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Effect of Standardized, Patient-Centered Label Instructions to Improve Comprehension of Prescription Drug Use

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Abstract

Objective—To evaluate the effectiveness of standardized, patient-centered label (PCL) instructions to improve comprehension of prescription drug use compared to typical instructions.

Methods—500 adult patients recruited from two academic and two community primary care clinics in Chicago, IL and Shreveport, LA were assigned to receive: 1) standard prescription instructions written as times per day (once, twice three times per day) [usual care], 2) PCL instructions that specify explicit timing with standard intervals (morning, noon, evening, bedtime) [PCL], or 3) PCL instructions with a graphic aid to visually depict dose and timing of the medication [PCL + Graphic]. The outcome was correct interpretation of label instructions.

Results—Instructions with the PCL format were more likely to be correctly interpreted compared to standard instructions (Adjusted Relative Risk (RR) 1.33, 95% Confidence Interval (CI) 1.25 – 1.41). Inclusion of the graphic aid (PCL + Graphic) decreased rates of correct interpretation compared to PCL instructions alone (RR 0.93, 95% CI 0.89 - 0.97). Lower literate

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patients were better able to interpret PCL instructions (low literacy: RR 1.39, 95% CI 1.14 – 1.68; p=0.001).

Conclusion—The PCL approach could improve patients' understanding and use of their medication regimen.

Keywords

Prescription; medication; comprehension; patient; labels; safety; health literacy

Patients frequently have difficulty correctly interpreting common prescription drug instructions,[1-5] Those with limited literacy are at greater risk for making errors in understanding how to use a specified medication. Multiple factors may contribute to misunderstanding, including unnecessarily complex and variable instructions.[6] Recent studies have shown considerable variability in both the way that physicians write prescriptions and how pharmacies transcribe physicians' instructions.[7,8] These problems have been highlighted in two recent Institute of Medicine (IOM) reports.[9,10]

The Food and Drug Administration and other organizations have long sought ‘best practice’ standards for prescription drug labeling.[11-15] Some evidence suggests that simplified and explicit instructions can improve patient comprehension.[16-18] In 2007, an evidence-based, patient-centered drug label design (PCL) was proposed to improve understanding and eliminate variability in clinical practice.[10] The PCL sequences and organizes information on the label from a patient's perspective, and encourages prescribing medication around four standard time periods (morning, noon, evening, bedtime); a format that accounts for how nearly 90 percent of solid pill form medications are prescribed.[10]

We sought to evaluate whether use of PCL instructions would improve patient comprehension compared to a current, widely used standard. In addition, the use of a graphic aid accompanying the text PCL instructions that visually depicted the PCL time periods was evaluated to determine if it produced any incremental improvement in patient comprehension, particularly among those with limited literacy.[19]

Methods

A cross-sectional evaluation of the efficacy of PCL instructions was conducted. Patients were sequentially assigned to receive either 1) standard prescription drug label instructions [usual care], 2) labels using the PCL format and plain language instructions mapped to four standard specified time periods [PCL], or 3) labels using the PCL label instructions with an included graphic aid to visually depict dose and timing of the medication [PCL + Graphic] (Table 1).

Study Participants

Adults attending one of four outpatient clinics were recruited in Shreveport, Louisiana and Chicago, Illinois. One clinic in each city was an academic general medicine practice while a second was a community health center. Subject recruitment took place between June and August 2007. Patients were eligible if they were 18 or older, and ineligible if the clinic nurse or study research assistant (RA) identified a patient as having one or more of the following conditions: (1) severely impaired vision; (2) hearing problems; (3) too ill to participate; 4) non-English speaking. Institutional Review Boards for all locations approved the study. A total of 562 patients were approached in the order they arrived at clinics and prior to medical encounters; 530 consented to the study. In all, 500 patients participated in the study (30 patients deemed ineligible); the sample was evenly split across the two study locations

(n=250 per city) and practice setting (academic, community; n=125 within each study location). A response rate of 92.8% was determined following American Association for Public Opinion Research standards.[20]

Intervention

We tested the use of PCL instructions to help patients accurately read and dose out medication regimens at appropriately spaced intervals. Four time periods are used to identify when medicine should be taken: morning, noon, evening, and bedtime. In addition, text is simplified, numeric characters instead of words detail dose (e.g. number of pills), and 'carriage returns' place each dose on a separate line to clearly identify every time period a medicine is to be taken (see instructions 2 and 3, Table 1). The use of a graphic aid to visually depict the four PCL time periods and the number of pills to be taken at each time was also included and its added benefit targeted in the evaluation. The graphic was pilot tested among 50 primary care patients at the academic internal medicine practice in Chicago to confirm its feasibility.

Structured Interview and Assignment

A structured interview protocol was developed to assess patient understanding of the PCL with and without the graphic aid; a process previously used by our research team.[3,5,16] A trained RA collected sociodemographic information, then presented patients, one at a time, with three prescription pill bottle containers with either standard, PCL, or PCL + Graphic drug labels attached for review. Subjects were exposed to only one label type. Once patients provided their interpretations, the RA administered the Rapid Estimate of Adult Literacy in Medicine (REALM).[21-23]

Outcomes

Correct interpretation of the three prescription drug label instructions was evaluated by 1) subjects' verbatim response to the RA asking "In your own words, how would you take this medicine?", and 2) subjects' demonstration of understanding by a second question: "How many pills would you take of this medicine in one day?" Responses to the first question were independently rated as either correct or incorrect by three general internal medicine attending physicians from three different academic medical centers. Patients had to respond correctly to both questions in order to be classified as having correctly interpreted a prescription instruction. This was deemed necessary as a prior study found that patients could passively repeat instructions but not operationalize them by correctly identifying the proper dose of the medication.[5]

Blinding and Coding

The three physician raters who coded the patients' verbatim responses to the first question describing appropriate use were blinded to all patient information and trained to follow stringent coding guidelines pre-specified by the research team. Inter-rater reliability between the physicians was high (Kappa = 0.87). The 380 responses (8.4%) that received discordant ratings were sent to a three-member expert panel for further review and a final coding decision.

Analysis Plan

A generalized linear model with a Poisson distribution and complementary log link function was used to estimate the risk ratio of correct interpretation of dosage instructions for covariates in the model compared to each referent condition. Robust error estimation was used to correct for overestimation of variance resulting from using Poisson distribution for binomial outcome. The primary independent variable of interest was label type (standard,

PCL, PCL + Graphic). The final multivariate model included the potential confounding variables age, gender, race (African American vs. white), literacy, education, and number of medications currently taken daily. Patient literacy was classified as low (≤ 6th grade), marginal (7th -8th grade) or adequate (≥ 9th grade). Interaction terms between label type, literacy, age, and regimen complexity were included in models to determine whether associations varied according to these characteristics. Statistical analyses were performed using STATA 10.0 (College Station, TX).

Results

Table 2 presents the sociodemographic characteristics of subjects. Overall, patient literacy was limited; 20.2 percent were reading below a 7th grade level (low literacy) and 32.0 percent were reading at the 7th-8th grade level (marginal literacy). Lower literacy was associated with older age ($p<0.001$), African American race ($p<0.001$), less education ($p<0.001$), and the Shreveport study site ($p<0.001$). No significant differences were reported between literacy level, gender or number of prescription medications taken daily.

Overall rates of correct interpretation to prescription drug container label instructions varied among standard, PCL, and PCL + Graphic labels (69%, 91%, and 86% respectively, $p<0.001$). PCL instructions (with or without graphic aid) were more likely to be correctly interpreted than their standard label counterparts when a drug was to be taken 2 times (88% and 84% vs. 77%, $p<0.04$) or 3 times per day (91% and 91% vs. 44%, $p<0.001$).

In multivariate analyses, prescription instructions with the PCL format were significantly more likely to be correctly interpreted compared to standard instructions (Adjusted Relative Risk (RR) 1.33, 95% Confidence Interval (CI) 1.25 – 1.41, $p<0.001$; Table 3). The inclusion of the graphic aid on the label (PCL + Graphic) significantly decreased rates of correct interpretation compared to the PCL instructions alone (RR 0.93, 95% CI 0.89 - 0.97, $p=0.001$). Greater regimen complexity, less education, and fewer prescription medications currently taken by patients all were significant independent predictors of lower rates of correct interpretation.

Low literacy was not associated with misinterpretation (RR 0.95, 95% CI 0.86 – 1.04, $p=0.25$). However, a significant interaction between literacy and label type was found; low literate patients were more likely to correctly interpret PCL instructions compared to standard label instructions (low literacy: RR 1.39, 95% CI 1.14 – 1.68; $p=0.001$; see Figure). Among subjects with low literacy, the graphic aid did not improve or hinder comprehension compared to the PCL instructions alone (RR 0.98, 95% CI 0.88 – 1.10; $p=0.75$). In addition, an interaction between regimen complexity and label type was found; differences between rates of correct interpretation for the PCL and standard instructions was significant for the most complex regimen (refer to Table 1, regimen 3 - RR 2.00, 95% CI 1.44 – 2.42; $p<0.001$). The addition of the graphic aid did not benefit interpretation by regimen.

Discussion

Patient-centered label instructions that used explicit time periods significantly improved understanding of the appropriate time medications should be taken. Rates of understanding PCL instructions exceeded 90 percent in this diverse sample of patients. These rates were even higher than those achieved previously using clock times (8am, 5pm) or periods of day in an earlier investigation by this research team.[16] The PCL format was particularly useful for patients with low literacy skills and when regimens displayed some level of complexity (i.e. > one pill a day).

The inclusion of a graphic aid to support comprehension among the elderly and those with limited literacy provided no additional benefit and may even impair comprehension. Currently there is disagreement in the literature on the use of icons, particularly among the elderly to convey medication use, and table formats have been found to be challenging among lower literate adults.[24-28] It is possible the graphic aid was redundant, causing confusion as subjects tried to interpret and mentally resolve both presentations. In the second and third regimens given to patients where the prescribed drug was to be taken at multiple time periods, rates of correct interpretation were higher for the PCL + graphic compared to the standard, but not when compared to the PCL alone. This emphasizes the importance of first validating even intuitively reasonable interventions.

Contrary to prior findings, lower literacy was not associated with incorrect interpretation of prescription instructions. However, fewer years of schooling was significantly linked to poorer patient understanding. This might be explained by a more diverse sample or possibly model over-adjustment. We also found a threshold that patients currently taking ≥ 3 prescription medications were more likely to correctly interpret instructions. It could be that prior experience with a medication, and/or physicians and pharmacists, may have helped individuals comprehend instructions for these hypothetical regimens.

Our study did not examine the association between misinterpretation of prescription instructions and actual error in taking real medications. We also did not have information on patients' health background; in particular whether they had actual experience with medication use because the study design did not include a formal chart review. Patients' motivation, concentration and comprehension might have been greater if they were reporting on their own medicine given by their physician for conditions they actually had.[29-32] Although patients were not randomly assigned, no differences were noted by demographic characteristics across study arms. Finally, the generalizability of our findings may be limited as patients were predominantly African American and female, and that participation was limited to patients who spoke English.

Further enhancements to the PCL instructions may be required. For example, attention must be given to tailoring directions for patients who work at night, or who fast for long periods of the day for cultural reasons. Also strategies must be developed to address instructions for prescription drugs that are to be taken only as needed, for non-pill form medications, medications with tapered doses, and for complex regimens that include auxiliary warnings and precautions that would affect how a patient administers a drug (i.e. with food, not to lie down after taking). We are currently learning more about the feasibility and effectiveness of the PCL to improve patients' actual use of prescription medications within a clinical trial funded by the Agency for Healthcare Research and Quality.[33,34] There are also clear opportunities for the PCL approach to become a standard, as it was included in recent legislation passed by the State Board of Pharmacy in California to promote better labeling practices.[35]

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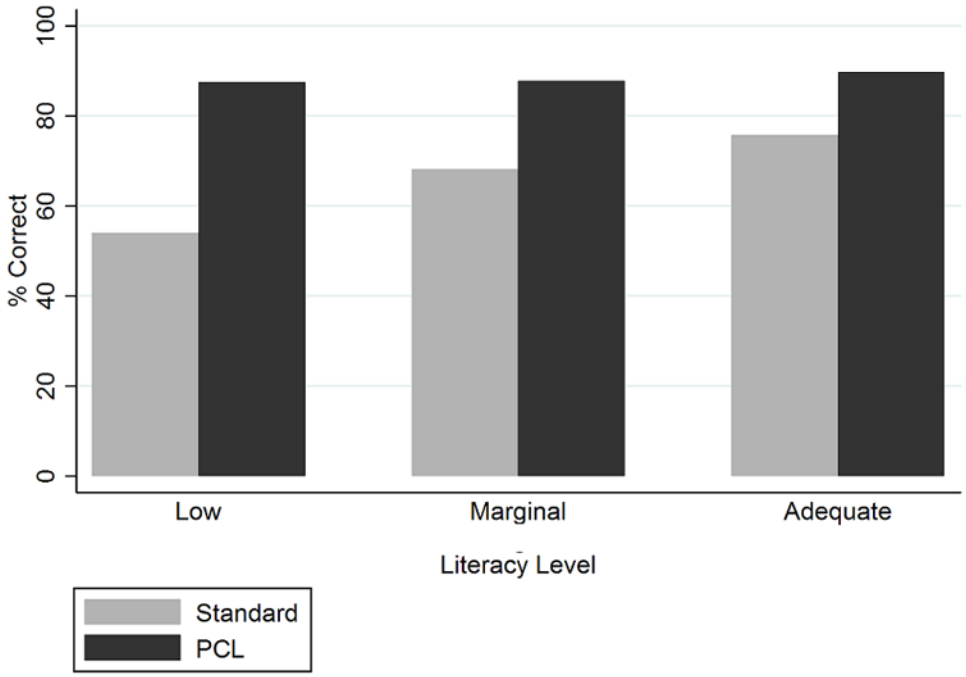


Figure 1. Rates of correct interpretation by literacy Level and Study Arm

Table 1

Prescription Label Instructions by Study Arm.

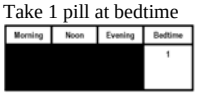
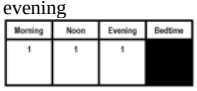
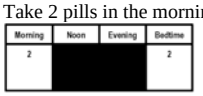
Instruction	Standard	PCL	PCL + Graphic
1	Take one pill by mouth once daily	Take 1 pill at bedtime	Take 1 pill at bedtime 
2	Take one pill by mouth three times daily	Take 1 pill in the morning, 1 pill at noon, and 1 pill in the evening	Take 1 pill in the morning, 1 pill at noon, and 1 pill in the evening 
3	Take two pills by mouth twice daily	Take 2 pills in the morning, and 2 pills at bedtime	Take 2 pills in the morning, and 2 pills at bedtime 

Table 2

Characteristics of Study Sample, Stratified by Literacy Level

Variable	All Subjects (n=500)	Literacy Level			P Value
		Low (n=101)	Marginal (n=160)	Adequate (n=239)	
Age, Mean (SD)	48.9 (14.4)	48.1(13.3)	45.6(14.6)	51.5(14.2)	<0.001
Male, %	39.6	44.6	38.8	38.1	0.52
Race, %					<0.001
African American	63.6	90.1	83.1	39.3	
White	32.8	6.9	15.0	55.7	
Other	3.6	3.0	1.9	5.0	
Years of Education, %					<0.001
< 12	19.4	36.6	30.0	5.0	
12	33.2	53.5	36.2	22.6	
13-15	20.4	6.9	21.9	25.1	
16-20	26.6	2.0	11.9	46.9	
Medications Taken Daily, Mean (SD)	2.9 (3.1)	2.8(3.5)	2.6(2.9)	3.1(3.1)	0.28
Site, %					<0.001
Chicago, IL	50.0	31.7	54.4	54.8	
Shreveport, LA	50.0	68.3	45.6	45.2	

Table 3

Generalized Estimating Equation (GEE) Model for Correct Interpretation of Prescription Label Instructions.

Variable	Correct Interpretation		
	RR	95% CI	P value
Instruction Type			
Standard			
Patient-Centered Label (PCL)	1.33	(1.25 - 1.41)	<0.001
Use of Graphic			
No graphic on label			
Graphic on label	0.93	(0.89 - 0.97)	0.001
Regimen complexity			
1 pill a day			
3 pills a day	0.95	(0.90 - 0.99)	0.02
4 pills a day	0.85	(0.80 - 0.89)	<0.001
Age Group			
< 40			
40 – 49	0.95	(0.88 - 1.03)	0.23
50 – 59	0.94	(0.87 - 1.02)	0.13
≥ 60	0.96	(0.89 - 1.04)	0.32
Gender			
Female			
Male	0.95	(0.90 - 1.01)	0.12
Race			
White			
African American	0.98	(0.92 - 1.04)	0.52
Literacy Level			
Adequate			
Marginal	1.00	(0.94 - 1.07)	0.99
Low	0.95	(0.86 - 1.04)	0.25
Years of Schooling			
≥ College Graduate			
Some College	0.98	(0.91 - 1.06)	0.64
High School Graduate/GED	0.91	(0.84 - 0.99)	0.02
< High School	0.90	(0.81 - 1.00)	0.05
# Medications Taken Daily			
None			
1 - 2	1.03	(0.95 - 1.12)	0.49
3 – 4	1.13	(1.04 - 1.23)	0.003
≥ 5	1.09	(0.99 - 1.19)	0.08
Clinic			
Shreveport			
Chicago	0.90	(0.85 - 0.96)	0.001

RR=Relative Risk Ratio adjusted for all variables shown; CI= Confidence Interval