

Original Research

Community pharmacy-based interprofessional care and health literacy: implications for medication beliefs and adherence in an underserved community

Sean R. King , Erica R. King , Jeffrey S. Hallam , Virginia Schwindt 

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Abstract

Background: Social determinants of health and limited health literacy are major contributors to health inequities within underserved communities. Community pharmacies represent accessible healthcare locations where interprofessional collaborative teams can address such challenges. Understanding how health literacy influences medication beliefs and adherence may inform strategies to improve education and patient outcomes. **Objective:** To compare medication beliefs and medication refill adherence behaviors between underserved residents with adequate versus inadequate health literacy attending interprofessional-led health events in community pharmacies, using a social-ecological perspective. **Methods:** This cross-sectional study was conducted in partner pharmacies serving underserved communities between May and November 2019. Interprofessional collaborative teams included faculty and students from pharmacy, social work, athletic training, and nursing. Services provided included cardiovascular risk assessments, glucose and blood pressure screenings, medication counseling, and referrals for free physician follow-up visits. Consenting participants completed interviewer-administered questionnaires assessing health literacy, beliefs about medicines, and demographics. Medication refill data for diabetes, hypertension, and cholesterol therapies were collected from pharmacy records, and medication refill adherence was calculated. Differences between participants with adequate versus inadequate health literacy were analyzed using chi-square tests, analysis of variance, and t-tests. **Results:** A total of 120 participants completed the researcher-administered questionnaire. No significant differences in demographic or clinical variables were observed between the health literacy groups. Medication refill adherence did not significantly differ between adequate and inadequate literacy groups. However, participants with inadequate literacy reported significantly stronger necessity of medication beliefs ($p=0.01$) and greater concern beliefs about potential adverse effects ($p=0.03$) than those with adequate health literacy. Overall, forty-percent of participants reported a necessity score associated with medications lower than or equal to their concern score. **Conclusion:** While health literacy was not directly associated with medication refill adherence, it was strongly linked to beliefs about medications. Patients with inadequate health literacy simultaneously expressed greater belief in the necessity of medications and heightened concerns about adverse effects. These findings underscore the importance of tailoring provider-patient communication to address both necessity and concern beliefs, particularly within underserved populations. Interprofessional teams in community pharmacy settings, guided by a social-ecological perspective, may be well positioned to improve health literacy, support medication counseling, and reduce health disparities.

Key Words: health literacy, social determinants of health, medication adherence, medically underserved area, community pharmacy services

Sean R. King*. MS, PhD, Associate Professor and Director, Center for Population Health and Rural Medicine, Union University College of Pharmacy, sking@uu.edu

Erica R. King. PharmD, Pharmacy Manager, West Tennessee Healthcare, Jackson-Madison County General Hospital. erica.king2@wth.org

Jeffrey S. Hallam. PhD, Professor and Senior Associate Dean for Research and Global Affairs, College of Public Health, Kent State University. jhallam1@kent.edu

Virginia Schwindt. LCSW, Associate Professor and Director of Field Education, School of Social Work, Union University. vschwindt@uu.edu

INTRODUCTION

Social determinants of health (SDoH), or conditions within environments where people are born, live, learn, work, play, worship, and age, influence many aspects of health, and their impact varies across communities^{1,2}. Consequently, if potential inequalities related to SDoH are to be improved, healthcare professionals must provide individuals with appropriately communicated health education. Coleman and colleagues recently reiterated the importance of health information that patients easily understand³. For this reason, patients' health literacy should be considered for any

educational effort to be effective¹. Health literacy, or the degree to which individuals have the capacity to obtain, process, and understand health information and services needed to make appropriate health decisions influences adherence to prescribed therapeutic regimens and health outcomes⁴⁻⁶. Research suggests millions of Americans have difficulties adequately comprehending basic health information⁷⁻⁹. As a result, patients' adherence to health advice may be compromised^{10,11}.

Adherence is the extent to which a person's behavior, taking medication, following a diet, and/or executing lifestyle changes, corresponds with agreed recommendations from a healthcare provider¹². The significance of effective provider-patient communication is highlighted in this definition¹³. Inadequate provider-patient communication contributes to findings suggesting that even adherent patients fail to comply with all aspects of recommended regimens¹⁴. A key factor influencing adherence is patient belief as individuals are more likely to adhere to prescribed regimens if the therapy is believed necessary to maintain health. Conversely, proper adherence is less likely if concern regarding the therapy is high^{15,16}.

Collectively, health literacy, adherence behaviors, and medication beliefs appear to be interrelated factors that may contribute to health inequities, particularly among communities with



limited access to healthcare resources. Specifically, although previous studies have demonstrated inadequate health literacy to be associated with poorer health outcomes, the direct relationship with medication adherence is less clear⁴⁻⁶. Additionally, patient beliefs concerning medications, including perceptions of necessity and concerns pertaining to side effects, are consistently linked with adherence behaviors^{15,16}. Better understanding these relationships is critical in underserved communities, where systemic barriers such as limited access to healthcare, socioeconomic inequities, and structural racism may constrain both communication and self-management opportunities¹⁷.

Evidence suggests SDoH may be more efficiently addressed at the community level¹⁸⁻²⁰. This may particularly apply to the determinants of healthcare access and quality, as well as social and community contexts. Elliot and colleagues elucidated the benefits of utilizing connections between community and healthcare sectors, including community-based pharmacies, to provide health screenings and education to underserved populations²¹. Such efforts are believed to help educate underserved communities on many important health topics and increase the possibility of participation in follow-up and preventative health behaviors²²⁻²⁶. It is also believed properly including interprofessional collaborations (IPCs) within healthcare environments is necessary to address patient needs adequately²⁷⁻²⁹. The perceived benefits of IPCs are thought to positively impact many health-related outcomes and have been incorporated into the educational requirements of various health professional programs²⁹⁻³⁵. Community pharmacies represent an important access point-of-care in underserved areas and by integrating IPC teams into pharmacy-based health events, it may be possible to extend health education and outreach to individuals who otherwise face barriers to traditional health systems. While IPC approaches are increasingly recommended to address SDoH, evidence describing how these teams can support underserved patients' medication beliefs, health literacy, and adherence behaviors remains limited.

The purpose of this investigation was to compare medication beliefs and refill adherence behaviors among residents with adequate versus inadequate health literacy who attended free IPC-led health events conducted in community pharmacies serving medically underserved areas.

Specifically, we compared participants with inadequate versus adequate health literacy to explore differences in their beliefs about medicines, adherence behaviors, and related clinical characteristics. By doing so, this study seeks to inform communication strategies and future IPC outreach efforts in pharmacy settings serving underserved communities. It was believed considering a social-ecological perspective would allow for a better appreciation of the SDoH and their potential influence on needs among underserved communities. A social-ecological perspective recognizes health as being influenced by multiple factors, including those at the intrapersonal,

interpersonal, organizational, community, and public policy levels³⁶. By considering the interactions between individuals and their physical and cultural environments, a social-ecological perspective acknowledges the possibility that behaviors both influence and are influenced by social environments^{18,36}.

METHODS

We utilized a cross-sectional design and gathered data from visitors of partner pharmacies located in underserved communities of our county. Permission was granted from these pharmacies for our IPC team to offer patrons free health screenings and education and recruit potential participants for study inclusion. The University's Institutional Review Board approved this investigation. Health screenings and education were offered, and data were collected between May and November 2019 at partner community pharmacies. All associated activities were offered on multiple occasions, on various days, and during various times to increase access to the services. The IPC team comprised faculty and students from our university's College of Pharmacy, Social Work, Athletic Training programs, and nurses representing a local disease management department. The following services and corresponding education were offered at each event: diabetes, heart, stroke, and vascular risk assessments, blood glucose and blood pressure screenings, medication counseling, smoking cessation information, body mass index measurements, and social work services. Participants received a report explaining their risk factors, a blood screening analysis, consultation with a licensed professional, and a follow-up appointment with a local physician if they were at increased risk. All who visited partner pharmacies were eligible for study inclusion and invited to participate in the screenings and education. However, individuals were excluded from the research if they refused to participate, were under 18 years of age, did not speak English as their first language, had a severe hearing impairment, poor visual acuity, overt psychiatric illness, dementia, severe aphasia, or were too ill to participate. Additionally, because our research concerning adherence focused solely on cholesterol, hypertension, and diabetes medications, individuals prescribed associated regimens for less than three months were excluded.

Instrumentation

Given this investigation emphasized the health literacy of participants, data were collected using interviewer-administered questionnaires. The questionnaires were administered following the consent process for health screenings and research participation. Interviewer-administered questionnaires were used not only to reduce barriers for individuals with limited health literacy but also to enhance data quality and feasibility within the pharmacy-based health event setting. This mode of administration helped minimize missing or incomplete responses, ensured consistent interpretation of items across participants with diverse cognitive or sensory needs, and standardized delivery across multiple locations. Additionally, because health screenings occurred



in active community pharmacy environments, interviewer administration reduced participant burden and allowed data collection to occur seamlessly alongside clinical assessments. The first section of the questionnaire gathered participants' demographic information and estimates of health literacy. The second section collected the health screening results and information necessary to assess participants' personal beliefs about medications and adherence behavior.

The one-item screening tool developed by Chew and colleagues was utilized to discern participants possessing inadequate health literacy from those possessing adequate health literacy^{37,38}. This item reads, "How confident are you filling out medical forms by yourself?" and is measured on a five-point scale where 1=extremely, and 5=not at all. This item is among the top predictors of health literacy and has been validated against the Short Test of Functional Health Literacy in Adults (s-TOFHLA), and the Rapid Estimate of Adult Literacy in Medicine (REALM)³⁹⁻⁴⁴. Responses to this question are dichotomized along a validated cut-point (3=somewhat) to classify patients as adequate or inadequate health literate^{37-42,45}. This screening tool was selected to mitigate the response burden of participants.

The Medication Refill Adherence (MRA) calculation was utilized to evaluate the adherence behavior of participants. The MRA is calculated as the percentage of eligible prescription days filled (total days' supply for all qualifying drug classes/total number of days from the first to the last fill in the interval $\times$ 100, capped at 100%)⁴⁶⁻⁴⁸. The MRA was calculated for all qualifying participants prescribed cholesterol, hypertension, and diabetes medications. These medications were selected because of their relationship to the screenings and education offered by the IPC team and their importance to the study population's health. An employee of the partner community pharmacy assessed the computerized medication profiles of qualifying, consenting participants once health screenings were completed. All necessary data for medications of interest were recorded on a confidential form during the reviews, and the MRA rate was computed. Individuals were considered adherent if they refilled medications as prescribed at least 80% of the time. This percentage is commonly accepted within the adherence literature and considered appropriate⁴⁹.

Participants' beliefs concerning medications were assessed utilizing the previously validated Beliefs about Medicines Questionnaire (BMQ)⁵⁰. This instrument consists of two five-item Likert scales, where 1=strongly disagree, and 5=strongly agree. The first scale assessed individuals' beliefs concerning the necessity of prescription medications, while the second assessed their concerns regarding the potential negative consequences of these products. These constructs were measured by summing responses to individual scale items. Total scores for each scale had a possible minimum score of 5 to a maximum score of 25, with higher scores indicating stronger beliefs^{15,50}. Calculating the difference between each scale provides a necessity-concerns differential score, which ranges

from -20 to +20¹⁵. This score is considered as a cost-benefit analysis for each participant, where costs (i.e., concerns) associated with medications are weighted against their perceived benefits (i.e., necessity). Positive scores indicate that the individual believes the benefits of medications outweigh the costs, whereas negative scores indicate that costs are perceived as greater than the benefits¹⁵.

Statistical Analysis

Patient characteristics were summarized using frequency, mean, and standard deviation. Chi-square analyses were employed to compare between-group differences for categorical variables, and analysis of variance (ANOVA) was used to test continuous variables. Two-tailed, independent samples t-tests were used to evaluate the health literacy groups' differences in clinical characteristics, personal beliefs about medications, and MRA rates. All analyses were conducted using IBM SPSS version 28. The a priori alpha level of .05 was used to examine significance.

RESULTS

One hundred and twenty visitors of partner pharmacies received health education from the IPC team and completed the researcher-administered questionnaire (Table 1). The majority of individuals were female (65.0%), Black/African American (53.3%), prescribed hypertension medications (52.5%), reported having a primary care provider (67.5%), and requested consultation with a pharmacist to discuss their current medication regimen (65.0%). The average age of participants was 57.2 ± 17.6 years, and 38.3% possessed inadequate health literacy. Those possessing adequate health literacy were not found to significantly differ from those possessing inadequate health literacy in the distribution of age, gender, race, or any other descriptive variable. Clinical characteristics of participants are reported in Table 2, including mean blood pressure, heart rate, and glucose levels. Significant differences in clinical characteristics were not observed between the health literacy groups. Further, Cohen's effect size values for systolic blood pressure ($d = 0.1$), diastolic blood pressure ($d = 0.1$), heart rate ($d = 0.1$), random blood glucose ($d = 0.2$), and fasting blood glucose ($d = -0.4$) suggested small to negligible practical significance. MRA rates were calculated for all consenting participants meeting the study's inclusion criteria (Table 3). Calculations for this variable included data from participants who only filled prescriptions for study medications at a partner pharmacy. The MRA for individuals possessing adequate health literacy was not found to differ significantly from those with inadequate health literacy overall (adequate health literacy = 0.9 ± 0.2 vs inadequate health literacy = 0.9 ± 0.2 , $t(40)=0.6$, $p=0.5$) or for any study medication. Cohen's effect size values for MRA rates suggested low practical significance for overall medications ($d = 0.2$), hypertension medications ($d = 0.3$), cholesterol medications ($d = 0.4$), and a negligible effect for diabetes medications ($d = 0.1$).

Cronbach's alphas of the necessity and concern scales of the



Table 1. Descriptive Characteristics, overall and by health literacy level (N=120)				
Variable	Adequate HL	Inadequate HL	Total	P Value ^a
	(n=74)	(n=46)	(N=120)	
Age in years (Mean, SD)	57.4, 18.2	56.8, 16.8	57.2, 17.6	0.9
	Freq (%)	Freq (%)	Freq (%)	Chi-Square^a
Gender				
Male	25 (33.8)	17 (37.0)	42 (35.0)	0.7
Female	49 (66.2)	29 (63.0)	78 (65.0)	
Ethnicity				
White	39 (52.7)	17 (37.0)	56 (46.7)	0.1
Black/African American	35 (47.3)	29 (63.0)	64 (53.3)	
Primary Care Provider				
Yes	49 (66.2)	32 (69.6)	81 (67.5)	0.7
No	25 (33.8)	14 (30.4)	39 (32.5)	
Prescribed Hypertension Meds				
Yes	35 (47.3)	28 (60.9)	63 (52.5)	0.2
No	39 (52.7)	18 (39.1)	57 (47.5)	
Prescribed Cholesterol Meds				
Yes	21 (28.4)	15 (32.6)	36 (30.0)	0.6
No	53 (71.6)	31 (67.4)	84 (70.0)	
Prescribed Diabetes Meds				
Yes	10 (13.5)	11 (23.9)	21 (17.5)	0.2
No	64 (86.5)	35 (76.1)	99 (82.5)	
Take a Daily Aspirin				
Yes	28 (37.8)	16 (34.8)	44 (36.7)	0.7
No	46 (62.2)	30 (65.2)	76 (63.3)	
Daily Tobacco Use				
Yes	16 (21.6)	12 (26.1)	28 (23.3)	0.6
No	58 (78.4)	34 (73.9)	92 (76.7)	
Request Pharm. Consultation				
Yes	47 (63.5)	31 (67.4)	78 (65.0)	0.9
No	24 (32.4)	15 (32.6)	39 (32.5)	
Refused	3 (4.1)	0 (0.0)	3 (2.5)	
Abbreviations: n=number; HL=health literacy; SD=standard deviation; Freq=Frequency; Meds=medications; pharm=pharmacist.				
* Significant at 0.05 level.				
^a Chi-square analyses were used to compare between-group differences for categorical variables, and analysis of variance (ANOVA) was used to test continuous variables.				

BMQ were found to be 0.9 and 0.8, respectively. Overall, the majority of participants (53.3%) believed their medications were necessary for sustaining health (Table 4). Most believed medications are necessary for their current and future health and to prevent their health from worsening. Almost one-half (48.3%) believed they would be very ill if it were not for their medication, and 39.2% believed their life would be impossible without their medications. A greater percentage of those possessing inadequate health literacy (65.2%) believed in the

necessity of medications than those possessing adequate health literacy (46.0%). However, over one-third (38.5%) of all participants reported concerns regarding possible negative consequences of their medications. Almost one-half (49.2%) reported being worried about taking medications, and 58.3% were concerned with the potential long-term effects of medications. A greater percentage of the inadequate health literacy group (46.1%) were found to be more concerned about the potential adverse effects of medications than the adequate



Table 2. Clinical Characteristics, overall and by health literacy level (N=120)				
Variable	Adequate HL	Inadequate HL	Total	P Value
	Frequency	Frequency	Frequency	
	Mean (SD)	Mean (SD)	Mean (SD)	
Systolic BP	70	41	111	0.7
	135.0 (20.0)	137.0 (19.0)	136.0 (19.5)	
Diastolic BP	70	41	111	0.6
	81.0 (12.7)	82.2 (9.7)	81.4 (11.7)	
Heart Rate	67	41	108	0.6
	75.6 (13.0)	76.7 (12.0)	76.0 (12.4)	
Glucose (Random)	50	29	79	0.4
	114.9 (36.5)	121.4 (36.7)	117.3 (36.5)	
Glucose (Fasting)	9	6	15	0.4
	105.6 (35.4)	91.0 (30.2)	100.0 (33.1)	
Abbreviations: HL=Health Literacy; SD=Standard Deviation; BP=Blood Pressure.				
Due to missing data, results were calculated for less than 120 participants.				

Table 3. MRA rate, overall and by health literacy level				
Variable	Adequate HL	Inadequate HL	Total	P Value
	Frequency	Frequency	Frequency	
	Mean% (SD)	Mean% (SD)	Mean% (SD)	
Adherence to Diabetes Medications	3	8	11	0.6
	0.8 (0.3)	0.9 (0.2)	0.8 (0.2)	
Adherence to Cholesterol Medications	7	8	15	0.9
	0.8 (0.3)	0.8 (0.3)	0.8 (0.3)	
Adherence to Hypertension Medications	22	17	39	0.4
	0.9 (0.2)	0.9 (0.1)	0.9 (0.2)	
Overall Adherence	24	18	42	0.5
	0.9 (0.2)	0.9 (0.2)	0.9 (0.2)	
Abbreviations: MRA=Medication Refill Adherence; HL=Health Literacy; SD=Standard Deviation; %=Percentage.				
MRA rates reflect consenting participants meeting the inclusion criteria who only filled prescriptions for study medications at a partner pharmacy. Individuals may have been prescribed more than one medication.				

health literacy group (33.8%).

Comparison between the two health literacy groups revealed the mean necessity score for those possessing inadequate health literacy (17.8 ± 5.7) to be significantly greater than that of those possessing adequate health literacy (15.1 ± 5.8 ; $t(118)=2.5$, $p=0.01$) (Table 5). Similarly, the mean concern beliefs score was also found to be significantly higher for the inadequate health literacy group (15.1 ± 5.1) than for the adequate health literacy group (13.1 ± 4.9 ; $t(118)=2.2$, $p=0.03$). The two health literacy groups did not differ significantly on the mean necessity-concerns differential score (adequate health literacy = 2.0 ± 6.5 vs. inadequate health literacy = 2.7 ± 5.3 , $t(118)=0.6$, $p=0.6$). However, 48 of the 120 participants (40.0%) possessed a necessity score lower than or equal to

their concern score. Cohen's effect size values suggested small to moderate practical significance for concern beliefs ($d = 0.4$) and necessity beliefs ($d = 0.5$), and a negligible effect for the necessity-concern differential ($d = 0.1$). These findings indicate that health literacy significantly influences patients' cognitive representations of their medications, encompassing both their perceived necessity and concerns, even in the absence of discernible differences in refill adherence behavior.

DISCUSSION

This study examined the health literacy status, medication beliefs, and adherence behaviors of residents participating in free community pharmacy health events staffed by interprofessional teams. Despite the lack of a significant



Table 4. Percentage of respondents agreeing or strongly agreeing with BMQ scale items (N=120)			
	Adequate HL (n=74)	Inadequate HL (n=46)	Total (N=120)
Necessity Scale	%	%	%
My health at present depends on my medicines	56.8	65.3	60
My life would be impossible without my medication	28.4	56.5	39.2
Without my medication, I would be very ill	37.8	65.2	48.3
My health in the future will depend on my medication	44.6	63.1	51.7
My medication protects me from becoming worse	62.2	76.1	67.5
Concerns Scale			
Having to take medication worries me	44.6	56.5	49.2
I sometimes worry about the long-term effects of my medication	52.7	67.4	58.3
My medication is a mystery to me	25.7	32.6	28.3
My medication disrupts my life	16.3	32.6	22.5
I sometimes worry about becoming too dependent on my medication	29.8	41.3	34.2
Abbreviations: BMQ=Beliefs about Medication Questionnaire; HL=Health Literacy; %=Percentage			

Table 5. Means and standard deviations for BMQ scales overall and by level of health literacy (N=120)				
BMQ Scale	Adequate HL (n=74)	Inadequate HL (n=46)	Total (N=120)	P Value
	Mean (SD)	Mean (SD)	Mean (SD)	
Necessity Beliefs	15.1 (5.8)	17.8 (5.7)	16.1 (5.9)	0.01*
Concern Beliefs	13.1 (4.9)	15.1 (5.1)	13.9 (5.1)	0.03*
Necessity-Concerns Differential	2.0 (6.5)	2.7 (5.3)	2.3 (6.1)	0.6
Abbreviations: BMQ=beliefs about medication questionnaire; HL=health literacy; n=number; SD=standard deviation.				
*Significant at 0.05 level.				
Total scores for each scale range from 5 to 25, with higher scores indicating stronger beliefs.				

association between health literacy and medication refill adherence, important differences in medication beliefs emerged. To clarify, participants with inadequate health literacy reported significantly higher necessity beliefs as well as greater concerns about potential negative effects compared to those with adequate health literacy. These findings suggest that health literacy may shape how individuals perceive and evaluate their medications, even if it is not directly associated with adherence behavior. Practically, this information may assist healthcare professionals and organizations in developing policies and better tailoring communication strategies when interacting with underserved patients. Beyond these belief-focused results, we were able to provide health screenings, health education, and follow-up appointments free of charge to many underserved residents within the community. Given approximately one-third of participants reported not having a primary care provider, the possibility exists that many of these individuals may not otherwise have access to such services. Furthermore, while differences in medication refill adherence between health literacy groups were not statistically significant, small sample sizes for adherence calculations limit the power to detect meaningful effects. Notably, adherence rates in the

inadequate health literacy group trended slightly higher than those in the adequate health literacy group across all medication categories. These trends should be interpreted cautiously but may warrant further exploration in larger samples, as they could reflect contextual factors, such as reliance on pharmacy staff or more frequent healthcare encounters that influence refill patterns.

The service-learning aspect of this endeavor was significant. Throughout this project, several local healthcare professionals and students gained valuable experience working within IPC teams to address public health issues often encountered within medically underserved areas. This experience may be essential as it relates to the health profession students and community pharmacies who participated in delivery of the health events. The possibility exists that the positive relationship between IPCs and health outcomes is due, at least in part, to information conveyed by members of IPC teams being more efficiently communicated, which patients better understand.²⁹⁻³² Therefore, allowing students to gain experience working within an atmosphere that promotes IPCs to assist underserved communities may allow them to better appreciate the

potential value of such partnerships in future practice settings. It is important to note that while this project took place within the context of IPC-led community pharmacy health events, the study was not designed to evaluate the effectiveness of IPC models, access to care, or social determinants of health. Instead, the findings provide an example of how pharmacies can serve as community-based venues for outreach and how IPC teams may be positioned to engage populations that experience systemic barriers to healthcare. Given this study employed a cross-sectional design, we cannot determine whether participation in IPC-led pharmacy events influenced participants' medication beliefs or health literacy-related outcomes. References to the potential value of IPC models should, therefore, be interpreted as contextual considerations rather than causal conclusions. Consequently, longitudinal or intervention-based studies are needed to assess whether IPC engagement directly influences beliefs, communication quality, or adherence behaviors.

Notwithstanding these limitations, the importance of considering the health literacy skills of patient populations is reiterated within this project, as is the potential influence of health literacy on health outcomes. The finding that 65.0% of those completing the interviewer-administered questionnaire requested a phone call from a pharmacist to better understand their medication regimens indicates many recognize the importance of health advice and education provided by healthcare professionals. However, given over one-half (52.5%) of participants reported being prescribed hypertension medication, the concern is raised whether this population adequately comprehends and acts upon the advice they receive from healthcare professionals. Interestingly, we found individuals possessing adequate health literacy not to be statistically more adherent to their medication regimens than those with inadequate health literacy. Although sample sizes were small, results indicate the mean MRA rate for those possessing inadequate health literacy trended slightly higher overall, and across all study medications than for individuals possessing adequate health literacy. The literature has previously expressed concern over a lack of clarity regarding the relationship between health literacy and adherence behavior⁵¹. The findings reported here highlight the need for further exploration of contextual factors influencing adherence. Our results point toward the importance of addressing medication-related beliefs in patient care. In particular, healthcare professionals may need to tailor their counseling approaches to simultaneously affirm the necessity of prescribed medications while directly addressing concerns, especially among individuals with limited health literacy.

Although this study did not include measures assessing participants perceived self-management abilities or confidence in managing their health, we cannot conclude why adherence patterns differed or trended in particular directions by literacy level. However, the possibility exists that those possessing adequate health literacy may believe they can adequately

manage their health and adhere to prescribed therapeutic regimens based on their knowledge and abilities and, therefore, do not require extensive counseling from healthcare providers. Conversely, those with inadequate health literacy may rely more heavily on healthcare providers' verbal (i.e., spoken) advice and any accompanying written information provided but still fail to comprehend prescribed regimens appropriately. Additional research is needed to identify potential communication techniques and styles that may better serve the two health literacy groups. Studies should incorporate measures of self-efficacy, patient activation, or treatment confidence to clarify how these factors interact with health literacy to influence adherence behaviors.

An important discovery from this project relates to the population's beliefs about medications. We found participants possessing inadequate health literacy to hold significantly stronger beliefs concerning the necessity of medications than those possessing adequate health literacy. The inadequate health literacy group also expressed significantly stronger concerns about the possible adverse effects of medications. In other words, while those possessing inadequate health literacy believed their medications were necessary to maintain health more than those with adequate health literacy, they were also significantly more concerned about the potential consequences of consuming medications. It is important to note that while over one-half (53.4%) of all participants held positive beliefs about the necessity of medications, almost forty percent (38.5%) expressed strong concerns about the possible consequences of their medications. The long-term effects of medications were of particular concern. Research indicates that individuals possessing strong beliefs about the necessity of treatments are more likely to adhere to healthcare regimens, while those possessing greater levels of concern regarding potential consequences are more likely to be non-adherent¹⁵. Given 40.0% of underserved residents participating in our investigation reported a necessity score equal to or lower than their concern score, appropriate provider-patient education and communication are especially important to this population. This finding may be particularly significant given the influence of one's social environment, including relationships and interactions with community members, on beliefs, adherence, and overall health^{52,53}. Within community pharmacy settings, IPC teams are uniquely positioned to address these dynamics by tailoring counseling strategies that simultaneously reinforce the necessity of prescribed therapies while directly acknowledging and alleviating patient concerns. Pharmacists, in particular, can serve as accessible medication experts, while other IPC members such as nurses and social workers can provide complementary support addressing broader health and social needs. Together, this approach may help mitigate the tension between necessity and concern beliefs observed in patients with inadequate health literacy, thereby promoting more informed decision-making and potentially improving adherence behaviors.



A significant benefit of applying a social-ecological approach to health promotion practices is that potential causes of health behaviors and interventions within specific populations are encouraged to be considered from multiple perspectives⁵⁴. For example, adherence to prescribed healthcare regimens may be influenced at multiple levels of the social-ecological model: personal beliefs about medications and health literacy (intrapersonal), provider–patient communication that clarifies necessity versus concern beliefs (interpersonal), the support and coordination of interprofessional collaborative teams within pharmacies (organizational), accessibility of community pharmacies serving as local points of care (community), and allocation of funds to sustain free or reduced-cost healthcare services for underserved populations (public policy). Provider–patient interactions are described as being influenced by each concept from a social-ecological perspective⁵⁵. Therefore, if inequalities concerning the educational and communication needs of underserved communities are to be improved, interventions for patients, providers, and organizations will be needed⁵⁵. Framing our findings in this way demonstrates how differences in health literacy and medication beliefs among underserved residents are embedded within broader systems, highlighting multiple targets for intervention.

Considering a social-ecological perspective and utilizing IPC teams in such a manner could also help to address SDoH, particularly those domains relating to health communication, health literacy, prevention services, access to care, and underserved populations¹. In addition to recent updates concerning the definition of health literacy and the attention devoted to this area within Healthy People 2030, the findings presented here further demonstrate the importance of healthcare professionals and community organizations considering the communication needs of patient populations^{56–58}. Importantly, updates to the health literacy definition emphasize the importance of individuals possessing the ability to use information and make well-informed decisions instead of simply understanding the information to make appropriate decisions. Additionally, the responsibility of organizations to address health literacy and ensure all individuals are capable of adequately utilizing health-related information and services is acknowledged within the updated definitions, as is the connection between health equity and health literacy^{57,58}. Research applying the updated definitions of health literacy is needed to elucidate further the influence of applying a social-ecological perspective and incorporating IPC teams within community settings on provider–patient communication, health beliefs, and adherence behaviors of underserved populations.

Interpreting findings from our investigation should be considered within the context of various limitations. First, although the use of interviewer-administered questionnaires improved feasibility and reduced missing data, the presence of interviewers may have introduced researcher-presence bias. Participants receiving health screenings and counseling

from interprofessional team members may have felt inclined to provide socially desirable responses, particularly regarding medication beliefs or health behaviors. Also, multiple individuals conducted the interviews. This variability may have resulted in participants responding differently to the various interviewers. Additionally, participants were rural, underserved residents whose responses may not adequately reflect other populations. Participants were recruited using convenience sampling during voluntary visits to partner community pharmacies. As a result, the sample may not be fully representative of all underserved residents in the region. Individuals who elected to participate in the health events may differ from non-participants in their health-seeking behaviors, medication use patterns, or interest in interprofessional services, introducing the potential for recruitment bias. These limitations should be considered when interpreting the generalizability of our findings. Secondly, participants were asked to self-report regarding specific questions (e.g., Do you use tobacco products daily?), introducing the possibility of social desirability bias. Third, the sample size for some variables (e.g., MRA rates) was small. The findings indicate that MRA rates trend higher for those with inadequate health literacy than those possessing adequate health literacy, both overall and across study medications, which may be a direct result of the small sample of patients from which rates could be calculated. Additionally, 80% or higher MRA rates for each health literacy group across all medications were not expected. It may be significant for researchers to examine this finding using a larger sample and various medications. Fourth, participants were not randomly selected, raising the possibility of selection bias. Fifth, information sharing between participants at various locations could not be controlled. If participants in the various locations did share aspects of the questionnaire, it may have influenced the scores of the latter participants and reduced the likelihood of finding differences between the health literacy groups. Finally, the nature of data collection prohibited the use of traditional health literacy assessments (i.e., s-TOFHLA or REALM). The one-item health literacy screening tool used in this investigation, while validated and practical for community-based environments, provides only a proxy for functional health literacy^{37,38}. It does not assess multidimensional domains such as numeracy skills, oral literacy, or the ability to interpret risk information. Because these aspects of health literacy may independently influence medication beliefs, adherence behaviors, and communication needs, the measure may underestimate the complexity of participants' literacy-related challenges. Future research using multidimensional literacy assessments is needed to more fully characterize literacy profiles within underserved populations.

CONCLUSION

We found that participants possessing inadequate health literacy believed medications were necessary to maintain their health more than those possessing adequate health literacy. However, the inadequate health literacy group was also more concerned about the potential adverse consequences



of consuming medications. This study demonstrates the importance of healthcare professionals considering all individuals' health beliefs and communication needs during provider-patient encounters. This finding may be especially important, considering inadequate provider-patient communication could be contributing to systemic racism and placing underserved communities at other significant disadvantages. Results presented here may assist healthcare providers in developing policies and adapting counseling strategies to address the educational and communication needs of patient populations more effectively. This study contributes to the literature by demonstrating that health literacy status was associated with differences in medication beliefs, though not adherence behaviors, among underserved residents. These insights suggest that future interventions in pharmacy and interprofessional practice should incorporate strategies that address both health literacy and patient beliefs in order to more effectively support medication use in underserved communities. Further study is required to elucidate the application of social-ecological perspectives and IPC teams within underserved communities and to identify

potential communication practices that may better serve both adequate and inadequate individuals.

AUTHOR CONTRIBUTIONS

Sean R. King: Data curation, Resources, project administration, supervision, writing - original draft, conceptualization, formal analysis, methodology, validation

Erica R. King: Data curation, project administration, supervision, conceptualization, resources, writing - review and editing

Jeffrey S. Hallam: Writing - review and editing, methodology, validation, conceptualization

Virginia Schwindt: Writing - review and editing, investigation, resources

CONFLICTS OF INTEREST

None declared

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