Hindawi
Health & Social Care in the Community
Volume 2023, Article ID 9332777, 13 pages
https://doi.org/10.1155/2023/9332777

Research Article

Ten-Year Trends and Predictors of Unplanned Hospitalisation in Community-Dwelling Older People Receiving Home-Based Care

Marissa Dickins,[1,2,3] **Angela Joe**,[1] **and Judy A. Lowthian**[1,4,5]

[1]*Bolton Clarke Research Institute, Bolton Clarke, Level 1-347 Burwood Highway, Forest Hill, VIC 3131, Australia*
[2]*Southern Synergy, Department of Psychiatry, School of Clinical Sciences at Monash Health, Monash University, Clayton, VIC 3800, Australia*
[3]*Silverchain, 19/567 Collins Street, Melbourne, VIC 3000, Australia*
[4]*School of Public Health and Preventive Medicine, Monash University, 553 St Kilda Road, Melbourne, VIC 3004, Australia*
[5]*Faculty of Health and Behavioural Sciences, University of Queensland, St Lucia, QLD 4072, Australia*

Correspondence should be addressed to Judy A. Lowthian; jlowthian@boltonclarke.com.au

Received 7 September 2022; Revised 5 January 2023; Accepted 10 January 2023; Published 9 February 2023

Academic Editor: Kathiravan Srinivasan

Older people prefer to remain living in their own home for as long as possible; however, many require support to do so through health and other care services provided in the home. This study aimed to explore the trends in usage of a home-based care service by older people in metropolitan Melbourne and factors associated with unplanned hospitalisations. This longitudinal study analysed episodes of home-based care for people aged ≥65 years between 2006 and 2015. An episode of care was defined as the period of time during which the home care services were provided to the client. Care episodes culminated in a planned discharge from the service or an unplanned hospitalisation. Descriptive statistics and multivariable logistic regression were utilised to investigate the characteristics associated with unplanned hospitalisations. Utilisation of home-based care services over the 10-year period showed an increasing rate of use by people aged ≥85 years and a reduced usage rate by females aged 70–84 years and males 75–79 years old. Of 170,001 episodes of care, 43,608 (25.7%) resulted in an unplanned hospitalisation. Home-based care delivered to people aged ≥85 years showed an increasing rate of episodes ending in an unplanned transfer to the hospital. Between 2006 and 2015, individuals aged 85–89 years displayed a rate increase of 18.7% in episodes ending in an unplanned hospitalisation; for those aged ≥90 years, the rate rise was 43.6%. Factors associated with an unplanned hospitalisation included advancing age, male gender, living alone, cognitive dysfunction, and the complexity of medical issues. Health policy has focussed on providing services to enable older people to remain in their own home. The increasing rate of unplanned hospitalisations for community-dwellers aged ≥85 years suggests more support is required to enable ageing in place.

1. Introduction

Older people aged ≥65 years are the fastest growing demographic in Australia [1]. Ageing is strongly associated with increasing dependence on care provided by others [2]. It is vital that a consumer-centred aged care system is in place to support the wellbeing of older persons. Most older Australians reside in a private household; in 2018, this was the case for 95% of all persons aged ≥65 years, including 75% of Australians aged 85 years and older [2]. The majority prefers to remain in their own home for as long as possible [3], with most not transitioning to institutionalised living unless it is unavoidable.

Recent changes in the aged care system guided by Living Longer Living Better [4], a 10-year reform plan implemented in 2013, has focussed on home-based formal care for older people. Primary healthcare and community services are tasked with delivering the care needed to sustain older Australians in their home.

Acute unplanned hospital admissions represent a distressing event for older people. Older hospitalised patients are at risk of adverse outcomes such as functional decline,

loss of mobility [5], unplanned readmissions [6], and earlier death [7]. An unplanned hospitalisation jeopardises an older person's ability to remain independent, with increased likelihood of needing higher level care upon discharge [8]. Emergency hospitalisations often precipitate an unplanned and urgent move to residential care, leaving an older person feeling displaced, confused, and depressed [8].

Strategies to reduce unplanned hospitalisations would not only benefit older people but also help alleviate the demands on acute care hospitals and residential care. Data from community care providers are a rich source of information to monitor the impact of ongoing reforms on older Australians. The present study utilised home-based nursing and personal care data collected between 1 January 2006 and 31 December 2015. This period spans the years preceding implementation of Living Longer Living Better and includes the initial years of aged care reform. The aims of our analyses were to reveal the trends for home-based care across the pre-reform and early reform periods and to explore the risk factors associated with unplanned hospitalisations.

2. Methods

This study is reported in accordance with the REporting of studies Conducted using Observational Routinely collected health Data (RECORD) Statement [9].

2.1. Study Design and Setting. A retrospective cohort study was conducted utilising routinely collected data from a large not-for-profit provider of home nursing and personal care in Victoria, Australia. The predominant types of care activities conducted in home visits were assessments; nursing care; education, counselling, and support; monitoring and surveillance; and care coordination. Upon admission to the provider, opt-out consent was sought for use of clients' data for research. Clients who did not opt out had their data de-identified and provided to the research team.

An *episode of care* was defined *as* "a period of health care with a defined start and end" [10] and represented the period of time that a client received nursing or personal care services from the home care provider. Ethics approval was from the Bolton Clarke Human Research Ethics Committee, Approval Number 170003.

2.2. Participants and Data Source. Data comprised completed episodes of home-based nursing and personal care between 1 January 2006 and 31 December 2015 for clients aged ≥65 years living in metropolitan Melbourne. Episodes that culminated in a planned discharge from the service (hereafter, a planned discharge) or an unplanned discharge to the hospital (hereafter, an unplanned hospitalisation) were included in the analysis. In a planned discharge, home care ceased and the client continued residing in their own home without further nursing or personal care from the service. This could occur for a range of reasons, including an improvement in their condition or a change in the formal care arrangement (for example, a family member taking over care). In an unplanned hospitalisation, the client was transferred to hospital for acute care with the termination of home-based care. Other types of discharge (for example, to residential care or rehabilitation) were excluded from the analysis.

Socioeconomic information included age, gender, living arrangement, primary language, and country of birth. As a socioeconomic status proxy, the Index of Relative Socioeconomic Disadvantage (IRSD) deciles for postal areas in 2016 [11] were linked to clients' postcodes. Low IRSD values indicate areas of high disadvantage. Service information included contact time with the provider, the source of referral to home care, and the requirement and availability of informal carers. Diagnostic information was available as International Classification of Diseases 10^{th} revision (ICD-10) codes [12]. The Charlson Comorbidity Index (CCI) was used as a proxy for disease burden [13]. A cognitive dysfunction variable was generated by grouping ICD-10 data for cognitive impairment (F06.7, R41.8, and R41.3), senility (R54), Alzheimer's disease (F00 and G30), and dementia (F01, F02, F03, and G31).

2.3. Statistical Analysis. Descriptive statistics compared episodes culminating in an unplanned hospitalisation with episodes ending in a planned discharge. Associations between categorical variables were determined using the chi-squared test for independence. For continuous variables, an independent samples t-test was utilised. A Wilcoxon rank sum test was employed for non-normal distributions. Due to the large sample size, significance was set at $p = 0.001$ [14]. Rates per 1,000 episodes per year and relative rates per year (with 2006 as the base year) were calculated.

Multivariable logistic regression was used to identify factors associated with an unplanned hospitalisation. Candidate variables, selected based on the literature and the descriptive analyses, were tested for multicollinearity. Collinearity between two variables, defined as $r \geq 0.3$, resulted in the removal of one variable from the analysis. Univariate analyses were conducted, with candidate variables retained if the unadjusted odds ratio was $p < 0.1$. Multivariable analyses were then undertaken, with the final model run with 1,000 bootstrapped samples drawn with replacement to ensure robust results. Analyses were conducted using Stata 15.1 [15].

3. Results

The number of care episodes analysed was 170,001. Across all episodes of care the average age of clients was 80.2 years (SD 7.8) and 55% of episodes were for a female (Tables 1 and 2). Of the episodes of home-based care, 49% involved a client who lived with family members; 33% of care delivery was to a person who lived alone. Eighteen percent of episodes were associated with persons residing in an area of high socioeconomic disadvantage in metropolitan Melbourne.

3.1. Trends and Characteristics Associated with Episodes of Care. Over the 10-year period, females aged 75–79 years and

Table 1: Characteristics of the clients in 170,001 episodes of home-based care, by discharge type, 1 January 2006 to 31 December 2015.

Client attributes	Unplanned hospitalisation		Planned discharge		Total	
	n	%	*n*	%	*n*	%
Number of episodes	43,608	26	126,393	74	170,001	100
Number of unique clients	27,985		81,016		94,200[†]	
Age (mean, standard deviation)*	81.5 (7.8)		79.8 (7.8)		80.2 (7.8)	
Age categories**						
65–69	3,760	9	15,288	12	19,048	11
70–74	5,226	12	19,256	15	24,482	14
75–79	7,541	17	25,120	20	32,661	19
80–84	10,199	23	29,130	23	39,329	23
85–89	10,154	23	23,790	19	33,944	20
90+	6,728	15	13,809	11	20,537	12
Missing	0	0	0	0	0	0
Gender**						
Female	23,008	53	71,323	56	94,331	55
Male	20,598	47	55,049	44	75,647	44
Others/not stated	2	0	21	0	23	0
Missing	0	0	0	0	0	0
Living arrangements**						
Alone	16,741	38	38,961	31	55,702	33
Special purpose accommodation	1,611	4	2,120	2	3,731	2
With family	21,010	48	62,889	50	83,899	49
With others who are not family	989	2	2,319	2	3,308	2
Missing	3,257	7	20,104	16	23,361	14
Index of Socioeconomic Disadvantage (IRSD) quintiles**						
1 (high disadvantage)	7,294	17	23,813	19	31,107	18
2	5,296	12	15,702	12	20,998	12
3	6,893	16	20,537	16	27,430	16
4	10,080	23	30,494	24	40,574	24
5 (low disadvantage)	14,031	32	35,822	28	49,853	29
Missing	14	0	25	0	39	0

[†]Of the total number of unique clients, 56,120 (60%) had 1 episode only during the study period; 38,080 people (40%) had multiple episodes; * $p < 0.0001$ (*t*-test for independent samples); ** $p < 0.0001$ (chi-square test for independent samples).

males aged ≥90 years exhibited the greatest change in demand for home care (Figures 1(a) and 1(b)). Comparing 2006 to 2015, females aged 75–79 years showed a 26% decrease in the rate of home care usage (Figure 1(c)). Males in this age group also showed a steady decline in utilisation of home-based services, with a 17% reduction over the 10 year period (Figure 1(d)). In contrast, the rate of episodes of home care for males aged ≥90 years increased by 67% (Figure 1(d)).

Of the total number of care episodes, 26% ($n = 43,608$) resulted in an unplanned hospitalisation. An unplanned hospitalisation was more likely in episodes comprising individuals who were older, of the male gender, living alone or in special purpose accommodation, spoke English as their primary language, and who were born in Australia (Tables 1 and 2).

Care episodes ending in an unplanned hospitalisation, rather than a planned discharge, were associated with 2.7 times more contact time with home care staff (median hours of care: 14.5 hours vs. 5.4 hours per episode; $p < 0.0001$) (Tables 3 and 4). Episodes involving individuals who required a carer (regardless of carer status), who were referred to home-based care by a palliative care team, or who had a higher number of diagnoses were more likely to conclude with an unplanned hospitalisation. The median CCI score was identical for episodes culminating in unplanned hospitalisation or planned discharge; however, there was a statistically significant difference in the distribution of scores for these discharge groups, such that higher CCI scores had a greater likelihood of an unplanned hospitalisation. Episodes resulting in an unplanned hospitalisation were more likely for clients experiencing cognitive dysfunction.

3.2. Rates of Discharge. Discharge rates per 1,000 episodes and relative rates across the 10-year period are presented in Figure 2. Rates of planned discharge, for all ages, were 746 and 735 per 1,000 care episodes in 2006 and 2015, respectively. Unplanned hospitalisation rates, for all ages, were 254 and 265 per 1,000 episodes for 2006 and 2015, respectively (Figure 2(a)). Discharge rates relative to those in 2006, for both planned discharge and unplanned hospitalisation, appeared comparatively stable over 10 years (Figure 2(b)). However, further investigation disclosed these trends were nuanced by age.

Stratification of data by age revealed distinct patterns for different age groups (Figures 2(c) and 2(d)). For both

Table 2: Detailed characteristics of the clients in 170,001 episodes of home-based care, by discharge type, 1 January 2006 to 31 December 2015.

Client attributes	Unplanned hospitalisation		Planned discharge home		Total	
	n	%	*n*	%	*n*	%
Number of episodes	43,608	25.7	126,393	74.3	170,001	100
Number of unique clients	27,985		81,016		94,200[§]	
Age (mean, standard deviation)*	81.5 (7.8)		79.8 (7.8)		80.2 (7.8)	
Age categories**						
65–69	3,760	8.6	15,288	12.1	19,048	11.2
70–74	5,226	12	19,256	15.2	24,482	14.4
75–79	7,541	17.3	25,120	19.9	32,661	19.2
80–84	10,199	23.4	29,130	23.1	39,329	23.1
85–89	10,154	23.3	23,790	18.8	33,944	20
90+	6,728	15.4	13,809	10.9	20,537	12.1
Missing	0	0	0	0	0	0
Gender**						
Female	23,008	52.8	71,323	56.4	94,331	55.5
Male	20,598	47.2	55,049	43.6	75,647	44.5
Other/not stated	2	0	21	0	23	0
Missing	0	0	0	0	0	0
Living arrangements**						
Alone	16,741	38.4	38,961	30.9	55,702	32.8
Special purpose accommodation	1,611	3.7	2,120	1.7	3,731	2.2
With family	21,010	48.2	62,889	49.8	83,899	49.2
With others who are not family	989	2.3	2,319	1.8	3,308	1.9
Missing	3,257	7.5	20,104	15.9	23,361	13.7
Index of socioeconomic disadvantage (IRSD) quintiles**						
1 (high disadvantage)	7,294	16.7	23,813	18.8	31,107	18.3
2	5,296	12.1	15,702	12.4	20,998	12.4
3	6,893	15.8	20,537	16.3	27,430	16.1
4	10,080	23.1	30,494	24.1	40,574	23.9
5 (low disadvantage)	14,031	32.2	35,822	28.3	49,853	29.3
Missing	14	0	25	0	39	0
Language**						
English	35,321	81	97,126	76.8	132,447	77.9
Eastern Asian languages	210	0.5	1,220	1	1,430	0.8
Eastern European languages	1,933	4.4	5,643	4.5	7,576	4.5
Northern European languages (excl. English)	230	0.5	604	0.5	834	0.5
South-East Asian languages	200	0.5	1,357	1.1	1,557	0.9
Southern Asian languages	72	0.2	309	0.2	381	0.2
Southern European languages	4,740	10.9	15,064	11.9	19,804	11.7
Southwest and Central Asian languages	485	1.1	1,743	1.4	2,228	1.3
Australian indigenous languages	1	0	16	0	17	0
Other	66	0.2	261	0.2	327	0.2
Supplementary codes	30	0.1	152	0.1	182	0.1
Missing	320	0.7	2,898	2.3	3,218	1.9
Country of birth^**						
Australia	25,529	58.5	63,921	50.6	89,450	52.6
Southern and Eastern Europe	9,457	21.7	29,251	23.1	38,708	22.8
North-West Europe	4,807	11.0	13,425	10.6	18,232	10.7
North Africa and the Middle East	829	1.9	2,618	2.1	3,447	2.0
South-East Asia	378	0.9	2,046	1.6	2,424	1.4
Southern and Central Asia	535	1.2	2,081	1.7	2,616	1.5
North-East Asia	217	0.5	1,065	0.8	1,282	0.8
Oceania and Antarctica (excl. Australia)	265	0.6	958	0.8	1,223	0.7
Sub-Saharan Africa	257	0.6	897	0.7	1,154	0.7
Americas	214	0.5	789	0.6	1,003	0.6
Other	40	0.1	111	0.1	151	0.1
Missing	1,080	2.5	9,231	7.3	10,311	6.1

[§]Of the total number of unique clients, 56,120 (59.6%) had 1 episode only during the study period; 38,080 people (40.4%) had multiple episodes; ^Collapsed to binary variable (Language: English versus Other; Country of birth: Australia versus Other) for significance testing; * $p < 0.0001$ (*t*-test for independent samples); ** $p < 0.0001$ (chi-square test for independent samples).

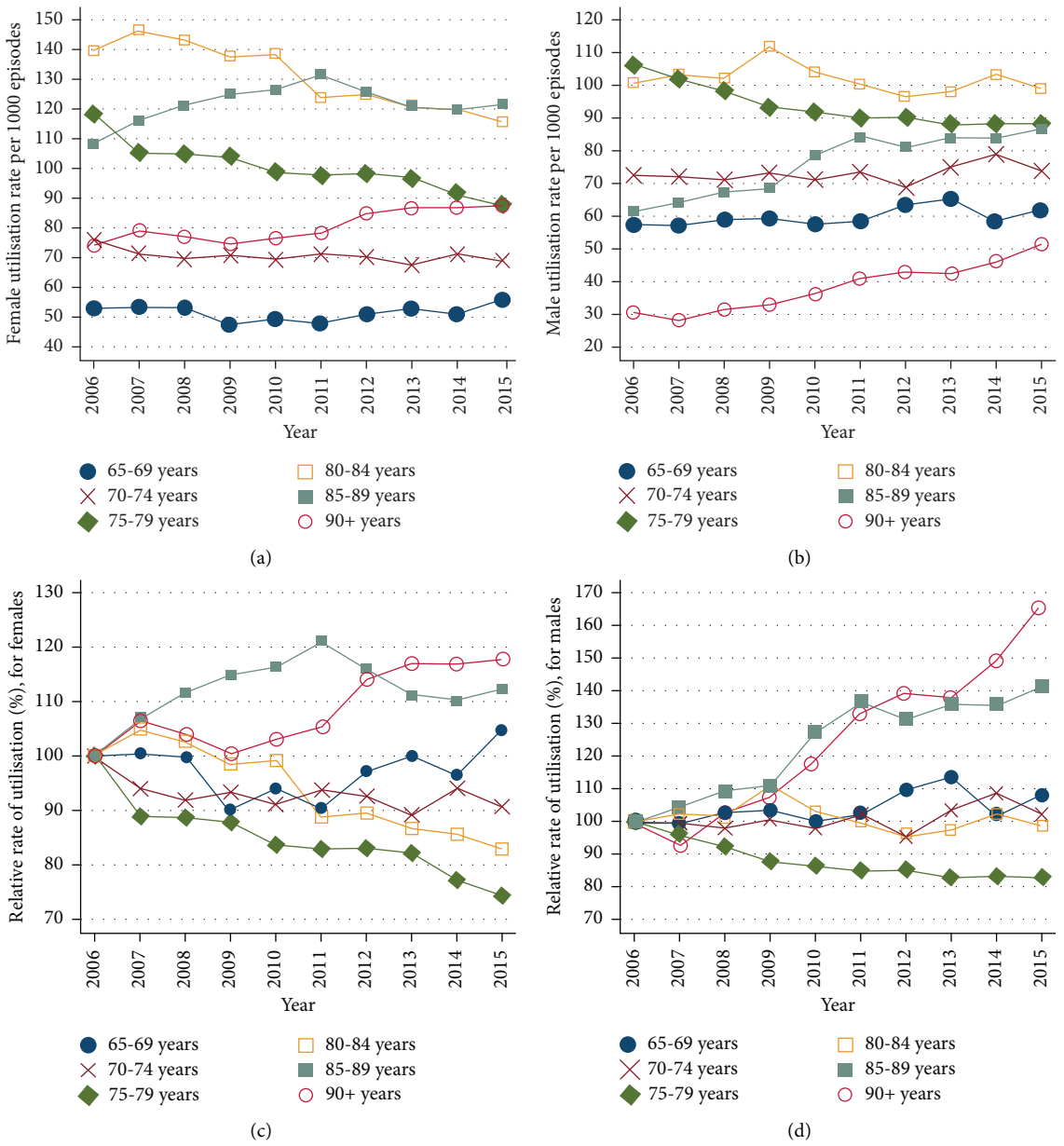

FIGURE 1: Rates of utilisation of home-based care services by gender and age group, metropolitan Melbourne, 1 January 2006 to 31 December 2015. (a) Female utilisation rate per 1000 episodes. (b) Male utilisation rate per 1000 episodes. (c) Females, relative rates of utilisation. (d) Males, relative rates of utilisation. Number of episodes per year: 2006, $n = 11{,}832$; 2007, $n = 14{,}180$; 2008, $n = 14{,}535$; 2009, $n = 15{,}950$; 2010, $n = 16{,}401$; 2011, $n = 17{,}901$; 2012, $n = 19{,}630$; 2013, $n = 20{,}010$; 2014, $n = 20{,}557$; 2015, $n = 19{,}005$.

discharge types, relative rates remained comparatively stable for the youngest age groups (65–69; 70–74 years) and decreased for the middle age groups (75–79; 80–84 years). In contrast, from 2006 to 2015, home-based care for individuals aged 85–89 years showed a 25% increase in the rate of planned discharge and a 19% increase in the rate of unplanned hospitalisation. For people aged ≥90 years, there were rate increases of 27% and 44% in planned discharge and unplanned hospitalisation, respectively.

3.3. Factors Associated with Unplanned Hospitalisation. Adjusted Odds Ratios (OR_{ad}) showed episodes resulting in an unplanned hospitalisation differed to those ending in a planned discharge in several characteristics (χ^2 (31, $N = 142{,}121$) = 17,048.19, and $p < 0.001$) (Figure 3; Table 5).

Total contact time with home care staff (OR_{ad}: 1.97, 95% CI: 1.95–2.00) was a significant predictor of an unplanned hospitalisation. The need for a carer (that is, has carer OR_{ad}: 1.73, 95% CI: 1.67–1.79; no carer although one was required OR_{ad}: 1.50, 95% CI: 1.44–1.55) and male gender (OR_{ad}: 1.32, 95% CI: 1.29–1.36) also raised the odds of this discharge type. Increased odds of an unplanned hospitalisation were associated with age (ranging from OR_{ad}: 1.10, 95% CI: 1.04–1.16 for clients aged 70–74, to OR_{ad}: 1.73, 95% CI: 1.63–1.83 for those aged ≥90) and if the client was not living

Table 3: Characteristics of the care needs and client diagnoses in 170,001 episodes of home-based care, by discharge type, 1 January 2006 to 31 December 2015.

Home care requirement or client diagnoses information	Unplanned hospitalisation		Planned discharge		Total	
	n	%	*n*	%	*n*	%
Number of episodes	43,608	26	126,393	74	170,001	100
Number of unique clients	27,985		81,016		94,200	
Total hours of home care contact time, median (IQR)*	14.5 (31.3)		5.43 (8.53)		6.74 (12.59)	
Source of referral for home-based care**						
Hospital	19,039	44	56,276	44	75,315	44.3
Individuals	5,617	13	14,751	12	20,368	12
Subacute care	7,422	17	20,297	16	27,719	16.3
Doctor	4,837	11	13,309	10	18,146	10.7
Others	6,693	15	21,760	17	28,453	16.7
Missing	0	0	0	0	0	0
Carer requirement/availability**						
Carer not required	7,302	17	32,026	25	39,328	23
No carer (carer required)	10,803	25	23,118	18	33,921	20
Has informal carer	22,082	51	50,112	40	72,194	42
Missing	3,421	8	21137	17	24,558	14
Number of diagnoses, median (IQR)*	5 (3)		4 (3)		5 (3)	
Charlson Comorbidity Index, median (IQR)*	1 (2)		1 (1)		1 (1)	
Presence of cognitive dysfunction**	6,333	14	14,036	11	20,369	12

* $p < 0.0001$ (Wilcoxon rank sum test); ** $p < 0.0001$ (chi-square test for independent samples).

with family (that is, in special purpose accommodation OR_{ad}: 1.91, 95% CI: 1.77–2.05; living alone OR_{ad}: 1.22, 95% CI: 1.19–1.26; living with others (non-family) OR_{ad}: 1.21, 95% CI: 1.11–1.32). Other risk factors for an unplanned hospitalisation were cognitive dysfunction (OR_{ad}: 1.09, 95% CI: 1.05–1.13), a high CCI score (OR_{ad}: 1.21, 95% CI: 1.20–1.22), or a referral to home-based care by a palliative care team (OR_{ad}: 1.21, 95% CI: 1.13–1.30). Primary language other than English (OR_{ad}: 0.88, 95% CI: 0.85–0.91) was associated with lower odds of an unplanned hospitalisation.

4. Discussion

Home care policy reforms implemented in 2013 have reoriented the primary healthcare system to support older people to live in their own home [4]. Monitoring the use of health services and patient outcomes is critical to assessing the impact of the reforms on older Australians. Our study of utilisation of home-based care services from 2006 to 2015 showed a rising rate of home care use by individuals aged ≥85 years; persons aged 75–79 showed the greatest decline in use of services. The factors contributing to the marked reduction in home care use for this age group are unclear and warrant further investigation. It could be that these individuals are moving in with family or transitioning to residential aged care. The rate of unplanned hospitalisations for individuals aged ≥85 years increased over the 10-year study period. To our knowledge, this is the first study to quantify rates of unplanned hospitalisation and associated risk factors in a community-dwelling cohort supported by home-based care amidst home care policy reform.

Australian housing trends show a steadily decreasing proportion of people aged ≥80 years living in residential aged care (27% in 2000, declining to 22% in 2014) [3]. The growing number of oldest older Australians living in the community was reflected in our finding that home-based care to people aged ≥85 years increased over time. More care delivery to this cohort accounted for the upward trend in both the rate of planned discharge and the rate of unplanned hospitalisations for those aged ≥85 years.

Advancing age increased the likelihood of an unplanned hospitalisation, corroborated by other studies [16, 17]. In 2008-09, 61% of people aged ≥85 years attending a public hospital emergency department in metropolitan Melbourne were admitted to hospital [16]. Men aged ≥85 years warrant attention as they exhibited the steepest increase in demand for home care. Furthermore, we identified male gender as a risk factor for unplanned hospitalisations, as have previous researchers [17, 18]. Men who lived alone, rather than with someone, were more likely to have an unplanned hospital admission [18].

Older people living with family, compared to other living arrangements, had lower odds of an unplanned admission. This appears to contradict the finding of an increased likelihood of an unplanned hospitalisation if there is an informal carer. A possible explanation is that living with family does not imply an older person cannot manage their own activities. However, the requirement for a carer indicates assistance is needed. The requirement for a carer, taken as a measure of diminished capability, is consistent with increased odds of an unplanned hospitalisation.

Episodes involving individuals with greater medical complexities, as evidenced by a high CCI score or the client requiring more contact time with home care staff, had greater odds of an unplanned admission. Akugizibwe and colleagues reported that multimorbidity increases the risk of unplanned hospitalisations [19]. Improved primary care

Table 4: Detailed characteristics of the care needs and client diagnoses in 170,001 episodes of home-based care, by discharge type, 1 January 2006 to 31 December 2015.

	Unplanned hospitalisation		Planned discharge home		Total	
	n	%	*n*	%	*n*	%
Number of episodes	43,608	25.7	126,393	74.3	170,001	100
Number of unique clients	27,985		81,016		94,200	
Total hours of home care contact time, median (IQR)[§]	14.5 (31.3)		5.43 (8.53)		6.74 (12.59)	
Source of referral for home-based care**						
Hospital	19,039	43.7	56,276	44.5	75,315	44.3
Individuals	5,617	12.9	14,751	11.7	20,368	12
Subacute care	7,422	17	20,297	16.1	27,719	16.3
Doctor	4,837	11.1	13,309	10.5	18,146	10.7
Government and referral services	1,007	2.3	5,765	4.6	6,772	4
Palliative care	2,043	4.7	3,935	3.1	5,978	3.5
Residential aged care	486	1.1	1,433	1.1	1,919	1.1
Other	3,157	7.2	10,627	8.4	13,784	8.1
Missing	0	0	0	0	0	0
Carer requirement/availability**						
Carer not required	7,302	16.7	32,026	25.3	39,328	23.1
No carer (carer required)	10,803	24.8	23,118	18.3	33,921	20
Has informal carer	22,082	50.7	50,112	39.7	72,194	42.5
Missing	3,421	7.8	21137	16.7	24,558	14.5
Number of diagnoses, median (IQR)[§]	5 (3)		4 (3)		5 (3)	
Charlson Comorbidity Index, median (IQR)[§]	1 (2)		1 (1)		1 (1)	
Presence of cognitive dysfunction**	6,333	14.52	14,036	11.11	20,369	11.98
ICD-10 chapter						
Chapter 1: Certain infectious and parasitic diseases**	1,269	2.9	3,108	2.5	4,377	2.6
Chapter 2: Neoplasms**	8,823	20.2	20,484	16.2	29,307	17.2
Chapter 3: Diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism**	2,238	5.1	4,299	3.4	6,537	3.9
Chapter 4: Endocrine, nutritional, and metabolic diseases**	17,065	39.1	43,749	34.6	60,814	35.8
Chapter 5: Mental and behavioural disorders**	9,356	21.5	21,990	17.4	31,346	18.4
Chapter 6: Diseases of the nervous system**	5,673	13.0	15,167	12.0	20,840	12.3
Chapter 7: Diseases of the eye and adnexa**	4,154	9.5	10,199	8.1	14,353	8.4
Chapter 8: Diseases of the ear and mastoid process	1,864	4.3	5,320	4.2	7,184	4.2
Chapter 9: Diseases of the circulatory system**	27,056	62.0	69,022	54.6	96,078	56.5
Chapter 10: Diseases of the respiratory system**	7,810	17.9	18,431	14.6	26,241	15.4
Chapter 11: Diseases of the digestive system**	7,094	16.3	22,659	17.9	29,753	17.5
Chapter 12: Diseases of the skin and subcutaneous tissue**	13,191	30.3	28,436	22.5	41,627	24.5
Chapter 13: Diseases of the musculoskeletal system and connective tissue	11,484	26.3	33,756	26.7	45,240	26.6
Chapter 14: Diseases of the genitourinary system**	8,446	19.4	18,132	14.4	26,578	15.6
Chapter 15: Pregnancy, childbirth and the puerperium	0	0.0	0	0.0	0	0.0
Chapter 16: Certain conditions originating in the perinatal period	5	0.0	11	0.0	16	0.0
Chapter 17: Congenital malformations, deformations, and chromosomal abnormalities*	125	0.3	261	0.2	386	0.2

Table 4: Continued.

	Unplanned hospitalisation		Planned discharge home		Total	
	n	%	*n*	%	*n*	%
Chapter 18: Symptoms, signs, and abnormal clinical and laboratory findings, not elsewhere classified**	14,631	33.6	40,975	32.4	55,606	32.7
Chapter 19: Injury, poisoning, and certain other consequences of external causes**	11,117	25.5	31,067	24.6	42,184	24.8
Chapter 20: External causes of morbidity and mortality	178	0.4	609	0.5	787	0.5
Chapter 21: Factors influencing health status and contact with health services**	9,861	22.6	29,994	23.7	39,855	23.4
Chapter 22: Codes for special purposes	0	0.0	0	0.0	0	0.0

§$p < 0.0001$ (Wilcoxon rank sum test); **$p < 0.0001$ (chi-square test for independent samples).

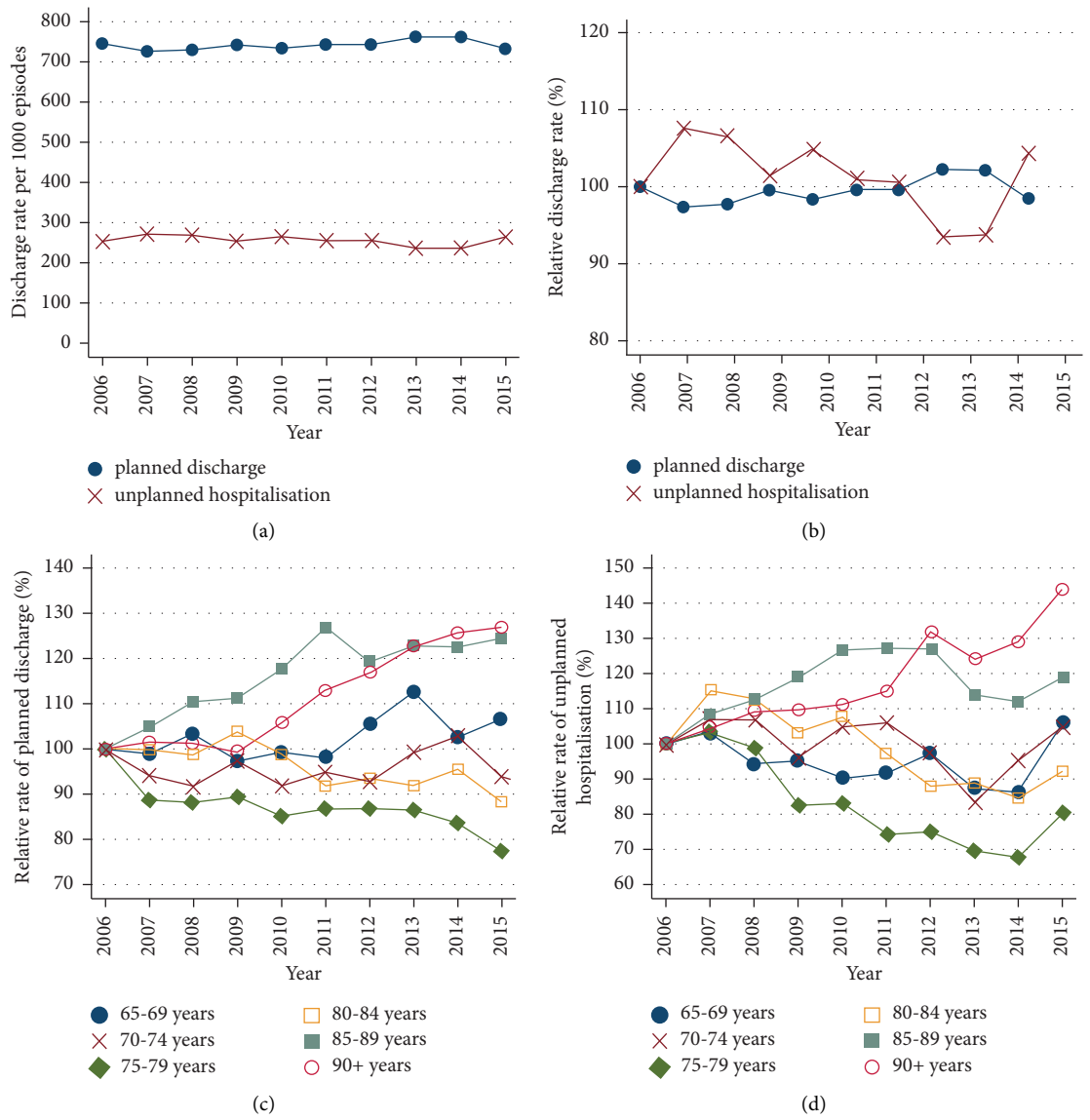

FIGURE 2: Rates of discharge from home-based care, metropolitan Melbourne, 1 January 2006 to 31 December 2015. (a) Discharge of persons aged ≥65 years, rates. (b) Discharge of persons aged ≥65 years, relative rates. (c) Planned discharge, relative rates by age group. (d) Unplanned hospitalisation, relative rates by age group.

monitoring of people with chronic conditions and/or multimorbidity, may reduce avoidable unplanned hospitalisations [19, 20].

There is unmet demand for comprehensive home-based care provided by the Living Longer Living Better Home Care Packages program [21, 22]. Government-funded assistance is available for basic care needs (Level 1 package) to high care needs (Level 4 packages); however, the number of available packages is limited. Older people, having been approved for a funded package, may wait a considerable time before receiving the home care they need. In 2018–19, the median wait times were 7 and 34 months for Level 1 and Level 4 packages, respectively [21, 23]. Without timely access to the home-based care required, older people are at risk of deteriorating health, preventable hospitalisation, premature admission to residential care, and early death [21].

In response to ongoing reforms in the aged care system, the health service continuum is calling for improved delivery of primary healthcare for older people [21, 24] alongside closer monitoring of the impact of reforms using data from across the health system [22]. Furthermore, surveillance of the outcomes of home-based care provides a reference point against which the introduction of new approaches to healthy ageing in community-dwelling older people can be compared. Still in its infancy is the development of drugs to kill senescent cells, thereby slowing ageing by treating age-related conditions and improving resiliency. It is envisaged that senotherapeutic drugs, many of which are

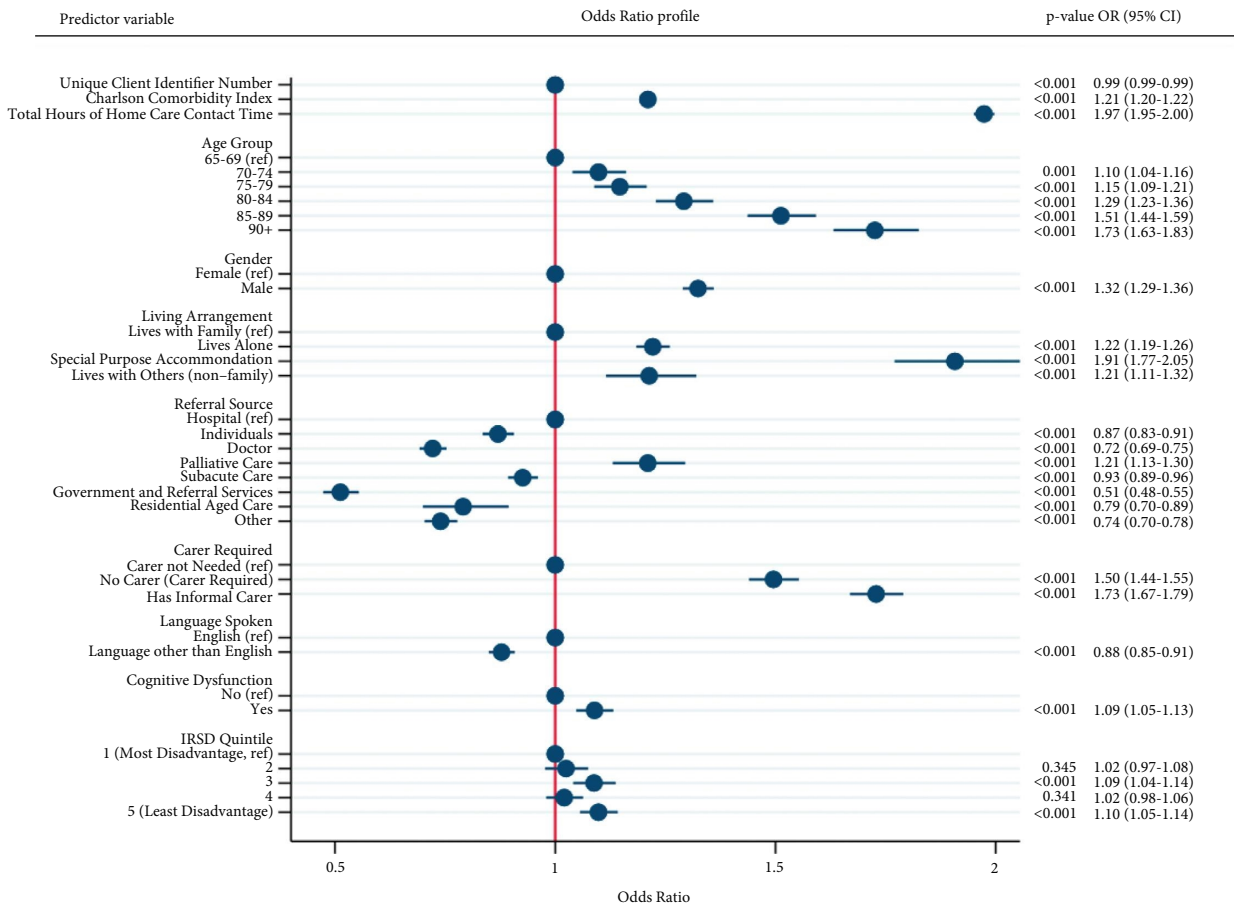

FIGURE 3: Multivariable logistic regression (1,000 bootstrapped samples) modelling the factors associated with an unplanned hospitalisation. OR, odds ratio; CI, confidence interval; IRSD, Index of Relative Socioeconomic Disadvantage.

approaching clinical trials, will in the future extend the healthspan and potentially the lifespan of humans [25, 26]. Advances in technological innovation have sparked a range of e-Health interventions which may currently be improving the lifestyles and health of older adults. Propelled by the COVID-19 pandemic, the delivery of health services through telemedicine, online networking, and virtual educational and physical activity sessions has enabled older people to receive care and support outside of clinics, hospitals, and other institutionalised settings [27, 28]. With the increasing use of mobile technology, such as smartphones, the development of mobile sensors that support older adults to stay healthy and active has rapidly grown. Mobile health devices include wearable technology to continually monitor biological or environmental data such as heart rate, glucose, and geographical location. These sensor systems may incorporate mobile phone text interventions to assist with the management of issues such as diabetes control or adherence to medication [29, 30]. Thus, changes in the delivery of healthcare and developments in medical technology may further promote the ability of older people to age in their own homes.

The strength of this study was the large amount of routinely collected data available, enabling sufficient power for accurate statistical analyses. Several limitations should be considered. Data were collected for the purposes of service provision, not research, therefore incomplete or misreported information was not unexpected. However, given the comprehensiveness of the data set, we believe inaccuracies to be minimal. The data analysed in this study is historical; however, we believe it provides insight into trends and service demands, which can then be compared to the outcomes from the provision of home care services from 2016 to current day. We are cautious regarding the generalisability of our findings, as data were from one provider of home nursing and personal care services. Culturally and linguistically diverse people may be underrepresented in our data set.

Table 5: Logistic regression modelling of factors associated with an unplanned hospitalisation. Abbreviations: OR = odds ratio, CI = confidence interval, IRSD = index of relative socioeconomic disadvantage.

	Univariate			Multivariable			Multivariable (bootstrapped 1,000 samples)		
	OR	95% CI		OR	95% CI		OR	95% CI	
Unique client identifier number	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Charlson Comorbidity Index Score	1.26	1.25	1.27	1.21	1.20	1.22	1.21	1.20	1.22
Total hours of home care contact time	2.07	2.05	2.09	1.97	1.95	2.00	1.97	1.95	2.00
Age group									
65–69	1.00			1.00			1.00		
70–74	1.10	1.05	1.16	1.10	1.04	1.16	1.10	1.04	1.16
75–79	1.22	1.17	1.28	1.15	1.09	1.21	1.15	1.09	1.21
80–84	1.42	1.36	1.48	1.29	1.23	1.36	1.29	1.23	1.36
85–89	1.74	1.66	1.81	1.51	1.44	1.59	1.51	1.44	1.59
90+	1.98	1.89	2.07	1.73	1.63	1.82	1.73	1.63	1.83
Gender									
Female	1.00			1.00			1.00		
Male	1.16	1.13	1.19	1.32	1.29	1.36	1.32	1.29	1.36
Other/not stated	0.30[a]	0.07	1.26	0.28[c]	0.04	2.26	0.28[f]	0.08	0.98
Referral source									
Hospital	1.00			1.00			1.00		
Individuals	1.13	1.07	1.17	0.87	0.84	0.91	0.87	0.83	0.91
Doctor	1.07	1.04	1.11	0.72	0.69	0.75	0.72	0.69	0.75
Palliative care	1.53	1.45	1.62	1.21	1.13	1.29	1.21	1.13	1.30
Subacute care	1.08	1.05	1.12	0.93	0.89	0.96	0.93	0.89	0.96
Government and referral services	0.52	0.48	0.55	0.51	0.47	0.55	0.51	0.48	0.55
Residential aged care	1.00[b]	0.90	1.11	0.79	0.70	0.89	0.79	0.70	0.89
Other	0.88	0.84	0.92	0.74	0.70	0.78	0.74	0.70	0.78
Carer situation									
Carer not required	1.00			1.00			1.00		
No carer (carer required)	2.05	1.98	2.12	1.50	1.44	1.55	1.50	1.44	1.55
Has informal carer	1.93	1.88	1.99	1.73	1.67	1.79	1.73	1.67	1.79
Living situation									
Family	1.00			1.00			1.00		
Alone	1.29	1.26	1.32	1.22	1.18	1.26	1.22	1.19	1.26
Special purpose accommodation	2.27	2.13	2.43	1.91	1.77	2.06	1.91	1.77	2.05
Others (non-family)	1.28	1.18	1.38	1.21	1.12	1.32	1.21	1.11	1.32
IRSD quintiles									
1 (low disadvantage)	1.00			1.00			1.00		
2	1.10	1.06	1.15	1.02[d]	0.98	1.07	1.02[g]	0.97	1.08
3	1.10	1.06	1.14	1.09	1.04	1.14	1.09	1.04	1.14
4	1.08	1.04	1.12	1.02[e]	0.98	1.06	1.02[h]	0.98	1.06
5 (high disadvantage)	1.28	1.24	1.32	1.10	1.06	1.14	1.10	1.05	1.14
Language									
English	1.00			1.00			1.00		
Language other than English	0.83	0.81	0.85	0.88	0.85	0.91	0.88	0.85	0.91
Cognitive dysfunction									
Not present	1.00			1.00			1.00		
Present	1.36	1.32	1.4	1.09	1.05	1.13	1.09	1.05	1.13

p values all <0.001 unless specified; [a]$p = 0.099$, [b]$p = 0.963$, [c]$p = 0.234$, [d]$p = 0.316$, [e]$p = 0.329$, [f]$p = 0.046$, [g]$p = 0.345$, [h]$p = 0.341$.

5. Conclusion

In recent years, Australian health policy has focussed on providing services to enable older people to remain in their own homes. The increasing rate of unplanned hospitalisations for community-dwelling individuals aged ≥85 years highlights the need for more home care support to reduce the risk and potentially adverse effects of unplanned hospitalisations. This is particularly important as innovative technology and drug therapies driving changes in the delivery of healthcare and management of chronic conditions may result in greater numbers of older adults being able to live independently in the community, provided adequate support is available to meet their needs.

Data Availability

Due to the ethically sensitive nature of the research, participants did not provide consent to their data being publicly shared, so the data supporting the findings of this study cannot be made available.

Additional Points

Knowledge about topic. Unplanned hospitalisations for older people are associated with functional decline, readmissions to hospital, and deteriorating health. For community-dwelling older Australians, unplanned hospitalisations may foreshadow transition to residential care. *Contributions of this article.* From 2006 to 2015, individuals aged ≥85 years showed a rising rate of home care episodes, whilst home care services for females aged 70–84 years and males aged 75–79 years showed a decrease in the rate of utilisation. For those aged ≥85 years, the rate of unplanned hospitalisations increased over this 10-year period.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

References

[1] Australian Bureau of Statistics, "3101.0 - Australian Demographic Statistics," 2019a, https://www.abs.gov.au/ausstats/abs@.nsf/0/1cd2b1952afc5e7aca257298000f2e76.

[2] Australian Bureau of Statistics, "Disability, Ageing and Carers Australia: Summary of Findings 2018, Cat. No. 4430.0," 2019b, https://www.abs.gov.au/statistics/health/disability/disability-ageing-and-carers-australia-summary-findings/latest-release#older-people.

[3] Australian Government Productivity Commission, "Housing Decisions of Older Australians Commission Research Paper," 2015, https://www.pc.gov.au/research/completed/housing-decisions-older-australians/housing-decisions-older-australians.pdf.

[4] Australian Government Department of Health, "Living Longer. Living Better. Aged Care Reform Package," 2012, https://apo.org.au/node/29086.

[5] S. J. Long, K. F. Brown, D. Ames, and C. Vincent, "What is known about adverse events in older medical hospital inpatients? A systematic review of the literature," *International Journal for Quality in Health Care*, vol. 25, no. 5, pp. 542–554, 2013.

[6] D. S. Shebeshi, X. Dolja-Gore, and J. Byles, "Unplanned readmission within 28 days of hospital discharge in a longitudinal population-based cohort of older Australian women," *International Journal of Environmental Research and Public Health*, vol. 17, no. 9, p. 3136, 2020.

[7] K. L. Quinn, N. M. Stall, Z. Yao et al., "The risk of death within 5 years of first hospital admission in older adults," *Canadian Medical Association Journal*, vol. 191, no. 50, pp. E1369–E1377, 2019.

[8] A. L. Koppitz, J. Dreizler, J. Altherr, G. Bosshard, R. Naef, and L. Imhof, "Relocation experiences with unplanned admission to a nursing home: a qualitative study," *International Psychogeriatrics*, vol. 29, no. 3, pp. 517–527, 2017.

[9] E. I. Benchimol, L. Smeeth, A. Guttmann et al., "The REporting of studies conducted using observational routinely-collected health data (RECORD) statement," *PLoS Medicine*, vol. 12, no. 10, Article ID e1001885, 2015.

[10] Australian Institute of Health and Welfare, "Episode of Care Definition," 2018, https://meteor.aihw.gov.au/content/index.phtml/itemId/268978.

[11] Australian Bureau of Statistics, "*2033.0.55.001* - Census of Population and Housing: Socio-Economic Indexes for Areas (SEIFA)," 2018, https://www.abs.gov.au/ausstats/abs@.nsf/Lookup/by%20Subject/2033.0.55.001%7E2016%7EMain%20Features%7EIRSD%7E19.

[12] World Health Organisation, "International statistical classification of diseases and related health problems 10th revision," 2010, http://apps.who.int/classifications/icd10/browse/2010/en.

[13] A. L. Huntley, R. Johnson, S. Purdy, J. M. Valderas, and C. Salisbury, "Measures of multimorbidity and morbidity burden for use in primary care and community settings: a systematic review and guide," *The Annals of Family Medicine*, vol. 10, no. 2, pp. 134–141, 2012.

[14] Y. Y. Palesch, "Some common misperceptions about P values," *Stroke*, vol. 45, pp. e244–e246, 2014.

[15] StataCorpLLC, "Stata - Statistical Software for Data Science," 2022, https://www.stata.com/.

[16] J. A. Lowthian, A. J. Curtis, D. J. Jolley, J. U. Stoelwinder, J. J. McNeil, and P. A. Cameron, "Demand at the emergency department front door: 10-year trends in presentations," *Medical Journal of Australia*, vol. 196, no. 2, pp. 128–132, 2012.

[17] J. K. Rönneikkö, M. Mäkelä, E. R. Jämsen et al., "Predictors for unplanned hospitalization of new home care clients," *Journal of the American Geriatrics Society*, vol. 65, no. 2, pp. 407–414, 2017.

[18] C. Pimouguet, D. Rizzuto, M. Lagergren, L. Fratiglioni, and W. Xu, "Living alone and unplanned hospitalizations among older adults: a population-based longitudinal study," *The European Journal of Public Health*, vol. 27, no. 2, pp. 251–256, 2017.

[19] R. Akugizibwe, A. Calderón-Larrañaga, A. Roso-Llorach et al., "Multimorbidity patterns and unplanned hospitalisation in a cohort of older adults," *Journal of Clinical Medicine*, vol. 9, no. 12, p. 4001, 2020.

[20] N. T. Ha, C. Wright, D. Youens, D. B. Preen, and R. Moorin, "Effect modification of multimorbidity on the association between regularity of general practitioner contacts and potentially avoidable hospitalisations," *Journal of General Internal Medicine*, vol. 35, no. 5, pp. 1504–1515, 2020.

[21] Australian Government, "Royal Commission into Aged Care Quality and Safety Final Report - Volume 1: Summary and Recommendations," 2021, https://agedcare.royalcommission.gov.au/publications/final-report-volume-1.

[22] M. Jorgensen and R. Haddock, "Debble Issues Brief No.27. 2018 The impact of the home care reforms on the older person, the aged care workforce and the wider Health System Australian Healthcare and Hospitals Association," 2018, https://ahha.asn.au/publication/health-policy-issue-briefs/deeble-issues-brief-no-27-impact-home-care-reforms-older.

[23] Australian Govenment and Productivity Commission, "Report on Government Services 2020. Part F: Community services, Section 14: Aged care services," 2020, https://www.pc.gov.au/research/ongoing/report-on-government-services/2020/community-services/aged-care-services.

[24] C. D. Pond and C. Regan, "Improving the delivery of primary care for older people," *Medical Journal of Australia*, vol. 211, no. 2, pp. 60–62, 2019.

[25] J. Campisi, P. Kapahi, G. J. Lithgow, S. Melov, J. C. Newman, and E. Verdin, "From discoveries in ageing research to therapeutics for healthy ageing," *Nature*, vol. 571, no. 7764, pp. 183–192, 2019.
[26] L. J. Niedernhofer and P. D. Robbins, "Senotherapeutics for healthy ageing," *Nature Reviews Drug Discovery*, vol. 17, no. 5, p. 377, 2018.
[27] R. Buyl, I. Beogo, M. Fobelets et al., "e-Health interventions for healthy aging: a systematic review," *Systematic Reviews*, vol. 9, no. 1, p. 128, 2020.
[28] J. Sin, C. Henderson, D. Spain, V. Cornelius, T. Chen, and S. Gillard, "eHealth interventions for family carers of people with long term illness: a promising approach?" *Clinical Psychology Review*, vol. 60, pp. 109–125, 2018.
[29] J. L. Helbostad, B. Vereijken, C. Becker et al., "Mobile health applications to promote active and healthy ageing," *Sensors*, vol. 17, no. 3, 2017.
[30] K. Yang, B. Isaia, L. J. E. Brown, and S. Beeby, "E-textiles for healthy ageing," *Sensors*, vol. 19, no. 20, 2019.