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Quality and safety indicators for home care recipients in Australia: development and cross-sectional analyses

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ABSTRACT

Objectives To develop and examine the prevalence of quality and safety indicators to monitor care of older Australians receiving home care packages (HCPs), a government-funded aged care programme to support individuals to live at home independently.

Design Cross-sectional.

Setting Home care recipients, Australia.

Participants 90 650 older individuals (aged ≥65 years old and ≥50 years old for people of Aboriginal or Torres Strait Islander descent) who received a HCP between 1 January 2016 and 31 December 2016 nationally were included.

Primary and secondary outcome measures The Registry of Senior Australians developed 15 quality and safety indicators: antipsychotic use, high sedative load, chronic opioid use, antimicrobial use, premature mortality, home medicines reviews, chronic disease management plan, wait-time for HCP, falls, fractures, medication-related adverse events, weight loss/malnutrition, delirium/dementia-related hospitalisations, emergency department (ED) presentations and pressure injuries. Risk adjusted prevalence (%, 95% CI) and geographical area (statistical level 3) variation during 2016 were examined.

Results In 2016, a total of 102 590 HCP episodes were included for 90 650 individuals, with 66.9% (n=68 598) level 1–2 HCP episodes (ie, for basic care needs) and 33.1% (n=33 992) level 3–4 HCP (ie, higher care needs). The most prevalent indicators included: antibiotic use (52.4%, 95% CI 52.0 to 52.7), chronic disease management plans (38.1%, 95% CI 37.8 to 38.4), high sedative load (29.1%, 95% CI 28.8 to 29.4) and ED presentations (26.4%, 95% CI 25.9 to 26.9). HCP median wait time was 134 days (IQR 41–406). Geographical variation was highest in chronic disease management plans and ED presentations (20.7% of areas outside expected range).

Conclusion A comprehensive outcome monitoring system to monitor the quality and safety of care and variation for HCP recipients was developed. It provides a pragmatic, efficient and low burden tool to support evidence-based quality and safety improvement initiatives for the aged care sector.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ This large population-based study used linked aged care and healthcare data that is routinely collected to provide a comprehensive overview of quality and safety measures of access to care processes, outcomes and variation in Australia that were risk adjusted.
⇒ Of the 15 indicators, seven indicators were examined using data from four states of Australia due to data access restrictions; however, these account for 86% of hospitalisations for aged care recipients in Australia.
⇒ There may be under-reporting of some indicators, namely those using hospitalisation data where only more severe cases are likely to have caused or be recorded during a hospitalisation.
⇒ Our findings are likely generalisable to aged care recipients internationally with similar aged care sectors in Western countries.
⇒ We were unable to examine quality of life or consumer experience as these measures (or suitable surrogates) are not available in the datasets employed.

INTRODUCTION

In response to ageing populations, increased demands on health and aged care services and older people's preference to remain at home for as long as possible, many countries are adapting their health and aged care systems to provide home or community-based aged care services.[1 2] Aged care services delivered through home care programmes generally aim to provide social supports and care services for assessed individuals with care needs to live independently and safely in their own homes and communities. In Australia, home care packages (HCPs) are comprehensive structured community-based services largely subsidised by the Australian federal government, which include provision of services to support clinical care needs in

addition to functional assistance services such as personal care, house cleaning, meal preparation and transportation.[3] The HCP programme comprises a four-level system of packages, ranging from basic (level 1, annual subsidy paid $A8900) to high (level 4, $A51 900) care needs.[3]

In 2018, the Australian Royal Commission into Aged Care Quality and Safety was established to examine the quality of aged care services and to deliver recommendations for positive change and reform, with the final report delivered in March 2021.[4] Highlighted in the final report was the increased need and preference for provision of home aged care services in the future. By 2050, it is estimated that 80% of Australian aged care services will be delivered in the community.[4] Currently, approximately one-third of Australia's aged care budget is spent on the provision of home care services, of which half is on HCPs.[5] Routine monitoring of home care quality is essential to ensure appropriate and high-quality home care services are provided and that consumer needs are being met. However, despite there being 149 819 Australians receiving care services from an HCP in September 2020 (a 26.9% increase since 2019),[3] there are no routine measures of the quality and safety of the HCP programme at the population level as yet.[4]

In 2017, the Registry of Senior Australians (ROSA) was established. The ROSA integrates aged care and healthcare data from various federal and state level sources and includes the largest Australian population-based cohort of people using aged care services (2.9 million individuals).[6] With the innovation of the ROSA, the opportunity to develop and report quality and safety indicators for the Australian population accessing HCP services is now feasible. The objectives of this study are therefore to describe the development of indicators to monitor the quality and safety of care provided to older Australians receiving HCPs and to examine the 2016 prevalence and variation of the developed indicators in a population-based cohort using the ROSA.

METHODS

Study design

This study is composed of two parts. The first detailed the development of quality and safety indicators for HCP recipients in Australia using literature review and expert engagement based on the iterative methodology recommended by the US Agency of Health Research and Quality for development of indicators[7] and also used in the development of quality and safety indicators for residential aged care in Australia.[8] The second part, a cross-sectional examination of the prevalence of the developed quality and safety indicators (n=15) in 2016 for all HCP recipients in Australia was undertaken using the ROSA dataset, stratified by the level of HCP (HCP level 1–2 and level 3–4). Level 1 HCP is for basic care needs, level 2 for low care needs, level 3 for intermediate and level 4 for high care needs.[3]

Data sources

The ROSA includes deidentified linked administrative aged care and healthcare data as previously described.[6] The Australian Aged Care Assessment Program (ACAP) dataset, containing all service eligibility assessments performed nationally, HCP service episodes (entry and exit dates of services and levels of care) and National Death Index (dates of death) from the Australian Institute of Health and Welfare National Aged Care Data Clearinghouse were used. Additional datasets included: Australian Government Medicare Benefits Schedule (MBS; Australia's national healthcare subsidy system), Pharmaceutical Benefits Scheme (PBS; Australia's national medication subsidy scheme) and state-based hospitalisation and emergency department (ED) presentations from South Australia (SA), New South Wales (NSW), Victoria (VIC) and Queensland (QLD), comprising ~86% of aged care recipient's hospitalisations nationally.

Study cohort

Older individuals (aged ≥65 years old and ≥50 years old for people of Aboriginal or Torres Strait Islander descent) who received an HCP between 1 January 2016 and 31 December 2016 nationally were included. Study entry date was the latest of either 1 January 2016 for those already receiving a HCP or the start date of receipt of a HCP during the study period. Study end date was 31 December 2016 or exit from HCP, death or transition to permanent residential aged care.

Development and specifications of quality and safety indicators for HCP

A systematic method to combine literature review and expert consensus as described previously was undertaken to develop 15 home care quality and safety indicators (table 1).[7 8] Briefly, a literature review was conducted to identify quality and safety indicators specific for aged care (including home care), with a shortlist generated based on the following criteria: (1) implemented in other countries, or recommended for monitoring of home care quality and safety at the population level, (2) associated with poor outcomes and/or increased risk of harm and (3) feasible using the ROSA data. Expert consensus included an expert advisory committee comprising of geriatricians, general practitioners (GPs), aged care providers and aged care consumer representatives who examined the face and content validity and acceptability of the indicators. Three additional process indicators were subsequently included based on findings from the Final Report of Australia's Royal Commission into Aged Care Quality and Safety.[4] These included home medicines review (a comprehensive medication review conducted by a pharmacist in collaboration with the GP, MBS item 900), chronic disease management plan (subsidised by the MBS, MBS items 721, 723, 729 and 732) and HCP wait-time (calculated as median time from the aged care eligibility assessment approval date to date of first HCP episode (new HCP recipients only) and proportion

Table 1 ROSA home care outcome monitoring system quality and safety indicators

	Indicator	Main data source	Numerator	Denominator	Exclusions/stratification*	Covariates*
Medication-related indicators						
1	High sedative load	Medications (PBS)	Number of HCP episodes where recipients experienced a high sedative load	Number of HCP episodes	Stratified by dementia status. Exclude history of cancer, schizophrenia and Huntington's disease.	Age, sex and number health conditions.
2	Antipsychotic use	Medications (PBS)	Number of HCP episodes where recipients had been dispensed an antipsychotic medication.	Number of HCP episodes	Stratified by dementia status. Exclude history of schizophrenia or Huntington's disease.	Age, sex, number health conditions† and prior antipsychotic use.
3	Chronic opioid use	Medications (PBS)	Number of HCP episodes where recipients are chronic opioid users, defined as continuous opioid use for at least 90 days, or for 120 non-consecutive days.	Number of HCP episodes	Exclude history of cancer.	Age, sex and number health conditions.
4	Antibiotic use	Medications (PBS)	Number of HCP episodes where recipients were dispensed an antibiotic	Number of HCP episodes		Age, sex and number health conditions.
Hospitalisation/mortality-related indicators						
5	Premature mortality	Mortality records (NDI)	Number of HCP episodes where recipients died from premature causes, that is, main cause of death is 'external' and considered potentially avoidable.	Number of HCP episodes		Age, sex and number health conditions.
6	Falls	Hospital and mortality (NDI) records	Number of HCP episodes where recipients had a fall that resulted in hospitalisation/ED presentation	Number of HCP episodes		Age, sex and number health conditions‡ and dementia.
7	Fractures	Hospital, mortality (NDI) subsidised health service records (MBS)	Number HCP episodes where recipients had a fracture requiring hospitalisation/ED presentation.	Number of HCP episodes		Age, sex, number health conditions‡, dementia and osteoporosis.
8	Medication-related adverse events	Hospital records	Number of HCP episodes where recipients had a medication-related hospitalisation/ED presentation	Number of HCP episodes		Age, sex and number health conditions.
9	Weight loss and malnutrition	Hospital records	Number of HCP episodes where recipients had a hospitalisation/ED presentation for malnutrition or weight loss	Number of HCP episodes	Exclude history of cancer.	Age, sex and number health conditions.

Continued

Table 1 Continued

	Indicator	Main data source	Numerator	Denominator	Exclusions/stratification*	Covariates*
10	Delirium and/or dementia hospitalisations	Hospital records	Number of HCP episodes where recipients had dementia and a hospitalisation/ED presentation for dementia and/or delirium	Number of HCP episodes with dementia recipient		Age, sex and number health conditions.
11	ED Presentation	Hospital records	Number of HCP episodes ED presentation within 30 days of discharge from hospital	Number of HCP episodes with hospitalisation		Age, sex, number health conditions and history of prior hospitalisations.
12	Pressure injury	Hospital records	Number of HCP episodes where recipients had a hospitalisation/ED presentation for pressure injury	Number of HCP episodes		Age, sex and number health conditions.
Process-related indicators						
13	Chronic disease management plan	Subsidised health service records (MBS)	Number of HCP episodes where eligible recipients§ had a chronic disease management plan	Number of HCP episodes	Exclude DVA card holders¶	Age, sex and number health conditions.
14	Home medicines review	Subsidised health service records (MBS)	Number of HCP episodes where eligible recipients§ had a home medicines review	Number of HCP episodes	Exclude DVA card holders¶	Age, sex and number health conditions
15	Wait-time	ACAP records	Wait time from ACAP assessment approval to commencement of first HCP, median days (IQR)	N/A		

*All health conditions determined using Rx-Risk-V comorbidity index in 6 months prior to HCP episode, apart from dementia and cancer, which included Rx-Risk-V and ACAP; schizophrenia and Huntington's disease from ACAP. History of prior hospitalisations (unplanned admissions) 12 months prior.
†Psychotic illness removed from the count of health conditions as included as covariate in model.
‡Dementia and osteoporosis removed from count of health conditions, where appropriate, as included as covariates in model.
§Chronic disease management plans and home medication reviews can be claimed once in a 12-month period, and only eligible HCP recipients were included in the denominator.
¶DVA card holders were excluded as these items are reimbursed through DVA and may not be fully captured in the dataset.
ACAP, Aged Care Assessment Program; DVA, Department of Veterans' Affairs; ED, emergency department; MBS, Medicare Benefits Schedule; NDI, National Death Index; PBS, Pharmaceutical Benefits Scheme; ROSA, Registry of Senior Australians.

of HCP recipients with a median wait-time >90 days), resulting in a total of 15 indicators for inclusion.

For each indicator the data source, numerator, denominator, additional inclusion and exclusion criteria, stratifications and covariates for consideration in adjustment are outlined in table 1.[4 8–16] The unit of measure in the analysis are episodes of HCP, instead of individuals, because individuals can have provider and care package level changes. Therefore, a change in level of a HCP (ie, level 1–2 to level 3–4) during the study period was considered to be a new episode of a HCP package, and multiple HCP episodes may be included for an individual. Of the 15 developed indicators, eight are reported using nationally available data and the remaining seven hospitalisation-based indicators are examined from the four states where data were available (SA, NSW, VIC and QLD) (table 1).

Statistical analyses

Descriptive statistics are used to summarise the overall study cohort by unique HCP episodes and stratified by HCP level (HCP level 1–2 and 3–4). Each outcome of interest was determined for each individual HCP episode (ie, the time period between HCP entry and exit date, which included death or entry to permanent residential aged care, during the study period). Prevalence estimates of the indicators (risk adjusted rates) and 95% CIs are presented. Funnel plots were used to display the level of variation by geographical area (Statistical Areas Level 3 (SA3)). The SA3 was determined based on postcodes in PBS data in the 12 months prior to study entry. Those who did not have a PBS dispensing and available postcode were not included in the analysis of variation by SA3 (<2%). All analyses were performed using SAS V.9.4.

Risk adjustment of indicators

For the SA3 geographical comparisons, indicators were adjusted to account for the varying profile of individuals receiving a HCP[17] and at minimum adjusted for age, sex, and number of health conditions, with additional covariates (eg, dementia, osteoporosis) included where relevant (table 1). Number of health conditions was based on the Rx-Risk-V, a pharmaceutical-based comorbidity measure using PBS records in the 6 months prior to a HCP episode.[18] Dementia and cancer were ascertained based on reporting of conditions from the aged care eligibility assessments (ACAP) and Rx-Risk-V. The probability of a specific event (ie, *expected rate*) was estimated using a logistic regression model that included the specified covariates for that model. For each measure and model variable, form specifications were examined and model fit assessed using Hosmer-Lemeshow goodness of fit criteria. The *ratio of the observed/expected* multiplied by the overall national rate was the adjusted rate, which is presented in the funnel plots.[17]

Visualising indicators

Funnel plots display variation by geographical area for each indicator. In these plots, each dot represents an SA3 area, the number of individuals included is shown on the X-axis and the adjusted rate of each indicator on the Y-axis (figure 1). The expected variation in performance is shown by upper and lower CIs (95% or 99% CI) around the indicator mean for the geographical areas. The Wilson method for binomially distributed estimates was used to estimate CIs.[17] Only SA3 geographical areas with more than 20 individuals were displayed in the plots; this excluded at least 9/332 (2.7%) areas nationally and 4/266 (1.5%) areas for the state-based analysis.

RESULTS

In 2016, a total of 102 590 HCP episodes were included for 90 650 individuals, with 66.9% (n=68 598) level 1–2 HCP episodes and 33.1% (n=33 992) level 3–4 HCP (table 2). Of the 10 865 individuals with multiple HCP episodes during the study period, 3655 had ≥2 episodes at the same HCP level and 7210 changed between HCP levels (ie, from level 1–2 HCP to level 3–4). Most HCP recipients were female (65.4%), with a median age of 83 years old (IQR 77–88), living in a major city (61.7%), and a median of 5 (IQR 3–7) chronic health conditions, including 19.6% living with dementia. There was a near-doubling in the prevalence of dementia among individuals receiving a level 3–4 HCP (27.4%) compared with those receiving level 1–2 HCP (15.7%). The study cohort is described in table 2.

Prevalence of HCP indicators

Of the eight indicators estimated nationally, antibiotic use had the highest prevalence (52.4%, 95% CI 52.0 to 52.7), followed by receiving a chronic disease management plan (38.1%, 95% CI 37.8 to 38.4) and experiencing a high sedative load (29.1%, 95% CI 28.8 to 29.4) (table 3). Stratification of antipsychotic use by the presence of dementia showed a higher prevalence of antipsychotic use in individuals with dementia (19.3%, 95% CI 18.8 to 19.9) compared with those without (5.4%, 95% CI 5.3 to 5.6). Conversely, the prevalence of high sedative load was lower in individuals with dementia (21.0%, 95% CI 20.4 to 21.6) compared with those without dementia (31.1%, 95% CI 30.7 to 31.4). Chronic opioid use was observed for 13.7% (95% CI 13.5 to 14.0) of HCP episodes. For all medication-related indicators, the prevalence was higher in individuals receiving a level 3–4 HCP compared with those receiving level 1–2 HCP, ranging from a 6.4% increase for antibiotic use to a 37.6% increase for antipsychotic use. Use of home medicines reviews was 3.0% (95% CI 2.9 to 3.1) and was slightly higher in those receiving a level 1–2 HCP (3.1%, 95% CI 3.0 to 3.3) compared with level 3–4 HCP (2.6%, 95% CI 2.5 to 2.8). Median wait-time from aged care eligibility assessment approval to receipt of first HCP was 134 days (IQR 41–406), with little differences between levels of HCP. Almost 60% (58.7%) of HCP recipients had a wait-time of greater than 90 days (table 3).

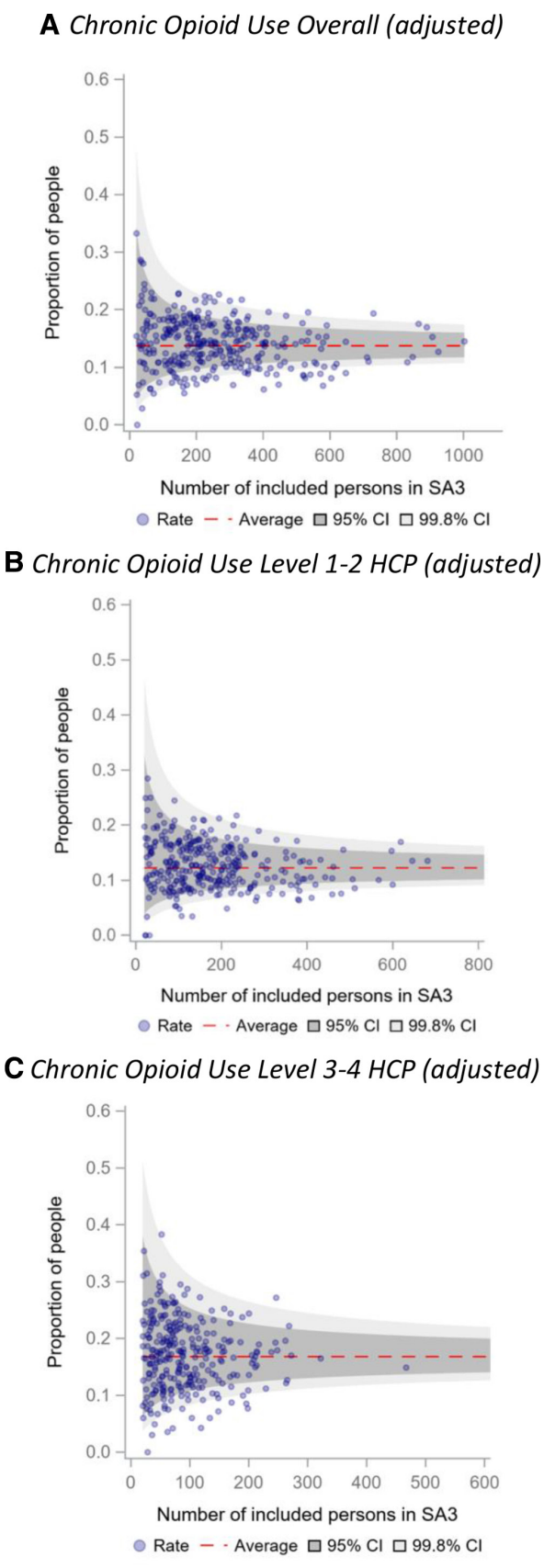

Figure 1 Variation of chronic opioid use by geographical region (SA3) in HCP episodes. (A) Chronic opioid use overall (adjusted). (B) Chronic opioid use level 1–2 HCP (adjusted). (C) Chronic opioid use level 3–4 HCP (adjusted). HCP, home care packages; SA3, Statistical Areas Level 3.

Of the seven indicators estimated using state-based hospitalisation data, an ED presentation within 30 days of a hospitalisation had the highest prevalence (26.4%, 95% CI 25.9% to 26.9%), followed by falls resulting in hospital presentation (11.7%, 95% CI 11.5% to 12.0%), delirium and/or dementia-related hospitalisations in HCP recipients living with dementia (9.7%, 95% CI 9.3% to 10.2%), fractures (5.3%, 95% CI 5.1% to 5.4%), weight loss/malnutrition (4.9%, 95% CI 4.8% to 5.1%), pressure injury (4.0%, 95% CI 3.8% to 4.1%) and medication-related adverse events (2.7%, 95% CI 2.6% to 2.8%).

Geographical variation of HCP indicators

An example funnel plot of an indicator illustrating national geographical variation and by level of HCP is shown in figure 1, using chronic opioid use as an illustration. All the remaining funnel plots are shown in online supplemental appendix 1. In decreasing order, the national indicators with the most regions outside the upper 95% CI (ie, poorest performing) were: chronic opioid use (n=43/323, 13.3%, figure 1), high sedative load (n=33/322, 10.2%), antibiotic use (n=33/323, 10.2%), premature mortality (n=15/323, 4.6%) and antipsychotic use (n=5/323, 1.5%) (table 4). The national indicators for chronic disease management plans (n=67/323, 20.7% below lower 95% CI) and home medicines review (n=35/323, 10.8% below lower 95% CI) also saw a high proportion of regions performing below expected. Of the state-based indicators, ED presentation had the most regions outside the upper 95% CI, with 12.0% (n=30/251) of regions, followed by weight loss/malnutrition (n=30/262, 11.5%) (table 4).

DISCUSSION

Using existing integrated aged care and healthcare data, a pragmatic and low burden quality and safety outcome monitoring system that includes process and outcome indicators for recipients of HCP was developed for Australia. Each of the developed indicators captured a specific aspect of quality based on robust evidence (including evidence to support the indicator and/or importance of the outcomes of measuring and reporting) and ability to result in impactful gains in healthcare quality (including safety, timeliness, effectiveness and efficiency) and improved health outcomes.[7]

Medication-related indicators had a high prevalence, with over half (52.4%) exposed to an antibiotic, almost a third had a high sedative load (29.1%) and over 1 in 10 exposed to chronic opioid use (13.7%). Furthermore, although level 1–2 and 3–4 HCP recipients were the same median age (83 years old), had the same number of health conditions (median=5) and medications dispensed (median=9), the prevalence of all medication-related indicators was higher for individuals receiving a level 3–4 HCP compared with level 1–2 HCP. Concerningly, utilisation of chronic disease management plans and home medicines reviews were lower in those receiving level

Table 2 Characteristics of home care package recipients, by level of home care package, in 2016

	Total HCP cohort n=102 590 episodes, n (%)	HCP level 1–2 n=68 598 episodes, n (%)	HCP level 3–4 n=33 992 episodes, n (%)
Sex, female n (%)	67 095 (65.4)	45 621 (66.5)	21 474 (63.2)
Age, median (IQR)	83 (77–88)	83 (77–88)	83 (77–88)
Age group years, n (%)			
<70	7472 (7.3)	4810 (7.0)	2662 (7.8)
70–79	27 139 (26.5)	17 835 (26.0)	9304 (27.4)
80–89	49 288 (48.0)	33 823 (49.3)	15 465 (45.5)
≥90	18 691 (18.2)	12 130 (17.7)	6561 (19.3)
Born in Australia	64 117 (62.5)	43 364 (63.2)	20 753 (61.1)
State‡, n (%)			
New South Wales	34 449 (33.6)	23 843 (34.8)	10 606 (31.2)
Victoria	24 694 (24.1)	17 583 (25.6)	7111 (20.9)
Queensland	18 054 (17.6)	12 154 (17.7)	5900 (17.4)
South Australia	8478 (8.3)	5814 (8.5)	2664 (7.8)
Western Australia	10 092 (9.8)	4675 (6.8)	5417 (15.9)
Tasmania	2598 (2.5)	1854 (2.7)	744 (2.2)
Australian Capital Territory	1679 (1.6)	877 (1.3)	802 (2.4)
Northern Territory	630 (0.6)	392 (0.6)	238 (0.7)
SEIFA RSAD quintile‡			
1 (least advantaged)	19 027 (18.3)	13 172 (19.0)	5855 (16.9)
2	18 678 (18.0)	12 478 (18.0)	6200 (17.9)
3	19 048 (18.4)	12 527 (18.1)	6521 (18.9)
4	18 705 (18.0)	12 444 (18.0)	6261 (18.1)
5 (most advantaged)	25 426 (24.5)	16 563 (24.0)	8863 (25.6)
Remoteness‡, n (%)			
Major cities	63 336 (61.7)	42 031 (61.3)	21 305 (62.7)
Inner regional	22 808 (22.2)	15 349 (22.4)	7459 (21.9)
Outer regional	11 848 (11.5)	8010 (11.7)	3838 (11.3)
Remote/very remote	1784 (1.7)	1266 (1.8)	518 (1.5)
Deceased during HCP episode, n (%)	5766 (5.6)	2936 (4.3)	2830 (8.3)
Number of medications*, median (IQR)	9 (6–13)	9 (6–13)	9 (6–13)
Number of health conditions, median (IQR)	5 (3–7)	5 (3–7)	5 (3–7)
Specific chronic conditions†, N (%)			
History of cancer	16 430 (16.0)	10 779 (15.7)	5651 (16.6)
Pain	33 303 (32.5)	21 651 (31.6)	11 652 (34.3)
Chronic respiratory disease	25 137 (24.5)	17 051 (24.9)	8086 (23.8)
Congestive heart failure	20 059 (19.6)	13 143 (19.2)	6916 (20.3)
Dementia	20 102 (19.6)	10 803 (15.7)	9299 (27.4)
Depression	38 461 (37.5)	24 602 (35.9)	13 859 (40.8)
Diabetes	21 137 (20.6)	13 838 (20.2)	7299 (21.5)
IHD/hypertension	44 720 (43.6)	30 930 (45.1)	13 790 (40.6)
Osteoporosis	19 506 (19.0)	13 221 (19.3)	6285 (18.5)

*Number medications determined in the 6 months prior.
†Chronic conditions ascertained from Rx-Risk-V comorbidity index in 6 months prior to HCP episode apart from dementia and cancer that used Rx-Risk-V and ACAP.
‡Missing data from state variable: n=1916 (1.9%), SEIFA RSAD: n=2865 (2.8%) and remoteness: n=2814 (2.7%).
HCP, home care package; IHD, ischaemic heart disease; NSW, New South Wales; QLD, Queensland; RSAD, relative socioeconomic advantage and disadvantage; SA, South Australia; SEIFA, socioeconomic indexes for area.

3–4 HCP, despite having more complex care needs and increased potential for suboptimal medication-related care and service utilisation. Hospitalisation-related indicators were also common: a quarter of HCP recipients had an ED presentation within 30 days of discharge, 1 in 10 had a fall resulting in hospitalisation and for those with dementia, another 1 in 10 had a dementia/delirium-related. The medication-related indicators such

Table 3 Overall prevalence and 95% CIs of ROSA home care quality and safety indicators, 2016

Indicator	Cohort captured	Total HCP episodes included (N)	Total HCP episodes with outcome (N)	Total HCP estimate % (95% CI)	Level 1–2 HCP estimate % (95% CI)	Level 3–4 HCP estimate % (95% CI)
1. High sedative load (overall)	National	102 590	29 840	29.1 (28.8 to 29.4)	28.3 (28.0 to 28.7)	30.6 (30.1 to 31.1)
With dementia	National	20 102	4222	21.0 (20.4 to 21.6)	19.5 (18.8 to 20.3)	22.7 (21.9 to 23.6)
Without dementia	National	82 488	25 618	31.1 (30.7 to 31.4)	30.0 (29.6 to 30.4)	33.6 (33.0 to 34.2)
2. Antipsychotic use (overall)	National	101 715	8279	8.1 (8.0 to 8.3)	6.8 (6.6 to 7.0)	10.9 (10.6 to 11.2)
With dementia	National	19 936	3852	19.3 (18.8 to 19.9)	17.1 (16.4 to 17.8)	22.0 (21.1 to 22.8)
Without dementia	National	81 779	4427	5.4 (5.3 to 5.6)	4.9 (4.7 to 5.0)	6.7 (6.4 to 7.0)
3. Chronic opioid use	National	86 160	11 835	13.7 (13.5 to 14.0)	12.2 (12.0 to 12.5)	16.8 (16.4 to 17.3)
4. Antibiotic use	National	102 590	53 711	52.4 (52.0 to 52.7)	51.2 (50.8 to 51.6)	54.7 (54.2 to 55.3)
5. Premature mortality	National	102 590	237	0.2 (0.2 to 0.3)	0.2 (0.2 to 0.2)	0.3 (0.3 to 0.4)
6. Falls	State*	85 675	10 060	11.7 (11.5 to 12.0)	11.2 (10.9 to 11.4)	13.0 (12.6 to 13.5)
7. Fractures	State*	85 675	4509	5.3 (5.1 to 5.4)	5.1 (4.9 to 5.3)	5.6 (5.4 to 5.9)
8. Medication-related adverse events	State*	85 675	2305	2.7 (2.6 to 2.8)	2.6 (2.5 to 2.8)	2.8 (2.6 to 3.1)
9. Weight loss or malnutrition	State*	71 611	3528	4.9 (4.8 to 5.1)	4.7 (4.5 to 4.8)	5.5 (5.2 to 5.9)
10. Delirium and/or dementia hospitalisations	State*	16 524	1604	9.7 (9.3 to 10.2)	8.4 (7.8 to 9.0)	11.4 (10.7 to 12.2)
11. ED Presentation	State*	31 845	8402	26.4 (25.9 to 26.9)	25.5 (24.9 to 26.1)	28.2 (27.3 to 29.1)
12. Pressure injury	State*	85 675	3388	4.0 (3.8 to 4.1)	2.9 (2.8 to 3.1)	6.3 (6.0 to 6.6)
13. Chronic disease management plan	National	96 837	36 919	38.1 (37.8 to 38.4)	40.8 (40.4 to 41.2)	32.7 (32.2 to 33.2)
14. Home medicines review	National	96 837	2886	3.0 (2.9 to 3.1)	3.1 (3.0 to 3.3)	2.6 (2.5 to 2.8)
15. Wait-time (median days)†	National	23 732	–	134 (41 to 406)	133 (41 to 411)	136 (42 to 394)
% Wait-time >90 days	National	23 732	16 042	67.6 (67.0 to 68.2)	67.6 (67.0 to 68.2)	67.7 (66.5 to 68.9)

*States included: SA, NSW, VIC and QLD. A total of 332 SA3 level regions included in the study nationally and 266 SA3 level regions for the state-based hospitalisation indicators.
†Wait-time from aged care eligibility assessment approval to commencement of first HCP in study period, median days (IQR).
ED, emergency department; HCP, home care package; NSW, New South Wales; QLD, Queensland; ROSA, Registry of Senior Australians; SA3, Statistical Areas Level 3; SA, South Australia; VIC, Victoria.

as opioids and sedatives may contribute also to these hospitalisations, and many are likely to be considered to be potentially preventable, in part, through improved clinical care and coordination.[19 20] This can be supported by HCP providers through increased awareness, proactive prevention and quality improvement programmes that improve coordination with primary care.

While routine monitoring and reporting of home care service quality is currently done in many countries including Canada,[14] USA,[15] Sweden[16] and the Netherlands,[12] there is no quality indicator reporting for HCP in Australia. These quality indicator systems are similarly, based on evidence and expert consensus, and many include transparent public reporting. These have been shown to facilitate the identification of home care recipients care needs, progression of needs over time and monitoring the provision of high quality of care. They can inform providers' quality improvement initiatives and provide benchmarking and reporting against other care providers. A recent Canadian study reported the use of quality indicator data to guide patient safety and quality improvement initiatives, specifically in the areas of antipsychotic use, management of pain and falls mitigation strategies.[21]

The Australian Government has pledged to introduce quality indicators for home care by the end of 2022 but is likely to include a minimal number of indicators similar to the current residential aged care National Mandatory Quality Indicator Program.[22 23] Use of administrative claims data as included in the current study provides data sources to support a timely, comprehensive and flexible quality indicator monitoring strategy that can be integrated into care delivery planning with minimal additional data collection burden.[24] There is increasing utilisation of administrative claims data by countries including the USA and Canada for key outcomes such as hospitalisation and ED presentations.[14 15] Importantly as in the current developed system, administrative claims data provide the ability to risk-adjust for HCP recipient characteristics, thereby providing the opportunity for benchmarking and meaningful comparisons between home care providers and client populations to provide valuable insight into variation and quality of care.

It needs to be acknowledged that assessment of quality and safety of HCP provision is complex due to the heterogeneity of the HCP population, which includes individuals with basic care and social needs, through to complex, high-dependency medical care needs. There are multidimensional factors that can influence measurement of quality of care, including the natural trajectories of declining health, cognition and functioning associated with ageing and chronic disease. Given the wide range

Table 4 Geographical regions (SA3) with HCP indicators above* or below† 95% CI

Indicators	Number of SA3s outside 95% CI	SA3s included (≥20), N	%
High sedative load*	33	322	10.2
With dementia	14	256	5.5
Without dementia	29	320	9.1
Antipsychotic use*	5	323	1.5
With dementia	2	267	0.8
Without dementia	8	321	2.5
Chronic opioid use*	43	323	13.3
Antibiotic use*	33	323	10.2
Premature mortality*	15	323	4.6
Falls*	16	262	6.1
Fractures*	11	262	4.2
Medication-related adverse events*	13	262	5.0
Weight loss or malnutrition*	30	262	11.5
Delirium and/or dementia hospitalisations*	15	228	6.6
ED presentation*	30	251	12.0
Pressure injury*	17	262	6.5
Chronic disease management plan†	67	323	20.7
Home medicines review†	35	323	10.8
Wait-time >90 days*	30	279	10.7

A total of n=332 SA3 level regions included in the study nationally and n=266 SA3 level regions for the state-based hospitalisation indicators.
*Number of SA3s above 95% CI.
†Number of SA3s below 95% CI.
ED, emergency department; HCP, home care package; SA3, Statistical Areas Level 3.

of services including both social and healthcare needs that HCP providers offer, attribution of specific services to these outcome measures may not be appropriate due to inability to influence utilisation of care processes and outcomes. Internationally, there is little recognition of this connection between specific services provided by home care providers with quality indicators. The USA, however, acknowledge that their home care quality indicators were developed specifically for use in assessing Medicare-certified home health agencies that focus on the provision of skilled care services (nursing and other health professional services) and as such, are largely outcome oriented.[25] This lack of discrimination between types of home care services provided and implementation of home care quality indicators may, in part, be attributable to some of the identified barriers to optimal utilisation internationally.[21]

Comprehensive chronic disease management plans, access to medication reviews and timeliness of service provision (wait-time) were identified by the Royal Commission's Final Report as key areas of focus needed to improve quality of care for home care recipients.[4] Chronic disease management plans have been shown to reduce the risk of hospitalisation[26] and, together with a health assessment, reduce the risk of mortality in older people receiving HCP.[27] Despite high levels of multimorbidity (multiple chronic conditions) and polypharmacy (defined as ≥5 medications), only 3% of HCP recipients received a medicines review, which has the potential to reduce medication-related harms and resolve medicines-related problems.[28] Prolonged wait times for HCP in Australia has been shown to be associated with an increased risk of mortality and transition to permanent residential aged care.[29] While not attributable directly to a home care service provider, it is reflective of the overall aged care system prioritisation and monitoring of unmet need.

The developed HCP quality monitoring system provides a comprehensive basis to examine access to care processes, outcomes and variation in Australia. However, there may be under-reporting of some indicators, namely those using hospitalisation records where only more severe cases are likely to have caused or be recorded during a hospitalisation. Importantly, these indicators provide an understanding of geographical variation and valuable information for quality improvement for the sector. Seven indicators were examined using data from four states of Australia due to data access restrictions; however, these account for 86% of hospitalisations for aged care recipients in Australia. Geographical variation did not include SA3 areas where the number of individuals was <20 and therefore deemed too small to examine. Methods to account for this type of uncertainty (low numbers) are needed for this type of reporting. Variation because of HCP provider characteristics (eg, staffing levels and models of care) or individual differences that are not captured in our models may still exist.[17] We were unable to examine quality of life or consumer experience as these measures (or suitable surrogates) are not available in the datasets employed. Collection of these data at the population level nationally is imperative to provide a holistic overview of care quality and satisfaction that requires investment.

CONCLUSIONS

The use of quality indicators to assess quality of HCP services provides an opportunity to guide quality improvement initiatives thus improving the safety and quality of home care services and ideally health outcomes for the older population. These developed quality indicators for HCP recipients in Australia reflect the complexities and heterogeneity of the HCP client profiles to provide a meaningful, appropriate and comprehensive quality indicator monitoring system to support effective monitoring of the quality of home care provision for Australia's older population.

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Contributors All coauthors fulfil the criteria required for authorship. The following authors made substantial contributions to study conception and design: GEC, CEL and MCI. Overall development of research plan: SCEB, JKS, CW, RV, KE, MC, VC, ALB and SW. Acquisition of data: MCI, CEL, SCEB, CW, RV and SW. Analysis and interpretation of data: all authors. Manuscript was drafted by GEC and MCI, and it was critically revised with inputs from CEL, SCEB, JKS, CW, RV, KE, MC, VC, AB and SW. All have approved the submitted version of the manuscript. GEC is the study guarantor and accepts full responsibility for the finished work and/or the conduct of the study, had access to the data, and controlled the decision to publish.

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Competing interests GEC is a board member of Life Care Inc, a not-for-profit organisation providing residential and community based aged care services. JKS is a pharmacist who is accredited to provide Home Medicines Reviews (HMRs). JKS, MCI and GEC report previous grant funding from the Australian Association of Consultant Pharmacy, an organisation that accredits pharmacists to provide HMRs in Australia. CW is a board member of the not-for-profit aged care organisation Helping Hand. RV is a board member of Resthaven Inc, a not-for-profit aged care organisation providing community aged care services. She is also a current member of the Assessment Working Group to the Department of Health funded project 'Options for the assessment, classification and funding model for the unified aged care at home program'. KE is a Strategic Advisor to Life Care Inc and a member of their Risk Management Committee.

Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Patient consent for publication Not applicable.

Ethics approval This study was approved by the University of South Australia's Human Ethics Committee (200487), the Australian Institute for Health and Welfare Ethics Committee (EO2018/1/418), the South Australian Department for Health & Wellbeing Human Research Ethics Committee (HREC/18/SAH/90) and the New South Wales Population Health Services Research Ethics Committee (2019/ETH12028).

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Appendix 1.

Figure A1 Sedative load, Overall

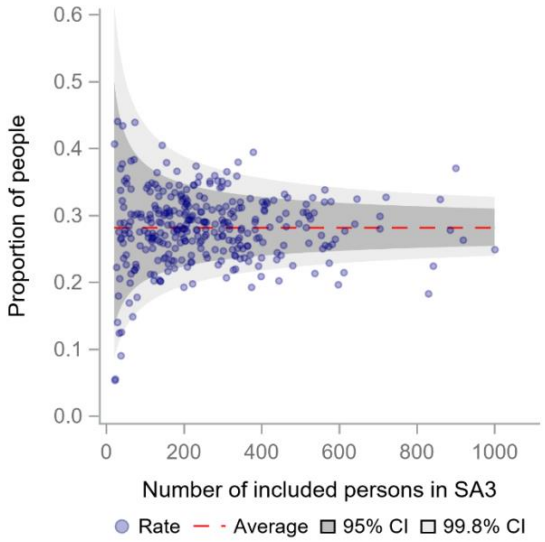

Figure A2 Sedative load, Level 1-2 HCP

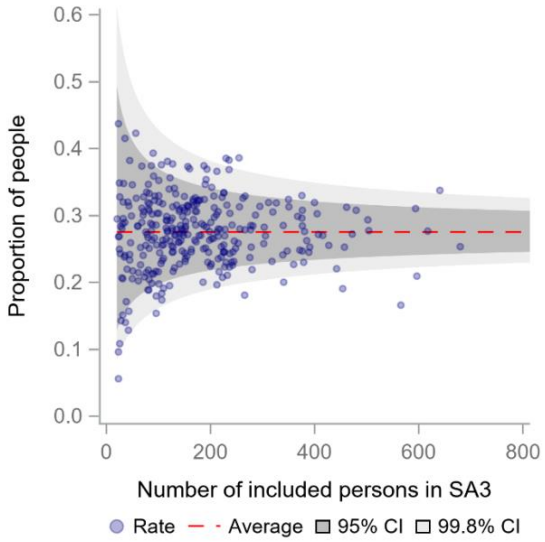

Figure A3 Sedative load, Level 3-4 HCP

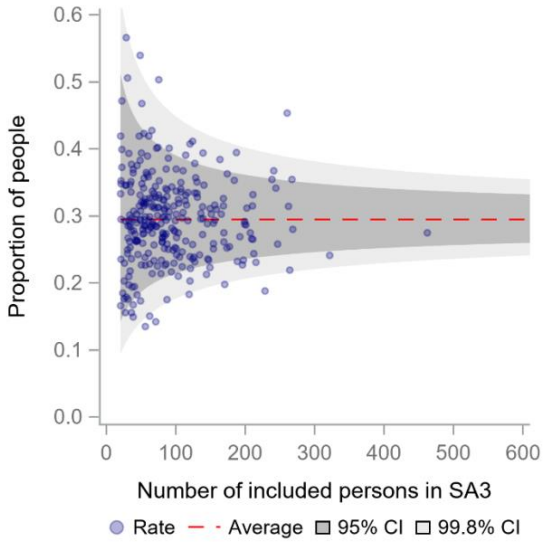

Figure A4 Antipsychotics, Overall

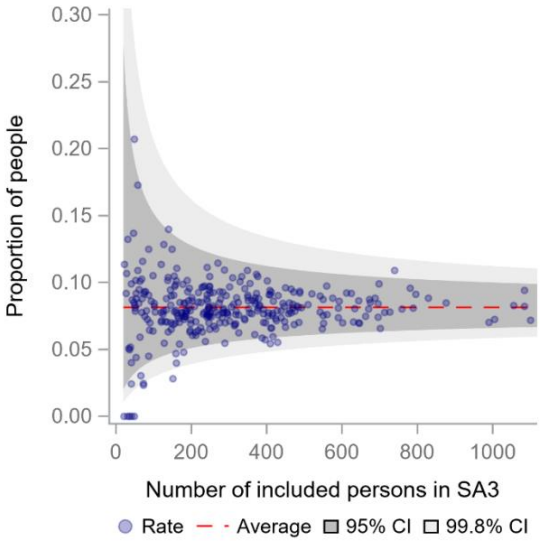

Figure A5 Antipsychotics, Level 1-2 HCP

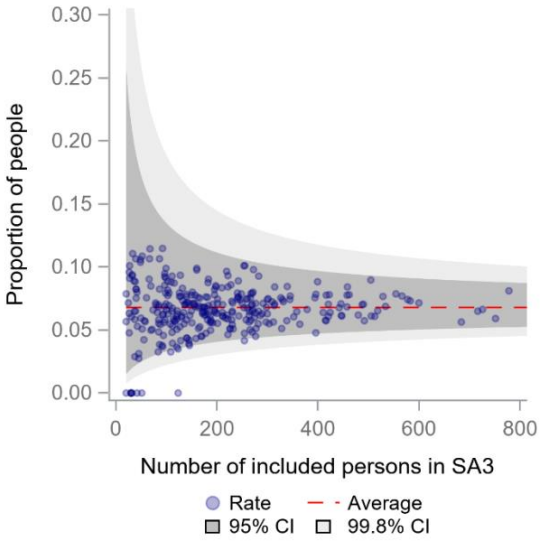

Figure A6 Antipsychotics, Level 3-4 HCP

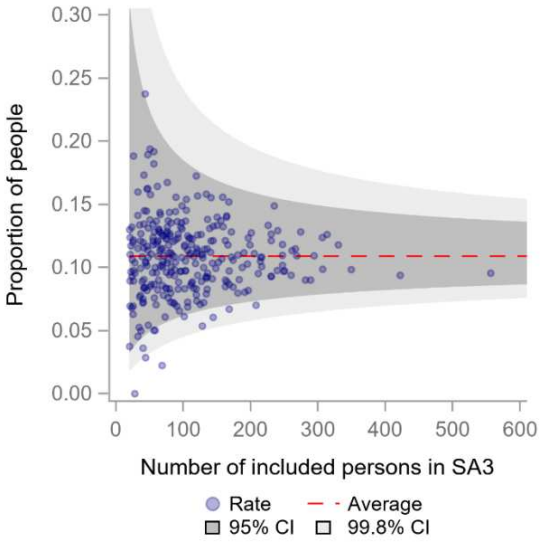

Figure A7 Chronic Opioid use, Overall

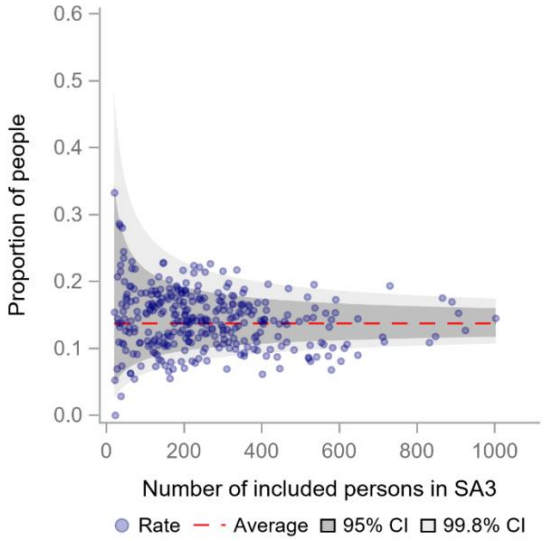

Figure A8 Chronic Opioid use, Level 1-2 HCP

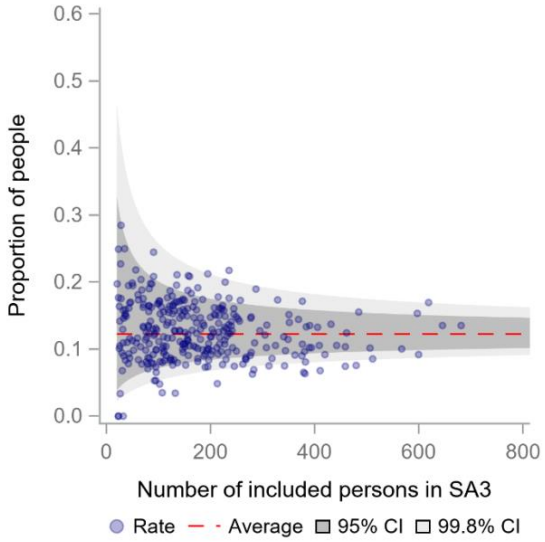

Figure A9 Chronic Opioid use, Level 3-4 HCP

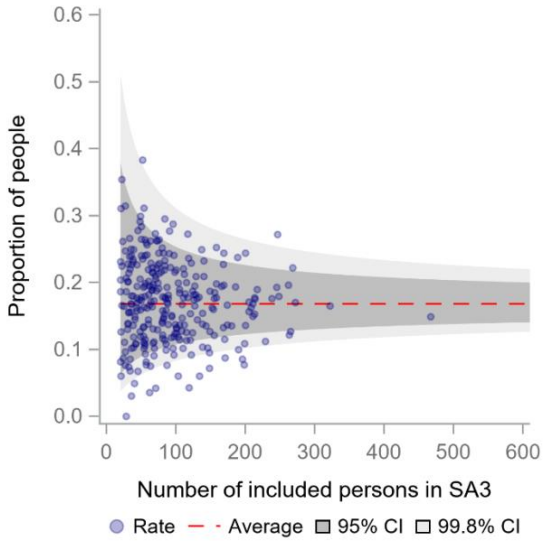

Figure A10 Antimicrobial use, Overall

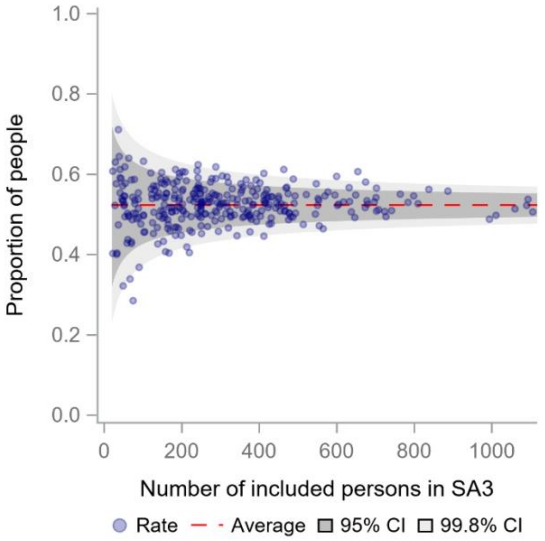

Figure A11 Antimicrobial use, Level 1-2 HCP

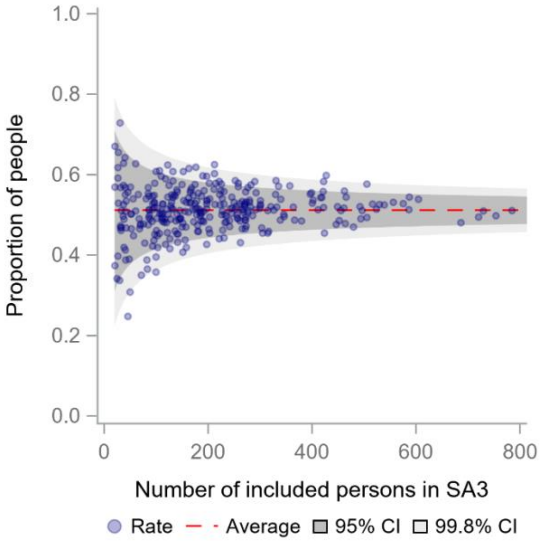

Figure A12 Antimicrobial use, Level 3-4 HCP

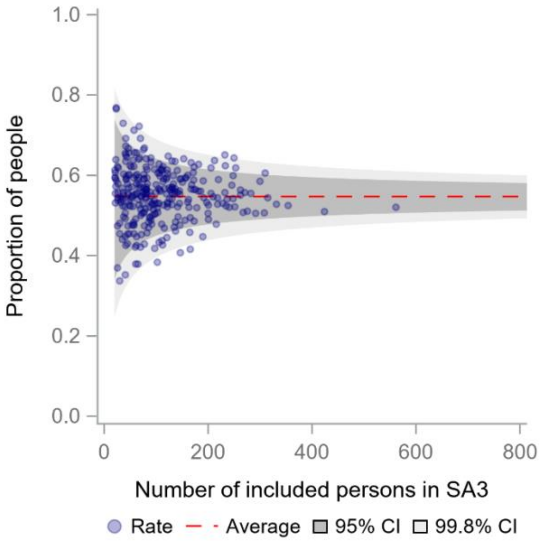

Figure A13 Premature Mortality, Overall

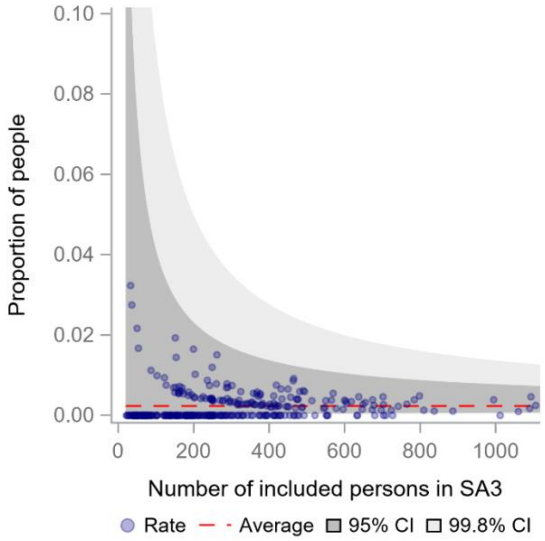

Figure A14 Premature Mortality, Level 1-2 HCP

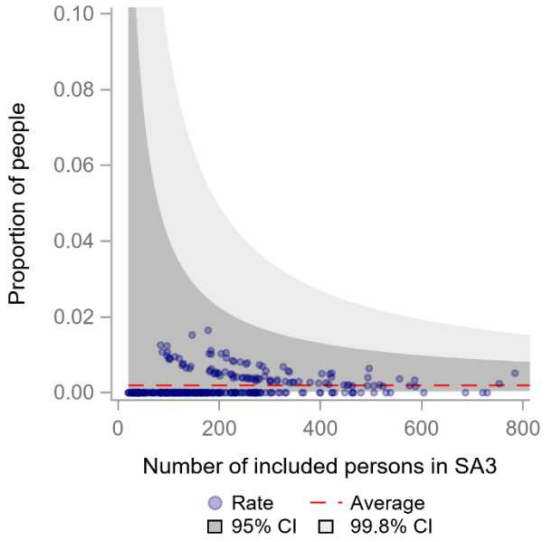

Figure A15 Premature Mortality, Level 3-4 HCP

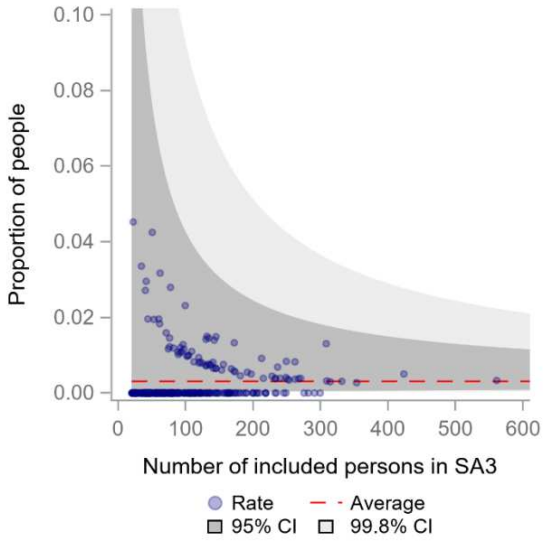

Figure A16 Falls, Overall

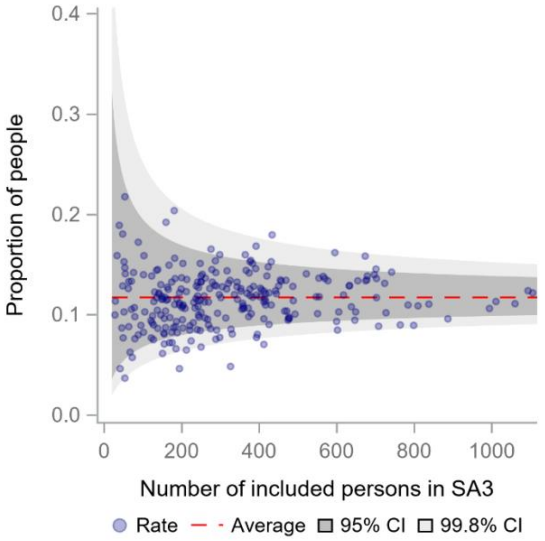

Figure A17 Falls, Level 1-2 HCP

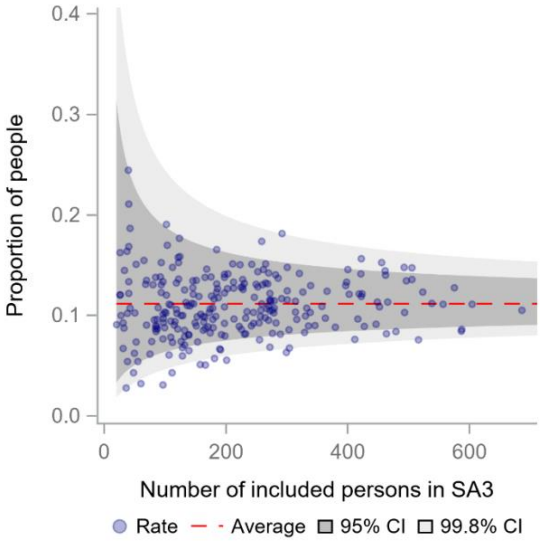

Figure A18 Falls, Level 3-4 HCP

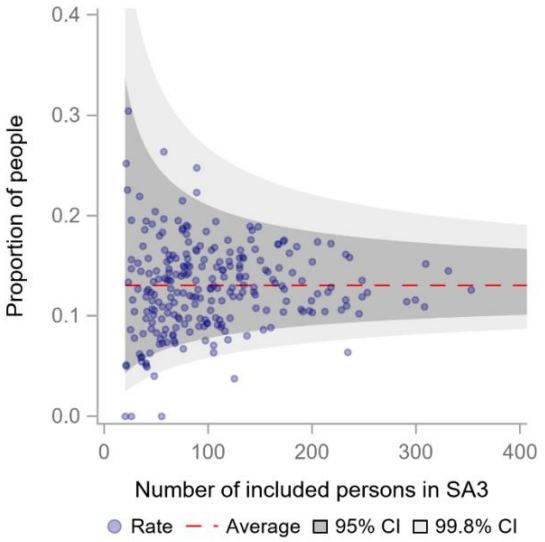

Figure A19 Fractures, Overall

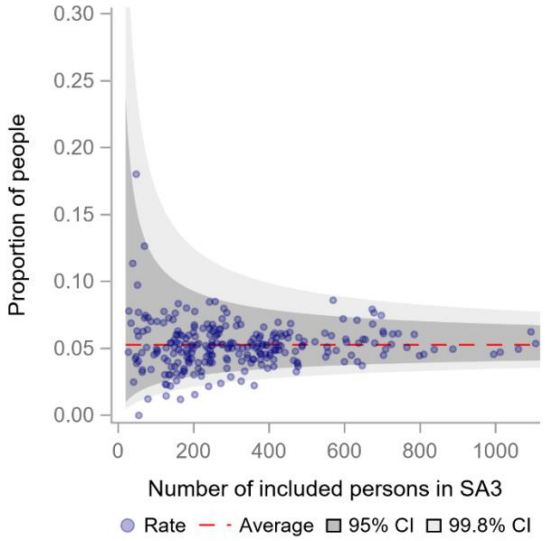

Figure A20 Fractures, Level 1-2 HCP

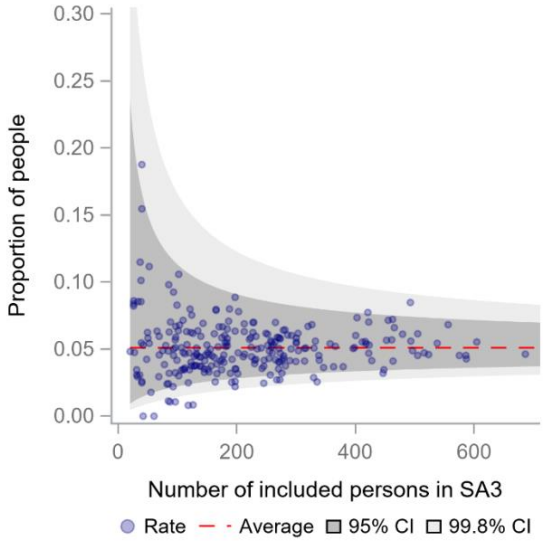

Figure A21 Fractures, Level 3-4 HCP

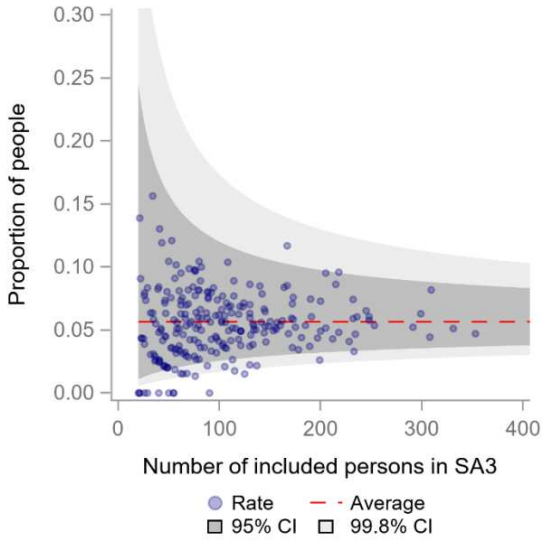

Figure A22 Medication-related adverse events, Overall

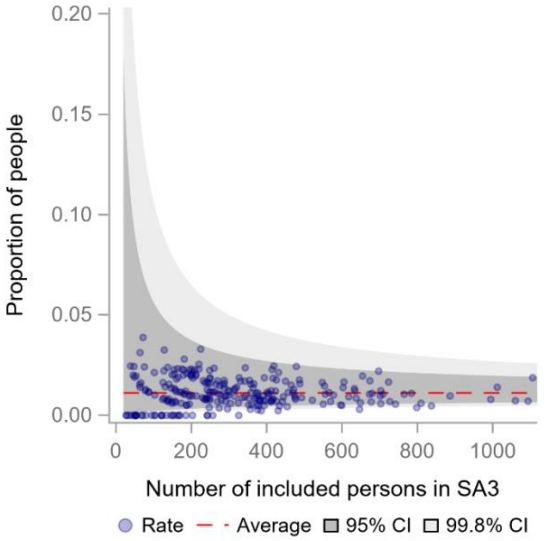

Figure A23 Medication-related adverse events, Level 1-2 HCP

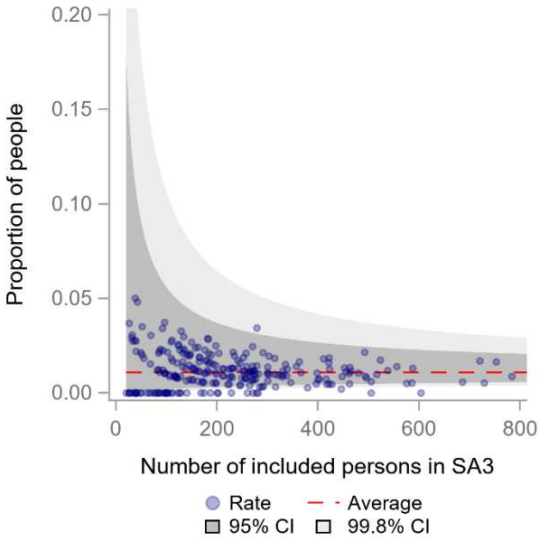

Figure A24 Medication-related adverse events Level 3-4 HCP

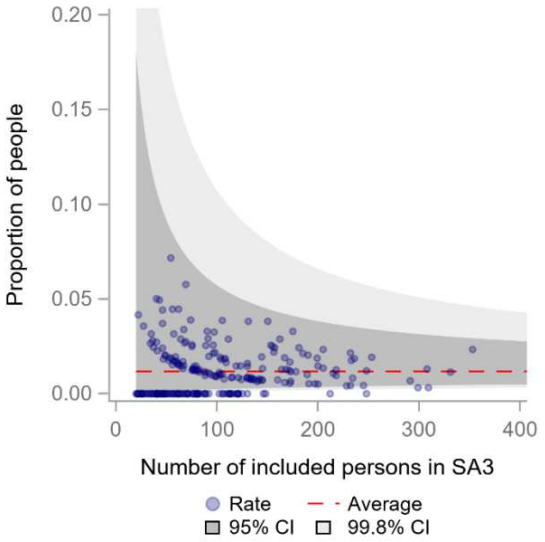

Figure A25 Malnutrition and weight loss, Overall

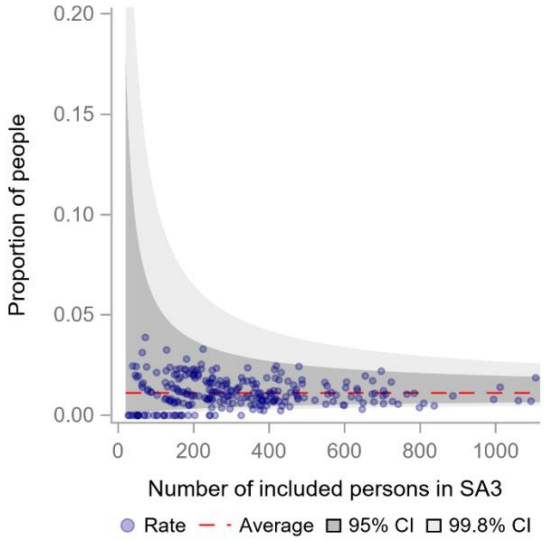

Figure A26 Malnutrition and weight loss, Level 1-2 HCP

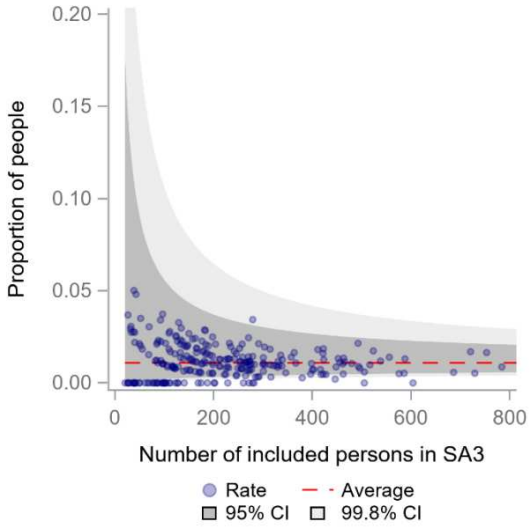

Figure A27 Malnutrition and weight loss, Level 3-4 HCP

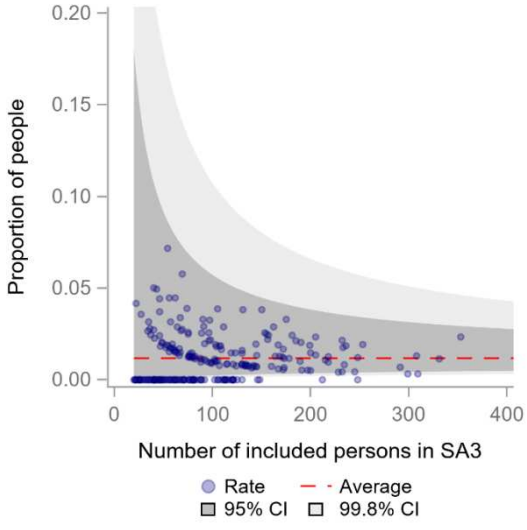

Figure A28 Dementia Hospitalisations, Overall

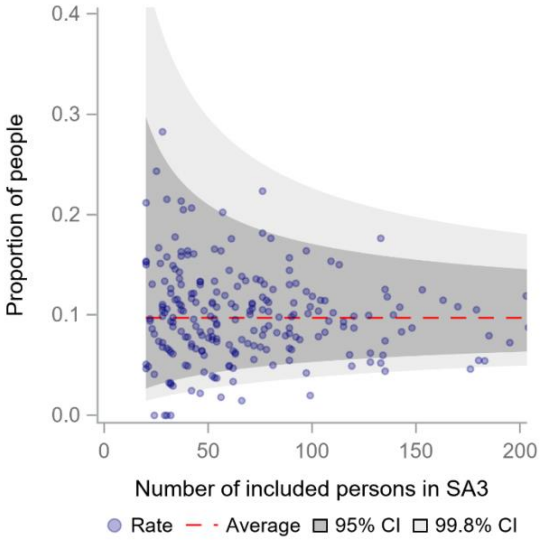

Figure A29 Dementia Hospitalisations, Level 1-2 HCP

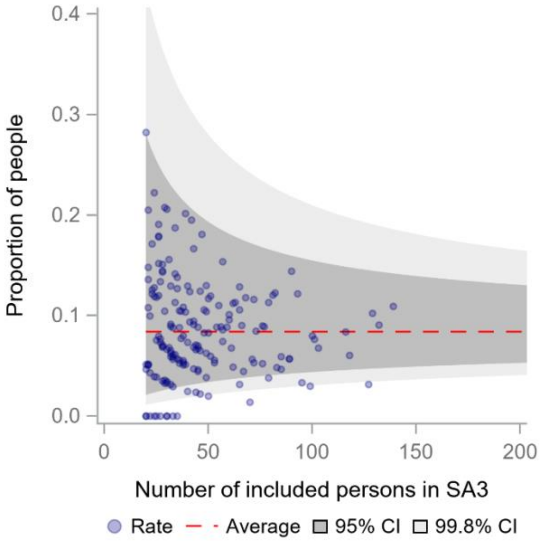

Figure A30 Dementia Hospitalisations, Level 3-4 HCP

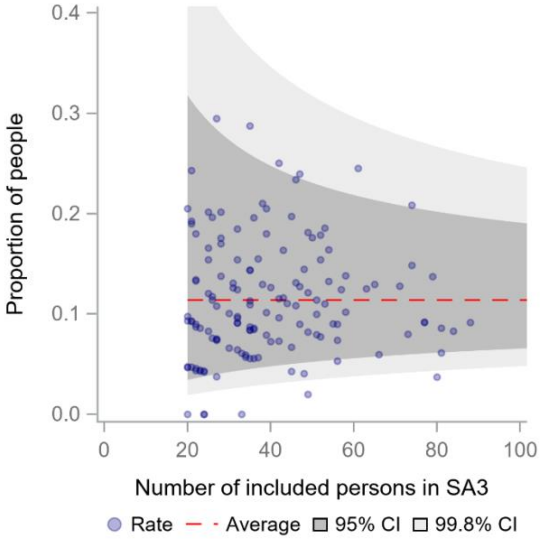

Figure A31 Emergency department presentations within 30 days of hospital discharge, Overall

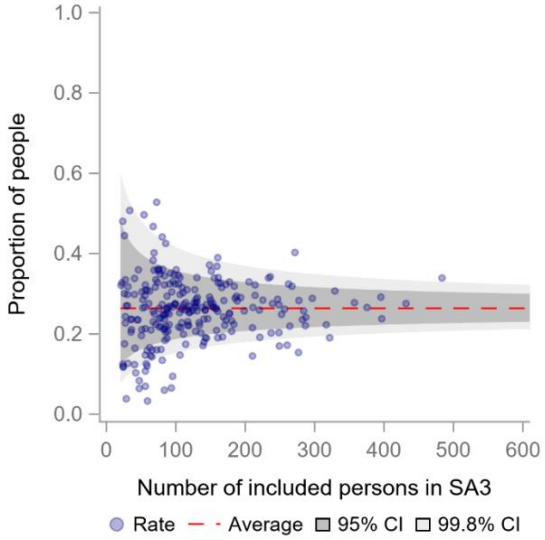

Figure A32 Emergency department presentations within 30 days of hospital discharge, Level 1-2 HCP

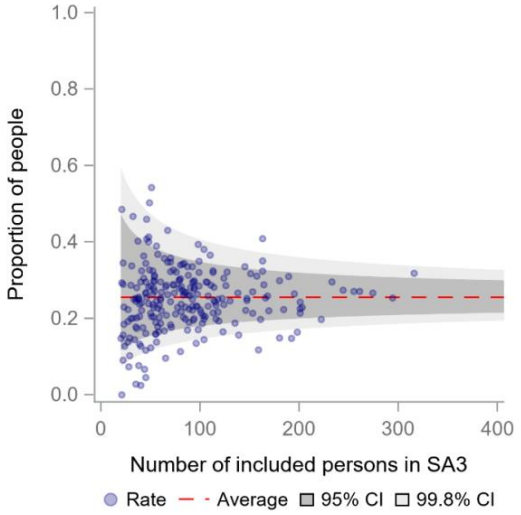

Figure A33 Emergency department presentations within 30 days of hospital discharge, Level 3-4 HCP

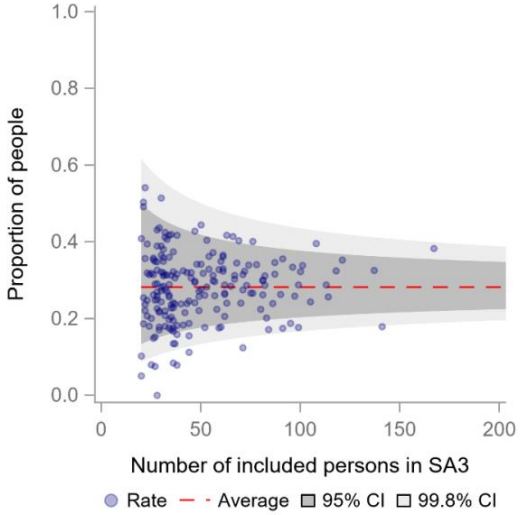

Figure A34 Pressure injury, Overall

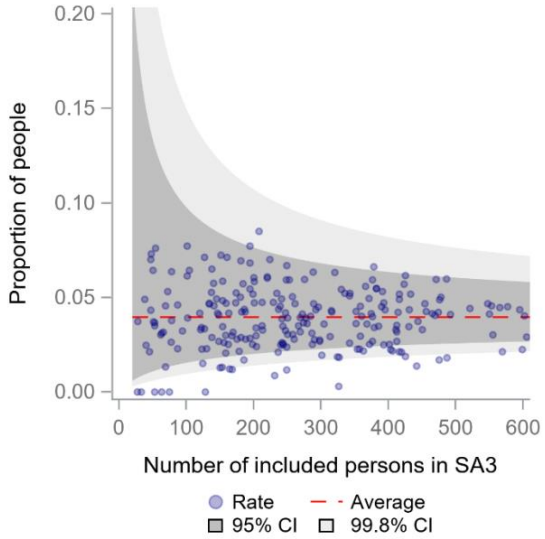

Figure A35 Pressure injury, Level 1-2 HCP

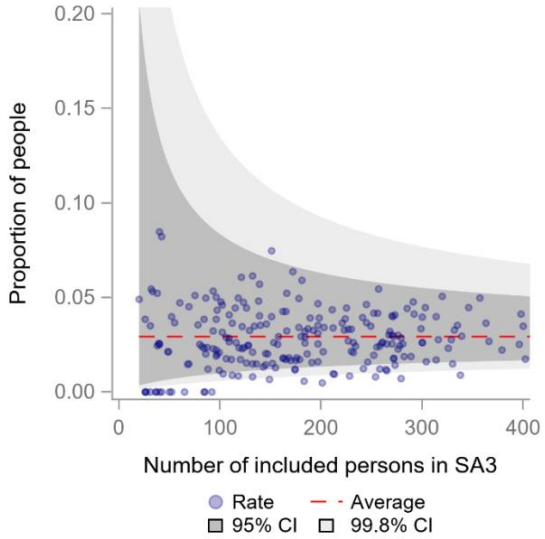

Figure A36 Pressure injury, Level 3-4 HCP

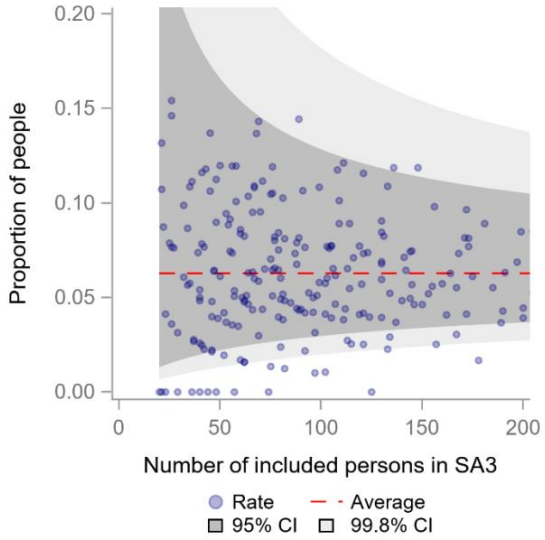

Figure A37 Chronic Disease Management Plan, Overall

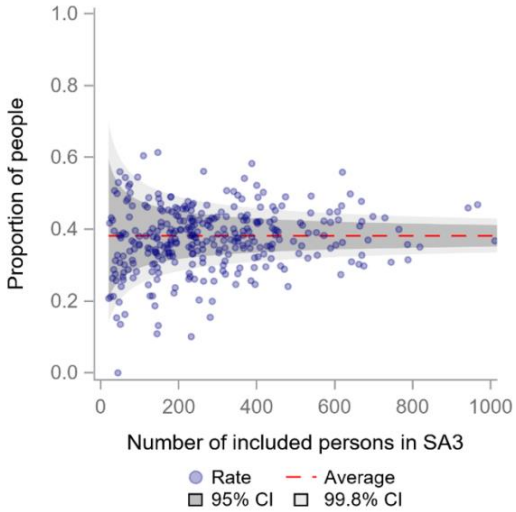

Figure A38 Chronic Disease Management Plan, Level 1-2 HCP

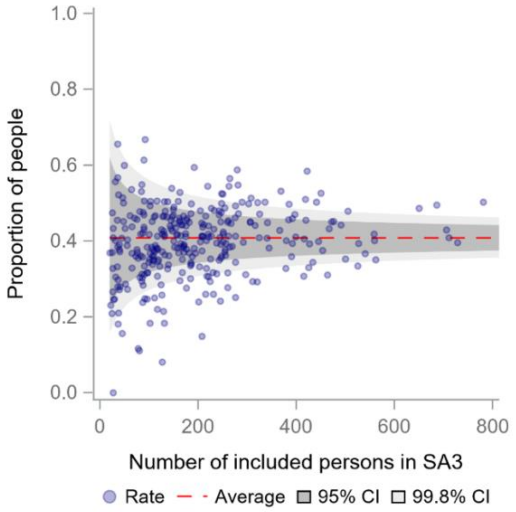

Figure A39 Chronic Disease Management Plan, Level 3-4 HCP

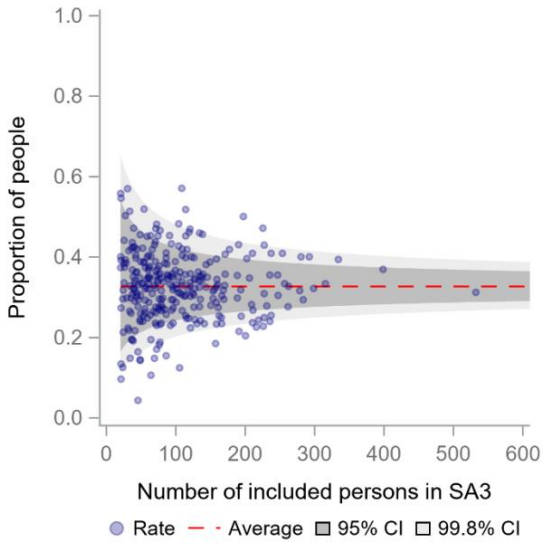

Figure A40 Home Medication Review, Overall

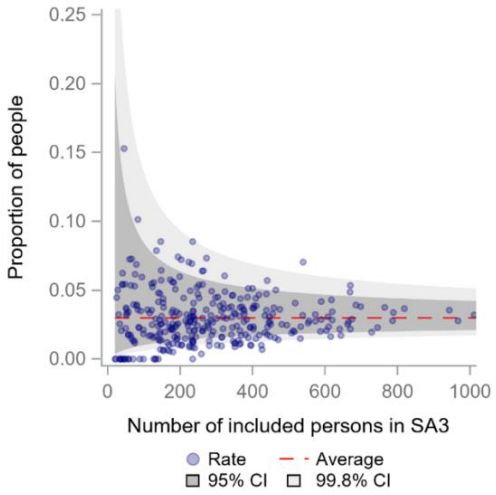

Figure A41 Home Medication Review, Level 1-2 HCP

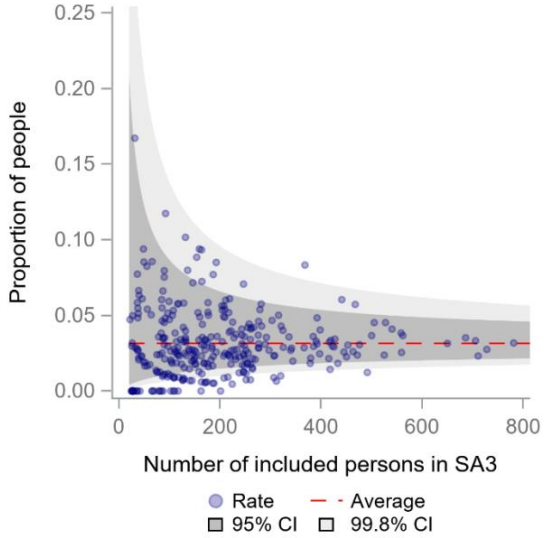

Figure A42 Home Medication Review, Level 3-4 HCP

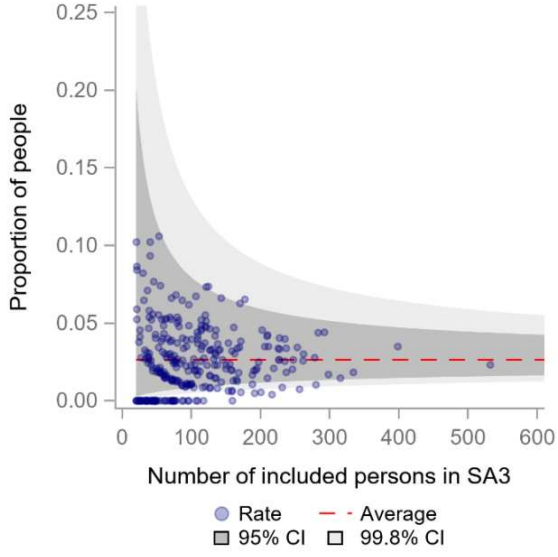

Figure A43 Wait time>90 days, Overall

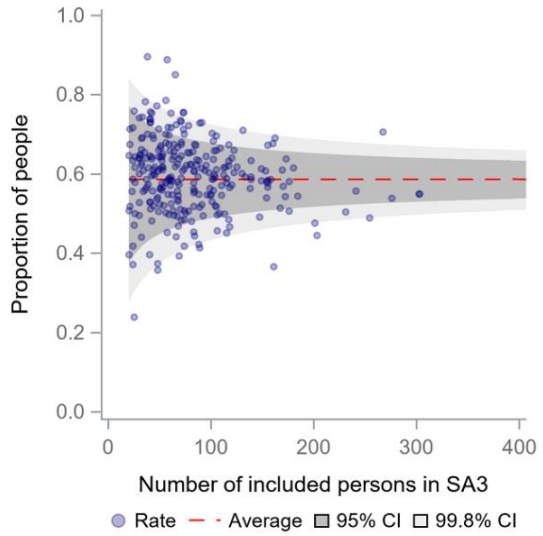

Figure A44 Wait time>90 days, Level 1-2 HCP

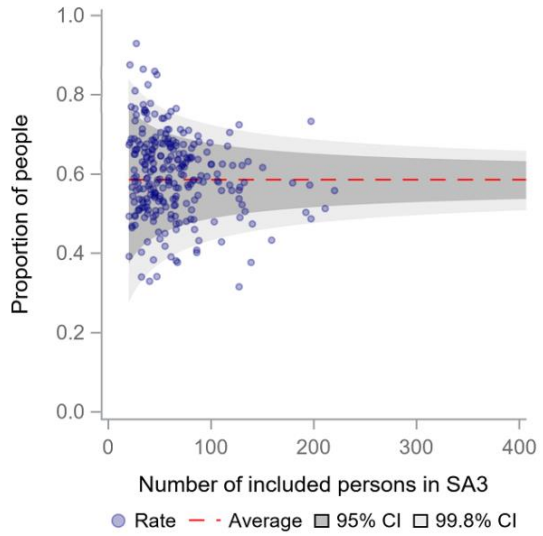

Figure A45 Wait time>90 days, Level 3-4 HCP