Geriatrician interventions on medication prescribing for frail older people in residential aged care facilities

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Objective: In Australian residential aged care facilities (RACFs), the use of certain classes of high-risk medication such as antipsychotics, potent analgesics, and sedatives is high. Here, we examined the prescribed medications and subsequent changes recommended by geriatricians during comprehensive geriatric consultations provided to residents of RACFs via videoconference.

Design: This is a prospective observational study.

Setting: Four RACFs in Queensland, Australia, are included.

Participants: A total of 153 residents referred by general practitioners for comprehensive assessment by geriatricians delivered by video-consultation.

Results: Residents’ mean (standard deviation, SD) age was 83.0 (8.1) years and 64.1% were female. They had multiple comorbidities (mean 6), high levels of dependency, and were prescribed a mean (SD) of 9.6 (4.2) regular medications. Ninety-one percent of patients were taking five or more medications daily. Of total medications prescribed (n = 1,469), geriatricians recommended withdrawal of 9.8% (n = 145) and dose alteration of 3.5% (n = 51). New medications were initiated in 47.7% (n = 73) patients. Of the 10.3% (n = 151) medications considered as high risk, 17.2% were stopped and dose altered in 2.6%.

Conclusion: There was a moderate prevalence of potentially inappropriate high-risk medications. However, geriatricians made relatively few changes, suggesting either that, on balance, prescription of these medications was appropriate or, because of other factors, there was a reluctance to adjust medications. A structured medication review using an algorithm for withdrawing medications of high disutility might help optimize medications in frail patients. Further research, including a broader survey, is required to understand these dynamics.

Keywords: frail older, geriatrician intervention, high-risk medications, residential aged care facilities

Introduction

Many frail older people spend their final years of life in aged care facilities. In Australia, the proportion of older people living in care accommodation increases with age from 2% of people aged 65–74 years to 6% of people aged 75–84 years and 26% of people aged 85 years and over.1 Those living in care homes often take more medications than noninstitutionalized elderly, and the risk of morbidity as a result of medication is high.2 Also, the incidence of adverse drug events increases with the number of medications prescribed.3 Residential aged care facilities (RACFs) in Australia are institutions in which prescribing of high-risk medication such as antipsychotics, potent analgesics, and sedatives is high, with between 25% and 30% of patients receiving such medication.4,6 Ensuring high-quality care and appropriate medication use for...
these residents is challenging given their frailty, complex disabilities, and multiple chronic conditions.7

Despite the growing body of literature indicating that medication errors and potentially inappropriate medications are important causes of morbidity and mortality, evidence for effective interventions and strategies to improve the pharmacological management of patients is still limited.8 Well-organized approaches are needed to provide specialist advice in nursing homes to ensure quality medical care. Practice models that include a pharmacist as part of the multidisciplinary team represent best practice in inpatient, ambulatory, and community settings, and in care transitions between settings.9 Geriatrician-led case conference reviews and comprehensive geriatric assessments (CGAs) have been shown to be effective in reducing potentially inappropriate medications use and improved suboptimal prescribing.7,10 Although access to geriatric services in Australian RACFs is limited, expert advice is increasingly provided by video-conferencing (VC).

In the model offered in relation to this study, a specialist geriatrician provides a comprehensive assessment of the patient and input into care plans via VC. Geriatricians make recommendation about patients’ medications, perhaps advising that some medications are stopped or others commenced. We designed this study to examine whether VC-mediated geriatric assessment resulted in changes to medications prescribed, and reduced the prevalence of potentially inappropriate medication use.

Methods
Study population and setting
We conducted a prospective observational cohort study of four RACFs in Queensland, Australia, that currently have regular access to geriatric consultations via VC. The participating facilities were the first four to be supported by the geriatrician service operating out of the Centre for Research in Geriatric Medicine. We were able to record the information for 153 patients assessed by four geriatricians over the research timeframe.

Data collection
At participating facilities, geriatrician-supported CGA is encouraged within 4–12 weeks of admission. All residents are offered CGA at entry into the participating RACF. However, uptake is determined by referral from the treating general practitioners. The CGA is conducted using a structured protocol based on the interRAI (Resident Assessment Instrument) Long-Term Facility assessment system, administered by a senior registered nurse. The assessment includes a comprehensive diagnosis list, justification of all medications documented, functional profile, cognitive assessment confirming the presence or absence of cognitive and mood disorders, recommendations for prevention and management, and advanced care planning. Observations made by the nurse are entered into a clinical decision support system, which generates a draft resident health care profile and care plan. The clinical decision support system is mounted on a web-based platform to permit review and comment by a specialist geriatrician. interRAI is a not-for-profit research consortium with international collaboration from more than 30 countries that aims to improve the quality of life of vulnerable persons through a unified comprehensive assessment system.

Ideally, 1–4 weeks following admission to the facility, residents who have been referred to a geriatrician by the GP are assessed via video-consultation by the specialist. The geriatrician is able to speak with the resident as well as attending RACF staff and resident’s family members if present. Recommendations to the GP and RACF are made, as necessary, regarding the resident’s care plan following the consultation. CGA is also offered to existing residents on an “as needs” basis. A formal functional profile is prepared, and a report is generated recording the recommendations made by the geriatrician. Data for this study were retrieved from these sources over an 18-month period from January 2013 to August 2014. Ethics approval was obtained from the University of Queensland Medical Research Ethics Committee. All patients or their substitute decision-maker gave informed consent for participation.

Key measures
The primary outcome measure was the appropriateness of prescribing. A high-risk medications list was created based on those recognized by the American Geriatric Society 2012 Beers Criteria,11 the McLeod criteria,12 the Laroche criteria,13 the PRISCUS criteria,14 and the Norwegian General Practice criteria15 (Table 1). These criteria consider a medication as high risk when it has a tendency to cause adverse drug events and drug toxicity in older adults due to its pharmacological properties and the physiologic changes of aging. For our study, we defined high-risk medications as those that are listed on any one of these criteria. We excluded medications not available in Australia. Polypharmacy status was categorized into three groups based on the number of medications prescribed: non-polypharmacy (0–4 medications), polypharmacy (5–9 medications), and hyper-polypharmacy (≥10 medications).16 Complementary and as-required medications were excluded. Three levels of change on current
## Table 1 High-risk medications list

| Medication | ATC codes | Main concerns | References |
|------------|-----------|---------------|------------|
| **Analgesics, anti-inflammatory** | | | |
| NSAID | | | |
| Aspirin (>325 mg/day) | N02BA01 | – Very high risk of gastrointestinal hemorrhage, ulceration, or perforation, which may be fatal | 11 |
| Diclofenac | M01AB05 | – Risk of renal toxicity especially in patients with preexisting chronic kidney disease | 11 |
| Ketoprofen | M01AE03 | | 11,14 |
| Ketorolac | M01AB15 | | 11,12 |
| Mefenamic acid | M01AG01 | – Risk of fluid retention and fluid overload leading to decompensated heart failure in patients with underlying cardiac dysfunction | 11,14 |
| Meloxicam | M01AC06 | | 11,14 |
| Naproxen | M01AE02 | | 11 |
| Piroxicam | M01AC01 | – Indomethacin may also have CNS side effects | 11,12,14 |
| Indomethacin | M01AB01 | | 11–14 |
| Etoricoxib | M01AH05 | | 14 |
| Ibuprofen | M01AE01 | | 11 |
| **Opioid analgesics** | | | |
| Pethidine | N02AB02 | – Elevated risk of delirium and falls | 11,12,14 |
| – Risk of neurotoxicity | | | |
| **Antiarrhythmic** | | | |
| Amiodarone | C01BD01 | – Predisposition to bradycardia and heart block | 11 |
| Flecaïnide | C01BC04 | – Pro-arrhythmic effects | 11,14 |
| Sotalol | C07AA07 | – Pro-arrhythmic effects | 11,14,15 |
| Disopyramide | C01BA03 | – Potent negative inotropic effects predisposing to heart failure – Anticholinergic activity | 11–13 |
| Digoxin (>0.125 mg/day) | C01AA05 | – Risk of toxicity especially in presence of renal insufficiency – Anticholinergic activity | 11,13,14 |
| Nifedipine | C08CA05 | – Potential for postural hypotension – Short-acting formulations associated with increased mortality in elderly patients | 11,13,14 |
| Spironolactone (>25 mg/day) | C03DA01 | – Risk of hyperkalemia | 11 |
| Diltiazem | C08DB01 | – Potential to promote fluid retention and exacerbate heart failure | 11 |
| Verapamil | C08DA01 | | 11 |
| **Antibiotics** | | | |
| Nitrofurantoin | J01XE01 | – Long-term use associated with pulmonary side effects, renal impairment, liver damage | 11,13,14 |
| **Anticholinergics** | | | |
| **Antihistamines** | | | |
| Chlorpheniramine | R06AB02 | – Risk of anticholinergic effect: constipation, dry mouth, visual disturbance, bladder dysfunction | 11,14 |
| Cyproheptadine | R06AX02 | – Clear eance reduced with advanced age | 11,13,15 |
| Dexchlorpheniramine | R06AB02 | – Increased risk of confusion and sedation, impaired cognitive performance | 11,13,14 |
| Diphenhydramine | R06AA02 | – Increased risk of confusion and sedation, impaired cognitive performance | 11,13,14 |
| Doxylamine | R06AA09 | – Potential for postural hypotension | 11,13,14 |
| Promethazine | R06AD02 | | 11,13,15 |
| **Antiparkinson agents** | | | |
| Benzhexol | N04AC01 | – Risk of anticholinergic side effects | 11 |
| – Not recommended for prevention of extrapyramidal symptoms due to antipsychotics | | | |
| **Antispasmodics** | | | |
| Propantheline | A03AB05 | – Highly anticholinergic, uncertain effectiveness | 11 |
| Oxybutynin | G04BD04 | – Anticholinergic side effects | 11,13,14 |
| Solifenacin | G04BD08 | – ECG changes (prolonged QT) | 11,13,14 |
| Tolterodine (non-sustained release) | G04BD07 | | 11,13,14 |
| **Antithrombotics** | | | |
| Dipyridamole (short-acting) | B01AC07 | – Risk of orthostatic hypotension | 11–13 |
| Warfarin | B01AA03 | – Increased risk of bleeding | 11,14 |
| Prasugrel | B01AC22 | | 11,14 |
| Ticlopidine | B01AC05 | | 11,14 |
| Medication                        | ATC codes | Main concerns                                                                 | References |
|----------------------------------|-----------|-------------------------------------------------------------------------------|------------|
| **Antidepressants**              |           |                                                                               |            |
| **TCA**                          |           |                                                                               |            |
| Amitriptyline                    | N06AA09   | – Peripheral anticholinergic side effects (eg, constipation, dry mouth,       | 11–15      |
|                                  |           | orthostatic hypotension, and cardiac arrhythmia)                             |            |
| Clomipramine                     | N06AA04   |                                                                               | 11,13–15   |
| Doxepin (>6 mg)                  | N06AA12   | – Central anticholinergic side effects (drowsiness, inner unrest,            | 11,13–15   |
|                                  |           | confusion, other types of delirium)                                         |            |
| Imipramine                       | N06AA02   | – Cognitive impairment                                                       | 11–14      |
| Nortriptyline                    | N06AA10   | – Increased risk of falls                                                     | 11         |
| **SSRI**                         |           |                                                                               |            |
| Fluoxetine (daily use)           | N06AB03   | – CNS side effects (nausea, insomnia,                                       | 11,14,15   |
|                                  |           | dizziness, confusion)                                                        |            |
|                                  |           | – Hyponatremia                                                               |            |
| Paroxetine                       | N06AB05   | – Confusion and other types of delirium                                      | 11         |
| **MAO inhibitors**               |           |                                                                               |            |
| Tranylcypromine                  | N06AF04   | – Hypertensive crises                                                        | 11,14      |
|                                  |           | – Cerebral hemorrhage                                                        |            |
|                                  |           | – Malignant hyperthermia                                                     |            |
| **Antiemetic drugs**             |           |                                                                               |            |
| Trimethobenzamide                | NA        | – Can cause extrapyramidal adverse effects                                   | 11         |
| **Antiepileptic drugs (AEDs)**   |           |                                                                               |            |
| Phenobarbitone                   | N03AA02   | – Sedation                                                                   | 11,14      |
|                                  |           | – Paradoxical excitation                                                     |            |
|                                  |           | – Highly addictive                                                           |            |
| **Antihypertensive agents**      |           |                                                                               |            |
| Clonidine                        | C02AC01   | – Hypotension (orthostatic), bradycardia, syncope                            | 11,13,14   |
| Methyldopa                       | C01AB01   | – CNS side effects: sediment, cognitive impairment                            | 11,13,14   |
| Moxonidine                       | C02AC05   | – Hypotension (orthostatic)                                                  | 13         |
|                                  |           | – Bradycardia                                                                |            |
|                                  |           | – Sedation                                                                   |            |
| Nifedipine                       | C08CA05   | – Short-acting nifedipine associated with increased risk of myocardial        | 11,13      |
|                                  |           | infarction, increased mortality in elderly patients                          |            |
| Prazosin                         | C02CA01   | – Hypotension                                                                | 11,13,14   |
| Terazosin                        | G04CA03   | – Dry mouth                                                                  | 11,14      |
|                                  |           | – Urinary incontinence/impaired micturition                                  |            |
|                                  |           | – Increased risk of cerebrovascular and cardiovascular disease               |            |
| **Antipsychotics (neuroleptic drugs)** |            |                                                                               |            |
| **First-generation (conventional) agents** |           |                                                                               |            |
| Chlorpromazine                   | N05AA01   | – Anticholinergic and extrapyramidal side effects                            | 11–13,15   |
| Fluphenazine                     | N05AB02   | – Parkinsonism                                                               | 11,13,14   |
| Haloperidol (>2 mg)              | N05AD01   | – Hypotonia                                                                  | 11,14      |
| Promazine                        | N05AA03   | – Sedation and risk of falls                                                 | 11,13      |
| Trifluoperazine                  | N05AB06   | – Increased mortality in patients with dementia                              | 11         |
| Prochlorperazine                 | N05AB04   |                                                                               | 11,13–15   |
| **Second-generation (atypical) agents** |           |                                                                               |            |
| Aripiprazole                     | N05AX12   | – Fewer extrapyramidal side effects                                          | 11         |
| Asenapine                        | N05AH05   | – Clozapine: increased risk of agranulocytosis and myocarditis               | 11         |
| Clozapine                        | N05AH02   |                                                                               | 11,13,14   |
| Olanzapine (>10 mg)              | N05AH03   |                                                                               | 11,13–15   |
| **Muscle relaxants**             |           |                                                                               |            |
| Baclofen                         | M03BX01   | – CNS side effects: amnesia, confusion, falls                                | 13,14      |
| Solifenacin                      | G04BD08   | – Anticholinergic side effects: constipation, dry mouth, CNS side effects    | 11,13,14   |
| Orphenadrine                     | N04AB02   | – More sedation and anticholinergic side effects than safer alternatives     | 11         |

(Continued)
### Table 1 (Continued)

| Medication                          | ATC codes | Main concerns                                                                                                                                                                                                 | References |
|-------------------------------------|-----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|
| **Sedative and hypnotics**          |           |                                                                                                                                                                                                              |            |
| Long-acting benzodiazepines         |           |                                                                                                                                                                                                              |            |
| Clonazepam                          | N03AE01   | In general, all benzodiazepines increase the risk of cognitive impairment, delirium, falls (muscle-relaxing effect, prolonged sedation) with risk of hip fracture, depression, psychiatric reactions (can cause paradoxic reactions, eg, agitation, irritability, hallucinations, and psychosis) and motor vehicle accidents in older adults | 11         |
| Diazepam                            | N05BA01   |                                                                                                                                                                                                              | 11–15      |
| Bromazepam                          | N05BA08   |                                                                                                                                                                                                              | 13,14      |
| Clobazam                            | N05BA09   |                                                                                                                                                                                                              | 13         |
| Nitrazepam                          | N05CD02   |                                                                                                                                                                                                              | 13–15      |
| Flunitrazepam                       | N05CD03   |                                                                                                                                                                                                              | 13–15      |
| **Short- and intermediate-acting benzodiazepines** |           |                                                                                                                                                                                                              |            |
| Alprazolam                          | N05BA12   |                                                                                                                                                                                                              | 11,13,14   |
| Lorazepam                           | N05BA06   |                                                                                                                                                                                                              | 11,13,14   |
| Oxazepam                            | N05BA04   |                                                                                                                                                                                                              | 11,13–15   |
| Temazepam                           | N05CD07   |                                                                                                                                                                                                              | 11,13,14   |
| Triazolam                           | N05CD05   |                                                                                                                                                                                                              | 11–14      |
| **Non-benzodiazepine hypnotics**    |           |                                                                                                                                                                                                              |            |
| Zolpidem                            | N05CF02   |                                                                                                                                                                                                              | 11,13,14   |
| Zopiclone                           | N05CF01   |                                                                                                                                                                                                              | 13–15      |
| Chloral hydrate                     | N05CC01   |                                                                                                                                                                                                              | 11,14      |
| **Others**                          |           |                                                                                                                                                                                                              |            |
| Theophylline                         | R03DA02   | Risk of arrhythmias                                                                                                                                                                                            | 11,15      |
| Glipizide                           | A10BB07   | No proof of efficacy in COPD                                                                                                                                                                                  | 13         |
| Cimetidine                          | A02BA01   | Long half-life leading to possible prolonged hypoglycemia                                                                                                                                                     | 11–13      |
|                                     |           | Confusion                                                                                                                                                                                                     |            |
|                                     |           | More interactions than other H2 antagonists                                                                                                                                                                   |            |
| Diphenoxylate                       | A07DA01   | No proof of efficacy                                                                                                                                                                                        | 12,13      |
|                                     |           | Blocks the muscarinic receptors                                                                                                                                                                               |            |

**Abbreviations:** ATC, anatomical therapeutic chemical; COPD, chronic obstructive pulmonary disease; CNS, central nervous system; ECG, electrocardiogram; MAO, monoamine oxidase; NSAID, non-steroidal anti-inflammatory drugs; SSRI, selective serotonin reuptake inhibitors; TCA, tricyclic antidepressants.

prescription were defined as drug stopped, dose altered, and new drug started.

**Statistical analysis**

The Statistical Package for Social Science 21.0 (IBM SPSS Statistics 21. Ink) was used for statistical analysis. Categorical variables were summarized using proportions and continuous variables using mean, standard deviation (SD), and range. In univariate analysis, the differences in the distribution of variables between patients with or without high-risk medications were compared using the chi-squared test for categorical variables, and nonparametric or parametric comparison of means for continuous variables, depending on the distribution of the data. Tests of significance were two-tailed, using a significance level of $P \leq 0.05$.

**Results**

Over the course of the study, 153 patients were assessed by the four participating geriatricians across four facilities. Demographics and clinical characteristics of the study population are presented in Table 2. The mean (± SD) patient age was 83.0 (±8.1) years and 64.1% were female. The median length of stay in the facility at the time of assessment was 488 days (range 6–3,213 days). Twenty-four percent of patients were assessed within 12 weeks of admission to the facility. Patients had multiple comorbidities (mean 6), including dementia diagnosed in 67.3%, depression in 46.4%, and delirium in 11.7%. Other prevalent comorbidities were hypertension (35.9%), diabetes (20.9%), heart diseases (13.7%), and respiratory diseases (11.1%). Patients were prescribed a mean (± SD) of 9.6 (±4.2) regular medications. Polypharmacy (≥5 medications) was seen in 91% (n=139) residents, half of whom (n=69) were exposed to hyper-polypharmacy (≥10 medications).

Of all medications prescribed (n=1,469), the geriatrician recommended withdrawal of 9.8% (n=145) and dose alteration for 3.5% (n=51) medications. Medications were stopped because of adverse effects (n=66), no clear
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Table 2 Demographic and clinical characteristics of study population

| Characteristics                        | Total, N=153 |
|----------------------------------------|--------------|
| Age, years                             | 83.0±8.1     |
| Median                                 | 83           |
| Females, n (%)                         | 98 (64.1)    |
| Length of stay at the time of assessment: median length of stay, days (IQR) | 488 (6–3,213) |
| Marital status (%)                     |              |
| Married                                | 50 (32.6)    |
| Widowed                                | 73 (47.7)    |
| Separated/divorced                     | 19 (12.4)    |
| Never married                          | 11 (7.1)     |
| Comorbidities (%)                      |              |
| Dementia                               | 103 (67.3)   |
| Delirium                               | 18 (11.7)    |
| Depression                             | 71 (46.4)    |
| Under nutrition                        | 49 (32.0)    |
| COPD/Asthma                            | 17 (11.1)    |
| Hypertension                           | 55 (35.9)    |
| Diabetes                               | 32 (20.9)    |
| Ischemic heart disease                 | 21 (13.7)    |
| Prescription medications              |              |
| Total number of prescribed medications | 1,469        |
| Mean ± SD                              | 9.6±4.2      |
| Polypharmacy categories (%)            |              |
| 0–4 medications (non-polypharmacy)     | 14 (9.2)     |
| 5–9 medications (polypharmacy)         | 70 (45.8)    |
| ≥10 medications (hyper-polypharmacy)   | 69 (45.1)    |

Abbreviations: COPD, chronic obstructive pulmonary disease; IQR, interquartile range; SD, standard deviation.

indication/medication burden (n=63), and disease cured (n=16). Similarly, the medication dose was altered because of adverse effects and other factors (n=36), changed to “as required” (n=5), and ineffective dose (n=10). New medications were initiated in 47.7% (n=73) patients (Table 3). High-risk medications prescribed (10.3%; n=151) and intervention by geriatricians are listed by drug classes in Table 4. At least one high-risk medication was prescribed to 58.2% (n=89) patients. The univariate analysis showed that the length of stay was the only variable significantly associated with patients having at least one high-risk medication (Table 5). Of the high-risk medications, the geriatrician ceased 17.2% (n=26) medications and altered the dose in 2.6% (n=4). High-risk medications stopped were analgesics (n=6), antispasmodics (n=5), sedative and hypnotics (n=5), antipsychotics (n=3), antiarrhythmic (n=3), antihypertensive (n=2), gastrointestinal medications (n=1), and antibiotics (n=1). The dose was altered for antiarrhythmic (n=2), antidepressants (n=1), and sedative and hypnotics (n=1).

Discussion

To our knowledge, this is the first study of a geriatrician intervention where the medication advice for residents at long-term residential care facilities was specifically assessed via video-consultation. We found moderate levels of high-risk medications prescribed to residents in RACFs. Geriatricians made relatively few changes. This suggests that either the prescription of these medications was appropriate or other factors influenced the decision not to adjust medications.

The aim of defining high-risk medication use is to focus on a group of medications for which there is common consensus about potential inappropriateness. In principle, the high-risk medications prescribed to RACF residents in our study should not have been started or continued except under certain conditions; for example, amiodarone, a high-risk medication used in older people, is a therapy that may be indicated to treat supraventricular arrhythmias effectively in patients with heart failure;17 and benzodiazepines, that may increase the risk of mental decline, delirium, falls, and fractures in older adults, may be appropriate for treating seizures, certain sleep disorders, and anxiety disorders.11 The reluctance on the part of the geriatrician in adjusting/ stopping many of these high-risk medications might suggest that prescription of some of these medications was appropriate. It is also possible that patients’ (or primary care

Table 3 Outcomes of geriatrician intervention

| Interventions                | No of medications | Reasons                                      |
|------------------------------|-------------------|----------------------------------------------|
| Drug stopped (145 [9.8%])    | 66                | Adverse effects                              |
|                              | 63                | No clear indication/medication burden        |
|                              | 16                | Disease cured or quiescent                   |
| Dose altered (51 [3.5%])     | 36                | Dose reduced (because of adverse effects and other factors) |
|                              | 10                | Dose increased (because of ineffective dose) |
|                              | 5                 | Changed to “as required”                     |
| New drug started (102 [6.9%])| 58                | Untreated morbidity                          |
|                              | 23                | Better alternative to present therapy        |
|                              | 21                | Symptom relief                               |

Notes: Total medication prescribed: 1,469; total high-risk medications prescribed: 151 (10.3%).
Table 4 High-risk medication prescribed and geriatrician intervention

| System/therapeutic category/medications | High-risk medications prescribed, N (%) | Result of geriatrician intervention |
|---------------------------------------|----------------------------------------|------------------------------------|
| Central nervous system medications    |                                        |                                    |
| Antidepressants                        | 10 (6.6)                               | DA – 1                             |
| Antipsychotics                         | 21 (13.9)                              | DS – 3                             |
| Sedative and hypnotics                 | 49 (32.4)                              | DS – 5, NDS – 1                    |
| Cardiovascular system medications      | 21 (13.9)                              |                                    |
| Antiarrhythmic                         | 12 (7.9)                               | DS – 3                             |
| Antihypertensive                       | 9 (5.9)                                | DA – 2                             |
| Antihistamines                         | 5 (3.3)                                | NDS – 1                            |
| Antispasmodics                         | 5 (3.3)                                |                                    |
| Analgesics                             | 9 (5.9)                                | DS – 6                             |
| Antibiotics                            | 2 (1.3)                                |                                    |
| Total                                  | 151 (100)                              | DA – 4, NDS – 26                   |

Abbreviations: DA, dose altered; DS, drug stopped; NDS, new drug started.

Medical practitioners’) strong belief in their medications might impact on an otherwise appropriate reduction in the number of medications taken, but this was not specifically explored in our study. In addition to these patient-related factors, there might be some prescriber-related factors that hinder medication adjustment, such as involvement of several prescribers, the use of preventive medication, and evidence-based medicine guidelines that often induce polypharmacy, uncertainties of precipitating disease relapse or drug withdrawal syndromes, and lack of risk/benefit information for the frail older residents.18

Interventions for appropriate prescribing in older people such as education, medication reviews, computerized support systems, and interdisciplinary team review have a positive impact on prescribing.10 Yet, evidence for effective interventions to improve care in residential care settings is limited. A study by Crotty et al suggested that case conferences help an outreach geriatrician team to optimize medication management.7 They describe the use of multidisciplinary case conference meetings to review medication in RACFs with significant improvement in medication appropriateness in the intervention group. There is conflicting evidence, however, concerning the efficacy of case conference medication reviews. One study using case conferencing to review the prescription and use of medications for community-dwelling older adults was unsuccessful in demonstrating the change in inappropriate use of medications.19 A similar study in residential care facilities was unsuccessful in establishing changes in the number of medications.20 Other approaches to optimize prescribing in frail older people might be the integration of a pharmacist in a team to make a collaborative approach on the quality of prescribing. Studies from inpatient settings suggest that the addition of a pharmacist to health care teams could lead to major reductions in morbidity and improved patient outcomes.21,22 Another study on older patients transferring from hospital to a long-term care facility showed that adding a pharmacist transition coordinator on evidence-based medication management and

Table 5 Univariate analysis of variables influencing the use of high-risk medications

| Characteristics                  | Patients Without high-risk medications (n=64) | With at least one high-risk medication (n=89) | P-value |
|----------------------------------|---------------------------------------------|----------------------------------------------|---------|
| Socio-demographic                |                                             |                                              |         |
| Age                              | 83.55±8.5                                   | 82.67±7.8                                    | 0.513   |
| Sex (female)                     | 44 (68.8)                                   | 54 (60.7)                                    | 0.304   |
| Clinical                         |                                             |                                              |         |
| Length of stay                   | 303 (70.75–780.50)                          | 630 (100–1,022.50)                           | 0.044   |
| Assessment status (within 12 weeks of admission) | 18 (28.1)                                   | 19 (21.3)                                    | 0.334   |
| Polypharmacy (>4 medications)    | 57 (89.1)                                   | 82 (92.1)                                    | 0.516   |
| Comorbid conditions              |                                             |                                              |         |
| Delirium                         | 7 (10.9)                                    | 11 (12.4)                                    | 0.788   |
| Dementia                         | 44 (68.8)                                   | 59 (66.3)                                    | 0.749   |
| Depression                       | 27 (42.2)                                   | 44 (49.4)                                    | 0.375   |
| Under nutrition                  | 24 (37.5)                                   | 25 (28.1)                                    | 0.218   |

Note: Values represent frequency (% of n).
health outcomes could improve the aspects of inappropriate use of medications. Optimizing prescribing requires appropriate ways to taper or withdraw high-risk medications in older adults. Available explicit and implicit criteria for appropriate prescribing encompass medications that have been validated in, and applied to, robust, healthy populations aged 65 and older. Therefore, these approaches may not be applicable to the more frail and multimorbid oldest old who reside in RACFs. Most attention has been paid to the development of guidelines on how to initiate medications, but there are limited studies on the most effective way to cease medications. Barriers to cease medications include time constraints on medical practitioners. This had led some to advocate that there should be some systematic approaches to follow in ceasing medications. In responding to polypharmacy and minimizing high-risk medications, there appears a need for a practical algorithm that helps clinicians identify and discontinue potentially inappropriate high-risk medications using a systematic approach. This algorithm should signify a range of different clinical scenarios in relation to high-risk medications and offer an evidence-based approach to identify and, if appropriate, discontinue such medications and/or suggesting alternative treatments when required.

Our study has several limitations. Although, combining five different explicit criteria gives us an opportunity to extract a comprehensive list of high-risk medications, this list is not meant to regulate practice in a manner that surpasses the clinical judgment and the assessment of a prescriber. Also, because of our definition of high-risk medications as a list of drugs, the further domains of inappropriate prescribing such as underuse of medications and drug–drug interaction might be missed. Any adverse health events occurring among the residents using high-risk medications were also not investigated in our study. Considering the small sample size of 153 patients, the study results may not be representative of larger sample size in different nursing home settings.

Conclusion
In this study of 153 residents of four RACFs, we found a moderate prevalence of potentially inappropriate high-risk medications. However, geriatricians made relatively few changes, suggesting either that, on balance, prescription of these medications was appropriate or, because of other factors, there was a reluctance to adjust medications. Further research, including a broader survey, is required to understand these dynamics. A structured medication review using an algorithm for withdrawing medications of high disutility might help optimize medication prescribing in frail older people.

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Disclosure
The authors report no conflicts of interest in this work.

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