Barriers to Medication Adherence in Homeless Populations in Phoenix, AZ

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Dedication

This project is dedicated to the patients at the SHOW Clinic who have contributed to the learning of health professional students on a weekly basis for the past four years.

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Abstract

Medication adherence describes the degree to which patients take medications as prescribed. Adhering to medication is a complex issue that has a significant impact on individual patients as well as on the effectiveness and financial burden of the health care system. Several factors emerge as common barriers to medication adherence in the general population including homelessness and its associated risk factors: low functional health literacy, psychiatric conditions, financial hardship, and transient lifestyle. Little research exists exploring what specific barriers prevent medication adherence in the United States homeless population and how these can be addressed.

This descriptive retrospective study seeks to answer which, if any, specific barriers exist as obstacles to medication adherence within the Phoenix area homeless population >=18 years of age. Data was collected via retrospective chart review from the web-based EMR, Practice Fusion, at the interdisciplinary Student Health Outreach for Wellness (SHOW) Clinic which included health literacy and medication adherence surveys administered by staff during patient triage.

A total of 127 patients between the age of 20 and 88 were chart reviewed. Charts were selected on the basis of whether or not medication adherence questionnaires had been administered. Data was collected from a two year period: July 2015 to July 2017. De-identified patient demographic information such as age, gender, chief complaint, chronic diagnosis, prescription medications, health literacy, and medication adherence were statistically analyzed for significance.

Upon analysis, data demonstrated that chronic conditions with increased symptomatology—such as dermatologic chief complaint—were more likely to increase medication adherence, whereas variables coinciding with chronic conditions that have extended asymptomatic periods were more likely to decrease medication adherence: for example, endocrine chronic conditions, type one and two diabetes mellitus prescription medications, and cardiovascular prescription

medications. Additionally, variables relating to psychiatric illness showed an increased effect on missed doses. An increase in total number of prescription medications also negatively affected adherence. The most common reason for missing a dose was needing a prescription refill. In regards to health literacy, the highest association with missed doses was with people who were 'somewhat confident,' as opposed to those with lower levels of health literacy.

Though this study focused on the process measure, into the future, we hope to answer the outcome measure which seeks to initialize appropriate interventions by the interdisciplinary care team at SHOW clinic. This study has helped specifically characterize barriers to medication adherence in the local Phoenix population receiving medical care at SHOW Clinic.

Table of Contents

List of Figures and Tables

Introduction

Background

Patient adherence in healthcare can be defined as "the degree or extent to which patients follow agreed upon recommendations from health care providers. (1) More specifically, medication adherence describes the degree to which patients take medications as prescribed. Adhering to medication is a complex issue that has a significant impact on the individual patient level as well as on the effectiveness and financial burden of the health care system. As an example, non-adherence to prescription mesalamine for medical management of ulcerative colitis in 4,000 patients from the general population was measured by failure to refill their prescription in a descriptive study. (10) Nearly 60% of patients failed to refill their script despite the medication's affordability and well tolerated side effect profile. Patients who were non-adherent had higher healthcare costs in the inpatient setting--two-fold difference in gastroenterology-related costs--and the outpatient setting--more total office visits.

Several factors emerge as common barriers to medication adherence in the general population. A systematic review by Bubalo et al. revealed the following common barriers to medication adherence: adverse effects, lack of effect in the absence of correct adherence, multiple daily doses, multiple concurrent treatments for chronic conditions, specialized dosing and/or administration requirements, asymptomatic conditions, conditions characterized by physical decline (e.g. loss of vision, hearing), psychiatric conditions, challenging disease states, low functional health literacy, homelessness, elderly or young patients, individual perceptions, and family/cultural issues. (1) As observed, medication adherence is a complex topic that involves many interacting factors that differ on an individual to individual basis.

Bubalo et al. described "homelessness" as a barrier in and of itself. However, homelessness serves as a broad umbrella term that itself encapsulates a multitude of risk factors for medication non-adherence such as low functional health literacy, psychiatric conditions, and financial hardship that represent common burdens in the homeless population. Homelessness is a risk-factor for poor adherence not only because of these associated burdens, but because

of the instability inherent to a transient lifestyle. (1,6) Muir-Cochrane et al. described "ritual cues that establish a daily pattern" as a key element to adherence. (4) In the unpatterned life of the homeless, daily structure and routine can be hard to come by.

Medication adherence has been studied at length in the general population, but relatively few studies characterize this issue in homeless populations. Muir-Cochrane et al. and Sleath et al. discuss medication adherence in homeless youth and mothers, respectively. (4, 7) Based on their findings, Muir-Cochrane et al. outline four main categories for poor adherence to treatment regimens in homeless youth with mental health instability: obtaining, managing, side effects, and interactions with illicit drugs. Within these generalized categories, poor adherence has stemmed from cost of medication, stolen medication, distrustful health care providers, lack of safe storage, and adverse effects such as drowsiness. (4) Substance abuse, lack of routine, lack of family support, and social isolation have also been associated with poor adherence in homeless youth. (9) When considering homeless mothers, Sleath et al. found the main reason for non-compliance related to cost as well as low functional health literacy and education when interpreting medication directions for themselves and when administering to their children. (7)

Health literacy can be defined as "the degree to which individuals can obtain, process, and understand basic health information and services needed to make an appropriate health decision." (12) It is estimated that over a third of US adults, over 90 million, lack the literacy skills necessary to navigate our current healthcare system. (11, 12) Multiple studies have consistently demonstrated a link between inadequate health literacy and poor health-related outcomes such as use of fewer preventative services and higher rates of hospitalization. (11) Given sizeable effect of literacy on health, Stagliano et al. sought to find the most valid and reliable health literacy assessment tool that could be realistically implemented into clinical practice to improve patient communication and education. (11) Historically, the two most significant factors are briefer screening tools, such as one-item sentences, which have greater viability in busy clinical settings then longer screening tools due to time constraints. And second, screening must occur in a non-threatening and non-judgmental way to prevent

embarrassment and decrease reliability of the tool. Stagliano et al. compared five health and numeracy literacy one sentence questionnaires. Their results confirmed that a brief one-item sentence screening tool can indeed effectively identify patients at risk of low health literacy. Additionally, of the five screening tools compared, they found that the one-item sentence developed by Chew et al. was the best predictor of health and numeracy literacy: "How confident are you filling out medical forms by yourself." (11, 13) These results were supported by Powers et al. (12)

In addition to the limited body of research of medication adherence in the homeless, there is little uniformity between study modalities determining patient adherence. Patient self-reporting is the most common and inexpensive method of data collection strategy for adherence. (1) Ho et al. used self-report and review of medication refill history in outpatient pharmacy records to determine adherence in patients with hepatitis C, psychiatric disorders, substance abuse, and housing instability. (3) However, patient self-reporting has historically led to overestimates in compliance. Burda et al. used an automated telephone interview for medication self-reporting to encourage truth-telling. (2) Other methods to determine adherence include pill counts and automated pharmacy refill databases. These two methods cannot ensure that medication is taken correctly, and moreover patients can simulate adherence by emptying pill bottles. More accurate methods such as having a pill bottle with a computer chip that records each time the capsule is opened are now available, but prohibitively expensive to implement. (1) One common method to collect patient self-report data is via patient intake forms. This method can be integrated into existing clinic work-flows with small effect on cost and time. For example, Sockalingam et al. used intake data from 129 charts from the Toronto Community Hep C Program (TCHCP) to determine adherence in patients with hepatitis C, serious mental illness, and active substance abuse. (8)

From the perspective of implementing intervention to improve medication adherence, using some permutation of a multidisciplinary clinic approach is a common outcome measure for populations at the crossroads of chronic disease, substance abuse, psychiatric disorders, and

homelessness with poor medication adherence. The Valley Homeless Clinic in San Jose, CA successfully integrated group medical visits involving primary care, psychology, and nursing in the context of a group of patients to concurrently treat hepatitis C, psychiatric disorders, and substance abuse. (3) Medication adherence was significantly increased using an integrated, multidisciplinary group medical visit model in this vulnerable population. Ho et al. suggested that this method will likely be beneficial in the treatment of other chronic conditions such as diabetes and hypertension. (3) The aforementioned TCHCP treated the same trimorbidity of hepatitis C, psychiatric disorders, and substance abuse with a multidisciplinary model that included a peer support group. TCHCP offered collaborative medical, psychiatric, and social support that emphasized a holistic approach to chronic disease management. Sockalingam et al. found that patients improved adherence to hepatitis C medications when they were receiving concurrent treatment for their other chronic conditions under the multidisciplinary model. (8) The Downtown Community Health Center (DCHC) in British Columbia, Canada used the interdisciplinary "Maximally Assisted Therapy" (MAT) Model for antiretroviral therapy in AIDs patients who demonstrated unstable housing. (6) MAT includes food provision, specialist appointment assistance, side effect management, and outreach workers. Under this study, MAT was associated with better adherence for "urban centers dealing with concurrent and interrelated adherence barriers: high-risk drug use, mental health disorder, food insecurity, and homelessness." (6) Neumiller et al. implemented an Assertive Community Treatment (ACT) model in settings with patients who are homeless with co-occurring mental and addictive disorders. (5) ACT is a multidisciplinary model with a low client-staff ratio providing community-based services. In addition to increasing medication adherence, ACT reduced hospitalization, psychiatric symptoms, and decreased substance abuse. (5) Though each of these four clinics used different models to increased medication adherence, the common thread was using a multidisciplinary-based clinic to care for patients.

Significance

The benefits of patients taking their medications as prescribed are obvious and numerous. The rationale behind this study is to increase our understanding of what obstacles to adherence are specific to homelessness as represented by the patients enrolled in this study from the SHOW Clinic. Our intention is to characterize specific barriers that we may address with future targeting interventions at the SHOW Clinic. In order to empower the homeless patient population seen at SHOW Clinic to most successfully manage their own health, we must have a grasp of what tangible obstacles exist. Furthermore, as an interdisciplinary clinic--MD, DO, PA, NP, RN, OT, PT, audiology-- SHOW Clinic is effectively poised to integrate models for adherence. Ultimately, improving medication adherence leads to a myriad of improved outcomes that improves individual quality of life as well as saves costly ED visits & hospital admissions.

Research Question, Objectives, and Hypothesis

This descriptive retrospective study will ultimately take place in two parts. My research will focus on part one, the process measure. It seeks to answer, what, if any, barriers exist for medication adherence in the Phoenix area homeless population >=18 years of age. Data was collected via retrospective chart review from the web-based EMR, Practice Fusion, at the interdisciplinary Student Health Outreach for Wellness (SHOW) Clinic which included health literacy and medication adherence surveys administered by staff during patient triage.

Part two, the outcome measure, hopes to address the findings of part one by initializing appropriate interventions by the interdisciplinary care team at SHOW clinic. If possible, it would be advantageous to assess medication adherence in returning patients after interventions have been implemented. For the purposes of my scholarly project, my research will focus on part one.

The objective of this study is to determine what statistically significant risk factors to medication non-adherence exist, if any. We hypothesize that there are a specific set of factors that prevent medication adherence in the Phoenix homeless population >=18 years of age.

Some of these factors may include: obtaining medications including cost and accessibility, managing medications including side effects, stolen medication, lack of safe storage, lack of routine, lack of family support, social isolation, low functional health literacy, and interactions with illicit drugs.

Research Materials and Methods

Data was collected via retrospective chart review from the web-based EMR, Practice Fusion, at the interdisciplinary Student Health Outreach for Wellness (SHOW) Clinic. Adults >=18 years of age who were administered a medication adherence questionnaire during intake between July 2015 and July 2017 were enrolled in the study.

Data collected included de-identified patient demographic and medical information: age, gender, chief complaint, chronic diagnosis, prescription medications, total number of medications, daily dosing of medication, and medication adherence questionnaire. Table 1 shows the medication adherence questionnaire that was administered verbally by SHOW clinical staff.

Table 1. Medication adherence questionnaire

1. How confident are you filling out medical forms by yourself?
    a. Extremely, quite a bit, somewhat, a little bit, or not at all (chew et al.)
    b. Very, somewhat, not at all, proxy (our study)
2. Are you currently taking prescription medications?
3. If yes, have you missed any doses in the last two weeks?
4. If yes, have you missed any doses in the past year?
5. *If yes to either #3 or #4, what has prevented you from taking your medication?*

Patient demographic and clinical characteristics between those who did versus those who did not miss medication doses at 2 weeks were assessed using means, standard deviations for continuous variables and frequencies, and proportions for categorical variables. Univariate logistic regression was used to ascertain independent predictors between the patient characteristics and the likelihood of missing their medication doses at 2 weeks. Those predictors with $p<0.20$ were entered into a second model where a backwards variable selection was implemented to ascertain which predictors as a group best predict medication misses at 2 weeks. The exact procedure was repeated for medication misses at 1 year. All p-value were 2-sided and $p<0.05$ were considered statistically significant. All data analyses were conducted using STATA version 14 (College Station, TX).

Results

Demographics

Overall, a total of 127 patients between the ages of 20 and 88 were chart reviewed. There was no statistical difference between the gender or mean age of those who missed versus those who did not miss a prescription medication dose at two weeks or one year.

Table 2. Demographic characteristics

Variable	Overall	No missed	Missed	P-value[1]
Doses missed in the past two weeks				
N	136	52	84	-
Age (mean, SD)	47.9 (11.7)	48.8 (12.3)	47.5 (11.3)	0.52
Gender (male, %)	67 (50.7)	27 (51.9)	40 (47.6)	0.62
Doses missed in the past year				
N	90	22	75	-
Age (mean, SD)	48.4 (10.8)	47.6 (11.7)	48.6 (10.5)	0.70
Gender (male, %)	43 (47.8)	11 (50.0)	32 (47.1)	0.81

[1]P-values calculated via univariate analysis using logistic regression.

Univariate analysis for two weeks

A univariate analysis was conducted measuring whether several independent variables including total number of medications, chief complaint, chronic conditions, or type of prescription medications bear any relationship to whether or not prescription medication doses were missed within the past *two weeks* of the patient encounter. Factors that demonstrated a *negative* relationship with medication adherence included endocrine chronic conditions such as type two diabetes mellitus (OR (95%) CI= 2.98 (1.04, 8.52); p=0.04), psychiatric chronic conditions (2.05 (1.01, 4.18); p=0.04), prescription medications taken for diabetes mellitus such as insulin (4.95 (1.07, 22.8); p=0.04), and cardiovascular prescription medications such as antihypertensives (2.15 (0.97, 4.75); p=0.05). Taking neurological prescription medications were also correlated to increased missed doses, though this relationship was not significant (3.72 (0.78, 17.6); p=0.09). Conversely, patients with dermatological or wound chief complaint were less likely to miss doses (0.40 (0.16, 1.02); p=0.05) as were patients with infectious disease comorbidities such as HIV or TB, though this trend was not statistically significant (0.38 (0.13, 1.09); p=0.07).

Univariate analysis for one year

Univariate analysis was repeated comparing the same independent variables as to whether or not prescription medications were missed or not missed *one year* prior to the patient encounter. Factors that demonstrated a statistically significant *negative* relationship to adherence included taking psychiatric medications such as antidepressants and mood stabilizers, but excluding antipsychotics which were analyzed separately (10.5 (1.31, 83.4); p=0.02) and cardiovascular medications (6.94 (1.48, 32.5); p=0.01). Additionally, patients with an increase in total number of prescription medications were at greater risk for missing doses (1.68 (1.14, 2.49); p=0.009). Patients with dermatological or wound chief complaints were again found to be less likely to miss a dose (0.30 (0.09, 1.3); p=0.05).

Table 3. Doses missed in the past two weeks and one year by chief complaint, chronic conditions, and prescription medications.

Variable	Two Weeks		One year	
	OR (95% CI)[1]	P-value[2]	OR (95% CI)	P-value[2]
Chief Complaints (example)				
Cardiovascular (chest pain)	1.96 (0.51, 7.60)	0.33	0.96 (0.18, 5.18)	0.96
Dermatologic (wound care)	0.40 (0.16, 1.02)	0.05	0.30 (0.09, 1.03)	0.05
Endocrine (hyperglycemia)	0.81 (0.17, 3.80)	0.79	0.62 (0.10, 3.66)	0.60
Gastrointestinal (abdominal pain)	1.96 (0.50, 7.60)	0.33	1.66 (0.18, 15.1)	0.65
Musculoskeletal (back pain)	0.70 (0.27, 1.75)	0.44	0.80 (0.25, 2.57)	0.71
Neurologic (headache)	1.89 (0.19, 18.6)	0.58	N/A	
Obstetric/gynecologic (vaginosis)	N/A		N/A	
Psychiatric (hallucinations)	1.96 (0.50, 7.60)	0.33	2.8 (0.33, 23.7)	0.34
Pulmonary (URI)	0.93 (0.41, 2.09)	0.87	0.75 (0.25, 2.26)	0.61
Renal/genitourinary (dysuria)	N/A		N/A	
Medication refill	2.38 (0.82, 6.9)	0.11	1.79 (0.46, 6.88)	0.39
Other	0.48 (0.14, 1.67)	0.25	N/A	
Chronic Conditions (example)				
No chronic diagnosis	0.29 (0.05, 1.67)	0.16	N/A	
Cardiovascular (CHF)	1.33 (0.66, 2.67)	0.42	2.03 (0.75, 5.48)	0.16
Dermatologic (psoriasis)	1.25 (0.11, 14.2)	0.85	N/A	
Endocrine (type II DM)	2.98 (1.04, 8.52)	0.04	2.15 (0.56, 8.2)	0.26
Gastrointestinal (GERD)	0.50 (0.18, 1.41)	0.19	1.96 (0.40, 2.64)	0.40
Infectious Disease (HIV)	0.38 (0.13, 1.09)	0.07	0.46 (0.13, 1.59)	0.22
Musculoskeletal (arthritis)	0.85 (0.34, 2.09)	0.72	2.64 (0.55, 12.7)	0.22
Neurologic (epilepsy)	1.64 (0.48, 5.54)	0.42	0.36 (0.08, 1.49)	0.16
Psychiatric (schizophrenia)	2.05 (1.01, 4.18)	0.04	1.39 (0.52, 3.66)	0.50
Pulmonary (COPD)	0.86 (0.40, 1.84)	0.70	0.57 (0.20, 1.55)	0.27
Renal (CKD)	N/A	0.28	N/A	
Other	0.59 (0.19, 1.79)	0.35	1.55 (0.30, 7.79)	0.59
Prescription Medications (example)				
No prescription medications	0.53 (0.23, 1.21)	0.13	0.36 (0.10, 1.19)	0.09
Glucocorticoids	N/A		N/A	
Antihistamines	0.56 (0.31, 1.61)	0.28	1.14 (0.21, 6.0)	0.87
Anticholinergics (benztropine)	0.72 (0.26, 1.98)	0.53	1.33 (0.25, 6.86)	0.73
Benzodiazepines	N/A		N/A	
Non-antipsychotic psychiatric (SSRI)	1.47 (0.58, 3.71)	0.40	10.5 (1.31, 83.4)	0.02
Anti-psychotic (haloperidol)	2.06 (0.75, 5.63)	0.15	1.27 (0.36, 4.41)	0.70
Neurologic (gabapentin)	3.72 (0.78, 17.6)	0.09	3.22 (0.38, 27.2)	0.28
Diabetic (insulin)	4.95 (1.07, 22.8)	0.04	3.65 (0.43, 30.5)	0.23
Gastrointestinal (PPI)	0.43 (0.09, 2.03)	0.28	0.96 (0.09, 9.8)	0.97
Cardiovascular (antihypertensive)	2.15 (0.97, 4.75)	0.05	6.94 (1.48, 32.5)	0.01
Anti-coagulant	0.59, 0.11, 3.05)	0.53	0.30 (0.04, 2.28)	0.24
Pulmonary (inhaler)	0.73 (0.32, 1.69)	0.47	0.75 (0.26, 2.21)	0.61

Statin	0.90 (0.14, 5.63)	0.91	0.31 (0.02, 5.22)	0.41
Narcotic (opiate)	1.59 (0.47, 5.40)	0.45	N/A	
NSAID (ibuprofen)	0.48 (0.18, 1.25)	0.13	0.50 (0.14, 1.75)	0.28
Infectious (antibiotic)	0.70 (0.20, 2.45)	0.58	1.31 (0.13, 12.5)	0.81
Daily Dosing				
As needed	0.64 (0.27, 1.53)	0.32	0.63 (0.18, 2.20)	0.46
One	1.13 (0.47, 2.69)	0.78	0.87 (0.26, 2.88)	0.82
Two	0.86 (0.30, 2.47)	0.78	1.07 (0.25, 4.5)	0.92
Three	2.44 (0.48, 12.2)	0.27	N/A	
Total number of medications	1.12 (0.97, 1.32)	0.09	1.68 (1.14, 2.49)	0.009

[1]OR > 1 means the patient is more likely to miss medications and OR < 1 indicates the patient is less likely to miss medications.

[2]P-values calculated via univariate analysis using logistic regression.

Multivariate analysis for two weeks

Variables demonstrating a $p<0.20$ in the univariate analysis in regards to missing or not missing doses were used to undergo stepwise backwards variable selection. P-values were then calculated via multivariate analysis using logistic regression. Results of this analysis demonstrated that patients taking antipsychotic prescription medications (3.35 (0.89, 12.6); p=0.07) as well as neurological medications (5.18 (0.69, 38.7); p=0.10) were best able to predict the likelihood of missing prescription medication doses, though the latter was not statistically significant. In contrast, patients with infectious disease chronic conditions such as HIV or TB were more likely to adhere to prescription medications (0.16 (0.03, 1.01); p=0.05). Though not statistically significant, patients prescribed NSAIDs bore a positive relationship on medication adherence (0.32 (0.08, 1.19); p=0.09).

Multivariate analysis for one year

Backwards variable selection was repeated for variables with a $p<0.20$ in the univariate analysis for *one year* prescription medication adherence. P-values were then calculated via multivariate analysis using logistic regression. Similar to the univariate analysis, increased total number of medications (2.24 (1.25, 4.02); p=0.006) and taking prescription cardiovascular medications (6.86 (0.89, 52.7); p=0.06) were best able to predict the likelihood of missing prescription medication doses. Dermatological or wound chief complaints were still found to be positively associated with adhering to prescription medications (0.05 (0.004, 0.59); p=0.01).

Table 4. Two week and one year predictors for missing and not missing doses

Variable	OR (95% CI)[1]	P-value[2]
Two weeks		
Infectious chronic disease	0.16 (0.03, 1.01)	0.05
Anti-psychotic prescription medications	3.35 (0.89, 12.6)	0.07
Neurologic prescription medications	5.18 (0.69, 38.7)	0.10
NSAID prescription medications	0.32 (0.08, 1.19)	0.09
One year		
Total number of prescription medications	2.24 (1.25, 4.02)	0.006
Dermatologic chief complaint	0.05 (0.004, 0.59)	0.01
Cardiovascular prescription medications	6.86 (0.89, 52.7)	0.06

[1]OR > 1 means the patient is more likely to miss medications and OR < 1 indicates the patient is less likely to miss medications.
[2]P-values calculated via multivariate analysis using logistic regression.

Descriptive review of "reasons missed"

For patients who missed medication doses in the past two weeks or the past year, the reasons for missing were recorded. However, p-values could not be calculated due to the small sample size. Of note, the most common reason for missing a dose for both time periods was needing a refill. For missed doses within the past two weeks, the next most common reasons were forgotten, lost, or stolen prescriptions. For missed doses within the past year, the next most common reasons were forgotten, lack of storage, or stolen prescriptions.

Table 5. Reasons for missed doses at two weeks and one year

Reason missed (n, %)	Two weeks N=84	One year N=64
Side effects	8 (9.6)	7 (10.9)
Stolen	13 (15.7)	8 (12.5)
Lost	14 (16.9)	7 (10.9)
No storage	7 (8.4)	8 (12.5)
Too expensive	3 (3.6)	4 (6.3)
Forgot	14 (16.9)	11 (17.2)
Need Refill	22 (26.5)	17 (26.6)
Unable to retrieve from pharmacy	6 (7.2)	2 (3.1)
Confusion	7 (8.4)	5 (7.8)
Too many medications	2 (2.4)	2 (3.1)
Asymptomatic / “Don’t need it”	3 (3.6)	6 (9.3)
Lack of privacy	2 (2.4)	0 (0.0)

P-value could not be calculated due to the small sample size.

Health literacy

Patients with decreased health literacy ('somewhat confident,' 'not confident,' or had the form filled by another person), showed an increase in doses missed in the past two weeks compared with patients who were 'very confident.' The highest association with missed doses was with people who were 'somewhat confident,' compared with lower levels of health literacy. When differing levels of health literacy were analyzed with respect to doses missed in the past year, requiring another person to help was protective in terms of missed doses while 'somewhat confident' and 'not confident' both showed an association with missed doses.

Table 6. Health literacy one-item screening questionnaire:
How confident are you filling out medical forms by yourself?

Variable	OR (95% CI)	P-value[1]
Doses missed in the past two weeks		
Very	REF	-
Somewhat	17.58 (1.8, 163.3)	0.01
None	4.04 (0.75, 21.7)	0.10
Proxy	1.87 (0.16, 20.9)	0.61
Doses missed in the past year		
Very	REF	-
Somewhat	6.91 (0.57, 83.6)	0.12
None	4.37 (0.66, 28.9)	0.12
Proxy	0.10 (0.002, 4.56)	0.24

[1] P-values calculated via multivariate analysis using logistic regression.

Discussion

Factors that increase the likelihood of adherence over baseline

The rationale behind this study is to increase our understanding of what obstacles to adherence are specific to homelessness and our intention is to characterize specific barriers that we may address with future targeting interventions at the SHOW Clinic. Several factors emerged from our retrospective chart review and analysis that correlate with increased or decreased likelihood of prescription medication adherence.

For patients who had missed prescription medication doses in the past *two weeks* from the time of the patient encounter, two variables emerged as demonstrating a *positive* effect on medication adherence: dermatologic chief complaints and chronic infectious disease. By nature, most patient chief complaints are symptomatic to the extent that the patient seeks medical care. Some exceptions might include well-visits or needing a medication refill in which the patient doesn't necessarily have a symptom that brings them into the doctor's office. Thus, in the case of a dermatologic chief complaint, it seems logical that medication adherence would increase as dermatologic issues will be visual and readily apparent to the patient thereby encouraging compliance with therapy to resolve symptoms. Of note, this also presupposes that the patient was already taking prescription medication for this same or equivalent chief complaint in the prior two weeks. Indeed the same trend was noted in patients who had missed prescription medication doses in the past *year* from the time of the patient encounter where dermatologic chief complaints had a positive effect on medication adherence. This relationship was reaffirmed in the multivariate logistic regression. In contrast, it is reasonable that other chief complaint variables did not significantly affect prescription medication adherence statistically because they relate to long term or asymptomatic conditions such as an elevated blood pressure discovered incidentally in a patient chronically taking antihypertensives or extremely elevated glucose levels discovered in a diabetic patient chronically taking insulin. In these cases, non-adherence may have precipitated the chief complaint.

When stepwise backwards variable selection was implemented on variables with a $p<0.20$ from the univariate analysis, chronic infectious disease emerged upon multivariate analysis as a clinically relevant factor in improved medication adherence. One explanation for this positive effect on medication adherence is that many of these patients may be receiving additional support through specialty clinics above and beyond the primary care setting. As mentioned in the introduction, many of these clinics use multi-disciplinary models with coexisting peer support to improve patient adherence in chronic infectious disease such as HIV and hepatitis C. Additionally, the extensive morbidity and especially mortality of these diseases is well known within the layman community and may spark additional prescription medication adherence above and beyond other chronic diseases with lesser apparent burden on quality of life and lifespan. Additionally, though not statistically significant, other chronic conditions with increased symptomatology also appear to increase medication adherence. For example, gastrointestinal conditions such as GERD, musculoskeletal conditions such as chronic back pain or arthritis, and pulmonary conditions such as COPD. As stated above, it seems logical that patients may be more adherent to prescription medication regimens when they improve daily symptoms and therefore quality of life.

Factors that decrease adherence over baseline

On the other hand, for patients who had missed prescription medication doses in the past *two weeks* from the time of the patient encounter, several variables demonstrated a *negative* effect on medication adherence: endocrine chronic conditions, psychiatric chronic conditions, type one and two diabetes mellitus prescription medications, and cardiovascular prescription medications. Neurologic prescription medications also had a negative effect on missing prescription medication doses, but this trend was not statistically significant. As aforementioned, it appears that chronic conditions that frequently have extended asymptomatic periods--For example, hypertension, type 2 diabetes mellitus, and epilepsy--may put a patient at increased risk for missing prescription medication doses. This trend holds true for patients taking prescription medications for these same types of conditions. Conversely, and

as previously stated, chronic conditions with increased symptomatology generally trend toward increasing medication adherence in this analysis.

Psychiatric disease also adversely affected prescription medication adherence. Given the prevalence of mental illness in this segment of the general population, understanding its effect is extremely important and central to improving healthcare in the homeless. Because of the innate effect on mentation in psychotic disorders, the most likely explanation for this trend in our analysis is increased missed doses secondary to impaired judgement. Severe mental illness presents a unique challenge where patients non-adherent to psychiatric prescription medications for various reasons--side effects and access, for example--are then more likely to remain non-adherent due to loss of insight secondary to the underlying psychiatric illness. For this same reason, patients with unstable mental disease typically require an inpatient hospital stay until mentation and insight can be regained through prescription therapy and counseling. Within our data analysis, psychiatric chief complaints for two week and one year prescription medication adherence, psychiatric chronic conditions for one year adherence, and anti-psychotic prescription medications for two week and one year adherence all demonstrate an increased effect on missed doses, though these are not statistically significant. Interestingly, non-antipsychotic psychiatric prescription medications such as SSRIs and mood stabilizers also had a pronounced and statistically significant adverse effect on adherence in the past year. One possible explanation for this trend are the prevalence of psychiatric diseases such as depression, anxiety, and bipolar I and II as well as the varied clinical affect mental disease can have for a given patient. For example, in the case of two patients with the same diagnosis of major depressive disorder: One may have a major depressive episode that is relatively well tolerated and mild with little to no effect on daily function while the other may have secondary psychotic symptoms and impaired mentation. Thus, mental disease can present on a phenotypic spectrum, varying patient by patient, and moreover, patients are often affected with more than one coexisting psychiatric disorder.

Another variable that negatively affects prescription medication adherence in the past *one year* of the patient encounter was total number of prescription medications. This relationship was reaffirmed in the multivariate logistic regression. This same trend held true for adherence in the past *two weeks* of the patient encounter, though the relationship was not statistically significant. In brief, as the total number of medications a given patient was taking increased so did the odds that the patient would miss prescription medication doses. The effect of "polypharmacy" is well characterized in the literature and is a targeting intervention in many primary clinics to reduce the overall number of medications a given patient is taking. Physicians and ancillary staff are encouraged to undergo regular medication reconciliation with patients to ensure that they are taking medications appropriately and to remove any unnecessary medications to simplify therapy regimens with hopes to improve overall adherence, decrease confusion, and decrease adverse events.

Reasons missed

The most common reason for missing a medication dose both at two weeks and one year was 'needing a refill.' This finding may be attributable to a number of possibilities. The first is that a common barrier to adhering to medications in our patient population is face-to-face or phone visits with a health care provider to obtain a script. Alternatively, this data could also reflect a patient not seeking another script when they have run out of a medication resulting in the cessation of that prescription. Ultimately, both explanations could potentially be improved by rigorously following up with patients after prescribing medications in the office and using methods such as reminder phone calls to decrease no-shows. Our data is supported by the results of the prospective cohort study conducted by Hunter et al. which demonstrated lack of access to a physician was the third most common reason for non-adherence and that having a primary care provider was associated with decreased likelihood of non-adherence. (14) However, our data also reflects the overall transient nature of many homeless patients who may frequently move to a different geographical location thereby making continuity and follow-up challenging.

The next most common reason for missing a medication dose both at two weeks and one year was 'forgot' to take medication closely followed by 'lost' or 'stolen' medication for two week data only. As discussed previously, our data shows that conditions with long asymptomatic periods generally lead to increased non-adherence and, presumably, because patients forget or do not feel convicted to adhere to medication regimens when there is no specific external factor to remind them to do so. One way in which this might be addressed is to enroll these "high-risk" patients into support groups for diabetes or cardiovascular disease, for example. Similarly, targeting these patients with nursing phone calls periodically may also serve as a reminder and ultimately improve medication adherence. Finally, the high incidence of 'stolen' medication represents a barrier to adherence that is likely unique to this vulnerable subset of the population, whereas needing refills or forgetting to take a medication, for example, may be factors more common to the general public.

Health literacy

Perhaps the most counterintuitive finding in our study was that patients who were 'somewhat confident' in their abilities to understand and respond to health questions and information were the most likely to miss doses as opposed to those who were less confident or who routinely asked for help. In considering this, it is possible that people who realize and accept their difficulties in processing health information are more likely to let the health care teams know about their health literacy limitations; in response, the health care teams may have spent greater time and energy reviewing the importance of the medications and may not have relied on written instructions. Those who state they are 'somewhat confident' may, in fact, be overestimating their abilities to themselves and/or the health care team. This may be a group where additional attention may make a big difference.

Future Directions and Conclusions

Our current work focuses on the process measure in identifying targetable barriers to medication adherence. Into the future, we hope to answer the outcome measure which seeks to initialize appropriate interventions by the interdisciplinary care team at SHOW clinic. Successfully identifying and implementing interventions will likely provide better healthcare to this demographic. Ideally, medication adherence will be reassessed in returning patients after interventions have been implemented.

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