Medication of older people admitted to acute care - Associations with functional capacity and outcomes

Authors:
Thorolfsdottir Rosa Björk (1)
Samuelsson Olafur (1,2)
Noro Anja (3)
Finne-Soveri Harriet (3)
Jonsson Palmi V (1,2)

(1) University of Iceland, Faculty of medicine
(2) Landspitali University Hospital Iceland, Department of Geriatrics,
(3) National Institute of Health and Welfare, Helsinki, Finland

Correspondence:
Olafur Samuelsson MD.
Landspitali University Hospital
101 Reykjavik, Iceland
Tel: 00 354 5431000
Email: olafs@landspitali.is

ABSTRACT

Introduction: The Inter RAI Minimal Data Set for Acute Care (MDS-AC) is a geriatric assessment tool designed for use in acute medicine care. We used data from a study on the MDS-AC to evaluate the medication use of 75+ year old patients (n=730) admitted to selected acute care hospitals in five Nordic countries. Associations of medication use with: Preadmission Activities of Daily Living (ADL), Instrumental Activities of Daily Living (IADL), Cognitive Performance Scale (CPS) , walking, memory, continence, falls, chronic pain, admission delirium, length of stay in hospital (LOS) and 12 months survival after discharge, were analyzed. Special focus was on polyphamacy, inappropriate medications, psychotropic medication use and cardiovascular medications.

Results: Average number of drugs was 6.2(SD+/-3.7). Polypharmacy (five or more medications) was found among 66% of patients and 16% used inappropriate medications. Women used on average more medications than men, 6.6 vs 5.7 respectively (p < .05). Polypharmacy was associated with worse IADL function and pain (p<.001) and better cognitive function and less falls (p < .05). Inappropriate medications were associated to increased length of stay (p<.05). Psychotropic medications had the most pronounced association with worse function and outcomes in a variety of variables. Cardiovascular drugs were associated with better functional outcome.

Conclusion: Polypharmacy, use of inappropriate medications and psychotropic medication use were prevalent in this study. Associations were found between these factors and negative functional outcomes. Individual tailoring of pharmacotherapy of acutely ill older patients with concomitant chronic illnesses combined with functional impairment is important.

Key words: Medications, elderly patients, acute care, polypharmacy, inappropriate medications, MDS-AC, Inter RAI

Introduction

Polypharmacy, disease burden and age related physiological changes contribute to making older individuals susceptible to Adverse Drug Reactions (ADRs).(1) Frail older people are known to be at greater risk of ADRs compared with their healthier peers. (2,3) With increasing availability of medications for various ailments, so has polypharmacy (here defined as five or more medications) increased among older people during the last decades. (5,6) Polypharmacy contributes to poor compliance and increased risk for drug-drug and drug-disease interactions, especially among the most frail. (7,8,9,10)

Because older people are especially vulnerable to negative effects of certain types of drugs several medications have been defined as potentially inappropriate for older people.(11,12)

Examples include benzodiazepines with long half life and drugs with high anticholinergic effects causing, among other concerns, increased risk for falls, delirium and orthostatic hypotension(13,14,15). The frequency of inappropriate prescribing among hospitalized older patients has in some studies been shown to be between 32-50% (16,17).

Psychotropic medications are the most prevalent among drugs considered inappropriate for older people, constituting about 50% of such defined drugs. (18) Cardiovascular drug use is very prevalent among older persons and a common cause of ADRs . While the benefit of these medications is often well documented on correct indications they should be used under good supervision and frequently reviewed among older persons. (19,20,21,22)

When treating older patients it is appropriate to individualize the approach. This requires a comprehensive evaluation of the patient and his/her environment and collecting information on cognitive and physical function. The benefits of a comprehensive geriatric evaluation has been studied both among hospitalized and community living older people. The usefulness of such an evaluation in relation to medications lies in a clearer view of an often complicated patient and can be a useful tool for follow up, measuring both positive and negative effects associated with change in treatment. Several different tools for geriatric evaluation have been developed. In this study we used the Inter RAI Minimal Data Set for Acute Care (MDS-AC). The MDS-AC instrument is used to register key information regarding social and functional aspects and comorbidity and is designed for use in the acute medicine care setting.(23,24,25)

The aim of this study was to analyze drug treatment of older acute care patients and its association with functional capacity and outcomes such as length of stay and one year survival. Special emphasis was on polypharmacy, inappropriate medications, psychotropics and cardiovascular drug use.

Methods

Data collection

A member of the Inter RAI (Resident Assessment Instrument) family, the Minimal Data Set for Acute Care (MDS-AC) is a standardized Inter-RAI instrument for comprehensive geriatic evaluation. It is specially designed for use in acute medicine care. The MDS-AC covers 14 key areas with 56 standardized variables conserning demographics, activities of daily living (ADL), instrumental activities of daily living (IADL), cognitive perfomance scale (CPS), pain, history of falls, nutrition, continence and more.(23) Information on medication use was collected at admission. At admission premorbid information on functional status one month prior to current illness was registered. For this study we used admission data on medication use and premorbid data for function to minimize the confounding effect of current acute illness on functional parameters.

Participants

The main original objective of the MDS-AC Nordic study was to test the MDS-AC instrument in the acute medical care setting.(24,25) Analyses of the drug data and possible effects of medication use on function adds information on the reliability and useability of MDS-AC.

The MDS-AC study was performed in one acute care hospital in each of the five Nordic countries, Denmark, Norway, Sweden, Finland and Iceland, between January 2001 and April 2002. Each study hospital had an uptake area of about 90,000 people and admitted patients for all internal medicine specialties. In each country, participants had to be 75 years of age or older and were randomly selected from the previous day admission lists. Excluded were patients who were admitted for less than 24 hours, those who needed intensive care and patients transferred from other hospitals.

Each study participant was evaluated in the first 24 hours after admission, admission drugs were registered and information on function one month before current admission and admission status was collected. Information on mortality and place of residence was collected 12 months later. Length of stay in hospital was registered. The evaluation was performed by nurses or doctors trained in the use of the MDS-AC instrument. In all, 770 patients were included in the study and sufficient information on medication use was registered for 730 participants (Table 1 - next page).

Medication use was analysed in relation to sex, age and countries but main emphasis was on looking at medications for the group as a whole. Focus was on polypharmacy, inappropriate medications, psychotropic and cardiovascular medications. Polypharmacy was defined as use of 5 or more drugs (excluding vitamins and calcium). Psychotropic medications were considered the following ATC (Anatomical Therapeutic chemical Classification) categories; antidepressants (N06A) , hypnotics and sedatives (N05C), anxiolytics (N05B) and antipsychotics (N05A). In our analyses we sometimes combined hypnotics, sedatives and anxiolytics as it was often difficult to know for which indication they were used. Benzodiazepines were looked at separately when estimating the association of medication use and outcome variables from the MDS-AC instrument.

Cardiovascular drugs were considered ATC group C. For evaluation of an association with functional and outcome variables statins (C10AA), beta blockers (C07), calcium channel blockers(C08), diuretics (C03), angiotensin converting enzyme

	Total	Denmark	Finland	Iceland	Norway	Sweden
N	730	159	108	151	159	153
Average age (SD)	83.7 (5.4)	84.8 (5.9)	83.9 (5,5)	83.3 (5.2)	84.0 (5.5)	82.6 (4.7)
Females %	65.1	71.1	73.1	65.6	53.5	64.7
Admitted from home %	93.3	93.7	97.2	92.7	85.5	98.7
Mortality after 12 months %	26.8	31.4	25.0	20.5	35.2	20.9
Average LOS: days	12.5	15.9	18.2	14.0	10.6	5.7
Average number of drugs (SD)	6.2 (3.7)	7.1 (3.7)	6.3 (3.1)	6.8 (3.7)	3.8 (2.5)*	7.4 (4.0)
Average number of drugs, males	5.7 (3.5)	6.3 (3.5)	7.8 (3.4)†	6.2 (3.5)	3.4 (2.1)	6.6 (3.6)
Average number of drugs, females	6.6 (3.8)‡	7.4 (3.8)	5.7 (2.8)	7.2 (3.8)	4.1 (2.8)	7.8 (4.1)
Average number of drugs according to age group 75-79 years	6.2 (3.7)	6.9 (4.2)	6.8 (3.1)	6.4 (4.0)	4.1 (2.8)	6.8 (3.6)
80-84 years	6.6 (3.8)	7.7 (4.1)	7.1 (3.3)	6.6 (3.7)	4.1 (2.1)	7.7 (4.0)
85-89 years	6.3 (3.7)	7.2 (3.5)	5.6 (2.7)	7.7 (3.1)	3.6 (2.8)	7.5 (4.4)
≥90 years	5.6 (3.6)	6.2 (3.0)	5.1 (2.9)	6.5 (4.3)	3.0 (2.2)	8.1 (4.0)
Classification of use of medications 0-4 drugs N (%)	250 (34)	42 (26)	31 (29)	40 (26)	100 (63)	37 (24)
5-9 drugs N (%)	342 (47)	77 (48)	63 (58)	77 (51)	55 (35)	70 (46)
≥10 drugs N (%)	138 (19)	40 (25)	14 (13)	34 (23)	4 (3)	46 (30)

Table 1. Characteristics and outcomes of elderly patients admitted to acute care

	Gender		Age			
	Male	Female	75-79 y	80-84 y	85-89	≥ 90 y
N	255	475	194	221	200	115
≥1 inappr. drug: N (%)	41(16)	74(16)	30 (16)	35 (16)	35 (18)	15(13)
≥1 Psychotr.: n (%)	108(42)	240(51)*	87(45)	105(48)	104(52)	52(45)
Hypnotics and anxiolytics: n (%)	85(33)	196(41)*	69 (36)	80 (36)	85 (43)	47 (41)
Antidepressants: n (%)	42(17)	115(24)*	38 (20)	54 (24)	53 (27)	12 (10)**
Neuroleptics n (%)	9 (4)	33 (7)	12 (6)	13 (6)	14 (7)	3 (3)
≥1 cardiovasc. drug: n(%)	169(66)	384(73)	129(67)	164(74)	144(72)	80(70)

*p <.05 more use among women, **p <.001 less use among >90 olds
Table 2: Type of medication used among elderly patients at admission according sex and and age

Medication use was analysed in relation to sex, age and countries but main emphasis was on looking at medications for the group as a whole. Focus was on polypharmacy, inappropriate medications, psychotropic and cardiovascular medications. Polypharmacy was defined as use of 5 or more drugs (excluding vitamins and calcium). Psychotropic medications were considered the following ATC (Anatomical Therapeutic chemical Classification) categories; antidepressants (N06A) , hypnotics and sedatives (N05C), anxiolytics (N05B) and antipsychotics (N05A). In our analyses we sometimes combined hypnotics, sedatives and anxiolytics as it was often difficult to know for which indication they were used. Benzodiazepines were looked at separately when estimating the association of medication use and outcome variables from the MDS-AC instrument.

Cardiovascular drugs were considered ATC group C. For evaluation of an association with functional and outcome variables statins (C10AA), beta blockers (C07), calcium channel blockers(C08), diuretics (C03), angiotensin converting enzyme inhibitors (ACEi) (C09A and B) and angiotensin receptor blockers (ARBs) (C09C and D) were looked at separately.

Potentially inappropriate medications were defined as the quality indicator on drug treatment used by the Swedish health authorities which includes (independent of dosage or diagnoses): a) drugs with high anticholinergic activity, b) benzodiazepines with long elimination half life, c) cimetidine, d) theophyllamine, e) quinine26. These drugs are grouped together so that having one or more of these medications counts as using a potentially inappropriate medication.

Drug treatment was assessed with regards to Activities of Daily Living Hierarchy (ADL, 0-6), Instrumental Activities of Daily Living (IADL, 0-21), Cognitive performance Scale (CPS,0-6), walking (0-4), memory (0 =intact, 1=impaired), continence (0-4), falls, chronic pain (0-3), admission delirium, length of stay in hospital (LOS) and survival 12 months after admission. For all the variables a higher number on a scale stands for worse function or a higher frequency of an event.

Statistical analysis
Data were analyzed using SPSS software version 11. Significance of association between categorical variables was assessed using Chi-square test. Assessment of mean difference between the two groups was made using t-test, and between more than two groups by using Anova. Following the Anova, Tukey was used as the post-hoc test for individual pairs of means. Multiple linear regression was used to assess the associations between drug treatment functional variables and chosen outcomes . The multiple linear regression analyses included the following variables: number of drugs, use of inappropriate medication, psychotropic drugs and cardiovascular drugs. The association between medical treatment and functional capacity or length of stay was also assessed using Spearman´s rho correlation or Mann-Whitney test, depending on whether the independent variable was continuous or categorical. One year survival was compared by making each independent variable categorical and using Chi-square test. A two-tailed p ≤ .05 was selected as the level of statistical significance.

Results
Table 1 shows characteristics of the study participants, average number of medications (excluding vitamins and calcium) and polypharmacy for the group as a whole and divided by countries, gender, and age. The average number of drugs was 6.2(SD+/- 3.7) ranging from zero to 19 drugs per person. The lowest number of medications was seen in Norway and it was significantly lower than in other countries (p<.001). Women tended to use more medications compared with men but this was a non-significant difference when looking at each country separately. Men used significantly more medications in Finland (p≤ .001). An association between age and number of medications was not seen but a trend was seen for an increase in number from age 75 to 85 and then a decline. The oldest group took on average the fewest medications. Polypharmacy (5 or more medications) was seen in 65.8% of participants.

	Association with number of drugs (Spearman)	Number of drugs (Multiple linear regression)	Number of inappropriate drugs = 0 (Mann_Whitney)	Any inappropriate drug ≥1 Mann_Whitney	Number of inappropriate drugs (Multiple linear regression)
IADL	0,16*	β = 0,17**†	8,73 (6,25)	10,52 (6,04)*	n.s.
Chronic pain	0,15*	β = 0,18**†	1,29 (1,36)	1,54 (1,37)	n.s
Falls	-0,06	β = -0,12*‡	1,04 (1,88)	1,22 (1,92)	n.s
CPS	-0,04	β = -0,12*‡	0,74 (1,14)	0,85 (1,13)	n.s.
LOS	0,03	n.s.	11,49 (15,69)	18,13 (38,87)*	β = 0,10*†
ADL	0,06	n.s.	0,44 (0,89)	0,60 (1,00)	n.s.
Walking	0,06	n.s.	0,25 (0,74)	0,43 (0,98)	n.s.
Delirium	-0,02	n.s.	0,27 (0,94)	0,26 (0,93)	n.s.
Continence	0,07	n.s.	0,96 (1,33)	1,18 (1,35)	n.s.
Memory	-0,04	n.s.	0,30 (0,46)	0,33 (0,47)	n.s

*• Inappropriate drugs defined as using one or more : drugs with high anticholinergic activity,benzodiazepins with long half lifes, cimetidine, theophyllamin or quinine Multiple linear regression adjusted for the following covariates: Gender,age, cardiovascular drugs,psychotrophics and number of drugs and inappropriate drugs. *p<.05, **p<.001*
†Significant association to worse outcome.
‡Significant association to better outcome.
n.s= not significant, IADL=insturmental activities of daily life, ADL= Activities of daily life,CPS=Cognitive perfomance scale, LOS= length of stay.
Table 3: Statistical testing of number of drugs and inappropriateo drugs among eldery people admitted to hospital at admission

	Average (SD) P(Mann-Whitney)		Multiple linear regression*	Average (SD) P(Mann-Whitney)		Multiple linear regression**
	Psychotropics = 0	Psychotropics ≥1		Cardiovascular drugs = 0	Cardiovascular dugs ≥1	
ADL	0,31 (0,74)	0,64 (1,03)***†	β = 0,17**†	0,46 (0,86)	0,47 (0,92)	n.s.
CPS	0,62 (1,10)	0,91 (1,17)***†	β = 0,17**†	0,91 (1,24)	0,70 (1,10)*‡	n.s.
Memory	0,24 (0,43)	0,37 (0,48)***†	β = 0,17**†	0,33 (0,47)	0,29 (0,45)	n.s.
IADL	7,91 (6,09)	10,22 (6,20)***†	β = 0,11†	9,00 (6,23)	9,02 (6,26)	β = -0,09*‡
Walking	0,19 (0,63)	0,38 (0,91)***†	β = 0,10*†	0,25 (0,72)	0,29 (0,81)	n.s.
LOS	10,26 (14,69)	15,01 (26,38)**†	β = 0,08*†	12,24 (15,43)	12,67 (23,23)	n.s.
Falls	0,94 (1,72)	1,20 (2,05)	β = 0,10††	1,04 (1,73)	1,08 (1,95)	n.s.
Delirium	0,22 (0,84)	0,33 (1,04)	n.s.	0,37 (1,11)	0,23 (0,86)	n.s.
Continence	0,93 (1,33)	1,07 (1,35)	n.s.	1,10 (1,38)	0,95 (1,32)	β = -0,10*‡
Chronic pain	1,27 (1,36)	1,41 (1,36)	n.s.	1,29 (1,36)	1,35 (1,36)	n.s.

• The multiple linear regression adjusted for the following covariates: Number of drugs, inappropriate drugs, cardiovascular drugs, gender and age

• •The multiple linear regression adjusted for the covariates: Number of drugs, inappropriate drugs, psychotrophics, gender and age

*p<.05 ,**p<.001

†Association to worse function ‡ Association to better function

n.s.=not significant,

IADL=Insturmental activities of daily life, ADL= Activities of daily life,CPS=Cognitive perfomance scale, LOS= length of stay.

Table 4: Statistical analyses of psychotrophic and cardiovascular drugs among elderly patients admitted to hospital at admission

Five to 9 medications were used by 47% and 19% used 10 or more medications. In Norway less polypharmacy was seen than in other countries.

Of the whole group, 15.8% used potentially inappropriate medications (Table 2). The majority of those used only one drug from the defined group and no patient used more than two potentially inappropriate medications. We therefore present these users as one group. One or more psychotrophic medications was used by 47.7% of the group. The most common psychotropics were hypnotic and anxiolytic drugs, 38.5%. Antidepressants were used by 21.5% and antipsychotics by 5.8%. Psychotropic medication use was significantly more common among females than males when looking at the group as a whole. Age difference was not significant, except for use of antidepressants with the oldest group using less than others but the numbers were small. The most common drug group in the study was cardiovascular drugs, 70.8% of the participants took at least one drug from this category.

Table 3 shows associations of number of drugs and inappropriate medications with tested variables. Number of medications had a significant association with worse IADL function and prevalence of chronic pain but to fewer falls and better cognitive function. The association of number of medications was non-significant with other studied variables and there was no relationship with survival at one year. The use of inappropriate medications had a significant association with length of stay which was on average seven days longer. There was no association of inappropriate medication with 12 months survival.

Use of psychotropic medications had a negative association with worse ADL, IADL, CPS, walking functions, and longer hospital stay. This kind of association was also seen after adjusting for confounding variables and in addition association with history of falls (Table 4). The use of cardiovascular drugs was shown to have an association with better functioning in IADL, continence, and better cognitive function. There was no association with survival at one year (Table 4).

We did an analysis of subgroups of psychotropics and cardiovascular drugs (not ín Table). Antipsychotics showed a significant association with worse function for ADL,CPS, memory, IADL and walking (p≤0.001). Antidepressants showed association with worse ADL, IADL and falls (p≤0.001) and with worse CPS, memory and increased length of stay (p≤ 0.05). Hypnotics and sedatives showed association with worse ADL, increased length of stay and delirium (p≤ 0.05).

The effect of medications on functional parameters was not strong in this study overall, only explaining about 2-14% of the variance in function and other outcome measures.

Discussion

Results of this analyses showed significant polypharmacy with persons 75+ years of age admitted to acute medical care and a high prevalence of both psychotropic and potentially inappropriate medication use. The association of different types of medications with functional variables, and length of stay, varied.

Polypharmacy was prevalent with 66% of participants using 5 or more medications. The average number of drugs was 6.2. This is similar to other studies for this group of old hospitalized patients(27,28) . Even though the study material is small there is a striking difference in the degree of polypharmacy between Norwegian (38%) and the other study sites (over 70%). This difference was also seen with specific groups like cardiovascular and psychotropic medications. Other studies have shown similar results for drug use in Norway and could point to differences in treatment policy in Norway compared with other countries. Polypharmacy was shown to have an association with worse IADL function and more chronic pain but better cognitive function and less falls. These findings might indicate that deterioration in IADLs occur due to severity of an acute or underlying chronic illness and the use of multiple medications might be an attempt to compensate for a serious health situation. The association between effect of polypharmacy and functional impairment is of course complicated as the conflicting result of association with fewer falls and better cognitive function shows.

Women used on average more medications than men. Particularly psychotropic medications which is in line with results from other studies.(29,30) The reason for gender difference has been speculated on. One of the reasons might be that women are more willing to seek medical care for their problems and accept medical treatment from physicians. Psychiatric diagnoses are also more common among women and could partly explain gender difference in psychotropic drug use(31,32,33).

Sixteen percent of participants took medications that fit a definition of potentially inappropriate drugs for old people. Comparing studies on frequency of inappropriate drug use can be difficult because of variations in definition between different studies(11,12,34,35,36). Inappropriate medication use in this study was associated with significantly longer hospital stay and worse IADL function as registered by the MDS-AC instrument.

The use of psychotropic medications in this study was quite high, 48%. Psychotropic drug use had, in our study, the most pronounced associatons with measured variables. There was an association with worse ADL and IADL function, CPS, walking function, falls and an association with longer hospital stay. This is consistent with other studies and psychotropic medications are justifiably common on lists of potentially inappropriate medications for older people.(15,37,38) Due to high risk of adverse effects use of any psychotropic medications should be carefully considered and avoided if possible in context of an acute illness.

Cardiovascular medication use in our study was associated with better function, a finding that is not consistent with some other studies.(19,21,39) The reason for this finding is not obvious but could be related to prevention of stroke or other benefits of these medications.

It is a strength of this study to use a standardized assessment instrument to register functional variables, the Inter RAI MDS-AC. The instrument gives an opportunity to associate drug treatment and outcome variables measured in a

standardized manner and opens the possibility of international comparative studies. Secondly the multicenter design is a strength with participation of all Nordic countries in the study, minimizing risk of confounding because of local factors. There are weaknesses. The small sample size per country did not allow for detailed analyses at country level. Information was lacking on diagnosis for the current acute disease as data was collected so early on admission that diagnoses had not been made. Also, it should be kept in mind that the data was ten years old and the profile of medication use and difference between countries might have evolved in time. However results on possible association of certain drug treatments with functional variables registered with the MDS-AC assessment are of course not affected by time. In this study the average score on the functional scales is low and on a narrow interval. As an example the average score on the ADL scale was only 0,47 on a 0 to 5 scale (0=no impairment and 5=great impairment). This might actually have caused an underestimation of the effect of drug treatment.

In conclusion, associations between polypharmacy, use of inappropriate medications and psychotropic medications and negative outcomes were seen and they were mostly consistent with current knowledge. We conclude that individual tailoring of the pharmacotherapy of acutely ill old patients with concomitant chronic illnesses combined with functional impairments, is necessary. On acute somatic wards attention has to be paid to individualizing treatment to avoid both overtreatment and undertreatment and minimize risk for ADRs.

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