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PRACTICE CONCEPTS

Improving Medication Knowledge Among Older Adults With Heart Failure: A Patient-Centered Approach to Instruction Design

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Purpose: We investigated whether patient-centered instructions for chronic heart failure medications increase comprehension and memory for medication information in older adults diagnosed with chronic heart failure. ***Design and Methods:*** Patient-centered instructions for familiar and unfamiliar medications were compared with instructions for the same medications from a chain pharmacy (standard pharmacy instructions). Thirty-two adults (age, $M =$ 63.8) read and answered questions about each instruction, recalled medication information (free recall), and then answered questions from memory (cued recall). ***Results:*** Patient-centered instructions were better recalled and understood more quickly than the standard instructions. Instructions for the familiar medications also were better recalled. Patient-centered instructions were understood more accurately for the unfamiliar medications, but standard instructions were understood more accurately for the familiar medications. However, the recall measures showed that the advantage of the standard format for familiar medications was short lived. ***Implications:*** The findings suggest that the patient-centered format may improve printed medication instructions available in many pharmacies, which should help older adults to better understand how to take their medications.

Key Words: Medication instructions, Adherence, Memory, Health literacy

Chronic heart failure (CHF) is a major health care problem that is associated with reduced functional capacity and quality of life, particularly among older adults (American Heart Association, 2004). Older adults with CHF often have multiple medications prescribed to provide symptom relief and slow disease progression (Fonarow, 2001). Such complex regimens challenge the ability of these adults to take the medications as prescribed (Ghali, Kadakia, Cooper, & Ferlinz, 1988; Murray, Darnell, Weinberger, & Martz, 1986). Although older adults' nonadherence relates to many factors, limited knowledge about medications is an important contributor (Ascione, 1994; Botelho & Dudrak, 1992; German, 1988; Lorenc & Branthwaite, 1993; Murray et al., 1986; Park, Morrell, Freske, & Kincaid, 1992; Salas et al., 2001). Limited knowledge may in turn be associated with several factors, including cognitive declines that impair

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comprehension (Park & Jones, 1997), poor health literacy (Baker, Gazmararian, Sudano, & Patterson, 2000), and inadequate medication instructions (Morrow & Leirer, 1999). These factors influence the ability to develop accurate adherence plans.

The relationship between patients' medication knowledge and adherence is articulated by the multifactor model of adherence developed by Park (e.g., Park & Jones, 1997). According to this model, adherence depends on cognitive abilities (e.g., working memory), medication and disease variables that influence beliefs about illness and treatment, and external cues (e.g., social support, reminders). Age primarily influences adherence through cognitive function. Thus, comprehension and other components of adherence may be compromised by age-related differences in working memory (Park et al., 1996; Salthouse, 1991) and health-related literacy (Baker et al., 2000).

An important strategy for increasing medication knowledge is to improve instructions, especially because the federal government has mandated a private-sector program to improve the quantity and quality of printed medication information provided to patients at pharmacies (Public Law 104-180, August 6, 1996). However, more information will only improve knowledge if this information is easy to understand and remember, especially for older adults who experience declines in the cognitive resources necessary for comprehension. Unfortunately, medication instructions now available at many commercial pharmacies are difficult to understand and use because of small print, complex language, and poor organization (Klein & Isaacson, 2003; Svarstad & Bultman, 1999; Wright, 1999).

We developed patient-centered medication instructions as part of a pharmacy-based educational intervention to improve health-related outcomes and adherence among older adults with CHF (for a description of the intervention study, see Murray et al., 2004). To validate these instructions, we first tested whether they were better understood, compared with instructions available in a chain pharmacy, by older adults with CHF.

The instructions were patient centered because they were designed according to patients' needs and abilities and they provided the patients the information needed to develop a plan for taking medication (Michie, Miles, & Weinman, 2003). More specifically, they were designed to support patients' comprehension and memory by minimizing demands on sensory (e.g., visual acuity) and cognitive (e.g., working memory) abilities that decline with age, and by taking advantage of patients' knowledge about taking medication. We took a multileveled approach, focusing on the content, language, organization, and presentation medium of the instructions. We conveyed information necessary for creating an accurate adherence plan (e.g., medication dose and schedule) by use of large print and simple language (short words and simple syntax, reflected in readability scores appropriate for low grade levels), which may especially benefit low literacy patients (Ad Hoc Committee on Health Literacy, 1999). We took a patient-centered approach to the organization as well as the content and language of the instructions. With increasing experience, older adults may develop a medication-taking schema that guides expectations about the information that should be provided by instructions. According to this schema, general information such as purpose should be followed by information about how to take the medication (e.g., dose and schedule), and then possible outcomes of taking the medication such as side effects (Morrow, Leirer, Andrassy, Tanke, & Stine-Morrow, 1996). We organized the instructions to match this schema because the order of information followed the schematic order. Finally, the presentation format of the instructions should also improve comprehension because we reinforced the text by icons that conveyed medication name, dose, and schedule. Combined icon–text formats improve older adults' memory for procedural instructions (Morrell & Park, 1993) and medication instructions (Morrow, Hier, Menard, & Leirer, 1998).

We have found that patient-centered instructions improve memory for medication information among educated, healthy older adults (for a review, see Morrow & Leirer, 1999). However, it is important to test whether they also improve medication knowledge among patients with CHF who vary in education, literacy, cognitive ability, and health status, as a first step to investigating the impact of such instructions on health behaviors in clinical settings.

Study Aims

We tested the hypothesis that older adults with CHF better understand and remember the patient-centered instructions than a standard format used in a chain pharmacy, which would suggest that the patient-centered format increases patients' medication knowledge. We found earlier that older adults generally preferred these instructions over standard instructions (Morrow et al., 2004), but preferences do not always predict objective measures such as recall of instructions (Davis, Holcombe, Berkel, Pramanik, & Divers, 1998).

We also examined whether older adults better understand and remember instructions for familiar (e.g., currently prescribed) medications. On one hand, prior knowledge about the medication and illness may provide a framework for organizing the encoding and retrieval of new information from instructions. On the other hand, learning new information is sometimes more difficult for familiar than for unfamiliar health topics, perhaps because new information can conflict with previously learned information (Brown & Park, 2003). Medication familiarity also may moderate the impact of the patient-centered instruction format. Participants already taking a medication also may be familiar with the standard format, which could mitigate potential benefits of the novel format.

Finally, we investigated whether patient characteristics predicted recall of medication information, which would have implications for tailoring instructions. We examined how recall related to patient age, education, and measures of health-related literacy, working memory, and speed of mental processing.

Methods

Study Design

We assessed patients' memory and comprehension of patient-centered and standard formats for familiar (a diuretic and an angiotensin-converting enzyme, or ACE, inhibitor) and unfamiliar (a beta blocker and digoxin) medications commonly prescribed to patients with CHF. All participants were prescribed the familiar medications at the time of the study and had never taken the unfamiliar medications. They were presented two patient-centered and two standard pharmacy instructions (one each for familiar and unfamiliar medications). All format–familiarity combinations were presented with equal frequency, with presentation order of instructions counterbalanced across participants.

Participants

A volunteer sample of 32 community-dwelling older adults diagnosed with CHF for which they were prescribed a diuretic and an ACE inhibitor was recruited at Wishard Health Services, Indianapolis, IN. Although the participants were not involved in the intervention study described by Murray and colleagues (2004), they met the study inclusion criteria.

Instructions

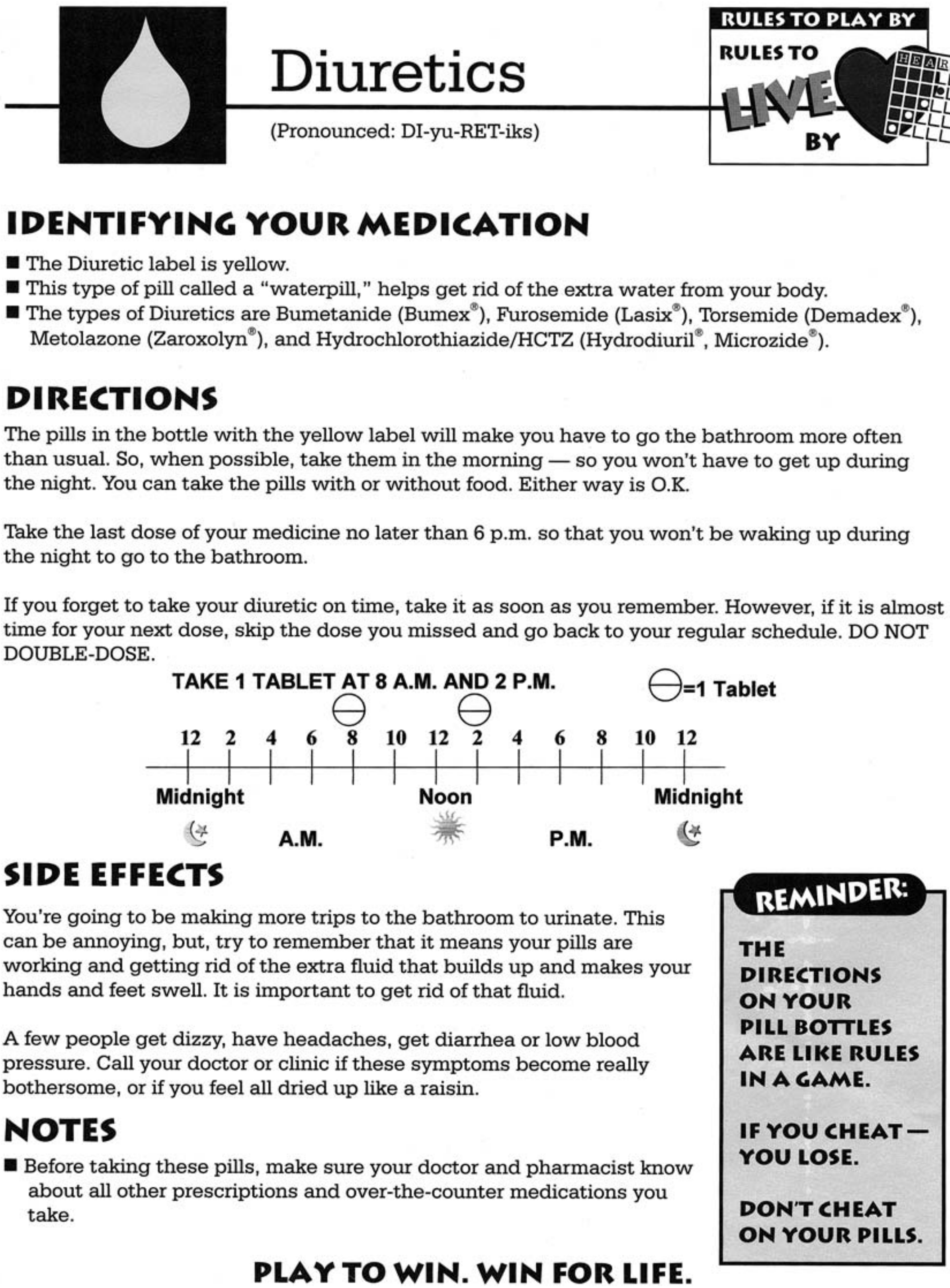
We compared patient-centered and standard pharmacy formats for familiar (the diuretic and the ACE inhibitor) and unfamiliar (the beta blocker and digoxin) medications. Figure 1 presents the patient-centered version for the diuretic. Although the two formats conveyed similar information, the patient-centered instructions should be better understood than the standard instructions for several reasons. They had a larger font (12–14 point vs 8–10 point for the body of the instructions) and better readability scores (mean grade level of 7.4 vs 9.3, Flesch–Kincaid readability formula), and they were shorter (mean of 251.3 vs 557.8 words; standard instructions contained more information about potential drug interactions and side effects). We organized the patient-centered instructions to be consistent with patients' medication-taking schema, and they contained icons that reinforced the text by explicitly conveying medication name, dose, and time information (for more details, see Morrow et al., 2004). The instructions for the familiar and unfamiliar medications did not differ in mean grade level of the Flesch–Kincaid readability formula; familiar = 8.2, unfamiliar = 8.7, $t(6) < 1.0$.

Procedure and Dependent Measures

We tested older adults individually at the Regenstrief Institute. In a 2-hr session, they completed (a) an informed consent and demographic questionnaire; (b) medication instruction tasks; (c) cognitive and literacy tests; and (d) The New York Health Association classification of CHF functional status. For the medication instruction tasks, we presented participants with two patient-centered and two standard instructions (one each for familiar and unfamiliar medications). The participants reviewed each instruction for 30 s and then, with the instruction still in front of them, answered 12 questions about information that was explicitly stated (e.g., medication name, purpose, dose, times to take, and potential side effects) or implied by the instruction (e.g., how many pills to take in a 24-hr period; what to do if a dose is missed). Because the type and amount of information sometimes varied between formats, we tested only the information contained in both. Although some information was more specific in the patient-centered instruction (e.g., take medication at a specific hour vs one time a day) and some more specific in the standard instructions (medication name vs drug class name), we phrased questions so that answers could be found in either version (e.g., "How many times a day do you need to take your medication?"). We audiotaped answers for later analysis.

Following the question task, we removed the instruction; after participants performed a 30-s distracter task (canceling each letter *e* in a passage), we asked them to recall information from the instruction (free recall task) and then answer questions about specific information (same as the explicit comprehension questions—cued recall task). We measured memory according to the percentage of correctly recalled information. We measured comprehension by time and accuracy to answer questions with instructions in view. We defined answer time as the interval from the end of the question to the beginning of the answer, and we measured it blind to condition from the audiotape. The question task may relate to the ability to initially read instructions to understand how to take medication, or to search for information in response to an event such as experiencing side effects. The recall tasks tap the ability to retrieve knowledge about how to take the medication.

We measured several cognitive abilities. We measured health-related literacy by using the Short Test of Functional Health Literacy in Adults (S-TOFHLA; see Baker, Williams, Parker, Gazmararian, & Nurss, 1999). This 7-min test assesses the ability to read and understand actual health-related passages with readability levels of 4.3 and 10.4 grade levels (Gunning–Fog index). Scores on this version of the test range from 0 to 36 (0–16 = inadequate health literacy, 17–22 = marginal literacy, and 23–36 = adequate literacy) and are often lower for older adults and predict health utilization (Baker et al., 2000). We measured verbal working memory, or the ability to simultaneously store and manipulate verbal information, by using the Listening Span task. Participants answered questions about progressively larger sets of simple spoken sentences (one to six sentences) and then recalled the final word of each sentence in the set. The span score is the size of


Diuretics

(Pronounced: DI-yu-RET-iks)

RULES TO PLAY BY
RULES TO LIVE BY

IDENTIFYING YOUR MEDICATION

- The Diuretic label is yellow.
- This type of pill called a "waterpill," helps get rid of the extra water from your body.
- The types of Diuretics are Bumetanide (Bumex®), Furosemide (Lasix®), Torsemide (Demadex®), Metolazone (Zaroxolyn®), and Hydrochlorothiazide/HCTZ (Hydrodiuril®, Microzide®).

DIRECTIONS

The pills in the bottle with the yellow label will make you have to go the bathroom more often than usual. So, when possible, take them in the morning — so you won't have to get up during the night. You can take the pills with or without food. Either way is O.K.

Take the last dose of your medicine no later than 6 p.m. so that you won't be waking up during the night to go to the bathroom.

If you forget to take your diuretic on time, take it as soon as you remember. However, if it is almost time for your next dose, skip the dose you missed and go back to your regular schedule. DO NOT DOUBLE-DOSE.

SIDE EFFECTS

You're going to be making more trips to the bathroom to urinate. This can be annoying, but, try to remember that it means your pills are working and getting rid of the extra fluid that builds up and makes your hands and feet swell. It is important to get rid of that fluid.

A few people get dizzy, have headaches, get diarrhea or low blood pressure. Call your doctor or clinic if these symptoms become really bothersome, or if you feel all dried up like a raisin.

NOTES

- Before taking these pills, make sure your doctor and pharmacist know about all other prescriptions and over-the-counter medications you take.

REMINDER:

THE DIRECTIONS ON YOUR PILL BOTTLES ARE LIKE RULES IN A GAME.

IF YOU CHEAT — YOU LOSE.

DON'T CHEAT ON YOUR PILLS.

PLAY TO WIN. WIN FOR LIFE.

Figure 1. Example of patient-centered instructions for diuretic medication.

the sentence set for which participants can reliably recall all sentence-final words (for details on materials and scoring, see Salthouse & Babcock, 1990). We measured processing speed by using the Letter Comparison and Pattern Comparison tasks (Salthouse & Babcock, 1991). In these timed paper-and-pencil tasks, participants decided as rapidly as possible whether pairs of letter sets or line patterns were the same or different (maximum score = 25). The working memory and speed measures account for age-related differences in performance of several verbal reasoning and memory tasks (Salthouse & Babcock, 1991).

Plan of Analysis

We analyzed recall and comprehension measures by using a randomized block factorial analysis of variance

Table 1. Characteristics of Participants

Variable	(N = 32)
Female, *n* (%)	24 (75.0)
Race, *n* (%)	
White	12.0 (37.5)
Black	20.0 (62.5)
Age, *M* (*SD*)	63.9 (9.4)
Education, *M* (*SD*)	11.5 (3.1)
S-TOFHLA score, *M* (*SD*)	26.3 (9.7)
Listening span task, *M* (*SD*)	2.4 (1.1)
Comparison tasks	
Pattern	22.5 (7.3)
Letter	13.4 (4.8)

Notes: S-TOFHLA = Short Test of Functional Health Literacy for Adults (Baker et al., 1999). More information on Listening Span task and Letter and Pattern Comparison tasks can be found in Salthouse & Babcock (1990, 1991, respectively).

(ANOVA) design with instruction format (patient-centered vs standard pharmacy) and medication familiarity (currently prescribed vs never prescribed) as repeated measures (Kirk, 1995). We included type of test (free vs cued recall) as a repeated measure for recall. These analyses collapsed over the order of instruction presentation variable because order did not influence recall, $F < 1.0$. We also investigated whether patient characteristics predicted recall. Because instruction format influenced recall, we conducted analyses separately for patient-centered and for standard instruction recall. In a set of hierarchical regressions, we first examined whether variance in recall was related to patient age (Model 1). We then examined how much age-related variance was explained by differences in education and health-related literacy (Model 2). Finally, we examined whether additional variance in recall was explained by the cognitive measures (processing speed and working memory; Model 3). There was no evidence for multicollinearity among variables entered together in these analyses.

Results

Participant Characteristics

The majority of participants were female and African American (see Table 1) and ranged in age from 51 to 87 years. Over half scored at the two most severe levels of the New York Heart Association measure for CHF function (Level 1 = 12.5%; Level 2 = 28%; Level 3 = 40.6%; Level 4 =18.8%; The Criteria Committee of the New York Heart Association, 1964). Although the mean S-TOFHLA score indicated adequate literacy for the sample as a whole, 34% of participants had marginal or inadequate health-related literacy. Participants also experienced typical age-related declines on the measures of literacy ($r = -.49$, $p < .010$, $\beta = -0.49$), working memory ($r = -.54$, $p < .010$, $\beta = -0.06$), and processing speed ($r = -.35$, $p < .050$, $\beta = -0.21$).

Table 2. Effects of Instruction Format and Familiarity on Individual Item Recall

Type of Medication Information	Recall: Patient Centered	Recall: Standard Pharmacy	Format $F(1,209)$	Familiarity $F(1,209)$	Instruction × Familiar $F(1,209)$
Name	65.6	53.1	6.04**	7.62***	2.29
Dose	71.5	61.5	4.27**	1.90	0.19
Time	64.0	63.0	0.07	1.92	9.66***
Side effects	78.5	70.5	3.60*	0.07	0.11
Contact	43.5	54.0	7.09***	0.34	0.06
Purpose	64.5	61.0	0.84	16.29***	0.82

Notes: For the table, N = 32. Data presented are the percentage correct.
*$p < .10$; **$p < .05$; ***$p < .01$.

Instruction Recall

Recall was more accurate for patient-centered instructions (patient centered or PC = 64%, standard = 60%), $F(1, 209) = 3.9$, $p = .05$, and for instructions about familiar medications (familiar = 64%, unfamiliar = 59%), $F(1, 209) = 5.4$, $p < .05$. The Format × Familiarity interaction was not significant, $F(1, 209) = 2.5$, $p > .10$. Cued recall was more accurate than free recall (cued = 75%, free = 50%), $F(1, 209) = 146.9$, $p < .001$, but type of recall did not interact with the instruction variables.

To explore reasons for the patient-centered advantage, we examined format effects for each type of information probed in the recall task. Table 2 shows that the patient-centered format advantage primarily occurred for medication name, dose, and time (the Format × Familiarity interaction for time information was produced because the patient-centered benefit occurred only in the unfamiliar medication condition). This analysis suggests that the icons improved recall because these three items were conveyed by icons as well as by text in these instructions. This analysis also showed that the patient-centered benefit for recall was greater for some adherence-critical information than for overall recall, with a 23% improvement for name and 16% for dose information. Finally, the familiarity advantage occurred only for general facts that patients were likely to know before the study (medication purpose, name).

Comprehension Time and Accuracy

An analysis of mean answer time (times for incorrect answers excluded) produced a pattern similar to recall. The answer time was shorter for questions about patient-centered instructions (PC = 2.9 s, standard = 3.3 s), $F(1, 79) = 7.0$, $p = .01$, and about familiar medication instructions (familiar = 2.3 s, unfamiliar = 3.9 s), $F(1, 79) = 31.0$, $p < .001$. The Format × Familiarity interaction was not significant, $F(1, 79) = 1.1$, $p > .10$.

Patient-centered instructions were understood more accurately for unfamiliar medications (PC = 81%, standard = 74%), $F(1, 93) = 5.8$, $p < .05$, but the

Table 3. Hierarchical Regression Analyses of Standard and Patient-Centered Instruction Recall

	Model Number								
	1			2			3		
Instruction Recall	B	Change R^2	Effect Size	B	Change R^2	Effect Size	B	Change R^2	Effect Size
Standard pharmacy		30%**	0.43		27%**	1.33		11%*	2.13
Age	−.57***			−.28			−.16		
Education				.22			.22		
Health literacy				.45***			.25		
Processing speed							.07		
Working memory							.36*		
Patient-centered pharmacy		18%**	0.23		35%**	1.13		1%	1.17
Age	−.45***			−.12			−.08		
Education				.25			.25		
Health literacy				.53***			.54***		
Processing speed							−.14		
Working memory							.16		

Note: For the table, $N = 32$.
*$p < .10$; **$p < .05$; ***$p < .01$.

standard instructions were more accurate for familiar medications (PC = 75%, standard = 82%), $F(1, 93) = 5.3, p < .05$; Format × Familiarity interaction, $F(1, 93) = 11.2$, $p < .001$. Main effects of format and familiarity were not significant, Fs < 1.0.

Predictors of Medication Information Recall

Age accounted for 30% of the variance in recall of standard instructions (Model 1, Table 3). Education and health-related literacy accounted for an additional 27% of the variance, and the literacy measure appeared to eliminate the impact of age on recall (Model 2). Finally, the working memory and processing speed measures accounted for an additional 11% of the variance. The impact of health literacy on recall was eliminated, primarily when working memory was controlled for (Model 3).

The pattern was somewhat different for patient-centered instruction recall. Age accounted for only 18% of the variance. As with standard instruction recall, the effect of age was eliminated when health literacy was controlled for (Model 2). Unlike standard instruction recall, literacy predicted recall even with cognitive ability controlled, primarily because working memory had a weaker relationship to patient-centered than to standard instruction recall (Model 3).

Discussion

Older adults often receive medication information in the form of expanded instructions at pharmacies (Svarstad & Bultman, 1999). Although these instructions do have advantages over directions on medication containers (e.g., larger print), more information is likely to improve patients' knowledge and self-care only if it is easy to understand and remember (Morrow & Leirer, 1999). Our goal is to increase memory for information about taking CHF medications by using a patient-centered approach to instruction design.

We previously found that older adults with CHF tend to prefer patient-centered instructions over instructions for the same medications from a chain pharmacy (Morrow et al., 2004). The present study shows that older adults also better understand and remember these instructions. Although only immediate recall was measured in our study, there is evidence that level of immediate recall of medication information predicts later recall at a 1-month test (McGuire, 1996).

The patient-centered and standard instructions differ on several dimensions, making it difficult to pinpoint why the patient-centered instructions were better remembered. For example, larger print reduced input limitations on comprehension, and simpler language (reflected in better readability scores) addressed literacy limitations. The icons may also have reinforced information about medication name, dose, and time. Indeed, analysis of instruction format effects for types of information (Table 2) suggested that icon-relevant information was especially likely to be recalled from the patient-centered instructions. Icons may particularly help less literate patients (Houts et al., 1998).

Instructions for familiar medications were better recalled than those for unfamiliar medications. An analysis by type of information suggested this advantage occurred for general facts that patients likely knew before the study. Although it is possible that variable content across instructions contributed to familiarity effects, familiar and unfamiliar instructions did not differ in mean readability scores.

Patient-centered instructions were understood more accurately for the unfamiliar medications, whereas the standard instructions were better understood for the familiar medications. Patients may have been familiar with the standard pharmacy format for medications they were already taking, which could mitigate effectiveness of the novel patient-centered format. However, the standard format advantage did not persist to the recall tasks, suggesting that any difficulty understanding the novel format for familiar medications was transient. Nonetheless, the patient-centered format may be easier to introduce for newly prescribed medications.

We also explored whether patient characteristics predicted recall. Although findings from these exploratory regression analyses must be interpreted with caution because of the small sample size, several findings are consistent with previous literature. The finding that age differences in recall were associated with differences in health literacy fits with evidence that less literate older adults are at risk for poor knowledge of self-care activities (Baker et al., 2000). There was also evidence that the effects of health literacy on standard instruction recall reflected age differences in working memory capacity, suggesting that age differences in health literacy reflect age-related differences in more basic cognitive resources (Baker et al., 2000). Working memory explained less variance in recall of the patient-centered instructions than of the standard instructions, suggesting that a patient-centered approach may especially benefit older adults with reduced working memory. However, the health-literacy measure predicted recall of the patient-centered instructions even after working memory was controlled for, perhaps because these instructions were primarily text based despite the presence of icons.

Implications for Improving Health Communication

Patient-centered instructions improved memory for medication information of older adults diagnosed with CHF. This suggests a fruitful approach to improving the design of instructions for prescribed medications that are available in many pharmacies, so that the instructions are useful as well as accurate, and thus likely to be used by older adults. The finding that participants with lower levels of health literacy recalled less of the patient-centered as well as the standard instructions suggests that such patients need to be supported by a patient-centered approach to spoken as well as printed communication (Morrow, 1997). These patients may also benefit from multimedia instructions such as those delivered by the Internet (Wright, 1999). Implementing these recommendations would require working with administrators, particularly regarding the use of computers to facilitate the distribution of patient-centered instructions in pharmacies.

Implications for Future Research

Patient-centered instructions may help increase medication adherence by improving patients' medication knowledge, and perhaps by influencing patients' beliefs about CHF and its treatment, both of which should support the ability to create effective adherence plans. However, this provisional conclusion must be verified by studies with larger diverse samples of patients in order to more definitively investigate the impact of literacy on patient knowledge and adherence. We also note that only one pharmacy format was tested in our study, and these instructions vary in quality across pharmacies (Svarstad & Bultman, 1999). Thus, future studies must assess larger samples of instructional materials. Finally, knowledge about medications is only one of many factors influencing adherence, such as external memory aids and the cost of medications (Park et al., 1999). The impact of the patient-centered instructions on adherence is now being investigated in an ongoing study assessing the impact of a multifaceted pharmacist-based educational intervention on adherence to CHF medications.

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