RESEARCH PAPER

Use of medication among nursing home residents: a Danish drug utilisation study

CARINA LUNDBY[1,2], JOHN JENSEN[3], SØREN POST LARSEN[3], HELENE HOFFMANN[3],
ANTON POTTEGÅRD[1,2], METTE REILEV[2]

[1]Hospital Pharmacy Funen, Odense University Hospital, Odense C, Denmark
[2]Clinical Pharmacology and Pharmacy, Department of Public Health, University of Southern Denmark, Odense C, Denmark
[3]Type2dialog, Kongens Lyngby, Denmark

Address correspondence to: Carina Lundby, Hospital Pharmacy Funen, Odense University Hospital, Solfaldsvej 38, Entrance 208,
DK-5000 Odense C, Denmark. Tel: 0045 23241245. Email: carina.lundby.olesen@rsyd.dk

Abstract

Background: Data on drug utilisation patterns in nursing home populations is scarce. We aimed to describe drug use patterns in Danish nursing home residents.

Methods: We established a cohort of 5,179 individuals (63% women; median age of 84 years) admitted into 94 nursing homes across Denmark during 2015–2017. Data on prescription drug use and other census data were obtained from the nationwide Danish health registries.

Results: The total number of drug classes filled increased from a median of 6 drugs (interquartile range [IQR] 3–9) at 18–24 months before nursing home admission to a median of 8 drugs (IQR 6–11) just after admission, with the most common drug classes comprising paracetamol (61%), platelet inhibitors (41%), proton pump inhibitors (34%), statins (33%) and potassium supplements (31%). The incidence rate of new drug treatments increased from 21 new treatments/100 residents/month at 12–24 months before admission to a peak of 71 new treatments/100 residents/month in the month prior to admission, while it levelled off to about 34 new treatments/100 residents/month after 6–9 months. The drug classes primarily responsible for this peak were laxatives, antibiotics and analgesics. The largest absolute increases were seen for laxatives (53%), paracetamol (43%) and antidepressants (36%), all showing a marked increase up to and following admission. A high proportion of residents remained on therapy in the 3-year period following admission, with users of antidepressants and antidementia drugs being most persistent.

Conclusion: Nursing home admission is associated with an increase in use of both predominantly preventive and non-preventive drug classes.

Keywords: *nursing home, drug utilisation, pharmacoepidemiology, older people*

Key points

- This paper describes drug use patterns in Danish nursing home residents.
- Nursing home admission is associated with an increase in use of both predominantly preventive and non-preventive drug classes.
- Following admission, residents' drug use remains on a level slightly higher than before admission.
- A high proportion of residents persistently use drug classes with questionable benefit in individuals with limited life expectancy.

Introduction

While use of prescription drugs is considerable among the oldest in our society, it is challenging to weigh potential risks of treatment with expected benefits in this population. For example, older people are particularly susceptible to experiencing adverse drug events and drug–drug interactions due to altered pharmacokinetics and -dynamics as well as a markedly changed physiology [1, 2]. Furthermore, for older people reaching the last years of life, the life expectancy might exceed the time to benefit of some medications, e.g. preventive medications, thereby minimising or eliminating the clinical effect of these drugs [3,4]. Thus, reconsidering and adjusting use of medication in relation to changes in physiology and disease status as well as shifts in goals of care is essential to ensure optimal care [5,6]. Despite this, use of preventive medication in people reaching the end of life is considerable [7–11]. As an example, more than half of all nursing home residents with severe dementia use at least one drug with questionable benefit [12], while use of medications with questionable benefit in general is common among people living in nursing home [7,10,13,14].

Admission to nursing home generally indicates an altered disease status, a certain level of frailty and a relatively limited life expectancy, thus representing a time where treatment goals might change from preventive to symptomatic control. This makes adjustment of drugs particularly relevant [6,15]. However, to reduce use of medications with questionable benefit and drug-related complications in this vulnerable population, more insight into trends in medication use in relation to nursing home admission is needed. Thus, we aimed to describe drug use patterns in Danish nursing home residents.

Methods

We established a database of individuals admitted into 94 nursing homes across 11 Danish municipalities during 2015–2017. The cohort was supplemented with individual-level registry data on prescription fills.

Study cohort and data sources

The data set used has previously been described in detail [16]. In brief, 11 Danish municipalities provided personal identification numbers [17] and date of nursing home admission on all individuals moving into a nursing home during 2015–2017. Through The Danish Health Data Authority, these data were linked to individual-level data on hospital diagnoses and prescription fills covering 1995 throughout 2018. As virtually all medical care in Denmark is furnished by the national health authorities, the use of these registries allows complete capture of health care contacts with the limited risk of selection bias [18].

Prescription data was obtained from the Danish National Prescription Registry [19] covering all prescriptions filled by Danish citizens, including nursing home residents, since 1995. These data include the type of drug, date of dispensing and quantity; however, dosing information and indication for prescribing are not available. Drugs are categorised according to the Anatomic Therapeutic Chemical (ATC) index [20]. ATC codes used to define drug use are provided in Supplementary Material A1.

Setting

According to Danish law, nursing home residency should be appointed to frail individuals needing all-day care. All Danish citizens can apply for nursing home residency; however, allocation of care to the frailest individuals is decided by the local municipalities. This prioritisation occurs irrespective of socio-economic status and is purely based on functional capacity [21]. In Danish nursing homes, a team of nurses and health care assistants with $1\frac{1}{2}$–4 years of basic education support and facilitate the well-being of the residents. A full description of the setting can be found elsewhere [16].

Analyses

The cohort was described in terms of patient characteristics at the time of nursing home admission, including age, sex and Charlson Comorbidity Index [22]. The Charlson Comorbidity Index was estimated using patient registry data on hospital diagnoses, thus only covering secondary care.

For describing use of prescription drugs, we used two approaches. First, to describe the overall drug use relative to nursing home admission, we determined the rate of new (incident) drug treatments initiated per 100 residents per month, specifying by involved drug classes. New (incident) use of a drug was defined as the first filling of a given drug class in at least 2 years. We also assessed the total number of unique drug classes used by the single individual in 6-month intervals and the 25 most commonly used drug classes used in the 6-month period prior to admission as well as up to 1 year before, 1 year after and 2 years after admission, respectively. Second, we selected specific drug classes representing a continuum from predominantly preventive therapy (antihypertensives, oral antihyperglycemics, statins, low-dose aspirin, antiplatelets, anticoagulants and bisphosphonates) to predominantly non-preventive therapy (paracetamol, NSAIDs, opioids, laxatives, benzodiazepines, antidepressants and antidementia drugs). For these, we described, at the cohort level, the changes over time in ongoing (prevalent) use. Ongoing (prevalent) use of a drug was defined as the filling of at least one prescription of the drug class within a 6-month interval, irrespective of previous use. Additionally, we described the individual-level persistence to treatment for a subset of these drug classes (statins, bisphosphonates, antidementia drugs, antidepressants, opioids and benzodiazepines), representing drugs where the benefit of treatment is questionable in a population reaching the last years of life. Treatment persistence was analysed using the 'proportion of patients covered' approach [23], denoting the proportion of a population which at any given point in time was recorded to have filled a prescription for the given drug class

within the last 6 months. Only individuals who received the drug class at baseline (defined as having filled a prescription within 6 months prior to admission) contributed to the latter analysis.

Workshops with municipalities

To ensure a better interpretation of study findings, we conducted two workshops with representatives from the participating municipalities. At the first workshop (conducted in January 2019), preliminary results were presented. In addition to the authors, 11 representatives from the municipalities participated, comprising heads of nursing homes and people working with quality assurance in the care of older residents. Based on their input, it was decided to drop a preplanned analysis of the effects on drug use of having a dedicated general practitioner affiliated with the nursing home, as this in practice only concerned a very small subset of residents at these nursing homes, meaning that no effect could therefore realistically be expected. At the second workshop (conducted in April 2019), the final results were presented and discussed with three representatives from the municipalities to ensure that the interpretation of study findings correlated with real-life practice.

Other

All analyses were performed using Stata Release 15.2 (Stata-Corp, College Station, TX, USA). According to Danish law, studies based solely on register data do not require approval from an ethics review board [18].

Results

We identified 5,179 individuals moving into a nursing home during the study period. Of these, 63% were women and had a median age of 84 years (interquartile range [IQR] 77–89 years) (Supplementary Material A2). A full description of the study cohort, including baseline comorbidities and number of hospitalisations the last year prior to admission, can be found elsewhere [16].

The total number of drug classes filled per 6-month intervals increased from a median of 6 drugs (IQR 3–9) at 18–24 months before nursing home admission to a median of 8 drugs (IQR 6–11 drugs) just after admission (Supplementary Material A3). Hereafter, it remained relatively unchanged, with a median of 8 drugs (IQR 5–11) filled at 18–24 months after admission. The most common drug classes at baseline, that is, drug classes most frequently filled within the last 6 months prior to admission, comprised paracetamol (61%), platelet inhibitors (41%), proton pump inhibitors (34%), statins (33%) and potassium supplements (31%) (Supplementary Material A4; for a full version over time, see Supplementary Material A5).

The incidence rate of new drug treatments peaked at 71 new treatments/100 residents/month in the month prior to nursing home admission (Figure 1). The drug classes

primarily responsible for this increase were laxatives, antibiotics and analgesics (Supplementary Material A6). Within 6–9 months after admission, the incidence rate of new drug treatments levelled off to a level slightly higher than that before admission (Figure 1).

In general, we observed an increase in prevalent use of both predominantly preventive and non-preventive drug classes (except low-dose aspirin and NSAIDs) in the years leading up to and after nursing home admission (Table 1). Though the absolute increases were more marked for predominantly non-preventive drugs, particularly laxatives (53%), paracetamol (43%), antidepressants (36%) and opioids (27%), the increase was also substantial among predominantly preventive drugs, such as antihypertensives (20%), anticoagulants (13%) and antiplatelets (8%). Of note, even prevalent use of statins, oral antihyperglycemics and bisphosphonates increased over time, with 6%, 5% and 4%, respectively.

When investigating persistence to treatment with specific drug classes expected to have questionable benefit in this population, we generally found that a high proportion of individuals remained on therapy in the 3-year period following nursing home admission (Figure 2). Three different persistence patterns were noted, with users of antidepressants and antidementia drugs being most persistent (76–85% after 3 years), followed by users of statins and bisphosphonates (66–70%) and opioids and benzodiazepines (49–58%), respectively.

Discussion

In this population-based drug utilisation study, we described drug use patterns in Danish nursing home residents. We found that nursing home admission is associated with an increase in medication use and that it remains on a level slightly higher than before admission. This applies to use of both predominantly preventive and non-preventive drugs, with nursing home residents generally taking a large number of different drugs. Although some drug classes may be of questionable benefit in individuals with limited life expectancy, a relatively high persistence to such treatment is common among nursing home residents.

Strengths and limitations

The principal strength of our study is the use of high-quality nationwide register data on prescription fills [19], with little risk of selection bias. Furthermore, our close collaboration with the municipalities ensured that our interpretation of the study findings correlates with real-life practice.

Limitations to our study should also be acknowledged. Some of the drugs investigated in this study are available over-the-counter in Denmark, meaning that use of these drugs is possibly underreported. However, as the vast majority of Danish nursing home residents have their drugs dispensed by the care staff, which requires that they are prescribed by a physician, we expect this to hold limited
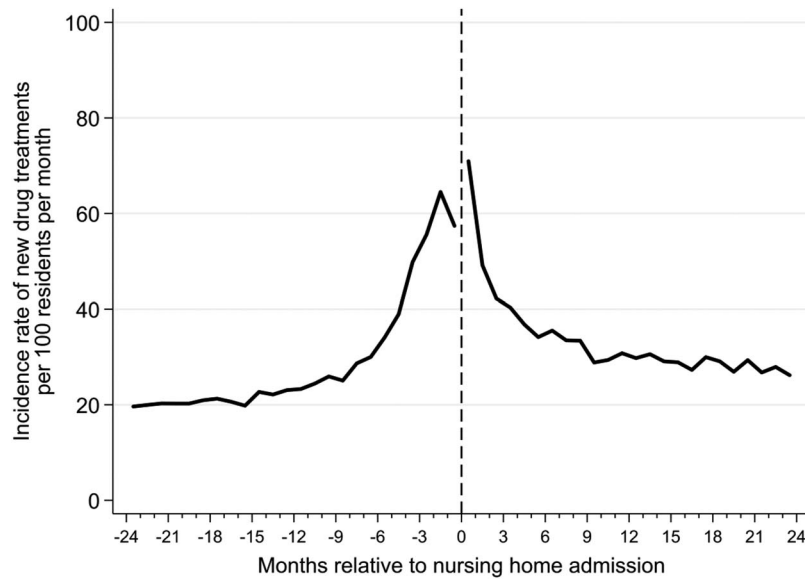
Figure 1. Incidence rate of new drug treatments per 100 residents per month relative to nursing home admission.

Table 1. Use of selected drug classes in 6-month intervals in timely relation to nursing home admission. Only those who survived throughout a specific period contributed to the estimates in the given stratum. ATC codes used to define drug classes are provided in Supplementary Material A1.

Drug class	24–18 months before	18–12 months before	12–6 months before	6 months before to baseline	Baseline to 6 months after	6–12 months after	12–18 months after	18–24 months after	24–30 months after	30–36 months after	Absolute increase
	(n = 5,179)	(n = 5,179)	(n = 5,179)	(n = 5,179)	(n = 4,203)	(n = 3,621)	(n = 2,709)	(n = 1,943)	(n = 1,320)	(n = 822)	
Predominantly preventive											
Antihypertensives	60%	61%	60%	61%	66%	62%	70%	73%	77%	80%	20%
Oral antihyperglycemics	10%	10%	10%	10%	11%	11%	12%	13%	15%	15%	5%
Statins	34%	34%	33%	33%	34%	33%	35%	36%	38%	40%	6%
Low-dose aspirin	32%	30%	30%	28%	28%	26%	28%	29%	31%	31%	−1%
Antiplatelets	14%	14%	15%	18%	20%	19%	21%	21%	22%	22%	8%
Anticoagulants	13%	14%	16%	19%	22%	21%	24%	24%	25%	26%	13%
Bisphosphonates	10%	10%	11%	11%	12%	11%	13%	13%	14%	14%	4%
Predominantly non-preventive											
Paracetamol	41%	45%	48%	61%	76%	66%	73%	76%	84%	84%	43%
NSAIDs	9%	9%	8%	9%	9%	7%	7%	7%	7%	7%	−2%
Opioids	20%	21%	23%	33%	42%	37%	41%	42%	45%	47%	27%
Laxatives	15%	16%	21%	38%	54%	50%	56%	59%	63%	68%	53%
Benzodiazepines	17%	17%	17%	19%	24%	20%	21%	23%	25%	24%	7%
Antidepressants	30%	32%	34%	41%	51%	51%	59%	61%	65%	66%	36%
Antidementia drugs	11%	13%	16%	19%	24%	24%	27%	27%	28%	28%	17%

ATC, Anatomical Therapeutic Chemical.

influence on the findings. Furthermore, our study is based on data on prescription fills and thereby an assumption that residents actually take the medication they are prescribed. However, the fact that most Danish residents have their drugs dispensed by care staff minimises the potential bias from this. Furthermore, information about the underlying indication for prescribing and continuing drug use is not available in the National Prescription Registry [19], meaning that we cannot assess whether the initiation and continuation of therapy are based on well-founded decisions. Finally, as we estimated the Charlson Comorbidity Index using patient

registry data on hospital diagnoses, that is, data only covering secondary care, this most likely underestimates the indices presented in this study.

Comparison to existing literature

Our study supports previous work describing drug use patterns in nursing home residents, all providing similar rates of total drug use and documenting a considerable drug use among this population [8,24–28]. These levels were

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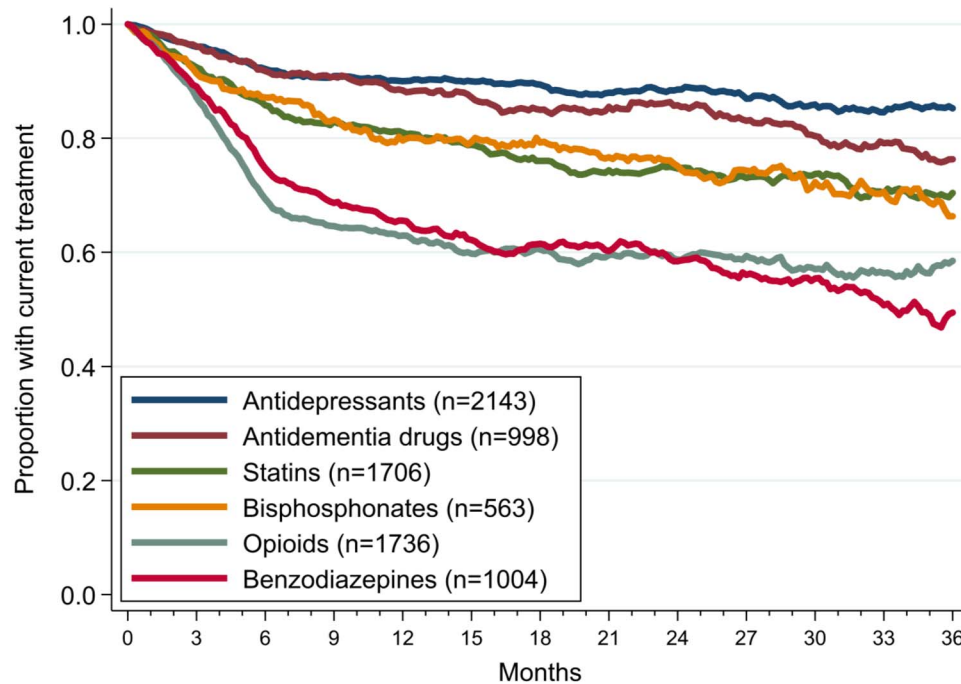

Figure 2. Persistence to treatment for selected drug classes among residents at baseline, in the 3-year period following nursing home admission.

reported largely irrespective of life expectancy and specific comorbidities such as dementia.

We observed a marked increase in new drug treatments in relation to nursing home admission. The use of specific drugs driving this increase particularly concerned laxatives, antibiotics and analgesics. The same pattern has been documented among other patient populations where disease onset has been associated with a temporary increase in the rate of drug initiation [9]. The substantial increase in new drug treatments prior to admission may be driven by more visits to the general practitioner as well as hospitalisation, where treatment is initiated in an attempt to compensate for a decline in patients' disease status. More visits at the general practitioner would likely also entail a review of patients' medication, including the prescription of medication previously obtained over-the-counter, to ensure that patients only get the medication that the physician and patient have agreed on. This likely, at least in part, explain the substantial increase in use of laxatives observed in our study, that is, while many patients are likely to have been taking laxatives as needed before, their use of this drug class is suddenly registered systematically.

The drug classes with the highest proportion of prevalent users at baseline concerned paracetamol, platelet inhibitors, proton pump inhibitors, statins and potassium supplements, which is generally in accordance with previous studies [24,25,27]. While an increase could be expected for predominantly non-preventive drug classes, we also observed an increase in the prevalent use of predominantly preventive drug classes following nursing home admission. This was seen for e.g. antihypertensives, anticoagulants and

antiplatelets. As information about the underlying indication for prescribing and continuing drug use is not available in the National Prescription Registry [19], we cannot directly assert the underlying reasons for the initiation and continuation of therapy; however, as individuals with limited life expectancy are generally not thought to benefit from treatment with preventive medication [3,4], the large proportion of nursing home residents persistently using such drugs is surprisingly high. Such treatments have been documented to be continued until the time of death among nursing home residents [8,29]. However, it should also be acknowledged that treatment with preventive medication may sometimes be appropriate among individuals reaching the last years of life, as it may prevent a serious complication, e.g. a stroke, or have a palliative indication. Thus, while it was outside the scope of our study, future studies should examine the indication for treatment. Finally, the large proportion of nursing home residents persistently using these drugs may also reflect, at least to some degree, a healthy survivor effect, that is, the healthiest individuals maintain their treatment, whereas those individuals with frailty who discontinue treatment die over the course of the 3-year follow-up applied.

When prescribing medications for individuals reaching the last years of life, such as the nursing home population, it is important to consider potential benefits and harms of medication, expected life expectancy and goals of care [6]. Adjusting and individualising treatment to ensure optimal care could include deprescribing [30], defined as the planned, supervised dose reduction or stopping of medication [31]. Recent randomised evidence supports that

discontinuation of statins in individuals with a life expectancy of <1 year is safe and improves quality of life [32], while deprescribing interventions in older patients with life-limiting illness and limited life expectancy have been shown to improve medication appropriateness [33]. Despite this, barriers towards deprescribing exist among prescribers, with common barriers including lack of evidence on benefits and harms of deprescribing as well as guidance on how to deprescribe [34–37],38]. Particularly, lack of considerations on deprescribing in single-disease clinical guidelines combined with lack of evidence on how to deprescribe have been reported to lead to poor self-efficacy and inertia among health care professionals, often resulting in prescribers refraining from initiating deprescribing [34,36,37]. Thus, in order to support prescribers and promote deprescribing among this population, more clinical guidelines, including specific sections on how to reduce and stop treatment, should be developed [39, 40].

We recently reported a study describing morbidity and mortality within the same cohort of Danish nursing home residents [16]. Although long-term care systems are structured substantially different across countries, we found that the characteristics of Danish nursing home residents are quite similar to that of other countries [16,41]. This suggests that our findings from the present study may also be useful in other countries in terms of both characterising nursing home populations and assessing long-term care systems.

In conclusion, our study demonstrates that nursing home admission is associated with an increase in use of both predominantly preventive and non-preventive drug classes and that it remains on a level slightly higher than before admission. Although some drug classes may be of questionable benefit in individuals with limited life expectancy, a relatively high persistence to such treatment is common among nursing home residents. Medication use should be reviewed and adjusted continuously in order to reduce the treatment burden of drugs with limited clinical benefit near the end of life. To promote such adjustment, more clinical guidelines including considerations on deprescribing should be developed.

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