

# Health Literacy, Medication Errors, and Health Outcomes: Is There a Relationship?

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## Abstract

**Purpose:** To definitively examine the relationship between health literacy and medication errors by reviewing the existing literature.

**Summary:** Over the past decade, our understanding of health literacy and its impact on society has greatly evolved, with research showing that patients with inadequate literacy levels are often subjected to inferior health outcomes. While several theoretical reasons exist to explain this suboptimal situation, one possible explanation is that patients with lower literacy levels do not have the skills necessary to effectively navigate the medication use process thus potentially leading to an increase in medication errors. Although the main focus of this article is to search for a direct association between literacy and medication errors, we also sought to identify an indirect relationship by evaluating previous studies, which explore the effects of literacy on health outcomes.

**Conclusion:** While we identified numerous studies that suggest that low literacy adversely affected patient outcomes, no study was found that directly linked low-health literacy to medication errors. The authors conclude that additional studies are needed to clarify this relationship.

**Key Words** — health literacy; medication errors; health outcomes

**Hosp Pharm** — 2006;41:542-551

ing and executing proper medication use.<sup>4,11,12</sup> This latter problem is particularly alarming given that errors in the medication process cause the death of one person every day and injure more than a million people each year in the US.<sup>13</sup>

Medication errors have been defined as “any preventable event that may cause or lead to inappropriate medication use or patient harm, while the medication is in the control of the health care professional, patient, or consumer.”<sup>14</sup> They can occur at any stage of the process, including the prescribing, transcribing, dispensing, administering, and monitoring of medications.<sup>15,16</sup> Although health care providers and the health care system represent a large part of the equation in ensuring the success of this process, much of the responsibility also lies on the patient or caregiver of the patient. While numerous barriers may exist to prevent patients from properly using their medications (eg, financial constraints, cultural beliefs, and limited educational attainment), it is also reasonable to assume that inadequate health literacy may lead to an increase in medication errors thus interfering with the intended drug therapy outcomes. The purpose of this article is to examine the relationship between health literacy and medication errors by briefly reviewing the existing literature. In addition to searching for a direct association between the two, we

Over a decade has passed since the landmark publication<sup>1</sup> that suggested 90 million Americans have limited literacy skills. Since then, many researchers have focused on examining both the prevalence and impact of inadequate health literacy on our society. In fact, the Institute of Medicine<sup>2</sup> cited over 300 studies that have suggested how

health information is often not understood by the intended audience. This has resulted in patients being less knowledgeable about their disease state,<sup>3-5</sup> more likely to have poorer health outcomes,<sup>6-8</sup> and more likely to be hospitalized.<sup>9,10</sup> In addition, studies have shown that patients with inadequate health literacy are more likely to have difficulties understand-

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also sought to identify an indirect relationship by evaluating previous studies exploring the effects of literacy on health outcomes.

### HEALTH LITERACY AND MEDICATION ERRORS

Our initial goal was to determine if a patient's health literacy level has any impact on the incidence of medication errors. To answer this, we used the National Library of Medicine's databases (PubMed and Medline), as well as the Cochrane databases to search all literature published on or before January 2005. The following search terms were used: literacy and medication errors, literacy and medication safety, literacy and patient safety, literacy and adverse drug events, and literacy adverse drug reactions. This produced approximately 90 articles. After reviewing the titles and abstracts of each of these articles, no studies appeared to have directly measured the effect of health literacy on medication errors. While it has been suggested that lower levels of literacy may compromise medication safety thus prompting some organizations to develop easy-to-read medication safety brochures,<sup>17</sup> to the best of our knowledge, no studies have objectively examined this theory and tested the effectiveness of these interventions. Studies that have asserted a link between low literacy and medication errors did so solely on the basis of vignette results measured in health literacy assessment instruments<sup>18</sup> and not on studies examining outcomes.<sup>10,11,19</sup>

### HEALTH LITERACY AND OUTCOMES

We also examined the possibility of an indirect relationship by examining the existing literature studying poor literacy and its effects on health outcomes. In

other words, what role (if any) did medication errors play in leading to the outcomes achieved in this body of literature. For purposes of this review, outcomes of interest were defined as: use of services (eg, outpatient visits, emergency department (ED) visits, and hospitalizations), management of chronic conditions/disease states (eg, diabetes, hypertension, arthritis, HIV/AIDS), self-reported health status, and health care costs. Using the same databases and methods described above, we performed a literature search using the terms "literacy and outcomes." In addition, references to outcome studies reported in previously published health literacy review articles<sup>12,20-22</sup> and books<sup>2</sup> were scanned to locate any articles not identified through electronic databases. A brief review of each of the relevant articles follows. In addition, a description of the literacy tests used in these studies can be found in Table 1, and a summary of all studies evaluated can be found in Table 2. For the interested reader, a more comprehensive review of the available health literacy tests has been recently published elsewhere.<sup>20</sup>

### UTILIZATION OF SERVICES

Baker DW, Gazmararian JA, Williams MV, et al. Health literacy and use of outpatient physician services by Medicare managed care enrollees. *J Gen Intern Med.* 2004;19:215-220.

The purpose of this prospective cohort study was to determine if inadequate health literacy adversely affected the use of physician outpatient services. Secondary analyses were also performed to examine any differences in the frequency of ED visits. Participants were new Medicare managed care enrollees from four US

cities (Cleveland, Houston, Tampa, and Fort Lauderdale-Miami). For those enrolled (n = 3,260), health literacy levels were assessed using the short version of the Test of Functional Health Literacy in Adults (S-TOFHLA), and claims data were used to identify all outpatient physician visits (including office, clinic, and ED visits) within 1 year of the date of enrollment into the plan. After adjusting for the worst health status of participants with limited health literacy and other demographic covariates, no difference was found in the total number of outpatient physician visits between those with inadequate and adequate literacy levels (13.7 vs 14.3, respectively;  $P = 0.38$ ). However, it was found that patients with inadequate health literacy were significantly more likely to have an ED visit than those with adequate health literacy levels (30.4% vs 21.8%, respectively;  $P < 0.001$ ). Reasons for an increase in the frequency of ED visits were not examined.

Baker DW, Gazmararian JA, Williams MV, et al. Functional health literacy and the risk of hospital admission among Medicare managed care enrollees. *Am J Public Health.* 2002;92:1278-1283.

The purpose of this prospective cohort study was to determine if inadequate health literacy affected the risk of hospital admission. Eligible new Medicare managed care enrollees from four US cities (Cleveland, Houston, Tampa, and Fort Lauderdale-Miami) that agreed to participate (n = 3,260) had their health literacy assessed using the S-TOFHLA and their claims data reviewed for approximately 2 years after enrollment into the managed care plan. At the completion of the study, it was

**Table 1. Literacy Tests Used to Assess Medical Errors and Poor Health Associated with Patient Literacy**

<i>Name of Test and Source Reference</i>	<i>Main Outcome Tested</i>	<i>Studies Using this Test</i>
<b>Test of Functional Health Literacy in Adults (TOFHLA)</b> Parker RM, Baker DW, Williams MV, Nurss JR. The Test of Functional Health Literacy in Adults (TOFHLA): a new instrument for measuring patient's literacy skills. <i>J Gen Inter Med.</i> 1995;10:537-541.	Reading and numeric comprehension, as well as ability to function in health care environment	Baker et al. 1998 Williams et al. 1998 Kalichman et al. 2000 Baker et al. 1997 Kalichman et al. 2000
<b>Shortened Test of Functional Health Literacy in Adults (s-TOFHLA)</b> Baker DW, Williams MV, Parker RM, Gazmararian JA, Nurss J. Development of a brief test to measure functional health literacy. <i>Patient Educ Couns.</i> 1999;38:33-42.	Abbreviated version of the TOFHLA	Baker et al. 2004 Baker et al. 2002 Schillinger et al. 2002 Gazmararian et al. 1999
<b>Rapid Estimate of Adult Literacy in Medicine (REALM)</b> Davis TC, Long SW, Jackson RH, et al. Rapid estimate of adult literacy in medicine: a shortened screening instrument. <i>Fam Med.</i> 1993;25:391-395.	Medical word recognition test	Rothman et al. 2004 Gordon et al. 2002
<b>Wide Range Achievement Test 3 (WRAT3)</b> Wilkinson GS. <i>Wide Range Achievement Test 3 Administration Manual.</i> Delaware, MA: Wide Range Inc; 1993.	Word recognition test	Ross et al. 2001
<b>National Adult Reading Test (NART)</b> Nelson HE, Willison JR. <i>National Adult Reading Test. Test Manual.</i> Windsor, UK: NFER-Nelson; 1992.	Word recognition test	Ross et al. 2001
<b>Tests of Adult Basic Education.</b> <i>Test of Adult Basic Education.</i> Monterey, CA: CTB/McGraw-Hill; 1976.	Reading level assessment	Weiss et al. 1992
<b>Instrument for the Diagnosis of Reading</b> Blanchard JS, Garcia HS, Cater RM. <i>Instrument for the Diagnosis of Reading.</i> Dubuque, IA: Kendall-Hunt Publishing Co.; 1989.	Reading comprehension test	Weiss et al. 1994

found that individuals with inadequate health literacy were more likely to be hospitalized than those with adequate health literacy levels (34.9% vs 26.7%, respectively;  $P < 0.001$ ). While primary diagnosis International Classification of Diseases, 9<sup>th</sup> Revision (ICD-9) codes were obtained for all admissions, the authors were unable to analyze differences in the reasons for hospital admissions due to inadequate power. Furthermore, only the most common discharge diagnoses were identified by the authors: congestive heart failure ( $n = 69$ ), acute myocardial infarction and unstable angina ( $n = 61$ ), stroke ( $n = 51$ ), cardiac arrhythmias ( $n = 46$ ), pneumonia ( $n = 36$ ),

exacerbations of chronic obstructive pulmonary disease or asthma ( $n = 35$ ), and gastrointestinal hemorrhage ( $n = 27$ ).

**Baker DW, Parker RM, Williams MV, Clark WS. Health literacy and the risk of hospital admission. *J Gen Intern Med.* 1998;13:791-798.**

This prospective cohort study was designed to determine the association between patient literacy and hospitalization. The study was conducted at Grady Memorial Hospital in Atlanta, GA, and any patient presenting to the Emergency Care Center and Walk-in Clinic with nonurgent medical problems between the hours of 9 AM and 5 PM was eligible. A total

of 958 eligible patients completed the Test of Functional Health Literacy in Adults (TOFHLA) and had an electronic medical record available for review. These patients were followed for a 2-year period. At the completion of this period, it was found that patients with inadequate health literacy were more likely to have been hospitalized than patients with adequate literacy (31.5% vs 14.9%, respectively;  $P < 0.001$ ). These differences remained after adjusting for differences in patient characteristics. While the authors state that principal discharge diagnosis ICD-9 codes for each admission were obtained, these diagnosis codes were not given. However,

**Table 2. Patient Literacy Study Highlights**

<i>Author</i>	<i>Year</i>	<i>Population Studied</i>	<i>Sample Size</i>	<i>Study Design</i>	<i>Outcome of Interest</i>
1. Baker, et al.	2004	New managed care enrollees in four US cities (Cleveland, Houston, Tampa, and Fort Lauderdale–Miami)	n = 3,260	Prospective cohort study	Inadequate literacy levels were associated with an increased risk for an emergency department visit when compared to those with adequate literacy levels (30.4% vs 21.8%, respectively; $P < 0.001$ )
2. Baker, et al.	2002	New managed care enrollees in four US cities (Cleveland, Houston, Tampa, and Fort Lauderdale–Miami)	n = 3,260	Prospective cohort study	Inadequate literacy levels were associated with more hospitalizations when compared to those with adequate literacy levels (34.9% vs 26.7%, respectively; $P < 0.001$ )
3. Baker, et al.	1998	Nonurgent patients presenting to the Grady Memorial Emergency Care Center and Walk-In Clinic (Atlanta, GA) between the hours of 9 AM and 5 PM	n = 958	Prospective cohort study	Inadequate literacy levels were associated with an increased risk of hospitalization when compared with those with adequate literacy levels (31.5% vs 14.9%, respectively; $P < 0.001$ )
4. Schillinger, et al.	2002	Adults with type 2 diabetes receiving care from one of two primary care clinics at San Francisco General Hospital	n = 408	Cross-sectional observational study	Patients with inadequate literacy levels were less likely than those with adequate literacy levels to have tight glycemic control (22% vs 33%, respectively; $P = 0.003$ ) and more likely to have poor glycemic control (30% vs 20%, respectively; $P = 0.02$ )
5. Williams, et al.	1998	Patients with hypertension and diabetes presenting to two urban, public hospitals in Torrance, CA and Atlanta, GA	n = 516	Cross-sectional survey	No significant differences in blood pressure or blood glucose control was noted between those with adequate literacy levels and those with inadequate literacy levels
6. Ross, et al.	2001	Children/adolescents with type 1 diabetes receiving care from the diabetic clinic at the Royal Hospital for Sick Children (Edinburgh, UK) and their mothers	n = 78 child/mother pairs	Cross-sectional prospective observational study	A significant correlation did exist between the reading ability of the mothers and the mean $A_{1C}$ of the children; as reading ability decreased, $A_{1C}$ values increased ( $r = 0.28$ , $P = 0.01$ )
7. Rothman, et al.	2004	Adult type 2 diabetics with poor glucose control ( $A_{1C} \geq 8\%$ ) receiving care from the University of North Carolina General	n = 111	Longitudinal interventional study	There was no difference in $A_{1C}$ values at baseline between the literacy groups ( $A_{1C} = 10.7\%$ in the lower literacy group vs 10.6% in the higher literacy group, 95% CI [-0.7, 0.9]). Furthermore, despite improvements in $A_{1C}$ levels in both literacy groups, 6 months after enrollment (and the introduction of low-literacy interventions), there was no significant difference between the literacy groups with regards to magnitude of the improvement ( $A_{1C}$ levels increased by 1.9% in the low-literacy group vs 1.8% in the higher literacy group)
8. Weiss, et al.	1992	Adult students enrolled in the Pima County Adult Education Program in Tucson, AZ	n = 193	Cross-sectional study	Lower literacy levels were more likely to be associated with higher scores on the Sickness Impact Profile (indicating worse health) than higher literacy levels (10.4 vs 6, respectively; $P = 0.02$ )

(continued)

**Table 2. Patient Literacy Study Highlights (Continued)**

<i>Author</i>	<i>Year</i>	<i>Population Studied</i>	<i>Sample Size</i>	<i>Study Design</i>	<i>Outcome of Interest</i>
9. Gazmararian, et al.	1999	New managed care enrollees in four US cities (Cleveland, Houston Tampa, and Fort Lauderdale-Miami)	n = 3,260	Cross-sectional survey	Those who had inadequate health literacy were twice as likely to report being in fair or poor health vs. excellent or good health (38.7% vs 19.2%, respectively; $P < 0.001$ )
10. Weiss, et al.	1994	Medicaid recipients receiving care through the Arizona Health Care Cost Containment System in Tucson, AZ	n = 402	Cross-sectional study	No relationship was found between literacy levels and health care costs ( $P = 0.43$ ; the median total medical charge for all participants was \$1,100.20)
11. Weiss, et al.	2004	Nonpregnant Medicaid recipients receiving care through the AZ Health Care Cost Containment System in Tucson, AZ	n = 74	Cross-sectional study	Lower literacy levels were associated with higher annual health care charges (mean = \$10,688 for lower literacy levels vs. \$2,891 for higher literacy levels; $P = 0.025$ )
12. Gordon, et al.	2002	Rheumatoid arthritis patients receiving care at the Center for Rheumatic Diseases in Glasgow, UK	n = 123	Prospective cross-sectional study	Patients with inadequate literacy levels were more likely to experience anxiety and depression ( $P = 0.011$ ) and more likely to visit an outpatient clinic each year (six median visits per year in the lower literacy group vs two visits per year in the higher literacy group; no $P$ -value given)
13. Kalichman, et al.	2000	HIV/AIDS infected patients recruited from AIDS service organizations, health care providers, social service agencies, community residencies for people living with HIV/AIDS, and infectious disease clinics	n = 294	Cross-sectional study	Patients with lower literacy levels were less likely to report undetectable viral loads when compared to their higher literacy counterparts (20% vs 42%, respectively; $P = 0.05$ ) and more likely to use health care services (63% reported visiting their doctor at least once a month vs only 43% in the higher literacy group; $P = 0.01$ )
14. Baker, et al.	1997	Adult patients presenting to the Emergency Care Center and Walk-In Clinic with nonurgent medical problems at Grady Memorial Hospital in Atlanta, GA and Harbor-UCLA Medical Center in Torrance, CA	n = 979 (in GA), n = 1,680 (in CA)	Retrospective cross-sectional study	Georgia patients with inadequate literacy levels were more likely than those with adequate literacy levels to report their health as poor (24.5% vs 11.3%, respectively; $P < 0.001$ ) and more likely to be hospitalized during the year preceding study entry (25.6% vs 14.9%, respectively; unadjusted OR = 1.96, 95% CI = 1.39, 2.76). California patients with inadequate literacy levels were also more likely to report their health as poor ( $P < 0.001$ ), but no significant differences in hospitalizations existed
15. Kalichman, et al.	2000	HIV/AIDS infected patients recruited from AIDS service organizations, health care providers, social service agencies, community residencies for people living with HIV/AIDS, and infectious disease clinics	n = 339	Cross-sectional survey and chart review	Patients with lower literacy levels were significantly more likely than those with higher literacy levels to perceive their health as poor (77% vs 64%, respectively; $P < 0.03$ ), have been hospitalized $\geq$ three times for HIV-related conditions (32% vs 21%, respectively; $P < 0.05$ ), have higher viral loads (4.1 copies/mL vs 2.9 copies/mL, respectively; $P < 0.01$ ), and have lower CD4 counts (228.5 cells/mm <sup>3</sup> vs 319.85 cells/mm <sup>3</sup> , respectively; $P < 0.05$ ). Those with lower literacy levels were also less likely to be taking antiretroviral medications (59% vs 73%, $P < 0.02$ )

they do state that there were no significant differences in the discharge codes between literacy levels; although, there were too few patients in any given category to definitively assess this finding.

### MANAGEMENT OF CHRONIC CONDITIONS/DISEASE STATES

Schillinger D, Grumbach K, Piette J, et al. Association of health literacy with diabetes outcomes. *JAMA*. 2002;288: 475-482.

This study, designed to evaluate the impact of poor health literacy on diabetes outcomes, took place in two primary San Francisco clinics. Eligible patients (English and Spanish speaking adults over the age of 30 with type 2 diabetes) had their literacy assessed using the S-TOFHLA and their diabetes control determined by hemoglobin A<sub>1C</sub> values. These A<sub>1C</sub> values were compared across literacy levels by creating cutoffs to define tight control and poor control according to the 25<sup>th</sup> and 75<sup>th</sup> percentiles of A<sub>1C</sub> distribution for the study sample. The mean A<sub>1C</sub> for the study population was 8.5%, with tight glycemic control being defined as A<sub>1C</sub> levels at or below 7.2%, and poor glycemic control being defined as A<sub>1C</sub> levels at or above 9.5%. Of the 408 patients participating in the study, 156 (38%) were found to have inadequate literacy levels. Only 22% of these patients with inadequate health literacy had tight glycemic control, whereas 33% of patients with adequate health literacy had tight glycemic control ( $P = 0.003$ ). Furthermore, 30% of patients with inadequate health literacy had poor glycemic control, whereas only 20% of patients with adequate health literacy had poor glycemic control ( $P = 0.02$ ). These findings remained after adjusting for differences in patient character-

istics, leading the authors to conclude that inadequate health literacy was an independent predictor of poor glycemic control and was associated with a lower likelihood of achieving tight control.

Williams MV, Baker DW, Parker RM, Nurss JR. Relationship of functional health literacy to patient's knowledge of their chronic disease: a study of patients with hypertension and diabetes. *Arch Intern Med*. 1998;158:166-172.

Although the main objective of this study was to examine the relationship between functional health literacy and knowledge of chronic disease and treatment among patients with hypertension or diabetes, secondary outcome measures included clinical markers such as blood pressure readings and hemoglobin A<sub>1C</sub> values. The study was conducted at two urban public hospitals in Torrance, CA and Atlanta, GA. Of the 516 patients enrolled and who had their literacy assessed using the TOFHLA, a total of 246 were identified as having inadequate literacy levels. While inadequate literacy levels did significantly correspond with having less knowledge of one's illness, this did not appear to translate into worse clinical outcomes. After adjusting for differences in patient age, only a non-significant ( $P = 0.12$ ) 6 mm Hg difference in systolic blood pressure existed. Similarly, although a trend of worse blood glucose control with lower literacy levels was noted, the difference between patients with inadequate and adequate functional health literacy in hemoglobin A<sub>1C</sub> levels was non-significant (8.3% vs 7.5%, respectively;  $P = 0.16$ ). However, the authors do state that these non-significant differences may be due to small sample sizes, as only 352

hypertensive patients and 55 diabetic patients had clinical outcome measures (ie, blood pressure readings and A<sub>1C</sub> levels) available for analysis.

Ross LA, Frier BM, Kelnar CJ, Deary IJ. Child and parental mental ability and glycemic control in children with type 1 diabetes. *Diabet Med*. 2001;18:364-369.

This study was designed to explore the influence of both the child's and their mother's measured intelligence on glycemic control in children with type 1 diabetes. Children participating in the study had their reading ability tested using the Wide Range Achievement Test 3 (WRAT3) and their general mental ability tested using Raven's Standard Progressive Matrices (RSPM). The National Adult Reading Test (NART) was used to assess the reading ability of the mother. Analysis of the 78 subject pairs (child-mother) enrolled in the study revealed that a significant correlation did exist between the mean hemoglobin A<sub>1C</sub> of the children and the NART scores of their mothers ( $P = 0.01$ ). However, no significant correlation was observed between the mean hemoglobin A<sub>1C</sub> of the child and their WRAT3 or RSPM score. The mean annual hemoglobin A<sub>1C</sub> for the group of children participating in this study was 8.6%  $\pm$  1.4%, and the median age was 12 years (5 to 17).

Rothman R, Malone R, Bryant B, Horlen C, DeWalt D, Pignone M. The relationship between literacy and glycemic control in a diabetes disease-management program. *Diabetes Educ*. 2004;30(2):263-273.

This study, enrolling type 2 diabetic patients from the University of North Carolina's General Internal Medicine Practice was

designed to examine the relationship between literacy and glycemic control in a cohort of patients being followed by a pharmacist-led diabetes management program. In addition to comparing hemoglobin A<sub>1C</sub> levels to literacy status at or prior to enrollment, A<sub>1C</sub> levels were then reassessed approximately 6 months post-enrollment after low-literacy pharmacist interventions were made (ie, one-to-one education and medication management). A total of 111 patients were enrolled and followed from September 1999 to December 2000, and participating subjects had their literacy measured using the Rapid Estimate of Adult Literacy in Medicine (REALM) test. Upon testing, it was discovered that 55% of patients had “low literacy levels,” which corresponded to a REALM score of less than 45 (6<sup>th</sup> grade reading level). However, these patients did not have significantly different A<sub>1C</sub> levels, when compared to those with higher literacy levels at baseline (10.7% vs 10.6%, respectively;  $P = 0.85$ ). Furthermore, there was no significant difference in improvement of A<sub>1C</sub> between the two groups at an average of 6 months after enrollment, with the low-literacy group improving by 1.9% points and the higher literacy group improving by 1.8% points. However, the authors do acknowledge a limitation in that the study may not have been adequately powered to detect a difference by literacy status.

#### **SELF-REPORTED HEALTH STATUS**

Weiss BD, Hart G, McGee DL, D’Estelle S. Health status of illiterate adults: relation between literacy and health status among persons with low literacy skills. *J Am Board Fam*

*Pract.* 1992;5:257-264.

The goal of this study was to determine if a relationship existed between literacy and health status among a group of US adults with poor literacy skills. Participants were adult students enrolled in the Pima County Adult Education Program in Tucson, AZ. Reading levels were determined using the Tests of Adult Basic Education, and the Sickness Impact Profile was used to measure health status. Of the 193 students that agreed to participate, 37 read at or below a 4<sup>th</sup> grade level. Those with lower literacy levels were significantly more likely to score higher on the Sickness Impact Profile (indicating worse health) than those with higher literacy levels (10.4 vs 6, respectively;  $P = 0.02$ ).

Gazmararian JA, Baker DW, Williams MV, et al. Health literacy among Medicare enrollees in a managed care organization. *JAMA.* 1999;281:545-551.

Although this cross-sectional survey was primarily designed to determine the prevalence of low-functional health literacy among community-dwelling Medicare enrollees in a national managed care organization, participants were also asked to complete a survey which, among other things, assessed self-rated health. A total of 3,260 new Medicare enrollees from Cleveland, Houston, Tampa, and South Florida agreed to participate and were administered the S-TOFHLA to assess literacy levels. Overall, 23.5% of English-speaking patients (total number of English-speaking patients = 2,956) and 34.2% of Spanish-speaking patients (total number of Spanish-speaking patients = 304) had inadequate health literacy levels, and more than one quarter of all respondents described their health

as fair/poor (27.2%). Individuals rating their health as fair or poor were twice as likely to have inadequate health literacy compared with individuals who rated their health as good or excellent (38.7% vs 19.2%, respectively;  $P < 0.001$ ).

#### **HEALTH CARE COSTS**

Weiss BD, Blanchard JS, McGee DL, et al. Illiteracy among Medicaid recipients and its relationship to health care costs. *J Health Care Poor Underserved.* 1994;5:99-111.

In this study, Weiss and colleagues sought to determine if there was an independent relationship between literacy skills and health care costs among Medicaid recipients receiving care through a program known as the Arizona Health Care Cost Containment System in Tucson, AZ. Literacy levels were assessed using the Instrument for the Diagnosis of Reading. Of the 402 subjects that were willing and able to participate, 28% had reading levels at or below a 4<sup>th</sup> grade level and only 39% read at or above the 8<sup>th</sup> grade level. The median value for total medical care charges for the 402 participants during the 1-year study interval was \$1,100.20 (range: \$0 to \$95,002.10), with statistical analysis revealing no relationship between reading levels and charges for medical care ( $P = 0.43$ ). However, limitations to the study were acknowledged by the authors in that most of the participants were young, relatively healthy pregnant women who typically do not have sufficient variation in health care costs to permit detection of a relationship between literacy and costs.<sup>23</sup>

Weiss BD, Palmer R. Relationship between health care costs and very low literacy skills in a medically

needy and indigent Medicaid population. *J Am Board Fam Pract.* 2004;17:44-47.

Due to the limitations listed above by Weiss and colleagues, data from the AZ health care cost study were reanalyzed after excluding subjects enrolled because of pregnancy. After these exclusions, a total of 74 subjects were available for analysis. Eighteen (24%) had literacy levels at or below a 3<sup>rd</sup> grade reading level, and 56 (76%) had literacy levels above a 3<sup>rd</sup> grade reading level. Statistical analysis revealed that the patients with lower reading levels had significantly higher annual health care charges than those with higher reading levels (mean = \$10,688 vs \$2,891, respectively;  $P = 0.025$ ). These differences remained after controlling for differences in patient demographics.

#### MULTIPLE OUTCOMES

Gordon MM, Hampson R, Capell HA, Madhok R. Illiteracy in rheumatoid arthritis patients as determined by the Rapid Estimate of Adult Literacy in Medicine (REALM) score. *Rheumatology.* 2002;41:750-754.

The purpose of this study was to determine the prevalence of illiteracy in rheumatoid arthritis patients and to identify the health consequences that are a result of it. Participants were recruited from the Center for Rheumatic Diseases in Glasgow, UK and had their literacy assessed using the REALM. Health status was assessed using the Health Assessment Questionnaire (HAQ) and the Hospital Anxiety and Depression (HAD) questionnaire. Of the 123 patients that enrolled, 18 (15%) had a REALM score of less than 60, indicating functional illit-

eracy and the need for low-literacy materials. While these lower literacy patients did not have significantly lower HAQ scores than their higher literacy counterparts, illiterate patients were significantly more likely to experience anxiety and depression based on the HAD score ( $P = 0.011$ ). In addition, patients from the illiterate group reported an increased likelihood of visiting an outpatient clinic each year, with these patients attending three times as many outpatient clinics as the literate group (six median visits per year vs two, respectively; no  $P$ -value given).

Kalichman SC, Benotsch E, Suarez T, Catz S, Miller J, Rompa D. Health literacy and health-related knowledge among persons living with HIV/AIDS. *Am J Prev Med.* 2000;18:325-331.

While this study was primarily designed to examine the relationship between health literacy and knowledge or understanding of HIV/AIDS, patients were also asked to provide their most recent CD4 cell count and their most recent viral load in an effort to determine the relationship between literacy and health status. For purposes of this review, the discussion is limited to only those results that are consistent with the topics of this review (ie, markers of disease control and use of services). Patients were recruited from AIDS service organizations, health care providers, social service agencies, community residences for people living with HIV/AIDS, and infectious disease clinics. A total of 294 patients agreed to participate in the study and had their literacy assessed using the TOFHLA. For study purposes, patients were identified as having lower health literacy if they scored below an 80% on the

TOFHLA. Fifty patients met this criterion. Although no significant differences were found in the CD4 cell counts between the two literacy groups (329.9 for the lower literacy group vs 365.1 for the higher literacy group), patients with lower literacy levels were significantly less likely to report undetectable viral loads, when compared to their higher literacy counterparts (20% vs 42%, respectively;  $P = 0.05$ ). Additionally, it was also found that patients with lower literacy levels were more likely to have an increase in the use of health care services, with 63% reporting that they visit their doctor at least once a month, as compared to only 43% in the higher literacy group ( $P = 0.01$ ). The authors of this study do acknowledge some limitations in that the results were based solely on self-report techniques that were not verified by more objective measures and the relatively small number of patients with lower health literacy may have affected the sensitivity of significance tests.

Baker DW, Parker RM, Williams MV, Clark WS, Nurss J. The relationship of patient reading ability to self-reported health and use of health services. *Am J Public Health.* 1997;87:1027-1030.

This study was conducted at two urban public hospitals (Grady Memorial Hospital in Atlanta, GA and Harbor-UCLA Medical Center in Torrance, CA) and was designed to examine the relationship between health literacy, self-reported health, and use of health services. Adult patients presenting to the Emergency Care Center and Walk-In Clinic with nonurgent medical problems were considered eligible. Eligible patients that agreed to participate ( $n = 979$  in GA and  $n = 1,680$  in CA) were

administered the TOFHLA to measure literacy and given a questionnaire to determine demographics, self-reported reading difficulties, barriers to health care access, health status, and health care use. Study results showed that self-reported health was strongly related to literacy, with patients having inadequate literacy levels being more likely than patients with adequate levels to report their health as poor (English speaking adults in CA: 32.5% vs 17.7%, respectively [ $P < 0.001$ ]; Spanish speaking adults in CA: 39.3% vs 25.5%, respectively [ $P < 0.001$ ]; GA adults: 24.5% vs 11.3%, respectively [ $P < 0.001$ ]). In addition, GA patients with inadequate literacy were more likely than patients with adequate literacy to report being hospitalized during the year preceding study entry (25.6% vs 14.9%, respectively; unadjusted odds ratio [OR] = 1.96, 95% CI = 1.39, 2.76). Reasons for hospitalization (ICD-9 codes) were not given. All differences remained even after adjusting for differences in patient demographics. Just as hospitalizations in CA did not differ significantly between literacy groups, no differences in ambulatory care use existed in either state after adjusting for differences in patient variables.

**Kalichman SC, Rompa D. Functional health literacy is associated with health status and health-related knowledge in people living with HIV-AIDS. *J Acquir Defic Syndr*. 2000;25:337-344.**

This study used surveys and interviews to test the hypothesis that poorer health literacy is associated with health status, awareness, and understanding of one's HIV disease status, and HIV disease and treatment-related knowl-

edge. In addition, medical records (used to verify disease control/health status) were available for a subset of patients. Participants were recruited from various community settings (eg, AIDS service organizations, health care providers, social service agencies, community residences for people living with HIV/AIDS, and infectious disease clinics), and all study measures were completed in a single session. Literacy levels were assessed using the TOFHLA. A total of 339 individuals completed the study, with 167 of these participants having medical records available from public and private infectious disease clinics for review. Study results showed that lower health literacy participants were significantly more likely to perceive their health as poor (77% vs 64%, respectively;  $P < 0.03$ ), have been hospitalized three or more times for HIV-related conditions (32% vs 21%,  $P < 0.05$ ), have higher viral loads (4.1 copies/mL vs 2.9 copies/mL,  $P < 0.01$ ), and have lower CD4 counts (228.5 cells/mm<sup>3</sup> vs 319.5 cells/mm<sup>3</sup>,  $P < 0.05$ ). In addition, patients with lower health literacy were significantly less likely to be taking antiretroviral medications than those with higher health literacy levels (59% vs 73%,  $P < 0.02$ ). Differences in health status remained even after controlling for these differences in medications.

## DISCUSSION

Adequate health literacy skills are an essential prerequisite needed to effectively navigate the health care system. Without these skills, quality of care can be significantly compromised. While it has been speculated that low levels of health literacy may result in an increase in medication errors,<sup>17</sup> it was unclear whether empirical evi-

dence of this relationship existed. Therefore, one of the purposes of our study was to specifically examine research that directly considered this relationship. Surprisingly, our review of the existing body of literature found no study that directly examined the link between health literacy and medication errors.

Furthermore, we were unable to identify any articles examining an indirect association between the two through the broader end point of poor health outcomes. While several studies report an adverse effect of low literacy on health outcomes, none attempted to answer what percentage, if any, was due to improper medication use. In addition, much of the data available were generated from relatively few research centers (with several studies stemming from the same or very similar patient populations) and a limited number of disease states.

A limitation of our work is acknowledged in that we systematically identified relevant articles by scanning titles and abstracts of studies identified by our search. While we used widely accepted search methodologies, the possibility exists that some important articles were not identified. Nevertheless, a review of all titles, abstracts, and bibliographies of select articles did not reveal any studies consistent with the topic of this article. Based on these findings, we conclude that the relationship between health literacy and medication errors is still poorly understood. We recommend that additional studies be conducted to more accurately define this association.

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