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Can Practical Nurses Identify Older Home Care Clients at Risk of Drug-Related Problems–Geriatricians' Appraisal of Their Risk Screenings: A Pilot Study

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Abstract

Background: Home care (HC) clients are increasingly older, have many chronic diseases, and use multiple medicines and thus are at high risk for drug-related problems (DRPs). **Objective:** Establish the sensitivity of practical nurse (PN) administered DRP risk assessment tool (DRP-RAT) compared with geriatrician's assessment of the medical record. Identify the clinically most significant DRPs needing action. **Methods:** Twenty-six PNs working in HC of Härkätie Health Center in Lieto, Finland, 46 HC clients (≥65 years), and a geriatrician participated in this pilot study. The geriatrician reviewed HC clients' medications using 3 different methods. The reviews were based on the following: (1) the PN's risk screening (ie, PN-completed DRP-RAT) and medication list, (2) health center's medical records, and (3) methods 1 and 2 together. The main outcome was the number of "at-risk patients" (ie, the patient is at risk of clinically significant DRPs) by using each review method. Secondary outcomes were clinically most significant DRP-risk predicting factors identified by the geriatrician. **Results:** The geriatrician reviewed 45 clients' medications using all 3 methods. Based on PN-completed DRP-RAT and medication list, 93% (42/45) of the clients were classified as "at-risk patients." Two other review methods resulted in 45/45 (100%) "at-risk patients." Symptoms suggestive of adverse drug reactions were the most significant risk predicting factors. Small sample size limits the generalizability of the results. **Conclusions:** The PN-completed DRP-RAT was able to provide clinically important timely patient information for clinical decision making. DRP-RAT could make it possible to more effectively involve PNs in medication risk management among older HC clients.

Keywords

geriatrics, drug-related problem, home care services, risk management, medication safety

Introduction

Due to demographic and societal developments, the demand for long-term home health care services for older adults is growing.[1] Those needing home care (HC) are increasingly older and have more complex health problems.[1,2] In Finland, practical nurses (PNs) have 3-year vocational education that concentrates mainly on technical nursing rather than medical care, including pharmacotherapy.[3] As PNs are those who make regular home visits to the older HC clients, they are in a key position to monitor and notice changes in their client's health status including positive and negative outcomes of possible drug treatments, and to further report them to other health care providers (in Finland, we do not have clinical pharmacists to visit the HC clients in primary care). However, PNs need a practical tool for identifying problems related to drug treatments. This tool should be feasible in routine use and focus on the most critical drug-related problems (DRPs). According to

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our recent systematic reviews, such tools designed to be used by PNs are rare.[4-6] The existing nurse-administered tools primarily focus on issues relating to adherence and medication management, but not on risks related to the pharmacological effects of the medications or factors related to the medication use process.[7-9]

To fill this gap, we developed and content-validated an easy-to-use drug-related problem risk assessment tool (DRP-RAT) for PNs caring for home-dwelling older adults ≥65 years.[6] The tool focuses on the identification and resolution of the highest priority DRP risks and consists of 18 questions with mainly "yes" or "no" answers. In addition to identifying DRP risks, it assists in finding solutions to these risks and actual problems, which is a unique feature compared with earlier similarly purposed tools. Content of the tool was validated using a 3-round Delphi survey,[6,10] and the feasibility of the content-validated tool was tested by PNs working in HC of 2 municipalities in southern Finland.[11] In addition to having valid content and being feasible to use, the medication risk screenings conducted by PNs need to be reliable before they can support physicians in clinical decision making. The aim of this study was to establish the sensitivity of a PN-administered DRP-RAT compared with geriatrician's assessment of the medical record and to identify the clinically most significant DRPs in the study sample (ie, DRPs needing intervening actions).

Methods

This study was conducted in the HC of Härkätie Health Center in Lieto (HC clients, n = 170; entire HC staff, including nurses and PNs, n = 31) in the 4 months from September to December 2013. Lieto is a municipality with approximately 17 000 inhabitants located in southwestern Finland. Härkätie Health Center is a primary care unit and part of the public health care system in Finland, which is the dominating health care system covering the entire population.[12] The outline of the study is presented in Figure 1.

Data Collection

Data collection comprised 2 phases: (1) DRP risk screenings by PNs and (2) DRP risk assessments and medication reviews by a geriatrician (PV) using 3 review methods differing in the amount of clinical patient information available (Figure 1).

After a 1-day interactive training on the content and use of the DRP-RAT (ie, the PNs were trained about potential risks in geriatric pharmacotherapy),[11] the PNs conducted risk screening for 1 to 3 self-selected clients' medications using the DRP-RAT. Based on the learned during the training, they were instructed to select for screening such clients they supposed to be at risk of DRPs. They also were asked to print the same client's medication list from the health center's medical record and to complete the Alcohol Use Disorders Identification Test (AUDIT-C) for alcohol consumption.[13,14] They returned the completed documents to the HC office, which subsequently forwarded the documents to the geriatrician, who completed her section of the forwarded data collection forms (see the supplementary material, available in the online version of this article).

The geriatrician recruited for the study normally worked outside the Härkätie Health Center and, thus, did not know the HC clients whose medications she reviewed in advance. Based on each of the 3 reviews and her clinical geriatric expertise, she was asked to classify whether the client was "an at-risk patient" (ie, being at risk for clinically significant DRPs needing more comprehensive medication review) or "not an at-risk patient." The geriatrician conducted all 3 reviews patient by patient (clarified in Figure 1), and when conducting each review she was asked to be "blind" to the results of the other reviews for the same client. If the geriatrician classified the client as "an at-risk patient" based on PN's risk screening and medication list (Method 1, ie, medication risk assessment by the geriatrician), she was asked to tick those PN-identified risk predicting notes in the tool that she regarded as clinically significant risk factors. If the client was classified as "an at-risk patient" based on the health center's medical record (Method 2), the geriatrician was asked to write an open case report about the identified DRPs and to document the DRPs according to the Pharmaceutical Care Network Europe (PCNE) classification V6.2[15] on a structured data collection form (the geriatrician received training to use the PCNE classification by one of the researchers [MD]). For ethical reasons, the geriatrician forwarded her observations about potential DRPs to the health center's chief physician and subsequently to each client's personal physicians.

Statistical Analysis

The data in this study were drawn from completed study forms and the geriatrician's case reports, including her PCNE classifications.[15] Aspects studied and methods used for data analysis are presented in Table 1. Quantitative data were analyzed using SAS System for Windows, version 9.4 (SAS Institute Inc, Cary, NC). Continuous variables were described using means (ranges) and categorical variables using frequencies and percentages. The confidence interval for percentages was based on the exact binomial distribution. Qualitative data, that is, analysis of the geriatrician's justifications, was analyzed using standard methods of content analysis.[16]

Compliance With Ethical Standards

Ethical approval for this study was received from the Ethics Committee of Southwest Finland's Hospital District (ETMK: 125/180/2012). The study permission was received from the health service manager of Härkätie HC unit (113/27.11.2012).

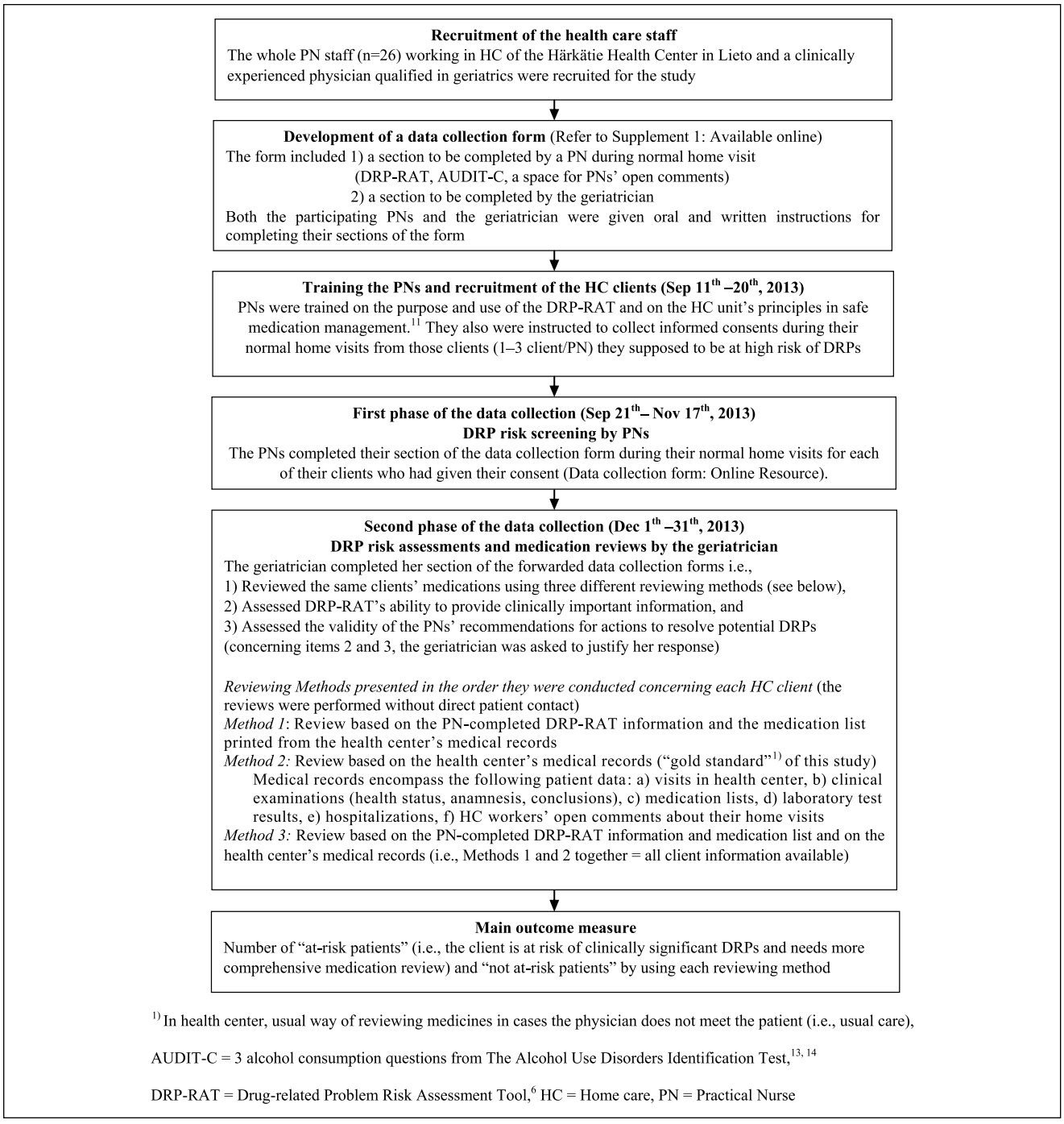

Figure 1. Outline of the study.

Informed consent was obtained from all individual participants included in the study.

Results

The PNs (n = 26) returned a total of 46 completed DRP-RATs with AUDIT-C and medication list (mean 1.8 risk screenings per PN). The mean age of the HC clients whose medications the PNs screened was 83 (range = 64-96) years. Most of them (65%) were women and lived alone (91%). They had a mean of 9.5 (range = 4-15) prescription drugs in regular daily use, mean 2.9 (range = 0-12) as needed prescription drugs, and mean 0.2 (range = 0-1) prescription drugs taken as a course. Twelve clients (26%) had used over-the-counter-medications during 2 weeks prior to the risk screening. Two of the HC clients (5%) administered

Table 1. Aspects Studied and Methods Used for Data Analysis to Appraise the Reliability of the Medication Risk Screenings Conducted by PNs by Using DRP-RAT.

Aspects Studied	Data Analysis
The DRP-RAT's ability to assist in identifying older HC clients at risk of clinically significant DRPs	Frequencies and percentages (95% CI) of the identified "at-risk patients" resulting from each medication review method
Geriatrician's assessment of the DRP-RAT's ability to provide clinically important timely patient information for clinical decision making	Frequencies and percentages of the geriatrician's "yes," "no," and "some additional information" responses Qualitative analysis of the geriatrician's justifications
Geriatrician's evaluation about the validity of the PNs' recommendations for action to resolve potential DRPs listed in the DRP-RAT	Frequencies and percentages of "valid" and "invalid" recommendations Qualitative analysis of the geriatrician's justifications
Relevance of the questions in the DRP-RAT, that is, prevalence of the DRP risk predicting notes reported by the PNs in the completed DRP-RATs in the study sample	Frequencies and percentages of the risk predicting notes on each question of the tool
Clinical significance of potential DRPs reported by PNs confirmed by an experienced geriatrician Significance was determined as follows: the more often the geriatrician evaluated the PNs' DRP risk predicting note as a risk factor (ie, those risk predicting notes in PN-completed DRP-RATs that the geriatrician had ticked in order to be risk factors [Medication Review Method 1]) the more important the note is	Frequencies of the PN's positive risk predicting notes that the geriatrician evaluated as clinically significant risk factors needing action
DRPs in the study sample documented by the geriatrician and the associated drugs or drug groups resulting of the review basing on the health center's medical records (Medication Review Method 2) Geriatrician's case reports of each client and the PCNE classification V6.2 done by the geriatrician are analyzed (Two researchers independently double-checked the geriatrician's PCNE classifications by comparing the case reports and the PCNE classifications. Obscurities were resolved by discussion.)	The documented DRPs and the associated drugs or drug groups
Time the geriatrician spent reviewing one client's medication using the DRP-RAT	Time scale, the mean time the geriatrician spent reviewing one client's medication with the tool

Abbreviations: PN, practical nurse; DRP-RAT, drug-related problem risk assessment tool[6]; HC, home care; CI, confidence interval; PCNE, Pharmaceutical Care Network Europe.[15]

medicines themselves, 4 clients' (9%) medicines were administered by a family member, and the rest (n = 38; 86%) by HC professional (2 missing values).

DRP-RAT's Ability to Assist in Identifying Older HC Clients at Risk of Clinically Significant DRPs

The geriatrician reviewed altogether 45 clients' medications using all 3 methods (1 client was excluded as he regularly visited a specialist and tertiary care university hospital). Based on Method 1 (PN-completed DRP-RAT and medication list), 93% (n = 42/45) of the clients were classified as "at-risk patients." Method 2 ("gold standard" in this study, ie, health center's medical records) and Method 3 (PN-completed DRP-RAT, medication list, and health center's medical records) both showed that all the clients (100%) were "at-risk patients." Thus, Method 1 (PN-completed DRP-RAT and medication list) resulted in a false negative rating in 7% (95% confidence interval = 1.4-18.3) of the cases (n = 3/45). The additional data from the health center's medical records (blood pressure, weight loss, laboratory values) resulted in positive ratings concerning these 3 cases. The time the geriatrician spent reviewing 1 client's medicines using the DRP-RAT varied from 2 to 6 minutes (mean = 3.9).

DRP-RAT's Ability to Provide Clinically Important Timely Patient Information for Clinical Decision Making

The geriatrician reported that 87% (n = 39/45) of the PNs' medication risk screenings provided her with clinically important timely patient information for clinical decision making. Four (9%) of the risk screenings provided some and 2 (4%) no additional clinically important information. In 71% (n = 32/45) of the risk screenings the tool provided the geriatrician with valuable information about symptoms suggestive of adverse drug reactions (ADRs). Other important information for clinical decision making were related

to the caregiver's concern about the client's medication use, information about the client's alcohol consumption, and poor adherence; each in 3 (7%) of the risk screenings.

The geriatrician perceived as a deficiency that the DRP-RAT lacked information about the client's health status (eg, current blood pressure, heart rate, weight, weight changes, bowel motion). However, her experience-based opinion was that the PN-completed tool, even in its current form, assisted her to focus on the most important DRPs and, thus, helped her prepare better for the more comprehensive medication reviews.

Validity of PNs' Recommendations for Intervening Actions to Resolve Potential DRPs

The PNs had completed the section "Recommendations for action to resolve potential DRPs" in 87% (n = 39/45) of the DRP-RATs. A comprehensive medication review was the most commonly recommended action, followed by automated dose dispensing service. The geriatrician appraised the PNs recommendations valid in 82% (n = 32/39) of the cases.

Prevalence and Clinical Significance of the Risk Predicting Factors Included in DRP-RAT

According to PNs' risk screenings, most of the risk predicting factors listed in the tool were prevalent among the study sample, the prevalence varying from 2% to 91% (Table 2). Over half (62%) of the risk predicting factors exceeded the prevalence of 25%.

Based on the PN-completed DRP-RAT information the geriatrician classified symptoms suggestive of ADRs as the most important indicator for clinically significant DRPs and, thus, a reason to conduct a more comprehensive medication review (Table 2). Visiting several practitioners, having more than one fall in the past 12 months prior to the DRP risk screening, using high-risk medicines and nonadherence were also among the most important risk predicting factors. In this study, the number of medicines and the number of daily medicine doses were not classified among the most important risk predicting factors.

DRPs in the Study Sample Documented by the Geriatrician and Drugs or Drug Groups Involved in Them

Based on the health center's medical records (Method 2), the geriatrician identified altogether 139 potential DRPs (an average of 3.1 per client, range = 1-8; Table 3). Over half (52%; 73/139) of the identified DRPs were related to potential adverse reactions (ie, patient suffers, or will possibly suffer, from an adverse drug event [nonallergic, allergic, toxic]), 34% (47/139) were related to treatment effectiveness (ie, there is a [potential] problem with the [lack of] effect of the pharmacotherapy), and the rest (14%; 19/139) were related to treatment costs. Drug groups most commonly involved in the potential DRPs were drugs for cardiovascular diseases (n = 20), hypnotics and sedatives (n = 13), drugs for osteoporosis (n = 13), selective serotonin reuptake inhibitors (n = 11), and drugs used for diabetes (n = 8).

Discussion

To the authors' knowledge, this is the first reported study in which a clinically experienced geriatrician has appraised the reliability of PN-conducted medication risk screenings. The results indicate that the DRP-RAT can be clinically used by PNs. PNs had succeeded to select for risk screenings those HC clients who were at high risk for DRPs, indicating that they are a highly important resource in medication safety work and should be more intensively involved in medication risk management among older HC clients. This is very important, as due to lacking physician resources in HC, the physician-conducted home visits are rare and, thus, the PNs' role in medication risk management is pronounced. The study also brought up new information about the highest priority risks that should be focused on in geriatric pharmacotherapy. These risks are related both to pharmacological effects of medication as well as medication use process; symptoms suggestive of ADRs, using high-risk medicines, involving more than one physician in client's care, and nonadherence being among the most important risk factors.

DRP-RAT's Ability to Identify Older HC Clients at Risk of Clinically Significant DRPs

According to the medication review basing on health center's medical records (Method 2) the geriatrician classified all clients (n = 45) as "at-risk patients." This confirms that the "at-risk patients" (n = 42) identified using Method 1 (DRP-RAT information and medication list) really were "at-risk patients," but Method 1 could not find 7% (3/45) of the all "at-risk patients" (95% confidence interval = 1.4-18.3). This indicates that the DRP-RAT can be used by PNs as a screening tool to screen older HC clients at risk for medication misadventures. As according to the medication reviews based on Method 2 (health center's medical records), all clients in the study sample were "at-risk patients," we were not able to assess the advantages of the tool when the reviews based on the information provided by Method 1 (PN-completed DRP-RATs and medication lists) and Method 2 (health center's medical records) together (Method 3).

In respect of several HC clients the geriatrician commented on the DRP-RAT's lack of questions about measurement results of the client's health status (eg, current blood

Table 2. Prevalence of DRP Risk Predicting Factors and Importance of the Items of the DRP-RAT in Identifying Risks for Clinically Significant DRPs (the Items Are Presented in the Order of Importance).

Risk Predicting Factors[a]	Prevalence of the Risk Predicting Factors Reported by PNs, n (% of the cases)	Importance of the Items in Identifying Risks for Clinically Significant DRPs Confirmed by the Geriatrician, n[b] (% of the cases)
Has the client had any of the following symptoms in the last 4 weeks? *Drowsiness, fatigue, skin rash or itch, dizziness, urination problems, muscle pains, nausea, diarrhea, constipation, dizziness when getting up, recurrent falls, swellings, memory problems, confusion, visual problems, stiffness, troubles in walking, low blood pressure; systolic pressure under 110 mm Hg (n = 44)*	40 (yes) (91%)	26 (65%)
Does the client have more than one physician involved in his/her care (eg, general practitioners, specialists, private practitioners)? (n = 44)	22 (yes) (50%)	20 (91%)
Has the client had more than one fall in the past 12 months? (n = 44)	18 (yes) (41%)	18 (100%)
Does the client use any of the following medicines (please check the ones used)? *Amiodarone, carbamazepine, digoxin, fluoxetine, lithium, methotrexate, theophylline, warfarin* (n = 44)	16 (yes) (36%)	14 (88%)
Has the client had troubles in (a) remembering to take the medicines, (b) following the medicines regimen, (c) knowing what his or her medicines are used for, (d) affording the medicines (ie, economic problems), (e) opening the drug bottles or packages or managing with medicines related therapeutic devices? (n = 44)	30 (yes)[c] (68%)	11 (37%)
Does the client use medicines that (a) relieve pain by reducing inflammation (does not apply to paracetamol), (b) elevate the rate of urination (diuretics), (c) are intended to lower the cholesterol level (statins), (d) the physician does not know about? (n = 44)	35 (yes) (80%)	8 (23%)
Have the client's relatives/proxies expressed their concern about the client's medicine use? (n = 43)	7 (yes) (16%)	7 (100%)
Has the client started a new medicine in the last 4 weeks (excluding different brands of the same active ingredient)? (n = 44)	7 (yes) (16%)	6 (86%)
Has the client/relative/visitor noticed any changes in client's condition that could indicate adverse drug reactions related to changes in the medicines regimen? (n = 44)	5 (yes) (11%)	5 (100%)
Has the client been in short-term care (eg, interval care) in hospital, nursing home, sheltered housing, health center ward, or some other institution in the past 4 weeks? (n = 44)	15 (yes) (34%)	3 (60%)
Has the client used over-the-counter medicines or vitamin, mineral, or herbal products in the past 2 weeks? (n = 44)	12 (yes) (27%)	2 (17%)
Does the client consciously sometimes take medicines differently than prescribed? (n = 44)	2 (yes) (5%)	2 (100%)
Is there anyone who determines whether the client takes his/her medicines? (n = 44)	23 (no) (52%)	1 (4%)
Does the client have an up-to-date medication card/list? (n = 35)	7 (no) (20%)	1 (14%)
Who administers the client's medicines? (n = 44)		
The client himself/herself (n = 2)	2 (5%)	0 (0%)
Someone else (n = 42)		
Does the client have 7 or more prescription medicines in current regular use (excluding basic creams)? (n = 44)	37 (yes) (84%)	0 (0%)
Does the client take 12 or more medicine doses regularly each day (excluding basic creams)? (n = 44)	27 (yes) (61%)	0 (0%)
Is the client currently taking medicines for 3 or more diseases or symptoms (including acute diseases)? (n = 43)	39 (yes) (91%)	0 (0%)
Does the client have 3 or more chronic diseases? (n = 41)	34 (yes) (83%)	0 (0%)
Is the client (or his/her caregiver) aware of the client's diseases and their treatments? (n = 44)	1 (no) (2%)	0 (0%)
Is the client (or his/her caregiver administering the medication) aware of the medicines that the client uses? (n = 43)	6 (no) (14%)	0 (0%)

Abbreviations: PN, practical nurse; DRP, drug-related problems; HC, home care.

[a]n = number of PNs' notes (yes or no) on a risk predicting item; totals vary because of missing data.

[b]n = number of times the geriatrician evaluated the risk predicting factor as a reason for risk.

[c]Economic problems had been reported concerning one HC client, who also had some troubles with taking the medicines.

Table 3. Potential Drug-Related Problems (DRPs; n = 139) in the Study Sample and the Associated Drugs or Drug Groups.

(Potential) Drug-Related Problem	Home Care Clients (n = 45), % (n)	DRPs, % (n)	Drugs or Drug Groups Associated (n)
Indication for drug treatment not noticed	51.1 (23)	20.3 (28)	Ca + vitamin D (n = 9), laxatives (n = 7), bisphosphonates (n = 3), vitamin D (n = 2), PPIs (n = 2), statins (n = 1), folic acid (n = 1), low-dose ASA (n = 1), local estrogen (n = 1), and sublingual nitroglycerine (n = 1)
Duration of treatment too long	37.8 (17)	15.9 (22)	Hypnotics and sedatives (n = 9), PPIs (n = 5), folic acid (n = 3), systemic antihistamines (n = 2), anti-infectives (n = 2; nitrofurantoin; n = 1, trimethoprim; n = 1), and potassium (n = 1)
Inappropriate combination of drugs	33.3 (15)	15.9 (22)[a]	Warfarin + SSRI (n = 1), warfarin + SSRI + ChEI (n = 3), warfarin + SSRI + ASA (n = 1), SSRI + ASA (n = 3), SSRI + ASA + dipyridamole (n = 1), ASA + NSAID + ChEI (n = 2), ASA + NSAID + dipyridamole (n = 1), paracetamol + carbamazepine (n = 1), α-receptor antagonists (tamsulosin) + β-blocker (bisoprolol; n = 1), and ACE-inhibitor + potassium-sparing diuretic (n = 1)
Inappropriate drugs	26.6 (12)	13.8 (19)	Amitriptyline (n = 3), theophylline (n = 3), diazepam and combination products (n = 2), solifenacin (n = 2), betahistine (n = 2), ibuprofen (n = 1), sodium picosulfate (n = 1), bulk laxative (n = 1), statins (n = 1), SSRI (n = 1), tramadol (n = 1), and trimethoprim (n = 1)
No indication for drugs	24.4 (11)	10.9 (15)	Oral nitrates (n = 7), blood glucose lowering drugs, excluding insulins (n = 2), potassium (n = 2), allopurinol (n = 1), antipsychotics (n = 1), sedatives (n = 1), and tizanidine (n = 1)
Drug dose too high	26.6 (12)	10.1 (14)	Blood glucose lowering drugs, including insulins (n = 5), statins (n = 3), β-blockers (n = 2), ASA 250 mg (n = 1), furosemide (n = 1), paracetamol (n = 1), and SSRI (n = 1)
Inappropriate duplication of therapeutic group or active ingredient—*or*—Too many drugs prescribed for indication	20 (9)	7.2 (10)	Loop-diuretic + tiatside-diuretic + AT-blocker (n = 1), loop-diuretic + potassium-sparing diuretic (n=1), loop-diuretic + vascular selective Ca-channel blocker + AT-blocker (n = 1), tiatside-diuretic + ACE-inhibitor (n = 1), loop-diuretic + ACE-inhibitor + β-blocker (n = 2), vascular selective Ca-channel blocker + β-blocker + dipyridamole and ASA 25 mg combination product (n = 1), (central-acting) α_1-receptor antagonist (prazosin)+ β-blocker + vascular selective Ca-channel blocker (n = 1), concomitant use of 3 CNS drugs for sedation (oxazepam, zopiclone, mirtazapine) (n = 1), ASA 100 mg + dipyridamole and ASA 25 mg combination product (n = 1)
More cost-effective drug available	4.4 (2)	1.4 (2)	Glucosamine (n = 2)
Inappropriate drug form	4.4 (2)	1.4 (2)	Long-acting tramadol (n = 1) and fentanyl plaster (n = 1)
Drug dose too low	4.4 (2)	1.4 (2)	Blood pressure medication (n = 2)
Dosage regimen too frequent	4.4 (2)	1.4 (2)	Pregabalin (n = 1) and calcium (n = 1)
Deterioration/improvement of disease state requiring dose adjustment	2.2 (1)	0.7 (1)	Metformin (n = 1)

Abbreviations: DRP, drug-related problem; Ca, calcium; PPI, proton pump inhibitor; ASA, acetylsalicylic acid; SSRI, selective serotonin reuptake inhibitor; ChEI, cholinesterase inhibitor; NSAID, non-steroidal anti-inflammatory drug; ACE, angiotensin converting enzyme; AT-blocker, angiotensin II receptor blocker; CNS, central nervous system.

[a]If there are both pharmacokinetic and dynamic interactions in the drug combination (eg, warfarin + SSRI + ChEI), it has been counted as 2 potential DRPs.

pressure, heart rate, weight, weight changes, bowel motion). This information lacking about the clients' health and also information lacking about laboratory values resulted in false negative ratings in reviews based on Method 1 (PN-completed DRP-RAT and medication list). Including these in the tool could decrease the number of false outcomes, but then the tool might be too expensive and time-consuming for clinical use by PNs during home visits. In addition, taking in to

account PNs' educational level[3] interpreting laboratory values would make the DRP-RAT too difficult for their skills. Overall, the DRP-RAT has the advantage of being consistent. When applied, it provides the same benefit level for all HC clients.

Symptoms Suggestive of ADRs as the Highest Priority Risks for DRPs

This study brought some new information about the clinical importance of different risk factors for DRPs. Nearly all (91%) of the HC clients in the study sample had suffered from symptoms suggestive of ADRs in the last 4 weeks. The geriatrician reported this timely patient information as the most important information provided by DRP-RAT. She also classified the documented symptoms suggestive of ADRs as the most important risk factors for DRPs. The clinical importance of identifying ADRs has also been found in several previous studies.[17-19] Actually, ADRs have been recognized as the most common type of DRPs to result in severe harm jeopardizing patient safety.[18-21] However, in older patients, the majority (40% to 70%) of ADRs are judged to be preventable.[17,18] Thus, in clinical practice, identification and early detection of ADRs are critically important in order to reduce the rate of iatrogenic illnesses and subsequently to reduce medicine use because of the use of another medicine.[20,21] Previous studies also indicate that experiencing ADRs may result in nonadherence,[22] which in several medication review studies comprise a significant proportion of DRPs.[23-25] However, any tool, including the DRP-RAT, cannot replace clinical judgement, and thus, although the symptoms suggestive of ADRs are listed in the DRP-RAT as potential risk factors for DRPs, it must be taken into account that in all cases, the potential problem may not be related to medicine use.

This study did not find the number of medicines or the number of daily doses to be among the most significant risk factors included in DRP-RAT. Fulton and Allen reported that the risk of ADR is 13% when using 2 medications, increasing up to 58% when using 5 medications.[26] When using 7 or more medications the incidence of ADRs increases to 82%.[27] Several risk managing studies also list the number of medicines and/or number of daily doses as an important risk factor for DRPs.[7,8,28,29] One explanation for our differing result may be that the listed symptoms suggestive of ADRs are much stronger indicators than the number of medicines or daily doses, as they measure the unwanted outcome of inappropriate prescribing or medicine use. It has also been stated that polypharmacy is not a problem if effectively managed.[30] However, this cannot be considered as an explanation in this study as the HC clients had several DRPs (an average of 3.1 potential DRPs per client [range = 1-8]). As a result of a strict validation process of the items included in DRP-RAT,[4-6,11] all items (including the number of medicines and daily doses) are indicators for high risk of DRPs, and thus, this study picked out the most significant risk predicting factors that should be prioritized in medication risk management among older adults. It also must be noticed that even one medicine alone may cause clinically significant risks and, thus, the number of medicines alone is not adequate criterion for predicting risks for medication misadventures.

Strengths and Weaknesses of the Study

Before using the DRP-RAT in the field its content and feasibility were strictly validated in previous studies, which is the strength of this study.[4-6,11] Collecting and analyzing both quantitative and qualitative data can also be considered as a strength, as it offered a wider approach in evaluating the reliability of the PNs' risk screenings. The geriatrician who reviewed the medications is experienced both in clinical patient care and in geriatric pharmacotherapy research. Thus, we consider that she was able to conduct the reviews in the best possible way. The fact that the geriatrician did not know in advance the HC clients whose medications she reviewed and, thus, had no preconception of them, strengthens the results of this study. The major limitations are a small sample size and the fact that the same geriatrician did all the medication reviews regardless of their comprehensiveness. When conducting the reviews patient by patient (ie, patient 1: review 1, review 2, review 3), the geriatrician was instructed to be "blind" to her previous reviews for the same client. How much the previous reviews finally affected the next ones remains unknown and may have led to recall bias in this study. There is also a selection bias as the PNs were instructed to select for screening such patients they supposed to be at risk for DRPs (those who benefit most have been selected in the study). However, this was a pilot study producing first-hand information of real life in HC. According to the reviews based on health center's medical records (Method 2), all clients were classified as "at-risk patients," which can be considered as a weakness of this study as we were not able to compare "the at-risk patients" with "not at-risk patients," and the resolution power of the 3 medication review methods used.

Future Studies

The data of this study were collected from only 45 clients the PNs selected out of 170 clients. Thus, we do not know if those were the only the PNs considered to be at risk for DRPs. We also do not know what the geriatrician's assessment of those rest would have been. To investigate if the PNs' assessment of "at-risk patients" matches up with geriatrician's assessment would be a very interesting topic for future studies. It also would be interesting to know how much the 1-day interactive training affects the PNs to have

the "touch of risk patients." Overall, this was a pilot study with small sample size and, thus, future studies with larger number of older adults and with more than one geriatrician or with a geriatrician and a clinical pharmacist are needed. Currently, we have ongoing an effectiveness study of a coordinated medication management model with a larger sample size in which we have used the DRP-RAT to select those HC clients in need for different level medication reviews.

Conclusion

The DRP-RAT completed by the PNs was capable of providing reliable and timely information to support physician's clinical decision making and could make it possible to more effectively involve PNs in medication risk management among older HC clients. Future studies with larger number of older adults are needed to evaluate the effects of PNs' risk screenings using the DRP-RAT on clinical, humanistic, and economic outcomes.

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Supplemental Material

Supplementary material is available for this article online.

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