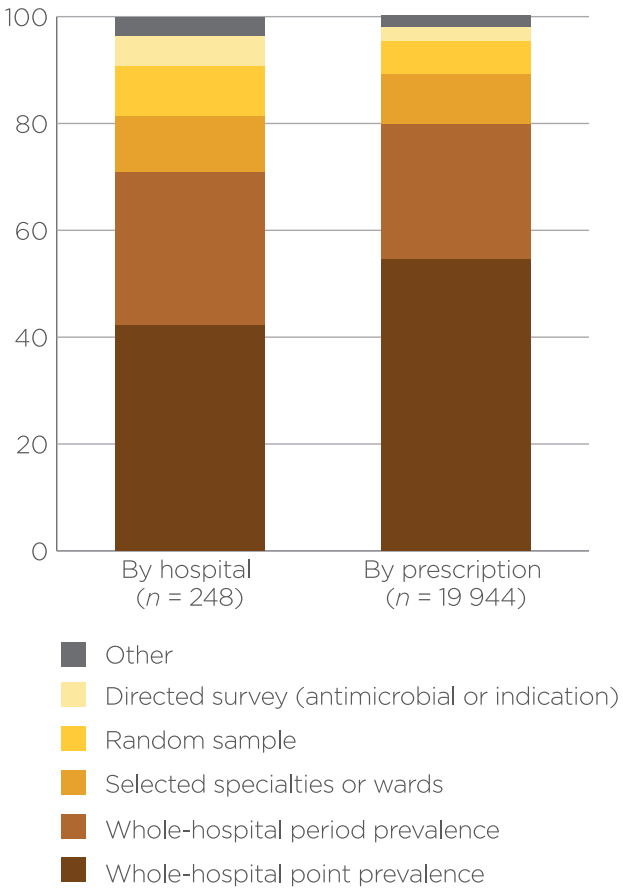
a Excludes unpeered (group G) facilities. Source: Australian Institute of Health and Welfare (2013). *Australian hospital statistics 2011–12*, www.aihw.gov.au/publication-detail/?id=60129543133.

Types of surveys performed

Whole-hospital PoPS or PePS were the most common methodologies. They were performed by 70.9% of hospitals and represented 79.9% of prescriptions (Figure 3), suggesting that larger facilities were more likely to perform these types of surveys.

Surveys of selected wards or specialties were performed by 10.5% of hospitals, randomly selected patients by 9.3%, selected antimicrobials or indications by 5.6%, and other nonspecified survey types by 3.6%.

Figure 3 Survey methodologies, by percentage of hospitals and prescriptions



Number of prescriptions

In total, 19 944 prescriptions were entered into the database for 12 634 patients in 2014. This compares with 12 800 prescriptions for 7700 patients in 2013.

Table 3 shows the number of prescriptions assessed under the various survey methodologies.

Table 3 Number of prescriptions assessed, by survey methodology

Survey methodology	Number of prescriptions	% of prescriptions
Whole-hospital point prevalence	10 894	54.6
Whole-hospital period prevalence	5 050	25.3
Selected specialties or wards	1 790	9.0
Random sample	1 231	6.2
Selected antimicrobials or indications	527	2.6
Other	452	2.3

Analysis of hospitals that conducted a whole-hospital PoPS revealed the prevalence of antimicrobial use to be 38.4%. This is comparable with the values commonly cited in literature (21.4–54.7%).[6] There were no substantial differences in prevalence across the different remoteness areas.

6 European Centre for Disease Prevention and Control (2013). *Point prevalence survey of healthcare associated infections and antimicrobial use in European acute care hospitals*, ECDC, Stockholm.

Findings on key indicators

Table 4 summarises the results for key indicators on antimicrobial prescribing for the participating facilities.

Tables 5 and 6 provide a more detailed breakdown of these results by state, peer group, remoteness and funding type.

Table 4 Results for key indicators in 2013 and 2014 for all contributing facilities

Key indicator		% of total prescriptions		% change from 2013	
		2013	2014	Absolute	Relative
Indication documented in medical notes (best practice >95%)		70.9	74.0	+3.1	+4.4
Surgical prophylaxis given for >24 hours (best practice <5%)		41.8	35.9[a]	–5.9	–14.1
Compliance with guidelines	Compliant with *Therapeutic Guidelines: Antibiotic* or local guidelines	59.7 (72.2)[b]	56.2 (73.7)[b]	–3.5	–6.0
	Noncompliant	23.0 (27.8)[b]	24.3 (26.3)[b]	+1.3	+5.5
	Directed therapy[c]	na	10.4	na	na
	No guideline available	11.0	4.6	–6.4	–58.3
	Not assessable	6.3	4.5	–1.8	–27.7
Appropriateness	Appropriate (optimal and adequate)	70.8 (75.6)[d]	72.3 (75.9)[d]	+1.5	+2.1
	Inappropriate (suboptimal and inadequate)	22.9 (24.4)[d]	23.0 (24.1)[d]	+0.1	+0.5
	Not assessable	6.3	4.7	–1.6	–24.9

na = not applicable
a Where surgical prophylaxis was selected as the indication (2785 prescriptions)
b Where compliance was assessable (15 899 prescriptions). The denominator excludes antimicrobial prescriptions marked 'Directed therapy', 'Not available' or 'Not assessable'.
c Introduced in the 2014 survey as a new classification category.
d Where appropriateness was assessable (18 998 prescriptions). The denominator excludes antimicrobial prescriptions marked 'Not assessable'.

Table 5 Results for key indicators, by jurisdiction, peer group, remoteness and funding type

		Number of hospitals	Number of prescriptions	Indication documented (%)	Surgical prophylaxis >24 hours (%)[a]	Compliance with guidelines (%)					Appropriateness (%)		
						Compliant	Noncompliant	Directed therapy	Not available	Not assessable	Appropriate	Inappropriate	Not assessable
State or territory	ACT	2	185	57.3	54.2[b]	57.8	31.4	7.0	2.7	1.1	66.5	33.0	0.5
	NSW	79	6 609	76.3	49.9	52.5	26.7	11.3	5.1	4.5	70.2	25.5	4.3
	NT	2	287	92.3	60[b]	54.6	21.6	19.2	3.1	1.7	78.4	20.6	1.1
	Qld	36	2 363	75.6	39.8	58.8	23.5	9.6	2.2	5.9	73.6	21.6	4.8
	SA	15	1 733	76.2	20.8	63.3	24.4	6.6	2.7	3.1	71.2	25.3	3.6
	Vic	80	6 250	73.6	33.2	56.9	22.7	10.7	4.9	4.8	74.1	19.9	6.1
	WA	34	2 517	65.2	31.1	56.9	22.1	10.4	6.5	4.3	72.5	23.2	4.3
Peer group (public hospitals only)	A	69	10 955	75.9	45.8	55.2	21.8	13.3	5.7	4.0	74.4	21.7	3.9
	B	29	2 087	78.4	39.9	54.8	29.3	8.6	4.1	3.3	71.9	24.2	3.9
	C	39	2 133	79.4	17.0	56.4	28.5	6.5	2.3	6.3	73.0	21.1	6.0
	D	42	1 650	77.6	22.0	62.7	25.0	5.5	2.6	4.4	69.6	26.2	4.2
	E	10	144	86.8	na	52.8	28.5	4.2	4.9	9.7	68.8	21.5	9.7
	F	1	11	54.5	100[b]	36.4[b]	45.5[b]	18.2[b]	0	0	63.6[b]	36.4[b]	0
	G	7	129	75.2	na	63.6	10.9	8.5	10.9	6.2	69.8	14.7	15.5
Remoteness (public hospitals only)	Major cities	83	11 325	76.9	42.5	54.8	22.4	13.2	5.8	3.9	74.3	21.6	4.1
	Inner regional	60	3 248	73.3	31.4	58.1	27.0	6.1	3.3	5.6	70.9	23.5	5.6
	Outer regional	33	1 600	84.8	27.7	57.7	24.3	9.5	2.8	5.8	73.4	21.4	5.2
	Remote	10	785	73.8	19.6	62.8	28.3	4.5	2.0	2.4	71.3	27.0	1.7
	Very remote	4	151	88.1	0[b]	47.7	39.7	6.0	3.3	3.3	60.3	35.8	4.0
Funding type	Public	197	17 075	77.0	37.7	56.0	23.9	11.1	4.8	4.3	73.4	22.3	4.4
	Private	51	2 869	55.8	34.1	57.1	26.7	6.9	3.5	5.9	65.7	27.3	7.0
Combined national result		248	19 944	74.0	35.9	56.2	24.3	10.4	4.6	4.5	72.3	23.0	4.7

na = not applicable
a Where surgical prophylaxis was selected as the indication (2785 prescriptions)
b Low numbers of surgical prophylaxis prescriptions (<30)

Table 6 Medians and interquartile ranges for key indicators, by jurisdiction, peer group, remoteness and funding type

		Number of hospitals	Indication documented (%)	Surgical prophylaxis >24 hours (%)[a]	Compliance with guidelines (%)[b]		Appropriateness (%)[c]	
					Compliant[b]	Noncompliant[b]	Appropriate[c]	Inappropriate[c]
State or territory	ACT	2	62.1 (53.5, 70.7)	61.1 (33.3, 88.9)[d]	65.2 (64.6, 65.8)	34.9 (34.2, 35.4)	68.2 (65.7, 70.7)	31.8 (29.3, 34.3)
	NSW	61	81.5 (67.2, 91.1)	45.5 (32.3, 71.4)	66.7 (52.8, 78.3)	33.3 (21.7, 47.2)	73.7 (59.1, 82.0)	26.3 (18.0, 40.9)
	NT	2	90.3 (81.1, 99.4)	61.9 (57.1, 66.7)[d]	68.6 (54.7, 82.6)	31.4 (17.4, 45.3)	76.2 (63.3, 89.1)	23.8 (10.9, 36.7)
	Qld	29	85.7 (73.7, 96.2)	41.2 (0, 61.9)[d]	73.8 (57.9, 80.9)	26.2 (19.1, 42.1)	79.2 (74.3, 88.7)	20.8 (11.3, 25.7)
	SA	14	80.5 (76.2, 100.0)	33.3 (4.3, 50)[d]	72.5 (57.4, 85.6)	27.5 (14.4, 42.6)	78.9 (64.4, 87.0)	21.1 (13.0, 35.6)
	Vic	60	77.1 (60.6, 91.7)	34.0 (15.6, 62.5)	69.5 (59.1, 84.6)	30.5 (15.4, 40.9)	78.6 (67.9, 87.1)	21.4 (12.9, 32.1)
	WA	25	74.6 (38.7, 92.1)	30.0 (2.1, 53.0)[d]	70.6 (56.1, 91.7)	29.4 (8.3, 43.9)	76.4 (52.9, 87.0)	23.6 (13.0, 47.1)
Peer group (public hospitals only)	A	67	79.9 (69.2, 87.9)	50 (36.4, 66.7)	73.0 (59.6, 82.7)	27.0 (17.3, 40.4)	77.5 (67.7, 85.6)	22.5 (14.4, 32.3)
	B	27	88.0 (72.6, 96.5)	41.4 (0, 94.4)[d]	66.0 (52.9, 78.3)	34.0 (21.7, 47.1)	78.1 (63.2, 82.6)	21.9 (17.4, 36.8)
	C	32	86.8 (72.9, 95.1)	9.1 (0, 38.5)[d]	65.3 (54.4, 82.1)	34.7 (17.9, 45.6)	77.7 (62.4, 89.7)	22.3 (10.3, 37.6)
	D	23	91.1 (60.0, 95.9)	15.4 (0, 70)[d]	72.5 (56.4, 92.3)	27.5 (7.7, 43.6)	72.1 (60.5, 87.0)	27.9 (13.0, 39.5)
	E	1	85.7 (85.7, 85.7)	No data	58.5 (58.5, 58.5)	41.5 (41.5, 41.5)	73.8 (73.8, 73.8)	26.2 (26.2, 26.2)
	F	0	No data	No data	No data	No data	No data	No data
	G	2	82.0 (77.4, 86.5)	No data	56.2 (76.2, 96.3)	13.8 (3.7, 23.8)	87.1 (74.3, 100.0)	12.9 (0.0, 25.7)
Remoteness (public hospitals only)	Major cities	73	81.3 (73.3, 91.8)	42.9 (25, 53.3)	71.5 (59.6, 81.6)	28.5 (18.4, 40.4)	78.0 (70.1, 85.2)	22.0 (14.8, 29.9)
	Inner regional	46	81.6 (51.9, 92.7)	40 (2.6, 83.3)	68.3 (56.1, 84.4)	31.7 (15.6, 43.9)	75.5 (61.0, 87.8)	24.5 (12.2, 39.0)
	Outer regional	22	86.8 (80.6, 95.9)	51.7 (13.8, 60.0)[d]	68.9 (52.8, 87.9)	31.1 (12.1, 47.2)	75.7 (66.1, 89.1)	24.3 (10.9, 33.9)
	Remote	8	85.3 (37.5, 97.2)	15.4 (0, 57.1)[d]	70.3 (58.0, 87.7)	29.7 (12.3, 42.0)	72.4 (61.4, 85.4)	27.6 (14.6, 38.6)
	Very remote	2	88.4 (78.7, 98.2)	0 (0.0, 0.0)[d]	51.6 (49.1, 54.2)	48.4 (45.8, 50.9)	60.8 (43.6, 78.0)	39.2 (22.0, 56.4)
Funding type	Public	151	82.3 (72.2, 93.3)	41.2 (13.8, 62.5)	70.6 (57.4, 82.7)	29.4 (17.3, 42.6)	77.2 (65.7, 86.7)	22.8 (13.3, 34.3)
	Private	42	59.3 (23.6, 87.5)	34.0 (21.1, 61.9)	65.2 (51.9, 80.9)	34.8 (19.1, 48.1)	75.1 (55.6, 76.7)	24.9 (13.3, 44.4)
Combined national result		193	81.1 (63.1, 92.9)	40.0 (18.3, 60.5)	69.4 (56.1, 82.6)	30.6 (17.4, 43.9)	76.5 (64.5, 86.7)	23.5 (13.3, 35.5)

a Where surgical prophylaxis was selected as the indication
b Prescriptions marked 'Directed therapy', 'Not available' or 'Not assessable' have been excluded from the denominator.
c Prescriptions marked 'Not assessable' have been excluded from the denominator.
d Low numbers of hospitals with surgical prophylaxis prescriptions (<30)

Note: Facilities that contributed fewer than 30 prescriptions have been excluded.

Documentation of indication

Documentation of indication (74.0%) was similar to 2013 results (70.9%). If prophylaxis indications (surgical and medical) are excluded, documentation increases to 79.1%. This value still falls short of the best-practice target of 95%.

Documentation was significantly better in public facilities than in private facilities (median 82.3% vs 59.3%, $P = 0.0002$); this difference was also seen in 2013. Although no statistically significant differences were seen between jurisdictions, documentation appeared to be highest in the Northern Territory (92.3%) and lowest in the Australian Capital Territory (57.3%).

Surgical prophylaxis

A reduction in the proportion of surgical prophylaxis prescriptions prescribed for more than 24 hours was observed between 2014 (35.9%) and 2013 (41.8%); however, no statistically significant differences were observed after adjustment for hospital demographics. Both figures are substantially higher than the best-practice target of less than 5%. The lowest median of 33.3% was observed in South Australia. The Australian Capital Territory (61.1%) and the Northern Territory (61.9%) recorded the highest, although numbers of prescriptions were low in these territories.

There was a statistically significant difference in the median result between public hospitals and private hospitals (41.2% vs 34.0%, $P = 0.0001$). However, no statistically significant differences were seen between jurisdictions, peer groups or remoteness classifications.

Compliance with guidelines

Because of a change in the classification of compliance with guidelines and the release of the new *Therapeutic Guidelines: Antibiotic* (version 15), comparisons between 2014 and 2013 are difficult.

In 2014, 10.4% of all antimicrobials were prescribed for directed therapy, where known microbiology and susceptibility information was available. The introduction of this new category is likely to have contributed to the reduction in the proportion of prescriptions classified as 'no guideline available' (4.6% in 2014 vs 11.0% in 2013) and 'not assessable' (4.5% in 2014 vs 6.3% in 2013). Given that the majority of auditing occurred before the release of the new *Therapeutic Guidelines: Antibiotic*, it is unlikely that this change had a meaningful impact on the result.

Appropriateness

The proportion of prescriptions assessed as being appropriate remained similar in 2014 (72.3% of all prescriptions, 75.9% of assessable prescriptions) to 2013 (70.8% of all prescriptions, 75.6% of assessable prescriptions).

Interestingly, despite the 14.1% relative reduction in the proportion of surgical prophylaxis prescriptions for more than 24 hours, the relative improvement in appropriateness of this subset of prescriptions was only 2.3% (57.5% in 2014; 55.4% in 2013). This indicates that, although there may have been an improvement in the duration of surgical prophylaxis, the choice of antimicrobial may still have been inappropriate.

Specific findings on prescribing practices

The following sections describe more specific findings on the prescribing practices for certain antimicrobials and indications. Because calculations of prevalence are made, only antimicrobial prescriptions covered by surveys conducted as a whole-hospital PoPS or PePS, or randomised sample are included. Directed surveys have been excluded to minimise the impact of selection bias on the results.[7]

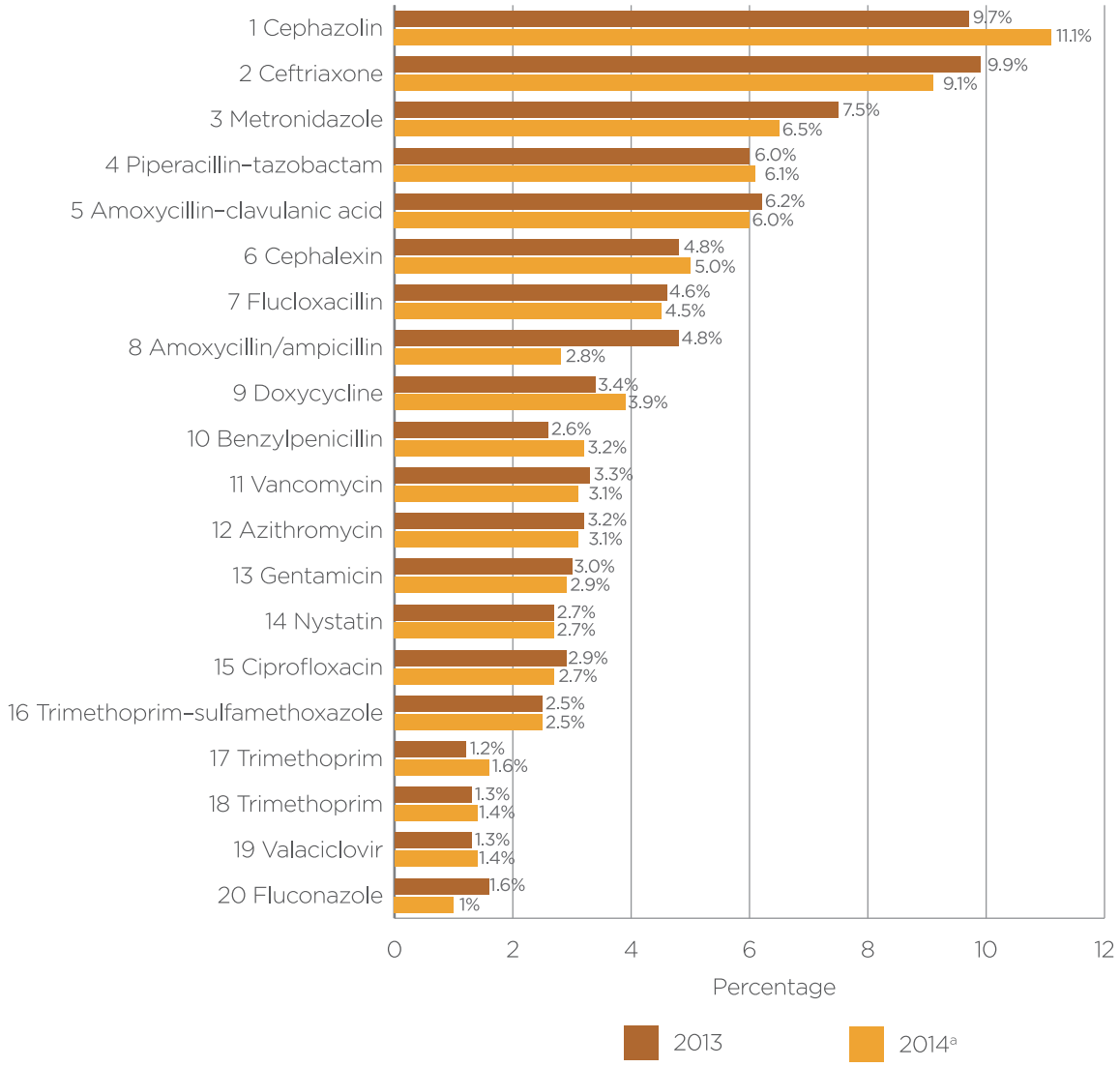
7 The 2014 and 2013 survey results are compared in this section. However, the denominators are not identical because data on survey methodology were not collected in 2013, and it was therefore not possible to exclude prescriptions based on survey methodology. This may explain some changes in the prevalence rates of some antimicrobials and indications.

Most commonly prescribed antimicrobials

The five most commonly prescribed antimicrobials were cephazolin (11.1%), ceftriaxone (9.1%), metronidazole (6.5%), piperacillin–tazobactam (6.1%) and amoxycillin–clavulanic acid (6.0%) (Figure 4).

Compared with 2013, cephazolin appears to have overtaken ceftriaxone as the most commonly prescribed antimicrobial; however, this is likely to reflect the increased numbers of lower-acuity hospitals that participated. A subgroup analysis of only hospitals that participated in 2013 revealed that ceftriaxone remained the most commonly prescribed antimicrobial.

Figure 4 The 20 most commonly prescribed antimicrobials



a Results only include surveys performed as a point prevalence survey, period prevalence survey or random sample survey. Number of prescriptions included was 17 175.

Appropriateness for the 20 most commonly prescribed antimicrobials

The appropriateness of prescribing for the five most commonly prescribed antimicrobials ranged from 63.1% to 76.9% (Table 7), and values were similar to the 2013 results. The prescribing of cephalexin remains a concern, with approximately 40% of these prescriptions deemed to be inappropriate; as well, an indication was documented for only 58.6% of these prescriptions.

The majority of cephazolin prescriptions were for surgical prophylaxis (73.7%). Of these, 30.7% were deemed to be inappropriate, and 32.2% were noncompliant with guidelines.

Higher rates of appropriateness were seen for the narrower-spectrum antimicrobials, including flucloxacillin, benzylpenicillin, vancomycin and trimethoprim–sulfamethoxazole. Valaciclovir, fluconazole and nystatin were also well prescribed.

Table 7 Appropriateness for the 20 most commonly prescribed antimicrobials

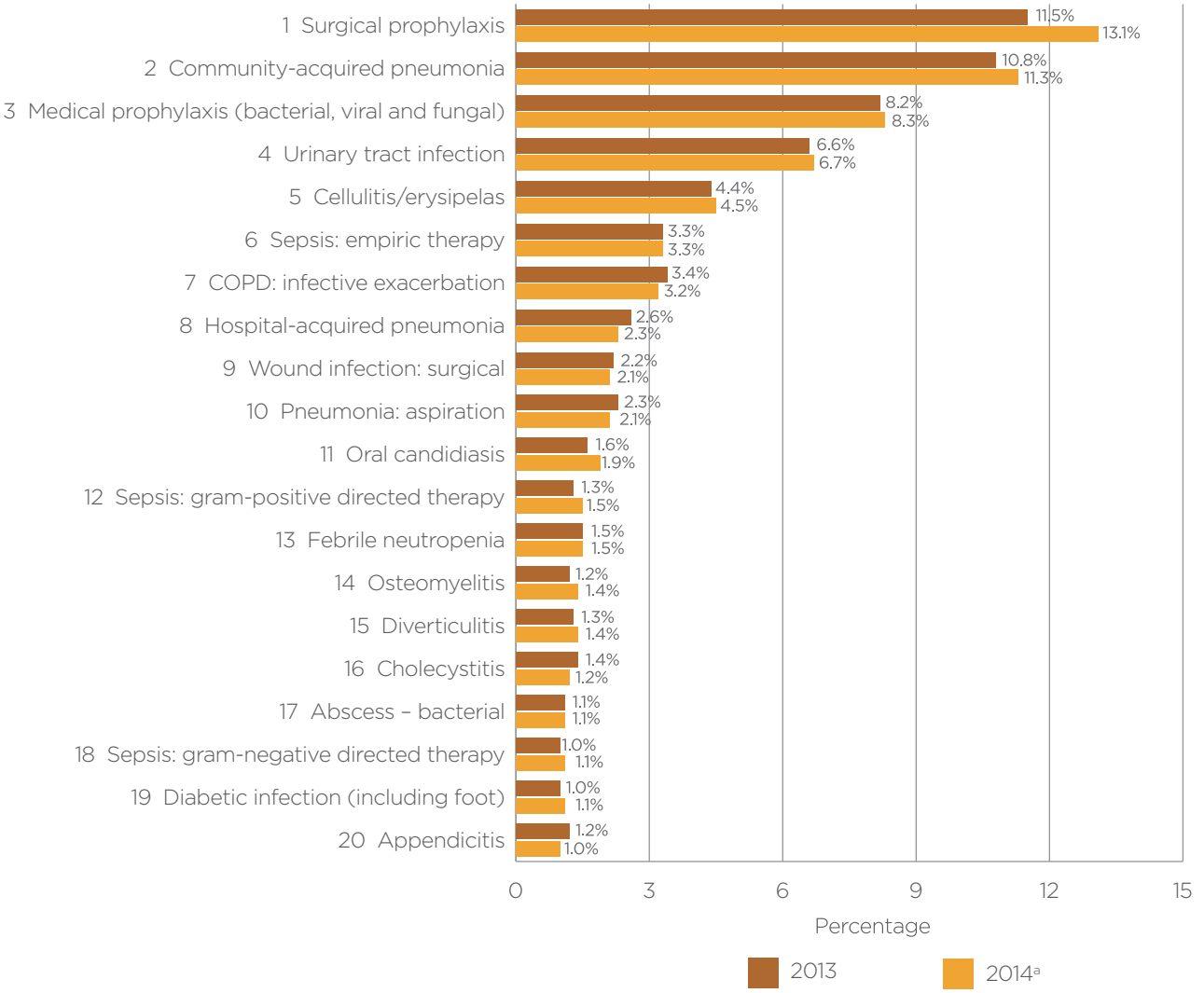
Rank	Antimicrobial	Number of prescriptions	Appropriate (%)	Inappropriate (%)	Not assessable (%)
1	Cephazolin	1908	66.0	31.6	2.4
2	Ceftriaxone	1558	64.8	30.6	4.6
3	Metronidazole	1114	65.8	27.7	6.5
4	Piperacillin–tazobactam	1052	76.9	19.5	3.6
5	Amoxycillin–clavulanic acid	1026	63.1	31.5	5.5
6	Cephalexin	853	50.1	39.9	10.1
7	Flucloxacillin	775	83.7	13.9	2.3
8	Amoxycillin/ampicillin	732	72.8	24.5	2.7
9	Doxycycline	674	74.3	21.5	4.2
10	Benzylpenicillin	556	83.8	14.7	1.4
11	Vancomycin	539	82.0	13.4	4.6
12	Azithromycin	524	64.9	32.1	3.1
13	Gentamicin	499	76.4	19.8	3.8
14	Nystatin	471	84.1	5.1	10.8
15	Ciprofloxacin	456	68.9	24.6	6.6
16	Trimethoprim–sulfamethoxazole	428	92.5	4.0	3.5
17	Trimethoprim	272	75.7	19.9	4.4
18	Clotrimazole	247	76.9	10.1	13.0
19	Valaciclovir	246	94.7	2.4	2.8
20	Fluconazole	234	88.0	6.4	5.6

Note: Results only include surveys performed as a point prevalence survey, period prevalence survey or random sample survey.

Most common indications

As shown in Figure 5, the five most common indications for which antimicrobials were prescribed remained unchanged from 2013. They were surgical prophylaxis, community acquired pneumonia, medical prophylaxis, urinary tract infections and cellulitis/erysipelas.

Figure 5 The 20 most common indications



COPD = chronic obstructive pulmonary disease

a Results only include surveys performed as a point prevalence survey, period prevalence survey or random sample survey. Indications marked as 'unknown' or 'other' have been excluded. Number of prescriptions included was 15 967.

Appropriateness for the 20 most common indications

Table 8 shows the levels of appropriateness of prescribing for the 20 most common indications.

Table 8 Appropriateness for the 20 most common indications

Rank	Indication	Number of prescriptions	Appropriate (%)	Inappropriate (%)	Not assessable (%)
1	Surgical prophylaxis	2246	56.9	40.2	2.9
7	COPD: infective exacerbation	552	62.3	36.8	0.9
16	Cholecystitis	209	72.2	27.8	0.0
2	Community-acquired pneumonia	1936	73.9	25.0	1.1
4	Urinary tract infection	1156	73.1	25.0	1.9
5	Cellulitis/erysipelas	759	74.7	24.8	0.5
20	Appendicitis	159	76.7	22.6	0.6
9	Wound infection: surgical	369	74.5	21.4	4.1
10	Pneumonia: aspiration	362	77.1	21.3	1.7
8	Hospital-acquired pneumonia	401	77.8	21.2	1.0
17	Abscess	190	77.9	19.5	2.6
6	Sepsis: empiric therapy	563	80.8	17.1	2.1
15	Diverticulitis	219	85.8	14.2	0.0
14	Osteomyelitis	249	81.9	13.3	4.8
18	Sepsis: gram-negative bacteraemia	188	87.2	12.8	0.0
19	Diabetic infection (including foot)	169	88.2	11.2	0.6
12	Sepsis: gram-positive bacteraemia	261	89.7	10.0	0.4
13	Febrile neutropenia	258	92.6	6.6	0.8
3	Medical prophylaxis (bacterial, viral and fungal)	1320	89.9	6.4	3.6
11	Oral candidiasis	332	89.8	5.7	4.5

COPD = chronic obstructive pulmonary disease

Note: Results only include surveys performed as a point prevalence survey, period prevalence survey or random sample survey. Indications marked as 'unknown' or 'other' have been excluded. Number of prescriptions included was 15 967.

Prophylaxis

Prophylaxis continued to feature heavily among the top 20 indications, with the combination of surgical and medical prophylaxis accounting for 21.4% of antimicrobial prescriptions.

Although surgical prophylaxis was the leading indication, its contribution to the overall burden of antimicrobial use is likely to be lower than this might suggest because most use is of relatively short duration. However, surgical prophylaxis should be a key target for future improvement, given that approximately 40% of these prescriptions are deemed to be inappropriate. The most commonly cited reasons for inappropriateness of prescribing for surgical prophylaxis were incorrect duration (39.7%), antimicrobial not indicated (22.9%), and incorrect dose or frequency (15.7%) (Table 9).

Table 9 Reasons for inappropriateness of surgical prophylaxis prescriptions

Reason	Reason found (%)	Reason not found (%)	Not specified (%)
Incorrect duration	39.7	36.3	24.1
Antimicrobial not indicated	22.9	51.8	25.3
Incorrect dose or frequency	15.7	57.4	26.8
Spectrum too broad	7.1	63.2	29.7
Incorrect route	4.1	66.3	29.6
Spectrum too narrow	2.8	66.5	30.7
Allergy mismatch	1.0	99.0	0.0
Microbiology mismatch	0.7	99.3	0.0

Note: Results only include surveys performed as a point prevalence survey, period prevalence survey or random sample survey. Number of prescriptions included was 902.

In contrast, while medical prophylaxis is likely to contribute a significant burden to antimicrobial use overall, it was very well prescribed, with almost 90% of prescriptions deemed to be appropriate.

Indications most commonly assessed as appropriate

In the surveys conducted as a whole-hospital PoPS or PePS, or random survey, 74.0% of antimicrobials (14 413 prescriptions) were classified as being appropriate. Of these, 76.7% were optimal, and 23.3% were adequate.

Indications for which antimicrobials were most appropriately prescribed (≥80% appropriate) are listed in Table 10.

NAPS done once a year as a whole facility point prevalence survey is incredibly valuable to us as a snapshot of antimicrobial usage and areas to improve. It offers real benefits in terms of accreditation and procedure governance, and having a survey that captures just about everything is extremely useful for reporting purposes.

– response from feedback questionnaire

Table 10 Indications most commonly assessed as appropriate

Indication	Number of prescriptions	Appropriate (%)	Inappropriate (%)	Not assessable (%)
Endocarditis: prosthetic valve	32	100.0	0.0	0.0
Endocarditis: native valve	61	98.4	1.6	0.0
Mycobacterium tuberculosis	95	96.8	3.2	0.0
Hepatitis B virus	31	96.8	3.2	0.0
Pneumocystis jiroveci pneumonia	39	94.9	2.6	2.6
Helicobacter pylori	38	94.7	5.3	0.0
Febrile neutropenia	258	92.6	6.6	0.8
Prosthetic joint infection	117	92.3	4.3	3.4
Cystic fibrosis: infective exacerbation	108	91.7	8.3	0.0
Necrotising fasciitis	30	90.0	10.0	0.0
Medical prophylaxis (bacterial, fungal and viral)	1320	89.9	6.4	3.6
Oral candidiasis	332	89.8	5.7	4.5
Human immunodeficiency virus	68	89.7	0.0	10.3
Sepsis: gram-positive directed therapy	261	89.7	10.0	0.4
Empyema	54	88.9	11.1	0.0
Abscess – intra-abdominal	94	88.3	10.6	1.1
Diabetic infection (including foot)	169	88.2	11.2	0.6
Sepsis: gram-negative directed therapy	188	87.2	12.8	0.0
Hepatic encephalopathy	53	86.8	11.3	1.9
Cutaneous and mucosal candidiasis	94	86.2	9.6	4.3
Diverticulitis	219	85.8	14.2	0.0
Clostridium difficile	113	85.8	12.4	1.8
Septic arthritis	98	84.7	9.2	6.1
Cholangitis	93	83.9	16.1	0.0
Abscess (including quinsy)	31	83.9	16.1	0.0
Pelvic inflammatory disease	72	81.9	18.1	0.0
Osteomyelitis	249	81.9	13.3	4.8
Tinea – fungal	155	81.3	11.6	7.1
Sepsis: empiric therapy	563	80.8	17.1	2.1

Note: Results only include surveys performed as a point prevalence survey, period prevalence survey or random sample survey. Indications marked as 'unknown' or 'other' have been excluded. Number of prescriptions included was 15 967. For simplicity, indications with fewer than 30 prescriptions are not displayed but are included in the data analysis.

Indications most commonly assessed as inappropriate

In the surveys conducted as a whole-hospital PoPS or PePS, or random sample survey, 23.0% of antimicrobials prescribed (4585 prescriptions) were deemed to be inappropriate. Of these, 53.1% were suboptimal and 46.9% were inadequate.

The most commonly cited reason for inappropriateness (Table 11) was antimicrobial not indicated (26.4%), followed by spectrum too broad (20.6%), incorrect duration (18.8%), and incorrect dose or frequency (18.3%).

Table 12 shows the indications for which antimicrobials were assessed as being most inappropriately prescribed.

Table 11 Reasons for inappropriateness of prescribing

Reason	Reason found (%)	Reason not found (%)	Not specified (%)
Antimicrobial not indicated	26.4	47.7	25.8
Spectrum too broad	20.6	54.3	25.1
Incorrect duration	18.8	57.3	23.9
Incorrect dose or frequency	18.3	59.0	22.7
Microbiology mismatch	6.4	93.6	0.0
Spectrum too narrow	5.9	66.9	27.2
Incorrect route	4.9	70.3	24.9
Allergy mismatch	2.2	97.8	0.0

Note: Results only include surveys performed as a point prevalence survey, period prevalence survey or random sample survey. Number of prescriptions included was 3910.

Table 12 Indications for which antimicrobials were most inappropriately prescribed (>30% inappropriateness)

Indication	Number of prescriptions	Appropriate (%)	Inappropriate (%)	Not assessable (%)
Asthma: infective exacerbation	40	30.0	70.0	0.0
Bronchitis	75	46.7	50.7	2.7
Surgical prophylaxis	2246	56.9	40.2	2.9
COPD: infective exacerbation	552	62.3	36.8	0.9
Fever/pyrexia of unknown origin	67	50.7	34.3	14.9
Conjunctivitis	83	65.1	33.7	1.2
Bronchiectasis	107	66.4	31.8	1.9
Deep soft tissue infection	32	65.6	31.3	3.1
Pancreatitis	42	69.0	31.0	0.0
Colitis	52	67.3	30.8	1.9

COPD = chronic obstructive pulmonary disease

Note: Results only include surveys performed as a point prevalence survey, period prevalence survey or random sample survey. Indications marked as 'unknown' or 'other' have been excluded. Number of prescriptions included was 15 967. For simplicity, indications with fewer than 30 prescriptions are not displayed but are included in the data analysis.

Respiratory tract infections

High rates of inappropriateness were observed for a number of respiratory tract infections, including infective exacerbation of asthma, infective exacerbation of chronic obstructive pulmonary disease (COPD) and bronchitis. The most commonly cited reasons for inappropriateness for these three conditions (Table 13) were spectrum too broad (38.7%) and antimicrobial not indicated (27.9%).

Table 13 Reasons for inappropriateness of prescribing for infective exacerbation of COPD, infective exacerbation of asthma and bronchitis

Reason	Reason found (%)	Reason not found (%)	Not specified (%)
Spectrum too broad	38.7	35.3	26.0
Antimicrobial not indicated	27.9	44.2	27.9
Incorrect dose or frequency	8.6	60.6	30.9
Incorrect route	5.6	64.7	29.7
Microbiology mismatch	5.2	94.8	0.0
Incorrect duration	4.5	63.6	32.0
Spectrum too narrow	2.6	63.2	34.2
Allergy mismatch	1.9	98.1	0.0

COPD = chronic obstructive pulmonary disease
Note: Results only include surveys performed as a point prevalence survey, period prevalence survey or random sample survey. Number of prescriptions included was 269.

Documentation of indication was an area that we have asked the prescribers to improve on.

– response from feedback questionnaire

Compliance with guidelines for the 20 most common indications

Overall, 24.3% of antimicrobials (4839 prescriptions) were noncompliant with guidelines. Of these, 26.7% were still deemed to be appropriate and 72.1% inappropriate.

The most common reason for noncompliance (Table 14) was spectrum too broad (23.3%), antimicrobial not indicated (22.7%), and incorrect dose or frequency (20.1%).

Table 14 Reasons for noncompliance with guidelines

Reason	Reason found (%)	Reason not found (%)	Not specified (%)
Spectrum too broad	23.3	52.8	23.9
Antimicrobial not indicated	22.7	49.0	28.3
Incorrect dose or frequency	20.1	58.0	21.9
Incorrect duration	16.0	60.1	24.0
Incorrect route	5.0	70.7	24.3
Spectrum too narrow	5.0	68.1	26.9
Microbiology mismatch	4.5	95.5	0.0
Allergy mismatch	1.3	98.7	0.0

Note: Results only include surveys performed as a point prevalence survey, period prevalence survey or random sample survey. Number of prescriptions included was 269.

Table 15 shows the levels of compliance for the 20 most commonly prescribed indications.

Table 15 Compliance with guidelines for the 20 most common indications

Rank	Indication	Number of prescriptions	Compliant (%)	Noncompliant (%)	Directed therapy (%)	None available/ not assessable (%)
1	Surgical prophylaxis	2246	51.7	43.1	0.2	5.0
2	Community-acquired pneumonia	1936	64.3	30.7	3.0	1.9
3	Medical prophylaxis (bacterial, fungal and viral)	1320	82.5	5.7	1.5	10.3
4	Urinary tract infection	1156	47.8	24.4	24.4	3.5
5	Cellulitis/erysipelas	759	60.6	27.4	8.7	3.3
6	Sepsis: empiric therapy	563	66.8	19.0	2.8	11.4
7	COPD: infective exacerbation	552	50.0	42.4	5.6	2.0
8	Hospital-acquired pneumonia	401	62.3	26.9	7.5	3.2
9	Wound infection: surgical	369	38.8	22.8	24.7	13.8
10	Pneumonia: aspiration	362	67.4	27.9	2.2	2.5
11	Oral candidiasis	332	85.8	8.7	2.1	3.3
12	Sepsis: gram-positive bacteraemia	261	34.1	8.0	55.9	1.9
13	Febrile neutropenia	258	86.8	5.4	5.0	2.7
14	Osteomyelitis	249	30.1	9.6	47.8	12.4
15	Diverticulitis	219	72.6	26.0	0.9	0.5
16	Cholecystitis	209	66.5	30.1	1.9	1.4
17	Abscess	190	41.6	16.3	29.5	12.6
18	Sepsis: gram-negative bacteraemia	188	21.8	6.4	69.7	2.1
19	Diabetic infection (including foot)	169	62.7	9.5	19.5	8.3
20	Appendicitis	159	64.8	33.3	0.0	1.9

COPD = chronic obstructive pulmonary disease

Note: Results only include surveys performed as a point prevalence survey, period prevalence survey or random sample survey. Indications marked as 'unknown' or 'other' have been excluded. Number of prescriptions included was 15 967.

Indications with high levels of noncompliance were similar to indications with high levels of inappropriate prescribing. Surgical prophylaxis and infective exacerbation of COPD were the conditions for which prescribing was most commonly deemed to be noncompliant with guidelines.

Prescribing for a number of conditions – in particular, gram-positive and gram-negative sepsis – was prominently categorised as directed therapy. Although the indication itself implies that an organism has been isolated (and therefore most cases should meet the definition of directed therapy), 34.1% of gram-positive cases and 21.8% of gram-negative cases were assessed as compliant with guidelines, rather than as directed therapy. Users may have been unsure of the most appropriate categorisation for indications where directed therapy recommendations are included in prescribing guidelines. For example, *Therapeutic Guidelines: Antibiotic* makes specific recommendations on the management of sepsis caused by *Staphylococcus aureus*, *Streptococcus pyogenes*, *Pseudomonas* and gram-negative enteric bacteria. This will be addressed in future training.

Substantial proportions of prescribing for osteomyelitis, surgical wound infection, abscesses and urinary tract indications were also specified as being directed therapy.

The NAPS results have been used for education of medical staff. Documentation of indications has improved, ceftriaxone is now not our most prescribed drug (as it was in the first NAPS audit two years ago), more careful prescribing habits are developing, and our infectious diseases physicians are being used more for complex cases.

– response from feedback questionnaire

Feedback and review of processes

General comments

The vast majority (96.7%) of respondents to the feedback questionnaire were willing to participate in NAPS again. Lack of resources was the main barrier to participation – many felt that appropriate staffing to conduct the survey (75.0%) and to enter the data (32.6%) would improve participation.

Some users described how NAPS had improved doctor awareness about appropriate antibiotic prescribing, assisted with accreditation, assisted with education for nursing and medical staff, reduced antimicrobial use, and increased open dialogue among healthcare professionals about antimicrobial stewardship. For many, NAPS has highlighted gaps for targeted audits and validated concerns about antimicrobial prescribing for particular indications.

Approximately half of the respondents to the feedback questionnaire attended the online training sessions for auditors, and most found the sessions to be informative. Twenty-three hospitals – mainly from regional or remote areas – requested the remote assessment service; of the 20 responses received to the feedback questionnaire, 100% were very satisfied with this service, and felt that their level of understanding was either greatly improved or somewhat improved as a result.

Early promotion of NAPS and encouragement for facilities to conduct the survey before AAW resulted in a noticeable shift in timing compared with 2013. In 2013, most (95%) of the auditing occurred during and after AAW; in 2014, half of the auditing occurred between the launch and AAW.

The Commission will consider the responses to the 2014 feedback questionnaire in the design and conduct of future NAPS surveys.

Future directions

The 2014 NAPS had a strong uptake across a range of healthcare facilities, and a substantial increase in participation compared with 2013. Active recruitment of regional and remote hospitals, combined with increased support provided to these facilities, is likely to have contributed to the pronounced increases in participation by these types of facilities. NAPS provides important information to facilitate local quality improvement and identify target areas for improvement at a national level.

Feedback from users was overwhelmingly positive. Many users indicated that NAPS is a core component of their antimicrobial stewardship programs, and has assisted in guiding the development of interventions and educational activities within their facilities.

On a national level, the findings from the 2014 NAPS confirm those of the 2013 survey. These similarities were seen despite some differences in the profile of participating hospitals and some changes to data fields, and therefore strengthen the following conclusions:

- The appropriateness of prescribing of the five most commonly prescribed antimicrobials ranged from 63.1% to 76.9%. Overall, 23.0% of prescriptions were deemed to be inappropriate. The most common reasons for inappropriate prescribing were that antimicrobials were used unnecessarily for the given indication or for the required spectrum of activity.
- Inappropriate prescribing was very common for some respiratory infections – in particular, infective exacerbation of COPD, infective exacerbation of asthma and bronchitis.
- Surgical prophylaxis was the most common indication for antimicrobial use. As in 2013, this is a significant concern, with 40.2% of such prescriptions deemed to be inappropriate. The most common reason was an inappropriately extended duration of antimicrobial use.
- Overall, 74.0% of prescriptions had a reason documented in the medical notes. Hospitals should be encouraged to continue to improve this towards the best-practice target of 95%.
- The most common prescriptions were for cephalosporin antibiotics – in particular, cephazolin and ceftriaxone. As the sixth most commonly prescribed antimicrobial, oral cephalexin is a concern, with 39.9% of these prescriptions deemed to be inappropriate.

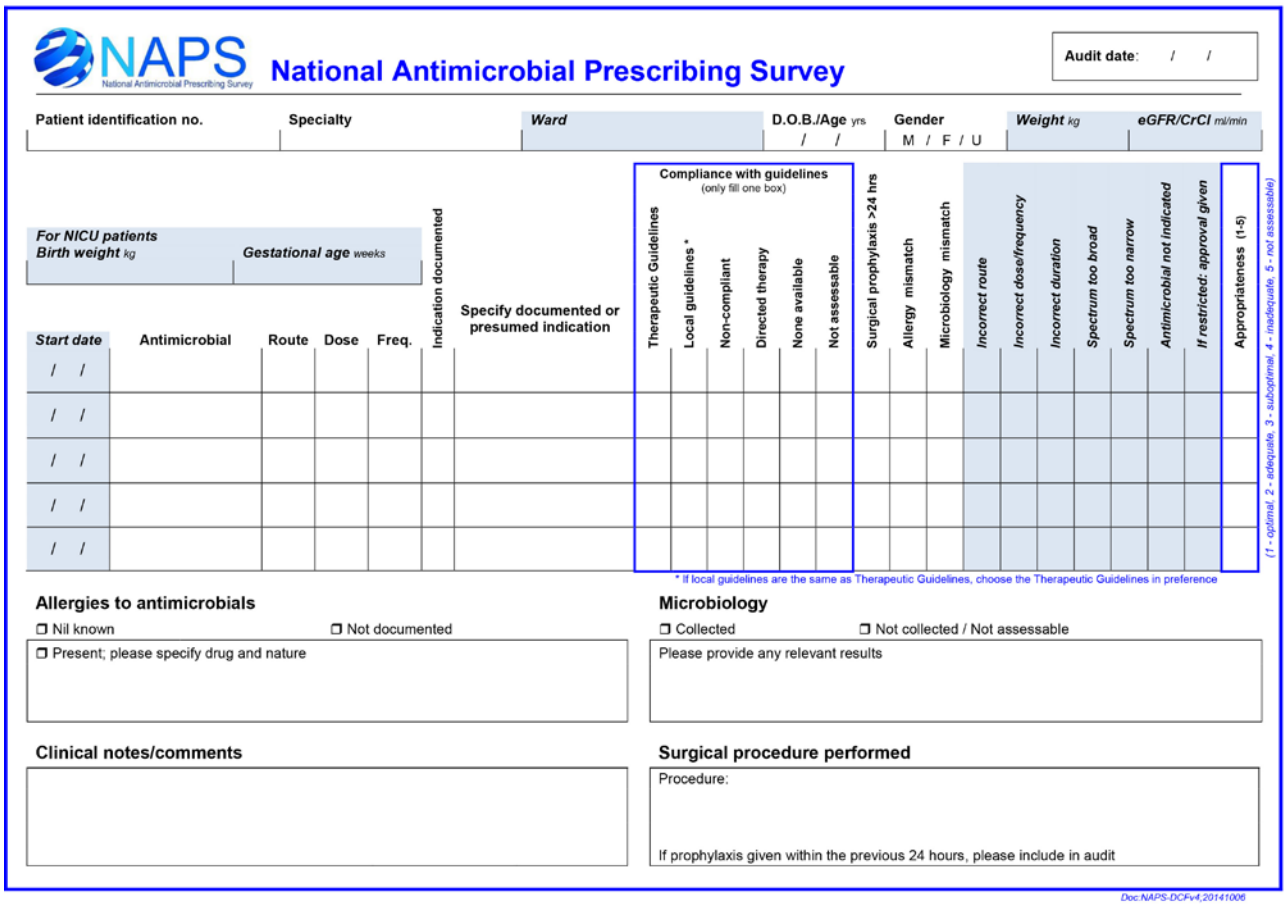
The Commission will continue to work with the National Centre for Antimicrobial Stewardship on expanding NAPS into other health sectors, beginning with development and piloting of a dedicated aged care module. This will be the first standardised antimicrobial and infection auditing tool available for use in Australian residential aged care facilities, and will be an important first step in improving antimicrobial stewardship activities in this setting.

As NAPS continues to grow in scope and reach, the National Centre for Antimicrobial Stewardship and the Commission will promote its relevant and practical use.

Based on what we have learnt from 2014, the following enhancements will be considered for future surveys:

- Ensure that the annual NAPS is launched early, ideally in August, so that all facilities are given appropriate time to conduct surveys before AAW.
- Improve the benchmarking functionality so that participants have greater flexibility in their ability to compare results.
- Develop an online competency module to improve the consistency of auditing.
- Through the NAPS team, continue to promote and provide expert assessments and online training sessions.
- Develop templates to help facilities communicate NAPS results.
- Develop a dedicated surgical prophylaxis survey.
- Develop additional modules to assess particular antimicrobials and indications.

Appendix 1 Data collection form



NAPS National Antimicrobial Prescribing Survey

National Antimicrobial Prescribing Survey

Audit date: / /

Patient identification no. | Specialty | Ward | D.O.B./Age yrs / / | Gender M / F / U | Weight kg | eGFR/CrCl ml/min

For NICU patients
Birth weight kg | Gestational age weeks

Start date	Antimicrobial	Route	Dose	Freq.	Indication documented	Specify documented or presumed indication	Compliance with guidelines (only fill one box): 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	Antimicrobial not indicated	If restricted: approval given	Appropriateness (1-5)
/ /																							
/ /																							
/ /																							
/ /																							
/ /																							

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

* If local guidelines are the same as Therapeutic Guidelines, choose the Therapeutic Guidelines in preference

Allergies to antimicrobials

❒ Nil known ❒ Not documented

❒ Present; please specify drug and nature

Microbiology

❒ Collected ❒ Not collected / Not assessable

Please provide any relevant results

Clinical notes/comments

Surgical procedure performed

Procedure:

If prophylaxis given within the previous 24 hours, please include in audit

Doc:NAPS-DCFv4,20141006

Appendix 2 Guidelines to assist with assessment of appropriateness

NAPS National Antimicrobial Prescribing Survey

Guidelines to assist with the assessment of appropriateness

Appropriateness			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], (including for surgical prophylaxis)	The antimicrobial prescription has been reviewed and endorsed by a clinician with expert antimicrobial prescribing knowledge.[4] **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, (including for surgical prophylaxis)
	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	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 or an unnecessary overlap in spectrum of activity • failure to appropriately de-escalate with microbiological results **OR** There may be a mild or non-life-threatening allergy mismatch	
	4	Inadequate	Antimicrobial prescription including antimicrobial choice , dosage, route or duration[3] is ***unlikely*** to treat the likely causative or cultured pathogens **OR** An antimicrobial is not indicated for the documented or presumed indication **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 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 age, weight, renal function or other prescribed medications, if this information is available
[2] Antibiotic Expert Group. Therapeutic Guidelines: Antibiotic. Version 14 (2010) **OR** Version 15 (2014). http://online.tg.org.au/ip/
[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
[4] Examples include infectious diseases physician or registrar, clinical microbiologist or registrar, or specialist pharmacist

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Appendix 3 Definitions to assess compliance with guidelines

Term	Definition
Compliant with *Therapeutic Guidelines*	The prescription complies with the current paper or online *Therapeutic Guidelines: Antibiotic*, including route, dose and frequency; and takes into account acceptable alterations due to the patient's age, weight, renal function (eGFR/CrCl), etc., or other prescribed medications.
Compliant with local guidelines	The prescription complies with officially endorsed local guidelines, including route, dose and frequency; and takes into account acceptable alterations due to the patient's age, weight, renal function (eGFR/CrCl), etc., or other prescribed medications. This does not include individual consultant, departmental or historical guidelines that do not have executive, or drug and therapeutic committee approval. If the local guidelines are based exactly on the *Therapeutic Guidelines*, choose the 'Therapeutic Guidelines' box in preference to the 'Local guidelines' box.
Noncompliant with guidelines	There is noncompliance with both *Therapeutic Guidelines: Antibiotic* and any officially endorsed local guidelines. UNLESS the prescription takes into account acceptable alterations due to the patient's age, weight, renal function (eGFR/CrCl), etc., or other prescribed medications.
Directed therapy	The prescription has changed from empirical therapy to directed therapy with microbiology culture and sensitivity results.
Guideline not available	There are no guidelines available for the documented or presumed indication.
Not assessable	The medical records are not comprehensive enough to determine a documented or presumed indication. OR It is difficult to assess if there is compliance.

Appendix 4 Antimicrobial usage by specialty report

NAPS
National Antimicrobial Prescribing Survey

Hospital X

NAPS October 2014

Antimicrobial Usage by Specialty

Specialty	Number of prescriptions	Percentage of total prescriptions	Number of patients on an antimicrobial	Number of occupied beds	Percentage of patients on an antimicrobial
Aged care	7	2.4%	6	29	20.7%
Cardiology	2	0.7%	2	22	9.1%
Cardiothoracic surgery	5	1.7%	5	16	31.3%
Colorectal surgery	3	1.0%	2	3	66.7%
Endocrinology	6	2.1%	5	8	62.5%
Gastroenterological surgery - general	7	2.4%	4		
Gastroenterology	1	0.3%	1	6	16.7%
General medicine	45	15.4%	32	91	35.2%
General surgery	1	0.3%	1	4	25.0%
Haematology	23	7.9%	10	12	83.3%
Head and neck surgery	1	0.3%	1	2	50.0%
Hepatobilliary surgery	7	2.4%	5	6	83.3%
Infectious diseases and HIV	11	3.8%	5	9	55.6%
Nephrology	20	6.8%	10	17	58.8%
Neurology	12	4.1%	6	15	40.0%
Neurosurgery	19	6.5%	10	17	58.8%
Oncology - medical	5	1.7%	3	5	60.0%
Orthopaedic surgery	12	4.1%	12	27	44.4%
Palliative care	11	3.8%	4	15	26.7%
Plastic surgery	5	1.7%	5	7	71.4%
Respiratory	17	5.8%	10	10	100.0%
Stroke	1	0.3%	1	11	9.1%
Transplant-bone marrow	42	14.4%	12	12	100.0%
Trauma	21	7.2%	16	29	55.2%
Urology	4	1.4%	3	7	42.9%
Vascular surgery	4	1.4%	4	7	57.1%
Total	**292**	**100.0%**			

Page 1 of 1

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Appendix 5 Time-series report

NAPS
National Antimicrobial Prescribing Survey

Survey Comparison

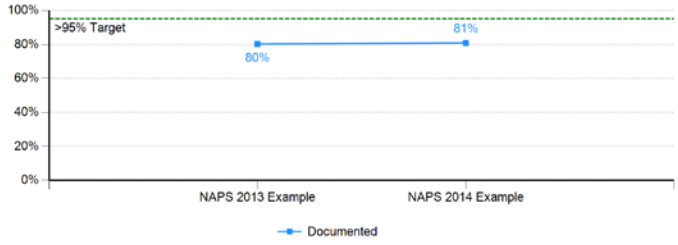
Surveys: ***NAPS 2013 Example***

Hospital X
NAPS-Training 2013
Hospital Y
NAPS 2013

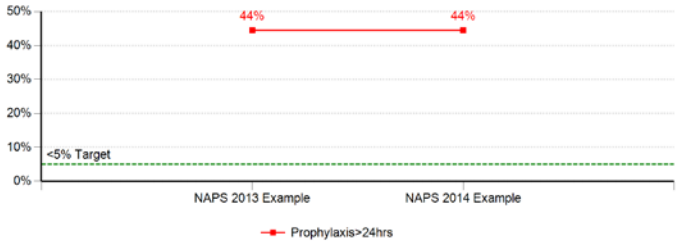
NAPS 2014 Example

Hospital X
NAPS-Training 2013
Hospital Y
NAPS 2014

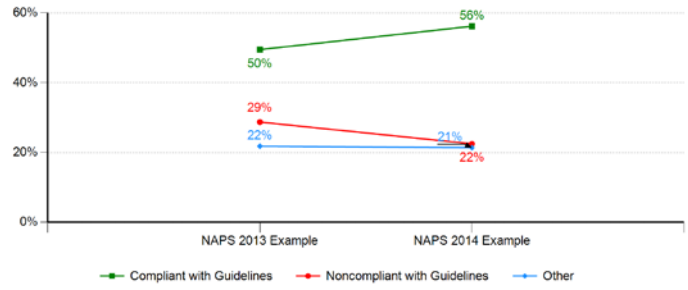
Documentation of Indication



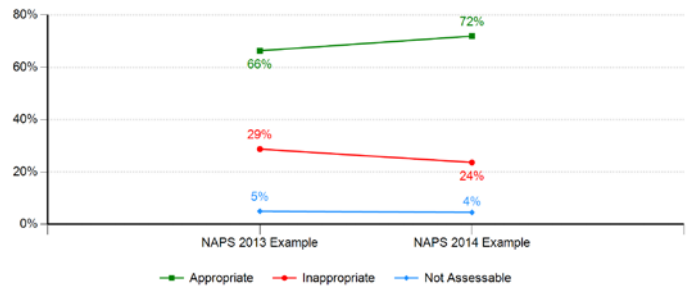
Surgical Prophylaxis given for greater than 24 hours



Compliance with Guidelines



Appropriateness of Antimicrobial



Appendix 6 Australian Institute of Health and Welfare peer group definitions for public hospitals

Peer group	Subgroup	Code	Definition
Principal referral and specialist women's and children's hospitals	Principal referral	A1	Major city hospitals with >20 000 acute casemix-adjusted separations, and regional hospitals with >16 000 acute casemix-adjusted separations per year
	Specialist women's and children's	A2	Specialised acute women's and children's hospitals with >10 000 acute casemix-adjusted separations per year
Large hospitals	Major city	B1	Major city acute hospitals treating more than 10 000 acute casemix-adjusted separations per year
	Regional and remote	B2	Regional acute hospitals treating >8000 acute casemix-adjusted separations per year, and remote hospitals with >5000 casemix-adjusted separations per year
Medium hospitals	Group 1	C1	Medium acute hospitals in regional and major city areas treating 5000–10 000 acute casemix-adjusted separations per year
	Group 2	C2	Medium acute hospitals in regional and major city areas treating 2000–5000 acute casemix-adjusted separations per year, and acute hospitals treating 2000 separations per year
Small acute hospitals	Regional	D1	Small regional acute hospitals (mainly small country town hospitals), acute hospitals treating <2000 separations per year, and with less than 40% nonacute and outlier patient-days of total patient-days
	Remote	D3	Small remote hospitals (<5000 acute casemix-adjusted separations but not 'multipurpose services' and not 'small nonacute'). Most are <2000 separations
Subacute and nonacute hospitals	Small nonacute	D2	Small nonacute hospitals treating <2000 separations per year, and with more than 40% nonacute and outlier patient-days of total patient-days
	Multipurpose services	E2	
	Hospices	E3	
	Rehabilitation	E4	
	Mothercraft	E5	
	Other nonacute	E9	For example, geriatric treatment centres combining rehabilitation and palliative care, with a small number of acute patients
Psychiatric hospitals		F	
Unpeered and other hospitals		G	Prison medical services, dental hospitals, special-circumstance hospitals, major city hospitals with <2000 acute casemix-adjusted separations, hospitals with <200 separations

Appendix 7 Breakdown of peer groups of participating public hospitals by state and territory

Peer group code	State or territory							
	ACT	NSW	NT	Qld	SA	Vic	WA	Total
A1	0	25	2	8	4	16	6	61
A2	0	0	0	0	0	1	0	1
A2	0	3	0	0	1	1	2	7
B1	1	8	0	1	2	6	0	18
B2	0	3	0	2	0	5	1	11
C1	0	8	0	1	2	3	3	17
C2	0	7	0	4	0	9	2	22
D1	0	7	0	4	0	10	4	25
D2	0	2	0	1	0	3	1	7
D3	0	0	0	4	0	0	6	10
E2	0	0	0	1	0	4	0	5
E4	0	2	0	0	0	0	0	2
E9	0	3	0	0	0	0	0	3
F	0	1	0	0	0	0	0	1
G	0	2	0	0	0	5	0	7
Total	1	71	2	26	9	63	25	197

Glossary

Term	Definition
allergy mismatch	Prescription of an antimicrobial that is in a class to which there is a documented allergy. (Known side effects such as nausea and vomiting are not considered to be an allergy.)
antimicrobial	A chemical substance that inhibits or destroys bacteria, viruses or fungi and that can be safely administered to humans or animals.
antimicrobial resistance	Failure of an antimicrobial to inhibit a microorganism at the antimicrobial concentrations usually achieved over time with standard dosing regimens.
antimicrobial spectrum	The range and different types of organisms that are affected by a particular antimicrobial. The antimicrobial may affect many organisms (broad spectrum) or target a specific few (narrow spectrum).
antimicrobial stewardship	An ongoing effort by a health service organisation to optimise antimicrobial use to improve patient outcomes, ensure cost-effective therapy and reduce adverse sequelae of antimicrobial use, including antimicrobial resistance.
clinical indication	An infection that makes a particular treatment or procedure advisable.
directed survey	A type of survey that looks specifically at a particular antimicrobial, indication, specialty, ward, etc. A directed survey may be useful following a point prevalence survey that identifies a particular issue, such as overprescription of a particular antimicrobial, or when a particular specialty or ward is not prescribing within guidelines.
directed therapy	The chosen antimicrobial therapy is based on the result of a confirmed microbiology test that has identified a likely bacterial pathogen and the susceptibility profile for that pathogen.
interquartile range	The range of values between the first and third quartiles of the data.
microbiology mismatch	Prescription of an antimicrobial to which an organism is resistant or likely to be resistant.
National Safety and Quality Health Service (NSQHS) Standards	Standards developed by the Australian Commission on Safety and Quality in Health Care to drive the implementation of safety and quality systems and improve the quality of health care in Australia. The 10 NSQHS Standards provide a nationally consistent statement about the level of care consumers can expect from health service organisations. (See the NSQHS Standards for more information.)
peer group	Hospitals of a similar type and complexity, as defined by the Australian Institute of Health and Welfare (AIHW). (See the AIHW web site for more information on each of the peer groups.)
surgical prophylaxis	Administration of an antimicrobial to prevent postoperative infection.
Therapeutic Guidelines: Antibiotic	An evidence-based guideline, prepared by an expert group of experienced clinicians, that combines a consensus approach to best practice with critical appraisal of the evidence regarding the treatment and prophylaxis of infections in Australia.
whole-hospital period prevalence survey	A method of performing serial surveys, which is recommended for sites that may have only a small number of patients on antimicrobials on any given day. For example, a survey can be performed on the same day every week until data for a minimum of 30 patients who have met the inclusion criteria have been collected. Patients with data already collected from surveys in the preceding weeks should be excluded.
whole-hospital point prevalence survey	A survey that collects data on all patients within a facility who meet the selection criteria. Because of the extensiveness of this type of survey, an appropriate number of assessors are required. This survey can be performed over a one-week period by auditing different specialties or different wards on different days. However, it is important to collect and maintain audited bed numbers and patients for each ward to produce an accurate denominator number at the end of the survey, and not to collect the same patient's details twice.