2.3 Proton pump inhibitor medicines dispensing, 18 years and over

Why is this important?

Proton pump inhibitor (PPI) medicines are among the most commonly used medicines in Australia, and most use is for gastro-oesophageal reflux disease (GORD). Although PPI medicines are highly effective at controlling symptoms of gastro-oesophageal reflux in adults, there is good evidence that they are overused, that opportunities for lifestyle interventions are not maximised and that many people are inappropriately using PPI medicines for long periods of time. There are some concerns about side effects with long-term use.

What did we find?

The Atlas found that the rate of PPI medicines dispensing varies up to five-fold between local areas in Australia. Fifteen per cent of the adult population had at least one prescription for a PPI medicine dispensed in the year.

What can be done?

Interventions should focus on consumer education about modifiable lifestyle factors that increase the risk of GORD, on appropriate prescribing when adults are first placed on a PPI medicine, and on deprescribing. Multifaceted approaches directed at both clinicians and consumers have been found to be effective. These could include information for consumers, information for general practitioners encouraging 'stepping-down' PPI therapy for GORD and a list of their patients taking ongoing PPI therapy, and information for pharmacists. Quality improvement interventions in hospitals could improve appropriateness of care in this setting. This could then have a flow-on effect to prescribing in the community, as hospital recommendations for PPI medicines use may influence PPI medicines use after discharge.[1]

Proton pump inhibitor medicines dispensing, 18 years and over

Context

PPIs are a group of medicines that reduce acid production in the stomach.[2] Medicines in the PPI group include omeprazole, pantoprazole, lansoprazole, rabeprazole and esomeprazole.[3] This data item analyses PPI medicines use in adults (aged 18 years and over). See page 71 for analysis of PPI medicines use in infants (aged 1 year and under).

The most common reasons for PPI therapy for adults in Australia are gastro-oesophageal reflux (68%) and, less frequently, oesophagitis (15%).[4] Both conditions are associated with exposure of the gullet (oesophagus) to stomach acid. PPI medicines are also often prescribed for prophylaxis in people taking non-steroidal anti-inflammatory drugs. A trial of PPI therapy may be worthwhile in people with functional dyspepsia if the main symptom is epigastric burning.[5]

PPI medicines are the most potent acid suppression therapy available. They are therefore attractive as first-line therapy because they give fast symptom relief.[6,7] Many patients are not appropriately 'stepped down' to less potent therapy such as a low-dose PPI medicine, histamine 2 antagonist or, least potent of all, antacids. Many people have mild or intermittent symptoms and do not require PPI medicines or regular treatment. Long-term treatment with PPI medicines is appropriate for people with complicated GORD or a small number of other conditions, and for prophylaxis in people treated with medicines that can cause upper gastrointestinal problems such as gastric bleeding.[7]

Pharmaceutical treatment does not address the underlying promoters of reflux and oesophageal cancer (an uncommon long-term complication of poorly controlled GORD). Lifestyle measures such as dietary changes, smoking cessation and weight loss can reduce reflux and reduce oesophageal cancer risk.[6-8] There is good evidence that these factors are given insufficient attention in the Australian population. While smoking rates have declined overall in Australia, other risk factors for GORD have increased. In 2014–15, the national rate of overweight and obesity in Australia was 63.4% (equivalent to 11.2 million Australian adults), up from 56.3% in 1995.[6-8]

PPI medicines are among the most commonly used medicines in the world. The issue of their widespread and possibly inappropriate long-term use has been raised as a problem in several countries.[9,10] International studies suggest that approximately half of prescriptions for PPI medicines are inappropriate according to guidelines; recent estimates of the proportion of inappropriate prescribing of PPI medicines in Australia range from 22% to 63%.[11-13]

PPI medicines became available in Australia in the early 1990s, and their use increased by 1,300% from 1995 to 2006.[9] The rate of increase then slowed, rising by 5% between 2007 and 2017, but PPI medicines have remained among the top 10 prescribed drugs in Australia since the 2000s.[14] In 2015–16, an estimated 12% of the Australian population were taking a PPI medicine or had in the past year.[4] Similar patterns have been seen in other countries. For example, in the United Kingdom, PPI medicine prescriptions increased from 26 million in 2006 to 58 million in 2016, and 15% of the population were estimated to be taking a PPI medicine in 2014.[15-17] PPI medicines are also available over the counter in Australia and are advertised to consumers; however, figures for this supply are not readily available.

Although PPI medicines are generally well tolerated, concerns have been raised about rare, but serious, risks associated with long-term PPI medicines use. For example, PPI medicines alter the gut microbiome and there is some evidence that this may increase the risk of enteric infections with *Clostridium difficile* and other pathogens, as well as bone fractures, chronic kidney disease and interstitial nephritis.[7,10,13,18,19] Most of this evidence is from observational studies, and strong evidence of a causal link is lacking.[10,20]

About the data

Data are sourced from the Pharmaceutical Benefits Scheme (PBS) dataset, which includes all prescriptions dispensed under the PBS or the Repatriation Pharmaceutical Benefits Scheme. This includes prescriptions with co-payment 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 people aged 18 years and over 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 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 21,768,718 PBS prescriptions dispensed for PPI medicines, representing 105,294 prescriptions per 100,000 people aged 18 years and over (the Australian rate).

The number of PBS prescriptions dispensed for PPI medicines across 333* local areas (Statistical Area Level 3 – SA3) ranged from 34,489 to 172,780 per 100,000 people aged 18 years and over. The rate was **5.0 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 63,230 per 100,000 people aged 18 years and over in the Northern Territory to 127,993 in Tasmania.

After the highest and lowest 10% of results were excluded and 267 SA3s remained, the number of prescriptions dispensed per 100,000 people aged 18 years and over was 1.6 times as high in the area with the highest rate compared to the area with the lowest rate.

* There are 340 SA3s. For this item, data were suppressed for 7 SA3s due to a small number of prescriptions dispensed and/or population in an area.
Notes:
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.

Proton pump inhibitor medicines dispensing, 18 years and over

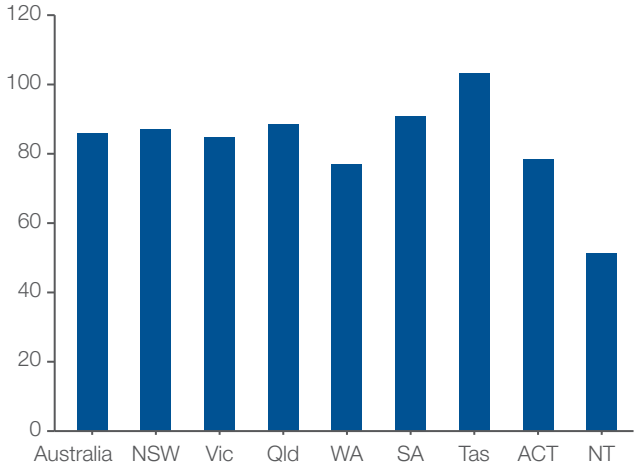
Analysis by remoteness and socioeconomic status

Rates of PPI medicines dispensing were higher in inner regional and outer regional areas than in other areas. There was a pattern of an increasing rate of PPI medicines dispensing with socioeconomic disadvantage in major cities, and inner regional and outer regional areas (Figure 2.23).

Rate of defined daily doses

The number of defined daily doses (DDD)† of PPI medicines per 1,000 people aged 18 years and over dispensed on any given day was 85.95 – this is equivalent to 8.6% of the adult population receiving a PPI medicine on any given day of 2016–17. The DDD rate varied across states and territories from 51.15 per 1,000 people per day in the Northern Territory to 103.32 in Tasmania (Figure 2.17).

Figure 2.17: Number of defined daily doses of proton pump inhibitor medicines per 1,000 people aged 18 years and over per day, age and sex standardised, by state and territory of patient residence, 2016–17

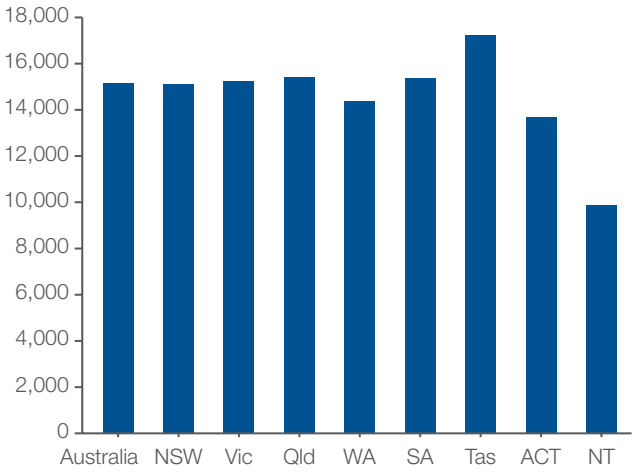


The data for Figure 2.17 are available at www.safetyandquality.gov/atlas

People dispensed at least one prescription

The number of people aged 18 years and over who had at least one prescription for a PPI medicine dispensed in 2016–17 was 15,135 per 100,000 people – that is 15% of the adult population (Figure 2.18).

Figure 2.18: Number of patients dispensed at least one proton pump inhibitor medicine per 100,000 people aged 18 years and over, age and sex standardised, by state and territory of patient residence, 2016–17



The data for Figure 2.18 are available at www.safetyandquality.gov/atlas

Interpretation

Variation in rates of PPI medicines dispensing is likely to be due to geographical differences in the factors discussed below. In addition, variation in use of over-the-counter PPI medicines may influence rates of prescription PPI medicines dispensing. Affordability of over-the-counter PPI medicines may contribute to some of the variation seen in PBS-subsidised dispensing, including the lower rates of dispensing seen in less disadvantaged areas.

† A defined daily dose (DDD) is a measure of medicines use that allows comparison between different therapeutic groups, and between countries. The DDD is based on the average dose per day of the medicine when used for its main indication by adults.

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.

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.

Rates of underlying disease

Variation is warranted and desirable when it reflects variation in the underlying need for care. Rates of PPI medicines use may vary according to rates of GORD risk factors in adults (such as obesity, smoking and alcohol intake) and other indications for PPI medicines use, such as *Helicobacter pylori* infection (when PPI medicines are used as an adjunct to antibiotic therapy) and use of medicines that increase the risk of gastrointestinal bleeding.[6] GORD is more common among people with lower levels of education and other elements of socioeconomic disadvantage, and the higher rates of PPI medicines use in areas of socioeconomic disadvantage are consistent with this pattern.[21,22] Higher rates of obesity and smoking may contribute to the higher rates of GORD in socioeconomically disadvantaged areas.[23]

Clinical decision-making

Clinician and consumer willingness to discuss lifestyle risk factors and to act to reduce their impact may affect PPI prescribing rates. Variation in adherence to guidelines for prescribing PPIs in adults and infants is also likely to influence the pattern of use – for example, rates of prescribing PPIs for simple gastro-oesophageal reflux, which is not recommended.[6] Differences in participation in national interventions to increase appropriateness of PPI prescribing for adults, such as academic detailing for general practitioners (GPs), audit and feedback, and a multifaceted program for veterans, may also influence rates of use.[24]

Access to medical care

Access to GPs and gastroenterologists may influence the likelihood of consumers seeking care for gastro-oesophageal reflux and GORD for themselves or their children, and therefore affect rates of PPI use.[25]

Variation in rates of PPI medicines dispensing between areas 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 large numbers of practising clinicians.

Addressing variation

The number of prescriptions for PPI medicines dispensed in 2016–17 equates to every person in Australia aged 18 years and over receiving at least one prescription for a PPI medicine annually.

The quality of evidence on long-term risks of PPI medicines is generally low, but these possible risks are important when seen in the context of large-scale inappropriate use.[10] Limiting use to appropriate indications would also reduce waste of health resources and patient costs.[10,20]

Despite recommendations to reserve long-term use for select situations, the average duration of PPI therapy is 3.8 years in Australia.[4] Almost all of the serious side effects associated with PPI medicines occur in people on long-term therapy, so periodic review of the need for ongoing PPI therapy and minimising the duration of therapy could greatly reduce the risk of harm.[13] Australian Choosing Wisely recommendations advise not using PPI medicines long term in patients with uncomplicated disease without regular attempts at reducing the dose or ceasing therapy.[26,27] PPI therapy should also be discontinued in patients with functional dyspepsia if it does not improve symptoms.[5]

Proton pump inhibitor medicines dispensing, 18 years and over

Interventions that simply identify patients as having potentially inappropriate PPI therapy and highlight them as possible candidates for deprescribing (for example, by a discharge letter) have been unsuccessful.[28] Interventions that not only identified inappropriate PPI medicines prescription but also focused on knowledge translation and close stakeholder engagement have had greater success.[28] Any deprescribing also needs to be carefully targeted, to avoid adverse effects from inappropriate discontinuation of PPI therapy.

A multifaceted series of initiatives conducted in the Australian veterans population exemplified this approach. The initiatives ran between 2004 and 2012, and resulted in a 21% relative decrease in use of PPI medicines.[24] The program included repeating the following interventions, several years apart:

- Information to consumers
- Information encouraging 'stepping-down' PPI therapy for GORD to all GPs caring for veterans taking a PPI medicine, and a list of their patients taking ongoing PPI therapy
- Information to community pharmacies and pharmacists accredited to perform home medicines reviews.

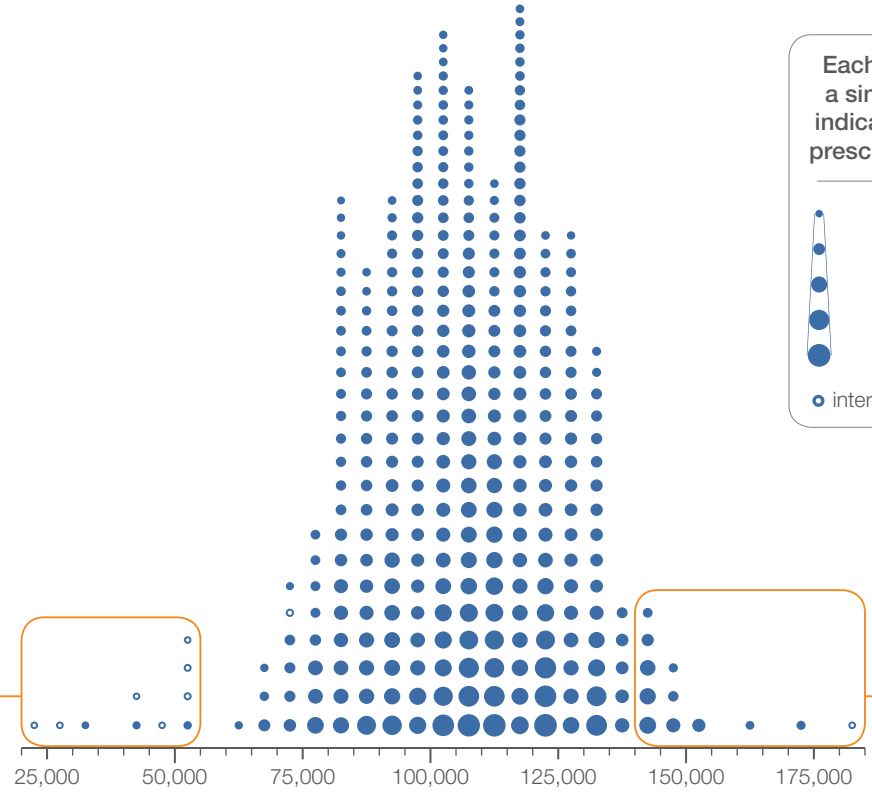
Over the same period, a national program to improve the quality of PPI medicines use was conducted with all GPs at three points. Elements of the program included academic detailing, prescribing recommendations, audit and feedback, and peer meetings including presentations.[24]

The combination and repetition of these strategies were thought to be key to the success in the veterans population.[24] Using a similar multifaceted approach, with repetition, in a wider population of adult PPI medicine users and their health professionals could be effective in improving appropriate use of PPI medicines in Australia.

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.[1]

Rates by local area

Figure 2.19: Number of PBS prescriptions dispensed for proton pump inhibitor medicines per 100,000 people aged 18 years and over, age and sex standardised, by Statistical Area Level 3 (SA3) of patient residence, 2016–17



Lowest rate areas

SA3	State	Rate	Prescriptions
East Arnhem	NT	**21,765***	1,389
Daly - Tiwi - West Arnhem	NT	**28,709***	2,540
Katherine	NT	**34,489**	3,833
Christmas Island	OT	**40,006***	458
Kimberley	WA	**43,023**	8,465
Barkly	NT	**48,081***	1,357
East Pilbara	WA	**52,214***	5,883
Alice Springs	NT	**52,876**	11,836
Norfolk Island	OT	**52,947***	1,160
West Pilbara	WA	**54,586***	7,170

Highest rate areas

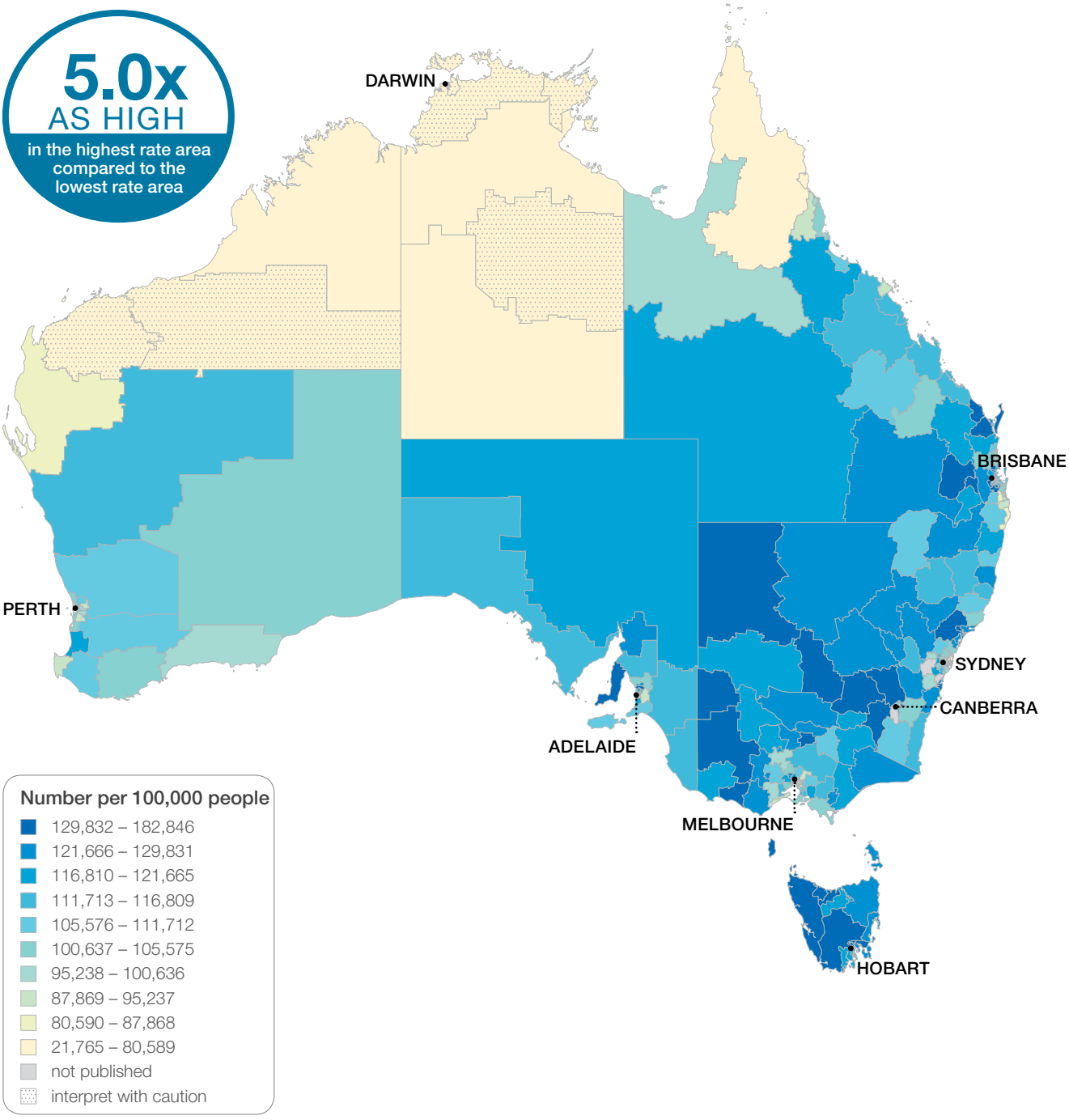
SA3	State	Rate	Prescriptions
Canberra East	ACT	**182,846***	1,923
Brighton	Tas	**172,780**	21,338
Central Highlands (Tas.)	Tas	**163,948**	16,813
Hobart - North West	Tas	**154,053**	75,396
Jimboomba	Qld	**147,767**	39,397
Sorell - Dodges Ferry	Tas	**147,423**	22,622
Maitland	NSW	**145,767**	87,845
Wagga Wagga	NSW	**143,082**	124,185
Ipswich Inner	Qld	**141,639**	116,319
Griffith - Murrumbidgee (West)	NSW	**141,624**	62,654
Broken Hill and Far West	NSW	**141,460**	29,573
Lower Hunter	NSW	**140,953**	107,185

Notes:
Hollow circles (○) and asterisks (*) indicate rates that are considered more volatile than other published rates and should be interpreted with caution.
OT represents other territories.
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, 18 years and over

Rates across Australia

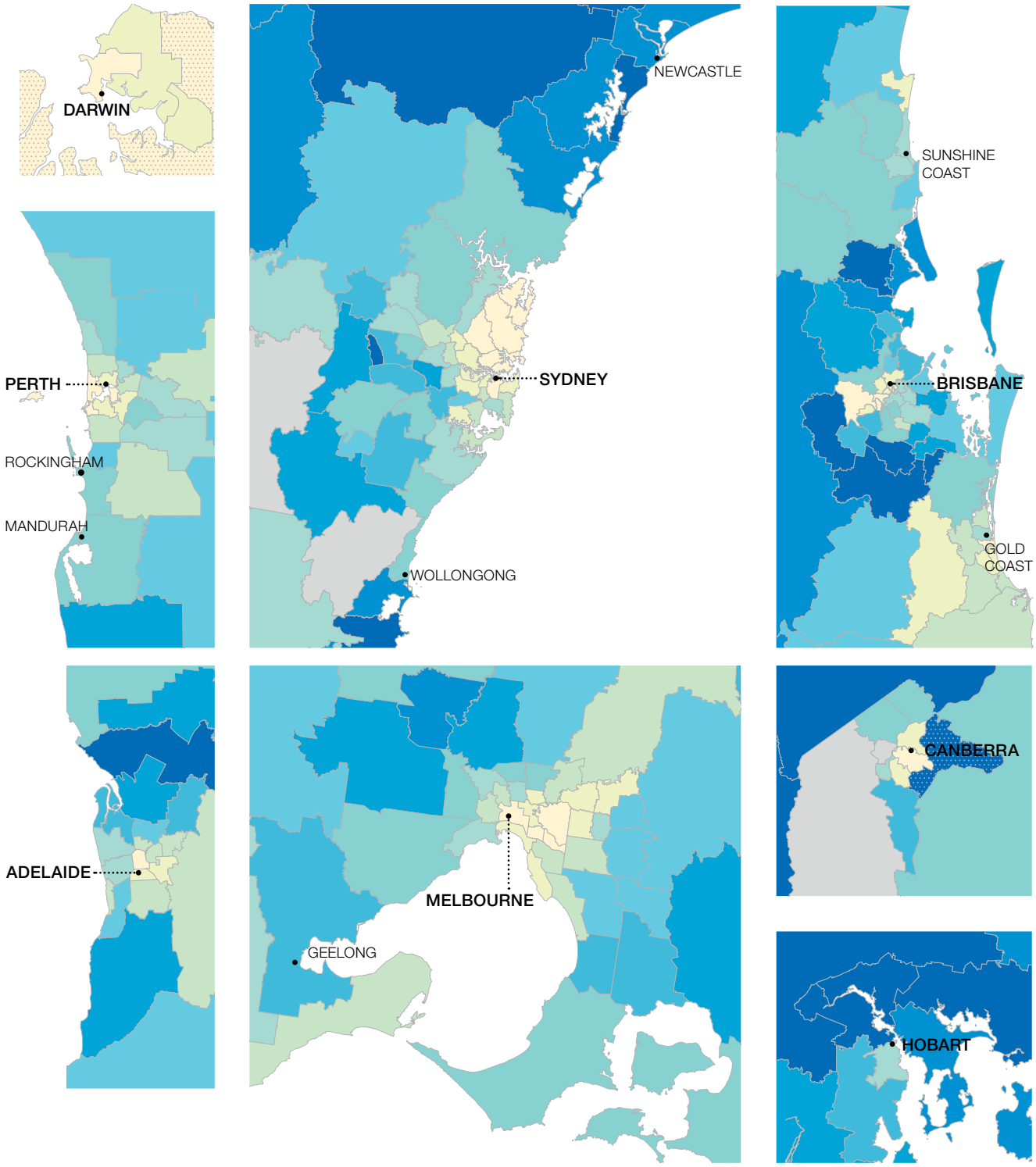
Figure 2.20: Number of PBS prescriptions dispensed for proton pump inhibitor medicines per 100,000 people aged 18 years and over, age and sex standardised, by Statistical Area Level 3 (SA3) of patient residence, 2016–17



Notes:
Dotted areas 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 Pharmaceutical Benefits Scheme data and ABS Estimated Resident Population 30 June 2016.

Rates across capital city areas

Figure 2.21: Number of PBS prescriptions dispensed for proton pump inhibitor medicines per 100,000 people aged 18 years and over, age and sex standardised, by Statistical Area Level 3 (SA3) of patient residence, 2016–17



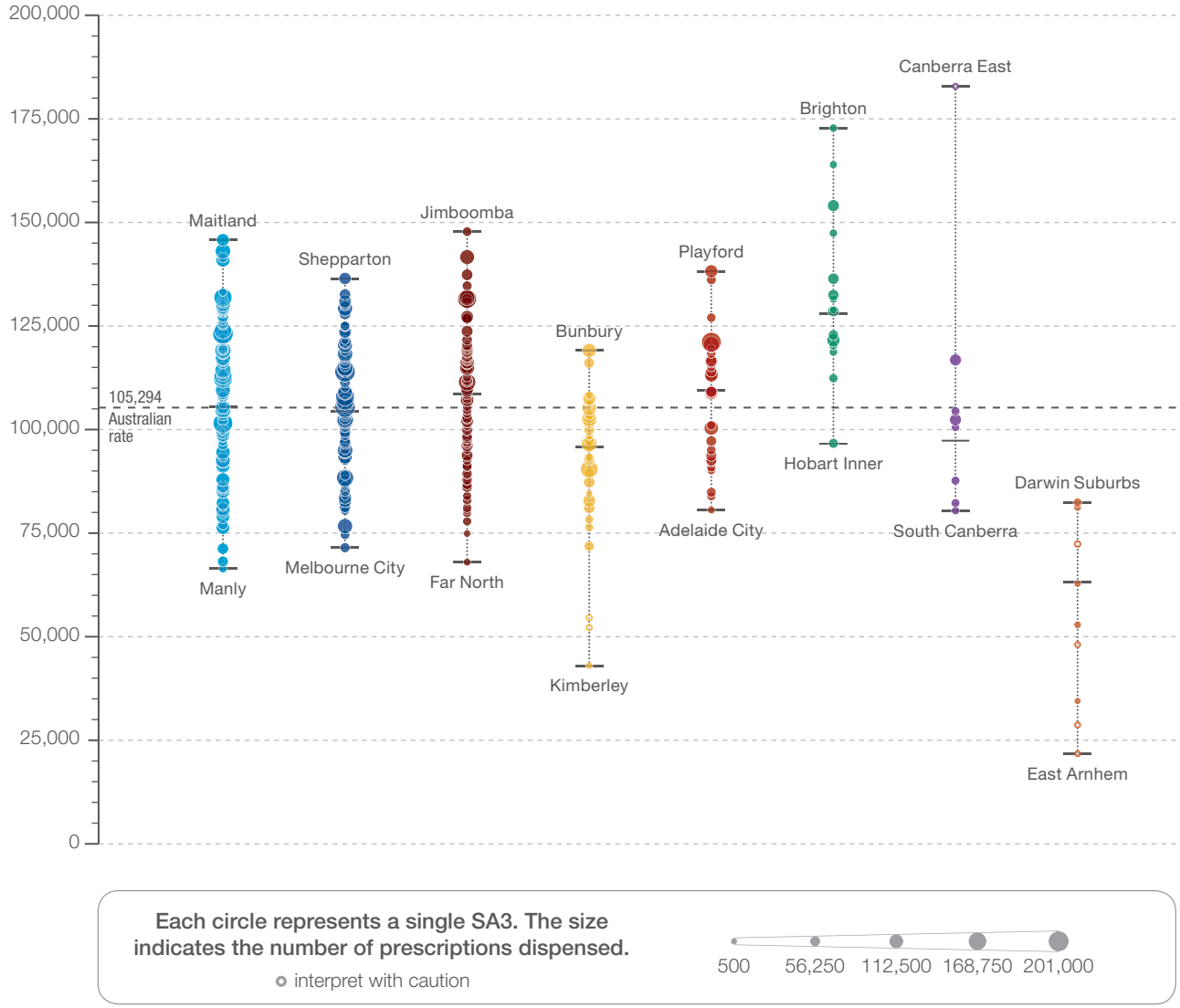
Notes:
Dotted areas indicate rates that are considered more volatile than other published rates and should be interpreted with caution.
For further detail about the methods used, please refer to the Technical Supplement.
Sources: AIHW analysis of Pharmaceutical Benefits Scheme data and ABS Estimated Resident Population 30 June 2016.

Proton pump inhibitor medicines dispensing, 18 years and over

Rates by state and territory

Figure 2.22: Number of PBS prescriptions dispensed for proton pump inhibitor medicines per 100,000 people aged 18 years and over, age and sex standardised, by Statistical Area Level 3 (SA3) of patient residence, 2016–17

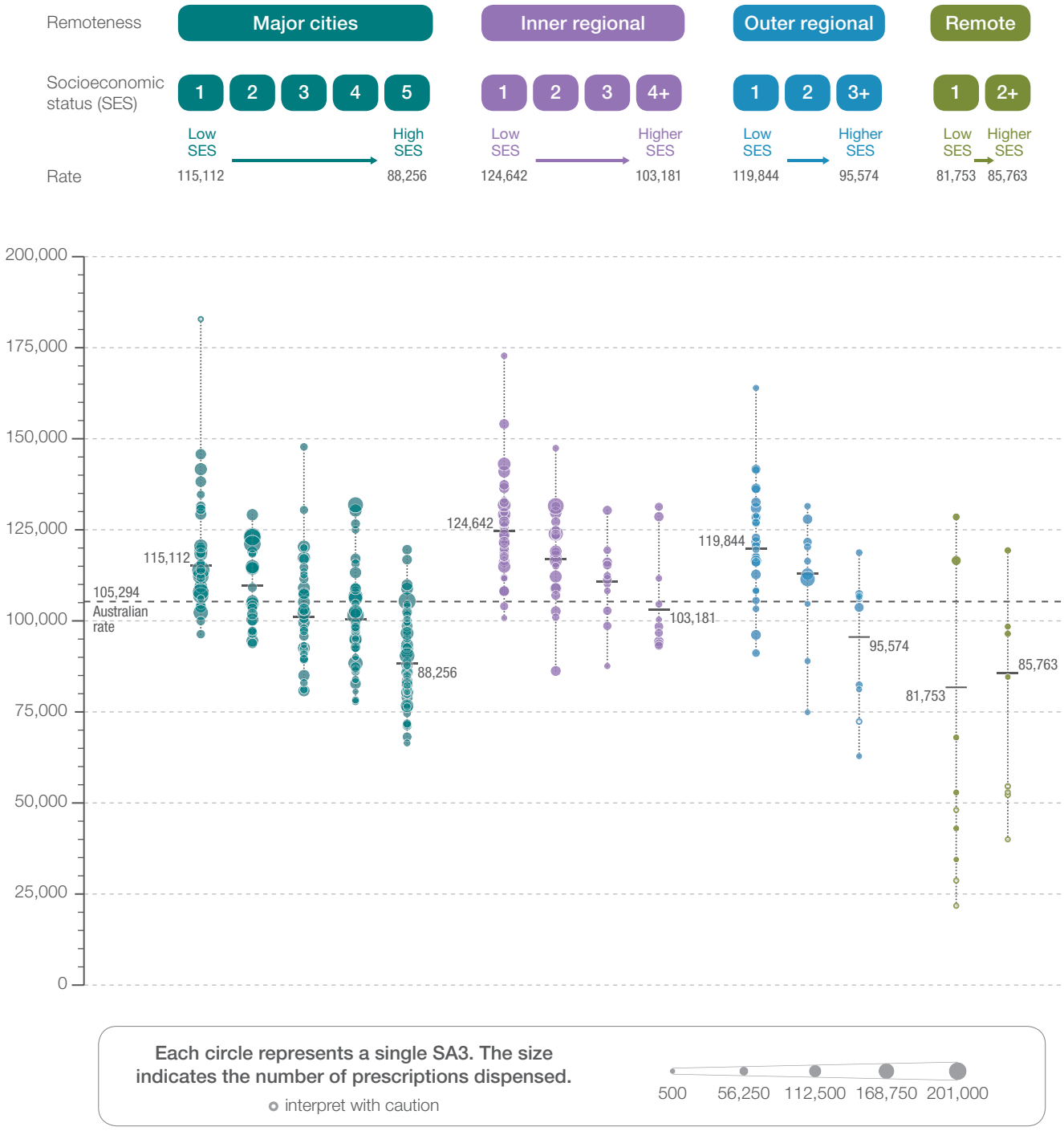
	NSW	Vic	Qld	WA	SA	Tas	ACT	NT
Highest rate	145,767	136,475	147,767	119,093	138,226	172,780	182,846*	82,423
State/territory	105,543	104,408	108,660	95,806	109,527	127,993	97,312	63,230
Lowest rate	66,462	71,488	67,992	43,023	80,589	96,691	80,420	21,765*
No. prescriptions	7,159,289	5,482,136	4,384,675	1,948,629	1,770,298	646,894	288,088	83,684



Notes:
Hollow circles (○) and asterisks (*) 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 Pharmaceutical Benefits Scheme data and ABS Estimated Resident Population 30 June 2016.

Rates by remoteness and socioeconomic status

Figure 2.23: Number of PBS prescriptions dispensed for proton pump inhibitor medicines per 100,000 people aged 18 years and over, age and sex standardised, by Statistical Area Level 3 (SA3) of patient residence, 2016–17



Notes:
Hollow circles (○) 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 Pharmaceutical Benefits Scheme data and ABS Estimated Resident Population 30 June 2016.

Proton pump inhibitor medicines dispensing, 18 years and over

Resources

- NPS MedicineWise, 'Starting, stepping down and stopping medicines – PPIs' program, includes educational visiting program for GPs, online clinical audit[29], information for prescribers[30] and a consumer resource *Managing Your Medicine for Reflux and Heartburn*[31]
- Primary Health Tasmania, *A Guide to Deprescribing Proton Pump Inhibitors*[3]
- Veterans' MATES (Medicines Advice and Therapeutics Education Services), information for consumers and health professionals[32]
- *Therapeutic Guidelines: Gastointestinal*[6]
- Gastroenterological Society of Australia, *Gastro-oesophageal Reflux in Adults: Clinical update*[8]
- National Institute for Health and Care Excellence, Gastro-oesophageal Reflux Disease and Dyspepsia in Adults: Investigation and management (clinical guideline).[33]

Australian initiatives

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

- NPS MedicineWise, 'Starting, stepping down and stopping medicines – PPIs' program (includes educational visiting program for GPs, online clinical audit[29], information for prescribers[30] and a consumer resource *Managing Your Medicine for Reflux and Heartburn*[31])
- Veterans' MATES, Department of Veterans' Affairs, series of initiatives to improve PPI use[24]
- Royal Australian College of General Practitioners, Choosing Wisely recommendation 1: Don't use PPIs long term in patients with uncomplicated disease without regular attempts at reducing dose or ceasing[27]
- Gastroenterological Society of Australia, and Choosing Wisely recommendation 3: Do not continue prescribing long term PPI medication to patients without attempting to reduce the medication down to the lowest effective dose or cease the therapy altogether[26]
- Pharmaceutical Benefits Advisory Committee, recommendations in 2018 to change PBS restriction levels for some PPIs, including authority requirement for higher-dose esomeprazole and streamlined authority requirement for standard-dose PPIs, and reduction of the number of repeats for some PPIs to align with recommended duration of treatment.[34]

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

- Primary Health Tasmania, *A Guide to Deprescribing Proton Pump Inhibitors*[3], deprescribing workshops for a number of medicines including PPIs, and Health Pathways for dyspepsia and heartburn/GORD
- Western Australia, Choosing Wisely initiative conducted in five hospitals.

References

1. 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.
2. Centers for Medicare & Medicaid Services (CMS). 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).
3. Tenni P, Dunbabin D. A guide to deprescribing proton pump inhibitors. Hobart: Primary Health Tasmania; 2016. https://www.primaryhealthtas.com.au/resources/deprescribing-guides/ (accessed Jul 2018).
4. Family Medicine Research Centre University of Sydney. SAND abstract number 241 from the BEACH program 2015–16: proton pump inhibitor use among general practice patients. Sydney: FMRC University of Sydney; 2016.
5. Therapeutic Guidelines Limited. Functional gastrointestinal disorders – functional dyspepsia. In: Therapeutic guidelines: gastrointestinal [Internet]. Melbourne: Therapeutic Guidelines Limited; 2018 [updated 2018; cited 2018 Jul 2018]. Available from: www.tg.org.au
6. Therapeutic guidelines: gastrointestinal. Version 6. Melbourne: Therapeutic Guidelines Limited; 2016.
7. NPS MedicineWise. Proton pump inhibitors: too much of a good thing? [Internet]. Sydney: NPSMedicineWise; 2015 [updated 2015 Mar 15; cited 2017 Dec 19]. Available from: www.nps.org.au/medical-info/clinical-topics/news/proton-pump-inhibitors-too-much-of-a-good-thing
8. Gastroenterological Society of Australia. Gastro-oesophageal reflux disease in adults: clinical update. Melbourne: Digestive Health Foundation; 2011. http://cart.gesa.org.au/membes/files/Clinical%20Guidelines%20and%20Updates/Reflux_Disease.pdf (accessed Jul 2018).
9. Hollingworth S, Duncan EL, Martin JH. Marked increase in proton pump inhibitors use in Australia. Pharmacoepidemiol Drug Saf 2010;19(10):1019–24.
10. 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.
11. Naunton M, Peterson GM, Bleasel MD. Overuse of proton pump inhibitors. J Clin Pharm Ther 2000;25(5):333–40.
12. Hughes JD, Tanpurekul W, Keen NC, Ee HC. Reducing the cost of proton pump inhibitors by adopting best practice. Qual Prim Care 2009;17(1):15–21.
13. Naunton M, Peterson GM, Deeks LS, Young H, Kosari S. We have had a gutful: the need for deprescribing proton pump inhibitors. J Clin Pharm Ther 2018;43(1):65–72.
14. Medicare Australia Statistics. Pharmaceutical Benefits Schedule item reports: proton pump inhibitors from 2007 to 2017 [Internet]. Canberra: Australian Government Department of Health; 2017 [cited 2018 Jun 20]. Available from: http://medicarestatistics.humanservices.gov.au/statistics/pbs_item.jsp
15. National Health Service (NHS) Digital. Prescriptions dispensed in the community, statistics for England, 2006–2016: trend tables [Internet]. NHS Digital; 2017 [updated 2017 Jun 29; cited 2017 Dec 19]. Available from: http://digital.nhs.uk/data-and-information/publications/statistical/prescriptions-dispensed-in-the-community/prescriptions-dispensed-in-the-community-statistics-for-england-2006-2016-pas
16. National Health Service (NHS) Digital. Prescriptions dispensed in the community, statistics for England, 2006–2016: appendix tables [Internet]. NHS Digital; 2017 [updated 2017 Jun 29; cited 2017 Dec 19]. Available from: http://digital.nhs.uk/data-and-information/publications/statistical/prescriptions-dispensed-in-the-community/prescriptions-dispensed-in-the-community-statistics-for-england-2006-2016-pas
17. Othman F, Card TR, Crooks CJ. Proton pump inhibitor prescribing patterns in the UK: a primary care database study. Pharmacoepidemiol Drug Saf 2016;25(9):1079–87.
18. Scarpignato C, Gatta L, Zullo A, Blandizzi C. Effective and safe proton pump inhibitor therapy in acid-related diseases – a position paper addressing benefits and potential harms of acid suppression. BMC Medicine 2016;14(1):179.
19. Imhann F, Bonder MJ, Vich Vila A, Fu J, Mujagic Z, Vork L, et al. Proton pump inhibitors affect the gut microbiome. Gut 2016;65(5):740–8.
20. Gracie DJ, Ford AC. The possible risks of proton pump inhibitors. Med J Aust 2016;205(7):292–3.
21. Dent J, El-Serag HB, Wallander MA, Johansson S. Epidemiology of gastro-oesophageal reflux disease: a systematic review. Gut 2005;54(5):710–7.
22. Jansson C, Nordenstedt H, Johansson S, Wallander MA, Johnsen R, Hveem K, et al. Relation between gastroesophageal reflux symptoms and socioeconomic factors: a population-based study (the HUNT Study). Clin Gastroenterol Hepatol 2007;5(9):1029–34.
23. Australian Institute of Health and Welfare. Australia's health 2018. Canberra: AIHW; 2018. (AIHW Cat. No. AUS 221; Australia's Health Series No. 16.)
24. Pratt NL, Kalisch Ellett LM, Sluggett JK, Gadzhanova SV, Ramsay EN, Kerr M, et al. Use of proton pump inhibitors among older Australians: national quality improvement programmes have led to sustained practice change. Int J Qual Health Care 2017;29(1):75–82.
25. van Boxel OS, Hagenaars MP, Smout AJ, Siersema PD. Socio-demographic factors influence chronic proton pump inhibitor use by a large population in the Netherlands. Aliment Pharmacol Ther 2009;29(5):571–9.
26. Choosing Wisely Australia. Gastroenterological Society of Australia: tests, treatments and procedures clinicians and consumers should question – recommendation 3 [Internet]. Sydney: NPS MedicineWise; 2016 [updated 2016 Oct 1; cited 2018 Oct 3]. Available from: www.choosingwisely.org.au/recommendations/gesa
27. Choosing Wisely Australia. The Royal Australian College of General Practitioners: tests, treatments and procedures clinicians and consumers should question – recommendation 1 [Internet]. Sydney: NPS MedicineWise; 2015 [updated 2015 Apr 22; cited 2017 Dec 19]. Available from: www.choosingwisely.org.au/recommendations/racgp
28. Wilsdon TD, Hendrix I, Thynne TR, Mangoni AA. Effectiveness of interventions to deprescribe inappropriate proton pump inhibitors in older adults. Drugs Aging 2017;34(4):265–87.
29. NPS MedicineWise. Managing GORD with PPIs in primary care [Internet]. Sydney: NPS MedicineWise; 2018 [updated 2018 Jun 26; cited 2018 July 10]. Available from: www.nps.org.au/cpd/activities/ppis-in-gord-a-stepped-approach
30. NPS MedicineWise. Stepping the appropriate path with GORD medicines [Internet]. Sydney: NPS MedicineWise; 2018 [updated 2018 Jun 26; cited 2018 July 10]. Available from: www.nps.org.au/news/stepping-the-appropriate-path-with-gord-medicines
31. NPS MedicineWise. Patient action plan: managing your medicine for reflux and heartburn [Internet]. Sydney: NPS MedicineWise; 2018 [updated 2018 Jun 26; cited 2018 July 10]. Available from: www.nps.org.au/medical-info/managing-gord-with-ppis-in-primary-care#resources
32. Veterans' MATES (Medicines Advice and Therapeutics Education Services). Topics: Proton pump inhibitors [Internet]. Canberra: Australian Government Department of Veterans' Affairs; 2018 [cited 2018 Oct]. Available from: http://veteransmates.net.au/topic-52
33. National Institute for Health and Care Excellence. Gastro-oesophageal reflux disease and dyspepsia in adults: investigation and management [Internet]. London: NICE; 2014 [updated 2014 Nov; cited 2018 Jul 10]. Available from: www.nice.org.uk/guidance/cg184
34. 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).