CLINICAL PRACTICE

# Implementation of a medication management improvement system for community-dwelling older adults

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## Abstract

**Background:** Older adults have many chronic medical problems. Along with these issues, an older adult is prescribed multiple medications. This medication regimen increases the risk of adverse events. The purpose of this study was to evaluate the effectiveness of student nurses implementing a medication management program in a home care population.

**Methods:** The study was carried out with a convenience sample of community-dwelling older adults who were receiving home care services. Included a sample of 34 adults aged 62 and older who took an average of 12 medications daily. Participants were assessed for medication problems on two separate home visits 30 days apart. Medication problems identified at the first visit were addressed using an established protocol. A total of 14 student nurses conducted the assessment over an eight-month period.

**Results:** Findings showed a statistically significant ($Z=2.33$, $p<0.05$) reduction in the mean number of medication problems between two visits.

**Conclusions:** Student nurses can effectively implement a medication management program.

### Key words

Student nurses, Clinical experience, Medication problems, Older adults, Home health care

## 1 Introduction

Adverse drug events are injuries that are a direct result of medication use [1]. In the United States, there are approximately 1.5 million preventable adverse drug events annually, resulting in 7,000 deaths [2]. Moreover, the cost associated with the treatment of adverse drug events is approximately $170 billion a year [1]. It is estimated that at least 25% of adverse drug events could be prevented by systematically assessing for potential medication problems [3].

Among older adults medication problems are of particular concern. In order to prevent adverse drug events in older adults, interventions to improve medication use have been developed and piloted in the older adult population. One such system is the HomeMeds program, which is an evidenced-based intervention program that has been implemented to decrease the risks associated with medication use in older adults. The HomeMeds program has been implemented and evaluated in a

variety of older adult populations, including clients in Medicaid waiver programs and clients in home care agencies [3]. In both settings, pharmacists reviewed the medication problems. A randomized controlled study demonstrated the effectiveness of the HomeMeds program when used by nurses and non-nursing personnel to identify and reduce potential medication-related problems in community-dwelling older adults [4]. Patients were randomized to usual care or usual care with HomeMeds. Outcomes were one of four medication problems described in Table 1. At baseline, 16% had a therapeutic duplication of medication, 14% had a cardiovascular medication problem, 40% had a problem with psychotropic medication, and 35% had a problem with an NSAID. Overall, medication use (i.e., potential problems) was reduced for 50% of the clients in the intervention group compared with 38% in the control group. While there was no change in problems associated with psychotropic medications or NSAID use, duplication of medications was reduced in 71% of the intervention group compared with 24% of the non-intervention group ($p$=0.003). Likewise, problems with cardiovascular medication were reduced in 55% of the intervention group, compared with 18% of the non-intervention group, ($p$=0.017). These results suggest that the HomeMeds program can decrease the risks associated with specific medication use in the older adult population.

**Table 1.** Definition of four potential medication problems identified by HomeMeds [3]

| Medication Problem | Alert | Alert Definition |
|---|---|---|
| Therapeutic Duplication | Therapeutic Duplication | Use of multiple agents from the same chemical family or therapeutic class |
| Cardiovascular | Suboptimally controlled hypertension | Systolic blood pressure > 140 and/or diastolic blood pressure > 90 |
| | Orthostasis | Dizziness on standing and a > 20 mm Hg drop in systolic on standing (related medication includes: tricyclic antidepressants, antipsychotics, or certain antihypertensive medication (diuretic, alpha-blocker, beta-blocker, other vasodilator), and/or levodopa) |
| | Slow pulse | Pulse < 55 with the use of eta-blockers, verapamil/diltiazem, clonidine, digoxin, methyldopa, thyroid replacement |
| | Low Systolic Blood Pressure | Systolic blood pressure < 100 mm Hg with use of thiazides, loop diuretics, calcium channel blockers, ACE inhibitors, eta-blockers, other antihypertensive medication, nitrates |
| Psychotropic | Benzodiazepines | Use with evidence of current confusion or fall in 3 months |
| | Cyclic Antidepressants | Use with evidence of current confusion or fall in 3 months, change in mentation from previous visit should raise red flag |
| | Antipsychotics | Use with evidence of current confusion or fall in 3 months |
| NSAIDs | NSAIDs | Use of NSAIDS and risk factor for serious peptic ulcer disease: age > 80, or concomitant use of anticoagulant, or concomitant use of oral corticosteroid and on H2 blockers or other antiulcer drugs |

Multiple studies have documented the magnitude of medication-related problems in community-dwelling older adults, relying primarily on the Home Health Criteria [5] and the Beers Criteria [6]. The Home Health Criteria identifies a pattern of medication use with signs and symptoms that indicate a medication-related problem that requires evaluation. The Beers Criteria identifies medications that are deemed inappropriate in the use of older adults. Meredith and colleagues [7] studied the frequency of possible medication using both the Home Health Criteria and the Beers Criteria. In this study, 97% of participants were taking at least one medication, and 19% of the participants were taking 9 or more. The median number of medications was five. Applying the Home Health Criteria, 4% of older adults had therapeutic duplication, 6.3% had cardiovascular related medication problems, 6.9% had problems associated with psychotropic medications, and 4.3% had an error with NSAID medication. Using the Beers Criteria, 17% of the participants were taking an inappropriate medication and 7% were taking medications that had a high risk for an adverse reaction. When both criteria were used, 30% of the participants had a possible medication problem. In this population, as the number of medications increased so did the medication problems, a finding consistent with the work of Rollason and Vogt [8] who found that when eight or

more medications were taken daily there was a 100% increase in the number of adverse drug events that occurred, when compared to patients who took greater than eight.

Using a cross-sectional design, Alkema and colleagues [9] investigated the prevalence and predictors of one of four potential medication problems as defined in Table 1 in community-dwelling older adults who received a Medicaid waiver service. They reported that 49% of the participants had a potential medication problem, and 20% of the participants had two or more potential problems. The most frequent problem was unnecessary therapeutic duplication (24%), followed by inappropriate psychotropic medications (14%) and cardiovascular medications (14%).

In the current study, student nurses under faculty supervision used the HomeMeds program to identify potential medication problems in a home care population. Home care nurses reviewed the identified medication problems, with physician or pharmacist consultation as needed. This study compared this innovative implementation of the HomeMeds program with existing evidence. The purpose of this study was to evaluate the impact of the HomeMeds program in a sample of community-dwelling older adults who were receiving services from a home health care agency with monitoring assistance by student nurses. The following research question was addressed: When implemented by student nurses under faculty supervision does the HomeMeds program reduce potential medication problems in community-dwelling older adults.

# 2 Methods

The study was classified as a quality improvement project and identified as exempt by the University Institutional Review Board (IRB). The home care agency agreed to be a part of the study through a collaborative agreement with the University's School of Nursing.

## 2.1 Setting

The study was conducted with individuals who were receiving home care services from a home care agency in the Northeast. The setting of the study took place in the home of each participant.

## 2.2 Design

The student nurses visited patient participants in pairs to interview and complete the HomeMeds instrument. Student nurses visually inspected and recorded all medications (prescribed and over-the-counter), and patients were asked to self-report on the following: falls, unusual confusion or unusual dizziness/lightheadedness in the past three months. Other assessment items included the following: age, gender, blood pressure and pulse in a sitting or lying and standing position, chronic illness history, allergies to food and/or medication, alcohol intake, and a pain scale. Using a university computer lab, the data were entered into the HomeMeds (web-based) program and the nurse report was printed. This report identified any potential medication problems (i.e., nine possible alerts). The student nurse also prepared a narrative note for the visit and attached the appropriate protocol for each alert generated. All of the documents were then assembled into a packet, which was hand delivered to the home care agency and reviewed by the clinical director. The clinical director insured that the client's nurse was informed of the potential medication problems and the protocol for responding to the problem. Student nurses attempted to re-visit each client on a monthly basis and repeat the assessment, reviewing the client's home care chart prior to the visit.

Data were collected over a two-semester time frame by ten undergraduate nursing students from May 2011-August 2011 and four RN to BSN students from September 2011-December 2011. All students received the same training, and were supervised by at least one faculty member, but no inter-rater reliability was established.

## 2.3 Sample

A convenience of 34 home care patients who received home care services in the Northeast.

The inclusion criteria were: age at least 60 years or older, took a minimum of one medication, spoke and understood the English language, received long-term home care services, and agreed to monthly visits by student nurses to assess medication use.

Of the 34 study participants that provided data at Visit 1, 27 (79.4%) also provided Visit 2 data and were included in the inferential analysis. Table 2 presents the demographic characteristics and potential covariates of the 34 study participants that provided data at Visit 1. The sample was mainly female, white, non-hispanic, and widowed. The average study participant was about 80 years of age (range between 62-97). Within the three months prior to the study, 38.2% had been hospitalized, 29.4% had a fall, 35.3% had become dizzy, and 17.6% had experienced confusion. Lastly, the average study participant took about 12 medications (range between 4-25) and had over five co-morbidities (range between 1-9).

**Table 2.** Demographic and Covariate Variables (n=34)

| **Demographic Variables** | **n (%)**<br>**M (SD)** |
|---|---|
| **Gender** | |
| Male | 5 (14.7%) |
| Female | 29 (85.3%) |
| **Race** | |
| White | 28 (82.4%) |
| Black | 2 (5.9%) |
| Other | 4 (11.8%) |
| **Ethnicity** | |
| Hispanic | 2 (5.9%) |
| Non-Hispanic | 32 (94.1%) |
| **Marital Status** | |
| Married | 9 (26.5%) |
| Single | 4 (11.8%) |
| Divorced/Separated | 7 (20.6%) |
| Widowed | 14 (41.2%) |
| **Age** | 79.5 (9.48) |
| *Covariate Variables* | |
| **Hospitalization in Past 3 Months** | |
| Yes | 13 (38.2%) |
| No | 21 (61.8%) |
| **Fall in Past 3 Months** | |
| Yes | 10 (29.4%) |
| No | 24 (70.6%) |
| **Dizzy in Past 3 Months** | |
| Yes | 12 (35.3%) |
| No | 22 (64.7%) |
| **Confusion in Past 3 Months** | |
| Yes | 6 (17.6%) |
| No | 28 (82.4%) |
| Medications | 12.09 (5.42) |
| Co-morbidities | 5.56 (1.93) |


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## 2.4 Instruments

The HomeMeds instrument was used to identify nine possible alerts, which were collapsed into the four potential medication problems listed in Table 1.

Demographic variables included: age; gender; race; ethnicity; marital status; number of medications prescribed; number of co-morbidities; history of falls, dizziness, confusion, and hospitalizations within the previous three months.

## 2.5 Statistical analysis

Data were initially examined using computer-generated plots where maximum and minimum scores of each variable were cross-checked to determine the normality of the data and the presence of outliers. No outliers were found. There were three steps involved in the data analysis plan, which was conducted using the statistical software SPSS version 20.0. First, all study variables were presented descriptively (e.g., frequencies, means). Second, a series of bivariate analysis (i.e., Pearson r correlation, and t-test analysis) were conducted to determine if the dependent variable (i.e., Visit 1 to Visit 2 changes in the number of medication problems) was associated with any demographic/covariate variables at a statistically significant level. Visit 1 to Visit 2 change in medication problems was measured via a change score variable computed by subtracting individual Visit 1 scores from Visit 2 scores (i.e., a negative change score indicates a reduction in medication problems). Third, a paired samples *t*-test analysis was conducted to determine if the mean level of medication problems at Visit 1differed from the mean level of medication problems at Visit 2 at a statistically significant level. Due to the relatively small sample size and a questionable normal distribution, a non-parametric version of this test, the Wilcoxon Signed Ranks Test, was also conducted to examine this relationship.

# 3 Results

Of the 34 study participants that provided data at baseline, 27 (79.4%) also provided Visit 2 data. Table 3 presents a descriptive analysis of the number of medication problems at Visit 1 and Visit 2. Among the 27 participants, 16 (59.3%) had a medication problem at the baseline visit, which decreased to 13(48.1%) during Visit 2 visit. Those with a medication problem, 30% had therapeutic duplication, 30% had a cardiovascular medication problem, 15% had psychotropic medication problems and 11% had NSAID medication problems.

**Table 3.** Number and Proportion of Participants with Medication Problems at Visit 1 and Visit 2 (n=27)

| Number of Medication Problems | Visit 1 n (%) | Visit 2 n (%) |
|---|---|---|
| 0 | 11 (40.7%) | 14 (51.9%) |
| 1 | 10 (37.0%) | 10 (37.0%) |
| 2 | 5 (18.5%) | 3 (11.1%) |
| 3 | 1 (3.7%) | 0 (0%) |
| 4 | 0 (0%) | 0 (0%) |

There was no association between changes in medication problems at Visit 1 and Visit 2 and age, gender, race, ethnicity, marital status, hospitalization, fall, being dizzy or confused in the previous three months, number of medications taken, and number of participant co-morbidities.

**Table 4.** Differences in Medication Problems at Visit 1 and Visit 2 (n=27)

| Non-Parametric-Wilcoxon Signed Ranks Test | Visit 1 | Visit 2 | t/Z (df) | *p* |
|---|---|---|---|---|
| Medication Problems | .85 (.86) | .69 (.13) | 2.33 (26) | .02 |

Table 4 presents the results of a bivariate parametric and non-parametric analysis examining changes in medication problems from Visit 1 to Visit 2. A parametric paired samples t-test indicated a statistically significant level (*t*=2.56,

$p$=<0.05) difference from the mean value representing medication problems at Visit 1 and Visit 2. A non-parametric Wilcoxon signed ranks test indicated that this relationship was statistically significant (Z=2.33, $p$<0.05), while not assuming a normal distribution for the Visit 1 and Visit 2 variables.

# 4 Discussion

Consistent with previous studies, the current study demonstrated a decrease in medication problems from Visit 1 to Visit 2. At the baseline (Visit 1) visit, a total of 30% of the participants had therapeutic duplication, 30% had a cardiovascular medication problem, 15% had psychotropic medication problems and 11% had NSAID medication problem. This population differed from Meredith and colleagues [4] at baseline. The current population had higher rates of therapeutic duplication and cardiovascular medication problems, compared to psychotropic or NSAID problems at baseline. Meredith's population, in contrast, had higher proportions of psychotropic and NSAID associated problems, compared to therapeutic duplication and cardiovascular problems, which were lower (i.e., 40 and 35% psychotropic and NSAID compared to 16 and 14% therapeutic duplication and cardiovascular problems, respectively).

Between Visit 1 and Visit 2, there was a decrease in the following medication problems: unnecessary therapeutic duplication, psychotropic medication, and NSAID problems, and an increase in cardiovascular problems. These results differ from Meredith and colleagues [4], who demonstrated a decrease in cardiovascular and therapeutic duplication in their population and no change in psychotropic medication or NSAID problems.

Baseline differences could be related to geographic differences, prescribing practices, or participant characteristics such as co-morbidities, age, or other unmeasured characteristics. In addition, change differences could be due to differences in implementation of the HomeMeds program. In the current study there was less direct involvement by pharmacists, and a small sample size. In addition, one participant had an elevated blood pressure at Visit 2, despite medication and provider practices (i.e., no modification to medication regimen). This decrease could be a result of a change in the participants' medication regimen and no verbal report of falls, dizziness or confusion during Visit 2. An increase in cardiovascular medication problems was noted during Visit 2. Reason for this increase could be related to a participants' provider not modifying the medication regimen and one participant experiencing suboptimally controlled hypertension. These results are not consistent with Meredith and colleagues (4) study, which showed a decrease in both therapeutic duplication and cardiovascular medication problems.

Differences in this study and Merediths' (4) study could be related to a difference in the geographical locations. The sample for Merediths' (4) study was taken from the Los Angeles and New York area, and this study utilized only the Connecticut region. Another reason for the variation could be related to the difference in the preference of certain medications to treat medical diagnosis between the two different geographical areas. An example would be the use of Verapamil to treat hypertension in the Los Angeles region during the 2001-2002, which is not a common medication used to treat hypertension in the Northeast in 2011. Finally, the results of this study could be a reflection of the small sample size included. In Meredith's (4) study there was a larger sample, conducted over a longer duration, and implementation was by home care nurses with pharmacist consultants.

# 5 Limitations

This study has several limitations. All participants were selected from one home care agency. The sample size was small and homogeneous. Results are not generalizable outside of the home care agency from which the participants were selected. Problems with recall on the part of the participants may have biased the results. Identification of potential medication problems requires information about events and symptoms such as falls or dizziness in the prior three months, as well as verification of current medications. Current medications can be verified by visual inspection, but self-report of falls and dizziness is not verifiable. Participants may be reluctant to report signs and symptoms that may jeopardize their

ability to remain living independently at home. In addition, problems with memory could result in either under or over reporting of events. Additionally, the participants only had two visits, which were one month apart for all participants.

# 6 Conclusions

Results indicate that the use of the HomeMeds program when implemented by student nurses does decrease the number of potential problems associated with specific medication use. A reduction in potential medication problems may lead to lower morbidity and mortality rates that are associated with adverse medication-related events. Future research should include investigating the potential alerts (i.e., suboptimally controlled hypertenstion, orthostasis, slow pulse, low systolic blood pressure, confusion and falls) and how this correlates to hospital admissions or number of emergency room visits. Also, the instruments four different areas could be separated and interventions for each developed and expanded. Further testing needs to be completed in order to determine the reliability and validity of the instrument. A replication of this study over a longer time period with multiple visits. A larger sample size would allow for a more heterogeneous population and in turn make the results more generalizable.

This study has demonstrated that student nurses can implement the HomeMeds program. Use of this program provides an opportunity for nurse educators to educate students regarding home care and the resources available to older adults. Moreover the additional "nurse hours" provided by student nurses assisting in the HomeMeds program may mean that problems associated with medication use in this vulnerable population are identified in a more timely manner. Finally, student nurses can serve as a cost-effective, "value-added" benefit to a home care agency. The HomeMeds program can offer a meaningful and relevant clinical experience outside of the acute care setting. In the future, the HomeMeds program can be utilized with nursing students in clinical areas such as public health, and within health policy courses. Pharmacy schools are another disciple that would benefit from the use of the HomeMeds program.

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