Published in final edited form as:

J Am Pharm Assoc (2003). 2017 ; 57(1): 30–37. doi:10.1016/j.japh.2016.08.012.

Low–health literacy flashcards & mobile video reinforcement to improve medication adherence in patients on oral diabetes, heart failure, and hypertension medications

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Abstract

Objective—To design and investigate a pharmacist-run intervention using low health literacy flashcards and a smartphone-activated quick response (QR) barcoded educational flashcard video to increase medication adherence and disease state understanding.

Design—Prospective, matched, quasi-experimental design.

Setting—County health system in Dallas, Texas.

Participants—Sixty-eight primary care patients prescribed targeted heart failure, hypertension, and diabetes medications

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Supplementary data

Supplementary data related to this article can be found at <http://dx.doi.org/10.1016/j.japh.2016.08.012>.

Previous presentation: Previously presented at the Alcaldé Southwest Leadership Conference, Houston, Texas, April 9–10, 2014, and the Texas Society of Health-System Pharmacists Annual Seminar, Houston, Texas, April 11–13, 2014.

Intervention—Low health literacy medication and disease specific flashcards, which were also available as QR-coded online videos, were designed for the intervention patients. The following validated health literacy tools were conducted: Newest Vital Sign (NVS), Rapid Estimate of Adult Literacy Medicine–Short Form, and Short Assessment of Health Literacy–50.

Main outcome measures—The primary outcome was the difference in medication adherence at 180 days after pharmacist intervention compared with the control group, who were matched on the basis of comorbid conditions, targeted medications, and medication class. Medication adherence was measured using a modified Pharmacy Quality Alliance proportion of days covered (PDC) calculation. Secondary outcomes included 90-day PDC, improvement of greater than 25% in baseline PDC, and final PDC greater than 80%. Linear regression was performed to evaluate the effect of potential confounders on the primary outcome.

Results—Of the 34 patients receiving the intervention, a majority of patients scored a high possibility of limited health literacy on the NVS tool (91.2%). The medication with the least adherence at baseline was metformin, followed by angiotensin-converting enzyme inhibitors and beta blockers. At 180 days after intervention, patients in the intervention group had higher PDCs compared with their matched controls (71% vs. 44%; $P = 0.0069$).

Conclusion—The use of flashcards and QR-coded prescription bottles for medication and disease state education is an innovative way of improving adherence to diabetes, hypertension, and heart failure medications in a low-health literacy patient population.

Medication adherence is defined as the extent to which patients are able to follow recommendations for prescribed medications.¹ According to a recent study, adherence rates are lowest in patients with pulmonary disease and diabetes mellitus.² As a result, medication nonadherence can result in up to 50% of treatment failures and 125,000 deaths annually.³ Contributing factors to nonadherence are complex and multidimensional in the United States, with an average nonadherence rate of 25%, costing an estimated \$100 billion annually.⁴ Patient barriers, such as low health literacy and reading ability, financial instability, transportation issues, and lack of social support, can contribute to medication nonadherence. Consequences of medication nonadherence include treatment failures, indirectly affecting mortality, and increasing health care costs.^{1,3}

Numerous methods have been used to estimate and objectively quantify a patient's medication adherence. The Pharmacy Quality Alliance has endorsed a standard method for calculation of medication adherence called the proportion of days covered (PDC) that uses data that are widely available across prescription drug plans and pharmacies. This method uses the pharmacy refill history by taking the days supply filled divided by a specified time period.⁵ This measure can be used as a performance measure for pharmacists to identify nonadherent patients.

Medication nonadherence at a safety-net hospital and health care system is further complicated by patient barriers to health care such as employment, financial and housing instability, and lack of social support system. Safety-net health systems care for vulnerable populations of low-income, uninsured, or underinsured patients who have higher rates of chronic health problems and lower health literacy than the general population.⁶ According to the Institute of Medicine, 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. Health literacy is more than just the ability to read. It encompasses comprehension, problem solving skills, analysis of information, abstract thinking and reasoning, and the capacity to recognize patterns and to develop a broad general knowledge base. Health literacy levels cannot be judged or estimated reliably on the basis of a patient's demographics of age, level of education, or economic status.⁷ Low health literacy leads to poorer clinical outcomes, and it is a significant barrier to high-quality care.⁸ There are numerous studies that show negative health outcomes associated with low health literacy, with a majority of these clinical outcomes being preventable.^{9–13} In one systematic review, differences in health literacy level were consistently associated with increased hospitalization, higher rates of emergency department use, poorer ability to take medications appropriately, poorer ability to interpret labels and health messages, and poorer overall health status and higher mortality.¹⁴ For this reason, patient education tools using tailored approaches for low health literacy are vital to improving patient outcomes. Health professionals can change how patient education is presented to help patients with low health literacy make the most of the skills they have.

Despite poor adherence rates and patient low health literacy, several interventions can contribute to improved medication adherence. Interventions directed toward nonadherence include simplification of dosing regimens, patient reminders, improved communication, and patient counseling.¹ Although many of these interventions necessitate a health care provider or travel to a health care facility, the use of modern technologies has begun to fill this need. Approximately two-thirds of Americans own a smartphone, and 19% of Americans rely on a smartphone for accessing online information and staying connected to the world, because they either lack internet connectivity at home or have few options for online access other than a cell phone.¹⁵ Thus, mobile phone interventions are becoming a unique strategy in tackling medication adherence.¹ Researchers have begun to investigate the role of medication adherence smartphone applications (apps), including trials in specific patient populations, such as young adults or those with chronic disease states.^{4,16,17} One metaanalysis showed that mobile phone text message approximately doubles the odds of medication adherence.¹⁸ In addition, multiple national organizations provide educational videos for patients to access online.¹⁹ However, often the medication education provided to patients is targeted to a tenth-grade reading level,²⁰ which may be difficult for some patients to understand. Little information is known about how these novel technologies can be used to educate low-health literate populations.

A survey on mobile technology was conducted at our safety-net institution, and it indicated 46% of clinic patients owned a smartphone device, 43% owned a non-smartphone cellular phone, and 58% of patients owned a computer with Internet access. Since a significant portion of our underserved patient population owned a smartphone or had access to the Internet, the use of smartphone applications represented an innovative and feasible strategy in improving medication adherence at our county institution. We proposed the creation of low health literacy patient education materials using a quick response (QR) barcode, which is a matrix barcode that can be read by an imaging device, such as a smartphone, and data processed or linked to a specific Internet website. We hypothesized that using a combination of traditional low-health literacy cardstock paper flashcards and smartphone-activated QR-

coded instructional video flashcards attached to the patient's medication bottles would lead to increased medication adherence and disease state understanding.

Objective

The objective of this prospective, matched, quasi-experimental study was to design and investigate a pharmacist-run intervention using low-health literacy flashcards and a smartphone-activated QR-coded educational flashcard video to increase medication adherence and disease state understanding at a large, academic county health system.

Methods

Parkland Health and Hospital System is a safety-net, public institution that provides both inpatient and outpatient services to the residents of Dallas County. Seventy-nine percent of patients cared for within the system use self-pay, charity pay, or Medicaid to receive medical or pharmacy services. The Parkland system has 20 community-based clinics with more than 1 million outpatient clinic visits annually and more than 8 million prescriptions processed at our community pharmacies. This research was conducted as a collaboration between our ambulatory and inpatient clinical pharmacy specialists and the Parkland Center for Clinical Innovation. The intervention was conducted in a community-oriented outpatient clinic, which has established clinical pharmacy services under a collaborative practice agreement and a physical outpatient pharmacy. Data were collected for control patients at a similar community-oriented clinic within the same system, which did not have established clinical pharmacy services or a physical outpatient pharmacy. Control patients were matched to intervention patients based on comorbid conditions, number of targeted medications, and medication class, in respective order. Control patients were not matched on the basis of health literacy, as this intervention would have required an in-person interview with the study investigators during a clinic visit at a clinic in which clinical pharmacy services were not available.

Parkland's patient health literacy and reading level has previously been studied using the Test of Functional Health Literacy in Adults in an effort to assess our institution's patient population and to provide appropriate educational materials for our English- and Spanish-speaking patients. This evaluation was conducted in both the inpatient and outpatient settings on 277 patients and showed that 40% of our overall patient population had marginal or inadequate health literacy. Patients who were older, had less than college education, were African American reading English, or were Hispanic reading Spanish had lower scores. Our hospitalized patients had higher scores than our community-based clinic patients did (Pestonjee SF, Morrow RL, Gomez BH, et al. Report of the reading level determination study: Parkland Health & Hospital System. Unpublished results; 1998). Since the community clinic patient population in our health system has an overall low reading and health literacy level, these study investigators believed that collecting the health literacy level in the control group would initially not be needed. However, if the intervention group displayed adequate health literacy in more than 15% of patients, then a health literacy evaluation would be scheduled for each of the control patients to ensure that no bias toward the intervention group occurred. All intervention patients were consented and completed

Health Insurance Portability and Accountability Act authorization forms. The research protocol and all forms were approved by the local institutional review board.

Patients were included in the study if they were 18 years of age or older, spoke either English or Spanish as the primary language, actively filled their medications at Parkland's outpatient pharmacy, had a baseline PDC of less than or equal to 50% for the previous 6 months, and were prescribed targeted oral type 2 diabetes or heart failure medications based on the institution formulary. Table 1 describes all the targeted heart failure, hypertension, and diabetes medications included based on the institution's formulary. Exclusion criteria included any patient with type 1 diabetes, any prescription for insulin, pregnant women, and patients who filled prescriptions outside the Parkland Pharmacy system. Prescriptions for insulin were excluded because of inherent limitations in calculating PDC and because of dose titrations over a 6-month period. Patients were enrolled in the pharmacist intervention following their primary care physician appointments from November 1, 2013, to January 10, 2014. All patients with primary care physician appointments who met inclusion and exclusion criteria in the specified enrollment period were invited to participate in the study.

Validated literacy tools were performed in the intervention group to quantify literacy and health literacy level. These validated tools were developed by the Agency for Healthcare Research and Quality to measure an individual's reading comprehension in a medical context and have been commonly used in research and clinical settings.^{21,22} They are easy to use, and they take 2–3 minutes to perform. The Rapid Estimate of Adult Literacy Medicine–Short Form (REALM-SF) and Short Assessment of Health Literacy–50 (SAHLSA-50) were used to evaluate literacy level in English and Spanish patients, respectively.^{21,22} The REALM-SF is a 7-item word recognition test to provide clinicians with a valid quick assessment of patient health literacy. A score of 7 indicates a high school reading level, a score of 4–6 indicates a seventh- to eighth-grade reading level, a score of 1–3 indicates a fourth- to sixth-grade reading level, and a score of zero indicates a reading level of third grade or below.²¹ The SAHLSA-50 was based on the REALM test and is a validated health literacy assessment tool containing 50 items designed to assess a Spanish-speaking adult's ability to read and understand common medical terms. A score of 37 or lower suggests inadequate health literacy.²² The Newest Vital Sign (NVS), a validated tool, was used to assess health literacy, specifically. NVS was available in both English and Spanish and was conducted to measure numeracy, reading, and interpretation skills as applied to health information content. The patient is given an ice cream nutritional label to review and is asked a series of questions regarding the label. A score of 0–1 suggests a high likelihood (50% or more) of limited literacy. A score of 2–3 indicates the possibility of limited literacy, and a score of 4–6 usually indicates adequate literacy.²³

Low health literacy flashcards for both targeted medications and disease states were designed by study investigators to educate intervention patients on medication indications, administration counseling, disease state counseling, and common side effects. Sixty-eight flashcards were designed in both English and Spanish, and a physical cardstock paper copy was given to all intervention patients. Patients received only flashcards that were relevant to their disease state and medications. Flashcards were validated using Microsoft Word tools, Flesch Reading Ease, and Flesch-Kincaid Grade Level to target a first-grade reading level or

below. Online pharmacist counseling videos on YouTube were created for each flashcard in English and Spanish and linked to a QR code that was affixed to the patient's medication bottle during the intervention (Figure 1). The online counseling videos contained the same content to supplement the physical cardstock flashcards, in consideration of low health literate patients who might prefer auditory learning versus visual learning. Before the start of the study, both flashcards and videos were pilot tested to ensure understanding and readability by our patient population in both English and Spanish. The pharmacist intervention consisted of counseling on all targeted medications and targeted disease states with the physical flashcards. To maintain consistency, all interventions were led by a single pharmacist. If the patient owned a smartphone device, the QR code was affixed to the medication bottle, and the patient was counseled on how to use the code. If the patient did not own a smartphone device but had access to the Internet, the website addresses for the online videos were provided. All videos lasted no longer than 30 seconds to help with audience retention. Google analytics were used to create QR codes and to determine the number of views for each QR code used. YouTube views for each video were also collected.

The primary outcome was the difference in medication adherence at 180 days after pharmacist intervention between the intervention and control groups. Medication adherence was quantified using a modified PDC methodology. The Parkland pharmacy claims database was used to determine PDC. Study investigators modified the PDC to adjust for the days that a patient was admitted into Parkland Hospital. Hospital days were subtracted from the denominator of the PDC equation. New doses of medications canceled out the remaining day supply of previous doses in the PDC equation. Secondary outcome measures included 90-day PDC, improvement in PDC from baseline (defined as a final PDC increase by greater than or equal to 25%), and a final PDC indicating compliance (defined as a PDC greater than or equal to 80%). Additional information collected in the intervention group included education level and QR code and online video utilization. Intervention patients received a follow-up telephone call to address any questions or concerns and to obtain feedback and overall satisfaction with the intervention. For the nonintervention group, a retrospective review of the pharmacy claims database was completed to verify that patients were still using the hospital system outpatient pharmacy during the study period. After the intervention was completed, patients in the intervention group received a follow-up telephone call to determine patient satisfaction with the intervention.

Descriptive statistics were used to describe demographic data and baseline characteristics. A sample size of 56 patients in each group was needed to detect a 25% difference in PDC between the intervention and control groups with an 80% power. The Wilcoxon signed rank test for continuous variables was used to evaluate the differences in final PDC between the 2 groups at both 90 and 180 days. A McNemar test was used to evaluate nominal variables for the secondary outcomes of percentage of patients achieving an increase of 25% in their PDC and percentage of patients achieving a final 180-day PDC greater than 80%. A two-sided *P* value less than 0.05 was considered statistically significant. A linear regression was also performed to evaluate the effect of potential confounders including age, race, and total number of medications. Analyses were performed using STATA version 12.0.

Results

Demographics

Thirty-four patients were consented and included for the pharmacist intervention. Of the patients who were screened for the intervention, 8 were excluded for the following reasons: filled medications at a pharmacy outside of Parkland ($n = 4$), no longer taking targeted medications ($n = 2$), type 1 diabetes ($n = 1$), and dropped out of the study ($n = 1$). Baseline characteristics are highlighted in Table 2. The most common indication for the targeted medications included the combination of diabetes and hypertension. At baseline, metformin was the medication that patients were the least compliant with taking, followed by angiotensin-converting enzyme inhibitors or angiotensin II receptor blockers and insulin secretagogues, respectively. Patients in the intervention group had an overall baseline PDC of 38% compared with a baseline PDC of 34% in the control group.

Of the English-speaking intervention patients, 36% were able to read at a high school reading level (Table 3). Of the Spanish-speaking intervention patients, 58% scored less than 37 on the SAHLSA-50. The NVS tool was performed on all intervention patients and was available in both English and Spanish. A majority of patients (62%) scored 0 or 1 on the NVS tool. Only 9% of the cohort scored 4–6 on the NVS tool. Because only 9% of patients in the intervention group had an NVS score that indicated adequate health literacy, consenting and testing of the control group was not performed. Of the intervention patients, 29% reported having a fifth-grade education or below, 9% had an eighth-grade education or below, and 43% had a high school education (grades 9–12). Six patients received some college education, and 1 patient completed post-graduate schooling. Of note, patients with a higher level of formal education or higher REALM-SF or SAHLSA-50 reading score did not necessarily correlate to a higher NVS health literacy score.

All 34 patients in the intervention group received the cardstock flashcards and the website addresses to view the online educational videos. The average number of flashcards and website addresses patients received was 8. Five patients of the group received the QR codes along with the other intervention materials. Of these patients, the average number of QR codes received was 9.2.

Medication adherence

Patients in the intervention group had a statistically significant higher 180-day PDC, compared with the nonintervention group (71% vs. 44%; $P = 0.0069$), and a higher 90-day PDC (67% vs. 38%; $P = 0.01$). There were no differences between the groups in regard to improvement in PDC from baseline by 25% and a final PDC greater than 80% indicating compliance (Table 4). Linear regression revealed that the intervention group PDC remained significantly higher when adjusted for confounders (beta coefficient = -0.34 ; $P = 0.003$; $r^2 = 0.17$). The most viewed online videos were the medication videos on losartan and enalapril in English, which received over 900 views. Of the patients who participated in the QR code portion of the intervention, the most popular video accessed through the QR code was the “English–Furosemide” video, followed by the “English–Lisinopril” and “Spanish–What is A1c?” videos (Table 5).

Follow-up telephone call

Of the 34 intervention patients, 30 patients (88%) participated in a follow-up telephone call and were asked 9 questions regarding the pharmacist intervention. When asked about overall satisfaction with the pharmacist intervention, all 30 patients who completed the telephone follow-up call stated that they were satisfied with the pharmacist educational intervention and would recommend the intervention service to family and friends. Six patients reported losing or changing insurance coverage or changing pharmacies, 5 patients stated that they had difficulties affording their medications leading to medication noncompliance, and 1 patient reported transportation issues in regard to difficulty refilling medications on time. Four patients reported filling their medications from an outside pharmacy after starting the study. Of the 5 patients who received QR codes, only 1 patient reported difficulty accessing the online videos and using the QR code.

A retrospective review of the pharmacy refill history database showed that of the 34 nonintervention patients, 31 patients (91%) continued to use the hospital system outpatient pharmacy during the specified study period. Of the 3 patients who did not use the outpatient pharmacy, 1 patient was lost to follow-up and 2 patients appeared to be filling their medications at an outside pharmacy.

Discussion

We studied the use of low health literacy flashcards and mobile video reinforcement to improve medication adherence in a large, academic county hospital system. We found that patients who received education from a pharmacist using tailored low-health literacy education tools had a higher percentage of medication adherence compared with the control group at both 90 and 180 days after the intervention.

Overall, patients in the intervention group were highly satisfied with the medication and disease state education, and they believed that the intervention helped them better understand the purpose and instructions for taking their medications. We believe that the ease of using the flashcards and QR codes with increased portability of the education materials allowed the patients to access educational materials at their convenience from either a mobile device or computer with Internet access. With the increasing use of mobile and handheld devices in our patient population, patients may be more inclined to use these technologies that are already at their disposal for health care education. Our study findings suggest that novel low health literacy educational interventions could be feasible strategies in improving medication adherence versus traditional standard-of-care counseling at the pharmacy window.

To date, few published trials have studied low health literacy novel interventions with medication adherence outcomes. One feasibility study compared patient education through an audio booklet in English and Spanish on the knowledge and understanding of statins compared with a standard-of-care education group. The study showed that patients enjoyed the audio booklet with significant increases in knowledge when listening, but medication adherence was not assessed.²⁴ Another study published in Germany introduced a novel mobile application called the “Medication Plan” that was downloaded by more than 11,000

smartphone users to support medication adherence; it found that 49% of its users had finished secondary school as the highest educational qualification.¹⁷ A pilot study used Meducation technology, which included a medication calendar that incorporated education via reminders, was written at a sixth-grade reading level, and showed an improvement of medication possession ratio by 3.2% in anti-hypertensive medications.²⁵ More recently, evidence of mobile phone short message service (SMS) reminders and voice messaging in patients with acute coronary syndromes have been studied and shown to improve medication adherence.^{26–28}

In our study, flashcards were designed to target a first-grade reading level or below and used pictures to illustrate medical concepts.²⁹ Studies have shown that videos that have text with audio are more effective for retention of information and videos less than 30 seconds in length have an 85% duration of view, with each additional 10 seconds decreasing the duration of view tremendously.^{30,31} Our mobile online videos lasting 30 seconds or less were created to reinforce the educational flashcards and to provide verbal and visual aids for patients who had trouble reading.

Limitations

Although our results were positive, we recognize the limitations associated with this study. The results of the health literacy evaluations in the intervention group showed that less than 10% of patients had adequate literacy. Therefore, the control group did not have their health literacy assessed as previously specific. The baseline PDCs in both the control and intervention groups were similar. Given that the majority of the intervention group had a high or possible likelihood of limited health literacy and health literacy may serve a proxy to adherence,³² we believed that the similar baseline PDCs indicated poor health literacy in the control group as well. Second, we realize that the availability of clinical pharmacy services and a physical outpatient pharmacy in the intervention group may have played a role in the adherence of the patients in the intervention group outside the use of technology. In addition, patients in the control group were taking a greater number of over-the-counter medications, which may have contributed to an overall lower medication adherence in this group. After the study period, patients in both study groups filled prescriptions at outside pharmacies, which could have affected the proportion of days covered.

Other limitations included the small sample size and reduced power that could have decreased the generalizability to other patient populations and overestimated the effect size. The possibility of previously nonadherent patients “stockpiling” medications may have also affected the final PDC. We used the method of PDC to define medication adherence, as it is the preferred method of measuring medication adherence endorsed by the Pharmacy Quality Alliance.⁵ This method is based on the assumption that patients who refill their medications in the pharmacy are actually taking them, and the PDC method in itself is an inherent limitation of the study. However, we improved the calculation by subtracting out the hospital days for admitted patients from the denominator. Selection bias may have been present in the study, as patients in the intervention group were enrolled after their primary care physician appointments and could represent a patient population that is inherently more likely to be

adherent to their medications. Lastly, clinical outcomes were not measured in our study, but they represent a target for future research.

Conclusion

Patients who received education from a pharmacist using tailored low health literacy education tools had a higher percentage of medication adherence as compared with the control group after the designed intervention. Our study used a unique strategy in providing medication and disease state education to a vulnerable patient population. To date, the pharmacist-run, low health literacy intervention was the first of its kind and was an innovative way of educating a patient population who can use technology to increase medication adherence. There is limited evidence regarding the use of novel technologies to improve medication adherence in chronic disease states, but this represents a major area of interest in future research.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

The authors thank Elizabeth Moss, PharmD, for support and guidance in creating the health literacy flashcards; Antonio Maldonado and Javier Velazquez for assistance in data collection; and Ruben Amarasingham, MD, for study oversight.

Disclosure: Research and data collection were sponsored by Parkland Center for Clinical Innovation (PCCI), a non-profit research and development corporation in Dallas, Texas. Denise L. Yeung, Kristin S. Alvarez, Marissa E. Quinones, Christopher A. Clark, George H. Oliver, and Adeola O. Jaiyeola declare no conflict of interest in any product or service mentioned in this article, including grants, employments, gifts, stock, holdings, or honoraria. Dr. Alvarez was supported in part by the National Institutes of Health (grant number K08 DK101602). The National Institutes of Health had no part in conducting the study.

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Key Points

Background

- Medication nonadherence is a serious health care problem that can result in negative patient outcomes.
- Pharmacists have been shown to help improve medication adherence through a variety of interventions, including Internet videos and smartphone applications.
- Few published trials have studied novel interventions with medication adherence outcomes for low–health literate populations.

Findings

- Patients who received targeted low health literacy medication- and disease-specific flashcards, which were also available as QR-coded online videos, had higher medication adherence (proportion of days covered) versus their matched controls.
- The findings of the study promote future research and implementation of novel technologies to improve medication adherence.

Figure 1.
Example of a quick response (QR) code education video (<https://goo.gl/4AHNtX>).

Table 1

Targeted formulary medications for flashcards

Heart failure and hypertension	Type 2 Diabetes
Loop diuretics	Biguanides
Furosemide, torsemide	Metformin
Beta blockers	Secretagogues
Carvedilol, metoprolol tartrate, metoprolol succinate	Glyburide, glipizide, glimepiride
ACE inhibitors and ARBs	Thiazolidinedione
Lisinopril, ramipril, captopril, enalapril, losartan	Pioglitazone
Other	Other
Spironolactone, digoxin, hydralazine, isosorbide dinitrate/mononitrate	Saxagliptin, acarbose, repaglinide

Abbreviations used: ACE, angiotensin-converting enzyme; ARB, angiotensin II receptor blocker.

Table 2

Baseline characteristics

Characteristic	Intervention (n = 34)	Control (n = 34)	P value
Mean age in years	51.8 ± 8.4	53.8 ± 9.4	0.27
Female sex, n (%)	21 (61.8)	18 (53)	0.25
Race, n (%)			0.12
White, Non-Hispanic	4 (11.8)	1 (3.0)	
White, Hispanic	17 (50)	23 (67.6)	
African American	13 (38.2)	8 (23.5)	
Asian	0	2 (5.9)	
Language, n (%)			0.06
English	22 (64.7)	17 (50)	
Spanish	12 (35.3)	17 (50)	
Number of clinic visits	2.9 ± 1.3	2.0 ± 1.1	0.003
Payor, n (%)			0.12
Charity funding	30 (88.2)	31 (91.2)	
Medicare	4 (11.7)	3 (8.8)	
Total number of prescription medications	6.7 ± 3.3	7.0 ± 3.4	0.51
Total number of OTC medications	0.6 ± 0.8	1.2 ± 1.0	0.003
Medication indications, n (%)			
DM and HTN	27 (79.4)	27 (79.4)	
DM only	1 (3.0)	1 (3.0)	
CHF	3 (8.8)	3 (8.8)	
HTN only	3 (8.8)	3 (8.8)	
Nonadherent medications, n (%)			
Metformin	21 (61.8)	21 (61.8)	
ACEi/ARB	20 (58.8)	20 (58.8)	
Secretagogue	11 (32.4)	11 (32.4)	
Beta blocker	6 (17.6)	6 (17.6)	
Loop diuretic	4 (11.8)	5 (14.7)	
Thiazolidinedione	4 (11.8)	4 (11.8)	
Nitrate	2 (5.9)	1 (2.9)	
Hydralazine	2 (5.9)	1 (2.9)	
Spironolactone	0	1 (2.9)	
Overall baseline PDC, range (%)	38 (17–50)	34 (13–50)	

Abbreviations used: OTC, over-the-counter; ACEi, angiotensin-convertingenzyme inhibitor; ARB, angiotensin II receptor blockers; PDC, proportion of days covered; DM, type 2 diabetes mellitus; HTN, hypertension; CHF, congestive heart failure.

Table 3

Results of the REALM-SF and SAHLSA-50 health literacy tools

Variable	Number of patients (%)
REALM-SF-English score (n = 22)	
0 (grade 3 or lower reading level)	2 (9.1)
1–3 (grade 4–6 reading level)	5 (22.7)
4–6 (grade 7–8 reading level)	7 (31.8)
7 (high school reading level)	8 (36.4)
SAHLSA-50-Spanish score (n = 12)	
37 ^a	7 (58.3)
>37	5 (41.7)

^aScores ≤ 37 considered inadequate reading levels.

Table 4

Primary and secondary outcomes

Outcomes	Intervention (n = 34)	Control (n = 34)	P value
Primary outcome			
180-day PDC, %	71	44	0.007
Secondary outcomes			
90-day PDC, %	67	38	0.01
Increase of 25% in PDC, n (%)	22 (64.7)	16 (47.1)	0.17
Final PDC greater than 80%, n (%)	12 (35.3)	5 (14.7)	0.09

Abbreviation used: PDC, proportion of days covered.

Table 5Video views for most popular videos^a

Video of flashcards	QR clicks	YouTube views
English–Furosemide	7	50
English–Lisinopril	4	70
Spanish–What is A1c?	4	13
English–What is A1c?	3	11
English–Captopril	0	270
English–Enalapril	0	243
English–Losartan	0	219
English–Carvedilol	0	207
English–Glimepiride	0	148

^aViews recorded after end of study period.