Journal of Pharmacy Technology
2015, Vol. 31(6) 262–269

DOI: 10.1177/8755122515588370
pharmatech.sagepub.com
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The Effect of Health Literacy on Medication Knowledge and Medication Discrepancy in Chinese Americans

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Abstract

Background. Functional health literacy (FHL) is increasingly recognized as a useful predictor of health outcomes in different populations. However, the effect of FHL on medication knowledge and medication discrepancy in Chinese Americans is not well defined. **Objectives.** To examine the effects of FHL on medication knowledge and medication discrepancy in Chinese American patients. **Methods.** This was a cross-sectional study conducted at an academic internal medicine clinic. The Short Test of Functional Health Literacy in Adults was used to assess participants' FHL. Data for patients' demographic information, medication knowledge, and medication discrepancy (direction discrepancy and name discrepancy) were collected through patient interviews and chart reviews. The primary outcome was medication knowledge of purpose and the secondary outcomes included medication direction discrepancy and medication name discrepancy. **Results.** Of the 158 Chinese American patients who participated in the study, 54% had adequate FHL. More participants with adequate FHL had correct medication knowledge compared to participants with inadequate FHL (87% vs 56%, respectively, odds ratio = 3.4, 95% confidence interval = 1.2-9.7). Fewer participants with adequate FHL had medication direction discrepancy compared to those with inadequate FHL (42% vs 62%, odds ratio = 0.18, 95% confidence interval = 0.06-0.55). Both adequate and inadequate FHL groups had high prevalence of medication name discrepancy (77% vs 89%) even though the between-group difference was insignificant. **Conclusions.** Adequate FHL among Chinese American patients is significantly associated with increased medication knowledge of purpose and decreased medication direction discrepancy. Both adequate and inadequate FHL groups had high prevalence of medication name discrepancy.

Keywords

Chinese Americans, health literacy, medication knowledge, medication discrepancy

Introduction

Functional health literacy (FHL) is a measure of a person's ability to read, understand, and process basic health information and services needed to make appropriate health decisions.[1] Patients with inadequate FHL may experience difficulties in obtaining patient education materials and in managing their chronic diseases.[2,3] They are more likely to have poor health outcomes, including higher hospital admissions and death rates than those with adequate FHL.[4,5] Health literacy has been assessed in different ethnic populations. Previous research showed that Spanish-speaking patients had lower levels of health literacy than their English-speaking counterparts.[6] African American patients with inadequate FHL were more likely to take medications incorrectly.[7] As the largest Asian subgroup, more than 2.7 million Chinese Americans reside in the United States. According to the 2010 US Census, there were 35, 661 Chinese Americans living in San Diego, which was ranked the 10th US city with significant Chinese American population.[8] At the time of this study, there were 4500 unique patients with their language indicated as Chinese within the University of California San Diego (UC San Diego) Health System. Little is known about the impact of health literacy has on patient safety of Chinese Americans.

Patients' medication knowledge and medication discrepancy are very important to patient education and patient safety. Medication knowledge is defined as the patients' knowledge or understanding related to medication information, including

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medication name and purpose as well as instructions and precautions.[9] Medication knowledge includes a measure of the patients' ability to report correct reasons for taking each medication. Medication discrepancy is defined as any discrepancy between medications listed in the patients' medical records and medications patients take or report taking.[10] Medication name discrepancy refers to a measure of inconsistency between patients' self-reported medication names and medication names listed in their medical records. Reconciliations of medication name discrepancy could help health care providers identify medications taken by patients but not recorded in medical records, and medications recorded in medical records but not taken by patients. Medication direction discrepancy refers to a measure of inconsistency between patients' self-reported medication use (dosage, route, and frequency) and medication direction listed in their medical records. Reconciliations of medication direction discrepancy could help health care providers assess if patients take those medications correctly.[11]

Patients' medication knowledge of instructions may be affected by FHL, age, gender, number of medications taken, and race.[2,11,12] A previous study did not find a significant relationship between FHL and medication knowledge of purpose in English-speaking adults.[11] However, Chinese Americans' health knowledge and medication knowledge may be affected by complicated factors, such as employment, marital status, place of birth, and years in the United States.[13-15] We hypothesized that Chinese Americans with inadequate FHL would be less likely to report correct reasons for taking each medication. One of the safety goals by the Joint Commission since 2006 is to identify medication discrepancy.[10] Reconciliation of medication discrepancy was considered an effective measure to improve patients' medication safety.[16-18] Previous research found that older age, male gender, less education, increasing number of medications, and race were associated with more medication discrepancies.[11,19,20] Chinese Americans' medication use may be influenced by employment, place of birth, and years living in the United States, which may result in medication discrepancy.[15,21,22] A study that surveyed 198 Chinese Americans and examined their use of traditional Chinese medicine (TCM) found that almost all participants used TCM during the previous year yet few informed their health care providers about their TCM use.[15] Such medication discrepancy may produce potential risks for side effects, drug interactions, and toxicity.[15] We hypothesized that Chinese Americans with inadequate FHL would have more medication direction discrepancies and medication name discrepancies.

In this study, we focused on the effect of FHL on medication knowledge of purpose, medication discrepancy of direction, and medication discrepancy of name among Chinese American patients at a primary care clinic located in San Diego, California. Findings from this study can be used to help design effective interprofessional interventions to improve medication knowledge and to reconcile medication discrepancy among Chinese American patients.

Methods

Designs and Participants

This cross-sectional study was conducted at an internal medicine clinic within the UC San Diego Health System during patients' regular clinic visits with their primary care physicians. Self-identified Chinese American patients at least 18 years old and taking at least one medication (including prescription medications, over-the-counter medications, or supplements) were eligible to participate. Patients were excluded if they resided in a skilled nursing home or had conditions such as cancer, severely impaired vision, dementia, or overt psychiatric illness. The protocol was approved by the UC San Diego Institutional Review Board, and informed consent was obtained from each patient prior to patient interviews, surveys, and chart reviews.

The study used the English version of the Short Test of Functional Health Literacy in Adults (S-TOFHLA) to assess participants' FHL. S-TOFHLA, which had been used in previous studies, consists of 2 sections: a 36-item reading comprehension test and a 4-item numeracy test. Each of the 36 cloze items was assigned a score of 2 points, giving a total of 72 possible points for the comprehension section.[23] Similarly, each of the 4 numeracy items was assigned a score of 7 points, giving a total of 28 possible points for the numeracy section. Thus, the maximum possible total score for S-TOFHLA was 100. Scores were categorized into 3 FHL levels: inadequate (0-53), marginal (54-66), and adequate (67-100). Even though the original S-TOFHLA scores assessed patients into 3 groups (inadequate, marginal, and adequate groups), previous studies had recategorized patients into 2, instead of 3, groups for comparison purpose.[11,24] For the purpose of our study, participants were also categorized into 2 comparison groups according to their S-TOFHLA test scores: those with inadequate FHL (0-66) and those with adequate FHL (67-100).

Sample Size

The sample size estimation was based on a proxy indicator of the understanding of the prescription instruction label between the adequate (67-100 scores) and inadequate (0-53 scores) FHL groups. These were previously reported in a relevant study where more participants with adequate literacy correctly understood the prescription instruction compared to those with low literacy (62% vs 37%).[3] A sample size of 140 (or 70 in each of the 2 comparison groups) was estimated to achieve 80% power at a 2-sided 5% level of significance.[25]

Data Collection and Outcomes

A convenience sampling method was used to recruit patients between May and December 2009. Patients were recruited from physician referrals, flyers posted in the clinic for patient self-enrollment, or research staff approaching patients in the clinic waiting room area. Research staff (WQ and RL) interviewed participants using their preferred language (Mandarin, Cantonese, or English). They assessed FHL using the English S-TOFHLA, which takes up to 12 minutes to administer to each participant.[24] The S-TOFHLA was conducted in English. During data collection for demographics information and outcomes (medication purpose, name, and direction) we used English, Mandarin, or Cantonese according to the patients' preference. This method enabled us to include as many participants as possible while allowing participants to represent as many Chinese American subgroups as possible. Although some patients reported medication names in Chinese, it did not affect the accuracy of outcomes measured. The purpose of reconciliation of medication name discrepancy was to find medications taken by patients but not recorded in the medical records and medications recorded in the medical records but not taken by patients. The electronic medical records (EMRs) were kept in the health system's computerized network where both primary care and other specialty providers had access to use and update during each clinical encounter. The information kept in the EMRs was as accurate and up-to-date as possible.

The primary outcome was medication knowledge of purpose, which was compared between the self-reported reason for taking each medication (including prescription medications, over-the-counter medications, and supplements) and the Food and Drug Administration–approved, or off-label indications, listed in the Facts and Comparison drug information reference.[26] Investigators (WQ, PY, JC, GM, and GK) coded the response for each medication either as correct (ie, when self-reported reasons and indications listed in Facts and Comparison were the same) or incorrect (ie, when self-reported reasons and indications listed in Facts and Comparison were different). Secondary outcomes included medication direction discrepancy and medication name discrepancy. Medication direction discrepancy was coded as with or without discrepancy between participants' self-reported medication use (dosage, route, and frequency) and medication direction listed in their EMRs. Medication name discrepancy was coded as with or without discrepancy between medication names reported by patients and medication names listed in the EMR. The research team (GMK, PSY, JJC, and GM) reviewed and resolved coding discrepancies for all outcome endpoints. We did not consider differences between products or generic names as medication name discrepancies; we accepted either product or generic names during the data collection process and coded them as the same medications. The main purpose of identifying medication name discrepancy was to assess medications taken by patients but not recorded in the medical records and medications recorded in the medical records but not taken by patients.

We further coded age (less than 65 years old or 65 years and older), gender (male or female), education level (less than high school or high school and higher), employment (employed or all others), marital status (being married or living with someone vs all others), and US born (yes or no). Previous studies usually considered the effect of age, gender, education level, and employment on medication knowledge or medication use.[16,27] Marital status, US born, and number of years in the United States provided an indication of social support and acculturation status, and the 3 factors were associated with health knowledge and medication use in Chinese immigrants.[13,15,22,27] The number of medications in EMR indicated the complexity of medication regimens.[27]

Data Analysis

Statistical analyses were performed using Stata software in the univariate analyses; Pearson's χ^2 test (or Fisher's exact test if appropriate) was used to analyze dichotomous outcome variables. Multivariate logistic regression was used to assess associations between dichotomous outcome variables and demographic or medication regimen complexity variables. We compared the proportions of patients with correct and incorrect medication knowledge across FHL, patient demographics (age, gender, education, employment, marital status, US born, and years in the United States), and medication regimen complexity (the number of medications listed in the EMR) groups. We also compared the proportions of patients with and without medication discrepancy across FHL, demographic, and medication regimen complexity groups. After adjusting for demographic variables, the associations between FHL and medication knowledge and the associations between FHL and medication discrepancy were assessed using multivariate logistic regression analyses.

Results

A total of 219 patients were referred, self-enrolled, or approached for the study. Of these, 198 patients were eligible to participate, 164 patients consented to participate in the study, and 158 of them completed the study (80% response rate). Of the 158 participants, 86 (54%) had adequate FHL. Table 1 shows demographic and medication regimen information of the study population. Of 819 medications recorded in the EMR from the 158 participants, 7% (n = 57) of the medications were associated with incorrect medication knowledge, 16% (n = 135) with medication direction discrepancy, and 44% (n = 362) had medication

Table 1. Demographic and Medication Regimen Information of 158 Participants.

	Adequate FHL (n = 86)	Inadequate FHL (n = 72)
Age >65, n (%)	33 (34)	65 (66)*
Gender, n (%)		
Male	23 (46)	27 (54)
Female	63 (58)	45 (42)
Education, n (%)		
Less than high school	2 (9)	20 (91)*
High school and higher	84 (63)	50 (37)
Employment, n (%)		
Employed	50 (89)	6 (11)*
All others	36 (35)	66 (65)
Marital status, n (%)		
Married or living with someone	61 (54)	53 (46)
All others	25 (57)	19 (43)
US born, n (%)		
Yes	6 (100)	0 (0)*
No	80 (53)	72 (47)
Years in the United States, mean ± SD (range)	26 ± 15 (3-61)	13 ± 9 (3-46)*
Medication in EMR, mean ± SD (range)	4 ± 3 (0-18)	6 ± 3 (1-13)*

Abbreviations: FHL, functional health literacy; EMR, electronic medical record.
*Statistical significance of $P < .05$.

name discrepancy. The top 5 therapeutic categories of medications with incorrect medication knowledge and medication discrepancy are listed in Table 2.

A higher proportion of participants with adequate FHL reported correct medication knowledge compared to those with inadequate FHL (87% vs 56%, $P < .001$), in the univariate analysis. Similarly, the multivariate logistic regression model showed that participants with adequate FHL were more likely to report correct knowledge of medication purpose compared to those with inadequate FHL (odds ratio [OR] = 3.4, 95% confidence interval [CI] = 1.2-9.7; Table 3). When the number of medications recorded in the EMR increased, participants became less likely to report correct knowledge of medication purpose (Table 3).

A higher proportion of participants with adequate FHL had less medication direction discrepancy compared to those with inadequate FHL (42% vs 62%, $P < .05$), in the univariate analysis. Similarly, the multivariate logistic regression model showed that participants with adequate FHL were less likely to have medication direction discrepancy compared to those with inadequate FHL (OR = 0.18, 95% CI = 0.06-0.55; Table 4). When the years in the United States increased and the number of medications recorded in the EMR increased, participants became more likely to have direction discrepancy, respectively (Table 4).

A higher proportion of participants with adequate FHL had less medication name discrepancy compared to those with inadequate FHL (77% vs 89%, $P < .05$), in the univariate analysis. However, multivariate logistic regressions did not find significant relationships between FHL and medication name discrepancy after adjusting for age, marital status, years in the United States, and being born in the United States (OR = 0.22, 95% CI = 0.02-2.2).

Discussion

Understanding the effects of health literacy on health outcomes across race and ethnicity has important implications in clinical practice.[6,7] To the best of our knowledge, this is the first published study investigating the relationship between FHL and medication knowledge and medication discrepancy in Chinese American patients. Previously a study conducted in Hong Kong reported that health literacy was inversely related to HbA1c levels among Chinese patients with type 2 diabetes mellitus ($P < .001$).[28] The study used a Chinese version of health literacy instrument.[28] We used the English version of S-TOFHLA and considered it an appropriate instrument for assessing patients' FHL since medical information distributed in the US health care systems is written in English. Our study showed that S-TOFHLA scores could be a useful predictor for the evaluation of medication knowledge and medication discrepancy in Chinese American patients.

TOFHLA (Test of Functional Health Literacy in Adults), S-TOFHLA, and REALM (Rapid Estimate of Adult Literacy in Medicine) are useful instruments for assessing health literacy. S-TOFHLA is the abbreviated version of TOFHLA. Generally TOFHLA and S-TOFHLA are considered more valid FHL measures than REALM.[24] TOFHLA and S-TOFHLA measure patients' ability to comprehend text (including numeracy skills), while REALM measures one's ability to pronounce words in isolation.[24,29] A study showed that REALM scores between African Americans and Caucasians with similar educational attainment were discordant, which meant that validity and reliability of REALM may vary among various patient subgroups.[30] On the other hand, study populations in the initial testing of TOFHLA and S-TOFHLA included indigent African American residents, thus providing a foundation for application in minority populations.[24] Many studies used TOFHLA or S-TOFHLA to assess FHL in minority populations.[6,7,31] The outcomes of medication knowledge and medication discrepancy in our study indicated patients' ability to manage their medications. Based on the core design of "ability assessment," we determined that S-TOFHLA containing the comprehension and numeracy skill evaluation was more suitable to assess our study outcomes. A study showed that patients who had difficulty pronouncing words in isolation on the REALM test did better

Table 2. The Top 5 Therapeutic Categories of Medications With Incorrect Medication Knowledge of Purpose or Medication Discrepancies.

Incorrect Medication Knowledge of Purpose			Medication Direction Discrepancy			Medication Name Discrepancy		
Rank	Therapeutic Classes	n (%)	Rank	Therapeutic Classes	n (%)	Rank	Therapeutic Classes	n (%)
1	Central nervous system agents	14 (25)	1	Cardiovascular agents	39 (25)	1	Nutrients and nutritional agents	256 (71)
2	Cardiovascular agents	7 (12)	2	Nutrients and nutritional agents	29 (19)	2	Traditional Chinese medicine	40 (11)
3	Respiratory agents	7 (12)	3	Respiratory agents	25 (16)	3	Central nervous system agents	21 (6)
4	Nutrients and nutritional agents	6 (11)	4	Central nervous system agents	24 (15)	4	Ophthalmic and otic agents	15 (4)
5	Endocrine and metabolic agents	5 (9)	5	Dermatological agents	18 (12)	5	Gastrointestinal agents	7 (2)

Table 3. Multivariable Analysis of Factors Associated With Correct Medication Knowledge of Purpose.

	β	OR (95% CI)
FHL	1.2	3.4 (1.2-9.7)*
Age	−1.3	0.28 (0.06-1.4)
Gender	−1.9	0.14 (0.02-1.2)
Education	0.54	1.7 (0.57-5.3)
Employment	−0.23	0.79 (0.19-3.3)
Medication in EMR	−0.35	0.70 (0.55-0.90)*
Gender * Medication in EMR	0.32	1.4 (1.03-1.8)*

Abbreviations: OR, odds ratio; CI, confidence interval; FHL, functional health literacy; EMR, electronic medical record.
*Statistical significance of $P < .05$.

Table 4. Multivariable Analysis of Factors Associated With Medication Direction Discrepancy.

	β	OR (95% CI)
FHL	−1.7	0.18 (0.06-0.55)*
Age	0.16	1.2 (0.37-3.7)
Employment	0.88	2.4 (0.77-7.6)
US born	−1.3	0.28 (0.02-3.1)
Years in the United States	0.05	1.05 (1.02-1.09)*
Medication in EMR	0.12	1.1 (1.005-1.3)*

Abbreviations: OR, odds ratio; CI, confidence interval; FHL, functional health literacy; EMR, electronic medical record.
*Statistical significance of $P < .05$.

on the S-TOFHLA test when they had the proper context to assist them with (as in the case of health care scenarios).[24] In our study, some Chinese American patients were professionals highly educated in China before moving to the United States. They may not have correctly pronounced medical words but they had adequate ability for numeracy and English language comprehension.

Our study found that participants with inadequate FHL were less likely to report correct medication knowledge of purpose. Although similar trends were reported about patients with low health literacy being less able to understand dosage instructions and warning labels ($P < .05$),[2,3] Backes and Kuo did not report significant relationship between FHL and medication knowledge of purpose.[11] Language barriers and cultural differences among various populations may contribute to the different findings. Speaking in English was an inclusion criterion for participants in Backes and Kuo's study but not in ours. Chinese American patients may have encountered additional communication barriers due to different language and communication styles.[22] Patients with inadequate health literacy may lack resources or skills to communicate with their health care providers.[32] Furthermore, Chinese Americans' perception of disease is influenced by culture, which could affect medication knowledge of purpose indirectly. For example, a previous study of Chinese American patients did not show perceived impact of hypertension on their personal life, suggesting they might not understand the overall threat of uncontrolled hypertension.[21] One probable reason is that a disease term of hypertension in the cultural understanding of the TCM does not exist. Moreover, patients who have not yet experienced symptoms or complications from uncontrolled hypertension may not feel vulnerable. If patients did not perceive the severity of illness, they might not strive to understand and remember the medication purpose, especially when handicapped by language barriers. Patients' misunderstandings on prescription drug labels could be a potential source of medication errors.[12] Effective educational strategy for improving medication knowledge of this patient population is warranted.

Without considering the effect of health literacy, senior patients were shown to be more vulnerable in misunderstanding drug labels and instructions.[33] However, the effect of older age diminished in our study as well as the study by Davis et al after adjusting for the effect of FHL. These results suggested that patients of all ages would benefit from efforts to improve comprehensibility of drug labels.[12] While Davis et al found male gender to be associated with incorrect interpretation of medication warning labels, gender was not significantly associated with knowledge of medication purpose in our study or with medication identification in the study by Kripalani et al.[27] Education might be associated with health literacy and could operate in the same causal pathway for health outcomes. Therefore, controlling for differences in education may overadjust the relationship between health literacy and outcomes of interest.[12,27,34] Nevertheless, we included education as a covariate to present conservative estimates of the effect of literacy on patients' knowledge of medication purpose.[12,34] FHL remained a significant predictor of medication knowledge of purpose after adjusting for education, which is consistent with previous findings.[12,34] Perhaps due to its limited effects on medication management and views of health,[14,27] employment was not significantly associated with medication knowledge in our study. Davis found that the number of medications was associated with understanding the prescription medication label but not with comprehension of the prescription medication warning label.[2,12] Our study indicates that the number of medications recorded in the EMR affected the medication knowledge of purpose, especially knowledge related to certain types of medications. It seems that medication purposes for central nervous system agents, cardiovascular agents, and respiratory agents were difficult for patients to understand (Table 2). Patients with these diseases may have cognitive declines that impair their comprehension for complex medication regimen. Educational programs have been shown to improve medication knowledge for patients with these diseases.[35-37]

Our study showed that FHL was significantly associated with medication direction discrepancy, which is in accordance with previous findings that low health literacy participants were more likely to misunderstand dosage instructions and miss doses.[17,18] Therefore, the reading ease of dosage instructions on drug labels should be improved, especially for patients with low FHL.[3] The health consequences of medication direction discrepancy could be severe, especially for patients taking cardiovascular medications.[38] In our study, cardiovascular agents took the largest part of medication direction discrepancy (Table 2). Chinese American patients may not have perceived the severity of cardiovascular diseases, resulting in poor understanding of medication direction of cardiovascular agents (Table 2). Our study did not find a significant relationship between age and medication direction discrepancy. This is similar to what Davis et al[12] and Backes and Kuo[11] found although other studies found that misunderstanding medication instructions was more common among the elderly.[33,39,40] Employment status provided an indication of socioeconomic support for participants but it did not show significant effects on medication direction discrepancy in our study or on medication use in other studies.[14,27] Previous studies suggested that if participants were born outside of the United States they might have unique customs and traditions that would affect their medication use;[15,21] we did not find a significant relationship between patients born in the United States and medication discrepancy. Further study is needed to confirm the relationship between years spent in the United States and medication discrepancy. Similar to previous findings,[10] our study showed that when the number of medications increased, patients became more likely to have medication direction discrepancy.

In addition, we found a high prevalence of medication name discrepancy in both FHL groups even though the difference between groups was not significant. Supplements and TCM were responsible for most of the medication name discrepancies (Table 2). This could be possible since Chinese American patients use self-prescribed over-the-counter herbal supplements and TCM for many health problems without telling their health care providers.[15] Some herbal supplements and TCM have adverse interactions with prescription medications via cytochrome P450 and P-glycoprotein systems, resulting in potential adverse drug reactions.[41] Further research is needed to investigate the relationship between FHL and medication name discrepancy.

Limitations

This was a pilot study involving 158 Chinese American patients at one internal medicine clinic in San Diego. Findings drawn from this observational study might not represent the Chinese American population at large. Furthermore, our results suggest associations rather than causal relationships between the effect of adequate health literacy and medication knowledge or medication discrepancy among Chinese American patients.

Conclusion

S-TOFHLA is a useful instrument to evaluate Chinese American patients' FHL in clinical practice. Adequate FHL among Chinese American patients was significantly associated with increased medication knowledge of purpose and decreased medication direction discrepancy. Both adequate and inadequate FHL groups had high prevalence of medication name discrepancy. To lower health care costs associated with medication errors, it is necessary to evaluate patients' medication knowledge and

medication discrepancy during clinical encounters, especially for patients with inadequate FHL.

Acknowledgments

We thank the study participants at the UC San Diego La Jolla Internal Medicine Group and acknowledge the physicians who helped in this project: Neil Faber, MD; Lisa Wastila, MD; Tony Lopez, MD; Paul Gamble, MD; Unna Mcpherson, MD; Eduardo Grunvald, MD; Edward Brown, MD; Nicholas Olson, MD; and Anthony Martinez, MD. We thank the pharmacist and the nurses who helped in this project: Panteha Kelly, RPh; Michelle Chavez, MA; Tiffany Cabading, LVN; Krystal Cerdenola, LVN; and Lim Liz, LVN. We thank the volunteer student, Regina Lam, for helping interview patients, collect data, and transcribe interview data, as well as staff associates at Dr Kuo's research office (Jessica Bryan, MPH, and Ashley To, BA) for their technical and administrative assistance. We also thank Jiwon Helen Shin for her editorial assistance.

Authors' Note

The preliminary data were presented as a poster at the 44th American Society of Health-System Pharmacists Midyear Clinical Meeting; December 8, 2009; in Las Vegas, NV. Statistical analyses were performed using Stata/SE version 10.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: Personnel time and efforts in this study were supported in part by the China Scholarship Council-University of California Visiting Graduate Student Scholarship (to WQ) and Agency for Healthcare Research and Quality Grant K08HS014552 (to GMK). Health literacy medication interview and data collection tools were derived from tools developed with funding from the NIH National Institute of Aging Grant R03AG026420 (to GMK).

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