

Intellectual Humility and Medication Adherence: A Path Toward Productive Interactions with Medical Information

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Medical nonadherence is costly to individuals and health systems. According to the Information, Motivation, and Strategy model, adherence could be improved by facilitating more effective interactions with medical information. Given that intellectual humility concerns people's approach to new knowledge and information, it could serve as a predictor of adherence. As such, this study aims to demonstrate intellectual humility's (IH) ability to predict adherence above and beyond general humility, demographics, and health status. Participants ($N = 385$; 47% female; $M_{\text{age}} = 40.61$; $SD_{\text{age}} = 11.14$) completed an online study with measures for IH, general humility, demographics, health status, and general medication adherence. Bivariate correlations showed that IH was positively correlated with adherence, and hierarchical multiple regression showed that IH predicted overall and individual facets of general medication adherence above and beyond other measured factors. The IH factors of Independence of Intellect and Ego and Lack of Intellectual Overconfidence were mainly responsible for driving this relationship. This study offered evidence to show that IH could play an influential role in medical adherence. However, this cross-sectional evidence is modest and IH needs to be further explored in the medical context, particularly given the complexity of adherence as a health behavior.

Keywords: adherence, nonadherence, intellectual humility, humility

INTRODUCTION

Nonadherence is prevalent and costly for both patients' health and the health economy. According to the IMS model of adherence (DiMatteo et al., 2012), patient adherence depends on three factors: information, motivation, and strategy (IMS). As a starting point, patients must interact with medical information in a productive way to carry out their treatment regimen. We proposed that intellectual humility, characterized by openness to new information and acceptance of the fallibility of one's own

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knowledge, may help patients interact with medical information and improve medical adherence. As such, this study aimed to connect people's intellectual humility with general medical adherence. These findings could be leveraged to develop strategies that could help address the complicated issue of adherence.

Adherence

Adherence has been referred to as compliance in the medical literature, but adherence is preferred as it reflects a partnership, and not a paternalistic arrangement, between the patient and their provider (WHO, 2003). *Nonadherence* refers to patients' failure to follow their clinician's recommended treatment plans (DiMatteo et al., 2012). These behaviors could take on several forms. Primary nonadherence occurs when patients fail to fill their prescribed medications. Nonpersistence occurs when patients stop taking their medications earlier than prescribed. Patients can also take their medications incorrectly (i.e., wrong dosage), or ignore behavioral regimens such as diets or exercise plans, or improperly carry out their regimens (changing their diets, but not avoiding the right foods). Therefore, there are a variety of ways in which adherence can be conceptualized. In this paper, we conceptualized adherence according to the components outlined in the General Medication Adherence Scale (Naqvi et al., 2019). The three components assess nonadherence due to patients' behaviors (i.e., intentional and non-intentional), nonadherence related to additional disease and pill burden, and cost-related nonadherence.

Nonadherence has critical implications for patient health as it directly interrupts the treatment to outcome chain (Brown & Bussell, 2011). For example, nonadherence can lead to disease progression (Catz et al., 2000; Hinkin et al., 2002; Lee et al., 2019; Lee et al., 2022), increase severe medical incidents (Elliott et al., 2000) and jeopardize survival (Lee et al., 2019; Lewey et al., 2013; McDermott, 1997). Additionally, nonadherence places an immense burden on the medical system. For example, a meta-analysis found that about 25% of patients across 569 study samples were nonadherent (DiMatteo, 2004), while the World Health Organization (WHO) found that this rate is closer to 50% in developed countries (WHO, 2003). A more recent meta-analysis including 161 studies from 2010 to 2020 conducted amongst hypertension patients found that between 27% and 40% of patients were considered nonadherent (Lee et al., 2022). The cost of nonadherence has been widely studied (see meta-analysis by Cutler et al., 2018). Each year nonadherence washes out hundreds of millions of medical visits, costing the United States economy close to 300 billion U.S. dollars (New England Healthcare Institute, 2009).

As adherence is multifaceted, strategies to combat nonadherence also have to be comprehensive. DiMatteo and colleagues (2012) outlined the Information-Motivation-Strategy model as an approachable heuristic to capture the complexity of adherence-related approaches. The model was built on the extant evidence on adherence research and interventions, with foundations from sound health behavior theories. In addition to the information component, the motivation component highlights the idea that patients will need to commit and be driven to fulfill their treatment plans and the strategy component reflects the fact that patients must have the practical means to execute any treatment plan.

The information component underscores the importance of patient knowledge and communication of key health information between the patient and their clinician. This aspect is critical because research demonstrates that many patients do not understand the health information they receive (Brown & Bussell, 2011; Nielsen-Bohlman et al., 2004). This lack of understanding could be a result of health literacy (Bauer et al., 2013; Miller, 2016) and/or from other factors associated with the communication process. Of course, clinicians share this responsibility. They need to share health information in a clear way, check for understanding, express empathy (Hall et al., 1988; McCabe & Healey, 2018; Simões et al., 2021; Stømer et al., 2020; Street, 2003) and be well-informed and open about their patient's illness and the treatments available for them (Aremu et al., 2022; Mariampillai et al., 2017). The perceived support patients receive is critical for treatment adherence (Levy et al., 2018).

Patients also share in the work of creating an effective line of communication to receiving and incorporating the necessary information to successfully carry out their treatment plan. Patients need to ask questions to clarify their misunderstandings and share potential barriers to adherence based on their personal history and status (Kalichman et al., 2016; Smith et al., 1991). Of course, that is easier said than done. Given the complex dynamics of the medical interaction, emotions are likely to be elevated due to uncertainties of diagnoses and treatment strategies. Such an emotional stance may put patients into a defensive stance and gear them toward rejecting forthcoming information, which may lead to resistance against treatment recommendations (Mariampillai et al., 2017). Additionally, power dynamics inherent in the clinician and patient roles also make it difficult for patients to ask questions (Sloan et al., 2022). For example, patients may have worries about looking foolish by asking different questions when in fact they may be valid. As such, patients may not ask follow-up questions that would help improve their understanding of the treatment plan. This issue may be especially true if patients have had adverse medical experiences in the past (Sloan et al., 2022). Intellectual

humility may help to counter these challenges and help patients interact more productively with medical information.

Intellectual Humility

Intellectual humility is a specific type of humility that is different from general humility (Davis et al., 2016). General humility is often regarded as a broad or moral virtue (e.g., associated with being a good person; Exline et al., 2004) characterized by having an accurate and secure identity along with being other-oriented (Chancellor & Lyubomirsky, 2013). On the other hand, intellectual humility can be viewed as an epistemic virtue (e.g., being a good knower; Brady & Prichard, 2003; Whitcomb et al., 2017). As such, intellectual humility may predict adherence above and beyond general humility in that it specifically helps people interact with medical information in productive ways.

Although various definitions and conceptualizations of intellectual humility exist, we followed Krumrei-Mancuso and Rouse's (2016) four-facet model, which has been used across a variety of domains (e.g., education, Huynh et al., 2023; Huynh et al., 2025; conspiracy theories, Huynh & Bayles, 2022). The facets include Independence of Intellect and Ego, Openness to Revising One's Viewpoint, Respect for Others' Viewpoints, and Lack of Intellectual Overconfidence. These facets underscore the fact that intellectual humility represents a non-defensive and nonthreatening approach to new information, particularly in relation to one's own knowledge. Below we speculate on how these facets could affect the medical interaction and improve adherence via more productive interactions with medical information.

Independence of intellect and ego represents one's disentanglement of their knowledge and self-worth. That is, people can view their knowledge separate from themselves, as such new information that challenges existing knowledge is not perceived as a specific threat directed at the self. As such, a person who is high on this attribute may approach a medical encounter without concern that new information could damage their ego. For example, a patient may do research on their condition prior to the medical visit (Wang et al., 2021), and although they are tasked with information and knowledge they have attained, they are not emotionally invested in this knowledge as an extension of themselves. Therefore, they may be more open to receiving new information during the medical encounter, thus supporting their increased adherence to treatments recommended during the visit.

Respect for others' viewpoints and an *openness to revising one's viewpoints* represent people's general inclination to be civil as they interact with other people, and people's willingness to change their minds. It

should be noted that a core component of intellectual humility lies in the “happy medium” effect. That is, intellectually humble people are open and willing to change their minds in the face of satisfactory evidence, but they are not infinitely yielding (Krumrei-Mancuso & Rouse, 2016). Therefore, people who respect others’ viewpoints and are open to revising their viewpoints may have more productive medical encounters due to their respect for their provider’s viewpoints and being open to changing their minds about medical information exchanged, such as their diagnosis or proposed treatment. We want to emphasize that respect here refers to a patient’s active choice to value their provider’s opinion, not respect in the paternalistic sense (Taylor, 2009).

Lack of intellectual overconfidence refers to people holding their opinions about their knowledge within perspective and knowing that their knowledge has limits. A lack of intellectual overconfidence allows people to not be arrogant about their knowledge and to not easily deem other people’s thoughts and positions as inferior. As such, this facet allows patients to overcome any potential resistance to treatment recommendations. For example, given the changing medical context, research has demonstrated an increase in patient resistance to treatment recommendations (e.g., Stivers & Timmermans, 2020). Although such resistance can be viewed positively in the form of patient participation and agency (Koenig, 2011), it could also be counterproductive to the medical encounter and negatively affect adherence. As such, this facet of intellectual humility may help people interact productively with new medical information during the medical visit by helping them balance their own knowledge and information presented by their clinicians.

Previous research has provided solid evidence for the importance of humility in the medical exchange (Huynh et al., 2020; Huynh et al., 2021; Huynh & Dicke-Bohmann, 2020) and preliminary evidence to link intellectual humility to beneficial health behaviors. For example, intellectual humility lowers people’s naturalness bias in drug choice (Cao & Li, 2023). Additionally, intellectual humility was found to be negatively associated with anti-vaccination attitudes (Senger & Huynh, 2021) and positively related to intentions to receive the COVID-19 vaccines (Huynh & Senger, 2021). However, these associations were established with relatively contentious health attitudes and behaviors, especially as they relate to political conservatism (Huynh et al., 2024), which underscored intellectual humility’s ability to help people navigate controversial topics. However, intellectual humility could also promote beneficial health behaviors within more routine but nevertheless essential contexts, such as everyday medical visits where critical information is exchanged.

Demographic and Health Factors

To adequately examine intellectual humility's ability to predict general medical adherence, it was important to consider and account for the potential contributions of other factors that predict patient adherence. Various sociodemographic and health factors have been found to be associated with treatment adherence. Researchers have found that age is positively correlated to treatment adherence in adults (Chen et al., 2014; Cheung et al., 2022; Venditti et al., 2023). The role of sex in treatment adherence is still unclear; some studies have reported that women tend to be less adherent than men (Venditti et al., 2023), while others have found the opposite (Akbari et al., 2022). The relationship between ethnicity and treatment adherence is relatively consistent across studies in developed Western countries, with minority patients less adherent than White patients (Lewey et al., 2013; Marshall et al., 2020; Rolnick et al., 2013). This trend is often associated with medical mistrust (Kalichman et al., 2016). Religion/religiosity has also been considered as a potential factor for treatment adherence, but its impact is still unclear and seems to depend on the religion and the area studied (Finocchiaro-Kessler et al., 2011; Medved Kendrick, 2017; Parsons et al., 2006; Zagożdżon et al., 2017).

Socioeconomic status (SES) is consistently reported to have a positive effect on treatment adherence (Gebremariam et al., 2010; Nezenega et al., 2020; Parra et al., 2019; Wasti et al., 2012). The higher the SES the more likely the patient is to adhere to treatment. This correlation can be explained by a variety of factors, mainly the financial constraints linked to the patients' condition (Aziz et al., 2016; Enslin et al., 2022). On the other hand, education's role in treatment adherence is uncertain. Some researchers have found a negative correlation between treatment adherence and education (Akbari et al., 2022; Lolong et al., 2023), while others have shown that education positively affects treatment adherence (Venditti et al., 2023). Finally, there appears to be a negative relationship between subjective health and adherence. For example, patients interrupt their treatment when they start feeling better, without consulting with their doctor (Marshall et al., 2012).

Summary and Hypotheses

According to the Information-Motivation-Strategy model of adherence, to increase adherence, patients must have productive encounters with medical information. As such, intellectual humility, characterized by the ability to separate one's own intellect and ego, remain open to revising one's viewpoint, respect others' viewpoints, and down-regulate intellectual overconfidence may allow people to interact with

medical information more meaningfully. As such, we hypothesized that intellectual humility would be positively related to general medical adherence. Additionally, we hypothesized that intellectual humility would predict general medical adherence above and beyond the contributions of patient demographic factors, patient subjective health, and general humility.

METHOD

Participants

Participants were recruited from Amazon Mechanical Turk (MTurk) in March 2022. MTurk is an online crowdsourcing platform frequently used in the social sciences for convenient community samples (for a review, see Aguinis et al., 2021). We compensated participants at the rate of \$10/hour USD based on the average completion time calculated from piloting the study. Participants had to be at least 18 years old and self-reported as living in the U.S.A. in order to participate in the study. We restricted this study to American participants in order to focus on a singular healthcare framework. A total of 541 people opened the study, 510 of whom completed more than 50% of the study. We included two open-ended questions to screen for potential bots. We had a total of 385 participants remain after deleting participants with non-genuine and/or incorrect responses. Of these participants, 52.5% self-identified as male, 47% as female, and 0.5% as other. Additionally, 81.3% identified as White/Caucasian, 8.3% Black/African American, 0.3% as American Indian/Native American, 2.3% as Asian/Pacific Islander, 2.9% as Hispanic Latino, and 4.9% as mixed.

Measures

Adherence

We used the General Medication Adherence Scale (GMAS; Naqvi et al., 2019) to measure adherence. Participants used a scale ranging from 0 (*never*), 1 (*sometimes*), 2 (*mostly*), and 3 (*always*) to respond to 11 items. The 11 items can be combined to gain a total adherence score. In our study, the 0-3 score was recoded by Qualtrics as 1-4. Additionally, the scale could be divided into three domains of adherence: 1) Nonadherence due to patient behaviors (5 items), 2) Nonadherence due to additional disease and pill burden (4 items), 3) Cost-related nonadherence (2 items). Sample items for each domain include: “Do you have difficulty in remembering to take your medications?”; “Do you discontinue your medicines due to other medicines that you have to take for your additional disease?”; “Do you

find it difficult to buy your medicines because they are expensive?” All items were phrased in terms of nonadherence. Participants did not have to indicate that they were taking medications at the time of the study as this measure captures people’s general tendency toward adherence. For our study, we reversed all items so we could discuss the outcome in terms of adherence. See Table 1 for descriptive statistics and Cronbach’s alphas.

Intellectual Humility

We used the Comprehensive Intellectual Humility Scale (Krumrei-Mancuso & Rouse, 2016) to assess intellectual humility. The 22-item scale measures four aspects of intellectual humility: 1) Independence of intellect and ego (5 items); 2) Openness to revising one’s viewpoint (5 items); 3) Respect for others’ viewpoints (6 items); 4) Lack of intellectual overconfidence (6 items). Sample items for each aspect include: “I feel small when others disagree with me on topics that are close to my heart.” (reverse coded); “I am open to revising my important beliefs in the face of new information.”; “I can respect others, even if I disagree with them in important ways.”; “My ideas are usually better than other people’s ideas.” (reverse coded). Participants used a 5-point Likert scale, 1-*strongly disagree* to 5 *strongly agree*, to respond to the scale items.

General Humility

We used the HEXACO Honesty-Humility (HEXACO-HH) subscale of the HEXACO-60 personality measure (Ashton & Lee, 2009) to assess general humility. Although a number of self-reported measures of humility exist, they all carry some limitations (McElroy-Heltzel et al., 2019). We elected to use this measure because it is the most popular measure for self-reported humility, which offers better grounding for comparison across other humility-related findings.

Demographics and Health

Participants responded to questions about their age, sex, race/ethnicity, religiosity, socioeconomic status (SES), education, and subjective health. Age was an open-ended question. Participants indicated their sex by selecting from male, female, prefer not to say, other. Participants selected from several categories available for race/ethnicity (White/Caucasian, Black/African American, Native American, Asian/Pacific Islander, Hispanic/Latino, Mixed). Religiosity was measured using a single item “How religious do you consider yourself to be?” Participants used a scale of 1 (not at all religious) to 10 (extremely religious). We used the MacArthur Scale of Subjective Social Status (Singh-Manoux et al., 2005) to assess participants’ SES. Participants selected the step on a 10-rung ladder that they thought best described their own status relative to others;

1 = worst off relative to others, 10 = best off relative to others. Subjective SES has been demonstrated to be a stronger predictor of health and psychological-related outcomes relative to objective measures of SES (Rabin & Charro, 2001; Singh-Manoux et al., 2005). Participants indicated their highest level of education from the available options ranging from some high school to professional/doctorate degree. Lastly, we used the EuroQol measure of subjective health (EuroQol Group, 1990), where participants used a sliding scale ranging from 0 (worst state of health you can imagine) to 100 (best state of health you can imagine) to indicate their current health. See Table 1 for descriptives of these measures.

Procedures

The study was conducted online via Qualtrics. Participants clicked on the weblink to the study, which took them to the Information Page, on which they could indicate their consent to participate. Then participants continued with the study measures. The measures were presented in random order to avoid potential order effects. Demographic questions were presented last. After completing the demographic section, participants read a debriefing statement and were thanked for their participation. All study procedures and materials followed the Declaration of Helsinki principles for research ethics and were approved by the author's Institutional Review Board (Texas A&M University–San Antonio IRB Protocol No. 2020-04).

Analysis Plan

The primary goal of the research was to demonstrate the predictive ability of intellectual humility for adherence above and beyond basic demographic and health factors, and people's general level of humility. That is, we wanted to highlight intellectual humility's unique ability to predict adherence. As such, we used hierarchical multiple regression and entered the predictor variables in three steps, running separate models for each outcome (overall adherence, adherence relating to patient behaviors, adherence related to additional disease and pill burden, adherence related to cost): 1) Patient demographic and health (age [continuous], sex [dummy coded; male 0, female 1], race/ethnicity [dummy code; White 0, all others 1], religiosity [continuous], socioeconomic status (SES; continuous), education [continuous], and subjective health [continuous]; 2) general humility; 3) Intellectual humility (Independence of intellect and ego; Openness to revising one's viewpoint; Respect for others' viewpoints; Lack of intellectual overconfidence). We should note that we included all patient characteristics that we thought would be associated with adherence based on previous research. We did not eliminate them from the regression

model if they were not associated with adherence based on the bivariate correlation analysis. Essentially, we elected to take a theoretical approach to building our model instead of taking a mathematical approach based on eliminating non-significant factors. We recognize that there are strengths and weaknesses to each approach, but we favored the theoretical approach in this paper.

Prior to conducting the analyses, we examined the assumptions for linear regression. We used Cook's distance to examine potential outliers; their range of 0–.05 indicated that outliers were not an issue. We compared our variance inflation factor (VIF) scores to the conservative benchmark of 5 (Tabachnick & Fidell, 2007) to assess potential multicollinearity because of the relatively high correlations between the four facets of intellectual humility. The highest VIF value was 1.91, which suggested that multicollinearity was not an issue. Finally, our assessment of the histogram of standardized residuals, P-P plots, and residual scatter plots suggested that the assumptions of normality, linearity, and homoscedasticity were met.

RESULTS

Bivariate Correlations

Bivariate correlations showed that overall intellectual humility was positively associated with overall adherence, $r = .56, p < .001$. Unpacking that correlation, we found that the two intellectual humility components of Independence of Intellect and Ego and Lack of Intellectual Overconfidence were largely driving this association. These two components were strongly and positively correlated with overall adherence and its subscales ($r_s = .42 - .57, p_s < .01$). On the other hand, Openness to Revising One's Viewpoint and Respect for Others' Viewpoints were either not correlated or weakly associated with adherence ($r_s = .02 - .20$). Regarding patient demographics and health status, we found that religiosity was strongly and negatively related to adherence ($r_s = -.47$ to $-.57, p_s < .01$). Age, SES, and education were also consistently associated with adherence. Age was positively correlated with all measures of adherence ($r_s = .21$ to $.23, p_s < .01$). SES and education were negatively related to adherence ($r_s = -.18$ to $-.45, p_s < .01$). Health status was not consistently related to our adherence measures ($r_s = .02-.10$). See Table 1 for the correlation matrix between main study variables.

Table 1 Descriptives of and Correlations Between Study Variables

Measure	<i>M</i> (<i>SD</i>)	α	1	2	3	4	5	6	7	8
1. Adh. Ov.	3.10 (.81)	.95	--							
2. Adh. beh.	3.03 (.81)	.87	.96**	--						
3. Adh. burd	3.21 (.86)	.88	.96**	.88**	--					
4. Adh. cost	3.05 (.95)	.80	.89**	.80**	.82**	--				
5. HEX-HH	3.34 (.83)	.80	.50**	.47**	.51**	.41**	--			
6. Ind. I&E	3.02 (1.25)	.94	.56**	.54**	.55**	.49**	.39**	--		
7. Open. Rev.	4.14 (.67)	.82	.02	-.01	.06	<.001	.06	.12*	--	
8. Respect	4.15 (.61)	.81	.14**	.10*	.16**	.14**	.23**	.20**	.62**	--
9. Lack of IC	2.75 (.956)	.88	.56**	.52**	.57**	.48**	.53**	.42**	.18**	.19**

Note. * $p < .05$; ** $p < .01$; Ind. I&E = Independence of Intellect and Ego; Open. Rev. = Openness to Revising One's Viewpoint; Respect = Respect for Others' Viewpoints; Lack of IC = Lack of Intellectual Overconfidence.

Hierarchical Multiple Regression

Below, we summarize the results from Step 3 of the hierarchical multiple regression analyses, with intellectual humility added to the model. To avoid repetition and for ease of navigation, we have provided all results of the final model, including β s and β s for all predictors and variance accounted for (R^2 and ΔR^2) in Tables 2 and 3.

All four models were significant and explained a notable amount of variance in adherence (R^2 s = .44 - .56, $ps < .001$). For all models, patient demographic and health status predicted adherence (R^2 s = .29 - .42, $ps < .001$). The most consistent predictors of adherence relating to patient demographic factors and health status were religiosity (more religious, lower adherence), age (older, higher adherence), and health status (better health, higher adherence). Education, race/ethnicity, and SES did not predict adherence, after all factors were entered into the model. General humility explained additional variance in adherence beyond patient demographics and health status (ΔR^2 s = .06 - .10, $ps < .001$). Notably, intellectual humility explained additional variance in adherence beyond general humility (ΔR^2 s = .07 - .09, $ps < .001$). In particular, Independence of Intellect and Ego (β s = .22-.27) and Lack of Intellectual Overconfidence (β s = .21-.24) consistently and positively predicted adherence, whereas

Openness to Revising Viewpoints consistently and negatively predicted adherence (β s = $-.11$ to $-.19$).

Table 2 Outcomes of Hierarchical Multiple Regression Analyses

	Adhere overall		Adh. patient behavior	
Step 1: Demogra.	b [95% CI]	β	b [95% CI]	β
Race/ethnicity	.06 [-.08, .21]	.03	.06 [-.08, .21]	.03
Sex	-.04 [-.16, .07]	-.03	-.04 [-.16, .07]	-.01
Religiosity	-.05 [-.08, -.04]**	-.27	-.06 [-.08, -.04]**	-.23
Age	.01 [<.01, .01]**	.12	.01 [<.01, .01]*	.10
SES	-.01 [-.05, .02]	-.03	-.01 [-.05, .02]	-.02
Education	-.01 [-.06, .04]	-.01	-.01 [-.06, .04]	.00
Health Status	.01 [<.01, .01]**	.12	.01 [<.01, .01]*	.10
R^2	.38**		.31**	
Step 2: Gen. Hum.				
HEXACO - HH	.17 [.08, .25]**	.17	.17 [.08, .25]**	.17
R^2	.47**		.39**	
ΔR^2	.09**		.08**	
Step 3: IH				
Ind. I&E	.16 [.11, .22]**	.25	.16 [.11, .22]**	.27
Open. Rev.	-.18 [-.29, -.07]**	-.15	-.18 [-.29, -.07]**	-.15
Respect	.05 [-.07, .17]	.04	.05 [-.11, .15]	.01
Lack of IC	.20 [.11, .28]**	.23	.20 [.11, .28]**	.22
R^2	.56**		.49**	
ΔR^2	.09**		.10**	
Overall model	$F(12, 372) = 38.82, p < .001$		$F(12, 372) = 29.31, p < .001$	

Table 3 Hierarchical Multiple Regression Analyses (cont.)

	Adh. disease & pill burden		Adh. cost-related	
Step 1: Demogra.	b [95% CI]	β	b [95% CI]	β
Race/ethnicity	.08 [-.08, .23]	.03	.05 [-.14, .24]	.02
Sex	-.06 [-.18, .07]	-.03	-.06 [-.22, .09]	-.03
Religiosity	-.07 [-.09, -.05]**	-.29	-.07 [-.10, -.05]**	-.27
Age	.01 [<.01, .02]**	.12	.01 [<.01, .02]**	.13
SES	-.03 [-.06, .01]	-.07	.02 [-.03, .06]	.03
Education	-.02 [-.07, .03]	-.03	.01 [-.06, .07]	.01
Health Status	.01 [<.01, .01]**	.10	.01 [<.01, .01]**	.16
R^2	.42**		.29**	
HEXACO - HH	.19 [.10, .28]**	.18	.14 [.02, .25]*	.12
R^2	.50**		.35**	
ΔR^2	.08**		.06**	
Ind. I&E	.15 [.09, .21]**	.22	.16 [.09, .24]**	.22
Open. Rev.	-.14 [-.26, -.03]*	-.11	-.27 [-.42, -.13]**	-.19
Respect	.060 [-.07, .19]	.04	.13 [-.03, .29]	.08
Lack of IC	.19 [.10, .28]**	.21	.24 [.13, .35]**	.24
R^2	.57**		.44**	
ΔR^2	.07**		.09**	
Overall model	$F(12,372) = 40.37, p < .001$		$F(12, 372) = 24.38, p < .001$	

Note. * $p < .05$, ** $p < .01$; Ind. I&E = Independence of Intellect and Ego; Open. Rev. = Openness to Revising One's Viewpoint; Respect = Respect for Others' Viewpoints; Lack of IC = Lack of Intellectual Overconfidence.

Discussion

In support of our hypotheses, we found that intellectual humility was positively correlated with general medical adherence, and it predicted adherence above and beyond the contributions of demographic factors, patient subjective health, and general humility. Specifically, the intellectual humility components of Independence of Intellect and Ego and Lack of Intellectual Overconfidence were the most consistent and robust positive predictors of adherence. These results point to the unique role and potential that intellectual humility may play for increasing adherence,

potentially through improving their interactions with medical information as suggested in the IMS Model (DiMatteo et al., 2012).

Intellectual humility enables people to treat their knowledge as separate from themselves, which may allow them to approach medical encounters without concern that new information could negatively affect their ego. As the internet has increased access to medical information, many patients may come into medical visits with pre-established notions about their medical conditions (Wang et al., 2021). Intellectual humility allows for a flexible barrier between that knowledge and their ego, such that conflicting information proposed during the visit by the clinician does not serve as an attack on them as a person. Instead, intellectually humble people can remain emotionally untethered to established information, which enables a productive exchange with clinicians and/or the presentation of new medical information. As such, intellectually humble people may have more productive exchanges over information regarding their treatment and thus be more adherent to their treatment recommendations.

Additionally, intellectually humble people can hold their opinions about their knowledge within perspective and know that their knowledge has limits. That is, they can down-regulate arrogance to avoid treating others' opinions as inferior and allow for an equal exchange of information. In this sense, intellectual humility may be associated with better adherence because it helps people overcome potential resistance to treatment recommendations (e.g., Stivers & Timmermans, 2020). Although patient resistance may be viewed through the lens of active participation and agency (Koenig, 2011), in some instances (e.g., vaccinations), such resistance could be counterproductive and could negatively affect adherence. As such, lack of intellectual overconfidence can help people balance their own knowledge and information presented by their clinicians. Ultimately, intellectually humble people may interact more productively with clinicians' recommendations, both in the process of communication and with the information itself, and thereby increase their adherence to treatment recommendations.

Interestingly, the facet of Openness to Revising Viewpoints negatively predicted all four measures of adherence in the regression models but was not correlated with these adherence measures when examined with bivariate correlations. This pattern of results suggests that these associations may have been obscured (i.e., suppressed) by their shared variance with the other IH facets. Additional research is recommended to tease out the role of this particular facet of IH in relation to adherence.

Regarding other factors in the model, we found that general humility, age, health status (subjective health), and religiosity predicted adherence. In our study, being broadly humble tended to predict

adherence, which is consistent with previous research showing positive associations between humility and various aspects of health (Chancellor & Lyubomirsky, 2013). Additionally, in line with previous literature, age positively predicted treatment adherence (Cheung et al., 2022; Venditti et al., 2023). This relationship may be due to better health literacy as patients get older or may be linked to patients' individual experiences. Future work can clarify this relationship, as we did not assess health literacy in the current study. Better health status also predicted higher adherence, which is different from previous findings (Marshall et al., 2012). This pattern can be explained by the fact that healthy people may have lower burdens for adherence (such as pain or co-morbidities) and may therefore be better positioned to execute their health plans. Consistent with previous studies, we found that religiosity was negatively correlated with treatment adherence (Parsons et al., 2006). This relationship is unsurprising given that some religions have established stances on certain diseases or treatments, which can encourage people to disregard medical advice. Overall, these factors emphasise the complex nature of adherence and more research is needed to gain a better understanding of treatment adherence in different communities.

Limitations and Future Directions

There were several limitations to our study. First, the sample consisted mostly of White participants, which restricts our ability to generalize to the general population. Future research could overcome this limitation by using more purposive sampling techniques, such as stratified sampling. We also acknowledge that this study's contribution is likely to be modest overall, as it begins the conversation on the role of intellectual humility in predicting adherence. However, it lacks more robust evidence such as those from longitudinal studies or experiments, which would help to clarify the causal direction between intellectual humility and medical adherence. In the same vein, we recognize that medical adherence is quite complex and varies by illness. In our study, we only examined general medication adherence; as such, the study's findings may not translate to all types of adherence and illnesses. Additionally, intellectual humility may only address parts of the Information component of the IMS model (DiMatteo et al., 2012), and therefore leaves the Motivation and Strategy components largely untouched in this approach. Thus, our study may only offer a partial solution to the larger approach of tailoring treatments to help improve adherence.

Finally, it is quite important to note that patients should not carry the bulk of the nonadherence problem. Adherence is a complex issue that includes critical roles played by clinicians and health systems. It would be

a misuse of our study to claim that when patients are nonadherent to treatment that they lack intellectual humility. There are myriad factors that may be outside of patients' control that may account for patient adherence. We simply offered intellectual humility as a potential factor that may help promote adherence, but more research is necessary to create a strategy centered on intellectual humility.

Conclusion

The Information-Motivation-Strategy model proposes that information is a critical component to improving medical adherence. In our study, we demonstrated that intellectual humility predicted general medical adherence above and beyond the contributions of participants' general humility, demographic factors, and subjective health status. Intellectually humble people may be more likely to detach their ego from their intellect and approach new medical knowledge with equanimity, thereby improving their interactions with medical information and ultimately their adherence to treatment recommendations. However, these findings are based on cross-sectional data and only offer an initial glimpse into these associations. Future research could clarify these relationships and leverage them into strategies to help improve adherence.

Declarations

Competing Interests/Conflict of Interest

All authors declare that they have no competing/conflict of interest.

Informed Consent

Informed consent was obtained from all individual participants included in the study.

Consent for Publication

All participants in the study consented to have their data collected and included in publications, according to the consent process of the study.

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Authors' Contributions

Elisa Eche was involved in writing the article and revising it critically for important intellectual content. Ho Phi Huynh was involved with all aspects of the article from conceptualization to writing and revising.

Availability of Data and Materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Ethics Approval/Ethical Statement

Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki and was approved by an Institutional Review Board/Ethics committee. See details under Methods.

All methods were carried out in accordance with relevant and necessary guidelines and regulations. All study procedures and materials were approved by the Institutional Review Board at Texas A&M University-San Antonio.

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