

A Health Plan's Investigation of Healthy Days and Chronic Conditions

Tristan Cordier, MPH; S. Lane Slabaugh, PharmD; Eric Havens, MA; Jonathan Pena, MS; Gil Haugh, MS; Vipin Gopal, PhD; Andrew Renda, MD; Mona Shah, PhD; and Matthew Zack, MD

Health-related quality of life (HRQoL) is a valid measure of disease burden and population health encompassing physical, mental, emotional, and social functioning.¹⁻³ HRQoL is associated with traditional health measures, including morbidity, mortality, and healthcare costs.⁴⁻⁸ Despite these relationships, health plans have not traditionally prioritized quality of life (QoL) outcomes in decision making, possibly due to a lack of confidence in the ability to quantify the relationship between HRQoL and clinical status or healthcare utilization. The shift toward population health and value-based care is challenging health plans to look beyond traditional health improvement measures. HRQoL can supplement these measures by providing insight into vulnerable populations, identifying specific diseases that negatively impact a person's holistic health view, and highlighting opportunities to reduce the burden of disease. HRQoL may also indicate perceived health benefits after clinical interventions or population-based health improvement efforts.⁹

Although several available HRQoL instruments have demonstrated validity and reliability, they vary in scope, intended purpose, applicability, and ease of use. The ideal instrument for use by a health plan would be holistic, easy to administer, tied to a single measure that reflects the individual's perspective, and understandable to healthcare providers and the general public alike. For these reasons, Humana Inc selected the QoL survey instrument, Healthy Days, to measure progress toward a goal of improving the health of the communities it serves by 20% by 2020.¹⁰

Healthy Days (formally, CDC-HRQOL-4), developed by the CDC in the early 1990s, contains 4 questions that ask about a person's perceived health: 1) would you say that, in general, your health is excellent, very good, good, fair, or poor? 2) Now thinking about your physical health, which includes physical illness and injury, for how many days during the past 30 days was your physical health not good? 3) Now thinking about your mental health, which includes stress, depression, and problems with emotions, for how many days during the past 30 days was your mental health not good? 4) During the past 30 days, approximately how many days

ABSTRACT

OBJECTIVES: To investigate whether self-reported unhealthy days are related to 6 chronic conditions and other health indicators by using administrative claims.

STUDY DESIGN: Cross-sectional study using Healthy Days survey data linked to administrative claims.

METHODS: Survey respondents 65 years or older with Medicare Advantage coverage in November or December 2014 and 12 months continuous presurvey enrollment were identified. Mean physically and mentally unhealthy days were reported by chronic condition subgroups. Mean incremental unhealthy days were calculated for individuals in chronic condition subgroups and those exhibiting noncompliance with 2014 quality measures after adjusting for age, gender, provider/insurer contractual relationship, dual Medicaid/Medicare eligibility, and sum of chronic conditions. The relationship between the unhealthy days category and adjusted mean resource utilization (inpatient and outpatient visits) and total healthcare costs for the year prior to the survey was also described.

RESULTS: The population averages for physically and mentally unhealthy days were 7.24 and 4.05, respectively. After adjustment, all 6 chronic conditions were associated with significantly more physically unhealthy days, and chronic obstructive pulmonary disease, depression, and diabetes were associated with significantly more mentally unhealthy days ($P < .001$ vs not having the condition). After adjustment, quality measure noncompliance was generally associated with incremental increases in unhealthy days. Utilization and cost generally increased with increasing unhealthy days.

CONCLUSIONS: This is the first study to use administrative claims to demonstrate a relationship between Healthy Days and chronic conditions, related healthcare quality measures, utilization, and costs. Our findings underscore the validity of using Healthy Days to supplement traditional health measures in assessing health status in this population.

Am J Manag Care. 2017;23(10):e323-e330

TAKEAWAY POINTS

Humana Inc selected the CDC's quality of life instrument, Healthy Days, to measure progress toward a goal of improving the health of the communities it serves by 20% by 2020. In 2014, Humana began collecting Healthy Days data through an annual telephone-administered voice-activated technology survey and linking the data with administrative claims to measure health. This is the first published study combining Healthy Days with administrative claims to investigate whether physically and mentally unhealthy days are related to chronic condition prevalence and other health indicators. In a Medicare Advantage population, this cross-sectional analysis found that:

- ▶ Patients with chronic conditions reported higher mean physically and mentally unhealthy days than the population average.
- ▶ Patients who were compliant with certain quality measures related to chronic conditions reported fewer unhealthy days after statistical adjustment.
- ▶ Patients who reported more unhealthy days had higher adjusted mean total healthcare costs and healthcare utilization.
- ▶ Healthy Days is a valid tool that can supplement traditional measures in assessing overall population health.

did poor physical or mental health keep you from doing your usual activities, such as self-care, work, or recreation?²¹

Answers to the second and third questions are used to develop a summary index of unhealthy days for each individual. Reported Healthy Days are typically expressed as means or dichotomized as above or below 14 days.⁹ Healthy Days data have been collected extensively in national surveys, such as the Behavioral Risk Factor Surveillance System and the National Health and Nutrition Examination Survey, as well as the Medicare Health Outcomes Survey, a longitudinal, patient-reported outcomes measure that CMS requires all Medicare Advantage plans to collect.^{9,12}

Several published studies have utilized large, national survey responses to assess the relationship between HRQoL, measured in Healthy Days, and various chronic conditions.¹²⁻²⁰ To date, only 1 such study has linked self-reported Healthy Days data to claims-based diagnoses. That study evaluated Healthy Days in an elderly Pennsylvania population with arthritis.²¹ No other studies have utilized administrative claims data to assess the relationship between Healthy Days and other objective health measures. Furthermore, no studies have evaluated the association with quality measure compliance or healthcare utilization and self-reported Healthy Days. The objective of this study was to explore the relationship between HRQoL (assessed using Healthy Days) and the presence of 6 chronic conditions, condition-related quality measures, healthcare utilization, and costs. The 6 chronic conditions—coronary artery disease (CAD), congestive heart failure (CHF), chronic obstructive pulmonary disease (COPD), depression, diabetes, and hypertension—were identified by *International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM)* codes and were chosen based on their prevalence in the plan population, the ability to improve disease outcomes through intervention, and their plausible relationship to HRQoL. Understanding the relationship between Healthy Days and health indicators can further validate the use of Healthy Days as a health status measure and

highlight key drivers of unhealthy days at the population level, thus informing downstream strategies for improving population health.

METHODS

Healthy Days Survey

A cross-sectional survey using Healthy Days questions was administered to individuals with health plan coverage from Humana Inc, a health and well-being company serving millions of enrollees across the United States through Medicare Advantage, standalone prescription drug plans, and commercial plan offerings.²² Voice-activated technology (VAT) surveys were conducted in a stratified

random sample of all individuals across multiple Humana medical coverage plans (employer group, Medicare, and individual) from November 24 to December 24, 2014, via a computer-operated phone system. The random survey sample was stratified to ensure representation of various geographic locations (25 geographies based on county codes), medical coverage plans, and chronic conditions of the larger plan population (**Figure 1**). Individuals were removed from the survey sample if they did not have a viable phone number or did not respond after 3 consecutive calls. Only individuals who responded to both physically and mentally unhealthy days questions were included in the survey sample. Of the 4.1 million eligible medical plan enrollees, contact was attempted for 870,791 individuals. Of those, 618,984 did not have a viable phone number or did not respond and 118,034 did not answer both types of Healthy Days questions, leaving 133,773 individuals (15%) with complete survey responses.

Survey analysis was performed using SAS survey procedures that accounted for sample design and respondent weighting. Weighting was used to standardize the survey respondent profile to that of the entire health plan population as of September 30, 2014, using an iterative proportional fitting (raking) algorithm to account for differences between respondents and nonrespondents in gender, age (6 categories: 18-34, 35-44, 45-54, 55-64, 65-74, ≥75 years), and the presence of 5 diagnosed conditions (CAD, CHF, COPD, diabetes, and hypertension, identified using *ICD-9-CM* codes obtained from claims).

Study Population

From those with complete survey responses, this study included only the 83,732 individuals (63%) with Medicare Advantage insurance. Survey results were linked to administrative, medical, pharmacy, and enrollment data. The 55,681 survey respondents who met the following further criteria were selected for the study

population: 1) 65 years or older at the beginning of the study period and 2) continuous health plan enrollment for 12 months prior to the survey date.

Measurements and Analyses

This study explored the relationship between Healthy Days and the following health indicators: 1) a chronic condition (ie, CAD, CHF, COPD, depression, diabetes, or hypertension), 2) condition-related quality measures captured in the Medicare Star Ratings for calendar year 2014 (Healthcare Effectiveness Data and Information Set [HEDIS] and Pharmacy Quality Alliance [PQA] measures), and 3) healthcare resource utilization (inpatient admissions and outpatient visits) and total healthcare costs for the 12 months prior to the Healthy Days survey. Responses to Healthy Days questions were extracted from the VAT survey. Total unhealthy days were calculated individually for questions 2 and 3 and combined and capped at 30 days per CDC methodology.^{9,11}

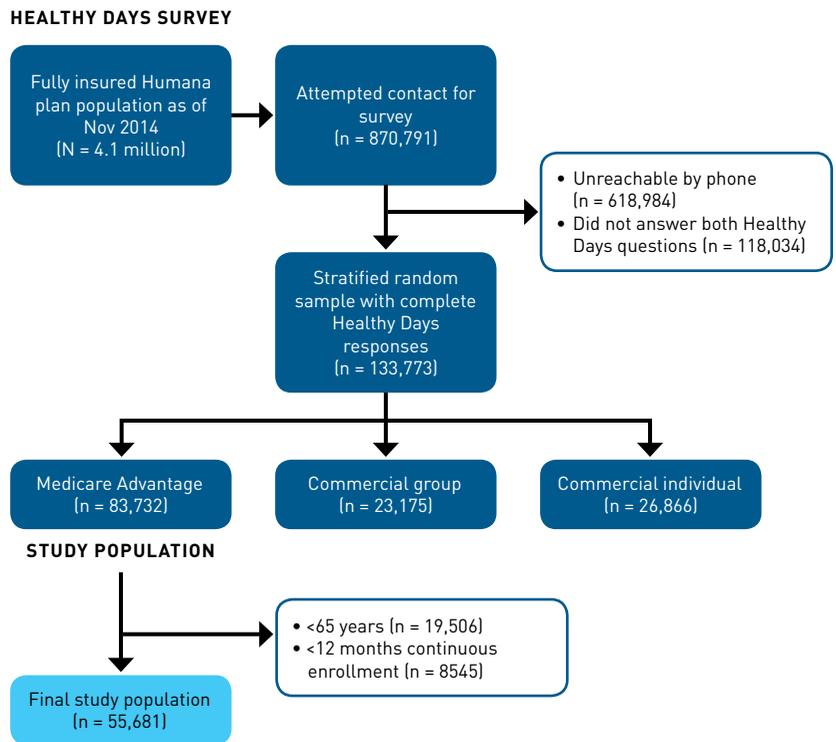
The 6 chronic conditions were identified using ICD-9-CM codes and pharmacy claims in the 12 to 24 months prior to the VAT survey (eAppendix [available at ajmc.com]). Chronic condition subgroups were not mutually exclusive. To account for comorbidities within each chronic condition subgroup, the mean numbers of chronic conditions of interest were reported. The mean numbers of physically and mentally unhealthy days were reported for the total study population and for each of the chronic condition subgroups. Multiple linear regression accounting for survey design was used to calculate the incremental mean number of unhealthy days for individuals with a condition of interest, adjusting for age, gender, provider payment relationship with Humana (fee-for-service vs capitated), dual Medicaid/Medicare eligibility, and the additional number of conditions of interest excluding the specified condition subgroup.

HEDIS and PQA measures related to conditions of interest that were included in Medicare Star Ratings in 2014 were analyzed for quality measures. PQA measures were obtained from claims, and HEDIS quality measures were obtained from a National Committee for Quality Assurance–certified vendor that evaluates medical and lab claims to determine HEDIS measure eligibility and compliance. HEDIS measures included cardiovascular care (low-density lipoprotein cholesterol [LDL-C] screening) and diabetes care (glycated hemoglobin [A1C] screening, LDL-C screening, yearly eye exams, nephropathy screening, A1C <9, and LDL-C <100). PQA measures included medication adherence for statins, oral diabetes

medications, and the combined group of angiotensin-converting enzyme (ACE) inhibitors and angiotensin receptor blockers (ARBs), calculated as the proportion of days covered (PDC). Adherence was defined as a PDC of 80% or greater. The incremental mean number of physically and mentally unhealthy days for individuals noncompliant with HEDIS and PQA measures was assessed using multiple linear regression accounting for survey design. Covariates adjusted for in the regression were age, gender, provider payment relationship with Humana (fee-for-service vs capitated), dual Medicaid/Medicare eligibility, and the sum of chronic conditions of interest (0, 1, 2, 3, ≥4).

Utilization and total medical and pharmacy costs (sum of plan- and patient-paid) were identified from claims for the 12 months before the VAT survey date. The mean number of inpatient admissions and outpatient visits per 1000 individuals annually within each category of unhealthy days was calculated using multiple linear regression accounting for survey design. Linear regression was also used to calculate total per-person-per-month (PPPM) cost for each additional unhealthy day. Cost analyses were only completed for 29,994 individuals (54%) whose primary physician was not part of a shared-risk arrangement, as claims data for patients with primary physicians in shared-risk arrangements do not include

FIGURE 1. Survey and Study Populations and Attrition



CLINICAL

TABLE 1. Survey Respondents 65 Years or Older With Medicare Advantage Coverage and 12 Months Continuous Enrollment Prior to Survey Date

Characteristic	N	Mean or % ^a	95% CI
Age in years, mean (SE)	55,681	75.5 (0.05)	75.4-75.5
Female	33,093	56.6%	55.9-57.3
Race			
White	45,702	87.4%	87.0-87.8
Black	7696	8.7%	8.4-9.0
Asian/Pacific Islander	444	0.8%	0.7-0.9
Hispanic	812	1.2%	1.1-1.3
Alaska Native/Native American	64	0.2%	0.1-0.3
Other/unknown ^b	963	1.7%	1.5-1.8
CMS Medicare region			
New England	38	0.3%	0.2-0.3
Middle Atlantic	169	1.2%	1.0-1.3
East North Central	7934	16.6%	16.1-17.2
West North Central	3694	5.8%	5.5-6.1
South Atlantic	18,373	27.5%	27.0-28.0
East South Central	10,024	9.9%	9.5-10.3
West South Central	6776	12.8%	12.3-13.3
Mountain	7325	16.9%	16.3-17.4
Pacific	1321	8.9%	8.5-9.4
Unknown	27	0.2%	0.1-0.2
Dual Medicaid/Medicare eligibility	4887	7.4%	7.1-7.8
Chronic condition prevalence			
Coronary artery disease	14,564	26.7%	26.1-27.4
Congestive heart failure	6539	11.6%	11.2-12.1
COPD	8721	16.0%	15.4-16.5
Depression	7837	13.3%	12.9-13.8
Diabetes	18,196	32.5%	31.9-33.2
Hypertension	41,047	72.6%	71.9-73.2
Number of chronic conditions of interest per patient, mean			
Coronary artery disease	14,564	3.01	2.98-3.03
Congestive heart failure	6539	3.61	3.56-3.65
COPD	8721	3.07	3.03-3.11
Depression	7837	2.81	2.77-2.86
Diabetes	18,196	2.71	2.69-2.74
Hypertension	41,047	2.17	2.15-2.18
Zero unhealthy days	18,933	34.7%	34.0-35.4

CI indicates confidence interval; COPD, chronic obstructive pulmonary disease; SE, standard error.

^aPercentages were weighted to adjust for survey design and nonresponse bias.

^bReported as "other" or "unknown" by CMS, or missing in claims.

cost information. Utilization and cost results were adjusted for the same covariates used to adjust quality measures.

All analyses were completed using SAS Enterprise Guide 5.4 (SAS Institute; Cary, North Carolina). The statistical significance level was set a priori at 0.05. This study was conducted as a part of Humana's normal quality improvement operations and did not meet HHS's regulatory definition of research under 45 Code of Federal Regulations 46.102(d).

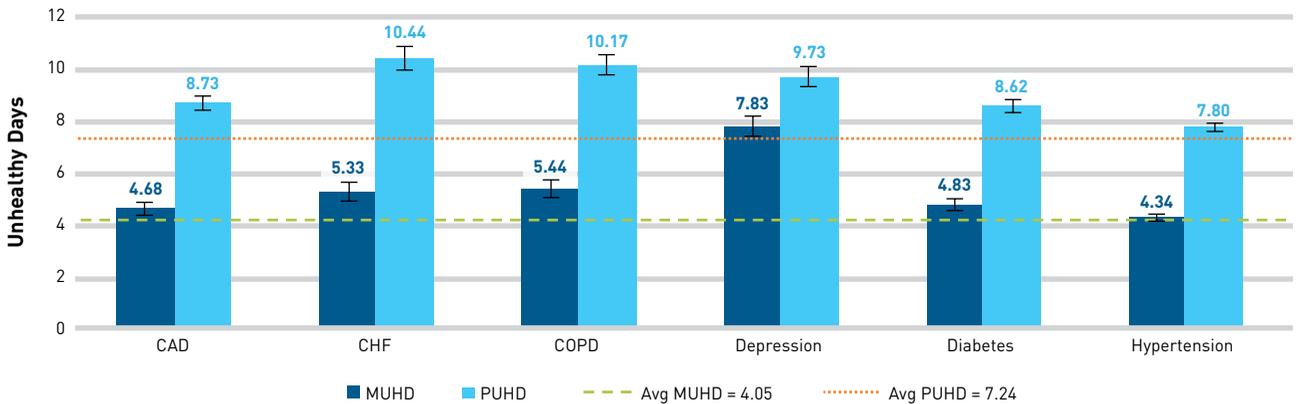
RESULTS

A total of 55,681 individuals were included in the study (Figure 1). The study population had a mean age of 75.5 years, was 56.6% female, was 87.4% white, and resided primarily in the South Atlantic, Mountain, East North Central, and West South Central Medicare regions of the United States; a small percentage (7%) were eligible for both Medicare and Medicaid (Table 1). Hypertension was the most prevalent condition (73%) and CHF was least prevalent (12%). The mean number of chronic conditions of interest ranged from 2.2 for patients with hypertension to 3.6 for those with CHF.

Chronic Conditions and Healthy Days

The study population reported a mean number of 7.2 physically unhealthy days (95% CI, 7.1-7.4) and 4.1 mentally unhealthy days (95% CI, 3.9-4.2). Approximately one-third (34.7%; 95% CI, 34.0%-35.4%) reported 0 unhealthy days (0 physically unhealthy days: 41.3%; 95% CI, 40.5%-42.0%; 0 mentally unhealthy days: 62.0%; 95% CI, 61.3%-62.7%). Individuals diagnosed with CAD, CHF, COPD, depression, diabetes, and hypertension reported more unadjusted mean physically and mentally unhealthy days than the total study population (Figure 2). After adjusting for covariates, all chronic conditions were associated with significantly more physically unhealthy days, and COPD, depression, and diabetes with significantly more mentally unhealthy days (Table 2). COPD and depression had the biggest incremental impacts with 2.93 and 2.41 excess physically unhealthy days and 1.08 and

FIGURE 2. Unadjusted Mean Total Unhealthy Days by Chronic Condition*



Avg indicates average; CAD, coronary artery disease; CHF, congestive heart failure; COPD, chronic obstructive pulmonary disease; MUHD, mentally unhealthy days; PUHD, physically unhealthy days.

*Averages for the total population and are not mutually exclusive of the populations in each chronic condition group; the populations in each chronic condition group are not mutually exclusive of each other.

TABLE 2. Adjusted Incremental Unhealthy Days for Chronic Condition Subgroups and Quality Measures of Interest

Measure Type	Measure	Eligible, N	Diagnosed With Condition, ^a n	Incremental PUHD, Mean	95% CI	P	Incremental MUHD, Mean	95% CI	P
Condition ^b	CAD	55,681	14,564	0.66	0.21-1.11	.004	0.02	-0.35 to 0.38	.927
	CHF	55,681	6539	1.49	0.82-2.16	<.001	0.12	-0.43 to 0.68	.662
	COPD	55,681	8721	2.93	2.38-3.49	<.001	1.08	0.61-1.54	<.001
	Depression	55,681	7837	2.41	1.85-2.97	<.001	4.02	3.50-4.54	<.001
	Diabetes	55,681	18,196	1.44	1.04-1.85	<.001	0.59	0.26-0.92	<.001
	Hypertension	55,681	41,047	0.68	0.30-1.07	<.001	0.09	-0.22 to 0.40	.563
Measure Type	Measure	Eligible, N	Noncompliant, ^c n	Incremental PUHD, Mean	95% CI	P	Incremental MUHD, Mean	95% CI	P
HEDIS, ^d Diabetes	Eye exam	8458	2814	1.13	0.18-2.08	.019	0.87	0.10-1.64	.027
	A1C control (<9)	8458	2171	1.04	0.08-2.00	.034	0.78	0.00 to -1.56	.051
	LDL-C control (<100)	8458	3766	0.74	-0.18 to 1.66	.117	0.94	0.20-1.68	.013
	LDL-C screening	8503	715	2.23	0.69-3.76	.005	1.30	0.01-2.59	.049
	Nephropathy screening	8458	704	0.98	-0.50 to 2.45	.194	0.08	-1.02 to 1.18	.883
HEDIS, ^d CV	LDL-C screening	4018	399	-0.36	-2.16 to 1.45	.700	0.57	-1.14 to 2.29	.511
PQA ^d (Part D)	ACE inhibitor/ARB	25,399	4320	1.50	0.73-2.82	<.001	0.83	0.18-1.49	.013
	Oral diabetes medications	7994	1440	1.43	0.04-2.82	.044	1.54	0.26-2.82	.018
	Statins	26,286	5415	0.53	-0.17 to 1.22	.136	0.98	0.37-1.58	.001

A1C indicates glycated hemoglobin; ACE, angiotensin-converting enzyme; ARB, angiotensin receptor blocker; CAD, coronary artery disease; CHF, congestive heart failure; CI, confidence interval; COPD, chronic obstructive pulmonary disease; CV, cardiovascular; HEDIS, Health Care Effectiveness Data and Information Set; LDL-C, low-density lipoprotein cholesterol; MUHD, mentally unhealthy days; PQA, Pharmacy Quality Alliance; PUHD, physically unhealthy days.

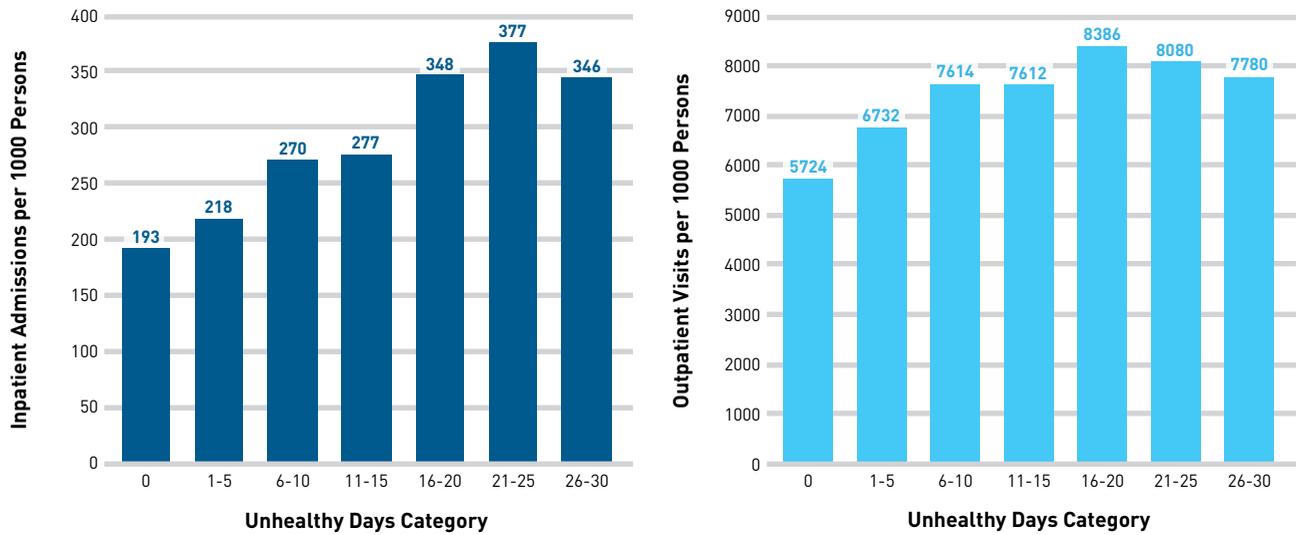
^aIndividuals diagnosed with chronic condition of interest; not mutually exclusive of having other chronic condition of interest.

^bAdjusted for age, gender, provider relationship with Humana, dual Medicaid/Medicare eligibility, and number of additional chronic conditions of interest using multiple linear regression.

^cNoncompliant with quality measures; noncompliance to medication adherence measures interpreted as proportion of days covered <80%.

^dAdjusted for age, gender, provider relationship with Humana, dual Medicaid/Medicare eligibility, and sum of chronic conditions of interest (0, 1, 2, 3, ≥4) using multiple linear regression.

FIGURE 3. Adjusted Utilization by Unhealthy Days Category^a



^aAdjusted for age, gender, provider relationship with Humana, dual Medicaid/Medicare eligibility, and sum of chronic conditions of interest (0, 1, 2, 3, ≥4) using multiple linear regression.

4.02 excess mentally unhealthy days, respectively ($P < .001$ vs not having these conditions) (Table 2).

Quality Measure Compliance

Table 2 shows the adjusted incremental physically and mentally unhealthy days for individuals noncompliant with quality measures. Noncompliance with diabetic eye exams, A1C control, and LDL-C screening in diabetes was associated with significantly more physically unhealthy days, whereas only noncompliance with diabetic eye exams and LDL-C control in diabetes was associated with significantly more mentally unhealthy days. Individuals noncompliant with diabetic nephropathy screening or noncompliant with LDL-C screening in cardiovascular disease did not differ from compliant individuals in unhealthy days. Nonadherence with ACE inhibitors/ARBs and oral diabetes medications was associated with significantly more physically and mentally unhealthy days, whereas nonadherence with statins was associated with only significantly more mentally unhealthy days.

Healthcare Resource Utilization and Cost

Adjusted utilization and cost results indicate that inpatient admissions and outpatient visits generally increased with increasing total unhealthy days (Figure 3). Those reporting 0 unhealthy days had an adjusted annual mean of 193 inpatient admissions and 5724 outpatient visits per 1000 individuals. Peak adjusted mean inpatient visits (377 admissions per 1000 individuals) corresponded to 21 to 25 unhealthy days, whereas adjusted mean outpatient visits

(8386 visits per 1000 individuals) peaked at 16 to 20 unhealthy days. The adjusted PPM cost of each additional unhealthy day in the entire study population was \$15.64 (95% CI, \$13.16-\$18.11).

DISCUSSION

Several studies have utilized Healthy Days to describe the impact of various disease states on HRQoL, but they have relied heavily on survey and clinical data collection or on self-reported clinical information. This is the first study to use administrative claims data to describe the relationship between self-reported Healthy Days and various claims-based health indicators.

Our study validates previous findings, showing that individuals diagnosed with chronic conditions report more unhealthy days. Previous studies in individuals diagnosed with similar chronic conditions reported comparable numbers of physically unhealthy days (8.4-9.3) but slightly fewer mentally unhealthy days (3.0-4.5) than those reported in this study.^{12,14-18} One notable exception is a study of patients with serious psychological distress (SPD) and similar comorbidities to those studied here.¹³ The authors reported fewer physically unhealthy days in patients with SPD and comorbid depression (5.9), diabetes (6.6), and a diagnosis of respiratory disease (6.0), and more mentally unhealthy days in patients with comorbid depression (8.2), which may reflect differences in the studied population (ie, California residents with SPD). Because these other studies used Healthy Days surveys spanning 6 or 12 months whereas our survey was administered only in

November and December, seasonality may account for differences in these findings.

Importantly, our analysis adds to current evidence by showing higher incremental unhealthy days for individuals with CHF, COPD, and depression, which supports the results of other studies showing increased odds of reporting unhealthy days in patients with certain chronic conditions, such as COPD and diabetes.^{14,16} Continuous efforts to prevent and manage chronic conditions are needed given their negative impact on QoL. Moreover, understanding correlations between management of depression and reported mentally unhealthy days is paramount to guiding mental health treatment decisions. These combined findings highlight the potential of using Healthy Days as a marker for higher disease burden and identification of participants in whom chronic condition management interventions may be most beneficial.

Compliance with HEDIS and PQA measures is an important indicator of healthcare quality. Of the 6 HEDIS measures studied in those with diabetes, individuals noncompliant with diabetic eye exams, A1C <9, and LDL-C screening reported significantly more unhealthy days than compliant individuals. Although a causal relationship cannot be established using a cross-sectional study design, this is the first report of any relationship between healthcare quality measures and better HRQoL. Future research to understand this relationship—whether poor compliance is a symptom, cause, or result of poor QoL—would provide insight into the ultimate benefit to be gained from quality compliance initiatives. Additionally, patients not adherent to ACE inhibitor/ARB and oral diabetes medications reported significantly more mentally and physically unhealthy days, and those not adherent to statins reported significantly more mentally unhealthy days. Given the consistent and significant association of medication nonadherence and higher mentally unhealthy days, additional studies exploring Healthy Days as a reflection of medication adherence may be warranted.

Finally, this is also the first study to explore the relationship between unhealthy days and healthcare utilization and cost. Utilization varied directly with total unhealthy days after accounting for certain covariates, and individuals reporting more unhealthy days exhibited higher utilization compared with those reporting fewer unhealthy days. Increased utilization paralleled an incremental PPPM cost increase of \$15.63 per additional unhealthy day. Although these findings are not surprising, they highlight Healthy Days as a potential indicator for identifying individuals in greatest need of multifaceted interventions aimed at improving both actual and perceived health. Validation of our findings could support the use of Healthy Days as an early marker of changes in health outcomes prior to the manifestation of such changes in claims data. Lastly, evaluating whether interventions that improve health and decrease utilization and cost exert a corresponding decrease on reported unhealthy days is an important area for future research.

Limitations

Certain limitations impact interpretation of study results. Healthy Days survey data are subject to response and recall bias. Selection bias due to survey nonresponse was adjusted for by weighting responses so that they were applicable to the mix of demographic characteristics and distribution of key chronic conditions in the study sample; however, residual bias may remain. Administrative claims data have inherent limitations, including coding errors and missing data. Potential confounders, such as socioeconomic characteristics, employment, and marital status, were not available in claims and could not be adjusted for in the analysis. Given the potential impact of seasons on depression, measuring Healthy Days during the winter (November through December) may overestimate mentally unhealthy days. This study was conducted in a Medicare Advantage population heavily concentrated in the southern United States, and results may not be generalizable to a younger, commercially insured population residing elsewhere. Finally, the analysis of unhealthy days and chronic conditions did not differentiate between individuals with mild versus severe disease.

CONCLUSIONS

This is the first study linking Healthy Days data with health indicators from administrative claims, and results should be corroborated in other populations. The findings of higher incremental unhealthy days in the presence of certain chronic conditions and noncompliance with certain quality measures underscore the validity of using Healthy Days to supplement traditional health measures in assessing health status in this population. Humana is creating population-level healthcare interventions that can potentially reduce the burden of chronic disease and improve overall well-being. Future studies will use Healthy Days data to investigate the impact of such interventions. ■

Acknowledgments

The authors would like to thank Laura Happe, PharmD, and Charron Long, PharmD, for their contributions to manuscript development.

Author Affiliations: Humana Inc (TC, SLS, EH, JP, GH, VG, AR), Louisville, KY; Robert Wood Johnson Foundation (MS), Princeton, NJ; Centers for Disease Control and Prevention (MZ), Atlanta, GA.

Source of Funding: None.

Author Disclosures: Mr Cordier, Dr Slabaugh, Mr Havens, Mr Pena, Mr Haugh, Dr Gopal, and Dr Renda are employees of Humana Inc. Dr Slabaugh and Dr Gopal own stock in Humana Inc. The remaining authors report no relationship or financial interest with any entity that would pose a conflict of interest with the subject matter of this article. The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the CDC.

Authorship Information: Concept and design (TC, SLS, EH, JP, GH, VG, AR); acquisition of data (TC, EH, JP, GH); analysis and interpretation of data (TC, SLS, EH, JP, GH, AR, MS, MZ); drafting of the manuscript (TC, SLS, EH, GH, AR); critical revision of the manuscript for important intellectual content (TC, SLS, EH, JP, GH, VG, AR, MS, MZ); statistical analysis (TC, EH, GH, MS, MZ); administrative, technical, or logistic support (EH); and supervision (JP, VG).

Address Correspondence to: Tristan Cordier, MPH, Humana Inc, 500 W Main St, Louisville, KY 40202. E-mail: tcordier1@humana.com.

REFERENCES

1. Healthy People 2020 Foundation health measure report: health-related quality of life and well-being. Healthy People website. <https://www.healthypeople.gov/sites/default/files/HROoLWBFullReport.pdf>. Published November 2010. Accessed July 20, 2015.
2. Moriarty DG, Zack MM, Kobau R. The Centers for Disease Control and Prevention's Healthy Days Measures—population tracking of perceived physical and mental health over time. *Health Qual Life Outcomes*. 2003;1:37. doi: 10.1186/1477-7525-1-37.
3. Zahran HS, Kobau R, Moriarty DG, Zack MM, Holt J, Donehoo R; CDC. Health-related quality of life surveillance—United States, 1993–2002. *MMWR Surveill Summ*. 2005;54(4):1–35.
4. DeSalvo KB, Fan VS, McDonnell MB, Fihn SD. Predicting mortality and healthcare utilization with a single question. *Health Serv Res*. 2005;40(4):1234–1246. doi: 10.1111/j.1475-6773.2005.00404.x.
5. Latham K, Peek CW. Self-rated health and morbidity onset among late midlife U.S. adults. *J Gerontol B Psychol Sci Soc Sci*. 2013;68(1):107–116. doi: 10.1093/geronb/gbs104.
6. Schron E, Friedmann E, Thomas SA. Does health-related quality of life predict hospitalization or mortality in patients with atrial fibrillation? *J Cardiovasc Electrophysiol*. 2014;25(1):23–28. doi: 10.1111/jce.12266.
7. Dominick KL, Ahern FM, Gold CH, Heller DA. Relationship of health-related quality of life to health care utilization and mortality among older adults. *Ageing Clin Exp Res*. 2002;14(6):499–508.
8. Idler EL, Benyamini Y. Self-rated health and mortality: a review of twenty-seven community studies. *J Health Soc Behav*. 1997;38(1):21–37.
9. Slabaugh SL, Shah M, Zack M, et al. Leveraging health-related quality of life in population health management: the case for Healthy Days. *Popul Health Manag*. 2016;20(1):13–22. doi: 10.1089/pop.2015.0162.
10. Broussard BD. Humana CEO: we're going to make the communities we serve 20% healthier. Forbes website. <https://www.forbes.com/sites/matthewherper/2015/04/06/humana-ceo-were-going-to-make-the-communities-we-serve-20-healthier>. Published April 6, 2015. Accessed October 30, 2015.
11. Measuring Healthy Days: population assessment of health-related quality of life. CDC website. <https://www.cdc.gov/hrqol/pdfs/mhd.pdf>. Published November 2000. Accessed September 2017.
12. Austin S, Qu H, Shewchuk RM. Association between adherence to physical activity guidelines and health-related quality of life among individuals with physician-diagnosed arthritis. *Qual Life Res*. 2012;21(8):1347–1357. doi: 10.1007/s11136-011-0046-x.
13. Shih M, Simon PA. Health-related quality of life among adults with serious psychological distress and chronic medical conditions. *Qual Life Res*. 2008;17(4):521–528. doi: 10.1007/s11136-008-9330-9.
14. Brown DW, Balluz LS, Giles WH, et al; Behavioral Risk Factor Surveillance System (BRFSS). Diabetes mellitus and health-related quality of life among older adults: findings from the Behavioral Risk Factor Surveillance System (BRFSS). *Diabetes Res Clin Pract*. 2004;65(2):105–115. doi: 10.1016/j.diabres.2003.11.014.
15. Huang DL, Chan KC, Young BA. Poor oral health and quality of life in older U.S. adults with diabetes mellitus. *J Am Geriatr Soc*. 2013;61(10):1782–1788. doi: 10.1111/jgs.12452.
16. Brown DW, Pleasants R, Dhar JA, et al. Health-related quality of life and chronic obstructive pulmonary disease in North Carolina. *N Am J Med Sci*. 2010;2(2):60–65. doi: 10.4297/najms.2010.260.
17. Ford ES, Mannino DM, Homa DM, et al. Self-reported asthma and health-related quality of life: findings from the Behavioral Risk Factor Surveillance System. *Chest*. 2003;123(1):119–127.
18. Smith DW. The population perspective on quality of life among Americans with diabetes. *Qual Life Res*. 2004;13(8):1391–1400. doi: 10.1023/B:OURE.0000040785.59444.7c.
19. Wubben DP, Porterfield D. Health-related quality of life among North Carolina adults with diabetes mellitus. *N C Med J*. 2005;66(3):179–185.
20. Cook EL, Harman JS. A comparison of health-related quality of life for individuals with mental health disorders and common chronic medical conditions. *Public Health Rep*. 2008;123(1):45–51. doi: 10.1177/003335490812300107.
21. Dominick KL, Ahern FM, Gold CH, Heller DA. Health-related quality of life among older adults with arthritis. *Health Qual Life Outcomes*. 2004;2:5. doi: 10.1186/1477-7525-2-5.
22. Humana reports fourth quarter and full year 2014 financial results; reaffirms 2015 financial guidance [news release]. Louisville, KY: Humana Inc; February 4, 2015. <http://press.humana.com/press-release/humana-reports-fourth-quarter-and-full-year-2014-financial-results-reaffirms-2015-fina>. Accessed December 17, 2015.

Full text and PDF at www.ajmc.com

eAppendix. Diagnosis Codes and Pharmacy Data Used to Identify Chronic Conditions of Interest

Chronic Condition	Definitions
Chronic obstructive pulmonary disease	ICD-9 Codes: 491.0-491.22, 491.8, 491.9, 492.0, 492.8, 496, 518.1, 518.2
Coronary artery disease	ICD-9 Codes: 410.0-414.9, 429.5, 429.6, V4581-V4582
Congestive heart failure	ICD-9 Codes: 398.91, 402.01, 402.11, 402.91, 404.01, 404.11, 404.91, 415.0, 428.0-428.43, 428.9
Depression	ICD-9 Codes: 296.2x, 296.3x, 300.4, 311, 293.83, 296.82, 296.9, 296.90, 296.99, 309.1, 625.4
Diabetes (type I or II)	ICD-9 Codes: V5867, 249.0-250.9, or Pharmacy: Oral or injectable antidiabetic medications
Hypertension	ICD-9 Codes: 401.0, 401.1, 401.9, 997.91

ICD-9 indicates *International Classification of Diseases, Ninth Revision*.