Correlates of Medication Knowledge and Adherence: Findings From the Residency Research Network of South Texas

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Background: *Medication adherence is a complex phenomenon, influenced by a variety of factors. Most adherence research focuses on one medicine and does not represent the realities of clinical family medicine. This analysis examined factors associated with medication knowledge and adherence in family medicine patients with chronic conditions.* Methods: *The Residency Research Network of South Texas (RRNeST) enrolled 150 patients with chronic disease who "sometimes have trouble taking medicines." Seventy-five percent were Latinos. This cross-sectional analysis used baseline survey data from an intervention study. Investigators correlated medication knowledge and adherence with known predictors—patient, health, medication, economic, and physician factors. New variables related to patients' motivation to change treatment behaviors ("importance" and "confidence") were also included.* Results: *Linear regression analysis demonstrated that patient satisfaction, education level, and confidence were associated with better medication knowledge. Higher confidence, Spanish language, better functional and health status, and more prescription medicines were correlated with medication adherence.* Conclusions: *We recommend that family physicians enhance medication adherence by providing good information about treatment and counseling strategies to build patients' confidence. Our findings suggest that poor health status can be a barrier to, rather than a motivator for, treatment adherence.*

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Medication adherence is defined as the extent to which patients accept and follow the instructions they are given for prescribed treatments.[1] Reviewing 50 years of research findings, DiMatteo observed that 25%–40% of the adult patient population were not adherent to treatment.[2] Nonadherence can have significant effects on chronic disease treatment outcomes.[3] Multiple factors influence medication adherence: (1) patient variables such as age, gender, personality, beliefs, etc, (2) health status and disease, (3) characteristics of the medicines, (4) economic variables, and (5) physician variables.[4] Medication knowledge (eg, knowing the name of medication, dosage, how to take it, etc) is also highly correlated with medication adherence.[5,6]

One factor associated with poor adherence is a lack of motivation.[7] When identifying predictors of adherence, Becker and Maiman[8] noted that health-related motivations, such as readiness to undertake recommended adherence behavior (eg, intention to comply, willingness to seek and accept medical direction, etc), were the "most productive dimension[s] for present intervention and further exploration." Additional studies focused on intrinsic and extrinsic motivating factors that encourage and sustain adherence[9,10] and ways to incorporate the patient's motivations and difficulties with the treatment plan.[11,12] According to Rollnick et al,[13] motivation to change behaviors is comprised of two specific components: "importance" and "confidence." The change must be important to the patient, and patients must feel confident that they can successfully change. Understanding these components may shape clinical interventions to improve medication adherence.

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Existing research on medication adherence tends to focus on one treatment of one chronic illness and does not reflect the reality of primary care practice, where patients often present with multiple concerns and take several medicines. Our study was a collaboration of six family medicine settings, involving 150 patients who had multiple medical problems and took multiple medications. Our goal was to examine factors associated with medication knowledge and adherence in a primary care population, including known predictors—patient, health, medication, economic, and physician factors. In addition, the analysis adds new predictors—importance and confidence—that influence patients' motivation to take medications as prescribed.

Methods

The study was conducted in the Residency Research Network of South Texas (RRNeST), a network of six family medicine residency programs in South Texas, funded by grants from the Health Resources and Services Administration. These data represent baseline information collected in a study of a brief physician intervention for medication adherence. The Institutional Review Board at the University of Texas Health Science Center at San Antonio approved this study for involvement of human subjects.

Subjects

Clinic or research staff invited patients to participate in this study if patients met the following eligibility criteria: having one or more of the following diagnoses: type 2 diabetes, hypertension, hypercholesterolemia; taking one or more prescribed medications on a chronic basis; and responding "yes" to the screening question: "Do you sometimes have trouble taking all your medications as prescribed?" A total of 150 patients met eligibility requirements for the study and gave informed consent.

Measurement

This paper reports on data analyses using patients' self-report survey responses. Outcome variables include medication knowledge and medication adherence. Predictors include social desirability, motivation, patient characteristics, health status, medication characteristics, economic factors, and physician factors. These are described below.

Self-reported Medication Knowledge. We developed five self-report questions to assess patients' medication knowledge. These items asked how well the patients knew the names, purposes, recommended doses, frequencies, and side effects of their medications.[14] Patients responded to each item using a 5-point Likert-type scale. Internal consistency measured by Cronbach's alpha was .633. We tested our scale against actual knowledge of medications on a pilot sample of 25 patients and found high correlations, ranging from $r = .730$ to $r = .829$ ($P \leq .001$). Thus, these five self-report items accurately reflected patients' knowledge of their medication regimen.

Self-reported Adherence. We assessed patients' medication adherence at baseline using self-report. Other methods were considered. Pill counts were biased toward adherence, requiring patients to be "adherent to" providers' requests to bring pills to the office visit. Refill frequency was considered. Patients in five of six clinics filled prescriptions in any pharmacy in town, spreading refill information across five cities. Time-stamped pill bottles were very expensive and could potentially act as an intervention. Thus, we selected a self-report scale for adherence and sought other measures to corroborate the responses.

The adherence instrument is a four-item adherence scale by Morisky and colleagues.[15] These authors found good concurrent and predictive validity in this measure, with significant correlations between scale scores at enrollment and blood pressure measured at enrollment and at 2 and 5 years after enrollment. We corroborated patients' reports of adherence with a social desirability scale that assessed their propensity to exaggerate their adherence (see below). For the 63 patients in the intervention group, we also asked their physicians to rate their medication adherence, providing additional corroboration.

Social Desirability. Experts in psychometrics understand that self-report measurements are flawed by respondents' desire to provide socially acceptable or desirable answers. We expected that the concept of medication adherence would be especially vulnerable to this bias. To provide statistical controls, we included a social desirability scale, a short form of the Marlowe-Crowne Scale.[16,17] These 10 true/false questions are "defined by behaviors which are culturally sanctioned and approved but which are improbable of occurrence." Sample items include: "I like to gossip at times," "I have never deliberately said something that hurt someone's feelings," and "I always practice what I preach." Scores can range from 0 to 10, from no social desirability bias to very high bias. The Marlowe-Crowne has been used in hundreds of trials and has been tested for reliability and validity against gold-standard personality inventories, such as the Minnesota Multiphasic Personality Inventory (MMPI).[16]

Predictors of Medication Knowledge and Adherence. The patient survey also assessed groups of predictor variables related to motivation, patient characteristics, health status, medication characteristics, economic factors, and physician factors. "Motivation" was assessed

with two questions addressing importance ("On a scale from 1 to 10, how important is it to you to take medications as your doctor prescribes?") and confidence ("On a scale from 1 to 10, how confident are you that you can take your medications as your doctor prescribes?").[13] "Patient characteristics" included age, gender, ethnic identity, language preference, education, household size, marital status, and occupation. "Health status" included the general health status question (one-item scale, where high score is excellent health), functional status (a six-item functional status scale, where high scores indicate high function), and the presence of chronic health conditions, based on the National Ambulatory Medical Care Survey's (NAMCS) most frequent conditions seen in primary care practices.[18] "Characteristics of medications" included taste, side effects, number of medicines, and frequency of dose. "Economic factors" included family income and out-of-pocket costs for medications. "Physician factors" included number of visits in the past 6 months with family physicians and specialists and patient satisfaction with medical care (a four-item scale).

Procedure

Investigators recruited three family physician volunteers from each study site (18 total) to receive special training to improve patient treatment adherence. Staff approached patients of these physicians in the waiting room prior to routine office visits and screened patients for eligibility for the study. A total of 150 eligible patients gave informed consent and completed the baseline survey. We did not collect data from ineligible subjects or those who refused to participate in the study. Participants were assigned to intervention or control groups; physicians were not informed of control participants' study enrollment, and they received usual care. For intervention participants only, a checklist was attached to their charts to assure quality of the physician's intervention. The checklist also requested physicians' assessment of patients' adherence ("In your opinion, how compliant is this patient with his/her medicines?") Research assistants administered patient surveys 6 and 12 weeks after enrollment and conducted medical record reviews 1 year later. This paper analyzed data from the baseline assessment only, including 63 intervention and 87 control-group participants.

Analysis

We examined the simple relationships between predictors (motivation, patient, health, medication, economic, and physician factors) and outcomes (medication knowledge and adherence) using Pearson's correlation coefficients and Student's *t* tests. Correlations with adherence were controlled for social desirability. To determine the strongest predictors, we conducted linear regression analysis. Predictors were selected from the simple analyses where the correlation and *t* test *P* values were less than .25. To aid interpretation of findings, we conducted post hoc correlations and *t* tests to examine simple relationships between predictors.

Results

Participant Characteristics

From six practices, we enrolled 150 patients with diabetes type 2, hypertension, and/or hypercholesterolemia. Most were female (66%) and Latino (75%). Fifteen percent spoke Spanish only. Fifty-seven percent were married. Patients' ages ranged from 25 to 92 years, with a mean of 57 years; 25% were 65 years or older. About one third had occupations in clerical, service, or blue-collar jobs. More than half (60%) were at home as homemakers, disabled, or retired persons. Six percent were professionals, working as teachers or health care providers. Income was low—82% had family incomes less than $2,000 per month. Forty-eight percent had not attained a high school diploma or GED. Previous studies in this network show that these characteristics are representative of our patients with chronic illnesses.[19,20]

Participants took an average of 4.4 prescription medications and checked an average of 3.8 chronic health conditions on our survey checklist. Fifty-one percent rated their health as "fair" or "poor." Their mean score on the six-item functional status scale was 3.0 (standard deviation [SD]=.9), which is the central value on this scale. They reported an average of 4.5 visits to their family doctor in the past 6 months (median=4) and an average of 2.0 visits to a specialist (median=1).

All participants reported that they "sometimes had trouble taking all their medicines," as part of the screening process. On average, they reported good medication knowledge. The mean knowledge score was 3.9, where 5.00 was "perfect knowledge" about their medications. The mean adherence score was fair to poor, averaging 1.6, where 4.0 was "perfect adherence." Participants' rated importance of their medicines as 9.4 out of 10 on average (SD=1.5). They rated confidence about their ability to take medicines as prescribed at an average 8.4 out of 10 (SD=1.8).

Corroborating Adherence Measures

Participants' social desirability scores averaged 6.0 out of 10 (SD=2.0). Social desirability correlated significantly and positively with medication adherence (*r*=.197, *P*=.016). That is, those who reported good adherence were more likely to bias their responses in a socially desirable manner. Medication knowledge did not correlate significantly with social desirability. Physicians rated adherence on 56 of 63 intervention patients. The correlation coefficient between physicians' and patients' reports, controlled for patients' social desirability, was positive and statistically significant (*r*=.379, *P*=.003).

Predictors of Medication Knowledge and Adherence

To examine predictors of medication knowledge and adherence, we correlated motivation, patient, health, medication, economic, and physician factors with knowledge and adherence scores (Table 1). Because social desirability was significantly correlated with adherence scores, we used partial correlations for this analysis to control for the influence of socially desirable responses on adherence.

Motivation Factors. Confidence was strongly related to both knowledge and adherence scores, even when controlled for social desirability (Table 1). Importance, which had low variance, was not significantly correlated with knowledge or adherence. Examining correlations between predictors, we found that confidence was correlated with patient satisfaction (r=.184, P=.025).

Patient Factors. We found that ethnic background and education level were correlated with medication knowledge (Table 1). Medication knowledge, social desirability, age, and Spanish language were positively correlated with medication adherence, while education was negatively correlated with adherence. Correlations between predictors revealed that ethnicity and education were significantly related to each other such that non-Hispanic whites had more education than Latinos (13.0 years versus 8.3 years, t=7.66, P=.000), and

Table 1

Correlates of Medication Knowledge and Adherence

n=150	***Medication Knowledge***	***Medication Adherence***
Predictors	*Pearson Correlations Between Predictors and Knowledge*	*Pearson Correlations Between Predictors and Adherence, Partialling Out Social Desirability*
Motivation		
Importance	NS	NS
Confidence	r = +.194, P = .017	r = +.437, P = .000
Patient factors		
Medication knowledge	—	r = +.203, P = .019
Social desirability	NS	r = +.197, P = .016
Sex (t test)	NS	NS
Married (t test)	NS	NS
Age	NS	r = +.190, P = .029
Ethnicity (t test)	t = 3.51, P = .001 Non-Latino>Latino	NS
Spanish language (t test)	NS	t = 3.72, P = .001, Spanish>English
Education in years	r = +.253, P = .002	r = -.238, P = .006
Health factors		
Health status (one item) (High score is poor health)	r = +.235, P = .004	r = +.258, P = .003
Disability score (six item) (High score is poor health)	r = +.218, P = .007	r = +.269, P = .002
# of medical problems	NS	NS
Medication factors		
Number of medicines	r = -.161, P = .049	NS
Frequency of dose	NS	NS
Trouble reading labels	r = -.349, P = .000	NS
Side effects	NS	r = -.238, P = .006
Economic factors		
Income	r = +.185, P = .024	NS
Cost of medicine	NS	NS
Physician factors		
Patient satisfaction (four item)	r = +.336, P = .000	r = +.201, P = .020
Number of visits in 6 months	NS	NS

NS—not significant

English speakers had more education than Spanish speakers (mean 10.6 years versus 3.3 years, t=8.05, P=.000). Spanish speakers were older than English speakers (mean 64.1 years versus 55.2 years, t=3.30, P=.001).

Health Factors. Health factors were strongly related to knowledge and adherence. Participants with better subjective health status reported higher knowledge and adherence (Table 1).

Medication Factors. A greater number of medicines and trouble reading labels predicted poorer knowledge, while side effects predicted poorer adherence (Table 1). Correlations between predictors indicated a relationship between number of medicines and age (r=.226, P=.006), general health status (r=-.378, P=.000) and functional status (r=-.372, P=.000). People who took more medicines were older, with poorer subjective health. Trouble reading labels was associated with low education (F [2,141]=22.26, P=.000) and Spanish language (X^2=19.7, P=.000). Those who reported a lot of trouble reading labels had on average a fourth-grade education; half were Spanish speakers.

Economic Factors. In this sample, income was correlated to medication knowledge, but cost of medicine had little influence on outcomes (Table 1). Examining correlations between predictors, we found a significant relationship between age and cost (F (2,146)=3.54, P=.032) and income and education (r=.495, P=.000). Older participants were more likely to report their medications as "very expensive." Higher-income participants had higher education.

Physician Factors. Patient satisfaction scores based on a four-item scale were significantly correlated to medication knowledge and adherence (Table 1). Correlations with individual scale items examined this relationship more closely. Adherence was significantly related to item 1, "Satisfied with medical care overall" (r=.174, P=.037), and item 2, "Satisfied with the way your doctor talks to you" (r=.175, P=.035). Medication knowledge was related to item 3, "Satisfied with getting my questions answered" (r=.308, P=.000), and item 4, "It's easy to understand how to use my medicines" (r=.433, P=.000).

Linear Regression. Finally, we used linear regression analyses to determine the strongest predictors of medication adherence and knowledge (Table 2). Model 1 examined predictors of medication knowledge. Patient satisfaction, education level, and confidence were significant predictors, correlating positively with knowledge. Model 2 examined predictors of medication adherence. First, we directly entered social desirability to control for its influence, then used forward stepwise methods to enter the remaining significant variables. Confidence, Spanish language, functional status, number of prescriptions, and general health status were significant predictors, correlating positively with adherence.

Discussion

Medication adherence is a complex phenomenon with many causes and correlates. In this analysis, education level, patient satisfaction, and confidence were positively related to medication knowledge. Confidence, Spanish language, functional and health status, and complexity of the regimen were associated with medication adherence. We also found unexpected correlations with good subjective health, high number of medicines, and Spanish language, all of which predicted better adherence.

Number of Medicines

Those who took more medicines were more adherent. This finding contradicts the common medical dictum that more medicines lead to poorer adherence. However, other studies have had similar results.[21-23] Shalansky[21] found that patients in long-term treatment for cardiac disease had better adherence with more prescriptions (six versus four). This finding should not prompt health care providers to advocate polypharmacy, of course, because multiple drug interactions are a significant concern. However, when multiple drugs are clinically

Table 2

Predictors of Medication Knowledge and Adherence: Results From Linear Regression Analysis

Outcome: Medication Knowledge*		
Significant Predictors	*Beta*	P *Value*
Patient satisfaction	β=+.281	*P*=.001
Education in years	β=+.304	*P*=.000
Confidence	β=+.196	*P*=.016
Outcome: Medication Adherence**		
Significant Predictors	*Beta*	P *Value*
Social desirability	β=+.002	*P*=.979
Confidence	β=+.340	*P*=.000
Spanish language	β=+.193	*P*=.006
Functional status	β=+.238	*P*=.006
Number of prescriptions	β=+.320	*P*=.000
General health status	β=+.180	*P*=.039

* Model F (3,136)=11.18, P=.000, R^2=.445
** Model F (3,132)=8.91, P=.000, R^2=.357

indicated, one can be cautiously optimistic about a patient's ability to adhere to treatment, given appropriate instruction and support.

Health Status

We found that patients who felt healthier and more functional reported better adherence with their medicines. This finding contradicts a second medical dictum that states that patients who feel ill are more motivated to take their medicines. Were healthier patients more adherent because they had a simpler treatment regimen? We observed the opposite; patients who took fewer medications were less adherent. Feeling ill appears to be a barrier to adherence. Subjective poor health may indicate a decreased ability to concentrate on doctors' instructions about treatment, make daily decisions about medications, or provide self-care. We assume that sicker patients have a greater need for their medications, but these findings imply that illness itself can prevent the successful implementation of therapeutic intervention. When the illness interferes with the treatment regimen, a health care provider may want to involve family members or caregivers who can support the patient to make sound medical decisions and successfully adopt the best treatment.

Confidence

The health behavior change model posits that motivation to implement healthy behaviors is based on the perceived importance of the behavior and patients' confidence that they can succeed.[13] We found a strong correlation between patient confidence and both medication knowledge and adherence. Post hoc correlations may inform possible explanations for this finding. Confidence was correlated with patients' satisfaction with getting their questions answered. In a busy office practice, health care providers often rush through prescriptions at the end of the visit. These findings suggest that providing clear instructions and responding to questions may increase patients' confidence and knowledge while enhancing their willingness to follow the treatment plan. Simple counseling strategies described in the literature on health behavior change can enhance a provider's skills in building confidence and motivating patients.[13]

Spanish Language

In our sample, Spanish-speaking patients reported higher adherence than English-speaking patients, on average. The Spanish speakers tended to be older Latinos (average 64 years) with very low education (average third grade) who reported more trouble reading their medication labels. Their levels of medication knowledge were about the same as English speakers. Previous researchers have found that poor health literacy has a deleterious effect on health outcomes, medication knowledge, and treatment adherence.[24,25] Health literacy is the capacity to obtain, process, and understand basic information needed to make appropriate health decisions.[26] While we did not measure health literacy specifically, one might expect that low education, language differences, and trouble reading labels in the Spanish-speaking group would predict poor literacy and interfere with adherence.

Yet our analyses supported the opposite. What are the possible explanations? First, many family physicians in South Texas speak Spanish, eliminating language as a barrier for their patients. Second, Latino cultures value family closeness and loyalty. Perhaps these patients have support from family caregivers who have a good understanding of their medicines and help them adhere to treatment. Third, many older Latino patients interact with physicians in a tradition of *respeto* and *paternalismo,* treating doctor's advice with great respect and authority.[27] Are they perhaps more likely to respond in a doctor-pleasing, socially desirable way? Post hoc tests indicate that Spanish speakers and English speakers had similar scores on the social desirability scale. This respectful attitude may provide motivation for patients to cooperate with treatment plans, allowing them to overcome other potential barriers such as low education.

Limitations

This study presents a cross-sectional picture of self-reported medication adherence and its correlates; causal relationships between predictors and outcomes cannot be presumed. A key limitation of the study is the use of self-report to measure medication adherence. Other methods were considered but discarded due to sample bias, lack of feasibility, and/or expense. Instead, we selected a self-report measure with known reliability and validity and incorporated two methods to corroborate participants' responses: social desirability scale and physicians' assessments. The social desirability scores were then used to control statistically for self-report bias, improving the accuracy of the adherence measure.

Our screening question created a second limitation related to sample bias: "Do you sometimes have trouble taking all your medications as prescribed?" This sample included individuals who probably had lower-than-average means and variation in medication knowledge and adherence scores. With a more diverse sample and wider standard deviations in the outcome variables, correlations between predictors and outcomes may have changed.

Finally, this study is limited by its small size and the demographics of our South Texas patient population; 75% are Latino and 15% speak Spanish only. However, with the growth of Latino populations in the United States, the characteristics of this group are relevant to many other regions in the country.[28]

Conclusions

In conclusion, we recommend that family physicians and other health care providers assess their current educational practices about medications and enhance personal communication skills to increase patients' knowledge about their medications. Providers should seek opportunities to build patient confidence and enhance patient satisfaction through patient education and counseling. Our findings suggest that subjective poor health can interfere with a patient's adherence to treatment. When that occurs, the provider may need to involve family members or caregivers who can help the patient successfully adopt the best treatment.

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