

Short Communication

A health literacy pilot intervention to improve medication adherence using Meducation[®] technology



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ABSTRACT

Objective: To determine whether antihypertensive medication adherence could improve using a Meducation[®] technology health literacy intervention.

Methods: We conducted a six-month feasibility study among patients with cardiovascular disease (CVD) risk factors receiving care from hospital-based primary care clinics. All patients received a personalized Meducation[®] calendar listing CVD-related medications. We evaluated changes in medication adherence and clinical outcomes at six months.

Results: There was a 42% enrollment rate ($n = 23$). Forty percent had low health literacy, defined as less than 9th grade reading level. At three months, self-reported medication adherence improved. At six months, medication possession ratio improved 3.2%. Also, at six months there were decreases in patients' average systolic blood pressure (0.5 mmHg), diastolic blood pressure (1.5 mmHg), and body weight (3.6 pounds) ($p > 0.05$).

Conclusions: A health literacy intervention may be a feasible mechanism to improve cardiovascular-related medication adherence and outcomes.

Practice implications: Health literacy interventions may improve adherence while requiring relatively few resources to implement.

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1. Introduction

Chronic conditions account for 70% of American deaths [1]. Over one-quarter of Americans manage multiple chronic diseases [2]. Medication non-adherence directly effects chronic disease patients' outcomes, yet up to one-half of patients fail to take medications as prescribed [3,4]. Low health literacy is a contributing factor to medication non-adherence [5,6].

An estimated 90 million Americans have difficulty reading complex texts [7,8], making interpreting medication instructions difficult. Health literacy is critical for multiple chronic diseases; as the number of conditions increase, so does prescription complexity and likelihood of non-adherence [9–11].

Medication adherence self-management requires cyclical phases: fill, understand, organize, take, monitor, sustain [12]. Adherence improvement strategies may focus on one or more phase. Previous studies have intervened to improve cardiovascular disease (CVD) adherence using refill reminder postcards, illustrated daily medication schedules, or both [13]; and through a combined approach (automated telephone reminder calls to refill prescriptions, picture prescription card, and health communication training for pharmacists) [14] – though neither significantly improved adherence.

We conducted a pilot study evaluating the effectiveness of an innovative health literacy tool, addressing multiple phases of the medication self-management model, to improve cardiovascular medication adherence. The study was conducted in the Veterans Health Administration, the largest U.S. health care provider. More than 80% of Veterans have multiple CVD risk factors [15,16], contributing to an increased number of medications which decreases the likelihood of medication adherence. To enhance medication adherence, we used Meducation[®] technology [17],

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which provides a medication calendar that incorporates reminders with education, written at a sixth grade reading level. Our primary aim was to determine whether antihypertensive medication adherence could improve over six months using Medication[®] technology.

2. Methods

2.1. Study design

We conducted a six-month pilot study among patients with CVD risk factors receiving care from hospital-based primary care clinics associated with Durham Veterans Affairs Medical Center (VAMC). The study clinical pharmacist entered information for each medication into individualized Medication[®] calendars, containing: (1) medication name; (2) time of day, including a pictorial display, that medication should be consumed (Fig. 1); (3) number of times daily that medication should be taken; (4) dose of medication administered; and (5) clinical indication for medication. Patients were given instructions on use of the calendar and importance of adherence.

2.2. Sample identification and recruitment

Potential participants were identified through an electronic health record data pull. Eligible patients met all of the following criteria: enrolled in one of three primary care clinics affiliated with the Durham VAMC for at least one year; at least one visit to an affiliated primary care provider in the previous 12 months; outpatient diagnostic code for hypertension (ICD9 401.1, 401.9) diabetes (ICD9 250.x), and/or hypercholesterolemia (ICD9 272.x); prescribed metoprolol tartrate and have poor adherence for the prior 12 months (medication possession ratio [MPR] of <80%); and prescribed more than nine active medications (i.e., excessive polypharmacy) [18]. We selected metoprolol tartrate, a beta-blocker and commonly prescribed anti-hypertension medication, for MPR because: (1) it is a widely prescribed; (2) taken twice daily; and (3) used concomitantly to treat hypertension among patient who also have CVD. By using metoprolol we targeted patients who we posited were most likely to benefit.

The statistician randomly selected patients for contact by a research team member. The following exclusion criteria were considered during secondary review: diagnosed with metastatic cancer; dementia; psychosis with admission within 30 days prior; current participation in another clinical trial; not currently receiving care at the Durham VAMC; resident of a nursing home; severe vision or speech difficulties; limited or no telephone access; enrolled in the primary care pharmacist medication management clinic; or planned to move medical care in next 12 months.

Introductory letters were mailed and potential participants were contacted via telephone to confirm eligibility. An in-person interview was conducted at baseline. A follow-up telephone interview was administered three months later. Participants provided informed consent and were compensated \$20 for each interview. The Durham VAMC Institutional Review Board approved this project.

Table 1
Baseline sample characteristics (n=23).

	Total n (%)
Demographic characteristics	
Age (mean (SD))	66.6 (8.4)
Race	
Caucasian	9 (39)
African American	14 (61)
Male	21 (91)
Married	13 (57)
Completed less than 12 years of school	2 (9)
Low health literacy level (<9th grade; REALM score <60)	9 (40)
Employed (full- or part-time)	7 (31)
Inadequate income	7 (31)
Current smoker	5 (21)
Clinical characteristics	
Diabetic	14 (61)
Hypertension	21 (91)
High cholesterol	20 (87)
Systolic clinic blood pressure (mean (SD))	130.6 (15.06)
Diastolic clinic blood pressure (mean (SD))	76.6 (7.9)
Clinic pulse (mean (SD))	73.2 (20.9)
Clinic weight ((mean (SD); pounds)	223.0 (2.9)

All data except age, gender (national VA database) were patient-reported. Inadequate income defined as reporting difficulty paying bills no matter what was done or having money to pay the bills only because cut back on things.

2.3. Main measures

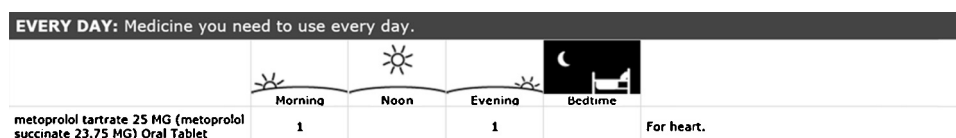
We assessed patients' demographic characteristics, smoking status (smoker vs. non-smoker), and inadequate financial status (difficulty paying bills no matter what was done or having money to pay the bills only because cut back on things). We obtained laboratory and clinical outcomes from patients' electronic health record including systolic and diastolic blood pressure, pulse, and body weight (i.e., most recently recorded values available in the electronic health record).

Health literacy was assessed using the Rapid Estimate of Adult Literacy in Medicine (REALM) test [19]. REALM is a 66-item word recognition evaluation to provide a health literacy appraisal. Low health literacy was defined as a REALM score of up to and including 8th grade (≤ 60 score) versus 9th grade or higher (≥ 61 score) [20].

Medication adherence was evaluated using self-report and MPR. Patients self-reported individual items from a validated measure, which has predictive validity for biological outcomes [21–23]. Possible responses were a four-point Likert scale ranging from 'strongly agree' (1) to 'strongly disagree' (4). The MPR was calculated based on electronic health record data over the previous year prior to enrollment for metoprolol tartrate (i.e., MPR = days supply received/actual number of pills received during time interval). Poor adherence was defined as less than 80%.

2.4. Statistical analysis

We analyzed sociodemographic and clinical variables at baseline and six months using descriptive statistics. We examined



If you take any medicine that is not on this list, please tell your healthcare provider.

Fig. 1. Medication[®] calendar.

Table 2

Change in self-reported medication adherence from baseline to three months.

	Baseline <i>n</i> = 23 <i>n</i> (%)	3 Months <i>n</i> = 22 <i>n</i> (%)	% Change from baseline to 3 months
I sometimes forget to take my heart medicine.	15 (65)	8 (36)	↓ 45
I am sometimes careless about taking my heart medicine.	10 (43)	4 (18)	↓ 58
When I feel better, I sometimes stop taking my heart medicine.	2 (9)	0 (0)	↓ 100
If I feel worse when I take the heart medicine, sometimes I stop taking it.	3 (13)	2 (9)	↓ 31
When I travel or leave home I sometimes forget to bring along my heart medicine.	4 (17)	4 (18)	↑ 6
I forgot to take my heart medicine yesterday.	5 (22)	1 (5)	↑ 77
I feel hassled about sticking to my heart medication treatment plan.	4 (17)	1 (5)	↓ 71

Self-reported medication adherence information was reported at baseline and at three months. Participants who responded affirmatively (e.g., that they 'agree' or 'strongly agree' or that a statement is definitely true' or 'probably true').

Table 3Change in clinical characteristics and medication possession ratio from baseline to three months (*n* = 23).

	Baseline (mean (SD))	95% CI(mean (SD))	6 Months	95% CI	Change from baseline to 6 months	<i>p</i> -Value
Systolic BP	130.6 (15.1)	124.1–137.2	130.1 (18.4)	122.1–138.0	↓ 0.5 mmHg	0.87
Diastolic BP	76.6 (8.0)	73.1–80.1	75.1 (10.4)	70.6–79.6	↓ 1.5 mmHg	0.53
Clinic pulse	73.2 (20.9)	64.1–82.3	70.3 (14.0)	64.2–76.4	↓ 2.9 BPM	0.40
Clinic weight	223.0 (2.9)	202.7–244.4	219.4 (48.9)	198.3–240.6	↓ 3.6 pounds	0.08
LDL	77.0 (17.4)	66.5–87.5	82.3 (16.9)	72.1–92.5	↑ 5.3 mg/dL	0.30
HDL	45.1 (19.5)	36.7–53.6	46.4 (26.1)	35.2–57.7	↑ 1.3 mg/dL	0.52
Total cholesterol	152.4 (41.4)	134.5–170.3	163.0 (41.7)	144.9–181.0	↑ 10.6 mg/dL	0.07
Creatinine	1.1 (0.2)	1.0–1.2	1.2 (0.3)	1.0–1.3	↑ 0.1 mg/dL	0.05
MPR	65.0% (0.14)	0.6–0.7	68.2% (0.28)	0.5–0.8	↑ 3.2 4.9%	0.73

the percentage change in medication adherence using patient self-report and MPR. The statistical significance of differences was examined using paired *t*-tests. Data were collected and analyzed using Illume Version 5.1 (DatStat Inc., Seattle, WA, USA), Excel 2010 (Microsoft Inc., Redmond, WA, USA), and Stata, version 12.1 (StataCorp, College Station, TX, USA).

3. Results

The sample (*n* = 23) was predominantly married (57%), African American (61%), men (91%) (Table 1). Mean age was approximately 67 years. Few participants (9%) completed less than 12 years of school. Forty percent had low health literacy levels (i.e., less than 9th grade reading level). Less than one-third of participants reported inadequate income (31%) or current smoking (31%). The majority of participants were diagnosed with hypertension (91%), hyperlipidemia (87%), or diabetes (61%). On average, participants' baseline blood pressure was controlled (Table 1).

At three months participants self-reported improved medication adherence (Table 2). There was a 45% (29 points) decrease in participants who agreed or strongly agreed about sometimes forgetting heart medications (65% at baseline versus 36% at follow-up). Similarly, 58% (25 points) fewer participants reported agreement or strong agreement that they were sometimes careless with how they take their medications (43% at baseline versus 18% at follow-up).

At six months, there were insignificant improvements in systolic and diastolic blood pressure, decreasing by 0.5 mmHg (*p* = 0.87) and 1.5 mmHg (*p* = 0.53), respectively (Table 3). Participants' body weight decreased, on average, by 3.6 pounds (*p* = 0.08). Total cholesterol was slightly higher at six months (increased 10.6 mg/dL; *p* = 0.07). MPR increased by 3.2% (*p* = 0.73).

4. Discussion and conclusion

4.1. Discussion

Our findings suggest that health literacy interventions could be feasible mechanisms to improve cardiovascular-related medication

adherence and patient outcomes. Much medication information is targeted to a tenth grade reading level [24], which may be inaccessible to patients. Increasing health literacy equips patients with skills to adhere and remain adherent as medication needs evolve. The Meducation[®] system could increase health literacy and improve adherence.

Given the pilot nature and short exposure window of our study, the magnitude of the improvement in medication adherence behaviors is interesting. For example, 45% fewer participants reported that sometimes forget to take medications and 58% fewer reported carelessness. MPR improved by 3.2%. While clinical improvements were generally insignificant, these results may suggest that the intervention prompted intentional medication-taking behavior.

Our feasibility study had four main limitations: (1) small sample size; (2) short timeframe; (3) lack of control group; and (4) possible confounding ongoing clinical efforts. The small sample size may have been inadequate to make determinations about generalizability, particularly because the VA patient population may have a higher comorbidity burden than non-federal health system patients [25]. The six-month timeframe may have been insufficient to sustain change. These issues are exacerbated by the lack of control group, which was not possible in the context of this small pilot study. Finally, ongoing prevention efforts may have confounded results.

4.2. Conclusion

Previous studies have suggested limited, strong associations between medication adherence and health literacy [13,26]. In our study the delivery of health literacy intervention positively effected medication adherence and clinical outcomes. Future interventions may target patients at risk for health literacy-related medication non-adherence.

4.3. Practice implications

Interventions to improve adherence through health literacy require few resources, making them important tools to combat medication non-adherence, though this requires confirmation.

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The authors confirm all patient/personal identifiers have been removed or disguised so the patient/person(s) described are not identifiable and cannot be identified through the details of the story.

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