Incidence of adverse incidents in residential aged care

Bella St Clair [iD] [1,2] BSc, MAppMgt(Hlth), MBA, PhD Candidate

Mikaela Jorgensen [iD] [1] PhD, Adjunct Fellow

Andrew Georgiou [iD] [1] PhD, Professor

[1] Centre for Health Systems and Safety Research, Australian Institute of Health Innovation, Faculty of
 Medicine and Health Sciences, Macquarie University, Level 6, 75 Talavera Road, Sydney, NSW 2109,
 Australia. Email: mikaela.jorgensen@mq.edu.au, andrew.georgiou@mq.edu.au
[2] Corresponding author. Email: bella.stclair@students.mq.edu.au

Abstract.

Objective. Adverse incident research within residential aged care facilities (RACFs) is increasing and there is growing awareness of safety and quality issues. However, large-scale evidence identifying specific areas of need and at-risk residents is lacking. This study used routinely collected incident management system data to quantify the types and rates of adverse incidents experienced by residents of RACFs.

Methods. A concurrent mixed-methods design was used to examine 3 years of incident management report data from 72 RACFs in New South Wales and the Australian Capital Territory. Qualitative thematic analysis of free-text incident descriptions was undertaken to group adverse incidents into categories. The rates and types of adverse incidents based on these categories were calculated and then compared using incidence rate ratios (IRRs).

Results. Deidentified records of 11 987 permanent residents (aged ≥65 years; mean (±s.d.) age 84 ± 8 years) from the facilities were included. Of the 60 268 adverse incidents, falls were the most common event (36%), followed by behaviour-related events (33%), other impacts and injuries (22%) and medication errors (9%). The number of adverse incidents per resident ranged from 0 (42%) to 171, with a median of 2. Women (IRR 0.804; $P < 0.001$) and residents with low care needs (IRR 0.652; $P < 0.001$) were significantly less likely to adverse incidents compared with men and residents with high care needs respectively.

Conclusion. This study demonstrates that data already collected within electronic management systems can provide crucial baseline information about the risk levels that adverse incidents pose to older Australians living in RACFs.

What is known about the topic? To date, research into aged care adverse incidents has typically focused on single incident types in small studies involving mitigation strategies. Little has been published quantifying the multiple adverse incidents experienced by residents of aged care facilities or reporting organisation-wide rates of adverse incidents.
What does this paper add? This paper adds to the growing breadth of Australian aged care research by providing baseline information on the rates and types of adverse incidents in RACFs across a large and representative provider.
What are the implications for practitioners? This research demonstrates that the wealth of data captured by aged care facilities' incident management information systems can be used to provide insight into areas of commonly occurring adverse incidents. Better use of this information could greatly enhance strategic planning of quality improvement activities and the care provided to residents.

Introduction

Within Australia, reports of inadequate care, abuse and poor clinical outcomes in aged care have culminated in a Royal Commission.[1] The Royal Commission found communication, reporting and accountability within the aged care system to be inadequate.[1]

Failures of care, such as using restrictive practices to manage behaviour, inadequate knowledge and training of staff and, more recently, infections and deaths from the COVID-19 pandemic, have highlighted systemic failures within the aged care system.[1–3]

Governance, adverse events and residential aged care

Since 1948, the World Health Organization has defined 'health' as not only the absence of disease, but also as an intersection of 'physical, mental and social well being'.[4] Using this principle, adverse incidents can be viewed as any incident or event that affects the health of an individual.[5]

Within the residential aged care system, documentation and understanding of the way adverse incidents affect the lives of aged care residents is expanding. To date, adverse incident

research within the residential aged care facility (RACF) setting has focused on single types of events, such as falls,[6,7] medication management issues,[8] pressure injuries[9,10] and mitigation strategies and interventions.[11,12] Little has been developed examining the rate of occurrence, demographics and trends of adverse incidents across organisations as a whole or clients across multiple events. Examinations of a single type event can lead to a focus on the minutiae while missing the broader context. Adding these single stories together can form a broader understanding of the RACF environment as experienced by individuals over time. This should include the interactions of the clinical, environmental, mental and social factors that provide good quality of life.[13]

Good governance requires organisations to manage risk and safety, and to be transparent and accountable while balancing the rights and dignity of residents.[14] Using existing data to understand who experiences adverse incidents and how frequently may provide organisations with information that can help ensure that reporting, accountability and transparency in care are maintained. Adding this information to a wider range of measures can help form a broader perspective of the lived experience of residents.[15] Understanding trends in adverse incident events is key to promoting the development of care models that target safety and manage risks while respecting the dignity of the older population.[14]

Adverse incident reporting

Providers of aged care services within Australia have responsibility under *Aged Care Act 1997* (Cth) to record and report allegations or suspicion of unlawful sexual contact with a resident, unreasonable use of force on a resident and whether a resident is absent without explanation. More recently, the Serious Incident Response Scheme (SIRS) has been introduced to expand on the reporting of incidents of neglect and abuse.[16]

In July 2019, Australia introduced a mandatory indicator reporting system, the Australian National Aged Care Mandatory Quality Indicator program. This system requires quarterly reporting of pressure injuries, the use of physical restraint and unplanned weight loss.[3]

Aged care organisations generally collect data on a broader range of adverse incidents than those that are mandatory. This information, collected and held within facilities, has the potential to be analysed and to provide transparent evaluation of the needs and safety of residents through understanding wider trends in adverse incidents across the services.

Information systems use in residential aged care

Several commercially available electronic management systems (EMS) are designed specifically for use in residential aged care settings. EMS allow for the capture of a broad range of information, such as resident demographics, health conditions and medication administration. These systems can also be used to record and monitor adverse incidents. Terminals available throughout facilities and at point-of-care areas provide staff with mechanisms to view resident information and make timely entries.[17]

The increasing use of organisation-wide, interlinked EMS within RACF provides opportunities to understand quality and safety and to identify at-risk groups by linking demographic, clinical care and health outcomes information.[18,19]

The aim of this study was to quantify the types and rates of adverse incidents experienced by aged care facility residents at a large Australian residential aged care provider by examining routinely collected electronic management data across a 3-year period.

Methods

Mixed-method design

The study used a mixed-method concurrent embedded design.[20] Free-text descriptions of incidents within the dataset were examined using a deductive qualitative approach.[21] Categorisation of incident groupings based on the instigating cause was undertaken using inductive analysis. The emergent categories were then used to quantify the rates and types of adverse incidents experienced by residents.

Data source

This study was undertaken with a large non-profit Australian provider who offers a range of aged care services, including residential care, across metropolitan and inner and outer regional areas of New South Wales (NSW) and the Australian Capital Territory (ACT). Deidentified data were extracted from the provider's EMS. Information relating to adverse incidents (incidents) was sourced from Cintellate (SAI Global, Chicago, Illinois, USA), an environment, health and safety software package. Demographic information was retrieved from iCareHealth (Telstra Health, Victoria, Australia), a clinical information and care management software package.

Study population

The study population included permanent residents of the providers' facilities across NSW and the ACT during the period 1 November 2013–31 October 2016. People receiving home and community care or respite care, those in independent living units, people aged <65 years and those where insufficient gender identification information was available were excluded (see Appendix 1).

Sociodemographic and care needs data

Sociodemographic and care needs data included age, gender, marital status, country of birth and care level. Within the extracted data, gender was described in binary terms (female and male). Due to the limited numbers of people with missing gender data, and to ensure that insufficient gender identification information was not reflective of a resident preferring a gender identity other than male or female, residents with missing gender data were excluded from the analysis. For the purposes of this study, country of birth was categorised as Australian born and non-Australian born. Marital status was categorised using the organisation's definitions of single, married (registered and de facto), widowed, divorced, separated or unknown.

The Aged Care Funding Instrument (ACFI) classification was used as a measure of care needs. The ACFI is a resource allocation instrument based on the assessment of frequency of assistance with daily care needs.[22] It comprises two diagnostic sections (mental and behavioural and medical conditions) and a

series of 12 questions grouped into three domains: activities of daily living (ADL), cognition and behaviour and complex health care. Residents' scores for the three domains were used as a measure of care needs.

The provider classified residents' overall care needs using the terminology of 'high' and 'low' care. High-care residents were those who required 24-h support, whereas residents requiring low care were those needing assistance with ADL such as showering, dressing, meals and taking medication.[23]

Incident data

The organisation's classification system of adverse incident data included the date of the incident, a free-text event summary, outcome (near miss or injury), a free-text detailed description, injury classification (whether first aid or medical treatment was required), bodily location (if injury occurred), mechanisms (factors such as medication, falling or hitting objects that contributed to the event), agency (human, environmental, client) and potential outcome (whether the incident resulted in an injury). These incident status categories reflect the outcome information of each incident rather than its cause.

Qualitative analysis

Qualitative analysis was undertaken to develop a coding algorithm to categorise the cause of each incident based on the description in the free-text fields (summary and detailed description). To determine keywords identifying precipitating factors for the incident, 10% of incident entries ($n = 6664$) were examined. Keywords were thematically grouped to create adverse incident categories that were used to categorise all incidents. Four categories emerged: behaviour-related events; falls; medication-related incidents; and other impacts and injuries (Table 1).

Data cleaning

Monthly adverse incident data for each facility were examined for consistency of recording over time. Facilities with <12 months' data were excluded, as were facilities with more than 10 gaps of ≥2 weeks in recording any adverse incidents (four facilities excluded in total).

Incidents involving more than one resident were typically recorded in the system against each resident involved. Incidents involving more than one resident were retained where the event was recorded against individual resident records. Incidents that were not attributed to a resident or were attributed to staff were removed.

Medication audit results where multiple errors were found were recorded in the database against multiple resident files. A medication audit was counted as a single incident for calculations of the overall number of incidents. For calculations of individual resident incidents, each of the medication errors found in the audit was counted.

Quantitative analysis

Data cleaning and analysis were conducted using SAS version 9.4 (SAS Institute, Cary, NC, USA) and STATA Release 16 (StataCorp, College Station, TX, USA). The number of adverse incidents per person over the study period was summed and the mean, median and range values calculated. Length of stay (days of care) for each resident was calculated based on the study start and end date (for those residing in care across the entire period) or using the date of entry and exit from care (for those entering or leaving care during the study period).

The primary measure of incidence used was incidence density, which was the number of adverse incidents experienced by each resident per 1000 days of care. Using the denominator of days of care allows for easier comparison across different populations. Incidence rate ratios (IRRs) were calculated to compare the rate of adverse incidents by gender and care needs using Poisson regression, with clustering by facility accounted for in calculating standard errors.

Ethics approval

This research was approved by the Macquarie University Human Research Ethics Committee (Reference number 5201401031).

Results

Study demographics

Over the study period, 11 987 residents lived permanently in one of the aged care provider's 72 facilities included in this study. The mean (±s.d.) age of residents was 84 ± 8 years and 67% were women. Approximately two-thirds (68.2%) of the resident population was Australian born (Table 2), and over three-quarters (76.9%) of residents were classified as high care by the provider. More than half of all residents had high care needs across all three ACFI domains.

Comparisons against national aged care data[24] indicated the study population had a similar gender balance and care level of residents to the wider Australian population in residential aged care. Specifically, the proportion of women in present study was 66.9%, compared with 67.0% in the wider Australian RACF population,[24] and the proportion of men was 33.2% and 33.0%[24] respectively.

Number of incidents per resident

The median number of incidents per resident (Table 3) over the study period was 2 (with median values of 2 for women and 1 in

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Table 1.   Qualitative categories for incident coding

Category	Description
Behaviour	Incidents where the trigger related to verbal or physical abuse, absconding and resistance to undertake direction
Falls	Incidents involving an observed fall or trip; unobserved, but resident-confirmed falls were also classified as a fall
Medication	Missed medications, pharmacy medication errors and medication audit non-compliances
Impact and injuries	Any other event not covered by the behaviour, falls and medication categories where a resident sustained a physical injury, or their physical or mental well-being was affected

Table 2.   Sociodemographic characteristics and care needs of 11 987 aged care facility residents

Unless indicated otherwise, data are presented as *n* (%)

Total no. residents	11 987 (100)
Gender	
Women	8034 (67.0)
Men	3953 (33.0)
Country of birth	
Australian born	8172 (68.2)
Non-Australian born	3815 (31.8)
Marital status	
Single	994 (8.3)
Married (registered or de facto)	2940 (24.5)
Widowed	6286 (52.4)
Divorced	897 (7.5)
Separated	169 (1.4)
Unknown	701 (5.6)
Mean (± s.d.) age (years)	84 ± 8
Age group	
65–69 years	614 (5.1)
70–74 years	913 (7.6)
75–79 years	1631 (13.6)
80–84 years	2662 (22.2)
85–89 years	3239 (27.0)
90–94 years	2186 (18.2)
95–99 years	649 (5.4)
≥100 years	93 (0.78)
Level of care	
High	9212 (76.9)
Low	2775 (23.1)
ACFI ADL domain	
Level 0 (lowest care needs)	16 (0.13)
Level 1	1152 (9.6)
Level 2	2982 (24.9)
Level 3 (highest care needs)	6197 (51.7)
Unknown	1640 (13.7)
ACFI cognition and behaviour domain	
Level 0 (lowest care needs)	217 (1.8)
Level 1	1023 (8.5)
Level 2	2464 (20.6)
Level 3 (highest care needs)	6643 (55.4)
Unknown	1640 (13.7)
ACFI complex health care domain	
Level 0 (lowest care needs)	173 (1.4)
Level 1	1449 (12.1)
Level 2	2667 (22.2)
Level 3 (highest care needs)	6058 (50.5)
Unknown	1640 (13.7)

Table 3.   Descriptive statistics of adverse incidents per resident

	Total	Women	Men
Total no. residents	11 987	8034	3953
No. adverse incidents per resident			
Mean (s.d.)	5.2 ± 8.8	5.2 ± 8.4	5.2 ± 9.6
Maximum	171	171	111
Median	2	2	1
0	4763 (39.73)	3102 (38.61)	1661 (42.09)
1	1031 (8.6)	667 (8.3)	364 (9.21)
2	824 (6.87)	562 (6.99)	262 (6.63)
3	699 (5.83)	466 (5.8)	233 (5.89)
4	510 (4.59)	391 (4.87)	159 (4.02)
5	529 (4.41)	371 (4.62)	158 (3.99)
6	454 (3.79)	305 (3.8)	149 (3.77)
7	381 (3.18)	266 (3.31)	115 (2.91)
8	291 (2.43)	213 (2.65)	78 (1.97)
9	273 (2.28)	191 (2.38)	82 (2.07)
10	263 (2.19)	192 (2.39)	71 (1.8)
≥11	1929 (16.1)	1308 (16.28)	621 (15.71)

Types of adverse incidents

The qualitative thematic analysis allowed key themes to emerge into four categories: behaviour-related, falls, medication and impacts and injuries (Table 1).

Descriptive statistics for these categorisations revealed that falls were the most common adverse incident experienced by residents (36%), followed by events arising from a behaviour-related instigating factor (e.g. verbal and physical violence, absconding or defiance; 33%). Events causing an injury or impact on a resident (other than a fall) were the next highest category (22%), with medication errors being the least common (9%; Table 5). This pattern was seen across both care types (high and low) and gender. The two categories of falls and behaviour-related events accounted for nearly three-quarters of all adverse incidents recorded in residential care facilities.

Discussion

This study provides an examination of adverse incidents across 3 years of data from a large and representative Australian aged care provider. The study identified rates and types of incidents across four categories: behaviour-related, falls, medication and other impacts (which included injury and illness). Adding to the growing body of aged care research, this study provides key data on the overall burden of adverse incidents for residents in Australian aged care.

Direct comparison of the results of this study to those of other studies is difficult because previous research has traditionally concentrated on single types of adverse incidents in aged care. Although important for highlighting deleterious issues, this focus can ignore the range and number of events that contribute to each resident's care needs and quality of care outcomes.

Within the present study, falls accounted for the highest proportion of adverse incidents experienced by residents during their time in an RACF. There is an extensive body of literature on hospitalisations due to falls,[25] falls mortality and morbidity[26,27] and interventions to prevent falls.[12] The burden of falls

men). Forty-two per cent of residents had no recorded adverse incidents, but some residents experienced over 150 events during their stay. A total of 1929 residents (16.1%) each had more than 11 adverse incidents recorded.

Group differences in adverse incident rates

Female residents had a significantly lower rate of adverse incidents (Table 4) than men (IRR 0.804 vs 1 respectively; $P \leq$ 0.0001). In addition, the rate of adverse incidents was lower for residents in low care than in high care (IRR 0.662 vs 1 respectively; $P \leq$ 0.0001).

Table 4.   Rates of adverse incidents according to resident demographics and care needs
CI, confidence interval

	Incidence rate (no. per 1000 care days)	IRR	Standard error	Z	P-value	95% CI
Gender						
Male	9.53	1				
Female	7.68	0.804	0.029	−5.99	<0.001	0.749–0.863
Care level						
High	8.85	1				
Low	5.81	0.662	0.044	−6.14	<0.001	0.580–0.755
Age group						
65–69 years	7.68	1				
70–74 years	7.96	1.03	0.109	0.32	0.748	0.841–1.27
75–79 years	8.30	1.08	0.094	0.83	0.409	0.905–1.28
80–84 years	8.44	1.10	0.109	0.93	0.355	0.902–1.33
85–89 years	8.20	1.07	0.112	0.61	0.544	0.866–1.31
90–94 years	8.40	1.10	0.122	0.81	0.420	0.879–1.36
95–99 years	7.10	0.930	0.107	−0.63	0.530	0.742–1.16
≥100 years	7.48	0.995	0.145	−0.04	0.972	0.748–1.32
ACFI ADL domain						
0	2.70	1				
1	4.35	1.62	0.542	1.44	0.151	0.839–3.12
2	6.48	2.40	0.783	2.69	0.007	1.27–4.55
3	9.76	3.62	1.21	3.84	<0.001	1.88–6.98
Unknown	5.99					
ACFI cognition and behaviour domain						
0	6.55					
1	6.19	0.932	0.169	−0.39	0.697	0.653–1.33
2	6.60	0.993	0.195	−0.04	0.972	0.676–1.46
3	9.09	1.37	0.264	1.62	0.105	0.937–1.99
Unknown	5.99					
ACFI complex health care domain						
0	5.26	1				
1	6.03	1.15	0.228	0.68	0.494	0.776–1.69
2	6.97	1.33	0.238	1.58	0.115	0.933–1.88
3	9.24	1.76	0.334	2.96	0.003	1.21–2.55
Unknown	5.99					

Table 5.   Types of adverse incidents by care level and gender
Data are presented as *n* (%)

	Total	Care level		Gender	
		High	Low	Female	Male
Falls	21 994 (36.5)	18 493 (36.1)	3501 (38.5)	14 038 (34.9)	7911 (39.6)
Behavioural	19 676 (32.6)	16 770 (32.8)	2906 (31.9)	12 510 (31.1)	7166 (35.7)
Impacts and injuries	13 078 (21.7)	11 579 (22.6)	1499 (16.5)	9671 (24.0)	3407 (17.1)
Medication events	5520 (9.2)	4329 (8.5)	1191 (13.1)	4023 (10.0)	1497 (7.5)
Total	60 268 (100.0)	51 171 (100.0)	9097 (100.0)	40 287 (100.0)	19 981 (100.0)

incidents on aged care services means that falls are at the forefront of adverse incidents seen and reported.[26] The high number of falls in the present study demonstrates the ongoing need to address falls risk among aged care residents, while also adding to this literature by describing how falls incidents sit within the broader range of adverse incidents experienced by residents.

The impacts and injuries category described in this study covered adverse incidents (other than falls) that caused physical injuries or had a negative effect on a resident's physical well-being. This included cuts, bruises, pressure injuries and other illness. Previous injury research has predominately focused solely on pressure injuries. However, even among pressure injury studies, different incidence rate measures are used, making comparisons difficult. For example, the American Agency for Healthcare Research and Quality measures pressure injuries as the number of pressure ulcers per number of residents during a time period,[28] whereas the Australian Institute of Health and Welfare uses a calculation of pressure injuries per 1000 care days.[29] Although pressure injuries are a major source

of physical distress to residents and a cost burden on healthcare systems,[30] our findings highlight that residents may have cuts, bruising and sickness that may also need to be considered when examining the impact of incidents resulting in an injury on resident well-being and healthcare costs.

Approximately 60% ($n = 7224$) of residents had an adverse incident recorded over the study period. This indicates that, at some stage during their time in an RACF, more than half the resident population is likely to experience an incident that may have a significant impact on their health and well-being.

However, the range in the number of adverse incidents experienced by an individual resident was broad, ranging from 0 to 171 adverse incidents during their care. In addition, 42% of residents had no adverse incident recorded, highlighting the need for organisations to be strategic as to where they direct the focus for improvements, because generalised interventions may be missing key targets or vulnerable groups.

Although women account for the majority of residents within RACFs,[31] the present study demonstrated that men had a significantly higher rate of adverse incidents, after accounting for number of days spent living in care. Gender mix should be considered when undertaking risk assessments and when developing safety interventions and improvement projects to ensure that programs are targeted where the greatest value can be achieved.

Although not a surprising finding, this study also confirmed that the rate of adverse incidents was significantly higher in residents with high care needs compared with those with low care needs.

There is growing recognition of adverse incidents involving behaviour that threatens the physical safety of a resident themselves or other residents. Resident-to-resident aggression, elder mistreatment by residents and elder abuse have implications for resident quality of life[32] and safety.[33] There are also implications for the safety and work safe practices of facility staff.[34] The present study confirmed that over one-third (32.65%) of adverse incidents recorded were due to a behaviour-related cause and, overwhelmingly, these events (85.23%) occurred among high care residents. The high frequency of behavioural-related incidents suggests that much greater access to support and education for staff to identify and reduce environmental triggers for behavioural-related adverse incidents is needed.

Need for indicators and value of EMS

The high frequency of adverse incidents in aged care identified in this study and the lack of research with which to make comparisons demonstrates that the aged care sector would benefit from having a more standardised mechanism for reporting quality, risk and health and well-being measures. Quality indicators are widely used in other areas of the healthcare system to enable performance comparison.[35] Calls have already been made to review and expand the range of indicators within the Australian aged care sector.[36] Developing quality indicators for aged care could assist in having a standardised language across the sector that would enable comparisons across organisations, facilities and countries. Without standardised baseline indicators, facilities and providers are unable to accurately monitor the effectiveness of changes in safety and procedures.

EMS provide a tool for aged care facilities to record, catalogue and investigate adverse incidents. Where a system is organisation wide, data can be used to identify variations between facilities, as well as over time, and to link adverse incidents to resident outcomes. Using key information already captured in management systems would also enable the reporting of a broader range of indicators, providing a comprehensive assessment of adverse incidents in aged care while minimising the administrative burden on aged care staff and management to capture information and develop additional reporting mechanisms.[37]

The missing voice of residents

What is limited in the aged care adverse incident research literature and in incident reports is residents' reflections on the way they view the incident and its impact (aside from any injury) on them. For example, little is known about how a fall affects a resident's wish to balance the need to avoid the potential for falls with their right to take reasonable risks.[38] Further work is needed to capture resident-centred concepts that lie outside the realm of traditional adverse incidents reporting.

Limitations

This study demonstrates the use of EMS data to provide information for aged care providers, but some limitations should be noted. The demographic data indicate that the study population was a representative sample of the wider residential aged care population. However, because the data are sourced from a single provider, the findings may reflect localised regulations and requirements and not the recording of incident data and responses of different providers.

The ACFI has been demonstrated to provide a measure of care levels.[39] However, because the ACFI is used for funding purposes, there is the potential that this data source may be skewed due to 'up-coding'.[40]

In addition, EMS are not without limitations. They require robust procedures for ensuring training, appropriate use in daily work practice and data quality. Routinely collected data may not always contain the rigour required by researchers for analysis.

Conclusion

This study adds to the growing volume of aged care research by providing a broader view on adverse incidents in RACFs and brings to light an area of study missing from the narrative in aged care. The study has shown that men, although accounting for only one-third of RACF residents, have a higher rate of adverse incidents, and this information highlights the importance of gender mix on resident incident risk levels. Falls and behaviour-related events make up the bulk of adverse incidents reported, and this supports the focus on these types of incidents in the body of research.

However, this study has also demonstrated that gaps remain in the standard definitions and calculations needed to facilitate comparisons and benchmarking of adverse incidents between facilities. Valuable information is available to aged care organisations through their EMS. Expanded use of this information could provide a method for ongoing monitoring of adverse

incidents to improve safety and quality for residents living in aged care facilities.

Data availability

The data that support this study cannot be publicly shared due to ethical or privacy reasons and may be shared upon reasonable request to the corresponding author if appropriate.

Competing interests

The authors have no competing interests to declare.

Acknowledgements

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Appendix 1.   Flowchart of study inclusion and exclusion criteria

All incidents recorded in Cintellate, 1 Nov 2013 to 31 Oct 2016 (*n* = 66 312)

→ Exclude incidents involving staff only (*n* = 19)

All resident incidents recorded in Cintellate (*n* = 66 293)

→ Exclude incidents in non-RACF accommodation (*n* = 335)

All resident incidents in residential care facilities (*n* = 65 958)

→ Exclude incidents for those <65 years (*n* = 1785) and no gender recorded (*n* = 10)

Incidents for residents aged 65+ years (*n* = 64 163)

→ Exclude facilities with inconsistent incident data (4 RACFs, *n* = 397 incidents)

Incidents for residents in facilities with consistent data (*n* = 63 766)

→ Exclude incidents for residents without iCare data (*n* = 1598)

Incidents for residents with matched iCare data (*n* = 62 168)

→ Exclude duplicate incidents (*n* = 1900)

All incidents for residents included in the study (*n* = 60 268)