



## Feature Article

# The impact of inadequate health literacy on patient satisfaction, healthcare utilization, and expenditures among older adults



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## ABSTRACT

Inadequate health literacy (HL) is associated with impaired healthcare choices leading to poor quality-of-care. Our primary purpose was to estimate the prevalence of inadequate HL among two populations of AARP® Medicare Supplement insureds: sicker and healthier populations; to identify characteristics of inadequate HL; and to describe the impact on patient satisfaction, preventive services, healthcare utilization, and expenditures. Surveys were mailed to insureds in 10 states. Multivariate regression models were used to identify characteristics and adjust outcomes. Among respondents ( $N = 7334$ ), 23% and 16% of sicker and healthier insureds, respectively, indicated inadequate HL. Characteristics of inadequate HL included male gender, older age, more comorbidities, and lower education. Inadequate HL was associated with lower patient satisfaction, lower preventive service compliance, higher healthcare utilization and expenditures. Inadequate HL is more common among older adults in poorer health, further compromising their health outcomes; thus they may benefit from expanded educational or additional care coordination interventions.

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## Introduction

Health literacy (HL) is defined as the ability to obtain, process, and understand basic health information and services needed to manage one's health and make appropriate health decisions.<sup>1–6</sup> HL encompasses various skills needed to navigate the healthcare system, including print literacy (reading, interpreting, and understanding written information), oral literacy (speaking/listening effectively), and numeracy (applying quantitative information).<sup>1,7–9</sup> Individuals with inadequate HL may have trouble

with even basic health-related tasks, such as following prescription instructions, calculating dosages, completing medical history or insurance forms, communicating with providers, interpreting test results, and understanding the risks and benefits of procedures.<sup>10</sup> More importantly, older adults with inadequate HL may struggle to self-manage multiple conditions and coordinate their care across various providers in an increasingly complex healthcare system.

In the US, over 46 million Americans are age 65 or older, a number that is increasing rapidly and projected to nearly double by 2050.<sup>11–13</sup> This population is the fastest-growing age group in the US, dominated by Baby Boomers who are reaching retirement and Medicare eligibility. Considering the rapid growth of this population and their generally higher healthcare needs, efforts to help seniors age successfully with optimal outcomes have become a priority.

The US Department of Education's National Assessment of Adult Literacy (NAAL) found that inadequate HL is especially prevalent among the elderly: 59% of adults age 65 years and older score in the two lowest ranges of HL, basic and below basic.<sup>1,14</sup> Of these, 29%

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have below basic HL.<sup>14</sup> Considering specific components of HL, 68% of older adults reportedly have difficulty understanding numbers and calculations; 71% using printed materials; and 80% using health-related documents.<sup>14,15</sup>

Several common characteristics of low HL among older adults have been established.<sup>16,17</sup> Individuals with inadequate HL are more likely to be older, male, minorities, and have lower income, education, and are generally sicker with poorer physical and mental health.<sup>1,10,14,18–22</sup> Commonly reported mental health-related characteristics include low general literacy, poor decision-making ability, reduced cognitive functioning, and a lack of social support.<sup>16,17</sup> Physical health characteristics most often tied to inadequate HL include lack of engagement in health-promoting behaviors such as exercise, reduced physical functioning, poor self-care, more chronic conditions, increased mortality risk, and poorer overall physical health.<sup>14,16–18,22,23</sup>

According to research, inadequate HL more strongly predicts health status than age, income, education, or race.<sup>10,24</sup> Studies support a relationship between inadequate HL and health outcomes, in addition to health behaviors including decision-making, compliance with prescription medications, self-management of chronic conditions, and participation in health screenings.<sup>10,23,25,26</sup> Low levels of HL have been associated with suboptimal outcomes including poorer overall health and physical fitness, increased disability and pain, increased prevalence and severity of certain conditions, reduced physical functioning, limited mobility, reduced quality of life, and poorer disease outcomes.<sup>16–18,22,25,27–34</sup> Those who rate their health as only fair or poor are twice as likely to have inadequate HL compared to those who rate their health as either good or excellent.<sup>23,35</sup>

Inadequate HL has also been shown to impact patient satisfaction with providers, services, and overall care, as well as compliance with recommended preventive services, healthcare utilization including inpatient (IP) admissions, and medical expenditures among older adults.<sup>36–40</sup> Older adults with inadequate HL tend to receive fewer cancer screenings and flu shots as compared to those with adequate HL.<sup>21,22,32,41,42</sup> Research also indicates higher emergency room (ER) visits and IP admissions among those with inadequate HL, perhaps due to these individuals bypassing less costly preventive services.<sup>23,25,43–51</sup>

To our knowledge, there is little research examining the impact of inadequate HL specifically within populations of Medicare Supplement insureds with different health status levels. In the US, government-funded Medicare covers adults age 65 and older as well as those under 65 and disabled. Medicare pays about 80% of medical expenditures for these individuals but offers no prescription drug benefits. Those enrolled in Medicare plans are personally responsible for obtaining additional insurance plans to cover the remaining 20% of medical expenses (i.e., Medicare Supplement or Medigap plans) and prescription drug coverage (Medicare Part D Rx plans). Among the 54 million older adults in the US with Medicare coverage, 10.2 million purchase Medigap insurance plans from private insurers to defray out-of-pocket (OOP) expenses from copayments, coinsurance, and deductibles that Medicare does not cover in entirety.<sup>52,53</sup> Since this population may differ from general older adult and/or Medicare populations, it was of interest to examine HL within subgroups that vary by health status and to detail associated characteristics and health outcomes of inadequate HL. Additionally, most research studies focus on specific chronic conditions (e.g., hypertension, heart disease, congestive heart disease, asthma) rather than overall health status.<sup>54,55</sup> This study uses an objective measure derived from administrative medical claims to characterize poor health status as compared to a generally healthier randomly selected control group.

## Statement of purpose

The purpose of this study was to estimate the prevalence of inadequate HL among a sicker sample of older adults eligible for a care coordination program and a healthier randomly selected older adult sample; to identify common characteristics associated with inadequate HL within these cohorts; and to describe the impacts of inadequate HL on patient satisfaction, preventive services compliance, healthcare utilization, and expenditures. In doing so, we will demonstrate a potential need for population-level intervention programs targeting older adults with inadequate HL, especially those with poorer health.

## Methods

### Study design and sample selection

In 2015, approximately 4 million Medicare beneficiaries were covered by an AARP® Medicare Supplement Insurance plan insured by UnitedHealthcare Insurance Company (or, for New York residents, UnitedHealthcare Insurance Company of New York), offered in all 50 states, Washington DC, and various US territories. Those eligible for the study must have been enrolled in AARP Medicare Supplement plans for at least six months and have been 65 years or older at the time of the survey. A randomly selected sample of 31,000 insureds in 10 states (Arizona, California, Colorado, Florida, Missouri, New Jersey, New York, North Carolina, Ohio, and Texas) was mailed surveys in 2012 and 2013. The sampling strategy included an objective eligibility criterion for care coordination programs within five states (i.e., New Jersey, New York, North Carolina, Ohio, and Texas) and a randomly selected population with no health criteria within the remaining states (i.e., Arizona, California, Colorado, Florida and Missouri). Care coordination programs are generally telephonic outreach programs conducted by nurse counselors and are offered by US health plans to individuals with selected diagnosis codes and high medical expenditures. Starting in 2008, five states operated care coordination programs; the remaining five states were chosen as suitable controls for the evaluation of the effectiveness of the designated programs. Among those who were mailed surveys, 9708 insureds responded. Those who did not meet plan eligibility ( $N = 472$ ), did not answer the HL question ( $N = 348$ ), had duplicate surveys ( $N = 288$ ), were missing on any other of the variables ( $N = 1218$ ), or were in the top 0.5% of medical expenditures (i.e., outliers;  $N = 48$ ) were excluded. The final study population included 7334 survey respondents. Those eligible for the care coordination programs will be referred to as “sicker” while the randomly selected insureds will be considered the “healthier” group. No bias on the primary variable of interest (HL) was evident; the prevalence of inadequate HL prior to and after exclusions remained unchanged. This study was approved by the New England Independent Review Board (NEIRB#: 12-114).

### Survey

A modified version of the Consumer Assessment of Healthcare Providers and Systems (CAHPS) survey was used. CAHPS is funded and overseen by the US Agency for Healthcare Research and Quality (AHRQ). The survey is designed to query patients and healthcare consumers to report on and evaluate their experiences and satisfaction with Medicare delivery systems, including physicians, health plans, and supplemental plans. Version 4.0 was adapted for use in the AARP Medigap population in 2012 and 2013 by adding questions about HL, AARP Medicare Supplement plan satisfaction, and use of advance directives. The survey distribution methodology included mailing of the printed survey with a second copy sent to

those who did not respond during the two-month survey period (March through April in the respective years).

### Measurement of HL

A validated, single-item screener was used to identify inadequate HL: “How confident are you filling out medical forms by yourself?”.<sup>56</sup> The five-point response scale included choices of *Extremely*, *Quite a bit*, *Somewhat*, *A little bit*, and *Not at all*. Responses of *A little bit* and *Not at all* were categorized as inadequate HL.<sup>56</sup> This single item is routinely used as a screening question for HL, often included on surveys. Those identified with inadequate HL (i.e., responses of *A little bit* and *Not at all*) can then be targeted for subsequent longer surveys to detail types of literacy deficits and possible interventions.

### Covariates

Independent variables shown to be associated with HL were used to adjust for effects of potential confounders in multivariate models. Demographic variables of age (ranges of 65–69, 70–74, 75–79, 80–84, and  $\geq 85$ ), gender, state of residency (10 states), living arrangement (live in own home or elsewhere), and race (white or minority) were included. Education level (8th grade or less, some high school, high school graduate, some college/two-year degree, four-year college graduate) was captured. Years 2012 or 2013 were added to control for the year of survey distribution. Smoking (i.e., current smoker) was included as a health behavior. Self-reported chronic conditions (yes/no) included the following: arthritis, cancer, cardiovascular artery disease (CAD), diabetes, digestive problems, heart attack, high blood pressure, low back pain, osteoporosis, other heart problems, and stroke. In addition, to control for severity, self-reported perception of physical and mental health were added: fair or poor vs. good, very good, and excellent. To control for disability status, Activities of Daily Living (ADLs; difficulties with bathing, dressing, eating, getting in and out of chairs, walking, or using the toilet) were added grouped to 0, 1–2, or  $\geq 3$  difficulties.

### Outcomes

#### Patient dissatisfaction

Levels of dissatisfaction with physicians, specialists, AARP Medicare Supplement Insurance plans, and general health care were measured on 10-point scales. Based on the distributions of the scale, scores of  $\leq 8$  (i.e., a cut-point at the 80<sup>th</sup> percentile) were considered evidence of dissatisfaction.

#### Preventive services or quality of care

Flu vaccinations and recommended compliance with preventive services associated with common chronic conditions were used as markers for preventive services compliance. Flu vaccinations were self-reported on the survey. Optum Symmetry® EBM Connect® software (version 8.1) was used to evaluate compliance with other preventive services such as recommended laboratory tests or other routine examinations associated with common chronic conditions. This software program was developed to calculate compliance based on paid medical claims. An 80% or greater compliance level at the individual level for recommended services indicated compliance (yes/no).

#### Healthcare utilization and expenditures

Healthcare service utilization, including IP admissions and ER visits, was measured from administrative medical claims databases from place-of-service codes. Total fee-for-service (FFS) annual

medical expenditures were obtained from administrative claims databases and included payments made by Medicare, Medicare Supplement plans, and patient OOP costs. Medical expenditures were inflation-adjusted to 2015 dollars using Consumer Price Index (CPI) inflation factors.

#### Propensity weighting for survey non-response bias

To address documented bias among survey respondents compared to non-respondents on the mailing list, propensity score weighting was utilized. Propensity weighting is a widely accepted technique used to adjust for non-respondent bias and has broad utility in healthcare applications.<sup>57,58</sup> This method was applied by modeling the probability of survey response as a function of available demographic (age, gender, location), socioeconomic (geocoded minority and income levels), and healthcare supply variables (number of hospital beds per 100,000 and number of primary care physicians per 100,000). We then used that estimated probability to create inversed probability of treatment weight (IPTW) and applied as a weighting variable to the data, to make those who did respond better resemble all eligible insureds who received the survey.

#### Descriptive and multivariate methods

Descriptive statistics were used to generate summaries of demographics, socioeconomic characteristics, and chronic conditions (Table 1). The characteristics associated with inadequate HL were modeled with multivariate logistic regressions. Separate binomial logistic regression models were also used with several other health outcome measures. These multivariate models were used to predict the likelihood of utilization of costly healthcare services (any ER visit or IP admission), self-reported non-receipt of flu shots, non-compliance with preventive services, and individual dissatisfaction with health care (i.e., physicians, specialists, AARP Medicare Supplement Insurance plans, and general health care) due to inadequate HL while simultaneously adjusting other confounding demographic, socioeconomic, and health status variables listed in Table 1.

Exponential Conditional Mean (ECM) modeling, a type of nonlinear regression, was used to estimate annual medical expenditures separately for those with high and inadequate HL for the two populations of interest: sicker and healthier. The same confounding covariates established in logistic regression models and described in Table 1 were used. Differences in adjusted annual medical expenditures for high and inadequate HL were calculated and statistically tested. All statistical analyses were performed using SAS® Enterprise Guide software (version 5.1, SAS Institute, Inc., Cary, NC).

### Results

Overall, 9708 responded to the surveys (31% response rate). Of these, 7334 (75%) met the eligibility criteria and were included in the study. Our population was predominantly white, female, not currently smoking, and had at least some college education. Among respondents, 23% of sicker insureds indicated inadequate HL compared to 16% of the healthier subgroup.

Tables 2 and 3 show the common characteristics associated with inadequate HL for the sicker and healthier subgroups, respectively. Significant characteristics of inadequate HL for the sicker subgroup included lower education, poorer mental and physical health status, more disabilities, older age, male, and stroke and heart problems. The healthier subgroups demonstrated similar demographic and health status characteristics, but had stroke, other heart problems, and diabetes. Of note, while the general characteristics were similar, the magnitude of the odds ratios was greater among the sicker subgroup.

**Table 1**

Unadjusted demographic characteristics of sicker and healthier populations.

Variables	Sicker			p-Value	Healthier			p-Value
	Overall	High HL	Inadequate HL		Overall	High HL	Inadequate HL	
	% or mean	% or mean	% or mean		% or mean	% or mean	% or mean	
Number (N)	3617				3717			
<b>Gender</b>				0.001				<0.0001
Male	39.1	38.2	42.2		41.3	40.4	46.1	
Female	60.9	61.8	57.8		58.7	59.6	53.9	
<b>Age groups</b>				<0.0001				<0.0001
65–69	14.1	15.7	8.7		18.8	20.6	9.6	
70–74	21.2	23.5	13.7		26.4	27.4	21.1	
75–79	19.9	20.1	19.2		20.4	20.7	18.8	
80–84	21.6	21.1	23.5		15.7	15.4	17.6	
≥85	23.2	19.7	34.8		18.6	15.9	32.9	
<b>Education</b>				<0.0001				<0.0001
≤Some HS	10.6	6.2	25.4		8.9	6.0	23.7	
HS graduate	31.2	29.5	37.1		30.3	28.0	41.7	
≤2-yr. college	29.0	30.8	22.9		28.9	30.8	18.9	
≥4-yr. college	29.2	33.5	14.6		32.0	35.2	15.7	
<b>Living arrangement</b>				<0.0001				<0.0001
Live at home	92.1	93.6	87.1		92.5	94.0	85.2	
All other	7.9	6.4	12.9		7.5	6.0	14.8	
<b>Race</b>				0.0007				0.0007
Minority (non-white)	7.3	6.9	8.5		3.4	3.2	4.4	
White	92.7	93.1	91.5		96.6	96.8	95.6	
<b>Smoking</b>				0.07				0.0003
Smoker	4.0	3.7	4.7		4.5	4.2	5.9	
Non-smoker	96.0	96.3	95.3		95.5	95.8	94.1	
<b>Prevalence of conditions</b>								
Arthritis	23.3	23.0	24.2	0.23	16.9	16.5	19.3	0.0009
CAD	9.7	8.9	12.4	<0.0001	5.4	5.1	6.9	0.0003
Cancer	9.0	9.4	7.8	0.002	4.8	4.4	6.8	<0.0001
CHF	7.9	7.0	10.9	<0.0001	3.5	2.8	7.2	<0.0001
COPD	16.5	16.3	17.5	0.21	10.4	9.5	15.2	<0.0001
Depression	11.6	10.4	15.7	<0.0001	7.7	7.0	11.5	<0.0001
Diabetes	24.0	24.3	23.1	0.49	13.0	12.3	16.6	<0.0001
Digestive problems	9.5	9.1	10.7	0.02	6.3	6.2	6.6	0.61
Heart attack	1.9	1.5	3.0	<0.0001	1.4	1.3	2.0	0.03
High blood pressure	47.6	48.3	45.5	0.01	42.4	41.9	45.1	0.001
Low back pain	16.5	15.9	18.6	0.0012	11.6	10.9	15.5	<0.0001
Osteoporosis	9.6	9.2	11.0	0.04	7.0	6.6	8.9	<0.0001
Other heart problems	15.4	15.4	15.5	0.73	10.2	9.2	15.0	<0.0001
Stroke	2.4	1.5	5.5	<0.0001	1.6	1.1	4.0	<0.0001
<b>Self-rated physical health</b>				<0.0001				<0.0001
Excellent/very good	24.5	28.3	11.8		44.1	49.2	18.0	
Good	42.0	43.5	36.8		36.8	36.4	38.7	
Fair/poor	33.5	28.2	51.5		19.2	14.4	43.3	
<b>Self-rated mental health</b>				<0.0001				<0.0001
Excellent/very good	55.7	62.4	32.9		67.7	74.1	34.9	
Good	30.6	28.4	38.1		24.7	21.4	41.2	
Fair/poor	13.7	9.1	29.0		7.6	4.4	23.9	
<b>ADLs</b>				<0.0001				<0.0001
None	48.4	52.6	34.1		63.9	68.5	40.2	
1–2	30.7	31.8	26.7		21.7	20.7	26.5	
≥3	20.9	15.5	39.2		14.4	10.8	33.3	
<b>Patient satisfaction (≥8 out of 10)</b>				<0.0001				<0.0001
Physicians	87.1	89.0	80.4	<0.0001	88.4	89.4	83.4	<0.0001
Medicare supplement	87.4	88.1	85.1	<0.0001	87.5	87.5	87.1	0.79
Specialists	87.0	88.9	79.4	<0.0001	87.9	88.3	86.0	0.02
Health care	81.7	84.7	71.4	<0.0001	84.8	86.0	78.8	<0.0001
<b>Preventive services</b>				0.56				0.40
Flu shot (No)	14.0	13.8	14.6		20.0	19.7	21.4	
EBM <80% compliance	34.6	34.5	35.0	0.49	28.9	27.6	35.1	<0.0001
<b>Healthcare utilization</b>				<0.0001				<0.0001
≥1 ER visit	33.1	30.9	40.4	<0.0001	25.1	23.6	32.6	<0.0001
≥1 IP admission	24.3	21.9	32.2	<0.0001	13.5	12.3	19.9	<0.0001

HL = health literacy; HS = high school; CAD = coronary artery disease; CHF = congestive heart failure; ADLs = activities of daily living; EBM = evidence-based measures; ER = emergency room; IP = inpatient.

Table 4 shows the effect of inadequate HL on several different health outcomes: patient dissatisfaction, flu shot non-compliance, preventive services non-compliance, and healthcare utilization (IP and ER). Overall, sicker adults with inadequate HL were more likely to be dissatisfied with the healthcare system and health care in

general, whether with physicians, specialists, insurers, or general experiences. Healthier adults were dissatisfied only with their physicians and general healthcare experiences. Regarding preventive healthcare services and costly healthcare utilization, sicker adults with inadequate HL were more likely to have an ER visit and an IP



**Table 2**  
Characteristics associated with inadequate health literacy: sicker population.

Variable	Odds ratio	95% confidence intervals	p-Value
≤Some HS	7.41	(6.420, 8.554)	<0.0001
Fair/poor mental health	3.43	(3.024, 3.880)	<0.0001
Stroke	2.94	(2.315, 3.723)	<0.0001
HS graduate	2.64	(2.344, 2.968)	<0.0001
≥3 ADL difficulties	2.40	(2.145, 2.682)	<0.0001
Good mental health	2.22	(2.011, 2.452)	<0.0001
Age ≥ 85	1.99	(1.697, 2.327)	<0.0001
Heart attack	1.80	(1.350, 2.393)	<0.0001
Fair/poor physical health	1.66	(1.440, 1.910)	<0.0001
Age 80–84	1.61	(1.367, 1.904)	<0.0001
≤2-yr. degree	1.59	(1.402, 1.799)	<0.0001
Male	1.53	(1.397, 1.671)	<0.0001
Age 75–79	1.39	(1.173, 1.645)	<0.0001
Good physical health	1.31	(1.146, 1.491)	<0.0001
Smoker	1.28	(1.028, 1.583)	0.03
Minority	1.19	(1.018, 1.389)	0.03
Hypertension	0.88	(0.803, 0.974)	0.01
Arthritis	0.82	(0.730, 0.920)	0.001
Other heart problems	0.81	(0.720, 0.921)	0.001
Cancer	0.74	(0.631, 0.868)	<0.0001

OR = odds ratio; HS = high school; ADL = activities of daily living. Only significant variables are shown in the table. Other insignificant variables used in the models listed in Table 1 were not shown for brevity.

admission but inadequate HL demonstrated no impact on preventive services. Healthier adults with inadequate HL were less likely to get flu vaccinations, less likely to be compliant with other preventive services, and more likely to have an ER visit or IP admission.

Finally, results demonstrated higher annual medical expenditures for those with inadequate HL compared to those with high HL. After adjusting for the variables listed in Table 1, sicker individuals with inadequate HL incurred \$1267 ( $p < 0.0001$ ) more annually in medical expenditures compared to those with high HL; healthier individuals with inadequate HL incurred \$487 higher expenditures ( $p < 0.0001$ ; Table 5).

## Discussion

The common prevalence of inadequate HL among older adults in this study (23% among sicker and 16% among healthier) is

**Table 3**  
Characteristics associated with inadequate health literacy: healthier population.

Variable	OR	95% confidence intervals	p-Value
≤Some HS	5.91	(4.988, 7.006)	<0.0001
Fair/poor mental health	5.38	(4.576, 6.331)	<0.0001
HS graduate	2.68	(2.324, 3.084)	<0.0001
Good mental health	2.62	(2.326, 2.944)	<0.0001
≥3 ADL difficulties	2.55	(2.223, 2.928)	<0.0001
Age ≥ 85	2.26	(1.906, 2.675)	<0.0001
Fair/poor physical health	2.16	(1.842, 2.532)	<0.0001
Smoker	1.82	(1.457, 2.267)	<0.0001
Stroke	1.72	(1.247, 2.366)	0.001
Minority	1.63	(1.271, 2.094)	<0.0001
Age 80–84	1.57	(1.303, 1.890)	<0.0001
Male	1.54	(1.386, 1.710)	<0.0001
Age 70–74	1.45	(1.221, 1.725)	<0.0001
Age 75–79	1.39	(1.158, 1.665)	<0.0001
1–2 ADL difficulties	1.37	(1.209, 1.560)	<0.0001
Good physical health	1.35	(1.173, 1.550)	<0.0001
Other heart problems	1.33	(1.138, 1.559)	<0.0001
≤2-yr. degree	1.26	(1.076, 1.470)	0.004
Diabetes	1.20	(1.036, 1.397)	0.02
Low back pain	0.84	(0.717, 0.993)	0.04
Digestive problems	0.75	(0.614, 0.927)	0.007
Arthritis	0.72	(0.617, 0.831)	<0.0001

OR = odds ratio; HS = high school; ADL = activities of daily living. Only significant variables are shown in the table. Other insignificant variables used in the models listed in Table 1 were not shown for brevity.

concerning, considering that making sound healthcare decisions is critical for optimal health outcomes, continued independence, quality of life, and successful aging later in life. Furthermore, our prevalence estimate for inadequate HL may be conservative given the general demographics of the AARP Medicare Supplement insured population compared to national Medicare populations (i.e., fewer minorities, female, and more highly educated). By comparison, the estimated prevalence of inadequate HL for the sicker population at 23% and for the healthier population at 16% was considerably lower than the 29% reported national estimates of inadequate HL among adults age 65+.<sup>14</sup>

Characteristics associated with inadequate HL were consistent with the scientific literature. Low education was among the strongest predictors associated with inadequate HL for both sicker and healthier populations.<sup>59,60</sup> Similarly, poor mental health, disability, and greater ADL limitations along with older age (≥85 years) and minority race were highly predictive of inadequate HL,<sup>59</sup> consistent with research elsewhere demonstrating that those with poorer health or more disabilities struggle with self-care and managing complex conditions.<sup>35</sup>

Furthermore, HL appears to be more important in successfully managing certain specific chronic conditions than others. Studies show that older adults with inadequate HL tend to have poorer outcomes with asthma and coronary heart failure (CHF) in particular, compared to those with adequate HL.<sup>38,54,55</sup> Meanwhile, research shows minimal evidence of a relationship between HL and older adults' adherence with medications for conditions such as cardiovascular disease (CVD) or diabetes.<sup>61</sup> These conditions did present as meaningful in our healthier population but not in the sicker. Thus specific chronic conditions as well as general health status (i.e., fair or poor) appear to be especially impacted by poor HL.

The results of this study support the previously established relationship between inadequate HL and a variety of suboptimal health outcomes as well as lower satisfaction with physicians and general healthcare delivery. Our results demonstrate an association of inadequate HL among sicker adults with higher use of costly services including IP admissions and ER visits but no impact on preventive services. In contrast, healthier older adults with inadequate HL demonstrated a lower likelihood of receiving preventive healthcare services including flu shots, and reduced compliance with other quality measures as well as higher utilization of ER visits and IP admissions. Many of these findings confirm those of others reported elsewhere but have not characterized inadequate HL by health status categories.<sup>1,23,25,32,41</sup>

Evidence regarding the impact of low HL specifically on patient satisfaction with physicians, healthcare services, and overall health care has been inconsistent. Most studies have focused on patient satisfaction with health-related educational materials or programs, survey response options, methods of receiving communications, or the status of their conditions.<sup>25,38,62</sup> In some cases, research findings reveal high rates of satisfaction with healthcare services and/or interactions with healthcare providers among individuals with inadequate HL as compared to highly literate adults.<sup>36,37</sup> Other studies have demonstrated that patients with inadequate HL tend to be less satisfied with health care, including overall delivery of and access to care, courtesy of providers, emotional support, patient education, specialist care, and care coordination.<sup>38–40</sup> Our results confirmed that poorer health exacerbated these issues within the healthcare system. The increased magnitude of dissatisfaction associated with inadequate HL among sicker adults would indicate that more intervention resources should be targeted to this population.

Inadequate HL has consistently been tied to a lower likelihood of receiving screenings and other preventive healthcare services in various populations, including older adults.<sup>17,18,21,22,25,26,29,34,50</sup> Our results regarding preventive services compliance were consistent

**Table 4**

Impact of inadequate health literacy on health outcomes.

Health outcomes	Sicker				Healthier			
	N	OR	95% confidence interval	p-Value	N	OR	95% confidence interval	p-Value
<b>Patient dissatisfaction</b>								
Physicians	3061	1.46	(1.284, 1.657)	<0.0001	2898	1.52	(1.297, 1.776)	<0.0001
Medicare supplement plans	3474	1.25	(1.104, 1.418)	0.0004	3561	1.15	(0.985, 1.343)	0.08
Specialists	2544	1.74	(1.514, 2.007)	<0.0001	2215	0.98	(0.800, 1.188)	0.80
Health care	3490	1.51	(1.363, 1.677)	<0.0001	3566	1.18	(1.038, 1.343)	0.01
<b>Preventive services</b>								
Flu shot (No)	3560	1.08	(0.955, 1.220)	0.22	3657	1.28	(1.128, 1.450)	0.0001
EBM compliance <80%	3432	0.98	(0.899, 1.076)	0.72	2959	1.26	(1.124, 1.419)	<0.0001
<b>Healthcare utilization</b>								
≥1 ER visits	3617	1.23	(1.124, 1.343)	<0.0001	3717	1.12	(1.004, 1.250)	0.04
≥1 IP admissions	3617	1.38	(1.159, 1.521)	<0.0001	3717	1.25	(1.095, 1.427)	0.001

OR = odds ratio; EBM = evidence-based measures; ER = emergency room; IP = inpatient. Each health outcome measure listed was also adjusted for other confounding variables listed in Table 1 including demographic, socioeconomic and health status variables.

with other research studies only for the healthier population. Various studies have reported an association between inadequate HL and lower odds of receiving flu shots among older adults.<sup>21,22,25,32,41,42</sup> Other studies have also demonstrated that Medicare-eligible (age ≥ 65) older adults with inadequate HL receive fewer screenings for colon, cervical, and breast cancer.<sup>21,25,42</sup>

Increased utilization of certain costly healthcare services such as IP admissions and ER visits has been associated with inadequate HL perhaps partially due to individuals bypassing preventive care when they do not understand its benefits.<sup>22,23,25,29,31,34,50</sup> One review of studies examining the relationship of inadequate HL with healthcare utilization reported significant associations with increased IP admissions and greater ER use, including among elderly populations although without stratification by health status levels.<sup>25</sup>

Research also indicates associations between inadequate HL and increased healthcare spending.<sup>50,51</sup> The financial impact of inadequate HL on the US economy is estimated between \$106 and \$238 billion annually, and between \$1.6 and \$3.6 trillion in cumulative lifetime costs.<sup>10,34</sup> Estimates place the annual financial impact of inadequate HL among American adults at 7%–17% of total individual medical expenditures.<sup>10,34</sup> Furthermore, Medicare beneficiaries with low or marginal HL tend to accrue higher ER expenditures than individuals with adequate HL.<sup>46,50,51</sup> One study of older adults enrolled in Medicare managed care plans found that those with inadequate HL accrued \$1551 more in total medical expenditures compared to those with adequate HL.<sup>46</sup> These estimates are in line with our results that indicate about 6% of annual expenditures were associated with lower HL: \$1267 for the sicker and \$487 for the healthier, respectively. The excess costs associated with inadequate HL demonstrate potential savings associated with the improvement of HL, especially among those with high healthcare needs.

While interventions to address HL among older adults are warranted, few have been applied at a population level. Furthermore, many studies have demonstrated design weaknesses, mixed effects on outcomes, and insufficient evidence of success. A recent review identified interventions targeting outcomes including patient

knowledge, behavior, adherence, disease status, quality of life, and healthcare utilization. Most existing interventions appear to be single-session programs primarily focused on educating individuals with various HL levels about consent forms, health plan choices, medication labels and instructions, and advance directives, with the use of simplified materials.<sup>22,25,63–69</sup> Personalized approaches have also incorporated counseling, tutorials, telephone outreach, and medical visits for those with inadequate HL.<sup>70–73</sup> However, most existing interventions target a combination of levels of HL with no specific targeting for adults at various health status levels.<sup>25</sup> Thus further work in this area is recommended, incorporating a range of educational program types and intensities, tailored toward older adults with inadequate HL by health status levels.

There are some natural limitations to the results reported here. Since HL and its proxies were only measured by a single screener, identifying further details about HL, such as health-related oral or print literacy and numeracy, was not possible. In addition, administration of the CAHPS survey in only five states with randomly selected AARP Medicare Supplement insureds may not generalize to other Medicare or Medicare Supplement populations. While these results were adjusted for survey non-response bias, other unaddressed factors may have introduced bias not controlled for; however, our relatively large sample size should have minimized these more random effects.

## Conclusions

In this study, inadequate HL was less prevalent in a Medigap population as compared with other adult and elderly populations studied elsewhere. However, the factors impacting inadequate HL were consistent with those reported in the literature. As individuals with Medigap coverage represent a major subpopulation of seniors, the impact of inadequate HL on national healthcare systems, utilization, and spending is significant and likely to increase given the aging of the US population. Our results suggest that HL efforts should target sicker older adults, especially those who are male, less educated, and in poorer health with more chronic conditions. UnitedHealthcare and AARP are currently collaborating in this effort to develop initiatives targeting vulnerable seniors with inadequate HL. With effective educational interventions such as those planned, improved HL could potentially drive higher patient satisfaction, better compliance with preventive services, and reduced healthcare utilization and spending.

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**Table 5**

Adjusted medical expenditures associated with inadequate health literacy.

	Sicker			Healthier		
	Annual costs (\$)	Difference (\$)	p-Value	Annual costs (\$)	Difference (\$)	p-Value
<b>Medical expenditures</b>						
High HL	21,190	1267	<0.0001	13,303	487	<0.0001
Inadequate HL	22,457			13,790		

HL = health literacy. Medical expenditures were also adjusted for other confounding variables listed in Table 1 including demographic, socioeconomic and health status variables.

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