Chapter 1
Neonatal and paediatric health

At a glance

Early planned caesarean section without medical or obstetric indication

Planned early birth is an important intervention in maternity care, but the timing of birth should be carefully considered to optimise the outcome. There is growing evidence that planned caesarean section before 39 weeks' gestation increases short-term risks, including neonatal respiratory problems and infections in the first five years of life. It may also increase the risk of long-term developmental problems, poorer school performance and attention deficit hyperactivity disorder.

The Atlas found that, in 2015, between 42% and 60% of planned caesarean sections performed before 39 weeks' gestation did not have a medical or obstetric indication, and between 10% and 22% performed before 37 weeks did not have a medical or obstetric indication. These data have recently begun to be collected routinely in Australia; four states or territories with reliable data have been reported on. Rates were generally higher for privately funded patients than for publicly funded patients.

Antibiotics in children

The rate of antibiotic use in children in Australia is high compared with similar countries. For example, Australia's use in children aged 0–9 years is three times higher than in Norway and the Netherlands. In many cases, antibiotics are not needed – for example, for viral illnesses. Overuse of antibiotics contributes to bacterial resistance. Emerging research also suggests that changes to the normal gut bacteria caused by antibiotics may increase the risk of chronic autoimmune diseases in children, such as asthma. The Atlas found high rates of antibiotic use in children, with more than 3 million antibiotic prescriptions dispensed for children aged 0–9 years in 2016–17.

Proton pump inhibitor medicines in infants

Proton pump inhibitor medicines are often used to treat infants with simple reflux or colicky symptoms, such as irritability or crying, even though they are not effective for these symptoms. These medicines reduce the level of stomach acid, and increase the risk of infections such as pneumonia. They can also change the gut microbiome, which may increase the risk of allergies. The Atlas found about a four-fold difference between the lowest and highest state and territory rates in dispensing of proton pump inhibitor medicines under the Pharmaceutical Benefits Scheme for infants aged 1 year and under in Australia.

Recommendations

Early planned caesarean section without medical or obstetric indication

1a. Local Hospital Networks, health service organisations and clinicians to have systems in place to obtain fully informed patient consent for planned caesarean section by providing prospective parents with comparative information on the short- and long-term risks of planned early-term caesarean section without a medical or obstetric indication.

1b. The Medicare Benefits Schedule (MBS) Review Taskforce to review item 16519 (Management of labour and birth by any means including caesarean section), and ensure that item descriptors align with current clinical evidence and support a gestation period of at least 39 weeks unless there are medical or obstetric indications.

1c. Relevant colleges to initiate a joint project to develop evidence-based guidance, education and consumer information on early planned caesarean section without a medical or obstetric indication. This guidance should emphasise the need to ensure that potential risks for both mother and baby are discussed with the prospective parents.

1d. Local Hospital Networks and health service organisations to have systems in place, as part of their clinical governance processes, for regular review and reporting of rates of early planned caesarean section without a medical or obstetric indication, and for addressing unwarranted variation.

1e. All states and territories to ensure consistent, routine collection and reporting of data on gestational age for planned caesarean section without a medical or obstetric indication to improve the quality of data collections. This should include reporting of gestational age in days to allow more in-depth understanding of the distribution of births occurring before 39 weeks.

1f. The National Health and Medical Research Council to consider funding research to identify the effects of gestational age and delivery method on childhood development.

1g. The Commission to investigate the potential to include early planned caesarean section without a medical or obstetric indication in the national list of hospital-acquired complications, given the evidence about potential short- and long-term risks.

Inappropriate use of proton pump inhibitor medicines and antibiotics in children

1h. The Pharmaceutical Benefit Advisory Committee to recommend Pharmaceutical Benefits Scheme streamlined authority required listings for proton pump inhibitor medicines that have Therapeutic Goods Administration-approved indications in infants and children, such as gastro-oesophageal reflux disease.

1i. NPS MedicineWise to ensure that its public education campaigns highlight the potential harms of inappropriate antibiotic use in children, and provide advice for parents on managing coughs, colds, earaches and sore throats without the use of antibiotics.

1j. The Commission, as part of the Antimicrobial Use and Resistance in Australia Surveillance System, to monitor antibiotic use in children in hospitals and the community.

1k. The National Health and Medical Research Council to consider funding research into approaches to reduce antibiotic overuse in children, particularly in acute respiratory infections when antibiotics are most commonly prescribed.

1.1 Early planned caesarean section without medical or obstetric indication – special report

Why is this important?

Planned early birth is an important intervention in maternity care, but the timing of birth should be carefully considered to optimise the outcome for mother and child. Birth before 39 weeks' gestation is associated with higher risks of short-term adverse effects on the baby, such as respiratory distress, hypoglycaemia and jaundice, and an increased likelihood of admission to a neonatal intensive care unit. There is also emerging evidence of potential long-term adverse developmental effects, such as poorer educational outcomes in childhood.[1-6] Until recently, neonatal outcomes were generally thought to be the same whether planned birth occurred at 37, 38 or 39 weeks' gestation – but this is not the case. Pregnant women may not be aware that waiting until 39 weeks is best for their baby if there are no medical reasons for earlier birth.[7]

What did we find?

In 2015, the percentage of planned caesarean sections performed at less than 39 weeks' gestation without an obstetric or medical indication ranged from 42% to 60% in the four states/territories with presented data. The percentage of planned caesarean sections performed at less than 37 weeks' gestation without an obstetric or medical indication ranged from 10% to 22% in the four states/territories with presented data. Rates were generally higher for privately funded patients than for publicly funded patients for planned caesareans done before both gestational ages.

These findings should be seen in the context that Australian states and territories began routinely collecting standardised data on the main reason for caesarean section relatively recently, and the quality of data was sufficient for publication for four states/territories only. Of the reporting states/territories, data collection processes may be at different stages of maturity, so rates are not comparable across states/territories.

Early planned caesarean section without medical or obstetric indication

What can be done?

The emerging data on long-term adverse effects show that practices need to be reconsidered. Outcomes for babies could be improved by reducing rates of planned caesarean section without obstetric or medical indication at less than 39 weeks' gestation. Strategies to reduce rates should include:

- Providing parents with information about short and long-term adverse effects of early-term births
- Clinician education
- Improving data collection and monitoring
- Hospital-level public reporting.

Why a special report?

This report presents data on rates of planned caesarean section at less than 39 weeks', and at less than 37 weeks', gestation, without an obstetric or medical indication – that is, caesarean section when there was no established labour or other obstetric or medical reason for not waiting until 39 weeks.

Collection of data for this indicator is relatively new in Australia, and many states and territories do not yet collect the data required to calculate this national indicator. Therefore, the mapping and data analyses presented for other items in the Atlas are not possible for this item. Among the reporting states/territories, data collection processes may be at different stages of maturity, so rates are not comparable across states/territories. In addition, the difference between the gestational age recommended in the Royal Australian and New Zealand College of Obstetricians and Gynaecologists (RANZCOG) position statement and the indicator for this data item ('approximately 39 weeks' versus '39 weeks', respectively) may increase the rates reported for this item.[8] For example, deliveries at 38 weeks and 6 days' gestation are appropriate according to the RANZCOG position statement, but are included in the data for this indicator.[8] The additional analysis with 37 weeks as the cut-off gestation period was included to clarify the proportion of planned caesarean sections that occurred well before the RANZCOG recommended minimum gestational age.

Given the emerging evidence of what appears to be high rates of early planned caesarean section without a medical indication, a discussion of the issue and the available data are presented despite these limitations.

The timing of planned caesarean section, in light of the potential effects on the child's subsequent health, is the focus of this report. A broader discussion about rates of caesarean section was presented in the *Second Australian Atlas of Healthcare Variation*.[9]

Risks of early-term birth

Until recently, birth at any time between 37 and 41 weeks' gestation was considered full term, and neonatal outcomes were generally thought to be uniform during this period.[10,11] Evidence of poorer outcomes for babies born before 39 weeks prompted a re-evaluation of this definition, and, from 2010, the descriptor 'early term' began to be used for 37 and 38 weeks' gestation, and 'full term' for 39–41 weeks' gestation.[10,11]

Where there are certain obstetric or medical complications, such as pre-eclampsia or foetal growth restriction, earlier planned caesarean section may be necessary because the risks of waiting until 39 weeks' gestation outweigh the benefits.[8] If serious complications develop in the mother or baby, caesarean section may be performed regardless of gestation (that is, an emergency caesarean section).

Waiting until 39 weeks' gestation for a planned caesarean section, if there are no medical reasons for earlier birth, is now recommended by several international organisations and some Australian states.[12-16] A position statement from RANZCOG states: 'On balance, weighing up the risk of respiratory morbidity following elective caesarean section and the risk of labouring prior to caesarean section, it is recommended that elective caesarean section in women without additional risks should be carried out at approximately 39 weeks gestation'.[8]

Short-term risks

The increased risk of respiratory problems and of admission to neonatal intensive care for babies born by planned caesarean section at early term rather than full term is well established.[17-19] The risk of serious neonatal respiratory morbidity is significantly higher in babies delivered by elective caesarean section at 37–38 weeks than in those delivered at 39–41 weeks (1.2% compared with 0.5%).[20] The risks of hypoglycaemia, jaundice and admission to a neonatal intensive care unit are also increased in babies delivered by elective caesarean section at 37 or 38 weeks' gestation rather than at 39 to 41 weeks' gestation.[18,20]

The risk of hospitalisation for infections in the first five years of life is also higher among children delivered by planned caesarean section performed at 37–38 weeks' gestation rather than at 39 weeks' gestation.

Long-term risks

Evidence of longer-term effects of early-term birth has also grown recently. Children born at early term are at increased risk of poorer school performance and attention deficit hyperactivity disorder compared with those born at full term.[1-4]

In some cases, poorer developmental outcomes may be explained by the maternal or foetal factors that prompted the earlier birth. Studies that accounted for these factors still found poorer outcomes with birth at early term rather than full term. This suggests that harm is associated with the earlier timing, regardless of the effect of the factors that prompted it.[5]

For example, a United States study of 128,050 children in third grade found that those born at early term had significantly worse performance in maths than those born at full term.[5] This effect remained even after accounting for the effect of obstetric factors such as caesarean birth, birth weight and maternal age, as well as socioeconomic disadvantage.[5]

Although developmental risks are greater for babies born before 37 weeks' gestation, the greater frequency of births at 37 or 38 weeks' gestation means that these births have larger implications at a population level.[2,6] In a Scottish study, early-term births were estimated to account for a higher proportion of special educational needs in school-aged children than were preterm (less than 37 weeks' gestation) births (5.5% and 3.6%, respectively).[6]

Risks of waiting until 39 weeks

A United States study of the effect of policies to reduce planned births before 39 weeks' gestation did not find an increase in adverse outcomes. The prospective study of outcomes in 27 hospitals reported no significant increase in stillbirths when the rate of planned births at less than 39 weeks' gestation without an obstetric or medical indication was reduced from 9.6% to 4.3% of all births.[21] (Note that these rates are not directly comparable with the data presented in this report.)

A common concern about waiting until 39 weeks' gestation for a planned caesarean section is the risk of the mother going into spontaneous labour beforehand, and possibly requiring an emergency caesarean section.[22] Emergency caesarean section is associated with higher risks of complications and higher costs.[23,24] If caesarean section is planned for 39 weeks' gestation, an estimated 13–25% of women will end up having a caesarean section after labour has started, compared with 8–11% if it is planned for 38 weeks' gestation.[22]

Early planned caesarean section without medical or obstetric indication

Trends in Australia

Caesarean section rates

Rates of caesarean section overall have risen steadily in Australia since the early 1990s. In 2016, 34% of births in Australia were by caesarean section, compared with 31% in 2006 and 18% in 1990.[25,26]

Planned caesarean section and early-term planned birth

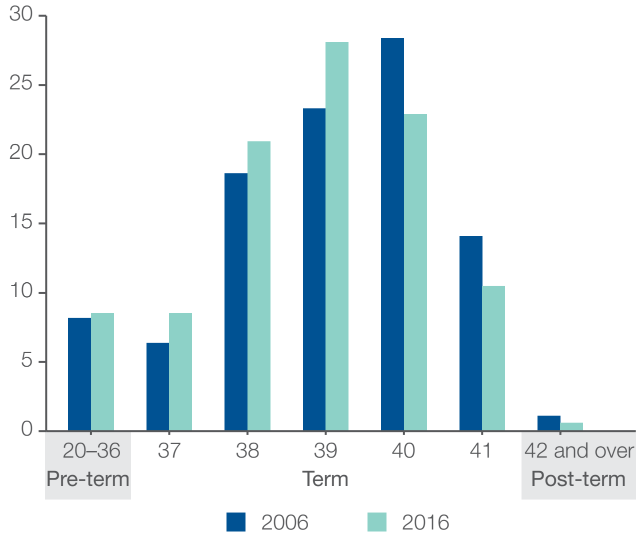
Few Australian data are available on trends in the proportion of caesarean sections that are planned and occur at early term. In New South Wales, between 1994 and 2009, the contribution of all (pre-labour) planned caesarean sections to all singleton births almost doubled, increasing from 9.1% to 17.1% over this period.[27]

Another study of New South Wales data showed that, between 2001 and 2009, the rate of planned caesarean section at 38 weeks' gestation increased by 25%, and at 39 weeks' gestation by 68%.[28] The proportion of all caesarean sections or inductions reported with established medical indications, such as maternal hypertension or foetal distress, decreased between 2001 and 2009, while the proportion increased for conditions in which evidence is equivocal (for example, diabetes mellitus).[28]

Gestational age at birth

The proportion of babies born at early term has increased in the past decade in Australia. Between 2006 and 2016, the proportion of babies born between 37 and 39 weeks' gestation increased, while the proportion born from 40 weeks onwards decreased (Figure 1.1).[25] Between 2006 and 2016, the average gestational age for all babies born in Australia fell from 38.9 weeks to 38.6 weeks.[25,29] A number of factors may have contributed to this shift.

Figure 1.1: Percentage of babies, by gestational age in weeks, 2006 and 2016



Note:
Pre-term births include a small number of births of less than 20 weeks' gestation.
Source: *Australia's Mothers and Babies 2016.*[25]

Important notes on the data used in this report

The draft National Core Maternity Indicator 18 – 'Caesarean sections <39 completed weeks (273 days) without obstetric or medical indication' – was created to benchmark practice and to reduce neonatal respiratory morbidity by minimising early birth. However, this indicator has not yet been submitted for endorsement by the National Health Data and Information Standards Committee. While the indicator was developed by the Expert Commentary Group responsible for the National Core Maternity Indicators, it was not further tested for reporting because the data were not available, and it is not currently reported by the Australian Institute of Health and Welfare (AIHW).

There are a number of limitations with the data quality for one of the data elements: 'main reason for caesarean section'. This data element is new to the National Perinatal Data Collection, and data that meet its specification are only available for some states and territories. Of the reporting states, data collection processes may be at different stages of maturity, so rates are not comparable across states/territories. For this reason, the reporting states/territories have not been identified.

In addition, state health departments that reviewed their data found that recording of the main reason for caesarean section was not always updated as the clinical situation evolved. For example, medical indications for early birth, such as foetal compromise, were not always recorded as the main indication for early caesarean section if a caesarean section had already been planned for other reasons. Similarly, clinical events such as pre-labour rupture of membranes may lead to an unplanned early caesarean section, but these were not always recorded if the caesarean section had already been planned for other reasons. Data on the original planned date are not available in these cases, and a proportion are likely to have been planned for 39 weeks. This means that the count of planned caesarean sections performed before 39 weeks without medical or obstetric indication is an overestimate for some states. For example, data from one state/territory are overestimated by approximately 3%; another state/territory was unable to distinguish between the main and additional reasons for caesarean section. In this instance, the reason reported as the main reason is the first-listed reason. Another state/territory was unable to collect data for this item (main reason for caesarean section) according to revised specifications introduced from 1 July 2015. Data were mapped by the AIHW to the revised specifications, where possible, and remaining data have been included in the 'Other, not further defined' category.

Data on the main indication for caesarean section are published at the state and territory level in the supplementary tables for the AIHW report *Australia's Mothers and Babies*.[25] It is anticipated that, as clinicians start to use the data for quality improvement purposes, more states and territories will be able to report according to the specifications.

The numerator of the indicator contains caesarean sections 'without obstetric/medical indication' where the caesarean section occurred in the absence of labour and at less than 39 completed weeks for the following reasons:

- Maternal choice in the absence of any obstetric, medical, surgical or psychological indication
- Previous caesarean section
- Previous severe perineal trauma
- Previous shoulder dystocia.

While these may be indications for planned caesarean section, they were not considered reasons for early planned caesarean section – that is, before 39 weeks.

The denominator is the total number of women who gave birth by caesarean section at less than 39 completed weeks' gestation and where there was no established labour.

Early planned caesarean section without medical or obstetric indication

Data source and subanalyses

Data are sourced from the National Perinatal Data Collection, which includes births that occur in hospitals, birth centres and the community (such as home births), for public and private patients. Because of small numbers, data are reported only at state/territory level. Reporting by smaller geographical area, remoteness and socioeconomic disadvantage is not possible.

Data availability

Data of sufficient quality for publication were available from four states/territories. Data on 'main reason for caesarean section' did not meet the specification for the remaining four states and territories. The states/territories with publishable data are leaders in data usage for exploring this issue; the other states and territories are developing their capabilities in this area.

Nationally, there were 36,757 caesarean sections before 39 weeks' gestation without established labour (denominator of the indicator) in 2015. Of these, 15,236 caesarean sections (41%) were from the four reporting states/territories; 21,521 (59%) were from other states and territories, and are not included in the data for this item.

What do the data show?

In 2015 in the four states/territories for which data were published, there were 8,547 caesarean sections without obstetric or medical indication at less than 39 weeks' gestation, out of a total of 15,236 caesarean sections at less than 39 weeks' gestation. There were 510 caesarean sections without obstetric or medical indication at less than 37 weeks, out of a total of 3,045 caesarean sections at less than 37 weeks' gestation in the four states/territories with published data.

In 2015 in the four states/territories for which data were published, the percentage of planned caesarean sections performed at less than 39 weeks' gestation without an obstetric or medical indication ranged between 42% and 60%. The percentage of planned caesarean sections performed at less than 37 weeks' gestation without an obstetric or medical indication ranged between 10% and 22%.

Analysis by patient funding status

In 2015 in the four states/territories with published data, the percentage of caesarean sections at less than 39 weeks' gestation without an obstetric or medical indication was 51.6% for publicly funded patients, compared with 60.1% for privately funded patients,. The percentage of caesarean sections performed at 39 weeks' gestation without an obstetric or medical indication was higher for privately funded patients in three of the four states/territories for which data are published.

At 37 weeks' gestation, the percentage of caesarean sections without an obstetric or medical indication for publicly funded patients was 14.3%, compared with 20.3% for privately funded patients. The percentage was higher for privately funded patients in the three states/territories for which both public and private data could be presented.

Analysis by Aboriginal and Torres Strait Islander status

Data analysed by Aboriginal and Torres Strait Islander status were available from two states/territories for caesarean section without obstetric or medical indication at less than 39 weeks' gestation, and from one state/territory at less than 37 weeks' gestation. The denominators are low for this category (for example, for one state/territory, the denominator is 163 for less than 39 weeks' gestation), so caution should be exercised in judging whether differences are significant.

The percentage of caesarean sections performed at less than 39 weeks' gestation without an obstetric or medical indication in one state/territory was lower among Aboriginal and Torres Strait Islander women (53.4%) than among other Australian women (56.1%). Percentages were similar for both groups in the other state/territory with publishable data (61.3% for Aboriginal and Torres Strait Islander women and 59.6% for other Australian women). The rate of caesarean section at less than 37 weeks' gestation without an obstetric or medical indication in the state/territory with published data in this category was higher among Aboriginal and Torres Strait Islander women (19.8%) than among other Australian women (15.2%).

Interpretation

Data from the four published states/territories showed that between 42.2% and 59.6% of planned caesarean sections performed before 39 weeks' gestation did not have an obstetric or medical indication, and between 9.6% and 22.2% performed before 37 weeks' gestation did not have an obstetric or medical indication. The variation between states was relatively small, but the reported rates suggest that the opportunity to improve outcomes in Australia is substantial.

Reported rates could be influenced by a number of factors, such as adherence to guidelines, differences in guidelines (for example, whether clinicians follow recommendations for planned caesarean no earlier than 39 weeks or at approximately 39 weeks)[8,15,16,31-33], and rates of private health insurance.

The need to avoid an emergency caesarean section is greater in settings without rapid access to 24-hour obstetric care. Rates of caesarean section before 39 weeks' gestation may be higher in some non-metropolitan areas for this reason.

Public–private partnership models may increase the rate of caesarean sections in some areas; for example, a public–private partnership in Western Australia was associated with a 4% increase in the rate of caesarean section in the catchment area in 2016–17. Social factors may influence rates in some areas – for example, timing to ensure that spouses are present for the birth in areas with military bases or fly-in-fly-out workers. Operating theatre capacity may also influence rates.

Differences in the quality of data collection may also influence rates. See 'Important notes on the data used in this report', page 45.

Policy and guideline differences

Differences in the gestational age used as the cut-off for this indicator ('39 completed weeks and over') versus that recommended in the RANZCOG position statement ('approximately 39 weeks') may have inflated rates reported for this item.[8] For example, births at 38 weeks and 6 days' gestation are appropriate according to the RANZCOG position statement, but are included in the data for this indicator.[8]

Data were available only in completed weeks of gestation. Data reported by days of gestation would provide more information about the proportion of planned caesarean sections without medical or obstetric indication that occurred at 38 weeks and 6 days compared with earlier gestation. However, even if the actual rates of planned caesarean sections without an obstetric or medical indication before 39 weeks' gestation were much lower than the rates reported, the scope to reduce preventable harm by reducing early-term births is still considerable. In addition, the percentage of planned caesarean sections without obstetric or medical indication occurring before 37 weeks' gestation (9.6–22.2%) shows that a substantial number are occurring well before the RANZCOG recommendation of approximately 39 weeks' gestation.[8]

Early planned caesarean section without medical or obstetric indication

Reducing early planned caesarean section

The high rates reported for planned caesarean sections without an obstetric or medical indication occurring before 39 weeks' gestation, and before 37 weeks' gestation, highlight the need for a concerted effort to address this issue.

Many organisations in the United States have worked to reduce rates of preterm and early-term birth without a medical indication, and large improvements have been seen in recent years.[34] Strategies have included publishing data, public awareness campaigns, clinician education and prohibiting bookings for births before full term. At least one state Medicaid agency in the United States has also stopped providing reimbursement for non-indicated births before 39 weeks' gestation.[13]

A multifaceted approach is also needed in Australia. This could include:

- Providing parents with information about short- and long-term adverse effects of early-term births
- Clinician education
- Improving data collection and monitoring
- Hospital-level public reporting.

Informed consent

More than half of pregnant women believe 37–38 weeks' gestation is the earliest time for safe birth, according to a recent Australian survey.[7] Education about the difference in outcomes, and particularly the effects on long-term child development, between early-term and full-term births could be a powerful strategy to reduce early caesarean section where there are no medical or obstetric indications. Prospective mothers who have opted for a planned caesarean section and who have no obstetric or medical indications for an early-term birth should be given information about the optimal time for the caesarean section, and the short- and long-term effects of early-term caesarean section. Prospective mothers should be given this information as far in advance as possible.

Informing mothers about the role of vaginal birth after caesarean section could also reduce the overall planned caesarean section rate, as approximately 58% of caesarean sections are repeat procedures.[28]

Clinician education and hospital policies

Educating clinicians about the most recent evidence for optimal timing of planned caesarean section may be useful for reducing planned caesarean section without medical or obstetric indication, but combining education with changes to hospital policies is more effective.[21] Three different approaches to reducing elective early-term births (inductions and caesarean sections) were compared in a United States study of births in 27 hospitals:[21]

- Education only – physicians were given literature and recommendations against performing purely elective births at less than 39 weeks' gestation
- Education plus a 'soft stop' approach – compliance with a policy of not scheduling purely elective births at less than 39 weeks' gestation was left up to individual physicians, but all exceptions to the policy were referred to a local peer review committee
- Education plus a 'hard stop' approach – purely elective planned births at less than 39 weeks' gestation were prohibited, and the policy was enforced by hospital staff who were empowered to refuse to schedule such births.

During the two-year study period, the hard stop policy was associated with the largest drop in elective births before 39 weeks (from 8.2% to 1.7%).[21] The soft stop approach was associated with a smaller, but still significant, drop (from 8.4% to 3.3%). Clinician education alone was less effective in changing practice, with a non-significant drop in rates (from 10.9% to 6.0%). For all groups combined, the rate of neonatal intensive care unit admission fell significantly during the study (from 8.9% to 7.5%). The study authors suggested that a rate of elective birth at less than 39 weeks' gestation, without medical indication, of less than 5% was a realistic national quality benchmark.[21] (Note that the data used in this study are not directly comparable with those in this report.)

An education campaign specifically focused for Australian general practitioners (GPs) on optimal timing for planned caesarean section could be worthwhile, as GPs undertake shared care with obstetricians in some cases.

Hospital monitoring and public reporting of local rates

Quality improvement activities by hospitals, obstetricians and neonatologists could provide insights into local rates of planned caesarean section without an obstetric or medical indication before 39 weeks' gestation. For example, local monitoring of clinical variation, as required by Action 1.28 of the Clinical Governance for Health Service Organisations Standard in the National Safety and Quality Health Service Standards (second edition)[35], could include monitoring of variation between the local rate and the state rate, variation between practitioners, and deviation from evidence-based guidelines.

Improving data collection and monitoring

The lack of publishable data for this indicator from many states and territories in Australia underscores the urgency of improving the completeness and consistency of national data collection on early planned caesarean section. Complete data would clarify the scale of the problem in Australia, allow efforts to be targeted where they are most needed, and show whether interventions are having an effect.

Data improvements could include:

- Complete collection from all states and territories to allow regular reporting as part of the National Core Maternity Indicators
- Reporting of gestational age in days to allow more in-depth understanding of the distribution of births occurring before 39 weeks
- Hospital monitoring and public reporting of local rates
- Inclusion of early planned caesarean section as a hospital-acquired complication.

In the United States, planned early-term birth without a medical indication is a national perinatal quality benchmark monitored by the National Quality Forum and the Joint Commission.[14] Consumers in the United States also have access to published rates of early elective births for many hospitals.[14,34]

United States data from the Leapfrog Hospital Survey (a voluntary safety and quality survey) showed that the proportion of planned births by caesarean section or induction performed without medical necessity before 39 weeks' gestation was 4.6% in 2013.[34] This rate fell to 1.6% in 2017, following increased interventions to reduce the rate.[34] (These rates are not directly comparable with the state rates reported in this chapter because the denominators are different, the participating United States hospitals may not be a representative sample and the measure includes inductions.[14]) The percentage of planned births before 39 weeks without an obstetric or medical indication, along with other indicator results, is publicly reported in a consumer-friendly format for each hospital assessing this indicator for the Leapfrog survey.[36]

Early planned caesarean section without medical or obstetric indication

Resources

- United States National Quality Forum Maternity Action Team, *Playbook for the Successful Elimination of Early Elective Deliveries*[37]
- California Maternal Quality Care Collaborative Toolkit to Transform Maternity Care, *Elimination of Non-medically Indicated (Elective) Deliveries Before 39 Weeks Gestational Age*[38]
- March of Dimes Foundation, Healthy Babies are Worth the Wait® community education toolkit[39]
- World Health Organization, statement on caesarean section rates[40]
- 'Antenatal care for Aboriginal and Torres Strait Islander women'.[41]

Australian initiatives

The information in this chapter will complement work already under way to improve outcomes from planned caesarean section in Australia. At a national level, this work includes:

- RANZCOG statement on timing of elective caesarean section at term[8]
- RANZCOG statement on caesarean delivery on maternal request.[42]

Many state and territory initiatives are also in place, including:

- Australian Capital Territory, policy of booking all elective caesarean sections for 39 weeks unless there is an obstetric or medical indication for earlier delivery
- South Australia Maternal and Neonatal Clinical Network, perinatal practice guidelines for caesarean section[31]
- New South Wales Health, guideline on timing of elective or pre-labour caesarean section[16]
- New South Wales Health translational research project grant for 'Are we there yet? Optimising timing of planned birth to improve newborn outcomes and reduce health service costs'
- Safer Care Victoria, *Planning for Birth After Caesarean*[15]
- Queensland Clinical Guidelines, *Vaginal Birth After Caesarean Section (VBAC)*[32]
- Western Australian Preterm Birth Prevention Initiative.[33]

References

1. Dong Y, Chen SJ, Yu JL. A systematic review and meta-analysis of long-term development of early term infants. Neonatology 2012;102(3):212–21.
2. Searle AK, Smithers LG, Chittleborough CR, Gregory TA, Lynch JW. Gestational age and school achievement: a population study. Arch Dis Child Fetal Neonatal Ed 2017;102(5):F409–16.
3. Bentley JP, Roberts CL, Bowen JR, Martin AJ, Morris JM, Nassar N. Planned birth before 39 weeks and child development: a population-based study. Pediatrics 2016;138(6):e20162002.
4. Murray SR, Shenkin SD, McIntosh K, Lim J, Grove B, Pell JP, et al. Long term cognitive outcomes of early term (37–38 weeks) and late preterm (34–36 weeks) births: a systematic review. Wellcome Open Res 2017;2:101.
5. Noble KG, Fifer WP, Rauh VA, Nomura Y, Andrews HF. Academic achievement varies with gestational age among children born at term. Pediatrics 2012;130(2):e257–64.
6. MacKay DF, Smith GC, Dobbie R, Pell JP. Gestational age at delivery and special educational need: retrospective cohort study of 407,503 schoolchildren. PLoS Med 2010;7(6):e1000289.
7. Zhang LY, Todd AL, Khambalia A, Roberts CL. Women's beliefs about the duration of pregnancy and the earliest gestational age to safely give birth. Aust N Z J Obstet Gynaecol 2015;55(2):156–62.
8. Royal Australian and New Zealand College of Obstetricians and Gynaecologists. Timing of elective caesarean section at term. Sydney: RANZCOG; 2014. https://www.ranzcog.edu.au/RANZCOG_SITE/media/RANZCOG-MEDIA/Women%27s%20Health/Statement%20and%20guidelines/Clinical-Obstetrics/Timing-of-elective-caesarean-section-(C-Obs-23)-March18.pdf?ext=.pdf (accessed Jan 2018).
9. Australian Commission on Safety and Quality in Health Care, Australian Institute of Health and Welfare. The Second Australian Atlas of Healthcare Variation. Sydney: ACSQHC; 2017.
10. Fleischman AR, Oinuma M, Clark SL. Rethinking the definition of 'term pregnancy'. Obstet Gynecol 2010;116(1):136–9.
11. American College of Obstetricians and Gynecologists. Definition of term pregnancy [Internet]. Washington, DC: ACOG; 2013 [updated 2013 Nov; cited 2018 Jan 16]. Available from: www.acog.org/Clinical-Guidance-and-Publications/Committee-Opinions/Committee-on-Obstetric-Practice/Definition-of-Term-Pregnancy
12. National Institute for Health and Care Excellence. Caesarean section clinical guideline [Internet]. London: NICE; 2011 [updated 2012 Aug; cited 2018 Jan 16]. Available from: www.nice.org.uk/guidance/cg132
13. American College of Obstetricians and Gynecologists. Nonmedically indicated early-term deliveries. Washington, DC: ACOG; 2013.
14. Joint Commission. Specifications manual for Joint Commission national quality measures: set measure PC-01 [Internet]. Washington, DC: Joint Commission; 2017. Available from: https://manual.jointcommission.org/releases/TJC2016A/TableOfContentsTJC.html
15. Safer Care Victoria Maternity and Newborn Network. Planning for birth after caesarean. Melbourne: Safer Care Victoria; 2018.
16. NSW Health. Maternity: timing of planned or pre-labour caesarean section at term. Sydney: NSW Ministry of Health; 2016.
17. Morrison JJ, Rennie JM, Milton PJ. Neonatal respiratory morbidity and mode of delivery at term: influence of timing of elective caesarean section. Br J Obstet Gynaecol 1995;102(2):101–6.
18. Tita AT, Landon MB, Spong CY, Lai Y, Leveno KJ, Varner MW, et al. Timing of elective repeat cesarean delivery at term and neonatal outcomes. N Engl J Med 2009;360(2):111–20.
19. Hansen AK, Wisborg K, Uldbjerg N, Henriksen TB. Risk of respiratory morbidity in term infants delivered by elective caesarean section: cohort study. BMJ 2008;336(7635):85–7.
20. Doan E, Gibbons K, Tudehope D. The timing of elective caesarean deliveries and early neonatal outcomes in singleton infants born 37–41 weeks' gestation. Aust N Z J Obstet Gynaecol 2014;54(4):340–7.
21. Clark SL, Frye DR, Meyers JA, Belfort MA, Dildy GA, Kofford S, et al. Reduction in elective delivery at <39 weeks of gestation: comparative effectiveness of 3 approaches to change and the impact on neonatal intensive care admission and stillbirth. Am J Obstet Gynecol 2010;203(5):449 e1–6.
22. Glavind J, Uldbjerg N. Elective cesarean delivery at 38 and 39 weeks: neonatal and maternal risks. Curr Opin Obstet Gynecol 2015;27(2):121–7.
23. Visco AG, Viswanathan M, Lohr KN, Wechter ME, Gartlehner G, Wu JM, et al. Cesarean delivery on maternal request: maternal and neonatal outcomes. Obstet Gynecol 2006;108(6):1517–29.
24. Petrou S, Khan K. An overview of the health economic implications of elective caesarean section. Appl Health Econ Health Policy 2013;11(6):561–76.
25. Australian Institute of Health and Welfare. Australia's mothers and babies 2016: in brief. Canberra: AIHW; 2018. (Cat. No. PER 97; Perinatal Statistics Series No. 34.)
26. Lancaster PA, Pedisich EL. Caesarean births in Australia, 1985–1990. Sydney: AIHW Perinatal Statistics Unit; 1993.
27. Nassar N, Schiff M, Roberts CL. Trends in the distribution of gestational age and contribution of planned births in New South Wales, Australia. PLoS One 2013;8(2):e56238.
28. Morris JM, Algert CS, Falster MO, Ford JB, Kinnear A, Nicholl MC, et al. Trends in planned early birth: a population-based study. Am J Obstet Gynecol 2012;207(3):186 e1–8.
29. Laws PJ, Hilder L. Australia's mothers and babies 2006. Sydney: AIHW National Perinatal Statistics Unit; 2008. (Cat. no. PER 46; Perinatal Statistics Series No. 22.)
30. Australian Institute of Health and Welfare. Australia's mothers and babies 2015: in brief. Canberra: AIHW; 2017. (Cat No. PER 91; Perinatal Statistics Series No. 33.)
31. SA Maternal and Neonatal Clinical Network. South Australian perinatal practice guidelines: caesarean section. Adelaide: SA Health; 2014. www.sahealth.sa.gov.au/wps/wcm/connect/Public+Content/SA+Health+Internet/Clinical+resources/Clinical+topics/Perinatal/Perinatal+Practice+Guidelines (accessed Jul 2018).
32. Queensland Health Queensland Clinical Guidelines. Vaginal birth after caesarean section (VBAC). Brisbane: Queensland Health; 2015.
33. Newnham JP, White SW, Meharry S, Lee HS, Pedretti MK, Arrese CA, et al. Reducing preterm birth by a statewide multifaceted program: an implementation study. Am J Obstet Gynecol 2017;216(5):434–42.
34. Castlight, Leapfrog Group. Maternity care: data by hospital on nationally reported metrics. San Francisco: Castlight; 2018.
35. Australian Commission on Safety and Quality in Health Care. National Safety and Quality Health Service Standards. 2nd ed. Sydney: ACSQHC; 2017.
36. Leapfrog Group. Compare hospitals [Internet]. Washington, DC: Leapfrog Group; 2018 [cited 2018 Jul 20]. Available from: www.leapfroggroup.org/compare-hospitals
37. National Quality Forum Maternity Action Team. Playbook for the successful elimination of early elective deliveries. Washington, DC: National Quality Forum; 2014.
38. Main E, Oshiro B, Chagolla B, Bingham D, Dang-Kilduff L, Kowalewski L. Elimination of non-medically indicated (elective) deliveries before 39 weeks gestational age (California Maternal Quality Care Collaborative Toolkit to Transform Maternity Care). Sacramento: California Department of Public Health, Maternal, Child and Adolescent Health Division; 2010.
39. March of Dimes Pregnancy and Newborn Health Education Center. Healthy Babies are Worth the Wait® community education toolkit. March of Dimes Foundation; 2010.
40. World Health Organization. WHO statement on caesarean section rates. Geneva: WHO; 2015.
41. Clarke M, Boyle J. Antenatal care for Aboriginal and Torres Strait Islander women. Aust Fam Physician 2014;43(1):20–4.
42. Royal Australian and New Zealand College of Obstetricians and Gynaecologists. Caesarean delivery on maternal request (CDMR). Sydney: RANZCOG; 2017. www.ranzcog.edu.au/RANZCOG_SITE/media/RANZCOG-MEDIA/Women%27s%20Health/Statement%20and%20guidelines/Clinical-Obstetrics/Caesarean-delivery-on-maternal-request-(C-Obs-39)-Review-July-2017_1.pdf.

1.2 Antibiotics dispensing in children, 9 years and under

Why is this important?

Much of current antibiotic use is inappropriate, with antibiotics being prescribed for viral illnesses when their use is not indicated.[1] More than 30 million prescriptions for antimicrobials were dispensed to people of all ages in the Australian community in 2015, with no change in this number since 2008.[2] There are harms associated with high use of antibiotics. For example, development of bacterial resistance that means some antibiotics are no longer effective in combating infections. Antimicrobial resistance is known to be increasing in Australia.[2] Other potential harms of high use of antibiotics are now being investigated. Antibiotic use in children is associated with a higher risk of asthma, Crohn's disease and weight gain, although researchers are still exploring these links.[3-6]

What did we find?

The rate of dispensing of antibiotics to children aged 9 years and under is almost equivalent to one antibiotic prescription annually per child in this age group in Australia.

What can be done?

Improving antibiotic prescribing has been a focus of attention for many years, but there has been limited success in reducing rates.[7-10] Sustained and concerted efforts to ensure patient and community awareness of the potential harms associated with antibiotic use in children are essential.[2,11] Improving patient knowledge of the trade-offs between likely benefits and harms has been shown to reduce the use of antibiotics.[12,13] Tools to assist with shared decision making should be promoted to ensure that parents are properly informed about appropriate use of antibiotics in their children. More attention needs to be given to strategies that would encourage clinician adherence to guidelines on appropriate prescribing.[11]

Antibiotics dispensing in children, 9 years and under

Context

This item focuses on rates of antibiotic dispensing for children aged 9 years and under. Antibiotics are used to treat infections, and to prevent infections in some susceptible patients (for example, during some types of surgery).[14] Antibiotic use in Australia is highest in children aged 0–9 years and in older people (aged 65 years and over).[2]

Upper respiratory tract infections are a common reason for seeking medical care, accounting for 26% of paediatric general practitioner (GP) consultations in Australia.[15] As most respiratory tract infections are caused by viruses, antibiotics have a limited role in treatment and should be reserved for cases in which a bacterial cause is suspected.[7] Inappropriate use of antibiotics was highlighted by a 2017 Australian study showing that GPs prescribed antibiotics for acute respiratory infections in children and adults at 4–9 times the rate expected if guidelines were followed.[1] Australia's rate of antibiotic use for children aged 9 years and under is about three times higher than that of similar countries such as Norway and the Netherlands.[8]

Antibiotic use promotes bacterial resistance, both in the individual and the community.[9,16] For example, an individual prescribed an antibiotic for a respiratory tract infection is more likely to carry bacteria resistant to that antibiotic within 12 months of use.[17] Longer duration of antibiotic use and multiple courses are associated with higher rates of bacterial resistance in an individual.[17] Children appear to be important transmitters and recipients of resistant bacteria[18], so inappropriate antibiotic use in children affects rates of resistance in the whole community.

Evidence of a link between childhood antibiotic use and an increased risk of chronic diseases is growing. Antibiotic use causes changes in the gut microbiome, and this may cause immune system changes that subsequently increase the risk of some conditions.[3-5,19] Antibiotic use in young children and babies is associated with an increased risk of asthma.[3,20,21] Childhood use of certain antibiotics is associated with an increased risk of weight gain, and the risk is higher with more courses of antibiotics.[6,22] Childhood antibiotic use is also associated with an increased risk of developing Crohn's disease.[4,23] The incidence of inflammatory bowel disease in children has increased markedly in Australia and worldwide, and antibiotic use has been suggested as a contributor to this trend.[24-27]

About the data

Data are sourced from the Pharmaceutical Benefits Scheme (PBS) dataset. This dataset includes all prescriptions dispensed under the PBS or the Repatriation Pharmaceutical Benefits Scheme, including prescriptions that do not receive an Australian Government subsidy. Note that some dispensed medicines may not be used.

The dataset does not include prescriptions dispensed for patients during their admission to public hospitals, discharge prescriptions dispensed from public hospitals in New South Wales and the Australian Capital Territory, direct supply of medicines to remote Aboriginal health services, over-the-counter purchase of medicines, doctor's bag medicines or private prescriptions.

Rates are based on the number of prescriptions dispensed for systemic antibiotics per 100,000 children aged 0–9 years in 2016–17. Antibiotics used orally, intravenously and intramuscularly are included; topical antibiotics are not included.

The term 'antibiotics' is used rather than 'antimicrobials' in this data item because other antimicrobials (antifungals, antivirals and antiparasitics) are not included. Note that the repeat analysis of antimicrobial medicines (in Chapter 5, page 239) includes a wider range of antimicrobials, not only antibiotics.

The analysis and maps are based on the residential address of the patient recorded in the PBS prescription claim and not the location of the prescriber or the dispensing pharmacy.

Rates are age and sex standardised to allow comparisons between populations with different age and sex structures.

This analysis was not undertaken by Aboriginal and Torres Strait Islander status because this information was not available for the PBS data at the time of publication.

What do the data show?

Magnitude of variation

In 2016–17, there were 3,053,315 PBS prescriptions dispensed for antibiotics in children, representing 96,721 prescriptions per 100,000 children aged 9 years and under (the Australian rate).

The number of PBS prescriptions dispensed for antibiotics across 328* local areas (Statistical Area Level 3 – SA3), ranged from 9,707 to 159,688 per 100,000 children aged 9 years and under. The rate was **16.5 times as high** in the area with the highest rate compared to the area with the lowest rate. The number of prescriptions dispensed varied across states and territories, from 69,015 per 100,000 children aged 9 years and under in the Northern Territory to 102,339 in Queensland (Figures 1.4–1.7).

After the highest and lowest 10% of results were excluded and 264 SA3s remained, the number of prescriptions dispensed per 100,000 children aged 9 years and under was 1.7 times as high in the area with the highest rate compared to the area with the lowest rate.

Analysis by remoteness and socioeconomic status

Rates of antibiotic dispensing in children aged 9 years and under were higher in major cities than in other areas. Rates were higher in areas with lower socioeconomic status in major cities and inner regional areas. However, there was no clear pattern according to socioeconomic status in other remoteness categories. Low rates of antibiotic dispensing in some remote, low-socioeconomic-status areas may be underestimates because dispensing through Aboriginal health services is not captured in the data (Figure 1.8).

* There are 340 SA3s. For this item, data were suppressed for 12 SA3s due to a small number of prescriptions dispensed and/or population in an area.

Antibiotics dispensing in children, 9 years and under

Analysis by age group

The rate of antibiotic dispensing was higher for children aged 4 years and under (113,906 prescriptions per 100,000 children) than for children aged 5–9 years (80,417 prescriptions per 100,000 children). This pattern was consistent across all states and territories (Figure 1.2).

Figure 1.2: Number of PBS prescriptions dispensed for antibiotics per 100,000 children in specific age group, sex standardised, by state and territory of patient residence, 2016–17

The data for Figure 1.2 are available at www.safetyandquality.gov.au/atlas

Children dispensed at least one prescription

The number of children aged 9 years and under who had at least one prescription for an antibiotic dispensed in 2016–17 was 45,085 per 100,000 – that is, 45% of the child population aged 9 years and under. The rate varied from 32,108 per 100,000 children aged 9 years and under in the Northern Territory to 46,824 per 100,000 in New South Wales (Figure 1.3).

Figure 1.3: Number of children dispensed at least one antibiotic per 100,000 children aged 9 years and under, age and sex standardised, by state and territory of patient residence, 2016–17

The data for Figure 1.3 are available at www.safetyandquality.gov.au/atlas

Notes:
For further detail about the methods used, please refer to the Technical Supplement.
Source: AIHW analysis of Pharmaceutical Benefits Scheme data and ABS Estimated Resident Population 30 June 2016.

Interpretation

The overall rates of antibiotic dispensing in children aged 9 years and under are high. Variation in rates of antibiotic dispensing is likely to be due to geographical differences in the factors discussed below.

Clinical decision-making

Differences in clinicians' perceptions, attitudes towards managing patient illness and patient expectations, and prescribing behaviour will affect patterns of antibiotic prescribing.[28] Clinician adherence to guidelines about antibiotic use (for example, prescribing antibiotics for upper respiratory tract infections only when a bacterial infection is identified) is likely to affect rates of dispensing. Clinician non-adherence to guidelines, such as prescribing antibiotics for viral infections, will contribute to higher rates of inappropriate antibiotic use.

Socioeconomic status and health literacy

Parents with lower levels of education may have a poorer understanding of viral versus bacterial causes of childhood illnesses, and may have a greater expectation of antibiotic prescription for viral illnesses.[29,30] Other groups with low health literacy may also have higher expectations of antibiotic prescription, which in turn influences GP prescribing behaviour.[29-31] In some cases, prescribers may incorrectly assume that patients expect a prescription for an antibiotic.[31]

Rates of underlying illnesses

The local rate of bacterial infections that require antibiotic treatment is likely to affect rates of dispensing. Rates in some areas may be increased by small numbers of patients who require frequent antibiotics – for example, children with chronic diseases such as cystic fibrosis. Variation could also be influenced by local rates of influenza (flu) vaccination, as this could affect the number of patients seeking antibiotics during the flu season.

The burden of infectious disease tends to be higher in low-income communities.[32,33] The rate of infections may be influenced by social and housing conditions, including smoking in the household and overcrowding, and other factors such as climate.[34,35] Low rates of antibiotic dispensing in some remote, socioeconomically disadvantaged areas may be underestimates because dispensing through Aboriginal medical services is not captured in the data.

Access to medical care

Geographic access to medical care and the ability to pay out of pocket costs, are likely to affect the rates of people seeking care from clinicians for conditions that may require antibiotic treatment, or that are believed to require treatment, and subsequent rates of antibiotic dispensing. Clinicians treating patients who face financial or geographical barriers to accessing care may be more likely to prescribe opportunistically because of uncertain follow-up of the patient. Additionally, clinicians in regional and remote Australia may have less access to pathology services to support their decision-making.

Data limitations

Rates in remote geographic areas with high proportions of Aboriginal and Torres Strait Islander children are likely to be artificially low because the PBS dataset does not include data from Aboriginal health services, which supply medicines under the S100 scheme (an alternative arrangement for supplying PBS medicines).

Rates of prescriptions dispensed could be different from rates of medicines consumed.

Antibiotics dispensing in children, 9 years and under

Promoting appropriate care

Increasing antibiotic resistance highlights the urgency of reducing Australia's rate of inappropriate antibiotic use in children[1], especially in the areas shown to have the highest rates. Although the link between childhood antibiotic use and diseases in later life is not firmly established, this possibility adds to the case for restricting antibiotic use to situations where the need for antibiotics is clear.

Many groups have been working to reduce inappropriate antibiotic use in Australia; some success has been seen, but major challenges remain.[7-10] Antimicrobial use in Australian hospitals has been declining since the peak usage rate in 2010.[2] However, most antibiotic use occurs in the community.[2] The rate of antimicrobial prescribing in the community in Australia peaked in 2008, and the rate in 2015 was very similar, with more than 30 million prescriptions for antimicrobials in Australia in 2015.[2,11] Sustained efforts, combining different approaches, will be needed to make a difference to community prescribing.

A lack of access to data on dispensing from Aboriginal health services limited the current analysis, and initiatives to include these data are vital to providing a more complete picture of antibiotic use across Australia. Differences in the burden of disease need to be taken into account when interpreting antibiotic use in different settings. Interventions to address antibiotic resistance need to take into account differences in the type of infections in Aboriginal and Torres Strait Islander children in some areas compared with other children, as well as cultural differences.[36,37]

In an Australian survey of GPs, patient expectations were the main reason given for prescribing antibiotics for an upper respiratory tract infection.[31] This overarching reason may include other factors such as limited time, poor doctor–patient communication and diagnostic uncertainty.[31]

Communication skills training for prescribers and shared decision making have been successful in reducing antibiotic use for respiratory tract infections in the community.[38,39] Communication skills training evaluated in trials involved learning to deal with perceived pressure to prescribe, and to communicate with patients about their expectations on antibiotic prescribing.[38] This training reduced the rate of antibiotic prescribing for lower respiratory tract infections from 54% to 27% among patients in a Dutch trial.[40] A multi-centre European trial reported a reduction in primary care antibiotic prescribing for upper respiratory tract infections from 45% to 36% with internet-based communication skills training.[41]

Shared decision making has been shown to reduce the rate of antibiotic prescribing for acute respiratory infections in general practice from 47% to 29%.[12] In shared decision making interventions, the patient and clinician discuss the benefits and harms of antibiotic treatment, and the evidence of antibiotic effectiveness.[13] Patient decision aids on antimicrobial use, including for sore throat, acute bronchitis and middle ear infection in children, have been developed for use in the Australian primary care setting.[42-44] Interventions that promote shared decision making could also provide clinicians with skills that can be used in the management of other conditions, which may add to the cost-effectiveness of this approach.[39]

Counselling about appropriate use of antibiotics can be more time-consuming than writing a prescription, and time pressures on doctors are a contributor to inappropriate antibiotic prescribing.[31] Using resources to aid explanations of why an antibiotic prescription is not appropriate for some conditions, and support from nurse practitioners in counselling patients about antibiotic use, could help reduce inappropriate prescribing.

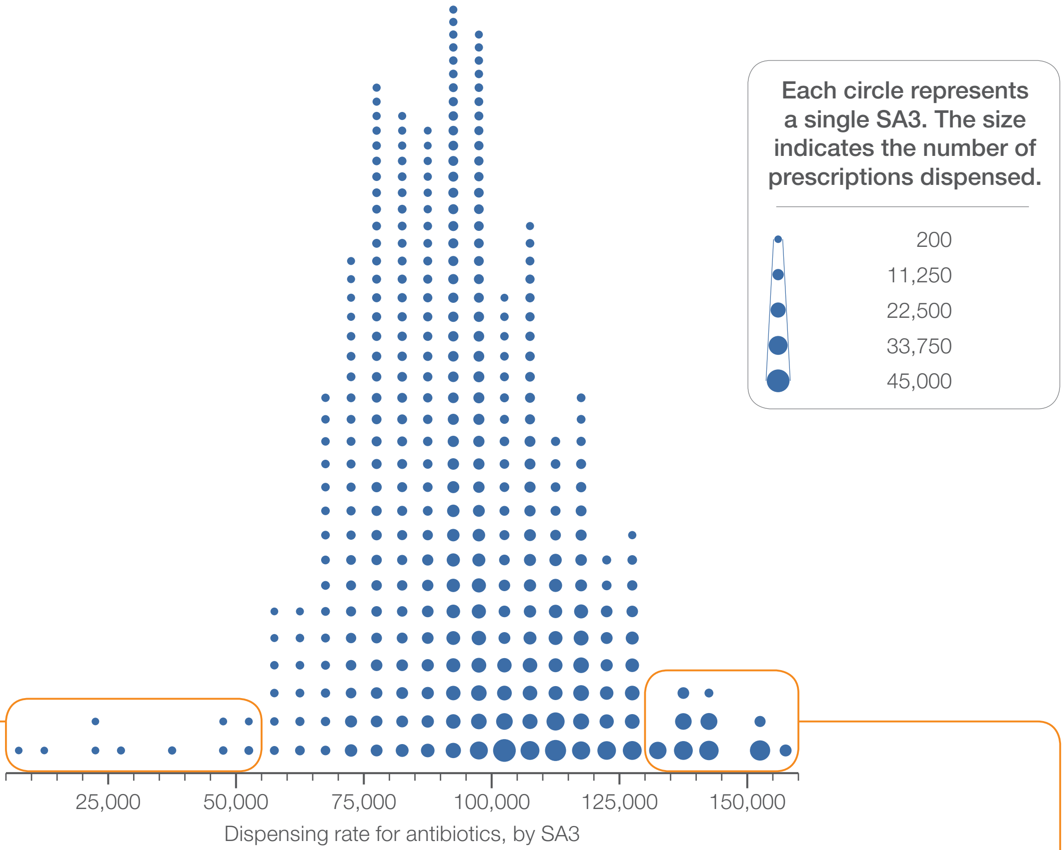
Public education is essential for supporting any interventions targeting prescribers, and ongoing, repeated efforts are required to make a substantial change in public awareness of the issues concerning antibiotic prescribing.[11,45] NPS MedicineWise has led programs to reduce the inappropriate use of antibiotics in Australia, including academic detailing and prescribing feedback for GPs, as well as public awareness campaigns.[11] Some success has been seen; for example, NPS MedicineWise campaigns between 2009 and 2015 were estimated to have resulted in a reduction of 14% in antibiotic dispensing volumes over this period.[46] However, data showing that GPs prescribe antibiotics at 4–9 times the rate expected if guidelines were followed highlight the size of the challenge that remains.[1]

A variety of other interventions could help reduce overuse of antibiotics in Australia – for example, changes to prescribing software so the default option for antibiotic prescriptions is 'no repeats', and aligning the dispensed amount of antibiotic with the recommended duration of therapy to avoid leftover doses.[11] Providing antibiotic prescriptions to patients with respiratory tract infections for use if symptoms do not resolve (delayed prescriptions) is another strategy that reduces unnecessary use of antibiotics.[47]

Antibiotics dispensing in children, 9 years and under

Rates by local area

Figure 1.4: Number of PBS prescriptions dispensed for antibiotics per 100,000 children aged 9 years and under, age and sex standardised, by Statistical Area Level 3 (SA3) of patient residence, 2016–17



Lowest rate areas

SA3	State	Rate	Prescriptions
Daly - Tiwi - West Arnhem	NT	**9,707**	316
East Arnhem	NT	**13,446**	375
Barkly	NT	**23,535**	271
Katherine	NT	**24,302**	915
Alice Springs	NT	**29,028**	1,741
Kimberley	WA	**35,930**	2,319
Far North	Qld	**48,065**	2,957
Huon - Bruny Island	Tas	**48,730**	1,103
Esperance	WA	**50,215**	1,125
Augusta - Margaret River - Busselton	WA	**54,387**	4,029

Highest rate areas

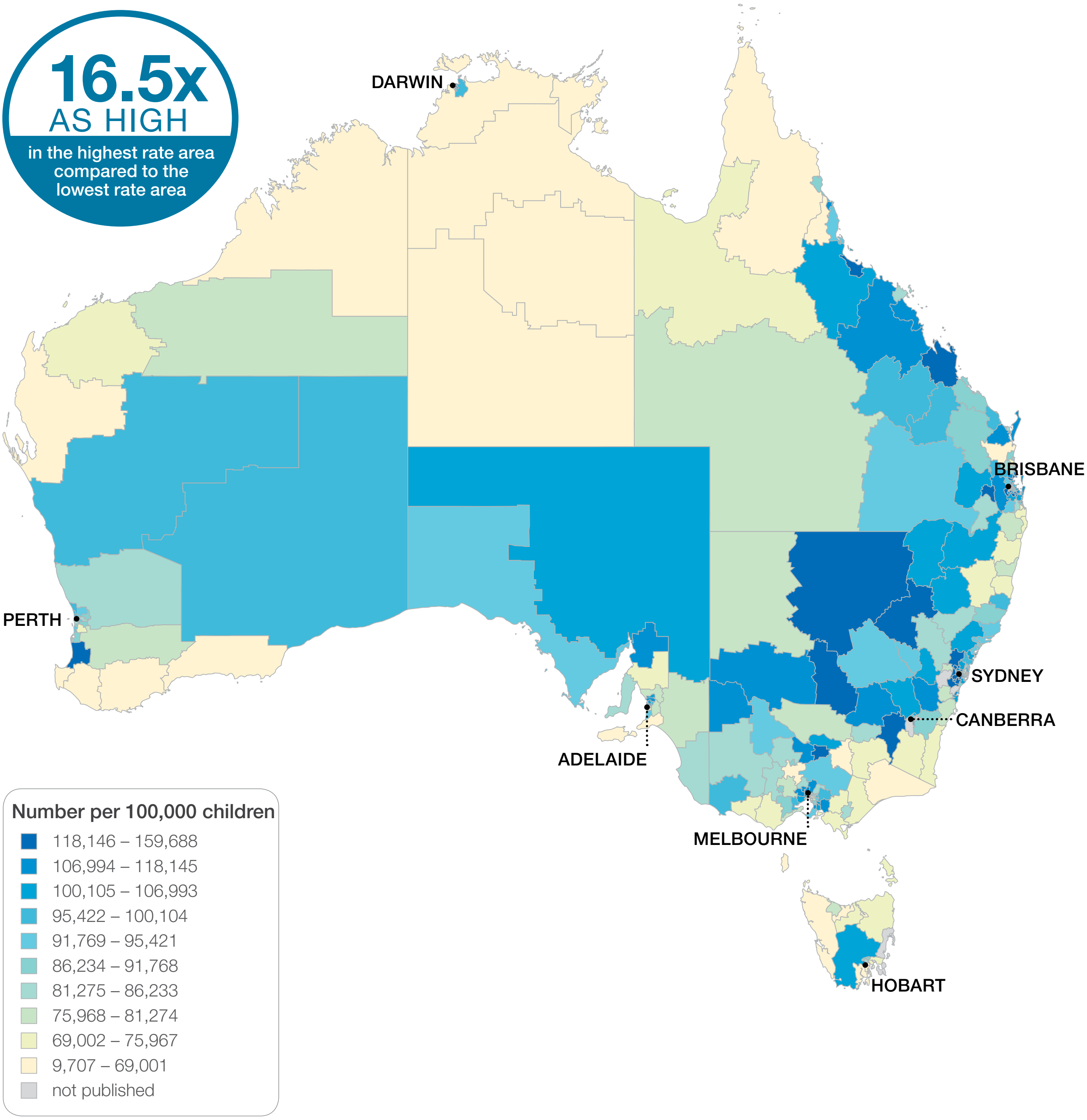
SA3	State	Rate	Prescriptions
St Marys	NSW	**159,688**	13,152
Fairfield	NSW	**154,713**	37,602
Griffith - Murrumbidgee (West)	NSW	**152,566**	10,681
Campbelltown (NSW)	NSW	**142,501**	35,189
Bribie - Beachmere	Qld	**142,207**	4,113
Mount Druitt	NSW	**141,411**	27,748
Liverpool	NSW	**137,887**	26,855
Shepparton	Vic	**136,694**	12,329
Merrylands - Guildford	NSW	**136,160**	33,383
Penrith	NSW	**132,552**	29,335

Notes:
For further detail about the methods used, please refer to the Technical Supplement.
Sources: AIHW analysis of Pharmaceutical Benefits Scheme data and ABS Estimated Resident Population 30 June 2016.

Antibiotics dispensing in children, 9 years and under

Rates across Australia

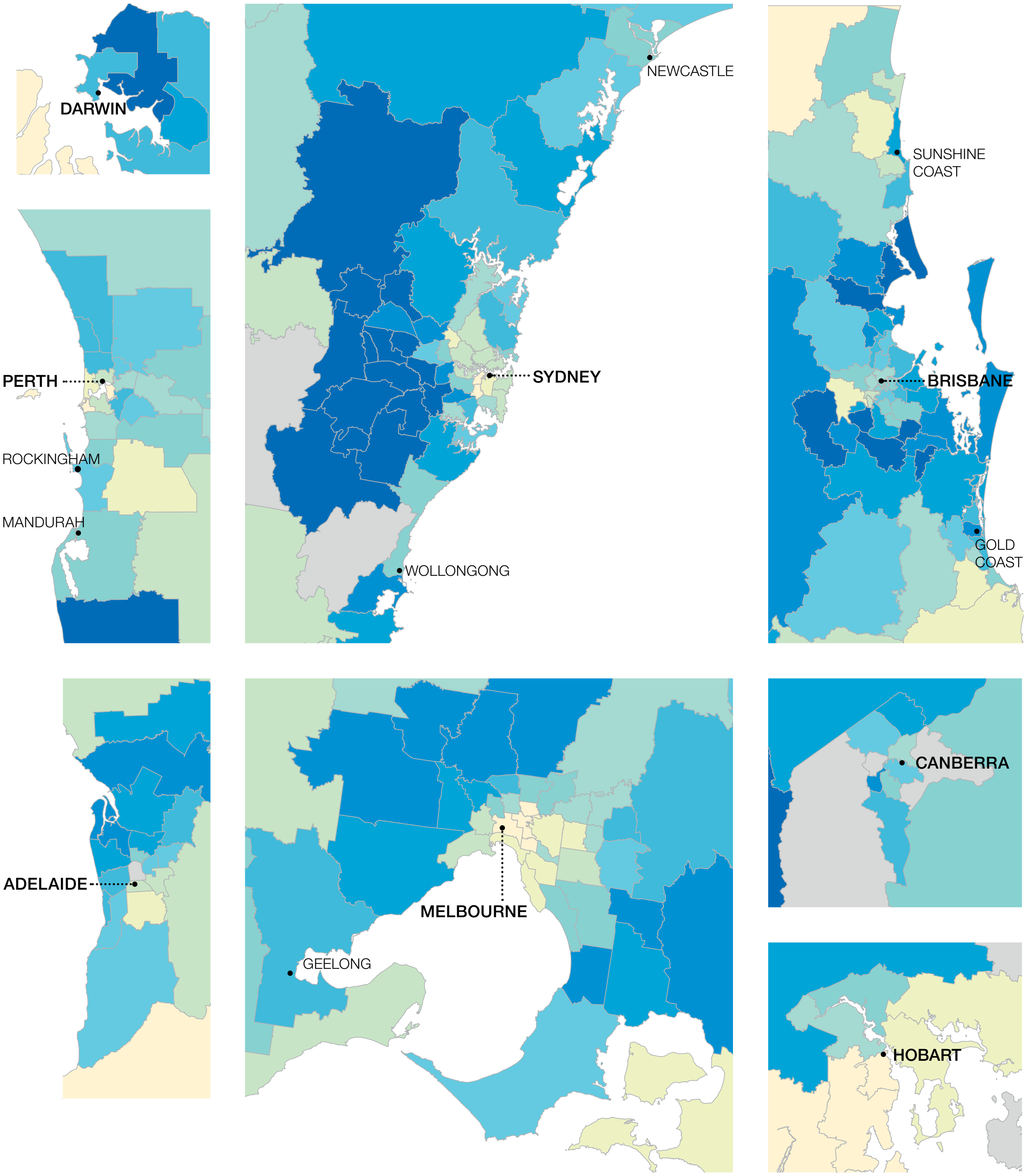
Figure 1.5: Number of PBS prescriptions dispensed for antibiotics per 100,000 children aged 9 years and under, age and sex standardised, by Statistical Area Level 3 (SA3) of patient residence, 2016–17



Notes:
For further detail about the methods used, please refer to the Technical Supplement.
Sources: AIHW analysis of Pharmaceutical Benefits Scheme data and ABS Estimated Resident Population 30 June 2016.

Rates across capital city areas

Figure 1.6: Number of PBS prescriptions dispensed for antibiotics per 100,000 children aged 9 years and under, age and sex standardised, by Statistical Area Level 3 (SA3) of patient residence, 2016–17



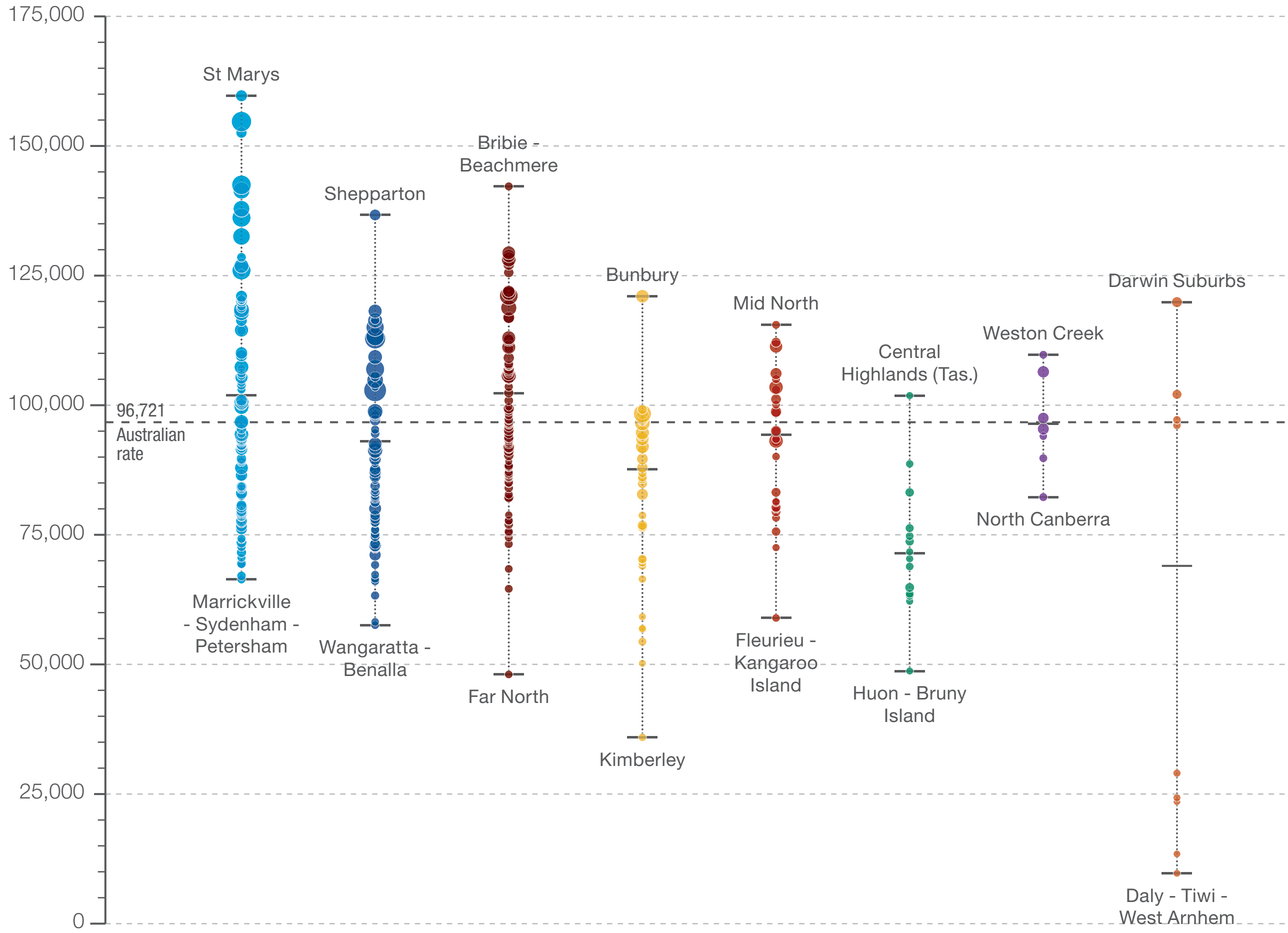
Notes:
For further detail about the methods used, please refer to the Technical Supplement.
Sources: AIHW analysis of Pharmaceutical Benefits Scheme data and ABS Estimated Resident Population 30 June 2016.

Antibiotics dispensing in children, 9 years and under

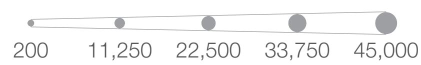
Rates by state and territory

Figure 1.7: Number of PBS prescriptions dispensed for antibiotics per 100,000 children aged 9 years and under, age and sex standardised, by Statistical Area Level 3 (SA3) of patient residence, 2016–17

	NSW	Vic	Qld	WA	SA	Tas	ACT	NT
Highest rate	159,688	136,694	142,207	121,012	115,504	101,857	109,733	119,885
State/territory	101,950	93,018	102,339	87,662	94,312	71,472	96,447	69,015
Lowest rate	66,391	57,562	48,065	35,930	58,958	48,730	82,273	9,707
No. prescriptions	1,023,567	738,699	664,062	302,588	196,083	44,699	52,890	26,240



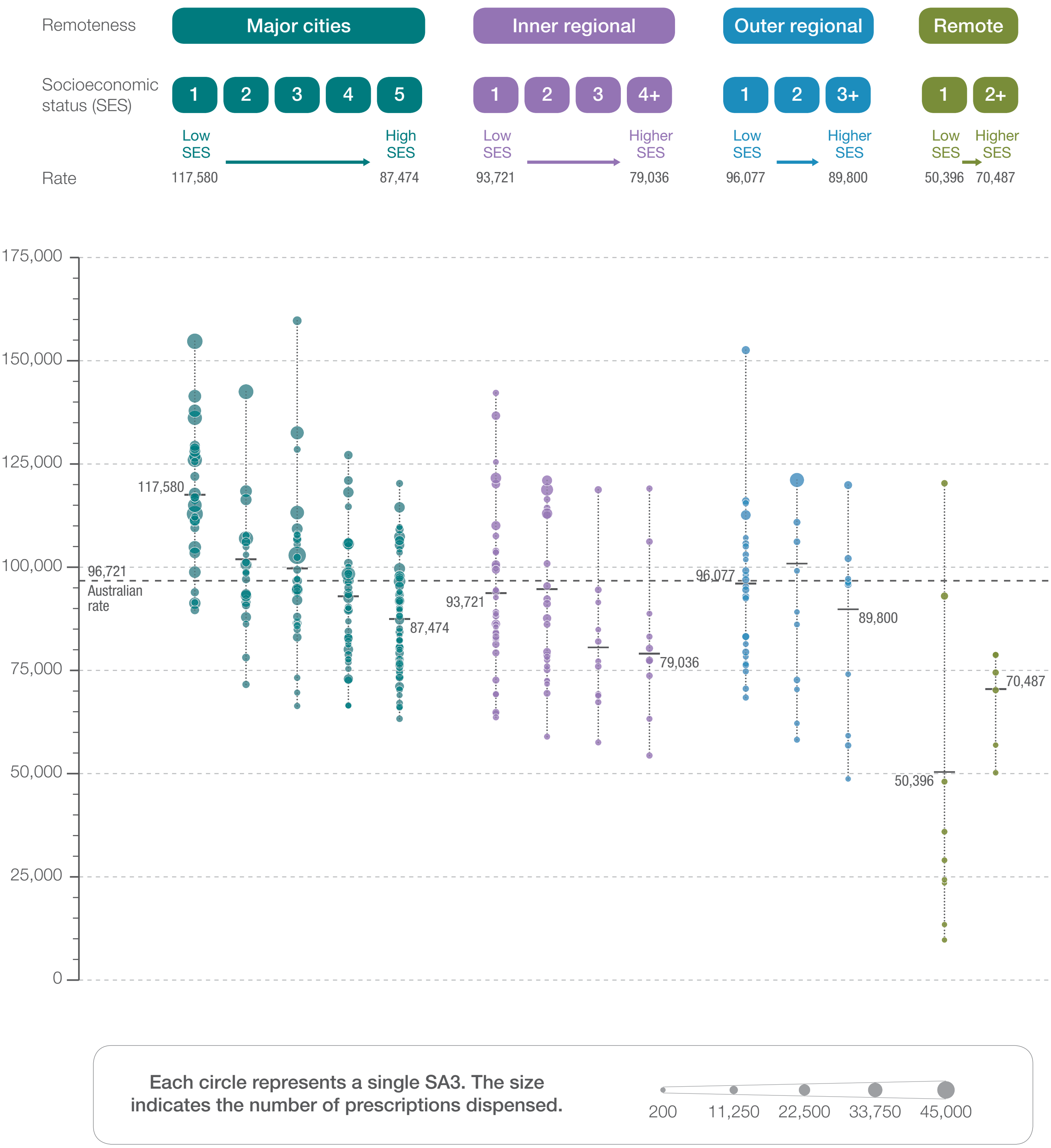
Each circle represents a single SA3. The size indicates the number of prescriptions dispensed.



Notes:
For further detail about the methods used, please refer to the Technical Supplement.
Sources: AIHW analysis of Pharmaceutical Benefits Scheme data and ABS Estimated Resident Population 30 June 2016.

Rates by remoteness and socioeconomic status

Figure 1.8: Number of PBS prescriptions dispensed for antibiotics per 100,000 children aged 9 years and under, age and sex standardised, by Statistical Area Level 3 (SA3) of patient residence, 2016–17



Notes:
For further detail about the methods used, please refer to the Technical Supplement.
Sources: AIHW analysis of Pharmaceutical Benefits Scheme data and ABS Estimated Resident Population 30 June 2016.

Antibiotics dispensing in children, 9 years and under

Resources

- *Therapeutic Guidelines: Antibiotic*[48], including mobile app
- Australian Commission on Safety and Quality in Health Care, Antimicrobial Stewardship Clinical Care Standard[49]
- Australian Commission on Safety and Quality in Health Care, patient decision aids on antibiotic use for sore throat, acute bronchitis and middle ear infection[42-44]
- Australian Commission on Safety and Quality in Health Care, *Helping Patients Make Informed Decisions: Communicating risks and benefits* (eLearning module)[50]
- NPS MedicineWise, *What Every Parent Should Know About Colds, Coughs, Earaches and Sore Throats*
- NPS MedicineWise, antimicrobial learning modules
- Australian Government, Nurses and antimicrobial resistance fact sheet
- Australian Government, What health professionals can do; What you can do (infographics)
- National Centre for Antimicrobial Stewardship, 'Antimicrobial prescribing in children' (infographic).[51]

Australian initiatives

The information in this chapter will complement work already under way to improve the appropriateness of antibiotic use in children in Australia. At a national level, this work includes:

- Antimicrobial Stewardship Clinical Care Standard and accompanying indicators[49]
- Antibiotic Awareness Week
- Antimicrobial Use and Resistance in Australia (AURA) Surveillance System[2]
- *Australia's First National Antimicrobial Resistance Strategy 2015–2019*[10]
- National Antimicrobial Prescribing Survey, education and training[10]
- National Antimicrobial Utilisation Surveillance Program[52]
- NPS MedicineWise consumer and clinician interventions
- Royal Australian College of Physicians Paediatrics Child Health Division, Choosing Wisely recommendation 1: Do not routinely prescribe oral antibiotics to children with fever without an identified bacterial infection[53]
- Royal Australian College of General Practitioners, Choosing Wisely recommendation 9: Don't treat otitis media (middle ear infection) with antibiotics, in non-Indigenous children aged 2–12 years, where reassessment is a reasonable option[9]
- Australian Society of Infectious Diseases, Choosing Wisely recommendations 1–4:
  - Do not use antibiotics for asymptomatic bacteriuria
  - Do not take a swab or use antibiotics for the management of a leg ulcer without clinical infection
  - Avoid prescribing antibiotics for upper respiratory tract infection
  - Do not investigate or treat for faecal pathogens in the absence of diarrhoea or other gastrointestinal symptoms.[54]

Many state and territory initiatives are also in place to improve the appropriateness of antibiotic use in children, including antimicrobial stewardship programs and guidelines for managing childhood infections. For example:

- The Tasmanian Infection Prevention and Control Unit provides feedback to rural inpatient facilities and GP prescribers on their antimicrobial prescribing, and Primary Health Tasmania provides education on antimicrobial prescribing
- Safer Care Victoria, New South Wales Health and Queensland Health have recently developed the Paediatric Improvement Collaborative; this involves a tri-state memorandum of understanding and funding agreement to enable New South Wales Health and Queensland Health to formally use the Victorian clinical practice guidelines.

Antibiotics dispensing in children, 9 years and under

References

1. McCullough AR, Pollack AJ, Plejdrup Hansen M, Glasziou PP, Looke DF, Britt HC, et al. Antibiotics for acute respiratory infections in general practice: comparison of prescribing rates with guideline recommendations. Med J Aust 2017;207(2):65–9.
2. Australian Commission on Safety and Quality in Health Care. AURA 2017: second Australian report on antimicrobial use and resistance in human health. Sydney: ACSQHC; 2017.
3. Ahmadizar F, Vijverberg SJ, Arets HG, de Boer A, Turner S, Devereux G, et al. Early life antibiotic use and the risk of asthma and asthma exacerbations in children. Pediatr Allergy Immunol 2017;28(5):430–7.
4. Ungaro R, Bernstein CN, Gearry R, Hviid A, Kolho KL, Kronman MP, et al. Antibiotics associated with increased risk of new-onset Crohn's disease but not ulcerative colitis: a meta-analysis. Am J Gastroenterol 2014;109(11):1728–38.
5. Korpela K, Salonen A, Virta LJ, Kekkonen RA, Forslund K, Bork P, et al. Intestinal microbiome is related to lifetime antibiotic use in Finnish pre-school children. Nat Commun 2016;7:10410.
6. Rasmussen SH, Shrestha S, Bjerregaard LG, Angquist LH, Baker JL, Jess T, et al. Antibiotic exposure in early life and childhood overweight and obesity: a systematic review and meta-analysis. Diabetes Obes Metab 2018;20(6):1508–14.
7. Australasian Society for Infectious Diseases. Five things clinicians and consumers should question. Sydney: NPS MedicineWise; 2016.
8. Organisation for Economic Co-operation and Development. Health at a glance 2017: OECD indicators. Figure 6.5. Paris: OECD Publishing; 2017.
9. Choosing Wisely Australia. Royal Australian College of General Practitioners: tests, treatments and procedures clinicians and consumers should question – recommendation 9 [Internet]. Sydney: NPS MedicineWise; 2016 [updated 2016 Mar; cited 2018 Jul 20]. Available from: www.choosingwisely.org.au/recommendations/racgp
10. Department of Health, Department of Agriculture and Water Resources. Australia's first national antimicrobial resistance strategy 2015–2019: progress report. Canberra: Australian Government; 2017.
11. Del Mar CB, Scott AM, Glasziou PP, Hoffmann T, van Driel ML, Beller E, et al. Reducing antibiotic prescribing in Australian general practice: time for a national strategy. Med J Aust 2017;207(9):401–6.
12. Coxeter P, Del Mar CB, McGregor L, Beller EM, Hoffmann TC. Interventions to facilitate shared decision making to address antibiotic use for acute respiratory infections in primary care. Cochrane Database Syst Rev 2015;(11):CD010907.
13. Hoffmann TC, Del Mar CB. Shared decision making: what do clinicians need to know and why should they bother? Med J Aust 2014;201(9):513–14.
14. Drug Utilisation Sub-Committee. Antibiotics: PBS/RPBS utilisation. Pharmaceutical Benefits Scheme (PBS), October 2014 and February 2015 [Internet]. Canberra: Australian Government Department of Health [updated 2015 May 29; cited 2018 Jul 20]. Available from: www.pbs.gov.au/info/industry/listing/participants/public-release-docs/antibiotics/antibiotics-oct-14-feb-15
15. Biezen R, Pollack AJ, Harrison C, Brijnath B, Grando D, Britt HC, et al. Respiratory tract infections among children younger than 5 years: current management in Australian general practice. Med J Aust 2015;202(5):262–6.
16. NPS MedicineWise. Antibiotic resistance in Australia: here and now [Internet]. Sydney: NPS MedicineWise; 2016 [updated 2016 Nov 11; cited 2018 Jul 20]. Available from: www.nps.org.au/news/antibiotic-resistance-in-australia-here-and-now#current-trends-in-resistance
17. Costelloe C, Metcalfe C, Lovering A, Mant D, Hay AD. Effect of antibiotic prescribing in primary care on antimicrobial resistance in individual patients: systematic review and meta-analysis. BMJ 2010;340:c2096.
18. Bryce A, Costelloe C, Hawcroft C, Wootton M, Hay AD. Faecal carriage of antibiotic resistant *Escherichia coli* in asymptomatic children and associations with primary care antibiotic prescribing: a systematic review and meta-analysis. BMC Infect Dis 2016;16:359.
19. Doan T, Arzika AM, Ray KJ, Cotter SY, Kim J, Maliki R, et al. Gut microbial diversity in antibiotic-naive children after systemic antibiotic exposure: a randomized controlled trial. Clin Infect Dis 2017;64(9):1147–53.
20. Mitre E, Susi A, Kropp LE, Schwartz DJ, Gorman GH, Nylund CM. Association between use of acid-suppressive medications and antibiotics during infancy and allergic diseases in early childhood. JAMA Pediatr 2018;172(6):e180315.
21. Penders J, Kummeling I, Thijs C. Infant antibiotic use and wheeze and asthma risk: a systematic review and meta-analysis. Eur Respir J 2011;38(2):295–302.
22. Shao X, Ding X, Wang B, Li L, An X, Yao Q, et al. Antibiotic exposure in early life increases risk of childhood obesity: a systematic review and meta-analysis. Front Endocrinol (Lausanne) 2017;8:170.
23. Theochari NA, Stefanopoulos A, Mylonas KS, Economopoulos KP. Antibiotics exposure and risk of inflammatory bowel disease: a systematic review. Scand J Gastroenterol 2018;53(1):1–7.
24. Schildkraut V, Alex G, Cameron DJ, Hardikar W, Lipschitz B, Oliver MR, et al. Sixty-year study of incidence of childhood ulcerative colitis finds eleven-fold increase beginning in 1990s. Inflamm Bowel Dis 2013;19(1):1–6.
25. Phavichitr N, Cameron DJ, Catto-Smith AG. Increasing incidence of Crohn's disease in Victorian children. J Gastroenterol Hepatol 2003;18(3):329–32.
26. Benchimol EI, Fortinsky KJ, Gozdyra P, Van den Heuvel M, Van Limbergen J, Griffiths AM. Epidemiology of pediatric inflammatory bowel disease: a systematic review of international trends. Inflamm Bowel Dis 2011;17(1):423–39.
27. Shouval DS, Rufo PA. The role of environmental factors in the pathogenesis of inflammatory bowel diseases: a review. JAMA Pediatr 2017;171(10):999–1005.
28. Patel SV, Vergnano S. The impact of paediatric antimicrobial stewardship programmes on patient outcomes. Curr Opin Infect Dis 2018;31(3):216–23.
29. Vaz LE, Kleinman KP, Lakoma MD, Dutta-Linn MM, Nahill C, Hellinger J, et al. Prevalence of parental misconceptions about antibiotic use. Pediatrics 2015;136(2):221–31.
30. Gaarslev C, Yee M, Chan G, Fletcher-Lartey S, Khan R. A mixed methods study to understand patient expectations for antibiotics for an upper respiratory tract infection. Antimicrob Resist Infect Control 2016;5:39.
31. Fletcher-Lartey S, Yee M, Gaarslev C, Khan R. Why do general practitioners prescribe antibiotics for upper respiratory tract infections to meet patient expectations: a mixed methods study. BMJ Open 2016;6(10):e012244.
32. Laxminarayan R, Matsoso P, Pant S, Brower C, Rottingen JA, Klugman K, et al. Access to effective antimicrobials: a worldwide challenge. Lancet 2016;387(10014):168–75.
33. Chang AB, Grimwood K, Maguire G, King PT, Morris PS, Torzillo PJ. Management of bronchiectasis and chronic suppurative lung disease in Indigenous children and adults from rural and remote Australian communities. Med J Aust 2008;189(7):386–93.
34. Quinn EK, Massey PD, Speare R. Communicable diseases in rural and remote Australia: the need for improved understanding and action. Rural Remote Health 2015;15(3):3371.
35. Jones LL, Hashim A, McKeever T, Cook DG, Britton J, Leonardi-Bee J. Parental and household smoking and the increased risk of bronchitis, bronchiolitis and other lower respiratory infections in infancy: systematic review and meta-analysis. Respir Res 2011;12:5.
36. Oliver SJ, Cush J, Ward JE. Community-based prescribing for impetigo in remote Australia: an opportunity for antimicrobial stewardship. Front Public Health 2017;5:158.
37. Dunne EM, Carville K, Riley TV, Bowman J, Leach AJ, Cripps AW, et al. Aboriginal and non-Aboriginal children in Western Australia carry different serotypes of pneumococci with different antimicrobial susceptibility profiles. Pneumonia (Nathan) 2016;8:15.
38. Kochling A, Loffler C, Reinsch S, Hornung A, Bohmer F, Altiner A, et al. Reduction of antibiotic prescriptions for acute respiratory tract infections in primary care: a systematic review. Implement Sci 2018;13(1):47.
39. Tonkin-Crine SK, Tan PS, van Hecke O, Wang K, Roberts NW, McCullough A, et al. Clinician-targeted interventions to influence antibiotic prescribing behaviour for acute respiratory infections in primary care: an overview of systematic reviews. Cochrane Database Syst Rev 2017;(9):CD012252.
40. Cals JW, Butler CC, Hopstaken RM, Hood K, Dinant GJ. Effect of point of care testing for C reactive protein and training in communication skills on antibiotic use in lower respiratory tract infections: cluster randomised trial. BMJ 2009;338:b1374.

41. Little P, Stuart B, Francis N, Douglas E, Tonkin-Crine S, Anthierens S, et al. Effects of internet-based training on antibiotic prescribing rates for acute respiratory-tract infections: a multinational, cluster, randomised, factorial, controlled trial. Lancet 2013;382(9899):1175–82.
42. Hoffman T, Del Mar C, Coxeter P. Acute bronchitis: should I take antibiotics? Sydney: ACSQHC; 2016.
43. Hoffman T, Del Mar C, Coxeter P. Middle ear infection: should my child take antibiotics? Sydney: ACSQHC; 2016.
44. Hoffman T, Del Mar C, Coxeter P. Sore throat: should I take antibiotics? Sydney: ACSQHC; 2016.
45. Sabuncu E, David J, Bernede-Bauduin C, Pepin S, Leroy M, Boelle PY, et al. Significant reduction of antibiotic use in the community after a nationwide campaign in France, 2002–2007. PLoS Med 2009;6(6):e1000084.
46. Wu J, Taylor D, Ovchinikova L, Heaney A, Morgan T, Dartnell J, et al. Relationship between antimicrobial-resistance programs and antibiotic dispensing for upper respiratory tract infection: an analysis of Australian data between 2004 and 2015. J Int Med Res 2018;46(4):1326–38.
47. Spurling GK, Del Mar CB, Dooley L, Foxlee R, Farley R. Delayed antibiotic prescriptions for respiratory infections. Cochrane Database Syst Rev 2017;(9):CD004417.
48. Therapeutic guidelines: antibiotic. Version 15 [Internet]. Melbourne: Therapeutic Guidelines Limited; 2014 [cited 2018 Jul 20]. Available from: www.tg.org.au
49. Australian Commission on Safety and Quality in Health Care. Antimicrobial stewardship clinical care standard. Sydney: ACSQHC; 2014.
50. Australian Commission on Safety and Quality in Health Care. Helping patients make informed decisions: communicating risks and benefits (eLearning module) [Internet]. Sydney: ACSQHC; 2017 [cited 2018 Jul 20]. Available from: https://contenttest.learningseat.com/safetyandquality/index.html
51. National Centre for Antimicrobial Stewardship. Antimicrobial prescribing in children infographic. Melbourne: NCAS [cited 2018 Jul 20]. Available from: irp-cdn.multiscreensite.com/d820f98f/files/uploaded/10.%20Paeds%20Final.pdf.
52. SA Health, Australian Commission on Safety and Quality in Health Care. Antimicrobial use in Australian hospitals: 2016 annual report of the National Antimicrobial Utilisation Surveillance Program. Sydney: ACSQHC; 2018.
53. Choosing Wisely Australia. RACP Paediatrics and Child Health Division: tests, treatments and procedures clinicians and consumers should question – recommendation 1 [Internet]. Sydney: NPS MedicineWise; 2017 [updated 2017 Sep 25; cited 2018 Jul 20]. Available from: www.choosingwisely.org.au/recommendations/paediatrics-and-child-health-division-(racp)
54. Choosing Wisely Australia. Australasian Society for Infectious Diseases: tests, treatments and procedures clinicians and consumers should question – recommendations 1–4 [Internet]. Sydney: NPS MedicineWise; 2016 [updated 2016 Mar 1; cited 2018 Jul 20]. Available from: www.choosingwisely.org.au/recommendations/asid

1.3 Proton pump inhibitor medicines dispensing, 1 year and under

Why is this important?

Proton pump inhibitor (PPI) medicines have become increasingly prescribed for managing gastro-oesophageal reflux in infants. They are also prescribed for general symptoms such as irritability and crying (or colic) on the basis that reflux might be causing these symptoms. This is despite a lack of evidence of effectiveness, as well as uncertainty about the long-term effects of these medicines in the very young. In particular, there is concern about the potential for increased susceptibility to infections and food allergies that may result from the alteration of normal gut bacteria.[1-3]

What did we find?

There was about a four-fold difference between the lowest and highest state and territory rates in Pharmaceutical Benefits Scheme (PBS) dispensing of PPI medicines for infants aged 1 year and under in Australia.

What can be done?

Greater clarity and consistency of guidelines on gastro-oesophageal reflux and colic in infants, with a focus on alternative approaches to managing symptoms that lead to PPI medicine prescribing by general practitioners (GPs) and specialists, could help to reduce the rate of inappropriate use of PPI medicines in infants in Australia. Ensuring that support is available for new parents, and that information about the potential risks and likelihood of benefits of PPI medicines use in infants is more readily available, may also reduce inappropriate use. Introducing an authority requirement for prescribing PPI medicines for infants could also reduce inappropriate use.

Proton pump inhibitor medicines dispensing, 1 year and under

Context

PPIs are a group of medicines that reduce acid production in the stomach.[4] Medicines in the PPI group include omeprazole, pantoprazole, lansoprazole, rabeprazole and esomeprazole.[5] This data item analyses PPI medicines use in infants (aged 1 year and under). See Chapter 2, page 117, for analysis of PPI medicine use in adults (aged 18 years and over).

Use of PPI medicines for gastro-oesophageal reflux and gastro-oesophageal reflux disease (GORD) in infants is common and increasing in Australia[6,7], despite concerns about side effects and evidence that PPI medicines are not effective in this age group for these conditions or for colic.[8-10] Most guidelines recommend non-medical therapy for simple reflux in infants aged 1 year and under (0–12 months)[11-13], but guidelines for the management of infant GORD (which involves complications, such as oesophagitis) are unclear in some cases and inconsistent.[6] Australian advice includes:

- Do not routinely treat GORD in infants with acid suppression therapy[11]
- Consider PPI therapy if there are concerns that excessive GORD of long duration is the cause of irritability in infants.[13]

Although a trial of PPI therapy has become a common recommendation for infants for problematic reflux symptoms, or for those with complications, trials have shown it is no better than placebo for symptoms of infant reflux.[14]

An Australian study of children treated in 2012–2013 either by a GP, by a paediatrician in an emergency department or as an inpatient reported that 41% of healthy, thriving infants presenting with irritability or unexplained crying were prescribed an acid suppression medicine at first presentation.[15] A study of Australian GPs found that the proportion of infants with gastro-oesophageal reflux that they managed by prescribing a PPI medicine increased from 12% in 2006–2008 to 28% in 2014–2016.[6] The proportion of infants with GORD managed by prescribing a PPI medicine increased from 33% to 50% over the same period.[6]

Gastric acid is an important factor in infection resistance and the composition of gastrointestinal flora.[1] A prospective study of 91 otherwise healthy young children (average age 10 months) taking either omeprazole or ranitidine (another type of acid suppression medicine) for GORD found that they were significantly more likely to develop acute gastroenteritis or pneumonia than the control group.[1] Retrospective studies have also found an association between PPI medicine use in infants and children and an increased risk of developing allergies.[2,3]

About the data

Data are sourced from the PBS dataset which includes all prescriptions dispensed under the PBS or the Repatriation Pharmaceutical Benefits Scheme. This includes prescriptions that do not receive an Australian Government subsidy and prescriptions dispensed under the Closing the Gap scheme.

The dataset does not include prescriptions dispensed for patients during their admission to public hospitals, discharge prescriptions dispensed from public hospitals in New South Wales and the Australian Capital Territory, direct supply of medicines to remote Aboriginal health services, over-the-counter purchase of medicines, doctor's bag medicines or private prescriptions.

Rates are based on the number of prescriptions dispensed for PPI medicines per 100,000 infants aged 1 year and under in 2016–17.

The analysis and maps are based on the residential address of the patient recorded in the PBS prescription claim and not the location of the prescriber or the dispensing pharmacy.

Rates are sex standardised to allow comparisons between populations with different sex structures.

Because of small numbers, data are reported only at state level. Reporting by smaller geographical area, remoteness and socioeconomic disadvantage is not possible.

This analysis was not undertaken by Aboriginal and Torres Strait Islander status because this information was not available for the PBS data at the time of publication.

What do the data show?

Magnitude of variation

In 2016–17, there were 22,810 PBS prescriptions dispensed for PPI medicines to infants aged 1 year and under, representing 3,628 prescriptions per 100,000 infants aged 1 year and under (the Australian rate).

The number of PBS prescriptions dispensed for PPI medicines varied across states and territories, from 2,195 per 100,000 infants in the Northern Territory to 8,066 per 100,000 in South Australia (Figure 1.9).

Analysis by prescriber type

GPs prescribed 66% of the PBS prescriptions dispensed for PPI medicines in infants, paediatricians prescribed 27%, and other health professionals prescribed 7%. The proportion prescribed by GPs varied across states and territories from 30% in the Northern Territory to 80% in Western Australia (Figure 1.9).

Interpretation

Variation in rates of PPI medicines dispensing is likely to be due to geographical differences in the factors discussed below.

Clinical decision-making

Variation in awareness of, and adherence to, guidelines for management of simple reflux symptoms in infants is likely to influence the pattern of use, as could over-diagnosis of reflux in infants presenting with irritability and unexplained crying (colic).

Use of other medicines

Use of other types of acid suppression medicines, such as H2 blockers, for reflux symptoms in infants is likely to influence the patterns of PPI medicines use.[6]

Access to medical care

Access to GPs, paediatricians and gastroenterologists may influence the likelihood of consumers seeking care for gastro-oesophageal reflux and GORD for their children, and therefore affect rates of PPI medicines use. Access to programs that provide education and support for parents may also affect rates of consultation for unexplained crying in infants, and affect rates of PPI medicines use.

As well, variations between states/territories may not directly reflect the practices of the clinicians who are based in these areas. The analysis is based on where people live rather than where they obtain their health care. Patients may travel outside their local area to receive care.

Proton pump inhibitor medicines dispensing, 1 year and under

Promoting appropriate care

The quality of evidence on long-term risks of PPI medicines is generally low[16], but these possible risks are important when seen in the context of large-scale inappropriate use and the potential for effects on health over an infant's life course. Limiting use to appropriate indications would also reduce patient costs and waste of health resources.[16,17]

The Pharmaceutical Benefits Advisory Committee recently proposed reconsidering the PBS restriction levels for PPI medicines.[18] Introducing an authority requirement for prescribing PPI medicines for infants could reduce inappropriate use in Australia.

Educational campaigns for family and child health nurses, GPs and parents, as well as greater clarity and consistency of guidelines for managing gastro-oesophageal reflux and colic in infants, could also help to reduce the rate of inappropriate use of PPI medicines in infants in Australia.[6,19] Further research to give a better understanding of the influences on PPI medicines prescribing would also be helpful for informing strategies.[6]

Misinformation about the appropriate use of PPI medicines in infants – in both medical and consumer publications – poses a risk to children.[20] Providing evidence-based information is vital, especially in widely read publications that family and child health nurses and GPs may rely on for continuing education.

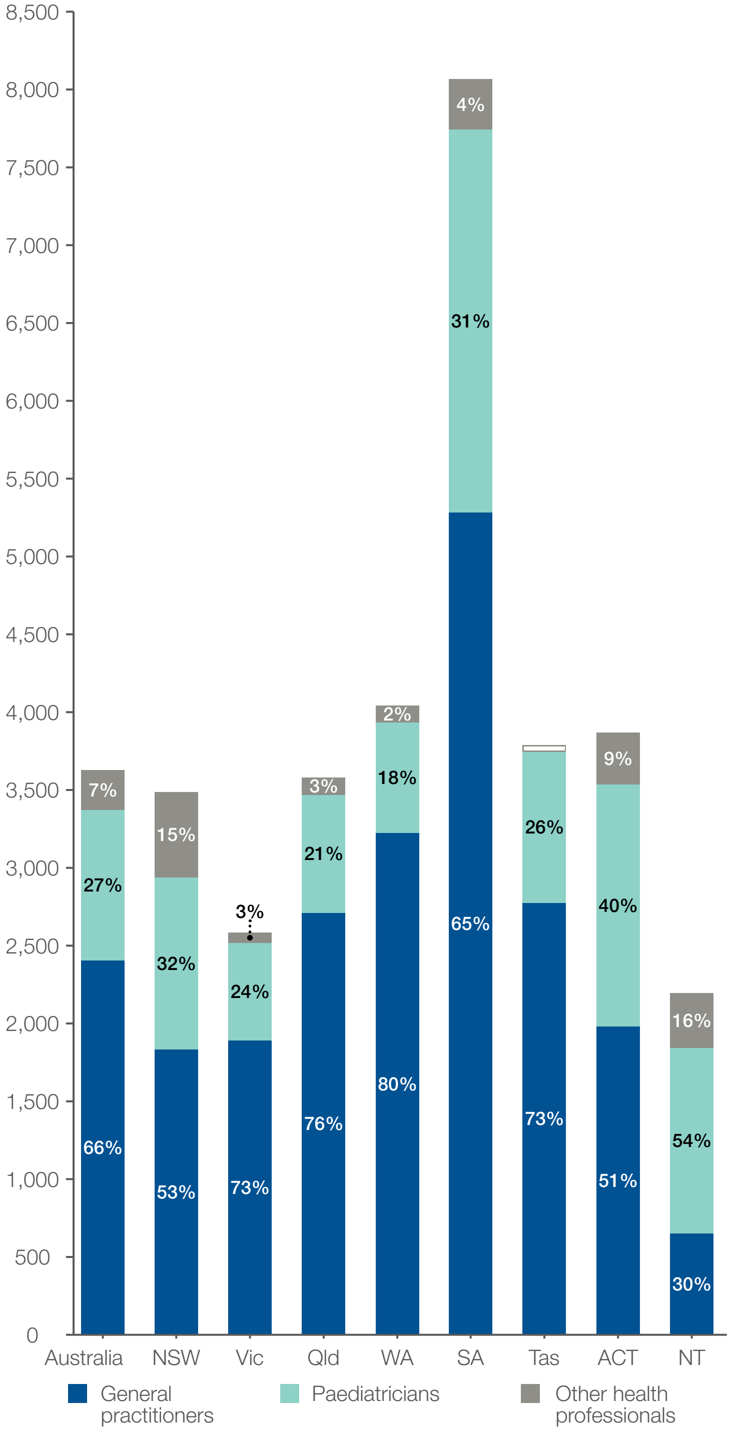
Infants may be over-diagnosed with GORD, which could lead to other causes of symptoms not being addressed, as well as overuse of PPI medicines.[21,22] The great majority of infants will respond to non-pharmacological measures, or get better with time, and a stepwise approach to investigation and management will reduce the number of infants exposed to PPI medicines.[20] Irritable infants with uncomplicated GORD are recommended to continue lifestyle modifications and to avoid acid suppression therapy.[23] Further research is needed to determine how best to support parents to manage gastro-oesophageal reflux in infants, and to get to the root cause of their reasons for seeking medical help.[21]

United States research shows that adherence to guidelines recommending against empirical acid suppression for gastro-oesophageal reflux in infants is low in children's hospitals.[22,24] Quality improvement interventions in hospitals could improve appropriateness of care in this setting, and could have a flow-on effect to prescribing in the community, as hospital recommendations for PPI medicines use may influence PPI medicines use after discharge.[25]

Creating hospital-specific policies could improve adherence to the recommendations of national guidelines.[24] Implementing an evidence-based guideline in a United States neonatal intensive care unit correlated with a substantial decrease in non-indicated prescriptions of PPI medicines (from 7.5 per month to zero).[26] The intervention followed plan–do–study–act cycles of quality improvement, and included staff education and guideline revision based on staff feedback. Keys to the program's success were thought to include leadership involvement, staff incentives and real-time data tracking.[26] The intervention could be implemented in similar inpatient settings for newborns.[26]

Rates by state and territory and prescriber type

Figure 1.9: Number of PBS prescriptions dispensed for proton pump inhibitor medicines per 100,000 infants aged 1 year and under, sex standardised, by state and territory of patient residence, by prescriber type, 2016–17



The data for Figure 1.9 are available at www.safetyandquality.gov.au/atlas

Notes:
Unshaded data (Tasmanian other health professionals) are based on a small number of prescriptions dispensed.
For further detail about the methods used, please refer to the Technical Supplement.
Sources: AIHW analysis of Pharmaceutical Benefits Scheme data and ABS Estimated Resident Population 30 June 2016.

Proton pump inhibitor medicines dispensing, 1 year and under

Resources

- National Institute for Health and Care Excellence, *Gastro-oesophageal Reflux Disease in Children and Young People: Diagnosis and management* (clinical guideline)[12]
- Royal Children's Hospital Melbourne, 'Gastro-oesophageal reflux in infants'[13]
- Royal Children's Hospital Melbourne, *Reflux (GOR) and GORD*, fact sheet for parents[27]
- New South Wales Health, *Infants and Children: Acute management of the unsettled and crying infant*.[28]

Australian initiatives

The information in this chapter will complement work already under way to improve the appropriateness of PPI medicines use in Australia. At a national level, this work includes:

- Royal Australian College of Physicians, Paediatrics and Child Health Division top 5 low-value practices and interventions – EVOLVE recommendation 4: Do not routinely treat gastroesophageal reflux disease (GORD) in infants with acid suppression therapy.[11]
- Pharmaceutical Benefits Advisory Committee, recommendations in 2018 to change PBS restriction levels for some PPI medicines.[18]

Many state and territory initiatives are also in place to improve the appropriateness of PPI medicines use, including:

- Tasmanian HealthPathways web-based information portal, 'Gastro-oesophageal reflux in children'.[29]

References

1. Canani RB, Cirillo P, Roggero P, Romano C, Malamisura B, Terrin G, et al. Therapy with gastric acidity inhibitors increases the risk of acute gastroenteritis and community-acquired pneumonia in children. Pediatrics 2006;117(5):e817–20.
2. Mitre E, Susi A, Kropp LE, Schwartz DJ, Gorman GH, Nylund CM. Association between use of acid-suppressive medications and antibiotics during infancy and allergic diseases in early childhood. JAMA Pediatr 2018;172(6):e180315.
3. Trikha A, Baillargeon JG, Kuo YF, Tan A, Pierson K, Sharma G, et al. Development of food allergies in patients with gastroesophageal reflux disease treated with gastric acid suppressive medications. Pediatr Allergy Immunol 2013;24(6):582–8.
4. Centers for Medicare & Medicaid Services. Proton pump inhibitors: use in adults. CMS; 2013. www.cms.gov/Medicare-Medicaid-Coordination/Fraud-Prevention/Medicaid-Integrity-Education/Pharmacy-Education-Materials/Downloads/ppi-adult-factsheet.pdf (accessed Dec 2017).
5. Tenni P, Dunbabin D. A guide to deprescribing proton pump inhibitors. Hobart: Primary Health Tasmania; 2016. https://www.primaryhealthtas.com.au/wp-content/uploads/2018/09/A-Guide-to-Deprescribing-Proton-Pump-Inhibitors.pdf (accessed Jul 2018).
6. Bell JC, Schneuer FJ, Harrison C, Trevena L, Hiscock H, Elshaug AG, et al. Acid suppressants for managing gastro-oesophageal reflux and gastro-oesophageal reflux disease in infants: a national survey. Arch Dis Child 2018;103(7):660–4.
7. Kirby CN, Segal AY, Hinds R, Jones KM, Piterman L. Infant gastro-oesophageal reflux disease (GORD): Australian GP attitudes and practices. J Paediatr Child Health 2016;52(1):47–53.
8. van der Pol RJ, Smits MJ, van Wijk MP, Omari TI, Tabbers MM, Benninga MA. Efficacy of proton-pump inhibitors in children with gastroesophageal reflux disease: a systematic review. Pediatrics 2011;127(5):925–35.
9. Vandenplas Y, Rudolph CD, Di Lorenzo C, Hassall E, Liptak G, Mazur L, et al. Pediatric gastroesophageal reflux clinical practice guidelines: joint recommendations of the North American Society for Pediatric Gastroenterology, Hepatology, and Nutrition (NASPGHAN) and the European Society for Pediatric Gastroenterology, Hepatology, and Nutrition (ESPGHAN). J Pediatr Gastroenterol Nutr 2009;49(4):498–547.
10. Gieruszczak-Białek D, Konarska Z, Skórka A, Vandenplas Y, Szajewska H. No effect of proton pump inhibitors on crying and irritability in infants: systematic review of randomized controlled trials. J Pediatr 2015;166(3):767–70.e3.
11. Royal Australian College of Physicians. Paediatrics and Child Health Division: top 5 low-value practices and interventions. EVOLVE recommendation 4 [Internet]. Sydney: RACP; 2016 [cited 2018 Apr 12]. Available from: https://evolve.edu.au/published-lists/paediatrics-and-child-health-division
12. National Institute for Health and Care Excellence. Gastro-oesophageal reflux disease in children and young people: diagnosis and management. London: NICE; 2015. www.nice.org.uk/guidance/ng1/resources/gastrooesophageal-reflux-disease-in-children-and-young-people-diagnosis-and-management-51035086789 (accessed Jul 2018).
13. Royal Children's Hospital Melbourne. Gastrooesophageal reflux in infants [Internet]. Melbourne: RCH [cited 2018 Apr 12]. Available from: www.rch.org.au/clinicalguide/guideline_index/Gastrooesophageal_reflux_in_infants
14. Therapeutic guidelines: gastrointestinal. Version 6. Melbourne: Therapeutic Guidelines Limited; 2016.
15. Braithwaite J, Hibbert PD, Jaffe A, White L, Cowell CT, Harris MF, et al. Quality of health care for children in Australia, 2012–2013. JAMA 2018;319(11):1113–24.
16. Freedberg DE, Kim LS, Yang YX. The risks and benefits of long-term use of proton pump inhibitors: expert review and best practice advice from the American Gastroenterological Association. Gastroenterology 2017;152(4):706–15.
17. Gracie DJ, Ford AC. The possible risks of proton pump inhibitors. Med J Aust 2016;205(7):202–3.
18. Pharmaceutical Benefits Advisory Committee. March 2018 PBAC outcomes: other matters. Canberra: Australian Government Department of Health; 2018. www.pbs.gov.au/industry/listing/elements/pbac-meetings/pbac-outcomes/2018-03/other-matters-03-2018.pdf (accessed Apr 2018).
19. Quitadamo P, Miele E, Alongi A, Brunese FP, Di Cosimo ME, Ferrara D, et al. Italian survey on general pediatricians' approach to children with gastroesophageal reflux symptoms. Eur J Pediatr 2015;174(1):91–6.
20. Hassall E. Over-prescription of acid-suppressing medications in infants: how it came about, why it's wrong, and what to do about it. J Pediatr 2012;160(2):193–8.
21. Dahlen HG, Foster JP, Psaila K, Spence K, Badawi N, Fowler C, et al. Gastro-oesophageal reflux: a mixed methods study of infants admitted to hospital in the first 12 months following birth in NSW (2000–2011). BMC Pediatr 2018;18(1):30.
22. Slaughter JL, Stenger MR, Reagan PB, Jadcherla SR. Neonatal histamine-2 receptor antagonist and proton pump inhibitor treatment at United States children's hospitals. J Pediatr 2016;174:63–70 e3.
23. Safe M, Chan WH, Leach ST, Sutton L, Lui K, Krishnan U. Widespread use of gastric acid inhibitors in infants: are they needed? are they safe? World J Gastrointest Pharmacol Ther 2016;7(4):531–9.
24. Long HA, Solski L, Rebuck JA, Bridgeman C. Infantile gastroesophageal reflux: adherence to treatment guidelines in the hospital setting. J Pediatr Pharmacol Ther 2018;23(1):41–7.
25. Ahrens D, Behrens G, Himmel W, Kochen MM, Chenot JF. Appropriateness of proton pump inhibitor recommendations at hospital discharge and continuation in primary care. Int J Clin Pract 2012;66(8):767–73.
26. Angelidou A, Bell K, Gupta M, Tropea Leeman K, Hansen A. Implementation of a guideline to decrease use of acid-suppressing medications in the NICU. Pediatrics 2017;140(6):e20171715.
27. Royal Children's Hospital Melbourne, Emergency, Gastroenterology and Clinical Nutrition departments. Reflux (GOR) amd GORD [Internet]. Melbourne: RCH; 2018 [updated 2018 May; cited 2018 Jul]. Available from: www.rch.org.au/kidsinfo/fact_sheets/Reflux_GOR
28. NSW Health Office of Kids and Families. Infants and children: acute management of the unsettled and crying infant. Sydney: NSW Ministry of Health; 2016.
29. Tasmanian HeathPathways. Gastro-oesophageal reflux in children [Internet]. Available from: https://tasmania.healthpathways.org.au.