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Development of an illustrated medication schedule as a low-literacy patient education tool

Sunil Kripalani [a,*], Rashanda Robertson [a], Melissa H. Love-Ghaffari [a], Laura E. Henderson [a], Jessica Praska [b], Akilah Strawder [c], Marra G. Katz [a], Terry A. Jacobson [a]

[a] *Emory University School of Medicine, Atlanta, GA, United States*
[b] *Department of Veterans Affairs, Denver, CO, United States*
[c] *Grady Memorial Hospital, Atlanta, GA, United States*

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Abstract

Objective: Patients with low health literacy have difficulty understanding prescription drug labels and other medication instructions. This article describes the development, implementation, and preliminary evaluation of an illustrated medication schedule (a ''pill card'') that depicts a patient's daily medication regimen using pill images and icons.
Methods: Participants in a randomized controlled trial who were assigned to receive the pill card intervention described their use of the card and its perceived effectiveness. Responses were analyzed by level of patient literacy and other characteristics.
Results: Among the 209 respondents, 173 (83%) reported using the pill card when they initially received it, though use declined to 60% approximately 3 months later. Patients with inadequate or marginal literacy skills, less than high school education, or cognitive impairment were most likely to refer to the card on a regular basis initially and at 3 months ($p < 0.05$). Most pill card users (92%) rated the tool as very easy to understand, and 94% found it helpful for remembering important medication information, such as the name, purpose, or time of administration.
Conclusion: Nearly all patients considered an illustrated medication schedule to be a useful and easily understood tool to assist with medication management. Patients with limited literacy skills, educational attainment, or cognitive function referred to the aid with greater frequency.
Practice implications: Picture-based instructions promote better understanding of prescription medications, particularly among patients with limited literacy skills or cognitive impairment, and should be used more widely in practice.

Keywords: Health literacy; Patient education; Medication adherence

1. Introduction

Research demonstrates that 20–50% of patients do not take prescription medications as directed [1–3]. Medication nonadherence may be intentional or unintentional, and it may take the form of missing or changing doses, deviating from the intended time schedule, or discontinuing medications altogether [4].

The consequences of medication nonadherence are significant. In the setting of chronic diseases such as hypertension and hypercholesterolemia, poor adherence limits the effectiveness of therapies proven to improve cardiovascular outcomes [5,6]. Nonadherence has also been linked to significantly higher health care costs, hospitalization, and patient mortality [7,8].

1.1. Health literacy

Low health literacy has emerged as a potentially important risk factor for nonadherence [9–12]. Health literacy is defined as ''the degree to which individuals have the capacity to obtain, process, and understand basic health information and services needed to make appropriate health decisions'' [13]. At least 90 million adult Americans lack the literacy skills needed to function effectively in today's health care environment [14–16].

Individuals with low health literacy commonly have difficulty comprehending and remembering medical instructions, such as those found on medication labels [17,18]. In a

* Corresponding author at: Division of General Medicine, Emory University School of Medicine, 49 Jesse Hill Jr Dr SE, Atlanta, GA 30303, United States. Tel.: +1 404 778 1627; fax: +1 404 778 1602.
E-mail address: skripal@emory.edu (S. Kripalani).

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large study of Medicare enrollees, 54% of patients with low health literacy could not understand instructions to take medication on an empty stomach, and 48% did not understand how to take a medication every 6 h [18]. Low-literacy patients are twice as likely to misinterpret prescription drug labels [17] and three to four times more likely to misinterpret drug warning labels [19]. They have 10–18 times the odds of being unable to identify all of their medications [20]. Medication mismanagement or nonadherence among low-literacy patients is likely related to poor comprehension and is therefore unintentional.

The effects of low health literacy extend to many other areas of healthcare, contributing to disparities in disease-related knowledge, self-care activities, and health outcomes [21,22]. Low-literacy patients demonstrate greater utilization of acute care services, incur significantly higher health care costs, and have higher mortality rates [23–26]. It is important to develop strategies to help patients with low health literacy better understand and perform required self-care activities, including medication management [14,27].

1.2. Pictorial-based medication instructions

To reduce misinterpretation and improve adherence, pharmacists and physicians have begun to use pictorial images to enhance communication of verbal or written medication instructions [28,29]. Pictorials are useful for conveying information such as the drug indication, dosing schedule, special instructions for administration, side effects, and importance of completing the full course of therapy [30,31]. Experts suggest that graphics be used in combination with verbal or written instructions [31–35], as some images can be confusing when they appear alone [36–38].

Evidence summarized in a recent review shows that the addition of graphic images to prescription information increases patient satisfaction as well as patients' ability to recall the regimen, comprehend dosing instructions, and adhere to therapy [29]. Medication adherence also improved in two related studies that involved a color-coded medication schedule and a reminder chart that displayed which time of day patients should take each medication [39,40].

Most studies of pictorial medication instructions were conducted using single therapies or in a laboratory environment with simulated regimens, indicating a need for additional research involving the patient's own set of medications in a real-world setting [29]. Most of the studies in this area also did not analyze outcomes by level of patient literacy. However, at least two investigations suggest that low-literacy patients may derive greater benefit from pictorial medication instructions than their counterparts with adequate literacy skills [31,41].

1.3. Self-efficacy

When studying educational interventions that seek to enhance patients' medication understanding and adherence, social cognitive theory provides a useful conceptual foundation. Self-efficacy, the key construct of social cognitive theory, is defined as ''one's judgment of one's capabilities to organize and execute courses of action required to achieve designated types of performances'' [42]. Self-efficacy enhances individuals' perceptions of their ability to perform certain skills, such as medication management, and individuals with greater self-efficacy should have higher levels of adherence [43]. An effective means of building self-efficacy is through the simplification of specific behavioral steps while providing the opportunity to rehearse the steps [44]. Therefore, a patient education tool that simplifies medication instructions and serves as a useful reference to facilitate correct daily dosing should improve self-efficacy, as well as medication adherence.

In this article, the authors describe the development and implementation of an illustrated medication schedule (a ''pill card'') which provides pictorial-based dosing instructions specific to an individual's daily medication regimen. Formative and summative evaluations were performed among primary care patients, to examine the utility of the educational tool among adults with different levels of literacy.

2. Methods

2.1. Pill card development

2.1.1. Background research

Development of the pill card design began with a search for similar interventions already in use by others (see Fig. 1). We reviewed the medical and pharmacy literature and performed internet searches [29]. We also surveyed local pharmacists by telephone and posted emails on national pharmacy listservs, asking about the use of medication aids, visuals, or other simple patient education tools. The use of pictorial aids and other low-literacy educational approaches was rare in community pharmacies [45].

2.1.2. Initial design and formative evaluation

Two physicians with expertise in medication adherence, patient education, and literacy drafted the pill card design. The underlying concept was to use pictures to illustrate instructions for following a medication regimen, in order to maximize comprehension across levels of health literacy. The pictures would be appropriately reinforced with short text labels, and only the most essential medication instructions would be

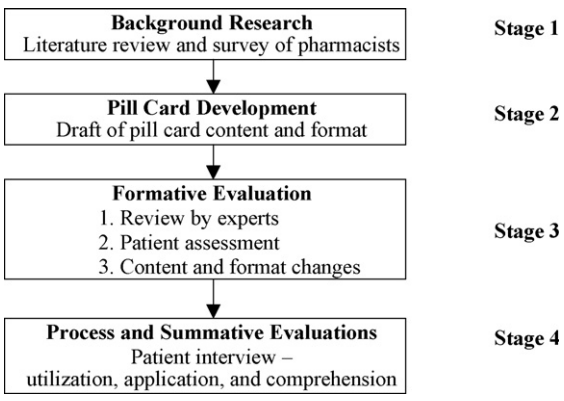

Fig. 1. Pill card development and evaluation.

included (e.g., name, purpose, appearance, and time of administration).

In the formative evaluation phase, a multidisciplinary team of healthcare providers reviewed the content and format of the design draft. Twelve patients of different age and educational attainment reviewed sample pill cards to provide input into the types of pictures used, the size of the text and overall document, and the desired content.

2.1.3. Pill card format

The final pill card design showed color photographs of each chronic oral medication, with pictorial aids to indicate the medication's purpose and time of administration (Fig. 2). Medication names and the column headings were printed in Times New Roman font, 16 and 18 point, respectively. Up to 5 medications could be listed on each page of the 8 1/2 × 11 in. pill card. All of the information on the front of the card would be customized to the patient's regimen and printed at the point of care. The back of the card contained preprinted instructions alerting patients to call a dedicated phone line if any of their medicines changed or if the pills they received at the pharmacy looked different from those printed on their card. The back of the card also explained that the pill card listed only the patient's chronic oral prescription medications, and that over-the-counter, short-term, or "prn" medications (e.g., certain analgesics, antibiotics, and cough and cold medicines) were not listed, nor were liquids and inhalers (because of difficulties indicating the proper dosing instructions).

Based on the health system formulary, a library of approximately 250 digital pill photos was assembled on a laptop computer and updated monthly to reflect changes in the formulary and suppliers. The database was kept in a formatted table similar to that of the pill card, which facilitated the creation of each patient's pill card by allowing research assistants to easily cut and paste rows from the master pill database.

2.2. Overview of study design

The illustrated pill card was developed as an intervention for a randomized controlled trial, Improving Medication Adherence through Graphically Enhanced interventions in Coronary Heart Disease (IMAGE-CHD). Consenting subjects who enrolled in IMAGE-CHD were randomized to receive usual care, illustrated pill cards, refill reminder postcards, or both interventions. Subjects were asked to complete a follow-up interview approximately 3 months after enrollment, in which they described their perceptions and use of each intervention. Of the 435 total subjects, 242 were randomized to a group receiving the pill card intervention, and they are the subjects of the present analysis. The Emory University Institutional Review Board and the Grady Health System Research Oversight Committee approved the study design and materials.

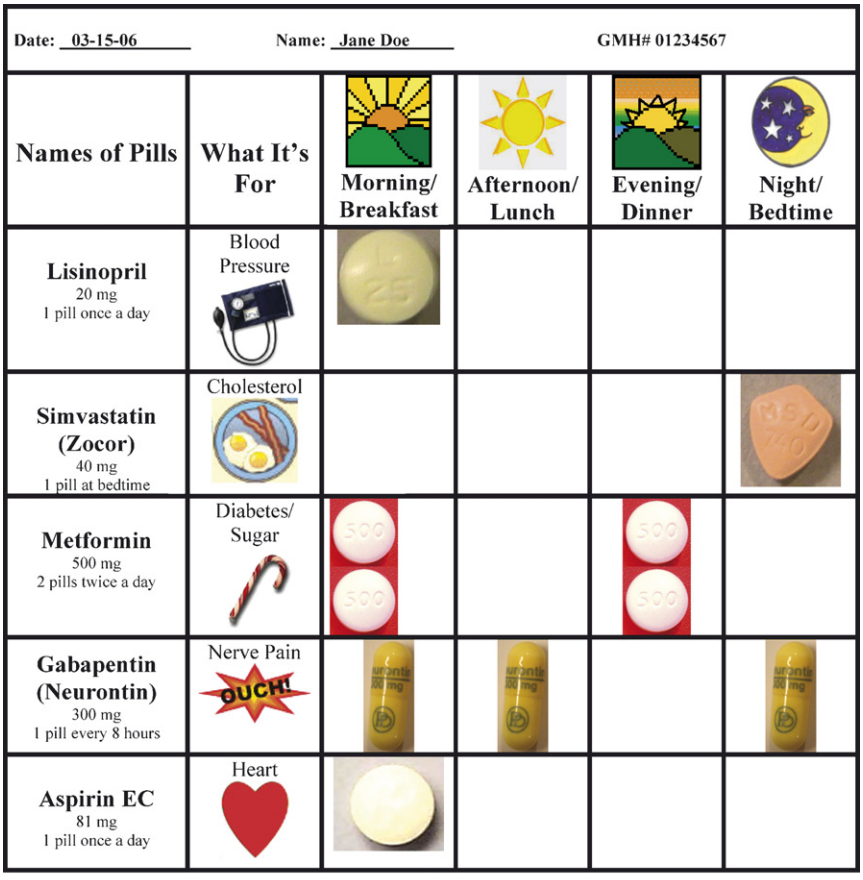

Fig. 2. Sample pill card.

2.3. Setting and population

IMAGE-CHD was conducted in a large primary care center that serves a predominately inner-city, African-American population with relatively low-literacy skills. Patients were eligible if they presented for a routine appointment and had a documented history of coronary heart disease [20]. Individuals were excluded if they were unable to communicate in English, had no telephone number or mailing address, did not regularly fill prescriptions through the health system's pharmacies, had a visual acuity worse than 20/60, had a chronic psychotic disorder, or demonstrated overt delirium or severe dementia as determined by several screening questions.

2.4. Pill card implementation

Customized pill cards were generated on the day of a patient's study enrollment using different sources of information to verify the patient's medication regimen. First, research staff used the health system's online pharmacy database, Pharmnet, which usually contained information on all of the patient's medications. The manufacturer and specific dosage dispensed (e.g., 1–20 mg tablet or 2–10 mg tablets) were confirmed, as they each affected the medication appearance. Second, the staff reviewed the physician's clinic note and prescriptions written that day for new medications, dosage changes, or discontinued medications. The physician was consulted as needed for clarification and to resolve any discrepancies. Patients were also asked to indicate if they adjusted the time of administration to suit their daily schedule, so the pill card could be appropriately tailored.

Research staff then printed the customized pill card on heavy card stock paper using a color ink jet printer. With a maximum of five medications per page, many patients required 2- or 3-page pill cards. Each patient's set of pill cards took approximately 10 min to make. The cost of production was approximately $5 per patient, including supplies and research staff time.

A pharmacist then briefly oriented the patient to the pill card and reviewed the medication regimen as illustrated on the card, along with any major side effects and other special instructions for administration (e.g., take with food or on an empty stomach). The pharmacist suggested where to keep the pill card and emphasized the importance of bringing the card and medications to medical appointments. The amount of information was relatively standardized and designed to be at a level which could be provided by a nurse instead.

Every 3 months during the intervention, research staff reviewed each patient's most recent pill card against the current medication list in Pharmnet. Patients were contacted by phone to confirm any apparent changes. In cases of uncertainty, the clinic chart and/or study pharmacist were consulted. After appropriate confirmation of the current regimen, a new card was produced and mailed to the patient. Some patients' pill cards were updated more frequently if they or their physician notified the research team by phone of medication changes, as they were requested to do.

2.5. Summative evaluation

Follow-up interviews were conducted with participants approximately 3 months after they enrolled in the study and received their first pill card. This summative evaluation provided information on how patients used the intervention and its perceived effectiveness, as well as how responses varied by patient characteristics such as literacy level [46].

2.5.1. Survey instrument

The instrument administered by the interviewer during follow-up contained both open-ended and fixed-choice questions. Patients indicated how often they used the pill card initially and currently, and where they kept it. Additional questions assessed its understandability and perceived usefulness. Patients also indicated whether they took the pill card to their physician visits, and whether their physician used it to review their medications. Participants also provided suggestions for how to improve the pill card.

Data from the follow-up interviews were linked to information obtained at study enrollment, including the patient's gender, age, marital status, cohabitation status, race/ethnicity, years of schooling, literacy level, and cognitive function. Following standard scoring procedures, cognitive impairment was indicated by a value <24 on the Folstein Mini-Mental State Examination (MMSE) [47]. The Rapid Estimate of Adult Literacy in Medicine (REALM) provided a reliable and valid assessment of literacy in the health care setting [48]. This 66-point word pronunciation test was also scored in a standard fashion, and performance was grouped into three literacy levels – inadequate (0–44, signifying $\leq$6th grade reading level), marginal (45–60, 7–8th grade reading level), and adequate (61–66, $\geq$9th grade level) [49].

Self-efficacy was assessed at study enrollment and again during follow-up interviews using a new measure, the Self-Efficacy for Appropriate Medication Use Scale (SEAMS) [50]. It consisted of 13 items, which required patients to rate their confidence to take medications correctly under a variety of challenging or uncertain situations. A composite score of 13–39 points is obtained by summing the scores of the individual items, which are rated on a three-point scale of ''not confident'' to ''very confident.'' The SEAMS has good internal consistency reliability (Cronbach's alpha = 0.886), and its validity has been established among low-literacy patients [50].

2.6. Analysis

Open-ended responses from the patient interview at 3 months were compiled, reviewed for commonalities and contrasts, and summarized qualitatively.

Quantitative data were analyzed using SPSS version 13.0 for Windows. Descriptive statistics assessed the frequency and distribution of patient characteristics. Univariate analyses were used to examine the pill card's usefulness, frequency of use initially, and frequency of use near the time of the follow-up interview. Bivariate analyses included use of the chi-square statistic or Fisher's exact test, where appropriate, to examine

the association of patient characteristics (e.g., literacy level, age, gender, cohabitation status, years of schooling, and cognitive function) with the perceived usefulness and frequency of use of the pill card. The Mann–Whitney test assessed the relationship between frequency of pill card use and self-efficacy scores. One-way analysis of variance (ANOVA) was performed to examine pill card use and changes in self-efficacy from baseline to follow-up. Alpha was set at 0.05 for all analyses.

3. Results

3.1. Formative evaluation

After processing patients' formative comments during the design phase, several changes were made to the format and content of the pill card, which are reflected in Fig. 2. The font size was enlarged, meal times were added to the time of administration headings, and the images of the morning and evening sun were more clearly differentiated. The orientation of the card was also changed from landscape to portrait to maximize the usable space. Overall, patients who participated in the formative evaluation phase provided positive feedback about the design and readability of the pill card. Patients considered the card to be a trustworthy tool that would help them remember to take their medications correctly.

3.2. Summative evaluation

Of the total 242 participants randomized to receive the pill card intervention, 209 completed the follow-up interview and provided complete responses for interpretation (effective response rate 86%). Non-responders did not differ from responders in terms of literacy, age, cognitive function, or other measured characteristics.

The population was predominantly African-American and female. Approximately half (52.6%) had completed high school, but most (78.5%) read at less than the 9th grade level based on their REALM scores (Table 1). All patients had coronary heart disease, 99% had hypertension, 46% had diabetes, and 87% had hypercholesterolemia. Accordingly, use

Table 1
Patient characteristics

Characteristic	Completed interview ($N = 209$)
Age, mean (S.D.)	63.7 (10.3)
Women, no. (%)	122 (58.4)
Race, no. (%)	
African American (non-Hispanic)	191 (91.4)
White (non-Hispanic)	15 (7.2)
Hispanic/Latino	2 (1.0)
Asian	1 (0.4)
Years of schooling, no. (%)	
<12	99 (47.4)
≥12	110 (52.6)
Literacy level, no. (%)	
Inadequate (≤6th grade)	87 (41.6)
Marginal (7–8th grade)	77 (36.9)
Adequate (≥9th grade)	45 (21.5)
MMSE score, no. (%)	
<24	74 (35.4)
≥24	135 (64.6)

MMSE: Mini-Mental State Examination, scores <24 indicate cognitive impairment.

Table 2
Frequency of initial use of pill card by patient characteristics

Characteristic	Every day, N (%)	≥ Once a week, N (%)	< Once a week, N (%)	Never, N (%)
Total ($N = 209$)	84 (40.2)	54 (25.8)	35 (16.8)	36 (17.2)
Age ($p = 0.695$)				
<65	41 (38.7)	31 (29.2)	16 (15.1)	18 (17.0)
≥65	43 (41.8)	23 (22.3)	19 (18.4)	18 (17.5)
Gender ($p = 0.477$)				
Female	50 (41.0)	27 (22.1)	23 (18.9)	22 (18.0)
Male	34 (39.1)	27 (31.0)	12 (13.8)	14 (16.1)
Cohabitation ($p = 0.942$)				
Married or living with a partner	13 (44.8)	7 (24.1)	4 (13.8)	5 (17.3)
Other	71 (39.4)	47 (26.1)	31 (17.2)	31 (17.3)
Years of schooling ($p = 0.010$)				
<12	49 (49.5)	25 (25.3)	16 (16.2)	9 (9.0)
≥12	35 (31.8)	29 (26.4)	19 (17.3)	27 (24.5)
Literacy level ($p = 0.017$)				
Inadequate	46 (52.9)	20 (23.0)	13 (14.9)	8 (9.2)
Marginal	28 (36.4)	20 (26.0)	14 (18.2)	15 (19.5)
Adequate	10 (22.2)	14 (31.1)	8 (17.8)	13 (28.9)
MMSE score ($p = 0.015$)				
<24	38 (51.4)	14 (18.9)	15 (20.3)	7 (9.4)
≥24	46 (34.1)	40 (29.6)	20 (14.8)	29 (21.5)

MMSE: Mini-Mental State Examination, scores <24 indicate cognitive impairment.

of multiple medications was common (median number of prescription medications = 6).

3.2.1. Initial use of pill card

Over 80% of patients ($N = 173$) used the pill card with some frequency when they initially received it. About 40% reported using it every day, and an additional 25.8% referred to it at least once a week (Table 2). In bivariate analyses, frequency of pill card use was highest among patients with inadequate or marginal literacy skills, less than high school education, or cognitive impairment ($p < 0.05$ for each).

3.2.2. Perceived helpfulness and ease of use

Patients who used the pill card ($N = 173$) found it helpful for remembering which medicines to take, as well as the medication name, indication, dosage, and time of administration (Fig. 3). Patients with inadequate or marginal literacy skills were more likely to note that the pill card helped them remember what medications to take (87.3% for inadequate, 77.4% for marginal, 65.6% for adequate, $p < 0.05$). Nearly all users (94%) reported that the pill card helped with at least one of these domains.

Overall, most pill card users (76.3%) found the card to be very helpful, while 19.7% found it somewhat helpful (Table 3). Ratings varied little by patient characteristics, except those with cognitive impairment more often rated the cards as very helpful ($p = 0.032$).

Overall ease of use was found to be high with 92.5% ($N = 160$) reporting that it was very easy to understand and 6.5% ($N = 13$) reporting it was somewhat easy. Ease of use ratings did not vary significantly across patient characteristics.

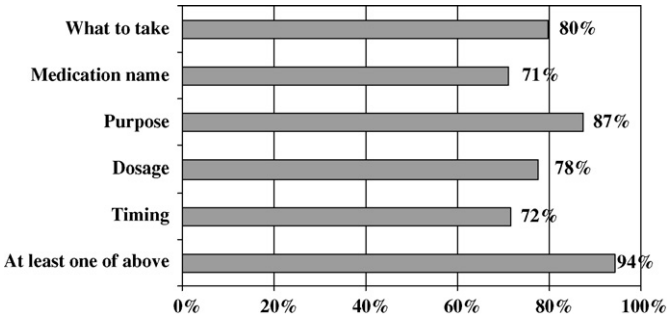

Fig. 3. Helpfulness of the pill card in remembering aspects of medication use, among initial users ($N = 173$).

3.2.3. Continued use of pill card

Most respondents ($N = 126$) reported continued use of the pill card at the time of the follow-up interview, representing 60.3% of all respondents and 72.8% of those who used the pill card initially (Table 4). Patients with inadequate or marginal literacy, fewer years of schooling, or impaired cognition were more likely to continue using the pill card, as were patients who rated the pill card as very helpful ($p < 0.05$ for each).

One-fourth (24.4%) of patients reported taking the pill card to their physician visits to facilitate communication about the medication regimen. Among them, 81.6% showed it to their physician, who reviewed it with the patient 60% of the time.

3.2.4. Self-efficacy

On the 39-point self-efficacy assessment scale, scores were high at baseline (mean = 30.8, S.D. = 6.1) and at follow-up (mean = 33.3, S.D. = 5.3). Patients who reported not using the pill card initially tended to be more confident at baseline about medication use (mean baseline self-efficacy score 32.1 versus

Table 3
Perceived helpfulness of pill card by patient characteristics, among initial users ($N = 173$)

Characteristic	Very helpful, *N* (%)	Somewhat helpful, *N* (%)	Not at all helpful, *N* (%)
Total ($N = 173$)	132 (76.3)	34 (19.7)	7 (4.0)
Age ($p = 0.382$)			
<65	70 (79.5)	16 (18.2)	2 (2.3)
≥65	62 (72.9)	18 (21.2)	5 (5.9)
Gender ($p = 0.373$)			
Female	74 (74.0)	23 (23.0)	3 (3.0)
Male	58 (79.5)	11 (15.0)	4 (5.5)
Cohabitation ($p = 0.208$)			
Married or living with a partner	22 (91.7)	2 (8.3)	0 (0.0)
Other	110 (73.8)	32 (21.5)	7 (4.7)
Years of schooling ($p = 0.205$)			
<12	73 (81.1)	13 (14.4)	4 (4.5)
≥12	59 (71.1)	21 (25.3)	3 (3.6)
Literacy level ($p = 0.094$)			
Inadequate	65 (82.3)	11 (13.9)	3 (3.8)
Marginal	46 (74.2)	12 (19.4)	4 (6.5)
Adequate	21 (65.6)	11 (34.4)	0 (0.0)
MMSE score ($p = 0.032$)			
<24	56 (83.6)	7 (10.4)	4 (6.0)
≥24	76 (71.7)	27 (25.5)	3 (2.8)

MMSE: Mini-Mental State Examination, scores <24 indicate cognitive impairment.

Table 4
Frequency of pill card use at 3-month follow-up by patient demographics, literacy level, and cognitive function

Characteristic	Every day, *N* (%)	≥Once a week, *N* (%)	< Once a week, *N* (%)	Never, *N* (%)
Total (*N* = 209)	40 (19.1)	37 (17.7)	49 (23.5)	83 (39.7)
Age ($p = 0.538$)				
<65	20 (18.9)	17 (16.0)	22 (20.8)	47 (44.3)
≥65	20 (19.4)	20 (19.4)	27 (26.2)	36 (35.0)
Gender ($p = 0.557$)				
Female	25 (20.4)	18 (14.8)	28 (23.0)	51 (41.8)
Male	15 (17.2)	19 (21.8)	21 (24.1)	32 (36.9)
Cohabitation ($p = 0.317$)				
Married or living with a partner	7 (24.1)	7 (24.1)	8 (27.7)	7 (24.1)
Other	33 (18.3)	30 (16.7)	41 (22.8)	76 (42.2)
Years of schooling ($p = 0.047$)				
<12	26 (26.3)	19 (19.2)	22 (22.2)	32 (32.3)
≥12	14 (12.7)	18 (16.4)	27 (24.5)	51 (46.4)
Literacy level ($p = 0.001$)				
Inadequate	24 (27.6)	18 (20.7)	24 (27.6)	21 (24.1)
Marginal	14 (18.2)	13 (16.9)	16 (20.8)	34 (44.2)
Adequate	2 (4.4)	6 (13.3)	9 (20.0)	28 (62.2)
MMSE score ($p = 0.005$)				
<24	21 (28.4)	12 (16.2)	22 (29.7)	19 (25.7)
≥24	19 (14.1)	25 (18.5)	27 (20.0)	64 (47.4)

MMSE: Mini-Mental State Examination, scores <24 indicate cognitive impairment.

30.5 for pill card users, $p = 0.19$), but this difference was not statistically significant. A similar trend was seen among patients not using the pill card at follow-up (mean self-efficacy at follow-up 33.8 versus 32.9 for pill card users, $p = 0.169$). No association could be found between frequency of pill card use and changes in self-efficacy from baseline to follow-up.

3.3. Process evaluation

During the follow-up interview, participants provided additional information about how they used the pill card and made suggestions for further improvements. Most patients (79%) kept the card with their medications, usually in the bedroom or bathroom. About 5% carried it with them in a purse or wallet, and 8% posted it on the refrigerator, where it would serve as a daily reminder. Although the pill card was intended primarily as a tool to assist patients in managing their own medications, several older patients noted that their family members also referred to the card to either remind them to take a medication on time or select the proper dose for them.

Regarding the card format, several participants suggested creating a wallet-sized card to serve as a more portable reminder of their medication schedule, feeling it would improve adherence. Several subjects also suggested further increasing the font size on the pill card (beyond 16 or 18 point), making it more user-friendly for older populations.

The main content-related suggestion was to print the strength of each medication on the card. This originally was omitted for parsimony, but added during the study in response to numerous requests from both participants and their physicians. Patients were also interested in having other medications, such as inhalers, liquids, and over the counter drugs, included on the pill cards.

Some patients suggested adding a system that would allow users to check off a box when they had taken each medication dose. However, this would have required a different format, such as a laminated pill card with a dry erase marker. Others suggested lamination as a way to make the pill card more sturdy or adding magnets to the back of the cards for posting on the refrigerator.

4. Discussion and conclusion

4.1. Discussion

We developed an illustrated medication schedule to serve as a low-literacy patient education tool to promote appropriate use of prescription medications. All patient groups reported the pill card was easy to understand and that it served as a useful reminder of their daily medication regimen. Patients with inadequate or marginal literacy skills, fewer years of schooling, or cognitive impairment appeared to derive the greatest benefit from the pill card. These groups were the most likely to use the card initially and to continue using it over time.

In its national action plan for improving the use of prescription medications, the National Quality Forum emphasized the need for patient education strategies suitable for adults with limited literacy skills [51]. The illustrated pill card serves as an example of such an educational tool which could be delivered in multiple settings, including physician offices, retail pharmacies, and mail order pharmacies. Although the approach described here involved electronically creating pill cards at the point of care, production could be adapted to the particular

setting. For example, at the health system where this evaluation was performed, pharmacists sometimes fasten patients' actual pills with tape or glue to a hand-drawn card to illustrate the daily regimen.

An illustrated pill card also offers promise as a way to communicate important medication instructions across languages and cultures, because the pictorial format may be more easily understood than traditional medication labels [29]. However, when applying pictorial images cross-culturally, it is important to pilot test the images to ensure that they are easily interpreted and culturally appropriate. Groups may misinterpret pictorial materials which do not coincide with culturally specific patterns of medication use [32,38,52–54], or which are not accompanied by an explanation [36,55].

Mild improvements in self-efficacy were evident between the baseline and follow-up evaluations, but they were not statistically significant and could not be tied to frequency of pill card use. It is possible that the newly developed self-efficacy measure used in the study, the SEAMS [50], was not sensitive enough to detect changes in patient confidence that may have resulted from use of the pill card. Conceptually, use of an educational aid that allows patients to practice appropriate medication use should increase patients' confidence, and trends in the results lend some support to this notion.

Because the present evaluation was conducted in the context of a randomized trial, patients did not request the pill card intervention, nor was it prescribed by their physicians. Thus, although nearly all patients perceived the pill card to be somewhat or very helpful for medication management, about one out of six patients assigned to the intervention chose to not use it initially, and more patients stopped using it over time. These patients tended to have higher self-efficacy toward medication use, and significantly higher educational attainment, literacy skills, and cognitive function. They likely perceived the educational aid to be less necessary for their own medication management. It is possible that greater use of the pill cards would be observed initially and over time if they were given selectively to patients who requested them or who had low self-efficacy, poor understanding of how to take their medications, inadequate or marginal literacy skills, lower educational attainment, or cognitive impairment. Use could also increase if patients were specifically encouraged by their physician or pharmacist to refer to the card on a daily basis.

The present study was limited in part by its performance at a single inner-city health system with a large percentage of patients who have inadequate or marginal literacy skills. It is unclear how the findings would differ in other patient populations. Second, some of the data are subject to recall bias, because patients were asked to report their initial pill card usage over a 3-month interval. Third, it is possible that patients' responses were affected by their interaction with a pharmacist at the time they received the illustrated medication schedule. However, this possible effect was minimized by the wording of the interview questions, which focused specifically on the use and perceived value of the pill card. Fourth, the findings presented here should be considered preliminary. Research is presently underway to examine the effect of the pill card on patient adherence and outcomes in the outpatient setting with coronary heart disease and at the point of hospital discharge in acute coronary syndromes. A version of the pill card, created automatically through a proprietary software application, is also under study as part of a system-based pharmacy intervention designed to improve patients' understanding and adherence. That investigation will also examine how the pill card may facilitate pharmacist counseling, and it will include a detailed cost-effectiveness evaluation [56].

4.2. Conclusion

The present experience suggests that creating an illustrated medication card at the point of care is feasible and considered valuable by patients. Individuals with inadequate or marginal literacy skills, lower educational attainment, or cognitive impairment found the educational tool to be most helpful, and they were the most likely to continue using it over time. Further research is needed to see if continued use of the pill card could translate into improved outcomes.

4.3. Practice implications

Each year, Americans fill over 3 billion prescriptions [57], and 20–50% of medications are managed incorrectly [1–3]. The economic consequences of medication nonadherence and misuse are valued at $100–300 billion annually [3]. From a societal standpoint, interventions to improve medication use can have a large positive impact on health care utilization and net expenditures [8].

Practicing clinicians and health systems should place greater emphasis on identifying and assisting patients who have difficulty understanding medication instructions and who demonstrate poor medication adherence [51,58]. Additional strategies are needed to promote safe and effective medication use, which also take into account the pervasive problem of low health literacy [51].

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