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Health status and healthcare trends of individuals accessing Australian aged care programmes over a decade: the Registry of Senior Australians historical cohort

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Key words
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Abstract

Background: Understanding the health profile, service and medicine use of Australians in the aged care sector will help inform appropriate service provision for our ageing population.
Aims: To examine the 2006–2015 trends in (i) comorbidities and frailty of individuals accessing aged care, and (ii) health services, medicine use and mortality after entry into long-term care.
Methods: Cross-sectional and population-based trend analyses were conducted using the Registry of Senior Australians.
Results: From 2006 to 2015, 509 944 individuals accessed permanent residential care, 206 394 home care, 283 014 respite and 124 943 transition care. Over this time, the proportion of individuals accessing permanent residential care with high frailty scores (≥0.3) increased (19.7–49.7%), as did the proportion with 5–9 comorbidities (46.4–54.5%), with similar trends observed for those accessing other services. The median number of medicines dispensed in the year after entering permanent residential care increased from 9 (interquartile range (IQR) 6–12) to 10 (IQR 7–14), while remaining stable in home care (2006: 9, IQR 5–12, 2015: 9, IQR 6–13). Short-term (within 100 days) mortality in those accessing permanent care was higher in 2006 (15.6%, 95% CI 15.2–16.0) than 2015 (14.6%, 95% CI 14.3–14.9). Longer term (101–1095 days, 2006: 44.3%, 95% CI 43.7–45.0, 2015: 46.4%, 95% CI 45.8–46.9) mortality was higher in 2015 compared to 2006. Mortality in individuals accessing home care did not change.
Conclusion: The health of older Australians accessing aged care programmes has declined while frailty increased, with an increasing use of medicine and worse long-term mortality in some. Funding and care models need to adapt to this changing profile.

Introduction

The Australian population is increasing, ageing, using more healthcare and progressively needing more aged care services.[1] Between 2008 and 2016, the number of people accessing aged care increased by 19%, but the proportion of individuals over 65 years accessing care

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remained steady (5.4% in 2008 and 5.6% in 2016).[2] This slow increase in access does not reflect the increase in service demand, evidenced by the significant long wait lists for services.[3]

Government subsidised Residential Aged Care in Australia was rolled out in 1963, followed by Community Aged Care, and Home and Community Care programmes in the 1990s and the Aged Care Act 1997.[4] Since the Aged Care Act, programmes and policies supporting residential and home-based aged care service provision have been implemented, evolved, replaced or retired. For example, the Aged Care Assessment Program was introduced in 2003, the Extended Aged Care at Home programme in 2002, the Transition Care Program for restorative services in 2005 and the Extended Aged Care at Home programme for people living with dementia in 2006.[5] In 2013 the Home Care Package programme was changed to a four-level programme and the 'extended' programmes were retired,[6] in 2015 the Community Home and Support Programme replaced the Home and Community Care programme and in 2016 Consumer Directed Care for home packages and the MyAgedCare platform were introduced.[7] During these changes the cohort of people accessing aged care has been monitored[8,9] and few studies have evaluated the burden of certain conditions in this population.[10,11] The overall population level health, frailty profile, healthcare service utilisation and specific outcomes of those entering aged care have not been examined, especially relating to trends over time.

In 2017, the Registry of Senior Australians (ROSA) established the linkage of information from the aged care and healthcare sectors, so the experience, overall health profile and service utilisation of individuals navigating these two sectors could be investigated.[12] ROSA contains a Historical Cohort (1997–2017) with 2.9 million individuals and a Prospective South Australian Cohort (2018-onwards, ~16 000 annual entries), which together are a national resource for understanding consumers of aged care and their outcomes.

Using ROSA, we examined the major Australian population-based trends between 2006 and 2015 in (i) health status and frailty of individuals accessing aged care, and (ii) health services, medicine use and mortality after entry into long-term care.

Methods

A cross-sectional evaluation and population-based trend analysis were conducted using data from the Historical Cohort of ROSA (1997–2017), which in its entirety includes older individuals accessing aged care services in Australia. Over 1.2 million of the individuals in ROSA accessed aged care services between 2002 and 2017 for which an aged care eligibility assessment by an Aged Care Assessment Team (ACAT) is required.

The ROSA contains de-identified linked information from the Australian Institute of Health and Welfare (AIHW) National Aged Care Data Clearinghouse (NACDC), and Australian Government Medicare Benefits Schedule (MBS), and Pharmaceutical Benefits Scheme (PBS). From the NACDC, the Aged Care Assessment Program (ACAP), Aged Care Funding Instrument (ACFI), episodes of Residential Aged Care Services, episodes of Community Aged Care Packages, episodes of Home Care Packages and National Death Index (NDI) datasets were used. The ACAP dataset includes information on the person seeking services, assessor and recommended services. The ACFI dataset provides information on the care needs assessment performed at permanent residential care entry. The episodes of care datasets provide details on services received. The NDI dataset provides dates and causes of death. The MBS dataset provides information on Australian Commonwealth subsidised healthcare services. The PBS dataset provides information on medicines provided under the PBS and Repatriation PBS. The linkage report from AIHW indicated that the aged care cohorts were linked to the Medical Enrolment File with linkage rates of 99.5% for residential aged care and home care package recipients, and 99% for aged care eligibility assessment individuals, indicating high matching rates between the aged care and MBS and PBS datasets.

Non-indigenous individuals ≥65 years old who received permanent residential care, home care and respite care for the first time between 1 January 2006 and 31 December 2015 were included in this study due to complete national implementation of the ACAP. Transition care was introduced nationally gradually from 2005; therefore, individuals with transition care service between 1 January 2007 and 31 December 2015 were included.

To describe the individuals accessing services, sex, age and country of birth were obtained from eligibility assessments. Index of Relative Socio-Economic Disadvantage and Index of Education and Occupation and remoteness status were obtained by linking the individuals' post codes to the 2016 Australian Bureau of Statistics Socio-Economic Indexes for Areas and to the Accessibility/Remoteness Index of Australia Plus 2016, respectively.[13,14] Concession and Department of Veterans' Affairs card status were determined from PBS records. To ascertain individuals' health status we used

the medicine-based comorbidity measure RxRisk-V (6 months lookback period).[15] To ascertain dementia, we used any indication of dementia in the eligibility assessments or the RxRisk-V, except for those entering permanent residential care, where the entry into care assessment was also used. Frailty status was ascertained using a frailty index developed for the aged care eligibility assessment dataset.[16]

To evaluate trends in healthcare service use after long-term care (i.e. permanent residential and home care only) entry the MBS dataset was used. Most commonly used services in the 1-year after service entry were identified. As individuals with DVA benefits use MBS services differently, the health services analysis only included non-DVA card holders. The types of services examined included professional attendances (codes A*) and use of major MBS groups, including diagnostic procedures and investigations (codes D01*), therapeutic procedures (codes T08*), diagnostic imaging services (codes I0*) and miscellaneous services (M0*). Using the PBS dataset, medicines used in the year after long-term care entry were identified. Mortality and cause of death were stratified into short-term (0–100 days after entry) and long-term (101–1095 days after entry); see Table A1 for all MBS, PBS and NDI codes used.

Analyses were stratified by care received (not mutually exclusive): permanent residential, home, respite and transition care. Descriptive statistics characterised the cohorts. The yearly prevalence of health conditions, frailty status, health services use and medicine use were calculated. Direct standardisation (reference year = 2010) was used to estimate age and sex adjusted yearly prevalence rates of health services, medicine uses and mortality rates after entry into care. Kaplan–Meier curves described survival after entry into care. SAS 9.4 (SAS Institute, Cary, NC, USA) was employed.

Results

Between 2006 and 2015, 509 944 individuals accessed permanent residential care, 206 394 accessed home care, 283 014 accessed respite and 124 943 accessed transition care. Individuals accessing any services in 2015 were slightly older than those in 2006 and the proportion of females had decreased over time. Table 1 shows cohort characteristics.

Both in 2006 (or 2007 for transition) and 2015 the median number of comorbidities for the cohorts was 5 (interquartile range (IQR) 3–7, although permanent residential IQR increased to 4–7 in 2015) except for those in transition care, which increased to 6 (IQR 4–8) in 2015. The proportion of individuals with 5–9 comorbidities increased in all services (Table 1), with the biggest increases seen for those accessing permanent residential (46.4–54.5%) and home care (47.2–53.5%). While the prevalence of dementia in those accessing all services decreased (Table 1), the prevalence of gastro-oesophageal reflux disease, hyperlipidaemia, hypertension, ischaemic heart disease, depression and pain increased between 2006 and 2015 (Table A2, Fig. 1, Supporting Information Fig. S1).

The proportion of individuals with a higher frailty index score (≥0.3) increased in all services between 2006 and 2015 (Table 1), including from 19.7% to 49.7% for those accessing permanent residential care and from 15% to 51.1% in those accessing home care.

In individuals accessing permanent residential or home care between 2006 and 2015, increases in the age and sex adjusted prevalence of primary care and preventative services were observed, including use of optometrical services, urgent attendance after hours and general practitioner management plans (Figs 2,S2, Table A3). The use of cardiovascular diagnostic procedures and investigations, diagnostic radiology, and allied health services increased in those accessing home and permanent residential care, while surgical operations remained similar (Figs 2,S2, Table A3).

The median number of medicines dispensed within 1 year of entering permanent residential care was 9 (IQR 6–12) in 2006 and 10 (IQR 7–14) in 2015, and for those entering home care it was 9 (IQR 5–12) in 2006 and 9 (IQR 6–13) in 2015. Of the 10 most frequently dispensed medicines in the first year of permanent residential care, the age and sex adjusted use between 2006 and 2015 of paracetamol (68.4–74.4%), macrogol (8.8–35.9%), cefalexin (28.1–31.0%), pantoprazole (12.0–25.0%), oxycodone (11.2–23.1%), atorvastatin (11.9–18.4%) and risperidone (13.6–15.9%) increased, while aspirin (31.0–26.6%) and temazepam (28.6–18.8%) decreased. Out of the 10 most frequently dispensed medicines for those in home care, use of paracetamol (46.6–53.0%), macrogol (4.9–17.9%), cefalexin (25.1–28.0%), pantoprazole (12.7–23.2%), atorvastatin (18.2–24.1%), metoprolol (11.9–16.0%) and esomeprazole (13.3–21.1%) increased and aspirin (27.8–18.0%), temazepam (20.3–13.2%) and perindopril (15.1–13.2%) decreased between 2006 and 2015 (Figs 3,S3, Table A3).

Overall survival is lower in those in permanent care than living in the community with home care packages (Fig. S4). For those in residential care the age and sex adjusted short-term mortality rate was higher in 2006 (15.6%, 95% CI 15.2–16.0) than 2015 (14.6%, 95% CI 14.3–14.9), while the long-term mortality rate was slightly higher in more recent years (2006: 44.3%, 95% CI 43.7–45.0; 2014: 46.4%, 95% CI 45.8–46.9) (Table 2).

Table 1 Cohort characteristics, health conditions, and frailty index scores, by service accessed and by year

	Service							
	Permanent residential care		Home care		Respite care		Transition care	
	2006	2015	2006	2015	2006	2015	2007	2015
Total	42 801 (100.0)	56 846 (100.0)	16 578 (100.0)	24 830 (100.0)	22 512 (100.0)	36 601 (100.0)	7224 (100.0)	18 075 (100.0)
Age, median (IQR) (years)	84 (79,88)	86 (80,90)	83 (78,87)	83 (77,87)	84 (79,88)	85 (80,90)	83 (78,87)	83 (77,87)
Female†	26 998 (63.1)	34 593 (60.9)	11 135 (67.2)	15 473 (62.3)	14 227 (63.2)	21 857 (59.7)	4682 (64.8)	11 181 (61.9)
Born in Australia†	30 753 (71.9)	38 873 (68.4)	11 046 (66.6)	15 663 (63.1)	16 149 (71.7)	24 786 (67.7)	4796 (66.4)	11 914 (65.9)
Remoteness†								
Major cities	27 875 (65.1)	36 134 (63.6)	10 682 (64.4)	15 505 (62.4)	13 725 (61.0)	22 193 (60.6)	5366 (74.3)	11 496 (63.6)
Inner regional	9531 (22.3)	13 506 (23.8)	3751 (22.6)	5963 (24.0)	5311 (23.6)	9007 (24.6)	1420 (19.7)	4253 (23.5)
Outer regional	4508 (10.5)	6312 (11.1)	1842 (11.1)	2975 (12.0)	2967 (13.2)	4727 (12.9)	387 (5.4)	2076 (11.5)
Remote/Very remote	657 (1.5)	773 (1.4)	244 (1.5)	340 (1.4)	392 (1.7)	600 (1.6)	24 (0.3)	207 (1.1)
DVA card holder	8846 (20.7)	7974 (14.0)	2593 (15.6)	1449 (5.8)	4753 (21.1)	4922 (13.4)	993 (13.7)	1232 (6.8)
Other concession card holder	32 115 (75.0)	47 150 (82.9)	13 366 (80.6)	22 944 (92.4)	16 829 (74.8)	30 518 (83.4)	5982 (82.8)	16 203 (89.6)
SEIFA-Index of Education and Occupation†								
1 (Lower education/occupation status)	7938 (18.5)	11 005 (19.4)	3035 (18.3)	4842 (19.5)	4228 (18.8)	7033 (19.2)	1093 (15.1)	3408 (18.9)
2	7317 (17.1)	10 112 (17.8)	2857 (17.2)	4787 (19.3)	4073 (18.1)	7003 (19.1)	840 (11.6)	3133 (17.3)
3	7280 (17.0)	10 368 (18.2)	2795 (16.9)	4690 (18.9)	3719 (16.5)	6234 (17.0)	1354 (18.7)	3496 (19.3)
4	7585 (17.7)	10 024 (17.6)	3039 (18.3)	4266 (17.2)	4043 (18.0)	6661 (18.2)	1306 (18.1)	3186 (17.6)
5 (Higher education/occupation status)	12 451 (29.1)	15 216 (26.8)	4793 (28.9)	6198 (25.0)	6332 (28.1)	9596 (26.2)	2603 (36.0)	4809 (26.6)
SEIFA-relative socio-economic disadvantage								
1 (Most disadvantaged)	8178 (19.1)	10 813 (19.0)	3043 (18.4)	4729 (19.0)	4375 (19.4)	7183 (19.6)	1187 (16.4)	3350 (18.5)
2	8241 (19.3)	10 989 (19.3)	3175 (19.2)	5076 (20.4)	4478 (19.9)	7590 (20.7)	1105 (15.3)	3578 (19.8)
3	8056 (18.8)	11 364 (20.0)	3154 (19.0)	5214 (21.0)	4212 (18.7)	6945 (19.0)	1320 (18.3)	3565 (19.7)
4	7767 (18.1)	10 363 (18.2)	3102 (18.7)	4491 (18.1)	3962 (17.6)	6518 (17.8)	1463 (20.3)	3443 (19.0)
5 (Least disadvantaged)	10 329 (24.1)	13 196 (23.2)	4045 (24.4)	5273 (21.2)	5368 (23.8)	8291 (22.7)	2121 (29.4)	4096 (22.7)
Health conditions‡								
Median (IQR)	5 (3,7)	5 (4,7)	5 (3,7)	5 (3,7)	5 (3,7)	5 (3,7)	5 (3,7)	6 (4,8)
0	2403 (5.6)	1636 (2.9)	795 (4.8)	734 (3.0)	1123 (5.0)	1310 (3.6)	303 (4.2)	428 (2.4)
1–4	17 976 (42.0)	19 460 (34.2)	6983 (42.1)	9026 (36.4)	9420 (41.8)	13 350 (36.5)	2672 (37.0)	5517 (30.5)
5–9	19 880 (46.4)	31 007 (54.5)	7851 (47.4)	13 273 (53.5)	10 684 (47.5)	19 359 (52.9)	3669 (50.8)	10 349 (57.3)
10+	2542 (5.9)	4743 (8.3)	949 (5.7)	1797 (7.2)	1285 (5.7)	2582 (7.1)	580 (8.0)	1781 (9.9)
Dementia§	20 210 (51.7)¶	28 276 (48.2)	4569 (26.9)	5545 (21.9)	7962 (34.6)	11 007 (29.4)	1427 (19.5)	2642 (14.4)
Frailty Index Score††								
Median (IQR)	0.18 (0.14,0.23)	0.23 (0.18,0.30)	0.16 (0.11,0.20)	0.25 (0.18,0.3)	0.18 (0.14,0.23)	0.25 (0.18,0.30)	0.18 (0.14,0.23)	0.25 (0.18,0.30)
0	437 (1.0)	276 (0.5)	209 (1.3)	112 (0.5)	282 (1.3)	208 (0.6)	64 (0.9)	62 (0.3)
0.1–0.19	12 841 (30.0)	6969 (12.3)	6014 (36.3)	2712 (10.9)	7437 (33.0)	4021 (11.0)	1857 (25.7)	2043 (11.3)
0.2–0.29	20 761 (48.5)	21 178 (37.3)	7768 (46.9)	9273 (37.3)	10 686 (47.5)	13 333 (36.4)	3535 (48.9)	6452 (35.7)
0.3–0.39	8171 (19.1)	26 374 (46.4)	2438 (14.7)	12 034 (48.5)	3837 (17.0)	17 698 (48.4)	1686 (23.3)	8964 (49.6)
0.4+	249 (0.6)	1856 (3.3)	43 (0.3)	634 (2.6)	106 (0.5)	1222 (3.3)	54 (0.7)	493 (2.7)

†Missing data: sex <0.1%, Country of birth <1.5%, remoteness <=0.5%, SEIFA<=0.5% for all services and years. ‡Table A2 has prevalence of specific conditions by service and year. §Dementia ascertained from aged care eligibility assessment (Aged Care Assessment Program) and Rx-Risk-V for all services, except Permanent Residential Care where it was determined from aged care eligibility assessment, RxRisk-V, and entry into care assessment (Aged Care Funding Instrument). ¶Estimate is for year March 2008–December 2008, or N = 38 891 individuals. This was the first year when ACFI was introduced. ††Missing data <0.5%. DVA, Department of Veterans' Affairs; IQR, interquartile range; SEIFA, Socio-Economic Indexes for Areas.

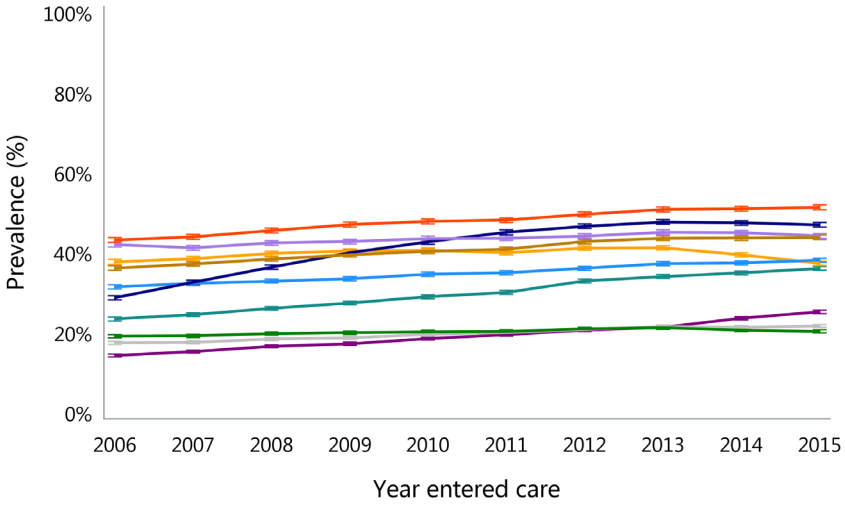

Figure 1 Ten most prevalent health conditions and trends in individuals entering permanent residential care. (——), Anticoagulants; (——), antiplatelets; (——), chronic airways disease; (——), congestive heart failure; (——), depression; (——), gastro-oesophageal reflux disease; (——), hyperlipidaemia; (——), hypertension; (——), ischaemic heart disease: hypertension; (——), pain.

Cancer, coronary heart disease, dementia and Alzheimer disease, cerebrovascular disease and chronic obstructive pulmonary disease were the most common causes of short- and long-term deaths, both in 2006 and 2014/2015.

For those entering home care services, neither short- (2006: 4.4%, 95% CI 4.4–5.0; 2015: 5.0%, 95% CI 4.8–5.3) nor long-term (2006: 35.6%, 95% CI 34.7–36.5; 2014: 35.0%, 95% CI 34.2–35.8) mortality rates changed during the study period (Table 2, Fig. S4). The main causes of death (short- or long-term) also did not change (Table 2).

Discussion

In a decade, while the median age has increased slightly, the health and frailty status of Australians accessing various aged care programmes have worsened considerably. This reflects the increasing use of these programmes by people with higher burdens of illness and frailty. Correspondingly, polypharmacy was common and increased over time, highlighting potential areas of opportunity for improvement through appropriate prescribing. Subsequent to entry into long-term care, the most commonly used healthcare services highlight increasing access to preventive and disease management related services and

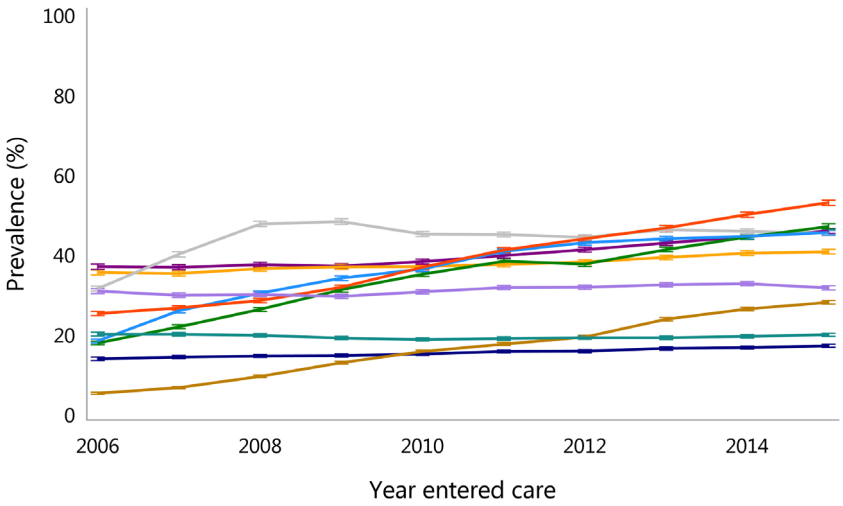

Figure 2 Ten most commonly used healthcare services by individuals in the first year after entering permanent residential care, age and sex adjusted prevalence. Does not include 'General practitioner attendances to which no other item applies', which >96.6% of the cohort has every year. (——), Optometrical services; (——), urgent attendance after hours; (——), health assessments; (——), GP and multidisciplinary care plans; (——), medication management reviews; (——), GP after hours attendances; (——), cardiovascular diagnostic procedures; (——), diagnostic radiology; (——), allied health services; (——), surgical operations.

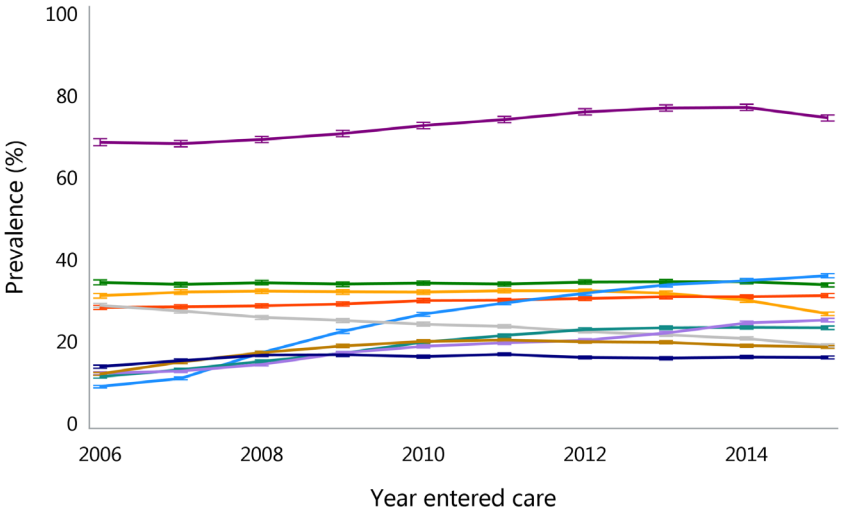

Figure 3 Ten most commonly dispensed medicines for individuals in the first year after entering permanent residential care, age and sex adjusted prevalence. (——), Paracetamol; (——), furosemide; (——), acetylsalicylic acid; (——), cefalexin; (——), macrogol; (——), temazepam; (——), oxycodone; (——), pantoprazole; (——), atorvastatin; (——), risperidone.

afterhours services. Finally, a modest increase in long-term mortality after entering permanent residential care was observed, while the main reasons for death remained similar.

Our study describes the increasingly high burden of frailty and comorbidities in individuals accessing aged care services. The high frailty estimates in our cohort falls within the range reported by others.[17–19] However, the observed 2.2–3.4-fold increase in higher scores over this decade has not been reported. This greater burden of frailty has implications for policy and funding decisions relating to aged care services given that frailty is associated with higher care needs and indicates a vulnerability to health stressors where health intervention may be required.[20] Our estimates of high multimorbidity confirm findings from smaller cohorts of older Australians in the community and in residential care.[15,21,22] Most individuals in our cohort had five or more comorbidities (median = 5), which is higher than that reported in the Australian Longitudinal Study of Ageing (median = 2) but similar to the Department of Veterans' Affairs (median = 5) cohorts, using similar comorbidity measures to our study.[15,22] Gastro-oesophageal reflux disease, hypertension, ischaemic heart disease, depression and pain were five of the seven most prevalent conditions in 2006 and 2015 and conditions that increased during the period. Dementia, as previously reported, is one of the most common conditions affecting these individuals, but the prevalence of dementia at the point of entry into care has decreased.[10] Our national comorbidity estimates are in line with studies of the general and older Australian population, and agree with prior reports of increases in gastro-oesophageal reflux disease, depression and pain.[1,23,24] However, decreases in cardiovascular disease in older individuals have been reported, which is contrary to our observations.[25] These changes in multimorbidity and frailty, along with the previously reported trends in demographics, limitations and higher care level needs of individuals accessing permanent care,[2,9] highlight the need for substantial planning for individuals with greater needs entering care.

In accord with the increasing frailty and morbidity of individuals accessing aged care services, professional attendances are increasingly frequent. Increases in the use of optometrical services, health assessments, management plans, collaborative medicine reviews, along with allied health services are necessary as these are likely beneficial for older individuals.[26–29] The use of these preventative services and timely management of conditions can contribute to reduced reliance on more expensive care. Increases in after hours attendances and cardiovascular diagnostic procedures and investigations were also observed, which are in line with national increases.[30,31] The national increase in after hours attendances was investigated by a MBS Review Taskforce, which found no clinical reasons for this and determined the changes were likely due to business practices.[30] MBS changes were implemented in March 2018 to address this and their impact remains to be determined. Small increases in diagnostic radiology use in this cohort may be reflective of the stable incidence rates of fractures in older individuals, a partial driver for the use of these services.[32] Finally, the proportion of individuals undergoing surgical operations has not changed, despite small national increases in surgeries, which is likely due to these cohorts' advanced age and frailty.[33]

Polypharmacy in individuals in long-term care is common. Additionally, the most commonly used medicines point to areas of concern both surrounding the care for

Table 2 Age and sex adjusted short and long term mortality rate and cause specific mortality after entering long term service, by service accessed and by year

	Service			
	Permanent residential care		Home care	
	2006	2015	2006	2015
Total, *n*	42 801 (100.0)	56 846 (100.0)	16 578 (100.0)	24 830 (100.0)
Short-term causes of death (0–100 days after entry)†, % (CI)				
Total deaths	15.6 (15.2,16.0)	14.6 (14.3,14.9)	4.4 (4.1,4.8)	5.0 (4.8,5.3)
Neoplasms	4.1 (3.9,4.3)	4.4 (4.2,4.6)	1.2 (1.1,1.4)	1.8 (1.6,2.0)
Coronary heart disease	2.8 (2.6,2.9)	1.8 (1.7,1.9)	0.9 (0.8,1.1)	0.7 (0.6,0.8)
Dementia and Alzheimer disease	0.9 (0.8,1.0)	1.3 (1.2,1.4)	0.1 (0.1,0.2)	0.2 (0.1,0.3)
Cerebrovascular disease	1.7 (1.6,1.8)	1.1 (1.0,1.2)	0.3 (0.2,0.4)	0.3 (0.2,0.4)
Chronic obstructive pulmonary disease	0.8 (0.7,0.9)	0.8 (0.7,0.8)	0.2 (0.1,0.3)	0.3 (0.2,0.4)
Other	0.6 (0.5,0.7)	0.7 (0.6,0.8)	0.3 (0.2,0.4)	0.4 (0.3,0.4)
Other circulatory system diseases	0.6 (0.5,0.7)	0.5 (0.5,0.6)	0.2 (0.1,0.3)	0.2 (0.1,0.2)
Diabetes	0.5 (0.4,0.6)	0.5 (0.4,0.6)	0.1 (0.1,0.2)	0.1 (0.1,0.1)
Diseases of the genitourinary system	0.6 (0.6,0.7)	0.4 (0.4,0.5)	0.1 (0.1,0.2)	0.2 (0.1,0.2)
Heart failure or heart disease	0.5 (0.4,0.6)	0.4 (0.4,0.5)	0.1 (0.1,0.2)	0.1 (0.1,0.2)
Other respiratory diseases	0.5 (0.4,0.5)	0.4 (0.4,0.5)	0.2 (0.1,0.3)	0.2 (0.2,0.3)
Diseases of the digestive system	0.3 (0.3,0.4)	0.4 (0.3,0.4)	0.1 (0.1,0.2)	0.1 (0.1,0.2)
Cardiac arrhythmias	0.2 (0.2,0.3)	0.3 (0.3,0.4)	0.0 (0.0,0.0)	0.1 (0.0,0.1)
Influenza and pneumonia	0.4 (0.4,0.5)	0.3 (0.3,0.4)	0.1 (0.1,0.2)	0.1 (0.0,0.1)
Accidental falls	0.2 (0.1,0.2)	0.3 (0.2,0.3)	0.0 (0.0,0.1)	0.1 (0.0,0.1)
Parkinson disease	0.3 (0.2,0.3)	0.2 (0.2,0.3)	0.1 (0.0,0.1)	0.1 (0.0,0.1)
Hypertensive disease	0.1 (0.1,0.2)	0.2 (0.2,0.3)	0.0 (0.0,0.1)	0.0 (0.0,0.0)
Other endocrine nutrition and metabolic diseases	0.1 (0.1,0.2)	0.2 (0.2,0.2)	0.1 (0.0,0.1)	0.1 (0.0,0.1)
Other external causes	0.1 (0.1,0.2)	0.1 (0.1,0.2)	0.0 (0.0,0.0)	0.0 (0.0,0.1)
Musculoskeletal system and connective tissue diseases	0.2 (0.1,0.2)	0.1 (0.1,0.2)	0.1 (0.0,0.1)	0.1 (0.0,0.1)
Unknown cause	0.0 (0.0,0.0)	0.0 (0.0,0.0)	0.0 (0.0,0.0)	0.0 (0.0,0.0)
	2006	2014‡	2006	2014‡
Long-term causes of death (101–1095 days after entry)†, % (CI)				
Total deaths	44.3 (43.7,45.0)	46.4 (45.8,46.9)	35.6 (34.7,36.5)	35.0 (34.2,35.8)
Dementia and Alzheimer disease	5.7 (5.5,6.0)	8.4 (8.2,8.7)	3.3 (3.0,3.6)	4.4 (4.1,4.7)
Coronary heart disease	8.5 (8.2,8.8)	6.0 (5.8,6.2)	6.7 (6.3,7.1)	4.5 (4.2,4.7)
Neoplasms	5.5 (5.3,5.7)	5.8 (5.6,6.0)	5.6 (5.2,6.0)	5.9 (5.6,6.2)
Cerebrovascular disease	6.0(5.7,6.2)	4.6(4.4,4.8)	3.8(3.5,4.1)	2.8(2.6,3.0)
Chronic obstructive pulmonary disease	1.8 (1.7,2.0)	2.6 (2.4,2.7)	1.7 (1.5,1.9)	2.0 (1.8,2.2)
Other	2.0 (1.8,2.1)	2.5 (2.3,2.6)	1.7 (1.5,1.9)	2.2 (2.0,2.4)
Diabetes	1.7 (1.5,1.8)	1.7 (1.5,1.8)	1.5 (1.3,1.7)	1.2 (1.0,1.3)
Unknown cause	1.2 (1.1,1.3)	1.5 (1.4,1.6)	0.7 (0.6,0.8)	1.0 (0.8,1.1)
Influenza and pneumonia	1.5 (1.4,1.6)	1.5 (1.4,1.6)	1.6 (1.4,1.8)	1.5 (1.4,1.7)
Other circulatory system diseases	1.3 (1.2,1.4)	1.4(1.3,1.5)	1.4(1.2,1.6)	1.2(1.1,1.4)
Other respiratory diseases	1.6(1.4,1.7)	1.4 (1.3,1.5)	1.2 (1.1,1.4)	1.0(0.8,1.1)
Diseases of the digestive system	1.4(1.3,1.6)	1.4(1.3,1.5)	1.4(1.2,1.5)	1.3 (1.1,1.4)
Diseases of the genitourinary system	1.5 (1.4,1.6)	1.3 (1.2,1.4)	1.3 (1.2,1.5)	1.1 (1.0,1.2)
Heart failure or heart disease	0.9 (0.8,1.0)	1.1 (1.1,1.2)	0.8 (0.6,0.9)	0.9 (0.8,1.0)
Parkinson disease	0.5 (0.5,0.6)	1.0 (0.9,1.1)	0.6 (0.5,0.7)	0.8 (0.7,0.9)
Cardiac arrhythmias	0.7 (0.6,0.8)	1.0 (0.9,1.1)	0.5 (0.4,0.6)	0.7 (0.6,0.8)
Accidental falls	0.9 (0.8,1.0)	1.0 (0.9,1.1)	0.5 (0.4,0.6)	0.7 (0.6,0.8)
Hypertensive disease	0.1 (0.0,0.1)	0.7 (0.7,0.8)	0.0 (0.0,0.0)	0.7 (0.6,0.8)
Other external causes	0.6(0.5,0.6)	0.6(0.5,0.6)	0.5(0.4,0.6)	0.6(0.5,0.7)
Musculoskeletal system and connective tissue diseases	0.6 (0.5,0.7)	0.5 (0.5,0.6)	0.4 (0.3,0.5)	0.3 (0.2,0.4)
Other endocrine nutrition and metabolic diseases	0.5 (0.4,0.5)	0.5 (0.5,0.6)	0.3 (0.3,0.4)	0.5 (0.4,0.5)

†To ensure the cohort had a minimum 365 days of follow up the 2014 cohort long-term mortality was evaluated only. ‡Unknown/not stated cause of death: <0.1% of cohort for short-term causes of death, <2% for long-term causes of death. CI, confidence interval.

individuals in this sector and national trends.[34–37] For example, an antibiotic was the third most commonly prescribed medicine in long-term care, highlighting the importance of antibiotic stewardship and infection control practices, which is now a national quality standard requirement for residential care facilities.[38] The common use of risperidone, while in line with other estimates from residential care facilities[37] and with increases in the general population during a similar period,[39] confirms concerns of its overuse. Encouragingly, recent reports note a national decrease in risperidone use for dementia related symptoms since 2015; however, this remains to be examined in the national cohort of individuals accessing aged care.[40] The common and increased use of proton pump inhibitors pantoprazole and esomeprazole[41] and opioid oxycodone,[42] both agree with growing national concerns regarding over-prescription of these medicines and their related harm. The five-fold increase in use of macrogol, a laxative, is potentially related to side-effects of other medicine use (e.g. opioids),[43] and reflects the changes in its PBS restriction level in 2007. Atorvastin and perindropril, which were the two most commonly prescribed medicines in the Australian PBS in 2015, have also increased in use in the cohort of people in long-term care.[35] Metoprolol, a beta blocker, commonly used in those in home care has also increased in use by individuals in long-term care, which could be an indication of better management of secondary prevention of heart failure.[44] Of note, temazepam use decreased, a trend also reported in the general population during this period.[39,45] Aspirin use also decreased, especially after 2013, which may be a result of increasing evidence of low benefits and potential risks associated its use for prevention of cardiovascular disease during this time,[46]a trend likely to continue.

Overall causes of short- and long-term mortality in individuals accessing aged care services are comparable to national estimates.[47] Our evaluation of short- compared to long-term mortality highlighted that approximately 15% of individuals die shortly after entering residential care, which is significantly higher than the 3% reported to be receiving palliative care.[48] Given this finding, permanent residential care needs to be considered an essential part of palliative care provision and the delivery of these services should be supported appropriately. Previous Australian residential aged care research also suggests that advance care planning for those most frail could contribute to reduced hospital presentation and increased likelihood of dying in place as opposed to the unfamiliar hospital environment.[49] Slight increases in longer-term mortality after permanent residential care entry over the years were noted and this could be related to the increase in comorbidity and frailty of the cohort.

Our study uses the ROSA datasets, which rely on linked data from various Australian Government datasets and suffers from the common observational studies' limitations, especially regarding its internal validity. However, much of the data used is mandatorily collected, and in some cases by trained/accredited professionals (i.e. ACAT). While the ACAP data collection tool remained consistent over the study period, we examined potential changes in data collection processes over the years by looking for significant changes in prevalence of health conditions and functional limitations, which were found to have changed gradually over the study period. However, it is possible that the increase in prevalence of health conditions and functional limitations of the cohort is due to changes in diagnostic criteria or recording practices. Our frailty estimates are also based on a cumulative deficit index derived measure, which uses the existing aged care eligibility assessment data and not a clinician administered frailty instrument.[16] We are limited in our ability to comment on the indications for medicines or services obtained, therefore only age and sex adjusted trends are discussed and not treatment appropriateness. Restrictions of subsidies for certain services, for example medicine reviews changed from being recommended yearly to every 2 years and pharmacist-initiated reviews no longer being acceptable more recently, may have led to changes in access to services. However, even with these restrictions, more individuals accessed these services in recent years. We cannot comment on medicine intake and adherence, as this is not available in our data sources, or treatment outcomes, as these were not evaluated in this study. Because trends for specific medicines and not classes were analysed, changes should be interpreted with care, for example a decline in temazepam use does not represent a decrease in benzodiazepine use. Additionally, medicines available without a prescription and inexpensive were likely underestimated in our study, and those dispensed during a hospitalisation were not captured. Finally, we have limited our investigation to the most commonly used healthcare services and medicines; therefore, we cannot comment on practice changes that occurred in less frequent events.

Strengths of our study include a population-based cohort of individuals accessing aged care services for a contemporary period in Australia. Ours is a national longitudinal study with limited loss to follow up. Finally, our study derived new information from the linkage of the aged care and healthcare datasets captured within the ROSA database that allowed for a comprehensive examination into the main trends affecting individuals in aged care.

Conclusion

We have determined that the population entering aged care programmes have worse health status and more frailty in more recent years. Funding and care models need to adapt to this changing profile, so they can translate into better overall care and reduced reliance on secondary and tertiary care. Models of care that focus on appropriate prescribing, including reduced antipsychotic use and antibiotic stewardship, as well as advance care planning could improve care outcomes for older individuals accessing aged care programmes in Australia.

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References

1 Australian Institute of Health and Welfare (AIHW). *Older Australia at a Glance*. Canberra: AIHW; 2018 [cited 2019 Mar 19]. Available from URL: https://www.aihw.gov.au/reports/older-people/older-australia-at-a-glance/contents/demographics-of-older-australians/australia-s-changing-age-and-gender-profile

2 Khadka J, Lang C, Ratcliffe J, Corlis M, Wesselingh S, Whitehead C *et al*. Trends in the utilisation aged care services in Australia, 2008–2016. *BMC Geriatr* 2019; **19**: 213.

3 Visvanathan R, Amare AT, Wesselingh S, Hearn R, McKechnie S, Mussared J *et al*. Prolonged wait time prior to entry to home care packages increases the risk of mortality and transition to permanent residential aged care services: findings from the registry of older south Australians (ROSA). *J Nutr Health Aging* 2019; **23**: 271–80.

4 Australian Government. Aged Care Act 1997. Compilation No. 66. 112. 1997.

5 Department of Social Services. *Aged Care Assessment Programme Guidelines*. Canberra: Australian Government; 2015 [cited 2018 Apr 1]. Available from URL: https://agedcare.health.gov.au/sites/g/files/net1426/f/documents/05_2015/acap_guidelines_-_accessible_version_-_may_2015_0.pdf

6 Department of Health and Ageing. *Home Care Packages Program Guidelines*. Canberra: Australian Government; 2013 [cited 2018 May 23]. Available from URL: http://fjnvpucvcprog01.acu.edu.au/wp-content/uploads/2014/05/Home-Care-Packages-Program-Guidelines-10-July-2013.pdf

7 Federal Register of Legislation. *Aged Care (Living Longer Living Better) Act 2013. No. 76, 2013*. Canberra: Australian Government; 2013 [cited 2019 Feb 14]. Available from URL: https://www.legislation.gov.au/Details/C2016C00170

8 Australian Institute of Health and Welfare (AIHW). *Characteristics of People in Aged Care*. Canberra: AIHW; 2016 [cited 2017 Sep 5]. Available from URL: http://www.aihw.gov.au/aged-care/residential-and-home-care-2014-15/characteristics/

9 Australian Institute of Health and Welfare (AIHW). *GEN Aged Care Data. Explore People's Care Needs in Aged Care*. Canberra: AIHW; 2018 [cited 2019 Aug 30]. Available from URL: https://www.gen-agedcaredata.gov.au/Topics/Care-needs-in-aged-care/Explore-care-needs-in-aged-care

10 Harrison SL, Lang C, Whitehead C, Crotty M, Ratcliffe J, Wesselingh S *et al*. Trends in prevalence of dementia for people accessing aged care services in Australia. *J Gerontol A Biol Sci Med Sci* 2020; **75**: 318–25.

11 Hillen JB, Vitry A, Caughey GE. Disease burden, comorbidity and geriatric syndromes in the Australian aged care population. *Australas J Ageing* 2017; **36**: E14–19.

12 Inacio MC, Bray S, Whitehead C, Corlis M, Evans K, Griffith E *et al*. The registry of older south Australians (ROSA): framework and plan. *BMJ Open* 2019; **9**: e026319.

13 Hugo Centre for Migration and Population Research. *Accessibility/Remoteness Index of Australia Plus (ARIA+) 2016*. Adelaide: The University of Adelaide; 2018 [cited 2019 Jun 26]. Available from URL: https://www.adelaide.edu.au/hugo-centre/services/aria

14 Australian Bureau of Statistics (ABS). *Census of Population and Housing: Socio-Economic Indexes for Areas (SEIFA), Australia*. Canberra: ABS; 2016 [cited 2019 Jun 26]. Available from URL: https://www.abs.gov.au/AUSSTATS/abs@.nsf/Lookup/2033.0.55.001Main+Features12016?OpenDocument

15 Pratt NL, Kerr M, Barratt JD, Kemp-Casey A, Kalisch Ellett LM, Ramsay E *et al*. The validity of the Rx-risk comorbidity index using medicines mapped to the anatomical therapeutic chemical (ATC) classification system. *BMJ Open* 2018; **8**: e021122.

16 Moldovan M, Khadka J, Visvanathan R, Wesselingh S, Inacio MC. Using elastic nets to estimate frailty burden from routinely collected national aged care data. *J Am Med Inform Assoc* 2020; **27**: 419–28.

17 Widagdo I, Pratt N, Russell M, Roughead E. How common is frailty in older Australians? *Australas J Ageing* 2015; **34**: 247–51.

18 Thompson MQ, Theou O, Karnon J, Adams RJ, Visvanathan R. Frailty prevalence in Australia: findings from four pooled Australian cohort studies. *Australas J Ageing* 2018; **37**: 155–8.

19 Theou O, Tan EC, Bell JS, Emery T, Robson L, Morley JE *et al*. Frailty levels in residential aged care facilities measured using the frailty index and FRAIL-NH scale. *J Am Geriatr Soc* 2016; **64**: e207–e12.

20 Hoogendijk EO, Muntinga ME, van Leeuwen KM, van der Horst HE, Deeg DJ, Frijters DH *et al*. Self-perceived met and unmet care needs of frail older adults in primary care. *Arch Gerontol Geriatr* 2014; **58**: 37–42.

21 Violan C, Foguet-Boreu Q, Flores-Mateo G, Salisbury C, Blom J, Freitag M *et al*. Prevalence, determinants and patterns of multimorbidity in primary care: a systematic review of

observational studies. *PLoS One* 2014; **9**: e102149.
22 Vitry A, Wong SA, Roughead EE, Ramsay E, Barratt J. Validity of medication-based co-morbidity indices in the Australian elderly population. *Aust N Z J Public Health* 2009; **33**: 126–30.
23 Australian Bureau of Statistics (ABS). *2017–18 National Health Survey (NHS)*. Canberra: ABS; 2018 [cited 2019 Jul 9]. Available from URL: https://www.abs.gov.au/ausstats/abs@.nsf/mf/4364.0.55.001
24 Miller G, Wong C, Pollack A. Gastro-oesophageal reflux disease (GORD) in Australian general practice patients. *Aust Fam Physician* 2015; **44**: 701–4.
25 Sarink D, Nedkoff L, Briffa T, Shaw JE, Magliano DJ, Stevenson C *et al*. Trends in age- and sex-specific prevalence and incidence of cardiovascular disease in Western Australia. *Eur J Prev Cardiol* 2018; **25**: 1280–90.
26 Vitry AI, Roughead EE, Ramsay EN, Ryan P, Caughey GE, Esterman A *et al*. Chronic disease management: does the disease affect likelihood of care planning? *Aust Health Rev* 2012; **36**: 419–23.
27 Sluggett JK, Ilomaki J, Seaman KL, Corlis M, Bell JS. Medication management policy, practice and research in Australian residential aged care: current and future directions. *Pharmacol Res* 2017; **116**: 20–8.
28 Hamirudin AH, Ghosh A, Charlton K, Bonney A, Walton K. Trends in uptake of the 75+ health assessment in Australia: a decade of evaluation. *Aust J Prim Health* 2015; **21**: 423–8.
29 Green C, Goodfellow J, Kubie J. Eye care in the elderly. *Aust Fam Physician* 2014; **43**: 447–50.
30 Department of Health. *Questions and Answers – New MBS Urgent After-Hours Items Starting on 1 March 2018*, Vol. 2019. Canberra: Australian Government; 2018 [cited 2019 Jul 15]. Available from URL: http://www.mbsonline.gov.au/internet/mbsonline/publishing.nsf/Content/news-2018-03-01-new-urgent-afterhours-items
31 Aged Care Quality and Safety Commission. *The Third Atlas of Healthcare Variation 2018–4.1 Cardiac Stress Tests and Imaging 18-Years and Over*. Canberra: Australian Government; 2018 [cited 2019 Jul 17]. Available from URL: https://www.safetyandquality.gov.au/publications-and-resources/resource-library/third-atlas-healthcare-variation-2018-41-cardiac-stress-tests-and-imaging-18-years-and-over
32 Cooper C, Cole ZA, Holroyd CR, Earl SC, Harvey NC, Dennison EM *et al*. Secular trends in the incidence of hip and other osteoporotic fractures. *Osteoporos Int* 2011; **22**: 1277–88.
33 Australian Institute of Health and Welfare (AIHW). *Admitted Patient Care 2016–17: Australian Hospital Statistics*. Canberra: AIHW; 2018 [cited 2019 Mar 19]. Available from URL: https://www.aihw.gov.au/getmedia/acee86da-d98e-4286-85a4-52840836706f/aihw-hse-201.pdf.aspx?inline=true
34 Somers M, Rose E, Simmonds D, Whitelaw C, Calver J, Beer C. Quality use of medicines in residential aged care. *Aust Fam Physician* 2010; **39**: 413–6.
35 Department of Health. *Australian Statistics on Medicines 2015*. Canberra: Australian Government; 2016 [cited 2019 Jul 9]. Available from URL: http://www.pbs.gov.au/info/statistics/asm/asm-2015
36 Jokanovic N, Tan EC, Dooley MJ, Kirkpatrick CM, Bell JS. Prevalence and factors associated with polypharmacy in long-term care facilities: a systematic review. *J Am Med Dir Assoc* 2015; **16**: e1–12.
37 Westaway K, Sluggett J, Alderman C, Moffat A, Procter N, Roughead E. The extent of antipsychotic use in Australian residential aged care facilities and interventions shown to be effective in reducing antipsychotic use: a literature review. *Dementia* 2020; **19**: 1189–202.
38 Aged Care Quality and Safety Commission. *Aged Care Quality Standards*. Canberra: Australian Government; 2019 [cited 2019 Jul 2]. Available from URL: https://www.agedcarequality.gov.au/providers/standards
39 Stephenson CP, Karanges E, McGregor IS. Trends in the utilisation of psychotropic medications in Australia from 2000 to 2011. *Aust N Z J Psychiatry* 2013; **47**: 74–87.
40 Kalisch Ellett LM, Moffat AK, Gadzhanova S, Pratt NL, Apajee J, Woodward M *et al*. Reduction in use of risperidone for dementia in Australia following changed guidelines. *Pharmacy* 2019; **7**: 100.
41 Hollingworth S, Duncan EL, Martin JH. Marked increase in proton pump inhibitors use in Australia. *Pharmacoepidemiol Drug Saf* 2010; **19**: 1019–24.
42 Veal FC, Bereznicki LR, Thompson AJ, Peterson GM. Pharmacological management of pain in Australian aged care facilities. *Age Ageing* 2014; **43**: 851–6.
43 Guinane J, Crone R. Management of faecal incontinence. *Aust J Gen Pract* 2018; **47**: 40–3.
44 Atherton JJ, Sindone A, De Pasquale CG, Driscoll A, MacDonald PS, Hopper I *et al*. National Heart Foundation of Australia and Cardiac Society of Australia and New Zealand: guidelines for the prevention, detection, and management of heart failure in Australia 2018. *Heart Lung Circ* 2018; **27**: 1123–208.
45 Hollingworth SA, Siskind DJ. Anxiolytic, hypnotic and sedative medication use in Australia. *Pharmacoepidemiol Drug Saf* 2010; **19**: 280–8.
46 Seshasai SR, Wijesuriya S, Sivakumaran R, Nethercott S, Erqou S, Sattar N *et al*. Effect of aspirin on vascular and nonvascular outcomes: meta-analysis of randomized controlled trials. *Arch Intern Med* 2012; **172**: 209–16.
47 Australian Institute of Health and Welfare (AIHW). *Cause of Death Patterns and People's Use of Aged Care: A Pathways in Aged Care Analysis of 2012–14 Death Statistics*. Cat. no. AGE 83. Canberra: AIHW; 2018.
48 Butler J. Palliative care in residential aged care: an overview. *Australas J Ageing* 2017; **36**: 258–61.
49 Theou O, Sluggett JK, Bell JS, Lalic S, Cooper T, Robson L *et al*. Frailty, hospitalization, and mortality in residential aged care. *J Gerontol A Biol Sci Med Sci* 2018; **73**: 1090–6.

Appendix I

Table A1 Health services, medicines and causes of death coding

Description	Code
Health services	MBS group or subgroup code
General practitioner attendances to which no other item applies	A01
Optometrical services	A10
Urgent attendance after hours	A11
Health assessments	A14
General practitioner management plans, team care arrangements, multidisciplinary care plans	A15
Domiciliary and residential management reviews	A17
Medical practitioner (emergency physician) attendances to which no other item applies	A21
General practitioner after hours attendances to which no other item applies	A22
Cardiovascular diagnostic procedures and investigations	D0106
Diagnostic radiology	I03
Allied health services	M03
Surgical operations	T08
Medicines	ATC code
Paracetamol	N02BE01
Furosemide	C03CA01
Acetylsalicylic acid	B01AC06
Cefalexin	J01DB01
Macrogol	A06AD15
Temazepam	N05CD07
Oxycodone	N02AA05
Pantoprazole	A02BC02
Atorvastatin	C10AA05
Risperidone	N05AX08
Esomeprazole	A02BC05
Metoprolol	C07AB02
Perindopril	C09AA04
Causes of death	ICD-10-AM
Neoplasms	C00-D48
Diabetes	E10-E14
Other endocrine nutrition and metabolic diseases	E00-E90, excluding E10-E14
Dementia and Alzheimer disease	F00-F03, G30
Parkinson disease	G20-G22
Hypertensive disease	I10-I15
Coronary heart disease	I20-I25
Cardiac arrhythmias	I47-I49
Heart failure or heart disease	I50-I51
Cerebrovascular disease	I60-I69, G45-G46
Other circulatory system diseases	I00-I99 excluding I10-I15, I20-I25, I47-I51,I60-I69
Influenza and pneumonia	J09-J18
Chronic obstructive pulmonary disease	J40-J44
Other respiratory diseases	J00-J99, excluding J09-J18, J40-J44
Diseases of the digestive system	K00-K93
Musculoskeletal system and connective tissue diseases	M00-M99
Diseases of the genitourinary system	N00-N99
Accidental falls	W00-W19
Other external causes	V01-Y98, excluding W00-W19
Unknown cause	R95-R99, missing
Other	Any code not included above

ATC, Anatomical, Therapeutic and Chemical Classification; ICD-10-AM, International Statistical Classification of Diseases, 10th Revision, Australian Modification; MBS, Medicare Benefits Schedule.

Table A2 Cohort prevalence of health conditions, by service accessed and by year

	Service							
	Permanent residential care		Home care		Respite care		Transition care	
Health condition	2006	2015	2006	2015	2006	2015	2007	2015
RxRisk-V condition†, *n* (%)								
Gastro-oesophageal reflux disease	18 506 (43.2)	29 174 (51.3)	7259 (43.8)	12 931 (52.1)	9753 (43.3)	18 606 (50.8)	3555 (49.2)	9984 (55.2)
Hyperlipidaemia	12 616 (29.5)	26 338 (46.3)	5819 (35.1)	12 866 (51.8)	7248 (32.2)	17 285 (47.2)	2825 (39.1)	9490 (52.5)
Hypertension	17 909 (41.8)	25 235 (44.4)	7173 (43.3)	11 352 (45.7)	9564 (42.5)	16 176 (44.2)	3143 (43.5)	8580 (47.5)
Ischaemic heart disease: hypertension	15 538 (36.3)	24 901 (43.8)	6587 (39.7)	11 054 (44.5)	8324 (37.0)	15 590 (42.6)	3149 (43.6)	8844 (48.9)
Antiplatelets	16 093 (37.6)	21 467 (37.8)	5804 (35.0)	7345 (29.6)	8277 (36.8)	11 786 (32.2)	2656 (36.8)	6365 (35.2)
Depression	13 744 (32.1)	21 178 (37.3)	5273 (31.8)	8938 (36.0)	7337 (32.6)	13 018 (35.6)	2161 (29.9)	6147 (34.0)
Pain	10 141 (23.7)	20 433 (35.9)	4028 (24.3)	8343 (33.6)	5280 (23.5)	11 990 (32.8)	2305 (31.9)	8129 (45.0)
Anticoagulants	6182 (14.4)	14 377 (25.3)	2362 (14.2)	5709 (23.0)	3405 (15.1)	8906 (24.3)	1595 (22.1)	6489 (35.9)
Chronic airways disease	7552 (17.6)	12 308 (21.7)	3197 (19.3)	5881 (23.7)	4229 (18.8)	7774 (21.2)	1573 (21.8)	4362 (24.1)
Congestive heart failure	8128 (19.0)	11 747 (20.7)	3005 (18.1)	4870 (19.6)	4229 (18.8)	7409 (20.2)	1485 (20.6)	3946 (21.8)
Osteoporosis/Paget	7826 (18.3)	10 013 (17.6)	3379 (20.4)	4640 (18.7)	4274 (19.0)	6388 (17.5)	1736 (24.0)	3702 (20.5)
Psychotic illness	6496 (15.2)	9721 (17.1)	1261 (7.6)	1951 (7.9)	2605 (11.6)	4411 (12.1)	522 (7.2)	1444 (8.0)
Diabetes	5571 (13.0)	9390 (16.5)	2381 (14.4)	4750 (19.1)	3050 (13.5)	6147 (16.8)	1193 (16.5)	3576 (19.8)
Steroid-responsive disease	5198 (12.1)	7908 (13.9)	2001 (12.1)	3764 (15.2)	2865 (12.7)	5371 (14.7)	986 (13.6)	2821 (15.6)
Arrhythmia	7022 (16.4)	7719 (13.6)	2544 (15.3)	2990 (12.0)	3706 (16.5)	4825 (13.2)	1148 (15.9)	2506 (13.9)
Anxiety	5825 (13.6)	7107 (12.5)	2217 (13.4)	2516 (10.1)	2954 (13.1)	3853 (10.5)	874 (12.1)	1827 (10.1)
Glaucoma	4937 (11.5)	6708 (11.8)	1865 (11.2)	2759 (11.1)	2591 (11.5)	4251 (11.6)	804 (11.1)	1875 (10.4)
Ischaemic heart disease: angina	6774 (15.8)	6581 (11.6)	2708 (16.3)	2704 (10.9)	3675 (16.3)	4147 (11.3)	1211 (16.8)	1986 (11.0)
Dementia	4326 (10.1)	6376 (11.2)	1497 (9.0)	2210 (8.9)	2463 (10.9)	4081 (11.1)	255 (3.5)	659 (3.6)
Hypothyroidism	3583 (8.4)	5977 (10.5)	1413 (8.5)	2538 (10.2)	1868 (8.3)	3624 (9.9)	596 (8.3)	1923 (10.6)
Inflammation/pain	6781 (15.8)	4937 (8.7)	3045 (18.4)	2844 (11.5)	3706 (16.5)	3348 (9.1)	1285 (17.8)	2424 (13.4)
Gout	3175 (7.4)	4464 (7.9)	1244 (7.5)	1980 (8.0)	1774 (7.9)	2864 (7.8)	565 (7.8)	1663 (9.2)
Parkinson disease	2624 (6.1)	3994 (7.0)	967 (5.8)	1715 (6.9)	1400 (6.2)	2596 (7.1)	393 (5.4)	1111 (6.1)
Epilepsy	2878 (6.7)	3841 (6.8)	931 (5.6)	1279 (5.2)	1453 (6.5)	2109 (5.8)	474 (6.6)	1071 (5.9)
Liver failure	2852 (6.7)	2848 (5.0)	806 (4.9)	703 (2.8)	1234 (5.5)	1227 (3.4)	602 (8.3)	807 (4.5)
Incontinence	1684 (3.9)	2184 (3.8)	649 (3.9)	1044 (4.2)	953 (4.2)	1485 (4.1)	287 (4.0)	693 (3.8)
Benign prostatic hyperplasia	124 (0.3)	1784 (3.1)	28 (0.2)	668 (2.7)	73 (0.3)	1142 (3.1)	7 (0.1)	550 (3.0)
Malignancies	843 (2.0)	1760 (3.1)	329 (2.0)	888 (3.6)	478 (2.1)	1265 (3.5)	174 (2.4)	704 (3.9)
Renal disease	895 (2.1)	1163 (2.0)	367 (2.2)	527 (2.1)	496 (2.2)	776 (2.1)	179 (2.5)	438 (2.4)
Hyperthyroidism	309 (0.7)	559 (1.0)	102 (0.6)	242 (1.0)	154 (0.7)	325 (0.9)	63 (0.9)	171 (0.9)
Allergies	533 (1.2)	449 (0.8)	192 (1.2)	73 (0.3)	354 (1.6)	302 (0.8)	54 (0.7)	79 (0.4)
Migraine	287 (0.7)	397 (0.7)	132 (0.8)	229 (0.9)	186 (0.8)	287 (0.8)	52 (0.7)	149 (0.8)
Irritable bowel syndrome	284 (0.7)	394 (0.7)	139 (0.8)	216 (0.9)	151 (0.7)	283 (0.8)	62 (0.9)	176 (1.0)
Smoking cessation	21 (<0.1)	361 (0.6)	11 (0.1)	149 (0.6)	12 (0.1)	158 (0.4)	<10 (0.1)	130 (0.7)
Pancreatic insufficiency	103 (0.2)	289 (0.5)	46 (0.3)	127 (0.5)	51 (0.2)	169 (0.5)	25 (0.3)	87 (0.5)
Psoriasis	80 (0.2)	225 (0.4)	47 (0.3)	131 (0.5)	42 (0.2)	161 (0.4)	<10 (0.1)	97 (0.5)
Bipolar disorder	159 (0.4)	175 (0.3)	53 (0.3)	101 (0.4)	103 (0.5)	108 (0.3)	23 (0.3)	60 (0.3)
Transplant	<10 (<0.1)	43 (0.1)	<10 (<0.1)	32 (0.1)	<10 (<0.1)	46 (0.1)	<10 (0.1)	34 (0.2)

†Only 38 conditions with prevalence ≥0.1% are shown. Eight conditions not shown: alcohol dependency, pulmonary hypertension, hepatitis B, HIV, hyperkalaemia, malnutrition, tuberculosis and hepatitis C.

Table A3 Age and sex adjusted healthcare and medicine use after entry into permanent residential care or home care, by service accessed and by year

	Service			
	Permanent residential care		Home care	
	2006	2015	2006	2015
Total, *n*	42 801 (100.0)	56 846 (100.0)	16 578 (100.0)	24 830 (100.0)
Total *N* excluding DVA card holders†	33 955 (79.3)	48 872 (86.0)	13 985 (84.4)	23 381 (94.2)
Healthcare services‡, prevalence (95% CI)				
General practitioner attendances to which no other item applies	96.6 (95.5,97.6)	96.6 (95.7,97.5)	96.9 (95.2,98.5)	97.3 (96.1,98.6)
General practitioner after hours attendances to which no other item applies	25.2 (24.6,25.7)	53.0 (52.3,53.6)	13.8 (13.2,14.4)	25.7 (25.1,26.4)
General practitioner management plans, team care arrangements, multidisciplinary care plans	17.8 (17.4,18.3)	47.1 (46.4,47.7)	24.8 (23.9,25.6)	57.3 (56.3,58.3)
Optometrical services	37.0 (36.3,37.6)	45.9 (45.3,46.5)	30.3 (29.4,31.2)	40.2 (39.4,41.1)
Collaborative domiciliary and residential management reviews	18.3 (17.8,18.8)	45.5 (44.9,46.1)	5.4 (5.0,5.8)	11.0 (10.6,11.4)
Health assessments	31.4 (30.8,32.0)	45.4 (44.8,46.0)	25.2 (24.3,26.0)	31.1 (30.4,31.9)
Urgent attendance after hours	35.5 (34.8,36.1)	40.7 (40.1,41.3)	15.6 (15.0,16.3)	19.7 (19.1,20.3)
Diagnostic radiology	30.8 (30.2,31.4)	31.6 (31.1,32.1)	42.2 (41.1,43.3)	46.1 (45.2,47.0)
Allied health services	5.2 (5.0,5.5)	28.0 (27.5,28.5)	8.6 (8.1,9.1)	44.0 (43.1,44.9)
Surgical operations	20.0 (19.5,20.5)	19.9 (19.5,20.3)	32.8 (31.8,33.8)	33.7 (32.9,34.5)
Cardiovascular diagnostic procedures and investigations	13.8 (13.4,14.3)	17.1 (16.8,17.5)	25.7 (24.9,26.6)	34.8 (34.0,35.6)
Medicines, prevalence (95% CI)				
Median number (IQR)	9 (6,12)	10 (7,14)	9 (5,12)	9 (6,13)
Paracetamol	68.4 (67.6,69.3)	74.4 (73.6,75.1)	46.6 (45.5,47.8)	53.0 (52.0,54.0)
Furosemide	34.3 (33.7,34.9)	33.6 (33.1,34.1)	32.9 (31.9,33.9)	31.6 (30.8,32.3)
Acetylsalicylic acid	31.0 (30.4,31.5)	26.6 (26.1,27.0)	27.8 (27.0,28.7)	18.0 (17.4,18.5)
Cefalexin	28.1 (27.5,28.6)	31.0 (30.5,31.5)	25.1 (24.2,25.9)	28.0 (27.3,28.7)
Macrogol	8.8 (8.5,9.1)	35.9 (35.3,36.4)	4.9 (4.5,5.3)	17.9 (17.3,18.5)
Temazepam	28.6 (28.1,29.1)	18.8 (18.4,19.2)	20.3 (19.5,21.1)	13.2 (12.7,13.7)
Oxycodone§	11.2 (10.8,11.5)	23.1 (22.7,23.6)	8.2 (7.8,8.7)	13.4 (13.0,13.9)
Pantoprazole	12.0 (11.7,12.4)	25.0 (24.6,25.5)	12.7 (12.1,13.3)	23.2 (22.5,23.8)
Atorvastatin	11.9 (11.6,12.3)	18.4 (18.1,18.8)	18.2 (17.5,18.9)	24.1 (23.4,24.7)
Risperidone§	13.6 (13.3,14.0)	15.9 (15.6,16.3)	5.7 (5.3,6.1)	5.9 (5.6,6.2)
Esomeprazole§	11.3 (10.9,11.6)	16.5 (16.1,16.8)	13.3 (12.6,13.9)	21.1 (20.4,21.7)
Metoprolol	10.6 (10.3,10.9)	15.4 (15.1,15.7)	11.9 (11.3,12.5)	16.0 (15.4,16.5)
Perindopril§	14.0 (13.6,14.4)	11.7 (11.4,12.0)	15.1 (14.5,15.8)	13.2 (12.7,13.7)

†For details on Australian Government Department of Veterans' Affairs Health Cards, refer to https://www.dva.gov.au/sites/default/files/files/providers/hospitals/dvacards.pdf. ‡Healthcare services were examined in the non-DVA cohort only. §Oxycodone and risperidone are part of the 10 most frequently prescribed medicines for residential care only. Esomeprazole and perindopril are part of the 10 most frequently prescribed medicines for home care only. CI, confidence intervals; DVA, Department of Veterans' Affairs; IQR, interquartile range.

Supporting Information

Additional supporting information may be found in the online version of this article at the publisher's web-site:

Figure S1 Ten most prevalent health conditions and trends in individuals entering home care.
Figure S2 Ten most commonly used healthcare services (not including 'General practitioner attendances to which no other item applies', which >96.6% of the cohort has every year) by individuals in the first year after entering home care, age and sex adjusted prevalence.
Figure S3 Ten most commonly dispensed medicines for individuals in the first year after entering home care, age and sex adjusted prevalence.
Figure S4 Kaplan–Meier curve of survival after entry into permanent residential care and home care, by whether individuals entered care in 2006 and 2014.