

Home Assessment of Adherence to Long-term Medication in the Elderly

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Background. Drug nonadherence to long-term medication is a common and poorly understood problem in the elderly. A study was conducted to assess whether elderly patients would accept a research assistant conducting pill counts in their homes, and to examine how nonadherence was associated with patient variables.

Methods. A letter and a telephone follow-up call were used to identify eligible patients (aged 65 years and over, with two or more chronic diseases).

Results. A total of 98 eligible patients were identified. Fifty-nine agreed to participate in the study. Of the 59 participants, 54.7% were nonadherent to their medication regimen. Nonadherence was defined as an overall mean level of compliance of less than 80%. Drug regimen nonadherence was associated with the inability to read medication labels ($P < .01$), but not with impaired visual acuity, the number of prescribed medications, the type of medication container lid, depression,

cognitive impairment, perceived health status, or the cost of medications. Frequency of drug administration affected patient adherence to the medication regimen. Mean adherence of patients to prescriptions for drugs to be taken once or twice daily was 72%, whereas drugs to be taken three or four times daily had a mean adherence rate of 54% ($P < .01$).

Conclusions. Using the simple pill count method on home visits, rates of nonadherence to long-term medication were comparable to those found in studies using electronic pill-counting devices. Larger studies are needed to clarify how other variables, in addition to patient inability to read medication labels, are associated with noncompliance with medication regimens for chronic diseases in elderly patients.

Key words. Chronic disease; patient compliance; prescriptions, drug; geriatrics. *J Fam Pract* 1992; 35:61-65.

Estimates of nonadherence of elderly patients to prescription drug regimens have generally ranged from 40% to 50%.¹⁻⁶ More elderly patients are prescribed medications for chronic illnesses than any other age group.⁷ Consequently, nonadherence to long-term medication regimens in the elderly is a significant clinical problem. In one recent study, nonadherence to prescriptions and adverse drug reactions accounted for 11.4% and 16.8%, respectively, of hospitalizations of the elderly.⁸ Hospitalizations due to nonadherence were associated with having poor recall of the medication regimen, seeing multiple physicians, being female, being in a medium income category, using numerous medications, and believing that medications are too expensive.⁸ In a study of elderly patients living in a housing complex, nonadherence to

medication regimens correlated with the total number of prescribed drugs, the inability to open flip-off tops of medication containers, and the inability to read medication container labels.⁹ Our understanding of the factors associated with nonadherence to long-term medication in the elderly is still limited. A better understanding of these factors could help physicians identify elderly patients who are at risk for drug nonadherence.

Patients often overreport their level of drug adherence, so physicians cannot rely solely on patient self-reports.¹⁰ Visiting elderly patients in their homes, particularly those living alone, has been advocated as a way to monitor patients who are at risk for drug nonadherence.¹¹ Although physicians infrequently conduct home assessments for such purposes, visiting nurses and family members can make such assessments.

The idea for conducting this study came from our experience of providing a primary care geriatric consultation service at the Family Medicine Center. As part of this consultation service, the geriatric nurse practitioner conducts a functional, environmental, and pharmacolog-

Submitted, April 22, 1992.

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ical assessment in the patient's home. Nonadherence to long-term medication is a common finding.

This study attempted to quantify the extent of nonadherence to long-term medication regimens in the elderly who had two or more chronic diseases. The objectives of this study were (1) to determine whether patients would accept a research assistant performing pill counts of their medications during visits to their homes, and (2) to assess how drug adherence in elderly patients was associated with the following variables: the number of prescribed medications, the ability to read prescription labels, the type of medication container lid, frequency of drug administration, visual acuity, perceived health status, depression, cognitive abilities, and monthly medication costs.

Methods

The study sample was drawn from patients of the Family Medicine Center who met the following inclusion criteria: aged 65 years and over, living at home, having two or more chronic diagnoses recorded on our computer system, and living in zip code areas near the Family Medicine Center. One hundred forty-eight patients were identified in the designated catchment area. Of these patients, 19 were living in a nursing home. Following a letter and a telephone follow-up call, 17 patients could not be reached. Fourteen patients were deceased.

During an 8-week period, the research assistant (R.D.) visited the participants in their homes. He conducted a short interview to obtain demographic information and an estimate of monthly medication costs. At the time of the visit, assessments were made of visual acuity, cognitive impairment using the Folstein questionnaire,¹² and the ability of the patient to open his or her medication bottles and to read both the instructions and the warning labels on them.

The medication containers had either childproof or flip-off lids. If a patient had both types of medication containers, the patient was coded as having a childproof container, as this container is the more difficult to open. Patients were categorized according to the following: (1) ability to read both the instructions and warning labels, (2) ability to read the instructions but not the warning labels (smaller print), or (3) inability to read either. With the patient's consent, the research assistant conducted pill counts on all medications for chronic diseases (ie, drugs continuously prescribed for longer than 30 days). During the visit, the patient was asked to complete the Medical Outcome Survey questionnaire and the Beck Depression Inventory.^{13,14}

Information recorded from the prescription label

was obtained, including the number of tablets dispensed by the pharmacy, the frequency at which the drug was prescribed, the date on which the medication was dispensed, and the current date. This information was used to calculate how many tablets the patient should have taken of each medication. The number of tablets taken by the patient was estimated by counting the actual number of tablets remaining in the bottle and subtracting that number from the number of tablets dispensed. The percentage of adherence for each medication was calculated using the following formula:

$$\frac{\text{actual number of tablets taken}}{\text{number of tablets that should have been taken}} \times 100$$

Each patient's overall adherence was then calculated by averaging the percentage of adherence for each prescribed long-term medication. A logarithmic transformation was used to change the data on the patients' overall drug adherence to a more normal distribution. The transformed data were used in the regression analysis.

Univariate relationships between the dependent variable (the overall mean drug adherence) and the independent variables were examined using *t* tests and chi-squared tests as appropriate. Using stepwise multiple regression analysis, the overall mean adherence scores were compared with all independent variables. Using a general linear models procedure, the frequency of drug administration was compared with the level of adherence for each individual drug.

Results

Of the 98 patients eligible for the study, 59 (60.2%) were willing to participate and agreed to having a research assistant visit them in their homes (Table 1). The age-sex distribution and the mean number of chronic illness diagnoses were not statistically different between the study participants (*n* = 59) and those patients who declined to participate in the study (*n* = 39).

The overall drug adherence for seven patients could not be estimated for the following reasons: one patient objected to the research assistant conducting a pill count; three patients received 3 months of medication at one time; two patients used old prescription bottles to store their new medications; and one patient had medications that were to be taken as needed. Defining nonadherence as having taken less than 80% of the amount of medication prescribed, approximately 55% of the participants were nonadherent.

Approximately 37% of the participants had childproof caps on some or all of their medication bottles. All

Table 1. Characteristics of 59 Elderly Subjects and Their Medication Use

Characteristic	Mean (SD)	Range
Age (y)	74.4 (± 6.2)	65-90
All medications (No.)	4.73 (± 2.64)	1-12
Long-term medication regimens (No.)	3.06 (± 2.06)	1-8
Adherence to long-term medication regimens (%)	67.5 (± 28.5)	0-111.9
Monthly cost of medications (\$)	25.02 (± 38.68)	0-200
Folstein scores*	25.4 (± 3.7)	15-30
Depression status BDI†	10.2 (± 7.35)	0-31

*A score of 21 or less indicates significant cognitive impairment.¹⁵

†Beck Depression Inventory. A score of 10 to 16 indicates mild or intermittent depression. A score of 17 or greater indicates moderate or severe depression.¹³

participants were able to open their medication containers, irrespective of the type of lid. Using a hand-held Snellen chart, approximately 78% of the participants had a visual acuity of 20/50 or less; the 20/50 letters were approximately the same size as those on the warning labels. Approximately 16% of patients had a score of 21 or less on the Folstein mental status examination (this cutoff has a higher specificity for significant cognitive impairment).¹⁵ On the Beck Depression Inventory, 34% of patients were "mildly or intermittently" depressed (score 10 to 16), and 17% were "moderately or severely" depressed (score 17 or greater).¹³

Statistical Analysis

With stepwise multiple regression, the overall percentage of adherence was compared with the independent variables. Only one variable, ie, the ability to read the medical labels, was statistically significant as predictive of adherence level ($P < .01$). In the correlation analysis, the ability to read medication labels correlated with visual acuity and adherence, but visual acuity did not correlate with adherence. To examine these associations further, the ability to read the warning labels was compared with drug regimen adherence (Table 2) and visual acuity (above and below 20/50). A visual acuity of 20/50 or less is needed to read the warning labels. Surprisingly, 6 of

Table 2. The Association Between Ability to Read the Warning Labels and Adherence to Prescribed Drug Regimens*

	Patients with >80% Adherence, No. (%)	Patients with <80% Adherence, No. (%)
Reading Ability		
Able to read warning labels	22 (53.6)	19 (46.3)
Unable to read warning labels	2 (18.1)	9 (81.8)

* $P = .036$.

Table 3. Univariate Analysis of Factors Potentially Associated with Adherence to Drug Regimen

Factors	Adherent	Nonadherent	P
Psychosocial			
Medical Outcome Survey score	12.42	12.82	.72*
Beck Depression Inventory (score)	9.375	12.00	.22*
Folstein score	26.25	24.28	.055*
Living situation			
Alone (%)	62	38	
With others (%)	67	33	.728†
Medication characteristics			
Number of medications	2.6	3.4	.17*
Total number of pills/day	6.0	7.2	.38*
Mean medication costs	\$33.58	\$22.00	.19*

* = *t* test.

† = *chi-square* test.

the 13 patients with a visual acuity >20/50 were able to read both the warning and instruction labels. In contrast, 5 of the 45 patients with a visual acuity of $\leq 20/50$ were unable to read the warning labels but were able to read the larger print on the instruction labels. Only three patients were unable to read any labels, and they were all nonadherent to their prescribed medication regimens.

The univariate analysis of the relationships between the dependent variable (the overall mean drug adherence) and the independent variables is shown in Table 3. A comparison of the frequency of drug administration with mean adherence is shown in Table 4.

Discussion

Fifty-nine out of an eligible 98 patients agreed to participate in this study. The simple pill count method used in this study could not estimate drug adherence in six pa-

Table 4. The Effect of Frequency of Drug Administration on Mean Drug Regimen Adherence of 59 Subjects*

Frequency of Drug Administration	Total Number of Drugs	Mean Drug Adherence (%)
Daily	78	74
Twice daily	36	72
Three times daily	29	52
Four times daily	15	53

* $P < .004$.

tients (10%) for the reasons previously stated. Only one of the 59 patients objected to the research assistant conducting a pill count. Thus, the simple pill count method was accepted by 98% of eligible responders. However, we do not know the reasons why 38 patients did not agree to participate in this study, which raises the issue of the acceptability of this method among nonresponders, given the different circumstances.

This method probably underestimates the degree of drug prescription adherence, because patients do not always renew their prescriptions on the day they need to obtain a new month's drug supply. Furthermore, in longitudinal research studies on hypertension, the pill count method has been questioned as a reliable way of assessing drug regimen adherence. In one study,¹⁶ 35% of the hypertensive patients exhibited what appeared to be *more than 100%* compliance on at least one visit in which this method of pill counting was used to assess adherence. Presumably, patients were either manipulating the pill counts or dumping their pills. These findings raise concerns about the accuracy and limitations of using the pill count method to assess drug adherence.

For the purpose of this cross-sectional study, patients were not specifically told in advance that pill counts were part of this study. Therefore, this approach avoided the problem of patients dumping pills or manipulating their drug counts. In spite of concerns about the limitations of using the simple pill count method, our findings were similar to other studies: 54.7% of the responders were not adherent to their long-term medication regimens.¹⁻⁶ Furthermore, the effects of frequency of administration on drug regimen adherence (Table 4) was similar to a hypertensive study in which special pill containers electronically recorded the date and time of medication removal; in that study, adherence improved from 59% on a three-times-daily regimen to 83.6% on a once-daily regimen for antihypertension medications.¹⁷ The findings from these other studies suggest that the selection bias in the responders may not be a significant factor affecting the results of our study. Thus, the simple pill count method is a clinically useful way of estimating adherence to long-term medication regimens in the homes of the elderly.

This study confirmed our clinical experience about the degree of nonadherence to long-term medication regimens that we have found from conducting primary care geriatric consultations. Nonadherence to prescribed long-term medication is a useful diagnostic finding for two important reasons. Obviously, physicians can advise patients about the need to take their medication as recommended so that their quality of life is improved (provided that there are not any unwarranted side effects). But just as important, this finding can help physicians

and patients decide to discontinue unnecessary medications and thereby minimize the risks of drug interactions and disease-drug interactions.

The finding that the inability to read the medication labels correlated with both poor compliance and poor visual acuity is not consonant with the finding that reduced visual acuity did *not* correlate with reduced drug adherence. Five patients who were not able to read the warning labels had adequate visual acuity to read them, and six patients who were able to read the warning labels had visual acuity recordings below a level that should have made it difficult to read these labels. These observations raise the possibility that the ability to read medication labels has one or more confounding variables in association with nonadherence.

In a recent home-based study, the most common reason for nonadherence was fear of side effects.^{18,19} Thus, it could be speculated that the patient's ability to read the warning labels serves the function of allaying fears about the medications and thereby promotes patient adherence. Conversely, the patient's inability to read the warning labels may exacerbate such fears.

Adherence to long-term medication regimens was not associated with impaired visual acuity, impaired cognitive abilities, depression, monthly medication costs and perceived health status, the type of medication container lids, and the number of prescribed medications. The small size of this study, however, may limit its power to uncover significant associations that may be clinically relevant. Larger home-based studies are needed to clarify what other factors are associated with nonadherence to long-term medication in the elderly and whether the inability to read the prescription labels has confounding variables in relation to nonadherence. As drug adherence to long-term medication in the elderly is so poorly understood, both qualitative and quantitative methods of research may enhance our understanding of this problem.

Acknowledgments

I wish to thank Karen Vane for her help in preparing this manuscript and Dr Peter Franks for his advice on presenting the data.

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