4.5 Appendicectomy hospitalisations

Context

This data item examines hospitalisations for appendicectomy in people of all ages based on their place of residence. Appendicectomy is the surgical removal of the appendix.[1] The most common reason for appendicectomy is appendicitis (inflammation of the appendix). Appendicitis can occur at any age, but is most common between the early teens and late forties.[2]

In 2013, Australia's rate of appendicectomy was among the highest in the Organisation for Economic Co-operation and Development (OECD). Rates per 100,000 population were 194 in South Korea, 177 in Australia, 168 in Germany, 139 in New Zealand, 105 in Canada and 94 in the United Kingdom.[3] Between 2000 and 2013, the rate of appendicectomy in Australia rose from 142 to 177 per 100,000 people.[3]

Appendicectomy was the most common emergency surgery performed in public hospitals in 2014–15.[4] In 2014–15, approximately 30,000 appendicectomies were performed in public or private hospitals as a result of an emergency admission.[4]

Acute appendicitis is essentially a clinical diagnosis[5,6] and is not determined by risk factors such as obesity or socioeconomic status. In a recent Australian study in a regional centre, 25% of patients had imaging before surgery; this was mainly ultrasound in women and children to exclude another pathology.[6]

Appendicectomy hospitalisations

It is not possible to monitor the rate of negative appendicectomy (that is, removal of a normal appendix) using nationally available data. Recent Australian studies of appendicectomy in adults have reported negative appendicectomy rates of 21–24%.[6-8] Reported rates of negative appendicectomy in other countries are 20–35% in the United Kingdom, 15–20% in the Netherlands, 16% in Canada and 12% in the United States.[6] Proposed methods for reducing the rate of negative appendicectomy in stable, uncomplicated patients with suspected appendicitis include greater use of imaging where the diagnosis is uncertain, observing a period of response to antibiotics in patients who are stable and reporting rates of both negative and perforated appendicectomy.[9,10] In the absence of a 'gold standard' diagnostic pathway, it is difficult to determine how much of the variation in rates of hospitalisation for appendicectomy is unwarranted. In addition, even with an agreed diagnostic pathway, linked data on the patient's treatment and care before surgery would be required at a national level.

Antibiotic treatment has been used instead of surgery as first-line treatment for some patients with appendicitis. The role of antibiotics in the treatment of suspected uncomplicated appendicitis will require further trials to assess the risk and benefits of this approach in stable, uncomplicated patients.[11-13] Patients with suspected uncomplicated appendicitis may benefit from initial antibiotic therapy during a period of limited observation or when surgery, if required, is likely to be delayed due to distance or access to theatre.

About the data

Data are sourced from the National Hospital Morbidity Database, and include both public and private hospitals. Rates are based on the number of hospitalisations for appendicectomy per 100,000 people in 2014–15.

The analysis and maps are based on the residential address of the patient and not the location of the hospital. Rates are age and sex standardised to allow comparison between populations with different age and sex structures. Data quality issues – for example, the recognition of Aboriginal and Torres Strait Islander status in datasets – could influence the variation seen.

What do the data show?

Magnitude of variation

In 2014–15, there were 40,752 hospitalisations for appendicectomy, representing 179 hospitalisations per 100,000 people (the Australian rate).

The number of hospitalisations for appendicectomy across 316† local areas (Statistical Area 3 – SA3) ranged from 103 to 360 per 100,000 people. The rate was **3.5 times as high** in the area with the highest rate compared to the area with the lowest rate. The number of hospitalisations varied across states and territories, from 164 per 100,000 people in South Australia to 215 in the Northern Territory (Figures 4.32–4.35).

After the highest and lowest 10% of results were excluded and 254 SA3s remained, the number of hospitalisations per 100,000 people was 1.7 times as high in the area with the highest rate compared to the area with the lowest rate.

Rates by SA3 for two additional years, 2012–13 and 2013–14, are available online at www.safetyandquality.gov.au/atlas.

† There are 333 SA3s. For this item, data were suppressed for 17 SA3s due to a small number of hospitalisations and/or population in an area. Some of the published SA3 rates were considered more volatile than others. These rates are excluded from the calculation of the difference between the highest and lowest SA3 rates in Australia.
For further detail about the methods used, please refer to the Technical Supplement.

Appendicectomy hospitalisations

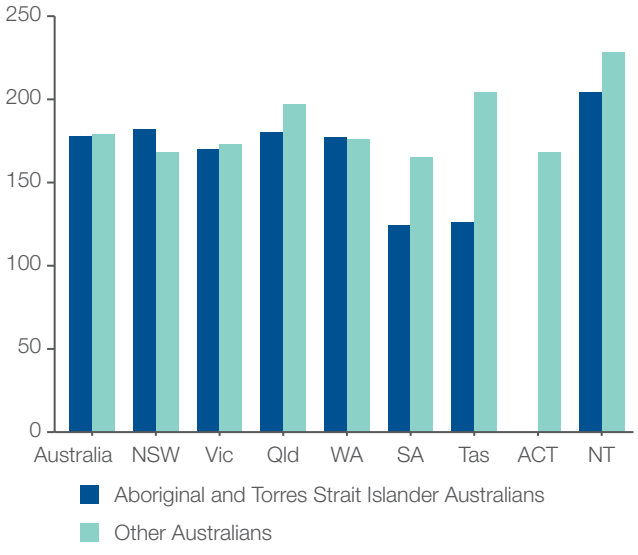
Analysis by remoteness and socioeconomic status

Rates of surgery tended to be higher in inner regional areas than in other categories of remoteness. There was no clear pattern according to socioeconomic disadvantage (Figure 4.36).

Analysis by Aboriginal and Torres Strait Islander status

The rate for Aboriginal and Torres Strait Islander Australians was almost identical to the rate for other Australians (178 vs 179 per 100,000 people) (Figure 4.30).

Figure 4.30: Number of hospitalisations for appendicectomy per 100,000 people, age and sex standardised, by state and territory and Indigenous status, 2014–15

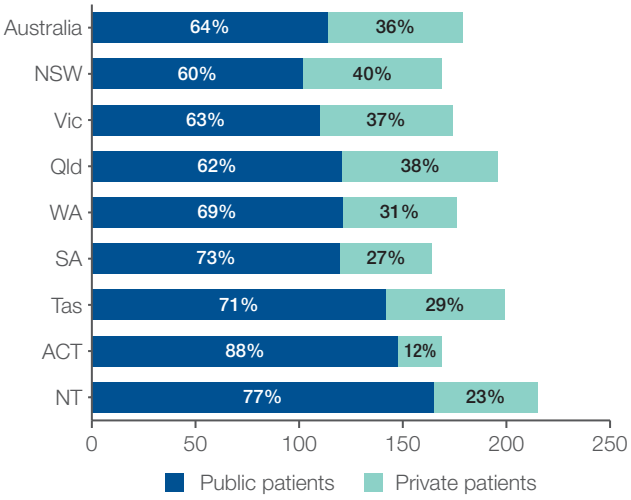


The data for Figure 4.30 are available at www.safetyandquality.gov.au/atlas.

Analysis by patient funding status

Overall, 36% of hospitalisations for appendicectomy were for privately funded patients. This proportion varied from 12% in the Australian Capital Territory to 40% in New South Wales. The median age of patients at the time of operation was 25 years for publicly funded patients and 31 years for privately funded patients (Figure 4.31).

Figure 4.31: Number of hospitalisations for appendicectomy per 100,000 people, age and sex standardised, by state and territory and patient funding status, 2014–15



The data for Figure 4.31 are available at www.safetyandquality.gov.au/atlas.

Notes:
Rates are age and sex standardised to the Australian population in 2001.
Rates are based on the number of hospitalisations in public and private hospitals (numerator) and people in the geographic area (denominator).
Analysis is based on the patient's area of usual residence, not the place of hospitalisation.
Hospitalisations for public patients do not incur a charge to the patient or to a third-party payer – for example, a private health insurance fund.
Hospitalisations for private patients do incur a charge to the patient and/or a third-party payer.
Data for ACT (Aboriginal and Torres Strait Islander Australians) have been suppressed.
Data by Indigenous status should be interpreted with caution as hospitalisations for Aboriginal and Torres Strait Islander patients are under-enumerated and there is variation in the under-enumeration among states and territories.
For further detail about the methods used, please refer to the Technical Supplement.
Sources: AIHW analysis of National Hospital Morbidity Database 2014–15 and ABS Estimated Resident Population 30 June 2014.

Interpretation

Potential reasons for the variation include differences in:

- The incidence of appendicitis and perforated appendicitis
- Use of ultrasound and computed tomography (CT) scans to aid diagnosis
- Use of C-reactive protein levels to aid diagnosis
- Thresholds for surgical management
- Use of antibiotics for uncomplicated appendicitis
- Capacity for prolonged observation of patients in whom diagnosis is uncertain.

The finding that the majority of appendicectomies are performed on publicly funded patients reflects the high proportion of emergency cases that are treated in public hospitals compared with the private system.

Variation between areas in rates of surgery may also be influenced by the number of clinicians providing services to people living in the area. The practices of specific clinicians are likely to have a greater impact on rates in smaller local areas with fewer clinicians, such as rural and regional locations. Specific clinicians may influence rates across several local areas, especially those with small populations. The effects of practice styles of individual clinicians will be diluted in areas with larger numbers of practising clinicians.

As well, variations between areas 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.

Addressing variation

CT scanning to diagnose appendicitis in adults reduces the rate of negative appendicectomy significantly, but the exposure to ionising radiation associated with CT scanning has prompted recommendations against its widespread use.[6,14] Ultrasound is recommended for imaging in suspected acute appendicitis in children and young adults, with CT scanning reserved for follow-up of equivocal results.[15] Australian resources guiding the appropriate use of CT scanning in children and young adults provide information to support decision-making by clinicians and consumers.[16]

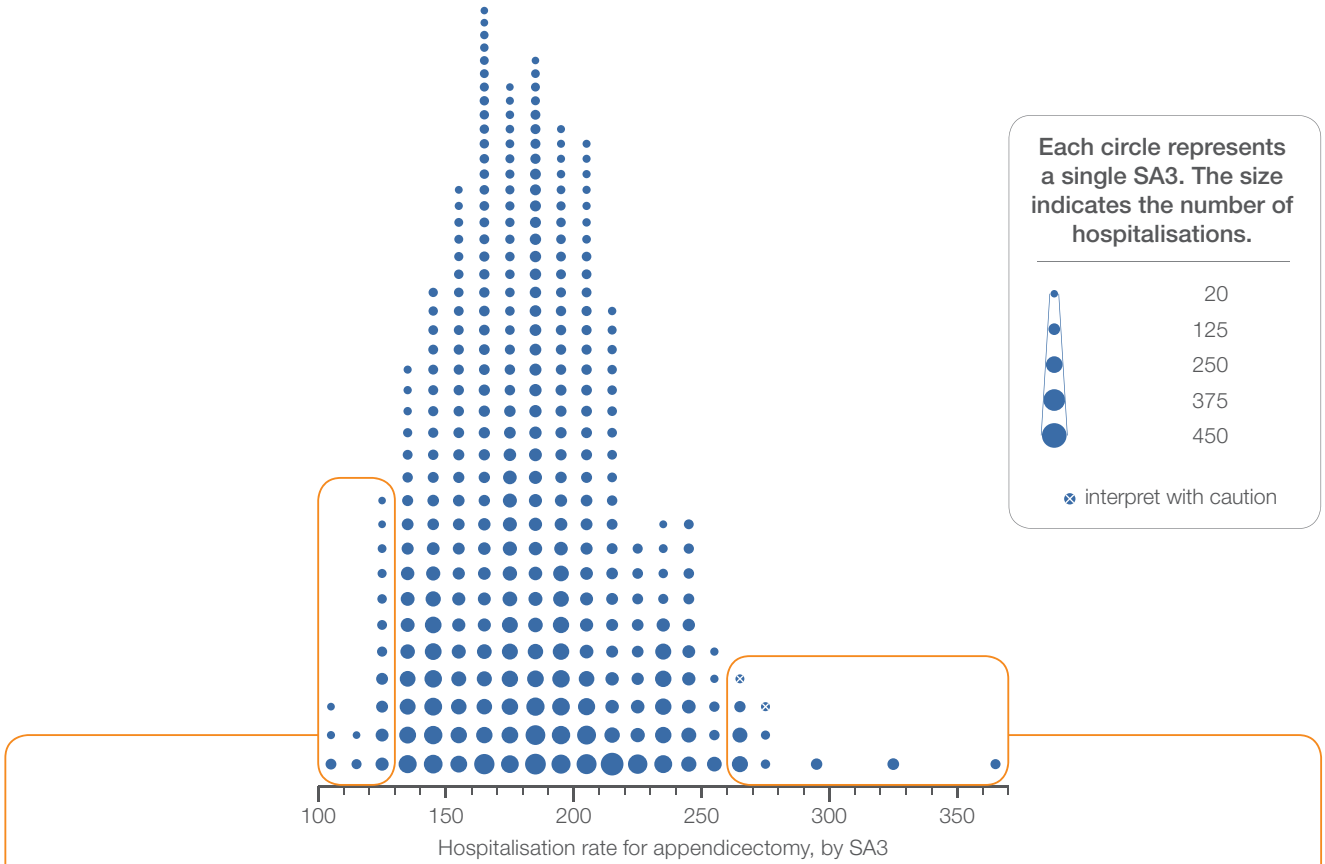
Reported reductions in the rate of negative appendicectomy attributed to using ultrasound, followed by CT scans in some cases, have varied widely. For example, two Dutch studies reported reductions of 15% and 3%, respectively.[10,17] The use of ultrasound has increased in recent years in some Australian hospitals. For example, between 1999 and 2009, the percentage of patients having ultrasound to aid in the diagnosis of appendicitis in a Sydney tertiary children's hospital rose from 28% to 43%.[18] The use of C-reactive protein in the same study increased from 0% to 26%.[18]

Commonly used clinical decision tools to aid diagnosis of appendicitis in children include blood tests such as the white blood count and levels of C-reactive protein.[19] However, blood tests alone are not diagnostic; the clinical findings and the patient's progress are as important as blood tests in deciding whether to perform appendicectomy or place the patient under overnight observation. Many respondents in a recent survey of consultant emergency physicians in Australia and New Zealand favoured prolonged observation to assist diagnosis, but this option can be limited by time targets for patient flow and the demand for emergency department beds.[18] Most (61%) agreed that there was a role for a validated clinical practice guideline for possible appendicitis in children.[19]

Appendicectomy hospitalisations

Views on disease progression and appropriate treatment are changing, and non-surgical management is often considered. Some studies have shown an association between the length of the pre-hospital delay and the proportion of perforations. However, evidence suggests that perforated appendicitis can rarely be prevented.[20] Monitoring perforation rates and negative appendicectomy rates could potentially provide greater insight into the variation in clinical criteria, including investigations and thresholds for surgery.

Figure 4.32: Number of hospitalisations for appendicectomy per 100,000 people, age and sex standardised, by Statistical Area Level 3 (SA3), 2014–15



Lowest rate areas

SA3	State	Rate	Hospitalisations
Woden	ACT	103	36
South Canberra	ACT	107	26
Darebin - North	Vic	108	104
Adelaide City	SA	117	25
Moreland - North	Vic	118	85
South Coast	NSW	120	71
Perth City	WA	122	131
Canning	WA	124	132
Carlingford	NSW	124	80
Kogarah - Rockdale	NSW	125	162
Wheat Belt - South	WA	125	23
Hurstville	NSW	126	156
Richmond Valley - Hinterland	NSW	128	87
Lower North	SA	128	26
South Perth	WA	129	60
Burnside	SA	129	53

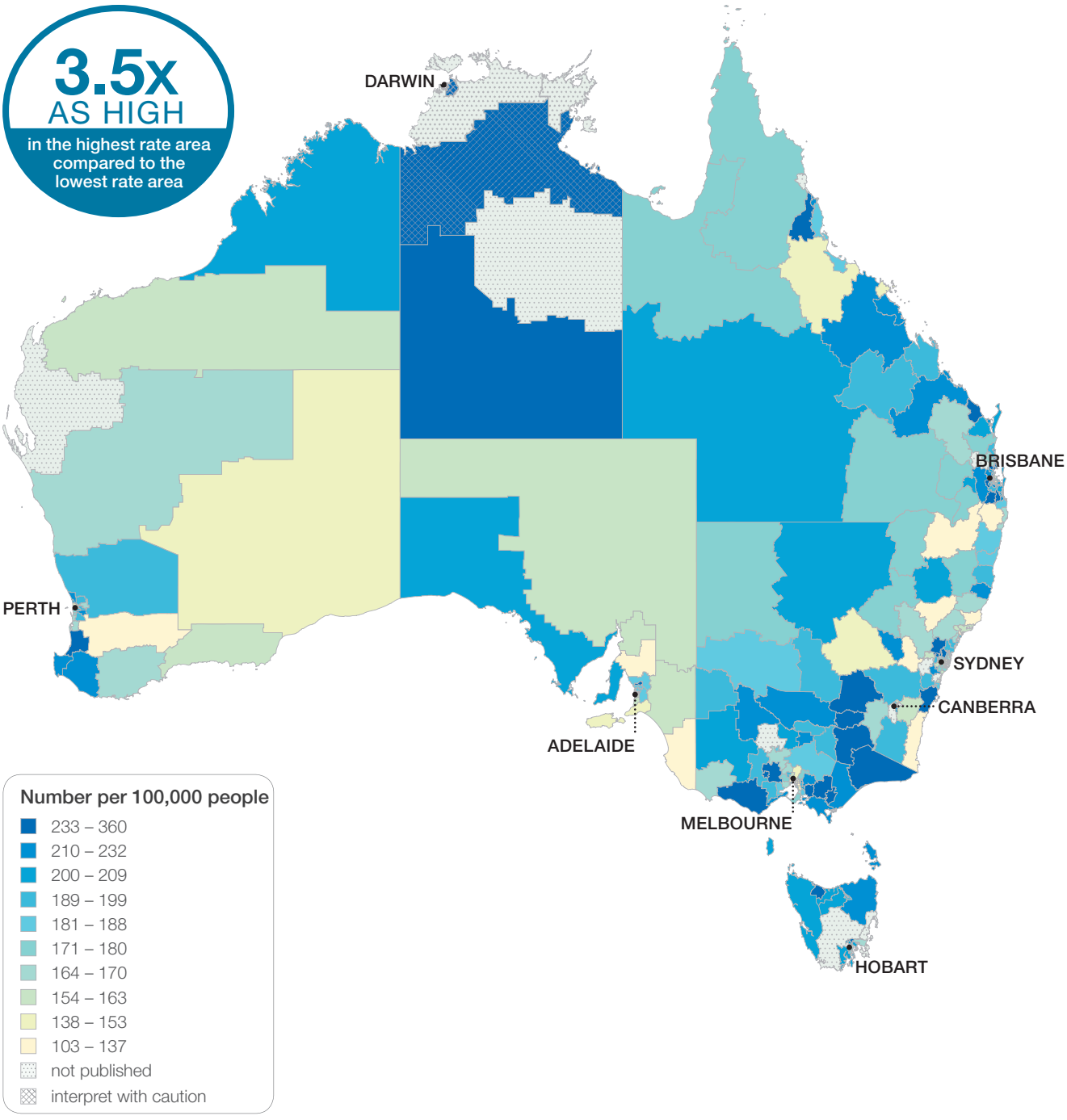
Highest rate areas

SA3	State	Rate	Hospitalisations
Hawkesbury	NSW	360	85
Richmond - Windsor	NSW	329	126
Baw Baw	Vic	293	119
Litchfield	NT	278*	59
Dural - Wisemans Ferry	NSW	275	68
Creswick - Daylesford - Ballan	Vic	271	62
Katherine	NT	265*	57
Wagga Wagga	NSW	264	236
Burnie - Ulverstone	Tas	263	116
Warrnambool - Otway Ranges	Vic	261	208

Notes:
Rates are age and sex standardised to the Australian population in 2001.
Rates are based on the number of hospitalisations in public and private hospitals (numerator) and people in the geographic area (denominator).
Analysis is based on the patient's area of usual residence, not the place of hospitalisation.
Crosses and asterisks indicate rates that are considered more volatile than other published rates and should be interpreted with caution. These rates are excluded from the calculation of the difference between the highest and lowest SA3 rates in Australia.
For further detail about the methods used, please refer to the Technical Supplement.
Sources: AIHW analysis of National Hospital Morbidity Database 2014–15 and ABS Estimated Resident Population 30 June 2014.

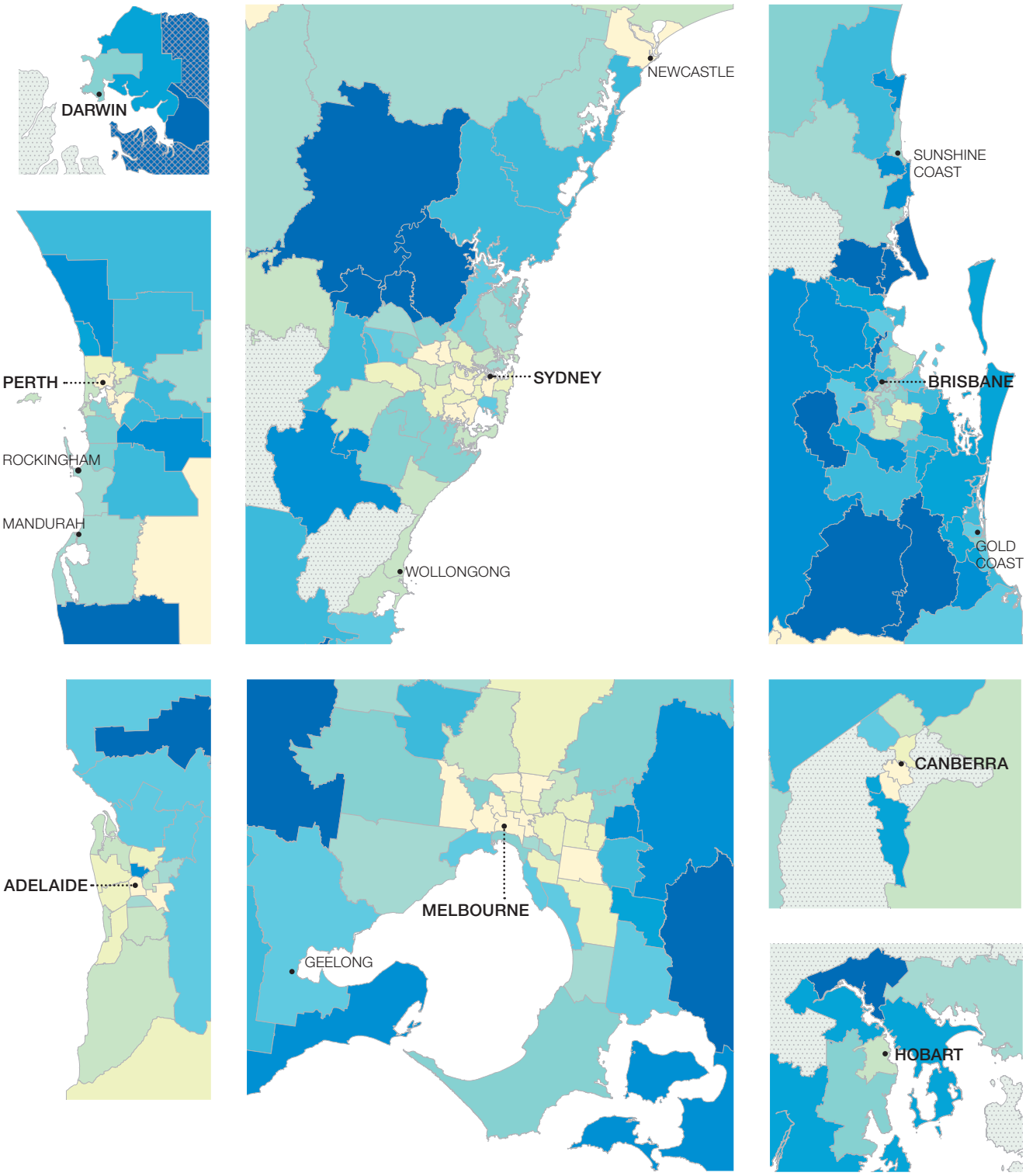
Appendicectomy hospitalisations

Figure 4.33: **Number of hospitalisations for appendicectomy per 100,000 people, age and sex standardised, by Statistical Area Level 3 (SA3), 2014–15: Australia map**



Notes:
Rates are age and sex standardised to the Australian population in 2001.
Rates are based on the number of hospitalisations in public and private hospitals (numerator) and people in the geographic area (denominator).
Analysis is based on the patient's area of usual residence, not the place of hospitalisation.
Hatching indicates a rate that is considered more volatile than other published rates and should be interpreted with caution.
For further detail about the methods used, please refer to the Technical Supplement.
Sources: AIHW analysis of National Hospital Morbidity Database 2014–15 and ABS Estimated Resident Population 30 June 2014.

Figure 4.34: Number of hospitalisations for appendicectomy per 100,000 people, age and sex standardised, by Statistical Area Level 3 (SA3), 2014–15: capital city area maps

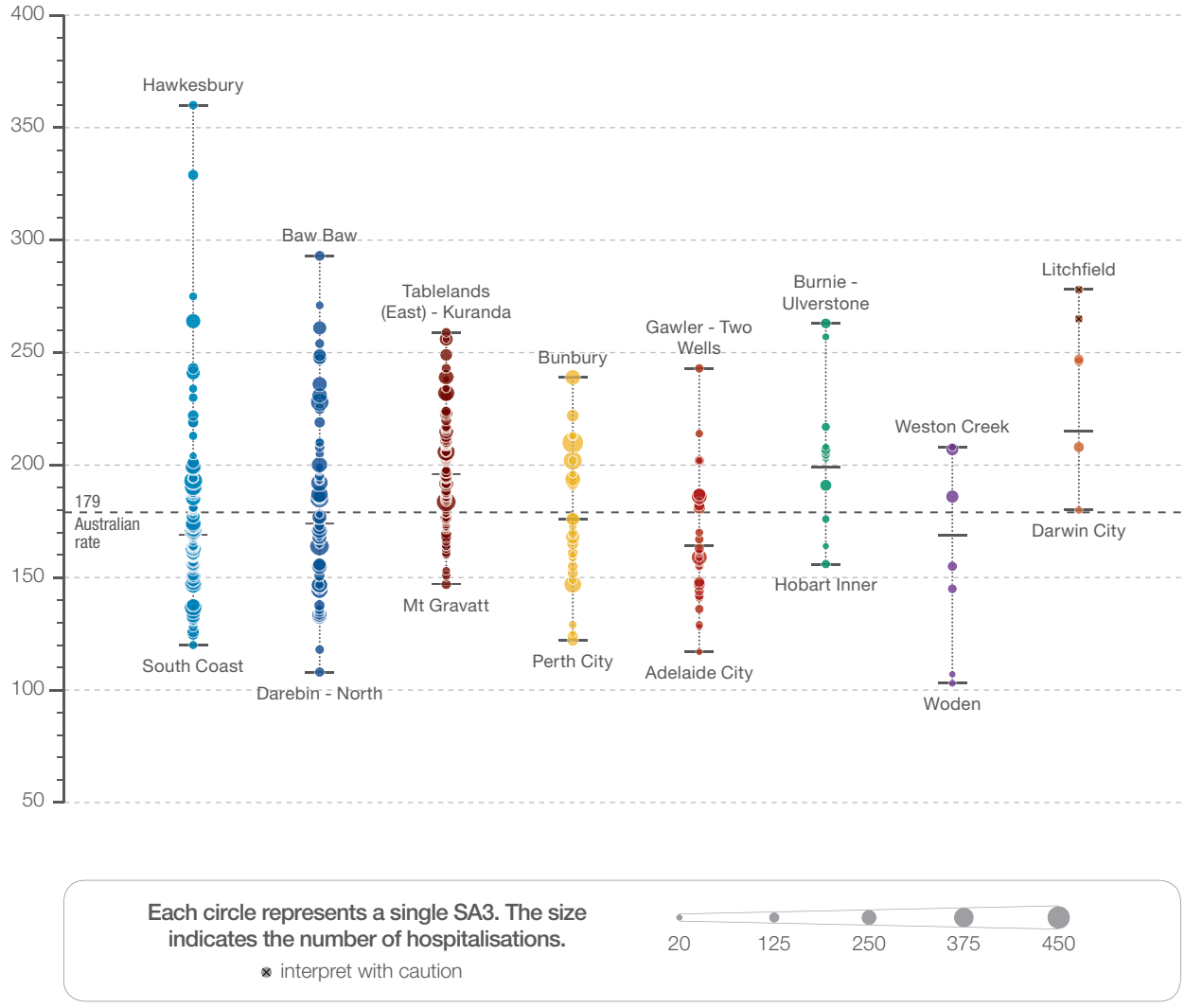


Notes:
Rates are age and sex standardised to the Australian population in 2001.
Rates are based on the number of hospitalisations in public and private hospitals (numerator) and people in the geographic area (denominator).
Analysis is based on the patient's area of usual residence, not the place of hospitalisation.
Hatching indicates a rate that is considered more volatile than other published rates and should be interpreted with caution.
For further detail about the methods used, please refer to the Technical Supplement.
Sources: AIHW analysis of National Hospital Morbidity Database 2014–15 and ABS Estimated Resident Population 30 June 2014.

Appendicectomy hospitalisations

Figure 4.35: Number of hospitalisations for appendicectomy per 100,000 people, age and sex standardised, by Statistical Area Level 3 (SA3), state and territory, 2014–15

	NSW	Vic	Qld	WA	SA	Tas	ACT	NT
Highest rate	360	293	259	239	243	263	208	278*
State/territory	169	174	196	176	164	199	169	215
Lowest rate	120	108	147	122	117	156	103	180
No. hospitalisations	12,165	9,850	9,048	4,422	2,626	947	663	547



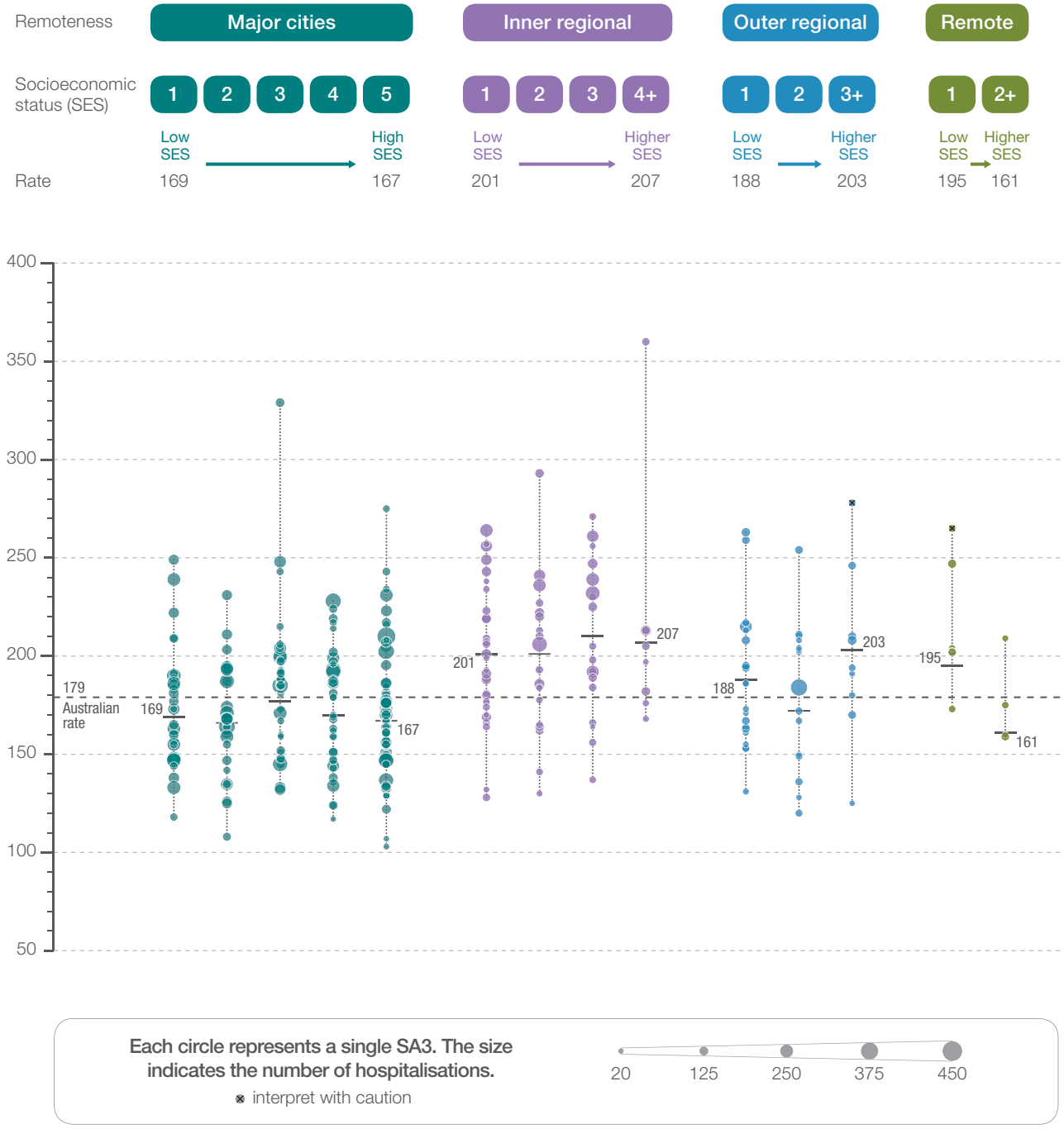
Each circle represents a single SA3. The size indicates the number of hospitalisations.

⊗ interpret with caution

20 125 250 375 450

Notes:
Rates are age and sex standardised to the Australian population in 2001.
Rates are based on the number of hospitalisations in public and private hospitals (numerator) and people in the geographic area (denominator).
Analysis is based on the patient's area of usual residence, not the place of hospitalisation.
Crosses and asterisks indicate rates that are considered more volatile than other published rates and should be interpreted with caution. These rates are excluded from the calculation of the difference between the highest and lowest SA3 rates in Australia.
For further detail about the methods used, please refer to the Technical Supplement.
Sources: AIHW analysis of National Hospital Morbidity Database 2014–15 and ABS Estimated Resident Population 30 June 2014.

Figure 4.36: Number of hospitalisations for appendicectomy per 100,000 people, age and sex standardised, by Statistical Area Level 3 (SA3), remoteness and socioeconomic status, 2014–15



Notes:
Rates are age and sex standardised to the Australian population in 2001.
Rates are based on the number of hospitalisations in public and private hospitals (numerator) and people in the geographic area (denominator).
Analysis is based on the patient's area of usual residence, not the place of hospitalisation.
Crosses indicate rates that are considered more volatile than other published rates and should be interpreted with caution.
For further detail about the methods used, please refer to the Technical Supplement.
Sources: AIHW analysis of National Hospital Morbidity Database 2014–15 and ABS Estimated Resident Population 30 June 2014.

Appendicectomy hospitalisations

Resources

- BMJ Best Practice. Acute appendicitis. London: BMJ Publishing Group; 2015.

Australian initiatives

The information in this chapter will complement work already under way to address the rate of appendicectomy in Australia. State and territory initiatives include:

- *A clinical practice guideline for acute management of abdominal pain in children* (www1.health.nsw.gov.au/pds/ActivePDSDocuments/PD2013_053.pdf), NSW Health.
- *Clinical practice guidelines for abdominal pain* (www.rch.org.au/clinicalguide/guideline_index/Abdominal_pain) that have been adapted for statewide use with the support of the Victorian Paediatric Clinical Network, Royal Children's Hospital Melbourne.
- Systematically applied audit process for monitoring appendicitis management and outcomes for children, South Australia Health.

References

1. Fitzmaurice GJ, McWilliams B, Hurreiz H, Epanomeritakis E. Antibiotics versus appendectomy in the management of acute appendicitis: a review of the current evidence. Can J Surg 2011;54:307.
2. BMJ Best Practice. Acute appendicitis. London: BMJ Publishing Group; 2015.
3. Organisation for Economic Co-operation and Development. Health at a glance 2015: health care activities. Paris: OECD; 2016.
4. Australia Institute of Health and Welfare. Admitted patient care 2014–2015: Australian hospital statistics. Canberra: AIHW; 2016. (Health Services Series No. 68.)
5. Ministry of Health, New South Wales. Infants and children: acute management of abdominal pain. North Sydney: Ministry of Health; 2013.
6. Brockman SF, Scott S, Guest GD, Stupart DA, Ryan S, Watters DA. Does an acute surgical model increase the rate of negative appendicectomy or perforated appendicitis? ANZ J Surg 2013;83:744–7.
7. Poh BR, Cashin P, Dubrava Z, Blamey S, Yong WW, Croagh DG. Impact of an acute care surgery model on appendicectomy outcomes. ANZ J Surg 2013;83:735–8.
8. Chandrasegaram MD, Rothwell LA, An EI, Miller RJ. Pathologies of the appendix: a 10-year review of 4670 appendicectomy specimens. ANZ J Surg 2012;82:844–7.
9. Gandy RC, Wang F. Should the non-operative management of appendicitis be the new standard of care? ANZ J Surg 2016;86:228–31.
10. Schok T, Simons PC, Janssen-Heijnen ML, Peters NA, Konsten JL. Prospective evaluation of the added value of imaging within the Dutch National Diagnostic Appendicitis Guideline: do we forget our clinical eye? Dig Surg 2014;31:436–43.
11. Sallinen V, Akl EA, You JJ, Agarwal A, Shoucair S, Vandvik PO, et al. Meta-analysis of antibiotics versus appendicectomy for non-perforated acute appendicitis. Br J Surg 2016 Mar 17:doi 10.1002/bjs.10147.
12. Smink D, Soybel D. Managment of acute appendicitis in adults. Up to date. Waltham, MA, United States: Wolters Kluwer Health; 2016.
13. Lundholm K, Hansson-Assarsson J, Engstrom C, Iresjo BM. Long-term results following antibiotic treatment of acute appendicitis in adults. World J Surg 2017 Mar 24: doi:10.1007/s00268-017-3987-6.
14. Health Policy Advisory Committee on Technology. Computed tomography to rule out suspected appendicitis in adults and reduce the negative appendectomy rate. Brisbane: Queensland Department of Health; 2016.
15. Royal Australasian College of Surgeons. 5 things clinicians and consumers should question. Sydney: NPS MedicineWise; 2016.
16. Australian Commission on Safety and Quality in Health Care. Reduction in Radiation Exposure to Children and Young People from CT Scans project. Sydney: ACSQHC; 2015. https://www.safetyandquality.gov.au/national-priorities/reduction-in-radiation-exposure-to-children-from-ct-scans
17. Poortman P, Oostvogel HJ, Bosma E, Lohle PN, Cuesta MA, de Lange-de Klerk ES, et al. Improving diagnosis of acute appendicitis: results of a diagnostic pathway with standard use of ultrasonography followed by selective use of CT. J Am Coll Surg 2009;208:434–41.
18. Wilson BE, Cheney L, Patel B, Holland AJ. Appendicectomy at a children's hospital: what has changed over a decade? ANZ J Surg 2012;82:639–43.
19. McCabe K, Babl FE, Dalton S. Management of children with possible appendicitis: a survey of emergency physicians in Australia and New Zealand. Emerg Med Australas 2014;26:481–6.
20. Andersson RE. Does delay of diagnosis and treatment in appendicitis cause perforation? World J Surg 2016;40:1315–7.