Nursing home residents in the Emergency Department (NuHR–ED): a review of resident characteristics and outcomes following Emergency Department attendance and the impact of a Nursing Home Liaison Service

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Declaration

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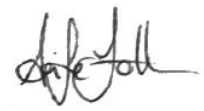

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List of Abbreviations

4AT	4 'A's Test
AD	Alzheimer's Disease
ADE	Adverse Drug Event
ADL	Activities of Daily Living
ANP	Advanced Nurse Practitioner
ATC	Anatomical Therapeutic Chemical
BI	Barthel Index
BMI	Body Mass Index
BNP	B-Natriuretic Peptide
CAM	Confusion Assessment Method
CCI	Charlson Comorbidity Index
CFS	Clinical Frailty Scale
CFR	Case Fatality Rate
CHO	Community Health Organisation
CNS	Central Nervous System
COPD	Chronic Obstructive Pulmonary Disease
CSO	Central Statistics Office
DOAC	Direct Oral Anticoagulant
DON	Director of Nursing
ED	Emergency Department
EOL	End of Life
EWS	Early Warning Score
GP	General Practitioner
HIPE	Hospital Inpatient Enquiry
HIQA	Health Information and Quality Authority
HSE	Health Service Executive
INEWS	Irish National Early Warning System
IQR	Interquartile Range
LOS	Length of Stay
LRTI	Lower Respiratory Tract Infection
LTC	Long-Term Care
MTS	Manchester Triage System
NH	Nursing Home
PIM	Potentially Inappropriate Medication
QOL	Quality of Life
RT-PCR	Reverse Transcription-Polymerase Chain Reaction
SD	Standard Deviation
SIRS	Systemic Inflammatory Response Syndrome
SNRI	Serotonin and Norepinephrine Reuptake Inhibitor
SpR	Specialist Registrar
SSRI	Selective Serotonin Reuptake Inhibitor
START	Screening Tool to Alert doctors to Right Treatment
STOPP	Screening Tool of Older Persons' Prescriptions
TCA	Tricyclic Antidepressant
UTI	Urinary Tract Infection
WHO	World Health Organisation

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Abstract

Introduction

Nursing Home (NH) residents are among the most vulnerable members of society. High rates of multimorbidity, functional dependence and frailty lead to high levels of health and social care needs in this cohort. As our population ages, the number of people living in NHs has increased. When they become unwell, the Emergency Department (ED) often acts as an access point to the acute hospital. ED presentations have been associated with adverse outcomes. The aims of this project were to: 1) describe characteristics and outcomes of NH residents attending the ED and factors influencing these outcomes, 2) review the prevalence and impact of polypharmacy and potentially inappropriate medications (PIMs) on outcomes for NH residents attending the ED, 3) examine the impact of the first wave of the COVID-19 pandemic on NH residents and staff, 4) review outcomes following the establishment of a dedicated NH Liaison service in an acute hospital.

Methods

1. All NH residents aged 50 years and older (≥50 years) attending the ED of an urban university teaching hospital over one year (01/10/2019 - 30/09/2020) were included. Data was collected through medical record review and included demographics, comorbidities, medications, baseline functional ability (Barthel Index, BI) and frailty status (Clinical Frailty Scale, CFS). Details of ED attendance, discharge disposition, and length of stay (LOS) and discharge destination for those admitted to hospital was analysed. Twelve-month outcomes included ED reattendance and mortality.

2. Participants were grouped according to the number of medications prescribed and three levels of polypharmacy examined (5 or more medications (≥5), 10 or more medications (≥10), and 15 or more medications (≥15)). Medications were further classified into PIM and non-PIM prescriptions according to STOPP version 2, STOPPFrail and Beers' Criteria.

3. The impact of the COVID-19 pandemic was analysed through distribution of surveys to NHs across three Community Healthcare Organisations (CHOs) to detail occupancy, size, COVID-19 outbreak, outbreak timing, total symptomatic/asymptomatic cases and outcomes for residents from 29/02/2020 - 22/05/2020.

4. The impact of a dedicated NH Liaison service was analysed through review of Health Information and Quality Authority (HIPE) data. This compared NH resident hospital admissions before the establishment of this service (2014 – 2017), following the development of the role of Advanced Nurse Practitioner (ANP) in Gerontology (2018 – 2019) and expansion to a dedicated team (2020 – 2022).

Results

Characteristics and outcomes of older NH residents attending the ED

There were 515 ED attendances by 341 individual NH residents over the study period. Mean age was 78.6 years (50 – 103, SD±10.9 years). Over half (56.3%, n = 192) were female. Mean CFS score was 6.6 (3 – 9, SD±0.9), mean BI score 9 (0 – 20, SD±7.8) and mean CCI score 5.3 (0 – 12, SD±2.1). Almost half (49.0%, n = 167) had a documented dementia diagnosis. At presentation, 92.8% (n=474) had a Manchester Triage System (MTS) score of 1–3 (mean 2.5, range 1 – 5, SD±0.7) indicating a need for urgent review. Most attendances occurred out-of-hours (OOH) (61.6%, n = 317). The most common presenting complaint was "generally unwell" (29.9%, n = 154). This was associated with higher 12-month mortality than other presentations (42.8% vs 33.7%, p = 0.048). Delirium was recorded in 31.8% (n = 164) and was associated with greater illness acuity (mean MTS 2.3 vs 2.7, p <0.001), admission rates (81.7% vs 53.4%, p <0.001) and 12-month mortality (50.6% vs 30.0%, p <0.001).

Polypharmacy and potentially inappropriate medications

An average of 12.7 medications (0 – 31, SD±5.3) per patient were prescribed. Polypharmacy (≥5 medications) was identified in 95.6% of presentations (n = 460) with 72.3% (n = 348) prescribed ≥10 medications. A higher proportion of those prescribed ≥5 (62.2% vs 40.0%, p = 0.046) and ≥10 medications (64.7% vs 52.3%, p = 0.013) presented OOH. Those prescribed ≥5

medications had a higher level of acuity (MTS 2.4 vs 2.8, p = 0.049) and longer mean ED LOS than those with <5 medications (14.0 vs 10.8 hours, p = 0.035). Those in all polypharmacy groups had a higher inpatient LOS (10.1 vs 5.4 days, p = 0.015 for ≥5 vs <5 medications; 10.8 vs 7.2 days, p = 0.009 for ≥10 vs <10 medications; 12.5 vs 8.3 days, p = 0.035 for ≥15 vs <15 medications).

At least one PIM was identified in 99.0% (n = 475) according to STOPP version 2, in all (100.0%, n = 480) according to STOPPFrail and 97.5% (n = 468) according to Beers' criteria. Mean proportion of PIMs per patient was 59.1% (0 – 100%, SD±18.7%), 68.9% (0 – 100%, SD±18.3%) and 35.0% (0 - 100%, SD±17.2%) according to STOPP version 2, STOPPFrail and Beers' Criteria respectively. STOPP version 2 and STOPPFrail demonstrated a higher proportion of PIMs in those with a falls history (61.2% vs 57.1%, p = 0.014 and 70.7% vs 67.2%, p = 0.039). Beers' criteria found those with delirium (31.7% vs 36.8%, p = 0.001) and those admitted (33.2% vs 38.1%, p = 0.003) had a lower proportion of PIMs. There was a lower mean proportion of PIMs in residents who died at 12 months using all tools (STOPP version 2: 54.5% vs 61.5%, p <0.001, STOPPFrail: 64.8% vs 71.0%, p <0.001, Beers': 29.5% vs 37.6%, p <0.001).

The impact of COVID-19 on NH residents and staff

Surveys were returned from 62.2% (28/45) of NHs. Three-quarters (21/28) had COVID-19 outbreaks (1,741 residents, 1,972 beds). Resident incidence was 43.9% (764/1,741). Case fatality rate (CFR) was 27.6% (211/764). Similar proportions of residents in NHs with 'early-stage' (<28 days) versus 'later-stage' outbreaks developed COVID-19. Of 395 NH staff across 12 sites with confirmed COVID-19, 24.7% (99/398) were asymptomatic. There was a significant correlation between the proportion of staff with symptomatic COVID-19 and resident numbers with confirmed/suspected COVID-19 (Spearman's rho = 0.81, P <0.001).

The impact of a dedicated NH Liaison Team

In the four years prior to the development of a NH Liaison service, NH residents accounted for 1.04 – 2.04% of total admissions per year with an average LOS of 10.63 – 12.33 days. An ANP-led in-reach service commenced in 2018. There were 353 NH resident admissions that year with an average LOS of 11.8 days. In 2019, there were 329 admissions and average LOS was 12.1 days. Readmissions decreased from 37.1% in 2018 to 24.0% in 2019. The NH Liaison

Team was established in 2020 and allowed residents be admitted under a specialist geriatric service. There were 250 NH resident admissions in 2020 with an average LOS of 8.9 days. Readmission rate decreased to 10.0%. In 2021 there were 251 admissions, average LOS was 10.3 days and readmission rate was 12.7%. In 2022 admissions increased to 385 NH residents but average LOS decreased to 7.3 days. Readmission rate was 16.1%.

Conclusion

These findings show NH residents presenting to the ED are a frail and complex cohort. Multimorbidity and polypharmacy are common. They are unwell at presentation, requiring urgent assessment and are frequently admitted to hospital. The COVID-19 pandemic highlighted this vulnerability. There are opportunities to enhance care for NH residents accessing the ED. This includes developing pathways for common presentations and presentations associated with an increased likelihood of adverse outcomes, improved recognition and management of delirium, regular medication review including deprescribing, education around PIMs, increased gerontological input in the ED and specialist teams to manage NH residents' care in hospital and follow up on discharge.

Lay Abstract

Nursing home (NH) residents are a frail group. They often have multiple complex medical conditions and need help with day-to-day activities. When they are unwell, due to an illness, injury, or change in a chronic condition, NH residents often come to the Emergency Department (ED) for medical care. This can lead to poor outcomes including hospital admission, a decline from a previous baseline cognition and function, and death. This project aimed to examine a number of aspects of care for older NH residents who came to the ED including: 1) their characteristics and outcomes, 2) the impact of being prescribed multiple medications and potentially inappropriate medications, 3) the effect of COVID-19 on NH residents and staff, 4) the impact of a NH Liaison Team formed to provide specialist care to NH residents in the acute hospital.

This project was carried out by gathering information on all NH residents coming to the ED of a hospital over one year and following their 12-month outcomes. To examine the impact of COVID-19, a survey was given to 45 nursing homes to be completed. Finally, we collected information on the number of NH residents admitted to hospital before and after the development of a NH Liaison Service.

There were 515 ED attendances by 341 individual NH residents over one year. We found high rates of frailty, medical conditions and dependence in daily activities in this group. Almost half had dementia. When they came to the ED, urgent review was recommended for most, indicating high levels of illness acuity. Most attended “out-of-hours”. Many NH residents presenting to ED were classified as “generally unwell” or did not have specific symptoms. About one-third had a diagnosis of delirium and this group were more likely to be admitted. The average number of medications prescribed was 12.7 with more than two-thirds prescribed more than 10 medications. Over 95% had potentially inappropriate medications prescribed according to three commonly used tools. However, those who had died one year after ED attendance had a lower proportion of potentially inappropriate medications prescribed.

Twenty-eight NHs completed surveys examining the impact of COVID-19. Three-quarters had COVID-19 outbreaks. Resident incidence was 44% and over a quarter of these residents died (28%). 395 NH staff reported confirmed COVID-19 and 25% were asymptomatic. There was a significant correlation between the proportion of staff with symptomatic COVID-19 and resident numbers with confirmed/suspected COVID-19.

NH residents accounted for 1 – 2% of all hospital admissions per year from 2014 - 2017 with an average inpatient stay of 10.6 – 12.3 days. An ANP-led in-reach service commenced in 2018 and continued in 2019. NH residents represented around 2% of admissions both years and had an average stay 11.8 and 12.1 days. Readmissions decreased from 37.1% in 2018 to 24.0% in 2019. The NH Liaison Team was established in 2020 and NH residents were admitted under a specialist geriatric service. In 2020 there were 250 admissions with an average stay of 8.9 days and readmission rate of 10%. In 2021 there were 251 admissions, an average stay of 10.3 days and readmission rate of 13%. In 2022 admissions increased to 385 NH residents but average stay was 7.3 days. Readmission rate was 16%.

Our study shows that NH residents are a frail group. They are at risk of hospital admission, reattendance and of death when they present to ED. We hope that this study can be used to improve their management in the ED, acute hospital and after discharge. This might be achieved by developing pathways for common presentations or for conditions associated with an increased likelihood of adverse outcomes, improved recognition and management of delirium, medication review and education around potentially inappropriate medications, gerontological input in the ED and specialist teams to manage NH residents' care in hospital and follow up on discharge.

Hypothesis and aims

The main hypothesis of this thesis is that NH residents presenting to the ED are a complex cohort who are at risk of adverse outcomes. This project explores factors that may contribute to this and to identify those most at risk. It examines the impact of the COVID-19 pandemic, which emerged over the course of this project and represented a challenging time for older people and those caring for them. COVID-19 significantly affected NHs in its early stages but also contributed to the development of new strategies to enhance care for this group of patients. The establishment of a NH Liaison Team was one such strategy, and its impact is reviewed as a part of this project.

The aims of this project are:

1. To examine characteristics and outcomes of Nursing Home residents attending the Emergency Department of an urban university hospital over one year.
2. To examine prevalence of polypharmacy and prescription of potentially inappropriate medications using STOPP version 2, STOPPFrail and Beers' criteria.
3. To examine the impact of COVID-19 on NH residents and staff across three Community Health Organisations.
4. To investigate the impact of a dedicated NH liaison service on bed days and cost of hospital admission for NH residents.

Outputs

Publications

Kennelly SP, Dyer AH, Noonan C, Martin R, Kennelly SM, Martin A, O'Neill D, **Fallon A.** Asymptomatic carriage rates and case fatality of SARS-CoV-2 infection in residents and staff in Irish nursing homes. Age Ageing. 2021 Jan 8;50(1):49-54. doi: 10.1093/ageing/afaa220. PMID: 32986806; PMCID: PMC7543256.[1]

Presentations

A Fallon, C Noonan, S P Kennelly, Polypharmacy and potentially inappropriate medication prescriptions in older Nursing Home Residents presenting to the Emergency Department, Age and Ageing, Volume 52, Issue Supplement_3, September 2023.
Irish Gerontological Society 70th Annual and Scientific Meeting, September 2023, Galway.

A Fallon, C Noonan, S P Kennelly. Characteristics and outcomes of older nursing home residents attending an Emergency Department, Age and Ageing, Volume 51, Issue Supplement_3, November 2022, afac218.109.
Irish Gerontological Society 69th Annual and Scientific Meeting, November 2022, Cavan.

A Fallon, C Noonan, S P Kennelly. Older nursing home residents attending an Emergency Department: characteristics and outcomes. Abstracts of the 18th Congress of the European Geriatric Medicine Society. Eur Geriatr Med 13 (Suppl 1), 1–439 (2022).
European Geriatric Medicine Society 18th Annual Congress, September 2022, London.

A Fallon, C Noonan, SP Kennelly. Characteristics and outcomes of Nursing Home Residents presenting to an Emergency Department over one year. Association of Physicians of Great Britain and Ireland 115th Annual Meeting. 10 March 2022, Dublin.

A Fallon, A Dyer, R Martin, S Kennelly, A Martin, D O'Neill , SP Kennelly. Profiling COVID-19 infection in Irish nursing homes. Abstracts of the 16th International E-Congress of the European Geriatric Medicine Society. Eur Geriatr Med 11 (Suppl 1), 1–309 (2020).
European Geriatric Medicine Society 16th Annual Congress, September 2020, Virtual.

1 Emergency Department utilisation by nursing home residents: a narrative review of the literature

1.1 *Background*

Nursing home (NH) residents are among the most vulnerable members of society. Multimorbidity, functional dependence and frailty are common in this population, contributing to high levels of health and social care needs [2-5]. Up to two-thirds are reported to have dementia or cognitive impairment, 80% require assistance with activities of daily living (ADLs) and three-quarters have limited mobility, all significantly higher rates than older people living in the community [4-6]. Urinary incontinence has been reported in 60 – 90% of NH residents [6, 7]. Pain, depression, falls and pressure areas are frequently seen [4, 6]. These factors contribute to polypharmacy. However, they can also occur as outcomes as a result of polypharmacy. Polypharmacy is commonly defined as being prescribed ≥5 medications [8] and, using this definition, it is present in 50 – 73% of NH residents [9, 10]. The presence of chronic disease, pain or depression has been directly associated with being prescribed ≥10 medications [10]. Potentially inappropriate medication (PIM) prescribing is also common [11].

Median survival time in NHs is 2.1 – 2.5 years [12-15]. An annual mortality rate of 32 - 63% has been reported, with some variation between countries [16, 17]. This may be related to the availability of integrated services and resources that enable older people to remain living in the community for longer. This impacts the timing of NH admission, in turn influencing median survival time [16]. Individual resident factors contributing to increased mortality risk include older age, higher rates of multimorbidity and polypharmacy, higher levels of dependency, lower body mass index (BMI) and a more rapid decline in physical performance [12, 17, 18]. NH residents without dementia were shown to have a shorter median survival than those with Alzheimer's Disease (AD) dementia [15]. There was no significant difference in survival between dementia subtypes [15] but more severe dementia was associated with an increased mortality risk [12, 15]. Characteristics of NH facilities that increase the risk of mortality include living on a ward with a higher number of residents, larger NH size, lower nursing ratios and for-profit status [12, 19-22].

In Ireland, the proportion of those aged ≥65 years living in NHs decreased from 3.9% in 2011 to 3.1% in 2022 according to the Central Statistics Office (CSO). However, there was an increase in the total number of older people living in long-term care (LTC) facilities over the

same time period, from 20,802 in 2011 to 24,527 in 2022 [23, 24]. This reflects an ageing population. The population aged ≥65 years is predicted to increase from 791,194 in 2022 to 1,007,000 by 2031 and to 1,597,000 by 2051, so the trend of increasing numbers of NH residents is likely to continue over the coming years [25].

NHs vary widely in staffing, structure and governance locally, nationally and internationally. This leads to differences in the level of care that can be provided onsite [26-29], although these differences can be difficult to quantify. Variation is further complicated by the lack of a single definition of what a "nursing home" is [30]. In many countries, NHs are considered to be "long-term care facilities" providing management of chronic medical conditions, full assistance with ADLs, as well as room and board [30]. However, in some jurisdictions the definition of a nursing home includes "subacute" or "skilled care facilities", which provide extensive medical care and rehabilitation, often after hospitalisation. Other types of NHs include "care homes" or "assisted living facilities", with varying levels of medical input and assistance with ADLs, or hospices that provide end-of-life care [30]. These differences should be considered when reviewing the literature around NHs.

In Ireland, NHs are generally long-term care facilities and there is a "mixed model" of NH provision. Public NHs are owned and operated by the government-funded Health Service Executive (HSE) and private NHs, by individual providers/provider entities. All are registered with the Health Information and Quality Authority (HIQA) and comply with regulations for standards of care. In 2021, there were 567 NHs in Ireland with 31,842 beds [31]. The average number of beds per NH was 56.2, 25 facilities had <20 beds and 59 had >100. The majority of NHs were private (77%, n = 439) [31].

The tertiary university hospital where this project was carried out has 11 NHs in the local catchment area, with a total of 1046 beds (range 46 – 190 beds). In addition to this, as a tertiary referral centre the hospital provides specialist care to a wider catchment area, including 14 further NHs. This compares to 13 NHs in the local catchment in 2018, with 974 beds. Four NHs have closed and two new facilities have opened [32]. The decrease in number of NHs and increase in total beds is reflective of a national trend. There was an increase in the total number of NHs in Ireland to a maximum of 585 in 2019, followed by a decline to 567 in

2021 and 553 in 2023. The total number of beds increased from 31698 in 2019 to 32214 in 2023 [33].

1.2 Nursing Home Residents in the Emergency Department

When NH residents become unwell due to acute illness, injury or decompensation of a chronic condition, the Emergency Department (ED) often acts as an access point to the acute hospital. NH residents have been reported to be more likely to attend ED than older people living in the community [34] and often account for a significant proportion of the ED workload. Previous studies from urban Irish teaching hospitals showed that NH residents account for 6.7 – 7.6% of ED attendances by those aged ≥65 years [35, 36]. This pattern is reflected in other countries. Older NH residents in the UK represented 6.5% of ED presentations by older people despite accounting for just 2.8% of that population, although variation between regions was noted [37]. A Canadian study showed that almost a quarter of all NH residents attended ED at least once over a six-month period [38]. A Swiss study showed a trend towards greater ED use by NH residents over a 6-year period, with a 50% increase in ED attendances despite an increase of just 2.5% in the number of NH beds over the same time period [39]. As the population ages and there are increasing numbers of NH residents, it is important that this trend is examined in an effort to improve care for this cohort.

Individual resident factors associated with an increased risk of ED presentation include younger age, male gender, and undiagnosed possible dementia or mild cognitive impairment [40, 41]. Lack of knowledge around an individual's preferences has been reported as a factor influencing ED transfer of dying NH residents [42]. Some individual characteristics and conditions, including functional dependence, immobility or severe dementia, have been associated with a decreased likelihood of ED attendance [41, 43, 44]. NH factors also impact the likelihood of ED attendances by NH residents. Limited resources within the NH, a lack of staff, or limited appropriately trained staff, and limited access to drugs may all contribute to ED transfers [42, 45, 46]. GP availability can influence decisions to transfer NH residents [47]. Location of the NH is another factor to be considered, with one study showing that ED transfers were significantly less common from rural NHs when compared to urban facilities ($p = 0.003$) [48].

When they attend the ED, NH residents are often acutely unwell. Studies have showed that 42 - 52% require urgent review, compared to 26% of older community-dwelling patients [39, 49]. NH residents presenting to ED have an increased risk of adverse outcomes including functional decline and mortality [50-52]. Older age, being more severely unwell at presentation and having had more hospitalisations in the previous month have been associated with an increased mortality risk in NH residents presenting to the ED [52]. NH residents have been shown to have higher rates of diagnostic testing and to spend longer in ED than those presenting from the community [50]. The challenges of providing gerontologically-attuned care to older people in the ED, including older NH residents, are well recognised and may have an impact on ED LOS and hospital admission rates [53, 54]. This is in part due to the ED environment, developed to manage acute trauma and critical illness as opposed to older multimorbid patients. EDs are busy, with bright lights and noise ongoing over 24 hours. This impacts sleep-wake cycles and increases the risk of delirium [54]. Patients often remain on trolleys with limited pressure relief, which can lead to the development of pressure ulcers [54]. There may be limited gerontological care within the ED, particularly OOH. Hospital admission rates of 60 - 70% have been reported for NH residents [2, 35, 39, 53]. Those who were admitted to hospital had a higher mortality rate than their community-dwelling counterparts [49]. Almost half (48%) of NH residents reattend the ED within 12 months [55].

1.3 The impact of COVID-19 on Nursing Home Residents

The COVID-19 pandemic started over the course of this project, with the first reported case in Ireland on 29 February 2020. Its early stages disproportionately impacted NHs and their residents, though the risk of infectious outbreaks in NHs had been considered prior to this. Studies examining NH pandemic preparedness indicated a high risk of outbreaks in long-term care facilities [56, 57]. This is due to both residents' underlying frailty and multimorbidity, and the NH environment where residents and staff are in close contact and have limited infection control [58, 59].

In our catchment area there were 12 NHs in 2020, but the total number of NH beds decreased to from 974 to 959 [32]. This decrease was likely related to the COVID-19 pandemic, which carried significant mortality rates for NH residents, and led to changes in the use of multi-occupancy rooms in some NHs [60].

The COVID-19 pandemic highlighted significant challenges in the management of care for complex older people in NHs, particularly those living with dementia [61]. Higher infection rates were seen in larger facilities and higher mortality rates were seen in older patients, those with complex chronic conditions, end stage renal disease and in those living with cognitive impairment and dementia [62-64]. Higher community prevalence of COVID-19 was associated with both increased infection and mortality rates [62]. Other outcomes were less widely reported but included an increase in rates of depression [65], in the use of antipsychotic medications for NH residents living with dementia [66, 67] and an increase in opioid prescribing [68]. In 2020, a decline in total ED visits by NH residents was reported in Ontario as well as a decline in hospitalisation when compared to 2010 – 2019 [69]. There was an increase in NH mortality over the same time period [69]. This reflects changes in patterns of ED and acute hospital utilisation by NH residents in the early stages of the COVID-19 pandemic.

The COVID-19 pandemic prompted an interest in NHs and their residents, with an increase in the number of studies completed in LTC facilities at this time. This led to development of new models of care for NH residents. With the emergence of vaccinations mortality rates improved [70], but new care models that developed in an effort to enhance care for this cohort remain. This included collaborative projects between NHs, primary care and acute hospital settings in an effort to provide care to NH residents without the need for ED transfer [71].

1.4 Common Emergency Department Presentations of Nursing Home Residents

Older NH residents attend the ED with a variety of presentations. Although there is heterogeneity between studies, the following presentations are among the most common: “generally unwell” or non-specific complaints, accounting for 15 – 31% of presentations [50,

72, 73], delirium which is reported in 38% [74], falls in 17 – 24% [2, 50, 72, 73, 75], urinary tract infection in 8 – 15% [2, 50] and respiratory presentations representing 10 – 29% of ED attendances by NH residents [2, 50, 53, 72, 75]. There is limited evidence around management of these common presentations in NH residents specifically, but ensuring high quality gerontologically-attuned care for this patient group as early as possible is of particular importance due to their complexity and risk of adverse outcomes.

1.4.1 *Non-specific Presentations*

Non-specific symptoms are common and account for up to one-fifth of ED presentations by older patients [76]. It has been shown that older adults attending ED with a non-specific presenting complaint often have multiple comorbidities [77]. This is reflected in NH residents, for whom “unwell adult” and “generally unwell” are among the most common presenting complaints documented at ED attendance [35, 53]. A non-specific presentation has been associated with hospital admission rates of over 80% [35, 53]. Despite this, there is little research into outcomes for NH residents as a cohort presenting to the ED with non-specific symptoms.

“Unwell adult” is included as one of the 52 Manchester Triage System (MTS) flow charts, commonly used in EDs. It is noted that those presenting in this category are more likely older and to be under-triaged [78, 79]. They spend a significantly longer time in the ED and are more likely to be admitted or to reattend ED within 72 hours, when compared to those presenting with more specific symptoms [80]. Non-specific presentations have been associated with a wide range of diagnoses including urinary tract infection (UTI), depression or anxiety, electrolyte disturbances and pneumonia [76]. One study showed the most common diagnosis in this group was "symptoms, signs and abnormal clinical and laboratory findings not classified elsewhere" [79]. A serious condition was diagnosed in 59% of participants in another study examining those with non-specific presenting complaints, and this group were found to have an overall mortality rate of 6% [77]. It has been suggested that delayed diagnosis may contribute to increased mortality rates [78].

Unlike other ED presentations, there is limited evidence around strategies for management of non-specific presentations in the emergency setting [77] for NH residents or the wider population. As with specific presentations, a full history and examination should be completed for all those presenting non-specifically [63]. An informant history is of particular importance in NH residents classified as "generally unwell" and, if obtained at triage, may allow more accurate classification of patients, reducing the risk of under-triage. As previously mentioned, this population have high rates of dementia and cognitive impairment, and in addition to this they are at an increased risk of delirium. A collateral history from a family member or carer may allow specific symptoms to be identified and will give information on the resident's usual cognitive and functional baseline [81].

The incorporation of a "non-specific complaint" score that indicates the presence of certain symptoms, such as chills or mottled skin, has been suggested to reduce the risk of under-triage in those presenting in this category [79]. The development of protocols to stratify risk has also been suggested, with a focus on common diagnoses with greater prevalence of morbidity and mortality following ED presentation, such as heart failure or pneumonia [76]. However, older people may not show typical signs of severe illness. They may have blunted responses in the context of infection or be unable to communicate specific symptoms [76]. Furthermore, conditions with lower morbidity and mortality are often diagnosed following investigation and exclusion of more serious conditions [76]. Geriatrician involvement at an early stage of ED attendance has been suggested to enhance care and improve outcomes for older people, including NH residents, who present to the ED with non-specific complaints [82]. Analysing cues in patient history that physicians describe as "crucial" may allow development of strategies to accurately diagnose non-specific presenting complaints [83].

1.4.2 Delirium

Delirium is defined as an acute confusional state, characterised by altered consciousness, cognitive function or perception, with a fluctuating course. It is common in NH residents, who often have multiple risk factors. A diagnosis of dementia, pain and the use of antipsychotics have been associated with an increased risk of delirium in NH residents [84]. In the ED, they may be 10 times more likely to have delirium compared to their community-dwelling

counterparts [74]. This increased likelihood of delirium for NH residents in ED remains when adjusted for dementia, hearing impairment, and the presence of systemic inflammatory response syndrome (SIRS) [74]. It is associated with an increased risk of adverse outcomes including hospital admission, and both inpatient and 6-month mortality [2].

Delirium screening is recommended for all older patients attending the ED. It has been listed as a key quality indicator in geriatric emergency care [85] but those working in ED report varying levels of confidence in the identification and management of delirium [86]. Delirium is likely under-recognised. In a study reviewing older people presenting to ED, just 16% of physician notes had any reference to cognition [81]. Although "behavioural or cognitive changes" have been identified as a common reason for ED transfer in NH residents [87], a study examining NH to ED transfers for "behavioural concerns" found 80% were admitted to hospital but delirium was not listed as a discharge diagnosis for any patient [88]. Tools such as the 4AT or Confusion Assessment Method (CAM) have been validated and should be used to screen for delirium in the ED in all older adults. As previously mentioned, a collateral history should be obtained from NH staff or a family member. This is especially important for suspected delirium, as documentation of acute change in cognitive status is necessary for diagnosis [85]. Collateral history should also review potential precipitants of delirium. It is important to recognise that delirium is often multifactorial. Difficulties in obtaining a collateral history on baseline cognition for NH residents in the ED have been described. Time constraints, a lack of space and the noisy environment have been reported as factors contributing to this [81, 86]. Improved communication and documentation, such as the use of a checklist including baseline cognition that could be provided by NHs, has been suggested to allow earlier recognition of changes [86].

The management of delirium in NH residents within the ED is challenging, due to both individual and environmental factors [86]. The development of "age-friendly" areas within the ED, and the implementation of strategies to reduce the risk of delirium developing in patients at risk, including NH residents, is recommended. When delirium is identified, a systematic assessment is recommended to identify life-threatening causes in the first instance, followed by other potential precipitants [89]. A multicomponent management plan is also recommended, including reorientation, promoting mobilisation and sleep hygiene, providing

glasses and hearing aids where needed, and regulating bowel and bladder function [89]. Management of the underlying causes of delirium is required in each individual case. Pharmacological management of symptoms should not be first line, and only considered if non-pharmacological techniques are ineffective or inappropriate, and the patient is a risk to themselves or to others [89]. The diagnosis of delirium should be discussed and information provided to family and carers. Ongoing monitoring for resolution of delirium is also required. A diagnosis of delirium and its precipitants should be included in transfer documentation on discharge from the ED or following inpatient stay.

1.4.3 Falls

Falls are common in NH residents, with an incidence of 43% reported in a meta-analysis [90]. They are a common cause of ED presentation in this cohort, reported to account for one-quarter to one-third of attendances [35, 38, 51, 53, 72, 91, 92]. A previous Irish study reported an admission rate of 50% [35] but NH residents presenting with falls may be less likely to be admitted to hospital than those with other presenting complaints [93]. It has been suggested that NH residents are less likely to attend the ED following a fall if they do not have severe injuries [73]. However, NH residents can sustain significant injuries as a result of falling. They are reported to account for up to one quarter of those presenting with femoral fractures [94] which are associated with an increased risk of functional decline following hospital discharge [52].

When a NH residents presents to the ED following a fall, a history should be obtained and examination performed to assess for any injury [54]. Pain assessment within one hour of ED attendance for all older people has been recommended as a quality indicator in geriatric emergency care [85]. Identifying pain is particularly important for those with dementia, cognitive impairment or delirium who may have difficulty reporting details of a fall, pain or injury. An informant history is again essential, and should be taken to determine the potential causes of the fall, if the patient is likely to have sustained an injury, and the NH resident's usual baseline, including mobility and cognition. It is important to note that falls from standing height are common in older populations and can result in significant injury [95, 96]. Relevant imaging should be completed as quickly as possible. Hip fractures and head injuries carry high

morbidity and mortality rates and should be identified and managed as a matter of urgency [34, 96]. Evidence of drowsiness, change in baseline cognition and focal neurological signs should be assessed for and monitored, with urgent neuroimaging considered in these cases. Any changes should prompt further review. Evidence of hypovolaemia may suggest bleeding and a need for further investigation and imaging.

In addition to identifying injury, it is important to identify potential causes of a fall [34]. Falls in older people, including NH residents, are often multifactorial, with impaired mobility, cognitive impairment and orthostatic hypotension commonly contributing [97]. Reviewing blood pressure, obtaining an ECG and blood tests should be considered for all NH residents presenting with a fall. A fall may be a result of an underlying acute illness or medication change [34]. Subacute deterioration of a pre-existing condition should also be considered. A collateral history should determine if any of these factors may have contributed. Addressing potential causes and developing multifaceted prevention strategies may reduce the risk of future falls [97].

1.4.4 Urinary Tract Infection

Urinary tract infections (UTIs) are common in NH residents. They account for up to 20% of ED presentations by this group [38, 43] and have been associated with an increased risk of hospital admission, with rates of 31 - 60% recorded [2, 35, 53, 98]. However, there are also concerns about overdiagnosis of UTI in older people and NH residents. This is influenced by a high prevalence of asymptomatic bacteriuria in NH residents [99]. The high prevalence of cognitive impairment and dementia adds to the challenge of accurate diagnosis in this group [100]. Older patients with dementia were more than twice as likely to be diagnosed with a UTI than those without a dementia diagnosis [101].

Atypical presentations of UTI are common in NH residents, and it is important to be aware of this when they attend the ED. Older NH residents presenting to the ED with a UTI have been reported as less likely to have urinary tract symptoms than community dwelling older adults [98]. They are more likely to present with altered mental status or fever [98]. Despite concerns

about inappropriate use of antibiotics in cases where there are no clear signs or symptoms of UTI [98], under-reporting of symptoms by patients has also been noted [102].

The development of diagnostic criteria for UTI in the ED setting has been recommended [98]. Current guidelines for diagnosing UTI require the presence of localising symptoms or signs including dysuria, suprapubic or costovertebral angle pain or tenderness, haematuria, frequency, urgency and new or worsening incontinence [99]. In patients with signs of severe infection or sepsis, immediate empiric therapy is indicated, but for milder symptoms it is recommended that treatment is not initiated before urine culture results are available [99]. These results are unlikely to be available while the NH resident remains in the ED. This is one of numerous obstacles associated with assessment, diagnosis and management of a UTI in the ED setting. As previously mentioned, atypical presentations are common and asymptomatic bacteriuria is seen in up to half of older NH residents [99]. Urinary dipstick tests have a high false negative rate [103]. Enhanced communication between the ED and NH may facilitate more appropriate treatment for NH residents with a potential UTI diagnosis [104]. Multicomponent interventions, incorporating education of those working in ED and implementation and dissemination of UTI management guidelines, may improve management of UTIs in NH residents presenting to ED [105].

1.4.5 Respiratory Presentations

Respiratory-related presentations are common in NH residents attending the ED and may represent 11 - 20% of presentations in this cohort [53, 72, 92, 106]. “Breathlessness” was associated with a higher mortality risk than other presentations in one study [52]. This presenting symptom can be associated with both respiratory and cardiac disease including lower respiratory tract infections (LRTI) or pneumonia, chronic obstructive pulmonary disease (COPD), heart failure and a wide range of other conditions [107]. Heart failure and COPD are both associated with frequent ED use by NH residents [55].

Pneumonia is diagnosed in up to 30% of NH residents attending the ED [38]. Common presenting symptoms include dyspnoea, seen in approximately two-thirds, and a cough, noted in just under half [108]. A change in mental status, suggesting delirium, is also common [108].

NH residents with pneumonia were shown to have longer ED LOS, higher hospital admission rates and higher mortality than those presenting to ED without pneumonia [93, 109]. Their hospitalisation rates for pneumonia are also higher than those of their community-dwelling counterparts [94]. One year after diagnosis, NH residents hospitalised with pneumonia reported lower quality of life (QoL) than those not hospitalised [110]. NH-associated pneumonia is challenging to diagnose and treat, due to atypical presentation, high levels of antibiotic pre-treatment and limited supportive findings on blood cultures and imaging [108, 111]. In addition to this, NH residents often have features that increase their risk of aspiration pneumonia [112]. Delay to time of antibiotics was associated with mortality, as was decreased mental status, temperature and signs of dehydration, all of which may be identified and managed from early stages of ED presentation [108].

Heart failure has a prevalence of 15 – 45% in NH residents [113] and is commonly associated with dyspnoea. A study examining treatment of heart failure in NH residents noted that recommended medical therapy was often not prescribed in this group [114]. Although this may be due to multimorbidity and potential adverse effects of medications, it can lead to decompensation of heart failure and the development of symptoms including dyspnoea. A quarter of all older people presenting to the ED with dyspnoea are diagnosed as having heart failure [107]. As with pneumonia, heart failure can present atypically, with fatigue or without classical radiological signs [115]. COPD is a common co-morbidity in NH residents with heart failure, adding to challenges in diagnosis when they present to the ED [116]. In NH residents, the presence of heart failure is associated with an increased risk of ED reattendance [113].

Development of pathways for NH residents with respiratory presentations may help to facilitate improved management. A study examining acute respiratory failure in older people presenting to ED, though not NH residents specifically, identified clinical signs of acute respiratory failure, along with hypercapnia and reduced creatinine clearance as factors associated with increased mortality [115]. History, including collateral history, and examination, are needed along with chest x-ray, ECG and blood tests. In suspected pneumonia, blood and sputum cultures are recommended. A history of dysphagia, choking incidents, neurological disease and cognitive impairment or dementia should be sought, as these factors may suggest aspiration pneumonia [112]. Prompt diagnosis of pneumonia allows

administration of antibiotics at an early stage, reducing the risk of mortality. NH acquired pneumonia is a healthcare-associated pneumonia, and this should be taken into consideration when choosing appropriate antibiotics [108]. Algorithms for heart failure management have been suggested [117], but in a NH population it is important to consider comorbidities and take an individualised approach to management [118]. Elevated b-natriuretic peptide (BNP) can act as a diagnostic tool and a prognostic variable in older people presenting with suspected heart failure [115]. As with other common presentations, gerontological input in the ED may allow improved management of this group.

1.5 Potentially preventable Emergency Department Attendances

Though "potentially preventable" ED attendances by NH residents have been an area of research focus for many years [119], in practice, decisions to transfer are often complex with multiple factors related to both the resident and NH contributing [44, 46, 47, 120-125]. A "potentially inappropriate" ED transfer has been defined as one that occurs in the absence of a physical or psychiatric emergency, where palliative care is in place before transfer, or there is an advance directive for non-hospitalisation and where clinical management can occur without a loss of opportunity to the patient should they not be transferred [126]. It has also been described as a transfer without ED laboratory testing or diagnostic imaging and that does not lead to hospital admission [91]. However, there is no single standard definition of either "appropriate" or "potentially preventable" transfers [127], leading to studies reporting on wide-ranging conditions and in some cases "do not resuscitate" documentation [3, 44, 47]. This should be considered, along with variations in NH structure and staffing, when reviewing evidence surrounding "potentially preventable" transfers of NH residents attending the ED.

High levels of disability, atypical presentations and a lack of promptly available medical advice can all lead to "potentially preventable" ED transfers by NH residents [44, 45, 125, 128]. The impact of NH staffing can be variable. Higher staffing levels have been associated with a potential increase in hospitalisations on the same day, but decreased hospitalisations on the following day [129]. This may suggest early recognition of deteriorating residents with higher staffing levels, allowing earlier ED transfer, and improved care planning for residents not

requiring urgent care when there are sufficient staff available. Staffing skillset also plays a role [45]. Having a pharmacy for internal use was associated with significantly fewer ED transfers (p=0.004) [48]. This heterogeneity between NH residents and services available within NH may explain a lack of consensus between experts around "potentially avoidable" and "appropriate" presentations [44, 130]. Studies examining "potentially preventable" attendances found that 80 - 90% of NH residents attending the ED had investigations carried out and almost half were admitted to hospital [50, 91, 131]. This suggests that many ED presentations by NH residents are not avoidable.

1.6 Strategies to enhance care for Nursing Home Residents accessing the Emergency Department.

A number of strategies have been examined to enhance care for NH residents attending the ED. These strategies are heterogenous. Relatively simple strategies have included focusing on improved communication for NH residents at ED attendance and discharge. For example, clear documentation between NHs and the ED has been recommended as a key quality indicator for geriatric emergency care [85] and standardised transfer forms have been suggested to reduce the risk of incomplete documentation [132].

More complex strategies have involved the development of roles and specialist teams across ED, NH and hospital settings to enhance gerontological care for NH residents. This includes projects such as an "Aged Care Team" to reduce ED length of stay and hospital admission [133], and a nurse-led model of care for NH residents attending the ED reducing admission and 28-day representation rates [134]. Outreach services attending NHs [135], rapid access to investigations and treatment, including intravenous therapy, [136, 137] and telehealth programmes [138] have also been examined as ways to improve care for this patient cohort.

There is limited evidence available for many of these strategies. It is important to note additional resources may be required for implementation. Rapid communication of results and timely referral to relevant specialities and services where necessary is of great importance in implementing strategies that aim to reduce ED attendance [139]. Gerontological expertise

and training within the ED may be effective [140] but it is important to consider the effect this may have on other resources and services before implementation. The impact of projects may vary between facilities [141]. It is important to note that due to variation in NHs, hospitals and community healthcare, as outlined previously, that not all initiatives will be successfully implemented across every setting. However, the increasing focus on strategies developed across community, ED and hospital environments highlights the importance of not considering an acute hospital presentation as an isolated event but as one part of complex care for an individual, and the need for close collaboration across services in managing the care of this cohort.

1.7 Nursing Home participation in research

There has been increasing interest in including NHs in research in recent years, particularly since the emergence of COVID-19. However, barriers to carrying out research within NHs still exist and are well recognised, contributing to the under-representation of NH residents in research studies. There are a number of challenges in addition to the heterogeneity of "nursing home" facilities nationally and internationally, as outlined above. They relate to individual residents, staff and NH facilities and can make recruitment of NH facilities and individual participants time-consuming and resource intensive [142].

As with older people in general, multimorbidity and functional impairment are often cited as exclusion criteria in research protocols [143, 144]. Cognitive impairment or dementia can further complicate recruitment, as potential participants may have difficulty giving consent or in participating in some projects [144, 145] although family members can act as proxies for this group [146]. Resident understanding of research may influence their decision to participate [144]. The type of research study being completed can have an impact on the likelihood of participation. Older NH residents have been reported to be more likely to become involved with low risk observational studies when compared to pharmacological or intervention based studies [143]. This may also influence the decisions of a proxy decision maker to consent to NH resident involvement [146]. Participant retention is cited as another issue [143, 145].

Other challenges relate to NH facilities. NHs are often private businesses and research may be viewed in relation to its impact on cost [143]. Those running facilities may have limited understanding of the potential risks and benefits of research, or there may be policies in place prohibiting research [143]. Where they are involved in research projects, some NHs are part of networks which have previously participated and are considered "research ready". This can limit the recruitment and inclusion of additional NHs which have not previously been involved in research [144]. There can be issues around implementation of research projects, with documentation often more limited than in other healthcare settings, and staff who may be unable to prioritise research due to existing workloads or limited understanding of the importance of research and adherence to protocols [143-145]. Despite these barriers, it is important that NH residents are included in research as it can be of benefit to them, their families, NH staff and NH facilities [145].

1.8 Conclusion

NH residents are a complex cohort with significant health and social care needs. They have traditionally been under-represented in research [147]. This is due to individual resident complexity as well as differences between NH facilities. ED presentations are common in this cohort and they remain at risk of adverse outcomes following presentation. The care of NH residents within the ED environment is challenging. Understanding characteristics of this group and common reasons for presentation may allow improvements in their management. Strategies such as dedicated pathways for NH residents presenting to the ED, greater communication and liaison across NHs, acute hospitals and community services and enhanced education and training are all likely to have a role in improving care and outcomes for older NH residents attending the ED.

2 Characteristics and outcomes of older nursing home residents attending the Emergency Department of an Irish tertiary referral hospital

2.1 Introduction

NH residents are among the most frail members of society, often with high levels of multimorbidity and significant care needs. When NH residents become unwell due to acute illness, injury or decompensation of a pre-existing condition, the ED often serves as an access point to the acute hospital [2]. EDs are designed to manage trauma and acute critical illness and are often not gerontologically attuned. ED presentations by NH residents are associated with an increased risk of adverse outcomes including functional decline and mortality [50-52].

The majority of NH residents are aged ≥65 years with limited research on younger residents. Available research often reports on those aged 18 – 64 years as a single group, but those aged ≥50 years often have similar characteristics and comorbidities to older residents, including dementia, stroke and Parkinson's disease [148, 149]. This contrasts with younger NH residents where diagnoses such as cerebral palsy, traumatic brain injury and multiple sclerosis are more common [148, 149]. Although both younger and older NH residents have complex needs, those aged 50 - 64 years are more likely to have similar health and social care needs to older residents.

A previous study reviewing NH resident ED presentations in this hospital found that they had high levels of multimorbidity, with two-thirds having a diagnosis of dementia [2]. Falls, reduced mobility and polypharmacy were also common. Many attendances occurred outside of "normal" working hours, with a minority having been seen by their usual doctor prior to ED attendance [2]. NH residents were commonly admitted to hospital [2]. Other studies have shown that NH residents have high levels of emergent triage, high rates of hospital admission and re-presentation following ED attendance [38, 39, 50]. It has been suggested that rates of ED attendance by NH residents have increased at a greater than expected rate over recent years [39].

The aim of this study was to examine characteristics, including demographics, comorbidities, frailty and functional status, of NH residents attending the ED, details of their ED presentation, and what impacted outcomes, including hospital admission, ED reattendance and 12-month mortality rates, for this group following an ED attendance.

2.2 Methods

An observational prospective cohort study was carried out. All NH residents aged ≥50 years attending the ED of an Irish tertiary university hospital over one year (1 October 2019 – 30 September 2020) were included in the study. Data was obtained through review of medical records (electronic and hard copy). Data collected included patient demographics, comorbid conditions (including documented dementia diagnosis and any visual or hearing impairment), medications, history of falls, baseline frailty status (Clinical Frailty Scale (CFS)) and functional ability (Barthel index (BI)) [150, 151] [Appendix 2, 3]. Charlson Comorbidity Index (CCI) scores were calculated for all patients [152] [Appendix 4]. Details of ED attendance were collected. This included presenting complaint, referral source, mode of attendance (ambulance or own transport) and time of attendance (in-hours weekday, out-of-hours (OOH) weekday and OOH weekend). Severity of acute illness was recorded through Manchester Triage System (MTS) score [153], with lower scores indicating greater acuity, and Irish National Early Warning System score (EWS) [154], where higher scores are associated with increasing illness severity, at attendance [Appendix 5]. The presence of delirium at the time of ED attendance (documented delirium or likely delirium through 4AT screening score [Appendix 6]) was also recorded. Information on discharge disposition from ED and length of stay (LOS) in ED was reviewed. For residents admitted, hospital LOS and discharge destination was recorded. Information on 12-month reattendance and mortality was also collected.

Data were analysed using IBM SPSS version 28. Descriptive statistics were reported as means (range, standard deviations [SDs]). Means were compared using independent t-test. Proportionate comparisons between groups were calculated using Pearson chi squared test and Spearman's rho as appropriate. Statistical significance was considered as $p<0.05$.

2.3 Results

2.3.1 Baseline Characteristics

There were a total of 515 ED attendances by NH residents aged ≥50 years over the study period. This included 341 individual residents, with a mean age of 78.6 years (50 – 103, SD±10.9 years). Over half (56.3%, n = 192) were female. Ninety-two residents accounted for those with multiple ED attendances over the study period (range 2 – 12 attendances). Mean CFS score was 6.6 (3 – 9, SD±0.9) and mean modified BI score 9 (0 – 20, SD±7.8). Almost two thirds (62.2%, n = 212) required an aid or assistance with mobilising and 47.7% (n = 163) had a documented history of falling. Visual impairment was documented in 29.6% (n = 103) of participants and hearing impairment in 10.1% (n = 35).

Mean CCI score was 5.3 (0 – 12, SD±2.1), with higher scores associated with older age (Spearman's rho = 0.660, p <0.001) and increasing frailty (Spearman's rho = 0.198, p <0.001). Patients were prescribed an average of 12.7 medications (0 – 31, SD±5.3) prior to presentation [Table 1]. Almost half of this cohort (49.0%, n = 167) had a documented diagnosis of dementia. The most common dementia subtype documented was Alzheimer's disease (AD) (31.1%, 52/167), followed by vascular dementia (21.0%, 35/167), mixed dementia (9.0%, 15/167), dementia with Lewy Bodies or Parkinson's related dementia (6.6%, 11/167) and Korsakoff's dementia (6.0%, 10/167) with frontotemporal dementia, Huntington's disease dementia and other specified dementia recorded in 4.8% (8/167). No dementia subtype was documented in 21.6% (36/167).

	n = 341	**%**	
Male	149	43.7	
Female	192	56.3	
	Mean	**Range**	**SD**
Age	78.6	50 - 103	±10.9
CCI	5.3	0 - 12	±2.1
CFS	6.6	3 - 9	±0.9
Modified BI	9	0 - 20	±7.8
Medications	12.7	0 - 31	±5.3

Table 1: Baseline Characteristics of NH residents attending the ED

2.3.2 ED Attendance

At the time of presentation, 92.8% (n = 474) of patients had MTS score of 1 – 3 (mean 2.5, range 1 – 5, SD±0.7) indicating a need for immediate (1), very urgent (2) or urgent (3) review. EWS score was ≥7 (emergency response recommended) in 16.5% of (n = 84) attendances. A higher acuity according to MTS score (lower score) was associated with higher levels of functional dependence according to BI (Spearman's rho = 0.121, p = 0.020) and increasing frailty according to CFS score (Spearman's rho = -0.813, p <0.001).

The majority of presentations (n = 469, 91.1%) were by ambulance with 38.3% (n = 197) of attendances occurring in-hours on weekdays (09:00 – 17:00, Monday – Friday), 32.4% (n = 167) OOH on weekdays (17:00 – 09:00, Monday – Thursday) and 29.1% (n = 150) at weekends (17:00 Friday – 09:00 Monday, bank holidays). A higher proportion of patients presenting OOH had an MTS score of 1 – 3 when compared to those presenting in-hours (89.9% vs 94.6%, p = 0.046) and those presenting OOH also had lower mean MTS scores than those presenting in-hours (2.5 vs 2.6, p = 0.04) indicating increasing illness acuity. The OOH group also had lower mean CCI scores (4.86 vs 5.26, p = 0.05) [Table 2].

	n =515	%	
MTS 1	24	4.7	
MTS 2	227	44.0	
MTS 3	223	43.2	
MTS 4	33	6.4	
MTS 5	4	0.8	
Missing data	4	1.0	
BIBA	469	90.1	
In-hours	197	38.3	
OOH Mon – Fri	167	32.4	
Weekend	150	29.1	
Missing data	1		
	In hours	**OOH**	**P value**
CCI (mean, SD)	**5.26, ±2.2**	**4.86, ±2.1**	**0.05**
CFS (mean, SD)	6.43, ±1.0	6.62, ±0.8	0.06
BI (mean, SD)	9.35, ±5.9	8.62, ±6.0	0.25
Medications (mean, SD)	12.00, ±6.0	12.68, ±4.8	0.08
MTS 1 – 3 (%)	**89.8**	**94.6**	**0.046**

Table 2: Characteristics of ED presentations for NH residents

The most commonly recorded presenting complaint at ED triage was "generally unwell" (29.9%, n = 154), followed by "fall" (16.1%, n = 83), "breathless" (14.4%, n = 74), "limb problems" (10.9%, n = 56) and "urinary problems" (4.3%, n = 22) [Appendix 1, Supplementary Table 1]. Those in the "generally unwell" group had a higher mean CFS score (6.72 vs 6.47, p = 0.015) and a lower mean BI score (7.63 vs 9.48, p = 0.004) at baseline when compared to those with a specific presenting complaint documented. A higher proportion of the "generally unwell" group were delirious in ED (47.4% vs 26.0%, p <0.001) [Table 3].

	Generally Unwell (n=154)	**Other specific Presenting Complaint (n=361)**	**p value**
Baseline Characteristics (n=515, mean, SD or %)			
Age	75.3, ±10.8	77.2, ±11.0	0.058
CCI	5.14, ±2.3	4.97, ±2.1	0.436
CFS	**6.72, ±0.8**	**6.47, ±0.9**	**0.015**
BI	**7.63, ±6.3**	**9.48, ±5.8**	**0.008**
Medications	13.31, ±5.5	12.35, ±5.2	0.073
Dementia (%)	52.6	45.4	0.135
History of Falls (%)	**40.0**	**59.1**	**<0.001**
ED Attendance (n=515, mean, SD or %)			
OOH (%)	63.0	61.2	0.699
MTS 1 – 3 (%)	90.1	93.9	0.140
Delirium in ED (%)	**47.4**	**26.0**	**<0.001**
ED LOS (hours)	13.4, ±9.3	13.7, ±11.7	0.751
Outcomes (n=515, %)			
Admitted (%)	64.9	60.7	0.368
Reattendance (%)	39.0	31.8	0.114
Case fatality (n=341, %)			
Death at 12 months (%)	**42.8**	**33.7**	**0.048**

Table 3: Characteristics and outcomes for NH residents presenting as "Generally Unwell" vs those with a specific presenting complaint

Delirium, or likely delirium according to 4AT result, was recorded in the ED in 31.8% of all NH resident presentations (n = 164). A higher proportion of those with delirium/likely delirium required immediate – urgent review according to MTS category (98.8% vs 90.6%, p <0.001). Mean MTS and EWS scores were also greater in the delirium/likely delirium group when compared to those without delirium (MTS score 2.3 vs 2.7, p <0.001, EWS score 3.8 vs 2.3, p <0.001). Those with delirium/likely delirium were more likely to be older (78.6 vs 75.7 years, p <0.001) and had higher mean CCI (5.4 vs 4.8, p = 0.004) and CFS scores (6.74 vs 6.43, p <0.001) than those without. A higher proportion of NH residents with delirium/likely delirium were admitted to hospital (81.7% vs 53.4%, p <0.001). At 12 months after presentation, a higher proportion of those with delirium/likely delirium had died (50.6% vs 30.0%, p <0.001) when compared to NH residents who did not have delirium/likely delirium in the ED [Table 4].

	Delirium/ Likely delirium in ED (n=164)	**No delirium (n=351)**	**p value**
Baseline Characteristics (n=515, mean, SD or %)			
Age	**78.6, ±10.5**	**75.7, ±11.1**	**0.005**
CCI	**5.41, ±2.1**	**4.81, ±2.0**	**0.004**
CFS	**6.74, ±1.0**	**6.43, ±0.8**	**<0.001**
BI	8.56, ±5.2	9.09, ±6.4	0.389
Medications	**11.95, ±4.7**	**12.97, ±5.5**	**0.038**
Dementia (%)	**60.1**	**41.7**	**<0.001**
History of Falls (%)	**61.2**	**49.8**	**0.023**
ED Attendance (n=515, mean, SD or %)			
OOH (%)	62.0	61.6	0.930
MTS 1 – 3 (%)	**98.8**	**90.6**	**<0.001**
ED LOS (hours)	**15.8, ±11.2**	**12.7, ±10.8**	**0.003**
Outcomes (n=515, %)			
Admitted (%)	**81.7**	**53.4**	**<0.001**
Reattendance (%)	**37.9**	**26.8**	**0.014**
Case Fatality (n=341, %)			
Death at 12 months (%)	**50.6**	**30.0**	**<0.001**

Table 4: Characteristics and outcomes for NH residents with delirium/likely delirium vs no delirium in the ED

The dementia subgroup (n = 167) had a total of 244 ED attendances and were significantly older than those without a documented dementia diagnosis (79.2 vs 74.3 years, p <0.001). There was no significant difference in the proportion of those in the dementia subgroup requiring immediate - urgent review when compared to those without dementia (91.8% vs 93.9%, p = 0.397). A higher proportion of those with delirium/likely delirium in the ED had a diagnosis of dementia when compared to those without dementia (60.1% vs 41.7%, p <0.001) [Table 5]. A higher proportion of the "generally unwell" group also had a diagnosis of dementia when compared to those with specific presenting complaints, but this was not statistically significant (52.6% vs 45.4%, p = 0.135).

	Dementia (n=167/341)	**No dementia (n=174/341)**	**p value**
Baseline Characteristics (n, % or mean, SD)			
Age	**81.8, ±9.8**	**75.5, ±11.4**	**<0.001**
CFS	**6.8, ±0.8**	**6.4, ±1.0**	**<0.001**
BI	**8.0, ±5.7**	**10.1, ±5.7**	**0.005**
CCI	**5.7, ±1.8**	**4.8, ±2.3**	**<0.001**
Medications	11.7, ±4.7	12.9, ±6.0	0.051
ED Attendance	**Dementia (n=244/515)**	**No Dementia (n=271/515)**	
In hours (%)	38.9	37.6	0.856
OOH (%)	61.1	62.4	0.788
MTS 1 – 3 (%)	91.8	93.9	0.397
Outcomes following ED attendance			
Admission	61.9	62.4	0.911
Reattendance	32.0	35.4	0.408
Death at 12 months (%)	**43.9**	**29.8**	**0.001**

Table 5: Characteristics and outcomes of NH residents with dementia attending the ED

2.3.3 Outcomes following ED attendance

Patients remained in ED for an average of 13.7 hours from the time of attendance (0 – 80.0 hours, SD±11.0). Those with documented delirium/likely delirium spent longer in ED than those without delirium (15.8 vs 12.7 hours, p = 0.003). Over half (61.0%, n = 315) of ED attendances by NH residents resulted in hospital admission. Those admitted had a greater mean age than those discharged from the ED (77.5 vs 75.2 years, p = 0.025) and significantly higher mean CCI scores (5.38 vs 4.40, p <0.001). Admitted NH residents were more acutely unwell according to MTS category (mean 2.34 vs 2.86, p <0.001), had a higher mean EWS score (3.7 vs 1.4, p <0.001) and spent longer in the ED (16.9 vs 8.7 hours, p <0.001) than those discharged to their NH from the ED [Table 6]. For those admitted to hospital, average LOS was 9.7 days (0 – 191 days, SD±8.9). Increased LOS was associated with a higher level of acuity at the time of presentation (p = 0.018). Of the admitted group, 85.4% (n = 269) were discharged back to their NH and 14% (n = 44) died in hospital.

	Admitted (n=315/515)	**ED Discharge (n=200/515)**	**p value**
Baseline Characteristics (n=515, mean, SD or %)			
Age (years)	**77.5, ±10.5**	**75.2, ±11.5**	**0.024**
CCI	**5.4, ±2.2**	**4.4, ±1.8**	**<0.001**
CFS	6.6, ±0.9	6.5, ±0.9	0.277
BI	9.0, ±6.0	8.8, ±6.0	0.760
Medications	12.9, ±5.6	12.2, ±4.9	0.156
Dementia (%)	47.3	47.7	0.937
History of Falls (%)	**46.7**	**65.5**	**<0.001**
ED Attendance (n=515, mean, SD or %)			
OOH (%)	62.4	60.5	0.672
MTS 1 – 3 (%)	**97.8%**	**84.6%**	**<0.001**
Delirium in ED (%)	**42.3**	**15.8**	**<0.001**
ED LOS (hours)	**16.8, ±12.2**	**8.6, ±5.8**	**<0.001**
Outcomes (n=515, %)			
Reattendance	**39.8**	**30.0**	**0.022**
Case Fatality (n=341, %)			
Death at 12 months	**45.0**	**22.6**	**<0.001**

Table 6: Characteristics and outcomes of NH residents attending ED who were admitted to hospital

2.3.4 12-month outcomes

One third of all presentations to ED (33.7%, 174/515) over the study period had at least one reattendance in the 12 months after their initial attendance (mean 2.13 reattendances, range 2 – 12, SD±1.86). The mean time to reattendance was 62.8 days (0 - 334.0 days, SD±68.7) with 44.3% (77/174) of reattendances occurring within 30 days, representing a 30-day reattendance rate of 15.0% (77/515). The majority of reattendances (88.5%, 154/174) occurred within 6 months of ED attendance. A higher proportion of admitted patients reattended when compared to those discharged directly from the ED on initial attendance (39.8% vs 30.0%, p = 0.022). A higher proportion of those with delirium/likely delirium reattended ED within 12 months (37.9% vs 26.8%, p = 0.014). There were no significant differences in the proportion of reattendances between those with and without dementia (32.0% vs 35.4%, p = 0.408) or those with a presenting complaint of "generally unwell" when compared to those with more specific presentations (39.0% vs 31.8%, p = 0.114).

Over half of NH residents attending ED had died 12 months after their most recent ED attendance (55.1%, 188/341) with a 30-day case fatality rate of 18.2% in the cohort (62/341). The mean time from attendance to death was 88.7 days (range 0 – 363 days, SD±98.1). One third of all of those who died, died within 30 days of ED attendance (33.0%, 62/188). Those who died were significantly older (mean 80.4 vs 74.5 years, p <0.001), had higher mean CCI (6.0 vs 4.4, p <0.001) and CFS scores (6.9 vs 6.2, p <0.001) and lower BI scores (7.2 vs 9.9, p <0.001) than those alive at 12 months. A higher proportion of NH residents with a diagnosis of dementia had died at 12 months compared to those without a dementia diagnosis (43.9% vs 29.6%, p <0.001) [Table 7]. Those who had died had higher mean MTS (2.4 vs 2.6, p = 0.006) and EWS scores (3.7 vs 2.2, p <0.001) at presentation. Although the majority were classified as requiring urgent review according to MTS category, there was no significant difference in the proportion between this group and those who were alive at 12 months (92.6% vs 92.0%, p = 0.479). A greater proportion of those recorded as "generally unwell" had died compared to those with a specific presenting complaint (42.8% vs 33.7%, p = 0.048). A higher proportion of those who had died were admitted to hospital from the ED (76.6% vs 53.8%, p <0.001) and had an ED reattendance (37.6% vs 27.1%, p = 0.015) [Table 7]. Approximately half (50.6%, 84/164) of those with documented delirium or likely delirium in ED had died at one year,

representing 44.6% (84/188) of all deaths. This compared to 30.0% of those without delirium (p <0.001) [Table 4, Table 5].

	Death at 12 months (188/341)	Alive 12 months (153/341)	p value
Baseline Characteristics (mean, SD or %)			
Age (years)	**80.4, ±9.6**	**74.5, ±11.1**	**<0.001**
CCI	**6.0, ±2.2**	**4.4, ±1.8**	**<0.001**
CFS	**6.9, ±0.8**	**6.2, ±0.9**	**<0.001**
BI	**7.2, ±5.2**	**9.9, ±6.2**	**<0.001**
Medications	12.5, ±5.1	12.7, ±5.5	0.759
Dementia (%)	**57.2**	**41.9**	**<0.001**
History of Falls (%)	50.6	55.3	0.328
ED Attendance (mean, SD or %)			
OOH (%)	62.8	61.0	0.699
MTS 1 – 3 (%)	92.6%	92.0%	0.479
Delirium in ED (%)	**44.6**	**25.2**	**<0.001**
ED LOS (hours)	14.5, ±11.4	13.2, ±10.8	0.098
Outcomes (mean, SD or %)			
Admitted (%)	**76.6**	**53.8**	**<0.001**
Hospital LOS (days)	10.0	4.3	0.701
Reattendance (%)	**37.6**	**27.1**	**0.015**

Table 7: Characteristics of NH residents who had died at 12 months vs those alive 12 months following ED attendance

2.4 Discussion

This study demonstrates the complexity of NH residents attending the ED, as shown previously [2]. This cohort had high rates of frailty, multimorbidity and polypharmacy. Nearly half had a documented diagnosis of dementia. BI scores showed high levels of functional dependence at baseline. All of these factors contribute to the challenges associating with managing NH residents in the ED. It also highlights the challenges in the use of usual instruments to assess frailty and functional dependence in a NH cohort, who tend to have high levels of both at baseline. Taking this into account, specific instruments have been developed to screen for frailty in NH residents, such as the FRAIL-NH scale [155]. However, all tools, including the CFS

and BI, should be used with caution in the ED and in the context of an acute illness. They carry a risk of overestimating baseline frailty and functional dependence in this setting.

Most NH residents were identified as needing immediate to urgent review (within one hour) at the time of ED attendance according to MTS score, with delirious patients and those requiring hospital admission having a higher level of acuity. A minority of NH residents presented in-hours, which has been demonstrated in other studies although not consistently [156]. In this study, those presenting in-hours had a higher mean CCI score than those presenting OOH. This suggests that decisions to transfer patients in-hours may relate to difficulties in managing acute illness in complex multimorbid residents within a NH setting. Those presenting OOH had lower mean MTS scores, and were more likely to require immediate – urgent review at the time of attendance, indicating greater acute illness severity. This likely contributed to decisions to transfer residents to the ED and suggests these residents are too unwell for appropriate management in the NH. Providing care OOH can be particularly challenging in NHs as there are often lower staffing levels and limited medical input available.

It is difficult to predict which older people are at most risk of adverse outcomes in the ED and this is particularly true for NH residents. There is also limited data on mortality in NH residents following ED presentation. One study reported a mortality rate of 12.2% in NH residents presenting to the ED, where death occurred in ED, in hospital or within 7 days of returning to the NH [52]. Another study reported a 30-day mortality rate of 19.4% in all those aged ≥75 years and older, which is comparable to the 18.2% mortality rate found in our study [157].

Previous evidence showed that the presenting complaint of “generally unwell” or “unwell adult is common in a NH cohort [35]. This presentation has been associated with longer ED LOS, higher rates of hospital admission and increased 30-day mortality rates in older adults in general [158]. In our study, those with the presenting complaint “generally unwell” were more frail and had higher functional dependency at baseline than those with other, specific presenting complaints. They also had higher rates of delirium than those with specific presenting complaints. Although it was associated with an increased 12-month case fatality rate, a non-specific presentation did not have a significant association with other outcomes. Similarly, those with a documented diagnosis of dementia were more frail and comorbid at

baseline, but there was no significant difference between ED LOS, admission or 12-month reattendance rates in this group. A diagnosis of delirium, however, was associated with a significantly longer ED LOS and admission rate, as well as higher 12-month ED representation and case fatality rate. It is important to note that while delirium was associated with an increased ED LOS, it is possible that this related to challenges in bed or ward allocation due to the presence of delirium.

Detecting delirium in NH residents at an early stage may be of greater benefit than prioritising review of those with a non-specific presenting complaint or those with a dementia diagnosis. The 4AT is the recommended screening tool for delirium in EDs nationally, and along with collateral history should allow identification of this high risk group. Education and training of those working in the ED may improve recognition and management of delirium in all patients presenting. Gerontological input in the ED may also help to facilitate this. The identification of delirium at an early stage along with potential precipitants, and use of care pathways may enhance management of NH residents within the ED and their outcomes. Staff education and a focus on delirium-friendly EDs may further contribute to improved outcomes.

The majority of NH residents presenting to ED over the study period were admitted to hospital, in keeping with previous studies [2, 35]. Average hospital LOS was almost 10 days. These results suggest that NH residents required a higher level of care than can be provided in their NH. The development of pathways to reduce time spent in ED for NH residents may be more effective than aiming to avoid the ED entirely. Ensuring specialist gerontological care of NH residents in ED, within the hospital, and appropriate follow up post discharge, is likely to be of use. Furthermore, enhanced liaison between NHs, community services and hospitals, including geriatric and emergency services, may lead to improved outcomes for patients.

The presence of delirium, increased illness acuity, admission and reattendance were all significantly associated with an increased 12-month case fatality rate. At baseline those who died were older, frailer and had higher rates of comorbidity, dementia and functional dependence. It is not surprising that these factors are associated with an increased case fatality rate. It may be beneficial to consider advanced care planning with NH residents, their

families and carers when these characteristics are noted. This can allow timely planning for future care, with individual resident preferences taken into account.

The limitations of this study include the fact that it was conducted at a single centre, though similar admission rates were reported in previous studies in urban Irish tertiary hospitals [2, 159]. The emergence of the first wave of the COVID-19 pandemic disproportionately impacted NH residents. It influenced pre-hospital transfer decisions. In some cases, residents who may ordinarily have been managed on-site were transferred due to limited availability of resources. In others, they were managed in the NH as it was felt a hospital transfer was unlikely to confer benefit, or where outreach services developed to provide increased support [71]. It also led to changes in management and pathways within the ED, which were implemented during the study period, and impacted inpatient mortality. All of these factors may have had an impact on results. However, the pandemic also highlighted the significant vulnerability of this cohort as reflected in our study, and in doing so aided the development of strategies in an effort to improve their care and outcomes.

2.5 Conclusion

NH residents remain a complex cohort who present to ED when acutely unwell and requiring urgent review. Presentations are often non-specific adding to challenges with management of this group. Delirium was associated with poorer outcomes in this cohort including hospitalisation and 12-month mortality. The majority of NH residents attending ED over the course of this study were admitted to hospital with an average LOS of 10 days. Strategies to improve care pathways within the ED and acute hospital, focusing on delirium or other factors associated with adverse outcomes, enhanced gerontological input and improved communication between hospitals and NHs may lead to enhanced care, decreased ED LOS and hospital LOS.

3 Polypharmacy and potentially inappropriate medication prescribing in older nursing home residents attending the Emergency Department

3.1 Introduction

Polypharmacy and potentially inappropriate medication (PIM) prescribing are common in NH residents [160]. Polypharmacy is commonly defined as the prescription of ≥5 medications, with terms including “minor”, “major” and “excessive” sometimes used to further differentiate levels [8, 161]. Polypharmacy of ≥5 medications has been reported in 50 - 73% of NH residents, with frailty, increasing age, functional dependence and cognitive impairment associated with lower rates [8, 9]. Polypharmacy may be appropriate or inappropriate. A potentially inappropriate medication (PIM) has been defined as any medication prescribed where the potential risk outweighs the potential benefit [162]. PIMs have been associated with an increase in ED use in NH residents [163]. Reported rates of PIM prescribing in previous studies of NH residents have reached 95% [11]. In a NH cohort, it is important to consider goals of care when prescribing any medication. Quality of life (QOL) may be more important than prolonged survival. Those working in NHs often recognise the potential adverse impact of polypharmacy and PIMs, but report deprescribing as challenging, as it is time and resource intensive [164].

A number of tools have been developed to assist with medication review and appropriate prescribing in older people. This includes the STOPP/START criteria, initially published in 2008 [165] and updated in 2015 [166]. This tool was developed through a Delphi consensus technique to improve prescribing in older populations, taking into account both PIM prescriptions (Screening Tool of Older Persons’ Prescriptions (STOPP)) and recommended treatments that may have been omitted. (Screening Tool to Alert doctors to Right Treatment (START)). STOPP criteria medications are significantly associated with adverse drug events (ADEs) and, when applied in the acute hospital setting, STOPP/START improved medication appropriateness and reduced ADEs and LOS [166]. STOPPFrail (Screening Tool of Older Persons Prescriptions in Frail adults with limited life expectancy) was also developed through Delphi consensus [167]. This tool is recommended for use in those with end-stage irreversible conditions, poor one-year survival prognosis, severe functional or cognitive impairment or both and when symptom control is the priority as opposed to disease prevention. NH residents are considered part of this population [167]. Beers’ criteria were initially published in 1991 and focused on PIM prescribing in a NH population [162]. Subsequent versions

expanded to include all older adults, with the American Geriatrics Society (AGS) publishing updated guides every three years since 2011 [168] [Appendix 6].

The aim of this study is to review medication prescribing, polypharmacy and PIM prescriptions in NH residents attending the ED, and to analyse associated outcomes.

3.2 Methods

All NH residents aged ≥50 years attending the ED over one year (1 October 2019 – 30 September 2020) were included in the study. Data on patient characteristics and outcomes and details of ED attendance, as previously detailed, were obtained through review of medical records (electronic and hard copy).

Details of medications prescribed at the time of ED attendance were recorded including indication for prescription where available. Medications were classified according to the World Health Organisation (WHO) Anatomical Therapeutic Chemical (ATC) code. Three levels of polypharmacy were analysed: ≥5 medications was considered "polypharmacy" and ≥10 medications as "excessive polypharmacy" [161]. A third subgroup of those on ≥15 medications was also analysed. STOPP version 2, STOPPFrail, and Beers' Criteria (2019) were applied to all individual medications [166-168], with every medication classified as a PIM or non-PIM using each of the three tools. The proportion of PIMs per patient was calculated as a percentage of total medications. The total number of PIM prescriptions for each individual criterion used was also analysed [Appendix 6].

IBM SPSS statistics version 28 was used for all data analysis. Descriptive statistics were reported as means and standard deviations [SDs]. Means were compared using independent t-test. Proportionate comparisons between different groups were calculated using Pearson chi squared test and Spearman's rho as appropriate. Statistical significance considered as $P < 0.05$.

3.3 Results

There was a total of 515 ED attendances by NH residents over the study period. This included 341 individual residents aged ≥50 years, with a mean age of 78.6 years (50 – 103, SD±10.9 years). Over half (56.3%, n = 192) were female. Mean CFS score was 6.6 (3 – 9, SD±0.9), mean BI score 9 (0 – 20, SD±7.8) and mean CCI score was 5.3 (0 – 12, SD±2.1). Prescriptions were available for 93.2% of attendances (480/515) with a total of 6103 individual prescriptions recorded. This included 199 nutritional supplements and 27 non-medication items which were excluded from analysis. A total of 5877 medication prescriptions were included in final analysis. The most commonly prescribed medication group according to WHO ATC was "nervous system", accounting for 32.3% (n = 1898) of all medications prescribed, this was followed by "alimentary tract" (27.8%, n = 1631) and "cardiovascular system" (10.7%, n = 626) medications [Appendix 1, Supplementary Table 2].

A mean of 12.7 (0 – 31, SD±5.24) medications were prescribed per patient. There was an inverse correlation between the number of medications prescribed and increasing age (Spearman's rho = -0.244, p <0.001). Those with a documented diagnosis of dementia were prescribed a mean of 11.9 medications, compared to 13.5 medications for those without dementia (p = 0.001) [Table 8]. There was no significant correlation between the number of medications prescribed and CCI score (Spearman's rho = -0.027, p = 0.565), CFS score (Spearman's rho = -0.033, p = 0.529) or BI score (Spearman's rho = -0.076, p = 0.150).

There was no difference in the mean number of medications prescribed between those presenting in-hours and OOH (12.6 vs 12.8 medications, p = 0.795). NH residents with a history of falls were prescribed fewer medications than those without previous falls (mean 11.9 vs 13.5, p <0.001), but there was no significant difference in mean medications between those in whom "fall" was documented as a presenting complaint and those with other ED presentations (11.8 vs 12.9, p = 0.055). NH residents with delirium/likely delirium in the ED were on fewer medications than those without delirium (mean 11.9 vs 13.1, p = 0.019) [Table 8].

There was no significant difference between the mean number of medications prescribed for NH residents admitted to hospital when compared to those discharged from ED (13.0 vs 12.3, p = 0.212). For those admitted, there was a correlation between number of medications prescribed at baseline and hospital LOS (Spearman's rho = 0.215, p <0.001). When 12-month outcomes were analysed, NH residents who reattended the ED had a higher mean number of medications prescribed (13.4 vs 12.3, p = 0.026) but there was no difference in the mean number of medications between those who were alive and those who had died (12.8 vs 12.7, p = 0.840) [Table 8].

	Yes (mean, SD)	No (mean, SD)	P value
Characteristics			
Dementia	**11.9, ±4.5**	**13.5, ±5.9**	**0.001**
History of falls	**11.9, ±4.5**	**13.5, ±5.8**	**<0.001**
Incontinent	**13.2, ±5.4**	**12.2, ±5.2**	**0.029**
ED Attendance			
In-hours	12.6, ±6.0	12.8, ±4.8	0.795
Delirium in ED	**11.9, ±4.8**	**13.1, ±5.5**	**0.019**
Outcomes			
Admitted	13.0, ±5.5	12.3, ±5.0	0.212
Reattendance	**13.4, ±5.1**	**12.3, ±5.4**	**0.026**
12-month RIP	12.7, ±5.0	12.8, ±5.5	0.840

Table 8: Association of mean medications prescribed with characteristics and outcomes of NH residents presenting to the ED

3.3.1 Polypharmacy

Polypharmacy (≥5 medications) was identified in 95.6% of prescriptions (n = 460) in this cohort. "Excessive polypharmacy" (≥10 medications) was seen in the majority of participants (72.3%, n = 348) with one-third (33.7%, n = 162) prescribed ≥15 medications. The mean age of those in all polypharmacy groups was significantly lower than those without polypharmacy. The mean age of those in the "polypharmacy" group was 76.2 years compared to 83.2 years,

in those without polypharmacy (<5 medications) (p <0.001), 75.1 years for those in the "excessive polypharmacy" group compared to 80.0 years for those prescribed <10 medications (p <0.001) and 74.3 years versus 77.6 years (p = 0.001) when ≥15 medications was used as a cut-off. Those in the "polypharmacy" group had a higher mean CCI score (6.5 vs 4.8, p = 0.009) and lower mean BI score (8.4 vs 13.6, p = 0.003) than those prescribed <5 medications, indicating higher levels of multimorbidity and functional dependence, though this was not seen in the "excessive polypharmacy" group [Table 9].

The majority of those presenting OOH had polypharmacy (≥5 medications) identified (97.3%, n = 286). A higher proportion of those in the "polypharmacy" group presented OOH when compared with those prescribed <5 medications (62.2% vs 40.0%, p = 0.046), this was also true for those in the "excessive polypharmacy" group when compared to <10 medications (64.7% vs 52.3%, p = 0.013). More than three-quarters of those presenting OOH were in the "excessive polypharmacy" group (76.5%, n = 225). There was no significant difference in the proportion of NH residents presenting OOH versus in-hours when ≥15 medications was used as a cut-off (61.1% vs 61.3%, p = 0.964). Those in the "polypharmacy" group had a higher level of acuity at presentation according to MTS score (2.4 vs 2.8, p = 0.049). This was not seen in the "excessive polypharmacy" group or when ≥15 medications were examined [Table 9]. The majority of those with delirium in ED were in the polypharmacy group (94.4%, n = 151) with 69.4% (n = 111) in the "excessive polypharmacy" group, although there was no statistically significant difference identified between groups (p = 0.261 for polypharmacy, p = 0.287 for excessive polypharmacy). Those in the "polypharmacy" group had a longer mean ED LOS than those with <5 medications prescribed (14.0 vs 10.8 hours, p = 0.035).

There was no significant difference in admission rates in the "polypharmacy" group, "excessive polypharmacy" group or when ≥15 medications was used as a cut-off, but those in all groups had a higher mean inpatient LOS (10.1 vs 5.4 days, p = 0.015 for polypharmacy vs <5 medications; 10.8 vs 7.2 days, p = 0.009 for excessive polypharmacy vs <10 medications; 12.5 vs 8.3 days, p = 0.035 for ≥15 vs <15 medications). There was no significant difference in 12-month mortality in any group [Table 9].

Number of Medications	<5 n=20	≥5 (n=460)	p value	<10 n=132	≥10 (n=348)	p value	<15 (n=318)	≥15 (n=162)	p value
Baseline (mean, SD)									
Age (years)	**83.2, ±6.4**	**76.2, ±11.0**	**<0.001**	**80.1, ±9.7**	**75.1, ±11.1**	**<0.001**	**77.6, ±11.4**	**74.3, ±9.8**	**0.001**
CCI	**4.8, ±2.3**	**6.5, ±2.3**	**0.009**	5.0, ±2.2	4.9, ±3.2	0.671	4.9, ±2.1	5.0, ±2.6	0.726
CFS	6.7, ±1.2	6.2, ±1.6	0.149	6.2, ±1.8	6.3, ±1.4	0.942	6.3, ±1.5	6.1, ±1.7	0.149
BI	**13.6, ±5.4**	**8.4, ±6.1**	**0.003**	9.3, ±6.5	8.3, ±6.0	0.208	8.9, ±6.1	8.1, ±6.3	0.251
ED Attendance (mean, SD or %)									
OOH (%)	**40.0**	**62.2**	**0.046**	**52.3**	**64.7**	**0.013**	61.3	61.1	0.964
MTS	**2.8, ±0.8**	**2.4, ±0.8**	**0.049**	2.5, ±0.9	2.5, ±0.7	0.879	2.5, ±0.8	2.4, ±0.8	0.094
Outcomes (mean, SD or %)									
Admitted (%)	60.0	63.3	0.933	59.1	64.7	0.157	60.4	68.5	0.18
LOS (days)	**5.4, ±5.3**	**10.1, ±14.0**	**0.015**	**7.2, ±7.8**	**10.8, ±15.2**	**0.009**	**8.3, ±8.1**	**12.5, ±19.8**	**0.035**
12-month reattendance (%)	30.0	36.3	0.565	**28.8**	**38.8**	**0.041**	33.6	40.7	0.126
12-month RIP (%)	25.0	33.1	0.67	31.8	35.1	0.504	36.2	30.2	0.196

Table 9: Polypharmacy, characteristics and outcomes

3.3.2 Potentially Inappropriate Medications (PIMs)

At least one PIM was identified in 99.0% (n = 475) of participant prescriptions reviewed according to STOPP version 2, in all participants (100.0%, n = 480) according to STOPPFrail and 97.5% (n = 468) according to Beers' criteria. The mean proportion of medications per patient classified as PIMs was 59.1% (0 – 100%, SD±18.7%), 68.9% (0 – 100%, SD±18.3%) and 35.0% (0 – 100%, SD±17.2%) according to STOPP version 2, STOPPFrail and Beers' Criteria respectively. The most common reason for medications to be classified as potentially

inappropriate was a lack of documented evidence-based clinical indication. Over half (52.8%, n = 3103) of all medications prescribed did not have a clear indication documented in their transfer documentation or in hospital medical records. This was most commonly seen in central nervous system (CNS) drug prescriptions (30.6%, n = 950), followed by alimentary system drugs (29.8%, n = 924) and blood and blood forming-organ medications (9.8%, n = 305).

3.3.2.1 STOPP version 2

On review of individual criteria, in addition to the 3103 medications without a documented evidence-based clinical indication, there were 2733 individual medication prescriptions considered potentially inappropriate according to STOPP version 2. The most commonly noted group of PIMs using this tool were drugs that "predictably increase the risk of falls in older people" (n = 717). This included neuroleptic drugs (50.8%, 364/717), benzodiazepines (31.2%, 224/717) and hypnotic z-drugs (16.3%, 117/717). The next most common group of PIMs were gastrointestinal system medications (n = 700). This included drugs likely to cause constipation (57.3%, 401/700) and proton pump inhibitor (PPI) prescriptions for a duration of over 8 weeks (42.3%, 296/700). The third most common group of PIMs was CNS and psychotropic drugs. Following benzodiazepines, there were 139 PIM prescriptions for neuroleptic antipsychotic medications in patients with behavioural and psychological symptoms of dementia (BPSD) and 80 PIMs involving anticholinergics/antimuscarinics in patients with delirium or dementia [Appendix 1, Supplementary Table 3].

There was a higher mean proportion of medications classified as PIMs according to STOPP version 2 in those with a history of falls (61.2% vs 57.1%, p = 0.014), although not in those presenting to ED with a fall when compared to other presentations (60.0% vs 58.9%, p = 0.603). Those presenting as "generally unwell" had a lower mean proportion of PIMs than those with specific presenting complaints (56.5% vs 60.3%, p = 0.029) and a lower mean proportion of PIMs were also seen in those who had died at 12 months compared to those alive at 12 months (54.5% vs 61.5%, p <0.001) [Table 10]. There was a correlation between proportion of PIMs according to STOPP version 2 and BI score (Spearman's rho = 0.141, p = 0.007) and an inverse correlation with CFS (Spearman's rho = -0.203, p <0.001) and CCI scores

(Spearman's rho = -0.245, p <0.001) as well as hospital LOS (Spearman's rho = -0.125, p = 0.032).

	Yes (mean, SD)	No (mean, SD)	p
Baseline			
Dementia	59.2, ±18.1	59.0, ±19.2	0.916
Falls history	**61.2, ±18.5**	**57.1, ±18.6**	**0.014**
Incontinent	57.5, ±17.9	60.7, ±19.4	0.060
ED Presentation			
In hours	59.9, ±20.2	58.6, ±17.7	0.456
"Generally Unwell"	**56.5, ±16.9**	**60.3, ±19.4**	**0.029**
Fall presentation	58.9, ±19.0	60.0, ±17.3	0.603
Delirium in ED	57.5, ±17.9	59.9, ±19.0	0.188
Outcomes			
Admitted	58.2, ±18.7	60.4, ±18.4	0.199
Reattendance	59.3, ±19.1	58.7, ±18.0	0.709
RIP	**54.5, ±19.0**	**61.5, ±18.1**	**<0.001**

Table 10: STOPP version 2: the association of % of total medications classified as PIMs with characteristics and outcomes of NH residents attending ED

3.3.2.2 STOPPFrail

When using STOPPFrail, there were 1934 PIM prescriptions in addition to medications without a documented indication (n = 3103). Due to limitations of documentation available, it was not possible to ascertain where "the patient persistently fails to take or tolerate despite adequate education and consideration of all appropriate formulations", and this category was excluded. The most common PIMs were found in gastrointestinal system medications (n = 331). This included PPI prescriptions (89.4%, 296/331) and gastrointestinal antispasmodics (7.6%, 25/331). The next most common group of PIMs were musculoskeletal system medications (n = 288), including calcium supplementation (52.1%, 150/288) and anti-resorptive/anabolic drugs for osteoporosis (27.8%, 80/288). There were 177 PIMs noted in the CNS group, including neuroleptic antipsychotics (78.5%, 139/177) and memantine (21.5%, 38/177) [Appendix 1, Supplementary Table 4].

A significantly higher proportion of medications were classified as PIMs according to STOPPFrail in those with a documented history of falls compared to those without (70.7% vs 67.2%, p = 0.039), although not in those presenting to ED with a fall when compared to those with another documented presenting complaint (70.3% vs 68.6%, p = 0.454). A higher proportion of PIMs were noted in NH residents who were continent compared to those with incontinence (71.9% vs 65.8%, p <0.001). NH residents with "generally unwell" recorded as a presenting complaint had a lower proportion of PIMs when compared to those with specific presentations (65.4% vs 70.6%, p = 0.003). There was also a lower proportion of PIMs in those who had died at 12 months when compared to those alive at 12 months (64.8% vs 71.0%, p <0.001) [Table 11]. There was a correlation between the proportion of medications classified as PIMs according to STOPPFrail and CFS (Spearman's rho = 0.270, p <0.001) and CCI scores (Spearman's rho = 0.179, p <0.001), and an inverse correlation with BI score (Spearman's rho = -0.145, p = 0.006).

	Yes (mean, SD)	No (mean, SD)	p
Baseline			
Dementia	67.9, ±18.4	69.9, ±18.2	0.233
Falls history	**70.7, ±19.0**	**67.2, ±17.3**	**0.039**
Incontinent	**65.8, ±18.6**	**71.9, ±17.5**	**<0.001**
ED Presentation			
In hours	70.0, ±19.3	68.3, ±17.6	0.319
"Generally Unwell"	**65.4, ±17.3**	**70.6, ±18.5**	**0.003**
Fall presentation	70.3, ±18.3	68.6, ±18.1	0.454
Delirium in ED	67.6, ±18.9	69.6, ±18.0	0.291
Outcomes			
Admitted	68.2, ±18.4	70.2, ±18.0	0.250
Reattendance	66.7, ±18.9	70.1, ±17.8	0.068
RIP	**64.8, ±18.1**	**71.0, ±18.0**	**<0.001**

Table 11: STOPPFrail: the association of % of total medications classified as PIMs with characteristics and outcomes of NH residents attending ED

3.3.2.3 Beers' Criteria

On review of PIMs according to Beers' criteria, there were 3860 indications for PIM prescribing, and an additional 1429 potential drug-drug interactions. "Potentially Inappropriate Medication Use in Older Adults Due to Drug-Disease or Drug-Syndrome" was the most common category of PIM prescriptions using Beers' criteria. This included 1563 medications. CNS drugs were the most common PIMs in this category, including 915 PIMs for those at risk of delirium and 226 for those living with dementia. There were 175 PIMs in participants with a history of falls or fractures.

There were 1429 individual drug prescriptions identified as potentially inappropriate due to "Potentially Clinically Important Drug-Drug Interactions". There were 335 patients in this group, of whom 70.7% (237/335) were prescribed three or more medications from the following drug classes: antidepressant, antipsychotic, antiepileptic, benzodiazepine, z-drug and opioid. There were 1125 prescriptions considered "Potentially Inappropriate for older adults", most commonly CNS agents (n = 695), including antipsychotic medications (52.4%, 364/695) and z-drugs (16.8%, 117/695), followed by gastrointestinal drugs (n = 299), most commonly PPIs (99.0%, 296/299).

The next most common category for PIM prescriptions was "Drugs To Be Used With Caution in Older Adults" which included 934 PIMs. Antipsychotics were the most frequent subgroup of medications in this category (39.0%, 364/934), followed by SSRIs (15.8%, 148/934) and diuretics (11.9%, 111/934). There were 173 PIM of medications with strong anticholinergic properties. Antipsychotic prescriptions accounted for 44.5% (77/173) of this group, followed by antimuscarinics (26.6%, 46/173) and antiemetics (13.9%, 24/173). There were 65 PIMs in the category "Medications That Should Be Avoided or Have Their Dosage Reduced With Varying Levels of Kidney Function in Older Adults", most commonly apixaban (29.2%, 19/65) [Appendix 1, Supplementary Table 5].

There was no significant difference in the proportion of medications classified as PIMs according to Beers' criteria in those with non-specific ("generally unwell") vs specific presenting complaints (33.4% vs 35.8%, p = 0.145). Patients with documented delirium/likely

delirium had a lower proportion of PIMs when compared to those without (31.7% vs 36.8%, p = 0.001), as did those admitted to hospital (33.2% vs 38.1%, p = 0.003). Those who died at 12 months had a lower proportion of medications classified as PIMs at the time of ED attendance than those who were alive (29.5% vs 37.6%, p <0.001) [Table 12]. There was an inverse correlation between the proportion of PIMs and CCI score (Spearman's rho = -0.223, p <0.001) and age (Spearman's rho = -0.214, p <0.001).

	Yes (mean, SD)	No (mean, SD)	p
Baseline			
Dementia	34.6, ±15.5	35.4, ±18.7	0.293
Falls history	36.0, ±16.9	34.1, ±17.7	0.229
Incontinent	34.3, ±15.2	35.8, ±19.1	0.350
ED Presentation			
In hours	35.5, ±18.4	34.7, ±16.5	0.640
"Generally Unwell"	33.4, ±15.4	35.8, ±18.0	0.145
Fall presentation	34.8, ±17.5	35.1, ±17.2	0.902
Delirium in ED	**31.7, ±14.3**	**36.8, ±18.3**	**0.001**
Outcomes			
Admitted	**33.2, ±16.5**	**38.1, ±18.0**	**0.003**
Reattendance	36.4, ±16.2	34.2, 17.9	0.082
RIP	**37.6, ±17.8**	**30.1, ±15.0**	**<0.001**

Table 12: Beers' Criteria: the association of % of total medications classified as PIMs with characteristics and outcomes of NH residents attending ED

3.4 Discussion

This study demonstrates the significant burden of polypharmacy and PIMs on older NH residents. It demonstrates the challenges associated with managing medication prescribing and deprescribing in this cohort. The vast majority of patients (95.8%) were prescribed ≥5 medications, which is the most common definition of polypharmacy and three-quarters were classified as having "excessive polypharmacy" (≥10 medications). In addition to this, at least one PIM prescription was identified in 97.5 – 100.0% participants using three tools designed for screening older populations.

Younger age was associated with a higher likelihood of polypharmacy, "excessive polypharmacy" and being prescribed ≥15 medications. It was also associated with a higher proportion of PIMs according to Beers' criteria, although not STOPP version 2 or STOPPFrail. Similar trends have been reported in previous studies, for example co-prescribing of cholinesterase inhibitors and anticholinergics was reported more frequently in younger patients living with dementia, with limited discontinuation of anticholinergics noted in this population [169]. This may be due to changing goals of treatment, with older age prompting medication review and deprescribing. High rates of frailty and multimorbidity are seen in NH populations in general and deprescribing should also be considered in younger residents when reviewing goals of care.

This study also shows the complexity of reviewing PIM prescriptions in older NH residents, with variation in PIMs depending on the screening tool used. Both STOPP version 2 and Beers' Criteria identified neuroleptic or CNS-acting medications as the most common PIMs prescribed. Previously, it has been shown that prescribing varies between NHs. A scoping review reported antipsychotic and anticholinergic use was more common in NHs with lower nursing ratios, with case mix also impacting antipsychotic use [170] [171]. This suggests deprescribing can be impacted by both staffing and resident factors. Studies have shown deprescribing is more likely in those with severe cognitive impairment and when more medications were prescribed at baseline [172]. Our study demonstrated a trend towards reduction in the number of medications prescribed in those with dementia and those presenting as "generally unwell". A lower proportion of PIMs were identified according to Beers' criteria in those admitted to hospital and in those with delirium in ED. NH residents who were continent had a higher proportion of PIMs prescribed according to STOPPFrail. Participants who were alive at 12 months had a greater proportion of PIMs according to all three tools. This suggests that medication review may be more likely in certain clinical conditions and situations but also highlights the fact that PIM prescriptions may be appropriate. A history of falls was associated with a higher proportion of PIMs using both STOPP version 2 and STOPPFrail criteria, although there was no difference in the mean number of medications prescribed in those presenting to ED with a fall when compared with other presentations. This also demonstrates the importance of regular individual medication review.

Ongoing education around prescribing across settings is required, regardless of the presence or level of polypharmacy. There were differences between the three tools used in this study, with a lower proportion of medications classified as PIMs according to Beers' Criteria. It is important to identify the correct tool for individual NH residents and recognising that they are screening tools to be used in conjunction with clinical judgement, as not all PIMs are truly inappropriate. Previous strategies to improve prescribing in NHs have included individualised medication review, which was found to result in a significant reduction in prescribing medications for NH residents when compared to those living with multimorbidity in the community [173]. Having a geriatrician as a part of NH facility staff has been associated with deprescribing [172]. The presence of an ongoing pharmacist service in NHs was found to lead to a recommendation to reduce medication use in 61% and had a significant impact on cognitive decline, although not functional decline, at 12 months [174]. A number of studies have discussed potential unintended consequences of deprescribing strategies. This has included an increase in the use of antidepressants and potentially inappropriate antiepileptic medications following a reduction in the rate of antipsychotic prescribing [175, 176] [177, 178].

There were a number of limitations associated with this study. It is a single site study. Full medication prescriptions were not available for all NH residents attending the ED and there was limited information on dosage or compliance with medications prior to presentation. The small number of patients in the non-polypharmacy (<5 medication) group limits interpretation of results but suggests that a higher cut-off for "polypharmacy" in NH residents may be necessary to examine the impact of polypharmacy on this cohort. Factors apart from polypharmacy and PIMs may have influenced outcomes, as NH residents are well-recognised as a complex cohort.

3.5 Conclusion

Polypharmacy and PIM prescriptions are common in NH cohorts. Multiple factors relating to individual residents as well as NH structure and governance likely contribute to this. Increasing awareness of the risks associated with polypharmacy and PIMs, as well as discussing goals of care with patients and families may reduce rates of both. However, PIM prescriptions are not always inappropriate. A NH resident ED presentation should prompt medication review. Developing enhanced communication between NHs, acute hospitals and primary care is required to ensure that residents, families and those working with NH residents across all sites are aware of changes, recommendations and the rationale behind them.

4 The impact of the COVID-19 pandemic on nursing home residents and staff: Asymptomatic carriage rates and case fatality of SARS-CoV-2 infection in residents and staff in Irish nursing homes

4.1 Introduction

SARS-CoV-2 and the related illness COVID-19 has disproportionately affected nursing homes (NH) since emerging in late 2019 [179]. NH residents are among the frailest in society, with multiple co-morbidities and high levels of care needs. NHs vary in size, staffing, governance and integration with wider health systems locally, nationally and internationally [180]. Policies on testing and reporting of COVID-19 in NHs differ between countries. Care home residents accounted for 53 – 82% of COVID-19-related deaths where confirmed and probable deaths are reported (Belgium, Canada, France, Ireland) [179]. Guidance published for long-term care facilities on infection prevention and management in the context of COVID-19 can be challenging to implement due to variability in facilities [181, 182].

Ireland has a 'mixed market' of NH provision. Public NHs, owned and operated by the government-funded Health Service Executive (HSE), and private NHs, by individual providers/provider entities. All are registered with the Health Information and Quality Authority and comply with regulations for standards of care [31]. There were 31,220 beds across 581 NHs in December 2018: the majority private NHs with approximately 25,000 residents and 121 (21%) public NHs with approximately 5,000 residents [183].

The first laboratory-confirmed COVID-19 case in Ireland occurred in the community on 29 February 2020 [184]. The first COVID-19 NH clusters were reported on 16 March 2020. The incidence of COVID-19 in long-term care residents in Ireland was 133/1,000 on 6 May 2020. As of 20 May 2020, 258 NH clusters were reported accounting for 4,872 cases and 851 deaths. The national COVID-19-related case-fatality figure for NH residents aged ≥70 years was 21% [184]. This may be an underestimate, failing to capture earlier attributable deaths.

Given emerging evidence on the impact of COVID-19 on NHs and on asymptomatic infection, the HSE directed a National Ambulance Service-led testing protocol in NHs followed by a national point-prevalence COVID-19 mass testing programme of all residents and staff in NHs from 18 April 2020 to 5 May 2020. Following this, systematic testing was completed at 2 week intervals as new NH COVID-19 cases were identified.

This study aimed to measure the impact of COVID-19 on NH residents and staff through analysing the proportion of NHs with a COVID-19 outbreak, the proportion of residents and staff members with laboratory-confirmed COVID-19 infection (symptomatic and asymptomatic) and outcomes for residents following COVID-19 infection. It also aimed to investigate the effect of outbreak timing and the potential impact of concurrent mass testing on outcomes.

4.2 Methods

An information sheet and survey document was distributed to lead Nursing and/or Medical Officers in 45 NHs across three CHOs, followed by a telephone call to obtain consent and aid survey completion, ensuring correct interpretation of information. The survey was administered on one occasion, with data requested from 29 February 2020 to 22 May 2020 and deadline for returns set for 29 May 2020. Responses were anonymised with no site, resident or staff identifiers requested or retained.

Details were requested on NH occupancy (29 February 2020), total bed numbers, proportion of single rooms, COVID-19 outbreak details, date of first laboratory-confirmed COVID-19 resident and/or staff member, total symptomatic/asymptomatic cases and residents' clinical outcomes. Symptoms were defined as per public health guidance (cough, fever, dyspnoea) and 'new-onset' symptoms the medical officer/general practitioner felt reflective of emerging information on atypical symptoms. Asymptomatic cases (without symptoms 7 days either side of test) were identified in the national point-prevalence testing programme of residents and staff (18 April 2020 to 5 May 2020). Mass testing occurred on one occasion at each NH during this time and is systematically repeated at 2 week intervals where new COVID-19 cases were identified.

Laboratory-confirmed cases were those with 'detected' SARS-CoV-2 by real-time reverse transcription-polymerase chain reaction (RT-PCR) testing on nasopharyngeal swabs. Suspected cases were based on senior medical/nursing opinion of COVID-19 symptoms but resident unable/unwilling to complete testing or isolated awaiting results. COVID-19 deaths were those where confirmed/suspected COVID-19 was recorded as the official cause of death.

Recovery was defined as an individual no longer in isolation; as per public health guidelines confirmed/suspected symptomatic individuals remained in isolation for 14 days (last 5 days without pyrexia) or for 14 days from testing date in the case of asymptomatic individuals.

For inclusion in analysis, an outbreak was defined as ≥1 resident with laboratory-confirmed COVID-19. NHs with one to two staff members and no residents affected were not considered outbreaks on the basis that infection may have been acquired outside of the NH setting. An 'active' outbreak was defined as being within 28 days of symptom onset for most recent laboratory-confirmed case in a resident/staff member.

Data are reported as proportions (and percentages) and mean/median with standard deviation/interquartile ranges (IQR) as appropriate. Data on NH size (number of beds: <50, 51 – 100, >100) and occupancy (percentage of beds: <75, 75 – 85, 86 – 95, >95%) were categorised for between-group analysis. Median time from first confirmed COVID-19 case in Ireland to first case in included NHs was used to distinguish between 'early' and 'late' outbreaks in context of the first wave of pandemic. Comparisons of proportions between groups were carried out using a Chi-square statistic. Spearman Rank correlations were used to analyse correlations between variables. The World Medical Association—Declaration of Helsinki Ethical Principles were followed, adhering to all standards in the acquisition, anonymisation and reporting of data through consultation with the local research ethics committee [185].

4.3 Results

Complete surveys were returned from 62.2% (28/45) of NHs representing 2,043 residents in 2,303 beds (median occupancy 96.7%, IQR 86.0 – 96.6%) on 29 February 2020. During the 83-day study period, 15.3% (312/2043) of residents died.

The first laboratory-confirmed case of COVID-19 in this series was on 16 March 2020. Median time from first COVID-19 infection in Ireland to first recorded cases in NHs (staff/residents) in this series was 27.0 days (IQR 22.5 – 40.5). Four recorded no cases in staff/residents. Three

further NHs had ≤2 staff members and no residents with COVID-19. The remainder (21/28, 75.0%) were managed as active outbreaks and included in the study. There were 1,741 residents in 1,972 beds across these sites (median occupancy rate 96.7%, IQR 86.0 – 98.6%) on 29 February 2020. Of resident deaths recorded, 96.2% (300/312) occurred in 'outbreak' NHs with a mortality rate of 17.2% (300/1741).

4.3.1 Outbreak NH Profile

An outbreak was recorded in 75.0% (21/28) of facilities: 4 public and 17 private. Occupancy rates at the start of the study period were 95.1% and 87.7% in public and private NHs respectively, decreasing to 75.2% in public and 73.2% in private NHs by 22 May 2020 [Table 13]. Eight NHs (38.1%) had ≥80% single rooms in line with regulatory standards [186]. There was no association between adherence to this standard and outbreak occurrence ($\chi 2 = 1.37$, $P = 0.24$).

	Public (n = 4)	**Private (n = 17)**	**Total (n = 21)**
Occupancy rate			
29 February 2020	95.1%, 157/165	87.7%, 1,584/1,807	88.3%, 1,741/1,972
%, n (median, IQR)	(98.1%, 94.9–100%)	(97.6%, 85.1–98.6%)	(97.8%, 86.0–98.8%)
22 May 2020	75.2%, 124/165	73.2%, 1,322/1,807	73.3%, 1,446/1,972
%, n (median, IQR)	(72.3%, 60.2–85.2%)	(80.3%, 69.4–86.7%)	(80.3%, 65.7–86.7%)
NH Size (%, n)			
< 50 beds	4/4	1/17	5/21
50 – 100 beds	0/4	7/17	7/21
≥100 beds	0/4	9/17	9/21

Table 13: COVID-19 Outbreak NH Profile

4.3.2 COVID-19 in NH Residents

During the study period, 40.8% (710/1741) of residents in 21 NHs with outbreaks had laboratory-confirmed COVID-19 and 3.1% (54/1741) clinically suspected COVID-19, giving a total prevalence of 43.9% (764/1741). Over a quarter of residents with laboratory-confirmed COVID-19 were asymptomatic [Table 14].

	Confirmed	**Suspected**	**Total**
COVID-19 infection (% total residents)	40.8%	3.1%	43.9%
	(710/1,741)	(54/1,741)	(764/1,741)
Asymptomatic (% confirmed COVID-19)	27.2%	N/A	27.2%
	(193/710)		(193/710)
Case Fatality	25.8%	3.7%	27.6%
	(183/710)	(28/764)	(211/764)

Table 14: COVID-19 infection in NH residents

The case-fatality rate (CFR) was 25.8% (183/710) in those with laboratory-confirmed COVID-19. When clinically suspected cases were included, overall CFR was 27.6% (211/764) reflecting almost three-quarters (70.3%; 211/300) of deaths recorded in these NHs. Across 18 NHs with COVID-19-related deaths, the median proportion of total residents (as per occupancy 29 February 2020) who died as a result of confirmed/suspected COVID-19 was 15.0% (range 13.1 – 19.4%). Non-COVID-19 mortality was similar in outbreak-affected and unaffected NHs (5.1% [89/1741] versus 4.0% [12/300] $\chi 2 = 0.71$, $P = 0.40$).

Comparisons of resident outcomes between public and private NHs are biased by low numbers of public NHs included (5/28, 17.9%). However, there were significantly more residents with confirmed/suspected COVID-19 in 4 public (106/157; 67.5%) versus 17 private (620/1,500; 41.3%) 'outbreak' NHs ($\chi 2 = 39.6$; $P < 0.001$). Similarly, case fatality attributable to COVID-19 was significantly higher in public NHs (35/157; 22.3% vs 168/1,500; 11.2%; $\chi 2 = 16.2$; $P < 0.001$).

In 11 NHs (11/21, 52.4%) with a first confirmed COVID-19 case 'early' in the course of the pandemic, 45.4% of residents developed confirmed/suspected infection, compared with 42.1% in NH with a 'late' first case. NHs with 'early' outbreaks had a higher number of deaths expressed as a proportion of total residents but similar CFR for residents with confirmed/suspected COVID-19 as NHs with 'late' outbreaks [Table 15].

By 29 February 2020, 55.8% (396/710) of residents with laboratory-confirmed COVID-19 had recovered. A lower proportion had recovered in NHs with 'early' outbreaks compared with NHs with 'late' outbreaks. A greater proportion of residents remained in isolation in the 'early' versus 'late' group [Table 14]. Six NHs (6/21, 28.6%) had no residents with confirmed/suspected COVID-19 in isolation at the end of the study period; two (18.1%; 2/11) in the 'early' and four (40.0%; 4/10) in the 'late' outbreak group.

In 10 'COVID-19 outbreak' NHs reporting total staffing levels, the median proportion of residents with confirmed/suspected COVID-19 was 43.7% (IQR 34.6 – 53.4%) overall. Two had a staff/resident ratios <1, six of 1 – 2 and two with >2 staff members per resident. NHs with staff/resident ratios of <1, 1 – 2 and >2 had a median of 46.7% (IQR 33.0 – 60.5%), 48.5% (IQR 36.3 – 53.4%) and 40.3% (IQR 39.4 – 41.3%) of residents with confirmed/suspected COVID-19, respectively. NHs with staff/resident ratios of <1, 1 – 2 and >2 had median CFR of 52.0% (IQR 45.3 – 59%), 24.8% (IQR 22.5 – 28.1%) and 10.9% (IQR 9.5 – 15.6%), respectively.

	Early outbreak (<28 days)	Late outbreak (≥28 days)	
Resident Outcomes			
Total residents confirmed/suspected COVID-19 infection	45.4% (425/936)	42.1% (339/805)	$\chi2 = 2.16$, $P = 0.14$
Confirmed/suspected COVID-19 deaths (% total residents)	13.5% (126/936)	10.6% (85/805)	$\chi2 = 3.42$, $P = 0.06$
CFR	29.7% (126/425)	25.1% (85/393)	$\chi2 = 1.14$, $P = 0.29$
Residents recovered from COVID-19	37.4% (159/425)	61.7% (209/339)	$\chi2 = 56.9$, $P < 0.001$
Residents remaining in isolation	32.9% (140/425)	13.3% (45/339)	$\chi2 = 15.2$, $P < 0.001$
Staff Outcomes			
Total staff members confirmed COVID-19 in 10 'outbreak' NH where total staffing reported (n, %)	33.6% (236/703)	28.9% (159/524)	$\chi2 = 1.43$, $P = 0.23$
Asymptomatic staff members confirmed in 10 'outbreak' NH where total staffing reported	21.6% (51/236)	28.9% (46/159)	$\chi2 = 2.75$, $P = 0.10$

Table 15: Residents and Staff outcomes with COVID-19 infection in NHs with early versus later pandemic outbreaks

4.3.3 COVID-19 in NH Staff

Twelve NHs (42.9%, 12/28) reported information relative to total staffing (all grades) with a total of 1,392 working across these sites. Over a quarter (29.0%, 403/1,392) had confirmed/suspected COVID-19. Almost a quarter of those confirmed were asymptomatic (24.7%, 99/398).

In total, 10 of these 12 NHs (83.3%, 10/12) met outbreak criteria (one had no staff/residents with COVID-19, another two staff but no residents infected). In those NHs, 32.2% (395/1227) of staff had confirmed/suspected COVID-19. Approximately a quarter were asymptomatic (24.6%; 97/395). The median proportion of staff with COVID-19 per outbreak site was 31.1%; (IQR 23.2 – 40.6%), with 19.6% (IQR 11.8 – 52.3%) asymptomatic. There was a significant correlation between the proportion of staff with symptomatic COVID-19 and number of residents with confirmed/suspected COVID-19 (Spearman's rho = 0.81, $P < 0.001$) but not between the proportion of asymptomatic staff and number of residents with confirmed/suspected COVID-19 (Spearman's rho = 0.18, P = 0.61).

Total staffing was reported in six NHs (6/10, 703 staff) with 'early' and four (4/10, 524 staff) with 'late' outbreaks. Approximately one-third of staff in 'early outbreak' NHs (33.3%; 236/703,) and 30.3% (159/524) in 'late outbreak' NHs had confirmed/suspected COVID-19. Less than a quarter of staff (21.6%; 51/236) in 'early outbreak' NHs were asymptomatic, compared with 28.9% (46/159) in those with 'late' outbreaks, though this difference was not statistically significant ($\chi 2 = 2.75$, P = 0.10) [Table 14].

4.4 Discussion

This large epidemiological study of NHs, residents and staff demonstrates the disproportionate impact of COVID-19 on this part of the health sector. Within 21 NH outbreak clusters in this report, 43.9% of residents had COVID-19 over the 12-week period (83 days). Additionally, 29.0% of staff had COVID-19 in 10 'outbreak' NHs reporting total staffing. Mass point-prevalence and contact-tracing testing revealed asymptomatic/pre-symptomatic

infection in 27.2% of residents and 24.7% of staff with COVID-19. Overall staffing ratios appeared to impact on CFRs across sites.

The CFR due to suspected/confirmed COVID-19 in residents was 26.7%, in contrast to the overall Irish national CFR (as of 6 June 2020) of 5.6%, almost half of which are deaths attributable to NH residents. This bias in the recording of national case fatality has led some commentators to suggest NH-related mortality should be examined separate to other community deaths [187]. NH residents have increased co-morbidities and frailty. Much of the increased mortality risk is associated with these factors. Usual annualised morality rate of residents is estimated at 31.8% typically equating to an expected rate of 7.2% over 83 days [17]. In the 83 days of this study, the mortality rate was 15.3% overall and 17.2% in 'COVID-19-outbreak' NHs, more than double the normal expected rate. With regard to international comparisons on NH COVID-19 infection rates and case fatality, results are consistent with a report on 89 residents from a US facility, with an infection rate of 64% and CFR of 26%, and a series from 394 residents in four UK NHs with an infection rate of 40% and CFR of 26% [188, 189]. In the UK series, 43% of residents and 4% of staff were asymptomatic.

This was the first report to investigate the effect of outbreak timing and the potential impact of concurrent mass testing on outcomes. Earlier in the pandemic, testing was on the basis of symptoms. There were significant challenges accessing timely testing, personal protective equipment availability and clinical knowledge regarding potential 'atypical' and asymptomatic presentation of COVID-19 in NHs. When comparing outcomes for NHs with 'early' versus 'late' outbreaks, while there were similar rates of infection and CFR among residents, greater proportions of asymptomatic staff were identified as a result of mass testing in NHs with later outbreaks. It is possible that some asymptomatic staff carriers in 'early' outbreak NHs had undetectable viral loads by the time of testing but had unwittingly propagated the spread of infection within NHs at early stages of the pandemic when testing was performed on the basis of symptoms. This potentially resulted in 'late' outbreak NHs having greater success in controlling outbreaks in a timely fashion, as evidenced by fewer people in isolation at the end of the study period. More recent evidence suggests that asymptomatic carriage is as virulent as symptomatic carriage, highlighting the importance of mass testing [190]. In NHs with 'early'

outbreaks, asymptomatic infected individuals were only identified when mass testing was performed, by which time the outbreak was well established.

Public NHs appeared to have been impacted disproportionately severely relative to private NHs, although we must be cautious interpreting this finding as five small public facilities returned outcomes (four with outbreaks). Nonetheless, there were substantially higher infection and CFRs in public facilities. This may be explained by the complex case mix in public NHs, with frailer residents who have higher medical and social care needs requiring greater amounts of close contact care [191].

While all COVID-19 outbreaks in this series were active at the end of the study period, by 6 August 2020 all were resolved, indicating success of systematic mass testing, in combination with other factors including reduced community transmission. The proportion of asymptomatic individuals identified during COVID-19 mass testing and the subsequent reduction in numbers of cases suggest regular testing in NH settings is appropriate. To complement the testing programme, NH staff have been trained to perform COVID-19 testing; testing kits supplied to all NHs and protocols implemented with local laboratories, with a 48-hour turnaround time. Systematic mass testing of all staff/residents occurs (unless known positive within 3 months) within 24 hours, in any NH with a new case.

There are limitations to this study. Despite the sample size, it represents 5% of Irish NHs and 8% with COVID-19 clusters. In total, 38.8% (17/45) of NHs did not respond within the timeframe and were excluded and eleven 'outbreak' NHs (52.4%, 11/21) did not provide total staffing information. Sensitivity analyses to account for potential bias were not completed. It should be noted that response rates of 33 – 54% were reported in various survey-based studies carried out in NHs during the early stages of the COVID-19 pandemic [192-194] and that low response rates have long been reported as a challenge in NH studies [195, 196]. Information, including COVID-19-related deaths, was self-reported, also increasing risk of bias, although senior NH medical/nursing staff were best placed to give accurate information. We did not have information on the nature and severity of symptoms that would be of interest in light of reports of 'atypical' symptoms in this cohort.

4.5 Conclusion

This study demonstrates the substantial impact of COVID-19 on NH residents and staff, supporting evidence that has emerged during the pandemic to date. Proportions of asymptomatic staff/residents and increasing knowledge of 'atypical' COVID-19 presentations support systematic mass testing in NH settings. The ability to test, trace and isolate asymptomatic residents/staff in a timely manner is an essential part of outbreak eradication and recovery in this setting.

5 The impact of a dedicated Nursing Home Liaison service on outcomes for older nursing home residents admitted to an Irish tertiary referral hospital

5.1 Introduction

NH residents present to the ED when they become unwell due to acute illness or injury, or decompensation of a pre-existing condition. Admission to hospital following ED attendance is common in this cohort, with rates ranging from 60 - 70% [2, 35, 39, 53]. Many factors that increase the likelihood of ED presentation are also found to increase the risk of hospital admission. This includes multimorbidity, polypharmacy and a history of falls [197, 198]. A history of dementia has been associated with reduced likelihood of admission [199]. Following hospital admission, NH residents have a higher mortality rate than their community-dwelling counterparts [49]. Reattendance rates of 25 - 34% have been reported following hospital discharge, as well as a 13% 30-day mortality rate [199, 200]. In-hospital mortality rates of 10 – 26% have been reported [201].

“Potentially avoidable” ED presentations and hospital admissions have been an area of focus in previous studies and strategies that aim to improve care of NH residents [3, 44, 87], but there has been less research into NH residents who are admitted to the acute hospital. Strategies to improve outcomes for NH residents admitted to hospitals have varied. This is likely related to NH structure, staffing and governance variation, as previously outlined, along with differences in acute hospitals and wider healthcare systems nationally and internationally. It has been shown that discharge by a hospitalist geriatrician may reduce the likelihood of readmission for NH residents [200].

The aim of this project is to review admission, readmission and mortality rates for NH residents before and after the establishment of a dedicated NH Liaison service in an acute hospital.

5.2 Methods

5.2.1 Study setting

A retrospective review of all NH resident admissions to an acute hospital was completed, including NH resident hospital admissions from 2014 – 2022. This study was carried out in an urban university teaching hospital with 562 beds. The hospital has a catchment population of 650,000 and includes 15 nursing homes with >1000 residents. The total number of inpatient admissions increased from 18,254 in 2014 to 19,734 in 2022.

5.2.2 Nursing Home Liaison Service

From 2014 – 2018, NH residents acutely admitted to hospital generally remained under the care of the admitting general medical or surgical team, with a consult service being provided through the geriatric medical service. The role of an Advanced Nurse Practitioner (ANP) in Gerontology was developed in 2018. Initially, this role included the provision of an in-reach service, completing comprehensive geriatric assessment (CGA) for all older NH residents admitted to hospital while residents remained under the care of their usual primary team.

In 2020, with the emergence of the COVID-19 pandemic, the service expanded to include a consultant geriatrician and specialist registrar (SpR) in geriatric medicine. This allowed residents to be admitted under the care of a dedicated NH Service. All NH residents admitted medically and not requiring specialist care (for example dialysis patients) were transferred to the care of the NH Service at the general medical handover meeting (Monday – Friday). An ongoing outreach service provided to those admitted under specialty services and surgical teams. It also allowed the development of a virtual ANP-led follow up clinic, where the NH Director of Nursing (DON) and/or General Practitioner (GP) are contacted two weeks post NH resident hospital discharge.

5.2.3 Data collection and analysis

Data was obtained through the Hospital Inpatient Enquiry (HIPE) portal for each year from 2014 – 2022. HIPE data on NH resident admissions coded as "transfer from nursing home" was reviewed and compared with total inpatient admissions. This data included total number of NH admissions, bed days, average LOS, case mix and cost of inpatient stay. Additional data was prospectively collected for NH resident admissions by medical record review (electronic and hard copy) from 2018 – 2022. This included admission date, specialty, readmissions and inpatient mortality from the time of development of both the ANP in-reach service and the expanded NH Liaison team. Data was analysed using IBM SPSS statistics version 28.

5.3 Results

There were a total of 2709 NH residents admitted from 2014 – 2022, 42.1% (n = 1141) in the four years prior to the establishment of a NH Liaison service (2014 – 2017). Additional data was available for 79.4% (1245/1568) of NH residents following the establishment of the service.

5.3.1 2014 – 2017: Prior to NH Liaison Service

In the four years prior to the provision of a dedicated NH Liaison service, the mean number of NH resident admissions per year was 285.25 (range 189 – 371). This represented 1.04 – 2.04% (mean 1.6%) of total admissions per year. Mean average LOS for NH residents was 11.43 days (10.63 – 12.33 days) over this time period, compared to a mean average LOS 9.39 days (9.06 – 9.58 days) for all inpatients. [Table 16].

	Total Inpatient Admissions	Total NH Admissions, n (total, % all admissions)	Total NH Bed Days	Average LOS NH resident (Days)	Average LOS all patients (Days)
2014	18254	275 (1.51%)	3318	12.07	9.06
2015	18165	189 (1.04%)	2331	12.33	9.33
2016	18359	306 (1.67%)	3254	10.63	9.58
2017	18224	371 (2.04%)	3966	10.69	9.58
2018	17068	353 (2.07%)	4170	11.81	9.99
2019	17136	329 (1.92%)	3991	12.13	9.31
2020	16520	250 (1.51%)	2214	8.90	8.91
2021	16556	251 (1.52%)	2582	10.30	8.91
2022	17116	385 (2.25%)	2800	7.30	9.44

Table 16: NH resident hospital admissions, 2014 - 2022

5.3.2 2018 – 2022: Impact of the development and expansion of a NH Liaison Service

There were 1568 NH residents admitted between 2018 and 2022. The mean number of residents admitted per year was 313.6 (range 250 – 385). NH residents represented 1.9% (1.5 – 2.3%) of all admissions over this time period. Mean average LOS was 10.09 days (range 7.30 – 12.13 days). The number of NH beds in the hospital catchment area increased by 14.1% over 5 years, from 1092 in 2018 to 1246 in 2022.

There were 353 NH resident admissions to hospital in 2018. Average inpatient LOS was 11.8 days and NH residents had a total of 4170 bed days. There was an inpatient mortality rate of 9.6% (n = 43). Over one-third of NH residents were readmitted (n = 131, 37.1%) [Table 17]. Additional data was available for 62.3% (220/353) of all admissions in 2018 [Appendix 1, Supplementary Table 6]. Mean age was 78.6 years (36 – 101 years, SD±12.1) and half (110/220) were male. Mean LOS in this group was 13.1 days (1 – 108 days, SD±17.0). NH residents were most commonly admitted under general medical services (52.7%, 116/220) with 13.6% (30/220) admitted under a specialist geriatric service. Orthopaedic admissions accounted for 12.3% (27/220).

In 2019, the first full year where the dedicated ANP-led in-reach service was available, there were 329 NH residents admitted, with 15.5% (n = 51) from outside of the hospital catchment area. Average LOS was 12.1 days with 3991 total bed days. There was a 9.7% inpatient mortality rate. Readmissions decreased to 24.0% (n = 79) [Table 17]. Additional data was available for 74.8% (246/329) of admissions this year [Appendix 1, Supplementary Table 6]. Mean age of this group was 78.0 years (34 – 104 years, SD±13.0) and 41.2% (102/246) were male. Mean LOS was 12.4 days (1 – 282 days, SD±23.7). The majority were admitted under general medical services (38.2%, 94/246) but there was an increase in the proportion admitted under a specialist geriatric team (22.8%, 56/246). There were 1730 telephone contacts made by the NH Liaison ANP.

The NH Liaison service expanded in March 2020, at the time of the COVID-19 pandemic, to a team including an ANP, specialist registrar (SpR), and consultant in geriatric medicine. There were 250 NH resident admissions in 2020, 18.8% (n = 47) were from NHs outside the hospital catchment area. Average LOS of 8.9 days and 2214 total bed days. Inpatient mortality for NH residents increased to 12.4% (n = 31). Readmission rate decreased to 10.0% (n = 25) [Table 17]. Additional data was available for 89.2% (183/205) of this group [Appendix 1, Supplementary Table 6]. Mean age was 78.0 years (38 – 102 years, SD±11.4) and 44.3% (81/183) were male. Mean LOS in this group was 10.3 days (1 – 171 days, SD±15.7). Nearly half were admitted under the care of the NH liaison service (49.7%, 91/183), approximately one quarter were admitted under general medical teams (24.6%, 45/183) and 11.5% (21/183) under an orthopaedic service. There were 997 ANP telephone contacts in 2020 and 34 virtual reviews.

In 2021, there were 251 NH resident admissions with 21.5% (n = 54) from outside of the hospital catchment area. Average LOS was 10.3 days and they accounted for a total of 2582 bed days. The readmission rate was 12.7% (n = 32). Inpatient mortality decreased to 8.0% (n = 20) [Table 17]. Additional data was available for 96.4% of patients (242/251) [Appendix 1, Supplementary Table 6]. Mean age was 77.0 years (47 – 99 years, SD±11.8) and 40.7% (n=98) were male. Mean LOS in this group was 10.8 days (1 – 192 days, SD±17.3). Over two-thirds of were admitted under the care of the NH Liaison Service (67.4%, 163/242) with 9.1% (22/242)

admitted under general medical services and 6.2% (15/242) admitted under orthopaedics. There were 295 telephone contacts this year.

In 2022 there were 385 NH residents admitted to hospital. Average LOS was 7.3 days and they accounted for 2800 total bed days. Inpatient mortality rate was 7.8% (n = 30) and readmission rate was 16.1% (n = 62) [Table 17]. NH residents from outside of the hospital catchment area accounted for 7.8% (n = 30) of admissions. Additional data was available for 91.4% (352/385) of this group [Appendix 1, Supplementary Table 6]. Mean age was 79.1 years (54 – 97 years, SD±10.0) and 46.0% (162/352) were male. Mean LOS for this group was 9.1 days (0 – 295 days, SD±22.4). Over two-thirds (67.6%, 238/352) were admitted under the NH Liaison Team, 12.9% (45/352) were admitted under other specialist medical services and 4.5% (16/352) were admitted under general medical teams. Orthopaedic admissions accounted for 7.8% (27/352) of admissions. There were 644 telephone contacts in 2022 and 473 virtual reviews.

	Total NH residents admitted	**Average Age**	**Average LOS (days)**	**Inpatient mortality rate (%)**	**Readmission rate (%)**
2018 *ANP (Sept)*	353	77.6	11.8	9.6	37.1
2019	329	77.0	12.1	9.7	24.0
2020 *NH Liaison Team (Mar), COVID pandemic*	250	76.7	8.9	12.4	10.0
2021 *COVID pandemic*	251	75.3	10.3	7.8	12.8
2022	385	76.3	7.3	7.8	16.1

Table 17: Outcomes for NH residents following the development of a dedicated NH Liaison Service

NH residents average LOS decreased following the establishment of the NH Liaison Team in 2020 (8.8 vs 11.6 days, p = 0.006) when compared to the years 2014 – 2019. Mean readmission rate was significantly lower in 2020 – 2022 when compared with 2018 – 2019 (13.0% vs 30.6%, p = 0.047) but there was no significant difference in inpatient mortality rate (9.3 vs 9.7%, p = 0.883). On review of additional data between 2018 and 2022, NH residents admitted under

specialist geriatric services over this time period were older than those admitted under other services (79.8 vs 76.8 years, p <0.001) and had a shorter average LOS (9.2 vs 12.8 days, p = 0.001). A significantly higher proportion of NH residents were admitted under the NH Liaison team (2020 – 2022) when compared to the proportion admitted under specialist geriatric services between 2018 and 2019 (63.2% vs 18.5%, p <0.001).

5.3.3 Cost of Care of NH residents

NH residents accounted for 1.9% of total admissions, 1.5% of hospital bed days and 2.2% of total inpatient costs between 2018 and 2022. The average hospital care cost (case mix cost) per NH resident inpatient increased by 47.1% over the 5 years examined, from €7,055 in 2018 to €10,376 in 2022. Mean cost was €8,604. This compares to a cost of €6,785 for non-NH residents in 2018, increasing to €8,243 in 2022 (mean €7,449), an increase of 21.5%. NH residents accounted for 2.2% of total inpatient costs between 2018 – 2022 [Table 18].

	NH Admissions	NH Bed Days	Average Cost		NH Inpatient net cost
	n, % of total	n, % of total	NH	Non-NH	n, % of total
2018	353, 2.07%	4169, 2.62%	€7055	€6786	€2,490,293, 2.15%
2019	329, 1.92%	3991, 2.49%	€8714	€7238	€2,866,767, 2.30%
2020	250, 1.51%	2214, 1.53%	€7693	€7476	€1,923,218, 1.56%
2021	251, 1.52%	2582, 1.78%	€9183	€7501	€2,304,834, 1.85%
2022	385, 2.25%	2800, 1.69%	€10376	€8243	€3,994,702, 2.82%

Table 18: Cost of care for NH inpatients, 2018 – 2022

5.4 Discussion

These results demonstrate both the complexity of managing NH residents as acute hospital inpatients, and the impact of a dedicated NH liaison service. NH residents accounted for 1.9% of admissions between 2018 and 2022, but represented 1.5% of bed days in the same period and 2.2% of inpatient net cost. In 2019, the year following the development of an ANP role in gerontology, there was a 13.1% reduction in the number of NH residents reattending hospital

and a reduction in the total number of bed days. An increase in NH resident average LOS was seen this year. This may reflect the limitations of a consult-based service which advises on patient management, compared to the provision of care by a specialist team completing CGA at the time of admission.

Over the time period reviewed, there has been an overall increase in the number of NH residents admitted to hospital. This may reflect the increasing complexity of NH residents and a greater total number of NH beds in the hospital catchment area. The average cost of care per NH resident inpatient also increased between 2018 and 2022, although it should be noted that there was also an increase in total health expenditure in Ireland from €22.5 billion in 2018 to €30.5 billion in 2022 (35.6%) [202, 203]. Average LOS decreased following the establishment of the NH Liaison team, along with total number of bed days and readmission rates. Having a specialist geriatric team provide care for the majority of NH residents admitted allows early CGA and management. The significant reduction in readmission rates may reflect virtual follow up, now provided for all NH residents following hospital discharge. This clinic has enhanced communication between the acute hospital and NH, likely allowing earlier discharge and reducing the likelihood of readmission. This may in turn influence hospital inpatient mortality rates. Having discussed preferred care with a relative has been shown to reduce the likelihood of hospitalisation in the last month of life [201]. It has been shown that higher quality end-of-life care for people with dementia is provided in nursing homes when compared to the acute hospital [204].

The impact of the COVID-19 pandemic is seen in this study. There was a lower admission rate for NH residents in 2020 and 2021. Inpatient mortality increased in 2020, with severity of acute illness and restrictions on discharges from hospital to NHs likely playing a role. The expanded NH Liaison service developed during the first wave of the pandemic. The service was in close contact with NHs in the catchment area at this time, providing advice and education to NHs, which were disproportionately impacted during the first wave. This contact, in addition to ANP virtual follow-up post discharge, enhanced the relationship between the service and local NHs likely reduced readmission rates. The COVID-19 pandemic also highlighted the importance of goals of care and advanced care planning. There was a reduction in inpatient mortality in 2021 and 2022, which may reflect this change. However,

the pandemic also limits the interpretation of results following NH Liaison Team establishment, particularly for the years 2020 and 2021.

There were a number of limitations in this study in addition to the COVID-19 pandemic. It was conducted at a single site. The total number of NH residents in the catchment area has varied since 2014 and regional pathways have been developed and implemented for certain conditions, such as hip fractures. This may have impacted NH resident admissions but could not be accounted for in data analysis. Detailed data on NH residents was not available for all patients or each year of the study, although the establishment of a NH liaison service has enabled better data collection. Further research is needed to better understand the impact of this service both locally and on a wider scale.

5.5 Conclusion

NH residents admitted to hospital are at risk of increased LOS, reattendance and mortality. As the population ages, increasing numbers of NH residents may present to acute hospitals and it is important to consider strategies that will enhance care and reduce the risk of adverse outcomes. The development of a dedicated ANP role in gerontology providing an in-reach service to NH residents was associated with a reduction in readmissions. The expansion of this service to a NH Liaison team demonstrated a further decline in readmissions as well as a reduction in LOS. Although this was a single-site study, it shows the impact of a dedicated service on outcomes of this vulnerable cohort of patients. In the future, strategies including outreach services and pathways to avoid ED attendance for certain conditions are planned to further improve care.

6 Application of knowledge in practice

6.1 Nursing Home residents in the Emergency Department: Characteristics increasing the risk of adverse outcomes

This project demonstrates that NH residents remain a frail cohort with significant health and social care needs. The NH residents included in this study had high rates of multimorbidity, dementia, polypharmacy and functional dependence. They demonstrated high levels of acuity on presentation to the ED which, combined with significant admission rates and LOS, suggests that NH residents present to the acute hospital when appropriate levels of care cannot be provided within the NH. The complexity of NH residents also contributes to challenges in managing this cohort in the ED.

One of the challenges faced in completing this project was the emergence of COVID-19. The early stages of the pandemic particularly affected older NH residents, both in the community and on presentation to hospital, and EDs which managed the care of patients presenting to the acute hospital at this time. This changed the focus of this project, both due to the impact of the pandemic on our patient cohort and hospital services, which led to new research hypotheses and questions, and due to the challenges associated with carrying out research at a very busy time for all clinicians.

6.2 Strategies to enhance care for Nursing Home Residents accessing the Emergency Department.

Strategies to enhance care and improve outcomes in ED remain of great importance. Greater numbers of NH residents are likely to continue to present to the ED as our population ages. Factors increasing the risk of adverse outcomes should be considered in the development of such strategies. For example, this study showed that those with delirium had a higher average ED LOS, were more likely to be hospitalised and more likely to reattend or have died at one year. It also demonstrated an association between polypharmacy and increased hospital LOS for NH residents. This suggests strategies to improve delirium pathways or to reduce levels of polypharmacy may be of benefit.

There are a number of other studies that have aimed to enhance care for NH residents who attend ED. Strategies are heterogenous and include examining communication and documentation at the time of transfer, pathways within the ED, liaison services and "potentially preventable" attendances. Education, training and advanced care planning have also been shown to improve care. There is limited evidence available for many strategies, and it is important to note that due to variation in NHs, hospitals and community healthcare, as outlined previously, that not all initiatives will be successfully implemented across every setting.

6.2.1 Identification of "at risk" NH residents

The challenges with assessing and managing NH residents in ED is highlighted in this project. The majority of NH residents required "immediate" to "urgent" review at the time of triage according to MTS score. Risk stratification may improve outcomes but is challenging. Risk screening instruments used at triage, such as the Identification of Seniors at Risk (ISAR) tool and Triage Risk Screening Tool (TRST) have already been found to be of limited predictive value for functional decline, reattendance and readmission in older populations in general [205-207]. NH residents are particularly likely to score as "at risk" using these tools. They include questions of cognitive impairment, polypharmacy and dependence in ADLs, all of which have high prevalence in NH populations. These factors highlight the barriers for stratifying risk of a NH cohort at triage.

This project identified a number of factors which can be detected at triage as increasing the risk of outcomes including hospital admission, hospital LOS, reattendance and 12-month mortality. This included older age, the presence of delirium and polypharmacy. Highlighting these factors might allow prioritisation of certain residents at presentation. It may also be appropriate to consider all NH residents as being "at risk" when they present to ED and have specific pathways in place to manage their care.

6.2.2 Documentation

Documentation can have a significant impact on the care of NH residents, both at presentation to ED and on discharge back to their NH. Incomplete documentation is common in this cohort. This was identified as a limitation in our project, particularly when reviewing medications. Previous studies have found that 48 - 75% of transfer documentation did not have a reason for transfer included, and up to 75% do not have baseline cognition documented [132, 208]. In our study, "generally unwell" was the most common presenting complaint for NH residents. The impact of transfer documentation on presenting complaint at triage was not reviewed, but limited information available at the time of transfer may lead to a non-specific classification at triage, particularly for NH residents with cognitive impairment and dementia.

Not having a documented reason for transfer can negatively impact ED LOS [208]. A lack of documentation on NH residents' own preferences can also impact their management within the ED [209]. Clear documentation between NHs and the ED has been recommended as a key quality indicator for geriatric emergency care [85]. Standardised transfer forms have been suggested to reduce the risk of incomplete documentation [132]. Such forms should include reason for transfer, medication list and allergies [85] and should have essential and current information on the first page. They should be person-centred, concise and regularly reviewed [210]. Communication and clear documentation of any medication changes and follow up plans should also be provided on transfer to the NH from ED [85]. Having dedicated liaison services between the hospital and NH can also enhance communication.

6.2.3 Enhanced Gerontological Care: ED and Hospital In-reach Services

Enhanced gerontological input for NH residents attending the ED has been suggested to improve care for this group. An Australian site implemented an "Aged Care Emergency" service which included an ED advanced practice nurse with aged care skills, clinical algorithms and education programmes for aged care facilities. This led to a reduced ED length of stay, significant reduction in the likelihood of hospital admission [133]. Another Australian study showed that a nurse led model of care for frail NH residents attending the ED reduced both admission and 28-day representation rates [134]. However, studies examining in-reach models are limited. One of the strengths of our study was the review of a NH Liaison service, which

initially provided a consult-based CGA before expanding to a full specialist geriatric medical team. A reduction in reattendance and inpatient mortality supports this model in our hospital. We plan to continue to review the impact of this service, taking into account the potential impact of the COVID-19 pandemic on our initial findings.

6.2.4 Potentially Avoidable ED Attendances and Outreach Services

"Potentially preventable" ED presentations by NH residents continue to be an area of interest, despite the complexity of factors impacting decision making at the time of ED transfer. There are a number of strategies that may reduce the likelihood of a NH resident attending the ED. This includes strategies to prevent acute illness, injuries and decompensation of chronic conditions, having timely access to investigations and treatments, and the provision of specialist advice either through telehealth or outreach services coming to the NH. It is important to consider resident preference for place of care. In a study examining this, residents expressed a preference for ED care in the case of a medical emergency [211]. The level of preference varied depending on diagnosis, waiting time, treatment success rate and comfort [211]. These findings may be impacted by limited alternatives to the ED. There is limited evidence supporting outreach services [212] and the impact of quality improvement projects may vary between facilities [141] highlighting the need to consider differences between NH models in the implementation of any strategy.

Taking steps to proactively manage NH residents' health can reduce the risk of ED transfer. This project has demonstrated high rates of delirium in the ED, and PIMs. Increasing delirium awareness and creating an environment to reduce the risk of delirium within the NH may allow residents to be managed without ED transfer. Regular review of medications, using tools such as STOPP version 2, STOPPFrail or Beers' criteria may reduce inappropriate medications. Although not used in this study, the START tool, which highlights potentially appropriate medications that have been omitted, is also of use when reviewing medications. Increased rates of vaccination for common pathogens may reduce rates of respiratory illnesses, ED attendances, and all-cause mortality in this group [48, 84]. Under-prescription of fracture prevention medications has also been reported in this cohort [213].

When a NH resident becomes unwell, the availability of timely access to imaging, blood tests, urine cultures, and intravenous therapy [136, 137] may allow them to remain in the NH. The use of telehealth is increasing, with one system providing urgent and specialty consults and transitional care coordination significantly reducing ED visits by NH residents [138]. NH in-reach services, for example a nursing/geriatrician-led service, have been shown to reduce ED attendances [135]. A "hospital in the home" strategy was shown to reduce ED presentations and hospital admissions in a NH population, with interventions such as urinary catheter change, wound care and the administration of IV antibiotics in the NH all suggested as potential ways to avoid a proportion of ED attendances [92].

Any new care pathways need to be well resourced. For example, one in four ED transfers for falls were considered "potentially avoidable" [140]. However, alternative appropriate services for assessment and management of NH residents outside of the ED are required to facilitate this, with outpatient diagnostic imaging and geriatric expertise and training have been suggested in order to reduce ED attendances for NH residents with falls [140]. A virtual fracture clinic which provided rapid imaging, rapid communication of results and referral to a specialist fracture clinic where necessary, was shown to enable timely management of fractures and avoided 100% of ED transfers [139]. A mobile emergency service, dispatching an ED consultant to NHs, was effective in reducing the number of transfers from NHs to ED [214]. In each of these instances, a new pathway is likely to require additional resources, or to impact currently available services.

6.2.5 Advanced Care Planning and Palliative Care in Nursing Homes

Over one-third of NH residents in our study had died within 12 months of presentation. Annual hospital inpatient mortality rates ranged from 7.8 – 12.4% for NH residents between 2018 and 2022. Other studies have reported an annual mortality rate of 32 – 63% [16, 17], and that NH residents have a mean life expectancy of 2.1 – 2.5 years from the time of admission [12-15]. These findings highlight the importance of advanced care planning. This should be considered from the time a resident is admitted to a NH. Individual wishes and preferences should be discussed and taken into account and options discussed with the resident and family members. Decisions should be clearly documented. NH residents may attend the acute

hospital at end-of-life for a variety of reasons. Educating residents, NH staff and families on the components of levels of acute care, intervention and palliative care in the acute hospital may allow more informed planning decisions on appropriate transfer at end-of-life [215].

Palliative care provision differs between facilities and NH staff report varying levels of experience and limited knowledge in palliative care [216, 217]. Other barriers to quality palliative care in NHs include staffing levels, time constraints, a lack of privacy and care provider beliefs around palliative care and end-of-life [218]. Lack of physician support can make on-site care in NHs challenging. Strategies to enhance care of NH residents include education and training of staff, education of family members and provision of enhanced supports at end-of-life in NHs [218]. A palliative care programme comprising of telehealth, education and advance care planning reduced ED visits by NH residents [219]. We noted a decline in inpatient mortality following the establishment of the NH Liaison team. This team provided NHs in the catchment area with support and advice on palliative care during the COVID-19 pandemic and have enhanced communication with NHs, particularly at the time of discharge and through virtual follow up strategies. We believe that this has contributed to the reduction in reattendance and inpatient mortality seen since 2021.

6.2.6 Education

Core competencies for NH staff differ from those in the acute setting, and include care planning, hygiene, urinary and bowel continence and care, pain management, skin viability and dementia care [220]. Education of NH staff can allow improved management of residents. NH staff include nurses and healthcare assistants, who may have varying levels of dedicated gerontological training and experience. It is essential to recognise the role all staff have in resident care.

Educational interventions are often multifaceted. Common themes have included palliative care in NHs [221], pressure ulcer care [222], and dementia care [223]. Reports of effectiveness of such programmes has varied [221, 222]. However, positive outcomes have been reported in a number of studies including improved communication, reduced antipsychotic use, and reduced neuropsychiatric symptoms [223-225]. Online training has become more prevalent

since the COVID-19 pandemic, and has been reported as effective [226, 227]. The pandemic also led to changes in management within NHs, as outlined above. Although education in NHs has often focused on gerontological care, education on identification management of unwell residents within the NH can also be of use. One study examining the use of the National Early Warning System (NEWS) in NHs reported that staff in NHs had a positive perception of the NEWS, with its education and support package, and felt empowered to use common clinical language in communication with those working outside of the NH [228]. However, it is important that appropriate escalation, support and care pathways, in conjunction with good advanced care planning, are available should the NEWS be introduced on a wider scale.

The implementation of the NH Liaison service in our hospital has helped to facilitate education and training for NH staff. Enhanced communication has allowed staff across NH and hospital settings share knowledge around care for individual patients. Following the establishment of this service, the team have been involved in virtual and in-person education sessions for NH staff.

6.3 Implications for future research

Future research is needed to examine characteristics of both NH residents and NH facilities to establish patterns of ED attendances and factors that may contribute to this. Identifying features which may highlight patients most at risk of adverse outcomes has been incorporated into ED triage tools over a number of years. Although these tools can be useful, research into specific characteristics that may increase a NH resident's risk of adverse outcomes is required. Specific risk stratification tools for NH residents may be appropriate, although it may be of greater use to highlight all NH residents as being at risk on ED presentation and prioritise their care accordingly.

There have been a number of projects examining new strategies to improve care for acutely unwell NH residents. Studies have been heterogenous, in terms of participant populations, NH structure and governance and in interventions and outcomes. Many have looked at ED avoidance with few projects examining NH resident care in the acute hospital. This single site

study demonstrated a reduction in LOS and reduced reattendance rate following the establishment of a NH liaison team. The impact of different models of care for NH residents as inpatients needs further examination and studies examining the wider continuum of care across community and hospital services would also be of value.

References

1. Kennelly SP, Dyer AH, Noonan C, Martin R, Kennelly SM, Martin A, O'Neill D, Fallon A: **Asymptomatic carriage rates and case fatality of SARS-CoV-2 infection in residents and staff in Irish nursing homes**. *Age Ageing* 2021, **50**(1):49-54.
2. Briggs R, Coughlan T, Collins R, O'Neill D, Kennelly SP: **Nursing home residents attending the emergency department: clinical characteristics and outcomes**. *QJM* 2013, **106**(9):803-808.
3. Lemoyne SEE, Van Bogaert P, Calle P, Wouters K, Deblick D, Herbots H, Monsieurs K: **Transferring nursing home residents to emergency departments by emergency physician-staffed emergency medical services: missed opportunities to avoid inappropriate care?** *Acta Clin Belg* 2023, **78**(1):3-10.
4. Yuan Y, Lapane KL, Tjia J, Baek J, Liu SH, Ulbricht CM: **Trajectories of physical frailty and cognitive impairment in older adults in United States nursing homes**. *BMC Geriatr* 2022, **22**(1):339.
5. Falconer M, O'Neill D: **Profiling disability within nursing homes: a census-based approach**. *Age Ageing* 2007, **36**(2):209-213.
6. Onder G, Carpenter I, Finne-Soveri H, Gindin J, Frijters D, Henrard JC, Nikolaus T, Topinkova E, Tosato M, Liperoti R *et al*: **Assessment of nursing home residents in Europe: the Services and Health for Elderly in Long TERm care (SHELTER) study**. *BMC Health Serv Res* 2012, **12**:5.
7. Leung FW, Schnelle JF: **Urinary and fecal incontinence in nursing home residents**. *Gastroenterol Clin North Am* 2008, **37**(3):697-707, x.
8. Masnoon N, Shakib S, Kalisch-Ellett L, Caughey GE: **What is polypharmacy? A systematic review of definitions**. *BMC Geriatr* 2017, **17**(1):230.
9. Gutierrez-Valencia M, Izquierdo M, Lacalle-Fabo E, Marin-Epelde I, Ramon-Espinoza MF, Domene-Domene T, Casas-Herrero A, Galbete A, Martinez-Velilla N: **Relationship between frailty, polypharmacy, and underprescription in older adults living in nursing homes**. *Eur J Clin Pharmacol* 2018, **74**(7):961-970.
10. Onder G, Liperoti R, Fialova D, Topinkova E, Tosato M, Danese P, Gallo PF, Carpenter I, Finne-Soveri H, Gindin J *et al*: **Polypharmacy in nursing home in Europe: results from the SHELTER study**. *J Gerontol A Biol Sci Med Sci* 2012, **67**(6):698-704.
11. Grace AR, Briggs R, Kieran RE, Corcoran RM, Romero-Ortuno R, Coughlan TL, O'Neill D, Collins R, Kennelly SP: **A comparison of beers and STOPP criteria in assessing potentially inappropriate medications in nursing home residents attending the emergency department**. *J Am Med Dir Assoc* 2014, **15**(11):830-834.
12. Vossius C, Selbaek G, Saltyte Benth J, Bergh S: **Mortality in nursing home residents: A longitudinal study over three years**. *PLoS One* 2018, **13**(9):e0203480.
13. Hjaltadottir I, Hallberg IR, Ekwall AK, Nyberg P: **Predicting mortality of residents at admission to nursing home: a longitudinal cohort study**. *BMC Health Serv Res* 2011, **11**:86.
14. McCann M, O'Reilly D, Cardwell C: **A Census-based longitudinal study of variations in survival amongst residents of nursing and residential homes in Northern Ireland**. *Age Ageing* 2009, **38**(6):711-717.
15. Vossius C, Bergh S, Selbaek G, Benth JS, Myhre J, Aakhus E, Lichtwarck B: **Mortality in nursing home residents stratified according to subtype of dementia: a longitudinal study over three years**. *BMC Geriatr* 2022, **22**(1):282.

16. Collingridge Moore D, Payne S, Keegan T, Van den Block L, Deliens L, Gambassi G, Heikkila R, Kijowska V, Pasman HR, Pivodic L *et al*: **Length of stay in long-term care facilities: a comparison of residents in six European countries. Results of the PACE cross-sectional study**. *BMJ Open* 2020, **10**(3):e033881.
17. Shah SM, Carey IM, Harris T, DeWilde S, Cook DG: **Mortality in older care home residents in England and Wales**. *Age Ageing* 2013, **42**(2):209-215.
18. Charles A, Detilleux J, Buckinx F, Reginster JY, Gruslin B, Bruyere O: **Physical performance trajectories and mortality among nursing home residents: results of the SENIOR cohort**. *Age Ageing* 2020, **49**(5):800-806.
19. Unroe KT, Greiner MA, Colon-Emeric C, Peterson ED, Curtis LH: **Associations between published quality ratings of skilled nursing facilities and outcomes of medicare beneficiaries with heart failure**. *J Am Med Dir Assoc* 2012, **13**(2):188 e181-186.
20. Baldwin R, Chenoweth L, Dela Rama M, Wang AY: **Does size matter in aged care facilities? A literature review of the relationship between the number of facility beds and quality**. *Health Care Manage Rev* 2017, **42**(4):315-327.
21. Ibrahim JE, Li Y, McKee G, Eren H, Brown C, Aitken G, Pham T: **Characteristics of nursing homes associated with COVID-19 outbreaks and mortality among residents in Victoria, Australia**. *Australas J Ageing* 2021, **40**(3):283-292.
22. Li Y, Temkin-Greener H, Shan G, Cai X: **COVID-19 Infections and Deaths among Connecticut Nursing Home Residents: Facility Correlates**. *J Am Geriatr Soc* 2020, **68**(9):1899-1906.
23. **Census 2022 / Summary Results - FY009 - Persons in Communal Establishments** [https://ws.cso.ie/public/api.restful/PxStat.Data.Cube_API.ReadDataset/FY009/XLSX/2007/en]
24. **Persons aged 65 years and over that were usually resident in a nursing home** [https://data.cso.ie/table/E3008]
25. **Projected Population aged 65+** [https://www.cso.ie/en/releasesandpublications/hubs/p-opi/olderpersonsinformationhub/ageingpopulation/projectedpopulationaged65/]
26. Yang BK, Carter MW, Trinkoff AM, Nelson HW: **Nurse Staffing and Skill Mix Patterns in Relation to Resident Care Outcomes in US Nursing Homes**. *J Am Med Dir Assoc* 2021, **22**(5):1081-1087 e1081.
27. Xu H, Bowblis JR, Caprio TV, Li Y, Intrator O: **Rural-Urban Differences in Nursing Home Risk-adjusted Rates of Emergency Department Visits: A Decomposition Analysis**. *Med Care* 2021, **59**(1):38-45.
28. Fassmer AM, Zuidema SU, Janus SIM, Hoffmann F: **Comparison of medical care needs and actual care in German and Dutch nursing home residents: A cross-sectional study conducted in neighboring European countries**. *Arch Gerontol Geriatr* 2023, **117**:105178.
29. Jutkowitz E, Landsteiner A, Ratner E, Shippee T, Madrigal C, Ullman K, Linskens E, Wilt TJ, Duan-Porter W: **Effects of Nurse Staffing on Resident Outcomes in Nursing Homes: A Systematic Review**. *J Am Med Dir Assoc* 2023, **24**(1):75-81 e11.
30. Sanford AM, Orrell M, Tolson D, Abbatecola AM, Arai H, Bauer JM, Cruz-Jentoft AJ, Dong B, Ga H, Goel A *et al*: **An international definition for "nursing home"**. *J Am Med Dir Assoc* 2015, **16**(3):181-184.

31. **Overview Report on the Monitoring and Regulation of Older Persons Services in 2020 and 2021** [https://www.hiqa.ie/sites/default/files/2022-12/Overview-Report-on-the-Monitoring-and-Regulation-of-Older-Persons-Services-in-2020-and-2021.pdf]
32. **Nursing Home Inspection Reports** [https://www.hiqa.ie/reports-and-publications/inspection-reports]
33. Chief Inspector of Social Services H: **15 Years of Regulating Nursing Homes**. In. George's Court, George's Lane, Smithfield, Dublin 7, D07E98Y: HIQA; 2024.
34. Ellis G, Marshall T, Ritchie C: **Comprehensive geriatric assessment in the emergency department**. *Clin Interv Aging* 2014, **9**:2033-2043.
35. Fan CW, Keating T, Brazil E, Power D, Duggan J: **Impact of season, weekends and bank holidays on emergency department transfers of nursing home residents**. *Ir J Med Sci* 2016, **185**(3):655-661.
36. Kennelly SP, Drumm B, Coughlan T, Collins R, O'Neill D, Romero-Ortuno R: **Characteristics and outcomes of older persons attending the emergency department: a retrospective cohort study**. *QJM* 2014, **107**(12):977-987.
37. Marincowitz C, Preston L, Cantrell A, Tonkins M, Sabir L, Mason S: **Factors associated with increased Emergency Department transfer in older long-term care residents: a systematic review**. *Lancet Healthy Longev* 2022, **3**(6):e437-e447.
38. Gruneir A, Bell CM, Bronskill SE, Schull M, Anderson GM, Rochon PA: **Frequency and pattern of emergency department visits by long-term care residents--a population-based study**. *J Am Geriatr Soc* 2010, **58**(3):510-517.
39. Carron PN, Mabire C, Yersin B, Bula C: **Nursing home residents at the Emergency Department: a 6-year retrospective analysis in a Swiss academic hospital**. *Intern Emerg Med* 2017, **12**(2):229-237.
40. de Souto Barreto P, Lapeyre-Mestre M, Mathieu C, Piau C, Bouget C, Cayla F, Vellas B, Rolland Y: **The nursing home effect: a case study of residents with potential dementia and emergency department visits**. *J Am Med Dir Assoc* 2013, **14**(12):901-905.
41. Stephens CE, Newcomer R, Blegen M, Miller B, Harrington C: **The effects of cognitive impairment on nursing home residents' emergency department visits and hospitalizations**. *Alzheimers Dement* 2014, **10**(6):835-843.
42. Kouyoumdjian V, Perceau-Chambard E, Sisoix C, Filbet M, Tricou C: **Physician's perception leading to the transfer of a dying nursing home resident to an emergency department: A French qualitative study**. *Geriatr Gerontol Int* 2019, **19**(3):249-253.
43. Giacomini G, Minutiello E, Politano G, Dalmasso M, Albanesi B, Campagna S, Gianino MM: **Trajectories and determinants of emergency department use among nursing home residents: a time series analysis (2012-2019)**. *BMC Geriatr* 2022, **22**(1):418.
44. Aryal K, Mowbray FI, Strum RP, Dash D, Tanuseputro P, Heckman G, Costa AP, Jones A: **Examining the "Potentially Preventable Emergency Department Transfer" Indicator Among Nursing Home Residents**. *J Am Med Dir Assoc* 2023, **24**(1):100-104 e102.
45. Trahan LM, Spiers JA, Cummings GG: **Decisions to Transfer Nursing Home Residents to Emergency Departments: A Scoping Review of Contributing Factors and Staff Perspectives**. *J Am Med Dir Assoc* 2016, **17**(11):994-1005.
46. Chen BA, Lai FC, Tsao LI, Chien HH, Chen CF, Jeng C: **Decision difficulties of long-term-care facility nurses in transferring residents to the emergency department: A cross-sectional nationwide study**. *J Adv Nurs* 2021, **77**(6):2728-2738.

47. Pulst A, Fassmer AM, Schmiemann G: **Unplanned hospital transfers from nursing homes: who is involved in the transfer decision? Results from the HOMERN study**. *Aging Clin Exp Res* 2021, **33**(8):2231-2241.
48. Dubucs X, de Souto Barreto P, Rolland Y: **Organizational and environmental factors associated with transfers of nursing home residents to emergency departments**. *Eur Geriatr Med* 2018, **9**(3):339-346.
49. Keevil VL, Martin GJ, Biram R, Wallis S, Romero-Ortuno R: **Care home residents admitted to hospital through the emergency pathway: characteristics and associations with inpatient mortality**. *J R Coll Physicians Edinb* 2018, **48**(3):202-209.
50. Wang HE, Shah MN, Allman RM, Kilgore M: **Emergency department visits by nursing home residents in the United States**. *J Am Geriatr Soc* 2011, **59**(10):1864-1872.
51. Mitchell JS, Young I: **Utilization of a UK emergency department by care home residents: a retrospective observational study**. *Eur J Emerg Med* 2010, **17**(6):322-324.
52. Guion V, De Souto Barreto P, Rolland Y: **Nursing Home Residents' Functional Trajectories and Mortality After a Transfer to the Emergency Department**. *J Am Med Dir Assoc* 2021, **22**(2):393-398 e393.
53. Kirsebom M, Hedstrom M, Wadensten B, Poder U: **The frequency of and reasons for acute hospital transfers of older nursing home residents**. *Arch Gerontol Geriatr* 2014, **58**(1):115-120.
54. McCabe JJ, Kennelly SP: **Acute care of older patients in the emergency department: strategies to improve patient outcomes**. *Open Access Emerg Med* 2015, **7**:45-54.
55. Gruneir A, Cigsar C, Wang X, Newman A, Bronskill SE, Anderson GM, Rochon PA: **Repeat emergency department visits by nursing home residents: a cohort study using health administrative data**. *BMC Geriatr* 2018, **18**(1):157.
56. Mody L, Cinti S: **Pandemic influenza planning in nursing homes: are we prepared?** *J Am Geriatr Soc* 2007, **55**(9):1431-1437.
57. Paphitis K, Achonu C, Callery S, Gubbay J, Katz K, Muller M, Sachdeva H, Warshawsky B, Whelan M, Garber G *et al*: **Beyond flu: Trends in respiratory infection outbreaks in Ontario healthcare settings from 2007 to 2017, and implications for non-influenza outbreak management**. *Can Commun Dis Rep* 2021, **47**(56):269-275.
58. Strausbaugh LJ, Sukumar SR, Joseph CL, High KP: **Infectious Disease Outbreaks in Nursing Homes: An Unappreciated Hazard for Frail Elderly Persons**. *Clinical Infectious Diseases* 2003, **36**(7):870-876.
59. Leece P, Whelan M, Costa AP, Daneman N, Johnstone J, McGeer A, Rochon P, Schwartz KL, Brown KA: **Nursing home crowding and its association with outbreak-associated respiratory infection in Ontario, Canada before the COVID-19 pandemic (2014-19): a retrospective cohort study**. *Lancet Healthy Longev* 2023, **4**(3):e107-e114.
60. Regulation Directorate H: **The impact of COVID-19 on nursing homes in Ireland**. In. Unit 1301, City Gate, Mahon, Cork, T12 Y2XT: HIQA; 2020.
61. Veronese N, Barbagallo M: **Specific approaches to patients affected by dementia and covid-19 in nursing homes: the role of the geriatrician**. *Ageing Res Rev* 2021, **69**:101373.
62. Soldevila L, Prat N, Mas MA, Massot M, Miralles R, Bonet-Simo JM, Isnard M, Exposito-Izquierdo M, Garcia-Sanchez I, Rodoreda-Noguerola S *et al*: **The interplay between infection risk factors of SARS-CoV-2 and mortality: a cross-sectional study from a cohort of long-term care nursing home residents**. *BMC Geriatr* 2022, **22**(1):123.

63. Lu Y, Jiao Y, Graham DJ, Wu Y, Wang J, Menis M, Chillarige Y, Wernecke M, Kelman J, Forshee RA *et al*: **Risk Factors for COVID-19 Deaths Among Elderly Nursing Home Medicare Beneficiaries in the Prevaccine Period**. *J Infect Dis* 2022, **225**(4):567-577.
64. Mehta HB, Li S, Goodwin JS: **Risk Factors Associated With SARS-CoV-2 Infections, Hospitalization, and Mortality Among US Nursing Home Residents**. *JAMA Netw Open* 2021, **4**(3):e216315.
65. Coe AB, Montoya A, Chang CH, Park PS, Bynum JPW, Shireman TI, Zhang T, McCreedy EM, Gerlach LB: **Behavioral symptoms, depression symptoms, and medication use in Michigan nursing home residents with dementia during COVID-19**. *J Am Geriatr Soc* 2023, **71**(2):414-422.
66. Yan D, Temkin-Greener H, Cai S: **Did the COVID-19 Pandemic Affect the Use of Antipsychotics Among Nursing Home Residents With ADRD?** *Am J Geriatr Psychiatry* 2023, **31**(2):124-140.
67. McDermid J, Ballard C, Khan Z, Aarsland D, Fox C, Fossey J, Clare L, Moniz-Cook E, Soto-Martin M, Sweetnam A *et al*: **Impact of the Covid-19 pandemic on neuropsychiatric symptoms and antipsychotic prescribing for people with dementia in nursing home settings**. *Int J Geriatr Psychiatry* 2023, **38**(1):e5878.
68. Maxwell CJ, Campitelli MA, Cotton CA, Hogan DB, Iaboni A, Gruneir A, Evans C, Bronskill SE: **Greater Opioid Use Among Nursing Home Residents in Ontario, Canada During the First 2 Waves of the COVID-19 Pandemic**. *J Am Med Dir Assoc* 2022, **23**(6):936-941.
69. Sundaram M, Nasreen S, Calzavara A, He S, Chung H, Bronskill SE, Buchan SA, Tadrous M, Tanuseputro P, Wilson K *et al*: **Background rates of all-cause mortality, hospitalizations, and emergency department visits among nursing home residents in Ontario, Canada to inform COVID-19 vaccine safety assessments**. *Vaccine* 2021, **39**(37):5265-5270.
70. Nilsson L, Andersson C, Kastbom L, Sjodahl R: **Association between vaccination and preventive routines on COVID-19-related mortality in nursing home facilities: a population-based systematic retrospective chart review**. *Prim Health Care Res Dev* 2022, **23**:e75.
71. Wong BM, Rotteau L, Feldman S, Lamb M, Liang K, Moser A, Mukerji G, Pariser P, Pus L, Razak F *et al*: **A Novel Collaborative Care Program to Augment Nursing Home Care During and After the COVID-19 Pandemic**. *J Am Med Dir Assoc* 2022, **23**(2):304-307 e303.
72. Lukin B, Fan LJ, Zhao JZ, Sun JD, Dingle K, Purtill R, Tapp S, Hou XY: **Emergency department use among patients from residential aged care facilities under a Hospital in the Nursing Home scheme in public hospitals in Queensland Australia**. *World J Emerg Med* 2016, **7**(3):183-190.
73. Ingarfield SL, Finn JC, Jacobs IG, Gibson NP, Holman CD, Jelinek GA, Flicker L: **Use of emergency departments by older people from residential care: a population based study**. *Age Ageing* 2009, **38**(3):314-318.
74. Han JH, Morandi A, Ely EW, Callison C, Zhou C, Storrow AB, Dittus RS, Habermann R, Schnelle J: **Delirium in the nursing home patients seen in the emergency department**. *J Am Geriatr Soc* 2009, **57**(5):889-894.
75. Graverholt B, Riise T, Jamtvedt G, Ranhoff AH, Kruger K, Nortvedt MW: **Acute hospital admissions among nursing home residents: a population-based observational study**. *BMC Health Serv Res* 2011, **11**:126.

76. Karakoumis J, Nickel CH, Kirsch M, Rohacek M, Geigy N, Muller B, Ackermann S, Bingisser R: **Emergency Presentations With Nonspecific Complaints-the Burden of Morbidity and the Spectrum of Underlying Disease: Nonspecific Complaints and Underlying Disease**. *Medicine (Baltimore)* 2015, **94**(26):e840.
77. Nemec M, Koller MT, Nickel CH, Maile S, Winterhalder C, Karrer C, Laifer G, Bingisser R: **Patients presenting to the emergency department with non-specific complaints: the Basel Non-specific Complaints (BANC) study**. *Acad Emerg Med* 2010, **17**(3):284-292.
78. Rutschmann OT, Chevalley T, Zumwald C, Luthy C, Vermeulen B, Sarasin FP: **Pitfalls in the emergency department triage of frail elderly patients without specific complaints**. *Swiss Med Wkly* 2005, **135**(9-10):145-150.
79. Brutschin V, Kogej M, Schacher S, Berger M, Graff I: **The presentational flow chart "unwell adult" of the Manchester Triage System-Curse or blessing?** *PLoS One* 2021, **16**(6):e0252730.
80. Erwander K, Ivarsson K, Olsson ML, Agvall B: **Elderly patients with non-specific complaints at the emergency department have a high risk for admission and 30-days mortality**. *BMC Geriatr* 2024, **24**(1):5.
81. Dyer AH, Nabeel S, Briggs R, O'Neill D, Kennelly SP: **Cognitive assessment of older adults at the acute care interface: the informant history**. *Postgrad Med J* 2016, **92**(1087):255-259.
82. van Dam CSP, M. J. L.; Hoogendijk, E.O.; Nanayakkara, P.W.B.; Muller, M.; Trappenburg, M. C.: **Older patients with nonspecific complaints at the Emergency Department are at risk of adverse health outcomes**. *European Journal of Internal Medicine* 2023, **112**:86 - 92.
83. Hertwig R, Meier N, Nickel C, Zimmermann PC, Ackermann S, Woike JK, Bingisser R: **Correlates of diagnostic accuracy in patients with nonspecific complaints**. *Med Decis Making* 2013, **33**(4):533-543.
84. Cheung ENM, Benjamin S, Heckman G, Ho JM, Lee L, Sinha SK, Costa AP: **Clinical characteristics associated with the onset of delirium among long-term nursing home residents**. *BMC Geriatr* 2018, **18**(1):39.
85. Terrell KM, Hustey FM, Hwang U, Gerson LW, Wenger NS, Miller DK, Society for Academic Emergency Medicine Geriatric Task F: **Quality indicators for geriatric emergency care**. *Acad Emerg Med* 2009, **16**(5):441-449.
86. LaMantia MA, Messina FC, Jhanji S, Nazir A, Maina M, McGuire S, Hobgood CD, Miller DK: **Emergency medical service, nursing, and physician providers' perspectives on delirium identification and management**. *Dementia (London)* 2017, **16**(3):329-343.
87. Unroe KT, Carnahan JL, Hickman SE, Sachs GA, Hass Z, Arling G: **The Complexity of Determining Whether a Nursing Home Transfer Is Avoidable at Time of Transfer**. *J Am Geriatr Soc* 2018, **66**(5):895-901.
88. Hathaway EE, Carnahan JL, Unroe KT, Stump TE, O'Kelly Phillips E, Hickman SE, Fowler NR, Sachs GA, Bateman DR: **Nursing Home Transfers for Behavioral Concerns: Findings from the OPTIMISTIC Demonstration Project**. *J Am Geriatr Soc* 2021, **69**(2):415-423.
89. Filiatreault S, Kreindler SA, Grimshaw JM, Chochinov A, Doupe MB: **Developing a set of emergency department performance measures to evaluate delirium care quality for older adults: a modified e-Delphi study**. *BMC Emerg Med* 2024, **24**(1):28.

90. Shao L, Shi Y, Xie XY, Wang Z, Wang ZA, Zhang JE: **Incidence and Risk Factors of Falls Among Older People in Nursing Homes: Systematic Review and Meta-Analysis**. *J Am Med Dir Assoc* 2023, **24**(11):1708-1717.
91. Burke RE, Rooks SP, Levy C, Schwartz R, Ginde AA: **Identifying Potentially Preventable Emergency Department Visits by Nursing Home Residents in the United States**. *J Am Med Dir Assoc* 2015, **16**(5):395-399.
92. Fan L, Hou XY, Zhao J, Sun J, Dingle K, Purtill R, Tapp S, Lukin B: **Hospital in the Nursing Home program reduces emergency department presentations and hospital admissions from residential aged care facilities in Queensland, Australia: a quasi-experimental study**. *BMC Health Serv Res* 2016, **16**:46.
93. Unroe KT, Caterino JM, Stump TE, Tu W, Carnahan JL, Vest JR, Sachs GA, Hickman SE: **Long-Stay Nursing Facility Resident Transfers: Who Gets Admitted to the Hospital?** *J Am Geriatr Soc* 2020, **68**(9):2082-2089.
94. Ronald LA, McGregor MJ, McGrail KM, Tate RB, Broemling AM: **Hospitalization rates of nursing home residents and community-dwelling seniors in British Columbia**. *Can J Aging* 2008, **27**(1):109-115.
95. Dixon JR, Lecky F, Bouamra O, Dixon P, Wilson F, Edwards A, Eardley W: **Age and the distribution of major injury across a national trauma system**. *Age Ageing* 2020, **49**(2):218-226.
96. Popp D, Frankewycz B, Lang S, Ernstberger A, Alt V, Worlicek M, Kerschbaum M: **Are There Any Red Flag Injuries in Severely Injured Patients in Older Age?** *J Clin Med* 2021, **10**(2).
97. Donnell DO, Romero-Ortuno R, Kennelly SP, O'Neill D, Donoghue PO, Lavan A, Cunningham C, McElwaine P, Kenny RA, Briggs R: **The 'Bermuda Triangle' of orthostatic hypotension, cognitive impairment and reduced mobility: prospective associations with falls and fractures in The Irish Longitudinal Study on Ageing**. *Age Ageing* 2023, **52**(2).
98. Caterino JM, Ting SA, Sisbarro SG, Espinola JA, Camargo CA, Jr.: **Age, nursing home residence, and presentation of urinary tract infection in U.S. emergency departments, 2001-2008**. *Acad Emerg Med* 2012, **19**(10):1173-1180.
99. Jump RLP, Crnich CJ, Mody L, Bradley SF, Nicolle LE, Yoshikawa TT: **Infectious Diseases in Older Adults of Long-Term Care Facilities: Update on Approach to Diagnosis and Management**. *J Am Geriatr Soc* 2018, **66**(4):789-803.
100. van Eijk J, Rutten JJS, Hertogh C, Smalbrugge M, van Buul LW: **Observation of urinary tract infection signs and symptoms in nursing home residents with impaired awareness or ability to communicate signs and symptoms: The development of supportive tools**. *Int J Older People Nurs* 2023, **18**(5):e12560.
101. Yourman LC, Kent TJ, Israni JS, Ko KJ, Lesser A: **Association of dementia diagnosis with urinary tract infection in the emergency department**. *J Am Coll Emerg Physicians Open* 2020, **1**(6):1291-1296.
102. Caterino JM, Stephens JA, Camargo CA, Jr., Wexler R, Hebert C, Southerland LT, Hunold KM, Hains DS, Bischof JJ, Wei L *et al*: **Asymptomatic Bacteriuria versus Symptom Underreporting in Older Emergency Department Patients with Suspected Urinary Tract Infection**. *J Am Geriatr Soc* 2020, **68**(11):2696-2699.
103. Arinzon Z, Peisakh A, Shuval I, Shabat S, Berner YN: **Detection of urinary tract infection (UTI) in long-term care setting: Is the multireagent strip an adequate diagnostic tool?** *Arch Gerontol Geriatr* 2009, **48**(2):227-231.

104. Valmadrid LC, Schwei RJ, Maginot E, Pulia MS: **The impact of health care provider relationships and communication dynamics on urinary tract infection management and antibiotic utilization for long-term care facility residents treated in the emergency department: A qualitative study**. *Am J Infect Control* 2021, **49**(2):198-205.
105. Ingalls EM, Veillette JJ, Olson J, May SS, Dustin Waters C, Gelman SS, Vargyas G, Hutton M, Tinker N, Fontaine GV *et al*: **Impact of a Multifaceted Intervention on Antibiotic Prescribing for Cystitis and Asymptomatic Bacteriuria in 23 Community Hospital Emergency Departments**. *Hosp Pharm* 2023, **58**(4):401-407.
106. Wang JY, Yang YW, Liu CH, Chang KC, Lin YT, Liu CC: **Emergency department visits and associated factors among people with dementia residing in nursing homes in Taiwan: a one-year cohort study**. *BMC Geriatr* 2023, **23**(1):503.
107. Kelly AM, Keijzers G, Klim S, Craig S, Kuan WS, Holdgate A, Graham CA, Jones P, Laribi S: **Epidemiology and outcome of older patients presenting with dyspnoea to emergency departments**. *Age Ageing* 2021, **50**(1):252-257.
108. Ayaz SI, Haque N, Pearson C, Medado P, Robinson D, Wahl R, Zervos M, O'Neil BJ: **Nursing home-acquired pneumonia: course and management in the emergency department**. *Int J Emerg Med* 2014, **7**:19.
109. Guion V, Sabra A, Martin C, Blanc E, De Souto Barreto P, Rolland Y: **Pneumonia-Associated Emergency Transfers, Functional Decline, and Mortality in Nursing Home Residents**. *J Am Med Dir Assoc* 2023, **24**(5):747-752.
110. Guion V, De Souto Barreto P, Cesari M, Rolland Y: **Quality of Life and Pneumonia in Nursing Home Residents: A 1-Year Observational Study**. *J Am Med Dir Assoc* 2022, **23**(10):1736-1740.
111. McClester Brown M, Sloane PD, Kistler CE, Reed D, Ward K, Weber D, Zimmerman S: **Evaluation and Management of the Nursing Home Resident With Respiratory Symptoms and an Equivocal Chest X-Ray Report**. *J Am Med Dir Assoc* 2016, **17**(12):1164.e1161-1164.e1165.
112. Hollaar V, van der Maarel-Wierink C, van der Putten GJ, van der Sanden W, de Swart B, de Baat C: **Defining characteristics and risk indicators for diagnosing nursing home-acquired pneumonia and aspiration pneumonia in nursing home residents, using the electronically-modified Delphi Method**. *BMC Geriatr* 2016, **16**:60.
113. Daamen MA, Schols JM, Jaarsma T, Hamers JP: **Prevalence of heart failure in nursing homes: a systematic literature review**. *Scand J Caring Sci* 2010, **24**(1):202-208.
114. Daamen MA, Hamers JP, Gorgels AP, Tan FE, Schols JM, Brunner-la Rocca HP: **Treatment of heart failure in nursing home residents**. *J Geriatr Cardiol* 2016, **13**(1):44-50.
115. Ray P, Birolleau S, Lefort Y, Becquemin MH, Beigelman C, Isnard R, Teixeira A, Arthaud M, Riou B, Boddaert J: **Acute respiratory failure in the elderly: etiology, emergency diagnosis and prognosis**. *Crit Care* 2006, **10**(3):R82.
116. Osundolire S, Goldberg RJ, Lapane KL: **Descriptive Epidemiology of Chronic Obstructive Pulmonary Disease in US Nursing Home Residents With Heart Failure**. *Curr Probl Cardiol* 2023, **48**(2):101484.
117. Miro O, Levy PD, Mockel M, Pang PS, Lambrinou E, Bueno H, Hollander JE, Harjola VP, Diercks DB, Gray AJ *et al*: **Disposition of emergency department patients diagnosed with acute heart failure: an international emergency medicine perspective**. *Eur J Emerg Med* 2017, **24**(1):2-12.

118. Collins S, Storrow AB, Albert NM, Butler J, Ezekowitz J, Felker GM, Fermann GJ, Fonarow GC, Givertz MM, Hiestand B *et al*: **Early management of patients with acute heart failure: state of the art and future directions. A consensus document from the society for academic emergency medicine/heart failure society of America acute heart failure working group**. *J Card Fail* 2015, **21**(1):27-43.
119. Caffrey C: **Potentially preventable emergency department visits by nursing home residents: United States, 2004**. *NCHS Data Brief* 2010(33):1-8.
120. Marincowitz C, Preston L, Cantrell A, Tonkins M, Sabir L, Mason S: **What influences decisions to transfer older care-home residents to the emergency department? A synthesis of qualitative reviews**. *Age Ageing* 2022, **51**(11).
121. Aryal K, Aryal K, Mowbray F, Gruneir A, Griffith L, Howard M, Jabbar A, Jones A, Costa AW: **The Association Between Nursing Home Resident Characteristics and Transfers to the Emergency Department: A Population-Level Retrospective Cohort Study**. *J Am Med Dir Assoc* 2021, **22**(3):B23-B24.
122. Aryal K, Mowbray F, Gruneir A, Griffith LE, Howard M, Jabbar A, Jones A, Tanuseputro P, Lapointe-Shaw L, Costa AP: **Nursing Home Resident Admission Characteristics and Potentially Preventable Emergency Department Transfers**. *J Am Med Dir Assoc* 2021.
123. Zuniga F, Gaertner K, Weber-Schuh SK, Low B, Simon M, Muller M: **Inappropriate and potentially avoidable emergency department visits of Swiss nursing home residents and their resource use: a retrospective chart-review**. *BMC Geriatr* 2022, **22**(1):659.
124. Vogelsmeier A, Popejoy L, Fritz E, Canada K, Ge B, Brandt L, Rantz M: **Repeat hospital transfers among long stay nursing home residents: a mixed methods analysis of age, race, code status and clinical complexity**. *BMC Health Serv Res* 2022, **22**(1):626.
125. Rolland Y, Mathieu C, Tavassoli N, Berard E, Laffon de Mazieres C, Hermabessiere S, Houles M, Perrin A, Krams T, Qassemi S *et al*: **Factors Associated with Potentially Inappropriate Transfer to the Emergency Department among Nursing Home Residents**. *J Am Med Dir Assoc* 2021, **22**(12):2579-2586 e2577.
126. Perrin A, Tavassoli N, Mathieu C, Hermabessiere S, Houles M, McCambridge C, Magre E, Fernandez S, Caquelard A, Charpentier S *et al*: **Factors predisposing nursing home resident to inappropriate transfer to emergency department. The FINE study protocol**. *Contemp Clin Trials Commun* 2017, **7**:217-223.
127. Lemoyne SE, Herbots HH, De Blick D, Remmen R, Monsieurs KG, Van Bogaert P: **Appropriateness of transferring nursing home residents to emergency departments: a systematic review**. *BMC Geriatr* 2019, **19**(1):17.
128. Dubucs X, Balen F, Charpentier S, Lauque D, De Souto Barreto P, Tavassoli N, Houze-Cerfon CH, Rolland Y: **Factors associated with Emergency Medical Dispatcher request and residents' inappropriate transfers from Nursing Homes to Emergency Department**. *Eur Geriatr Med* 2022, **13**(2):351-357.
129. Mukamel DB, Saliba D, Ladd H, Konetzka RT: **Associations Between Daily Nurse Staffing Levels and Daily Hospitalizations and ED Visits in Nursing Homes**. *J Am Med Dir Assoc* 2022, **23**(11):1793-1799 e1793.
130. Rousseau G, Thummel S, Vannier C, Paul Louis M, Debacq C, Ridoux C, Deneau P, Laribi S: **Evaluation of the appropriateness of nursing home residents' transfer to emergency departments**. *Int Emerg Nurs* 2023, **69**:101312.
131. Morphet J, Innes K, Griffiths DL, Crawford K, Williams A: **Resident transfers from aged care facilities to emergency departments: can they be avoided?** *Emerg Med Australas* 2015, **27**(5):412-418.

132. Gettel CJ, Merchant RC, Li Y, Long S, Tam A, Marks SJ, Goldberg EM: **The Impact of Incomplete Nursing Home Transfer Documentation on Emergency Department Care**. *J Am Med Dir Assoc* 2019, **20**(8):935-941 e933.
133. Hullick C, Conway J, Higgins I, Hewitt J, Dilworth S, Holliday E, Attia J: **Emergency department transfers and hospital admissions from residential aged care facilities: a controlled pre-post design study**. *BMC Geriatr* 2016, **16**:102.
134. Shrapnel S, Dent E, Nicholson C: **A nurse-led model of care within an emergency department reduces representation rates for frail aged care residents**. *Aging Clin Exp Res* 2019, **31**(11):1695-1698.
135. Kwa JM, Storer M, Ma R, Yates P: **Integration of Inpatient and Residential Care In-Reach Service Model and Hospital Resource Utilization: A Retrospective Audit**. *J Am Med Dir Assoc* 2021, **22**(3):670-675.
136. Kunkel E, Tanuseputro P, Hsu A, Talarico R, Lapenskie J, Calder-Sprackman S, Kobewka D: **Diagnostic Testing in Long-Term Care and Resident Emergency Department Visits: A Retrospective Cohort Study**. *J Am Med Dir Assoc* 2021, **22**(4):901-906 e904.
137. Plant E, McCloskey R, Shamputa IC, Chandra K, Atkinson P, Fraser J, Pishe T, Price P: **Nursing Home Residents' Use of Radiography in New Brunswick: A Case for Mobile Radiography?** *Healthc Policy* 2023, **18**(3):31-46.
138. Li SE, Hossain M, Gilman B, Forrow LV, Lee KM, Brown R: **Effects of a Nursing Home Telehealth Program on Spending and Utilization for Medicare Residents**. *Health Serv Res* 2022.
139. Ng G, Larouche J, Feldman S, Verduyn A, Ward S, Wong BM, Mayo A: **Virtual Fracture Care in Long-Term Care Homes Avoiding Emergency Department Visits**. *J Am Med Dir Assoc* 2023, **24**(5):661-663.
140. Guerbaai RA, Kressig RW, Zeller A, Troger M, Nickel CH, Benkert B, Wellens NIH, Osinska M, Simon M, Zuniga F *et al*: **Identifying Appropriate Nursing Home Resources to Reduce Fall-Related Emergency Department Transfers**. *J Am Med Dir Assoc* 2022, **23**(8):1304-1310 e1302.
141. Ouslander JG, Reyes B, Yang Z, Engstrom G, Tappen R, Newman D, Huckfeldt PJ: **Nursing home performance in a trial to reduce hospitalizations: Implications for future trials**. *J Am Geriatr Soc* 2021, **69**(8):2316-2326.
142. Ellwood A, Airlie J, Cicero R, Cundill B, Ellard DR, Farrin A, Godfrey M, Graham L, Green J, McLellan V *et al*: **Recruiting care homes to a randomised controlled trial**. *Trials* 2018, **19**(1):535.
143. Lam HR, Chow S, Taylor K, Chow R, Lam H, Bonin K, Rowbottom L, Herrmann N: **Challenges of conducting research in long-term care facilities: a systematic review**. *BMC Geriatr* 2018, **18**(1):242.
144. Nocivelli B, Shepherd V, Hood K, Wallace C, Wood F: **Identifying barriers and facilitators to the inclusion of older adults living in UK care homes in research: a scoping review**. *BMC Geriatrics* 2023, **23**(1):446.
145. Jenkins C, Smythe A, Galant-Miecznikowska M, Bentham P, Oyebode J: **Overcoming challenges of conducting research in nursing homes**. *Nurs Older People* 2016, **28**(5):16-23.
146. Shepherd V, Hood K, Sheehan M, Griffith R, Wood F: **'It's a tough decision': a qualitative study of proxy decision-making for research involving adults who lack capacity to consent in UK**. *Age Ageing* 2019, **48**(6):903-909.

147. Choong EKM, Gallagher JE, Patel R: **Methodology and outcome of trials involving older adults in UK care homes: A rapid review**. *Gerodontology* 2023, **40**(1):1-9.
148. Fries BE, Wodchis WP, Blaum C, Buttar A, Drabek J, Morris JN: **A national study showed that diagnoses varied by age group in nursing home residents under age 65**. *J Clin Epidemiol* 2005, **58**(2):198-205.
149. Shieu BM, Toles M, Hoben M, Schwartz TA, Beeber AS, Anderson RA: **A Cross-Sectional, Correlational Study Comparing Individual Characteristics of Younger and Older Nursing Home Residents using Western Canadian Resident Assessment Instrument-Minimum Data Set (RAI-MDS) 2.0**. *J Am Med Dir Assoc* 2022, **23**(11):1878-1882 e1873.
150. Mahoney FI, Barthel DW: **Functional Evaluation: The Barthel Index**. *Md State Med J* 1965, **14**:61-65.
151. Rockwood K, Song X, MacKnight C, Bergman H, Hogan DB, McDowell I, Mitnitski A: **A global clinical measure of fitness and frailty in elderly people**. *CMAJ* 2005, **173**(5):489-495.
152. Charlson M, Szatrowski TP, Peterson J, Gold J: **Validation of a combined comorbidity index**. *J Clin Epidemiol* 1994, **47**(11):1245-1251.
153. Kevin Mackway-Jones JM, Jill Windle: **Emergency Triage, Manchester Triage Group**, vol. 1, 2 edn: Blackwell Publishing; 2006.
154. **rish National Early Warning System V2 (NCEC National Clinical Guideline No. 1)** [https://www.gov.ie/en/collection/c9fa9a-national-clinical-guidelines/]
155. Grosshauser FJ, Schoene D, Kiesswetter E, Sieber CC, Volkert D: **Frailty in Nursing Homes-A Prospective Study Comparing the FRAIL-NH and the Clinical Frailty Scale**. *J Am Med Dir Assoc* 2022, **23**(10):1717 e1711-1717 e1718.
156. Dubucs X, de Souto Barreto P, Laffon de Mazieres C, Lauque D, Azema O, Charpentier S, Rolland Y: **The Temporal Trend in the Transfer of Older Adults to the Emergency Department for Traumatic Injuries: A Retrospective Analysis According to Their Place of Residence**. *J Am Med Dir Assoc* 2019, **20**(11):1462-1466.
157. Garcia-Perez D, Vena-Martinez A, Robles-Perea L, Rosello-Padulles T, Espaulella-Panicot J, Arnau A: **Prognostic Value of a New Tool (the 3D/3D+) for Predicting 30-Day Mortality in Emergency Department Patients Aged 75 Years and Older**. *J Clin Med* 2023, **12**(20).
158. Lucke JA, Mooijaart SP, Conroy S, Blomaard LC, De Groot B, Nickel CH: **Mortality risk for different presenting complaints amongst older patients assessed with the Manchester triage system**. *Eur Geriatr Med* 2021.
159. Mc Carthy CE, Keating T, Ramiah V, Power D, Duggan J, Fan CW: **Nursing home patients and Emergency Department attendance in a single urban Irish catchment area: an observational study surrounding the introduction of a community medicine for older person service**. *Ir J Med Sci* 2021, **190**(1):379-385.
160. Calcaterra L, Proietti M, Saporiti E, Nunziata V, Rolland Y, Vellas B, Cesari M: **Predictors of drug prescription in nursing home residents: results from the INCUR study**. *Intern Emerg Med* 2022, **17**(1):165-171.
161. Diez-Manglano J, Gimenez-Lopez M, Garces-Horna V, Sevil-Puras M, Castellar-Otin E, Gonzalez-Garcia P, Fiteni-Mera I, Morlanes-Navarro T, Researchers PS: **Excessive polypharmacy and survival in polypathological patients**. *Eur J Clin Pharmacol* 2015, **71**(6):733-739.

162. Beers MH, Ouslander JG, Rollingher I, Reuben DB, Brooks J, Beck JC: **Explicit criteria for determining inappropriate medication use in nursing home residents. UCLA Division of Geriatric Medicine**. *Arch Intern Med* 1991, **151**(9):1825-1832.
163. Rapp T, Sicsic J, Tavassoli N, Rolland Y: **Do not PIMP my nursing home ride! The impact of Potentially Inappropriate Medications Prescribing on residents' emergency care use**. *Eur J Health Econ* 2023, **24**(7):1085-1100.
164. Rosenthal M, Poling J, Wec A, Connolly E, Angell B, Crystal S: **"Medication Is Just One Piece of the Whole Puzzle": How Nursing Homes Change Their Use of Antipsychotic Medications**. *J Appl Gerontol* 2022, **41**(1):62-72.
165. Gallagher P, Ryan C, Byrne S, Kennedy J, O'Mahony D: **STOPP (Screening Tool of Older Person's Prescriptions) and START (Screening Tool to Alert doctors to Right Treatment). Consensus validation**. *Int J Clin Pharmacol Ther* 2008, **46**(2):72-83.
166. O'Mahony D, O'Sullivan D, Byrne S, O'Connor MN, Ryan C, Gallagher P: **STOPP/START criteria for potentially inappropriate prescribing in older people: version 2**. *Age Ageing* 2015, **44**(2):213-218.
167. Lavan AH, Gallagher P, Parsons C, O'Mahony D: **STOPPFrail (Screening Tool of Older Persons Prescriptions in Frail adults with limited life expectancy): consensus validation**. *Age Ageing* 2017, **46**(4):600-607.
168. By the American Geriatrics Society Beers Criteria Update Expert P: **American Geriatrics Society 2019 Updated AGS Beers Criteria(R) for Potentially Inappropriate Medication Use in Older Adults**. *J Am Geriatr Soc* 2019, **67**(4):674-694.
169. Gromek KR, Thorpe CT, Aspinall SL, Hanson LC, Niznik JD: **Anticholinergic co-prescribing in nursing home residents using cholinesterase inhibitors: Potential deprescribing cascade**. *J Am Geriatr Soc* 2023, **71**(1):77-88.
170. Lipori JP, Tu E, Shireman TI, Gerlach L, Coe AB, Ryskina KL: **Factors Associated with Potentially Harmful Medication Prescribing in Nursing Homes: A Scoping Review**. *J Am Med Dir Assoc* 2022, **23**(9):1589 e1581-1589 e1510.
171. Malagaris I, Mehta HB, Goodwin JS: **Trends and variation in benzodiazepine use in nursing homes in the USA**. *Eur J Clin Pharmacol* 2022, **78**(3):489-496.
172. Onder G, Vetrano DL, Villani ER, Carfi A, Lo Monaco MR, Cipriani MC, Manes Gravina E, Denkinger M, Pagano F, van der Roest HG *et al*: **Deprescribing in Nursing Home Residents on Polypharmacy: Incidence and Associated Factors**. *J Am Med Dir Assoc* 2019, **20**(9):1116-1120.
173. Molist-Brunet N, Sevilla-Sanchez D, Puigoriol-Juvanteny E, Bajo-Penas L, Cantizano-Baldo I, Cabanas-Collell L, Espaulella-Panicot J: **Individualized Medication Review in Older People with Multimorbidity: A Comparative Analysis between Patients Living at Home and in a Nursing Home**. *Int J Environ Res Public Health* 2022, **19**(6).
174. Roughead EE, Pratt NL, Parfitt G, Rowett D, Kalisch-Ellett LM, Bereznicki L, Merlin T, Corlis M, Kang AC, Whitehouse J *et al*: **Effect of an ongoing pharmacist service to reduce medicine-induced deterioration and adverse reactions in aged-care facilities (nursing homes): a multicentre, randomised controlled trial (the ReMInDAR trial)**. *Age Ageing* 2022, **51**(4).
175. Harris DA, Maclagan LC, Iaboni A, Austin PC, Rosella LC, Maxwell CJ, Campitelli M, Pequeno P, Guan J, Kirkham J *et al*: **Potential Unintended Consequences of Antipsychotic Reduction in Ontario Nursing Homes**. *J Am Med Dir Assoc* 2022, **23**(6):1066-1072 e1067.

176. Gerlach LB, Maust DT, Kales HC, Chang M, Kim HM, Wiechers IR, Zivin K: **Evaluation of Antipsychotic Reduction Efforts in Patients With Dementia in Veterans Health Administration Nursing Homes**. *Am J Psychiatry* 2022, **179**(8):544-552.
177. Harris DA, Maclagan LC, Pequeno P, Iaboni A, Austin PC, Rosella LC, Guan J, Maxwell CJ, Bronskill SE: **Changes in the Initiation of Antipsychotics and Trazodone Over Time: A Cohort Study of New Admissions to Nursing Homes in Ontario, Canada**. *Am J Geriatr Psychiatry* 2023, **31**(6):449-455.
178. Candon M, Strominger J, Gerlach LB, Maust DT: **Antiepileptic prescribing to persons living with dementia residing in nursing homes: A tale of two indications**. *J Am Geriatr Soc* 2023, **71**(1):89-97.
179. **Mortality associated with COVID-19 outbreaks in care homes: early international evidence** [https://ltccovid.org/2020/05/04/updated-report-mortality-associated-with-covid-19-outbreaks-in-care-homes-early-international-evidence/]
180. Fallon A, Dukelow T, Kennelly SP, O'Neill D: **COVID-19 in nursing homes**. *QJM* 2020, **113**(6):391-392.
181. **Infection Prevention and Control guidance for Long-Term Care Facilities in the Context of COVID-19** [https://apps.who/.int/iris/bitstream/handle/10665/331508/WHO-2019-nCOV-IPC_long_term_care-2020.1-eng.pdf]
182. **COVID-19: Managing the COVID-19 pandemic in care homes for older people** [https://www.bgs.org.uk/resources/covid-19-managing-the-covid-19-pandemic-in-care-homes]
183. **The impact of COVID-19 on people who use and provide long-term care in Ireland and mitigating measures.** [ltccovid.org
]
184. Health Do: **Overview of the Health System Response to date: Long-term residential healthcare settings.** In: *NPHET Meeting Paper 2020.* NPHET, Department of Health; 2020.
185. Helsinki WMADo: **Ethical Principles for Medical Research Involving Human Subjects.** In. 64th WMA General Assembly, Fortaleza, Brazil, October 2013: WMA; 2013.
186. HIQA: **National Standards for Residential Care Settings for Older People in Ireland**. In.: Health Information and Quality Authority; 2016.
187. Pillemer K, Subramanian L, Hupert N: **The Importance of Long-term Care Populations in Models of COVID-19**. *JAMA* 2020, **324**(1):25-26.
188. Arons MM, Hatfield KM, Reddy SC, Kimball A, James A, Jacobs JR, Taylor J, Spicer K, Bardossy AC, Oakley LP *et al*: **Presymptomatic SARS-CoV-2 Infections and Transmission in a Skilled Nursing Facility**. *N Engl J Med* 2020, **382**(22):2081-2090.
189. Graham NSN, Junghans C, Downes R, Sendall C, Lai H, McKirdy A, Elliott P, Howard R, Wingfield D, Priestman M *et al*: **SARS-CoV-2 infection, clinical features and outcome of COVID-19 in United Kingdom nursing homes**. *J Infect* 2020, **81**(3):411-419.
190. Lee S, Kim T, Lee E, Lee C, Kim H, Rhee H, Park SY, Son HJ, Yu S, Park JW *et al*: **Clinical Course and Molecular Viral Shedding Among Asymptomatic and Symptomatic Patients With SARS-CoV-2 Infection in a Community Treatment Center in the Republic of Korea**. *JAMA Intern Med* 2020, **180**(11):1447-1452.
191. Health Do: **Review of the Nursing Homes Support Scheme, A Fair Deal**. In. Edited by Health Do. assets.gov.ie; 2012.

192. Lombardo FL, Salvi E, Lacorte E, Piscopo P, Mayer F, Ancidoni A, Remoli G, Bellomo G, Losito G, D'Ancona F *et al*: **Adverse Events in Italian Nursing Homes During the COVID-19 Epidemic: A National Survey**. *Front Psychiatry* 2020, **11**:578465.
193. Siu HY, Kristof L, Elston D, Hafid A, Mather F: **A cross-sectional survey assessing the preparedness of the long-term care sector to respond to the COVID-19 pandemic in Ontario, Canada**. *BMC Geriatr* 2020, **20**(1):421.
194. Unroe KT, Evans R, Weaver L, Rusyniak D, Blackburn J: **Willingness of Long-Term Care Staff to Receive a COVID-19 Vaccine: A Single State Survey**. *J Am Geriatr Soc* 2021, **69**(3):593-599.
195. Clark M, Rogers M, Foster A, Dvorchak F, Saadeh F, Weaver J, Mor V: **A randomized trial of the impact of survey design characteristics on response rates among nursing home providers**. *Eval Health Prof* 2011, **34**(4):464-486.
196. Williams JAR, Vriniotis MG, Gundersen DA, Boden LI, Collins JE, Katz JN, Wagner GR, Sorensen G: **How to ask: Surveying nursing directors of nursing homes**. *Health Sci Rep* 2021, **4**(2):e304.
197. Hallgren J, Ernsth Bravell M, Molstad S, Ostgren CJ, Midlov P, Dahl Aslan AK: **Factors associated with increased hospitalisation risk among nursing home residents in Sweden: a prospective study with a three-year follow-up**. *Int J Older People Nurs* 2016, **11**(2):130-139.
198. Fassmer AM, Hoffmann F: **Acute health care services use among nursing home residents in Germany: a comparative analysis of out-of-hours medical care, emergency department visits and acute hospital admissions**. *Aging Clin Exp Res* 2020, **32**(7):1359-1368.
199. Kristensen GS, Kjeldgaard AH, Sondergaard J, Andersen-Ranberg K, Pedersen AK, Mogensen CB: **Associations between care home residents' characteristics and acute hospital admissions - a retrospective, register-based cross-sectional study**. *BMC Geriatr* 2023, **23**(1):234.
200. Bogaisky M, Dezieck L: **Early hospital readmission of nursing home residents and community-dwelling elderly adults discharged from the geriatrics service of an urban teaching hospital: patterns and risk factors**. *J Am Geriatr Soc* 2015, **63**(3):548-552.
201. Honinx E, Piers RD, Onwuteaka-Philipsen BD, Payne S, Szczerbinska K, Gambassi G, Kylanen M, Deliens L, Van den Block L, Smets T *et al*: **Hospitalisation in the last month of life and in-hospital death of nursing home residents: a cross-sectional analysis of six European countries**. *BMJ Open* 2021, **11**(8):e047086.
202. **Health Expenditure in Ireland 2018** [https://www.cso.ie/en/releasesandpublications/ep/p-sha/systemofhealthaccounts2018/healthexpenditureinireland2018/]
203. **Provisional Health Expenditure Estimates for 2022** [https://www.cso.ie/en/releasesandpublications/ep/p-sha/systemofhealthaccounts2021/provisionalhealthexpenditureestimatesfor2022/#:~:text=Total%20Health%20Expenditure%20and%20COVID,is%20shown%20in%20Table%202.2.]
204. Martinsson L, Lundstrom S, Sundelof J: **Better quality of end-of-life care for persons with advanced dementia in nursing homes compared to hospitals: a Swedish national register study**. *BMC Palliat Care* 2020, **19**(1):135.
205. Carpenter CR, Shelton E, Fowler S, Suffoletto B, Platts-Mills TF, Rothman RE, Hogan TM: **Risk factors and screening instruments to predict adverse outcomes for**

undifferentiated older emergency department patients: a systematic review and meta-analysis. *Acad Emerg Med* 2015, **22**(1):1-21.
206. Edmans J, Bradshaw L, Gladman JR, Franklin M, Berdunov V, Elliott R, Conroy SP: **The Identification of Seniors at Risk (ISAR) score to predict clinical outcomes and health service costs in older people discharged from UK acute medical units**. *Age Ageing* 2013, **42**(6):747-753.
207. Cousins G, Bennett Z, Dillon G, Smith SM, Galvin R: **Adverse outcomes in older adults attending emergency department: systematic review and meta-analysis of the Triage Risk Stratification Tool**. *Eur J Emerg Med* 2013, **20**(4):230-239.
208. Morphet J, Griffiths DL, Innes K, Crawford K, Crow S, Williams A: **Shortfalls in residents' transfer documentation: challenges for emergency department staff**. *Australas Emerg Nurs J* 2014, **17**(3):98-105.
209. Weinick RM, Wilcox SR, Park ER, Griffey RT, Weissman JS: **Use of advance directives for nursing home residents in the emergency department**. *Am J Hosp Palliat Care* 2008, **25**(3):179-183.
210. O'Reilly P, O'Brien B, Graham MM, Murphy J, Barry L, Doody O, Fahy A, Hoey C, Kiely M, Lang D *et al*: **Key stakeholders' perspectives on the development of a national transfer document, for older persons, when transferring between the residential and acute care settings: A qualitative descriptive study**. *Int J Older People Nurs* 2019, **14**(4):e12254.
211. Arendts G, Jan S, Beck MJ, Howard K: **Preferences for the emergency department or alternatives for older people in aged care: a discrete choice experiment**. *Age Ageing* 2017, **46**(1):124-129.
212. Kontunen PJ, Holstein RM, Torkki PM, Lang ES, Castren MK: **Acute outreach service to nursing homes: A systematic review with GRADE and triple aim approach**. *Scand J Caring Sci* 2023, **37**(2):582-594.
213. Niznik JD, Li X, Gilliam MA, Hanson LC, Aspinall SL, Colon-Emeric C, Thorpe CT: **Are Nursing Home Residents With Dementia Appropriately Treated for Fracture Prevention?** *J Am Med Dir Assoc* 2021, **22**(1):28-35 e23.
214. Udesen SEJ, Rasmussen CH, Mikkelsen S, Andersen N, Brabrand M, Lassen AT: **Mobile emergency department care to nursing home residents: a novel outreach service**. *Age Ageing* 2023, **52**(3).
215. Leong LJP, Crawford GB: **Residential aged care residents and components of end of life care in an Australian hospital**. *BMC Palliat Care* 2018, **17**(1):84.
216. Smets T, Pivodic L, Piers R, Pasman HRW, Engels Y, Szczerbinska K, Kylanen M, Gambassi G, Payne S, Deliens L *et al*: **The palliative care knowledge of nursing home staff: The EU FP7 PACE cross-sectional survey in 322 nursing homes in six European countries**. *Palliat Med* 2018, **32**(9):1487-1497.
217. Carpenter JG, Lam K, Ritter AZ, Ersek M: **A Systematic Review of Nursing Home Palliative Care Interventions: Characteristics and Outcomes**. *J Am Med Dir Assoc* 2020, **21**(5):583-596 e582.
218. Wowchuk SM, McClement S, Bond J, Jr.: **The challenge of providing palliative care in the nursing home part II: internal factors**. *Int J Palliat Nurs* 2007, **13**(7):345-350.
219. Ho P, Lim Y, Tan LLC, Wang X, Magpantay G, Chia JWK, Loke JYC, Sim LK, Low JA: **Does an Integrated Palliative Care Program Reduce Emergency Department Transfers for Nursing Home Palliative Residents?** *J Palliat Med* 2022, **25**(3):361-367.

220. Stanyon MR, Goldberg SE, Astle A, Griffiths A, Gordon AL: **The competencies of Registered Nurses working in care homes: a modified Delphi study**. *Age Ageing* 2017, **46**(4):582-588.
221. Anstey S, Powell T, Coles B, Hale R, Gould D: **Education and training to enhance end-of-life care for nursing home staff: a systematic literature review**. *BMJ Support Palliat Care* 2016, **6**(3):353-361.
222. Porter-Armstrong AP, Moore ZE, Bradbury I, McDonough S: **Education of healthcare professionals for preventing pressure ulcers**. *Cochrane Database Syst Rev* 2018, **5**(5):Cd011620.
223. Shaw C, Williams KN, Perkhounkova Y: **Educating Nursing Home Staff in Dementia Sensitive Communication: Impact on Antipsychotic Medication Use**. *J Am Med Dir Assoc* 2018, **19**(12):1129-1132.
224. Ballard C, Corbett A, Orrell M, Williams G, Moniz-Cook E, Romeo R, Woods B, Garrod L, Testad I, Woodward-Carlton B *et al*: **Impact of person-centred care training and person-centred activities on quality of life, agitation, and antipsychotic use in people with dementia living in nursing homes: A cluster-randomised controlled trial**. *PLoS Med* 2018, **15**(2):e1002500.
225. Hartmann CW, Mills WL, Pimentel CB, Palmer JA, Allen RS, Zhao S, Wewiorski NJ, Sullivan JL, Dillon K, Clark V *et al*: **Impact of Intervention to Improve Nursing Home Resident-Staff Interactions and Engagement**. *Gerontologist* 2018, **58**(4):e291-e301.
226. McDermid J, Henley W, Corbett A, Williams G, Fossey J, Clare L, Fox C, Aarsland D, Khan Z, Soto M *et al*: **Impact of the iWHELD digital person-centered care program on quality of life, agitation and psychotropic medications in people with dementia living in nursing homes during the COVID-19 pandemic: A randomized controlled trial**. *Alzheimers Dement* 2023.
227. Dowling MJ, Payne C, Larkin P, Ryan DJ: **Does an Interactive, Teleconference-Delivered, Palliative Care Lecture Series Improve Nursing Home Staff Confidence?** *J Palliat Med* 2020, **23**(2):179-183.
228. Stocker R, Russell S, Liddle J, Barker RO, Remmer A, Gray J, Hanratty B, Adamson J: **Experiences of a National Early Warning Score (NEWS) intervention in care homes during the COVID-19 pandemic: a qualitative interview study**. *BMJ Open* 2021, **11**(7):e045469.

Appendices

Presenting Complaint	n =	%
1. Generally Unwell	154	29.8%
2. Fall	83	16.1%
3. Breathless	74	14.3%
4. Limb problems	56	10.9%
5. Urinary problems	22	4.3%
6. Vomiting	20	3.9%
7. Abdominal pain	18	3.5%
8. Collapse	14	2.7%
9. Seizure	10	1.9%
10. Chest pain	8	1.6%
11. Head injury	8	1.6%
12. Back pain	7	1.4%
13. Bleeding	7	1.4%
14. Laceration/ Wound	4	0.8%
15. Behaving strangely/ Psychiatry	3	0.6%
16. Diarrhoea	3	0.6%
17. Eye problems	3	0.6%
18. Abscess	2	0.4%
19. Facial problems	2	0.4%
20. Foreign Body	2	0.4%
21. Headache	2	0.4%
22. Overdose	2	0.4%
23. Rash	2	0.4%
24. Dysarthria	1	0.2%
25. Ear problems	1	0.2%
26. GI Bleed	1	0.2%
27. Local infection	1	0.2%
28. Palpitations	1	0.2%
29. RIG	1	0.2%
30. Urinary Catheter problems	1	0.2%
31. Missing	2	0.4%
TOTAL	**515**	**100.0%**

Supplementary Table 1: NH Residents attending the ED – Presenting Complaint

ATC Anatomical Group, Therapeutic Subgroup	Frequency	Percent
Nervous System (n=1898)		
Psycholeptics	679	11.6
Psychoanaleptics	437	7.4
Analgesics	400	6.8
Antiepileptics	299	5.1
Anti-Parkinsonian Drugs	71	1.2
Other Nervous System Drugs	6	0.1
Anaesthetics	3	0.1
Total	**1898**	**32.3**
Alimentary Tract and Metabolism (n=1631)		
Drugs for Constipation	642	10.9
Drugs for Acid-Related Disorders	339	5.8
Vitamins	276	4.7
Mineral Supplements	158	2.7
Drugs used in Diabetes	106	1.8
Drugs for Functional Gastrointestinal Disorders	50	0.9
Antidiarrhoeals, Intestinal Anti-inflammatory/Anti-infective Agents	26	0.4
Antiemetics and Antinauseants	14	0.2
Stomatological Preparations	13	0.2
Digestives	2	0
Bile and Liver Therapy	1	0
Total	**1631**	**27.8**
Cardiovascular System (n=630)		
Lipid Modifying Agents	159	2.7
Diuretics	112	1.9
Beta Blocking Agents	107	1.8
Agents acting on the Renin-Angiotensin System	96	1.6
Calcium Channel Blockers	87	1.5
Cardiac Therapy	46	0.8
Antihypertensives	12	0.2
Vasoprotectives	4	0.1

Total	**630**	**10.7**
Blood and Blood Forming Organs (n=481)		
Antithrombotic Agents	268	4.6
Antianaemic Preparations	217	3.7
Blood Substitutes and Perfusion Solutions	13	0.2
Total	**481**	**8.2**
Respiratory System (n=415)		
Drugs for Obstructive Airways Diseases	264	4.5
Antihistamines for Systemic Use	79	1.3
Cough and Cold Preparations	56	1
Nasal Preparations	13	0.2
Throat Preparations	1	0
Total	**415**	**7.1**
Musculoskeletal System (n=214)		
Drugs for Treatment of Bone Diseases	89	1.5
Topical Products for Joint and Muscle Pain	36	0.6
Anti-inflammatory and Antirheumatic Products	35	0.6
Muscle Relaxants	35	0.6
Antigout Preparations	19	0.3
Total	**214**	**3.6**
Dermatologicals (n=157)		
Emollients and Protectives	61	1
Antifungals for Dermatological Use	55	0.9
Corticosteroids, Dermatological Preparations	17	0.3
Antipsoriatics	10	0.2
Antipruritics	7	0.1
Antibiotics and Chemotherapeutics for Dermatological Use	5	0.1
Antiseptics and Disinfectants	2	0
Total	**157**	**2.7**
Sensory Organs (n=137)		
Opthalmologicals	135	2.3
Otologicals	1	0
Ophthalmological and Otological Preparations	1	0

Total	**137**	**2.3**
Systemic Hormonal Preparations (n=123)		
Thyroid Therapy	97	1.7
Corticosteroids for Systemic Use	22	0.4
Pituitary and Hypothalamic Hormones and Analogues	2	0
Calcium Homeostasis	2	0
Total	**123**	**2.1**
Genitourinary System and Sex Hormones (n=114)		
Urologicals	113	1.9
Sex Hormones and modulators of the Genital System	1	0
Total	**114**	**1.9**
Anti-infectives for Systemic Use (n=40)		
Antibacterials for Systemic Use	38	0.6
Antivirals for Systemic Use	2	0
Total	**40**	**0.7**
Antineoplastic and Immunomodulating Agents (n=24)		
Endocrine Therapy	17	0.3
Immunosuppressants	4	0.1
Antineoplastic Agents	3	0.1
Total	**24**	**0.4**
Antiparasitic Products (n=4)		
Antiprotozoals	4	0.1
Total	**4**	**0.1**
Various (n=7)		
General Nutrients	4	0.1
All Other Therapeutic Products	3	0.1
Total	**7**	**0.1**
Total	**5877**	**100**

Supplementary Table 2: Medication prescriptions for NH residents attending the ED (WHO ATC subgroup)

STOPP version 2	
1. Any drug prescribed without an evidence-based clinical indication	3103
2. Any duplicate drug class prescription e.g. two concurrent NSAIDs, SSRIs, loop diuretics, ACE inhibitors, anticoagulants	58*
Section B: Cardiovascular System	
1. Digoxin for heart failure with normal systolic ventricular function	11
2. Verapamil or diltiazem with NYHA Class III or IV heart failure	4
3. Beta-blocker in combination with verapamil or diltiazem	0
4. Beta blocker with bradycardia	107
5. Amiodarone as first-line antiarrhythmic therapy in supraventricular tachyarrhythmias	0
6. Loop diuretic as first-line treatment for hypertension	83
7. Loop diuretic for dependent ankle oedema without clinical, biochemical evidence or radiological evidence of heart failure, liver failure, nephrotic syndrome or renal failure	83
8. Thiazide diuretic with current significant hypokalaemia, hyponatraemia, hypercalcaemia or with a history of gout (	4
9. Loop diuretic for treatment of hypertension with concurrent urinary incontinence	83
10. Centrally-acting antihypertensives, unless clear intolerance of, or lack of efficacy with, other classes of antihypertensives	0
11. ACE inhibitors or Angiotensin Receptor Blockers in patients with hyperkalaemia.	96
12. Aldosterone antagonists with concurrent potassium-conserving drugs without monitoring of serum potassium	3
13. Phosphodiesterase type-5 inhibitors in severe heart failure characterised by hypotension i.e. systolic BP < 90 mmHg, or concurrent nitrate therapy for angina	1
	475
Section C: Antiplatelet/Anticoagulant Drugs	
1. Long-term aspirin at doses greater than 160mg per day	0
2. Aspirin with a past history of peptic ulcer disease without concomitant PPI	1
3. Aspirin, clopidogrel, dipyridamole, vitamin K antagonists, direct thrombin inhibitors or factor Xa inhibitors with concurrent significant bleeding risk	1
4. Aspirin plus clopidogrel as secondary stroke prevention, unless the patient has a coronary stent(s) inserted in the previous 12 months or concurrent acute coronary syndrome or has a high grade symptomatic carotid arterial stenosis	1
5. Aspirin in combination with vitamin K antagonist, direct thrombin inhibitor or factor Xa inhibitors in patients with chronic atrial fibrillation	9
6. Antiplatelet agents with vitamin K antagonist, direct thrombin inhibitor or factor Xa inhibitors in patients with stable coronary, cerebrovascular or peripheral arterial disease	9
7. Ticlopidine in any circumstances	0

8. Vitamin K antagonist, direct thrombin inhibitor or factor Xa inhibitors for first deep venous thrombosis without continuing provoking risk factors for > 6 months	4
9. Vitamin K antagonist, direct thrombin inhibitor or factor Xa inhibitors for first pulmonary embolus without continuing provoking risk factors for > 12 months	1
10. NSAID and vitamin K antagonist, direct thrombin inhibitor or factor Xa inhibitors in combination	1
11. NSAID with concurrent antiplatelet agent(s) without PPI prophylaxis	1
	28
Section D: Central Nervous System and Psychotropic Drugs	
1. Tricyclic Antidepressants (TCAs) with dementia, narrow angle glaucoma, cardiac conduction abnormalities, prostatism, or prior history of urinary retention	7
2. Initiation of Tricyclic Antidepressants (TCAs) as first-line antidepressant treatment	7
3. Neuroleptics with moderate-marked antimuscarinic/anticholinergic effects with a history of prostatism or previous urinary retention	3
4. Selective serotonin re-uptake inhibitors (SSRI's) with current or recent significant hyponatraemia	1
5. Benzodiazepines for ≥ 4 weeks	224
6. Antipsychotics in those with parkinsonism or Lewy Body Disease	4
7. Anticholinergics/antimuscarinics to treat extra-pyramidal side-effects of neuroleptic medications	18
8. Anticholinergics/antimuscarinics in patients with delirium or dementia	80
9. Neuroleptic antipsychotic in patients with behavioural and psychological symptoms of dementia (BPSD) unless symptoms are severe and other non-pharmacological treatments have failed	139
10. Neuroleptics as hypnotics, unless sleep disorder is due to psychosis or dementia	11
11. Acetylcholinesterase inhibitors with a known history of persistent bradycardia, heart block or recurrent unexplained syncope or concurrent treatment with drugs that reduce heart rate such as beta-blockers, digoxin, diltiazem, verapamil	0
12. Phenothiazines as first-line treatment, since safer and more efficacious alternatives exist	18
13. Levodopa or dopamine agonists for benign essential tremor	5
14. First-generation antihistamines	9
Total	**526**
Section E: Renal System.	
1. Digoxin at a long-term dose greater than 125µg/day if eGFR < 30 ml/min/1.73m2	0
2. Direct thrombin inhibitors if eGFR < 30 ml/min/1.73m2	0
3. Factor Xa inhibitors if eGFR < 15 ml/min/1.73m2	10
4. NSAID's if eGFR < 50 ml/min/1.73m2	0
5. Colchicine if eGFR < 10 ml/min/1.73m2	0

6. Metformin if eGFR < 30 ml/min/1.73m2	2
	12
Section F: Gastrointestinal System	
1. Prochlorperazine or metoclopramide with Parkinsonism	3
2. PPI for uncomplicated peptic ulcer disease or erosive peptic oesophagitis at full therapeutic dosage for > 8 weeks	296
3. Drugs likely to cause constipation in patients with chronic constipation where non-constipating alternatives are available	401
4. Oral elemental iron doses greater than 200 mg daily	99
Total	799
Section G: Respiratory System	
1. Theophylline as monotherapy for COPD	1
2. Systemic corticosteroids instead of inhaled corticosteroids for maintenance therapy in moderate-severe COPD	3
3. Anti-muscarinic bronchodilators with a history of narrow angle glaucoma or bladder outflow obstruction	1
4. Non-selective beta-blocker with a history of asthma requiring treatment	10
5. Benzodiazepines with acute or chronic respiratory failure	0
Total	15
Section H: Musculoskeletal System	
1. Non-steroidal anti-inflammatory drug (NSAID) other than COX-2 selective agents with history of peptic ulcer disease or gastrointestinal bleeding, unless with concurrent PPI or H2 antagonist (	0
2. NSAID with severe hypertension or severe heart failure	13
3. Long-term use of NSAID (>3 months) for symptom relief of osteoarthritis pain where paracetamol has not been tried	11
4. Long-term corticosteroids (>3 months) as monotherapy for rheumatoid arthritis	0
5. Corticosteroids for osteoarthritis (	0
6. Long-term NSAID or colchicine (>3 months) for chronic treatment of gout where there is no contraindication to a xanthine-oxidase inhibitor	0
7. COX-2 selective NSAIDs with concurrent cardiovascular disease	3
8. NSAID with concurrent corticosteroids without PPI prophylaxis	0
9. Oral bisphosphonates in patients with a current or recent history of upper gastrointestinal disease i.e. dysphagia, oesophagitis, gastritis, duodenitis, or peptic ulcer disease, or upper gastrointestinal bleeding (	3
Total	30
Section I: Urogenital System	
1. Antimuscarinic drugs with dementia, or chronic cognitive impairment or narrow-angle glaucoma or chronic prostatism	15
2. Selective alpha-1 selective alpha blockers in those with symptomatic orthostatic hypotension or micturition syncope (risk of precipitating recurrent syncope)	3
Total	18

Section J. Endocrine System	
1. Sulphonylureas with a long duration of action with type 2 diabetes mellitus	0
2. Thiazolidinediones in patients with heart failure	0
3. Beta-blockers in diabetes mellitus with frequent hypoglycaemic episodes	30
4. Oestrogens with a history of breast cancer or venous thromboembolism	0
5. Oral oestrogens without progestogen in patients with intact uterus	0
6. Androgens in the absence of primary or secondary hypogonadism	0
Total	30
Section K: Drugs that predictably increase the risk of falls in older people	
1. Benzodiazepines	224
2. Neuroleptic drugs	364
3. Vasodilator drugs	12
4. Hypnotic Z-drugs e.g. zopiclone, zolpidem, zaleplon	117
Total	717
Section L: Analgesic Drugs	
1. Use of oral or transdermal strong opioids	19
2. Use of regular opioids without concomitant laxative	21
3. Long-acting opioids without short-acting opioids for break-through pain	28
Total	68
Section N: Antimuscarinic/Anticholinergic Drug Burden	
1. Concomitant use of two or more drugs with antimuscarinic/anticholinergic properties	15

Supplementary Table 3: PIM prescriptions according to STOPP version 2

STOPPFrail	
1. Antihypertensive therapies: reduce and discontinue in patients with systolic blood pressure (SBP) persistently <130mmHg	2*
2. Anti-anginal therapies	34
3. Aspirin for stroke prevention in atrial fibrillation	25
4. Vitamin D (ergocalciferol and cholecalciferol)Any vitamin D	178
5. Drugs for overactive bladder (muscarinic antagonists and mirabegron)	58
6. Diabetic therapies: Deintensify therapy	34
7. Folic acid	88
Total	
Section A: General	
A1: Any drug that the patient persistently fails to take or tolerate despite adequate education and consideration of all appropriate formulations - NA	
A2: Any drug without clear clinical indication.	3103
Total	3103
Section B: Cardiology system	
B1. Lipid lowering therapies	160
B2. Alpha-blockers for hypertension	12
Total	172
Section C: Coagulation system	
C1: Anti-platelets: Avoid anti-platelet agents for primary cardiovascular prevention	103
Total	103
Section D: Central Nervous System	
D1. Neuroleptic antipsychotics: Aim to reduce dose and discontinue these drugs in patients taking them for longer than 12 weeks if there are no current clinical features of behavioural and psychiatric symptoms of dementia	139
D2: Memantine	38
Total	177
Section E: Gastrointestinal System	
E1. Proton Pump Inhibitors: Proton Pump Inhibitors at full therapeutic dose ≥ 8/52, unless persistent dyspeptic symptoms at lower maintenance dose	296
E2: H2 receptor antagonist: H2 receptor antagonist at full therapeutic dose for ≥ 8/52, unless persistent dyspeptic symptoms at lower maintenance dose	10
E3. Gastrointestinal antispasmodics: Regular daily prescription of gastrointestinal antispasmodics agents unless the patient has frequent relapse of colic symptoms	25
Total	331
Section F: Respiratory System	
F1. Theophylline	1
F2. Leukotriene antagonists in COPD	6
Total	7
Section G: Musculoskeletal System	
G1: Calcium supplementation	150
G2: Anti-resorptive/bone anabolic drugs FOR OSTEOPOROSIS	89

G3. Selective Estrogen Receptor Modulators (SERMs) for osteoporosis	1
G4. Long-term oral NSAIDs	35
G5. Long-term oral steroids	13
Total	288
Section H: Urogenital System	
H1. 5-alpha reductase inhibitors	13
H2. Alpha blockers	44
H3. Muscarinic antagonists	46
Total	103
Section I: Endocrine System	
I1. Diabetic oral agents: Aim for monotherapy.	34
I2. ACE-Inhibitors for diabetes: Stop where prescribed only for prevention and treatment of diabetic nephropathy	8
I3. Angiotensin Receptor Blockers (ARBs): Stop where prescribed only for prevention and treatment of diabetic nephropathy	0
I4. Systemic oestrogens for menopausal symptoms	0
Total	42
Section J: Miscellaneous	
J1. Multi-vitamin combination supplements	49
J2. Nutritional supplements (other than vitamins)	199
J3: Prophylactic Antibiotics	4
	252

Supplementary Table 4: PIM prescriptions according to STOPPFrail

Potentially Inappropriate Medication Use in Older Adults (n=1125)	
First-generation antihistamines	
Chlorpheniramine	5
Promethazine	3
Total	**8**
Antispasmodics	
Scopolamine	1
Total	**1**
Anti-infective	
Nitrofurantoin	4
Total	**4**
Cardiovascular	
Doxazocin	12
Digoxin as first line treatment atrial fibrillation or heart failure	11
Total	**23**
Central nervous system	
Antidepressants, alone or in combination	
Amitriptyline	16
Paroxetine	4
Antipsychotics, first and second generation	364
Barbiturates	
Phenobarbital	4
Benzodiazepines	
Alprazolam	31
Lorazepam	63
Temazepam	2
Clonazepam	40
Diazepam	45
Flurazepam	9
Z-drugs	117
Total	**695**
Endocrine	
Megestrol	6

Sulfonylureas		22
Total		**28**
Gastrointestinal		
Metoclopramide		3
PPIs		296
Total		**299**
Pain medications		
Non-cyclooxygenase-selective NSAIDS		
Diclofenac		4
Ibuprofen		25
Mefenamic acid		1
Naproxen		1
Skeletal muscle relaxants		35
Total		**66**
Genitourinary		
Desmopressin		1
Total		**1**
	Total	**1125**
Potentially Inappropriate Medication Use in Older Adults Due to Drug-Disease or Drug-Syndrome. 2019 American Geriatrics Society Beers Criteria Interactions That May Exacerbate the Disease or Syndrome (n=1546)		
Cardiovascular		
Heart failure	HFrEF: Non dihydropyridine CCB	4
	NSAIDs	1
	Total	**5**
Central nervous system		
Delirium	Anticholinergics	176
	Antipsychotics	364
	Benzodiazepines	224

	Corticosteroids	24
	Cimetidine	7
	Famotidine	1
	Ranitidine	2
	z-drugs	117
Dementia and cognitive impairment	Anticholinergics	56
	Benzodiazepines	15
	z-drugs	11
	Antipsychotics	144
Falls or fractures	Antiepileptics	1
	Antipsychotics	6
	Benzodiazepines	4
	z-drugs	5
	TCA	8
	SSRI	75
	SNRI	18
	Opioids	58
Parkinson's disease	Prochlorperazine	3
	Total	**1319**
Gastrointestinal		
PUD	Non-COX-2-selective NSAIDs	3
	Total	**3**
Kidney		
CKD 4 +	NSAIDs	34

Urinary incontinence	Doxazocin	12
LUTS	Anticholinergics	173
	Total	**219**
		Total **1546**

2019 American Geriatrics Society Beers Criteria® for Potentially Inappropriate Medications: Drugs To Be Used With Caution in Older Adults (n=934)	
Aspirin for primary prevention of cardiovascular disease and colorectal cancer	91
Dabigatran	2
Rivaroxaban	22
Antipsychotics	364
Carbamazepine	38
SSRI	148
Diuretics	111
Mirtazapine	95
Oxycarbazepine	7
SNRI	29
TCA	18
Tramadol	9
Total	**934**

2019 American Geriatrics Society Beers Criteria® for Potentially Clinically Important Drug-Drug Interactions that should be Avoided in Older Adults (n=1429 drugs, n=335 participants)			
Drug 1	**Drug 2**	**N=drugs**	**N=Participant**
RAS inhibitor (ACEIs, ARBs, aliskiren)	Another RAS inhibitor	8	4
potassium-sparing diuretics (amiloride, triamterene)	Another RAS inhibitor	12	6
Opioids	Benzodiazepines	119	46
Opioids	Gabapentin	10	5
Opioids	pregabalin	58	25

Anticholinergic	Anticholinergic	15	7
Antidepressants	*Any combination of 3 or more*	245	
Antipsychotics	*Any combination of 3 or more*	320	
Antiepileptics	*Any combination of 3 or more*	155	
Benzodiazepines	*Any combination of 3 or more*	294	
Z-drugs	*Any combination of 3 or more*	82	
Opioids	*Any combination of 3 or more*	101	237
Lithium	ACEI	8	4
Warfarin	Macrolides	2	1
	Total	**1429 (drugs)**	**335 (participants)**

2019 American Geriatrics Society Beers Criteria® for Medications That Should Be Avoided or Have Their Dosage Reduced With Varying Levels of Kidney Function in Older Adults (n=65)

eGFR		
<30	Amiloride	1
<25	Apixaban	19
<30	Dabigatran	1
<15	Edoxaban	7
<50	Rivaroxaban	5
<60	Gabapentin	6
<80	Levetiracetam	7
<60	Pregabalin	13
<30	Tramadol	2
<50	Cimetidine	4
	Total	**65**

Drugs with Strong Anticholinergic Properties (n=173)	
Antidepressant	
Amitriptyline	16
Paroxetine	4
Total	**20**
Antiemetics	
Prochlorperazine	21
Promethazine	3
Total	**24**
Antihistamine (first generation)	
Chlorpheniramine	5
Total	**5**
Antimuscarinics	
Fexofenadine	11
Oxybutynin	5
Solifenacin	6
Tolterodine	19
Trospium	5
Total	**46**
Antipsychotics	
Chlorpromazine	12
Clozapine	5
Olanzapine	60
Total	**77**
Antispasmodics	
Scopolamine	1
Total	**1**
Total	**173**
TOTAL PIMs	**3857**

Supplementary Table 5: PIM prescriptions according to Beers' Criteria

	2018		2019		2020		2021		2022	
Total admissions	353		329		250		251		385	
Detailed data (n, %)	220	62.3%	246	74.8%	183	73.2%	242	96.4%	352	91.4%
Male	110	50.0%	102	41.5%	81	44.3%	98	40.5%	162	46.0%
Female	110	50.0%	144	58.5%	102	55.7%	144	59.5%	191	54.3%
Age (years)	78.6		78		78		77		79.1	
Admissions										
Geriatric medicine/ NH Liaison	30	13.6%	56	22.8%	91	49.7%	163	67.4%	238	67.6%
Mean Age	82.2		82.0		78.9		77.7		80.8	
Mean LOS	11.3		10.2		9.0		9.5		8.1	
General Medical	116	52.7%	94	38.2%	45	24.6%	22	9.1%	16	4.5%
Mean Age	78.0		74.4		73.6		70.6		73.6	
Mean LOS	13.3		12.1		9.6		13.1		9.5	
General Surgical	22	10.0%	10	4.1%	4	2.2%	15	6.2%	15	4.3%
Mean Age	72.8		75.6		79.3		79.6		75.0	
Mean LOS	11.3		12.0		14.0		10.2		15.1	
Orthopaedic	27	12.3%	49	19.9%	21	11.5%	15	6.2%	27	7.7%
Mean Age	82.7		80.0		83.0		81.7		81.3	
Mean LOS	17.6		13.0		13.9		9.1		13.4	
Specialist medical	7	3.2%	13	5.3%	8	4.4%	17	7.0%	45	12.8%
Mean Age	79.4		75.9		74.9		75.7		71.3	
Mean LOS	14.8		8.0		6.4		13.2		15.9	
Specialist surgical	18	8.2%	24	9.8%	14	7.7%	10	4.1%	11	3.1%
Mean Age	77.1		79.1		80.3		76.8		83.0	
Mean LOS	8.9		19.3		4.2		28.1		9.7	

Supplementary Table 6: Characteristics of NH residents admitted to hospital, 2018 – 2022

Appendix 2: Clinical Frailty Scale scoring

Clinical Frailty Scale*

1 Very Fit – People who are robust, active, energetic and motivated. These people commonly exercise regularly. They are among the fittest for their age.

2 Well – People who have **no active disease symptoms** but are less fit than category 1. Often, they exercise or are very **active occasionally**, e.g. seasonally.

3 Managing Well – People whose **medical problems are well controlled,** but are **not regularly active** beyond routine walking.

4 Vulnerable – While **not dependent** on others for daily help, often **symptoms limit activities.** A common complaint is being "slowed up", and/or being tired during the day.

5 Mildly Frail – These people often have **more evident slowing,** and need help in **high order IADLs** (finances, transportation, heavy housework, medications). Typically, mild frailty progressively impairs shopping and walking outside alone, meal preparation and housework.

6 Moderately Frail – People need help with **all outside activities** and with **keeping house**. Inside, they often have problems with stairs and need **help with bathing** and might need minimal assistance (cuing, standby) with dressing.

7 Severely Frail – **Completely dependent for personal care**, from whatever cause (physical or cognitive). Even so, they seem stable and not at high risk of dying (within ~ 6 months).

8 Very Severely Frail – Completely dependent, approaching the end of life. Typically, they could not recover even from a minor illness.

9. Terminally Ill - Approaching the end of life. This category applies to people with **a life expectancy <6 months**, who are **not otherwise evidently frail.**

Scoring frailty in people with dementia

The degree of frailty corresponds to the degree of dementia. Common **symptoms in mild dementia** include forgetting the details of a recent event, though still remembering the event itself, repeating the same question/story and social withdrawal.

In **moderate dementia**, recent memory is very impaired, even though they seemingly can remember their past life events well. They can do personal care with prompting.

In **severe dementia**, they cannot do personal care without help.

* 1. Canadian Study on Health & Aging, Revised 2008.
2. K. Rockwood et al. A global clinical measure of fitness and frailty in elderly people. CMAJ 2005;173:489-495.

DALHOUSIE UNIVERSITY *Inspiring Minds*

Appendix 3: Barthel Index

Bowels

0 = Incontinent or needs enema

1 = Occasional accident (once/week)

2 = Continent

Bladder

0 = Incontinent or needs enema

1 = Occasional accident (once/week)

2 = Continent

Grooming

0 = Needs help with personal care

1 = Independent (including face, hair, teeth, shaving)

Toilet Use

0 = Dependent

1 = Needs some help

2 = Independent

Feeding

0 = Unable

1 = Needs help (e.g. cutting)

2 = Independent

Transfer

0 = Unable, no sitting balance

1 = Major help (1 or 2 people), can sit

2 = Minor help (verbal or physical)

3 = Independent

Mobility

0 = Immobile

1 = Wheelchair independent (including corners)

2 = Walks with the help of 1 person (physical or verbal help)

3 = Independent (may use aid)

Dressing

0 = Dependent

1 = Needs help –can do ~½ unaided

2 = Independent (including buttons, zips, laces, etc.)

Stairs

0 = Unable

1 = Needs help (verbal or physical)

2 = Independent

Bathing

0 = Dependent

1 = Independent (bath or shower)

Appendix 4: Charlson Comorbidity Index

Condition		**Score**
Age	<50 years	0
	50 – 59 years	1
	60 – 69 years	2
	70 – 79 years	3
	≥80 years	4
Myocardial infarction		1
Congestive heart failure		1
Peripheral vascular disease		1
Stroke or transient ischaemic attack		1
Dementia		1
Chronic obstructive pulmonary disease		1
Connective tissue disease		1
Peptic ulcer disease		1
Liver disease	Mild	1
	Moderate – severe	3
Diabetes Mellitus	Diet controlled	0
	Uncomplicated	1
	End-organ damage	2
Hemiplegia		2
Moderate – severe chronic kidney disease		2
Solid tumour	Localised	2
	Metastatic	6
Leukaemia		2
Lymphoma		2
AIDS		6

Number	Name	Time (minutes)
1	Immediate	0
2	Very urgent	10
3	Urgent	60
4	Standard	120
5	Non-urgent	240

Table 1: Emergency Triage, Manchester Triage System

Irish National Early Warning System (INEWS) Scoring Key							
SCORE	**3**	**2**	**1**	**0**	**1**	**2**	**3**
Respiratory Rate (bpm)	≤8		9 - 11	12 - 20		21 - 24	≥25
SpO_2 (%)	≤91	92 - 93	94 - 95	≥96			
Inspired O_2 (F_iO_2)				Air			Any O_2
Systolic BP (mmHg)	≤90	91 - 100	101 - 110	111 - 249	≥250		
Heart Rate (BPM)		≤40	41 - 50	51 - 90	91 - 110	111 - 130	≥131
ACVPU/CNS Response				Alert (A)			New confusion (C), Voice (V), Pain (P), Unresponsive (U)
Temp (°C)	≤35.0		35.1 – 36.0	36.1 – 38.0	38.1 – 39.0	≥39.1	

Table 2: Irish National Early Warning System Scoring Key

		CIRCLE
[1] ALERTNESS		
This includes patients who may be markedly drowsy (e.g. difficult to rouse and/or obviously sleepy during assessment) or agitated/hyperactive. Observe the patient. If asleep, attempt to wake with speech or gentle touch on shoulder. Ask the patient to state their name and address to assist rating.		
	Normal (fully alert, but not agitated, throughout assessment)	**0**
	Mild sleepiness for <10 seconds after waking, then normal	**0**
	Clearly abnormal	**4**
[2] AMT4		
Age, date of birth, place (name of the hospital or building), current year.		
	No mistakes	**0**
	1 mistake	**1**
	2 or more mistakes/untestable	**2**
[3] ATTENTION		
Ask the patient: "Please tell me the months of the year in backwards order, starting at December." To assist initial understanding one prompt of "what is the month before December?" is permitted.		
Months of the year backwards	Achieves 7 months or more correctly	**0**
	Starts but scores <7 months / refuses to start	**1**
	Untestable (cannot start because unwell, drowsy, inattentive)	**2**
[4] ACUTE CHANGE OR FLUCTUATING COURSE		
Evidence of significant change or fluctuation in: alertness, cognition, other mental function (e.g. paranoia, hallucinations) arising over the last 2 weeks and still evident in last 24hrs		
	No	**0**
	Yes	**4**

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4 or above: possible delirium +/- cognitive impairment
1-3: possible cognitive impairment
0: delirium or severe cognitive impairment unlikely (but delirium still possible if [4] information incomplete)

4AT SCORE ☐ ☐

STOPP/START version 2

Screening Tool of Older Persons' Prescriptions (STOPP)

The following prescriptions are potentially inappropriate to use in patients aged 65 years and older:

Section A: Indication of medication

1. Any drug prescribed without an evidence-based clinical indication.
2. Any drug prescribed beyond the recommended duration, where treatment duration is well defined.
3. Any duplicate drug class prescription e.g. two concurrent NSAIDs, SSRIs, loop diuretics, ACE inhibitors, anticoagulants (optimisation of monotherapy within a single drug class should be observed prior to considering a new agent).

Section B: Cardiovascular System

1. Digoxin for heart failure with normal systolic ventricular function (no clear evidence of benefit).
2. Verapamil or diltiazem with NYHA Class III or IV heart failure (may worsen heart failure).
3. Beta-blocker in combination with verapamil or diltiazem (risk of heart block).
4. Beta blocker with bradycardia (< 50/min), type II heart block or complete heart block (risk of complete heart block, asystole).
5. Amiodarone as first-line antiarrhythmic therapy in supraventricular tachyarrhythmias (higher risk of side-effects than beta-blockers, digoxin, verapamil or diltiazem).
6. Loop diuretic as first-line treatment for hypertension (safer, more effective alternatives available).
7. Loop diuretic for dependent ankle oedema without clinical, biochemical evidence or radiological evidence of heart failure, liver failure, nephrotic syndrome or renal failure (leg elevation and /or compression hosiery usually more appropriate).
8. Thiazide diuretic with current significant hypokalaemia (i.e. serum K+ < 3.0 mmol/l), hyponatraemia (i.e. serum Na+ < 130 mmol/l) hypercalcaemia (i.e. corrected serum calcium > 2.65 mmol/l) or with a history of gout (hypokalaemia, hyponatraemia, hypercalcaemia and gout can be precipitated by thiazide diuretic).
9. Loop diuretic for treatment of hypertension with concurrent urinary incontinence (may exacerbate incontinence).

10. Centrally-acting antihypertensives (e.g. methyldopa, clonidine, moxonidine, rilmenidine, guanfacine), unless clear intolerance of, or lack of efficacy with, other classes of 2 antihypertensives (centrally-active antihypertensives are generally less well tolerated by older people than younger people).
11. ACE inhibitors or Angiotensin Receptor Blockers in patients with hyperkalaemia.
12. Aldosterone antagonists (e.g. spironolactone, eplerenone) with concurrent potassium conserving drugs (e.g. ACEI's, ARB's, amiloride, triamterene) without monitoring of serum potassium (risk of dangerous hyperkalaemia i.e. > 6.0 mmol/l – serum K should be monitored regularly, i.e. at least every 6 months).
13. Phosphodiesterase type-5 inhibitors (e.g. sildenafil, tadalafil, vardenafil) in severe heart failure characterised by hypotension i.e. systolic BP < 90 mmHg, or concurrent nitrate therapy for angina (risk of cardiovascular collapse).

Section C: Antiplatelet/Anticoagulant Drugs

1. Long-term aspirin at doses greater than 160mg per day (increased risk of bleeding, no evidence for increased efficacy).
2. Aspirin with a past history of peptic ulcer disease without concomitant PPI (risk of recurrent peptic ulcer).
3. Aspirin, clopidogrel, dipyridamole, vitamin K antagonists, direct thrombin inhibitors or factor Xa inhibitors with concurrent significant bleeding risk, i.e. uncontrolled severe hypertension, bleeding diathesis, recent non-trivial spontaneous bleeding) (high risk of bleeding).
4. Aspirin plus clopidogrel as secondary stroke prevention, unless the patient has a coronary stent(s) inserted in the previous 12 months or concurrent acute coronary syndrome or has a high grade symptomatic carotid arterial stenosis (no evidence of added benefit over clopidogrel monotherapy).
5. Aspirin in combination with vitamin K antagonist, direct thrombin inhibitor or factor Xa inhibitors in patients with chronic atrial fibrillation (no added benefit from aspirin)
6. Antiplatelet agents with vitamin K antagonist, direct thrombin inhibitor or factor Xa inhibitors in patients with stable coronary, cerebrovascular or peripheral arterial disease (No added benefit from dual therapy).
7. Ticlopidine in any circumstances (clopidogrel and prasugrel have similar efficacy, stronger evidence and fewer side-effects).
8. Vitamin K antagonist, direct thrombin inhibitor or factor Xa inhibitors for first deep venous thrombosis without continuing provoking risk factors (e.g. thrombophilia) for > 6 months, (no proven added benefit).

9. Vitamin K antagonist, direct thrombin inhibitor or factor Xa inhibitors for first pulmonary embolus without continuing provoking risk factors (e.g. thrombophilia) for > 12 months (no proven added benefit).
10. NSAID and vitamin K antagonist, direct thrombin inhibitor or factor Xa inhibitors in combination (risk of major gastrointestinal bleeding).
11. NSAID with concurrent antiplatelet agent(s) without PPI prophylaxis (increased risk of peptic ulcer disease).

Section D: Central Nervous System and Psychotropic Drugs

1. Tricyclic Antidepressants (TCAs) with dementia, narrow angle glaucoma, cardiac conduction abnormalities, prostatism, or prior history of urinary retention (risk of worsening these conditions).
2. Initiation of Tricyclic Antidepressants (TCAs) as first-line antidepressant treatment (higher risk of adverse drug reactions with TCAs than with SSRIs or SNRIs).
3. Neuroleptics with moderate-marked antimuscarinic/anticholinergic effects (chlorpromazine, clozapine, flupenthixol, fluphenazine, pipotiazine, promazine, zuclopenthixol) with a history of prostatism or previous urinary retention (high risk of urinary retention).
4. Selective serotonin re-uptake inhibitors (SSRI's) with current or recent significant hyponatraemia i.e. serum Na+ < 130 mmol/l (risk of exacerbating or precipitating hyponatraemia).
5. Benzodiazepines for ≥ 4 weeks (no indication for longer treatment; risk of prolonged sedation, confusion, impaired balance, falls, road traffic accidents; all benzodiazepines should be withdrawn gradually if taken for more than 4 weeks as there is a risk of causing a benzodiazepine withdrawal syndrome if stopped abruptly).
6. Antipsychotics (i.e. other than quetiapine or clozapine) in those with parkinsonism or Lewy Body Disease (risk of severe extra-pyramidal symptoms).
7. Anticholinergics/antimuscarinics to treat extra-pyramidal side-effects of neuroleptic medications (risk of anticholinergic toxicity).
8. Anticholinergics/antimuscarinics in patients with delirium or dementia (risk of exacerbation of cognitive impairment).
9. Neuroleptic antipsychotic in patients with behavioural and psychological symptoms of dementia (BPSD) unless symptoms are severe and other non-pharmacological treatments have failed (increased risk of stroke).
10. Neuroleptics as hypnotics, unless sleep disorder is due to psychosis or dementia (risk of confusion, hypotension, extra-pyramidal side effects, falls).
11. Acetylcholinesterase inhibitors with a known history of persistent bradycardia (< 60 beats/min.), heart block or recurrent unexplained syncope or concurrent

treatment with drugs that reduce heart rate such as beta-blockers, digoxin, diltiazem, verapamil (risk of cardiac conduction failure, syncope and injury).

12. Phenothiazines as first-line treatment, since safer and more efficacious alternatives exist (phenothiazines are sedative, have significant anti-muscarinic toxicity in older people, with the exception of prochlorperazine for nausea/vomiting/vertigo, chlorpromazine for relief of persistent hiccoughs and levomepromazine as an anti-emetic in palliative care).
13. Levodopa or dopamine agonists for benign essential tremor (no evidence of efficacy)
14. First-generation antihistamines (safer, less toxic antihistamines now widely available).

Section E: Renal System.

The following drugs are potentially inappropriate in older people with acute or chronic kidney disease with renal function below particular levels of eGFR (refer to summary of product characteristics datasheets and local formulary guidelines)

1. Digoxin at a long-term dose greater than 125µg/day if eGFR < 30 ml/min/1.73m2 (risk of digoxin toxicity if plasma levels not measured).
2. Direct thrombin inhibitors (e.g. dabigatran) if eGFR < 30 ml/min/1.73m2 (risk of bleeding).
3. Factor Xa inhibitors (e.g. rivaroxaban, apixaban) if eGFR < 15 ml/min/1.73m2 (risk of bleeding).
4. NSAID's if eGFR < 50 ml/min/1.73m2 (risk of deterioration in renal function).
5. Colchicine if eGFR < 10 ml/min/1.73m2 (risk of colchicine toxicity).
6. Metformin if eGFR < 30 ml/min/1.73m2 (risk of lactic acidosis).

Section F: Gastrointestinal System

1. Prochlorperazine or metoclopramide with Parkinsonism (risk of exacerbating Parkinsonian symptoms).
2. PPI for uncomplicated peptic ulcer disease or erosive peptic oesophagitis at full therapeutic dosage for > 8 weeks (dose reduction or earlier discontinuation indicated).
3. Drugs likely to cause constipation (e.g. antimuscarinic/anticholinergic drugs, oral iron, opioids, verapamil, aluminium antacids) in patients with chronic constipation where no constipating alternatives are available (risk of exacerbation of constipation).
4. Oral elemental iron doses greater than 200 mg daily (e.g. ferrous fumarate> 600 mg/day, ferrous sulphate > 600 mg/day, ferrous gluconate> 1800 mg/day; no evidence of enhanced iron absorption above these doses).

Section G: Respiratory System

1. Theophylline as monotherapy for COPD (safer, more effective alternative; risk of adverse effects due to narrow therapeutic index).
2. Systemic corticosteroids instead of inhaled corticosteroids for maintenance therapy in moderate-severe COPD (unnecessary exposure to long-term side-effects of systemic corticosteroids and effective inhaled therapies are available).
3. Anti-muscarinic bronchodilators (e.g. ipratropium, tiotropium) with a history of narrow angle glaucoma (may exacerbate glaucoma) or bladder outflow obstruction (may cause urinary retention).
4. Non-selective beta-blocker (whether oral or topical for glaucoma) with a history of asthma requiring treatment (risk of increased bronchospasm).
5. Benzodiazepines with acute or chronic respiratory failure i.e. $pO2 < 8.0$ kPa ± $pCO2 > 6.5$ kPa (risk of exacerbation of respiratory failure).

Section H: Musculoskeletal System

1. Non-steroidal anti-inflammatory drug (NSAID) other than COX-2 selective agents with history of peptic ulcer disease or gastrointestinal bleeding, unless with concurrent PPI or H2 antagonist (risk of peptic ulcer relapse).
2. NSAID with severe hypertension (risk of exacerbation of hypertension) or severe heart failure (risk of exacerbation of heart failure).
3. Long-term use of NSAID (>3 months) for symptom relief of osteoarthritis pain where paracetamol has not been tried (simple analgesics preferable and usually as effective for pain relief).
4. Long-term corticosteroids (>3 months) as monotherapy for rheumatoid arthritis (risk of systemic corticosteroid side-effects).
5. Corticosteroids (other than periodic intra-articular injections for mono-articular pain) for osteoarthritis (risk of systemic corticosteroid side-effects).
6. Long-term NSAID or colchicine (>3 months) for chronic treatment of gout where there is no contraindication to a xanthine-oxidase inhibitor (e.g. allopurinol, febuxostat) (xanthine oxidase inhibitors are first choice prophylactic drugs in gout).
7. COX-2 selective NSAIDs with concurrent cardiovascular disease (increased risk of myocardial infarction and stroke).
8. NSAID with concurrent corticosteroids without PPI prophylaxis (increased risk of peptic ulcer disease).

9. Oral bisphosphonates in patients with a current or recent history of upper gastrointestinal disease i.e. dysphagia, oesophagitis, gastritis, duodenitis, or peptic ulcer disease, or upper gastrointestinal bleeding (risk of relapse/exacerbation of oesophagitis, oesophageal ulcer, oesophageal stricture).

Section I: Urogenital System

1. Antimuscarinic drugs with dementia, or chronic cognitive impairment (risk of increased confusion, agitation) or narrow-angle glaucoma (risk of acute exacerbation of glaucoma), or chronic prostatism (risk of urinary retention).
2. Selective alpha-1 selective alpha blockers in those with symptomatic orthostatic hypotension or micturition syncope (risk of precipitating recurrent syncope).

Section J. Endocrine System

1. Sulphonylureas with a long duration of action (e.g. glibenclamide, chlorpropamide, glimepiride) with type 2 diabetes mellitus (risk of prolonged hypoglycaemia).
2. Thiazolidinediones (e.g. rosiglitazone, pioglitazone) in patients with heart failure (risk of exacerbation of heart failure).
3. Beta-blockers in diabetes mellitus with frequent hypoglycaemic episodes (risk of suppressing hypoglycaemic symptoms).
4. Oestrogens with a history of breast cancer or venous thromboembolism (increased risk of recurrence).
5. Oral oestrogens without progestogen in patients with intact uterus (risk of endometrial cancer).
6. Androgens (male sex hormones) in the absence of primary or secondary hypogonadism (risk of androgen toxicity; no proven benefit outside of the hypogonadism indication).

Section K: Drugs that predictably increase the risk of falls in older people

1. Benzodiazepines (sedative, may cause reduced sensorium, impair balance).
2. Neuroleptic drugs (may cause gait dyspraxia, Parkinsonism).
3. Vasodilator drugs (e.g. alpha-1 receptor blockers, calcium channel blockers, long-acting nitrates, ACE inhibitors, angiotensin I receptor blockers,) with persistent postural hypotension i.e. recurrent drop in systolic blood pressure ≥ 20mmHg (risk of syncope, falls).
4. Hypnotic Z-drugs e.g. zopiclone, zolpidem, zaleplon (may cause protracted daytime sedation, ataxia).

Section L: Analgesic Drugs

1. Use of oral or transdermal strong opioids (morphine, oxycodone, fentanyl, buprenorphine, diamorphine, methadone, tramadol, pethidine, pentazocine) as first line therapy for mild pain (WHO analgesic ladder not observed).
2. Use of regular (as distinct from PRN) opioids without concomitant laxative (risk of severe constipation).
3. Long-acting opioids without short-acting opioids for break-through pain (risk of persistence of severe pain).

Section N: Antimuscarinic/Anticholinergic Drug Burden

1. Concomitant use of two or more drugs with antimuscarinic/anticholinergic properties (e.g. bladder antispasmodics, intestinal antispasmodics, tricyclic antidepressants, first generation antihistamines) (risk of increased antimuscarinic/anticholinergic toxicity).

Screening Tool to Alert to Right Treatment (START).

Unless an elderly patient's clinical status is end-of-life and therefore requiring a more palliative focus of pharmacotherapy, the following drug therapies should be considered where omitted for no valid clinical reason(s). It is assumed that the prescriber observes all the specific contraindications to these drug therapies prior to recommending them to older patients.

Section A: Cardiovascular System

1. Vitamin K antagonists or direct thrombin inhibitors or factor Xa inhibitors in the presence of chronic atrial fibrillation.
2. Aspirin (75 mg – 160 mg once daily) in the presence of chronic atrial fibrillation, where Vitamin K antagonists or direct thrombin inhibitors or factor Xa inhibitors are contraindicated.
3. Antiplatelet therapy (aspirin or clopidogrel or prasugrel or ticagrelor) with a documented history of coronary, cerebral or peripheral vascular disease.
4. Antihypertensive therapy where systolic blood pressure consistently > 160 mmHg and/or diastolic blood pressure consistently >90 mmHg; if systolic blood pressure > 140 mmHg and /or diastolic blood pressure > 90 mmHg, if diabetic.
5. Statin therapy with a documented history of coronary, cerebral or peripheral vascular disease, unless the patient's status is end-of-life or age is > 85 years.
6. Angiotensin Converting Enzyme (ACE) inhibitor with systolic heart failure and/or documented coronary artery disease.
7. Beta-blocker with ischaemic heart disease.
8. Appropriate beta-blocker (bisoprolol, nebivolol, metoprolol or carvedilol) with stable systolic heart failure.

Section B: Respiratory System

1. Regular inhaled β2 agonist or antimuscarinic bronchodilator (e.g. ipratropium, tiotropium) for mild to moderate asthma or COPD.
2. Regular inhaled corticosteroid for moderate-severe asthma or COPD, where FEV1 < 8.0 kPa or 60 mmHg or SaO2 < 89%).

Section C: Central Nervous System & Eyes

1. L-DOPA or a dopamine agonist in idiopathic Parkinson's disease with functional impairment and resultant disability.
2. Non-TCA antidepressant drug in the presence of persistent major depressive symptoms.
3. Acetylcholinesterase inhibitor (e.g. donepezil, rivastigmine, galantamine) for mild - moderate Alzheimer's dementia or Lewy Body dementia (rivastigmine).
4. Topical prostaglandin, prostamide or beta-blocker for primary open-angle glaucoma.
5. Selective serotonin reuptake inhibitor (or SNRI or pregabalin if SSRI contraindicated) for persistent severe anxiety that interferes with independent functioning.
6. Dopamine agonist (ropinirole or pramipexole or rotigotine) for Restless Legs Syndrome, once iron deficiency and severe renal failure have been excluded.

Section D: Gastrointestinal System

1. Proton Pump Inhibitor with severe gastro-oesophageal reflux disease or peptic stricture requiring dilatation.
2. Fibre supplements (e.g. bran, ispaghula, methylcellulose, sterculia) for diverticulosis with a history of constipation.

Section E: Musculoskeletal System

1. Disease-modifying anti-rheumatic drug (DMARD) with active, disabling rheumatoid disease.
2. Bisphosphonates and vitamin D and calcium in patients taking long-term systemic corticosteroid therapy.
3. Vitamin D and calcium supplement in patients with known osteoporosis and/or previous fragility fracture(s) and/or (Bone Mineral Density T-scores more than -2.5 in multiple sites).
4. Bone anti-resorptive or anabolic therapy (e.g. bisphosphonate, strontium ranelate, teriparatide, denosumab) in patients with documented osteoporosis, where no pharmacological or clinical status contraindication exists (Bone Mineral Density T-scores -> 2.5 in multiple sites) and/or previous history of fragility fracture(s).

5. Vitamin D supplement in older people who are housebound or experiencing falls or with osteopenia (Bone Mineral Density T-score is > -1.0 but < -2.5 in multiple sites).
6. Xanthine-oxidase inhibitors (e.g. allopurinol, febuxostat) with a history of recurrent episodes of gout.
7. Folic acid supplement in patients taking methotrexate.

Section F: Endocrine System

1. ACE inhibitor or Angiotensin Receptor Blocker (if intolerant of ACE inhibitor) in diabetes with evidence of renal disease i.e. dipstick proteinuria or microalbuminuria (>30mg/24 hours) with or without serum biochemical renal impairment.

Section G: Urogenital System

1. Alpha-1 receptor blocker with symptomatic prostatism, where prostatectomy is not considered necessary.
2. 5-alpha reductase inhibitor with symptomatic prostatism, where prostatectomy is not considered necessary.
3. Topical vaginal oestrogen or vaginal oestrogen pessary for symptomatic atrophic vaginitis.

Section H: Analgesics

1. High-potency opioids in moderate-severe pain, where paracetamol, NSAIDs or low-potency opioids are not appropriate to the pain severity or have been ineffective.
2. Laxatives in patients receiving opioids regularly.

Section I: Vaccines

1. Seasonal trivalent influenza vaccine annually
2. Pneumococcal vaccine at least once after age 65 according to national guidelines

STOPPFrail

STOPPFrail

is a list of potentially inappropriate prescribing indicators designed to assist physicians with stopping such medications in older patients (≥65 years) who meet ALL of the criteria listed below:

1. End-stage irreversible pathology
2. Poor one year survival prognosis
3. Severe functional impairment or severe cognitive impairment or both
4. Symptom control is the priority rather than prevention of disease progression

The decision to prescribe/not prescribe medications to the patient, should also be influenced by the following issues:

1. Risk of the medication outweighing the benefit
2. Administration of the medication is challenging
3. Monitoring of the medication effect is challenging
4. Drug adherence/compliance is difficult

Section A: General

A1: Any drug that the patient persistently fails to take or tolerate despite adequate education and consideration of all appropriate formulations.
A2. Any drug without clear clinical indication.

Section B: Cardiovascular system

B1. Lipid lowering therapies (statins, ezetimibe, bile acid sequestrants, fibrates, nicotinic acid and acipimox) These medications need to be prescribed for a long duration to be of benefit. For short-term use, the risk of ADEs outweighs the potential benefits
B2. Alpha-blockers for hypertension: Stringent blood pressure control is not required in very frail older people. Alpha blockers in particular can cause marked vasodilatation, which can result in marked postural hypotension, falls and injuries

Section C: Coagulation system

C1: Anti-platelets: Avoid anti-platelet agents for primary (as distinct from secondary) cardiovascular prevention (no evidence of benefit)

Section D: Central Nervous System

D1. Neuroleptic antipsychotics: Aim to reduce dose and gradually discontinue these drugs in patients taking them for longer than 12 weeks if there are no current clinical features of behavioural and psychiatric symptoms of dementia (BPSD)

Section G: Musculoskeletal system

G1: Calcium supplementation: Unlikely to be of any benefit in the short term
G2: Anti-resorptive/bone anabolic drugs *FOR OSTEOPOROSIS* (bisphosphonates, strontium, teriparatide, denosumab): Unlikely to be of any benefit in the short term
G3. SORMs for osteoporosis: Benefits unlikely to be achieved within 1 year, increased short–intermediate term risk of associated ADEs particularly venous thromboembolism and stroke
G4. Long-term oral NSAIDs: Increased risk of side effects (peptic ulcer disease, bleeding, worsening heart failure, etc.) when taken regularly for ≥2 months
G5. Long-term oral steroids: Increased risk of side effects (peptic ulcer disease, etc.) when taken regularly for ≥2 months. Consider careful dose reduction and gradual discontinuation

Section H: Urogenital system

H1. 5-Alpha reductase inhibitors: No benefit with long-term urinary bladder catheterisation
H2. Alpha blockers: No benefit with long-term urinary bladder catheterisation
H3. Muscarinic antagonists: No benefit with long-term urinary bladder catheterisation, unless clear history of painful detrusor hyperactivity

Section I: Endocrine system

I1. Diabetic oral agents: Aim for monotherapy. Target of HbA1c < 8%/64 mmol/mol. Stringent glycaemic control is unnecessary

D2: Memantine: Discontinue and monitor in patients with moderate to severe dementia, unless memantine has clearly improved BPSD (specifically in frail patients who meet the criteria above)

Section E: Gastrointestinal system

E1. Proton Pump Inhibitors: Proton Pump Inhibitors at full therapeutic dose ≥8/52, unless persistent dyspeptic symptoms at lower maintenance dose

E2: H2 receptor antagonist: H2 receptor antagonist at full therapeutic dose for ≥8/52, unless persistent dyspeptic symptoms at lower maintenance dose

E3. Gastrointestinal antispasmodics: Regular daily prescription of gastrointestinal antispasmodics agents unless the patient has frequent relapse of colic symptoms because of high risk of anti-cholinergic side effects

Section F: Respiratory system

F1. Theophylline.: This drug has a narrow therapeutic index, requires monitoring of serum levels and interacts with other commonly prescribed drugs putting patients at an increased risk of ADEs

F2. Leukotriene antagonists (Montelukast, Zafirlukast): These drugs have no proven role in COPD, they are indicated only in asthma

I2. ACE-inhibitors for diabetes: Stop where prescribed only for prevention and treatment of diabetic nephropathy. There is no clear benefit in older people with advanced frailty with poor survival prognosis

I3. Angiotensin receptor blockers: Stop where prescribed only for prevention and treatment of diabetic nephropathy. There is no clear benefit in older people with advanced frailty with poor survival prognosis

I4. Systemic oestrogens for menopausal symptoms: Increases risk of stroke and VTE disease. Discontinue and only consider recommencing if recurrence of symptoms

Section J: Miscellaneous

J1. Multi-vitamin combination supplements: Discontinue when prescribed for prophylaxis rather than treatment

J2. Nutritional supplements (other than vitamins): Discontinue when prescribed for prophylaxis rather than treatment

J3: Prophylactic antibiotics: No firm evidence for prophylactic antibiotics to prevent recurrent cellulitis or UTIs

Beers' Criteria, 2019.

Table 2. 2019 American Geriatrics Society Beers Criteria® for Potentially Inappropriate Medication Use in Older Adults[a]

Organ System, Therapeutic Category, Drug(s)	Rationale	Recommendation	Quality of Evidence	Strength of Recommendation
Anticholinergics[b]				
First-generation antihistamines Brompheniramine Carbinoxamine Chlorpheniramine Clemastine Cyproheptadine Dexbrompheniramine Dexchlorpheniramine Dimenhydrinate Diphenhydramine (oral) Doxylamine Hydroxyzine Meclizine Promethazine Pyrilamine Triprolidine	Highly anticholinergic; clearance reduced with advanced age, and tolerance develops when used as hypnotic; risk of confusion, dry mouth, constipation, and other anticholinergic effects or toxicity Use of diphenhydramine in situations such as acute treatment of severe allergic reaction may be appropriate.	Avoid	Moderate	Strong
Antiparkinsonian agents Benztropine (oral) Trihexyphenidyl	Not recommended for prevention or treatment of extrapyramidal symptoms with antipsychotics; more effective agents available for treatment of Parkinson disease	Avoid	Moderate	Strong
Antispasmodics Atropine (excludes ophthalmic) Belladonna alkaloids Clidinium-chlordiazepoxide Dicyclomine Homatropine (excludes opthalmic) Hyoscyamine Methscopolamine Propantheline Scopolamine	Highly anticholinergic, uncertain effectiveness	Avoid	Moderate	Strong
Antithrombotics				
Dipyridamole, oral short acting (does not apply to the extended-release combination with aspirin)	May cause orthostatic hypotension; more effective alternatives available; IV form acceptable for use in cardiac stress testing	Avoid	Moderate	Strong
Anti-infective				
Nitrofurantoin	Potential for pulmonary toxicity, hepatoxicity, and peripheral neuropathy, especially with long-term use; safer alternatives available	Avoid in individuals with creatinine clearance <30 mL/min or for long-term suppression	Low	Strong
Cardiovascular				
Peripheral alpha-1 blockers for treatment of hypertension Doxazosin Prazosin Terazosin	High risk of orthostatic hypotension and associated harms, especially in older adults; not recommended as routine treatment for hypertension; alternative agents have superior risk/benefit profile	Avoid use as an antihypertensive	Moderate	Strong
Central alpha-agonists		Avoid as first-line antihypertensive	Low	Strong

Table 2 (Contd.)

Organ System, Therapeutic Category, Drug(s)	Rationale	Recommendation	Quality of Evidence	Strength of Recommendation
Clonidine for first-line treatment of hypertension Other CNS alpha-agonists Guanabenz Guanfacine Methyldopa Reserpine (>0.1 mg/day)	High risk of adverse CNS effects; may cause bradycardia and orthostatic hypotension; not recommended as routine treatment for hypertension	Avoid other CNS alpha-agonists as listed	Low	Strong
Disopyramide	May induce heart failure in older adults because of potent negative inotropic action; strongly anticholinergic; other antiarrhythmic drugs preferred	Avoid	Low	Strong
Dronedarone	Worse outcomes have been reported in patients taking dronedarone who have permanent atrial fibrillation or severe or recently decompensated heart failure.	Avoid in individuals with permanent atrial fibrillation or severe or recently decompensated heart failure	High	Strong
Digoxin for first-line treatment of atrial fibrillation or of heart failure	Use in atrial fibrillation: should not be used as a first-line agent in atrial fibrillation, because there are safer and more effective alternatives for rate control supported by high-quality evidence. Use in heart failure: evidence for benefits and harms of digoxin is conflicting and of lower quality; most but not all of the evidence concerns use in HFrEF. There is strong evidence for other agents as first-line therapy to reduce hospitalizations and mortality in adults with HFrEF. In heart failure, higher dosages are not associated with additional benefit and may increase risk of toxicity. Decreased renal clearance of digoxin may lead to increased risk of toxic effects; further dose reduction may be necessary in those with stage 4 or 5 chronic kidney disease.	Avoid this rate control agent as first-line therapy for atrial fibrillation Avoid as first-line therapy for heart failure If used for atrial fibrillation or heart failure, avoid dosages >0.125 mg/day	Atrial fibrillation: low Heart failure: low Dosage >0.125 mg/day: moderate	Atrial fibrillation: strong Heart failure: strong Dosage >0.125 mg/day: strong
Nifedipine, immediate release	Potential for hypotension; risk of precipitating myocardial ischemia	Avoid	High	Strong
Amiodarone	Effective for maintaining sinus rhythm but has greater toxicities than other antiarrhythmics used in atrial fibrillation; may be reasonable first-line therapy in patients with concomitant heart failure or substantial left ventricular hypertrophy if rhythm control is preferred over rate control	Avoid as first-line therapy for atrial fibrillation unless patient has heart failure or substantial left ventricular hypertrophy	High	Strong
Central nervous system				
Antidepressants, alone or in combination Amitriptyline Amoxapine Clomipramine Desipramine Doxepin >6 mg/day Imipramine	Highly anticholinergic, sedating, and cause orthostatic hypotension; safety profile of low-dose doxepin (≤6 mg/day) comparable to that of placebo	Avoid	High	Strong

(Continued)

Table 2 (Contd.)

Organ System, Therapeutic Category, Drug(s)	Rationale	Recommendation	Quality of Evidence	Strength of Recommendation
Nortriptyline Paroxetine Protriptyline Trimipramine				
Antipsychotics, first (conventional) and second (atypical) generation	Increased risk of cerebrovascular accident (stroke) and greater rate of cognitive decline and mortality in persons with dementia Avoid antipsychotics for behavioral problems of dementia or delirium unless nonpharmacological options (eg, behavioral interventions) have failed or are not possible *and* the older adult is threatening substantial harm to self or others	Avoid, except in schizophrenia or bipolar disorder, or for short-term use as antiemetic during chemotherapy	Moderate	Strong
Barbiturates Amobarbital Butabarbital Butalbital Mephobarbital Pentobarbital Phenobarbital Secobarbital	High rate of physical dependence, tolerance to sleep benefits, greater risk of overdose at low dosages	Avoid	High	Strong
Benzodiazepines *Short and intermediate acting:* Alprazolam Estazolam Lorazepam Oxazepam Temazepam Triazolam *Long acting:* Chlordiazepoxide (alone or in combination with amitriptyline or clidinium) Clonazepam Clorazepate Diazepam Flurazepam Quazepam	Older adults have increased sensitivity to benzodiazepines and decreased metabolism of long-acting agents; in general, all benzodiazepines increase risk of cognitive impairment, delirium, falls, fractures, and motor vehicle crashes in older adults May be appropriate for seizure disorders, rapid eye movement sleep behavior disorder, benzodiazepine withdrawal, ethanol withdrawal, severe generalized anxiety disorder, and periprocedural anesthesia	Avoid	Moderate	Strong
Meprobamate	High rate of physical dependence; sedating	Avoid	Moderate	Strong
Nonbenzodiazepine, benzodiazepine receptor agonist hypnotics (ie, "Z-drugs") Eszopiclone Zaleplon Zolpidem	Nonbenzodiazepine benzodiazepine receptor agonist hypnotics (ie, Z drugs) have adverse events similar to those of benzodiazepines in older adults (eg, delirium, falls, fractures); increased emergency room visits/ hospitalizations; motor vehicle crashes; minimal improvement in sleep latency and duration	Avoid	Moderate	Strong
Ergoloid mesylates (dehydrogenated ergot alkaloids) Isoxsuprine	Lack of efficacy	Avoid	High	Strong
Endocrine				

Table 2 (Contd.)

Organ System, Therapeutic Category, Drug(s)	Rationale	Recommendation	Quality of Evidence	Strength of Recommendation
Androgens Methyltestosterone Testosterone	Potential for cardiac problems; contraindicated in men with prostate cancer	Avoid unless indicated for confirmed hypogonadism with clinical symptoms	Moderate	Weak
Desiccated thyroid	Concerns about cardiac effects; safer alternatives available	Avoid	Low	Strong
Estrogens with or without progestins	Evidence of carcinogenic potential (breast and endometrium); lack of cardioprotective effect and cognitive protection in older women	Avoid systemic estrogen (eg, oral and topical patch)	Oral and patch: high	Oral and patch: strong
	Evidence indicates that vaginal estrogens for the treatment of vaginal dryness are safe and effective; women with a history of breast cancer who do not respond to nonhormonal therapies are advised to discuss the risks and benefits of low-dose vaginal estrogen (dosages of estradiol <25 µg twice weekly) with their healthcare provider	Vaginal cream or vaginal tablets: acceptable to use low-dose intravaginal estrogen for management of dyspareunia, recurrent lower urinary tract infections, and other vaginal symptoms	Vaginal cream or vaginal tablets: moderate	Topical vaginal cream or tablets: weak
Growth hormone	Impact on body composition is small and associated with edema, arthralgia, carpal tunnel syndrome, gynecomastia, impaired fasting glucose	Avoid, except for patients rigorously diagnosed by evidence-based criteria with growth hormone deficiency due to an established etiology	High	Strong
Insulin, sliding scale (insulin regimens containing only short- or rapid-acting insulin dosed according to current blood glucose levels without concurrent use of basal or long-acting insulin)	Higher risk of hypoglycemia without improvement in hyperglycemia management regardless of care setting. Avoid insulin regimens that include only short- or rapid-acting insulin dosed according to current blood glucose levels without concurrent use of basal or long-acting insulin. This recommendation does not apply to regimens that contain basal insulin or long-acting insulin.	Avoid	Moderate	Strong
Megestrol	Minimal effect on weight; increases risk of thrombotic events and possibly death in older adults	Avoid	Moderate	Strong
Sulfonylureas, long acting Chlorpropamide Glimepiride Glyburide (also known as glibenclamide)	Chlorpropamide: prolonged half-life in older adults; can cause prolonged hypoglycemia; causes SIADH Glimepiride and glyburide: higher risk of severe prolonged hypoglycemia in older adults	Avoid	High	Strong
Gastrointestinal				
Metoclopramide	Can cause extrapyramidal effects, including tardive dyskinesia; risk may be greater in frail older adults and with prolonged exposure	Avoid, unless for gastroparesis with duration of use not to exceed 12 weeks except in rare cases	Moderate	Strong
Mineral oil, given orally	Potential for aspiration and adverse effects; safer alternatives available	Avoid	Moderate	Strong
Proton-pump inhibitors	Risk of *Clostridium difficile* infection and bone loss and fractures	Avoid scheduled use for >8 weeks unless for high-risk patients (eg, oral corticosteroids or chronic NSAID use), erosive esophagitis, Barrett esophagitis, pathological hypersecretory condition, or demonstrated need for maintenance treatment (eg, because of failure of drug discontinuation trial or H2-receptor antagonists)	High	Strong

(Continued)

Table 2 (Contd.)

Organ System, Therapeutic Category, Drug(s)	Rationale	Recommendation	Quality of Evidence	Strength of Recommendation
Pain medications				
Meperidine	Oral analgesic not effective in dosages commonly used; may have higher risk of neurotoxicity, including delirium, than other opioids; safer alternatives available	Avoid	Moderate	Strong
Non–cyclooxygenase-selective NSAIDs, oral: Aspirin >325 mg/day Diclofenac Diflunisal Etodolac Fenoprofen Ibuprofen Ketoprofen Meclofenamate Mefenamic acid Meloxicam Nabumetone Naproxen Oxaprozin Piroxicam Sulindac Tolmetin	Increased risk of gastrointestinal bleeding or peptic ulcer disease in high-risk groups, including those >75 years or taking oral or parenteral corticosteroids, anticoagulants, or antiplatelet agents; use of proton-pump inhibitor or misoprostol reduces but does not eliminate risk. Upper gastrointestinal ulcers, gross bleeding, or perforation caused by NSAIDs occur in ~1% of patients treated for 3-6 months and in ~2%-4% of patients treated for 1 year; these trends continue with longer duration of use. Also can increase blood pressure and induce kidney injury. Risks are dose related.	Avoid chronic use, unless other alternatives are not effective and patient can take gastroprotective agent (proton-pump inhibitor or misoprostol)	Moderate	Strong
Indomethacin Ketorolac, includes parenteral	Increased risk of gastrointestinal bleeding/peptic ulcer disease and acute kidney injury in older adults Indomethacin is more likely than other NSAIDs to have adverse CNS effects. Of all the NSAIDs, indomethacin has the most adverse effects.	Avoid	Moderate	Strong
Skeletal muscle relaxants Carisoprodol Chlorzoxazone Cyclobenzaprine Metaxalone Methocarbamol Orphenadrine	Most muscle relaxants poorly tolerated by older adults because some have anticholinergic adverse effects, sedation, increased risk of fractures; effectiveness at dosages tolerated by older adults questionable	Avoid	Moderate	Strong
Genitourinary				
Desmopressin	High risk of hyponatremia; safer alternative treatments	Avoid for treatment of nocturia or nocturnal polyuria	Moderate	Strong

Abbreviations: CNS, central nervous system; HFrEF, heart failure with reduced ejection fraction; NSAID, nonsteroidal anti-inflammatory drug; SIADH, syndrome of inappropriate antidiuretic hormone secretion.
[a]The primary target audience is the practicing clinician. The intentions of the criteria include (1) improving the selection of prescription drugs by clinicians and patients; (2) evaluating patterns of drug use within populations; (3) educating clinicians and patients on proper drug usage; and (4) evaluating health-outcome, quality-of-care, cost, and utilization data.
[b]See also criterion on highly anticholinergic antidepressants.

Table 3. 2019 American Geriatrics Society Beers Criteria® for Potentially Inappropriate Medication Use in Older Adults Due to Drug-Disease or Drug-Syndrome Interactions That May Exacerbate the Disease or Syndrome[a]

Disease or Syndrome	Drug(s)	Rationale	Recommendation	Quality of Evidence	Strength of Recommendation
Cardiovascular					
Heart failure	Avoid: Cilostazol Avoid in heart failure with reduced ejection fraction: Nondihydropyridine CCBs (diltiazem, verapamil) Use with caution in patients with heart failure who are asymptomatic; avoid in patients with symptomatic heart failure: NSAIDs and COX-2 inhibitors Thiazolidinediones (pioglitazone, rosiglitazone) Dronedarone	Potential to promote fluid retention and/or exacerbate heart failure (NSAIDs and COX-2 inhibitors, nondihydropyridine CCBs, thiazolidinediones); potential to increase mortality in older adults with heart failure (cilostazol and dronedarone)	As noted, avoid or use with caution	Cilostazol: low Nondihydropyridine CCBs: moderate NSAIDs: moderate COX-2 inhibitors: low Thiazolidinediones: high Dronedarone: high	Cilostazol: strong Nondihydropyridine CCBs: strong NSAIDs: strong COX-2 inhibitors: strong Thiazolidinediones: strong Dronedarone: strong
Syncope	AChEIs Nonselective peripheral alpha-1 blockers (ie, doxazosin, prazosin, terazosin) Tertiary TCAs Antipsychotics: Chlorpromazine Thioridazine Olanzapine	AChEIs cause bradycardia and should be avoided in older adults whose syncope may be due to bradycardia. Nonselective peripheral alpha-1 blockers cause orthostatic blood pressure changes and should be avoided in older adults whose syncope may be due to orthostatic hypotension. Tertiary TCAs and the antipsychotics listed increase the risk of orthostatic hypotension or bradycardia.	Avoid	AChEIs, TCAs, and antipsychotics: high Nonselective peripheral alpha-1 blockers: high	AChEIs and TCAs: strong Nonselective peripheral alpha-1 blockers and antipsychotics: weak
Central nervous system					
Delirium	Anticholinergics (see Table 7 and full criteria available on www.geriatricscareonline.org.) Antipsychotics[b] Benzodiazepines Corticosteroids (oral and parenteral)[c] H2-receptor antagonists Cimetidine Famotidine Nizatidine Ranitidine Meperidine Nonbenzodiazepine, benzodiazepine receptor agonist hypnotics: eszopiclone, zaleplon, zolpidem	Avoid in older adults with or at high risk of delirium because of potential of inducing or worsening delirium Avoid antipsychotics for behavioral problems of dementia and/or delirium unless nonpharmacological options (eg, behavioral interventions) have failed or are not possible *and* the older adult is threatening substantial harm to self or others. Antipsychotics are associated with greater risk of cerebrovascular accident (stroke) and mortality in persons with dementia.	Avoid	H2-receptor antagonists: low All others: moderate	Strong
Dementia or cognitive impairment	Anticholinergics (see Table 7 and full criteria available on www.geriatricscareonline.org) Benzodiazepines Nonbenzodiazepine, benzodiazepine receptor agonist hypnotics	Avoid because of adverse CNS effects Avoid antipsychotics for behavioral problems of dementia and/or delirium unless nonpharmacological options (eg, behavioral interventions) have failed or are not possible *and* the older adult is	Avoid	Moderate	Strong

(Continued)

Table 3 (Contd.)

Disease or Syndrome	Drug(s)	Rationale	Recommendation	Quality of Evidence	Strength of Recommendation
	Eszopiclone Zaleplon Zolpidem Antipsychotics, chronic and as-needed use[b]	threatening substantial harm to self or others. Antipsychotics are associated with greater risk of cerebrovascular accident (stroke) and mortality in persons with dementia.			
History of falls or fractures	Antiepileptics Antipsychotics[b] Benzodiazepines Nonbenzodiazepine, benzodiazepine receptor agonist hypnotics Eszopiclone Zaleplon Zolpidem Antidepressants TCAs SSRIs SNRIs Opioids	May cause ataxia, impaired psychomotor function, syncope, additional falls; shorter-acting benzodiazepines are not safer than long-acting ones. If one of the drugs must be used, consider reducing use of other CNS-active medications that increase risk of falls and fractures (ie, antiepileptics, opioid-receptor agonists, antipsychotics, antidepressants, nonbenzodiazepine and benzodiazepine receptor agonist hypnotics, other sedatives/hypnotics) and implement other strategies to reduce fall risk. Data for antidepressants are mixed but no compelling evidence that certain antidepressants confer less fall risk than others.	Avoid unless safer alternatives are not available; avoid antiepileptics except for seizure and mood disorders Opioids: avoid except for pain management in the setting of severe acute pain (eg, recent fractures or joint replacement)	Opioids: moderate All others: high	Strong
Parkinson disease	Antiemetics Metoclopramide Prochlorperazine Promethazine All antipsychotics (except quetiapine, clozapine, pimavanserin)	Dopamine-receptor antagonists with potential to worsen parkinsonian symptoms Exceptions: Pimavanserin and clozapine appear to be less likely to precipitate worsening of Parkinson disease. Quetiapine has only been studied in low-quality clinical trials with efficacy comparable to that of placebo in five trials and to that of clozapine in two others.	Avoid	Moderate	Strong
Gastrointestinal					
History of gastric or duodenal ulcers	Aspirin >325 mg/day Non–COX-2–selective NSAIDs	May exacerbate existing ulcers or cause new/additional ulcers	Avoid unless other alternatives are not effective and patient can take gastroprotective agent (ie, proton-pump inhibitor or misoprostol)	Moderate	Strong
Kidney/urinary tract					
Chronic kidney disease stage 4 or higher (creatinine clearance <30 mL/min)	NSAIDs (non-COX and COX selective, oral and parenteral, nonacetylated salicylates)	May increase risk of acute kidney injury and further decline of renal function	Avoid	Moderate	Strong

Table 3 (Contd.)

Disease or Syndrome	Drug(s)	Rationale	Recommendation	Quality of Evidence	Strength of Recommendation
Urinary incontinence (all types) in women	Estrogen oral and transdermal (excludes intravaginal estrogen) Peripheral alpha-1 blockers Doxazosin Prazosin Terazosin	Lack of efficacy (oral estrogen) and aggravation of incontinence (alpha-1 blockers)	Avoid in women	Estrogen: high Peripheral alpha-1 blockers: moderate	Estrogen: strong Peripheral alpha-1 blockers: strong
Lower urinary tract symptoms, benign prostatic hyperplasia	Strongly anticholinergic drugs, except antimuscarinics for urinary incontinence (see Table 7 and full criteria available on www.geriatricscareonline.org)	May decrease urinary flow and cause urinary retention	Avoid in men	Moderate	Strong

Abbreviations: AChEI, acetylcholinesterase inhibitor; CCB, calcium channel blocker; CNS, central nervous system; COX, cyclooxygenase; NSAID, nonsteroidal anti-inflammatory drug; SNRI, serotonin-norepinephrine reuptake inhibitor; SSRI, selective serotonin reuptake inhibitor; TCA, tricyclic antidepressant.

*The primary target audience is the practicing clinician. The intentions of the criteria include (1) improving the selection of prescription drugs by clinicians and patients; (2) evaluating patterns of drug use within populations; (3) educating clinicians and patients on proper drug usage; and (4) evaluating health-outcome, quality-of-care, cost, and utilization data.

[b]May be required to treat concurrent schizophrenia, bipolar disorder, and other selected mental health conditions but should be prescribed in the lowest effective dose and shortest possible duration.

[c]Excludes inhaled and topical forms. Oral and parenteral corticosteroids may be required for conditions such as exacerbation of chronic obstructive pulmonary disease but should be prescribed in the lowest effective dose and for the shortest possible duration.

Table 4. 2019 American Geriatrics Society Beers Criteria® for Potentially Inappropriate Medications: Drugs To Be Used With Caution in Older Adults[a]

Drug(s)	Rationale	Recommendation	Quality of Evidence	Strength of Recommendation
Aspirin for primary prevention of cardiovascular disease and colorectal cancer	Risk of major bleeding from aspirin increases markedly in older age. Several studies suggest lack of net benefit when used for primary prevention in older adult with cardiovascular risk factors, but evidence is not conclusive. Aspirin is generally indicated for secondary prevention in older adults with established cardiovascular disease.	Use with caution in adults ≥70 years	Moderate	Strong
Dabigatran Rivaroxaban	Increased risk of gastrointestinal bleeding compared with warfarin and reported rates with other direct oral anticoagulants when used for long-term treatment of VTE or atrial fibrillation in adults ≥75 years.	Use with caution for treatment of VTE or atrial fibrillation in adults ≥75 years	Moderate	Strong
Prasugrel	Increased risk of bleeding in older adults; benefit in highest-risk older adults (eg, those with prior myocardial infarction or diabetes mellitus) may offset risk when used for its approved indication of acute coronary syndrome to be managed with percutaneous coronary intervention.	Use with caution in adults ≥75 years	Moderate	Weak
Antipsychotics Carbamazepine Diuretics Mirtazapine Oxcarbazepine SNRIs SSRIs TCAs Tramadol	May exacerbate or cause SIADH or hyponatremia; monitor sodium level closely when starting or changing dosages in older adults	Use with caution	Moderate	Strong
Dextromethorphan/ quinidine	Limited efficacy in patients with behavioral symptoms of dementia (does not apply to treatment of PBA). May increase risk of falls and concerns with clinically significant drug interactions. Does not apply to treatment of pseudobulbar affect.	Use with caution	Moderate	Strong
Trimethoprim-sulfamethoxazole	Increased risk of hyperkalemia when used concurrently with an ACEI or ARB in presence of decreased creatinine clearance	Use with caution in patients on ACEI or ARB and decreased creatinine clearance	Low	Strong

Abbreviations: ACEI, angiotensin-converting enzyme inhibitor; ARB, angiotensin receptor blocker; PBA, pseudobulbar affect; SIADH, syndrome of inappropriate antidiuretic hormone secretion; SNRI, serotonin-norepinephrine reuptake inhibitor; SSRI, selective serotonin reuptake inhibitor; TCA, tricyclic antidepressant; VTE, venous thromboembolism.

[a]The primary target audience is the practicing clinician. The intentions of the criteria include (1) improving the selection of prescription drugs by clinicians and patients; (2) evaluating patterns of drug use within populations; (3) educating clinicians and patients on proper drug usage; and (4) evaluating health-outcome, quality-of-care, cost, and utilization data.

Table 5. 2019 American Geriatrics Society Beers Criteria® for Potentially Clinically Important Drug-Drug Interactions That Should Be Avoided in Older Adults

Object Drug and Class	Interacting Drug and Class	Risk Rationale	Recommendation	Quality of Evidence	Strength of Recommendation
RAS inhibitor (ACEIs, ARBs, aliskiren) or potassium-sparing diuretics (amiloride, triamterene)	Another RAS inhibitor (ACEIs, ARBs, aliskiren)	Increased risk of hyperkalemia	Avoid routine use in those with chronic kidney disease stage 3a or higher	Moderate	Strong
Opioids	Benzodiazepines	Increased risk of overdose	Avoid	Moderate	Strong
Opioids	Gabapentin, pregabalin	Increased risk of severe sedation-related adverse events, including respiratory depression and death	Avoid; exceptions are when transitioning from opioid therapy to gabapentin or pregabalin, or when using gabapentinoids to reduce opioid dose, although caution should be used in all circumstances.	Moderate	Strong
Anticholinergic	Anticholinergic	Increased risk of cognitive decline	Avoid; minimize number of anticholinergic drugs (Table 7)	Moderate	Strong
Antidepressants (TCAs, SSRIs, and SNRIs) Antipsychotics Antiepileptics Benzodiazepines and nonbenzodiazepine, benzodiazepine receptor agonist hypnotics (ie, "Z-drugs") Opioids	Any combination of three or more of these CNS-active drugs[a]	Increased risk of falls (all) and of fracture (benzodiazepines and nonbenzodiazepine, benzodiazepine receptor agonist hypnotics)	Avoid total of three or more CNS-active drugs[a]; minimize number of CNS-active drugs	Combinations including benzodiazepines and nonbenzodiazepine, benzodiazepine receptor agonist hypnotics *or* opioids: high All other combinations: moderate	Strong
Corticosteroids, oral or parenteral	NSAIDs	Increased risk of peptic ulcer disease or gastrointestinal bleeding	Avoid; if not possible, provide gastrointestinal protection	Moderate	Strong
Lithium	ACEIs	Increased risk of lithium toxicity	Avoid; monitor lithium concentrations	Moderate	Strong
Lithium	Loop diuretics	Increased risk of lithium toxicity	Avoid; monitor lithium concentrations	Moderate	Strong
Peripheral α-1 blockers	Loop diuretics	Increased risk of urinary incontinence in older women	Avoid in older women, unless conditions warrant both drugs	Moderate	Strong
Phenytoin	Trimethoprim-sulfamethoxazole	Increased risk of phenytoin toxicity	Avoid	Moderate	Strong
Theophylline	Cimetidine	Increased risk of theophylline toxicity	Avoid	Moderate	Strong
Theophylline	Ciprofloxacin	Increased risk of theophylline toxicity	Avoid	Moderate	Strong
Warfarin	Amiodarone	Increased risk of bleeding	Avoid when possible; if used together, monitor INR closely	Moderate	Strong
Warfarin	Ciprofloxacin	Increased risk of bleeding	Avoid when possible; if used together, monitor INR closely	Moderate	Strong
Warfarin	Macrolides (excluding azithromycin)	Increased risk of bleeding	Avoid when possible; if used together, monitor INR closely	Moderate	Strong
Warfarin	Trimethoprim-sulfamethoxazole	Increased risk of bleeding	Avoid when possible; if used together, monitor INR closely	Moderate	Strong
Warfarin	NSAIDs	Increased risk of bleeding	Avoid when possible; if used together, monitor closely for bleeding	High	Strong

(Continued)

Table 5 (Contd.)

Abbreviations: ACEI, angiotensin-converting enzyme inhibitor; ARB, angiotensin receptor blocker; CNS, central nervous system; INR, international normalized ratio; NSAID, nonsteroidal anti-inflammatory drug; RAS, renin-angiotensin system; SNRI, serotonin- norepinephrine reuptake inhibitor; SSRI, selective serotonin reuptake inhibitor; TCA, tricyclic antidepressant.

[a]CNS-active drugs: antiepileptics; antipsychotics; benzodiazepines; nonbenzodiazepine, benzodiazepine receptor agonist hypnotics; TCAs; SSRIs; SNRIs; and opioids.

Table 6. 2019 American Geriatrics Society Beers Criteria® for Medications That Should Be Avoided or Have Their Dosage Reduced With Varying Levels of Kidney Function in Older Adults

Medication Class and Medication	Creatinine Clearance at Which Action Required, mL/min	Rationale	Recommendation	Quality of Evidence	Strength of Recommendation
Anti-infective					
Ciprofloxacin	<30	Increased risk of CNS effects (eg, seizures, confusion) and tendon rupture	Doses used to treat common infections typically require reduction when CrCl <30 mL/min	Moderate	Strong
Trimethoprim-sulfamethoxazole	<30	Increased risk of worsening of renal function and hyperkalemia	Reduce dose if CrCl 15-29 mL/min Avoid if CrCl <15 mL/min	Moderate	Strong
Cardiovascular or hemostasis					
Amiloride	<30	Increased potassium and decreased sodium	Avoid	Moderate	Strong
Apixaban	<25	Lack of evidence for efficacy and safety in patients with a CrCl <25 mL/min	Avoid	Moderate	Strong
Dabigatran	<30	Lack of evidence for efficacy and safety in individuals with a CrCl <30 mL/min. Label dose for patients with a CrCl 15-30 mL/min based on pharmacokinetic data.	Avoid; dose adjustment advised when CrCl >30 mL/min in the presence of drug-drug interactions	Moderate	Strong
Dofetilide	<60	QTc prolongation and torsade de pointes	Reduce dose if CrCl 20-59 mL/min Avoid if CrCl <20 mL/min	Moderate	Strong
Edoxaban	15-50 <15 or >95	Lack of evidence of efficacy or safety in patients with a CrCl <30 mL/min	Reduce dose if CrCl 15-50 mL/min Avoid if CrCl <15 or >95 mL/min	Moderate	Strong
Enoxaparin	<30	Increased risk of bleeding	Reduce dose	Moderate	Strong
Fondaparinux	<30	Increased risk of bleeding	Avoid	Moderate	Strong
Rivaroxaban	<50	Lack of efficacy or safety evidence in patients with a CrCl <30 mL/min	Nonvalvular atrial fibrillation: reduce dose if CrCl 15-50 mL/min; avoid if CrCl <15 mL/min Venous thromboembolism treatment and for VTE prophylaxis with hip or knee replacement: avoid if CrCl <30 mL/min	Moderate	Strong
Spironolactone	<30	Increased potassium	Avoid	Moderate	Strong
Triamterene	<30	Increased potassium and decreased sodium	Avoid	Moderate	Strong
Central nervous system and analgesics					
Duloxetine	<30	Increased gastrointestinal adverse effects (nausea, diarrhea)	Avoid	Moderate	Weak
Gabapentin	<60	CNS adverse effects	Reduce dose	Moderate	Strong
Levetiracetam	≤80	CNS adverse effects	Reduce dose	Moderate	Strong
Pregabalin	<60	CNS adverse effects	Reduce dose	Moderate	Strong
Tramadol	<30	CNS adverse effects	Immediate release: reduce dose Extended release: avoid	Low	Weak
Gastrointestinal					
Cimetidine	<50	Mental status changes	Reduce dose	Moderate	Strong
Famotidine	<50	Mental status changes	Reduce dose	Moderate	Strong
Nizatidine	<50	Mental status changes	Reduce dose	Moderate	Strong
Ranitidine	<50	Mental status changes	Reduce dose	Moderate	Strong
Hyperuricemia					
Colchicine	<30	Gastrointestinal, neuromuscular, bone marrow toxicity	Reduce dose; monitor for adverse effects	Moderate	Strong
Probenecid	<30	Loss of effectiveness	Avoid	Moderate	Strong

(Continued)

Table 6 (Contd.)

Abbreviations: CNS, central nervous system; CrCl, creatinine clearance; QTc, corrected QT interval; VTE, venous thromboembolism.

Table 7. Drugs With Strong Anticholinergic Properties

Antiarrhythmic	Promethazine
Disopyramide	Pyrilamine
	Triprolidine
Antidepressants	
Amitriptyline	
Amoxapine	
Clomipramine	Antimuscarinics
Desipramine	(urinary incontinence)
Doxepin (>6 mg)	Darifenacin
Imipramine	Fesoterodine
Nortriptyline	Flavoxate
Paroxetine	Oxybutynin
Protriptyline	Solifenacin
Trimipramine	Tolterodine
	Trospium
Antiemetics	
Prochlorperazine	Antiparkinsonian agents
Promethazine	Benztropine
	Trihexyphenidyl
Antihistamines (first generation)	
Brompheniramine	Antipsychotics
Carbinoxamine	Chlorpromazine
Chlorpheniramine	Clozapine
Clemastine	Loxapine
Cyproheptadine	Olanzapine
Dexbrompheniramine	Perphenazine
Dexchlorpheniramine	Thioridazine
Dimenhydrinate	Trifluoperazine
Diphenhydramine (oral)	
Doxylamine	Antispasmodics
Hydroxyzine	Atropine (excludes ophthalmic)
Meclizine	Belladonna alkaloids
Clidinium-chlordiazepoxide	Scopolamine (excludes ophthalmic)
Dicyclomine	
Homatropine (excludes ophthalmic)	Skeletal muscle relaxants
Hyoscyamine	Cyclobenzaprine
Methscopolamine	Orphenadrine
Propantheline	